Stabitlity calculation according to ISO 6185-3 and ISO 12217-3-2017

By Xiamen DAWN DESIGN
Company: 厦门道恩建筑设计有限公司
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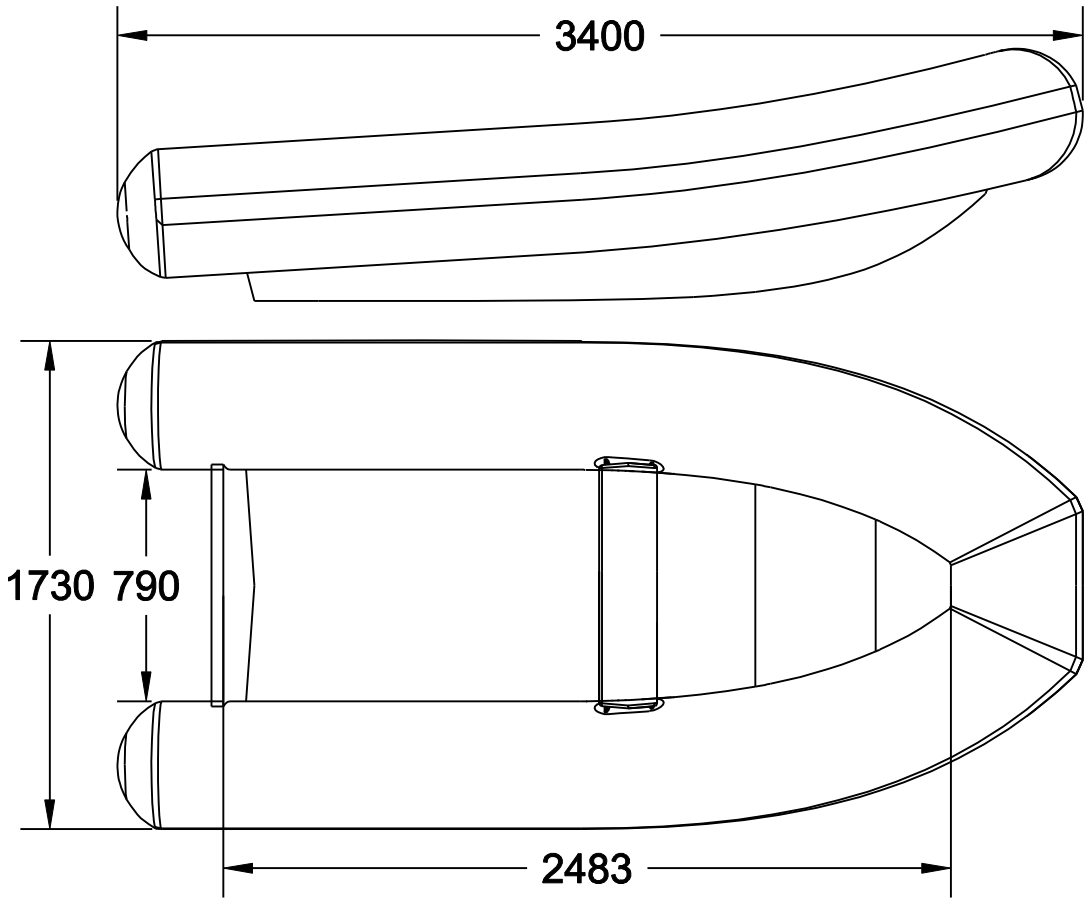
Owner: 王弘涛

DND DAWN YACHT DESIGN 厦门道恩建筑设计有限公司			ITEM	PROJECT:	CL 340
			CL 340	Cat.	cat. C
	Signature			PAPER	SCALE
Design by			Stability calculations	A4	
Checked by				sheet	1 of 16
Technic by					
Approved by		DATE 2018.07			

CONTENT



SPECIFICATION

Loa	3400mm
Beam	1730mm
Inside Length	2483mm
Inside Width	790mm
Weight	70Kg
Max Pax	6
Max Load (incl. motor)	585Kg
Max HP	25
Shaft	Short
Tube	44cm
Airtight Chambers	3

DND
DAWN YACHT DESIGN

	Signature		
Design by	S.C/L		
Checked by			
Technic by			
Approved by		DATE	2017.04.19

Drawing Title

General Arrangement

Project Name: CL340

Drawing NO cl34-01-01

	PAPER	SCALE
	A4	1:25
SHEET	1 of 1	

CL 340 Weight estimation CAT.C

Loa(m) = 3.4m
Lh(m) =3.4m
Bmax (m) =1.73m

HULL		Weight	XG (m)	YG(m)	ZG(m)	Mx	My	Mz	NOTE
Hull Plates		48.0	1.40	0.00	0.20	67.20	0.00	9.60	
Structures		14.0	1.27	0.00	0.19	17.78	0.00	2.66	
Inflatable tube		8.0	2.20	0.00	0.42	17.60	0.00	3.36	
TOT.	**70.0**		**1.47**	**0.00**	**0.22**	**102.58**	**0.00**	**15.62**	

Fixed MACHINERY									
battery		20.5	0.60	0.00	0.20	12.30	0.00	4.10	
Fuel tank		5.0	0.50	0.00	0.20	2.50	0.00	1.00	
Cables		2.0	1.10	0.00	0.22	2.20	0.00	0.44	
TOT.	**27.5**		**0.62**	**0.00**	**0.20**	**17.00**	**0.00**	**5.54**	

Tot. Empty Craft		**97.5**	**1.23**	**0.00**	**0.22**	**119.58**	**0.00**	**21.16**	

Standard Equipment									
Outboard		104.5	-0.30	0.00	0.50	-31.35	0.00	52.25	**25 hp**
Dry bag		2.0	3.00	0.00	0.30	6.00	0.00	0.60	
Foot pump		1.0	3.00	0.00	0.25	3.00	0.00	0.25	
Paddles		1.0	1.20	0.00	0.60	1.20	0.00	0.60	
Repair kit		1.0	2.20	0.00	0.50	2.20	0.00	0.50	
TOT.	**109.5**		**-0.17**	**0.00**	**0.49**	**-18.95**	**0.00**	**54.20**	

Additional eq.									
LIFEJACKETS		4.0	3.00	0.00	0.50	12.00	0.00	2.00	
Others not in standard equipment		5.0	3.00	0.00	0.35	15.00	0.00	1.75	
TOT. Addition	**9.0**		**3.00**	**0.00**	**0.42**	**27.00**	**0.00**	**3.75**	

Light Craft									
	EmptyCraft	**97.5**	**1.23**	**0.00**	**0.22**	**119.58**	**0.00**	**21.16**	
	standard eq.	109.5	-0.17	0.00	0.49	-18.95	0.00	54.20	
Light Craft	**Tot.**	**207.0**	**0.49**	**0.00**	**0.36**	100.63	0.00	75.36	

Minimum Operating condition									
	Light craft	**207.0**	**0.49**	**0.00**	**0.36**	**100.63**	**0.00**	**75.36**	
	additonal eq	9.0	3.00	0.00	0.42	27.00	0.00	3.75	
1	passengers+crews	75.0	0.50	0.00	0.70	37.50	0.00	52.50	
Minimum Operating condition	**Tot.**	**291.0**	**0.57**	**0.00**	**0.452**	165.13	0.00	131.61	
				addit.	0.05				
					0.50				

FULL LOAD									
	light craft	**207.0**	**0.49**	**0.00**	**0.36**	**100.63**	**0.00**	**75.36**	
12	FUEL	8.6	0.50	0.00	0.20	4.28	0.00	1.71	
4	drinking water	3.8	2.30	0.00	0.50	8.74	0.00	1.90	
	personal prov.	10.0	2.30	0.00	0.50	23.00	0.00	5.00	
	additonal eq	9.0	3.00	0.00	0.42	27.00	0.00	3.75	
6	passengers+crews	450.0	1.00	0.05	0.70	450.00	22.50	315.00	
FULL LOAD	**Tot.**	**688.4**	**0.89**	**0.03**	**0.59**	613.65	22.50	402.72	
				addit.	0.05				
					0.63				

Loaded Arrival									

	light craft	**207.0**	**0.49**	**0.00**	**0.36**	**100.63**	**0.00**	**75.36**	
12	FUEL	0.9	0.50	0.00	0.10	0.45	0.00	0.09	
4	drinking water	0.4	2.30	0.00	0.50	0.92	0.00	0.20	
	personal prov.	10.0	2.30	0.00	0.45	23.00	0.00	4.50	
	additonal eq	9.0	3.00	0.00	0.42	27.00	0.00	3.75	
6	passengers+crews	450.0	1.00	0.05	0.70	450.00	22.50	315.00	
Loaded Arrival	**Tot.**	**677.3**	**0.89**	**0.03**	**0.59**	602.00	22.50	398.90	
				addit.	0.05				
					0.64				

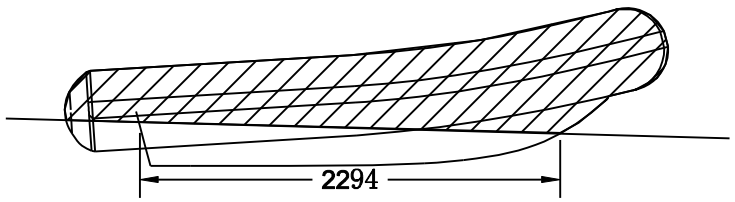
Crews	crew no.								
	1.0	85.0	0.25	-0.38	0.70	20.83	-32.30	59.50	
	2.0	85.0	0.65	-0.39	0.70	55.25	-33.41	59.50	
	3.0	85.0	1.10	-0.38	0.70	93.50	-32.39	59.50	
	4.0	85.0	1.70	-0.37	0.70	144.50	-31.20	59.50	
	5.0	85.0	2.00	-0.08	0.70	170.00	-6.80	59.50	
	6.0	85.0	0.40	0.06	0.70	34.00	4.76	59.50	
Tot. Crews		510.0	1.02	-0.26	0.70	518.08	-131.33	357.00	

Crew offset test condition									
	light craft	**207.0**	**0.49**	**0.00**	**0.36**	**100.63**	**0.00**	**75.36**	
12	FUEL	8.6	0.50	0.00	0.20	4.28	0.00	1.71	
4	drinking water	3.8	2.30	0.00	0.50	8.74	0.00	1.90	
	personal prov.	10.0	2.30	0.00	0.45	23.00	0.00	4.50	
	additonal eq	9.0	3.00	0.00	0.42	27.00	0.00	3.75	
6	passengers+crews	510.0	1.02	-0.26	0.70	518.08	-131.33	357.00	
Crew offset test condition	**Tot.**	**748.4**	**0.91**	**-0.18**	**0.59**	681.72	-131.33	444.22	
				additona	0.05				
	Tot.	**748.4**	**0.91**	**-0.18**	**0.64**	**681.72**	**-131.33**	**444.22**	

Weihai Haifei Marine Ltd. CL340

Design Category intended:	C		Monohull / multihull:	Monohull	Propul. type	OB
Item		**Symbol**	**Unit**	**Value**	**Ref.**
Length of hull as in ISO 8666		L_{HLH}	m	3.40	4. Table 1
Length of waterline in loaded arrival condition		L_{wlLwl}	m	2.64	4. Table 1
Empty Craft condition mass		m_{ECmEC}	kg	97.5	3.3.1
standard equipment			kg	109.5	3.4.10
water ballast in tanks which are notified in the owner's manual to be filled when the boat is afloat			kg	0.0	3.3.2
Light craft condition mass		m_{LCmLC}	kg	207.0	3.3.2
Mass of:					
Desired crew limit		CL	----	6	3.4.2
Mass of:					
desired crew limit at 75 kg each			kg	450.0	
provisions + personal effects			kg	10.0	3.3.3
drinking water			kg	3.8	3.3.3
fuel			kg	8.6	3.3.3
lubricating and hydraulic oils			kg	0.0	3.3.3
black water			kg	0.0	3.3.3
grey water			kg	0.0	3.3.3
water ballast			kg	0.0	3.3.3
any other fluids carried aboard (e.g. bait tanks)			kg	0.0	3.3.3
stores, spare gear and cargo (if any)			kg	0.0	3.3.3
optional equipment and fittings not included in basic outfit			kg	9.0	3.3.3
inflatable life raft(s)			kg	0.0	3.3.3
other small boats carried aboard			kg	0.0	3.3.3
margin for future additions			kg	0.0	3.3.3
Maximum load = sum of above masses		m_L	kg	481.4	3.3.3
Maximum Load condition mass		m_{LDC}	kg	688.4	3.3.4
mass to be removed for loaded arrival condition			kg	11.1	3.3.5
Loaded Arrival condition mass		m_{LA}	kg	677.3	3.3.5

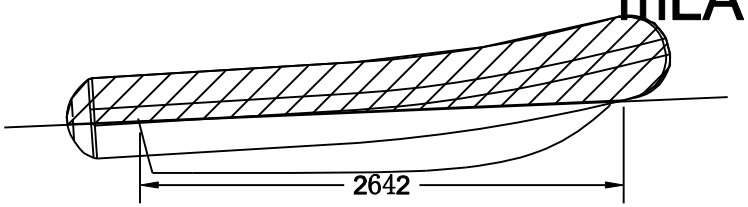
mMo



1.Calculation AT mMo

Item	Symbol	Unit	Value	
Windage area	A_{LV}	m2	1.36	
Waterline length of hull	L_{WL}	m	2.29	
Beam of hull	B_H	m	1.73	
Ratio of $A_{LV}/(0.5L_{WL}*B_H)$	-		≈0. 69	<1

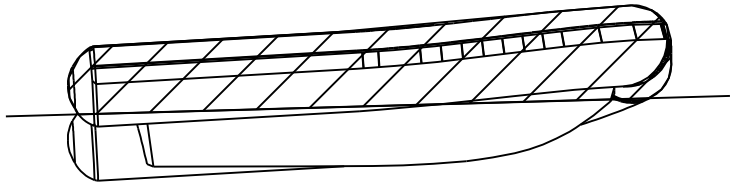
mLA



2.Calculation AT mLA

Item	Symbol	Unit	Value	
Windage area	A_{LV}	m2	1.04	
Waterline length of hull	L_{WL}	m	2.64	
Beam of hull	B_H	m	1.73	
Ratio of $A_{LV}/(0.5L_{WL}*B_H)$	-		≈0. 46	<1

Offset test



2.Calculation AT offset condition

Item	Symbol	Unit	Value	
Windage area	A_{LV}	m2	1.39	
Waterline length of hull	L_{WL}	m	3.13	
Beam of hull	B_H	m	1.73	
Ratio of $A_{LV}/(0.5L_{WL}*B_H)$	-		≈0. 51	<1

It is not necessary to perform wind resistance test

DND
DAWN YACHT DESIGN

	Signature		
Design by	S.C/L		
Checked by			
Technic by			
Approved by		DATE	2018.07.12

Drawing Title

Windage Area

Project Name: CL340

Drawing NO CL34-01-03

	PAPER	SCALE
SHEET	A4	1:40
	1 of 1	

CL 340 Hydrostatic tables															
Draft	Displ.	LCB	TCB	VCB	Wet Area	Awp	LCF	TCF	VCF	BMt	BMl	Cb	Cwp	Cws	Cvp
m	kg	m	m	m	m²	m²	m	m	m	m	m	-	-	-	-
0.000	0.000	0.00	0.00	0.000	0.000	0.000	0.262	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.100	43.173	0.710	0.00	0.069	1.084	0.977	0.672	0.00	0.100	1.381	8.058	0.123	0.285	3.397	0.431
0.110	54.077	0.699	0.00	0.076	1.279	1.152	0.640	0.00	0.110	1.780	7.956	0.134	0.321	3.549	0.416
0.120	66.845	0.685	0.00	0.083	1.489	1.339	0.619	0.00	0.120	2.074	7.598	0.146	0.360	3.688	0.405
0.130	81.563	0.672	0.00	0.091	1.712	1.536	0.607	0.00	0.130	2.282	7.127	0.159	0.400	3.814	0.398
0.140	98.354	0.661	0.00	0.098	1.946	1.739	0.604	0.00	0.140	2.418	6.623	0.174	0.441	3.922	0.394
0.150	117.214	0.652	0.00	0.106	2.178	1.938	0.611	0.00	0.150	2.483	6.122	0.189	0.480	3.998	0.393
0.160	138.095	0.647	0.00	0.113	2.407	2.133	0.625	0.00	0.160	2.501	5.674	0.204	0.517	4.049	0.394
0.170	160.950	0.645	0.00	0.121	2.632	2.321	0.644	0.00	0.170	2.486	5.298	0.219	0.552	4.082	0.397
0.180	185.674	0.646	0.00	0.128	2.845	2.496	0.664	0.00	0.180	2.434	4.979	0.235	0.583	4.089	0.403
0.190	212.125	0.650	0.00	0.135	3.048	2.658	0.685	0.00	0.190	2.361	4.708	0.250	0.611	4.080	0.409
0.200	240.175	0.655	0.00	0.142	3.239	2.807	0.706	0.00	0.200	2.277	4.477	0.265	0.636	4.059	0.417
0.210	269.696	0.662	0.00	0.149	3.421	2.945	0.727	0.00	0.210	2.189	4.279	0.280	0.658	4.029	0.425
0.220	300.569	0.670	0.00	0.156	3.593	3.071	0.747	0.00	0.220	2.098	4.106	0.294	0.678	3.994	0.434
0.230	332.681	0.678	0.00	0.162	3.756	3.187	0.767	0.00	0.230	2.009	3.953	0.308	0.695	3.955	0.442
0.240	365.932	0.687	0.00	0.169	3.911	3.293	0.786	0.00	0.240	1.922	3.816	0.321	0.711	3.915	0.451
0.250	400.233	0.696	0.00	0.176	4.060	3.392	0.804	0.00	0.250	1.838	3.692	0.334	0.726	3.874	0.460
0.260	435.505	0.706	0.00	0.182	4.203	3.483	0.821	0.00	0.260	1.759	3.578	0.347	0.740	3.834	0.469
0.270	471.675	0.715	0.00	0.188	4.342	3.567	0.838	0.00	0.270	1.682	3.473	0.360	0.754	3.796	0.477
0.280	508.675	0.725	0.00	0.195	4.478	3.645	0.855	0.00	0.280	1.609	3.374	0.372	0.766	3.760	0.486
0.290	546.445	0.734	0.00	0.201	4.610	3.717	0.871	0.00	0.290	1.539	3.282	0.384	0.778	3.726	0.494
0.300	584.933	0.744	0.00	0.207	4.740	3.785	0.887	0.00	0.300	1.472	3.197	0.396	0.789	3.695	0.502
0.310	624.091	0.753	0.00	0.213	4.869	3.848	0.903	0.00	0.310	1.409	3.119	0.407	0.798	3.667	0.510
0.320	663.610	0.763	0.00	0.219	5.083	3.824	0.940	0.00	0.320	1.343	2.933	0.418	0.790	3.705	0.529
0.330	702.454	0.774	0.00	0.225	5.352	3.748	0.985	0.00	0.330	1.279	2.734	0.427	0.772	3.785	0.554
0.340	740.494	0.786	0.00	0.231	5.623	3.668	1.027	0.00	0.340	1.220	2.588	0.436	0.753	3.866	0.579
0.350	777.696	0.799	0.00	0.236	5.897	3.584	1.066	0.00	0.350	1.167	2.482	0.443	0.733	3.950	0.604
0.360	814.026	0.811	0.00	0.242	6.174	3.498	1.101	0.00	0.360	1.117	2.406	0.450	0.714	4.037	0.630
0.370	849.447	0.824	0.00	0.247	6.455	3.407	1.133	0.00	0.370	1.070	2.350	0.456	0.694	4.128	0.657
0.380	883.921	0.837	0.00	0.252	6.739	3.313	1.161	0.00	0.380	1.025	2.307	0.462	0.675	4.225	0.684
0.390	917.462	0.849	0.00	0.257	7.003	3.238	1.185	0.00	0.390	0.984	2.270	0.462	0.652	4.282	0.708
0.400	950.402	0.861	0.00	0.261	7.250	3.176	1.215	0.00	0.400	0.944	2.204	0.461	0.632	4.328	0.729

CL340 Offset load test -cat. C

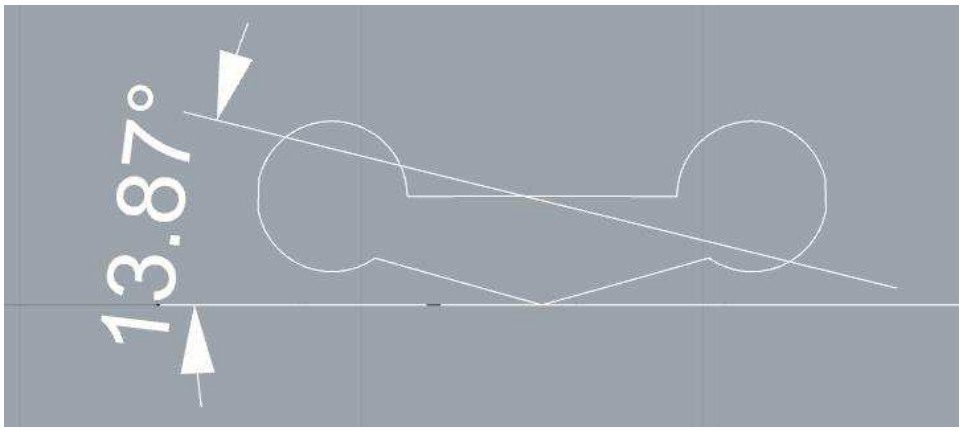
1.General

Length Overall, LOA	3.4	m
L_H=	3.4	m
Beam Overall, Boa	1.73	m
Depth Overall, D	0.82	m
Waterline Length, Lwl	3.1	m
Waterline Beam, Bwl	1.6	m
Navigational Draft, T	0.37	m
Displacement Weight	748.00	kgf
Volume	0.73	m³
LCG	0.91	m
TCG	0.18	m
VCG	0.64	m
Fluid Density	1025.00	kg/m³
LCB	0.92	m
TCB	0.27	m
VCB	0.27	m
Wetted Surface Area	5.60	m²
Waterplane Area, Awp	3.24	m²
LCF	1.07	m
TCF	0.07	m
Weight To Immerse	33.25	kgf/cm
Cb	0.405	
Cvp	0.616	
Cwp	0.657	
Cws	3.706	
I(transverse)	0.624	m^4
I(longitudinal)	1.983	m^4
BMt	0.856	m
BMl	2.718	m
GMt	0.47	m
GMl	2.332	m
Mt	0.726	m
Ml	2.588	m

2.Heel angle requirement

During the test , the heel angle Φ_O shall be not greater than

$$11.5 + \frac{(24 - L_H)^3}{520}$$ 28.31 °

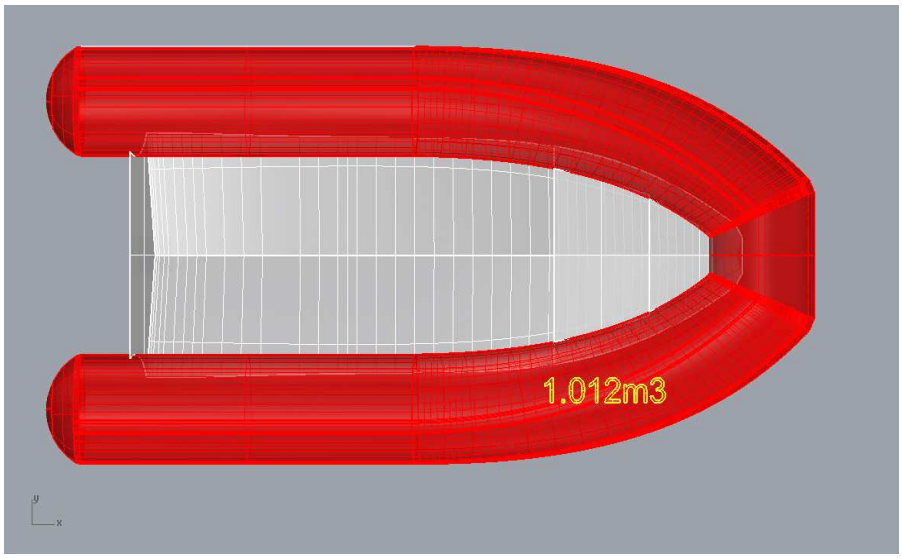


As shown from the graph , the real heel angle Φ_O= 13.87° < 28.31°

Result: **PASS**

CL 340 Buoyancy

Inflatable Buoyancy tube: 1.012 m3 (3.5)
Permanent sealed buoyancy: 0 m3 (3.8)



Inherent buoyancy of the rigid parts of the boat:

0.023 m3
0.035 m3
tot= **0.058** m3

Alluminium mass: 62 Kg
outboard engine ma 104.5 Kg

Table 4 — Material densities

Material	Density kg/m³
Aluminium alloys	2 700

$$v = \frac{m}{\rho}$$

v is the volume of an element, expressed in m³;

m is the mass of that element, expressed in kg;

ρ is the density of that element, expressed in kg/m³, as given in Table 4.

TOTAL BUOYANCY: 1.070 m3

The total buoyant volume in m³ (V) shall be as follows:

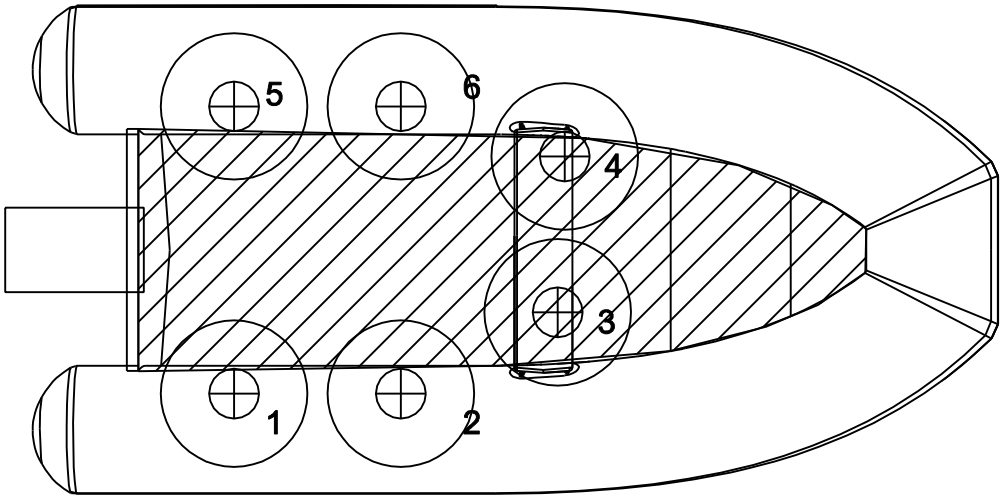
$$V > \frac{k \times m_{LDC}}{1\,000}$$

Where k is:

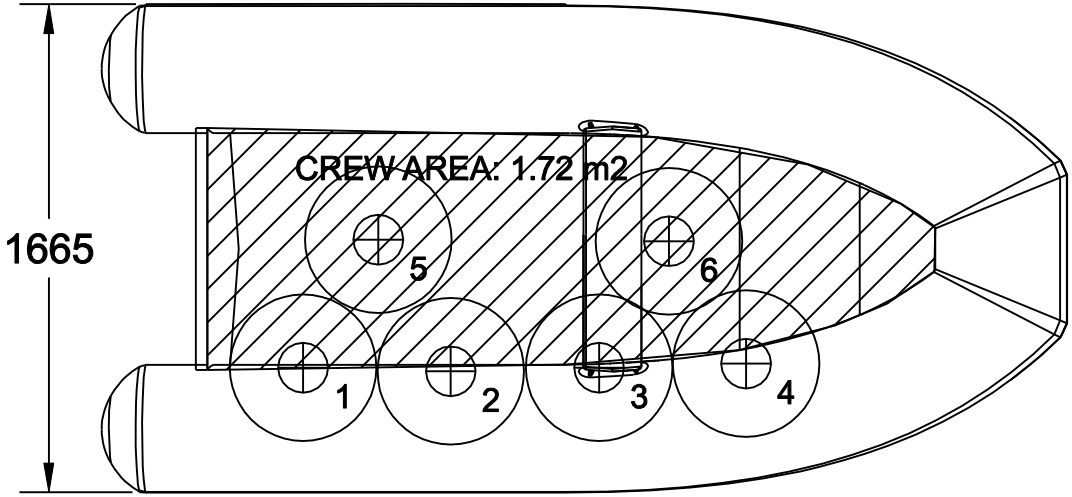
— 1,33 for boats assessed to design category B;

— 1,2 for boats assessed to design category C;

cat C mLDC= 688.4 Kg 1,2xmLDC/1000= 0.826 < 1.070
OK



NAVIGATION SEATS



CREW OFFSET TEST

SPECIFICATION

Crew Area	1.72m2
Max Pax	6

DND DAWN YACHT DESIGN			
	Signature		
Design by	S.C/L		
Checked by			
Technic by			
Approved by		DATE	2017.05.12

Drawing Title	Project Name: CL340
Crew Area	Drawing NO cl34-01-02
	PAPER A4 / SCALE 1:25
	SHEET 1 of 1

CL340 Righting Arm (Minimum operating)-cat. C

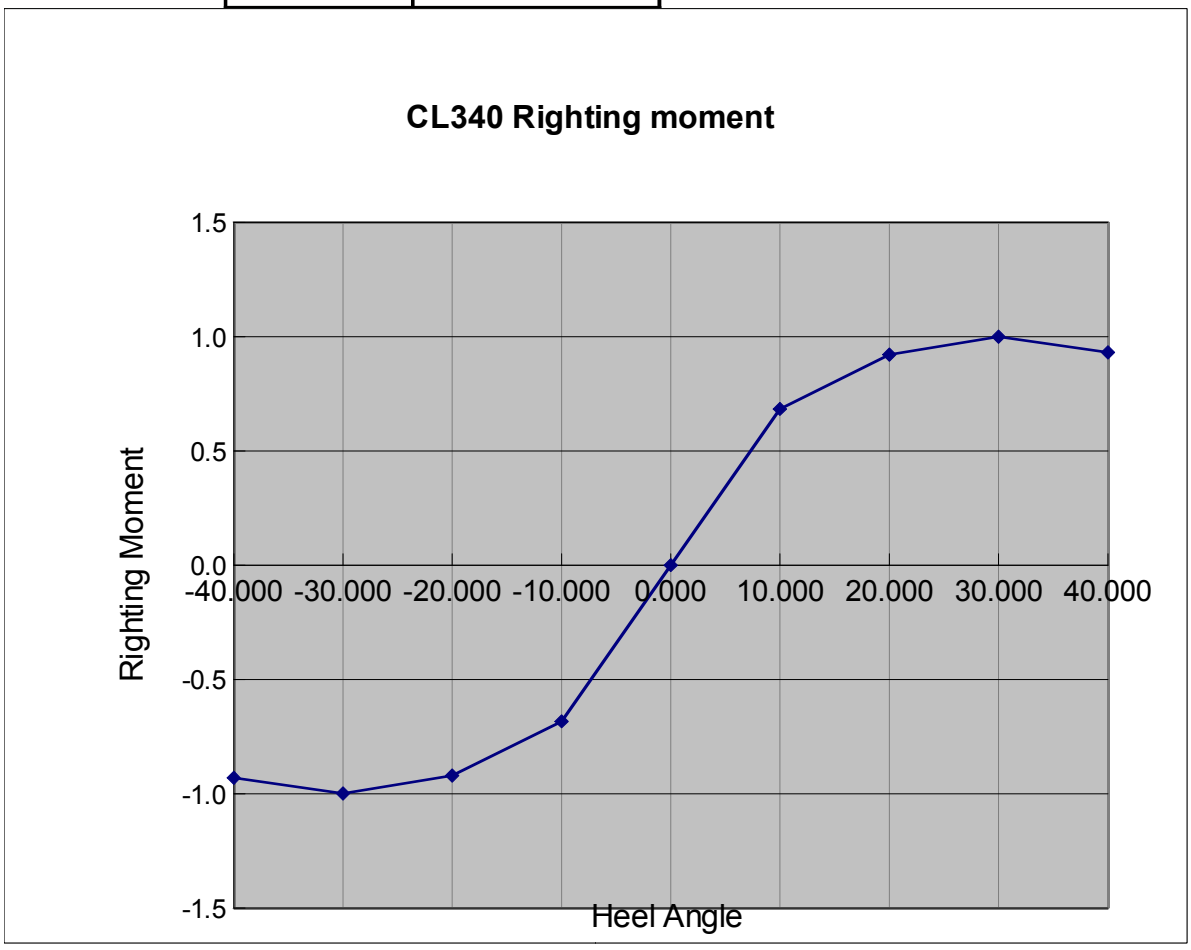
1.General

L_{OA}=	3.4 m
L_H=	3.4 m
Displacement=	291 Kg
Design Category	C
Condition	Miniumum Operating

2.Righting arm

The righting moment curve and Heeling moment curve plot on the same graph , as below:

Heel(deg)	Trim(deg)	Righting Arm (m)	Righting Moment (N*m)	
-40.000	-3.44	-0.33	-0.9	
-30.000	-2.10	-0.35	-1.0	
-20.000	-1.96	-0.32	-0.9	
-10.000	-2.17	-0.24	-0.7	
0.000	-1.57	0.00	0.0	
10.000	-2.17	0.24	0.7	
20.000	-1.96	0.32	0.9	
30.000	-2.10	0.35	1.0	
40.000	-3.44	0.33	0.9	



CL340 Righting Arm (Loaded Arrival)-cat. C

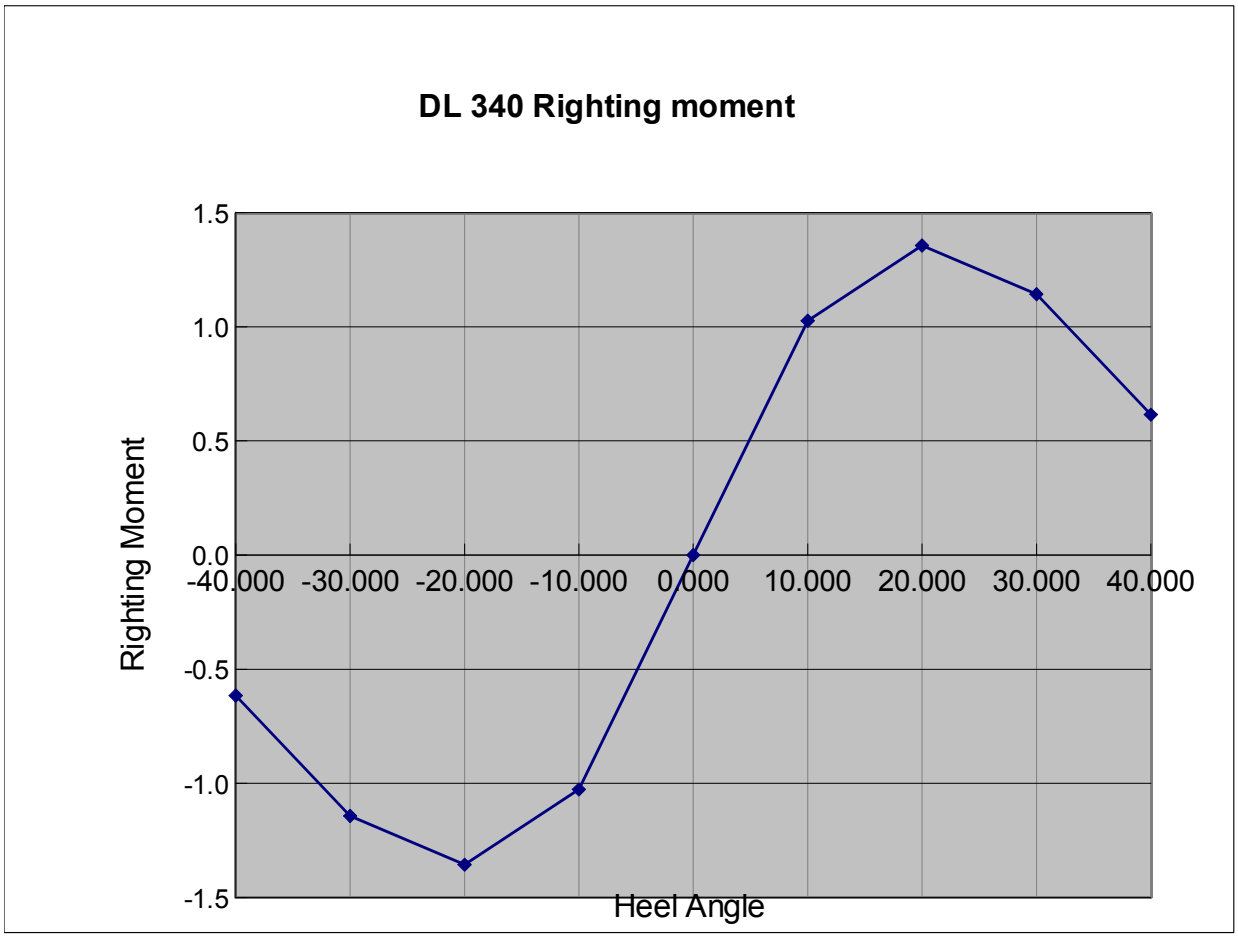
1.General

L_{OA}=	3.4 m
L_H=	3.4 m
Displacement=	677.3 Kg
Design Category	C
Condition	Loaded Arrival

2.Righting arm

The righting moment curve and Heeling moment curve plot on the same graph , as below:

Heel(deg)	Trim(deg)	Righting Arm (m)	Righting Moment (N*m)	
-40.000	-5.79	-0.09	-0.6	
-30.000	-0.98	-0.17	-1.1	
-20.000	0.93	-0.20	-1.4	
-10.000	1.98	-0.15	-1.0	
0.000	2.42	0.00	0.0	
10.000	1.98	0.15	1.0	
20.000	0.93	0.20	1.4	
30.000	-0.98	0.17	1.1	
40.000	-5.79	0.09	0.6	



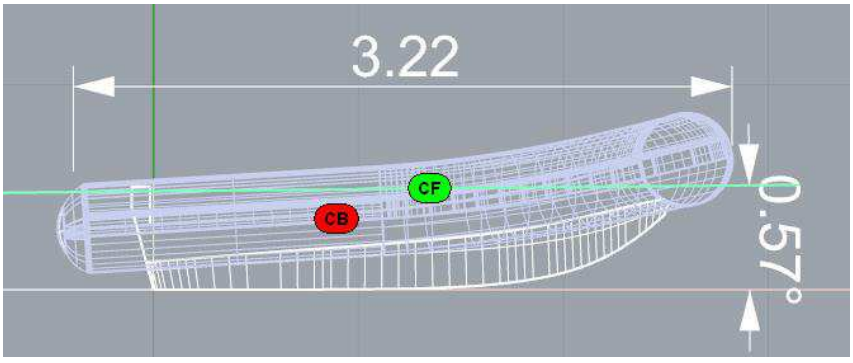
CL340 Swamped stability

1.General

Length Overall, LOA	3.4	m
L_H=	3.4	m
Beam Overall, Boa	1.73	m
Depth Overall, D	0.82	m
Waterline Length, Lwl	3.18	m
Waterline Beam, Bwl	1.62	m
Navigational Draft, T	0.40	m
Displacement Weight	815.0	kgf
Volume	0.67	m³
LCG	0.89	m
TCG	0	m
VCG	0.63	m
Fluid Density	1025.0	kg/m³
LCB	0.89	m
TCB	0	m
VCB	0.345	m
Wetted Surface Area	5.713	m²
Waterplane Area, Awp	2.452	m²
LCF	1.347	m
TCF	0	m
Weight To Immerse	25.15	kgf/cm
Cb	0.327	
Cvp	0.688	
Cwp	0.476	
Cws	3.913	
I(transverse)	0.748	m^4
I(longitudinal)	1.896	m^4
BMt	1.115	m
BMl	2.826	m
GMt	0.83	m
GMl	2.54	m
Mt	0.971	m
Ml	2.682	m
Design Category	C	

2.Trim angle requirement

When the boat in the fully loaded condition is filled to overflowing with water , it shall float with not more than 10°from the unswamped fully loaded waterline

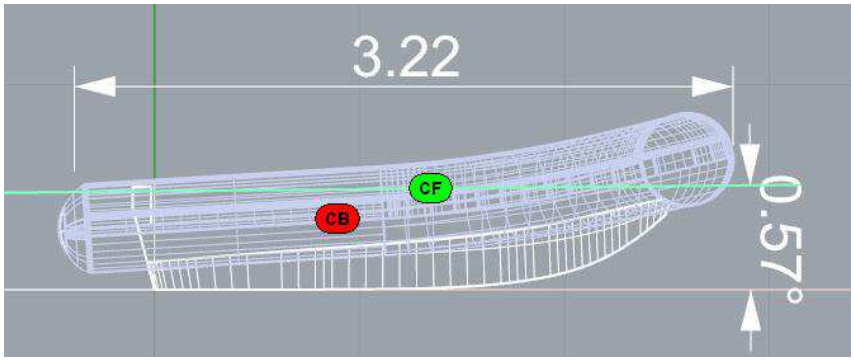


As shown from above , the trim angle Φ= 0.57 °<10°

Result: PASS

3.L_H requirement

When the boat in the fully loaded condition is filled to overflowing with water , it shall be more than 2/3 of L_H above the water



As shown from above , L_H'=		3.22 m		
	L_H'/L_H=	0.95	>2/3 L_H=	0.667
	Result:	PASS		

CL 340 Maximum power for initial testing

The maximum power for initial testing of outboard powered craft is determined based on the following:

— factor λ, calculated as follows:

$$\lambda = L_H \times B_T$$

where

L_H is the length of hull, in metres, as defined in ISO 8666;

B_T is the transom width, in metres, at or below the sheer, as defined in ISO 8666;

For craft with a factor λ greater than 5,1, the value of the maximum power for initial testing, expressed in kilowatts, is taken as the following (see Figure C.3):

— without remote wheel steering, deadrise angle $\alpha < 5$: $4{,}2\lambda - 11$;

— without remote wheel steering, deadrise angle $\alpha \geqslant 5$: $6{,}4\lambda - 19$;

— with remote wheel steering: $16\lambda - 67$.

cl340

Lh 3.4 m
Bt 1.73 m
λ 5.882 **λ>5**
Deadrise >5 deg.
Without steering wheel
18.6448

With steering wheel
27.112 KW 36.33008 HP

$7\sqrt{L_H}$ 12.90736 Kn

Vmax> $7\sqrt{L_H}$

The test has to be performed with the maximum power.