FOREWORD

DET NORSKE VERITAS is an autonomous and independent Foundation with the objective of safeguarding life, property and the environment at sea and ashore.

DET NORSKE VERITAS AS is a fully owned subsidiary Society of the Foundation. It undertakes classification and certification of ships, mobile offshore units, fixed offshore structures, facilities and systems for shipping and other industries. The Society also carries out research and development associated with these functions.

DET NORSKE VERITAS operates a worldwide network of survey stations and is authorised by more than 130 national administrations to carry out surveys and, in most cases, issue certificates on their behalf.

Classification Notes

Classification Notes are publications that give practical information on classification of ships and other objects. Examples of design solutions, calculation methods, specifications of test procedures, as well as acceptable repair methods for some components are given as interpretations of the more general rule requirements.

A list of Classification Notes is found in the latest edition of Pt.P Ch.1 of the "Rules for Classification of Ships" and the "Rules for Classification of High Speed, Light Craft and Naval Surface Craft".

The list of Classification Notes is also included in the current “Classification Services – Publications” issued by the Society, which is available on request. All publications may be ordered from the Society’s Web site http://exchange.dnv.com.

Main changes

This issue of CN 20.1 has been extensively rewritten. It replaces the previous issue dated February 1990.

The main changes are related to:

— The 2003 revisions of the rules.
— The list of data for damage stability calculations to accommodate the probabilistic regulations for dry cargo ships (to cover SOLAS-74 as amended).
— Data for floodable length calculations of passenger ships have been made more specific.
— Guidance on intact stability and inclining experiments to align with IMO's intact stability code, Res.A.749(18), as required by IACS UR L2.
— Implementation of IMO MSC/Circ.919, "Guidelines for damage control plans".
— The grain loading documentation has been aligned with the current International Grain Code, IMO Res. MSC.23(59).
— Provisions for a single loading manual, based on the revised IACS UR S1, "Requirements for loading conditions, loading manuals and loading instruments" and the new UR S1A, "Additional requirements for loading conditions, loading manuals and loading instruments for bulk carriers, ore carriers and combination carriers".
— A new section 3, "Additional documentation for certain ships" has been added to cover additional class notations and/or statutory regulations.

Comments may be sent by e-mail to rules@dnv.com

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1. Introduction

1.1 Scope

1.1.1 The purpose of this Classification Note (CN) is to provide DNV's clients and surveyors with guidelines on minimum contents of the stability documentation required in connection with stability approval of ships.

1.1.2 The information in this CN is made to suit various DNV stability rules and common IMO and IACS standards in those cases where DNV is authorised to conduct statutory stability approvals. This CN is not intended to cover statutory documentation requirements that may be in excess of those standards. One should therefore refer to the rules and regulations in question to verify the applicable information for the ship in question.

1.1.3 While this Classification Note has been written with application to newbuildings in mind, it should also be used as far as practicable whenever all or parts of stability documentation for existing ships is to be replaced.

1.1.4 This CN is not a substitute for the rules or regulations, but a means to help implementing them.

1.1.5 DNV stability rules allow that the class requirements may be considered complied with in some cases where a national authority has carried out the approval. In these cases it is nevertheless recommended that the contents of this CN be implemented in that documentation as far as practicable.

1.1.6 DNV may accept layouts of stability documentation other than those presented in this CN, provided the basic contents are included.

1.1.7 According to the Society's rules loading computer systems (LCS) are not accepted as an alternative to printed stability documentation. The documentation requirements for such systems are not within the scope of this CN. For information on approval and certification of LCS software please see CN 21:1.

1.2 General

1.2.1 The stability documentation/booklet should be presented in a binder (A4) and must be indexed and numbered.

1.2.2 All documentation should be equipped with a unique drawing and revision number as well as the revision date.

1.2.3 The stability documents shall be legible, clear and easy to use onboard.

1.2.4 The units in all stability documentation must be consistent.

1.2.5 Approval of preliminary stability documentation means preliminary stability approval. Short-term certificates require preliminary stability approval.

1.2.6 Approval of final stability documentation means final stability approval. Full-term certificates require final stability approval.

1.2.7 IMO has adopted certain mandatory documentation requirements for tankers and bulk carriers. An excerpt from these requirements has been included in this CN.

1.2.8 In this CN references to the expression "maximum allowable VCG curves" also covers the use of minimum allowable GMt curves.

2. Stability Documentation

2.1 Preliminary stability manual (PSM)

2.1.1 The PSM is to be submitted for approval at least three months before delivery.

2.1.2 For compliance with the intact stability criteria of IMO resolution A.749(18) only, the format of IACS standard LL45 may be accepted for the stability manual.

2.1.3 The PSM shall be kept onboard until replaced by FSM.

2.1.4 The following are the general contents of the stability manual. These contents are to be adjusted in accordance with the applicable regulations. Items marked with (F) need not be presented for preliminary approval, but must be included in the final stability manual (FSM).

Note:
Sea-going ships of 65 m in length and above which are contracted for construction on or after 1998-07-01 are to be provided with an approved loading manual based on the final light ship particulars of the ship, which includes strength considerations (IACS UR S1). There are also additional requirements for bulk carriers, ore carriers and combination carriers of 150 m in length and above (IACS UR S1A). The loading manual required for these ships may be submitted for approval as the FSM provided that it also contains the information set out below. See also section 3 of this CN for details.

Table of contents
Table of contents and index for each booklet forming part of the stability documentation.

Main particulars
The vessel's identification, including the IMO number, main dimensions, maximum draught, maximum trim and service information.

Applicable regulations
Reference to the statutory regulations and class notations that are basis for the approval and a brief list of the corresponding stability requirements.

Stability model
Sketch of volumes contributing to buoyancy in intact and damage stability calculations.

Reference system and baseline
These are to be clearly defined and are to be used consistently throughout the stability documentation.

Preliminary lightship particulars
Based on an estimate or sister vessel.

Deadweight data
Masses and positions of centre of gravity of typical deadweight groups/items to facilitate simplified calculation of loading conditions such as "consumables departure", "consumables arrival" or standard cargo loads and so forth.

Tank data
Tank plan and capacity tables with following information on each tank:
   — tank name/number.
Sounding or ullage tables may be included for this purpose.

**Slowing plan**
Applicable for carriage of containers or vehicles.

**Draught marks**
A sketch showing longitudinal position of draught marks, position relative to the hydrostatic reference system and baseline. Information on the correlation between the draught marks and appendages such as azimuth thrusters is to be particularly emphasised. Instructions on how to calculate from draught readings the corresponding draught to be used in tables for hydrostatic data, cross curves and maximum allowable VCG curves, assuming no deflection of hull girder are to be included.

**Hydrostatic data**
The hydrostatic data are to be presented on an extreme draught basis in tabular form, from lightship draught to above maximum draught with steps not exceeding 0.10 m.

In cases where the vessel is expected to operate with trim, the hydrostatic data must cover the intended trim range. Alternatively, trim correction tables are to be included.

As a minimum, the following hydrostatic data are to be presented:
- displacement moulded (m$^3$)
- displacement extreme (tonnes)
- tonnes per centimetre immersion
- moment to change trim one centimetre
- vertical centre of buoyancy
- longitudinal centre of buoyancy
- longitudinal centre of flotation
- transverse metacentre
- longitudinal metacentre.

**Cross curves**
The cross curves should be presented on an extreme draught or displacement basis in tabular form, from lightship draught to above maximum draught for at least the following angles of heel: 5, 10, 15, 20, 30 and 40 degrees. If the same curves are also intended for use in connection with grain stability, the curve for 12 degrees is to be included.

In cases where the vessel is expected to operate with trim, the cross curves must cover the intended trim range and the trim values must correspond with those presented for the hydrostatic particulars.

The cross curves are to be calculated on a “free to trim” basis.

**Water- and weathertight integrity**
Position of critical unprotected openings considered flooding points in intact- and damage stability calculations as applicable.

**Instructions on closing appliances and location of signboards.**

**Flooding angle curve**
Flooding angle curve representing the angle of flooding of critical unprotected openings as a function of extreme draught or displacement from lightship draught to above maximum draught.

In cases where the vessel is expected to operate with trim, multiple flooding angle curves covering the intended trim range is to be developed. The trim values are to correspond with those presented for hydrostatic particulars and cross curves.

**Maximum allowable VCG curves**
The draught reference point is to be same as for hydrostatic data.

The maximum allowable VCG curves may be presented on an extreme draught or displacement basis in tabular or curves form from lightship draught to maximum draught.

In cases where the vessel is intended to operate with trim, the maximum allowable VCG curves must cover the intended trim range. The trim values are to correspond with those presented for hydrostatic particulars and cross curves.

The maximum allowable VCG curves are to satisfy all intact and damage stability requirements of the regulations applicable to the ship. The curves are to be presented as resulting curves. Separate curves for intact and damage stability are not to be included in the documentation intended for use on board unless justified by multiple modes of operation.

Any limitations or conditions such as specific modes of operation related to the application of the maximum allowable VCG curves are to be clearly stated on the curves.

If no maximum allowable VCG curves have been calculated, the validity of the stability approval will be limited to the presented loading conditions.

**Note:**
See also Sec. 3 in the case of ships designed for carriage of timber deck cargoes.

---end---of---Note---

**Special loads/moments**
Special loads and external heeling moments are to be presented as required by the applicable rules, regulations and additional class notations, such as:
- high speed turning
- wind heeling moment
- passenger heeling moment
- davit launching moment
- towing heeling moment
- crane heeling moment
- entrapped water in pipes on deck, included in the loading conditions
- entrapped water on deck or other spaces included in the loading conditions
- water monitors heeling moment
- ice heeling moment
- ice accretion, included in the loading conditions.

**Loading conditions**
The loading conditions should be preceded by a summary of all loading cases in a tabular form giving a brief overview of the loading conditions included in the document. This overview should consist of:

- total capacity of cargo, tanks and other items included in each loading condition
- total displacement and corrected centre of gravity (VCG)
- extreme draughts and total trim
- corrected transverse metacentric height (GM$\text{c}$).

The presented loading conditions are to include the standard loading conditions required by the applicable regulations such as:
- full load condition, departure (100% consumables)
- full load condition, arrival (10% consumables)
- ballast condition, departure (100% consumables)
- ballast condition, arrival (10% consumables).
Special loads and external heeling moments such as ice load, crane load and entrapped water are to be applied to the presented loading conditions as may be required by the regulations applicable to the ship.

Notes:
Some regulations require that the special loads or heeling moments be applied to supplementary loading conditions assuming maximum allowable VCG.

In addition to the regulatory conditions above loading conditions covering the intended range of service modes including those most unfavourable are to be presented.

Note:
See also Sec. 3 for more specific guidance on loading conditions for certain types of ships.

The presented loading conditions are to be within the limit curves or satisfy the applicable requirements.

As a minimum, the following information is to be presented for each loading condition:
- individual masses with centre of gravity
- free surface moments of slack tanks
- total displacement and corrected centre of gravity
- extreme drafts and total trim
- propeller immersion, if applicable
- corrected transverse metacentric height (GM_{T})
- maximum allowable VCG or maximum required GM_{T}
- tabulated GZ - values and GZ - curves
- values of applicable stability criteria if maximum allowable VCG curves have not been calculated.

Notes on stability (F)
- general precautions against capsizing
- instructions on checking the stability
- use of free surface correction
- use of cross curves
- use of maximum allowable VCG curves.
- stability limitations regarding loading of the vessel including draught to prevent slamming, if applicable
- instructions on emergency situations (storm/damage)
- use of onboard computer in assessing the stability.

Worked example on stability (F)
A complete worked example on calculating and checking the stability of a loading condition.

Blank stability forms (F)
Blank forms for calculating and checking the stability for actual loading conditions.

Deadweight scale (F)
Conversion tables (F)

2.2 Inclining test and lightweight survey procedure (ITP)

2.2.1 For the purpose of procedures and reporting a lightweight survey the same as the inclining test disregarding inclining weights, shifts, pendulums and so forth.

2.2.2 An ITP should be submitted for approval in accordance with CN No. 20.2 at least one month before delivery.

2.2.3 If the yard/owner wishes to determine the lightship particulars based on a satisfactory lightweight survey and the inclining test of a sister vessel, a lightweight survey procedure is to be submitted as the ITP instead.

2.2.4 Subject to statutory regulations, a lightweight survey may be accepted in lieu of an inclining test for a series of sister vessels. This will also depend on:
- the type of vessel
- the time span of building the series
- whether the vessels are built for the same owner
- if there are dissimilarities between the vessels
- if the inclining test of the first vessel is approved
- if unaccounted differences in lightship particulars from the estimate and the results from the actual lightweight survey do not exceed 1% or, alternatively, if unaccounted differences in lightship particulars from the inclining test of the sister ship and the lightweight survey of the ship in question do not exceed 1%

2.2.5 The contents of the procedure are to be in accordance with CN 20.2 or, as an alternative, Annex 1 of IMO Res. A.749(18).

2.3 Inclining test and lightweight survey report (ITR, LWS)

2.3.1 An ITR/LWS should be submitted for approval according to CN 20.2 as soon as possible after the inclining test or lightweight survey. It is to be forwarded to the attending surveyor for endorsement before being submitted for approval.

2.3.2 In the case of newbuildings the ITR should be submitted for approval at least one week before delivery. The contents of the ITR are to be in accordance with CN 20.2.

2.4 Final stability manual (FSM)

2.4.1 The FSM should be submitted latest 2 months after delivery.

2.4.2 The FSM is basically the revision of the loading conditions from the PSM according to the approved lightship particulars in the ITR, and any other comments as may have been given in connection with the preliminary approval.

2.4.3 The date and place of the inclining test or lightweight survey upon which the FSM is based is to be entered under lightship particulars and also the name of the organisation responsible for the approval. Alternatively a stamped copy of the ITR could be included, if available.

2.4.4 The mass and location of any permanent ballast or other fixed weights not included in the results from the ITR/LWS is to be clearly specified in the FSM.

2.4.5 If the differences between lightship particulars for sister vessels are sufficiently small and within the accuracy and tolerances of inclining tests and lightweight surveys, the lightship particulars of the first vessels in a series may be used for the sister vessel. Identical final stability documentation to that of the first vessel may then be accepted for the sister vessel. This will normally be accepted if the difference in lightship mass is within 0.5% and the difference in LCG is within 0.5% of LBP.

2.5 Preliminary damage stability calculation (PDS)

2.5.1 Subject to appropriate class and statutory regulations a damage stability approval can be either general, based on approval of maximum allowable VCG curves or specific, based on approval of specific loading conditions representing the intended service of the vessel.

2.5.2 The PDS should be submitted as early as possible, preferably at the time of design approval, and in the case of new-
buildings at least 6 months before delivery. The reason is that such calculations often decide the limit curves that are to be used further in the PSM.

2.5.3 If the PDS is intended to provide maximum allowable VCG curves only, that is, they are independent of the lightship particulars, they may also be considered as the final damage stability calculations (FDC).

2.5.4 The presentation of the calculations depends on the calculation method, that is, whether the applicable regulations are based on deterministic or probabilistic principles or a combination of both.

Information common for both methods

- reference to the applicable damage stability requirements description and location of openings assumed watertight, weathertight or unprotected in the calculations
- description of the margin line or other immersion limits as may be applicable
- a list and sketches of the cross-flooding systems, double-flooding openings and other devices assumed to correct list due to flooding.

Deterministic method

The following are the minimum contents of the PDS in the case of deterministic calculations, such as for passenger ships under part B, chapter II-1 of SOLAS-74, oil tankers under regulation 25 of MARPOL 73/78 and the deterministic requirements in regulation 5 of IMO Res. A.265(VIII):

- a list of initial intact conditions is to be given if it is the intention to obtain an approval of specific loading conditions only.
- initial intact conditions covering the intended range of draughts and trims if only maximum allowable VCG curves are to be calculated
- assumed extent of damage and number of damaged compartments
- a list and sketches of the calculated damage cases, the calculated damage cases are to be the most severe damage cases according to the applicable requirements
- a specification of the initial contents of damaged tanks, if applicable
- details on the damage stability calculations and the results for each damage case:
  i) equilibrium position (draught, trim and heel) after damage;
  ii) the metacentric height (GM);
  iii) particulars of the GZ curve in intermediate and final stages of flooding, including maximum righting arm and the corresponding heel angle, positive range, freeboard to critical flooding points and the margin line, if applicable
  iv) time required for equalisation, if applicable
  v) other critical factors, such as crowding of passengers on one side, launching of lifeboats, effect of wind and so forth, if required by the regulations.
- maximum allowable VCG curves if applicable.

Probabilistic method

The following are the minimum contents of the PDS in the case of probabilistic calculations; such as for cargo ships under part B-1, chapter II-1 of SOLAS-74 and passenger ships under IMO resolution A.265(VIII):

- calculation of the required subdivision index R
- initial intact conditions. (Deepest subdivision load line, partial load line(s), assumed trims, VCG)
- a list and sketches of the calculated damage cases
- tables showing, for each damage case:
  i) the indices 'p', 'b', 'h', 'v' and 's'
  ii) particulars of the GZ curve in intermediate and final stages of flooding, including maximum righting arm and the corresponding heel angle, positive range, freeboard to critical flooding points and the margin line, if applicable
  iii) time required for equalisation, if applicable
- maximum allowable VCG curves.

Note:

For guidance on calculation of subdivision indices and maximum allowable VCG under part B-1 in chapter II-1 of SOLAS-74 refer to "Explanatory notes to the SOLAS regulations on subdivision and damage stability of cargo ships of 100 metres in length and over", IMO Res. A.684(17). For guidance on calculation of subdivision indices under IMO Res. A.265(VIII) refer to "Explanatory notes to the regulations on subdivision and stability of passenger ships as an equivalent to part B of Chapter II of the International Convention for the Safety of Life at Sea, 1960" as adopted by IMO in connection with IMO Res. A.265(VIII).

2.6 Final damage stability calculation (FDS)

2.6.1 The FDS is to be submitted latest 2 months after delivery. See also 2.5.3 above.

2.6.2 The FDS is the revised PDS according to the approved lightship particulars after the inclining test or lightweight survey, and any comments in connection with the preliminary approval.

2.6.3 If the approved PDS is based on loading conditions only it may be considered as the final damage stability calculations if the approved lightship particulars are not less favourable than the estimates used in those calculations.

2.7 Floodable lengths and subdivision calculations for passenger ships (FSC)

2.7.1 The FSC is to be submitted at least 6 months before delivery. Together with the PDS.

2.7.2 FSC for passenger ships should contain:

- calculations of permeability, criterion of service and factor of subdivision
- floodable- and permissible length curves.

Note:

SOLAS-74 and common interpretations permit certain alternatives for detailed calculation of permeability etc. The use of such alternative calculation methods is to be clarified with DNV in advance of the submission.

2.8 Damage control information

2.8.1 The damage control information is intended to provide the ship's officers with clear information on the ship's watertight subdivision and equipment related to maintaining the integrity of the watertight boundaries so that in the event of damage to the ship causing flooding proper precautions can be taken to prevent progressive flooding through openings therein and effective action can be taken quickly to mitigate and, where possible, recover the ship's loss of stability.
2.8.2 The damage control information is to be submitted latest 2 months after delivery.

2.8.3 The damage control information should consist of:
- damage control Plan (DCP)
- damage control Manual (DCM).

2.8.4 The DCP and DCM should be clear and easy to understand. They should not include information that is not directly relevant to damage control, and should be provided in the working language of the ship. If the languages used in the preparation of the plan and booklet is not one of the official languages of the SOLAS Convention, a translation into one of the official languages should be included.

2.8.5 For passenger ships, the DCP should be permanently exhibited on the navigation bridge, as well as in the ship’s control station, or equivalent.

2.8.6 For cargo ships, the DCP should be permanently exhibited or readily available on the navigation bridge. Furthermore, the DCP should be permanently exhibited or readily available in the cargo control room.

2.8.7 The DCM should be conveniently located in the vicinity of the DCP.

2.8.8 DCP and DCM are to be provided in printed form. The use of on-board computers with damage stability software developed for the specific ship and familiar to properly trained ship’s officers can provide a rapid means to supplement the information in the planned booklet for effective damage control but cannot be approved in lieu of the DCP and DCM.

2.9 Damage control plan (DCP)

2.9.1 The DCP should be of a scale adequate to show clearly the required contents of the plan, preferably in a scale not less than 1:200.

2.9.2 The DCP should include inboard profile, plan views of each deck and transverse sections to the extent necessary to show the following:

a) The watertight boundaries of the ship.

b) The locations and arrangements of all cross-flooding systems, blow-out plugs and any mechanical means to correct list due to flooding, together with the locations of their valves and remote controls, if any.

c) The locations of all internal watertight closing appliances, including internal ramps or doors acting as extension of the collision bulkhead on 'Ro-Ro ships', their controls and the locations of their local and remote controls, position indicators and alarms.

d) The locations of those watertight closing appliances which are not allowed to be opened during navigation, and of those watertight closing appliances which are allowed to be opened during navigation.

e) Watertight doors in passenger ships that are allowed to remain open during navigation in accordance with SOLAS regulation II-1/15.

f) The location of all doors in the shell of the ship, position indicators, leakage detection and surveillance devices.

g) The locations of all weathertight closing appliances in local subdivision boundaries above the bulkhead deck and on the lowest exposed weather decks, together with locations of controls and position indicators, if applicable.

h) The location of all bilge and ballast pumps, their control positions and associated valves.

i) Any pipes, ducts or tunnels through which limited progressive flooding has been accepted by the Administration.

j) Reference to where to find detailed information for each damage case. This information is to be given in the DCM. Each damage case should therefore refer to the corresponding plan number in the DCM.

Note: In the case of large passenger ships using a GAP as the basis for a DCP it is not advisable as information tends to get lost in the large amount of detail on such drawings.

2.10 Damage control manual (DCM)

2.10.1 The information listed in paragraph 2.9.2 should be repeated in the damage control booklet. In addition the DCM should include general instructions for controlling the effects of damage, such as:

- immediately closing all watertight and weathertight closing appliances
- establishing the locations and safety of persons on board, sounding tanks and compartments to ascertain the extent of damage and repeated soundings to determine rates of flooding
- cautionary advice regarding the cause of any list and of liquid transfer operations to lessen list or trim, and the resulting effects of creating additional free surfaces and of initiating pumping operations to control the ingress of water.

2.10.2 The booklet should contain additional details to the information shown on the DCP, such as the locations of all sounding devices, tank vents and overflows which do not extend above the weather deck, pump capacities, piping diagrams, instructions for operating cross-flooding systems, means of accessing and escaping from watertight compartments below the bulkhead deck for use by damage control parties, and alerting ship management and other organisations to stand by and to co-ordinate assistance, if required.

2.10.3 If applicable to the ship, locations of non-watertight openings with non-automatic closing devices through which progressive flooding might occur should be indicated as well as guidance on the possibility of non-structural bulkheads and doors or other obstructions retarding the flow of entering seawater to cause at least temporary conditions of unsymmetrical flooding.

2.10.4 An easily assimilated summary of the damage stability calculations is to be presented for the required draughts at each keel, assuming the corresponding maximum allowable VCG as initial intact conditions. Additional guidance should be provided to ensure that the ship's officers referring to that information are aware that the results are included only to assist them in estimating the ship's relative survivability.

2.10.5 The guidance should identify criteria on which the analyses were based and clearly indicate that the initial conditions of the ship's loading extents and locations of damage, permeability, assumed for the analyses may have no correlation with the actual damaged condition of the ship.

2.10.6 Simple, clear and concise guidance, such as damage consequence diagrams, can provide the master with a rapid means to evaluate the consequence of damage to the ship and
may be attached to the DCM.

2.11 General arrangement plan (GAP)

2.11.1 The GAP is to be submitted with the PSM or PDS and includes names of compartments, frame numbers, frame spacing and so forth.

2.12 Lines plan and offset tables (LPO)

2.12.1 LPO is to be submitted with the PSM or PDS.

2.12.2 The following drawings are to be included:
- offset tables
- body plan
- profile (elevation)
- lines plan (waterlines)
- appendages, both positive and negative.

2.12.3 The following information is to be indicated:
- definition of baseline and reference system
- stations/frame spacing.

2.13 External watertight integrity plan or freeboard plan (EWP)

2.13.1 A EWP is to be submitted with the PSM or PDS. The plan is to contain information on all external openings (air pipes, ventilators, hatches, doors and so forth.) of volumes affecting stability calculations.

2.13.2 The following information is to be shown on the plan:
- superstructures and deckhouses contributing to buoyancy in intact or damage stability calculations
- position of each opening (longitudinal, transverse and vertical)
- type of closing appliance (watertight, weakertight or unprotected)
- alarms, indicators, remote controls and signboards fitted for each opening/closing appliance
- spaces that each opening leads to.

If the above information is shown on the freeboard plan, that drawing can be submitted as the external watertight integrity plan.

2.14 Internal watertight integrity plan (IWP)

2.14.1 The IWP is only required in connection with approval of damage stability calculations and is to be submitted with PDS.

2.14.2 The plan is to contain items affecting damage stability calculations, such as internal subdivision, possibility of progressive flooding from one compartment to another through internal openings, pipes/tunnels or ventilation ducts and pipes, ducts, tunnels in the damage penetration zone specified in the applicable damage assumptions.

2.14.3 The following information is to be shown on the plan:
- internal watertight boundaries (bulkheads, decks and tunnels)
- internal openings in these boundaries such as: doors, hatches, stairways, ventilation ducts and so forth
- spaces each opening leads to (for ventilation ducts)
- type of closing appliance (doors, hatches, valves and so forth).
- alarms, indicators, remote controls and signboards fitted for each opening/closing appliance
- marking of the damage penetration zone, as specified in the applicable damage assumptions, on various waterlines/decks and cross sections
- pipes, ducts and tunnels in the marked damage penetration zone and spaces where these lead design pressure heads for watertight bulkheads and decks.

2.14.4 For cargo ships to which chapter II-1, part B-1, of SOLAS-74 applies the damage penetration zone is to be consistent with the depth of penetration (a) and position of horizontal subdivision (factor 'v') used in the attained subdivision index calculations.

3. Additional Documentation for Certain Ships

The following is an overview of documentation requirements for some mandatory ship type notations. They are also to be applied in the case of statutory approvals of the same ship types.

3.1 Sea-going ships of 65 m in length and above required to carry a loading manual

For compliance with IACS UR Stahl DNV-classed sea-going ships of 65 m in length or more contracted for construction on or after 1998-07-01 are to carry an approved loading manual containing the design loading and ballast conditions upon which the approval of the hull scantlings is based, subdivided into departure and arrival conditions and ballast exchange at sea conditions, where applicable. In particular the following loading conditions should be included.

3.1.1 General cargo ships, container ships, roll-on/roll-off and refrigerated carriers, ore carriers and bulk carriers:
- homogeneous loading conditions at maximum draught
- ballast conditions
- special loading conditions, e.g. container or light load conditions at less than the maximum draught, heavy cargo, empty holds or non-homogeneous cargo conditions (dry, mixed or non-homogeneous cargo conditions, deck cargo conditions, etc., where applicable)
- short voyage or harbour conditions, where applicable
- docking condition afloat
- loading and unloading transitory conditions, where applicable.

3.1.2 Oil tankers:
- homogeneous loading conditions (excluding dry and clean ballast tanks) and ballast or part loaded conditions for both departure and arrival
- any specified non-uniform distribution of loading
- mid-voyage conditions relating to tank cleaning or other operations where these differ significantly from the ballast conditions
- docking condition afloat
- loading and unloading transitory conditions.

3.1.3 Chemical tankers:
- conditions as specified for oil tankers
- conditions for high density or heated cargo and segregated cargo where these are included in the approved cargo list.

3.1.4 Liquefied gas carriers:
- homogeneous loading conditions for all approved cargoes for both arrival and departure
- ballast conditions for both arrival and departure.

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A cargo condition where one or more tanks are empty or partially filled or where more than one type of cargo has significantly different densities is carried, for both arrival and departure.

A harbour condition for which an increased vapour pressure has been approved.

Docking condition affects.

3.1.5 Combination carriers:

- Conditions as specified in 3.3.1 and 3.3.2 above.

Details related to the presentation of strength calculations are not within the scope of this CN. Please refer to the structural requirements for the ship in question and IACS UR S1 and S1A as may be applicable.

3.2 New tankers designed as combination carriers

3.2.1 This sub-section is intended for documentation required for oil tankers with additional notation Bulk Carrier or Tanker for Oil and its equivalents.

3.2.2 For oil tankers regulation 25A of MARPOL-73/78 requires that certain intact stability requirements included in that regulation be met through design measures alone. However, for combination carriers simple supplementary operational procedures may be allowed. Such supplementary operational procedures for liquid transfer means written procedures made available to the master. To comply with the MARPOL Convention these procedures must:

- Be approved by the Flag State and indicate those cargo and ballast tanks which may, under any specific condition of liquid transfer and possible range of cargo densities, be slack and still allow the stability criteria to be met. The slack tanks may vary during the liquid transfer operations and be of any combination provided they satisfy the criteria.

- Be readily understandable to the officer in charge of liquid transfer operations.

- Provide for planned sequences of cargo and ballast transfer operations.

- Allow comparisons of attained and required stability using stability performance criteria in graphical or tabular form.

- Require no extensive mathematical calculations by the officer in charge.

- Provide for corrective actions to be taken by the officer in charge in case of departure from recommended values and in case of emergency situations.

- Be prominently displayed in the approved trim and stability booklet and at the cargo/ballast transfer control station and in any computer software by which stability calculations are performed.

3.3 Bulk carriers

3.3.1 This sub-section is intended for documentation required for mandatory ship type notation Bulk Carrier.

3.3.2 Chapters VI and XII of SOLAS-74, as amended, contain certain additional requirements for information to be presented in conjunction with the stability documentation. The purpose of these requirements is to enable the master to prevent excessive stresses in the ship's structure. Information on statutory application to new and existing bulk carriers will be found in that Convention.

3.3.3 The ship is to be provided with a booklet, which shall be written in a language with which the ship's officers responsible for cargo operations are familiar. If this language is not English, the ship shall be provided with a booklet written also in the English language.

3.3.4 The booklet shall, as a minimum, include:

- Stability data, as required by SOLAS regulation II-1/22, effectively the PSM and FSM.
- Ballasting and deballasting rates and capacities.
- Maximum allowable load per unit surface area of the tank top plating.
- Maximum allowable load per hold.
- General loading and unloading instructions with regard to the strength of the ship's structure including any limitations on the most adverse operating conditions during loading, unloading, ballasting operations and the voyage.
- Any special restrictions such as limitations on the most adverse operating conditions imposed by the Administration or organisation recognised by it, if applicable; and
- Where strength calculations are required, maximum permissible forces and moments on the ship's hull during loading, unloading and the voyage.

Identification of any restrictions imposed on the carriage of solid bulk cargoes having a density of 1,780 kg/m³ and above or in accordance with the requirements of regulation XII/6 of SOLAS-74, as amended.

For convenience it is recommended that the above information be included in the PSM and FSM.

Note:

See also IMO Res. A.626(19), "Code of practice for the safe loading and unloading of bulk carriers" (BLU Code).

Regulation 10 of chapter XlI of SOLAS-74 requires that all bulk carriers of 150 m in length and upwards, regardless of their date of construction, shall be fitted with a loading instrument capable of providing information on hull girder shear forces and bending moments. For information on DNV approval procedures for such instruments refer to CN 21.1.

3.4 Ships intended for the carriage of grain in bulk

3.4.1 This sub-section is intended for documentation required in those cases where DNV is authorised to carry out the statutory approval of grain stability.

3.4.2 A preliminary grain loading manual (PGM) shall be submitted for approval at least three months before delivery.

3.4.3 The PGM shall be kept onboard until replaced by the final grain loading manual (FGM).

3.4.4 The FGM should be submitted latest 2 months after delivery.

3.4.5 The FGM is basically the revision of the loading conditions from the PGM according to the approved lightship particulars in the ITR and any other comments given in connection with the preliminary approval.

Note:

The date and place of the inclining test or lightweight survey is to be entered under lightweight particulars and also the name of the organisation responsible for the approval.

3.4.6 The following is the general contents of the grain loading manual. These contents are to be adjusted in accordance with the applicable regulations. Items marked with (P) need not be included in the PGM/FGM if it will be readily available in the PSM/FSM.
Table of contents
A table of contents and index for each booklet forming part of the grain stability documentation is to be included.

References to associated drawings
A list of references to associated drawings not included in the PGM such as grain fittings, hydrostatic tables and cross curves.

Main particulars
The vessel's identification, including the IMO number, main dimensions, maximum draught, maximum trim and relevant service information.

Applicable regulations
Reference to the regulations which are basis for the approval and a brief list of the corresponding grain stability requirements. It is to be clearly stated if calculations for "cargo holds filled, untrimmed" are included.

Stability model (P)
Sketch of volumes contributing to buoyancy in the stability calculations.

Reference system and baseline (P)
These are to be clearly defined and maintained throughout the manual.

Preliminary lightship particulars (P)
Based on an estimate or a sister vessel.

Deadweight data (P)
Masses and position of gravity centre of typical deadweight groups or items in order to facilitate simplified calculation of loading conditions such as "consumables departure", "consumables arrival" or standard cargo loads and so forth.

Tank data (P)
Tank plan and capacity tables with following information on each tank:
- tank name/number
- type
- volume
- centre of gravity
- maximum free surface effect.

Sounding or ullage tables may be included for this purpose.

Draught marks (P)
A sketch showing longitudinal position of draught marks, position relative to the hydrostatic reference system and baseline. Information on the correlation between the draught marks and appendages such as azimuth thrusters is to be particularly emphasised. Instructions on how to calculate from draught readings the corresponding draught to be used in tables for hydrostatic data, cross curves and maximum allowable VCG curves, assuming no deflection of hull girders are to be included.

Hydrostatic data (P)
The hydrostatic particulars are to be presented on extreme draught basis in tabular form, from lightship draught to above maximum draught with steps not exceeding 0.10 m. In cases where the vessel is expected to operate with trim, the hydrostatic data must cover the intended trim range. Alternatively, trim correction tables are to be included.

As a minimum, the following hydrostatic data are to be presented:
- displacement moulded (m³)
- displacement extreme (tonnes)
- tonnes per centimetre immersion
- moment to change trim one centimetre
- vertical centre of buoyancy
- longitudinal centre of buoyancy
- longitudinal centre of flotation
- transverse metacentre
- longitudinal metacentre.

Cross curves (P)
The cross curves should be presented on an extreme draught or displacement basis in tabular form, from lightship draught to above maximum draught for at least the following angles of heel: 5, 10, 15, 20, 30 and 40 degrees. If the same curves are also intended for use in connection with grain stability, the curve for 12 degrees is also to be included.

In cases where the vessel is expected to operate with trim, the cross curves must cover the intended trim range and the trim values must correspond with those presented for the hydrostatic particulars.

The cross curves are to be calculated on a "free to trim" basis.

Note:
The values for heeling angles 12 and 40 degrees are an explicit SOLAS/International grain code requirement.

Watertight integrity (P)
Position of critical unprotected openings considered down-flooding points for grain stability calculations.

Flooding angle curve (P)
Flooding angle curves representing the angle of flooding of critical unprotected openings as a function of extreme draught or displacement from lightship draught to above maximum draught.

In cases where the vessel is expected to operate with trim, multiple flooding angle curves covering the intended trim range is to be developed.

Maximum allowable VCG curves (P)
The draught reference point is to be the same as for hydrostatic data.

The curves may be presented on an extreme draught or displacement basis in tabular or curves form from lightship draught to maximum draught.

In cases where the vessel is intended to operate with trim, the curves must cover the trim range.

The curves are to satisfy all stability requirements of the applicable regulations.

Any limitations or conditions related to the application of the maximum allowable VCG curves are to be clearly stated on the curves.

Grain loading information
This shall include:
- curves or tables of volumes, vertical centres of volumes and volumetric heeling moments for every compartment, filled or partly filled, or combination thereof, including the effects of temporary fittings
- tables of volumetric heeling moments for holds "filled, ends untrimmed", if applicable
- curves or tables of maximum allowable heeling moments or other information sufficient to allow the master to demonstrate compliance with the applicable requirements
- details of the scantlings of any temporary grain fittings, feeders, feeder holes and so forth, if assumed in the calculations.

Note:
It is a requirement of the International Grain Code that the heeling moment data for each cargo compartment is to be provided as volumetric heeling moments in the grain loading information.
rather than as actual grain heeling moments. Instructions on how to accomplish the required conversion are to be provided.

The uppermost point on a curve of volumetric heeling moment versus either depth or grain ullage in a partly filled compartment should be based on the void in the filled condition shifted 25%. In other words, the curve of volumetric heeling moments for the partly filled condition should not be terminated at the point, at zero ullage, which represents the volumetric heeling moment based on a 150 shaft as that moment applies only to the filled condition. (IMO MSC/Circ.488)

Grain loading conditions

The presented loading conditions are to include the standard loading conditions required by the applicable regulations such as:

- full load conditions, departure (100% consumables) and arrival (10% consumables) with at least the following stowage factors 1.25, 1.53 and 1.81 m$^3$/t (45, 55 and 65 ft$^3$/t).

If, for reasons of carrying capacity, it is not practicable to carry cargoes with stowage factors less than a certain value, this limitation is to be included in the “Grain loading instructions” below.

Worst intermediate loading conditions are to be presented, if necessary.

As a minimum, the following information is to be presented for each loading condition:

- individual masses with centre of gravity
- free surface moments for slack tanks
- total displacement and corrected centre of gravity
- extreme draughts and total trim
- corrected metacentric height (GM_T)
- maximum allowable VCG or minimum required GM_T
- actual grain heeling moment
- maximum allowable grain heeling moment
- plotted GZ and grain heeling lever curves
- values of applicable stability criteria.

A summary of the loading conditions is to be presented in a tabular form giving information above except individual masses, GZ values and grain heeling lever curves.

Grain loading instructions

These shall include:

- general precautions against capsizing
- instructions on how to verify compliance with the grain loading requirements
- use of free surface correction
- use of cross curves
- use of limit curves
- stability limitations regarding loading of the vessel, including draught to prevent slamming, if applicable
- instructions on emergency situations (storm/damage)
- use of onboard computer in assessing the stability.

Worked example on grain stability

A complete worked example on calculating and checking the stability of a grain loading condition.

Blank grain stability forms

Blank forms for calculating and checking the stability for actual grain loading conditions.

Deadweight scale (P)

Conversion tables (P)

Grain heeling moment calculation

Underlying data related to calculation of grain heeling mo-

ments such as:

- capacity plan giving general dimensions and size of compartments.
- details of hatch covers and hatch coverings, dimensions of deck girders, hatch girders and hatch end beams.
- copy of input and output from computer calculations in addition to the drawings used in connection with the input data and any supporting calculation carried out.

The above information may be submitted separately, and need not be included in the FGM.

3.5 Ships designed to carry timber deck cargoes

3.5.1 Supplementary stability information for ships designed to carry timber deck cargoes may be inserted in the PSM/FGM. If the buoyancy of the timber deck cargo is taken into consideration when calculating the ship's stability all related calculations should be kept in a separate section of the manual and must be clearly marked to avoid confusion with other information.

3.5.2 The presentation in general is to be as for the PSM/FGM and PDC/FDC, but the following supplementary information is to be included:

Stowage plan

Drawing showing the location and dimensions of the deck cargo assumed in the calculations.

Note:

See also IMO Res. A.715(17), “Code of safe practice for ships carrying timber deck cargoes” for general advice on stowing and securing of cargo.

Cross curves

Account may be taken of the buoyancy of the timber deck cargo assuming that such cargo has a permeability of 25% of the volume of the cargo. However, the buoyancy of only one standard superstructure height of timber deck cargo is to be considered.

Maximum allowable VCG curves

If the buoyancy of the timber deck cargo has been taken into account a second limiting curve based on this assumption is to be included.

Loading conditions

Loading conditions indicating the maximum amount of deck cargo having regard to the lightest stowage rate likely to be met in service are to be included. They must at least include:

- full load condition, departure (100% consumables), with the ship loaded to its timber load line, if assigned
- full load condition, arrival (10% consumables).

In arrival conditions it is to be assumed that the mass of the deck cargo has increased by 10% due to water absorption.

Damage stability

For dry cargo ships to which damage stability requirements apply separate PDC/FDC may be submitted covering the conditions with timber deck cargo. The calculation principles and the presentation is basically as for ordinary dry cargo ships, but the buoyancy of the timber deck cargo may be taken into account.

Note:

See also IMO MSC/Circ.998 on IACS unified interpretation “Timber deck cargo in the context of damage stability requirements” (UI SC161).