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Loading Instruments for Inland Navigation Vessels

July 2016

Guidance Note
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BUREAU VERITAS

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, Shipbuilder, 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 appraisement 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 appraisement 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 appraisement 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 of 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 certificating 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.

BV Mod. Ad. ME 545 L - 7 January 2013

GUIDANCE NOTE NI 634

Loading Instruments for Inland Navigation Vessels

July 2016

Section 1 General Provisions

Section 2 Approval Requirements

Appendix 1 Type Approval

SECTION 1 GENERAL PROVISIONS

Symbols

LCB : Longitudinal centre of buoyancy
VCB : Transversal centre of buoyancy
TCB : Transversal centre of buoyancy
LCF : Longitudinal centre of flotation
KG : Vessel's vertical centre of gravity measured from the keel
KM_T : Transversal Metacentre measured from the keel
KM_T : Longitudinal Metacentre measured from the keel
GM_T : Transversal Metacentric Height
GM_L : Longitudinal Metacentric Height
KN : Transversal displacement of the keel at a specific heel angle
GZ : Righting lever, measured from the centre of gravity
MS : Residual stability
M_{CT} : Moment to change the trim the vessel a specific value
LCG : Longitudinal Centre of Gravity
VCG : Vertical Centre of Gravity
TCG : Transversal Centre of Gravity
FSM : Free Surface Moment
FSC : Free Surface Correction.

1 General

1.1 Scope of application

1.1.1 The following guidelines provide indications for the assessment and certification of loading instruments installed on board inland navigation vessels, developed to assist the loading officers, masters and other crew members to assess the stability and strength of the vessel in any given condition.

1.1.2 In general, these guidelines are applicable to the assessment of passive systems or the offline operating mode of either active or integrated systems, as defined in [2.5.2].

1.1.3 Each loading instrument is to be specifically designed for the vessel on which it is installed and its results are only applicable to the vessel and the type of calculations for which it has been approved.

A loading instrument shall not replace in any case the vessel's loading manuals and stability booklets approved by the Society. It is to be used as a supplement to the loading and stability information to facilitate calculations.

1.1.4 The requirements in this note apply also to loading instruments that, due to specific design considerations, cannot be fitted on board the vessel itself (e.g. barges). In such cases the accessibility of the instrument is to be agreed with the Society, and at least it has to be available in conjunction with the approved stability booklet.

1.1.5 Vessels having undertaken major alterations or conversions affecting longitudinal strength or the have their loading instrument re-assessed.

1.1.6 These guidelines are in accordance and refer to the documentation listed in Tab 1. In case of discrepancy between this Guidance Note and the referred documentation, the later takes precedence.

2 Definitions

2.1 Society

2.1.1 Society means the classification Society that is evaluating the loading instrument for approval.

2.2 Perpendiculars

2.2.1 Forward perpendicular (FP)

The FP is the perpendicular to the waterline (WL) at the forward side of the stem on the load waterline.

2.2.2 Aft perpendicular (AP)

The AP is the perpendicular to the WL at the after side of the rudder post or, for vessels without rudder post, at the centre of the rudder stock on the load waterline. When there is no rudder, the aft perpendicular is taken on the aftermost part of the WL in the hull.

2.2.3 Midship perpendicular

The midship perpendicular is the perpendicular to the WL at half the distance between forward and aft perpendiculars.

2.3 Loading instrument

2.3.1 A loading instrument is a computer based system consisting of a software and the hardware on which it runs able to perform either stability or strength calculations or both. In general, the loading instrument shall enable a vessel's crew to:

- Perform stability calculations that evaluate the stability criteria for any applicable condition of the vessel and in accordance with the approved stability booklet and loading manual.

- Ascertain that at specified read-out points and in any load or ballast condition, the still water bending moments, shear forces, torsional moments and lateral loads, as applicable, as well as the maximum permissible draught, do not exceed the specified permissible values.

2.4 Stability and loading documentation

2.4.1 Stability booklet

The stability booklet is a document containing sufficient information to enable the master to operate the vessel in compliance with the applicable stability requirements. These contents are to be adjusted in accordance with the applicable regulations and may also include information on longitudinal strength, if applicable for the vessel type.

2.4.2 Loading Manual

According to the vessel type, the stability booklet may include a loading manual, a document presenting strength and stability considerations for particular loading conditions and include, as applicable:

- the loading conditions on which the design of the vessel has been based, including permissible limits of still water bending moment and shear force
- the results of the calculations of still water bending moments, shear forces and, where applicable, limitations due to torsional and lateral loads
- the allowable localised loads for the structure (hatch covers, decks, double bottom, etc.).

2.5 Classification of loading instruments

2.5.1 By type of stability criteria calculation

Software of loading instruments may be categorized according to the type of stability criteria calculations it is enabled to perform as:

- 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 basis of the maximum allowable VCG curve of previously approved loading conditions.
- Type 3: Software calculating intact and damage stability by direct application of pre-programmed damage cases for each loading condition.

Note 1: Loading instruments enabled to perform calculations for any damage case being input by the user will only be assessed according to its ability to perform such analysis on the pre-programmed cases, thus analysed as type 3 software.

Note 2: All three types of software may as well perform strength calculations assessing hull girder forces and moments against predefined limits.

2.5.2 By type of interface capabilities

Software of loading instruments may be categorized according to the methods implemented to input the data, perform the calculations and interact with other systems as:

- Passive systems: Systems requiring the manual entry of data (tanks soundings, compartment status etc.).
- Active systems: Systems in which the data is input by means of sensors measuring and sending the information of content in tanks, draught readings, vessels inclination angles, etc. Active systems should have an offline operating mode in which all the data normally provided by sensors is input by the user.
- Integrated system: Systems that control or initiate actions based on the sensor supplied inputs and the calculations it performs.

Table 1 : Reference documentation

Reference	Title	Purpose in this document
NR 217	Rules for the Classification of Inland Navigation Vessels	General requirements for classification
NR 544	Survey of Materials and Equipment at Works for the Classification of Inland Navigation Vessels	Requirements for the assessment of equipment being surveyed, and specifically that Type Approved
ADN	European agreement concerning the International Carriage of Dangerous Goods by Inland Waterway	Applicable stability and strength criteria for vessels with additional class notation **ADN** having an on board loading instrument.

SECTION 2 APPROVAL REQUIREMENTS

1 General

1.1

1.1.1 Approval of a loading instrument is to be performed in compliance with the applicable requirements of this Section.

1.1.2 A loading instrument on board inland vessels is an equipment with Requirement Class 2, therefore no type approval is mandatory for its assessment. The guidelines in [3] provide guidance for the specification and design of its hardware, software and features, in compliance with the applicable requirements in NR217, Pt C, Ch 2, Sec 16.

1.1.3 After the installation test is completed and approved, an "Attestation for Loading Instrument" will be issued by the Society.

2 Approval procedure

2.1 Conditions of approval

2.1.1 The loading instrument approval process shall include the following steps for each vessel:

a) Approval of hardware in accordance with [3.1].

b) Approval of software which includes the following verifications/checks:

- compliance of the software system specification with [3.2]
- compliance of the general features with [3.3]
- review of the complete system's functionality, calculation methods and principles
- availability and review of the user manual.

c) Data verification which results in the Endorsed Test Conditions.

d) Installation testing which results in the Installation Test Report.

2.1.2 When the loading instrument is Type Approved or its software has a valid general Attestation of Software for Loading Instrument, as described in App 1 and it is ascertained that the scope of this attestation includes the type of vessel being verified, the procedure b) in [2.1.1] may be waived.

2.1.3 Any alteration of the loading instrument (including both hardware and software) must be subject to appropriate test with record of the corresponding results. In both cases, the society must be approached for update or renewal of the original approval.

2.1.4 In the case of modifications implying changes in the main characteristics of the vessel, including new loading conditions, the loading instrument is to be modified accordingly and approved.

2.1.5 The loading instrument is to be approved for the specific type of calculations that it performs. The certificate of approval or its appended technical note will specify the calculations the program is approved for as well as important limitations. Figures in [6.1] present a model of the certification issued.

2.2 Data verification - Endorsed test conditions

2.2.1 The Society is to verify software specification, results and actual vessel data used by the loading instrument for the particular vessel on which the program will be installed. This verification will be carried at the Society's offices and shall only be performed after the stability information of the concerned vessel is finalized and approved.

2.2.2 Data verification will only be performed after the specific version of the Loading Instrument has been assessed as stated in item b) in [2.1.1].

2.2.3 Upon application for data verification, the Society is to instruct the applicant of a minimum of four test loading conditions.

The test conditions normally cover the range of load draughts from the deepest envisaged loaded condition to the light ballast condition and trims between the maximum values approved. Within the range of these test conditions, each compartment is to be loaded at least once.

Additionally, for vessels carrying liquids in bulk, at least one of the conditions shall include partially filled tanks showing the most unfavourable free surface effect and, for vessels carrying grain in bulk, one of the grain loading conditions shall include a partially filled grain compartment.

2.2.4 Every proposed test conditions is to be input in the loading instrument, the calculations run and the results submitted to the Society. The system's computational accuracy will be determined comparing the submitted results against results from parallel calculations carried out by the Society or the information in the approved stability booklet.

2.2.5 Particular attention is drawn to the final lightship weight and centers of gravity derived from the inclining experiment and lightweight check.

2.2.6 The data verification procedure will be considered complete when:

a) The actual vessel's data as described in [2.3] is acceptable.

b) The computational accuracy of the instrument's program is within the acceptable tolerances presented in [5].

After satisfactory data verification, the Society endorses the test conditions and introduces them in the Installation Test Procedure, a copy of which is to be available on board during the installation testing. It is recommended that the endorsed test conditions are stored in the memory of the program when installed on board to facilitate system performance checks.

2.3 Data to be submitted

2.3.1 The following data to be submitted by the applicant are to be consistent with the as-built vessel:

- Identification of the calculation software including version number.
- Main dimensions, hydrostatic particulars and, if applicable, the vessel profile.
- The position of the forward and aft perpendiculars, and if appropriate, the calculation method to derive the forward and aft draughts at the actual position of the vessel's draught marks.
- Vessel lightweight and lightweight distribution along the vessel's length.
- Lines plans and/or offset tables.
- Compartment definitions, including frame spacing, and centers of volume, together with capacity tables (sounding/ullage tables).
- Deadweight definitions for each loading condition.

2.3.2 Additional information is to be submitted according to the specific different types of calculations described in [4]. The data to be submitted is listed under each specification.

2.4 Installation testing

2.4.1 The operation of the loading instrument is to be verified upon installation under the agreed conditions. It is to be checked that at the moment of the testing the Endorsed Test Conditions and the user manual for the instrument are available on board.

2.4.2 Vessel's officers and any designated user shall be able to use the loading instrument with proficiency. Evidence of sufficient training may be requested by the Society.

2.4.3 Hardware and software

A surveyor from the society will verify that the installation on board is in accordance with the general requirements of the Society and to the specifications for hardware and software that were previously approved.

Prior on testing its performance, it is to be checked that name and version of the software correspond to the ones that appear on both the Endorsed Test Conditions and User Manual.

2.4.4 Performance test

One of the vessel's officers is to operate the loading instrument and calculate the results while witnessed by a surveyor of the Society who, for each of the Endorsed Test Conditions, will indicate which data is to be input and compare all results with those endorsed.

The Society will check that the results from the instrument are identical to those in the endorsed test conditions. If the numerical output differs from the results endorsed, no approval will be confirmed to the instrument.

When the test conditions were previously stored in the loading instrument's memory or, at the surveyor's discretion, it is deemed to further survey the system performance, the following is to be performed to ascertain that the software is performing calculations correctly:

- Indicate to alter several items of deadweight to change at least 10% of the displacement or, for the analysis of still water torsional moments and stability, change of heel of at least 4° and review the results. The Surveyor is to ensure that the calculations differ from the base endorsed results in a logical manner.
- Restore the base loading conditions and confirm that the calculation results are still identical to the ones in the endorsed test condition.

Alternatively, the test condition may be manually input to the loading instrument for the results verification.

2.4.5 An installation test is also to be carried in any second nominated computer when it is available.

2.5 Periodical testing

2.5.1 The loading instrument shall be checked for accuracy at regular intervals by the vessel officers, by applying an approved loading condition. This test shall be carried out at least annually; the presence of a Society's surveyor in the annual check is not mandatory but documentation including the test results shall be kept on board and can be requested to be delivered to the Society.

2.5.2 At least at each Class Renewal Survey a performance test shall be carried out in the presence of a surveyor from the society.

2.5.3 During survey, system failures such as lag, presence of adware pop-ups and viruses, system crashes and, in general, evidence of inadequate system maintenance may result on an approval suspension for the loading instrument and require a new software or hardware assessment.

3 System specification

3.1 Hardware

3.1.1 In principle, a single computer unit with the loading instrument software installed should be available on board at all time. It is recommended that no other than specific technical and organisational software is installed in the computer unit to avoid altering its performance.

3.1.2 The hardware specification has to be in conformity with recognized standards and be at least in accordance with all the specifications defined by the loading instrument software for its correct performance and according to its intended application (under normal service), as well as any other software installed in it (Operating System, Antivirus, etc.). In general, the system does not need to be of the marinised type, and has to be in compliance with the local conformity requirements (e.g. European Community Declaration of Conformity EC DoC).

A hardware description may be requested for submission to the Society.

3.1.3 The housing of the loading instrument must ensure:

- protection against excessive vibrations, notably where the frequency may alter its functions
- ability to withstand various inclinations which are expectable during vessel's operation
- protection from weather
- protection from the effect of high and low temperatures.

Special attention must be paid where additional requirements regarding protection of electrical equipment must be complied (e.g. ADN regulations).

3.1.4 Input and output devices must be positioned in such manner that the operator has a clear view of the related controls and displays.

Visual display units (VDU) and other output devices must be suitably lighted and dimmable when installed in the wheelhouse. It must be possible to adjust brightness and VDU's colours to a minimum distinguishable level.

The position of the VDU must allow easy reading by the operator from his work station (the display size be chosen accordingly).

3.1.5 Hardware must be protected against damage and corruption of data in memory in case of power supply failure.

3.1.6 In active systems, all sensors distributed in the vessel (e.g. tank levels, draught sensors, inclinometers, etc.) are considered part of the loading instrument's hardware and shall be assessed in a case by case basis. Means to disconnect such devices (either digitally or physically) should be provided to activate the "off-line" operating mode of the loading instrument.

3.2 Software

3.2.1 The design and production of the software should be in accordance with appropriate international quality standards, for example ISO 9000-3 or equivalent. Systematic procedures should be followed during all phases of the software's life cycle.

3.2.2 The software should be written to ensure the user can not alter the critical vessel data files containing the following information:

- Lightship weight and weights distribution and associated centres of gravity.
- Society's imposed structural limitations.
- Geometric hull form data.
- Hydrostatic data.
- Compartment definitions including frame spacing, and centres of volume, together with capacity tables (sounding/ullage tables).

3.2.3 Any changes to the software that may affect the longitudinal strength and/or stability calculations shall only be made by the manufacturer or his appointed representative and the Society should be informed immediately of them. Failure to advice of any modifications to the calculation module may invalidate the certification issued.

In case a certification is considered invalid by the Society, the modified calculation program should be re-assessed in accordance with the approval procedure.

3.2.4 The loading instrument software shall specify additional hardware and software requirements for its correct functionality. Software specifications include Operative Systems and configurations, Plugins, Firewalls, Frameworks (e.g. Java, .NET, etc.), etc. Hardware specifications include processor speed capacity, hard drive memory availability, RAM memory capacity, graphic hardware requirements, etc.

Software protection in the equipment should include virus protection.

3.3 General features

3.3.1 Units

Basic loading and stability calculations are performed using weights, typically Ltons or Mtons. However, some cargoes are more commonly measured in short tons, TEUs, or barrels. Other liquid loads (fuel and ballast) might be initially measured as soundings or ullages. When alternate units are used, the program should minimize chances for unit confusion and, wherever possible, weight conversions should be calculated by the system. Screen displays and print-outs should then present in both the entered value and the computational weight value side-by-side.

The output format and units of the information supplied shall be consistent with the format and units of the stability booklet in order to facilitate easy comparison.

3.3.2 Language

The language in which the loading and stability information is displayed as well as in any print-out and in the operation manual should be the same as used in the vessel's stability booklet and in accordance to the language most commonly used by the vessel's crew. Whenever this language is different from English, an English translation may be required by the Society to be available on board.

3.3.3 Data and program protection

Although the program should be flexible enough to allow the user to override default data, certain data, such as lightship characteristics, allowable bending stress, required GM and the items listed in [3.2.2], as well as the program itself, should be protected against user revision. This could be achieved by furnishing the vessel with compiled or read-only versions.

Program and data of the system must be designed so as not to be altered by electrical transients or loss of the power supply.

Copies of all constant data residing in computer files, such as vessel's geometry and tables, should be available on independent storage units, such as flash memories (USB drives, SD cards or solid state drives) or hard disk drives. The number of such copies should not be less than two.

3.3.4 User interface

The loading instrument is to be user-friendly and designed such that it limits possible input errors by the user. The choice of colour, graphic symbols, etc., must be consistent with the other systems on board. The following characteristics may be implemented in the program:

- A simple command (keystroke/icon) that returns the user directly to a familiar "home" screen from any of the loading screens. This allows a "lost" user (who may have got disoriented among various loading screens) to quickly re-establish their orientation.
- Easily-accessed "help" functions such as designated function keys, or an on-screen menu bar.
- Default loading conditions should reflect any special loading or operating requirements imposed by the vessel's stability booklet (such as locked-in ballast requirements).
- Checking of data entered by the user for reasonableness in order to screen out possible input errors, for example, a cargo tank entry which exceeds the capacity of the tank. The program should not reject the entry as there may be special loading scenarios where unusual data must be entered, but it should clearly indicate to the user that the entry is out of expected bounds. Similarly, the program should alert the user if an output parameter such as "predicted GM" is out of expected bounds.
- Alerts to the user if an output indicates a critical or possible dangerous situation. Alerts should, when possible, be augmented by audio signals. It is recommended that the graphical presentation and audio signals are different in case of critical events and user errors.
- Warning for the maximum filling level of tanks.
- In most cases, load entries will be of the fixed-location type where LCGs, VCGs, etc., are pre-displayed and the user only needs to enter a weight value. However, the program should allow additional non-fixed load entries where the user can enter VCG, LCG, TCG, etc. Examples of non-fixed load entries might be an unusual deck cargo, temporary ballast or damaged stability inputs.

3.3.5 Displaying and printouts

All screen and hardcopy output data is to be presented in a clear and unambiguous manner. Each print-out should automatically contain the name of the vessel and the date of print-out as well as an identification of the loading instrument (including specific version number). This information should be repeated on each page of the print-out.

When a screening or a printout shows results of a calculation, they shall be presented in both numerical and graphical forms. The numerical values are to be given in both as absolute values and as the percentage of the permissible values or limits. Any results print-out shall include a description of the corresponding loading condition and/or stability case.

3.3.6 Program documentation and control

A careful procedure should be established so that revisions to the program are properly tracked and forwarded to the vessel.

Each revision delivered to the vessel should include change pages to the user's manual and instructions on how to delete obsolete files and install replacement (revised) files.

The updating process should include an "action complete" report that acknowledges the correct system update.

3.3.7 User training

Training/tutorial material should be provided according to the sophistication of the software. This may range from formal classroom sessions documentation to tutorial video, simulators and/or self- study lesson plans.

3.4 Operational manual

3.4.1 The loading instrument should be accompanied by a uniquely identified and vessel specific operational manual that shall be submitted to the Society for documentation. The manual should be written for the direct user (vessel's officers) in a simple and straightforward manner and include images and flow charts; it is to be written at least in English and in a language understood proficiently by the instrument's intended users (if different than English).

3.4.2 The operational manual should have a unique identification number and version that matches an on-screen ID number in the program. It should also clearly identify the stability booklet from which the light vessel data is taken.

3.4.3 System requirements

The operational manual shall identify computer system's hardware and software requirements such as compatible interfaces, operating system, memory capacity and other special requirements, such as video graphics, mouse, printer, etc.

3.4.4 File management

The operational manual should include a list of relevant software files, giving name, date and a brief description of each and its usage. The operational manual should also explain how any user-generated files, such as saved loading conditions, are named and stored. These measures should allow the user to review the disk directory and verify that the correct current files are present.

3.4.5 Instructions

It shall be included a clear explanation of how to install, use, and troubleshoot the program. The instructions should be user-friendly, recognizing that the user is a vessel officer. These instructions shall at least include descriptions on function keys, menu displays, input and output of data, use of test loading conditions and system warnings. The description of error and warnings messages shall include unambiguous actions to be taken by the user in each case.

These instructions should give basic guidance on the loading and stability procedures included in the software and, where applicable, present

- shear corrections factors
- local permissible limits for each read out point
- rule restrictions as maximum allowable load on double bottom, maximum specific gravity allowed in liquid cargo tanks, maximum filling level or percentage in liquid cargo tanks hold
- example of a calculation procedure supported by illustrations and sample output (screen displays with explanatory texts).

3.4.6 Information sources

It shall be included a list of all vessel-specific plans, drawings, tables and other documents, which provided information used in the program. In most cases, this information will probably come from the vessel's approved stability booklet; however, other sources (statutory regulations, Society's rules, etc.) should be clearly identified. Ideally, all such information sources should themselves be annotated on how they were used in developing the program (so that future revisions to the document will also prompt a review of the program).

4 Functional requirements

4.1 All loading instruments

4.1.1 The forward, midship and aft draughts, at the respective perpendiculars and at the actual position of the vessel's draught marks, are to be calculated and presented to the user.

4.1.2 The displacement is to be calculated for the specified loading condition and corresponding draught readings and presented to the user.

4.1.3 Draft readings

Draft readings shall not be available to be input or corrected manually into the loading instrument. In any case the loading instrument calculates draft values that differ from the real status of the vessel for more than an acceptable tolerance, the vessel's officer should refer to the stability booklet to continue his assessment.

4.2 Hull girder forces and moments

4.2.1 Loading instruments enabled to perform strength analysis through hull girder forces and moments computations are to be capable of calculating the values listed below in accordance with NR217 Ch 3, Sec 2. In vessels with relatively large deck openings or when the loading instrument includes the analysis of non-uniform loading conditions (e.g. container carrying vessels) additional considerations such as torsional loads are to be considered.

- Still Water Shear Force (SWSF) including shear force correction, where applicable.
- Still Water Bending Moment (SWBM).
- Still Water Torsional Moment (SWTM), when applicable.

4.2.2 The additional data in Tab 1 is to be submitted for approval by the Society, as applicable. Permissible values should include any strength criteria both from the Society and other applicable regulating bodies.

4.2.3 Where the still water torsional moments are required to be calculated, one test condition is to demonstrate such a calculation.

Table 1 : Data to be provided for hull girder forces and moments

Calculation	Data to be provided to the Society
Still Water Shear Force (SWSF)	• The read-out points (frame locations) for the SWSF calculations. These points are normally selected at the position of the transverse bulkhead or other obvious boundaries. Additional read-out points may be specified between the bulkheads of long holds or tanks or between container stacks. • Shear force correction factors and method of application. • The permissible Navigation and Harbour SWSF limits at the read-out points. Where appropriate, additional sets of permissible SWSF values may be specified.
Still Water Bending Moment (SWBM)	• The read-out points (frame locations) for the SWBM calculations. These points are normally selected at the position of the transverse bulkhead, mid-hold or other obvious boundaries. • The permissible Navigation and Harbour SWBM limits at the read-out points. Where appropriate, additional sets of permissible SWBM values may be specified.
Still Water Torsion Moment (SWTM), where applicable	• The read-out points (frame locations) for the SWTM calculations, where applicable. • The permissible limits at the read-out points.

4.2.4 The calculated forces and moments are to be displayed in both graphical and tabular formats, including the percentage of permissible values. The screen and hardcopy output is to display the calculated forces or moments, and the corresponding permissible limits, at each specified read-out point. Alternative limits may be considered by the Society on a case by case basis.

4.2.5 Permissible limits and restrictions

The user is to be able to view the following Society structural limitations in a clear and unambiguous manner:

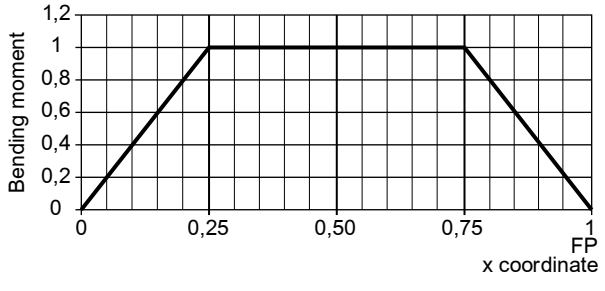
- All permissible still water shear forces and still water bending moments.
- Where applicable, the permissible still water torsion moments.
- Where applicable, all local loading limits both for one hold and for adjacent hold loadings.
- Maximum cargo weight on holds.
- Ballast tank/hold capacities.
- Filling restrictions.

It is to be readily apparent to the user when any of the structural limits has been exceeded.

4.2.6 Longitudinal strength

In general, the curve in Fig 1 is to be used for the definition of the maximum still water bending moments, when no other calculations is considered necessary. The Society may require modifications to this criteria to adapt it to transitional areas where it does not provide sufficient longitudinal strength considerations.

Figure 1 : Maximum bending moment distribution factor simple curve (hogg or sagg)



4.3 Intact stability

4.3.1 For Type 1 stability software calculating intact stability, the Endorsed Test Conditions will be defined considering:

- All the test loading conditions prescribed in [2.2.3] have to be part of the approved stability booklet or loading manual.
- At least one of the loading conditions is to show the compartments intended for liquid loads, in which the free surface effect is considerable, filled in order to have the maximum free surface moment.

4.3.2 All the intact stability requirements appropriate to the vessel, as required in NR217 and any applicable statutory regulation are to be presented in the output; the lack of any one of them is sufficient to prevent the endorsement of the test conditions.

4.3.3 The following additional data is to be submitted for approval by the Society:

- Cross curves of stability calculated on a free trimming basis, for the ranges of displacement and trim anticipated in normal operating conditions, with indication of the volumes which have been considered in the computation of these curves
- Capacity tables indicating, for each compartment or space, the values of the coordinates X_G, Y_G and Z_G of the centre of gravity, as well as the inertia, corresponding to an adequate number of filling percentages.
- List of all the openings (location, tightness, means of closure), pipes or other sources which may lead to progressive flooding.
- Deadweight definitions for each loading condition in which, for any load taken into account, the following information is to be specified:
  - Weight and centre of gravity coordinates.
  - Percentage of filling (if liquid load).
  - Free surface moment (if liquid load).
- Information on loading restrictions (maximum filling level or percentage in liquid cargo tanks, maximum KG or minimum GM curve or table), when applicable.
- All the intact stability criteria applicable to the vessel concerned.

4.4 Damage stability

4.4.1 Type 2 and 3 stability software performing damage stability calculation calculations will also perform intact stability analysis, and therefore the approval is to include the requirements specified in [4.3].

4.4.2 The approval of damage stability calculations performed by a loading instrument is limited to those deterministic criteria relevant to damage stability rules specified in NR217 and statutory regulations applicable to the specific vessels service notations. Nevertheless the software may perform any additional damage scenarios.

4.4.3 All the damage stability requirements applicable to the vessel are to be available in the output. The lack of any one of them is sufficient to prevent the endorsement of the test conditions.

4.4.4 In addition to the data required in [4.3.3], it shall be submitted all the damage stability criteria applicable to the vessel concerned and implemented in the instrument, including:

- For type 2 stability software, tabulated values of maximum allowable VCG and limit curves for the previously approved loading conditions.

- For type 3 stability software, a list of all the damage cases implemented, in accordance with the relevant deterministic damage stability rules. Each damage case is to clearly indicate all the compartments or spaces taken into account, as well as the permeability associated with each compartment or space.

This information is to be taken from the approved damage stability documentation and the source details are to be clearly indicated.

4.5 Additional provisions for vessels with additional class notation ADN

4.5.1 The following requirements provide indications for the implementation of the vessel's stability information in the loading instrument when fitted on board a vessel with additional class notation **ADN**. Nevertheless, all data shall be in accordance with the vessel's approved stability information.

4.5.2 In the case the information presented in other parts of this Guidance Note conflicts with the one listed hereunder, the later takes precedence.

4.5.3 Openings

In general, an opening can be considered as weathertight or watertight if it has been designed (its strength and features) and tested in accordance with the Rules of the Society. ADN definition as "open" type of opening is equivalent to "non-weathertight" in our Rules.

The following prescriptions apply for the definition of vessel's openings:

a) Main ventilation openings, inclusive those equipped with fire dampers, are to be considered as "open" type of opening.

b) Gooseneck and similar ventilation pipes shall be considered as "open" type of opening. Ventilation pipes fitted with closing devices (generally not allowed) are likewise considered as open.

When the opening sectional area is less than 710 mm^2 (diameter < 30 mm), it may be considered as weathertight for stability calculations. For vessels built before 1 January 2016, goosenecks or similar vent pipes having an opening sectional area ≤ 7850 mm^2 (diameter < 100 mm) may be considered as weathertight.

c) Tank vent automatic closing devices (check valves) with floating balls (i.e. Winel / Winteb systems) are considered as weathertight when tested in accordance to the Society's Rules. For vessels built before 1 January 2016, these systems may be considered as watertight. This provision applies only when the system is subject to inspection by the Society with a periodicity of maximum 2,5 years, otherwise it is considered as "open" type of opening.

d) Exhaust pipes leading through the outer shell are considered as "open" type of opening. They can be considered otherwise in a case by case basis, depending on the installation design of the exhaust system.

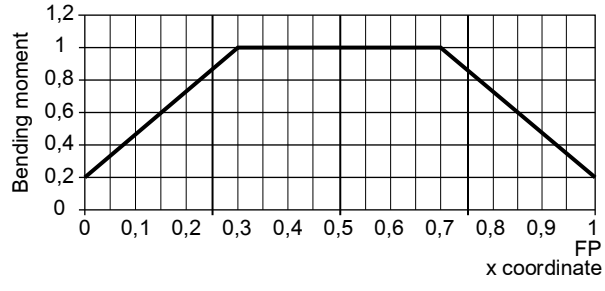
e) Doors, windows and hatches tested and approved as watertight or weathertight according to the Society's Rules, are considered as such on purpose of stability calculations, independent of the material on which they are constructed (including aluminium-glass doors). Windows that are enabled to be opened shall be considered as "open" type of opening, however windows that are only partially opened may be partially (for its fixed part) considered as weathertight if accordingly designed and tested.

f) The chain pipe to chainlocker opening is to be considered as "open", including those where the upper part of the pipe is fitted with a closing device.

4.5.4 Longitudinal strength

The curve in Fig 2 is used for the definition of the maximum still water bending moments, when no other calculations are considered necessary. The Society may require modifications to these criteria to adapt it to transitional areas where it does not provide sufficient longitudinal strength considerations. An optimised version of this curve based on real transverse sections may be applied.

Figure 2 : Maximum bending moment distribution factor simple curve (hogg or sagg) for vessels with additional class notation ADN



Maximum bending moment distribution factor.

5 Acceptable tolerances

5.1 General

5.1.1 Depending on the type and scope of software, the acceptable tolerances are to be determined differently. Deviation from these tolerances shall not be accepted unless the Society considers that there is a satisfactory explanation for the difference and that there will be no adverse effect on the safety of the vessel.

Examples of pre-programmed input data include the following:

- Hydrostatic data: Displacement, LCB, LCF, VCB, KM_T and M_{CT} versus draught.
- Stability data: KN or MS values at appropriate heel/ trim angles versus displacement, stability limits.
- Compartment data: Volume, LCG, VCG, TCG and FSM/ Grain heeling moments vs level of the compartment's contents.

Examples of output data include the following:

- Hydrostatic data: Displacement, LCB, LCF, VCB, KMt and M_{CT} versus draught as well as actual draughts and trim.
- Stability data: FSC (free surface correction), GZ-values, KG, GM, KG/GM limits, allowable grain heeling moments, derived stability criteria, e.g. areas under the GZ curve, weather criteria.
- Compartment data: Calculated Volume, LCG, VCG, TCG and FSM/ Grain heeling moments vs level of the compartment's contents.

5.1.2 The deviation in the tolerances (in percentage) is calculated as:

$$\text{deviation} = \frac{\text{value}_{\text{base}} - \text{value}_{\text{application}}}{\text{value}_{\text{base}}} \times 100$$

Where the base value is taken from the approved stability booklet or from a Society's computational model.

5.2 Systems with pre-programmed data

5.2.1 Programs which use only pre-programmed data from the approved stability information as the basis for stability calculations shall have zero tolerances for the printouts of input data.

5.2.2 Output data tolerances are to be close to zero, however, small differences associated with calculation rounding or abridged input data are acceptable. Additionally, differences associated with the use of hydrostatic and stability data for trims that differ from those in the approved stability information are acceptable subject to review by the Society.

5.3 Systems with hull form model computation

5.3.1 Programs which use hull form models as their basis for stability calculations shall have tolerances for the printouts of basic calculated data established against either data from the approved stability information or data obtained using the approval authority's model. Acceptable tolerances shall be in accordance with Tab 3.

5.4 Longitudinal strength calculations

5.4.1 The accuracy of the calculation program is to be within the acceptable tolerance band, specified in Tab 2, of the results at each read-out point obtained by the Society, using an independent program or the approved loading manual with identical input.

Table 2 : Tolerance band for the comparison of computational accuracy

Computation	Tolerance (percentage of the permissible values)
Still Water Shear Force	± 5%
Still Water Bending Moment	± 5%
Still Water Torsion Moment, where applicable	± 5%

Table 3 : Acceptable tolerances for stability calculations

Hull form dependent		
Displacement (in%)	L< 50: 2.0	L ≥ 50: $2.455 - \frac{L}{110}$
Longitudinal center of buoyancy, from AP	0.5% (50 cm max.)	
Vertical center of buoyancy	0.5% (5 cm max)	
Transverse center of buoyancy	0.5% of B (5 cm max)	
Longitudinal center of flotation, from AP	1% (50 cm max)	
Moment to trim 1 cm	2%	
Transverse metacentric height (GM_T)	1% (5 cm max)	
Longitudinal metacentric height (GM_L)	1% (50 cm max)	
Cross curves of stability	5 cm	
Compartment dependent		
Volume or deadweight	2%	
Longitudinal center of gravity, from AP	1% (50 cm max)	
Vertical center of gravity	1% (5 cm max)	
Transverse center of gravity	0.5% of B (5 cm max)	
Free surface moment	2%	
Shifting moment	5%	
Level of contents	2%	
Trim and stability		
Draughts (forward, aft, mean)	1% (5 cm max)	
GM_T	1% (5 cm max)	
GZ Values	5% (5 cm max)	
Free Surface Correction	2%	
Downflooding angles	2°	
Equilibrium angles	1°	
Distance to unprotected openings margin line from WL, if applicable	5% (5 cm max)	
Areas under righting arm curve	5% or 0,0012 mrad	

6 Certification

6.1 Model of attestation for loading instrument

6.1.1 Fig 3 and Fig 4 present the model of the attestation issued by the Society when a loading instrument has been assessed according to the requirements in this Section.

Figure 3 : Loading instrument attestation - Main reference sheet

BUREAU VERITAS

International Register for Classification of Ships - Established 1828
Registre International de Classification de Navires - Fondé en 1828

MARINE & OFFSHORE DIVISION
Inland Navigation Management

Attestation Nr.: .....

Loading Instrument

covering longitudinal strength, intact stability and damage stability(1)

(1) mention to be crossed out when not appropriate

Issued within the scope of the General Conditions of the Bureau Veritas Marine & Offshore Division
Délivrée dans le cadre des Conditions Générales de la Direction Marine & Offshore du Bureau Veritas

Name of Ship	:	.....
Owner	:	.....
BV Register Nr.	:	.....
Port of Registry	:	.....
Flag	:	.....

This is to certify that the system installed onboard the above vessel has been subject to examination, review and test according to the procedures of Bureau Veritas for the assessment of loading instruments NI634 DNI, and its Rules for the Classification of inland navigation vessels NR217 DNI and was found satisfactory.

This attestation is valid only for the system described below (hardware and software). Any change on one or the other must be declared to Bureau Veritas. Failure to advise of any modification to the system would invalidate the present attestation.

The approved operational manual must be available at the corresponding working station.

Maintenance of the system described below must be planned and documented.

The validated test cases must be run in the loading instrument at least at each Class Renewal Survey in the presence of the attending Bureau Veritas surveyor. Corresponding endorsements must be written at the back of the present attestation.

The original installation test report must be available at any time.

Reference of the approved loading manual or maximum admissible bending moments and shear force:

.....

Reference of the approved stability files (Regulation, Authority and Date of Approval):

.....

BUREAU VERITAS MARINE & OFFSHORE DIVISION PARIS 1828 DNI - Antwerp SAMPLE

The latest published Rules of the Bureau Veritas Marine & Offshore Division and its General Conditions, are applicable.
La dernière édition des Règlements de la Direction Marine & Offshore du Bureau Veritas ainsi que les Conditions Générales, sont applicables.

Any person not a party to the contract pursuant to which this document is delivered may not assert a claim against Bureau Veritas for any liability arising out of errors or omissions which may be contained in said document, or for errors of judgement, fault or negligence committed by personnel of the Society or of its Agents in the establishment or issuance of this document, and in connection with any activity for which it may provide.	*Toute personne qui n'est pas partie au contrat aux termes duquel ce document est délivré ne pourra engager la responsabilité du Bureau Veritas pour les inexactitudes ou omissions qui pourraient y être relevées ainsi que pour les erreurs de jugement, fautes ou négligences commises par le personnel de la Société ou par ses agents dans l'établissement de ce document et dans l'exécution des interventions qu'il comporte.*

Figure 4 : Loading instrument attestation - Details and surveys sheet

Description of the system:

Hardware:

.....

.....

Software:

.....

.....

Installation test report:

Reference: ..... Date of test .....

In witness whereof and subject to these reserves, the present attestation is delivered for the ends and purposes for which it was designed.

Issued in ..... **On** .....

BUREAU VERITAS MARINE & OFFSHORE DIVISION PARIS 1828 DNI - Antwerp SAMPLE

Bureau Veritas
Inland Navigation Management (DNI)

.....

Periodical check from Bureau Veritas surveyor:

Date ..... BV Center, Name and signature .....

Date ..... BV Center, Name and signature .....

Date ..... BV Center, Name and signature .....

Date ..... BV Center, Name and signature .....

Date ..... BV Center, Name and signature .....

Date ..... BV Center, Name and signature .....

Date ..... BV Center, Name and signature .....

Date ..... BV Center, Name and signature .....

APPENDIX 1 TYPE APPROVAL

1 General

1.1 Type approved loading instruments

1.1.1 Loading instruments type approval for inland navigation vessels is generally not mandatory, moreover when the system installed is type approved, some stages of the approval procedure may be waived as stated in Sec 2, [2.1].

1.1.2 A loading instrument may be granted a type approval when:

a) its software's performance is Generally Assessed and certified by the Society or a recognized body as described in Article [2].

b) its hardware has been found in compliance with all the applicable requirements for type approval of on board computer systems, as described in Article [3]. Tab 1 lists the standards referenced in this appendix for hardware testing.

References of both hardware and software shall be specified in the type approval certificate.

1.1.3 When a loading instrument's software is updated and its hardware remain unchanged a new general assessment of the software may be sufficient for the re-issuance of a type approval.

2 General assessment

2.1 Conditions of approval

2.1.1 A loading instrument's software performance may be generally assessed for specific types of vessels in accordance with the following guidelines. Upon satisfactory completion, the software may be issued with a general Attestation of Software for Loading Instrument as presented in [4.1].

2.1.2 The software assessment consist in the following examinations/checks:

a) Approval of software specification and features according to Sec 2, [3.2] and Sec 2, [3.3].

b) Approval of functional specification according to Sec 2, [4].

c) Review of the system's functionality and the calculation methods and principles.

d) Review that the computational accuracy of the loading instrument, obtained according to the performance test specified in [2.2], is within the acceptable tolerances.

e) Review of the operational manual in accordance with Sec 2, [3.4].

f) Review of the minimum hardware specification.

2.1.3 A general Attestation of Software for Loading Instrument is only valid for an identified and specified version of the loading and stability software, and its validity is limited for the vessel types for which the approval is requested and accepted. The certificate will specify, in detail, what calculations the program is approved for as well as important limitations and a list of all the accepted vessel types.

2.1.4 The general Attestation of Software for Loading Instrument will remain valid for a period not exceeding five years. It would be revalidated upon confirmation from the manufacturers of the software that the calculation algorithms remain unchanged.

The certificate held for any specified calculation software shall become invalid if the calculation algorithms have been modified by the manufacturer without the agreement of the Society. In such cases, the revised calculation program shall be treated as a new calculation program.

2.2 Performance testing

2.2.1 Upon application to the Society for general approval of the software, the Society will provide the applicant with test data for vessel types for which the software is to be approved for:

- at least two vessel types where the software computes by interpolating between precalculated data tables
- at least three vessel types where the software computes using input of hull forms and subdivisions.

2.2.2 At least one data set for each vessel type will be provided by the Society. When a general assessment is required for a unique vessel type at least two data sets of two different hull forms of this type shall be provided or three data sets for software using hull form data input. Each data set will include not less than four loading conditions to be tested.

The Society will define on a case by case basis if additional data sets are to be evaluated.

2.2.3 Alternatively, a general Attestation of Software for Loading Instrument may be given based on at least two test vessels agreed between the Society and the applicant.

2.2.4 The data submitted shall be used by the applicant to run the calculation program for the test vessels. The results obtained (together with the hydrostatic data and cross-curve data developed by the program, if appropriate) should be submitted to the Society for the assessment of the program's computational accuracy. The Society will perform parallel calculation and assess the system's accuracy according to the tolerances in Sec 2, [5].

Table 1 : Reference documentation

Reference	Title	Purpose
IEC CISPR 16-2	Specification for radio disturbance and immunity measuring apparatus and methods - Pt 2: Methods of measurement of disturbances and immunity	Applicable procedures for electromagnetic interference emissions tests
IEC 61000-4	Electromagnetic Compatibility (EMC) - Pt 4: Testing and measurement techniques	Applicable procedures for EMC immunity tests
IEC 60092-504	Electrical installations in ships - Pt 504: Special features - Control and instrumentation	Applicable procedure for inclination tests
IEC 60068-2	Environmental testing - Pt 2: Tests	Applicable procedures for Damp Heat, Dry Heat, Cold Temperatures and vibration tests
IEC 60945	Maritime navigation and radio communication equipment and systems	Additional test procedures for environmental immunity compliance tests

3 Hardware Certification

3.1 General

3.1.1 The hardware of a Type Approved loading instrument may be approved if found in compliance for the requirements of Computer Systems in NR217, Pt C, Ch 2, Sec 16. Notice that hardware is to be approved in combination with the main software it natively includes, including its firmware (e.g. BIOS, operative system, etc.).

3.1.2 When an approval has been already carried out by another Classification Society or a recognized laboratory, successful approval tests that consider all the Society relevant requirements may be accepted. All documentation on tests performed shall be submitted to the Society.

3.1.3 In general, the hardware performance and environmental tests are to include the following:

- Visual Inspection
- Performance and functional tests
- Electric power supply failure and variations
- Dry heat
- Damp heat
- Vibration
- Inclination
- Insulation resistance
- Cold temperatures
- EMC (Electromagnetic compatibility tests).

3.1.4 The description documentation for computer's hardware is to include:

- Hardware information of importance for the application and a list of documents that apply to the system.
- Supply circuit diagram and input and output diagrams.
- Relevant design drawings with materials specified, catalogues, data sheets, calculations and functional descriptions.
- Information of main software natively installed with names, version numbers and descriptions.

Additional information for configuration and setting to work of the equipment is also to be available, including:

- Description of tools for configuration.
- Information to activate the system.
- General information for trouble shooting and repair when the system is in operation.

3.1.5 Any alteration on hardware specifications shall be informed to the Society.

3.1.6 The extent of testing (i.e. selection of tests, sequence to carry them out and number of pieces to be tested) is to be determined upon examination and evaluation of the equipment or component subject to testing, giving due regards to its intended usage. Equipment is to be tested in its normal position if otherwise not specified in the test specification.

3.1.7 The guidelines provided hereunder give parameters for tests normally carried out in both hardware and software in loading instruments, according to the procedures in the standards listed in Tab 1. Moreover, depending on particular manufacturing or operation conditions, other tests may be required including:

- Mechanical endurance test
- Temperature shock test
- Immersion test
- Oil resistance test
- Shock test.

Applicable test procedures shall be defined with the society in each case.

3.2 Operation testing

3.2.1 Visual inspection

Visual inspection is to be carried out after each test in order to detect visual damage in the equipment. The hardware is tested for conformity with:

- Manufacturers specification
- Design drawings and data.

3.2.2 Overall performance test

Test on manufacturers performance specifications are to be carried out at standard atmospheric conditions (see Tab 2). It is to be verified that the operation is in accordance with the manufacturer's specifications and applicable rule requirements. As hardware is being type approved in association with a loading instrument's software, performance tests shall be carried out with the data in [2.2] and running the loading and stability software.

A performance test shall include the following examinations:

- Confirmation that operation is in accordance with the requirements specified for the equipment
- checking of self-monitoring features
- checking of specified protection against an access to the memory
- checking against effect of erroneous use of control elements.

Table 2 : Performance tests atmospheric conditions

Temperature	25°C ± 10°C
Relative Humidity	60% ± 30%
Air pressure	96 kPa ± 10 kPa

3.2.3 Functional test

In contrast to a performance test, a functional test is a simplified test sufficient to verify that the equipment under test has not suffered any deterioration caused by the environmental test being carried out.

3.3 Power supply tests

3.3.1 General

Power supply effects on the system performance shall be assessed according to the following guidelines. In general the equipment is to withstand a performance test after recovering from any power failure and functional test during power supply variations.

3.3.2 External power failure

Verification of the specified behaviour of the equipment on loss and restoration of supply in accordance with the system design.

a) Procedure:

Power supply shall be interrupted 4 times during a period of 5 minutes.

b) Test Parameters:

- Switching- off time: 30 s each case
- One interruption is to be carried out during booting.

c) Additional information:

Verification of possible corruption of programme or data held in programmable electronic systems, where applicable.

The time of 5 minutes may be exceeded if the equipment under test needs a longer time for its booting sequence under normal conditions.

3.3.3 AC Power supply variations

Verification of the specified behaviour of the equipment on application of disturbances on the AC supply in accordance with the system design.

a) Procedure:

AC Permanent variations are to be tested in each of the provided combinations for voltage and frequencies with the equipment operating. No overall performance variations shall be appreciated during the tests, its duration shall be as long as required to totally assess the system's performance.

Transient tests shall be carried with variations in cycles with the duty duration specified. Overall performance shall not be affected after the test, however self recovering degradation is acceptable when the variation is applied.

b) Test Parameters:

Test is to be carried for each voltage and frequency combination in Tab 3.

Table 3 : AC Power supply variations

	voltage	frequency
Permanent	+ 6%	+ 5%
	+ 6%	– 5%
	– 10%	– 5%
	– 10%	+ 5%
Transient	voltage transient (duration: 1.5 s)	frequency transient (duration: 5 s)
	+ 20%	+ 10%
	– 20%	– 10%

3.3.4 DC power supply variations

Verification of the specified behaviour of the equipment on application of disturbances on the DC supply in accordance with the system design.

a) Procedure:

Continuous voltage variation to be applied at least until the voltage reaches it steady state and for not less than 15 min. Cyclic variations to be applied with a frequency of 250 Hz.

b) Test parameters:

DC power variations listed in Tab 4.

c) Additional Information

Where batteries are used as electric power supply, test parameters to be taken as:

- [–25%; +30%] for equipment connected to charging batteries or charging devices.
- [–20%; +20%] for equipment not connected to charging devices.

Table 4 : DC Power supply variations

Voltage tolerance	± 10%
Voltage cyclic variation	± 5%
Voltage ripple	± 10%

3.4 Environmental tests

3.4.1 General

The tests described in [3.4.2] to [3.4.8] hereunder are to be carried out for the equipment under examination. The tests procedures are in accordance with the standards stated for each one; however, equivalent testing procedures may be accepted by the Society provided that the same requirements are fulfilled. When comparing standard procedures, the latest edition of the normative reference applies.

These procedures are specific for computer equipment installed in weather protected spaces.

3.4.2 Low temperatures

Verification of the equipment performance and its ability to start while being exposed to low temperatures.

a) Standard Procedure:

IEC 60068-2-1

b) Test parameters:

- Temperature: 0°C ± 3°C
- Duration: 2 hours

c) Additional information:

- Initial measurement of insulation resistance
- Equipment not operating during conditioning and testing except for functional test
- Functional test during the last hour at the test temperature
- Insulation resistance measurement and additional functional test after recovery.

3.4.3 Dry heat

Verification of the ability of the equipment to be operated at high temperatures and through temperature changes without suffering damage nor permanent or temporary malfunctions.

a) Standard Procedure:

IEC 60068-2-2

b) Test parameters:

- Temperature:
  + 55°C ± 2°C or + 70°C ± 2°C
- Duration:
  16 hours

c) Additional information

- Equipment mounted in consoles with other equipment shall be tested at 70°C.
- A functional test is to be conducted during the last hour of the test.
- Equipment specified for increased temperature, the dry heat test is to be conducted at the agreed conditions.

3.4.4 Damp heat

Verification of the ability of the equipment to be operated under conditions of high humidity.

a) Standard Procedure:

IEC 60068-2-30

b) Test parameters:

- Temperature

  + 55°C ± 3°C
- Humidity

  ≥ 95%
- Duration:

  2 cycles (12 + 12 hours)

c) Additional information

- Temperature fall shall guarantee 40°C ± 2°C at 1,5 h and 25°C ± 2°C at 2 h after the second half cycle. (Other temperature fall may be used only when the equipment does not have an open ventilation system, see IEC 60068-2-30).
- Equipment operating during the complete first cycle and switched off during second cycle except for functional test.
- Functional test during the first 2 hours of the first cycle at the test temperature and during the last 2 hours of the second cycle at the test temperature. The duration of the second cycle may be extended in order to carry correctly this functional test.
- Performance test carried after conclusion of all cycles and recovery at standard atmosphere conditions.
- Insulation resistance measurements carried before and after the test.

The temperature tolerance of 3°C takes account of absolute errors in the measurement, slow changes of temperature and temperature variations of the working space. However, in order to maintain the relative humidity, it is necessary to keep the temperature difference within 1°C and it may also be necessary to keep short term fluctuations within 0,5°C.

3.4.5 Vibration

Verification of the ability of the equipment to withstand vibrations without weakening its mechanical features nor modifying its performance.

a) Standard Procedure:

IEC 60068-2-6

b) Test parameters:

A continuos sweep over the following range with a sweep rate ≤ 1 octave/min is to be carried to find resonant frequencies.

- [2 Hz ± 3/0 Hz to 13,2 Hz ± 1 Hz]

  Amplitude: ± 1 mm
- [13,2 Hz to 100 Hz]
  Acceleration: ± 0,7 g

Endurance tests are to be carried in the found resonance frequencies for the following durations:

- 90 minutes at 30 Hz in case of no resonance condition.
- 90 minutes at each resonance frequency at which amplification factor Q > 2 is recorded.
- 120 minutes when a sweep test is to be carried out instead of discrete frequency test and a number of resonant frequencies is detected close to each other. Sweep over a restricted frequency range between 0,8 and 1,2 times the critical frequencies can be used where appropriate.

c) Additional information

Critical frequency is a frequency at which the equipment being tested may exhibit:

- Malfunction and/or performance deterioration
- Mechanical resonances and/or other response effects occur, e.g. chatter.

Tests to be carried out in three mutually perpendicular planes. Functional tests shall be carried out during the vibration tests. It is recommended that the resonance quality factor Q does not exceed a value of 5.

3.4.6 Inclination

Verification of the correct performance of the equipment according to the inclination of its body from the specified normal work orientation.

a) Procedure

- Standard Procedure:

  IEC 60092-504

- Static test procedure:
  - Inclined to the vertical at, at least, the test angle.
  - Inclined in the same plane to at least the test angle on the other side of the vertical.
  - Inclined to the vertical in a vertical plane orthogonal to the previous one to at least the test angle.
  - In the same plane, inclined to at least the test angle on the other side of the vertical.
- Dynamic test procedure:

  Using the directions defined in for static tests above, the equipment is to be rolled to an angle of at least the dynamic test angle at each side of the vertical with a period of 10 seconds.

b) Test parameters:

- Static test angle: 12,0°
- Dynamic test angle: 12,5°

c) Additional information

On the static analysis, the period of testing in each position should be sufficient to fully evaluate the behaviour of the equipment.

On dynamic analysis, the test in each direction is to be carried out for not less than 15 minutes.

Inclination tests are normally not required for equipment with no moving parts (e.g. fixed computers)

3.4.7 Insulation resistance

Verification of the insulation between the power feeding lines.

a) Standard Procedure:

Ensure that the equipment is unpowered and has reached its equilibrium test at atmospheric conditions. Measure insulation between each of the phases and earth, and, when the equipment has a metallic casing, between the case and the feed phases.

b) Test parameters:

Test according to parameters in Tab 5.

Insulation resistance test is to be carried out before and after damp heat test and low temperatures test.

c) Additional information:

Test is only to be carried on unpowered equipment. Before conducting insulation resistance tests, it is necessary to ensure that no risk of damaging the equipment is involved.

Certain components may be required to be disconnected for this test (e. g. EMC protections).

Table 5 : Insulation resistance parameters

Rated supply	Test voltage	Minimum insulation resistance	
		before	after
$U_e \leq 65$ V	2 x $U_e > 24$ V	10 MΩ	1,0 MΩ
$U_e > 65$ V	500 V	100 MΩ	10 MΩ

3.4.8 Environmental tests on portable equipment

Where the loading instrument hardware is portable (e.g. laptop) Tab 6 list test parameters that shall be modified and new tests to be included in the verification process.

General standard procedures tests as described in guidelines [3.4.2] to [3.4.7] and in IEC 60945.

Table 6 : Environment conditions for portable equipment

Dry Heat	55°C ± 2°C (70°C ± 2°C storage)
Cold	–20°C ± 2°C (–30°C ± 2°C storage)
Thermal shock	45 K into water
Drop onto hard surface	6 drops from 1 m
Drop onto water	3 drops from 20 m
Water immersion	100 kPa for 5 min
Solar radiation	1120 W/m²
Oil resistance	ISO Oil N°1, 24 h, 19°C
Note 1: Storage tests are to be carried maintaining the equipment unpowered at the indicated temperature for 10 h followed by a performance test at atmospheric conditions.	

3.5 Electromagnetic compatibility tests

3.5.1 General

Electromagnetic compatibility (EMC) tests are to be carried out in the equipment according to the following guidelines. Special considerations might be applicable if the equipment is limited to be used in controlled spaces in which case the extent of tests will be analysed in a case by case basis.

3.5.2 Performance criteria

Each of the EMC tests to be carried shall be evaluated according to the following performance criteria (each test specify the criterion to be used):

- Performance criterion A:

  For continuos phenomena. The equipment shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed as defined in relevant equipment standard and the technical specification published by the manufacturer.

- Performance criterion B:

  For transient phenomena. The equipment shall continue to operate as intended after the tests. No degradation of performance or loss of function is allowed as defined in the technical specification published by the manufacturer. During the test, degradation or loss of function or performance which is self-recoverable is however allowed but no change of actual operating state or stored data is allowed.

3.5.3 Immunity to electromagnetic fields

Verification that the electromagnetic field generated by different transmitters around the equipment does not affect its performance.

a) Standard Procedure:

   IEC 61000-4-3

b) Test parameters:
   - IEC Standard test level 3
   - Test parameters according to Tab 7.

c) Additional information
   - Performance criterion A.
   - The test is limited to equipment exposed to direct radiation by transmitters at their place of installation

Table 7 : Electromagnetic field test

Frequency range	80 MHz to 2 GHz
Modulation	80% AM at 1000 Hz
Field strength	10 V/m
Frequency sweep rate	≤ $1{,}5.10^{-3}$ decades/s (or 1% / 3 sec)

3.5.4 Immunity to electrostatic discharge

Verification of the equipment's performance when subject to electrostatic discharge, as may occur when persons touch the appliance

a) Standard Procedure:

   IEC 60068-2-2

b) Test parameters:
   - Standard Test level 3.
   - Test to be carried according to the parameters in Tab 8.

c) Additional information
   - Use performance criterion B.
   - The test is to be limited to the points and surfaces that can normally be reached by the operator.

Table 8 : Electrostatic discharge test parameters

Contact discharge	6 kV
Air discharge	2 kV, 4 kV, 8 kV
Interval between single discharges	1 second
No. of pulses	10 per polarity

3.5.5 Immunity to electrical fast transient (Burst)

Verification of the equipment's ability to work while a fast low energy transient signal is superimposed into its power lines and signal and control lines (trough capacitive coupling clamps), normally occurring because of arcs generated when actuating electrical contacts.

a) Standard Procedure:

   IEC 61000-4-4

b) Test parameters:
   - Standard test level 3.
   - Test to be carried according to the parameters listed in Tab 9.

c) Additional information:

   Performance criterion B.

Table 9 : Burst test parameters

Single pulse time	5ns (between 10% and 90% value)
Single pulse width	50 ns (50% value)
Amplitude (peak)	- 2 kV line on power supply port/earth - 1 kV on I/O data control and communication ports (coupling clamp)
Pulse period	300 ms
Burst duration	15 ms
Duration/polarity	5 min

3.5.6 Immunity to electrical slow transients (surge)

Verification of the equipment performance when subject to slow high energy transient interference generated in its power lines, for instance, by switching "ON" or "OFF" high power inductive consumers.

a) Standard Procedure:

   IEC 61000-4-5

b) Test parameters:
   - IEC Standard test level 2.
   - Test to be applied in AC and DC power ports.
   - Test parameters listed in Tab 10.

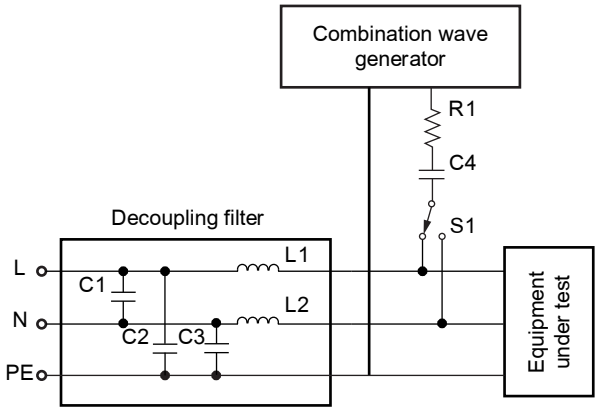
c) Additional information

- Performance criterion B.
- Typical test set up as in Fig 1, when a signal line is also used as power supply (e.g. PoE), a different coupling circuit is to be implemented accordingly (different configurations available in the proposed standard procedure).

Table 10 : Surge test parameters

Open circuit voltage	
Pulse rise time	1,2 µs (front time)
Pulse width	50 µs (time to half value)
Amplitude (peak)	1 kV line/earth; 0,5kV line/line
Short circuit current	
Pulse rise time	8 µs (front time)
Pulse width	20 µs (time to half value)
Repetition rate	1 pulse/min
N° of pulses	5 per polarity
Application	Continuous

Figure 1 : Surge test feed line coupling



Typical values for discrete components are R_1 = 10 Ω, C_4 = 9 µF, Generator Output Impedance R_i = 2 Ω x (1 ± 10%).

L1 = L2 ≤ 1,5 mH, decoupling inductance values are to be provided by the tester according to test conditions (power supply, in-line equipment, etc.).

3.5.7 Immunity to conducted radio frequency

Verification of the equipment performance when subject to electromagnetic fields coupled as high frequency into the test specimen via the connecting lines.

a) Standard Procedure:

IEC 61000-4-6

b) Test parameters:

- Standard level 2.
- Test parameters for equipment installed outside bridges and deck zones according to Tab 11.
- Test levels shall be increased to 10 Vrms for spot frequencies at 2; 3; 4; 6,2; 8,2; 12,6; 16,5; 18,8; 22 and 25 MHz (only if equipment is installed in the bridge and deck zones).

c) Additional information

- Performance criterion A.
- Tests all AC, DC, I/O ports and signal/control lines.
- If an input signal with a modulation frequency of 1000 Hz is necessary in the equipment, a test modulation frequency of 400 Hz should be chosen.

Table 11 : Conducted radio frequency test parameters

Frequency range	150 kHz – 80 MHz
Amplitude	3 Vrms
Modulation	80% AM at 1000 Hz
Frequency sweep rate	$1,5.10^{-3}$ decades/s (or 1/3%/sec).

3.5.8 Immunity to conducted low frequency

Verification of the equipment performance under distortions in the power supply system generated, for instance, by electronic consumers coupled in as harmonics.

a) Procedure:

Interference is to be applied in the power lines changing the frequencies within the specified values. Sweep rate is to be determined as to allow malfunctions to be detected and be generally not greater than $3,5.10^{-3}$ octaves/s (1/4%/sec).

b) Test parameters:

- Performance criterion A.
- Test parameters according to Tab 12.

c) Additional information

- This test might be waived proven that electronic equipment supply on board vessels is commonly immune to this distortions, unless the Society considers differently.
- Schematic in Fig 2 presents a general set up for this test.

Table 12 : Low frequency interference parameters

Supply	frequency	Voltage
AC	50 Hz - 15thharmonic	10% x U_n
	15th to 100th harmonic	10% - 1% x U_n
	100th to 200th harmonic	1% x U_n
DC	50 Hz - 10 kHz	10% x U_n
Note 1: Maximum applied power is 2W.		

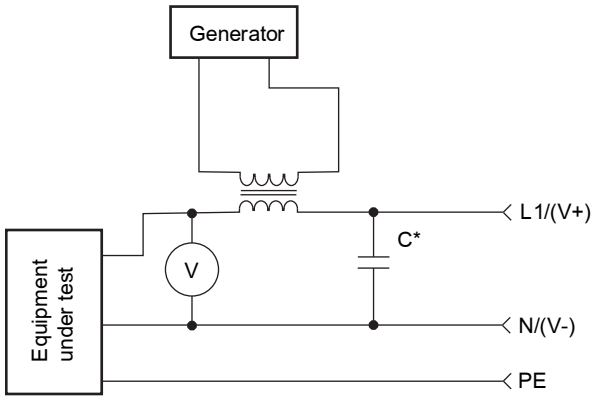
3.5.9 Conducted emissions

Verification that the equipment's generated signals that may appear in its power supply and therefore be conducted into the vessel's power distribution system (potentially affecting other equipment) are within an allowable limit.

a) Standard Procedure

IEC CISPR 16-2-1

Figure 2 : Conducted Low Frequency test setup



*The coupling capacitor is optional.

b) Test parameters

- The radio frequency voltage limits for conducted emissions for electrical and electronic equipment is specified in Tab 13.
- Emission limits for equipment designed to be permanently installed in power distribution zones is provided for information, as a loading instrument is normally not part of this category.

c) Additional information

- Tests to be conducted in all AC and DC power ports.
- Fig 3 present the emission voltage limits spectrum.

Table 13 : Conducted emission voltage limit

Frequency range	Voltage limit
Equipment installed in bridge and deck zones	
[10 - 150] kHz	[96 - 50] dBµV
[150 - 350] kHz	[60 - 50] dBµV
[0,35 - 30] MHz	50 dBµV
Equipment installed in power distribution zones	
10 kHz - 150 kHz	120 dBµV - 69 dBµV
150 kHz - 350 kHz	79 dBµV
0,35 MHz - 30 MHz	73 dBµV

3.5.10 Radiated emissions

Verification that radiated signals emitted by the equipment in any member other than an external antenna are within limits that prevent it from potentially disturbing other on board equipment.

a) Standard Procedure:

CISPR 16-2-3

b) Test Parameters

- The radiated emissions field strength for equipment installed on bridge and deck zones is to be within the limits in Tab 14.
- Emission limits if the equipment is to be installed in power distribution zones shall be as in IEC 60945.

c) Additional information

- Procedure in accordance with the standard but distance 3 m between equipment and antenna.
- Alternatively, in the range 156 MHz to 165 MHz a peak receiver or a frequency analyser can be used, in which case the radiation limit shall be 30 dBµV/m.
- The Fig 4 illustrates the radiated emissions limits spectrum.

Table 14 : Radiation field strength limits

Frequency Range	Emission limits
Equipment installed in bridge and deck zones	
[0,150 - 0,30] MHz	[80- 52] dBµV/m
[0,30 - 30^{-}] MHz	[52- 34] dBµV/m
[30^{+} - 2000] MHz	54 dBµV/m
Equipment installed in power distribution zones	
[0,150 - 0,30] MHz	[80- 50] dBµV/m
[0,30 - 100^{-}]MHz	[60- 54] dBµV/m
[100^{+} - 2000] MHz	54 dBµV/m
Note 1: In the range [156-165] kHz, emissions limit is 24 dBµV/m	

4 Certification

4.1 Model of general Attestation for Loading Instrument Software

4.1.1 Fig 5 presents the model of a general attestation for software of Loading Instruments. This type of attestation is issued by the Society when the software of a loading instrument has been assessed as described in Article [2].

Figure 3 : Conducted emissions voltage limits

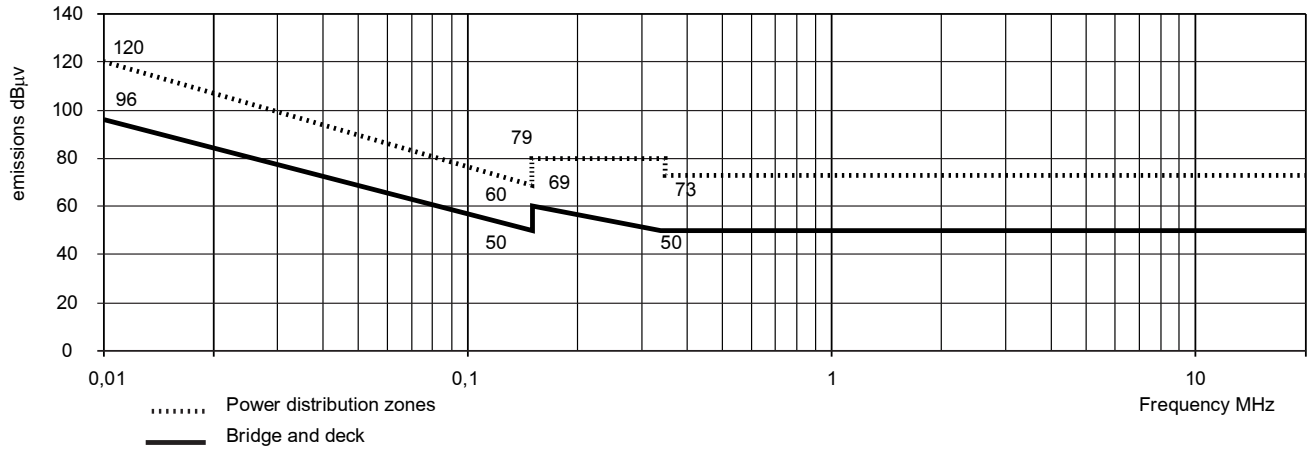


Figure 4 : Radiated emissions field strength limit

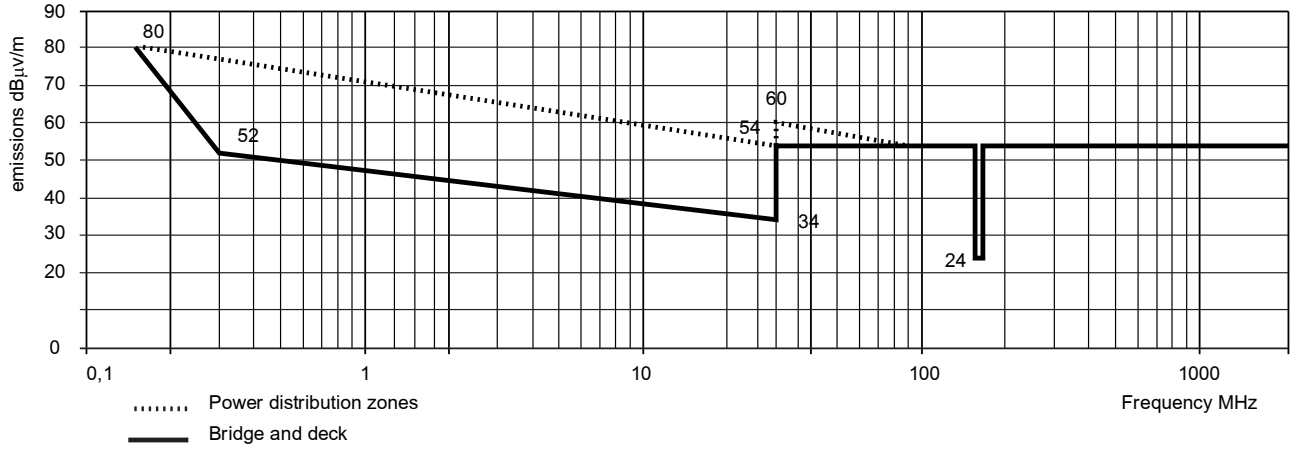


Figure 5 : Model of general attestation of Software for Loading Instrument

BUREAU VERITAS

International Register for Classification of Ships - Established 1828
Registre International de Classification de Navires - Fondé en 1828

MARINE & OFFSHORE DIVISION
Inland Navigation Management

Attestation Nr.: APO/16/0001
Software for Loading Instrument
covering longitudinal strength, intact stability and damage stability (1)

(1) mention to be crossed out when not appropriate

Issued within the scope of the General Conditions of the Bureau Veritas Marine & Offshore Division.
Délivrée dans le cadre des Conditions Générales de la Direction Marine & Offshore du Bureau Veritas.

Description of the software:

Developed by: *Loading Instruments Company Inc.*
Name of the software: Super *Stability Software*
Version and date: *1.0.0 / January 2016*

This is to certify that the software described above has been subject to examination, review and test according Bureau Veritas procedures for the assessment of loading instruments NI634 DNI, and in accordance with *its Rules for Classification of inland navigation vessels NR 217 and the requirements of the ADN Convention*, and was found satisfactory.

This attestation is valid only for the software and a complete approval of any individual loading instrument (i.e. the computer system with hardware and software together with the data from the dedicated vessel) must be conducted for each vessel according to the applicable procedures of Bureau Veritas.

Any change in the software must be declared to Bureau Veritas. Failure to advise of any modification to the software would invalidate the present attestation.

In witness whereof and subject to these reserves, the present attestation is delivered for the ends and purposes for which it was designed.

Issued in ANTWERP **On** 01/01/2016

Bureau Veritas
Inland Navigation Management (DNI)

BUREAU VERITAS MARINE & OFFSHORE DIVISION PARIS 1828 DNI - Antwerp SAMPLE

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