MV MARELLA

STABILITY ADDENDUM REPORT

TR-80M CRANE OPERATION ON DECK
VESSEL IN PARTIALLY SMOOTH WATERS

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1.0 SUMMARY

This report is intended to be read in conjunction with the original approved stability book for the vessel dated December 1983. It presents additional loading conditions for carriage of an operating crane in partially smooth waters.

Lightship particulars for the vessel are based on those derived from a displacement check experiment performed on the 8th of April 2009 and assuming a conservatively over-estimated vertical centre of gravity equivalent to main deck level.

All notes and warnings presented in the original stability book shall be adhered to.

The loading conditions presented in this report are compliant with the Uniform Shipping Laws Code.

Any deviations from the loading conditions as presented in this report will be required to be assessed separately.

2.0 NOTES TO THE MASTER

The master of the vessel is reminded that although the vessel exceeds the USL stability requirements, this does not mean that the vessel cannot capsize. Care must be taken to ensure that the vessel is properly handled in the weather and conditions prevailing at the time.

It is the responsibility of the master to ensure that all deck cargo is properly secured and crane operation is within recommended guidelines. This report does not assess safety of operation of crane, only vessel response to maximum crane operation.

The master shall endeavour to keep the vessel at level trim and heel commensurate with operations.

3.0 STABILITY COMPLIANCE CRITERIA

USL Code section 8C.3.3

Barges and lighters and similar vessels operating within partially smooth waters shall have a minimum GM allowing for any free surface corrections which is greater than the following:

(a) $GM = \frac{0.036 \times A \times h}{\Delta \times \tan\theta} + 0.15$

where A = *projected lateral area above the waterline (m^2)*
h = *vertical distance from centre of area above the waterline and centre of lateral resistance below the waterline (m)*
Δ = *displacement (t)*
θ = *angle of heel to one half of the freeboard being immersed or five (5) degrees whichever is less*

(b) $GM = \frac{0.0053 \times V^2 \times d}{L \times \sin\theta} + 0.15$

where V = *service speed (knots)*
L = *waterline length (m)*
d = *vertical distance between VCG and the centre of underwater lateral area (m)*
θ = *as above*

applicable for $V/L^{1/2} < 4$ *only*

(c) If a derrick, deck crane or cranes are fitted onboard, the vessel must have sufficient GM to ensure that it does not heel any more than an angle equivalent to one half the freeboard, in the condition being considered, or five (5) degrees whichever is the less, when the cranes have their working loads extended their maximum outreach over the side.

(d) GM = 1 metre

Note that for small angles of heel (less than five degrees) the initial righting lever GM is equivalent to the righting lever curve GZ for the vessel. This report shows and assesses the vessel's response to the crane heeling influence with the initial righting lever GM.

4.0 LOADING CONDITIONS

4.1 DEPARTURE CONDITION

Loading Table

ITEMS	Weight (t)	L.C.G (m)	L.Mom (t-m)	V.C.G (m)	V.Mom (t-m)	F.S.M. (t-m)
Aft F.W.Tk	8.80	-11.93	-104.97	2.47	21.74	51.60
F.O.Tk No.1 & 2	7.30	6.48	47.30	0.73	5.33	4.08
F.O.Tk No.3 & 4	9.80	0.80	7.84	0.70	6.86	7.58
Crew (6 persons)	0.45	0.00	0.00	4.25	1.91	0.00
Dive compressor	1.15	-6.00	-6.90	3.75	4.31	0.00
Steel structural cargo	3.00	-4.50	-13.50	23.3	69.9	0.00
TR-80M crane	11.65	-0.56	-6.52	4.65	54.15	0.00
Lightship	**120.03**	**0.46**	**55.21**	**3.25**	**390.10**	**0.00**
TOTAL	**162.18**	**-0.13**	**-21.53**	**3.42**	**554.3**	**63.26**
Free Surface Correction				**0.39**		
KGf				**3.64**		

Hydrostatics (from original stability book)

Δ	=	162.2	t
KMt	=	9.97	m
MTC	=	2.85	m
LCB	=	-0.27	m
Draft	=	2.13	m

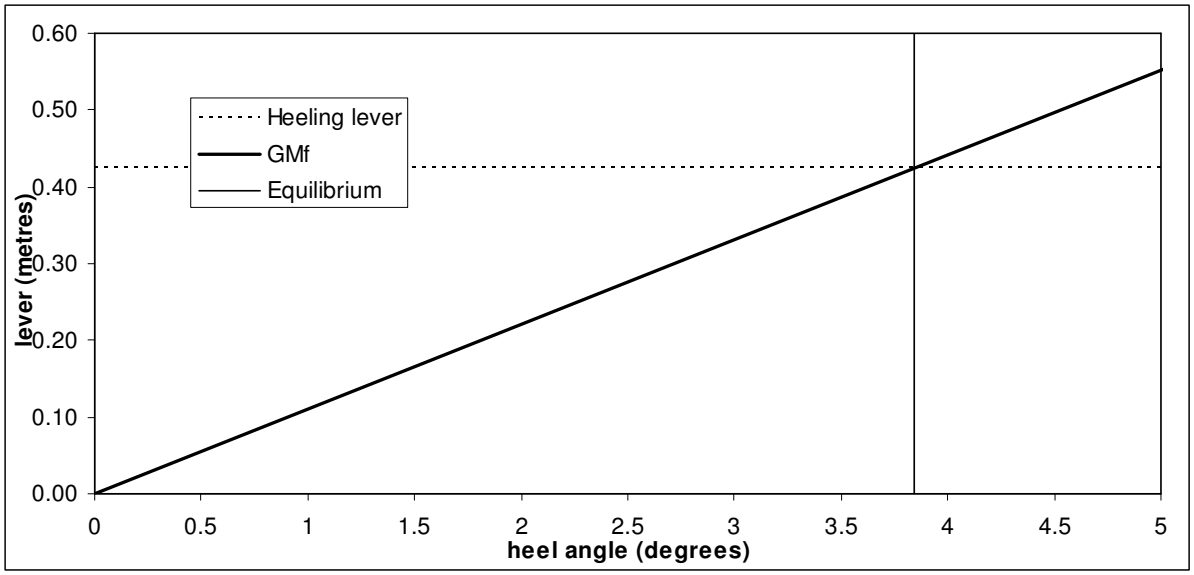
Level trim check

LCB	=	-0.27	m	
LCG	=	-0.13	m	
Lever	=	-0.14	m	
Δ	=	162.2	t	
Trim moment	=	-22.9	t-m	
MTC	=	2.85	t-m	
Trim change	=	-0.08	m	(negligible – original hydrostatics applicable)

GMf Calculation

GMf	=	KM - KGf
	=	6.16 m

Levers Plot



Stability Criteria Compliance

(a) $GM_{required} = \frac{0.036 \times A \times h}{\Delta \times \tan\theta} + 0.15$

$A = 94.1\ m^2$

$h = 3.143\ m$

$\Delta = 162.2\ t$

$\theta = 5\ deg$

$GM_{required} = 0.94\ m$

(b) $GM_{required} = \frac{0.0053 \times V^2 \times d}{L \times \sin\theta} + 0.15$

$V/L^{1/2} = 4$

$V^2/L = 16$

$d = 2.56\ m$

$GM_{required} = 2.64\ m$

(c) *If a derrick, deck crane or cranes are fitted onboard, the vessel must have sufficient GM to ensure that it does not heel any more than an angle equivalent to one half the freeboard, in the condition being considered, or five (5) degrees whichever is the less, when the cranes have their working loads extended their maximum outreach over the side.*

Freeboard	=	*1.12 m*
Heel due to crane	=	*3.95 deg*
Loss of freeboard	=	*34 %*

(d) $GM_{required}$ = *1.00 m*

ACTUAL GMf = 6.16 m

Additional check – loss of freeboard due to trim

Check to see loss of freeboard with crane operating at and over transom:

Trimming moment	=	68.8	t-m
MTC	=	2.85	t-m
Trim change	=	0.24	m
Freeboard	=	1.12	m
Loss of freeboard	=	22 %	(less than half)

Vessel passes all criteria with comfortable margin for this loading condition

4.2 ARRIVAL CONDITION

Loading Table

ITEMS	Weight (t)	L.C.G (m)	L.Mom (t-m)	V.C.G (m)	V.Mom (t-m)	F.S.M. (t-m)
Aft F.W.Tk	0.88	-11.928	-10.50	1.727	1.52	51.6
F.O.Tk No.1 & 2	0.73	6.26	4.57	0.16	0.12	4.08
F.O.Tk No.3 & 4	0.98	0.8	0.78	0.25	0.25	7.58
Crew (6 persons)	0.45	0.00	0.00	4.25	1.91	0.00
Dive compressor	1.15	-6.00	-6.90	3.75	4.31	0.00
Steel structural cargo	3.00	-4.50	-13.50	23.3	69.9	0.00
TR-80M crane	11.65	-0.56	-6.52	4.65	54.15	0.00
Lightship	**120.03**	**0.46**	**55.21**	**3.25**	**390.10**	**0.00**
TOTAL	**138.87**	**0.17**	**23.15**	**3.76**	**522.25**	**63.26**
Free Surface Correction				**0.46**		
KGf				**4.22**		

Hydrostatics (from original stability book)

Δ	=	138.9	t
KMt	=	11.18	m
MTC	=	2.70	m
LCB	=	-0.12	m
Draft	=	1.98	m

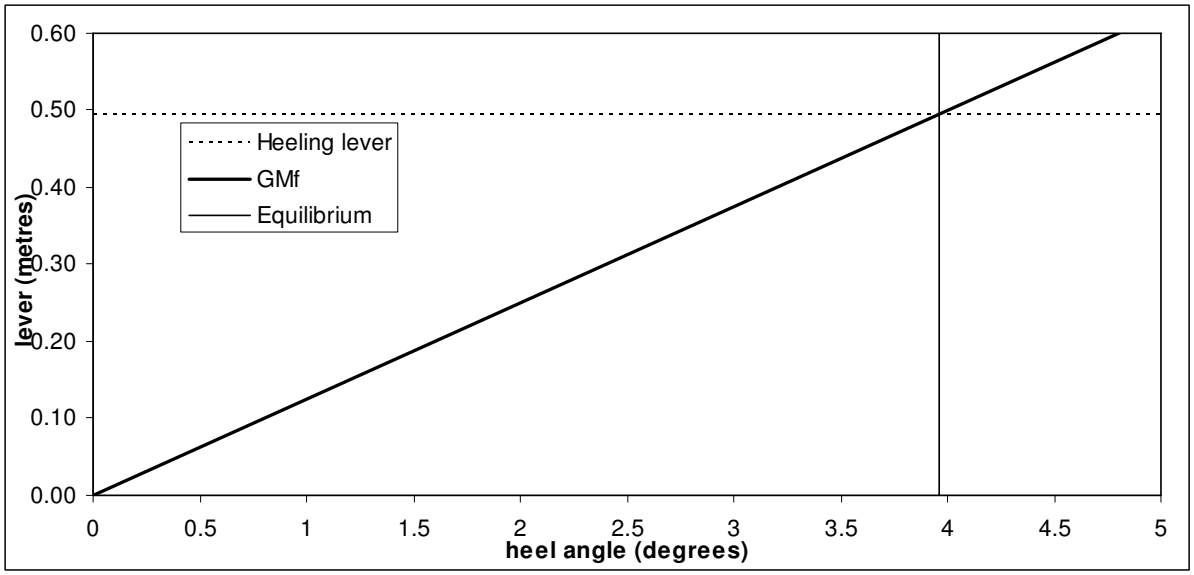
Level trim check

LCB	=	-0.12	m	
LCG	=	0.167	m	
Lever	=	-0.285	m	
Δ	=	138.9	t	
Trim moment	=	-39.6	t-m	
MTC	=	2.71	t-m	
Trim change	=	-0.15	m	(acceptable < Lh/50 = 0.5m)

GMf Calculation

GMf	=	KM - KGf	
	=	6.97	m

Levers Plot



Stability Criteria Compliance

(a) $GM_{required} = \frac{0.036 \times A \times h}{\Delta \times \tan\theta} + 0.15$

$A = 103.0\ m^2$

$h = 3.14\ m$

$\Delta = 138.9\ t$

$\theta = 5\ deg$

$GM_{required} = 1.11\ m$

(b) $GM_{required} = \frac{0.0053 \times V^2 \times d}{L \times \sin\theta} + 0.15$

$V/L^{1/2} = 4$

$V^2/L = 16$

$d = 3.03\ m$

$GM_{required} = 3.10\ m$

(c) *If a derrick, deck crane or cranes are fitted onboard, the vessel must have sufficient GM to ensure that it does not heel any more than an angle equivalent to one half the freeboard, in the condition being considered, or five (5) degrees whichever is the less, when the cranes have their working loads extended their maximum outreach over the side.*

Freeboard	=	*1.27 m*
Heel due to crane	=	*4.07 deg*
Loss of freeboard	=	*35 %*

(d) $GM_{required}$ = *1.00 m*

ACTUAL GMf = 6.97 m

Additional check – loss of freeboard due to trim

Check to see loss of freeboard with crane operating at and over transom:

Trimming moment	=	68.8	t-m
MTC	=	2.71	t-m
Trim change	=	0.25	m
Freeboard	=	1.27	m
Loss of freeboard	=	20 %	(less than half)

Vessel passes all criteria with comfortable margin for this loading condition

5.0 WINDAGE

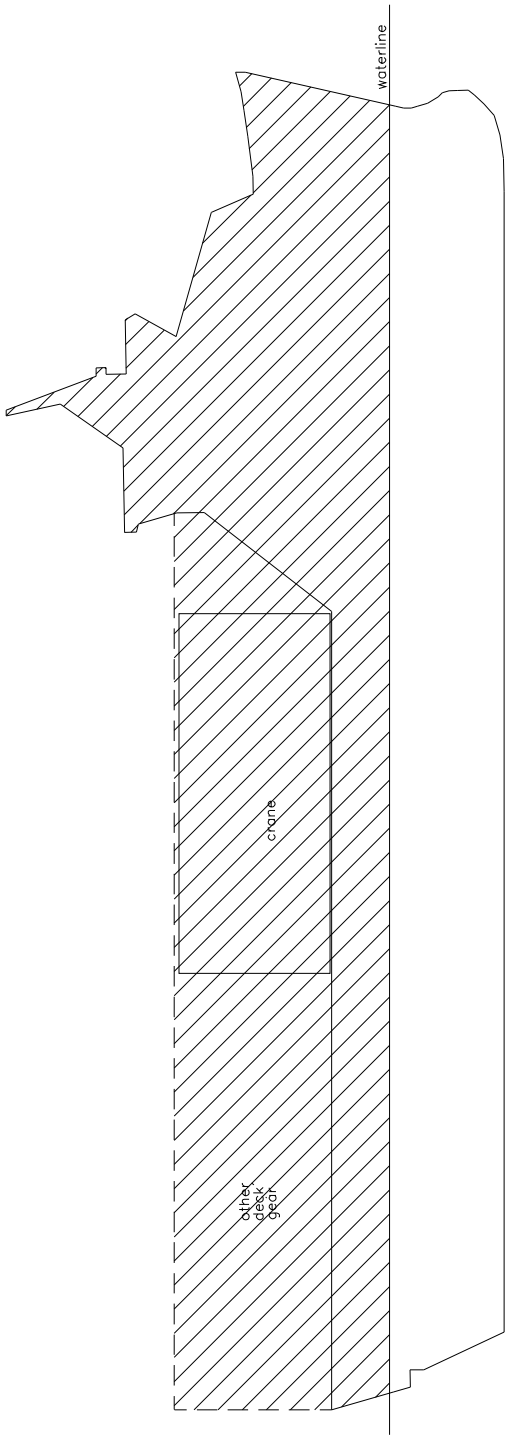


Figure 1 – Windage reference diagram

6.0 CRANE DETAILS

TR-80M-1-00103
TR-80M-1-00105

TR-80ML, TR-80M

CRANE SPECIFICATIONS

CRANE CAPACITY

4.9m Boom	8,000kg	at 2.5m (	7part-line)	-- TR-80ML
	4,900kg	at 3.5m (	4part-line)	-- TR-80M
9.0m Boom	5,000kg	at 3.5m (	4part-line)	-- TR-80ML
	4,900kg	at 3.5m (	4part-line)	-- TR-80M
13.1m Boom	4,500kg	at 4.0m (	4part-line)	
17.2m Boom	4,000kg	at 3.5m (	4part-line)	
21.3m Boom	2,000kg	at 6.0m (	4part-line)	
Single top	1,400kg	(	1part-line)	

MAX. LIFTING HEIGHT
Boom 21.5m
Single top 22.0m

MAX. WORKING RADIUS
Boom 19.8m
Single top 20.3m

BOOM LENGTH
4.9m - 21.3m

BOOM EXTENSION
16.4m

BOOM EXTENSION SPEED
16.4m / 70s

MAIN WINCH SINGLE LINE SPEED
High range: 106m/min (5th layer)

MAIN WINCH HOOK SPEED
High range: 26.5m/min (4 part-line)

AUXILIARY WINCH SINGLE LINE SPEED
High range: 93m/min (3rd layer)

AUXILIARY WINCH HOOK SPEED
High range: 93m/min (1 part-line)

BOOM ELEVATION ANGLE
-2° – 80°

BOOM ELEVATION SPEED
-2° – 80° / 27s

SWING ANGLE
360° continue

SWING SPEED
2.1rpm

WIRE ROPE
Main Winch
10mm × 118m(Diameter × Length)
7×7+6×Fi(29)
Spin-resistant wire rope
Auxiliary Winch
10mm × 50m (Diameter × Length)
7×7+6×WS(36)
Spin-resistant wire rope

BOOM
5-section hydraulically telescoping boom of box construction.
(stage 2: sequential; stages 3,4,5: synchronized)

BOOM EXTENSION
2 double-acting hydraulic cylinder
1 wire rope type telescoping device

SINGLE TOP
Single sheave. Mounted to main boom head for single line work.

HOIST
Driven by hydraulic motor driven and and via bevel gear reducer.
With free-fall device.
Automatic brake (with foot brake for free-fall device)
2 single winches
With flow regulator valve with pressure compensation

BOOM ELEVATION
1 double-acting hydraulic cylinders

SWING
Hydraulic motor driven planetary gear reducer
Swing bearing
Hydraulically released brake

OUTRIGGERS
Fully hydraulic X-type (floats mounted integrally)
Slides and jacks each provided with independent operation device.

Full extended width	4.4m
Middle extended width	3.4m
Minimum extended width	2.1m

OPERATION METHOD
Hydraulic pilot valve operation

MAX. OUTRIGGER LOAD
8.9t ····· TR-80ML
8.2t ····· TR-80M

HYDRAULIC PUMPS
Gear pumps

HYDRAULIC OIL TANK CAPACITY
172 liters

SAFETY DEVICES
Automatic moment limiter (AML)
Multi-display indication
Over-winding cutout
Working area control device
Outrigger extension width detector
Level gauge
Hook safety latch
Hydraulic safety valve
Telescopic counterbalance valve
Elevation counterbalance valve
Jack pilot check valve

EQUIPMENTS
Crane cab heater (with defroster)
Crane cab cooler
Hydraulic oil temperature indication lamp
Oil cooler
Operation pedals for telescoping
Radio
Multi-display
Television (option)

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Figure 2 – TR-80M Crane Specifications

7.0 MOMENT CALCULATIONS

7.1 HEELING MOMENT

From crane operation (refer to figure 2):

Maximum load	4.0 t
At lever	17.2 m
Operational heeling moment	68.8 t-m
Total heeling moment	68.8 t-m

This is the heeling moment that is used to derive the heeling levers in the loading conditions presented.

NOTE: THIS SATBILITY ADDENDUM IS BASED ON THE CRANE BEING FIXED ON THE VESSEL CENTRELINE BEHIND THE WHEEL HOUSE AND NOT BEING MOVED.

7.2 TRIMMING MOMENT

From crane operation (refer to figure 2):

Maximum load	4.0 t
At lever	17.2 m
Operational heeling moment	68.8 t-m
Total trimming moment	68.8 t-m

This is the trimming moment that is used to determine loss of freeboard due to trimming in the loading conditions presented.

8.0 OCEANIC YACHT DESIGN PTY LTD BACKGROUND

Oceanic Yacht Design (OYD) was established in 2001 to provide a specialised design, survey and consultancy service to the greater marine community. Our focus is to provide clientele with professional and reliable service that delivers superior results.

OYD's qualified and experienced team has extensive knowledge in all areas of the design and survey of aluminium, steel and composite vessel ranging up to 60 meters in length. Our portfolio covers a diverse range of vessels of both recreational and commercial design and includes monohull and low wash catamarans of both power and sail capabilities.

OYD is a sister company to Sea Transport Solutions (STS) which was formed in 1976 as an independent company to provide marine design and consultancy services to the Australian maritime industry. To date, over 33 countries have built STS designs, or have used STS consulting services.

For more information refer to our website www.oceanicdesign.com.au

9.0 CONFIDENTIALITY

10.0 REFERENCES

1. Uniform Shipping Laws Code

2. M.V. "MARELLA" – TRIM & STABILTY BOOKLET (DECEMBER 1983)

3. TRIM AND STABILTY BOOKLET ADDENDUM
   Oceanic Yacht Design (April 2009)