

BAB VII

PENUTUP

7.1. Kesimpulan

Sebagai penutup penulis mencoba menarik kesimpulan yang berhubungan dengan perancangan sistem permesinan kapal tanker 4.000 DWT yaitu :

1. Data spesifikasi teknis dari kapal Tanker 4.000 DWT :

- Panjang seluruhnya (Loa) = 85,68 m
- Panjang antara garis tegak (Lpp) = 84 m
- Lebar (B) = 15 m
- Tinggi (H) = 7 m
- Sarat air (T) = 5 m
- Koeffisien blok (Cb) = 0,631
- Koeffisien prismatic (Cp) = 0,645
- Koeffisien garis air (Cw) = 0,742
- Koeffisien tengah kapal (Cm) = 0,979
- Displacement (Δ) = 4.074,683 ton
- Volume (∇) = 10.292,832 m³
- Jumlah anak buah kapal (ABK) = 30 orang
- Alat penggerak yang digunakan :

Jumlah mesin : 1 (satu) buah

- Merk : MAN B&W
- Type : S26MC
- Daya : 2.725 HP/ 2.000 kW
- Putaran mesin : 250 rpm
- Bore x Stroke : 980 mm x 260 mm
- Cycle : 2 langkah
- Jumlah silinder : 5
- Berat : 34,2 Ton

| | |
|--------------------|--|
| Dimensi | : 4.057 mm (L); 1.880 mm (W); 4.825 mm (H) |
| SFOC | : 132 gr/ BHP.h. |
| SLOC | : 1,5 kg/ cylinder /24h. |
| Diameter propeller | : 3.488,00 mm |
| Jumlah daun | : 4 (empat) buah |
| Kecepatan dinas | : 14 knot |

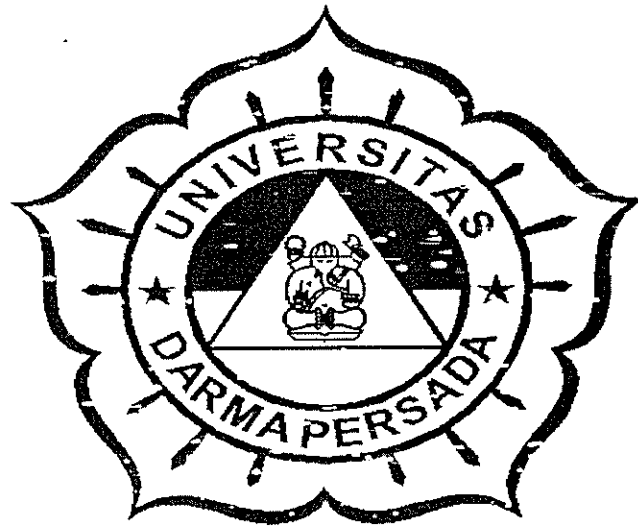
2. Agar dapat mencapai kecepatan kapal sesuai dengan permintaan yaitu 14 knot, hal- hal yang harus diperhatikan adalah :
 - Pemilihan mesin induk yang sesuai
 - Pemilihan jenis dan diameter *propeller* yang sesuai.

3. Dalam menentukan generator set didasarkan pada pembebanan penggunaan daya yang terbesar yaitu pada saat kapal melakukan manuver sebesar **281,2 kW**. dengan menggunakan 3 buah generator masing-masing berkapasitas **160 kW**. dimana satu diantaranya berfungsi sebagai generator cadangan atau stand by generator, daya yang dibutuhkan dapat terpenuhi.

4. Dalam perancangan kamar mesin, tidak lepas adanya asumsi-asumsi yang diberikan untuk mempermudah dalam perhitungan dengan tidak mengabaikan tanggung jawab secara teknis, ekonomis serta peraturan-peraturan yang ada sehingga hasil perhitungan dapat mendekati keadaan yang sebenarnya.
Tata letak mesin induk, mesin bantu serta permesinan lainnya diatur se efisien mungkin, hal ini untuk mempermudah dalam hal perawatan dan perbaikan peralatan yang ada di kamar mesin serta tata letaknya sangat berpengaruh.

DAFTAR PUSTAKA

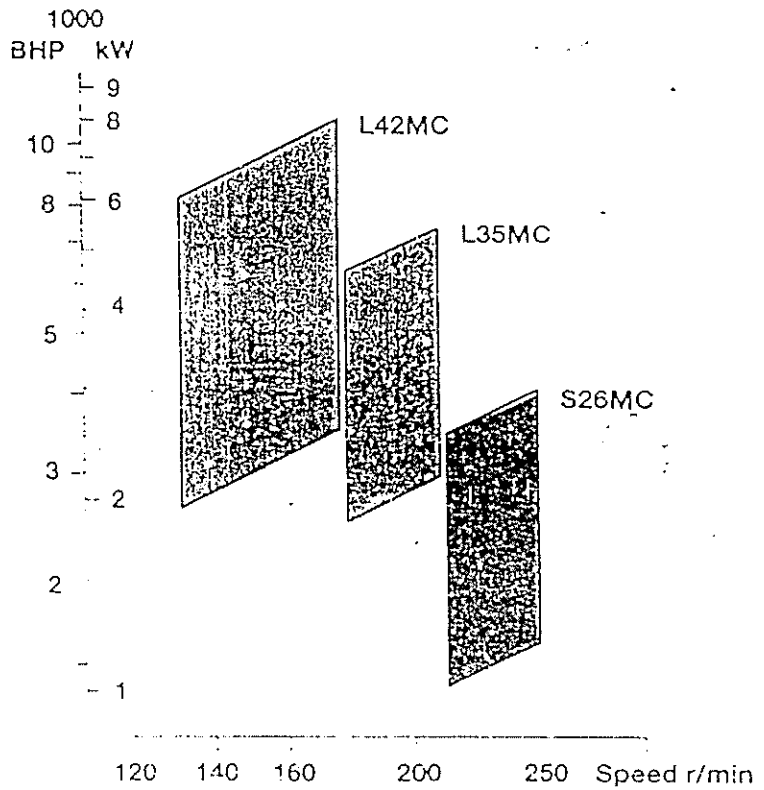
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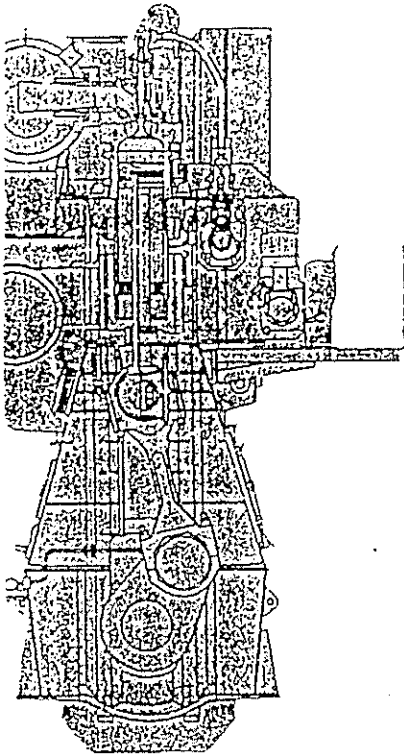
LAMPIRAN I
(CATALOG)

The MC Programme

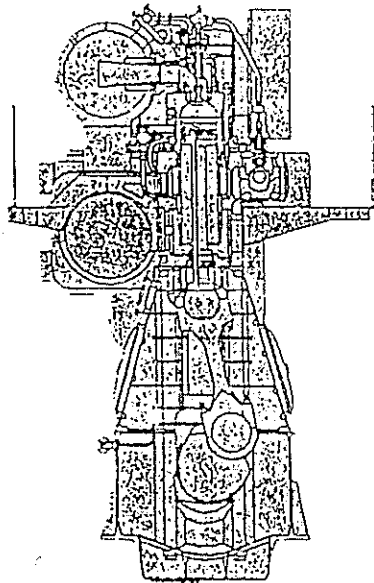
Small-bore engines



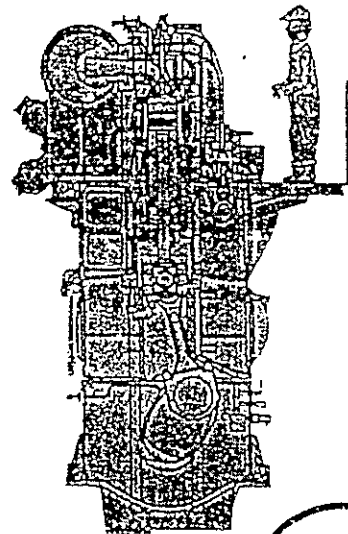
L42MC



L35MC



S26MC



M/19929.9-G/0592

Fig. 1

Engine Data

Engine Power

The table contains data regarding the engine power, speed and specific fuel oil consumption of the engines of the MC Programme.

Engine power is specified in both BHP and kW, in rounded figures, for each cylinder number and layout points L₁, L₂, L₃ and L₄:

L₁ designates nominal maximum continuous rating (nominal MCR), at 100% engine power and 100% engine speed.

L₂, L₃ and L₄ designate layout points at the other three corners of the layout area, chosen for easy reference.

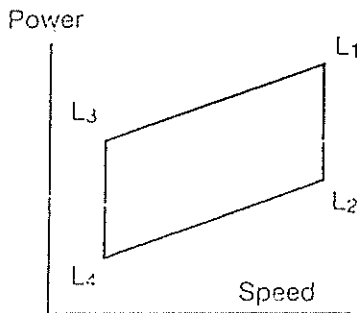


Fig. 1.01: Layout diagram for engine power and speed

Overload corresponds to 110% of the power at MCR, and may be permitted for a limited period of one hour every 12 hours.

The engine power figures given in the tables remain valid up to tropical conditions at sea level, i.e.:

Blower inlet temperature 45 °C
 Blower inlet pressure 1000 mbar
 Seawater temperature 32 °C

Specific fuel oil consumption (SFOC)

Specific fuel oil consumption values refer to brake power, and the following reference conditions:

ISO 3046/1-1986:

Blower inlet temperature 25 °C
 Blower inlet pressure 1000 mbar
 Charge air coolant temperature 25 °C
 Fuel oil lower calorific value 42,700 kJ/kg
 (10,200 kcal/kg)

Although the engine will develop the power specified up to tropical ambient conditions, the specific fuel oil consumption varies with ambient conditions and fuel oil lower calorific value. For calculation of these changes, see section 2.

SFOC guarantee

The figures given in this project guide represent the values obtained when the engine and turbocharger are matched with a view to obtaining the lowest possible SFOC values and fulfilling the IMO NO_x emission limitations.

The Specific Fuel Oil Consumption (SFOC) is guaranteed for one engine load (power-speed combination), this being the one in which the engine is optimised.

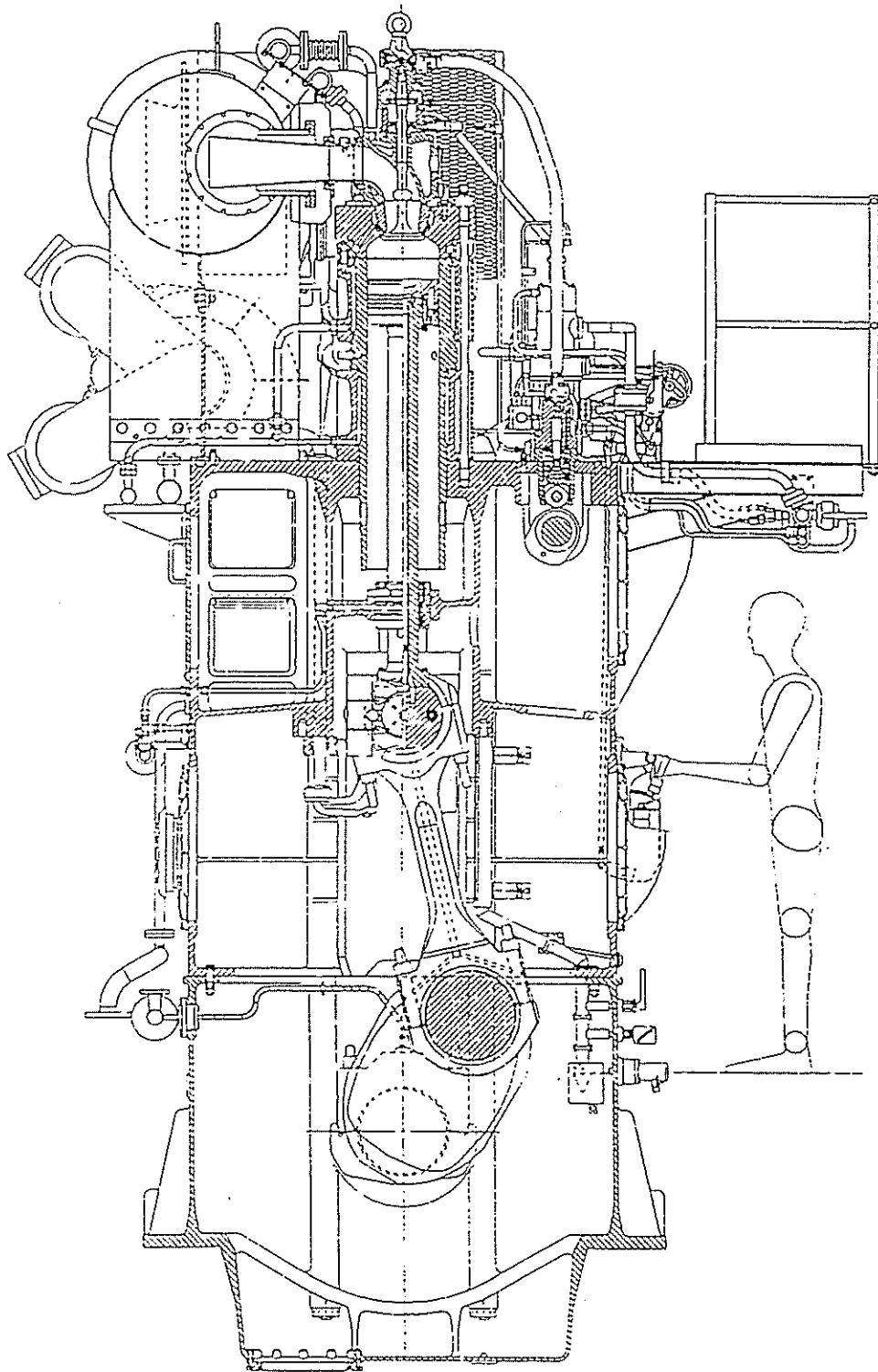
The guarantee is given with a margin of 5%.

As SFOC and NO_x are interrelated parameters, an engine offered without fulfilling the IMO NO_x limitations is subject to a tolerance of only 3% of the SFOC.

Lubricating oil data

The cylinder oil consumption figures stated in the tables are valid under normal conditions. During running-in periods and under special conditions, feed rates of up to 1.5 times the stated values should be used.

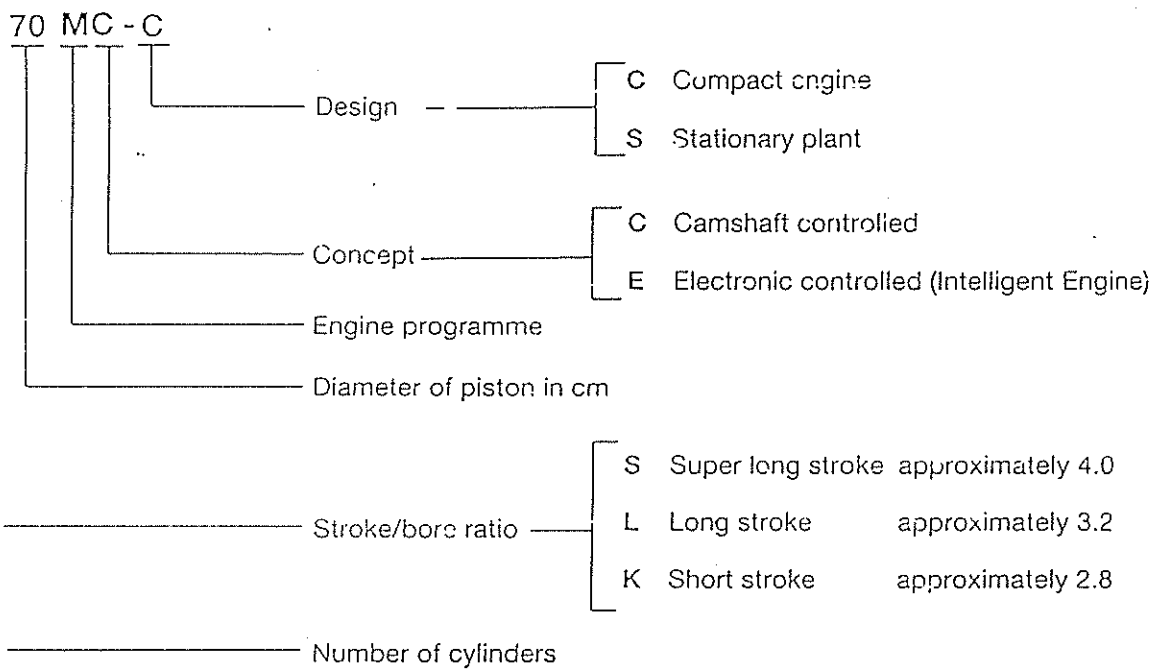
26MC



W/1992925-1/1152

Fig. 2

Engine types of the MC programme are designated by the following letters and figures



E
K
9
S
26
K9
9
S
24
S9
9
S
31
19
9
S
29
K
9
S
25

176 34 39-1.0

Engine type designation

Fig.

198 22 27

430100 400

| Engine type | Layout point | Engine speed r/min | Mean effective pressure bar | Power kW BHP | | | | | | | | |
|--|----------------|--------------------|-----------------------------|---------------------|--------------|--------------|---------------|---------------|---------------|----------------|----------------|----------------|
| | | | | Number of cylinders | | | | | | | | |
| | | | | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| S42MC Bore 420 mm Stroke 1764 mm | L ₁ | 136 | 19.5 | 4320 5880 | 5400 7350 | 6480 8820 | 7560 10290 | 8640 11760 | 9720 13230 | 10800 14700 | 11880 16170 | 12960 17640 |
| | L ₂ | 136 | 15.6 | 3460 4700 | 4325 5875 | 5190 7050 | 6055 8225 | 6920 9400 | 7785 10575 | 8650 11750 | 9515 12925 | 10380 14100 |
| | L ₃ | 115 | 19.5 | 3660 4960 | 4575 6200 | 5490 7440 | 6405 8680 | 7320 9920 | 8235 11160 | 9150 12400 | 10065 13640 | 10980 14880 |
| | L ₄ | 115 | 15.6 | 2920 3980 | 3650 4975 | 4380 5970 | 5110 6965 | 5840 7960 | 6570 8955 | 7300 9950 | 8030 10945 | 8760 11940 |
| L42MC Bore 420 mm Stroke 1360 mm | L ₁ | 176 | 18.0 | 3980 5420 | 4975 6775 | 5970 8130 | 6965 9485 | 7960 10840 | 8955 12195 | 9950 13550 | 10945 14905 | 11940 16260 |
| | L ₂ | 176 | 11.5 | 2540 3460 | 3175 4345 | 3810 5190 | 4445 6055 | 5080 6920 | 5715 7785 | 6350 8650 | 6985 9515 | 7620 10380 |
| | L ₃ | 132 | 18.0 | 2980 4060 | 3725 5075 | 4470 6090 | 5215 7105 | 5960 8120 | 6705 9135 | 7450 10150 | 8195 11165 | 8940 12180 |
| | L ₄ | 132 | 11.5 | 1920 2600 | 2400 3250 | 2880 3900 | 3360 4550 | 3840 5200 | 4320 5850 | 4800 6500 | 5280 7150 | 5760 7800 |
| S35MC Bore 350 mm Stroke 1400 mm | L ₁ | 173 | 19.1 | 2960 4040 | 3700 5050 | 4440 6060 | 5180 7070 | 5920 8080 | 6660 9090 | 7400 10100 | 8140 11110 | 8880 12120 |
| | L ₂ | 173 | 15.3 | 2380 3220 | 2975 4025 | 3570 4830 | 4165 5635 | 4760 6440 | 5355 7245 | 5950 8050 | 6545 8855 | 7140 9660 |
| | L ₃ | 147 | 19.1 | 2520 3420 | 3150 4275 | 3780 5130 | 4410 5935 | 5040 6840 | 5670 7695 | 6300 8550 | 6930 9405 | 7560 10260 |
| | L ₄ | 147 | 15.3 | 2020 2740 | 2525 3425 | 3030 4110 | 3535 4795 | 4040 5480 | 4545 6165 | 5050 6850 | 5555 7535 | 6060 8220 |
| L35MC Bore 350 mm Stroke 1050 mm | L ₁ | 210 | 18.4 | 2600 3520 | 3250 4400 | 3900 5280 | 4550 6160 | 5200 7040 | 5850 7920 | 6500 8800 | 7150 9680 | 7800 10560 |
| | L ₂ | 210 | 14.7 | 2080 2820 | 2600 3525 | 3120 4230 | 3640 4935 | 4160 5640 | 4680 6345 | 5200 7050 | 5720 7755 | 6240 8460 |
| | L ₃ | 178 | 18.4 | 2200 3000 | 2750 3750 | 3000 4500 | 3850 5250 | 4400 6000 | 4950 6750 | 5500 7500 | 6050 8250 | 6600 9000 |
| | L ₄ | 178 | 14.7 | 1760 2400 | 2200 3000 | 2640 3600 | 3080 4200 | 3520 4800 | 3960 5400 | 4400 6500 | 4840 6600 | 5280 7200 |
| S26MC Bore 260 mm Stroke 980 mm | L ₁ | 250 | 18.5 | 1600 2180 | 2000 2725 | 2400 3270 | 2800 3815 | 3200 4360 | 3600 4905 | 4000 5450 | 4400 5995 | 4800 6540 |
| | L ₂ | 250 | 14.8 | 1280 1740 | 1600 2175 | 1920 2610 | 2240 3045 | 2560 3480 | 2880 3915 | 3200 4350 | 3520 4785 | 3840 5220 |
| | L ₃ | 212 | 18.5 | 1360 1860 | 1700 2325 | 2040 2790 | 2380 3255 | 2720 3720 | 3060 4185 | 3400 4650 | 3740 5115 | 4080 5580 |
| | L ₄ | 212 | 14.8 | 1100 1480 | 1375 1850 | 1650 2220 | 1925 2590 | 2200 2960 | 2475 3330 | 2750 3700 | 3025 4070 | 3300 4440 |

176 46 78 9.0

Fig. 1.03e: Power and speed

| | | Specific fuel oil consumption | | g/kWh g/BHPH | | Lubricating oil consumption | |
|----------------------|----------------|---------------------------------|------------|------------------------|---------------------|-----------------------------|--|
| | | With conventional turbochargers | | System oil | Cylinder oil | | |
| At load layout point | | 100% | 80% | Approx. kg/cyl. 24h | g/kWh g/BHPH | | |
| L42MC | L ₁ | 177 130 | 174 129 | 3-4 | 0.8-1.2 0.6-0.9 | | |
| | L ₂ | 165 121 | 163 120 | | | | |
| | L ₃ | 177 130 | 174 129 | | | | |
| | L ₄ | 165 121 | 163 120 | | | | |
| S35MC | L ₁ | 178 131 | 177 130 | 2-3 | 0.95-1.5 0.7-1.1 | | |
| | L ₂ | 173 127 | 171 126 | | | | |
| | L ₃ | 178 131 | 177 130 | | | | |
| | L ₄ | 173 127 | 171 126 | | | | |
| L35MC | L ₁ | 177 130 | 175 129 | 2-3 | 0.8-1.2 0.6-0.9 | | |
| | L ₂ | 171 126 | 170 125 | | | | |
| | L ₃ | 177 130 | 175 129 | | | | |
| | L ₄ | 171 126 | 170 125 | | | | |
| S26MC | L ₁ | 179 132 | 178 131 | 1.5-3 | 0.95-1.5 0.7-1.1 | | |
| | L ₂ | 174 128 | 173 127 | | | | |
| | L ₃ | 179 132 | 178 131 | | | | |
| | L ₄ | 174 128 | 173 127 | | | | |

178 46 75-2.0

Fig. 1.05f: Fuel and lubricating oil consumption

| ENGINE TYPE | Number of cylinders | | | | | | | | |
|-------------|---------------------|-------------|------------|------------|------------|------------|-------------|------------|------------|
| | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 6S70MC-C | 1 x 80-B11 | 1 x 85-B11 | 1 x 85-B11 | 1 x 85-B12 | 2 x 80-B11 | - | - | - | - |
| 6S70MC | 1 x 80-B11 | 1 x 80-B12 | 1 x 85-B11 | 1 x 85-B12 | 2 x 80-B11 | - | - | - | - |
| 6S70MC | n.a. | n.a. | n.a. | n.a. | n.a. | - | - | - | - |
| 6S50MC-C | 1 x 77-B11 | 1 x 80-B11 | 1 x 80-B12 | 1 x 85-B11 | 1 x 85-B11 | - | - | - | - |
| 6S50MC | 1 x 77-B11 | 1 x 77-B12 | 1 x 80-B11 | 1 x 80-B12 | 1 x 85-B11 | - | - | - | - |
| 6S50MC | 1 x 77-B11 | 1 x 77-B12 | 1 x 80-B11 | 1 x 80-B12 | 1 x 85-B11 | - | - | - | - |
| 6S50MC-C | 1 x 73-B11 | 1 x 77-B11 | 1 x 77-B11 | 1 x 77-B12 | 1 x 80-B11 | - | - | - | - |
| 6S50MC | 1 x 73-B11 | 1 x 73-B12 | 1 x 77-B11 | 1 x 77-B12 | 1 x 80-B11 | - | - | - | - |
| 6S50MC | 1 x 73-B11 | 1 x 73-B12 | 1 x 77-B11 | 1 x 77-B11 | 1 x 77-B12 | - | - | - | - |
| 6S60MC-C | 1 x 73-B11 | 1 x 73-B11 | 1 x 77-B11 | 1 x 77-B11 | 1 x 77-B12 | - | - | - | - |
| 6A20MC | 1 x 69-A10 | 1 x 73-B11 | 1 x 73-B11 | 1 x 73-B12 | 1 x 77-B11 | 1 x 77-B11 | 2 x 73-B11 | 2 x 73-B11 | 2 x 73-B11 |
| 6A20MC | 1 x 69-A10 | 1 x 73-B11 | 1 x 73-B11 | 1 x 73-B12 | 1 x 73-B12 | 1 x 77-B11 | 2 x 73-B11 | 2 x 73-B11 | 2 x 73-B11 |
| 6S30MC | 1 x 65-A10 | 1 x 69-A10 | 1 x 69-A10 | 1 x 73-B11 | 1 x 73-B11 | 1 x 73-B11 | 2 x 69-A10 | 2 x 69-A10 | 2 x 69-A10 |
| 6S30MC | 1 x 65-A10 | 1 x 65-A10 | 1 x 69-A10 | 1 x 69-A10 | 1 x 73-B11 | 1 x 73-B11 | 2 x 65-A10 | 2 x 65-A10 | 2 x 69-A10 |
| 6S20MC | 1 x TPS57D* | 1 x TPS57D* | 1 x 61-A10 | 1 x 61-A10 | 1 x 65-A10 | 1 x 65-A10 | 2 x TPS57D* | 2 x 61-A10 | 2 x 61-A10 |

All turbochargers in this table are of the TPL-type.

*For 4 and 5 cylinder S26MC the full designation is listed in the table.

n.a. Not applicable

†Not included in the production programme

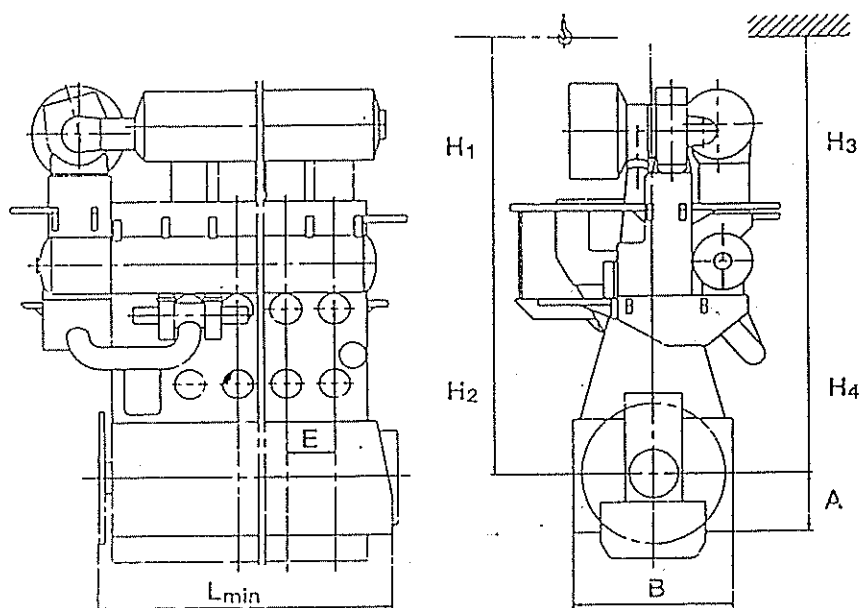
†Example of a full designation: 6S70MC-C requires 1 x TPL85-B11 at nominal MCR.

Fig. 3.07: ABB conventional turbochargers, type TPL, for engines with nominal rating (L1) complying with IMO's NO_x emission limits

| | | Cyl. | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
|------------------------------------|-----------------------------|--|----------------------------------|-------|-------|-------|-------|-------|-------|-------|------|-----|
| Nominal MCR at 250 r/min | | kW | 1600 | 2000 | 2400 | 2800 | 3200 | 3600 | 4000 | 4400 | 4800 | |
| Pumps | Fuel oil circulating pump | m ³ /h | 1.5 | 1.8 | 2.0 | 2.4 | 2.7 | 3.0 | 3.3 | 3.6 | 3.9 | |
| | Fuel oil supply pump | m ³ /h | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.1 | 1.2 | 1.3 | |
| | Jacket cooling water pump | m ³ /h | 1) | 16 | 20 | 24 | 28 | 32 | 36 | 40 | 44 | 48 |
| | | | 2) | 16 | 20 | 24 | 28 | 32 | 36 | 40 | 44 | 48 |
| | | | 3) | 24 | 28 | 25 | 29 | 34 | 38 | 55 | 47 | 51 |
| | | | 4) | 16 | 20 | 24 | 28 | 32 | 36 | 40 | 44 | 48 |
| | Central cooling water pump* | m ³ /h | 1) | 70 | 88 | 105 | 125 | 140 | 160 | 175 | 190 | 210 |
| | | | 2) | 71 | 88 | 105 | 125 | 140 | 160 | 175 | 195 | 210 |
| | | | 3) | 73 | 90 | 105 | 125 | 140 | 155 | 180 | 190 | 210 |
| | | | 4) | 71 | 88 | 105 | 125 | 140 | 155 | 175 | 190 | 210 |
| | Seawater pump* | m ³ /h | 1) | 52 | 66 | 79 | 92 | 105 | 120 | 130 | 145 | 160 |
| | | | 2) | 53 | 66 | 79 | 92 | 105 | 120 | 130 | 145 | 155 |
| | | | 3) | 56 | 68 | 79 | 91 | 105 | 115 | 130 | 145 | 155 |
| | | | 4) | 53 | 66 | 78 | 91 | 105 | 115 | 130 | 145 | 155 |
| | Lubricating oil pump* | m ³ /h | 1) | 49 | 57 | 55 | 72 | 84 | 94 | 53 | 105 | 115 |
| 2) | | | 51 | 58 | 66 | 73 | 83 | 93 | 100 | 105 | 115 | |
| 3) | | | 48 | 55 | 63 | 70 | 80 | 90 | 95 | 100 | 110 | |
| 4) | | | 50 | 57 | 65 | 72 | 82 | 92 | 99 | 105 | 115 | |
| Booster pump f. exh. valve actator | m ³ /h | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | |
| Coolers | Scavenge air cooler | kW | 560 | 710 | 850 | 990 | 1130 | 1270 | 1410 | 1550 | 1690 | |
| | Heat dissipation approx. | | | | | | | | | | | |
| | Central cooling water | m ³ /h | 45 | 56 | 68 | 79 | 90 | 101 | 112 | 123 | 134 | |
| | Lubricating oil cooler | kW | 1) | 220 | 275 | 350 | 400 | 460 | 510 | 550 | 600 | 700 |
| | | | 2) | 230 | 280 | 340 | 390 | 450 | 500 | 530 | 630 | 680 |
| | | | 3) | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 550 | 600 |
| | | | 4) | 225 | 275 | 325 | 375 | 425 | 475 | 550 | 600 | 650 |
| | Lubricating oil* | m ³ /h | See above "Lubricating oil pump" | | | | | | | | | |
| | Central cooling water | m ³ /h | 1) | 25 | 34 | 37 | 46 | 50 | 59 | 63 | 67 | 76 |
| | | | 2) | 25 | 34 | 37 | 46 | 50 | 59 | 63 | 72 | 76 |
| | | | 3) | 25 | 34 | 37 | 46 | 50 | 54 | 68 | 67 | 76 |
| | | | 4) | 25 | 34 | 37 | 46 | 50 | 54 | 63 | 67 | 76 |
| | Jacket water cooler | kW | 1) | 310 | 385 | 460 | 540 | 620 | 690 | 770 | 850 | 920 |
| | | | 2) | 310 | 385 | 460 | 540 | 620 | 690 | 770 | 850 | 920 |
| | | | 3) | 395 | 470 | 485 | 560 | 650 | 720 | 940 | 890 | 970 |
| 4) | | | 310 | 385 | 460 | 540 | 620 | 690 | 770 | 850 | 920 | |
| Jacket cooling water | m ³ /h | See above "Jacket cooling water" | | | | | | | | | | |
| Central cooling water | m ³ /h | See above "Central cooling water quantity" for lube oil cooler | | | | | | | | | | |
| Central cooler | kW | 1) | 1090 | 1370 | 1660 | 1930 | 2210 | 2470 | 2730 | 3000 | 3310 | |
| | | 2) | 1100 | 1380 | 1650 | 1920 | 2200 | 2460 | 2760 | 3030 | 3290 | |
| | | 3) | 1160 | 1430 | 1640 | 1900 | 2180 | 2440 | 2850 | 2990 | 3260 | |
| | | 4) | 1100 | 1370 | 1640 | 1910 | 2180 | 2440 | 2730 | 3000 | 3260 | |
| Central cooling water* | m ³ /h | See above "Central cooling water pump" | | | | | | | | | | |
| Seawater* | m ³ /h | See above "Seawater cooling pump" | | | | | | | | | | |
| Fuel oil heater | kW | 39 | 47 | 52 | 63 | 71 | 79 | 87 | 94 | 100 | | |
| Exhaust gas flow at 260 °C** | kg/h | 12400 | 15600 | 18700 | 21800 | 24900 | 28000 | 31100 | 34200 | 37300 | | |
| Air consumption of engine | kg/s | 3.4 | 4.2 | 5.1 | 5.9 | 6.8 | 7.6 | 8.4 | 9.3 | 10.1 | | |

178 42 76-5.1

6.04z: List of capacities, S26MC with central cooling system stated at the nominal MCR power (L1) engines complying with IMO's NO_x emission limitations



178 16 76-G.0

| | S50-C | S50 | L50 | S45-C | S42 | L42 | S35 | L35 | S26 |
|--------------------|-------|------|------|-------|-------|-------|------|------|------|
| Dimensions in mm | | | | | | | | | |
| A | 1085 | 1095 | 944 | 986 | 900 | 690 | 650 | 550 | 420 |
| B | 3150 | 2950 | 2710 | 2924 | 2670 | 2460 | 2200 | 1980 | 1890 |
| E | 850 | 890 | 890 | 782 | 748 | 748 | 600 | 600 | 490 |
| H1 | 8950 | 8300 | 7325 | 8600 | 8050 | 6700 | 6425 | 5200 | 4825 |
| H2 | 8375 | 8250 | 7325 | 8075 | 7525 | 6250 | 6050 | 4850 | 4725 |
| H3 | 8150 | 8100 | 7400 | 7850 | 7300 | 6350 | 5925 | 5025 | 4525 |
| H4 | | | | | | | 5850 | 4825 | 4500 |
| L_{min} | | | | | | | | | |
| 4 cyl. | 4720 | 5730 | 5515 | 4357 | 4240 | 4661 | 3480 | 3445 | 2975 |
| 5 cyl. | 5589 | 6620 | 6505 | 5139 | 4988 | 5409 | 4080 | 4045 | 3465 |
| 6 cyl. | 6439 | 7510 | 7395 | 5921 | 5736 | 6157 | 4680 | 4645 | 3955 |
| 7 cyl. | 7289 | 8400 | 8285 | 6703 | 6484 | 6905 | 5280 | 5245 | 4445 |
| 8 cyl. | 8139 | 9290 | 9175 | 7485 | 7232 | 7653 | 5880 | 5845 | 4935 |
| 9 cyl. | | | | | 7980 | 8401 | 6480 | 6445 | 5425 |
| 10 cyl. | | | | | 9476 | 9897 | 7080 | 7645 | 6405 |
| 11 cyl. | | | | | 10224 | 10645 | 8280 | 8245 | 6895 |
| 12 cyl. | | | | | 10972 | 11393 | 8880 | 8845 | 7385 |
| Dry masses in tons | | | | | | | | | |
| 4 cyl. | 155 | 171 | 163 | 133 | 109 | 95 | 57 | 50 | 32 |
| 5 cyl. | 181 | 195 | 188 | 153 | 125 | 110 | 65 | 58 | 37 |
| 6 cyl. | 207 | 225 | 215 | 171 | 143 | 125 | 75 | 67 | 42 |
| 7 cyl. | 238 | 255 | 249 | 197 | 160 | 143 | 84 | 75 | 48 |
| 8 cyl. | 273 | 288 | 276 | 217 | 176 | 158 | 93 | 83 | 53 |
| 9 cyl. | | | | | 195 | 176 | 103 | 92 | 58 |
| 10 cyl. | | | | | 232 | 210 | 122 | 108 | 68 |
| 11 cyl. | | | | | 249 | 229 | 132 | 118 | 74 |
| 12 cyl. | | | | | 269 | 244 | 141 | 126 | 79 |

The distances H_1 and H_2 are from the centre of the crankshaft to the crane hook. The distances H_3 and H_4 for the double jib crane are from the centre of the crankshaft to the lower edge of the deck beam.

E - Cylinder distance H_1 - Vertical lift H_2 - Tilted lift H_3 - Electrical double jib crane H_4 Manual double jib crane

178 87 19-G.0

Fig. 5.01b: Space requirements and masses

Starting air system: 30 bar (gauge)

| Cylinder No. | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|--------------|---|---|---|---|---|---|----|----|----|
|--------------|---|---|---|---|---|---|----|----|----|

S42MC

| | | | | | | | | | | |
|-----------------------------|-------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Reversible engine | | | | | | | | | | |
| Receiver volume (12 starts) | m ³ | 2 x 3.0 | 2 x 3.0 | 2 x 3.0 | 2 x 3.0 | 2 x 3.5 | 2 x 3.5 | 2 x 3.5 | 2 x 3.5 | 2 x 3.5 |
| Compressor capacity, total | m ³ /h | 180 | 180 | 180 | 180 | 210 | 210 | 210 | 210 | 210 |
| Non-reversible engine | | | | | | | | | | |
| Receiver volume (6 starts) | m ³ | 2 x 2.0 | 2 x 2.0 | 2 x 2.0 | 2 x 2.0 | 2 x 2.5 | 2 x 2.5 | 2 x 2.5 | 2 x 2.5 | 2 x 2.5 |
| Compressor capacity, total | m ³ /h | 120 | 120 | 120 | 120 | 150 | 150 | 150 | 150 | 150 |

L42MC

| | | | | | | | | | | |
|-----------------------------|-------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Reversible engine | | | | | | | | | | |
| Receiver volume (12 starts) | m ³ | 2 x 2.0 | 2 x 2.0 | 2 x 2.0 | 2 x 2.0 | 2 x 2.5 | 2 x 2.5 | 2 x 2.5 | 2 x 2.5 | 2 x 2.5 |
| Compressor capacity, total | m ³ /h | 120 | 120 | 120 | 120 | 150 | 150 | 150 | 150 | 150 |
| Non-reversible engine | | | | | | | | | | |
| Receiver volume (6 starts) | m ³ | 2 x 1.5 | 2 x 1.5 | 2 x 1.5 | 2 x 1.5 | 2 x 1.5 | 2 x 1.5 | 2 x 1.5 | 2 x 1.5 | 2 x 1.5 |
| Compressor capacity, total | m ³ /h | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 |

S35MC

| | | | | | | | | | | |
|-----------------------------|-------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Reversible engine | | | | | | | | | | |
| Receiver volume (12 starts) | m ³ | 2 x 1.0 | 2 x 1.0 | 2 x 1.0 | 2 x 1.0 | 2 x 1.5 | 2 x 1.5 | 2 x 1.5 | 2 x 1.5 | 2 x 1.5 |
| Compressor capacity, total | m ³ /h | 60 | 60 | 60 | 60 | 90 | 90 | 90 | 90 | 90 |
| Non-reversible engine | | | | | | | | | | |
| Receiver volume (6 starts) | m ³ | 2 x 0.5 | 2 x 0.5 | 2 x 0.5 | 2 x 0.5 | 2 x 1.0 | 2 x 1.0 | 2 x 1.0 | 2 x 1.0 | 2 x 1.0 |
| Compressor capacity, total | m ³ /h | 30 | 30 | 30 | 30 | 60 | 60 | 60 | 60 | 60 |

L35MC

| | | | | | | | | | | |
|-----------------------------|-------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Reversible engine | | | | | | | | | | |
| Receiver volume (12 starts) | m ³ | 2 x 1.0 | 2 x 1.0 | 2 x 1.0 | 2 x 1.0 | 2 x 1.5 | 2 x 1.5 | 2 x 1.5 | 2 x 1.5 | 2 x 1.5 |
| Compressor capacity, total | m ³ /h | 60 | 60 | 60 | 60 | 90 | 90 | 90 | 90 | 90 |
| Non-reversible engine | | | | | | | | | | |
| Receiver volume (6 starts) | m ³ | 2 x 0.5 | 2 x 0.5 | 2 x 0.5 | 2 x 0.5 | 2 x 1.0 | 2 x 1.0 | 2 x 1.0 | 2 x 1.0 | 2 x 1.0 |
| Compressor capacity, total | m ³ /h | 30 | 30 | 30 | 30 | 60 | 60 | 60 | 60 | 60 |

S26MC

| | | | | | | | | | | |
|-----------------------------|-------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Reversible engine | | | | | | | | | | |
| Receiver volume (12 starts) | m ³ | 2 x 0.9 | 2 x 0.9 | 2 x 1.0 | 2 x 1.0 | 2 x 1.0 | 2 x 1.0 | 2 x 1.0 | 2 x 1.0 | 2 x 1.0 |
| Compressor capacity, total | m ³ /h | 54 | 54 | 60 | 60 | 60 | 60 | 60 | 60 | 60 |
| Non-reversible engine | | | | | | | | | | |
| Receiver volume (6 starts) | m ³ | 2 x 0.4 | 2 x 0.4 | 2 x 0.4 | 2 x 0.4 | 2 x 0.5 | 2 x 0.5 | 2 x 0.5 | 2 x 0.5 | 2 x 0.5 |
| Compressor capacity, total | m ³ /h | 24 | 24 | 24 | 24 | 30 | 30 | 30 | 30 | 30 |

178 67 96-3.0.

6.01.05d: Capacities of starting air receivers and compressors for main engine

Starting Compressor (Water-cooled)

| Model No. | Speed (r.p.m.) | 25kg/cm ² | | | 30kg/cm ² | | |
|-----------|----------------|----------------------------------|-------------------|------------|----------------------------------|-------------------|------------|
| | | Capacity m ³ /hr (FA) | Power required PS | Motor (kW) | Capacity m ³ /hr (FA) | Power required PS | Motor (kW) |
| H-63 | 1,200 | 65 | 16.5 | 15 | 60 | 17 | 15 |
| | 1,500 | 80 | 20 | 18.5 | 75 | 21 | 18.5 |
| | 1,800 | 95 | 25 | 22 | 90 | 26.5 | 22 |
| H-64 | 1,200 | 90 | 23 | 18.5 | 85 | 24 | 18.5 |
| | 1,500 | 110 | 29 | 25 | 105 | 30 | 25 |
| | 1,800 | 135 | 36.5 | 30 | 130 | 37.5 | 30 |
| H-264 | 1,200 | 175 | 45.5 | 37 | 170 | 48 | 37 |
| | 1,500 | 215 | 57 | 45 | 210 | 60 | 50 |
| | 1,800 | 260 | 70.5 | 55 | 255 | 73.5 | 60 |
| H-73 | 1,200 | 110 | 28 | 25 | 105 | 29 | 25 |
| | 1,500 | 135 | 35 | 30 | 130 | 36 | 30 |
| | 1,800 | 160 | 46 | 37 | 155 | 47 | 37 |
| H-74 | 1,200 | 140 | 35 | 30 | 135 | 36 | 30 |
| | 1,500 | 175 | 45 | 37 | 170 | 46 | 37 |
| | 1,800 | 205 | 58 | 45 | 200 | 60 | 50 |
| H-273 | 1,200 | 220 | 55 | 45 | 215 | 58 | 45 |
| | 1,500 | 275 | 69 | 55 | 270 | 73 | 60 |
| | 1,800 | 325 | 86 | 65 | 320 | 88 | 70 |
| H-274 | 1,200 | 275 | 70 | 55 | 270 | 73 | 55 |
| | 1,500 | 340 | 88 | 70 | 335 | 91 | 75 |
| | 1,800 | 405 | 108 | 85 | 400 | 111 | 90 |
| H-373 | 1,200 | 330 | 83 | 65 | 320 | 97 | 70 |
| | 1,500 | 410 | 104 | 85 | 400 | 109 | 90 |
| | 1,800 | 485 | 128 | 100 | 475 | 132 | 110 |
| H-374 | 1,200 | 415 | 105 | 85 | 405 | 110 | 90 |
| | 1,500 | 515 | 130 | 110 | 505 | 135 | 110 |
| | 1,800 | 610 | 162 | 125 | 600 | 168 | 132 |

LEGEND: Capacity (free air) referred to inlet condition, measured according to vessel charging test method.

Emergency Compressor (Vertical 2-stage Air-cooled)

| Model No. | Speed (r.p.m.) | 15kg/cm ² | | 25 ~ 30kg/cm ² | |
|-----------|----------------|-----------------------|-----|---------------------------|-----|
| | | m ³ /hr FA | PS | m ³ /hr FA | PS |
| LSHC-20B | 900 | 4.7 | 1.4 | 4.3 | 1.6 |
| | 1000 | 5.2 | 1.5 | 5.0 | 1.7 |
| LSHC-30A | 900 | 13.5 | 4.8 | 12.8 | 5.3 |
| | 1000 | 14.8 | 5.3 | 13.8 | 5.8 |
| LSHC-40A | 900 | 20.4 | 7.2 | 19.4 | 8.0 |
| | 1000 | 22.3 | 7.9 | 21.2 | 8.9 |

Gear Pump

Merits of TAIKO-Type Gear Pump (Segmental Gear)

- 1. The gears are one point contact type originally designed for gear pump application, therefore, neither cavitation nor noise will occur.
- 2. Smooth rotation and slip ratio of only 1/10 against the ordinary gear pump result in less wearing of gear teeth.
- 3. Compact size with large capacity.
- 4. Longer life of bearings.
- 5. Constant suction and delivery volume.
- 6. Suitable even for fluid of high viscosity.
- 7. Changing the delivery pressure and capacity is almost nil.
- 8. High efficiency and less power consumption.

External Bearing Type

Application: L.O. Pump, L.O. Trans. Pump, F.O. Trans. Pump, F.O. Booster Pump

- 1) NHG-Series
(Horizontal Low press. small capacity type)
Capacity : 0.1-30 m³/hr
Head : Max. 6 kgf/cm²
H. Power : 0.2-15 kW
- 2) NHGH-Series
(Horizontal High press. small capacity type)
Capacity : 0.5-20 m³/hr
Head : Max. 16 kgf/cm²
H. Power : 0.4-18.5 kW
- 3) HG-Series
(Horizontal Low press. Medium capacity type)
Capacity : 30-200 m³/hr
Head : Max. 7 kgf/cm²
H. Power : 5.5-75 kW
- 4) VG-Series
(Vertical Low press. Medium capacity type)
Capacity : 20-200 m³/hr
Head : Max. 7 kgf/cm²
H. Power : 5.5-75 kW

External Bearing Type

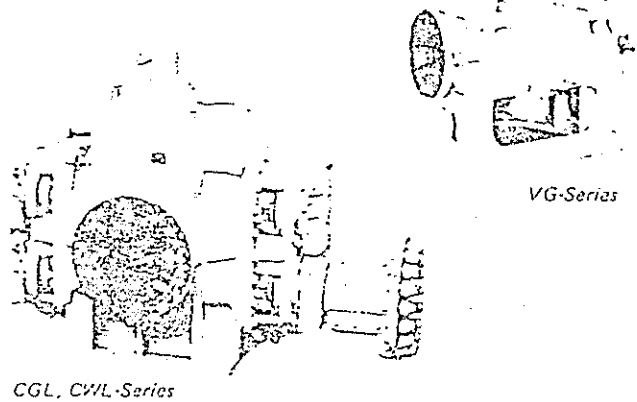
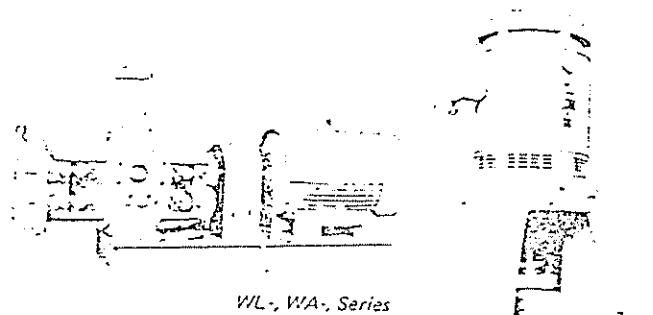
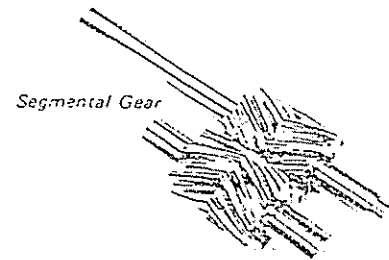
Application: Low grade F.O. pump, bilge pump, cargo pump, stripping pump, waste oil pump

- 1) WL-, WA-, SL-, Series
(Horizontal, Low press. small capacity type)
Capacity : 1-100 m³/hr
Head : Max. 16 kgf/cm²
H. Power : 0.75-55 kW
- 2) CGL/CWL Series
(Horizontal, medium press. large capacity type)
Capacity : 60-1500 m³/hr
Head : Max. 12 kgf/cm²
H. Power : 12-500 kW

Other Used Pump

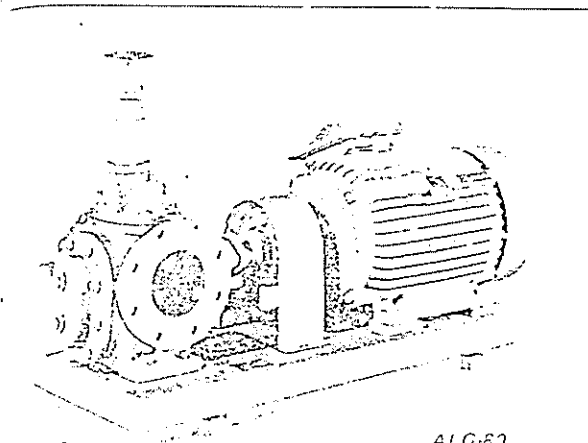
Engine Fixed Pump

Application: Main L.O. Pump, F.O. supply pump
OL/F Series (Engine driven bracket type)
Capacity : 0.3-300 m³/hr
Head : - 8 kgf/cm²



Rotary Gear Pumps and Screw Pumps

Naniwa rotary gear pumps and screw pumps are self-lubricating type, and equipped with a safety valve respectively so as to prevent a motor from overloading. The main advantages of these pumps are high performance, high durability, simple construction and low operation noise and vibration.



**ALG
ALGT**

ALG-60

Applications:
Fuel oil transfer
Lubricating oil
Lubricating oil
transfer

Specifications:
Horizontal double helical
inner bearing
Rotary gear
Capacity 1-125 m³/h
Head 2-7.5 kg/cm²

TLG

Applications:
Fuel oil transfer
Fuel oil booster
Lubricating oil

Specifications:
Horizontal trochoid
inner bearing
Rotary gear
Capacity 0.5-20 m³/h
Head 2-16 kg/cm²

BHG

Applications:
Cargo oil
Product cargo
Chemical cargo

Specifications:
Horizontal double helical
outer bearing
Rotary gear
Capacity 80-1200 m³/h
Head 5-15 kg/cm²

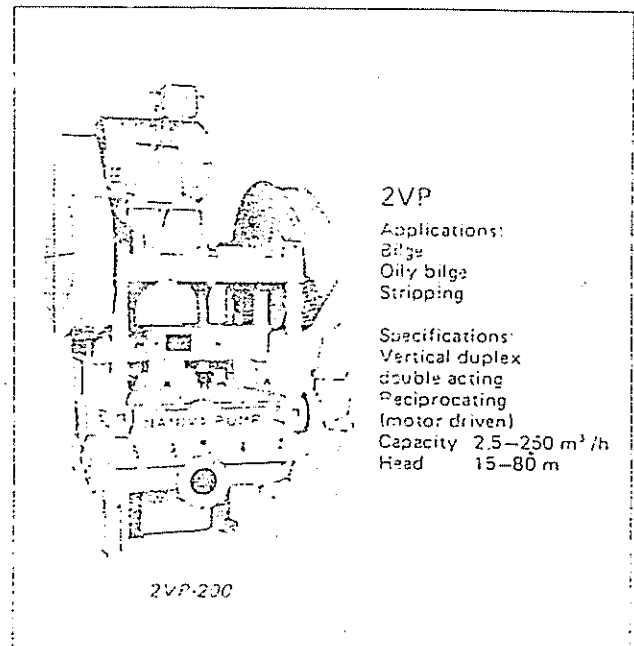
ALGV

Applications:
Fuel oil transfer
Lubricating oil
transfer

Specifications:
Vertical double helical
inner bearing
Rotary gear
Capacity 20-225 m³/h
Head 2-8.0 kg/cm²

Reciprocating Pumps

Naniwa reciprocating pumps are basically divided into two types, electrically driven and steam driven. Special attention was given to the design of the valves, rings and liners to ensure a long period of trouble free operation. The pumps are equipped with a safety valve respectively to prevent overloads.



2VP

Applications:
Bilge
Oily bilge
Stripping

Specifications:
Vertical duplex
double acting
Reciprocating
(motor driven)
Capacity 2.5-250 m³/h
Head 15-80 m

2VP-200

HP

Applications:
Bilge
Oily water
separator
Oily bilge

Specifications:
Horizontal simplex
double acting
Reciprocating
Capacity 0.5-5.0 m³/h
Head 5-70 m

HPL

Applications:
Hydraulic test
Boiler feed

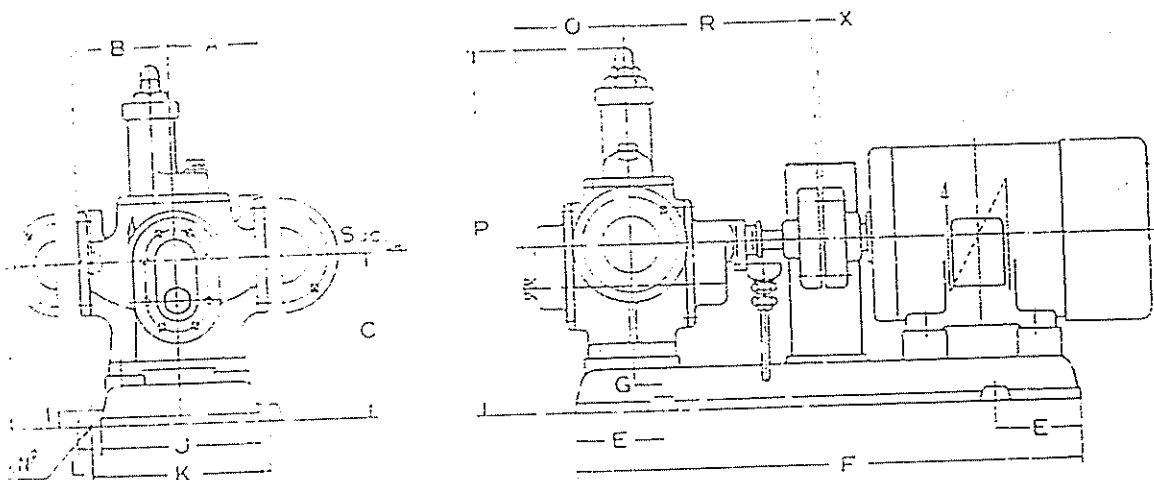
Specifications:
Horizontal multiplex
single acting
Reciprocating
Capacity 0.5-30 m³/h
Head 10.0-1,000 kg/cm²

WOV

Applications:
Bilge
Ballast
Stripping

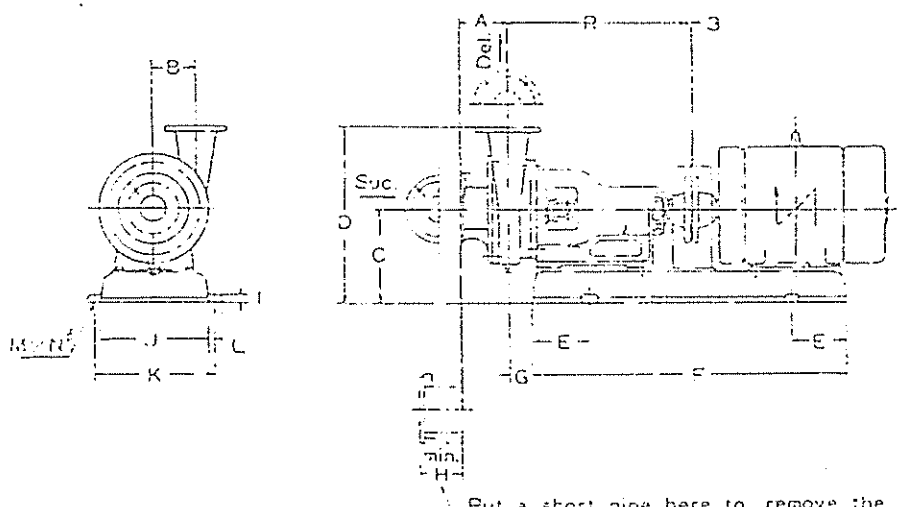
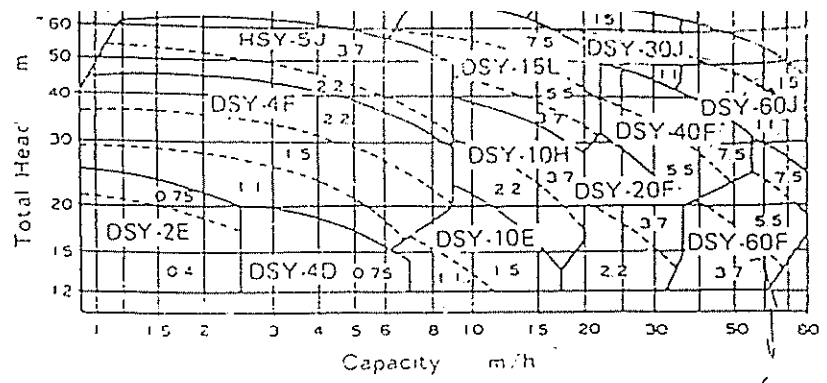
Specifications:
Vertical duplex
double acting
Reciprocating
(steam driven)
Capacity 20-500 m³/h
Head 10-100 m

type



Dimensions—mm

| Flow Rate (l/min) | Motor (kw) | Bore (mm) | Suc | Dis | A | B | C | D | E | F | G | I | J | K | L | M | N | O | P | R | X | Pump Weight (kg) |
|-------------------|------------|-----------|-----|-----|-----|-----|-----|-----|-----|------|------|----|-----|-----|----|---|----|-----|-----|-----|---|------------------|
| 1200 | 0.4 | 25 | 20 | | 110 | 110 | 200 | 200 | 50 | 365 | 21 | 20 | 170 | 140 | 15 | 4 | 15 | 55 | 330 | 122 | 3 | 30 |
| 1200 | 0.75 | 32 | 25 | | 95 | 95 | 195 | 195 | 100 | 500 | 60 | 25 | 260 | 300 | 23 | 4 | 15 | 89 | 380 | 175 | 3 | 47 |
| 1200 | 0.75 | 15 | 40 | 32 | 95 | 95 | 195 | 195 | 100 | 500 | 60 | 25 | 260 | 300 | 23 | 4 | 15 | 96 | 385 | 175 | 3 | 50 |
| 1200 | 0.75 | 15 | 50 | 40 | 100 | 100 | 210 | 210 | 100 | 550 | 35 | 25 | 260 | 300 | 23 | 4 | 15 | 98 | 412 | 185 | 3 | 55 |
| 1200 | 1.5 | 2.2 | 55 | 50 | 105 | 105 | 225 | 225 | 100 | 600 | 20 | 25 | 280 | 320 | 23 | 4 | 15 | 144 | 470 | 200 | 3 | 70 |
| 1200 | 1.5 | 2.2 | 65 | 50 | 105 | 105 | 225 | 225 | 100 | 600 | 20 | 25 | 280 | 320 | 23 | 4 | 15 | 111 | 470 | 200 | 3 | 72 |
| 1200 | 2.2 | | 65 | 50 | 105 | 105 | 225 | 225 | 100 | 600 | 20 | 25 | 280 | 320 | 23 | 4 | 15 | 55 | 470 | 200 | 3 | 72 |
| 1200 | 3.7 | | 65 | 50 | 105 | 105 | 230 | 230 | 130 | 640 | 60 | 25 | 300 | 330 | 25 | | | 63 | 475 | 200 | 3 | 76 |
| 1200 | 2.2 | 3.7 | 80 | 55 | 110 | 110 | 245 | 245 | 150 | 700 | 50 | 25 | 300 | 350 | 23 | 4 | 15 | 122 | 500 | 220 | 3 | 90 |
| 1200 | 2.2 | 3.7 | 80 | 55 | 140 | 140 | 230 | 230 | 125 | 700 | 30 | 25 | 310 | 350 | 23 | 4 | 15 | 137 | 530 | 245 | 3 | 95 |
| 1200 | 3.7 | | 50 | 55 | 140 | 140 | 230 | 230 | 125 | 700 | 30 | 25 | 310 | 350 | 23 | 4 | 15 | 152 | 530 | 250 | 3 | 103 |
| 1200 | 5.5 | | | | | | 230 | 230 | 125 | 750 | | | | | | | | 152 | | | | |
| 1200 | 3.7 | 5.5 | 50 | 55 | 150 | 150 | 260 | 260 | 100 | 750 | 0.20 | 25 | 310 | 350 | 23 | 4 | 15 | 165 | 555 | 285 | 3 | 140 |
| 1200 | 7.5 | | | | | | 270 | 270 | 150 | 950 | 65 | 30 | 350 | 390 | 22 | | | 19 | 575 | | | |
| 1200 | 5.5 | | 120 | 50 | 130 | 150 | 270 | 270 | 150 | 800 | 50 | 25 | 310 | 350 | 23 | 4 | 15 | 193 | 618 | 315 | 3 | 135 |
| 1200 | 7.5 | | | | | | | | 150 | 800 | 50 | 25 | 310 | 350 | 23 | 4 | 15 | 192 | 618 | 315 | 3 | 135 |
| 1200 | 5.5 | | | | 170 | 190 | 270 | 270 | 150 | 800 | 50 | 25 | 350 | 390 | 23 | 4 | 15 | 210 | 633 | 357 | 3 | 200 |
| 1200 | 7.5 | 11 | 120 | 50 | 170 | 190 | 270 | 270 | 150 | 800 | 50 | 25 | 350 | 390 | 23 | 4 | 15 | 210 | 633 | 357 | 3 | 200 |
| 1200 | 7.5 | 11 | 120 | 50 | 170 | 190 | 270 | 270 | 150 | 800 | 50 | 25 | 350 | 390 | 23 | 4 | 15 | 210 | 633 | 357 | 3 | 200 |
| 1200 | 7.5 | 11 | 120 | 50 | 170 | 190 | 270 | 270 | 150 | 800 | 50 | 25 | 350 | 390 | 23 | 4 | 15 | 210 | 633 | 357 | 3 | 200 |
| 1200 | 11 | 15 | 120 | 50 | 210 | 230 | 300 | 300 | 200 | 1100 | 100 | 25 | 350 | 390 | 23 | 4 | 15 | 225 | 675 | 405 | 3 | 305 |
| 1200 | 11 | 15 | 120 | 50 | 210 | 230 | 300 | 300 | 200 | 1100 | 100 | 25 | 350 | 390 | 23 | 4 | 15 | 225 | 675 | 405 | 3 | 305 |



Dimensions—mm

| Motor | Bore | | A | B | C | D | E | F | G | H | I | J | K | L | M | N | R | Pump Weight (kg) | |
|-------|------|------|-----|-----|-----|-----|-----|-----|-----|----|-----|----|-----|-----|----|---|----|------------------|------|
| | (kw) | Suc. | | | | | | | | | | | | | | | | | Del. |
| 2E | 0.75 | 32 | 32 | 88 | 73 | 165 | 315 | 100 | 550 | 35 | 100 | 25 | 200 | 240 | 23 | 4 | 15 | 350 | 45 |
| 4D | 0.75 | 32 | 32 | 90 | 65 | 172 | 290 | 100 | 550 | 35 | 100 | 25 | 200 | 240 | 23 | 4 | 15 | 350 | 45 |
| 10H | 1.5 | 32 | 32 | 96 | 92 | 165 | 315 | 100 | 600 | 30 | 100 | 25 | 200 | 240 | 23 | 4 | 15 | 350 | 50 |
| | 2.2 | 32 | 32 | 96 | 92 | 175 | 325 | 100 | 620 | 35 | 100 | 25 | 240 | 280 | 23 | 4 | 15 | 350 | 50 |
| 20F | 2.2 | 32 | 32 | 94 | 95 | 182 | 325 | 100 | 620 | 35 | 100 | 25 | 240 | 280 | 23 | 4 | 15 | 350 | 60 |
| | 3.7 | 32 | 32 | 94 | 95 | 197 | 340 | 100 | 650 | 30 | 100 | 25 | 260 | 300 | 23 | 4 | 15 | 350 | 60 |
| 30J | 1.5 | 50 | 50 | 96 | 75 | 165 | 295 | 100 | 600 | 30 | 100 | 25 | 200 | 240 | 23 | 4 | 15 | 350 | 60 |
| 40F | 2.2 | 50 | 50 | 96 | 96 | 175 | 325 | 100 | 620 | 35 | 100 | 25 | 240 | 280 | 23 | 4 | 15 | 350 | 55 |
| | 3.7 | 50 | 50 | 96 | 96 | 190 | 340 | 100 | 650 | 30 | 100 | 25 | 260 | 300 | 23 | 4 | 15 | 350 | 55 |
| 60J | 3.7 | 50 | 50 | 110 | 120 | 190 | 390 | 125 | 700 | 28 | 100 | 25 | 300 | 340 | 23 | 4 | 15 | 370 | 80 |
| | 5.5 | 50 | 50 | 110 | 120 | 210 | 410 | 125 | 700 | 28 | 100 | 25 | 300 | 340 | 23 | 4 | 15 | 370 | 80 |
| 60F | 7.5 | 50 | 50 | 110 | 120 | 210 | 410 | 150 | 750 | 28 | 100 | 25 | 300 | 340 | 23 | 4 | 15 | 370 | 80 |
| | 2.2 | 65 | 65 | 105 | 95 | 175 | 315 | 100 | 620 | 35 | 100 | 25 | 240 | 280 | 23 | 4 | 15 | 350 | 75 |
| 40F | 3.7 | 65 | 65 | 105 | 95 | 190 | 330 | 100 | 650 | 30 | 100 | 25 | 260 | 300 | 23 | 4 | 15 | 350 | 75 |
| | 5.5 | 100 | 100 | 118 | 105 | 202 | 420 | 125 | 700 | 28 | 100 | 25 | 300 | 340 | 23 | 4 | 15 | 370 | 125 |
| 60F | 7.5 | 100 | 100 | 118 | 105 | 202 | 420 | 150 | 750 | 28 | 100 | 25 | 300 | 340 | 23 | 4 | 15 | 370 | 125 |
| | 11 | 65 | 65 | 120 | 120 | 249 | 445 | 175 | 860 | 35 | 100 | 25 | 360 | 400 | 23 | 4 | 15 | 425 | 110 |
| 10H | 15 | 65 | 65 | 120 | 120 | 249 | 445 | 175 | 900 | 35 | 100 | 25 | 360 | 400 | 23 | 4 | 15 | 425 | 110 |
| | 3.7 | 100 | 100 | 122 | 115 | 210 | 390 | 120 | 700 | 35 | 100 | 25 | 300 | 340 | 23 | 4 | 15 | 425 | 150 |
| 20F | 5.5 | 100 | 100 | 122 | 115 | 210 | 390 | 150 | 750 | 30 | 100 | 25 | 300 | 340 | 23 | 4 | 15 | 425 | 160 |
| | 7.5 | 100 | 100 | 122 | 115 | 210 | 390 | 150 | 760 | 35 | 100 | 25 | 300 | 340 | 23 | 4 | 15 | 425 | 160 |
| 30J | 11 | 100 | 100 | 130 | 120 | 235 | 445 | 175 | 860 | 35 | 100 | 25 | 360 | 400 | 23 | 4 | 15 | 425 | 110 |
| | 15 | 100 | 100 | 130 | 120 | 235 | 445 | 175 | 900 | 35 | 100 | 25 | 360 | 400 | 23 | 4 | 15 | 425 | 110 |



Ankerwinde Windlass

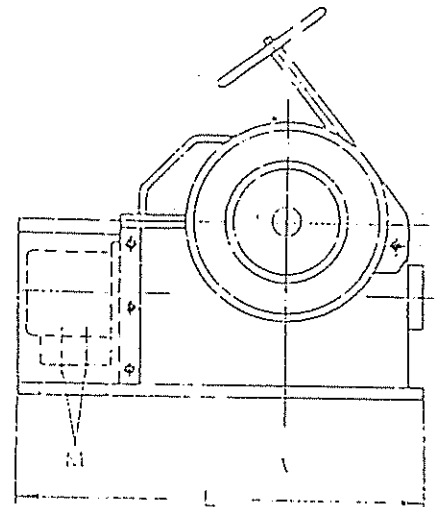
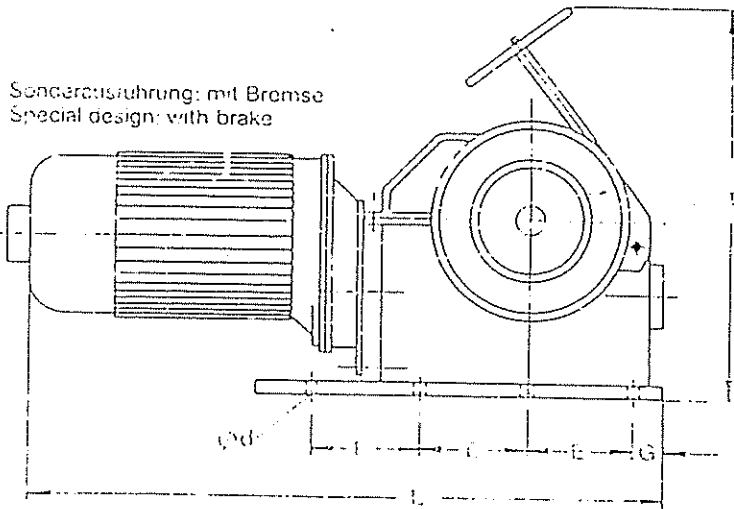
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HIP-C

Type E
Antrieb durch Elektromotor
Drive by electric motor

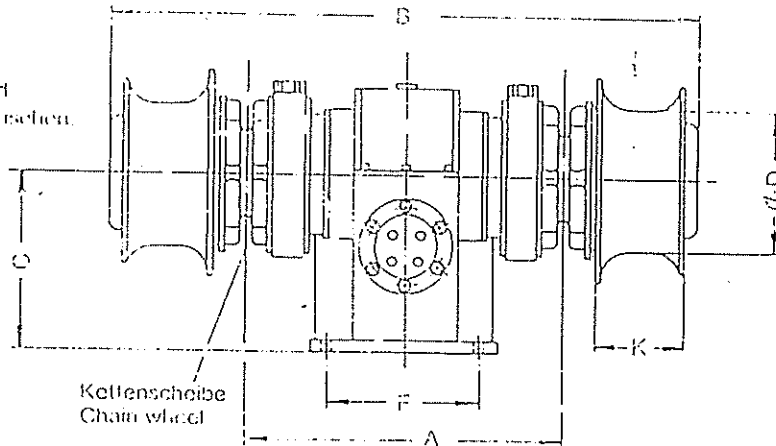
Type H
Antrieb durch Hydraulikmotor
Drive by hydraulic motor

Sonderausführung: mit Bremse
Special design: with brake



Achtung!
Kettenspeicher sind
von Kunden vorzugeben.

Chain stopper
to be supplied
by yard or
customer.



| Type | A | B | C | D | d | E | F | G | H | K | L | Z [kp] Ø Kette chain | V [m/min] Ø Kette chain | Antriebsleistung Driving power |
|---------|-----|------|-----|-----|----|-----|-----|----|-----|-----|------|----------------------------|-------------------------------|-----------------------------------|
| 720.03E | 450 | 850 | 250 | 200 | 22 | 150 | 215 | 40 | 550 | 130 | 900 | 1500 Ø 16 | 10 Ø 16 | 4,4 kW/390 V DS |
| 720.04H | 450 | 850 | 250 | 200 | 22 | 150 | 215 | 40 | 550 | 130 | 580 | R 1/2" Ø 16 | 10 Ø 16 | Δp 70 bar/55 l/min |
| 721.16E | 535 | 1100 | 320 | 290 | 22 | 190 | 250 | 82 | 680 | 180 | 1121 | 3400 Ø 18 | 10 Ø 22 | 7,5 kW/390 V DS |
| 721.15H | 535 | 1100 | 320 | 290 | 22 | 190 | 250 | 82 | 680 | 180 | 785 | R 3/4" Ø 18 | 10 Ø 22 | Δp 105 bar/65 l/min |
| 722.01E | 660 | 1270 | 395 | 290 | 26 | 240 | 350 | 85 | 690 | 180 | 1315 | 5600 Ø 26 | 10 Ø 28 | 13,5 kW/390 V DS |
| 722.02H | 660 | 1270 | 395 | 290 | 26 | 240 | 350 | 85 | 690 | 180 | 960 | R 3/4" Ø 26 | 10 Ø 28 | Δp 135 bar/65 l/min |

Konstruktionsänderungen vorbehalten / Subject to change of spec.

Maßangaben und Leistungswerte
sind nur für die aufgeführten Ketten gültig
Dimensions and performance data only
apply to the chains listed.

V = Hubgeschwindigkeit / Lifting speed
Z = max. Zugkraft / max. lifting power

Maße/Dimensions : [mm]

SHOP TEST AND INSPECTION METHOD FOR LIFEBOAT DAVIT & WINCH
救命艇用ダビット及びクランチ 工場試験及び検査要領

LIFEBOAT DAVIT
救命艇ダビット

| PARTICULARS 試験項目 | CONDITION OF DAVIT ダビットの状態 | TEST LOAD 試験荷重 |
|--|---|------------------------------------|
| Static overload test 静過負荷試験 | Fully turned out Upright 板出位置、水平状態 | $Wf \times 2.2 = 12551 \text{ Kg}$ |
| Hoisting and Turning test 巻上げ及び板出試験 | Upright 水平状態 | $Wex1.1 = 2976 \text{ Kg}$ |
| Block leave test ブロッック離脱試験 | 15° heel 10° trim 15° ヒール、 10° トリム状態 | $Wex1.1 = 2976 \text{ Kg}$ |

2) LIFEBOAT WINCH
救命艇クランチ

Tests of this item are performed prior to tests of davits.
本項目の各試験は、ダビットの試験に先立って行われる。

| PARTICULARS 試験項目 | CONDITION OF WINCH クランチの状態 | TEST LOAD 試験荷重 |
|--------------------------------|---|--|
| Static overload test 静過負荷試験 | Upright 水平状態 | $SWL \times 1.5 = 6750 \text{ Kg}$ |
| Lowering speed test 降下速度試験 | Allowable speed 15-36 m/min. 許容速度 | $Wf \times 1.1 \times 1/2 = 3138 \text{ Kg}$ |
| Braking test ブレーキテスト | Upright 水平状態 | $Wf \times 1.1 \times 1/2 = 3138 \text{ Kg}$ |
| Hoisting speed test 巻上げ速度試験 | Upright 水平状態 | $Wex1.1 \times 1/2 = 1486 \text{ Kg}$ |

3) OTHER TEST
他の試験

| PARTICULARS 試験項目 | CONDITION 状態 | TEST LOAD 試験荷重 |
|---|-----------------|------------------------------------|
| Sling block Static overload test ブロッック 静過負荷試験 | Upright 水平状態 | $Wf \times 2.5 = 14263 \text{ Kg}$ |

4) APPEARANCE
外觀検査

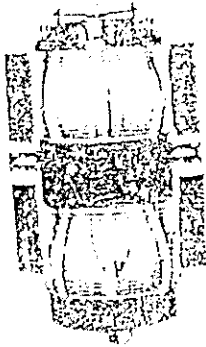
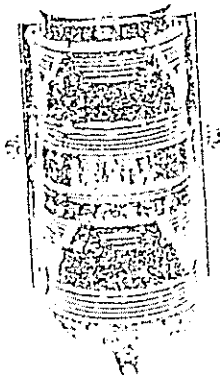
To be confirmed the welding parts & measured principal dimensions.
溶接部の確認及び主要寸法の計測を行う。

"STANDAR UNURAN SENCICI OLEH BCT (BOARD OF TRADE) ENGLAND"

| L. B. E | L. B. H. (ft) | Kapasitas (ft ³) | Jumlah orang | berat koci (kg) | berat su (kg) | berat perlangs (kg) | berat total (kg) |
|---------------------|--------------------|------------------------------|--------------|-----------------|---------------|---------------------|------------------|
| 5,4 x 2,74 x 1,11 | 5,0 x 3,25 | 607 | 60 | 2205 | 4500 | 356 | 7061 |
| 6,84 x 2,74 x 1,10 | 124 x 3,75 x 3,60 | 545 | 54 | 1976 | 4050 | 356 | 6382 |
| 6,55 x 2,59 x 1,07 | 124 x 3,50 x 3,50 | 500 | 50 | 1824 | 3750 | 350 | 5894 |
| 6,25 x 2,51 x 1,04 | 127 x 3,25 x 3,40 | 454 | 45 | 1646 | 3576 | 350 | 5551 |
| 6,25 x 2,44 x 0,99 | 123 x 3,00 x 3,25 | 405 | 40 | 473 | 3000 | 305 | 4778 |
| 7,62 x 2,56 x 0,96 | 125 x 3,75 x 3,15 | 366 | 36 | 1326 | 2700 | 305 | 4331 |
| 7,31 x 2,29 x 0,91 | 124 x 3,50 x 3,0 | 324 | 32 | 1160 | 2400 | 254 | 3843 |
| 7,01 x 2,29 x 0,88 | 125 x 3,50 x 2,90 | 300 | 30 | 1087 | 2250 | 254 | 3591 |
| 6,71 x 2,21 x 0,84 | 112 x 3,25 x 2,75 | 236 | 23 | 655 | 1950 | 229 | 3134 |
| 6,40 x 2,13 x 0,80 | 121 x 3,0 x 2,70 | 203 | 20 | 581 | 1725 | 229 | 2916 |
| 6,10 x 2,06 x 0,79 | 120 x 2,75 x 2,60 | 210 | 21 | 742 | 1575 | 203 | 2540 |
| 5,79 x 1,96 x 0,75 | 113 x 2,50 x 2,50 | 182 | 18 | 650 | 1350 | 175 | 2478 |
| 5,49 x 1,90 x 0,75 | 118 x 2,25 x 2,40 | 162 | 16 | 590 | 1200 | 152 | 1942 |
| 5,18 x 1,83 x 0,715 | 117 x 2,0 x 2,30 | 143 | 14 | 502 | 1050 | 152 | 1710 |
| 4,88 x 1,75 x 0,70 | 116 x 1,75 x 2,150 | 127 | 12 | 457 | 900 | 127 | 1484 |

NAVIGATION LIGHTS & WHISTLES

Navigation Lights



Over 50M Vessels

| Item | Model | Capacity | Type | Brass Made |
|----------------------|---------|----------|--------|------------|
| | | | | Weight |
| Wast Head Light | A-2-P23 | 60Wx2 | Dual | 3.4kg |
| Port Side Light | A-2-P23 | 60Wx2 | Dual | 3.6kg |
| Starboard Side Light | A-2-P23 | 60Wx2 | Dual | 3.6kg |
| Stern Light | A-2-P23 | 40Wx2 | Dual | 3.4kg |
| Anchor Light | A-2-P23 | 40Wx1 | Single | 1.75kg |
| NUC Light | A-2-P23 | 60Wx1 | Single | 1.75kg |

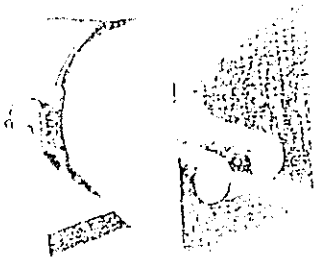
HK approved type

Over 50M Vessels

| Item | Model | Capacity | Type | Polycarbonate Made |
|----------------------|--------|----------|--------|--------------------|
| | | | | Weight |
| Wast Head Light | A2-D34 | 60Wx2 | Dual | 2.1kg |
| Port Side Light | A2-D1R | 60Wx2 | Dual | 2.1kg |
| Starboard Side Light | A2-D1G | 60Wx2 | Dual | 2.1kg |
| Stern Light | A2-D5 | 40Wx2 | Dual | 2.1kg |
| Anchor Light | A2-SW | 40Wx1 | Single | 1.1kg |
| NUC Light | A2-SR | 60Wx1 | Single | 1.1kg |
| Towing Light | A2-S1 | 60Wx1 | Single | 1.1kg |

HK approved type

Electronic Horn

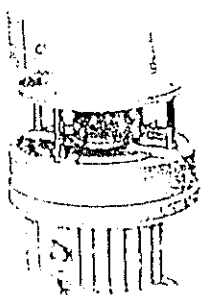


For Vessels Length 20M-75M

| Model | Voltage | Specifications | Weight |
|---------|---------|--|--------|
| EHV-130 | DC24V | 400Hz 130dB/1m Complete with time controller and microphone | 22kg |

HK approved type

Motor Sirens



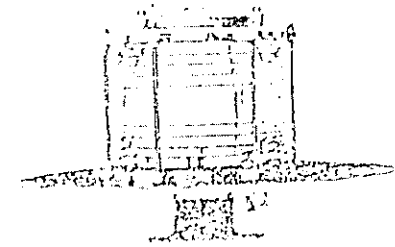
For vessels length 20M-75M

| Model | Voltage | Hz | Specifications | Weight |
|--------|---------|----|----------------|--------|
| MS-3 | AC220V | 60 | 462Hz 130dB/1m | 39.5kg |
| MS-3B | AC440V | 60 | 462Hz 130dB/1m | 39.5kg |
| MS-3 | AC220V | 60 | 462Hz W/Heater | 41kg |
| MS-3B | AC440V | 60 | 462Hz W/Heater | 41kg |
| MS-35 | AC220V | 50 | 482Hz 130dB/1m | 51kg |
| MS-35B | AC440V | 50 | 482Hz 130dB/1m | 51kg |

HK approved type

SIGNAL LIGHTS & SPECIAL LIGHTS

Large Signal Lights



Cast Brass or Iron Made

IP56

| Model | Capacity | Dimension (mm) | Weight |
|--------|----------|----------------|--------|
| JIS-I | 20Wx3 | D H 124x253 | 8.4kg |
| JIS-II | 20Wx4 | 181x310 | 9.7kg |
| KEY | | 100x132x114 | 2.4kg |

Small Signal Lights

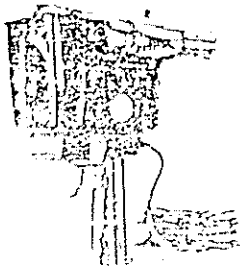


Cast Brass Made

IP56

| Model | Capacity | Dimension (mm) | Weight |
|-------|----------|----------------|--------|
| 1 | MAX 40W | D H 94x220 | 2.7kg |
| 2 | MAX 40W | 118x205 | 2.35kg |

Portable Day Light Signalling Lights



| Model | Capacity | Dimension (mm) | Weight |
|---------|----------|----------------|--------|
| SPS-10A | 24V 60W | 186x130x304 | 2.55kg |
| STS-10B | 12V 60W | 186x100x304 | 2.55kg |

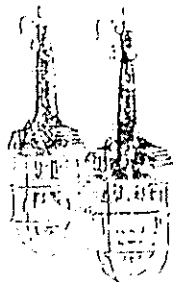
OK DOT Approved Type
ECE Approved Type

Art Table Lights



| Model | Capacity | Weight | Remarks |
|-------|----------|--------|--------------------|
| IZS | MAX 60W | 2.5kg | |
| IZSR | MAX 60W | 2.6kg | With Dimmer Switch |

Waterproof Lights

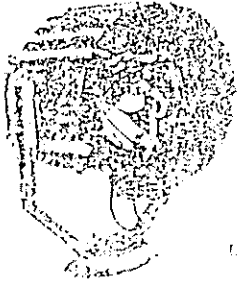


Polycarbonate

| Model | Capacity | Weight | Remarks |
|---------|----------|--------|---------------------|
| WT-60 | MAX 60W | 0.8kg | Watertight Type |
| NWT-100 | MAX 60W | 0.5kg | Non Watertight Type |

SEARCHLIGHTS

Neon Searchlights
Direct Controlled Type



AC220V 50

| Model | Capacity | Candle Power | Weight |
|-----------|----------|-------------------------|--------|
| EX-3010H2 | 1kW | 40.5x10 ⁴ cd | 135kg |
| EX-3020H2 | 2kW | 96x10 ⁴ cd | 160kg |
| EX-3040H2 | 4kW | 165x10 ⁴ cd | 260kg |
| EX-3060H2 | 7kW | 326x10 ⁴ cd | 325kg |

With ballast

Neon Searchlights
Electric Remote Controlled Type

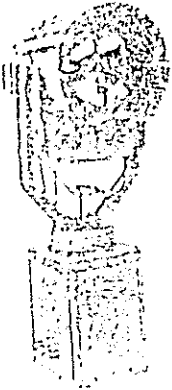


AC220V 50

| Model | Capacity | Candle Power | Weight |
|-----------|----------|-------------------------|--------|
| EX-3010H2 | 1kW | 40.5x10 ⁴ cd | 135kg |
| EX-3020H2 | 2kW | 96x10 ⁴ cd | 160kg |
| EX-3040H2 | 4.5kW | 165x10 ⁴ cd | 260kg |
| EX-3060H2 | 7kW | 326x10 ⁴ cd | 325kg |

With ballast

Neon Searchlights
Remote Controlled Type
Electric Focus Adjustment
Speed Controlled Available

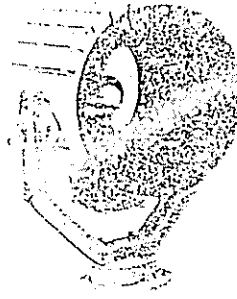


AC220V 50

| Model | Capacity | Candle Power | Weight |
|-------------|----------|-------------------------|--------|
| EX-3010H22T | 1kW | 40.5x10 ⁴ cd | 135kg |
| EX-3020H23T | 2kW | 96x10 ⁴ cd | 160kg |
| EX-3040H22T | 4.5kW | 165x10 ⁴ cd | 260kg |
| EX-3060H23T | 7kW | 326x10 ⁴ cd | 325kg |

With ballast

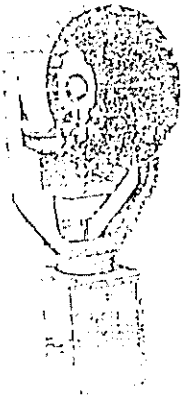
Incandescent Searchlights
Direct Controlled Type



AC110V or AC220V 50

| Model | Capacity | Candle Power | Weight |
|----------|----------|---------------------|--------|
| D-20 | 0.5kW | 40x10 ⁴ | 22kg |
| D-30 | 1kW | 140x10 ⁴ | 34kg |
| D-40 | 2kW | 300x10 ⁴ | 50kg |
| D-60 | 3kW | 700x10 ⁴ | 135kg |
| ACT-30SU | 1kW | 50x10 ⁴ | 24kg |

Incandescent Searchlights
Electric Remote Controlled Type

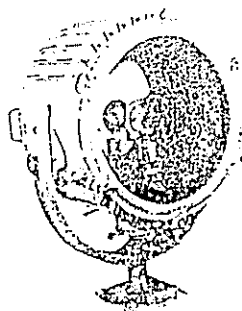


AC110V or AC220V 50

| Model | Capacity | Candle Power | Weight |
|----------|----------|---------------------|--------|
| E-20 | 0.5kW | 40x10 ⁴ | 95kg |
| E-30 | 1kW | 140x10 ⁴ | 104kg |
| E-40 | 2kW | 300x10 ⁴ | 149kg |
| E-60 | 3kW | 700x10 ⁴ | 201kg |
| ACT-30SU | 1kW | 50x10 ⁴ | 31kg |

ACT-30SU Only Caution: Controls by Manual

Suez Canal Searchlights



AC110V or AC220V 50

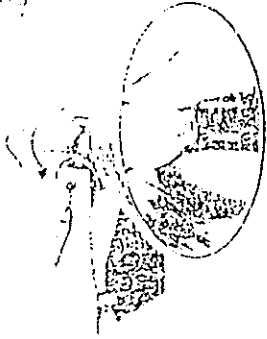
| Model | Capacity | Weight |
|----------|----------|--------|
| SCS-50SA | 2kW | 45kg |
| SCS-50SA | 3kW | 45kg |

Aluminum made

All searchlights are stainless steel made except Suez Canal Searchlights.

300D LIGHTS

300d Lights with Front Glass



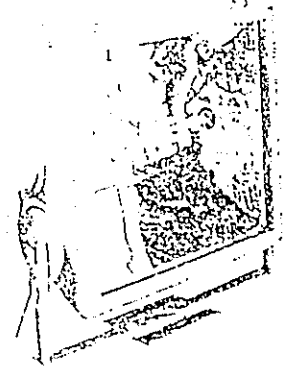
Mercury Type

| Model | Capacity | Dimension (mm) | | | Weight |
|--------|---------------|----------------|-----|-----|--------|
| | | D | H | L | |
| FDL-24 | 300W or 400W | 436 | 568 | 432 | 12.5kg |
| FDL-27 | 700W or 1000W | 586 | 728 | 526 | 19.0kg |

Incandescent Type

| Model | Capacity | Dimension (mm) | | | Weight |
|---------|--------------|----------------|-----|-----|--------|
| | | D | H | L | |
| FDL-24A | 300W or 500W | 436 | 568 | 432 | 12.5kg |

300d Lights with Front Glass



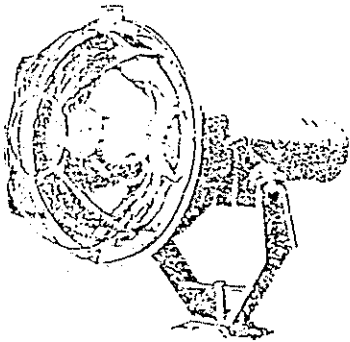
Sodium Type Round Shape

| Model | Capacity | Dimension (mm) | | | Weight |
|--------|---------------|----------------|-----|-----|--------|
| | | D | H | L | |
| FDL-24 | 400W | 436 | 568 | 432 | 12.5kg |
| FDL-27 | 700W or 1000W | 586 | 728 | 526 | 19.0kg |

Sodium Type Square Shape

| Model | Capacity | Dimension (mm) | | | Weight |
|----------|----------|----------------|-----|-----|--------|
| | | W | H | D | |
| FDL-24SW | 400Wx2 | 720 | 600 | 260 | 25kg |
| FDL-27SS | 700Wx1 | 720 | 600 | 260 | 25kg |

300d Lights without Front Glass



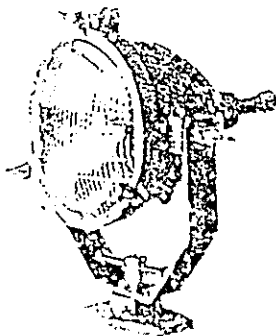
Mercury Type

| Model | Capacity | Dimension (mm) | | | Weight |
|----------|---------------|----------------|-----|-----|--------|
| | | D | H | L | |
| FDL-14AL | 300W or 400W | 230 | 326 | 485 | 3.6kg |
| FDL-17 | 700W or 1000W | 386 | 376 | 564 | 5.7kg |

Incandescent Type

| Model | Capacity | Dimension (mm) | | | Weight |
|----------|--------------|----------------|-----|-----|--------|
| | | D | H | L | |
| FDL-12A | 100W or 200W | 170 | 208 | 331 | 2.2kg |
| FDL-13AL | 300W or 500W | 230 | 326 | 426 | 3.2kg |

Boat Deck Lights



| Model | Capacity | Dimension (mm) | | Weight |
|--------|-----------------|----------------|---------|--------|
| | | D | L | |
| TYPE-1 | 700W | 350 | 390 | 8kg |
| TYPE-2 | 500W | 410 | 465 | 10kg |
| S1-R | Sealed Beam 80W | D | A H | 3.5kg |
| | | 158 | 190x279 | |

OPERATING COSTS

In this section we will try to quantify the most important factors influencing the operating costs of the engines for a low speed and a medium speed propulsion system.

The following factors are of great importance:

- Fuel oil consumption
- Lubricating oil consumption
- Spare parts costs
- Maintenance costs

Fuel costs

The fuel costs depend on the operating profile. It is assumed that the ship is operated at 1700 kW for 250 days/year (6000 hours/year). Taking 178 g/kWh at a lower calorific value (LCV) of 42,707 kJ/kg as a starting-point, the following savings can be roughly estimated:

| | Percentage Saving with Low Speed | Fuel Saving (tons/day) ¹⁾ LCV: 40,200 kJ/kg | Fuel Saving (tons/year) ¹⁾ LCV: 40,200 kJ/kg | Saving with Low Speed |
|----------------|----------------------------------|---|--|-----------------------|
| SFOC | 5% | 0.39 | 96 | 9,600 |
| Direct coupled | 2% ²⁾ | 0.15 | 39 | 3,900 |
| Total | 7% | 0.54 | 135 | 13,500 |

Estimated price of fuel oil: 100 USD/ton.

Difference in the specific fuel oil consumption (SFOC) multiplied by power, operating time and the relative difference between the LCV of 42,707 kJ/kg for reference and 40,200 kJ/kg for HFO, respectively.

Gear loss for medium speed engines. Normal accepted value is 2% but some yards even estimate 4%.

There are other factors which should be borne in mind when calculating the fuel consumption. For example, some medium speed manufacturers normally operate with a margin of +5% on the stated specific fuel oil consumption, whereas low speed manufacturers only use a +3% margin.

To obtain a medium speed consumption with a tolerance of +3%, it is necessary to add 2% to the stated consumption figures.

The 5S26MC has a margin of 3% and the medium speed a margin of 5% on the stated SFOC. Therefore, 2% has been added to the SFOC of the medium speed engine.

On occasion the optimum propeller speed is lower than the nominal speed of the two-stroke engine. This can largely be compensated by the layout flexibility of the two-stroke engine.

| | 5S26MC | Medium speed |
|-----------------------|--------|--------------|
| Number of cylinders | 5 | 6 |
| Bore (mm) | 260 | 320 |
| Stroke (mm) | 980 | 350 |
| Stroke/bore ratio | 3.8 | 1.1 |
| Piston speed (m/s) | 8.2 | 8.4 |
| Nominal speed (r/min) | 250 | 720 |
| Nominal MEP (bar) | 18.5 | 24.0 |
| Nominal power (kW) | 2,000 | 2,220 |
| Required MEP (bar) | 18.5 | 22.2 |
| Required power (kW) | 2,000 | 2,050 |

As the 5S26MC is direct coupled the power consumption is about 2% lower as there is no gear loss.

Although it is not possible to draw any definite conclusion from the above data, it should be noticed that the mean piston speed and mean effective pressure are considerably lower for the S26MC. All things being equal, this means greater reliability.

To compare two-stroke and four-stroke engines, we are obliged to use the component lifetimes and prices given by the manufacturer. However, in our experience, the relative expenses are about 1.8 times larger for the medium speed than for the 5S26MC.

Based on a 60,000-hour average of spare parts costs for the 5S26MC, the corresponding figures for the four-stroke alternatives are as follows:

Spare Parts Costs:

| | SPARE PARTS COSTS (USD/yr) | SAVING WITH LOW SPEED (USD/yr) |
|----------------------------|----------------------------|--------------------------------|
| 5S26MC | 25,000 | |
| Medium speed ¹⁾ | 45,000 | 20,000 |

¹⁾ 25,000 x 1.8

Maintenance costs

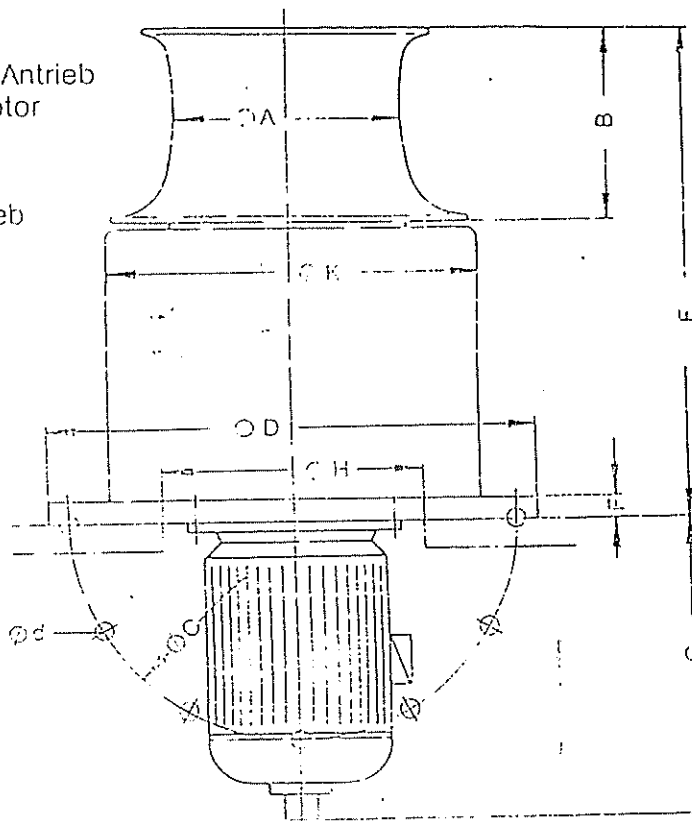
Estimating the maintenance time poses the same problems as those experienced when estimating spare parts consumption. Therefore, based on our experience, we use the figure for 5S26MC as a basis. The figure for the four-stroke alternative is estimated with a wear constant ratio of 1.8, the same as for spare parts costs, and we get:

Verholspill
Capstan

Blatt-Nr.
HP-0049

Type E
mit elektromotorischem Antrieb
with drive by electric motor

Type H
mit hydraulischem Antrieb
with hydraulic drive



Sonderausführung mit Bremse am E-Motor
Special design electric motor with brake

| Type | A | B | C | D | E | G | H | K | d | V [m/min] | Z [kp] | Antriebsleistung Driving power | |
|--------|-----|-----|-----|-----|-----|----|-----|-----|-----|--------------|-----------|-----------------------------------|--------|
| 2000 H | 290 | 180 | 460 | 500 | 500 | 25 | 100 | 320 | 394 | 12x22 | 10 | 38 l/min Δp 85 bar | R 1/2" |
| 2000 E | 290 | 180 | 460 | 500 | 500 | 25 | 310 | 320 | 394 | 12x22 | 10 | 3 kW 380 V~ | |
| 4000 H | 320 | 270 | 620 | 680 | 693 | 30 | 200 | 420 | 520 | 12x25 | 10 | 50 l/min Δp 140 bar | R 3/4" |
| 4000 E | 320 | 270 | 620 | 680 | 693 | 30 | 370 | 420 | 520 | 12x25 | 10 | 5,5 kW 380 V~ | |
| 6000 H | 400 | 340 | 740 | 800 | 800 | 40 | 250 | 520 | 622 | 12x25 | 8 | 55 l/min Δp 140 bar | R 3/4" |
| 6000 E | 400 | 340 | 740 | 800 | 800 | 40 | 410 | 520 | 622 | 12x25 | 8 | 7,5 kW 380 V~ | |

Kon. traktion... (partially obscured)

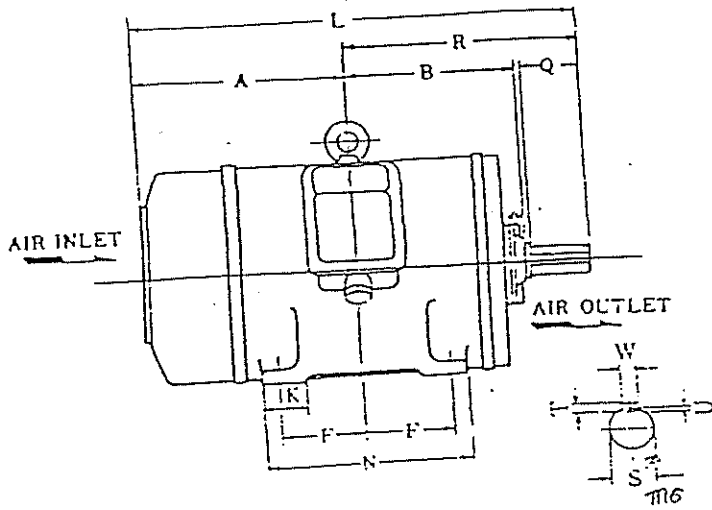
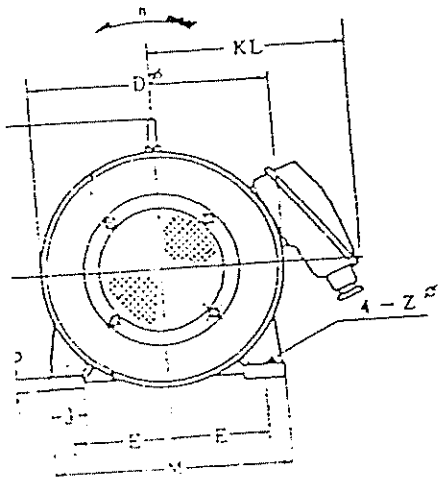
Maße/Dimensions = [mm]

V = Laufgeschwindigkeit max
Speed max.

Z = max. Zugkraft in kp
max. tractive power in kp

ION MOTOR

E: ID 440 V



(mm)

| | A | B | C | D | E | F | G | J | K | L | M | N | Q | R | S | W | T | U | Z | KL | KH |
|---|-------|-----|-----|-----|-------|-------|----|-----|-----|------|-----|-----|-----|-------|----|----|----|---|----|-----|-----|
| M | 405.5 | 299 | 225 | 444 | 178 | 155.5 | 28 | 90 | 90 | 850 | 440 | 370 | 140 | 444.5 | 65 | 18 | 12 | 6 | 19 | 470 | 520 |
| S | 438.5 | 317 | 250 | 474 | 203 | 155.5 | 32 | 90 | 100 | 902 | 480 | 380 | 140 | 463.5 | 75 | 20 | 13 | 7 | 24 | 490 | 573 |
| M | 458.5 | 337 | 250 | 474 | 203 | 174.5 | 32 | 90 | 100 | 941 | 480 | 420 | 140 | 482.5 | 75 | 20 | 13 | 7 | 24 | 515 | 655 |
| S | 501 | 367 | 280 | 546 | 228.5 | 184 | 35 | 100 | 110 | 1015 | 540 | 450 | 140 | 514 | 75 | 20 | 13 | 7 | 24 | 515 | 655 |
| M | 525.5 | 392 | 280 | 546 | 228.5 | 209.5 | 35 | 100 | 110 | 1055 | 540 | 500 | 140 | 539.5 | 75 | 20 | 13 | 7 | 24 | 585 | 740 |
| S | 571 | 415 | 315 | 588 | 254 | 203 | 40 | 100 | 125 | 1160 | 600 | 500 | 170 | 589 | 85 | 24 | 16 | 8 | 28 | 585 | 740 |
| M | 595.5 | 439 | 315 | 588 | 254 | 228.5 | 40 | 100 | 125 | 1210 | 600 | 550 | 170 | 614.5 | 85 | 24 | 16 | 8 | 28 | 585 | 740 |

| DEL | OUTPUT (KW) | NO. OF PHASES | AMPS (A) | r.p.m | WEIGHT (KG) |
|------|-------------|---------------|----------|-------|-------------|
| 225M | 33 | 6 | 58 | 1165 | 385 |
| 225S | 40 | 6 | 70 | 1165 | 440 |
| 250M | 50 | 6 | 86 | 1165 | 480 |
| 250S | 53 | 6 | 92 | 1165 | 480 |
| 280S | 60 | 6 | 100 | 1165 | 655 |
| 280S | 65 | 6 | 112 | 1165 | 680 |
| 280S | 70 | 6 | 114 | 1165 | 655 |
| 280M | 80 | 6 | 140 | 1165 | 725 |
| 280M | 85 | 6 | 142 | 1165 | 725 |
| 315S | 95 | 6 | 146 | 1170 | 860 |
| 315S | 97 | 6 | 152 | 1170 | 860 |
| 315S | 100 | 6 | 163 | 1170 | 860 |
| 315S | 106 | 6 | 160 | 1170 | 860 |
| 315M | 125 | 6 | 196 | 1170 | 940 |

| COMMON REMARK | |
|---------------|---------|
| RATING | CONT |
| VOLTS | 440 V |
| CYCLES | 60 HZ |
| NO. OF PHASES | 3 φ |
| INSULATION | □ CLASS |

| | | |
|-----------------------|-------------|----------------|
| 3 RD ANGLE PROJECTION | UNIT mm | CHIEF |
| SCALE | / | CHECK |
| DATE | Nov 27 1973 | DESIGN |
| | | TRACE TAKAJIMA |

OUTLINE

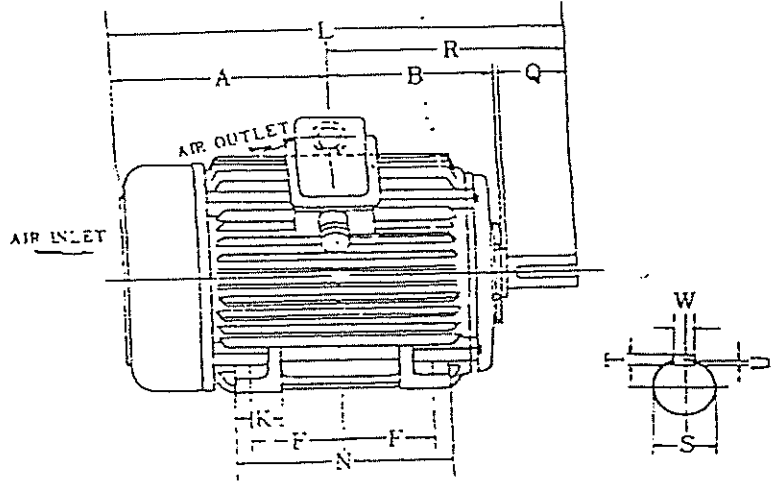
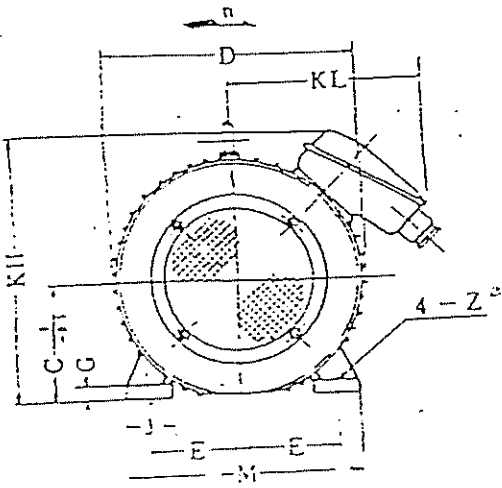
DRAW. NO M441396



APPROVED FOR ATL

COLD STORAGE MOTOR

TYPE : ITS-440 V



(mm)

| MODEL | A | B | C | D | E | F | G | H | J | K | L | M | N | Q | R | S | W | T | U | V | KL | RR |
|------------|-------|-----|-----|-----|-------|-------|----|-----|-----|-----|-----|-----|-----|-------|----|----|----|----|-----|----|-----|-----|
| ITS - 180L | 139.5 | 235 | 120 | 370 | 139.5 | 120.5 | 22 | 75 | 75 | 66 | 390 | 290 | 110 | 391.5 | 48 | h6 | 12 | 8 | 4.5 | 15 | 235 | 420 |
| ITS - 180H | 139.5 | 255 | 120 | 370 | 139.5 | 139.5 | 22 | 75 | 75 | 66 | 390 | 330 | 110 | 370.5 | 48 | h6 | 12 | 8 | 4.5 | 15 | 335 | 420 |
| ITS - 200L | 181.5 | 280 | 200 | 420 | 159 | 192.5 | 25 | 80 | 80 | 77 | 390 | 360 | 110 | 395.5 | 55 | m6 | 15 | 10 | 5 | 19 | 355 | 475 |
| ITS - 200H | 181.5 | 287 | 225 | 470 | 178 | 143 | 28 | 90 | 90 | 82 | 440 | 346 | 140 | 432 | 60 | m6 | 15 | 10 | 5 | 19 | 395 | 530 |
| ITS - 225H | 209.5 | 299 | 225 | 470 | 178 | 155.5 | 28 | 90 | 90 | 85 | 440 | 370 | 140 | 444.5 | 60 | m6 | 15 | 10 | 5 | 19 | 395 | 530 |
| ITS - 250H | 258.5 | 337 | 250 | 500 | 203 | 174.5 | 32 | 90 | 100 | 92 | 450 | 420 | 140 | 462.5 | 65 | m6 | 18 | 12 | 6 | 24 | 405 | 565 |
| ITS - 280S | 306 | 366 | 280 | 570 | 228.5 | 194 | 35 | 100 | 110 | 102 | 500 | 450 | 140 | 514 | 75 | m6 | 20 | 13 | 7 | 24 | 500 | 650 |
| ITS - 280H | 325.5 | 393 | 280 | 570 | 228.5 | 209.5 | 35 | 100 | 110 | 105 | 500 | 500 | 140 | 539.5 | 75 | m6 | 20 | 13 | 7 | 24 | 500 | 650 |

| MODEL | OUT PUT (KW) | NO. OF POLES | AMPS (A) | EFF. % | WEIGHT (KG) |
|------------|--------------|--------------|----------|--------|-------------|
| ITS - 180L | 18.5 | 4 | 39 | 75% | Ca 210 |
| ITS - 180H | 22 | 4 | 39 | 75% | Ca 208 |
| ITS - 200L | 30 | 4 | 70 | 75% | Ca 362 |
| ITS - 200H | 37 | 4 | 80 | 75% | Ca 395 |
| ITS - 225H | 45 | 4 | 70 | 75% | Ca 461 |
| ITS - 250H | 55 | 4 | 85 | 75% | Ca 675 |
| ITS - 280S | 75 | 4 | 125 | 75% | Ca 747 |
| ITS - 280H | 90 | 4 | 135 | 75% | Ca 747 |
| ITS - 180L | 15 | 6 | 25 | 75% | Ca 233 |
| ITS - 200L | 18.5 | 6 | 31 | 75% | Ca 293 |
| ITS - 200H | 22 | 6 | 37 | 75% | Ca 295 |
| ITS - 225H | 30 | 6 | 52 | 75% | Ca 350 |
| ITS - 250H | 37 | 6 | 62 | 75% | Ca 451 |
| ITS - 280S | 45 | 6 | 76 | 75% | Ca 667 |
| ITS - 280H | 55 | 6 | 84 | 75% | Ca 732 |
| ITS - 180L | 21 | 8 | 21 | 75% | Ca 228 |
| ITS - 200L | 25 | 8 | 26 | 75% | Ca 209 |
| ITS - 225S | 28.5 | 8 | 32 | 75% | Ca 360 |
| ITS - 225H | 22 | 8 | 38 | 75% | Ca 395 |
| ITS - 250H | 30 | 8 | 51 | 75% | Ca 446 |
| ITS - 280S | 37 | 8 | 64 | 75% | Ca 667 |
| ITS - 280H | 45 | 8 | 80 | 75% | Ca 732 |

| COMMON REMARK | |
|---------------|------------|
| RATING | ITS - 280H |
| VOLTS | 440V |
| CYCLES | 60Hz |
| NO. OF PHASES | 3φ |
| INSULATION | E CLASS |

ANGE

| | | | |
|-----------------------|------------|--------|-------------|
| 3 RD ANGLE PROJECTION | UNIT | CHEF | K. Kawamura |
| | mm | CHECK | K. OKAMURA |
| SCALE | / | DESIGN | |
| DATE | 11.28.1977 | TRACE | M. KOUKETSU |

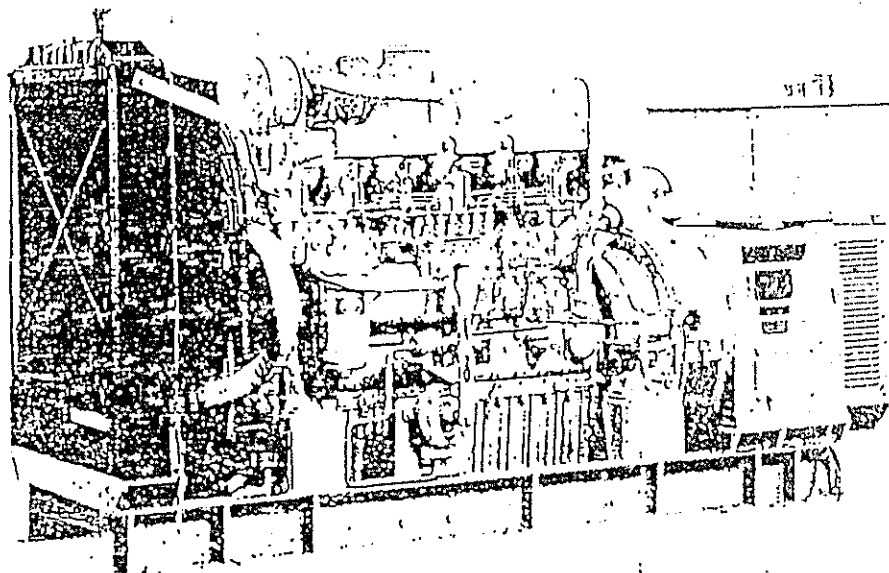
OUT LINE

DRAW. NO
S. 4M 016-03



Emergency-use Marine Power Generating Sets

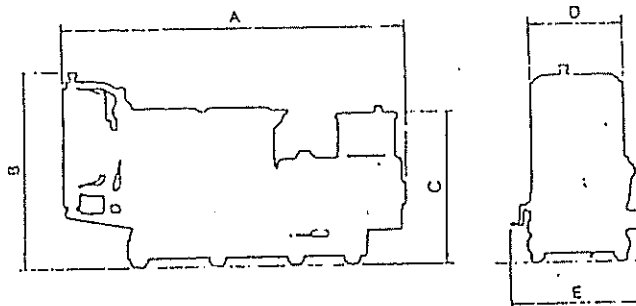
YMGH Series



Specifications

| Model | | YMGH30 | YMGH40 | YMGH55 | YMGH80 | YMGH100 | YMGH120 | YMGH150 | YMGH200 | YMGH250 |
|-------------------|---------|---|------------|----------|-----------|----------|-----------|-----------|-----------|-----------|
| Capacity | kVA | 30 | 40 | 55 | 80 | 100 | 120 | 150 | 200 | 250 |
| Frequency | Hz | 60 | | | | | | | | |
| Voltage | V | 450 | | | | | | | | |
| Power factor | % | 80 | | | | | | | | |
| Model | — | 4TN100L-H | 4TN100L-HH | 4T112L-H | 4T112L-TH | 6CHL-TH | 6CHL-HTH | 6HAL-H | 6HAL-TH | 6HAL-HTH |
| Output | kW (PS) | 31.3 (42.5) | 40 (54) | 51 (70) | 72 (98) | 89 (121) | 107 (145) | 132 (180) | 177 (240) | 221 (300) |
| Engine speed | rpm | 1800 | | | | | | | | |
| Type | — | Vertical 4-cycle diesel engine (radiator cooling) | | | | | | | | |
| Combustion system | — | Direct injection | | | | | | | | |
| Starting system | — | Remote (automatic) starting by starting motor | | | | | | | | |

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



YMGH-A Series Dimensions

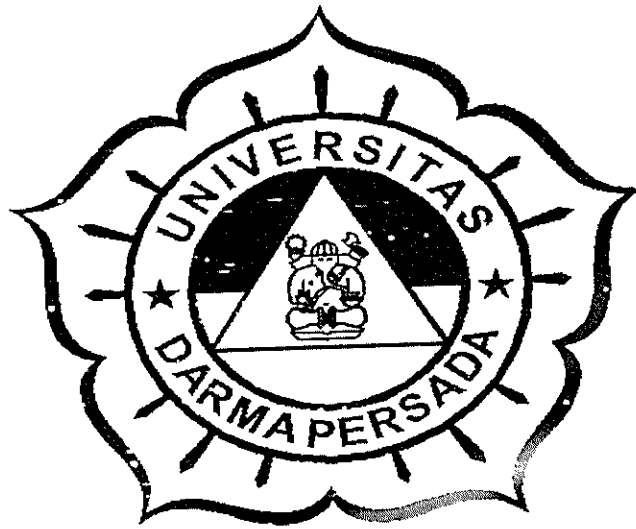
(Unit: mm)

| | A | B | C | D | E | Weight (kg) |
|---|------|------|------|-----|------|-------------|
| A | 1540 | 956 | 830 | 645 | 815 | 735 |
| A | 1680 | 965 | 830 | 645 | 815 | 770 |
| A | 1920 | 1050 | 925 | 690 | 945 | 940 |
| A | 1920 | 1050 | 960 | 650 | 945 | 1120 |
| A | 2320 | 1310 | 1050 | 720 | 845 | 1530 |
| A | 2300 | 1310 | 1155 | 720 | 845 | 1640 |
| A | 2600 | 1460 | 1210 | 720 | 1015 | 2110 |
| A | 2670 | 1460 | 1210 | 720 | 1015 | 2270 |
| A | 2725 | 1430 | 1210 | 720 | 1015 | 2440 |

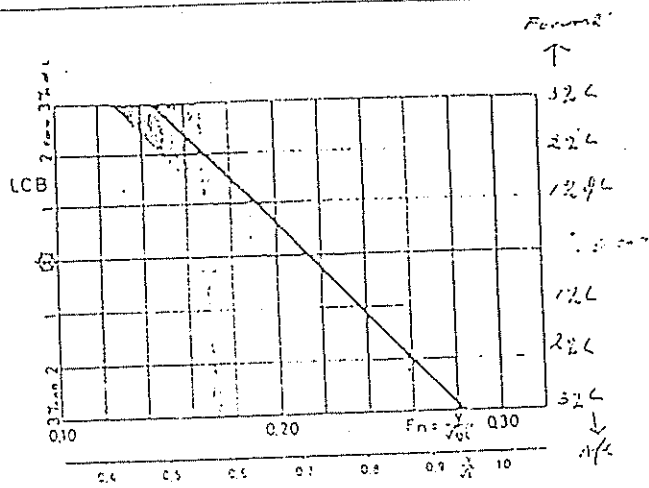
YMGH-B Series Dimensions

(Unit: mm)

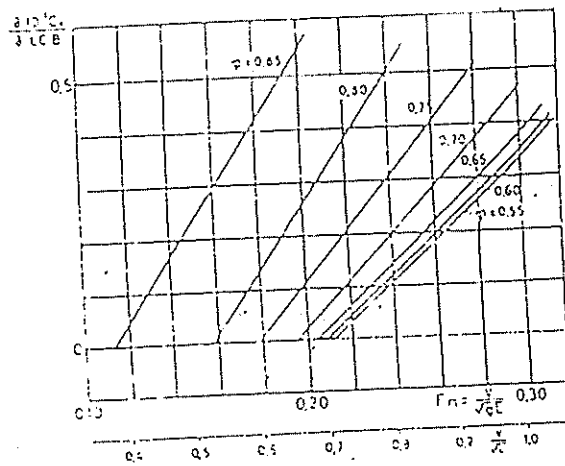
| Model | A | B | C | D | E | Weight (kg) |
|-----------|------|------|------|-----|------|-------------|
| YMGH-300 | 1590 | 965 | 905 | 645 | 815 | 765 |
| YMGH-400 | 1630 | 965 | 905 | 645 | 815 | 780 |
| YMGH-550 | 1800 | 1050 | 925 | 690 | 945 | 880 |
| YMGH-800 | 1920 | 1050 | 925 | 690 | 945 | 1000 |
| YMGH-1000 | 2290 | 1310 | 1070 | 720 | 845 | 1400 |
| YMGH-1200 | 2345 | 1310 | 1070 | 720 | 845 | 1440 |
| YMGH-1500 | 2615 | 1460 | 1125 | 720 | 1015 | 1910 |
| YMGH-2000 | 2705 | 1460 | 1205 | 720 | 1015 | 2420 |
| YMGH-2500 | 2830 | 1430 | 1310 | 720 | 1015 | 2700 |



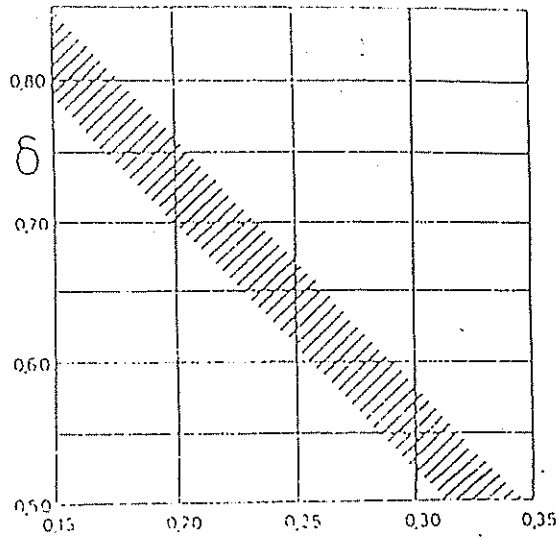
LAMPIRAN II
(TABEL & DIAGRAM)



Gbr.No.3 LCB Standar



Gbr.No.3 Koreksi LCB



Gbr No.1 Koefisien Block (C_b) Standar

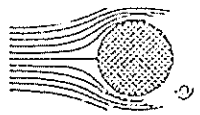


Aliran potensial

U

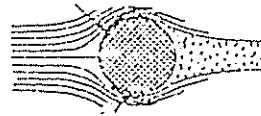
$R_n < 1$

$R_n > 1$



(Pisaran von Kármán)

Lapisan batas laminar

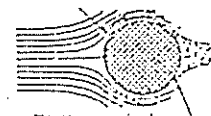


Titik pemisahan

$R_n < 5 \cdot 10^5$

Lapisan batas turbulen

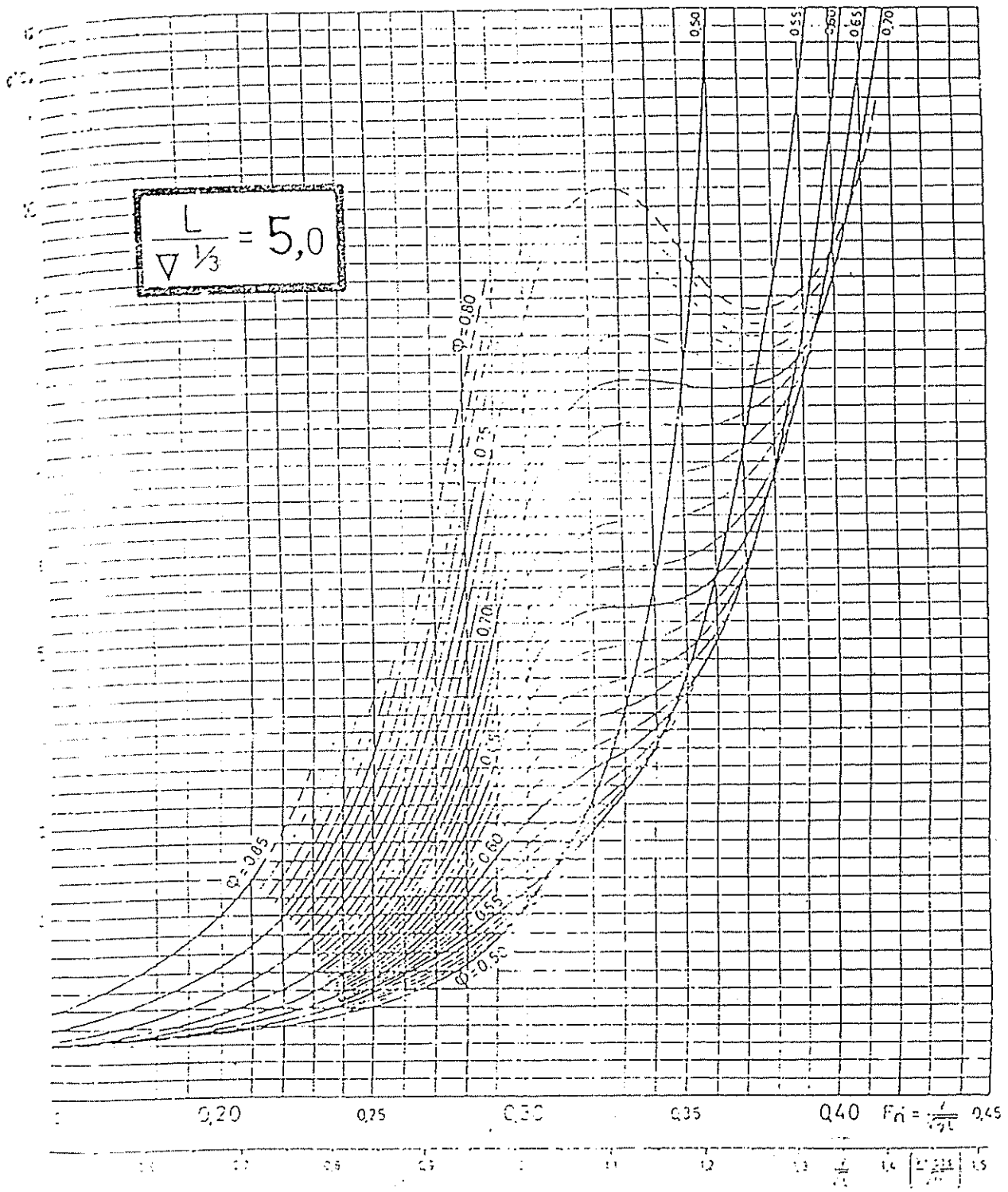
$R_n > 5 \cdot 10^5$



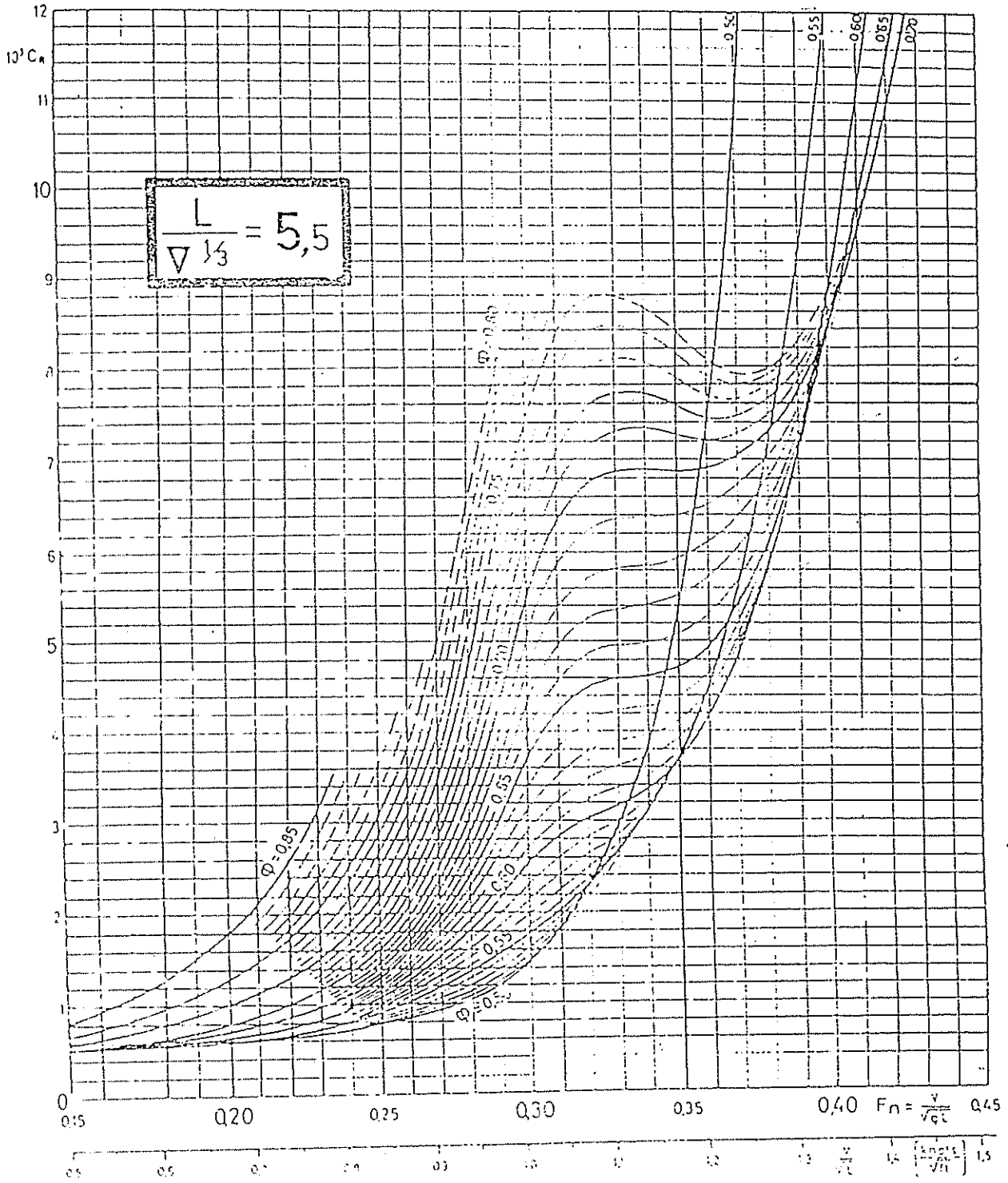
Titik pemisahan

ALIRAN TURBULEN

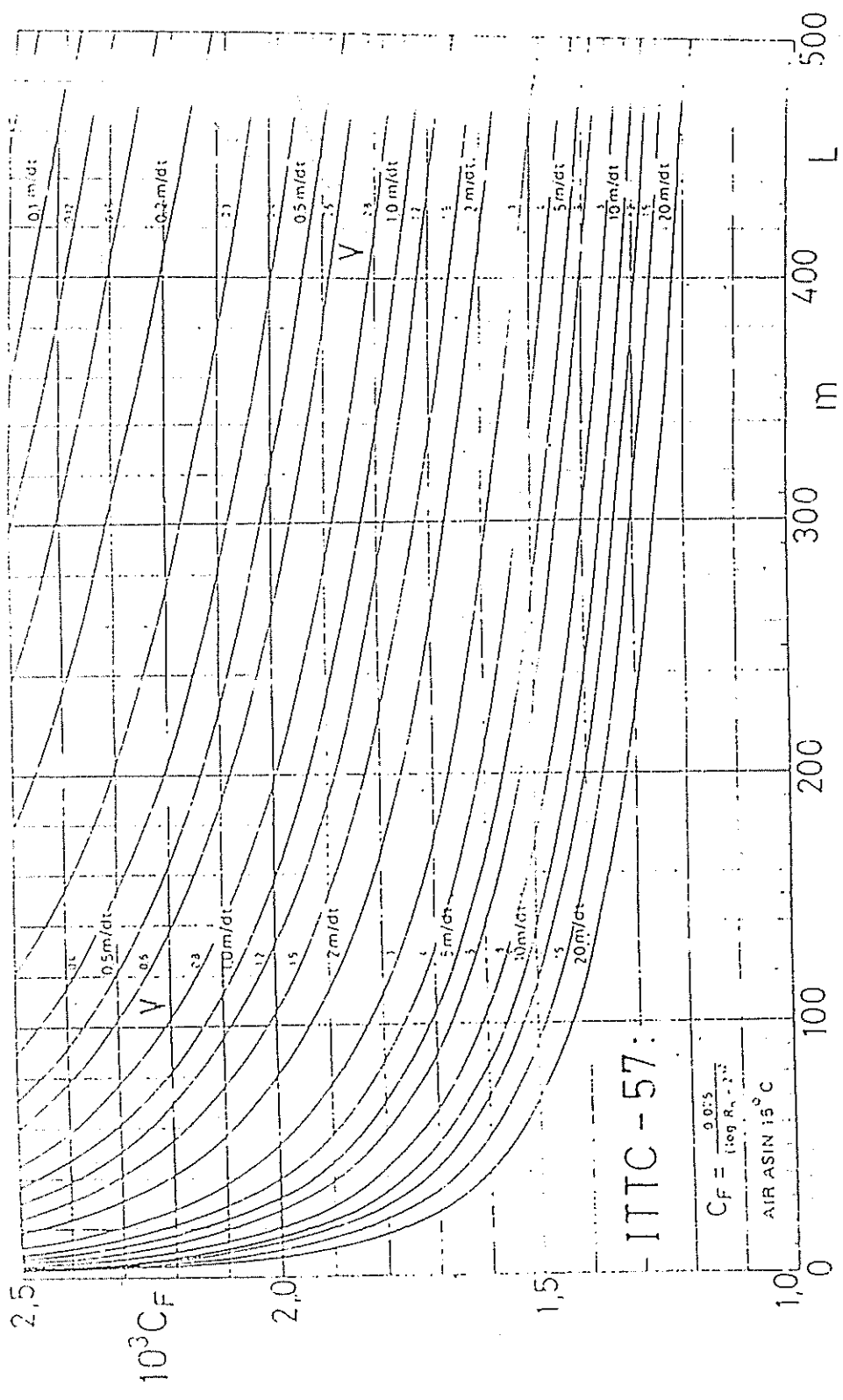
Tipe Aliran Sesuai Reynold Number (R_n)



Gbr. No. 2 Koeffizienten für die Spannung σ (L. / $\Delta \frac{1}{3}$)



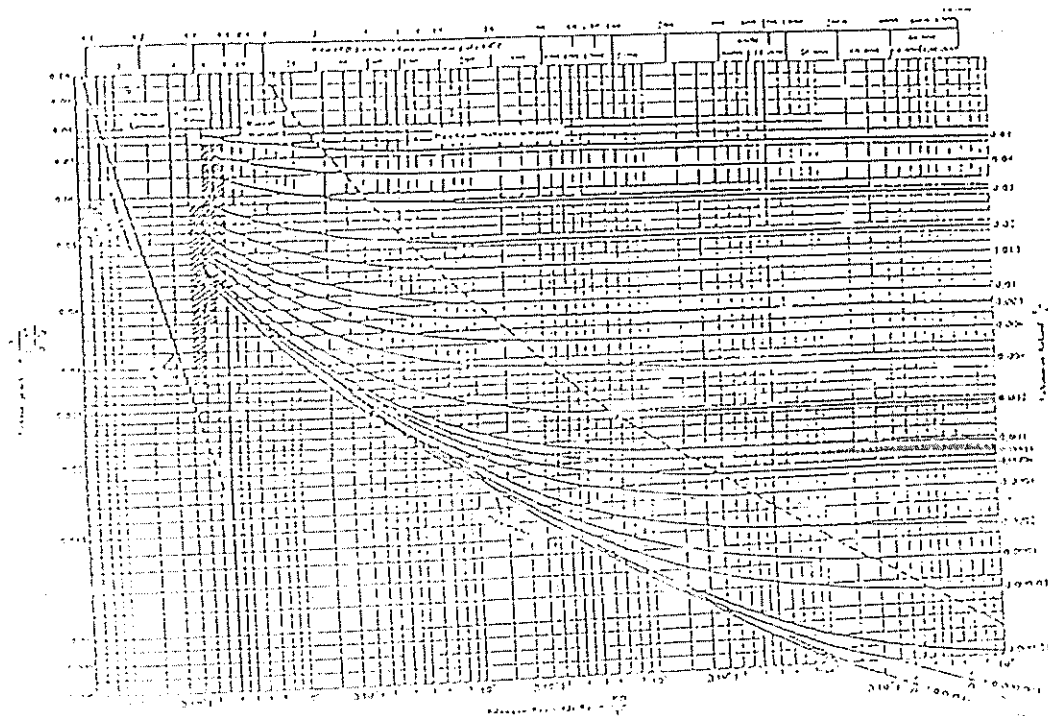
Glc. No. 7 Koeffizienten für den Sisko (L/Δ^{1/3})



Gbr. No. 3 "Handutan Gesekan" (ITTTC-57)

Modeling and Warping Ropes

| Characteristic | Twisting rope | | | Warping Ropes | | | | | | | | | |
|----------------|---------------|--------------------------------|----------------------------|-----------------|-----------------|--------------------------------|----------------------------|-----------------|-----------------|--------------------------------|----------------------------|---|---|
| | Length, m | Circumference of hemp rope, mm | Diameter of steel rope, mm | Total length, m | Number of ropes | Circumference of hemp rope, mm | Diameter of steel rope, mm | Cable steps | | | | | |
| | | | | | | | | Total length, m | Number of ropes | Circumference of hemp rope, mm | Diameter of steel rope, mm | | |
| 50 | 50 | 75 | — | 50 | 1 | 65 | — | — | — | — | — | — | — |
| 75 | 50 | 90 | 11 | 50 | 1 | 65 | — | — | — | — | — | — | — |
| 100 | 75 | 90 | 11 | 75 | 1 | 65 | 8.5 | — | — | — | — | — | — |
| 150 | 75 | 100 | 12 | 75 | 1 | 75 | 9.5 | — | — | — | — | — | — |
| 200 | 100 | 100 | 12 | 100 | 2 | 75 | 9.5 | — | — | — | — | — | — |
| 250 | 100 | 125 | 15 | 110 | 2 | 100 | 12 | — | — | — | — | — | — |
| 300 | 110 | 125 | 15 | 100 | 2 | 100 | 12 | — | — | — | — | — | — |
| 350 | 110 | 150 | 17.5 | 160 | 2 | 100 | 12 | — | — | — | — | — | — |
| 400 | 135 | 150 | 17.5 | 180 | 2 | 125 | 15 | 80 | 1 | 100 | 12 | — | — |
| 450 | 135 | 150 | 17.5 | 180 | 2 | 125 | 15 | 80 | 1 | 100 | 12 | — | — |
| 500 | 135 | 150 | 17.5 | 200 | 2 | 125 | 15 | 85 | 1 | 100 | 12 | — | — |
| 550 | 135 | 175 | 19.5 | 200 | 2 | 125 | 15 | 85 | 1 | 100 | 12 | — | — |
| 600 | 135 | 175 | 19.5 | 220 | 2 | 150 | 17.5 | 90 | 1 | 100 | 12 | — | — |
| 650 | 135 | 175 | 19.5 | 240 | 2 | 150 | 17.5 | 90 | 1 | 100 | 12 | — | — |
| 700 | 150 | 200 | 21.5 | 245 | 2 | 150 | 17.5 | 90 | 1 | 100 | 12 | — | — |
| 750 | 150 | 200 | 21.5 | 300 | 4 | 150 | 17.5 | 90 | 1 | 125 | 15 | — | — |
| 800 | 150 | 200 | 21.5 | 350 | 4 | 150 | 17.5 | 90 | 1 | 125 | 15 | — | — |
| 850 | 175 | 200 | 21.5 | 360 | 4 | 150 | 17.5 | 90 | 1 | 125 | 15 | — | — |
| 900 | 175 | 225 | 24 | 360 | 4 | 175 | 19.5 | 120 | 2 | 175 | — | — | — |
| 950 | 175 | 225 | 24 | 360 | 4 | 175 | 19.5 | 120 | 2 | — | — | — | — |
| 1000 | 175 | 225 | 24 | 360 | 4 | 175 | 19.5 | 130 | 2 | — | — | — | — |
| 1050 | 175 | 225 | 24 | 360 | 4 | 175 | 19.5 | 140 | 2 | 150 | 17.5 | — | — |
| 1100 | 175 | 225 | 24 | 360 | 4 | 175 | 19.5 | 140 | 2 | 150 | 17.5 | — | — |
| 1200 | 190 | 250 | 25 | 360 | 4 | 175 | 19.5 | 150 | 2 | 150 | 17.5 | — | — |
| 1250 | 190 | 250 | 25 | 400 | 4 | 200 | 21.5 | 150 | 2 | 150 | 17.5 | — | — |
| 1300 | 190 | 275 | 28 | 400 | 4 | 200 | 21.5 | 150 | 2 | 150 | 17.5 | — | — |
| 1350 | 190 | 275 | 28 | 400 | 4 | 200 | 21.5 | 150 | 2 | 150 | 17.5 | — | — |
| 1400 | 200 | 300 | 30 | 480 | 4 | 200 | 21.5 | 180 | 2 | 150 | 17.5 | — | — |
| 1450 | 200 | 300 | 30 | 480 | 4 | 200 | 21.5 | 180 | 2 | 150 | 17.5 | — | — |
| 1500 | 200 | 325 | 32.5 | 540 | 4 | 200 | 21.5 | 180 | 2 | 175 | 19.5 | — | — |
| 1550 | 200 | 350 | 34.5 | 540 | 4 | 200 | 21.5 | 180 | 2 | 175 | 19.5 | — | — |
| 1600 | 200 | 350 | 34.5 | 540 | 4 | 200 | 21.5 | 180 | 2 | 175 | 19.5 | — | — |
| 1650 | 200 | 350 | 34.5 | 540 | 4 | 225 | 24 | 180 | 2 | 175 | 19.5 | — | — |
| 1700 | 220 | 350 | 34.5 | 640 | 4 | 225 | 24 | 200 | 2 | 175 | 19.5 | — | — |
| 1750 | 220 | 350 | 34.5 | 640 | 4 | 225 | 24 | 200 | 2 | 200 | 21.5 | — | — |
| 1800 | 220 | 350 | 34.5 | 640 | 4 | 225 | 24 | 200 | 2 | 200 | 21.5 | — | — |
| 1850 | 240 | 375 | 39 | 640 | 4 | 250 | 26 | 200 | 2 | 200 | 21.5 | — | — |
| 1900 | 240 | 375 | 39 | 640 | 4 | 250 | 26 | 200 | 2 | 200 | 21.5 | — | — |
| 1950 | 240 | 400 | 43.5 | 640 | 4 | 250 | 26 | 200 | 2 | 225 | 24 | — | — |
| 2000 | 240 | 400 | 43.5 | 640 | 4 | 250 | 26 | 200 | 2 | 225 | 24 | — | — |
| 2050 | 240 | 425 | 45.5 | 720 | 4 | 250 | 26 | 200 | 2 | 225 | 24 | — | — |
| 2100 | 240 | 425 | 45.5 | 720 | 4 | 250 | 26 | 200 | 2 | 225 | 24 | — | — |
| 2150 | 240 | — | 53 | 720 | 4 | 275 | 28 | 240 | 2 | 250 | 26 | — | — |
| 2200 | 240 | — | 53 | 800 | 4 | 275 | 28 | 240 | 2 | 250 | 26 | — | — |
| 2250 | 240 | — | 53 | 800 | 4 | 275 | 28 | 240 | 2 | 250 | 26 | — | — |
| 2300 | 240 | — | 57 | 860 | 6 | 300 | 30 | 240 | 2 | 250 | 26 | — | — |
| 2350 | 240 | — | 57 | 860 | 6 | 300 | 30 | 240 | 2 | 250 | 26 | — | — |
| 2400 | 240 | — | 57 | 900 | 6 | 300 | 30 | 240 | 2 | 250 | 26 | — | — |
| 2450 | 240 | — | 57 | 900 | 6 | 300 | 30 | 240 | 2 | 250 | 26 | — | — |
| 2500 | 240 | — | 57 | 900 | 6 | 300 | 30 | 240 | 2 | 250 | 26 | — | — |
| 2550 | 240 | — | 61.5 | 940 | 6 | 325 | 32 | 240 | 2 | 275 | 28 | — | — |
| 2600 | 240 | — | 61.5 | 940 | 6 | 325 | 32 | 240 | 2 | 275 | 28 | — | — |
| 2650 | 240 | — | 61.5 | 940 | 6 | 325 | 32 | 240 | 2 | 275 | 28 | — | — |
| 2700 | 240 | — | 61.5 | 940 | 6 | 325 | 32 | 240 | 2 | 275 | 28 | — | — |
| 2750 | 240 | — | 61.5 | 940 | 6 | 325 | 32 | 240 | 2 | 275 | 28 | — | — |
| 2800 | 240 | — | 61.5 | 940 | 6 | 325 | 32 | 240 | 2 | 275 | 28 | — | — |
| 2850 | 240 | — | 61.5 | 940 | 6 | 325 | 32 | 240 | 2 | 275 | 28 | — | — |
| 2900 | 240 | — | 61.5 | 940 | 6 | 325 | 32 | 240 | 2 | 275 | 28 | — | — |
| 2950 | 240 | — | 61.5 | 940 | 6 | 325 | 32 | 240 | 2 | 275 | 28 | — | — |
| 3000 | 240 | — | 61.5 | 940 | 6 | 325 | 32 | 240 | 2 | 275 | 28 | — | — |



Gambar 1.13. Bilangan Moody untuk gesekan pipa ber dinding halus/kasar.

SIFAT-SIFAT ZAT CAIR YANG LAZIM PADA 1 atm DAN 20°C (68°F)

| Zat cair | ρ , kg/m ³ | μ , (N-s)/m ² | γ , N/m ³ | ρ_s , N/m ³ | Modulus limbak, N/m ² |
|--------------------|----------------------------|------------------------------|-----------------------------|-----------------------------|----------------------------------|
| Akrolein | 698 | 2.70 E-4 | 3.13 E-2 | 9.10 E+5 | 1.05 E+9 |
| Bensin | 681 | 6.51 E-4 | 2.88 E-2 | 1.01 E+4 | 9.65 E+8 |
| Karbon tetraklorid | 1,590 | 9.67 E-4 | 2.70 E-2 | 1.20 E+4 | 3.96 E+8 |
| Etilanol | 789 | 1.20 E-3 | 2.28 E-2 | 5.7 E+3 | 9.58 E+8 |
| Gasolin | 680 | 2.92 E-4 | 2.16 E-2 | 5.51 E+4 | 4.34 E+9 |
| Gliserin | 1,260 | 1.49 | 6.33 E-2 | 1.4 E-2 | 1.43 E+9 |
| Minyak tanah | 804 | 1.92 E-3 | 2.8 E-2 | 3.11 E+3 | 2.55 E+10 |
| Air raksa | 13,550 | 1.56 E-3 | 4.84 E-1 | 1.1 E-3 | 6.27 E+8 |
| Metan-1 | 791 | 5.98 E-4 | 2.25 E-2 | 1.34 E+4 | 1.31 E+9 |
| Polimer SAE 10 | 917 | 1.01 E-1 | 3.6 E-2 | - | 1.38 E+9 |
| Polimer SAE 50 | 917 | 2.20 E-1 | 3.5 E-2 | - | 2.19 E+9 |
| Uji | 528 | 1.00 E-3 | 7.23 E-2 | 2.34 E+3 | 2.05 E+9 |
| Uji lain | 1,025 | 1.07 E-3 | 7.23 E-2 | 2.34 E+3 | 2.05 E+9 |

Sumber: Perry, 1975, hal. 3-100

KEKENTALAN DAN KEKENTALAN KINEMATIK DELAPAN FLUIDA PADA 1 ATM DAN 20°C

| Fluida | μ (kg/m·s) | Nisbah μ/ρ | ρ (kg/m ³) | ν (m ² /s) | Nisbah $\nu/\text{ft}^2/\text{s}$ |
|--------------------|-------------------|----------------------|--------------------------------|------------------------------|--------------------------------------|
| Hidrogen | 6,8 E-6 | 1,0 | 0,084 | 1,05 E-4 | 920 |
| Udara | 1,8 E-5 | 2,1 | 1,20 | 1,51 E-5 | 130 |
| Benzin | 2,9 E-4 | 33 | 680 | 4,22 E-7 | 3,7 |
| Air | 1,0 E-3 | 114 | 998 | 1,01 E-6 | 8,7 |
| Ethanol | 1,2 E-3 | 135 | 789 | 1,52 E-6 | 13 |
| Air raksa | 1,5 E-3 | 170 | 13.580 | 1,16 E-7 | 1,0 |
| Minyak pelumas SAE | 0,22 | 33.000 | 891 | 3,25 E-4 | 2.850 |
| Gliserin | 1,5 | 170.000 | 1.264 | 1,18 E-3 | 10.300 |

1 ft²/s = 0,09290304 m²/s; 1 m³/s = 19,15 ft³/s

CONTOH GRAVITASI JENIS BEBERAPA ZAT CAIR PADA 20°C (68°F)

| Zat Cair | Gravitasi Jenis |
|------------------------|-----------------|
| Benzin | 0,66 - 0,69 |
| Alkohol denaturasi | 0,80 |
| Minyak tanah | 0,80 - 0,84 |
| Minyak mentah | 0,80 - 0,92 |
| Minyak kastor | 0,97 |
| Air laut | 1,025 |
| Karbon tetraklorida | 1,594 |
| Asetilena tetrabromida | 2,962 |
| Air raksa (Hg) | 13,546 |

BERAT JENIS BEBERAPA FLUIDA YANG LAZIM

| Fluida | Berat jenis ρ pada 68°F = 20°C | |
|-----------------------|-------------------------------------|------------------|
| | lb/ft ³ | N/m ³ |
| Udara (pada 1 atm) | 0,0752 | 11,8 |
| Ethanol | 49,2 | 7,733 |
| Minyak pelumas SAE 50 | 57,3 | 8,996 |
| Air | 62,4 | 9,790 |
| Air laut | 64,0 | 10,050 |
| Gliserin | 78,7 | 12,360 |
| Karbon tetraklorida | 99,1 | 15,570 |
| Air raksa | 846 | 133,109 |

Pumps

| Hose diameter d_h , mm | Hose length l_h , m | Nozzle orifice diameter d_n , mm | | | | Hose diameter d_h , mm | Hose length l_h , m | Nozzle orifice diameter d_n , mm | | | |
|-----------------------------|--------------------------|---------------------------------------|-------|-------|-------|-----------------------------|--------------------------|---------------------------------------|-------|-------|-------|
| | | 10 | 13 | 16 | 19 | | | 10 | 13 | 16 | 19 |
| | | Characteristic B | | | | | | | | | |
| 50 | 0 | 0.121 | 0.346 | 0.793 | 1.577 | 65 | 0 | 0.121 | 0.346 | 0.793 | 1.577 |
| | 10 | 0.119 | 0.331 | 0.722 | 1.320 | | 10 | 0.1205 | 0.342 | 0.776 | 1.51 |
| | 20 | 0.118 | 0.318 | 0.622 | 1.150 | | 20 | 0.120 | 0.339 | 0.758 | 1.44 |
| | 40 | 0.114 | 0.304 | 0.555 | 0.882 | | 40 | 0.1195 | 0.332 | 0.725 | 1.33 |
| | 60 | 0.111 | 0.274 | 0.498 | 0.723 | | 60 | 0.1185 | 0.326 | 0.696 | 1.23 |
| | 80 | 0.108 | 0.257 | 0.442 | 0.612 | | 80 | 0.118 | 0.320 | 0.669 | 1.15 |
| 100 | 0.105 | 0.241 | 0.393 | 0.531 | 100 | 0.117 | 0.314 | 0.644 | 1.08 | | |

| Tank capacity, tons | Inside diameter of pipe and fittings, mm | Tank capacity, tons | Inside diameter of pipe and fittings, mm |
|---------------------|--|---------------------|--|
| Up to 20 | 50 | 265 to 360 | 125 |
| 20 to 40 | 70 | 360 to 450 | 140 |
| 40 to 75 | 90 | 450 to 620 | 150 |
| 75 to 120 | 120 | 620 to 800 | 160 |
| 120 to 190 | 150 | 800 to 1000 | 175 |
| 190 to 265 | 175 | 1000 to 1300 | 190 |

| Inside diameter of the drainage main, mm | Capacity of each drainage pump, cu m per h | Inside diameter of the drainage main, mm | Capacity of each drainage pump, cu m per h |
|--|--|--|--|
| 50 | 15 | 133 | 133 |
| 57 | 19 | 140 | 140 |
| 64 | 23 | 145 | 145 |
| 70 | 28 | 152 | 152 |
| 76 | 34 | 158 | 158 |
| 82 | 40 | 165 | 165 |
| 89 | 45 | 171 | 171 |
| 95 | 53 | 178 | 178 |
| 103 | 57 | 184 | 187 |
| 103 | 58 | 190 | 200 |
| 114 | 75 | 197 | 224 |
| 120 | 84 | 205 | 240 |
| 127 | 93 | | |

Table 4. (continued)

| No. | Year | Sex | Age group (years) | | | Height (cm) | | | | Weight (kg) | | Chest (cm) | | Lung (cm) | | | |
|-----|------|-----|-------------------|------|------|-------------|------|------|----|-------------|--------|------------|--------|-----------|-----|--------|----|
| | | | Age | Mean | SD | Mean | | | | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| | | | | | | 1 | 2 | 3 | 4 | | | | | | | | |
| 101 | 1950 | M | 10-14 | 120 | 10 | 165 | 12.5 | | | 80 | 6.00 | 130 | 10.000 | 2 | 160 | 3.500 | |
| 102 | 1950 | M | 15-19 | 160 | 60 | 250 | 11 | 17.5 | | 85 | 6.60 | 130 | 10.000 | 2 | 160 | 3.500 | |
| 103 | 1950 | M | 20-24 | 170 | 50 | 270 | 16 | 11 | | 85 | 7.500 | 130 | 10.000 | 2 | 160 | 3.750 | |
| 104 | 1950 | M | 25-29 | 160 | 160 | 247.5 | 17.5 | 16 | | 90 | 8.300 | 130 | 10.000 | 2 | 170 | 4.000 | |
| 105 | 1950 | M | 30-34 | 160 | 120 | 247.5 | 19 | 17.5 | | 80 | 9.100 | 130 | 10.000 | 2 | 170 | 4.500 | |
| 106 | 1950 | M | 35-39 | 160 | 160 | 275 | 20.5 | 17.5 | | 80 | 10.000 | 130 | 10.000 | 2 | 170 | 5.000 | |
| 107 | 1950 | M | 40-44 | 160 | 160 | 275 | 22 | 18 | | 80 | 11.000 | 130 | 10.000 | 2 | 170 | 5.500 | |
| 108 | 1950 | M | 45-49 | 160 | 120 | 302.5 | 21 | 20.5 | | 80 | 12.000 | 130 | 11.000 | 2 | 170 | 6.000 | |
| 109 | 1950 | M | 50-54 | 160 | 60 | 302.5 | 25 | 22 | | 80 | 13.000 | 130 | 10.700 | 2 | 170 | 6.500 | |
| 110 | 1950 | M | 55-59 | 160 | 70 | 320 | 26 | 21 | | 80 | 14.000 | 130 | 11.300 | 2 | 170 | 7.250 | |
| 111 | 1950 | M | 60-64 | 160 | 60 | 357.5 | 24 | 26 | | 80 | 15.000 | 130 | 12.000 | 2 | 170 | 8.000 | |
| 112 | 1950 | M | 65-69 | 160 | 120 | 357.5 | 22 | 28 | | 80 | 16.000 | 130 | 12.700 | 2 | 170 | 8.750 | |
| 113 | 1950 | M | 70-74 | 160 | 110 | 385 | 21 | 30 | | 80 | 17.000 | 130 | 13.400 | 2 | 170 | 9.500 | |
| 114 | 1950 | M | 75-79 | 160 | 120 | 385 | 26 | 21 | | 80 | 18.000 | 130 | 14.100 | 2 | 170 | 10.250 | |
| 115 | 1950 | M | 80-84 | 160 | 140 | 412.5 | 22 | 21 | | 80 | 19.000 | 130 | 14.800 | 2 | 170 | 11.000 | |
| 116 | 1950 | M | 85-89 | 160 | 150 | 440 | 29 | 21 | | 80 | 20.000 | 130 | 15.500 | 2 | 170 | 11.750 | |
| 117 | 1950 | M | 90-94 | 160 | 170 | 460 | 32 | 20 | | 80 | 21.000 | 130 | 16.200 | 2 | 170 | 12.500 | |
| 118 | 1950 | M | 95-99 | 160 | 180 | 480 | 31 | 20 | | 80 | 22.000 | 130 | 16.900 | 2 | 170 | 13.250 | |
| 119 | 1950 | M | 100-104 | 160 | 210 | 480 | 36 | 19 | | 80 | 23.000 | 130 | 17.600 | 2 | 170 | 14.000 | |
| 120 | 1950 | M | 105-109 | 160 | 220 | 467.5 | 42 | 12 | | 80 | 24.000 | 130 | 18.300 | 2 | 170 | 14.750 | |
| 121 | 1950 | M | 110-114 | 160 | 250 | 467.5 | 50 | 11 | | 80 | 25.000 | 130 | 19.000 | 2 | 170 | 15.500 | |
| 122 | 1950 | M | 115-119 | 160 | 260 | 467.5 | 52 | 10 | 10 | 80 | 26.000 | 130 | 19.700 | 2 | 170 | 16.250 | |
| 123 | 1950 | M | 120-124 | 160 | 280 | 495 | 51 | 10 | 12 | 80 | 27.000 | 130 | 20.400 | 2 | 170 | 17.000 | |
| 124 | 1950 | M | 125-129 | 160 | 300 | 495 | 56 | 10 | 11 | 80 | 28.000 | 130 | 21.100 | 2 | 170 | 17.750 | |
| 125 | 1950 | M | 130-134 | 160 | 320 | 495 | 52 | 10 | 10 | 80 | 29.000 | 130 | 21.800 | 2 | 170 | 18.500 | |
| 126 | 1950 | M | 135-139 | 160 | 350 | 522.5 | 59 | 12 | 16 | 80 | 30.000 | 130 | 22.500 | 2 | 170 | 19.250 | |
| 127 | 1950 | M | 140-144 | 160 | 370 | 522.5 | 62 | 11 | 18 | 80 | 31.000 | 130 | 23.200 | 2 | 170 | 20.000 | |
| 128 | 1950 | M | 145-149 | 160 | 400 | 522.5 | 61 | 16 | 10 | 80 | 32.000 | 130 | 23.900 | 2 | 170 | 20.750 | |
| 129 | 1950 | M | 150-154 | 160 | 430 | 550 | 66 | 16 | 10 | 80 | 33.000 | 130 | 24.600 | 2 | 170 | 21.500 | |
| 130 | 1950 | M | 155-159 | 160 | 450 | 550 | 68 | 16 | 10 | 80 | 34.000 | 130 | 25.300 | 2 | 170 | 22.250 | |
| 131 | 1950 | M | 160-164 | 160 | 480 | 550 | 70 | 12 | 11 | 80 | 35.000 | 130 | 26.000 | 2 | 170 | 23.000 | |
| 132 | 1950 | M | 165-169 | 160 | 520 | 577.5 | 73 | 11 | 10 | 80 | 36.000 | 130 | 26.700 | 2 | 170 | 23.750 | |
| 133 | 1950 | M | 170-174 | 160 | 560 | 577.5 | 76 | 10 | 10 | 80 | 37.000 | 130 | 27.400 | 2 | 170 | 24.500 | |
| 134 | 1950 | M | 175-179 | 160 | 600 | 577.5 | 78 | 10 | 10 | 80 | 38.000 | 130 | 28.100 | 2 | 170 | 25.250 | |
| 135 | 1950 | M | 180-184 | 160 | 640 | 577.5 | 81 | 10 | 10 | 80 | 39.000 | 130 | 28.800 | 2 | 170 | 26.000 | |
| 136 | 1950 | M | 185-189 | 160 | 680 | 605 | 81 | 10 | 10 | 80 | 40.000 | 130 | 29.500 | 2 | 170 | 26.750 | |
| 137 | 1950 | M | 190-194 | 160 | 720 | 605 | 81 | 10 | 10 | 80 | 41.000 | 130 | 30.200 | 2 | 170 | 27.500 | |
| 138 | 1950 | M | 195-199 | 160 | 760 | 632.5 | 82 | 11 | 10 | 80 | 42.000 | 130 | 30.900 | 2 | 170 | 28.250 | |
| 139 | 1950 | M | 200-204 | 160 | 800 | 632.5 | 83 | 11 | 10 | 80 | 43.000 | 130 | 31.600 | 2 | 170 | 29.000 | |
| 140 | 1950 | M | 205-209 | 160 | 840 | 660 | 87 | 11 | 10 | 80 | 44.000 | 130 | 32.300 | 2 | 170 | 29.750 | |
| 141 | 1950 | M | 210-214 | 160 | 880 | 660 | 87 | 11 | 10 | 80 | 45.000 | 130 | 33.000 | 2 | 170 | 30.500 | |
| 142 | 1950 | M | 215-219 | 160 | 920 | 660 | 87 | 11 | 10 | 80 | 46.000 | 130 | 33.700 | 2 | 170 | 31.250 | |
| 143 | 1950 | M | 220-224 | 160 | 960 | 660 | 87 | 11 | 10 | 80 | 47.000 | 130 | 34.400 | 2 | 170 | 32.000 | |
| 144 | 1950 | M | 225-229 | 160 | 1000 | 687.5 | 86 | 12 | 11 | 80 | 48.000 | 130 | 35.100 | 2 | 170 | 32.750 | |
| 145 | 1950 | M | 230-234 | 160 | 1040 | 687.5 | 86 | 12 | 11 | 80 | 49.000 | 130 | 35.800 | 2 | 170 | 33.500 | |
| 146 | 1950 | M | 235-239 | 160 | 1080 | 687.5 | 86 | 12 | 11 | 80 | 50.000 | 130 | 36.500 | 2 | 170 | 34.250 | |
| 147 | 1950 | M | 240-244 | 160 | 1120 | 715 | 87 | 12 | 11 | 80 | 51.000 | 130 | 37.200 | 2 | 170 | 35.000 | |
| 148 | 1950 | M | 245-249 | 160 | 1160 | 715 | 87 | 12 | 11 | 80 | 52.000 | 130 | 37.900 | 2 | 170 | 35.750 | |
| 149 | 1950 | M | 250-254 | 160 | 1200 | 715 | 87 | 12 | 11 | 80 | 53.000 | 130 | 38.600 | 2 | 170 | 36.500 | |
| 150 | 1950 | M | 255-259 | 160 | 1240 | 742.5 | 87 | 12 | 11 | 80 | 54.000 | 130 | 39.300 | 2 | 170 | 37.250 | |
| 151 | 1950 | M | 260-264 | 160 | 1280 | 742.5 | 87 | 12 | 11 | 80 | 55.000 | 130 | 40.000 | 2 | 170 | 38.000 | |
| 152 | 1950 | M | 265-269 | 160 | 1320 | 742.5 | 87 | 12 | 11 | 80 | 56.000 | 130 | 40.700 | 2 | 170 | 38.750 | |
| 153 | 1950 | M | 270-274 | 160 | 1360 | 742.5 | 87 | 12 | 11 | 80 | 57.000 | 130 | 41.400 | 2 | 170 | 39.500 | |
| 154 | 1950 | M | 275-279 | 160 | 1400 | 770 | 87 | 12 | 11 | 80 | 58.000 | 130 | 42.100 | 2 | 170 | 40.250 | |
| 155 | 1950 | M | 280-284 | 160 | 1440 | 770 | 87 | 12 | 11 | 80 | 59.000 | 130 | 42.800 | 2 | 170 | 41.000 | |
| 156 | 1950 | M | 285-289 | 160 | 1480 | 770 | 87 | 12 | 11 | 80 | 60.000 | 130 | 43.500 | 2 | 170 | 41.750 | |
| 157 | 1950 | M | 290-294 | 160 | 1520 | 770 | 87 | 12 | 11 | 80 | 61.000 | 130 | 44.200 | 2 | 170 | 42.500 | |
| 158 | 1950 | M | 295-299 | 160 | 1560 | 770 | 87 | 12 | 11 | 80 | 62.000 | 130 | 44.900 | 2 | 170 | 43.250 | |
| 159 | 1950 | M | 300-304 | 160 | 1600 | 770 | 87 | 12 | 11 | 80 | 63.000 | 130 | 45.600 | 2 | 170 | 44.000 | |
| 160 | 1950 | M | 305-309 | 160 | 1640 | 770 | 87 | 12 | 11 | 80 | 64.000 | 130 | 46.300 | 2 | 170 | 44.750 | |

Self-Propelled Transport Ships with an Unlimited Region of Navigation

| No. | Cherok- teck- lic. X | Anchors | | | Chain cable for bow anchors | | Chain or steel rope for the stream anchor | | |
|-----|----------------------------|---------------|------------------------|-------------------------|--|-----------------------------|--|-----------------------------|----------------------------------|
| | | Bow | | Stream anchor, ke | Total length of two ca- bles, m | Anchor chain size, mm | Length, m | Anchor chain size, mm | Diameter of steel rope, mm |
| | | Quan- tity | Total weight, ke | | | | | | |
| 1 | 50 | 2 | 150 | 25 | 100 | 12 | 50 | — | 8.8 |
| 2 | 75 | 2 | 200 | 25 | 125 | 13 | 50 | — | 8.8 |
| 3 | 100 | 2 | 250 | 50 | 125 | 15 | 50 | — | 11 |
| 4 | 150 | 2 | 300 | 50 | 150 | 16 | 50 | — | 11 |
| 5 | 200 | 2 | 350 | 50 | 175 | 17 | 75 | — | 11 |
| 6 | 250 | 2 | 450 | 75 | 200 | 18 | 75 | 11 | 13 |
| 7 | 300 | 2 | 500 | 75 | 225 | 19 | 75 | 13 | 13 |
| 8 | 350 | 2 | 600 | 100 | 250 | 20 | 75 | 14 | 15.5 |
| 9 | 400 | 2 | 700 | 100 | 275 | 21 | 75 | 14 | 15.5 |
| 10 | 450 | 2 | 750 | 125 | 300 | 22 | 100 | 15 | 17.5 |
| 11 | 500 | 2 | 800 | 150 | 300 | 23 | 100 | 16 | 17.5 |
| 12 | 550 | 2 | 900 | 175 | 325 | 25 | 100 | 16 | 17.5 |
| 13 | 600 | 3 | 1500 | 200 | 350 | 27 | 100 | 17 | 17.5 |
| 14 | 650 | 3 | 1700 | 225 | 350 | 28 | 100 | 18 | 19.5 |
| 15 | 700 | 3 | 1800 | 250 | 375 | 29 | 100 | 18 | 20.5 |
| 16 | 750 | 3 | 2100 | 250 | 375 | 30 | 100 | 19 | 20.5 |
| 17 | 800 | 3 | 2250 | 250 | 375 | 31 | 125 | 19 | 20.5 |
| 18 | 850 | 3 | 2400 | 275 | 375 | 32 | 125 | 20 | 22 |
| 19 | 900 | 3 | 2700 | 300 | 375 | 33 | 125 | 21 | 24 |
| 20 | 950 | 3 | 3000 | 300 | 400 | 34 | 125 | 21 | 24 |
| 21 | 1000 | 3 | 3200 | 350 | 400 | 35 | 125 | 22 | 24 |
| 22 | 1100 | 3 | 3500 | 400 | 400 | 37 | 125 | 23 | 26 |
| 23 | 1200 | 3 | 3750 | 400 | 420 | 38 | 150 | 25 | 26 |
| 24 | 1300 | 3 | 4100 | 450 | 450 | 40 | 150 | 25 | 26 |
| 25 | 1400 | 3 | 4250 | 450 | 450 | 41 | 150 | 25 | 28 |
| 26 | 1500 | 3 | 4500 | 500 | 450 | 42 | 150 | 26 | 28 |
| 27 | 1600 | 3 | 4750 | 500 | 450 | 43 | 150 | 26 | 28 |
| 28 | 1700 | 3 | 5250 | 600 | 450 | 45 | 150 | 28 | 30 |
| 29 | 1850 | 3 | 5500 | 600 | 450 | 46 | 150 | 28 | 30 |
| 30 | 2000 | 3 | 5750 | 700 | 450 | 46 | 150 | 29 | 31.5 |
| 31 | 2150 | 3 | 6000 | 700 | 475 | 48 | 175 | 29 | 31.5 |
| 32 | 2300 | 3 | 6500 | 800 | 500 | 49 | 175 | 29 | 32.5 |
| 33 | 2300 | 3 | 6750 | 800 | 500 | 50 | 175 | 29 | 32.5 |
| 34 | 2700 | 3 | 7500 | 900 | 500 | 52 | 175 | 30 | 33.5 |
| 35 | 3050 | 3 | 8250 | 1000 | 500 | 53 | 200 | 31 | 33.5 |
| 36 | 3200 | 3 | 9000 | 1000 | 500 | 55 | 200 | 31 | 33.5 |
| 37 | 3500 | 2 | 9750 | 1250 | 525 | 57 | 200 | 33 | 34.5 |
| 38 | 3200 | 3 | 10500 | 1250 | 550 | 59 | 225 | 33 | 34.5 |
| 39 | 4200 | 3 | 11000 | 1400 | 550 | 61 | 225 | 34 | 37 |
| 40 | 4500 | 3 | 11500 | 1500 | 550 | 62 | 225 | 35 | 37 |
| 41 | 4800 | 3 | 12000 | 1550 | 550 | 65 | 225 | 35 | — |
| 42 | 5100 | 3 | 13500 | 1750 | 550 | 67 | 250 | 37 | — |
| 43 | 5100 | 3 | 14500 | 1750 | 575 | 68 | 250 | 37 | — |
| 44 | 5600 | 3 | 15000 | 2000 | 600 | 70 | 250 | 40 | — |
| 45 | 6200 | 3 | 15800 | 2000 | 600 | 72 | 250 | 40 | — |
| 46 | 6800 | 3 | 16300 | 2250 | 600 | 74 | 275 | 43 | — |
| 47 | 7000 | 3 | 17500 | 2250 | 600 | 75 | 275 | 43 | — |
| 48 | 7400 | 3 | 18000 | 2250 | 650 | 77 | 275 | 44 | — |
| 49 | 7800 | 3 | 19500 | 2250 | 600 | 80 | 275 | 45 | — |
| 50 | 8000 | 3 | 20000 | 2500 | 600 | 82 | 275 | 45 | — |
| 51 | 8500 | 2 | 21000 | 2500 | 600 | 83 | 275 | 45 | — |
| 52 | 9000 | 2 | 22500 | 2500 | 600 | 85 | 275 | 45 | — |
| 53 | 9500 | 2 | 24000 | 2500 | 600 | 87 | 275 | 45 | — |