Maritime & Coastguard Agency

MARINE GUIDANCE NOTE

MGN 611 (M)

Damage Stability: Alternative verification method for tankers - UK interpretations and procedures

Notice to all UK ship operators, ship owners, masters, port state control officers (PSCOs), authorised recognised organisations (ROs), insurance and protection and indemnity (P&I) clubs, and stability consultants.

This notice should be read with ... SI 1996/2154 The Merchant Shipping (Prevention of Oil Pollution) Regulations 1996 as amended; SI 2018/68 The Merchant Shipping (Prevention of Pollution from Noxious Liquid Substances in Bulk) Regulations 2018; IMO MSC.1/Circ.1461 "Guidelines for Verification of Damage Stability Requirements for Tankers"; IMO MSC/Circ.406/Rev.1 "Guidelines for the Uniform Application of the Survival Requirements of the IBC and IGC Code."

Summary

This notice clarifies areas of responsibility and UK procedures when applying the 2014 amendments to MARPOL Annex 1 chapter 1 regulation 3(6) and chapter 4 regulation 28(6) concerning the fitting of stability instruments on board oil tankers and the consequent amendments to the IOPP Certificate in APPENDIX II (Form B). Similar amendments on fitting stability instruments were made at the same time to the IBC Code, BCH or EGC Code, the IGC Code and the GC Code with equivalent modifications to their respective Certificates of Fitness.

Experience gained in applying the associated IMO Guidelines, MSC.1/Circ.1461, since they came into force on 8th July 2013 indicates that there are still some matters requiring clarification and/or interpretation, for example the issuance of waivers from using a stability instrument and the appropriate methods of demonstrating compliance with the required damage stability regulations when such an instrument is not employed either on board or via links to a shore support station.

The aim of this notice is to improve understanding and consistency of application of the Regulations and Guidelines and to re-emphasize that the MCA's expectation is that all UK tankers should be fitting IACS URL5 – Type 3 stability instruments capable of verifying damage stability by direct calculation on the hull form and compartments rather than through use of tables or limiting KG/GM curves.

Only in limited case-by-case circumstances, when evidence is provided to the MCA/RO that the ship will still comply with the IMO requirements by using the alternative verification method, will a waiver be agreed to permit the non-fitment of a stability instrument.

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Definitions

"Tanker", where not otherwise specified, is taken to include oil tankers and chemical tankers (as defined in SI 1996/2154 Part 1.1(2)), gas carriers (SI 1994/2464 Part 1.1(2)) and ships carrying noxious liquid substances (NLS) (SI 2018/68 Part 1.3(1));

"RO" is a Recognised Organisation duly authorised by the MCA to undertake survey and approval work on its behalf under the terms of a survey agreement (MSN1672 specifies). ROs may also be authorised by the MCA to issue waivers to UK vessels in accordance with this Notice;

"PSCO" a Port State Control Officer is a person trained and accredited to carry out PSC inspections in accordance with the Paris Memorandum of Understanding (MOU) on PSC;

"Stability Instrument" denotes an approved stability loading computer system covering all of the applicable intact and damage stability requirements, supplementing (but not replacing) the Stability Information Booklet ("SIB") approved by the MCA/RO and always carried on board;

"KG" is the height of the vertical centre of gravity above the moulded baseline in metres. Where the KG is corrected for the free surface effects it is denoted as KGf (see 2008 IS Code Part B, Chapter 3 for full details);

"GM" is the metacentric height, being the difference between the height of the metacentre (KM) above base and the KG (GM = KM – KG). Where the GM is corrected for the free surface effects it is denoted as GMf (see 2008 IS Code Part B, Chapter 3 for full details).

It should be noted that the value of GM depends on KM, which varies with draught, trim and heel whereas KG is a fixed point based on the distribution of weight and so is independent of draught, trim and heel. Therefore, the equation GM = KM – KG is strictly only valid by using the KM value at a specified draught, trim and heel. In practice the variation in KM due to initial heel can be discounted provided it is limited to no more than 1 degree (MSC.1/Circ. 1461 Part 1 paragraph 4.4 refers) but the variation due to draught and trim can be significant especially on smaller ships.

"KG/GM limit curves" (ref. MSC.1/Circ. 1461 Part 1 Section 4.3) provide a method for the loading officer to assess whether a proposed loading condition complies with the relevant intact and damage stability criteria. The condition is deemed to comply if the KGf is less than the maximum allowable KG or the GMf is greater than the minimum required GM. For the reasons stated, KG and GM limit curves may not be exactly equivalent due to the influence of the variation of KM with draught and trim on the GM limit curves. Care should therefore be taken both in constructing and using the curves to allow for the effect of trim when making the comparison between "actual" and "limiting" KG/GM values.

"Margin" refers to the degree to which a loading condition complies with the regulations. Depending on context, it could refer to the difference between the maximum permitted draught/displacement under the Load Line regulations and the actual value or the difference between the actual KG(GM) and the value derived from limit curves indicating compliance with the intact and damage stability regulations or the residual freeboard of a weathertight or unprotected opening above the equilibrium waterplane. Correction of a loading condition which a stability instrument indicates is failing to comply with the regulations becomes increasingly difficult as the margin of compliance of any given parameter reduces (see paragraphs 2.8 and 7.1 of this notice).

1. Introduction

1.1 Amendments to MARPOL and the tanker Codes (IBC Code, BCH or EGC Code, IGC Code and GC Code) introduce the requirement to fit stability instruments to new tankers (i.e. those constructed on or after January 1, 2016) and existing tankers (constructed prior to that date), as shown in Annex A to this Notice. They include several references to "the Administration" which, for the UK, is the MCA or ROs when they are authorised to act on the MCA's behalf. This MGN clarifies the MCA's policies wherever the regulations may be subject to interpretation and to highlight any areas where ROs or PSCOs may need to refer to the MCA for decisions.

1.2 The process of ensuring that all tankers eventually fulfil the revised regulations is the responsibility of many organisations and individuals: -

- the shipyard/consultant/designer undertaking the stability calculations and producing the statutory intact and damage stability information books;
- the software and hardware engineers designing and producing the stability instruments;
- the owners and operators responsible for ensuring that stability verifications are correctly made on their tankers;
- the approval authorities checking the stability and certifying the instruments;
- those on-board or at shore stations who use the instruments to ensure that the ship complies with the regulations and is safe to sail;
- the surveyors and auditors who check that suitable instruments are installed and working correctly, with appropriate documentary proof that agreed procedures are being followed;
- PSCOs concerned with ensuring that stability verifications are being made correctly on vessels calling at their ports.

1.3 This MGN sets out the background to IMO Circular MSC.1/Circ. 1461 and outlines the MCA's positions on each of the areas of responsibility listed above; the two Annexes of this Notice ("A" with the regulatory text and "B" with more information on each topic) provide further detail as required.

2. Background to IMO Circular MSC.1/Circ. 1461

2.1 The Guidelines in MSC.1/ Circ.1461, dated July 8, 2013, "Guidelines for preparation and approval of tanker damage stability calculations" (the Guidelines) were developed at the IMO after deficiencies in existing tanker damage stability approvals and verification methods were identified during stability approvals, surveys and inspections. Loading to conditions not included in the approved stability information meant some ships had no means to verify that these loading conditions complied with the damage stability requirements.

2.2 A series of data gathering exercises provided evidence to support these concerns, raising doubts relating to damage stability approvals (refer to IMO SLF 52-9-1 for details). Examples of some of the shortcomings found were: -

- For an asymmetric vessel, only considering one side damaged – usually the "most favourable" side;
- For a vessel which is loaded asymmetrically, only considering one side damaged;
- For a vessel subject to two compartment damages (damage in way of a transverse bulkhead), only considering the two compartment damage cases whilst omitting single compartment damages as lesser (and possibly worse) cases;
- For tankers using the critical KG/GM method to demonstrate compliance, not ensuring that loading restrictions required to validate the data are applied;
- When considering the verification made by a stability instrument, it is unsafe to omit damage cases which give a less severe outcome when applied to the approved loading conditions in the SIB (and were omitted on this basis) as operations may not be restricted to these approved loading conditions alone, and a more severe result could occur if the actual loading conditions were to be substantially different from the approved ones.

2.3 Failure to comply with the statutory stability requirements introduces unacceptable risks; the changes to the regulations and this guidance are intended to mitigate those risks (refer to the ISM Code Section 1.2.2).

2.4 The Guidelines are in two parts: -

- **PART 1**: defines how approval of damage stability calculations or stability instruments for new oil tankers, chemical tankers and gas carriers constructed on or after 14 June 2013 should be conducted. Although it directly applies to new approvals, Part 1 summarises all pre-existing guidance with which any previous damage stability approvals should have originally been made, so it may also be used to assess the validity of an existing approval. Technically, an existing stability approval which does not follow the Guidelines is deficient as it does not follow the original instruments against which it is approved (e.g. MARPOL Annex 1). It includes details of the qualifications of the personnel involved, the plans and data to be supplied, the calculation procedures and advice regarding the need to consider all relevant damage cases, including lesser cases of damage to both sides of the vessel and the bottom. It also describes the permissible limits within which damage stability calculations or a damage stability instrument must lie when checked for accuracy.

- **PART 2**: is mainly intended for the guidance of third parties, such as ship operators, ships' officers and PSCOs. Section 6 describes the records required to be kept on board all tankers and gas carriers to demonstrate damage stability compliance for the approved methods of verification listed in Section 4. The processes and records described here are also applicable to existing ships and Section 6 should be considered mandatory once re-certification of existing tankers is completed under the revised Instruments. Part 2 provides guidance for operators and ships' officers to meet their obligations under the ISM Code, and to third parties such as PSCOs and ISM auditors.

2.5 To ensure that tanker crews can reliably verify damage stability on board they must either be fitted with an approved stability instrument (the default position for new ships unless there are compelling reasons not to comply) or, for existing tankers, certified to continue to use a validated and approved existing method. All existing damage stability approvals in place at the time the Guidelines came into force remain valid provided they meet the standards from Part 1 (as this repeats the required practice at the time of the original approval) and on condition that any guidance is being correctly followed.

2.6 The Guidelines were developed by the IMO well before the applicable enforcement date for the changes to MARPOL and the Codes (1/1/2016) and this allowed time for operators to assess what changes, if any, were required to the stability verification methods used on existing tankers and, if deemed necessary, to order new computer systems and have them approved in time to comply with the new regulations within the phase-in period.

2.7 Following the phase-in of changes to the applicable Instruments and re-certification, the default method of damage stability verification shall be carriage of a Type 3 stability instrument, capable of verification by direct calculation. Other acceptable methods of verification, if retained from before re-certification, must be validated against the Guidelines and then authorised under a waiver on the IOPP Form B or Certificate of Fitness (see Annex A). These accepted methods include operating the tanker closely in accordance with loading conditions taken from the approved SIB.

2.8 An issue arose at IMO during development of the Guidelines regarding what degree of variation may be permitted before a tanker cannot be considered as loaded “in accordance with” such a condition. Freedom to vary the loading safely will depend upon the margins of compliance of the approved baseline loading condition and upon guidance as to how this margin may be treated (see Annex B paragraphs 2.4.4, 4.7 and 5.2 of this Notice and Section 4 of the Appendix to Part 2 of Circular MSC.1/Circ.1461 for more details).

2.9 Explicit tolerances, for densities, weights, centre of gravity location and filling levels were not agreed at IMO but, in general, the MCA will apply the tolerances in Table 1 of IACS URL5 rev. 3. For GM Required/KG Max on stability instruments with Type 2 software where comparison is made between the limiting value of KG/GM and the calculated value of KGf/GMf, the input limiting values should be the same as those in the approved SIB; for the calculated values see the tolerances in Table 1 of URL5 Rev. 3.

3. Actions to Take - Shipyard/Designer/Naval Architect/Consultant responsible for producing the Stability Information Booklet for a Specific Tanker

3.1 The minimum requirement for new tankers is possession of a stability information booklet and (usually) a separate damage stability calculation book to demonstrate that the loading conditions included in the stability information booklet will survive damages up to the maximum extent required by the applicable Convention or Code and achieve the minimum residual stability standard. The booklet(s) must then be assessed and approved by the MCA or the RO, if authorised. If approval is granted subject to conditions given by letter or other document, such as a Design Appraisal Document (DAD), a copy of the authorisation letter or document showing those conditions must always be kept with the approved booklet(s).

3.2 The form and content of the stability information booklet should conform to the requirements of the International Code on Intact Stability, 2008, as amended. For damage stability calculations, the type of tanker and the nature of its service will determine what is included and how compliance with the stability criteria is demonstrated. In general, the methodology and the content will be agreed between the MCA/RO and those responsible for

producing the booklets on a case-by-case basis. It is not expected that every single damage case will be included in the damage stability calculation booklet or that those which are included will necessarily be the worst cases.

3.3 The primary IMO instruments to be referenced when compiling the intact and damage stability booklet(s) are listed in Part 1, Section 2 of MSC.1/Circ.1461. Sections 3.2 to 3.4 include information on the scope, assumptions used and required documentation to be submitted for review by the RO, including the lines plan, hydrostatics etc. Section 4 describes the consideration of operating limits, loading patterns, range of loading conditions and the preparation of KG/GM limit curves, as appropriate. Section 6 details the methodology to be used in performing the damage stability calculations.

4. Actions to Take - Software and Hardware Engineers Producing Stability Instruments

4.1 A brief historical introduction to the development of stability instruments and software is given in Annex B section 7 of this Notice. Full details of the various types of stability instrument, describing which are most appropriate for any particular type of tanker, are given in Annex B section 2. Much more detail on the calculation methodology, modelling tolerances etc. is to be found in Part 1, Section 4 paragraph 5, Section 5 and Section 6 of MSC.1/Circ.1461.

4.2 A stability instrument with Type 3 software is required for all new tankers constructed on or after 1 January 2016 and this is also the MCA's preferred option for existing tankers which need to upgrade their hardware/software to meet the new regulations within the phase-in period of 1/1/2016 to 1/1/2021.

5. Responsibility for issuing a Waiver

5.1 Where stability approval has been delegated, and subject to the owner's request for a waiver from fitting a stability instrument to be granted, it is the RO's responsibility to notify the MCA so that it may be agreed in accordance with this Notice, whether an existing tanker may retain the current method of damage stability verification under a waiver or be provided with a stability instrument meeting the revised regulations. The RO should therefore provide the MCA with reasons for accepting the waiver and a recommendation so that the MCA can consider the matter and, if appropriate, issue a waiver letter (see also paragraph 6.3 below).

5.2 In Annex B section 3 to this Notice, a simplified flow chart is included to assist all those involved with deciding whether an existing tanker must be fitted with a stability instrument to meet the latest regulatory requirements or if the existing verification method may be retained.

6. Actions to Take - ROs Authorised to act on behalf of the MCA

6.1 The MCA authorises ROs to undertake stability approval on its behalf through a written agreement between the MCA and the individual RO concerned (ref. Survey and Certification Instructions to Surveyors Part B, Chapter 8 Table 2). For oil tankers of greater than 100 metres in length and chemical and bulk gas carriers of any size, the MCA has authorised all ROs to undertake all stability approvals and certification (including stability instruments) necessary to show compliance with MARPOL and the tanker Codes, following the amendments shown in Annex A. It is the aim of this document to clarify the MCA's policies where there is scope for interpretation of the amended regulations and Codes, to ensure consistency of authorised approvals with the MCA's objectives.

6.2 One area of specific interest is the issue of waivers under MARPOL Annex 1, Chapter 1 regulation 3(6) and the equivalent paragraphs in the tanker Codes which allow scope for interpretation, in the sub-paragraph concerning existing tankers which demonstrate compliance using limiting KG/GM curves.

6.3 Details of how applications for waivers should be dealt with are given in Annex B, section 4 of this Notice, with attention drawn to paragraph 4.2. It should be borne in mind that the amended International Instruments make fitment of an approved stability instrument compulsory and that the issue of a waiver is not an automatic right but should only be considered where existing means of verification are confirmed by the RO to be equally effective. The MCA's preference is for all UK tankers to have their damage stability verified by Type 3 stability instruments fitted on board or alternatively at shore stations (see also Annex B paragraph 4.9).

6.4 The MCA has the ultimate responsibility for granting waivers to UK flagged tankers under the procedure outlined in Annex B, sections 3, 4, 5, and 8 of this Notice. In every case where a waiver is required, the MCA should be notified well in advance to enable consultations to be held with the operators and the RO. The resulting waiver document or approval letter will be issued by the MCA with copies sent to the ship and the RO

6.5 Another important issue for existing tankers being fitted with new Type 3 stability instruments is how to deal with a situation where the output is incompatible with the previously approved SIB and/or damage stability calculations. It may be found that damage stability studies of existing vessels do not comply with the Guidelines (since they were issued and approved well before the Guidelines were created) and often assert compliance with the regulations of loading conditions that are shown not to be compliant by the loading instrument when the latter is correctly following the Guidelines. The question arises as to whether the approving authority should insist that the SIB and/or damage stability calculations be corrected, re-issued and re-approved such that the results are fully compatible with those produced by the new Type 3 stability instrument.

The MCA's position on this issue is that the approving authority shall seek to understand why the differences have arisen. If the differences are attributable to modern and more accurate calculation methodologies in comparison with, for example, the use of look-up tables in the SIB, the instrument may be approved, and the damage stability calculations/SIB will not require to be revised and re-approved. If the differences are due to fundamental changes to the stability information for the ship (including, but not limited to, items such as openings, arrangement, maximum draught etc.), then the original SIB and damage stability calculations must be revised and re-approved in conjunction with the approval of the stability instrument.

6.6 In general, the SIB includes loading conditions covering the intact situation which are aligned with those in the stability instrument. If the damage stability calculations are not in accordance with the Guidelines, then the SIB is invalidated for the purpose of evaluating any condition of loading and cannot be used. **The results from the approved stability instrument take precedence**. The SIB should be kept on board and but not used for validating the damage stability. This must be made clear to the owners/operators/PSCOs by endorsing the SIB and updating the Document of Compliance for the ISM Code.

6.7 For further clarification, new tankers constructed on or after 1 January 2016 must have a SIB fully compliant with the Guidelines and approved accordingly as well as an approved stability instrument fitted with Type 3 software. The legal verification that each loading condition complies with the intact and damage stability requirements before the tanker departs is made by the approved stability instrument. Only on those occasions when the tanker loads exactly in accordance with a condition in the approved SIB would it be expected that the results would

align precisely. More usually, the approved stability instrument can be relied upon to give accurate and reliable results for all loading conditions, whether or not they are included in the approved SIB.

6.8 Tankers constructed before 1 January 2016 are required, by 2021 (see Annex A paragraphs 1 to 6 for exact dates), to validate stability by a stability instrument approved in accordance with the Guidelines or by any other existing method which is also validated against the Guidelines. **Only one validated system is required**. An existing SIB cannot generally be used for this purpose with the one exception of where the tanker is always loaded in accordance with approved loading conditions, which for many ships would be highly restrictive operationally.

7. Actions to Take - Ship or Shore-based Stations Carrying out Stability Verification

7.1 Loading officers and their equivalent at shore-based stations must be familiar with the new requirements to fit stability instruments capable of verifying compliance with the intact and damage stability criteria prior to departure and at arrival (see Annex A of this Notice). Special attention should be paid on tankers with low margins, as indicated by the difference between the actual KG or GM and the limiting value. Where a tanker must ballast to compensate for consumables used during the voyage it is also necessary to confirm compliance with stability criteria at the beginning and end of the ballasting sequence (say with 5% and 95% of the total ballast used) with due allowance for the free surface effect. Part 2 Section 5 of MSC.1/Circ.1461 suggests some choices open to the operators should any proposed loading condition not comply with the intact and/or damage stability criteria.

7.2 There may well be difficulties where a new stability instrument has been installed on an existing tanker with a previously approved SIB. For example, older SIBs often: -

- only contain a very limited number of damage cases,
- only show damages on one side,
- only account for maximum damage extents
- take no account of intermediate phases of flooding.

This can result in the stability instrument showing non-compliances for approved loading conditions which lie close to the ship's limits. If these indications of non-compliance are persistent then the loading officer should notify the owner/operator/naval architect who should try to identify the causes and, if possible, make the necessary corrections to the loading conditions – for example by imposing deadweight restrictions – in consultation with the ROs. However, it should also be borne in mind that the revisions to MARPOL regarding stability instruments were designed to ensure that "marginally compliant" existing ships would in future fully comply with the regulations, hence the phase-in period to allow, *inter alia*, time for such issues to be resolved.

7.3 Not all tankers will necessarily be fitted with a stability instrument. If not so fitted they should be certificated by the MCA to confirm that this requirement has been waived and that a satisfactory alternative method may be used to demonstrate compliance with the stability criteria (see Annex B, paragraph 4.2). More information on demonstrating compliance is shown in Annex B, Section 5, which also contains a table showing the documentary evidence of compliance to be made available to surveyors and Port State Control Officers (PSCOs) depending on which verification method is being employed.

7.4 Attention is also drawn to Annex B, Section 6 regarding ISM procedures, including the need for checklists, and how these should ensure that appropriate records are available to demonstrate that a tanker crew or a shore-station has verified compliance with intact and damage stability criteria in accordance with the new Regulations. Co-operation between the loading officers, owners, surveyors and authorities is necessary to ensure that appropriate means are provided for this, that they are being correctly used and that documentary evidence is produced for inspection by surveyors and PSCOs. If any of the parties involved have doubts about any of these aspects the MCA or RO should be advised.

7.5 When shore-based support is provided, there should be a contract for the supply of such support at all times during the validity of the ship's certificate. Such support should be manned by adequately qualified persons with regard to stability and ship strength; no less than two qualified persons should be available to be on call at all times. The shore-based support should be operational within one hour of initial contact (i.e. with the ability to input details of the condition of the ship, as instructed by the crew or owners). The contract for the supply of shore-based support should be readily available for inspection at all times.

8. Actions to Take – MCA Surveyors and Port State Control Officers (PSCOs)

8.1 Surveyors and PSCOs boarding a tanker to conduct a renewal survey or routine inspection are advised to check that an approved stability instrument has been installed (see Flow Chart in Annex B, Section 3) and is working correctly or, if no stability instrument is fitted, that a valid waiver has been recorded and the specified alternative method for verifying the intact and damage stability prior to departure is satisfactory and is being correctly used. They should also check that there has been no change in operational profile which may invalidate the terms of the waiver.

8.2 If no certificate can be produced this is grounds for detention. If the certificate has been completed incorrectly this should be recorded as a deficiency to be rectified. If there is a waiver and the specified method is clearly wrong or incapable of making the necessary verification (for example, a waiver issued to allow the tanker to carry on using an old, ineffective system) then the tanker may be detained. If a new tanker has a waiver, this must be questioned but may not be a deficiency if the verification is satisfactory. See Annex B, Section 4 of this Notice for more information.

8.3 Section 5 of Annex B contains some checks which may be carried out to determine that the new damage stability regulations are being followed where no stability instrument is fitted; it also contains a tabular checklist of the documentation needed to demonstrate that one of the verification methods permitted by MSC.1/Circ.1461, Part 2 Section 6 is being employed.

8.4 For tankers already fitted with a stability instrument, attention is drawn to paragraphs 5.5.3 and 5.6.2 of Annex B, regarding appropriate documentation, and paragraph 7.1 regarding the requirement to ensure ship’s loading officers are aware of the need to verify compliance with the stability requirements prior to departure and the options available to them for corrective action should the proposed loading condition not fully comply.

8.5 Finally, Annex B Section 6 of this Notice contains some notes on what surveyors and PSCOs should look for as they check that the Guidelines are being followed, mentioning, in particular, the ISM Code requirements (e.g. Sections 1.2.2, 6.1, 6.2, 7, 10 and 12) with respect to the characteristics of Type 3 software.

9. Summary and Conclusions

9.1 This MGN is intended to promote a better understanding of the complexities of damage stability verification, the methods currently employed for this and their potential shortcomings, and why these have resulted in a change to the Regulations.

9.2 Although calculation of the damage stability of tankers is complex, recent advances in computer hardware and software are enabling the analysis to be performed increasingly quickly using onboard systems, which the MCA considers preferable to placing reliance upon shore-based stations. The recent amendments to MARPOL and the associated tanker Codes promote the use of these improved computer systems in preference to using simplified manual and semi-manual methods for verifying compliance with damage stability regulations.

9.3 The MCA prefers the use of stability instruments utilising Type 3 software on all tankers subject to these recent amendments even though existing approved methods of verification may still be permitted to be retained on tankers constructed before 1st January 2016.

9.4 It is intended that this MGN also shows why the MCA believes that running Type 3 software on an onboard stability instrument is the most reliable and cost-effective way for operators of tankers to ensure that they meet their statutory obligations. Such systems satisfy the aim of demonstrating compliance with the stability regulations to third parties thereby helping to fulfil the ultimate objectives of minimizing loss of life and potential damage to the environment following incidents at sea.

More Information

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Please note that all addresses and
telephone numbers are correct at time of publishing.

Safer Lives, Safer Ships, Cleaner Seas.

ANNEX A – Amendments to MARPOL and the Tanker Codes

1. MARPOL Annex 1 was amended on May 22, 2014 by the addition of Chapter 4 paragraph 28(6) and Chapter 1 paragraph 3(6), which state respectively that: -

28.6 All oil tankers shall be fitted with a stability instrument, capable of verifying compliance with intact and damage stability requirements approved by the Administration having regard to the performance standards recommended by the Organization:*

.1 oil tankers constructed before 1 January 2016 shall comply with this regulation at the first scheduled renewal survey of the ship on or after 1 January 2016 but not later than 1 January 2021;

.2 notwithstanding the requirements of subparagraph .1 a stability instrument fitted on an oil tanker constructed before 1 January 2016 need not be replaced provided it is capable of verifying compliance with intact and damage stability, to the satisfaction of the Administration; and

.3 for the purposes of control under regulation 11, the Administration shall issue a document of approval for the stability instrument.

** Refer to part B, chapter 4, of the International Code on Intact Stability, 2008 (2008 IS Code), as amended; the Guidelines for the Approval of Stability Instruments (MSC.1/Circ.1229), annex, section 4, as amended; and the technical standards defined in part 1 of the Guidelines for verification of damage stability requirements for tankers (MSC.1/Circ.1461).*

*3.6 The Administration may waive the requirements of regulation 28(6) for the following oil tankers if loaded in accordance with the conditions approved by the Administration taking into account the guidelines developed by the Organization**: -*

.1 oil tankers which are on a dedicated service, with a limited number of permutations of loading such that all anticipated conditions have been approved in the stability information provided to the master in accordance with regulation 28(5);

.2 oil tankers where stability verification is made remotely by a means approved by the Administration;

.3 oil tankers which are loaded within an approved range of loading conditions; or

.4 oil tankers constructed before 1 January 2016 provided with approved limiting KG/GM curves covering all applicable intact and damage stability requirements.

*** Refer to operational guidance provided in part 2 of the Guidelines for verification of damage stability requirements for tankers (MSC.1/Circ.1461).*

2. Ships constructed under the IBC Code, BCH or EGC Code before 1 January 2016 are also to be fitted with stability instruments at the first renewal survey after that date and no later than 1 January 2021.

3. For GC Code vessels, the compliance dates are the same but compliance is required at the first periodical (rather than renewal) survey after 1 January 2016.

4. For IGC Code vessels constructed prior to 1 July 2016 compliance is required at first renewal survey after this date and no later than 1 July 2021.

5. In addition, the MARPOL IOPP Certificate in Appendix II (Form B) now includes the following extra paragraphs: -

5.7.5 The ship is provided with an Approved Stability Instrument in accordance with regulation 28(6)…….....……..……..……. o

5.7.6 The requirements of regulation 28(6) are waived in respect of the ship in accordance with regulation 3.6. Stability is verified by one or more of the following means:

.1 loading only to approved conditions defined in the stability information provided to the master in accordance with regulation 28(5) ……..……..……... o

.2 verification is made remotely by a means approved by the Administration…..... o

.3 loading within an approved range of loading conditions defined in the stability information provided to the master in accordance with regulation 28(5)……..……..……..… o

.4 loading in accordance with approved limiting KG/GM curves covering all applicable intact and damage stability requirements defined in the stability information provided to the master in accordance with regulation 28(5) ..... o

6. Similar modifications were made to the Certificates of Fitness in the other Codes as follows: -

That the ship must be loaded:

.1 only in accordance with loading conditions verified compliant with intact and damage stability requirements using the approved stability instrument fitted in accordance with paragraph 2.2.6 of the Code;*

.2 where a waiver permitted by paragraph 2.2.7 of the Code is granted and the approved stability instrument required by paragraph 2.2.6 of the Code is not fitted, loading shall be made in accordance with the following approved methods:*

(i) in accordance with the loading conditions provided in the approved loading manual, stamped and dated ..... and signed by a responsible officer of the Administration, or of an organization recognized by the Administration; or

(ii) in accordance with loading conditions verified remotely using an approved means ……; or

(iii) in accordance with a loading condition which lies within an approved range of conditions defined in the approved loading manual referred to in (i) above; or

(iv) in accordance with a loading condition verified using approved critical KG/GM data defined in the approved loading manual referred to in (i) above;

.3 in accordance with the loading limitations appended to this Certificate.*

Where it is required to load the ship other than in accordance with the above instruction, then the necessary calculations to justify the proposed loading conditions shall be communicated to the certifying Administration who may authorize in writing the adoption of the proposed loading condition.

_____

** Delete as appropriate.*

7. The UK legislation covering the requirement to meet the damage stability criteria specified in MARPOL and supply loading information to the master is contained in SI 1996/2154 "The Merchant Shipping (Prevention of Oil Pollution) Regulations" 1996, as amended: -

29. (1) Every new oil tanker shall comply with the subdivision and damage stability criteria specified in Schedule 5, in Merchant Shipping Notice No. 1643/MARPOL 1.

(2) The master of every new oil tanker and the person in charge of a new non-self-propelled oil tanker to which these Regulations apply shall be supplied by the owner with—

(a) information relating to loading and distribution of cargo necessary to ensure compliance with the provision of this regulation; and

(b) data on the ability of the ship to comply with the damage stability criteria prescribed by this regulation, including the effect of any lesser requirements that may have been imposed by the Secretary of State.

Such information and data shall be supplied in an approved form.

8. Tankers constructed on or after 1 January 2017 must also comply with the Polar Code (Ref. IMO resolution MEPC.264(68) or MSC.385(94)) when being operated in polar waters.

ANNEX B – Background and Supplementary Notes

1. Introduction

1.1 In 2005 the UK became concerned that high risk ships such as oil, chemical and gas tankers were regularly being operated in conditions of loading which had not been shown to comply with damage stability requirements. Evidence showed that vessels were frequently operating in conditions of loading different from their approved conditions but had no approved means on board to verify compliance with damage stability criteria, and that loading conditions were not being submitted to the MCA or the RO for verification as required. Similar issues were identified on foreign flag ships calling at UK ports.

1.2 It was also evident that it is difficult to demonstrate damage stability compliance for such vessels. This finding was inevitable where vessels were operating to loading conditions different from those in the approved SIB but had no means of making a damage stability verification. The UK gathered evidence from tanker operators, during port state control inspections and through discussions with ship operators to support a submission made to the SLF52 Sub-Committee at the IMO to highlight the issues (see SLF 52/9/1).

1.3 As a result, the IMO produced the "*Guidelines for verification of damage stability requirements for tankers*", MSC.1/Circ.1461, dated 8th July 2013. The Guidelines represent a crucial element in the correct computation of tanker damage stability to ensure compliance with the mandatory Codes and Instruments. The MCA is also aware that there are areas of the Guidelines and the amendments to the Codes where there is scope for interpretation by the Administration. This MGN highlights these areas and clarifies any resulting issues to enhance consistency of application of the Guidelines and Codes by all parties.

2. Characteristics of Approved Loading Computer Systems

2.1 The International Association of Classification Societies (IACS) had previously introduced a unified requirement relating to stability computation under URL5, with the objective that any loading instrument fitted on an IACS classed vessel contracted after 1 July 2005, which incorporates a stability element, should be approved for verification of all stability requirements that apply, including damage. The requirement that a stability instrument installed on board should cover all applicable stability requirements is also included in Part B Chapter 4 Reg. 4.1 of the IS Code 2008, which is recommendatory rather than mandatory in nature. URL5 only applies to ships contracted after 1 July 2005 and not to stability instruments fitted on existing ships after this date. Also, from a Classification perspective, new vessels did not need to have a loading instrument capable of checking stability at all, so a loading instrument which only checks longitudinal strength could still be fitted.

2.2 It is therefore important to underline what constitutes an IACS URL5 stability instrument in the context of verifying that the damage stability of tankers complies with the amended Codes and Instruments. The following are extracts from URL5 Rev. 3, entitled "*On-board Computers for Stability Calculations*": -

> ***Application*** *"… stability software installed on board shall cover all mandatory class and statutory intact and damage stability requirements applicable to the ship. This UR requires approval of software, installed on on-board computers which is capable of performing stability calculations."*

3 "Four types of calculations performed by stability software are acceptable depending on a vessel's stability requirements:

***Type 1** – Software calculating intact stability only (for vessels not required to meet a damage stability criterion);*

***Type 2** – Software calculating intact stability and checking damage stability on the basis of a limit curve (e.g. for vessels to which SOLAS Part B-1 damage stability calculations etc. apply) or checking all the stability requirements (intact and damage stability) on the basis of a limit curve.*

***Type 3** – Software calculating intact stability and damage stability by direct application of pre-programmed damage cases based on the relevant Conventions or Codes for each loading condition (for some tankers etc.)*

***Type 4** – Software calculating damage stability associated with an actual loading condition and actual flooding case, using direct application of user-defined damage, for the purpose of providing operational information for safe return to port (SRtP).*

Damage stability of both Type 3 and Type 4 stability software shall be based on a hull form model, that is, directly calculated from a full three-dimensional geometric model."

4.1.2 "A clear warning shall be given on screen and in hard copy printout if any of the loading limitations are not complied with.

Loading limitations shall include, but may not be limited to:

- *Trim, draught, liquid densities, tank filling levels, initial heel;*
- *Use of limit KG/GM curves in conjunction with above for Type 2 ……..."*

4.1.3 "Type 3 software is to include pre-defined relevant damage cases according to the applicable rules for automatic check of a given loading condition"

4.1.7 For Type 3 (and Type 4) software, the system shall be pre-loaded with a detailed computer model of the complete hull, including appendages, all compartments, tanks and the relevant parts of the superstructure considered in the damage stability calculation, wind profile, down-flooding and up-flooding openings, cross-flooding arrangements, internal compartment connections and escape routes, as applicable and according to the type of stability software.

4.1.8 For Type 1 and Type 2 software, in case a full three-dimensional model is used for stability calculations, the requirements of the computer model are to be as per paragraph 4.1.7 above to the extent as applicable and according to the type of stability software."

2.3 It can be seen from the above definitions in URL5 that software only dealing with strength and/or with intact stability (**Type 1**) is insufficient to comply with the Guidelines even if fully approved and certified.

2.4 **Type 2** software is generally suitable for ships carrying dry cargo or passengers and which do not carry bulk liquid cargo. For these ships the consequences of damage are limited, and the worst-case scenarios usually occur when damage is applied to spaces which are initially assumed dry and empty and then fill up to the outside water-plane at final equilibrium. The procedures for calculating the results of these damages are fixed and well defined and relatively simple to conduct when compared to those involving the loss and replacement of an unknown existing liquid cargo by sea water. A ship of this type, suffering asymmetric damage, will almost always list towards the damaged side. Dry cargo and passenger ships of this type may be supplied with **Type 2** software, which operates by comparing the live condition KG or GM with a limiting value interpolated from pre-calculated limiting KG/GM curves or tables obtained from the approved SIB and which ensure that all mandatory damage cases can be survived for the input draught and trim.

2.4.1 Although tankers may be provided with approved limiting KG/GM curves covering all possible cases of intact and damage stability in accordance with Part 1 Section 4.3 of the Guidelines, in practice these are expensive to produce, can be complex to use and often restrict operability and flexibility because they must err on the conservative side for safety. Another difficulty for certain types of tanker is in providing limiting KG/GM curves which cover **all** foreseeable combinations of loading and damage stability involving varying tank filling depths, cargo specific gravities (SG's), draughts and trims etc. as required by MARPOL Annex 1, Regulation 3(6.4), for example.

2.4.2 To produce these curves or tables involves pre-calculating a very large number of damage/loading scenarios with no absolute guarantee that the full range of possible loading scenarios has been covered. In practice, extensive limit curve sets presented in a SIB may be used erroneously due to their complexity. Consequently, it is recommended that Type 3 stability software is installed for use on board, rather than using limit curve sets which would have been derived using a similar calculation approach (but with constraints and limitations).

To avoid complications associated with developing suitable KG/GM limit curves and their potential restriction on operational capacity, the MCA strongly recommends that Type 3 stability software is fitted on board.

2.4.3 Where operators choose to install **Type 2** software to meet the new carriage requirement for tankers, it should be appreciated that to meet the above concerns this will require any loading limitations needed to simplify the limiting KG/GM data to be rigidly defined, and for operational procedures to be put in place so these limitations can be demonstrated during audit or inspection.

2.4.4 Where waivers have been granted for tankers using consistent loading patterns (e.g. SG and tank filling) which have been approved in the SIB, it is important that such conditions are always adhered to. Tankers only loading to these approved conditions should preferably be provided with guidance indicating the tolerance of each parameter (e.g. draught, trim, KGf, tank filling and cargo SG). Alternatively, each new loading condition should be submitted for approval, for which a fee may be charged.

2.4.5 Alternatively, as described in Part 1 Section 4.2 of the Guidelines, to afford more flexibility and to avoid the necessity of adhering closely to the approved loading conditions, tankers can be supplied with a matrix clearly defining the allowable ranges of loading parameters such as draught, trim and KGf for ensuring compliance with the intact and damage stability criteria. Such information should be included in the approved SIB.

2.5 For **Type 3** stability software, “direct calculation” means that the stability instrument utilises a full 3-D geometrical model of the ship including all damageable compartments, tanks and spaces, and is programmed to analyse all the potential damage scenarios required by the relevant Code or Instrument (including the Polar Code if operating in polar regions, see Annex A, paragraph 8) when applied to the proposed loading conditions. Prior to sailing, the proposed loading conditions for the voyage (departure and arrival and, possibly, intermediate to allow for in-voyage ballasting operations, for example) are input into the stability instrument for assessment against the appropriate intact and damage stability criteria.

2.5.1 Once the initial heel is less than 1 degree (see Part 1 paragraph 4.4 of the Guidelines) and the intact stability is satisfactory, the **Type 3** software must then automatically analyse all the pre-set damage scenarios for each loading condition using the actual filling depths and SG’s for all liquid-carrying tanks together with an assumed permeability for dry spaces such as the engine room and storerooms. The resulting damage stability residual GZ curves for each loading/damage scenario must be calculated to both port and starboard over a comprehensive range of heel angles, at the same time allowing the tanker to be free to trim, with due allowance being made for movement of free liquid surfaces in the undamaged tanks.

2.5.2 A simplifying assumption for the final equilibrium condition after damage is that where tanks containing liquids are damaged the tank contents are assumed to be completely lost and replaced with sea water up to the final equilibrium water-plane (see Part 1, paragraph 6.4.3 of the Guidelines). However, it is also necessary to calculate intermediate stages of damage which accounts for variation in SG within the tank over time as the tank contents mix and are replaced by the incoming sea water (see Part 1 paragraph 9.3 of the Guidelines) to show if a worse scenario could arise during flooding. In practice the lowest residual GZ curve normally occurs at final equilibrium when the cargo has been fully replaced by sea water.

2.5.3 A significant concern is that the calculation of intermediate stages of flooding as just outlined using the on-board stability instrument could take an excessive amount of time especially if, for example, six stages of flooding per damage case are to be calculated as shown in Appendix 5 of Part 1 of the Guidelines. The MCA’s position on this is that the bulk of the calculation work should be undertaken at the design stage rather than using the onboard stability instrument. The approving authority must be satisfied that the number of stages chosen is sufficient to ascertain whether or not any particular intermediate stages produce worse results than the final stage for a specific damage case. If so, that damage case must be computed on board with sufficient stages to identify the worst flooding level. Whilst it is important not to over-burden the onboard computer with too many calculations it is equally important to ensure that the worst IS cases and stages are identified and analysed at the design stage so the computer can be “alerted” to the risk and programmed to include any affected damage cases accordingly. Experience tends to show that in only relatively few damage cases (most typically the engine room) does an intermediate stage produce worse results than the final stage.

2.5.4 Questions have arisen as to how to reconcile the results from the stability instrument with the various methods for calculating cargo outflow and flood water inflow at intermediate stages, as described in Part 1 paragraph 9.3 of the Guidelines, especially where the approved SIB and damage stability calculations do not specify which alternative has been used. The Guidelines are quite specific on these issues (see Part 1 Section 6 – "Methodology") and the MCA's position is that, for new ships, the calculations should be undertaken and approved for compliance with the Guidelines. Both the SIB and the stability instrument should use the method one of the methods recommended in the Guidelines. If a waiver from installation of a stability instrument has been issued and evidence is found that cargo outflow has not been correctly allowed for in the accordance with the Guidelines, then the damage stability calculations must be corrected and re-submitted for approval along with a revised SIB.

For existing ships, the results from the approved stability instrument have precedence over those in the SIB. It is most important that the stability instrument should adhere strictly to the Guidelines in MSC.1/Circ.1461. No attempt should be made to adjust the software to try to match whatever method may have been used in the SIB if this is not accordance with the Guidelines. It is essential that, following amendments, all stability is approved to a common set of Guidelines. There must not be any chance of flexibility or interpretation, and the whole purpose is lost if new approvals are undertaken by repeating poor practice identified in the original approval.

2.5.5 For tankers it is not unusual for the list at final equilibrium to lie on the opposite side to the damage, depending on the SG of the lost liquid and/or the original tank filling depths. It is possible for a single damage case to cause list in different directions when applied to different loading conditions in the SIB. It is for this reason that all residual GZ curves must be calculated right across the range of angles to both port and starboard with assessment for compliance to be made on the side closest to non-compliance with the stability criteria, this not necessarily being the side at which the tanker achieves equilibrium (see Part 1 paragraph 8.2 of the Guidelines).

2.6 **Type 4** stability software is not mandatory for tankers, but user-defined damage assessment could be employed to compute damage stability for non-standard scenarios beyond those stipulated by MARPOL and the tanker codes provided that the basic functions of approved **Type 3** software are still available for routine verification purposes.

2.7 From the above it can be seen that the variability in the capabilities of existing on-board systems, even if approved and certified, means that their breadth of application needs to be well understood by ships' officers, other users, certifying authorities and those undertaking Port State Control inspections. All need to have a thorough understanding of what the approval certificate should cover. To assist in this assessment, section 3 below contains a flow chart to help identify what may be on board any "existing" (as opposed to "new") tanker in terms of hardware, software and certification and whether further actions, if any, are needed to comply fully with the modified Codes, Instruments and the Guidelines.

3. Flow Chart to assess the suitability of existing tankers for issue of a waiver in accordance with the amended Codes, Instruments and Guidelines.

3.1 Below is a flow chart to explain the process of assessing suitability for issue of a waiver. This is intended to be indicative and may not cover every eventuality. If in doubt, then advice may be sought from the RO, or the RO may seek advice from the MCA.

3.2 To be considered for the issue of a waiver, other than one issued for verification at a shore office, the following minimum conditions must be met: -

1. The operator must be able to show a continuous previous history of stability management of the vessel which ensures compliance with both intact and damaged stability requirements.

2. The method used for historical damage stability management can only be accepted for continued use under a waiver if it is validated by the RO as meeting all requirements of the Guidelines published under MSC.1/Circ.1461, and that there is evidence of continuous application as per 1 above.

3. If the method used historically does not meet the Guidelines, so does not fully demonstrate compliance with damage stability requirements, a stability instrument must be fitted.

3.3 Waivers may not be issued to UK vessels in respect of new methods of stability management proposed as an alternative to fitting the required stability instrument. Where existing methods of demonstrating compliance are deemed deficient in some way then the solution is to fit a Type 3 stability instrument and not seek a waiver based on employing another alternative method.

<u>In the Flow Chart below: -</u>

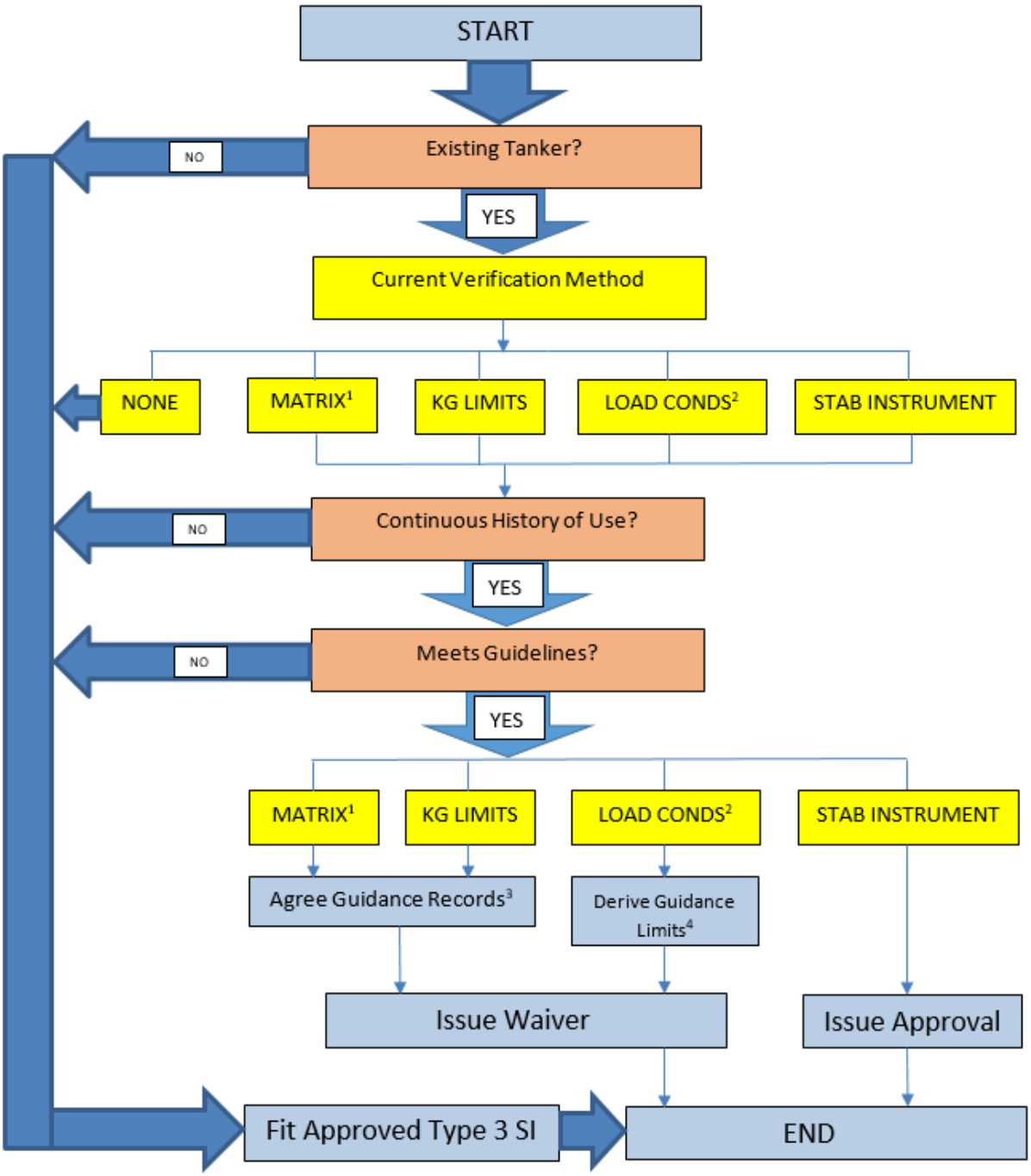
1. “MATRIX” refers to operating within a range of consistent loading conditions as described in paragraph 2.4.4 above.

2. “LOAD CONDS” refers to loading conditions in accordance with those included in the approved SIB as described in paragraph 4.7.

3. “Agree Guidance Records” requires confirmation that relevant procedures are in place
and suitable records maintained for audit purposes.

4. “Derive Guidance Limits” – see paragraph 4.7.4 for full details.

FLOW CHART TO ASSESS WHETHER A TANKER COMPLIES WITH THE AMENDED REGULATIONS AND GUIDELINES FOR FITTING A STABILITY INSTRUMENT (SI)



4. Waivers – who can issue them and under what circumstances?

4.1 Waivers are issued by the MCA. Where stability approval has been delegated, the RO should work in conjunction with the MCA to assess the validity of the request for a waiver to be granted (see paragraphs 5.1 and 6.3, above). The MCA will continue to assess the ability of the RO's to meet UK expectations as part of the ongoing stability monitoring process. Following the phase-in of changes to stability instruments to meet the new regulations, the default method of damage stability verification on UK ships shall be carriage of an Instrument capable of verification by direct calculation i.e. an IACS URL5 – **Type 3**. Any new approval of such stability instruments made after the Guidelines were introduced on 14th May 2013 should follow this guidance, including those fitted on existing vessels.

4.2 Other methods of damage stability verification, if retained from before re-certification, must be validated against the Guidelines and then specified under a waiver on the IOPP Form B or Certificate of Fitness. Issuing a waiver is justifiable only if enforcing the installation of a new stability instrument on a vessel would be unreasonable because it already does effective damage stability verification by another accepted means. **Requesting a waiver to avoid fitting a new stability instrument is not acceptable and should not be sanctioned by MCA/ROs unless all appropriate checks have been made in accordance with the Guidelines. In case of doubt the MCA should be consulted.**

4.3 If new-style certification is issued in advance of the application dates specified in Section 2 above then it might not specify that a stability instrument is fitted. Such certification may include a waiver for continued use of existing stability information in which case validation of the verification and maintenance of records in accordance with the Guidelines is not compulsory until the date of application in the amended IMO Instrument.

4.4 PSCOs should be aware that for some tankers a lines plan may not be available from which a computer model can be prepared for use in a stability instrument. Under these circumstances the operators of such tankers may apply increased pressure to obtain a waiver, but the increased cost for compliance is on its own insufficient justification to issue a waiver – they would have to demonstrate that they already make satisfactory stability verification using another means.

4.5 Before a waiver can be considered and issued the operators must be able to demonstrate that there is in place an existing ability to verify damage stability by one of the six approved methods listed in Section 4 Part 2 of the Guidelines: -

.1 the tanker loads strictly in accordance with the conditions in the approved SIB (see 4.7);

.2 if not to be loaded in accordance with the approved SIB, all new, previously unapproved, loading conditions may be sent to the authorised RO for approval before departure;

.3 alternatively such unapproved loading conditions may be approved prior to departure by an appointed shore-based operating company using an approved loading instrument;

.4 if the tanker has an approved stability instrument with Type 2 stability software on board, it may be used to verify the loading conditions on board or at the authorised shore station, but see sections 2.4.1 and 2.4.2 above;

.5 use of an approved stability instrument must be authorised by the MCA/RO and the software approved and certified as either Type 2 or Type 3 (see section 3 above for details);

.6 alternatives such as operating within an approved range of loading conditions (see section 2.4.4 above) or using approved combined intact and damage stability KG/GM limit curves (see sections 3.4.1 and 3.4.2, above) are permitted provided that any restrictions in their use are observed and evidence of their regular use can be demonstrated on board (see section 5).

4.6 It should be noted that existing stability instruments, even those with approval certificates, may not fully comply with the new requirements in the Guidelines. For example, some existing systems are approved and certified but only for intact stability or strength calculations. It is essential that on-board stability instruments are approved and certified to undertake damage stability calculations as well as intact stability and/or strength as appropriate.

4.7 The most common waiver likely to be issued is one permitting continued loading “in accordance with”, “closely to” or “not significantly different from” an approved loading condition. For a waiver to be granted under these circumstances, loading should be made strictly in accordance with an approved loading condition except that, to permit practical operation of such tankers, small variations in cargo SG, stores and minor tank fillings may be accepted.

1. It is recommended that a tanker which loads within the boundary provided by an approved pair of departure and arrival loading conditions, derived from a fixed distribution of cargo and ballast, may be considered to be loaded “in accordance with” these conditions.

2. To satisfy this recommendation the proposed loading condition should fall within the following limits: -

.1 displacement, to fall within the range of displacements of the approved departure and arrival conditions;

.2 KG, corrected for free surface, to fall below a value determined by linear interpolation at the displacement of the proposed loading condition between the respective KG values at the approved departure and arrival conditions used to verify damage stability compliance;

.3 if GM is used rather than KG, the value at the proposed loading condition, corrected for free surface, should fall above the value determined, as for KG, by linear interpolation between the approved departure and arrival conditions;

.4 trim, to fall within the range of trims encompassed by those of the approved departure and arrival conditions.

3. No further relaxations or deviations are permitted, unless specifically approved by the MCA/RO.

4.8 The amendments to international instruments permit a waiver to be issued if the approved stability instrument is located at a shore office and not on board the vessel. The intention of this waiver is to allow one shore office to provide approved loading information to several ships in the same fleet, if this is what the operator requests.

4.9 Waivers for shore operation may be issued for UK vessels on the following conditions: -

.1 The stability instrument provided at the shore office must be fully compliant with the Guidelines as if it were being fitted on the vessel.

.2 The shore office must be under the direct control of the vessel operator and subject to audit by the MCA or an authorised RO through the Document of Compliance (DOC) issued under ISM Code. Waivers may not be issued if verification is made by a third party.

.3 Shore-based calculations using non-approved stability instruments (including those performed by an independent naval architect) are not acceptable

4.10 Section 5 of this Notice describes various checks which can be carried out to ensure that damage stability is being validated in accordance with the Guidelines prior to departure.

5. Demonstration of Compliance with the Damage Stability Requirements

5.1 It is possible to make various checks to determine whether the method of verification being applied on a vessel is fully in compliance with the Guidelines. Although these checks are more important to ensure that the method being employed under a waiver is compliant, some checks can also be applied where an approved stability instrument is being employed.

5.2 **For tankers not fitted with a stability instrument and loading only to approved conditions under a waiver** the following checks should be applied, having regard to paragraph 4.7: -

.1 Examine the certification to ensure that the relevant waiver is issued.

.2 Examine the damage stability calculations to determine if all relevant damage cases have been considered. Tankers with asymmetric tank divisions or asymmetric loading cases must be assessed for damage stability compliance for port and starboard damage cases. Damage cases which extend across one or more bulkheads must also be assessed for lesser damages for any single or multiple compartment combination as they may be more onerous. Any errors identified will render this means of verification invalid.

.3 Compare the KGf (GMf) in the actual current loading condition against the KGf (GMf) from the target loading condition shown in the approved SIB. If the actual KGf is higher (or actual GMf is lower), then damage stability compliance may be compromised. This is more likely to occur on small parcel tankers which carry a mix of cargoes or any vessel which has deck tanks in use.

.4 Compare the actual draught and trim with those from the target loading condition shown in the approved SIB. If the draught or trim is increased, then damage stability compliance may be compromised.

.5 Compare actual tank fillings for cargo and WB with those from the target loading condition shown in the approved SIB. If the cargo and WB are distributed differently, even though the total amount of carried is very similar, then damage stability compliance may be compromised. This applies especially if deck tanks shown empty are filled or where WB is not carried outboard of an empty cargo tank as shown in the target loading condition.

.6 It is also possible to examine the supporting damage stability calculations to determine the margin by which the target loading condition meets the applicable damage stability criteria. If the margin can be determined and is small, the possibility of differences shown above affecting damage stability compliance is increased considerably.

.7 Ideally, tankers loading only to approved conditions should be provided with advice regarding how closely they need to adhere to these loading conditions to remain compliant with the damage stability criteria.

5.3 **For tankers which verify damage stability compliance using critical KGf or GMf data** the following checks should be applied: -

.1 Examine the certification to ensure that the relevant waiver is issued where a manual verification is made.

.2 Examine the damage stability calculations to determine if all relevant damage cases have been considered. Tankers with asymmetric tank divisions must be assessed for damage stability compliance for port and starboard damage cases. Damage cases which extend across one or more bulkheads must also be assessed for lesser damages for any single or multiple compartment combination as they may be more onerous. Any errors identified will render this means of verification invalid.

.3 Examine the approved SIB to determine if the critical KGf/GMf data being applied on board are subject to any loading restrictions required to validate them for use. Loading restrictions may include draught and/or trim limits, specified cargo distribution between tanks, tank filling levels and content densities. If loading restrictions are applied, then the vessel must have procedures in place to ensure these conditions are met in the actual loading condition. Where loading restrictions are not met the damage stability compliance may be compromised.

.4 Where critical KGf/GMf data are applied, they must be applied for the actual draught and trim of the vessel as this is loaded, not at the assumed draught and trim obtained from the loading calculation. Applying critical KGf/GMf data at the wrong draught or trim may compromise damage stability compliance, so procedures should be in place to prevent this.

.5 These checks apply equally whether a manual check or verification using an approved stability instrument on board or ashore is being made. In the case where an approved stability instrument is used it also recommended to check that the critical KGf/GMf data stored in the stability instrument are the same as those presented in the approved SIB.

5.4 **For tankers which verify damage stability compliance by loading within a range of approved conditions** the following checks should be applied: -

.1 Examine the certification to ensure that the relevant waiver is issued.

.2 Examine the damage stability calculations to determine if all relevant damage cases have been considered. Tankers with asymmetric tank divisions must be assessed for damage stability compliance for port and starboard damage cases. Damage cases which extend across one or more bulkheads must also be assessed for lesser damages for any single or multiple compartment combination as they may be more onerous. Any errors identified will render this means of verification invalid.

.3 Examine the approved SIB to determine any specific advice on how loading within the approved range of loading conditions is determined, and whether any loading restrictions apply. Loading restrictions may include draught and/or trim limits, specified cargo distribution between tanks, tank filling levels and content densities. If loading restrictions are applied then the vessel must have procedures in place to ensure these conditions are met in the actual loading condition, and that the specific advice regarding validation that the actual condition falls within the range claimed is also met. Where either of these conditions are not met the damage stability compliance may be compromised.

5.5 **For tankers which verify damage stability compliance through approved remote means ashore, by submission to Flag or the RO for approval or verification at a shore office**, the following checks should be applied.

.1 Examine the certification to ensure that the relevant waiver is issued.

.2 Examine the damage stability verification report to determine if all relevant damage cases have been considered. Tankers with asymmetric tank divisions must be assessed for damage stability compliance for port and starboard damage cases. Damage cases which extend across one or more bulkheads must also be assessed for lesser damages for any single or multiple compartment combination as they may be more onerous. Any errors identified will render this means of verification invalid.

.3 Verification should be made using an approved stability instrument and the approval certificate should be available for examination. It would be expected to be of Type 3, and the approval certificate should indicate all functions for which approval are given (see Annex B paragraph 8.1, below). This will normally be longitudinal strength, plus intact and damage stability verification.

.4 The verification process should include a process to correct the calculation if the actual draught and trim are different from the calculated draught and trim based upon the tank fillings provided by the vessel.

.5 All previous loading condition verification reports (commonly referred to as Stability Information Booklet Addendums) should be available as they are an auditable record for 3 years for ISM SMC purposes, and evidence should be available that verifications are being received on board prior to departure.

.6 Where verification is made ashore and is not conducted by the Flag or RO, it must be made by a shore office of the operating company and approved during IMO DOC audit.

5.6 **For tankers which verify damage stability compliance on board using a stability instrument**, the following checks should be applied.

.1 Examine the damage stability instrument to determine if all relevant damage cases have been considered. This means all bottom damage cases and side damage cases to both port and starboard. Damage cases which extend across one or more bulkheads must also be assessed for lesser damages for any single or multiple compartment combination as they may be more onerous. Any errors identified will render this means of verification invalid.

.2 Verification should be made using an approved stability instrument and the approval certificate should be available for examination. It would be expected to be of Type 3, and the approval certificate should indicate all functions for which approval are given

(see Annex B paragraph 8.1, below). This will normally be longitudinal strength, plus intact and damage stability verification.

.3 The verification process should include a process to correct the calculation if the actual draught and trim are different from the calculated draught and trim based upon the tank fillings provided by the vessel.

5.7 Approved document(s) should be available on board confirming that calculations of longitudinal strength (ILLC), intact stability (ILLC, MARPOL), damage stability (MARPOL, IBC & IGC) as applicable have been examined and approved. PSCOs should be aware that it is possible that the damage stability calculations may not have been specifically approved and their "approval" may be included under the general heading of "approved stability information" (see paragraph 5.9.1). If this is not clear from the documentation presented it should be confirmed with the RO or Administration which issued the approval whether the Damage Calculation Booklet is approved or only retained as supporting information to the approval of the Stability Information Booklet.

It should be realised that approval of damage stability will generally only cover the conditions in the SIB and so the content of any damage stability documents in themselves cannot be assumed to represent a complete record of approval of all possible cases. For example, an "approved" booklet may only cover damage cases involving the maximum extent of damage or a reduced number and not those of a lesser extent (which may be more onerous).

5.8 Whichever method is used to demonstrate compliance with the damage stability requirements it is essential that the ship departs only when the loading conditions for the voyage ahead are fully compliant (see Part 2 Section 5 of MSC.1/Circ.1461 for details on steps to take to adjust the loading of the ship should this not be the case). PSCOs should ensure that the loading officers are fully aware of the various options available to them for taking corrective measures.

5.9 The two primary stability documents are: -

.1 Approved stability information booklet;
- Contains proposed loading conditions
- On approval, these loading conditions are themselves deemed to be "approved" for use.

.2 Approved damage stability calculations;
- Usually a separate submission
- Demonstrates that the approved intact loading conditions will survive damages up to the maximum extent required by the applicable Convention or Code and achieve the minimum residual stability standard.

If approval is made by letter or Design Appraisal Document (DAD), for example, a copy of this letter or document must be available for examination to ensure any conditions of approval are being met.

5.10 In addition to the two primary stability documents, further documentary evidence, as shown in tabular form on the next page, should be maintained and kept available for inspection depending upon which of the six methods of verification described in Section 4 of Part 2 of the Guidelines is employed: -

DOCUMENTARY EVIDENCE OF DAMAGE STABILITY VERIFICATION METHOD USED

Ref:- MSC.1/Circ.1461 Guidelines Part 2, Section 6

REQUIRED DOCUMENTARY EVIDENCE - CHECK LIST:-		Manual		Type 2			Type 3		
Paragraph number in Guidelines	6.2.1	6.2.2	6.2.3	6.2.4	6.2.5	6.3	6.4	6.5	6.6
Approved stability information	X	X	X	X	X	X	X	X	X
Approved damage stability calculations	X	X	X	X	X	X	X	X	X
Details of the actual loading condition	X	X	X	X	X	X	X	X	X
Confirmation that actual conditions match the approved conditions within acceptable tolerances (see MSC.1/Circ.1461 Appendix paras 3 & 4)*	X								
Certificate including waiver from MCA/RO for using critical KG/GM on board vessel		X							
Certificate including waiver from MCA/RO for using approved means (critical KG/GM data) at the shore station			X						
Certificate including waiver from MCA/RO for using approved means (Type 2 stability instrument) at the shore station					X				
Certificate including waiver from MCA/RO for using approved means (Type 3 stability instrument) at the shore station								X	
Evidence to show that actual conditions are being transmitted to the shore station for approval in good time			X		X			X	
Evidence to show that verification of compliance is received from shore station prior to departure of the vessel			X		X			X	
Evidence to show that loading condition(s) are being transmitted directly to the MCA/RO for approval in good time						X			
Evidence to show MCA/RO confirm the loading condition(s) comply with damage stability and are approved prior to departure of the vessel						X			
Confirmation that the actual condition takes account of any assumptions used in deriving critical KG/GM data applied (may be manual check)		X	X	X	X				
Check calculations/records to confirm that the actual GM/KG complies with approved values for all damage cases (including lesser damages)		X	X						
Certificate from MCA/RO confirming use of approved Type 2 or Type 3 stability instrument on board for verifying loading conditions**				X			X		
Confirmation there is a copy of an approval certificate issued on behalf of the Administration for the stability instrument used, on board or ashore				X	X		X	X	
Evidence of any check calculations specified in the authorisation to demonstrate that the stability instrument remains accurate***				X			X		
Stability instrument output confirming the actual GM/KG complies with limiting values for all damage cases (including lesser damages)				X	X				
Output data from the stability software confirming that the loading condition(s) meet the intact and damage stability requirements in all cases							X	X	
Confirmation of the approved range of loading conditions being applied & that all parameters of loading lie within the prescribed limits									X

Key:-

6.2.1 - ship is loaded in accordance with approved loading conditions from the approved SIB.	
6.2.2 - ship is not loaded in accordance with 6.2.1; verification is made on board by manual calculation using approved critical KG/GM data.	Manual
6.2.3 - ship is not loaded in accordance with 6.2.1; verification is made ashore by manual calculation using approved critical KG/GM data.	
6.2.4 - ship is not loaded in accordance with 6.2.1; verification is made on board by Type 2 LCS using approved critical KG/GM data.	Type 2
6.2.5 - ship is not loaded in accordance with 6.2.1; verification is made ashore by Type 2 LCS using approved critical KG/GM data.	
6.3 - ship is not loaded in accordance with 6.2.1; verification is made by direct submission of the loading condition(s) to the MCA/RO.	
6.4 - ship is not loaded in accordance with 6.2.1; verification is made on board by Type 3 LCS	Type 3
6.5 - ship is not loaded in accordance with 6.2.1; verification is made ashore by Type 3 LCS	
6.6 - ship is loaded to a condition which lies within an approved range of loading conditions.	

Key to asterisks in the above table

* The Administration must specify this in their waiver (see 6.2.1) as they cannot issue unless they satisfy themselves that the vessel is closely loading historically, otherwise the vessel has no guidance on what this means.

** Issue of full certificate – no waiver – implies fitment of new Type 3 generally (but could be Type 2) or retention of existing stability instrument which may be of Type 2 or 3.

*** Checks must be made on board and in shore office. Shore office is supposed to be an office under control of the operator and which is subject to ISM audit through DOC. It should not be a third party. Any use of a third party (other than MCA or RO) should be flagged up to MCA or RO.

6. What to look out for when assessing compliance with the Guidelines

6.1 ISM certification requires that companies identify and assess risks, establish appropriate safeguards and put procedures in place, including checklists if appropriate, to ensure that statutory requirements are met. This requirement now more clearly extends to verification of intact and damage stability compliance on a tanker prior to departure from port.

6.2 It is clear from previous inspections of tankers that some company safety management systems rarely formalised this requirement and, in some cases, included no provision to make relevant verification checks. It is also seen that errors and omissions in this critical operation are rarely identified by internal or external ISM audits, despite stability verification being a critical mandatory operational procedure for all ships.

6.3 Inspections and audits have regularly identified loading conditions signed off by the master which carry warnings such as "*This loading condition complies with intact stability only, damage stability to be verified also*", or similar. This should no longer be possible if correct action is taken by companies to update equipment and procedures to comply with revised legislation and the damage stability Guidelines.

6.4 Where safety concerns in relation to tanker damage stability verification are identified, a PSCO may ask what operational procedures are defined to cover this task within the safety management system. The PSCO may need to determine whether these meet the objectives of the ISM Code and if an ISM related deficiency should be issued.

6.5 The safety management system commonly assigns responsibility for the calculation of stability to the mate, but there are often no supporting procedures or checklists which detail how the task is to be performed and recorded. These should be incorporated into the ISM procedures for each tanker and verified at intervals by PSCOs. Section 6.3 of the ISM Code states: -

> *6.3 The Company should establish procedures to ensure that new personnel and personnel transferred to new assignments related to safety and protection of the*

environment are given proper familiarization with their duties. Instructions which are essential to be provided prior to sailing should be identified, documented and given.

Also, based on the requirements for passenger ships (MSC.1/Circ.1532 para. 21) it is strongly recommended that "*At least two crew members should be competent in the operation of the system, including the communication links to the shore-based support (if employed). They should be capable of interpreting the output of the system to provide the required operational information to the master*".

6.6 In the absence of an approved stability instrument on board (or access to one via a shore station) there must be procedures in place to ensure any alternative system of compliance (authorised by waiver) is being correctly used and appropriate records kept demonstrating that effective intact and damage stability verification is being undertaken. Should the PSCO have any doubts as to the stability verification method being used, the operators and MCA/RO should be alerted so that any necessary corrective measures can be agreed upon and actioned.

6.7 The complexity involved and risk of operator error with supplying and using an alternative verification method, is one of the main reasons why it is the MCA's strong preference and firm recommendation that approved Type 3 software be installed on an on-board stability instrument or accessible via a shore station (see also 2.4.2 above).

7 Historical Background

7.1 The first loading instruments used on board tankers to compute and verify intact and damage stability were based on the use of pre-determined tabular data for hydrostatics, cross curves of stability, tank calibrations and critical KGf/GMf's. Just as for manual interrogation of the approved SIB, the computer would simply interpolate into the tables to produce all the output required to confirm and demonstrate compliance.

7.2 As computing power increased, some software developers started to use 3D models for the calculations, but the utilization of the model was limited in those days by the lack of availability of cheap processing power to fulfil the potential for direct computation of damage stability within a reasonable time.

7.3 Software steadily improved and computers speeded up so that eventually **Type 3** assessment (direct damage computation) became a realistic possibility in terms of cost and response time. The software on tankers existing at that time, which still used tabular data to a greater or lesser degree, was often not completely replaced but rather a new damage stability module using a full 3D definition of hull and compartments would be added. So, for example, the intact condition prior to damage could still be derived from tabular data, but the damaged calculations were based upon real fluid shifts and 3D hull properties.

7.4 These "hybrid" systems with an added 3D damage stability module were approved at that time for existing tankers and certified by administrations as they were based on a previously approved tabular system. However, they are not truly using **Type 3** software of the type envisaged by the Guidelines and so the certification and any accompanying documentation (e.g. Design Appraisal Document (DAD)) both need to be checked very carefully, particularly on older tankers, to fully ascertain the degree to which they comply. Cases have been found, for example, where even the added **Type 3** modules are still using tabular computation methods rather than performing direct damage stability calculations on a 3D geometrical computer model. It is emphasized that it is permissible for **Type 3** software to calculate intact stability by tabular methods

8. Considerations for approving damage stability calculations and stability instruments

8.1 To show whether a tanker is using the **Type 3** software effectively on its stability instrument the following should be considered: -

- the damage stability is being directly computed from the 3D geometrical computer model and not by interpolation from tables although the latter method is permissible for the calculation of intact stability;
- for the damaged ship, the free surfaces in the undamaged tanks and spaces are being directly calculated, accounting for both trim and list;
- the residual GZ curve and final equilibrium water-plane characteristics (if any) are being directly calculated, including intermediate stages of flooding when required, and details of down-flooding opening submersion points;
- compliance is being demonstrated by direct comparison with all individual criterion for each loading/damage scenario and not just by indicating compliance with the overall limiting KGf/GMf data.

In case of doubt over any or all the above points or over whether a “hybrid” computer is not fully functioning as a Type 3 stability instrument, for example, the case should be referred to the MCA for further consideration.

8.2 For tankers which are loading to approved conditions or within a limited range of operating parameters only, the approving authority should ensure that a representative selection of damage cases and loading scenarios are included in the SIB and operators should ensure that the ship operates closely to the target approved loading condition/range.

8.3 The following examples suggest some points to look out for when examining the damage stability calculations submitted for approval: -

8.3.1 Care should be taken to ensure that the damage cases included cover both the port and starboard sides, particularly on tankers which themselves may have some degree of design asymmetry or, as is more likely, are not loaded symmetrically. The damage cases covered may include both two-compartment and one-compartment scenarios but if checking damage is limited to the port side only, for example, the loading conditions (and the tanker itself) all must be fully symmetrical for the damage stability approval to remain valid in all damage cases (port and starboard).

8.3.2 Considering the worst case of damage for an approved loading condition it is possible that this has no safety margin, meaning that one criterion is on the limit. If the tank fillings in the damaged tanks vary between port and starboard for this condition and damage was only assessed to one side, then there is a possibility that the unevaluated damage on the other side will be non-compliant.

8.3.3 It may be borne in mind that a tanker damaged on the port side cargo tank could finish up listing to starboard, depending on the filling depth of the damaged tank and/or the SG of their cargo contents. For this reason, also, it is always necessary to analyse the stability compliance to both port and starboard.

8.3.4 It is noted that the stability information booklets of some tanker designs were approved at the new construction stage with specific progressive flooding being permitted in order to avoid failure of damage stability criteria through the immersion of an opening (see Part 1, paragraphs 6.9 and 10.1.5 of the Guidelines in MSC.1/Circular 1461).

Where the use of progressive flooding is granted in the approval of the stability information booklet then this should be clearly stated in an appropriately located comment in the stability information booklet and/or the Damage Control Booklet in accordance with the Guidelines Part 1 paragraph 3.4.2. For existing ships, where such comments are not included, then the damage information should be updated accordingly and re-approved.

It is important that the stability instrument reflects the basis of the approval of the stability information booklet in order to ensure that it is a useful tool for onboard use and does not indicate a "failure" in situations where the SIB permits some degree of progressive flooding in accordance with the Guidelines. In these cases, the approved use of progressive flooding may be modelled in the stability instrument by, for example, adding a discrete compartment(s) to a damage case, to the satisfaction of the approving authorities. However, it is not permissible to extrapolate this to further progressive flooding to other compartments to reduce the number of damage cases in the stability instrument.

8.3.5 The creation of lesser extent damages under the applicable rules is open to interpretation due to a certain lack of clarity in the Codes and associated Guidelines. This is reflected in the Guidelines in MSC.1/Circ. 1461, Part 1, paragraph 4.5.4 where it states: "*Sufficient damages, taking into account lesser damages, and variation of draft, cargo density, tank-loading patterns and extents of tank filling shall be performed to ensure that for any possible loading condition the most onerous damages have been examined according to the relevant criteria*".

The meaning of "*lesser extents*" is clarified in Part 1, Section 7.2 of the Guidelines where it states, "*If any damage of a lesser extent than the maximum damage specified in Table 3 would result in a more severe condition, such damage shall be considered (see section 4.5.4).*"

Table 3 of MSC.1/Circ. 1461, defining the maximum extents of all damages, is therefore interpreted to mean that lesser extent damages shall be applied to side and bottom damage and bottom raking damage wherever these would result in a more severe condition.

The definition of lesser extents is further explained in MSC/Circular.406 (Section 3 under guidelines for unified interpretation) where it states:

".1 *"Lesser extent" means the reduction of any one of the three maximum dimensions of damage singly or in combination and also the assessment of the effect of damage affecting any combination of compartments with the maximum extent of damage*."

With respect to the shape of the damages, they are assumed to be box-shaped with maximum dimensions according to the Regulations. The lesser extent damages are then, in accordance with MSC/Circular.406, generated by the scaling of the dimensions of that box-shaped damage in any or all three directions. There is no consideration given

to damages by other 3D shapes; for example, choosing a convex body to simulate a ship's bow.

Certain damages which are automatically generated by specialised software applications may not lie within the spirit of the Regulations and so may be discounted, for example: -

1. damaged compartment(s) above the waterline without any compartments damaged below the waterline;

2. compartment(s) above the waterline which, according to the approved stability information booklet, have no relevant openings may always be considered damaged in the related damage cases; i.e. damage cases which consider those compartment(s) as buoyant may be disregarded.

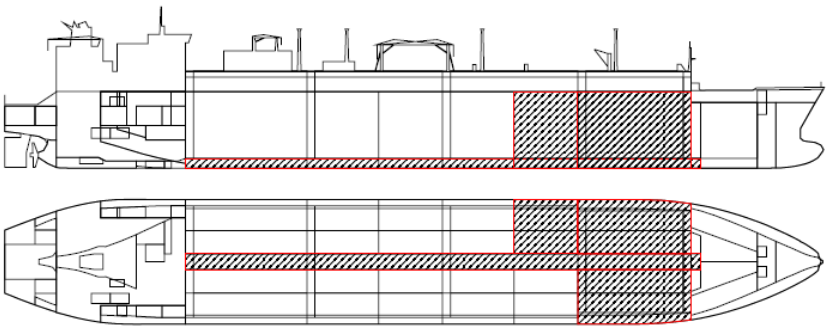
3. internal compartments with no shell plate boundary being considered as damaged when no compartments bounding the shell are damaged;

4. pairs of compartments which are diagonally opposite one another.

However, the following damages shall be included in the damage case list: -

1. Both port and starboard damages to account for any asymmetry in the design of the vessel;

2. "L-shaped" lesser extent damages; for example: -



3. Damages which are based on the applicable regulations, but which may be perceived to never realistically happen in the view of the designer or operators.

8.3.6 Questions have arisen as how to deal with very small tanks within a large space such as an engine room. The MCA's interpretation of "very small" is all tanks and other watertight spaces less than 5 m^3 or 0.5% of the volume of displacement at Summer load line draft. Such tanks or spaces should either not be modelled or should be included as damaged in all damage cases that involve the compartment that contains them.

8.3.7 Concerns have been expressed that the treatment of the free surface effect in the SIBs of existing tankers may not match that required by the Guidelines (see Part 1, paragraphs 6.5 and 9.4) in particular through use of the standard free surface calculation method for intact loading conditions and weight transference for the damage stability

calculations. The MCA's view is that as long as the Guidelines are adhered to in the approved stability instrument then these results will always take precedence over those in the SIB, wherever any discrepancies arise. There is no need to re-issue and re-approve the SIB to achieve consistency with the stability instrument.

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8.4 To reduce the volume of paperwork involved, a designer or consultant may consider the worst damage cases from a large array and from these only present a limited few of the "most severe" cases for approval by the authorities. There is a limitation here as the most severe damages are those which give the worst result when applied to the proposed loading conditions presented in the intact SIB, and other damages may become even more severe if alternative loading conditions are proposed. For example, the most severe cases may include several two-compartment damages and few one-compartment damages. If the considered loading conditions normally employ counter-ballasting in the wing tank outboard of an empty cargo tank to reduce list post-damage and this counter-ballasting is not actually present in service, the one-compartment damage cases may become the most severe (through damage now occurring to two empty tanks). Consideration of limited damage cases on this basis is not acceptable for a **Type 3** stability instrument, since this would leave the vessel unable to effectively assess conditions of loading which are different from those presented in the approved SIB.

8.5 Although, to avoid doubt and possible dispute, it is recommended that all damage cases are always submitted for approval purposes it should be borne in mind that it is ultimately the responsibility of the approving authority to ensure that the tanker design in question meets the applicable damage stability criteria in their entirety. If, for example, only 20 cases are included in the damage calculation booklet, the approving authority may find it necessary to perform independent calculations on a far larger number of cases just to ensure that the design always meets the criteria.

As long as no non-compliances are found, the SIB would be approved on the basis of the data submitted and re-submission of the damage calculation booklet to cover the "missing" cases would not be necessary. It is acknowledged that producing a damage stability calculation booklet to match all the possible cases in the computer loading instrument could result in a massive amount of documentation. It is the responsibility of all concerned to ensure that all eventualities have been considered in the calculation process and that the stability instrument is programmed to cover all the damage cases considered essential for demonstrating compliance with the criteria for any loading condition.

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