Revision History:

REV	DATE	DESCRIPTION	CALC	CHK	APP
B	23/02/2012	< >	DHE	< >	< >

1. Objectives:

To determine the minimum rigging requirements for compliance with DNV Standard for Certification No. 2.7-1 (2006)

2. References:

ID	REFERENCE	PUBLISHER	DATE/REV	DESCRIPTION
01	STD FOR CERTIFICATION 2.7-1	DET NORSKE VERITAS	NOV 2008	OFFSHORE CONTAINERS
02	RULES FOR CLASSIFICATION OF SHIPS	DET NORSKE VERITAS	JULY 2011	METALLIC MATERIALS
03	drg:11183-D-002	PRESSURE DYNAMICS	F	FMC PRELUDE PHPU - GA
04	SHACKLES	STANDARDS AUSTRALIA	2002	SHACKLES

3. Variables:

Variable	Description	Source
$R := 9500\ kg$	Rating or maximum gross mass of the offshore container including permanent equipment and its cargo, in kg; but excluding the lifting set	REF 03
$T := 9500\ kg$	Tare mass. Mass of the empty container including any permanent equipment but excluding cargo and lifting set, in kg;	REF 03
$P := R - T$ $P = 0\ kg$	Payload. The maximum permissible mass of cargo which may safely be transported by the container, in kg.	REF 01, 1.5
$\beta := 45\ °$	Sling Leg Angle to the vertical	REF 01, 8.3

4. Lifting Set Calculations: Section 8

Four leg wire rope sling, with forerunner

Table 8-1 Determination of Working Load Limit

Rating (kg)	*Enhancement factor*	*Minimum required Working Load Limit (WLL_{min}) (t)*
500	-	7.00
1 000	-	7.00
1 500	-	7.00
2 000	3.500	7.00
2 500	2.880	7.20
3 000	2.600	7.80
3 500	2.403	8.41
4 000	2.207	8.83
4 500	1.962	8.83
5 000	1.766	8.83
5 500	1.766	9.71
6 000	1.766	10.59
6 500	1.733	11.26
7 000	1.700	11.90
7 500	1.666	12.50
8 000	1.633	13.07
8 500	1.600	13.60
9 000	1.567	14.10
9 500	1.534	14.57
10 000	1.501	15.01
10 500	1.479	15.53
11 000	1.457	16.02
11 500	1.435	16.50
12 000	1.413	16.95
12 500	1.391	17.38
13 000	1.368	17.79
13 500	1.346	18.18
14 000	1.324	18.54
14 500	1.302	18.88
15 000	1.280	19.20
15 500	1.267	19.64
16 000	1.254	20.06
16 500	1.240	20.47
17 000	1.227	20.86
17 500	1.214	21.24
18 000	1.201	21.61
18 500	1.188	21.97
19 000	1.174	22.31
19 500	1.161	22.64
20 000	1.148	22.96
20 500	1.143	23.44
21 000	1.139	23.92
21 500	1.135	24.39
22 000	1.130	24.86
22 500	1.126	25.33
23 000	1.121	25.79
23 500	1.117	26.25
24 000	1.112	26.70
24 500	1.108	27.15
25 000	1.104	27.59

REF 01, Table 8-1

$R = (9.5 \cdot 10^3)\ kg$ Container Rating

$WLL_{min} := R \cdot 1.534$ Minimum WLL for sling set, forerunner and master link — REF 01, Table 8-1

$WLL_{min} = (14.573 \cdot 10^3)\ kg$

$WLL_S := \frac{WLL_{min}}{3 \cdot \cos(\beta)}$ Minimum WLL for sling leg components and shackles — REF 01, Table 8-3

$WLL_S = (6.87 \cdot 10^3)\ kg$

Table E-3 Working Load Limits for 1, 2 and 4 leg wire rope slings at different angles
Steel cored rope, grade 1770

Nominal size of sling	*Working Load Limits in tonnes*										
	Single leg sling and forerunners	*Four leg slings at*					*Two leg slings at*				
(mm)		45°	40°	35°	30°	25°	45°	40°	35°	30°	25°
18[1)]	3.70	7.8	8.5	9.1	9.6	10.1	[5.2]	[5.7]	[6.1]	[6.4]	[6.7]
20[1)]	4.60	9.8	10.6	11.3	12.0	12.5	[6.5]	7.0	7.5	8.0	8.3
22	5.65	12.0	13.0	13.9	14.7	15.4	8.0	8.7	9.3	9.8	10.2
24	6.70	14.2	15.4	16.5	17.4	18.2	9.5	10.3	11.0	11.6	12.1
26	7.80	16.5	17.9	19.2	20.3	21.2	11.0	12.0	12.8	13.5	14.1
28	9.00	19.1	20.7	22.1	23.4	24.5	12.7	13.8	14.7	15.6	16.3
32	11.8	25.0	27.1	29.0	30.7	32.1	16.7	18.1	19.3	20.4	21.4
36	15.0	31.8	34.5	36.9	39.0	40.8	21.2	23.0	24.6	26.0	27.2
40	18.5	39.2	42.5	45.5	48.1	50.3	26.2	28.3	30.3	32.0	33.5
44	22.5	47.7	51.7	55.3	58.5	61.2	31.8	34.5	36.9	39.0	40.8
48	26.0	55.2	59.8	63.9	67.5	70.7	36.8	39.8	42.6	45.0	47.1
52	31.5	66.8	72.4	77.4	81.8	85.6	44.5	48.3	51.6	54.6	57.1
56	36.0	76.4	82.7	88.5	93.5	97.9	50.9	55.2	59.0	62.4	65.3
60	42.0	89.1	96.5	103.2	109.1	114.2	59.4	64.3	68.8	72.7	76.1

1) Ropes with WLL values below 7.0 may not be used on offshore containers, ref. Table 8-1 in Section 8.

REF 01, Table E-3

1	2	3	4	5	6	7	8	9	10	11
Nominal size	Dimension, mm (Tolerance +8%, -5%)						WLL t	Test force, kN		Pin type
mm	*d*	*D*	*W*	*B*	*L*	*E*		Destructive test	Proof test	
5	5	6	10	15	22	14	0.33	19.5	6.5	
6	6	8	12	20	29	17	0.50	29.5	9.9	
8	8	10	13	21	31	21	0.75	44.2	14.8	Figure E7
10	10	11	17	26	37	25	1.0	58.9	19.7	
11	11	13	18	29	43	27	1.5	88.3	29.5	
13	13	16	21	33	48	33	2.0	118	39.3	
16	16	19	27	43	61	40	3.2	189	62.8	
19	19	22	32	51	72	48	4.7	277	92.3	
22	22	25	37	58	84	54	6.5	383	128	
25	25	29	43	68	95	60	8.5	501	167	
29	29	32	46	74	108	67	9.5	560	187	
32	32	35	52	83	119	76	12	707	236	Figures E7 and E8
35	35	38	57	92	133	84	13.5	795	265	
38	38	41	60	98	146	92	17	1010	334	
44	44	51	73	127	178	110	25	1480	491	
51	51	57	83	146	197	127	35	2070	687	
57	57	63	95	160	222	143	42.5	2510	834	
63	63	70	105	184	267	152	55	3240	1080	
76	76	83	127	200	330	165	85	5010	1330	
89	89	95	146	241	381	203	120	7070	1670	
102	102	108	165	279	432	229	150	8830	1970	

REF 04, Figure D3

5. Conclusions:

For forerunner, using:

$$WLL_{min} = \left(14.573 \cdot 10^3\right)\ kg$$

From REF 01, Table E-3, a minimum size of 36mm grade 1770, steel cored wire rope is required.
For each of the four legs, using:

$$WLL_S = \left(6.87 \cdot 10^3\right)\ kg$$

From REF 01, Table E-3, a minimum size of 18mm grade 1770, steel cored wire rope, and from REF 04, Figure D3, a minimum 8.5t WLL shackle is required.