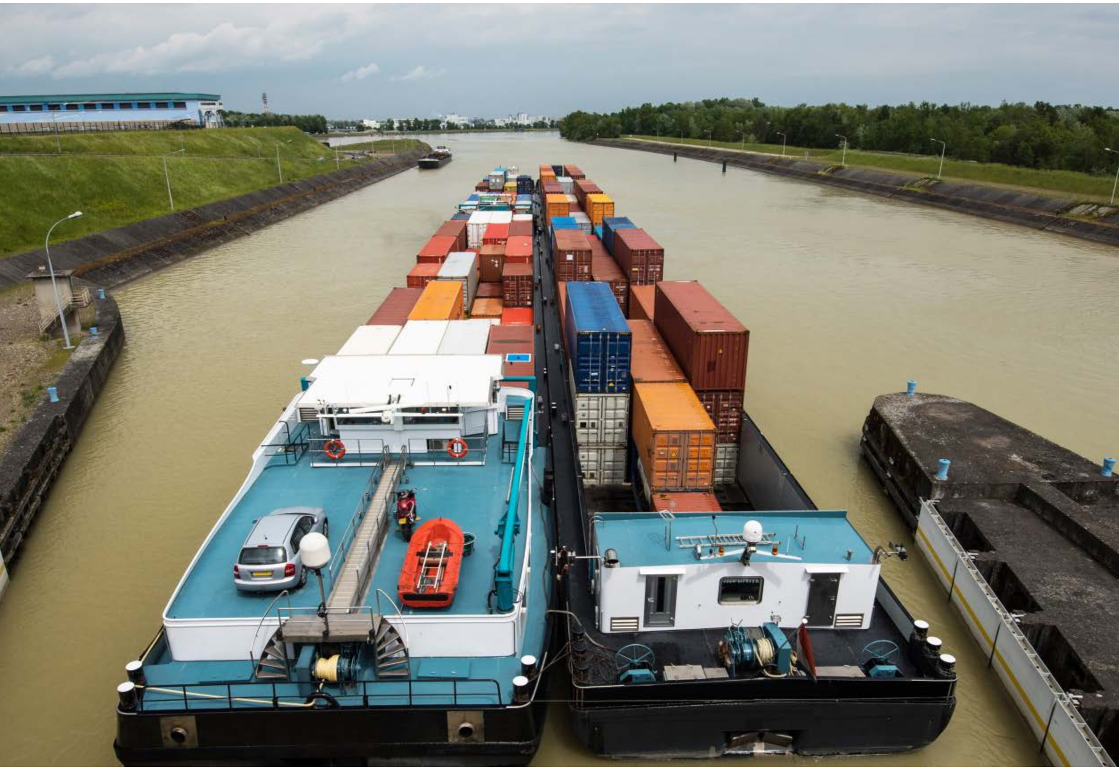
STABILITY GUIDE FOR CONTAINER TRANSPORT IN INLAND NAVIGATION



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1. INTRODUCTION

Container transport by inland waterway vessel is a particularly safe form of transport. Every year, millions of containers are transported safely and sustainably between the seaports on the one hand and hinterland terminals along the Rhine and other inland waterways on the other hand.

Nevertheless, there have been a number of accidents in recent years from which lessons can be learned. For example, in the spring of 2007 the Excelsior lost 31 containers, resulting in the Rhine being completely closed to navigation for more than a week. Also in the spring of 2007, 30 containers were lost overboard by the Arc-en-Ciel on the Seine, bringing navigation to a halt for a week. The Ferox capsized in Rotterdam in 2006.

The examples mentioned go to show that notwithstanding the fact that container transport is very safe, accidents do occur, which are attributable to stability defects. Stability defects can have a number of causes: incorrect stowage, incorrect information, for example about container weights, but insufficient knowledge of stability-related parameters may also play a role.

Stability is indeed part and parcel of inland waterway boatmen's general training but it bears pointing out that ensuring that all inland navigation crews' level of knowledge is kept up to the mark at all times is an important task.

With this in mind, the industry (ESO, EBU), Aquapol and CCNR have decided to publish this guide to good practice. This guide illustrates in an easy-to-remember way the basic principles of stability and tried and tested real-life examples with a positive impact on stability.

The target groups for this guide therefore also include the inland container navigation boatmaster and crew members who are responsible for the stability and safety of their vessel as they go about their day-to-day duties. At the same time, the guide is also helpful for employees in all sectors closely associated with inland navigation, e.g. for employees in the relevant authorities or terminal staff.

This guide is not binding and is therefore no substitute for the relevant regulatory provisions. For further information please refer to the list of sources and websites mentioned at the end of the guide.

2. GENERAL INFORMATION ABOUT STABILITY AND STOWING

2.1 STATUTORY PROVISIONS ON STABILITY AND STOWING

2.1.1 Police Regulations for the Navigation of the Rhine

The Police Regulations for the Navigation of the Rhine (RPR) are the legal basis for this stability guide for container transport in inland navigation. Under article 1.02, the boatmaster is responsible for complying with the RPR's provisions. That does not mean that the boatmaster bears sole responsibility, but the boatmaster is always the first to be held to account when stability problems arise.

Article 1.07 of the RPR contains the most important requirements for the areas for which the boatmaster is responsible. The first general provision is that the "stability of vessels carrying containers [...] must be ensured at all times" and that a vessel may not get under way if its stability is compromised by the cargo. That is why the boatmaster is required to prove that he has conducted a stability test. This test needs to be conducted at three points in time: prior to loading, before commencing unloading and before embarking on the voyage.

The requirements concerning unobstructed visibility may also affect loading. The unobstructed visibility requirements are also to be found in article 1.07 of the RPR, which stipulates that "the cargo or vessel's trim must not limit unobstructed visibility more than 350 m ahead of the bow". The area of obstructed visibility can be increased to 500 m if appropriate auxiliary means are used.

On waterways other than the Rhine, the appropriate regulations are to be complied with.

2.1.2 Reporting obligation

Under article 12.01 of the RPR, all vessels transporting one or more containers on the Rhine are subject to the reporting requirement. Reports must be submitted electronically and in accordance with the standard for electronic reporting in inland navigation.

The following information must be reported:

- Number of containers on board by size, type and state of loading (loaded or unloaded) and the relevant stowage plan location of the ADN containers,
- The container number of the containers with dangerous goods.

2.1.3 Proving stability

The RPR's requirements also clarify how the boatmaster is to prove stability. For example, the requirements stipulate how he is to conduct the stability test, namely manually or by using a stowage program with an inbuilt stability calculation (known as a "loading instrument"). A manual calculation however presupposes the boatmaster possesses sufficient knowledge of calculation methods, the vessel's stability documents and the containers' weights. Nowadays it is common practice for the boatmaster to have a loading instrument on board, namely a computer, running a stowage (software) program that calculates stability. The outcome of the stability test and stowage plan are to be kept on board, together with the vessel's stability-related documents, and the boatmaster must be able to produce them at any time.

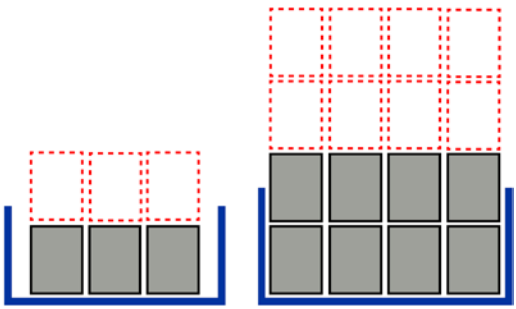
2.1.4 Exceptions to the stability test

A vessel does not require a stability test if the containers are loaded such that:

- there are no more than three abreast in one layer or
- no more than four abreast in two layers from the bottom of the cargo hold

2.1.5 Required stability test

A stability test is mandatory if one or more containers is situated in one of the positions indicated by the red dotted line in the diagram below.



2.1.6 Particular rules for ADN containers

If a vessel is carrying ADN containers there must always be a stowage plan on board. This includes the aforementioned exceptions. The boatmaster is also required to comply with the loading prohibitions in ADN article 7.1.4.5. These stipulate that the IMDG code's requirements governing stowage and separation are to be complied with. This includes compliance with particular distances between two ADN containers. Typically, the boatmaster uses a stowage program with a module that takes account of the restrictions applicable to ADN containers.

At the same time, useful “ADN applications” have now been developed indicating exactly which combinations of containers containing dangerous goods are prohibited. However, the boatmaster must also take account of the distance to be maintained between ADN containers and refrigerated and freezer containers (reefers) that need to be connected to the onboard power supply network.

2.1.7 Rhine Vessel Inspection Regulations

Chapter 22 of the Rhine Vessel Inspection Regulations (RVIR) stipulates exactly what needs to be in the stability documentation as it relates to container vessels) article 22.01). These documents are referred to hereafter in this guide as the “stability manual”. The general remarks section of this chapter expressly states that these documents must provide the boatmaster with clear information on the vessel’s stability in the relevant loading scenario.

The boatmaster must be sufficiently well trained to understand the available stability information on the vessel on which he is employed. The RVIR prescribes that the stability manual must also contain worked examples or user instructions to which the boatmaster can refer.

It goes without saying that the stowage program used by the boatmaster is based on the contents of the statutory stability documents. This means that the stowage program is configured for the characteristics of the specific vessel on which it is used. Consequently, according to the RVIR, the boatmaster is permitted to use electronic devices for the required stability test if they give the same result.

The most important thing with the statutory stability provisions is that in the event of the stability calculation returning a negative result, the boatmaster must take the required measures to ensure stability. What that means in practice is that he may be compelled to reposition or even reject containers. We will explore this topic in more depth in this practical guide.

2.2 GENERAL KNOWLEDGE ON STABILITY RELATED ISSUES

There is a large body of theoretical and scientific knowledge on the notion of stability. This section provides a brief general description of stability aspects as they relate to inland navigation container vessels. More information is to be found in the bibliography (see 7).

2.2.1 Forces influencing stability

A vessel may only move if stability is guaranteed; the vessel's stability must not be impaired by the way in which it is loaded and unloaded.

The term "stability" refers to the ability of an object (vessel) to return to its initial state of mechanical equilibrium – having been brought out of that state by an outside force – once the influence of this force has ended. Examples of such influencing factors in the navigational context include:

- Rudder hard over;
- Sudden evasive manoeuvres;
- Wind, especially from the beam;
- Current;
- Grounding or running aground;
- Water resistance during turning manoeuvres, passing another vessel in the opposite direction and lock transits;
- Flooding caused by a leak;
- Cargo not stowed on the vessel's centreline.

External forces may be magnified by a shift in the cargo or by the free surface effect (cf. 2.2.3).

Inland waterway vessels have a high initial stability. This is because of the wide beam relative to the draught, although the stability reduces the lower the vessel is in the water.

2.2.2 Stability and instability: theoretical rudiments

Two types of stability are relevant to inland navigation:

1. The vessel meets the stability criteria and is suitable for safe navigation.
2. The vessel does not meet the stability criteria, is in an unstable state and can capsize.

The stability is influenced by the following centroids:

1. Centre of gravity (G) of the vessel,
2. Centre of buoyancy (B) of the vessel,
3. Metacentre (M) of the vessel.

The vessel's stability depends on the weight distribution, draught, heeling angle, free surface effect (cf. 2.2.4) and shape of the waterline. If the weight distribution or shape of the underwater hull changes, the vessel's stability changes accordingly.

<u>Centre of gravity</u>

The centre of gravity or centre of mass (G) is the centroid of all downward directed forces, namely:

- the weight of the vessel's hull,
- the weight of the vessel's equipment,
- the weight of (fuel) supplies,
- the weight of the cargo.

<u>Centre of buoyancy</u>

When a vessel is in the water, it is subject to a vertical upthrust (according to “Archimedes’ principle”). The centroid of this thrust is known as the centre of buoyancy. This force, frequently represented by the letter “B”, from the English term “buoyancy”, depends on the shape of the underwater hull.

Gravitational force and buoyancy are equal in magnitude and act in opposite directions (figure 1).

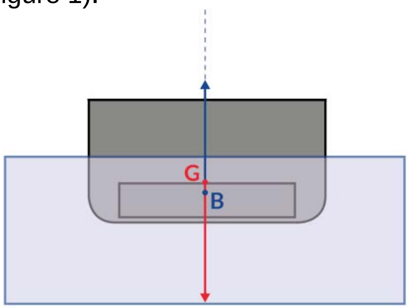


Figure 1

If the vessel is heeling in the water, the centre of buoyancy shifts, inducing a torque (vertical uplift) (figure 2).

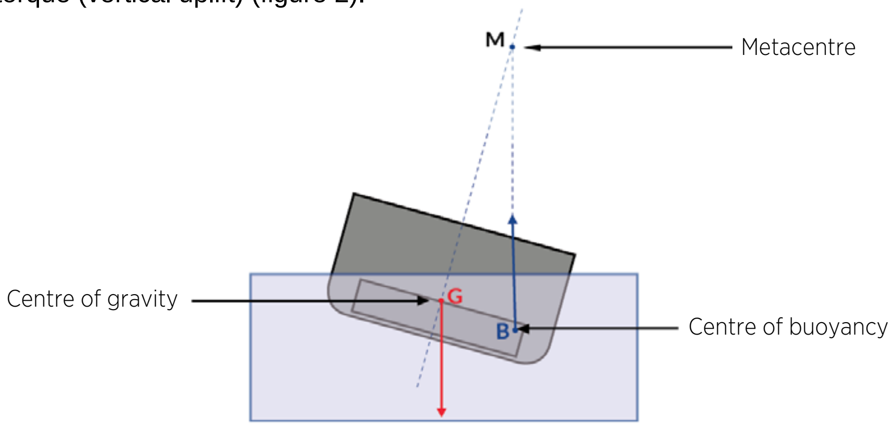


Figure 2

The distance (D) between this force couple is proportional to the magnitude of the force.

Otherwise expressed: a vessel with a broad beam is more stable than a vessel with a narrow beam (figure 3)

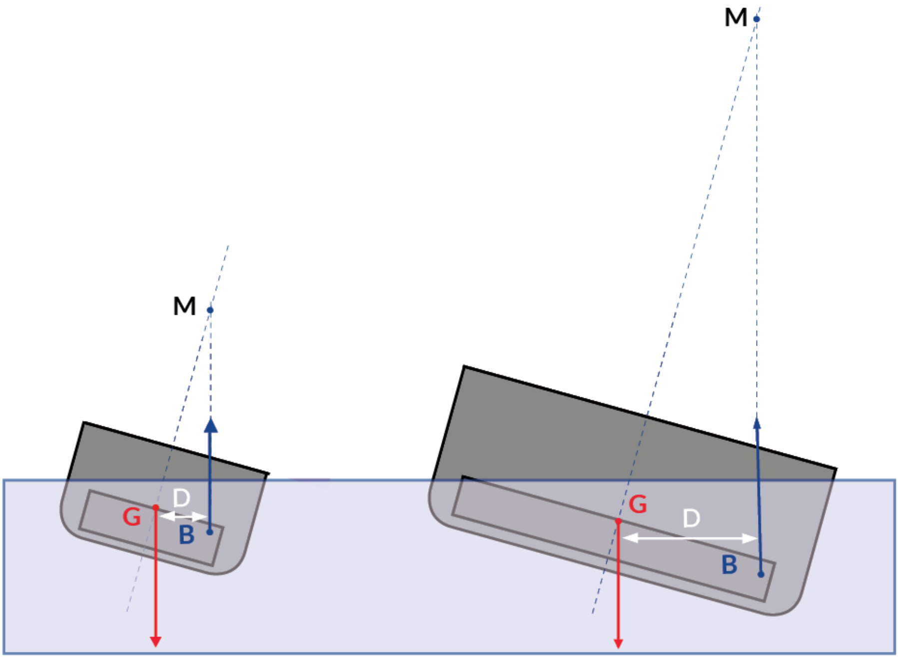


Figure 3

<u>Metacentre</u>

Vertical lines drawn from a vessel's centre of buoyancy at a small angle of heel intersect at a point known as the metacentre (M).

The initial metacentre is the point of intersection between the line of action of the upthrust when heeling and the vessel's centreline.

At a heel angle of approximately 5 or 7 degrees the metacentre is on the centreline but at a greater heel angle it moves away from the centreline because of the change in the shape of the underwater hull.

One can think of the metacentre as the vessel's pivot point that oscillates at a small heel angle.

The metacentric height (distance GM) is the distance between the metacentre and the centre of gravity. This is a criterion of the utmost importance to a vessel's stability.

The higher the metacentre, the greater the stability, the distance GM being both large and positive. If however the metacentre is located above the centre of gravity, there is a situation of stable equilibrium. As long as the centre of gravity is located beneath the metacentre, there is a righting moment and the vessel returns to its original state of equilibrium (figure 4).

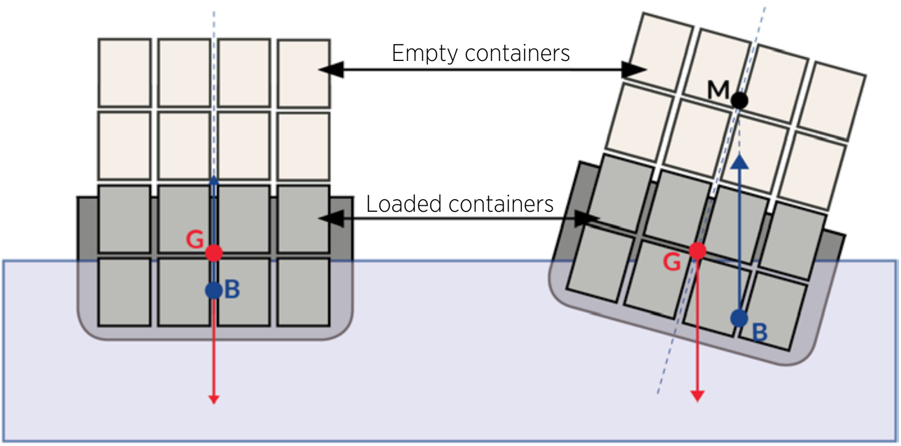


Figure 4

If on the other hand the metacentre is below the vessel's centre of gravity, the distance GM is small and negative. The equilibrium is then not stable and there is a negative moment of stability. In this case the heel angle increases and the vessel capsizes (figure 5).

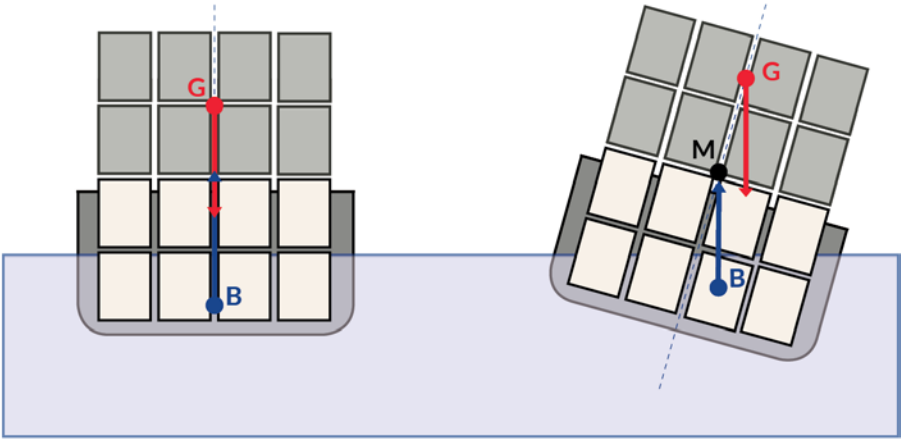


Figure 5

In summary one can say that the height of the centre of gravity in relation to the keel is important to stability in inland navigation. Stability is improved by a low centre of gravity and conversely is made worse by a high centre of gravity. One can therefore positively influence stability by positioning heavy containers low down in the hold with the empty containers uppermost. As the loaded containers in figure 4 are located at the bottom in the hold the centre of gravity in this case is lower than in figure 5, where the loaded containers were located in the higher up positions

Contrary to the centre of buoyancy and metacentre, the boatmaster can influence the centre of gravity, because the centre of gravity is determined primarily by the cargo.

2.2.3 Free surface effect

The free surface effect occurs on container vessels if (ballast) tanks (for drinking water, fuel etc.) are not completely full or if there are liquid surfaces on board for some other reason (e.g. rainwater in the cargo hold): If a vessel heels, the liquid in the tanks moves. This causes the liquid to flow in the direction of the heel, thereby magnifying the already existing heel angle.

A free surface negatively affects the vessel’s stability as the centre of gravity G also changes with the movement of the liquid. The righting moment is reduced as a consequence.

For optimal stability, each individual (ballast) tank must either be completely full or completely empty.

The free surface effect can have a major effect on stability. A boatmaster must be aware of this. Taking on ballast during loading and unloading is very dangerous as it is precisely while ballast is being taken on that the free surface effect occurs.

2.3 General knowledge of stowing

Stowing

The loading of containers on an inland waterway vessel always requires a stowing plan to be drawn up. This is no easy matter. There are many different aspects to be considered, such as

- the vessel’s stability;
- the vessel’s stability after loading or unloading parts of the cargo at an intermediate destination;
- the number and location of loading terminals;
- the number and location of unloading terminals;
- bridge clearance height and channel depths;
- the container weight, the heaviest containers to be stowed in the bottom of the hold;
- reefer containers that sometimes need to be connected to the on-board power supply;
- forces and stresses on the vessel;
- the vessel’s trim and heel;
- the loading requirements for ADN containers;
- the unobstructed visibility in front of the vessel.

Stackers and twistlocks

While the vessel is under way containers must not be able to move or slip if the vessel heels, or in the event of impact. That is why it is important to secure the containers firmly. This is achieved by using so-called stackers or twistlocks.

The stackers are located on the containers' corners, specifically on the corner castings known as corner fittings. Stackers can be used as a locking mechanism for interconnecting the container tiers above the hatchway coamings. Typically, the stackers are also positioned on the external walls of the third and fourth tier of containers. Slackers can also come in handy for securing an individual, centrally placed container with neighbouring containers. Stackers are not used for securing containers to one another, their sole purpose is to prevent them from slipping.

In certain nautical situations, it is preferable to use twistlocks instead of stackers, for example when operating on wide-open expanses of water (e.g. the Western Scheldt) in extreme weather conditions or with empty containers. When using twistlocks, the containers actually are connected with one another. Twistlocks do not influence stability per se, they simply connect the containers with one another to prevent them from being lost overboard as far as possible. In the case of positive stability, twistlocks have a positive effect on safety. (But this does not apply in the case of negative stability). In practice however stability cannot be negative if the statutory criteria are complied with.

Twistlock (photo Maira van Helvoirt)

3. GOOD PRACTICE

If the statutory stability provisions for inland waterway vessels as described in 2.1 are complied with, a vessel can take part safely in navigation. In addition to the stability rules, the inland navigation industry has devised a number of good practices for further improving stability, stowage or logistics services in the inland container navigation sector. The stability and stowing of the cargo on container vessels depend both on the vessel and the voyage. The **boatmaster** will always be **personally responsible** for loading and stowing.

The usual vessel loading and unloading procedures also apply to container vessels. Given the specific characteristics of a container cargo, the following additional tips can certainly be useful. The mandatory stability requirements are to be complied with and correctly applied at all times to ensure adequate safety for the vessel and crew members.

3.1 GOOD PRACTICE PRIOR TO LOADING

1. The following points need to be considered when preparing for the voyage:

- Information about the nautical conditions of the voyage (weather, tides, navigation sector, etc.);
- Are any height and draught restrictions anticipated?
- Stowing the cargo and checking whether the stability criteria defined in the stability manual (see 2.1.7) have been met;
- Checking whether the cargo can be safely loaded in in a stable manner;
- Container logistics: it is advisable to ensure that a good service can be provided while complying with the required stability criteria;
- If there are any ADN containers, it is advisable to display the appropriate dangerous goods markings (blue cones).

2. If possible, the containers are to be checked for damage or leaks and the client notified if necessary.

3. When drawing up the stowage plan, the boatmaster is to take account of the location of the reefer containers. Reefers need to be refrigerated, meaning they often have to be connected to the on-board power supply.

4. If containers with dangerous goods have been loaded, it is important (and mandatory!) to know exactly where they are located on the stowage plan. In emergency situations (average), it can be more quickly established whether these containers have been damaged.

5. For logistical reasons however, vessels are often loaded in “vertical blocks”. This entails the containers being stacked in a row in different tiers depending on destination terminal. When distributing the blocks in this way, the relevant vessel stability rules must be complied with!

3.2 GOOD PRACTICE DURING LOADING

3.2.1 Good practice for stability

6. Stability is improved by a low centre of gravity and conversely is made worse by a high centre of gravity. This is why, as far as possible, the heaviest containers are to be located in the bottom of the hold with the light ones higher up.

7. The vessel's roll period depends directly on the vessel's stability, the greater the stability, the shorter the roll period.

3.2.1.1 Communication between terminal and boatmaster

8. The boatmaster dictates the loading sequence based on the stowage plan he has previously drawn up. The stower is required to adhere to this stowage plan. Should this not be possible for very exceptional reasons, necessitating a departure from the stowage plan, the limits of stability may inadvertently be reached. "Tier by tier" stowage may then be the solution. This entails loading the vessel in successive tiers, the weights then also being included in the calculation of stability. A calculation of stability can be performed as each tier is added. The loading process can be halted in time if there were to be a risk of the stability limit being reached.

9. Prior to loading, the boatmaster gives the terminal appropriate loading instructions. The boatmaster is responsible for his vessel and determines how it is loaded. The boatmaster endeavours to stow his vessel simply and efficiently. The terminal personnel is required to comply with the boatmaster's instructions when loading and unloading containers to ensure safety is maintained at all times.

3.2.1.2 Container weight

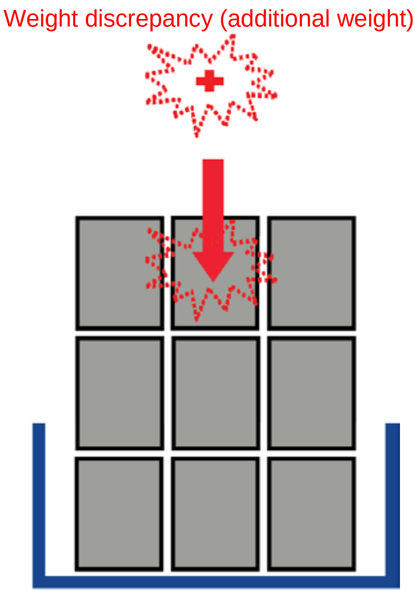
10. Providing correct container weight information is an important task for the industry. Hopefully, the Verified Gross Mass (see point 5 Introduction of mandatory weighing of containers loaded on a seagoing vessel and the impact on inland navigation) will be a positive contribution to this. The boatmaster must ensure that he has the gross mass of each individual container available so that he can perform the stability calculation.

11. If during loading the boatmaster detects a significant weight difference between the container and the reported weight, he must reject the container. If there are any doubts as to stability, then containers must be left behind at the terminal! Risks are often run because of pressure from third parties. The boatmaster should resist any such pressures because ultimately it is he who will be held responsible!

12. To gain a rough idea of a possible significant discrepancy between the actually loaded total weight and the expected theoretical weight, the boatmaster can compare the following:

- The sum of the weight of all the containers on board based on the information provided by the terminal;
- Weight actually loaded. The weight actually loaded can be established by measuring the vessel's draught. The bill of tonnage indicates the weight of cargo on board for a given draught.

13. If there are any doubts as to the total weight of the containers, it is recommended performing a stability calculation by adding the presumed additional weight to the uppermost tier.



3.2.1.3 Stability calculation

14. A stowing program with inbuilt stability calculation significantly simplifies stowing and is greatly to be recommended. The stowing program should be appropriately pre-configured for the vessel. It is strongly advised not to use desktop software spreadsheets because of the risk that the calculation formulae could be inadvertently amended or deleted.

15. Using a sister ship's stowing program is a false economy. Comparable vessels can differ from one another in several respects (e.g. the tank layout) to such an extent that the stability data are no longer comparable.

16. When commissioning the stowing program, the boatmaster checks with the responsible technician whether the correct data are being used to generate the stowage plan by performing a manual calculation and comparing it with the stowing program.

17. In the case of a manual calculation, it is advisable to use the correct table from the stability manual (cf. Point 2.1.7).

- The moment even one "high-cube" container (HC-container - cf. glossary) is used, the high-cube table is to be used for all containers.
- Containers are only deemed to be "fixed" in container-cell ships; containers are not referred to as "fixed" in any other circumstances, which is why the "loose" container table needs to be used.
- The moment even one ADN container is loaded the ADN table is to be used for all containers.

3.2.2 Good practice for stability meriting particular attention

18. Freely moving masses of water have a deleterious effect on stability, with rainwater proving to be particularly treacherous. Prior to loading and before embarking on your voyage, check whether there is any water in the vessel. In certain circumstances it is also advisable to close the cross-overs between the vessel's diesel and drinking water tanks.

19. Likewise, as far as possible, avoid having any large free surfaces on board. If ballast is required, always factor in the transverse moment of inertia of the free surface effect. Ballast tanks, especially transverse tanks, must be completely empty or completely full. This has to do with the free surface and heeling moments.

- If ballast is required it is always to be taken on **prior** to loading.
- Never fill ballast tanks if the vessel's stability is low or if the vessel has been loaded beyond the stability limits. Stability deteriorates markedly when taking on ballast water!

20. Take account of weather forecasts, including the wind, which has an influence. If necessary, the forecasts in question are to be taken into account when loading.

21. Container vessels are often loaded with a considerable gap between container rows. This applies, for example, to vessels that are not quite capable of accommodating three rows of containers side-by-side. Please note, however, that if the gap is too big, the containers can shift in the event of heeling, shocks or collisions. Where appropriate, ensure there is no gap between containers.

22. Before commencing the loading process, check the container types and take account of the specific requirements of container types that differ from the standard container. For example:

- High-cube containers are 30 cm high,
- Super-High-Cube containers are 60 cm higher;
- 45 feet pallet wide containers are 6 cm wider,
- 20 feet containers are sometimes 10 cm lower;
- Various intermediate sizes such as 23 feet, 25 feet, 30 feet;
- Reefers require ventilation and occasionally a power connection.

3.3 Good practice during the voyage

23. The boatmaster adjusts his boat handling according to its load state, especially when passing from calm water, or water where there is no current, into free-flowing water, water where there is a (cross) current and strong (side) winds.

24. Water on side decks is to be avoided. The immersion of the greater part of the side decks is a potential additional factor in a reduction in the vessel’s righting moment.

3.4 Good practice during stowing

25. The boatmaster checks whether the containers are located according to the stowage plan, namely that they are not just in the correct place but are stowed in the correct manner. The container's corners (corner castings) must be on the corners of the container below.

26. Stacked empty containers in the middle of the cargo hold can easily topple over. Try to fill the entire compartment or place the the containers on their side.

27. The stowing material you use should be solid and reliable.

3.5 Additional good practice

28. Communicating the correct maximum loading height to your crew after loading is important to a safe voyage if clearance height-related accidents with bridges are to be avoided.

29. Clear marking of the container compartments avoids confusion when loading and unloading. For example, stripes and numbers on the inside and outside of hatchway coamings and possibly stripes/crosses and numbering on the ship's bottom.

30. Do not place 20 foot containers on 40 foot containers. The 20 foot containers can damage the 40 foot containers because the latter have no reinforcement in the middle of the container.

31. Flat rack or open top containers with a special cargo need to be readily accessible at the time of unloading so that dock workers reach them if they have to unload them using special chains.

4. ONGOING PROFESSIONAL TRAINING AND UPDATING OF KNOWLEDGE

Good initial training and comprehensive ongoing training are very important. It is even probable that a good level of knowledge on the part of crew members is a greater contribution to safety than other factors over which the boatmaster has only limited control (such as correct container weights).

As of 1 January 2015, stability has been progressively introduced into the ADN foundation course syllabus.

It is advised to include regular ongoing professional training and updating of knowledge (i.e. over a full professional working life) in the risk assessment and to make it an integral part of the quality system on-board.

A number of factors militate in favour of regular ongoing training and updating of knowledge as stability is a complex issue. If new equipment is fitted on board, the boatmaster must be able to operate it and be familiar with its operational capabilities to avoid making mistakes.

The following is to be checked with the installer present:

- the stability calculation,
- the use of the correct tables in the stowage software,
- the correct use of the contracting value for free surface areas.

Ongoing training also affords the opportunity to improve and update one's knowledge of the regulations.

5. INTRODUCTION OF MANDATORY WEIGHING OF CONTAINERS LOADED ON A SEAGOING VESSEL AND THE IMPACT ON INLAND NAVIGATION)

The importance of correctly stated container weights is obvious. Because, by definition, incorrect container weights result in incorrect stowage plans. The introduction of mandatory weighing of containers increases the accuracy of container weights.

As of 1 July, 2016 containers can only be loaded on a seagoing vessel if their mass has been ascertained in a certified way. This mass is called the Verified Gross Mass - VGM.

The IMO (International Maritime Organization) has approved two methods for determining the VGM.

a) either calibrated scales are used,

b) or the mass is calculated using a certified method.

In the first place, responsibility lies with the carrier. In practice, the carrier frequently appoints a logistics service provider (e.g. the inland terminal) to establish the mass.

Ideally, the Verified Gross Mass should already have been established before the containers are loaded on an inland vessel in the hinterland. However, this mass must be authoritatively established before the container is loaded on a seagoing vessel. In principle therefore, a carrier could have the container weighed at the deep-water terminal. Consequently, the absence of the VGM cannot be adduced as a reason for declining a container.

The mass cannot be determined with 100% accuracy even with calibrated equipment. Therefore, the IMO member states allow a certain margin of accuracy, although it is not the same everywhere. The boatmaster is neither obliged nor able to check the VGM and fundamentally must assume that the data provided is correct. If, however, he has concrete evidence that the actual mass differs from the stated VGM, he must of course refuse to allow the container to be loaded on the vessel.

The availability of correct mass information will only have a positive effect on inland navigation if these masses are correctly entered in the information systems throughout the logistics chain. This requires several organisational or procedural changes. A new EDI (Electronic Data Interchange) message has since been developed (the so-called VERMAS message) and other legacy EDI messages (such as COPAR load) adapted so that the container mass information can be exchanged between the various parties electronically.

Even if mandatory verification of mass should in principle make a positive contribution to safe inland navigation, it remains to be seen whether this has an impact on inland navigation in practice.

6. FUTURE DEVELOPMENTS IN CONTAINER TRANSPORT

6.1 ELECTRONIC DATA INTERCHANGE

The next few years will see yet further electronic data interchange between fleet managers, terminal, and vessel. In the meantime, several pilot projects have been initiated using BAPLIE (ship plan) and MOVIN (stowage instructions) EDI messages. These EDI messages are automatically read into the terminal system, resulting in greater operational efficiency. It is advantageous for the boatmaster to receive a definitive BAPLIE from the terminal once his vessel has been loaded, giving him an exact overview of the locations of individual containers. The stowage programs have already been modified and are therefore able to process the EDI messages.

In summary we can say that the use of BAPLIE and MOVIN will enable the terminals and inland navigation to load vessels efficiently using a detailed stowage plan.

The aforementioned document interchange using EDI messages is not identical with the electronic data interchange using the BICS software for the electronic reporting obligation on the Rhine. It will however still be possible to use the stowage programs to comply with the reporting obligations under article 12.01 of the RPR via BICS. As such the boatmaster’s working practices will barely change at all.

6.2 Quality systems

Whereas quality systems such as EBIS have long been common practice in tanker navigation, the same is not true on an equivalent scale of inland container navigation. That is why several market participants are currently developing an integrated quality system instigated and supported by the industry. This system does not just assess vessels in terms of criteria such as maintenance state, environmental performance, certification, and crew requirements but also expressly checks whether procedures, instructions and safety and quality management systems are in place.

This will also include a risk assessment, and will specifically establish the stability risk. Based on this risk assessment, appropriate measures can be incorporated into standard vessel procedures. Likewise, the frequency, content and level of the crew members’ ongoing professional training and education will need to be included.

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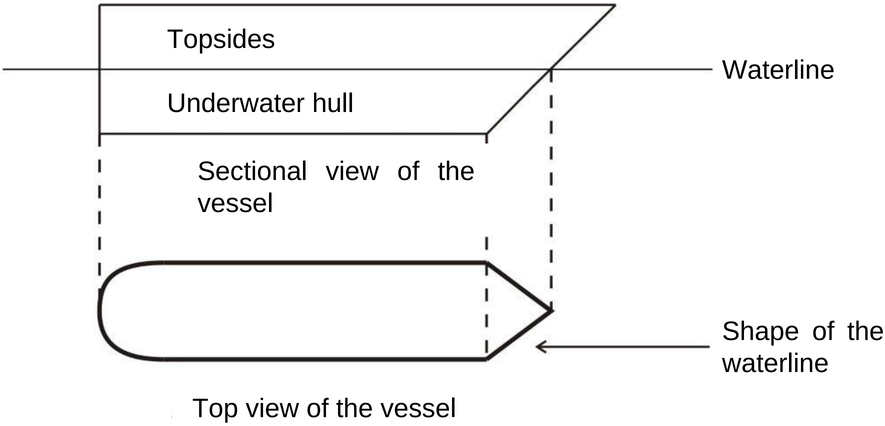
8. GLOSSARY



ADN container	An ADN container is loaded with dangerous goods as construed by the ADN agreement (cf. bibliography).
EDI - Electronic data Interchange	Electronic data interchange (EDI) entails the transmission of business data in a standard electronic format between business partners directly from one computer to the other.
HC container (High Cube)	A container has the following standard external dimensions: Length 20 feet (6.058 m) or 40 feet (12.192 m), width 8 feet (2.438 m) and height 8.5 feet (2.591 m). The height of an HC container is 9 feet (2.743 m) or 9.5 feet (2.896 m).
Roll period	The roll time is the time between two moments in which the vessel finds itself in the same position.

Stowage program / loading instrument	A loading instrument comprises a computer (hardware) and a digital program (software) which confer the ability to ensure that in all ballast or loading scenarios: the maximum permissible values in terms of longitudinal strength and draught are not exceeded; and the vessel's stability complies with the requirements as they apply to this vessel. This requires calculation of the stability in an undamaged state and after an average. To generate meaningful results, the software needs to be pre-configured with certain vessel-specific data (position of the centre of gravity, hull shape, compartmentation, etc.). The stowage program is also frequently combined with software to assist with generating a stowage plan.
Waterline	The intersection between the hull and the water. This line is horizontal.
Weight	Weight is a downward directed force applied to an object subject to gravity.
Net weight / gross weight	Gross weight = net weight + weight of the container empty.

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The seven golden rules for ensuring a container vessel is stable

- Comply with and correctly apply mandatory stability regulations.
- Give terminal personnel loading instructions to ensure that the vessel is loaded in accordance with the stowage plan.
- Place heavy containers at the bottom of the cargo hold and empty containers in the uppermost tiers.
- Ballast tanks are to be either completely full or completely empty.
- If a vessel is not stable after loading, no attempt should be made to make it stable by filling specific ballast tanks with water.
- If a stowage program is used to test for stability, this program has to be specially configured for the vessel.
- **Calculating stability and generating a good stowage plan takes less time and costs less money than raising and salvaging a sunken vessel.**