Innovative Ship Design

- Midterm Exam -

April 7th, 2012

Note: Budget your time wisely. Some parts of this exam could take you much longer than others. Move on if you are stuck and return to the problem later.

[Reference Data]

7,000 TEU Container Carrier

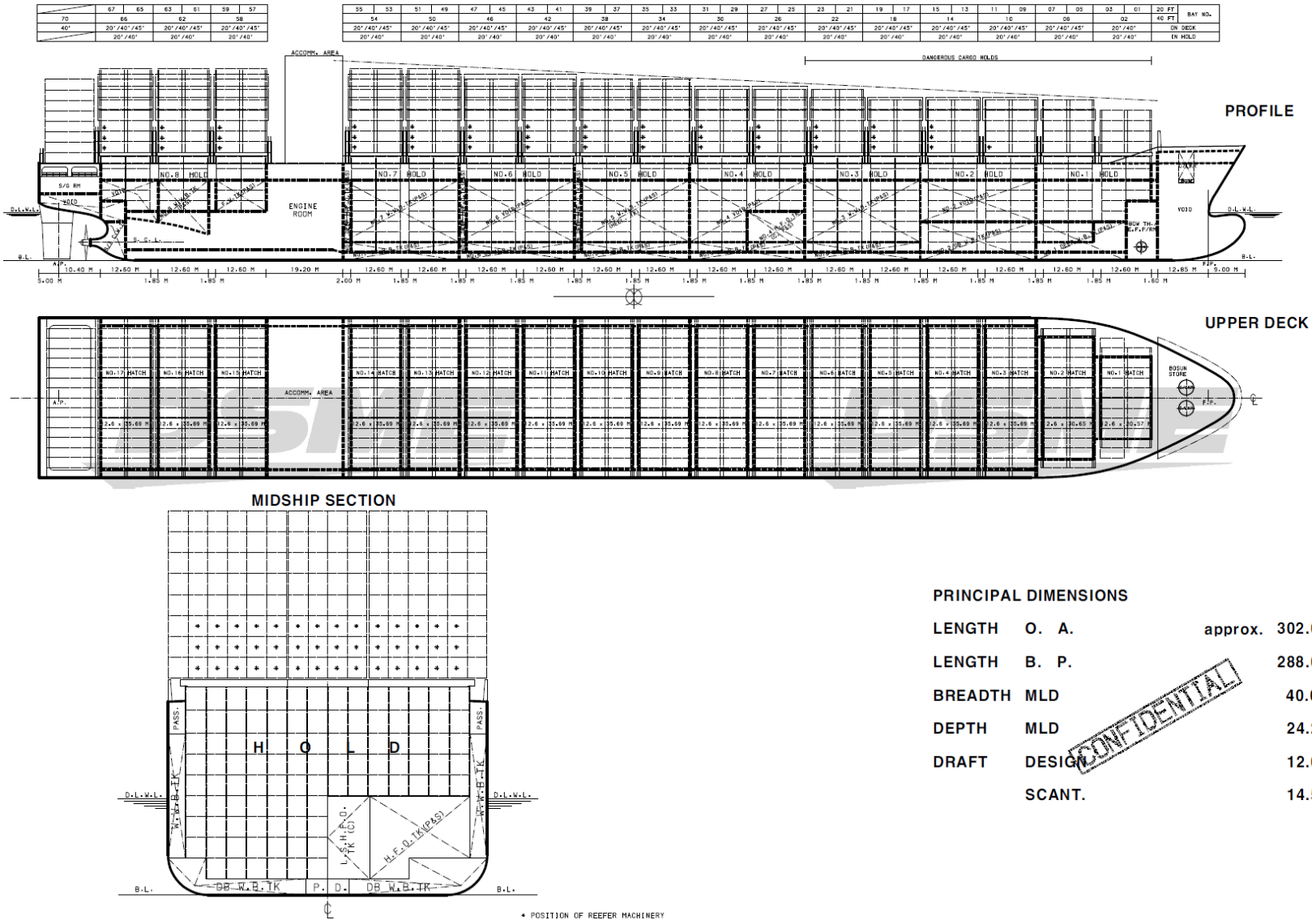
[Basis ship]

Table 1. Principal Particulars of 7,000 TEU Container Ship

	PROJECT NO.		SNU 40	
	PROJECT NAME		7,000 TEU CTN SHIP	Design Ship
DIMENSIONS	L.O.A (m)		302.0	302.0
	L.B.P (m)		288.0	288.0
	B mld (m)		40.0	
	D mld (m)		24.2	24.2
	Td mld (m)		12.0	12.0
	Ts mld (m)		14.5	14.5
	Lbp / Bmld		7.200	
	Bmld / Td		3.333	
	Cb at Td		0.691	
	Cb at Ts		0.721	
	LCB (%)		-1.30%	-1.30%
	Cm at Td		0.972	0.972
	Cb / (Lbp/Bmld)		0.096	
	FRBD Type/Deck Ht (m)		B/20.144	-
LWT[t]	Ws		19,670	
	Wo		4,320	
	Wm		3,710	
	Total LWT (t)		27,700	
	LCG × VCG (m)		-21.600 × 15.972	-
DWT[t]	At Td	Total Container	60,900(=4,350 x 14)	
		Water ballast	0	0
		Fresh water	415.9	415.9
		Heavy fuel oil	7264.1	
		Diesel oil	372.1	
		Lubrication oil	464.4	
		Deadweight constant	900	900
		Total	**70,317**	
	At Ts	Total Container	74,228(=5,302 x 14)	
		Water ballast	12,385.5	12,385.5
		Fresh water	415.9	415.9
		Heavy fuel oil	7264.1	
		Diesel oil	372.1	
		Lubrication oil	464.4	
		Deadweight constant	900	900
		Total	**96,030**	
Displacement	At Td		98,017	
	At Ts		123,730	
LENG	Bulb + Force Part (m)		9.0 + 12.85	-
	Cargo Hold (m)		204.1	-
	P/RM + E/RM (m)		0+60.7	-
	Aft Part + Trans. (m)		10.4+5.0	-
CAPA	Hatch Cover Type		Pontoon	Pontoon
	Complement		30	30
	Cont.(Hold/Deck) (TEU)		-	-
	14mt Homo. Load (TEU) at Scantling Draft		5,302	
	14mt Homo. Load (TEU) at Design Draft		4,350	
	Cargo Total (TEU/m^3)		7,000	
	W. B. T. Total (m^3)		-	-
	F. O. T. Total (m^3)		-	-
SPEED	Vs Guarantee (knot)		24.2	24.0
	NCR Portion (%)		90	90
	Sea Margin (%)		15	15
	Prop. Blade×Dia.×No		6×8.8	6×?
	M/E Type×No.		B&W 9K90ME9	
	NMCR(kW×rpm)		51,480 × 94	

	MCR(kW×rpm)	51,480 × 94	
	NCR(kW×rpm)	46,330 × 90.8	
	TRIAL(kW×rpm)	40,290 × 86.7	
	DFOC at NCR (t/day)	187.1	-
	Endurance (nm)	18,000	18,000

STD 7,000 TEU CONTAINERSHIP(SNU)



PRINCIPAL DIMENSIONS

LENGTH	O. A.	approx. 302.0 M
LENGTH	B. P.	288.0 M
BREADTH	MLD	40.0 M
DEPTH	MLD	24.2 M
DRAFT	DESIGN	12.0 M
	SCANT.	14.5 M

Figure 1. General Arrangement of 7,000 TEU Container Ship

Figure 2. Midship section of 7,000 TEU container ship and transverse clearance between containers

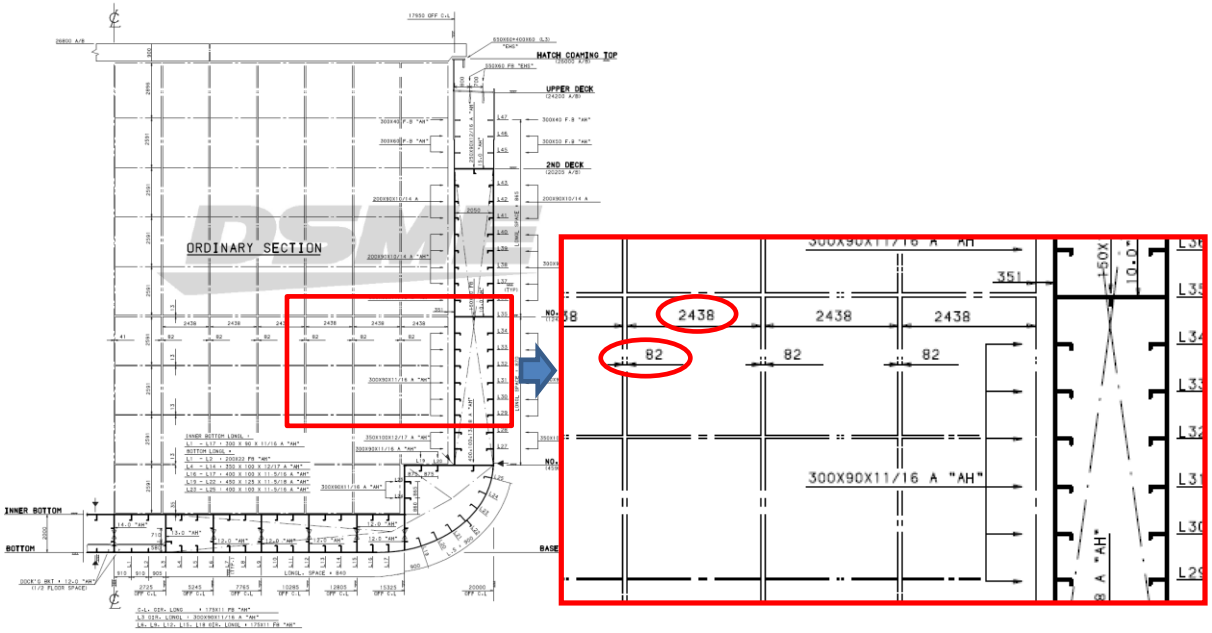


Table 2. Container stowage table

HOLD No.			No.8 Hold						No.7 HOLD				No.6 HOLD				No.5 HOLD				No.4 HOLD				No.3 HOLD				No.2 HOLD				No.1 HOLD				SUB. TOT
HATCH No.		MOOR. DK	No.17 Hat.		No.16 Hat.		No.15 Hat.		No.14 Hat.		No.13 Hat.		No.12 Hat.		No.11 Hat.		No.10 Hat.		No.9 Hat.		No.8 Hat.		No.7 Hat.		No.6 Hat.		No.5 Hat.		No.4 Hat.		No.3 Hat.		No.2 Hat.		No.1 Hat.		
BAY	20 FT	-	67	65	63	31	59	57	55	53	51	49	47	45	43	41	39	37	35	33	31	29	27	25	23	21	19	17	15	13	11	09	07	05	03	01	
NO.	40 FT	70	66		62		58		54		50		46		42		38		34		30		26		22		18		14		10		6		2		
ON DECK	8 TH	32	16	16	16	16	16	16	16	16	16	16																									192
	7 TH	32	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16																	320
	6 TH	32	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16											416
	5 TH	32	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	14			542
	4 TH	32	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	14	14	12	568
	3 RD	32	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	14	14	12	568
	2 ND	32	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	14	14	12	568
	1 ST	28	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	14	14	12	564
	SUB.T	252	128	128	128	128	128	128	128	128	128	128	112	112	112	112	112	112	112	112	96	96	96	96	96	96	80	80	80	80	80	80	70	56	48		3,738
IN HOLD	9 TH		14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	12	12	8	8	460
	8 TH		14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	12	12	8	6	458
	7 TH		14	14	14	14	8	8	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	12	10	6	4	440
	6 TH		12	14	14	14	8	8	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	12	12	10	8	4	2	426
	5 TH			10	12	14	8	8	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	12	12	10	8	6	2	0	396
	4 TH								14	14	14	14	14	14	14	14	14	14	14	14	14	14	0	0	14	14	14	14	12	12	10	8	6	4	2	0	306
	3 RD								14	14	14	14	14	14	14	14	14	14	14	14	14	14	0	0	14	14	14	12	12	10	8	6	4	4	0	0	294
	2 ND								14	14	14	14	14	14	14	14	14	14	14	14	14	14	0	0	14	12	12	10	8	8	6	4	4	2	0	0	276
	1 ST								10	12	12	12	12	12	12	12	12	12	12	12	12	12	0	0	10	10	8	8	6	4	4	2	0	0	0	0	218
	SUB.T	0	54	66	68	70	52	52	122	124	124	124	124	124	124	124	124	124	124	124	124	124	70	70	122	120	118	114	108	102	94	84	68	58	30	20	3,274
GRAND TOT.		252	182	194	196	198	180	180	250	252	252	252	236	236	236	236	236	236	236	236	220	220	166	166	218	216	198	194	188	182	174	164	148	128	86	68	7,012

Table 3. Resistance estimation result of design ship

(In calm water)

SPEED (Knots)	EHP (kW)
19	14297
20	16758
21	19610
22	22966
23	26979
24	31842
25	37802

w=0.358

t=0.209

η_R=1.020

Figure 3. Propeller Open-water Curve of MARIN B 6.98

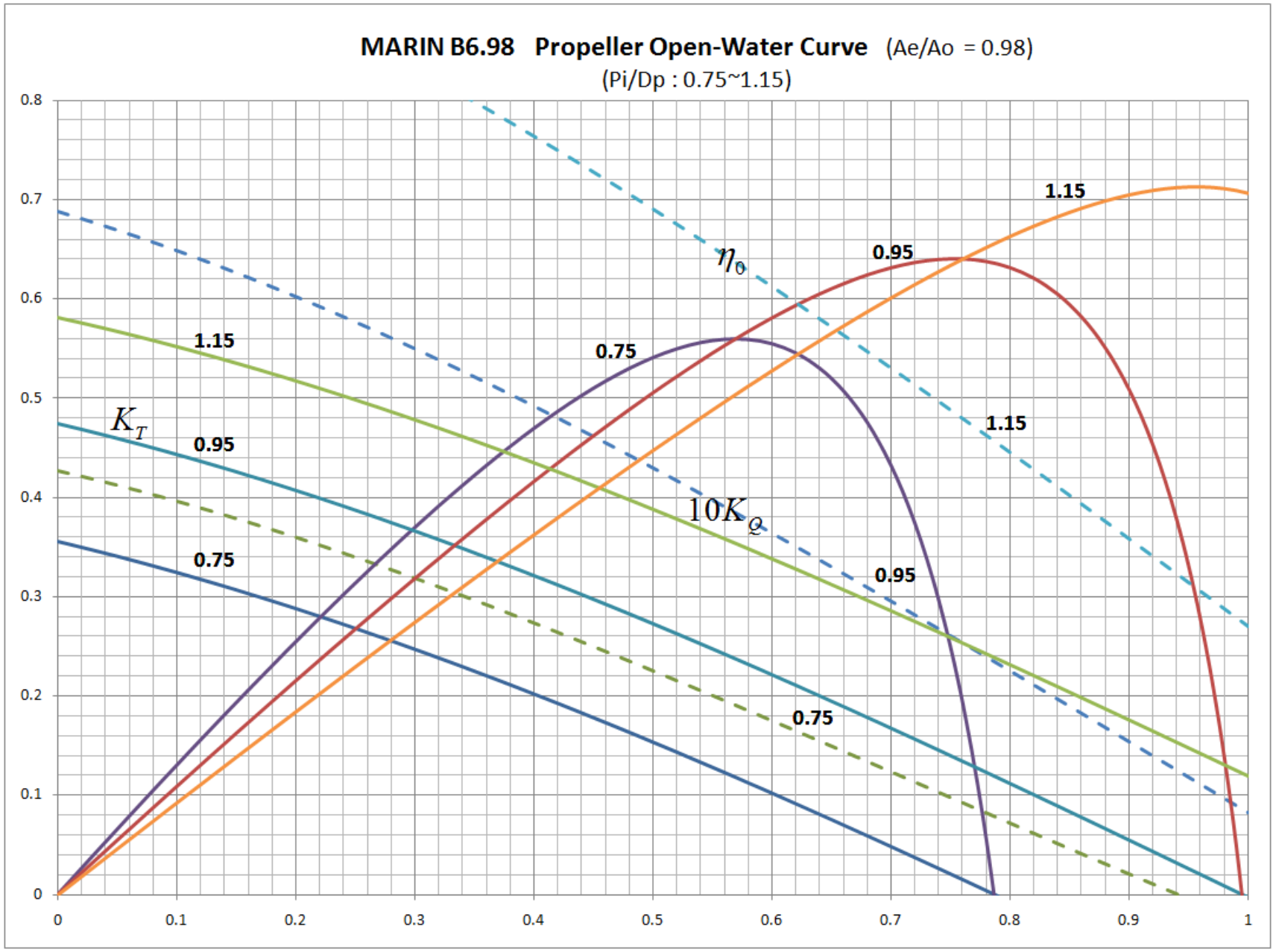
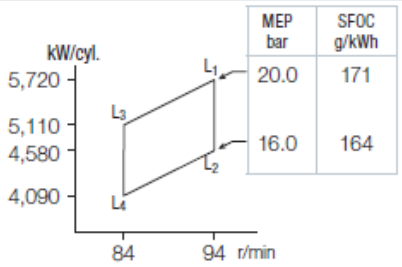
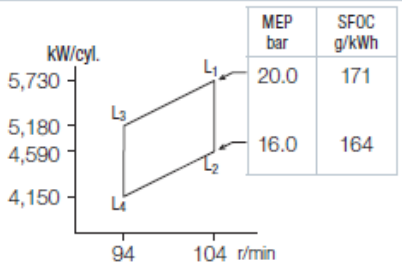
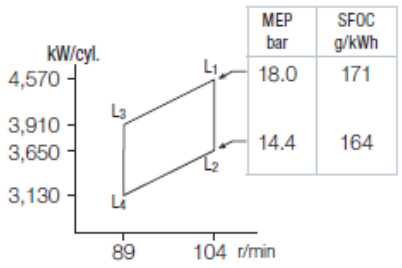


Figure 4. MAN B&W Diesel Marine Engine Catalog

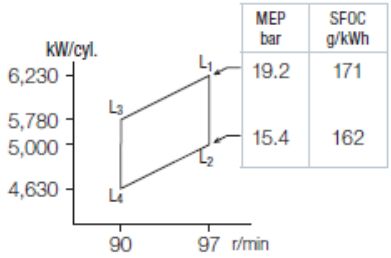
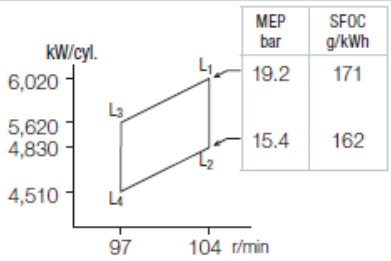
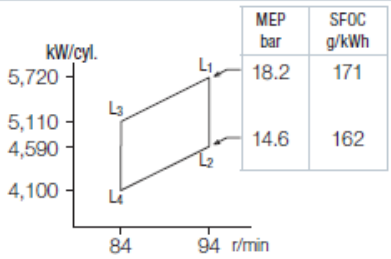
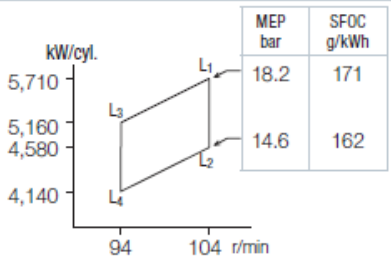
K90 MAN B&W

	Cyl.	L_1 kW	
ME9 Stroke: 2,870 mm	6 7 8 9 10 11 12	34,320 40,040 45,760 51,480 57,200 62,920 68,640	
ME-C9 Stroke: 2,600 mm	6 7 8 9 10 11 12	34,380 40,110 45,840 51,570 57,300 63,030 68,760	
MC-C6 Stroke: 2,300 mm	6 7 8 9 10 11 12	27,420 31,990 36,560 41,130 45,700 50,270 54,840	

MAN B&W K90

L_{min}:		6 cyl.	7 cyl.	8 cyl.	9 cyl.	10 cyl.	11 cyl.	12 cyl.
Mark 9	mm	11,210	12,690	14,170	17,360	19,056	20,536	22,124
Mark 6	mm	12,802	14,404	16,006	17,608	20,060	21,662	23,264
Dry mass:								
ME9	t	945	1,070	1,200	1,400	1,560	1,685	1,820
ME-C9	t	905	1,025	1,150	1,340	1,490	1,615	1,740
MC-C6	t	991	1,111	1,259	1,415	1,561	1,686	1,826

Dimensions:		A	B	C	H_1	H_2	H_3
ME9	mm	*	4,936	1,750	Data is available on request		
ME-C9	mm	*	4,760	1,700	13,375	12,550	12,325
MC-C6	mm	1,602	4,286	1,699	12,800	12,600	12,375
** Cyl. distance*		*6-8 cyl.*	*9 cyl.*	*10 cyl.*	*11 cyl.*	*12 cyl.*	
	mm	*1,480*	*1-6:1,480*	*1-5:1,480*	*1-6:1,480*	*1-6:1,480*	
	mm	-	*7-9:1,588*	*6-10:1,588*	*7-11:1,588*	*7-12:1,588*	

	Cyl.	L_1 kW	
ME7 MC7 Stroke: 2,660 mm	6	37,380	
	7	43,610	
	8	49,840	
	9	56,070	
	10	62,300	
	11	68,530	
	12	74,760	
	14	87,220	
ME-C7 MC-C7 Stroke: 2,400 mm	6	36,120	
	7	42,140	
	8	48,160	
	9	54,180	
	10	60,200	
	11	66,220	
	12	72,240	
	14	84,280	
ME6 MC6 Stroke: 2,660 mm	6	34,320	
	7	40,040	
	8	45,760	
	9	51,480	
	10	57,200	
	11	62,920	
	12	68,640	
	14	80,080	
ME-C6 MC-C6 Stroke: 2,400 mm	6	34,260	
	7	39,970	
	8	45,680	
	9	51,390	
	10	57,100	
	11	62,810	
	12	68,520	
	14	79,940	

L_{min}:		6 cyl.	7 cyl.	8 cyl.	9 cyl.	10 cyl.	11 cyl.	12 cyl.	14 cyl.
Mark 7/6	mm	12,865	14,615	16,410	19,135	20,885	22,635	24,385	27,885
Dry mass:									
ME7/6	t	1,067	1,220	1,437	1,581	1,755	1,895	2,058	2,328
MC7/6	t	1,156	1,315	1,536	1,697	1,882	2,034	2,190	2,446
ME-C7/6	t	1,046	1,211	1,393	1,532	1,680	1,912	1,975	2,246
MC-C7/6	t	1,111	1,277	1,472	1,618	1,774	1,947	2,089	2,405

Dimensions:		A	B	C	H_1	H_2	H_3
ME7/6	mm	1,750	4,640	1,700	13,375	13,075	13,450
MC7/6	mm	1,750	4,640	1,700	13,400	13,125	13,275
ME-C7/6	mm	1,750	4,370	1,700	12,750	12,425	12,825
MC-C7/6	mm	1,750	4,370	1,700	12,825	12,875	12,825