



UNFAVOURABLE COMBINATIONS OF ROLLING PERIOD, VESSEL SPEED, HEADING AND WAVE CONDITIONS, CAN TRIGGER SUDDEN AND EXTREMELY RAPID INCREASES IN ROLL MOTIONS, WHICH MIGHT LEAD TO EXCESS LOADING ON CONTAINER SECURING DEVICES AND IN THE WORST CASES, CONTAINER STACK COLLAPSES AND CONTAINER LOSSES.

IMO MSC.1 / Circ.1228 provides guidance to the Master for avoiding dangerous situations in adverse weather and sea conditions, which may cause capsizing of the vessel or heavy rolling with a risk of damage. The worst situations are identified as:

- **SURF-RIDING AND BROACHING-TO**
- **SUCCESSIVE HIGH-WAVE ATTACK**
- **SYNCHRONOUS AND PARAMETRIC ROLL MOTIONS**

HOW TO IDENTIFY SYNCHRONOUS AND PARAMETRIC ROLL MOTIONS

- **Synchronous rolling** occurs in beam seas, when the roll period of the vessel matches the wave period. The vessel heels over with ever larger successive roll angles.
- **Parametric rolling** occurs due to changes in vessel stability as the vessel moves in waves. It is most common in heavy head seas but can occur also in following seas. It is a sudden phenomenon with large and rapidly increasing roll angles experienced over a short period of time.

KEY TRIGGERING CONDITIONS TO WATCH FOR

- **Vessel rolling period** (time it takes for the vessel to roll from port, to starboard, then back to port) approximately equal to the wave encounter period, or twice the wave encounter period.
- **A low metacentric height (GM)** leading to long rolling period.
- Near following sea conditions or head seas.

The wave encounter period can be measured with a stopwatch as the time between two wave crests. It is close to the vessel pitching period (time it takes for the vessel to pitch bow down, stern down and back to bow down).

STEPS OF PARAMETRIC ROLLING



Vessel rolls to one side whilst on the wave crest, stability decreases and large roll motions are experienced.



As Vessel uprights on the trough of the wave, stability increases leading to a strong push, worsened by a high GM / stiff vessel.



Vessel is on top of the wave crest again, and rolls even further ...

WHAT TO DO WHEN IT HAPPENS

To reduce the risk of large roll motions, IMO guidance recommends changing the vessel heading or adjusting the speed, whilst avoiding abrupt steering. The guidance in the following pages shows, for a range of generic containership vessel sizes and typical loading conditions, the expected safe zone where dangerous situations are less likely to occur.

Masters should use this guidance with particular observation of the specific features of their vessel and its behaviour in heavy weather. All deck officers should familiarise themselves with the applicable chart for their size of vessel and the loading condition at the beginning of a voyage, so they are familiar with actions to be taken to reduce the rolling, as parametric rolling in particular, can develop quickly necessitating prompt remedial actions.

If you have any questions, or would like further advice on reducing container losses, then contact Waves Group at: mail@waves-group.co.uk



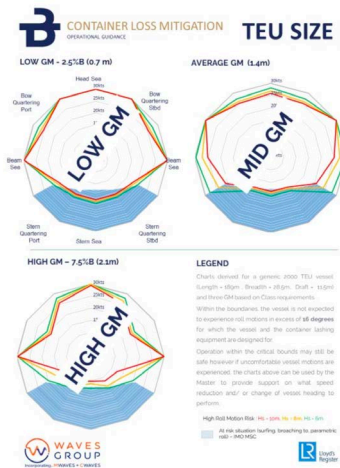
OPERATIONAL GUIDANCE FOR REDUCING CONTAINER LOSSES

For a typical containership vessel hull shape, and sizes ranging from 2000 TEU to 23500 TEU, this guidance gives an indication of significant wave height, vessel speed and heading combinations, for which there is a risk of experiencing high roll angles that may overload the vessel's cargo securing devices, leading to the collapse and / or loss of containers.

HOW TO USE THIS GUIDANCE

- 1 Select the page or two pages with the most relevant containership vessel sizes.
- 2 Find the two metacentric heights (GM) closest to the vessel operating conditions (Upper / Lower). For each containership size, three GM values are covered in the guidance (Low GM / Average GM and High GM), based on the range of GM values recommended by Classification Society Guidelines for the design of securing elements on containerships.

Depending on the Classification Society, the range can vary slightly. It is expressed as a % of the vessel Breadth in the following guidance.



HOW TO READ THE CHARTS

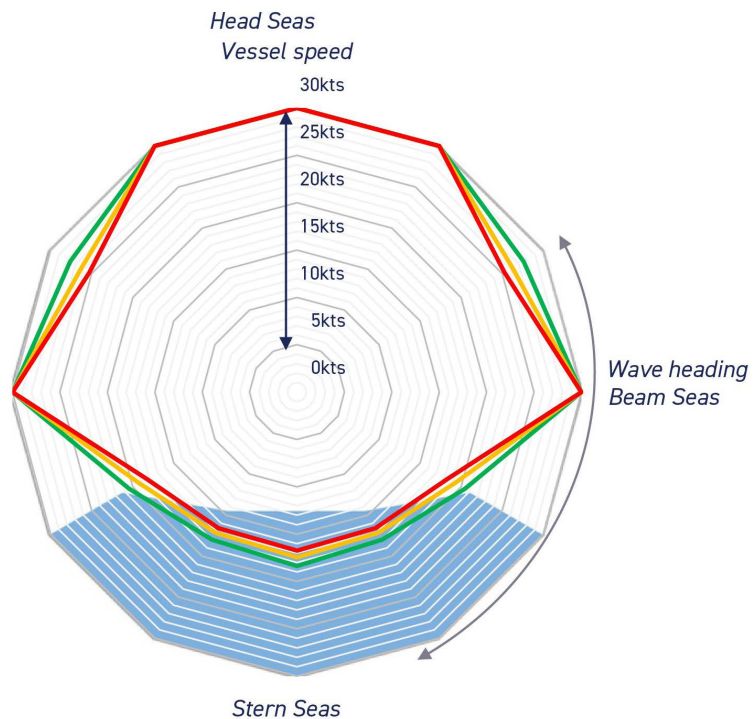
The charts show the vessel speed and headings at which roll motions in excess of 16 degrees (for vessels of 2,000TEU to 14,000TEU capacity), and 12 degrees (for vessels of 23,500TEU capacity) are expected for a range of significant wave height conditions (Hs=6m, Hs=8m, Hs=10m).

The 'at risk' areas are defined as per IMO Circular MSC.1 / Circ.1228 and are highlighted for the vessel category (vessel lengths and breadths are provided).

Operating within the at risk zone may still be safe, however, if uncomfortable motions are experienced, the charts can be used to identify what change of vessel speed and heading can be taken to bring the vessel to safer operating conditions (within the high roll motion risk curves, and away from the IMO Circular at risk zones).

This guidance is general only – it is not specific to any vessel or sea conditions. At all times, the prevailing sea conditions and the specific characteristics of the vessel for which you are responsible must be taken into account when assessing the correct action in any given situation.

High roll motion risks for a given Hs, wave heading and vessel speed.



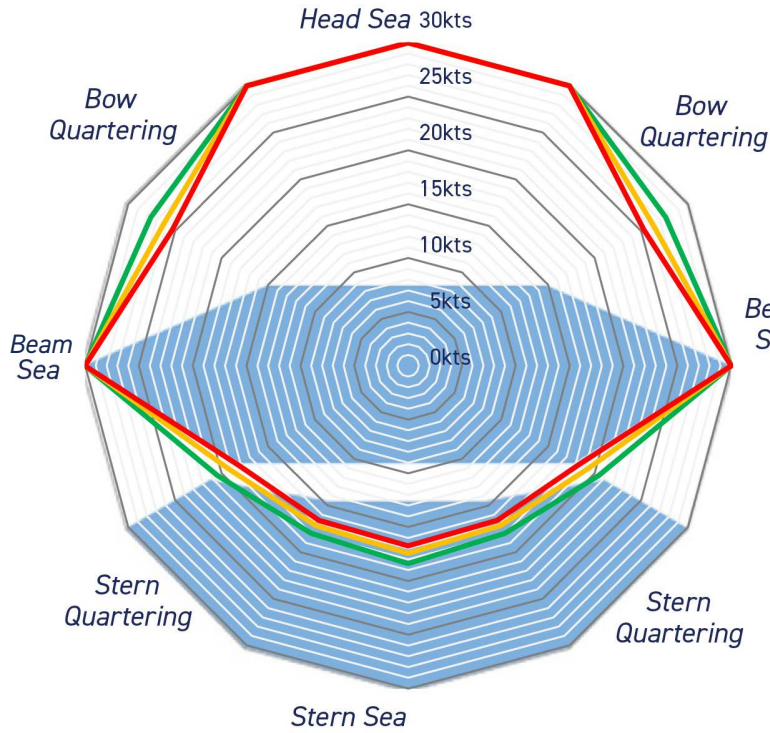


CONTAINER LOSS MITIGATION

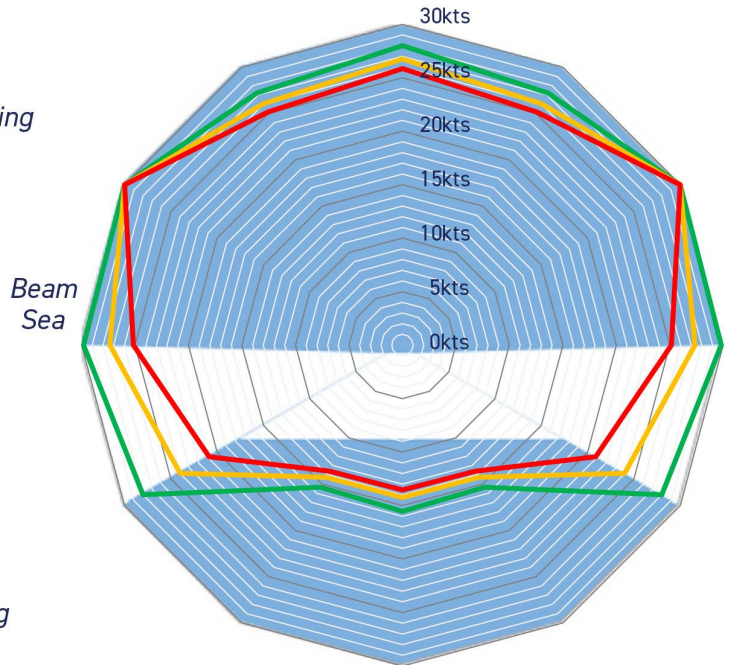
OPERATIONAL GUIDANCE

2,000 TEU

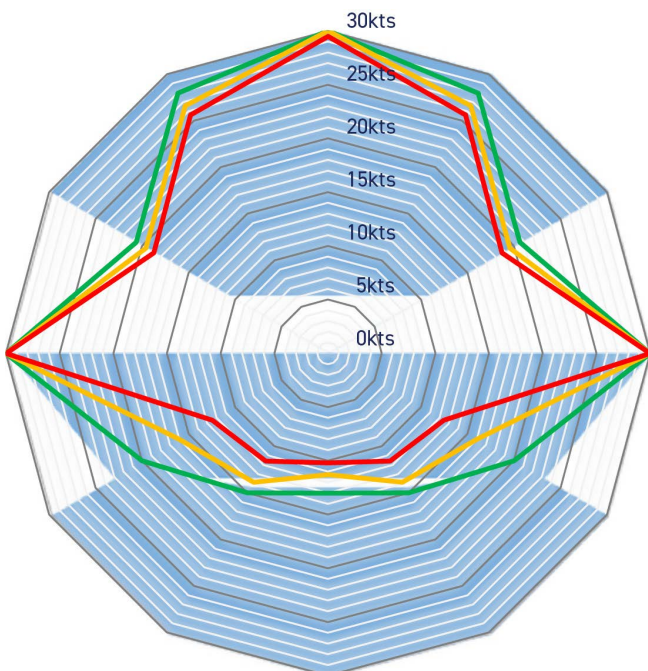
LOW GM - 2.5%B (0.7m)



AVERAGE GM - 5.0%B (1.4m)



HIGH GM - 7.5%B (2.1m)



LEGEND

Charts derived for a generic 2,000 TEU vessel (Length = 189m, Breadth = 28.5m, Draft = 11.5m) and three GM values based on Classification Society recommendations.

Within the boundaries of the high roll motion risk curves, the risk that a vessel will experience roll motions in excess of **16 degrees should be limited**.

Operation within the high roll motion risk curves (red, orange and green lines) may still be safe. However, whenever parametric or synchronous rolling is suspected, the charts can be used to provide support on what speed reduction and/or change of vessel heading are likely to bring the vessel to a safer operating zone.

High Roll Motion Risks

- Hs = 10m
- Hs = 8m
- Hs = 6m
- At risk situation (surfing, broaching parametric roll)

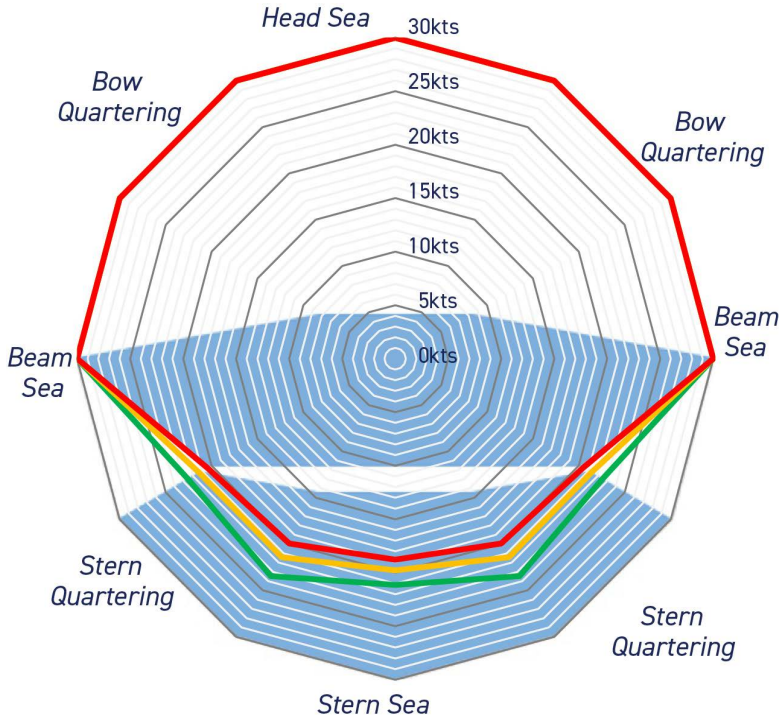


CONTAINER LOSS MITIGATION

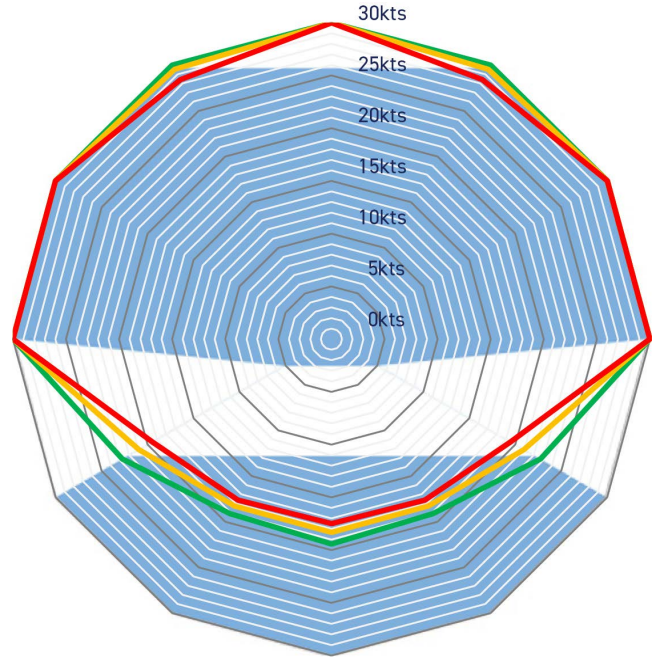
OPERATIONAL GUIDANCE

5,000 TEU

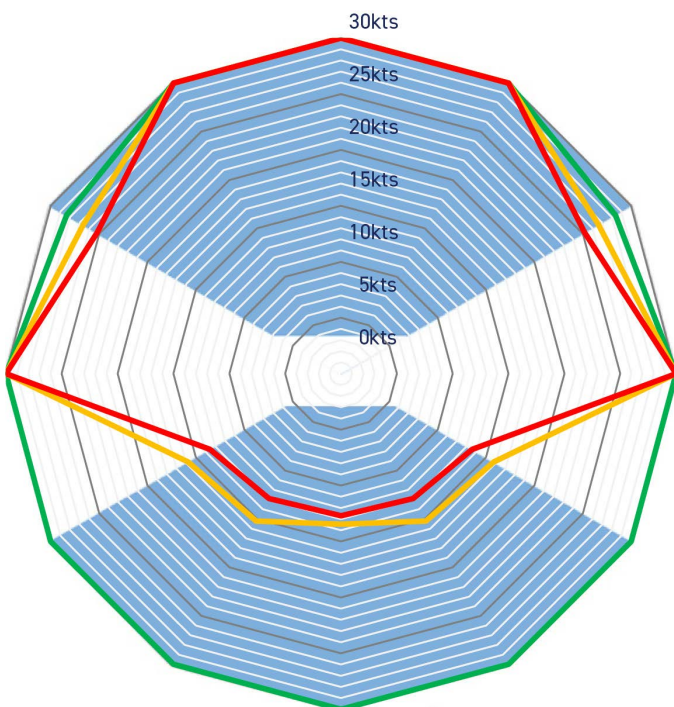
LOW GM - 2.5%B (0.8m)



AVERAGE GM - 5.0%B (1.6m)



HIGH GM - 7.5%B (2.4m)



LEGEND

Charts derived for a generic 5,000 TEU vessel (Length = 294m, Breadth = 32.2m, Draft = 12m) and three GM values based on Classification Society recommendations.

Within the boundaries of the high roll motion risk curves, the risk that a vessel will experience roll motions in excess of **16 degrees should be limited**.

Operation within the high roll motion risk curves (red, orange and green lines) may still be safe. However, whenever parametric or synchronous rolling is suspected, the charts can be used to provide support on what speed reduction and/or change of vessel heading are likely to bring the vessel to a safer operating zone.

High Roll Motion Risks

- Hs = 10m
- Hs = 8m
- Hs = 6m
- At risk situation (surfing, broaching parametric roll)

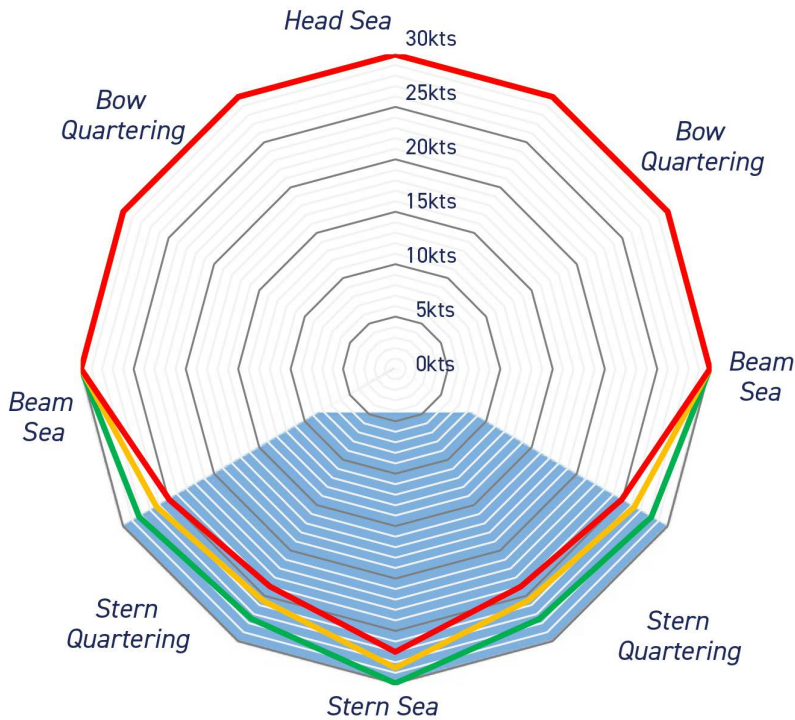


CONTAINER LOSS MITIGATION

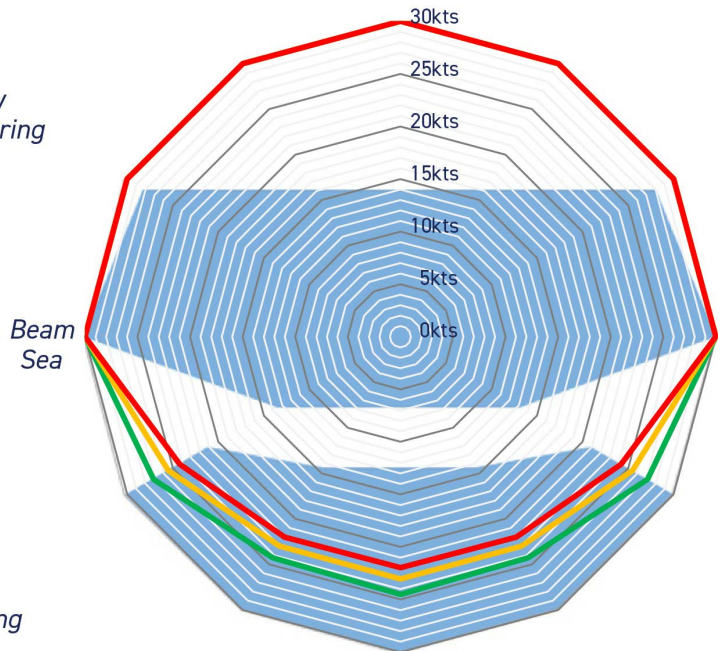
OPERATIONAL GUIDANCE

10,000 TEU

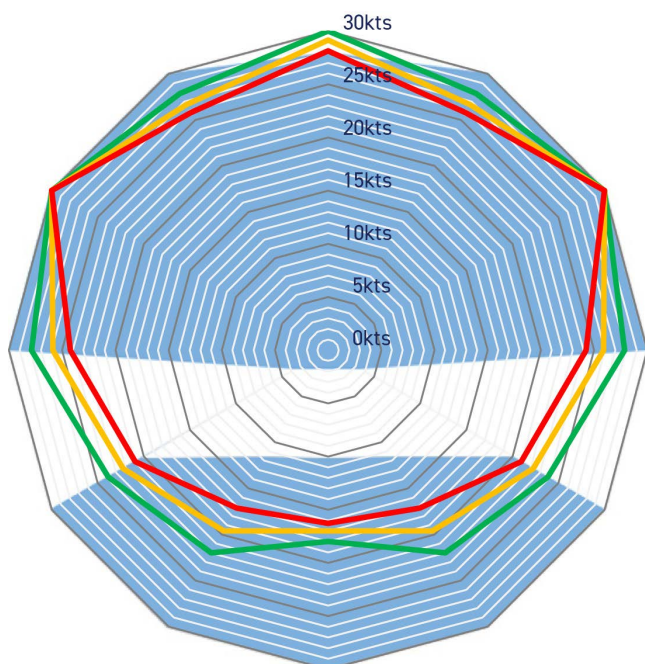
LOW GM - 2.5%B (1.1m)



AVERAGE GM - 5.0%B (2.3m)



HIGH GM - 7.5%B (3.4m)



LEGEND

Charts derived for a generic 10,000 TEU vessel (Length = 349m, Breadth = 45.6m, Draft = 15m) and three GM values based on Classification Society recommendations.

Within the boundaries of the high roll motion risk curves, the risk that a vessel will experience roll motions in excess of **16 degrees should be limited**.

Operation within the high roll motion risk curves (red, orange and green lines) may still be safe. However, whenever parametric or synchronous rolling is suspected, the charts can be used to provide support on what speed reduction and/or change of vessel heading are likely to bring the vessel to a safer operating zone.

High Roll Motion Risks

- Hs = 10m
- Hs = 8m
- Hs = 6m
- At risk situation (surfing, broaching parametric roll)

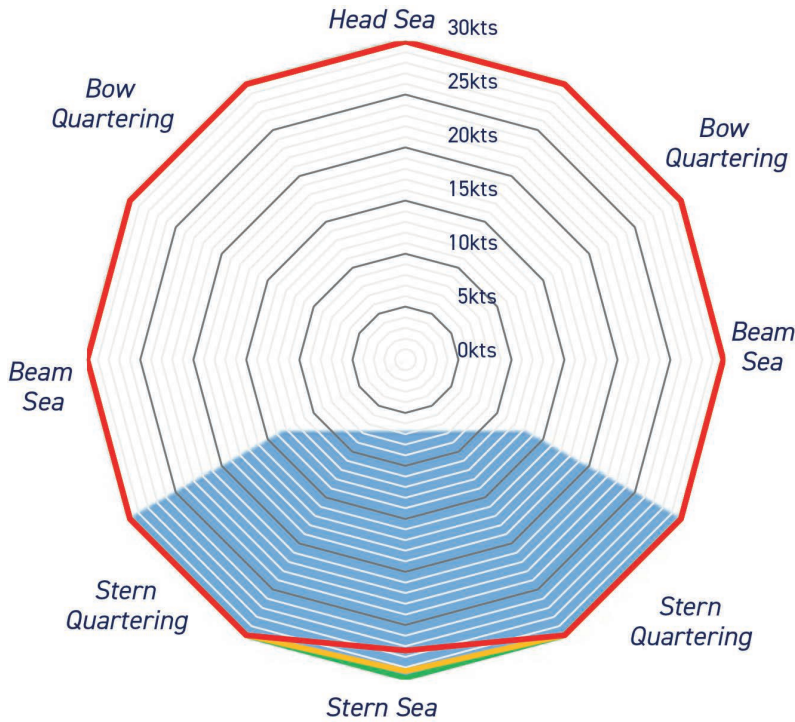


CONTAINER LOSS MITIGATION

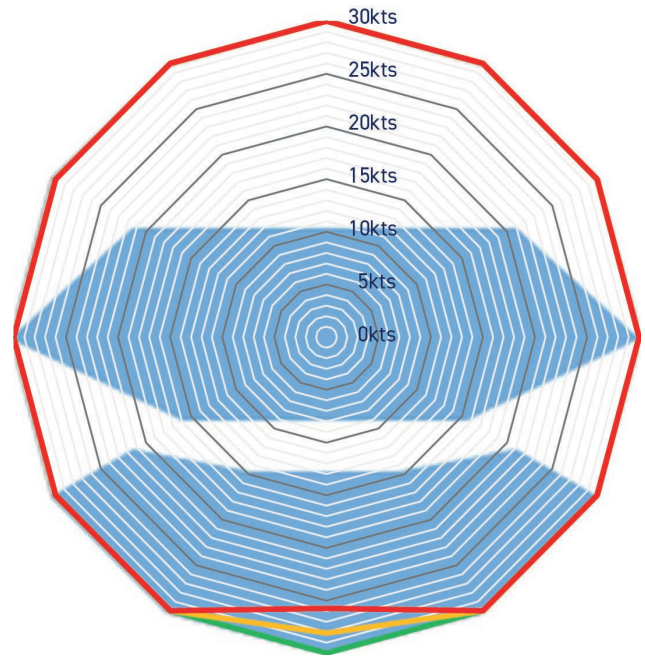
OPERATIONAL GUIDANCE

14,000 TEU

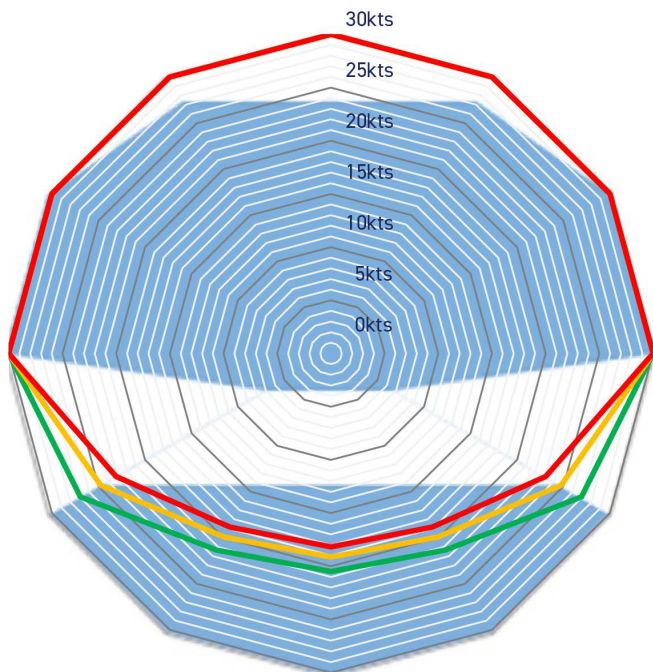
LOW GM - 2.5%B (1.3m)



AVERAGE GM - 5.0%B (2.6m)



HIGH GM - 7.5%B (3.8m)



LEGEND

Charts derived for a generic 14,000 TEU vessel (Length = 366m, Breadth = 51m, Draft = 16m) and three GM values based on Classification Society recommendations.

Within the boundaries of the high roll motion risk curves, the risk that a vessel will experience roll motions in excess of **16 degrees should be limited**.

Operation within the high roll motion risk curves (red, orange and green lines) may still be safe. However, whenever parametric or synchronous rolling is suspected, the charts can be used to provide support on what speed reduction and/or change of vessel heading are likely to bring the vessel to a safer operating zone.

High Roll Motion Risks

- Hs = 10m
- Hs = 8m
- Hs = 6m
- At risk situation (surfing, broaching parametric roll)

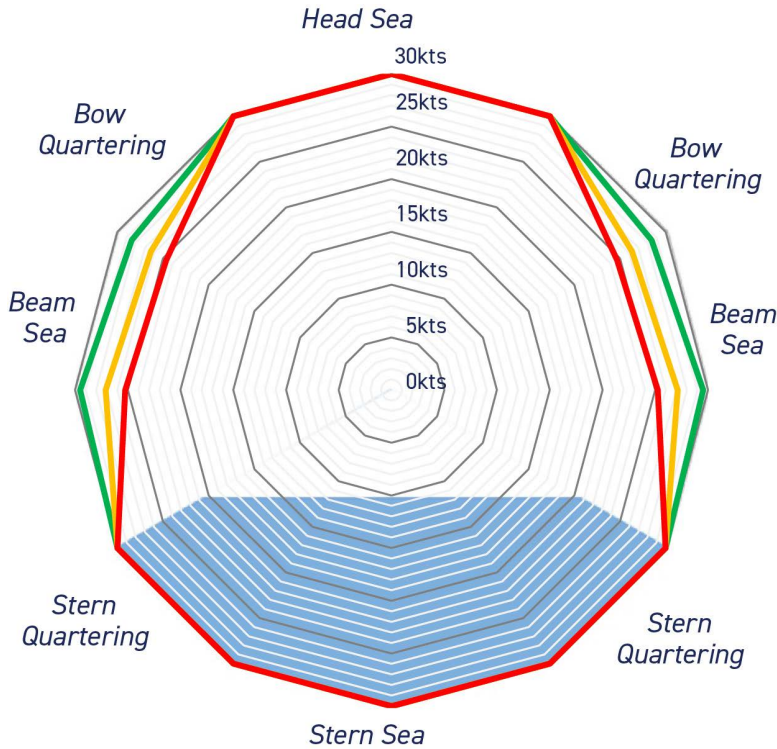


CONTAINER LOSS MITIGATION

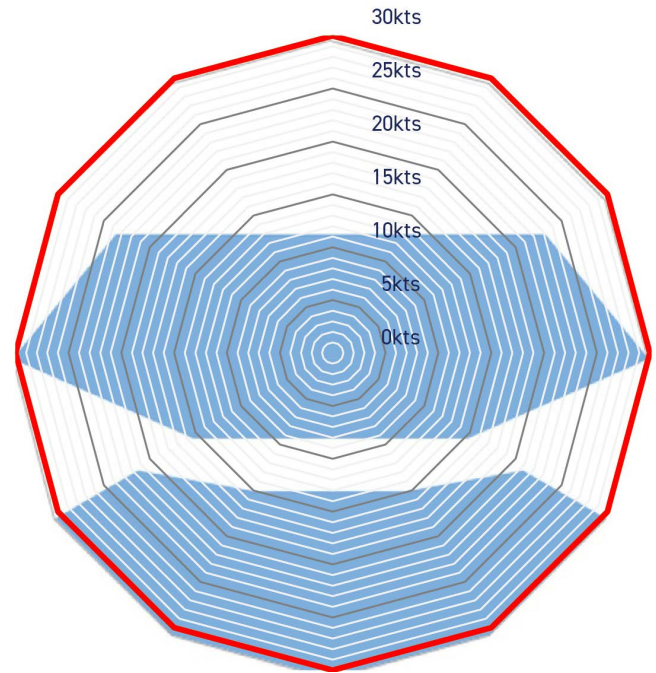
OPERATIONAL GUIDANCE

23,500 TEU

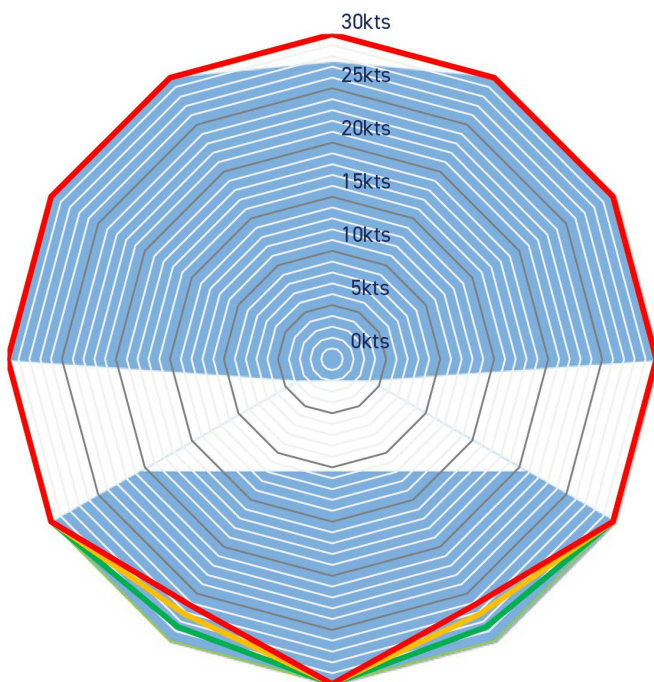
LOW GM - 2.5%B (1.5m)



AVERAGE GM - 6.3%B (3.8m)



HIGH GM - 10%B (6.2m)



LEGEND

Charts derived for a generic 23,500 TEU vessel (Length = 400m, Breadth = 61.5m, Draft = 16.5m) and three GM values based on Classification Society recommendations.

Within the boundaries of the high roll motion risk curves, the risk that a vessel will experience roll motions in excess of **12 degrees should be limited**.

Operation within the high roll motion risk curves (red, orange and green lines) may still be safe. However, whenever parametric or synchronous rolling is suspected, the charts can be used to provide support on what speed reduction and/or change of vessel heading are likely to bring the vessel to a safer operating zone.

High Roll Motion Risks

- Hs = 10m
- Hs = 8m
- Hs = 6m
- At risk situation (surfing, broaching parametric roll)

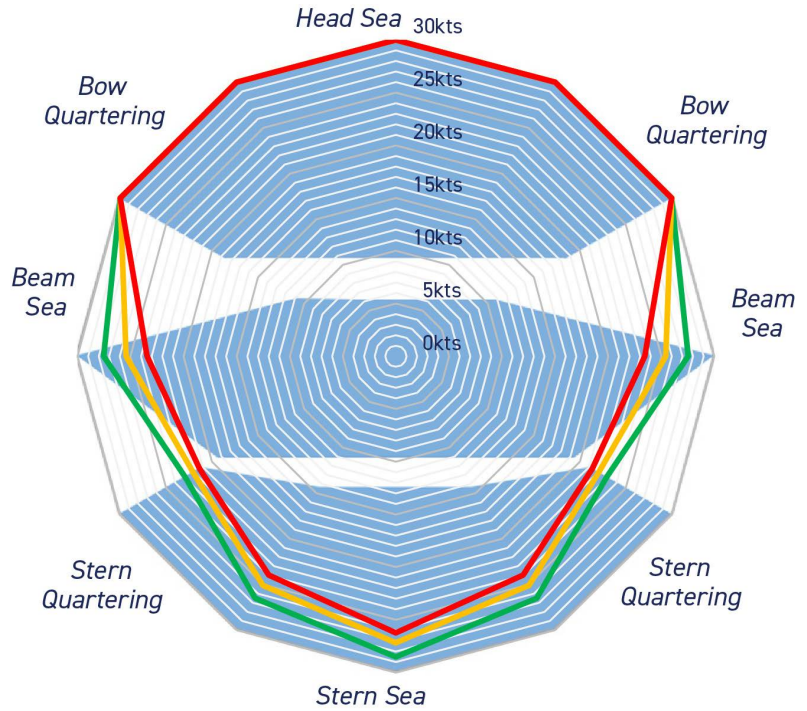


ADDITIONAL SCENARIOS

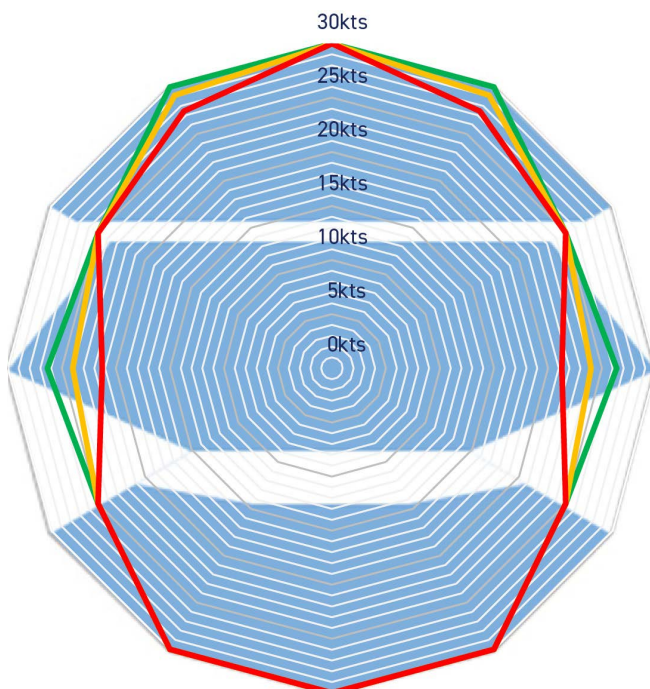
Experience from various container stack collapse incidents shows that vessels have sailed with larger GM values. All efforts should be made to keep the GM value within the range recommended by the Classification Society to ensure safe passage of the containership and its cargo.

Good seamanship should prevail and reduction of container stack weights or number of tiers should be considered to limit the loading on the container securing elements if the vessel sails with large GM values.

HIGH GM - 20%B (12.3 m)



HIGH GM - 25%B (15.4 m)



LEGEND

Additional charts are derived for a generic 23500 TEU vessel (Length = 400m , Breadth = 61.5m, Draft = 16.5m) and two GM values outside the Classification Society recommended ranges. Within the boundaries of the high roll motion risk curves, the risk that a vessel will experience roll motions in excess of **12 degrees should be limited**.

Operation within the high roll motion risk curves (red, orange and green lines) may still be safe. However, whenever parametric or synchronous rolling is suspected, the charts can be used to provide support on what speed reduction and/or change of vessel heading are likely to bring the vessel to a safer operating zone.

High Roll Motion Risks

- Hs = 10m
- Hs = 8m
- Hs = 6m
- At risk situation (surfing, broaching parametric roll)