



**BUREAU
VERITAS**

Guidelines for the Design of Ships subject to Bulk Cargo Liquefaction

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**Guidance Note
NI 639 DT R00 E**

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MARINE & OFFSHORE DIVISION

GENERAL CONDITIONS

ARTICLE 1

1.1. - BUREAU VERITAS is a Society the purpose of whose Marine & Offshore Division (the "Society") is the classification ("Classification") of any ship or vessel or offshore unit or structure of any type or part of it or system therein collectively hereinafter referred to as a "Unit" whether linked to shore, river bed or sea bed or not, whether operated or located at sea or in inland waters or partly on land, including submarines, hovercrafts, drilling rigs, offshore installations of any type and of any purpose, their related and ancillary equipment, subsea or not, such as well head and pipelines, mooring legs and mooring points or otherwise as decided by the Society.

The Society:

- "prepares and publishes Rules for classification, Guidance Notes and other documents ("Rules");
- "issues Certificates, Attestations and Reports following its interventions ("Certificates");
- "publishes Registers.

1.2. - The Society also participates in the application of National and International Regulations or Standards, in particular by delegation from different Governments. Those activities are hereafter collectively referred to as "Certification".

1.3. - The Society can also provide services related to Classification and Certification such as ship and company safety management certification; ship and port security certification, training activities; all activities and duties incidental thereto such as documentation on any supporting means, software, instrumentation, measurements, tests and trials on board.

1.4. - The interventions mentioned in 1.1., 1.2. and 1.3. are referred to as "Services". The party and/or its representative requesting the services is hereinafter referred to as the "Client". The Services are prepared and carried out on the assumption that the Clients are aware of the International Maritime and/or Offshore Industry (the "Industry") practices.

1.5. - The Society is neither and may not be considered as an Underwriter, Broker in ship's sale or chartering, Expert in Unit's valuation, Consulting Engineer, Controller, Naval Architect, Manufacturer, Ship-builder, Repair yard, Charterer or Shipowner who are not relieved of any of their expressed or implied obligations by the interventions of the Society.

ARTICLE 2

2.1. - Classification is the appraisal given by the Society for its Client, at a certain date, following surveys by its Surveyors along the lines specified in Articles 3 and 4 hereafter on the level of compliance of a Unit to its Rules or part of them. This appraisal is represented by a class entered on the Certificates and periodically transcribed in the Society's Register.

2.2. - Certification is carried out by the Society along the same lines as set out in Articles 3 and 4 hereafter and with reference to the applicable National and International Regulations or Standards.

2.3. - It is incumbent upon the Client to maintain the condition of the Unit after surveys, to present the Unit for surveys and to inform the Society without delay of circumstances which may affect the given appraisal or cause to modify its scope.

2.4. - The Client is to give to the Society all access and information necessary for the safe and efficient performance of the requested Services. The Client is the sole responsible for the conditions of presentation of the Unit for tests, trials and surveys and the conditions under which tests and trials are carried out.

ARTICLE 3

3.1. - The Rules, procedures and instructions of the Society take into account at the date of their preparation the state of currently available and proven technical knowledge of the Industry. They are a collection of minimum requirements but not a standard or a code of construction neither a guide for maintenance, a safety handbook or a guide of professional practices, all of which are assumed to be known in detail and carefully followed at all times by the Client.

Committees consisting of personalities from the Industry contribute to the development of those documents.

3.2. - The Society only is qualified to apply its Rules and to interpret them. Any reference to them has no effect unless it involves the Society's intervention.

3.3. - The Services of the Society are carried out by professional Surveyors according to the applicable Rules and to the Code of Ethics of the Society. Surveyors have authority to decide locally on matters related to classification and certification of the Units, unless the Rules provide otherwise.

3.4. - The operations of the Society in providing its Services are exclusively conducted by way of random inspections and do not in any circumstances involve monitoring or exhaustive verification.

ARTICLE 4

4.1. - The Society, acting by reference to its Rules:

- "reviews the construction arrangements of the Units as shown on the documents presented by the Client;
- "conducts surveys at the place of their construction;
- "classes Units and enters their class in its Register;
- "surveys periodically the Units in service to note that the requirements for the maintenance of class are met.

The Client is to inform the Society without delay of circumstances which may cause the date or the extent of the surveys to be changed.

ARTICLE 5

5.1. - The Society acts as a provider of services. This cannot be construed as an obligation bearing on the Society to obtain a result or as a warranty.

5.2. - The certificates issued by the Society pursuant to 5.1. here above are a statement on the level of compliance of the Unit to its Rules or to the documents of reference for the Services provided for. In particular, the Society does not engage in any work relating to the design, building, production or repair checks, neither in the operation of the Units or in their trade, neither in any advisory services, and cannot be held liable on those accounts. Its certificates cannot be construed as an implied or express warranty of safety, fitness for the purpose, seaworthiness of the Unit or of its value for sale, insurance or chartering.

5.3. - The Society does not declare the acceptance or commissioning of a Unit, nor of its construction in conformity with its design, that being the exclusive responsibility of its owner or builder.

5.4. - The Services of the Society cannot create any obligation bearing on the Society or constitute any warranty of proper operation, beyond any representation set forth in the Rules, of any Unit, equipment or machinery, computer software of any sort or other comparable concepts that has been subject to any survey by the Society.

ARTICLE 6

6.1. - The Society accepts no responsibility for the use of information related to its Services which was not provided for the purpose by the Society or with its assistance.

6.2. - If the Services of the Society or their omission cause to the Client a damage which is proved to be the direct and reasonably foreseeable consequence of an error or omission of the Society, its liability towards the Client is limited to ten times the amount of fee paid for the Service having caused the damage, provided however that this limit shall be subject to a minimum of eight thousand (8,000) Euro, and to a maximum which is the greater of eight hundred thousand (800,000) Euro and one and a half times the above mentioned fee. These limits apply regardless of fault including breach of contract, breach of warranty, tort, strict liability, breach of statute, etc.

The Society bears no liability for indirect or consequential loss whether arising naturally or not as a consequence of the Services or their omission such as loss of revenue, loss of profit, loss of production, loss relative to other contracts and indemnities for termination of other agreements.

6.3. - All claims are to be presented to the Society in writing within three months of the date when the Services were supplied or (if later) the date when the events which are relied on were first known to the Client, and any claim which is not so presented shall be deemed waived and absolutely barred. Time is to be interrupted thereafter with the same periodicity.

ARTICLE 7

7.1. - Requests for Services are to be in writing.

7.2. - Either the Client or the Society can terminate as of right the requested Services after giving the other party thirty days' written notice, for convenience, and without prejudice to the provisions in Article 8 hereunder.

7.3. - The class granted to the concerned Units and the previously issued certificates remain valid until the date of effect of the notice issued according to 7.2. here above subject to compliance with 2.3. here above and Article 8 hereunder.

7.4. - The contract for classification and/or certification of a Unit cannot be transferred neither assigned.

ARTICLE 8

8.1. - The Services of the Society, whether completed or not, involve, for the part carried out, the payment of fee upon receipt of the invoice and the reimbursement of the expenses incurred.

8.2. - Overdue amounts are increased as of right by interest in accordance with the applicable legislation.

8.3. - The class of a Unit may be suspended in the event of non-payment of fee after a first unfruitful notification to pay.

ARTICLE 9

9.1. - The documents and data provided to or prepared by the Society for its Services, and the information available to the Society, are treated as confidential. However:

- "Clients have access to the data they have provided to the Society and, during the period of classification of the Unit for them, to the classification file consisting of survey reports and certificates which have been prepared at any time by the Society for the classification of the Unit ;
- "copy of the documents made available for the classification of the Unit and of available survey reports can be handed over to another Classification Society, where appropriate, in case of the Unit's transfer of class;
- "the data relative to the evolution of the Register, to the class suspension and to the survey status of the Units, as well as general technical information related to hull and equipment damages, may be passed on to IACS (International Association of Classification Societies) according to the association working rules;
- "the certificates, documents and information relative to the Units classed with the Society may be reviewed during certifying bodies audits and are disclosed upon order of the concerned governmental or inter-governmental authorities or of a Court having jurisdiction.

The documents and data are subject to a file management plan.

ARTICLE 10

10.1. - Any delay or shortcoming in the performance of its Services by the Society arising from an event not reasonably foreseeable by or beyond the control of the Society shall be deemed not to be a breach of contract.

ARTICLE 11

11.1. - In case of diverging opinions during surveys between the Client and the Society's surveyor, the Society may designate another of its surveyors at the request of the Client.

11.2. - Disagreements of a technical nature between the Client and the Society can be submitted by the Society to the advice of its Marine Advisory Committee.

ARTICLE 12

12.1. - Disputes over the Services carried out by delegation of Governments are assessed within the framework of the applicable agreements with the States, international Conventions and national rules.

12.2. - Disputes arising out of the payment of the Society's invoices by the Client are submitted to the Court of Nanterre, France, or to another Court as deemed fit by the Society.

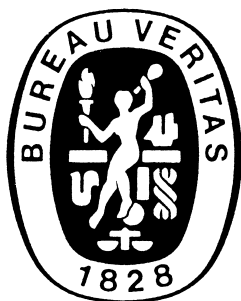
12.3. - Other disputes over the present General Conditions or over the Services of the Society are exclusively submitted to arbitration, by three arbitrators, in London according to the Arbitration Act 1996 or any statutory modification or re-enactment thereof. The contract between the Society and the Client shall be governed by English law.

ARTICLE 13

13.1. - These General Conditions constitute the sole contractual obligations binding together the Society and the Client, to the exclusion of all other representation, statements, terms, conditions whether express or implied. They may be varied in writing by mutual agreement. They are not varied by any purchase order or other document of the Client serving similar purpose.

13.2. - The invalidity of one or more stipulations of the present General Conditions does not affect the validity of the remaining provisions.

13.3. - The definitions herein take precedence over any definitions serving the same purpose which may appear in other documents issued by the Society.



GUIDANCE NOTE NI 639

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Section 1 General

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SECTION 1

GENERAL

1 General

1.1 Introduction

1.1.1 Liquefaction of a solid bulk cargo - such as bauxite, iron and nickel ore – has been identified as a cause of the capsizing of cargo vessels.

Shippers of solid bulk cargoes that may have the potential to liquefy have a legal obligation and responsibility to make sure their cargo is considered safe for transport by sea, or that their ship is appropriate for the safe carriage of such cargoes.

This Guidance Note provides structural strength and stability criteria for ships intended to carry bulk cargo which may liquefy, as well as general guidance on cargo moisture testing based on the International Maritime Solid Bulk Cargoes Code (IMSBC).

1.2 International Maritime Solid Bulk Cargoes Code (IMSBC)

1.2.1 The International Maritime Solid Bulk Cargoes Code (IMSBC) makes recommendations about cargoes that may liquefy. It specifies the sampling, testing and control procedures of such potentially life-threatening cargoes.

1.3 Transportable moisture limit (TML)

1.3.1 Transportable Moisture Limit (TML) of a cargo which may liquefy means the maximum moisture content of the cargo which is considered safe for carriage in ships not complying with the special provisions of articles [2] and [3]. It is determined by test procedures approved by a competent authority and described for guidance in [4].

1.4 Liquefaction at sea

1.4.1 A solid bulk cargo consists of three main components: a solid component; a moisture component; and an amount of air (void space) in between.

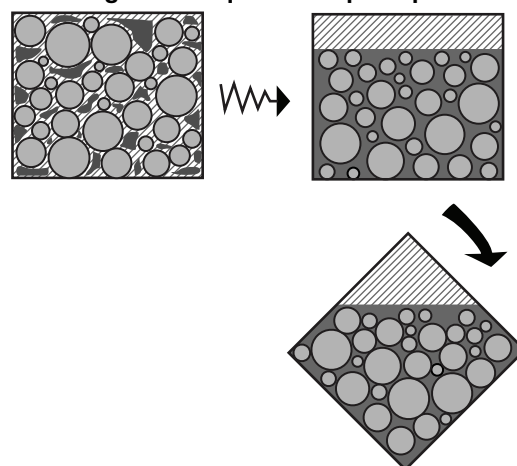
Vibration combined to the motions of a vessel may compact a solid bulk cargo. In certain conditions a cargo can compact to such an extent that there is no more void space (air) between solid and water particles. If vibration and motion continue to put pressure on the cargo, the water may become separated and will start to prise the solid particles apart. The cargo is then transformed from a solid state to a viscous fluid, as illustrated in Fig 1.

1.4.2 A liquefied cargo that has changed from a solid state to a viscous fluid state might unexpectedly flow from one side in the hold to the other in heavy seas and not move back to its

original position when rolling the other way. This has a dramatic effect on a ship stability and may even lead to capsizing.

Another consequence is that the pressures on the cargo hold boundaries change from dry bulk load to liquid pressures making the cargo hold boundaries strength potentially inappropriate for such unplanned loading conditions.

Figure 1 : Liquefaction principle



1.5 Application

1.5.1 When a cargo which may liquefy is carried on board a ship, the two following cases are distinguished:

- the liquefaction is considered as prevented by carrying exclusively cargoes which have their moisture content - as determined by test procedures described in [4] for guidance - within the TML
- the cargo has a moisture content in excess of the TML and the liquefaction is likely to occur.

1.5.2 Cargo ships complying with the hull and stability requirements of [2] and [3] are considered appropriate for the safe carriage of cargoes which have their moisture content above the TML in one or several identified holds.

They are provided by the Society with a "Statement of compliance" specifying which holds may be loaded with cargo having a moisture content above the TML.

1.5.3 Within these guidelines, the term "applicable Rules" means either:

- NR467 "Rules for the Classification of Steel Ships" or
- NR606 "Common Structural Rules for Bulk Carriers and Oil Tankers" or
- NR600 "Hull structure and arrangement for the classification of cargo ships less than 65 m and non cargo ships less than 90 m".

1.6 Documents to be submitted

1.6.1 In addition to the documents which are to be submitted according to applicable Rules, stability calculations taking into account loading arrangements and cargo shift, and showing the distribution of cargo and liquids in tanks and of tanks which may become fluid are to be provided to the Society for approval.

2 Stability

2.1 General

2.1.1 With regard to the stability, the cargo liquefaction may induce the two following behaviours, which both have to be considered for each hold intended to carry cargoes above the TML:

- a) the cargo is considered as a liquid of the same density (see [2.2])
- b) the cargo is shifting to one side based on the same principles as the ones applied to grain cargoes (see [2.3]).

2.2 Cargo considered as a liquid

2.2.1 General

The loading conditions are to comply with the stability criteria of NR467, Pt B, Ch 3, Sec 2, considering the cargo with the corresponding free surface effect calculated based on its original specific gravity.

2.2.2 Ships subject to damage stability

For ships having the additional class notation **SDS**, as defined in NR467, Pt A, Ch 1, Sec 2, [6.14.11], and subject to the compliance of damage stability requirements according to NR467, Pt B, Ch 3, Sec 3, the GM corrected by the effect of free surfaces is to be equal or greater than the minimum required GM corresponding to these damage stability requirements.

2.3 Cargo shifting

2.3.1 The loading conditions are to comply with the stability criteria of NR467, Pt D, Ch 4, Sec 3, [1.2.3], considering the cargo like a grain cargo shifting to an angle equal to 25 degrees and the corresponding calculated heeling moment.

3 Hull

3.1 General

3.1.1 The requirements in [3.2] and [3.3] shall apply to each hold intended to carry cargoes above the TML.

3.2 Local loads

3.2.1 Cargo considered as a liquid

The pressures due to the liquefied cargo shall be calculated according to the formulae for liquids as provided in the

applicable Rules, considering a liquid with the same density than the actual dry cargo, and a filling level corresponding to the maximum admissible mass of dry cargo in the considered hold.

When doing so, the highest point of the tank and the top of air pipe are to be taken at the liquid free surface level, and the setting pressure is to be disregarded.

Sloshing loads shall also be considered according to the applicable Rules.

3.3 Yield and buckling assessment

3.3.1 The yield and buckling strength of the hold structure are to be checked against the local loads defined in [3.2] using the applicable Rules criteria for normal seagoing operation (including sloshing if relevant).

4 TML testing

4.1 General guidance

4.1.1 TML test procedures are designed to be standardised and based on same principle: applied energy, rearrangement of particles, compaction of voids, build-up of water saturation and a point where a sample starts to flow.

4.1.2 The test procedures were developed around the maximum expected vibration and motion of ship at sea. Consequently, the energy simulation during test procedures is much higher than generally experienced by a ship in a normal sea voyage.

4.1.3 As with all standardised tests, they must be repeatable, easily reproducible between laboratories and meaningful. This requires tight control of the amount of energy that is applied on a test sample. When the test procedures of the IMSBC are correctly applied, the results provide information on the liquefaction characteristics of the sample to help the shipper and Master make the decision to accept or reject the cargo.

4.1.4 There are three general types of TML testing:

- a) Flow Table Testing, where the point is determined at which the sample starts to flow. This point is called Flow Moisture Point (FMP). TML is calculated by taking 90% of the moisture content at FMP,
- b) Penetration Testing determines FMP and calculates TML using the moisture content after drying of the sample at that point,
- c) Proctor/Fagerberg Testing determines compaction and degrees of saturation of successive sample portions for its TML calculation model.

4.1.5 Variations of these tests may be used, but only at the discretion of the competent authorities and only when alternative procedures are at least as effective and safe as those provided by the IMSBC. Competent authorities are required to publish an exemption when they deviate at any stage from the provisions of the IMSBC.