

ONBOARD LOADING

The Onboard Loading program has been developed in conjunction with serving bridge officers from Cunard Line's Queen Elizabeth 2 in order to allow rapid entry of data and calculation of stability. It is the first Onboard Loading program to be approved by the United Kingdom Dept. of Transport's Marine Safety Agency which performs all of its calculations directly from the hull form. It enables the operator to select and edit loaded condition information, and to compute sailing state and stability information in that condition, which may be used as the ship's official record at the time of departure. The program is supplied with data files which define the vessel's geometric shape and loaded conditions, including capacity data for all of the tanks.

The program allows for up to three loaded conditions, where each item of deadweight is described in each condition as its weight, centre of gravity position, and free surface moment. In the loaded conditions the ship's tankage is grouped under their various types, i.e. Ballast, Heavy Fuel Oil etc. as separate data blocks. These tank data include information on their centre of gravity and free surface at all levels, and may be edited individually by entering the content directly from the ship's daily condition sheets. The program then calculates the centre of gravity and free surface of the tank automatically.

After each change to an item of deadweight the program performs a full volumetric integration and updates the draught, trim and initial stability comparing this with the GM required under either Intact or Damage Stability requirements, as set in the Stability Booklet.

© Wolfson Unit Caronia Loading Program Version 131299

No	Item	Weight	LCG	VCG	HCG	FSM
1	Ballast	272.6	47.37	0.94	0.00	0.0
2	Drinking water	290.4	129.18	3.36	-0.70	0.0
3	Fresh water	376.5	138.34	4.63	0.00	0.0
4	Fuel Oil	2123.9	106.06	4.14	-0.12	0.0
5	Diesel Oil	281.2	70.17	1.31	0.48	0.0
6	Lube Oil	131.9	79.40	0.82	0.00	0.0
7	Polluted Water	199.5	101.06	1.56	-0.55	0.0
8	Pools	43.1	151.24	19.50	0.00	0.0
9	Provisions	200.0	51.32	6.50	0.00	0.0
10	Deck and engineering	120.0	91.45	11.86	0.00	0.0
11	Hotel stores	75.0	118.34	8.73	0.00	0.0
12	Crew and effects	69.9	93.82	15.00	0.00	0.0
13	Passengers and baggag	135.0	109.32	11.45	0.00	0.0
14	Permanent Ballast	640.0	83.19	0.95	-0.04	0.0

Condition

Displacement =	20379.0	LCG =	83.901	Effective KG =	9.764
Draught Fwd=	9.235	Trim =	-1.746	GM Solid =	0.628
Aft=	7.489	List =	-2.1	Fluid =	0.628
Mean=	8.362			KG Max. =	10.000

Conditions Menu Help - Alt F1. Calc - Alt F2

1 Edit	2 Mask	3 Set	4	5	6	7	8	9	10 Leave
Data		Cond's							Menu

Once the data are correct, the loaded conditions may be combined with the vessel's lightship displacement condition in order to calculate the final displacement, draught, trim, initial stability, and optionally the GZ curve. The results may be displayed either on the screen or sent to a disc file or printer.

If the overall centre of gravity lies off the centreline, the program makes an estimate of the vessel's list angle from the calculated GM.

Loaded conditions may be developed and stored for future use, including a predicted correction factor, so that the expected draught and trim may be investigated before arrival.

Before starting the program checks that both the Hull and Load files are correct, and will not allow operation if they have become corrupted. The program also checks its calculation routines against predetermined hydrostatic data to ensure that its operation is not affected by any hardware error

The program can make allowance for any discrepancy between the calculated displacement and that observed from the draught marks by creating a lightship correction which is added to the deadweight and lightship values prior to calculation. In this way the program creates a report which can be used as the ship's official record of loading and stability at departure.

Queen Elizabeth 2. Loading condition

Thursday 19th June 2008 at 13:00

Departure

Condition	Weight Tonnes	LCG Metres	VCG Metres	HCG Metres	FSM Tonne.M
Passengers & Cabin Bgs (1275)	196.154	-23.430	20.560	0.000	0.000
Baggage in Rooms	0.000	0.000	0.000	0.000	0.000
Crew & Effects (1108)	170.462	-30.140	14.080	0.000	0.000
Hotel Stores & Provisions	0.000	0.000	0.000	0.000	0.000
Cargo in lock up	70.000	81.890	5.870	0.000	0.000
Cargo in holds	0.000	0.000	0.000	0.000	0.000
Swimming pools	254.140	-37.370	13.231	0.000	481.400
Fresh water	1177.500	-37.375	4.000	0.215	1396.209
Feed Water	68.000	-17.205	1.987	2.352	158.108
Laundry Water	169.000	-107.992	7.212	0.820	618.104
Lubricating Oil	221.500	-24.239	2.767	-3.502	74.239
Diesel Oil	160.528	40.660	3.092	0.089	632.089
Heavy Fuel Oil	1519.530	-6.731	3.850	2.458	1770.033
Sundry Tanks	296.000	-26.806	2.514	-4.233	2474.219
Water Ballast	3828.796	44.156	2.274	-0.249	80.080
Dry Tanks	0.000	0.000	0.000	0.000	0.000
Sundries	0.000	99.137	3.469	-0.400	0.000
Deadweight	8131.609	9.240	4.019	0.162	7684.481
Lightship	38099.900	-14.100	14.670	0.000	0.000
Correction	1029.929	-20.310			
Displacement	47261.438	-10.220	12.797	0.000	7684.481

By Inspection

Draught Fwd 9.000 Metres

Aft 10.000 Metres

Mean 9.500 Metres

Trim 1.000 Metres by the stern

GM Solid 1.704 Metres

Fluid 1.542 Metres

Required 1.391 Metres

Effective VCG 12.959 Metres

Heel Angle Deg	GZ Metres	Area M.Rad	Criterion	Min	Actual
0.0	-0.029	0.000	Area 0 - 30	0.055	0.239
10.0	0.257	0.020	Area 0 - 40	0.090	0.420
20.0	0.610	0.094	Area 30 - 40	0.030	0.181
30.0	1.021	0.239	Max. GZ at 30+	0.20	1.067
40.0	0.958	0.420	Angle of max GZ	>30	34
50.0	0.390	0.543	Fluid GM	0.15	1.542
60.0	-0.425	0.542			
70.0	-1.329	0.389			
80.0	-2.220	0.079			

Signed as an official record

ONBOARD DAMAGE

The Onboard Damage program has been developed in conjunction with serving bridge officers from Cunard Line's Queen Elizabeth 2 in order to allow rapid selection of the damaged zones of the vessel, and to compute stability information. The program is supplied with data files which define the vessel's geometric shape including all of the tanks.

In the Microsoft Windows enhanced operating environment it is possible to run both the Onboard Loading and Damage Stability programs concurrently. In this way alternative ballasting and tankage configurations can be created by the Onboard Loading program and saved to disc, operation switched to the Damage Stability program, and the new configuration tested without leaving either program. This allows rapid analysis of possible remedial action.

The vessel is split into various damage zones, as in the damage control plan. Zones may be set to be damaged or intact. Within each damaged zone individual compartments or tanks may also be set either to be intact or damaged. Where a compartment is damaged which had a fluid content, as determined by the onboard loading results file, that fluid content and its CG position and free surface effect are deducted from the overall displacement before a calculation is performed.

The screenshot shows a window titled 'QDAMAGE' with a menu bar and a toolbar. The main display area shows a table titled 'Compartment 2A compartments Space Toggle. 'ESC' quit'. The table has columns for 'No', 'Name', 'Type', 'State', and 'Content'. The data is as follows:

No	Name	Type	State	Content
3	Deck 7 Comp 2A Buoy Flood space	Floodable	Empty	0.000
4	Dry Tank D	Tank	Intact	0.000
5	No 23 DB	Tank	Intact	125.300
6	No 24 DB	Tank	Intact	126.200
7	No 38 Deep	Tank	Intact	101.100
8	No 39 Deep	Tank	Intact	125.700
9	No 36 deep	Tank	Intact	85.200
10	No 37 Deep	Tank	Damaged	21.400
11	Laundry drain	Tank	Damaged	243.800
12	No 34 Deep	Tank	Intact	243.800
13	No 35 Deep	Tank	Damaged	243.800
14	No 5 FW	Tank	Intact	105.500

The program also allows the effects of accumulated fire fighting water on deck to be assessed. All of the large public spaces in the vessel are modelled, and a mean water level at their maximum beam may be entered. The program calculates its results as follows:-

- 1 The displacement condition is set to that read from the Onboard Loading program.
- 2 The weight, CG position and Free Surface Effect of any tanks in damaged zones which have a fluid content, as set by the Onboard Loading program, is deducted from the displacement.
- 3 The weight and CG of compartments set to hold fire fighting water is calculated.
- 4 Using the geometric properties of the hull form and the compartments and tanks, the program iterates to a draught and trim which balances the displacement condition, by means of longitudinal integration, at each heel angle. Water is allowed to flood the damaged areas of the hull up to the waterline, and all volumetric properties of the damaged portions, with due allowance for their permeability, are deducted from the intact hull characteristics. The true position of volumes of firewater is calculated allowing for the overall heel and trim, and the associated volumetric properties deducted from the total.
- 5 The equilibrium heel angle is found by an iterative method, always using full integrations.
- 6 The angles at which the various shell doors submerge are calculated from the draught, trim, and heel data previously calculated.

Once the extent of the damage has been set, the program will calculate the vessel's residual stability over a range of heel angles, including the angles at which the shell doors become immersed, and the equilibrium draught, trim, and heel angle.

Results may be viewed on the screen, or sent to the printer. In addition a graphical profile of the vessel, showing the extent of the damage and the waterline, and the GZ curve with overlaid wind heeling arm may also be viewed.

Queen Elizabeth 2 Damage Stability Data

Thursday 19th June 2008 at 13:00

Compartment data:

Zone 2A

- No 37 Deep: 85.20 tonnes lost
- Laundry drain: 30.00 tonnes lost
- No 35 Deep

Displacement 47620.12 Tonnes
 Longitudinal Centre of Gravity -9.589 Metres
 Vertical Centre of Gravity 13.002 Metres
 Horizontal Centre of Gravity 0.006 Metres
 Equilibrium Heel Angle 2.0 Degrees
 Equilibrium GM 2.056 Metres
 Longitudinal KM 570.446 Metres
 Equilibrium Draught 9.789 Metres
 Equilibrium Trim 2.358 Metres

Shiplength 269.748 Metres
 Rollcentre 11.500 Metres
 Specific Gravity of Water 1.0250

Longitudinal Reference Midships
 Vertical & Draught Reference Base Line

Heel Angle Degrees	Righting Lever GZ Metres	Waterline KN Metres	Trim Metres	VCB Volume Metres	Added Metre^3
-40.0	0.073	-8.145	10.347	1.475	7.103 2078.174
-30.0	-0.570	-6.963	9.926	1.706	6.714 2235.808
-20.0	-0.789	-5.161	9.726	1.945	6.260 2360.307
-10.0	-0.438	-2.659	9.769	2.239	5.844 2366.854
0.0	-0.072	-0.072	9.790	2.362	5.699 2368.701
10.0	0.296	2.516	9.769	2.239	5.844 2366.857
20.0	0.661	5.034	9.730	1.961	6.262 2390.657
30.0	0.481	6.873	9.953	1.825	6.728 2409.958
40.0	-0.133	8.085	10.402	1.709	7.127 2372.621

Equilib.

Downflooding X	Downflooding Y	Points Z Metres	Freeboard Metres	Angle Degrees	Name
-94.644	14.320	12.180	1.058	6.4	Aft car (5 deck)
-75.344	15.500	12.340	1.345	7.1	Aft cruise (5 deck)
-62.084	15.850	12.340	1.448	7.4	Linen (5 deck)
-7.674	16.000	12.400	1.979	9.2	Pilot (5 deck)
32.556	15.680	12.340	2.282	9.9	Fwd cruise (5 deck)
52.666	13.960	12.300	2.478	11.8	Fwd car (5 deck)
82.946	9.390	12.580	3.184	21.0	Fwd stores (5 deck)
-94.644	15.200	14.820	3.665	15.8	Aft car (4 deck)
52.666	15.000	14.870	5.010	20.7	Fwd car (4 deck)
76.036	11.900	15.110	5.564	26.8	Baggage (4 deck)
-88.954	15.800	20.100	8.970	31.4	Aft pass. (2 deck)
14.267	16.000	19.910	9.676	32.6	Main pass. (2 deck)
25.696	16.000	19.910	9.776	32.8	Baggage (2 deck)
62.726	14.800	19.890	10.122	35.4	Fwd pass. (2 deck)
77.766	13.700	20.260	10.662	38.5	Fwd baggage (2 deck)