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Condition Assessment Programme for Inland Navigation Vessels - CAP Inland -

July 2012

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BUREAU VERITAS

MARINE DIVISION
GENERAL CONDITIONS

ARTICLE 1

1.1. - BUREAU VERITAS is a Society the purpose of whose Marine Division (the "Society") is the classification (" Classification ") of any ship or vessel 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 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, respectively.

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 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.

The Society bears no liability for indirect or consequential loss such as e.g. 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, are 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.

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.**

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

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

GUIDANCE NOTE NI 575

NI 575
Condition Assessment Programme for Inland Navigation Vessels - CAP Inland -

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SECTION 3	HULL MACHINERY, FITTINGS AND SYSTEMS
SECTION 4	PROPULSION AND AUXILIARY MACHINERY, FITTINGS AND SYSTEMS
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SECTION 1 GENERAL PROVISIONS

1 Condition Assessment Programme for Inland Vessels

1.1 General

1.1.1 Our clients' need for vessel condition assessment varies for each type of vessel that they own and operate. Bureau Veritas' Condition Assessment Programme for Inland Navigation (CAP Inland) has been designed so that it can be adjusted to the clients' requirements and it is also flexible therefore it doesn't interrupt the schedules of the vessel.

1.1.2 The Bureau Veritas Condition Assessment Programme for Inland vessels:

- is a service which is provided as a supplement to class and is designed to be complementary. It is a consultancy service that documents the condition of a vessel at a specific period of time in the vessel's life and identifies the actual quality standard of the vessel in comparison to class Rules
- provides a comprehensive survey report in an easily accessible and understandable format, which includes observations, ratings and photographic records
- sets quality rating, between 1- 4 (See Tab 1), that easily identifies the condition, reliability and maintenance standard associated with the vessel, or sub-system, being assessed
- is an important tool for risk assessment, that is recognised by shipping operators, charterers and terminal receivers for its standard quality
- makes use of top experts on specific type of vessel, or vessel sub-system, being assessed
- is an added value product for vessel Owners who wish an independent assessment of their vessel's condition (benchmarking), or who wish a quality document which can be used to advertise their vessel(s) to prospective buyers, charterers, terminal receivers, underwriters or other parties
- may be used as proof of managing the best practice in vessel maintenance as well as managing record of the vessel's condition in case of navigation incidents or litigation
- may be used by vessel operators for benchmarking purposes as part of their self-assessment strategy
- is not limited to BV classed vessels. BV's CAP Inland services can easily be applied to any classed or un-classed unit. For all types of vessels covered by this note, Bureau Veritas has the capacity and experts to provide tailor-made condition assessment services to fulfill the clients' needs.

1.2 Types of Vessel

1.2.1 Tankers

CAP Inland covers all types of inland tankers:

- Tanker Type N
- Tanker Type C
- Tanker Type G.

1.2.2 Other vessels

For other vessels, guidance of this note may be used taking account of the vessel's specific particulars and the equivalence or similarity of structural elements.

Table 1 : CAP Ratings

Rating	Description
1	Superior Condition
2	Good Condition
3	Acceptable Condition
4	Poor Condition

2 Tailor-Made Condition Assessment Services

2.1 General

2.1.1 Clients can choose stand-alone condition assessment modules and services from the list of which allows the compilation of their own tailor-made programme of surveys. Whether the client's programme consists of a vessel sub-system survey, or a series of surveys covering an entire vessel and sub-systems, or covers a fleet of vessels, BV's modular CAP can be tailored to suit the clients' needs.

2.2 Examples of Tailor-made services

2.2.1 Vessel Condition Assessment Programme

It is a complete Condition Assessment Programme with a comprehensive condition report which contains photographic records of the inspection, provided for each, some, or all, of the following vessel sub-systems/areas:

a) Hull structure and cargo containment

b) Hull machinery, fittings and systems

c) Propulsion and auxiliary machinery, fittings and systems

2.2.2 Hull Structure Fatigue Analysis

It consists of computer analysis of the vessel structure using 2D or 2D/3D Finite Element modelling and calculation of hull girder strength. A full colour Condition Assessment Fatigue Analysis report is provided. Hot-spot maps, monitoring areas and recommended repair procedures may also be included in the report.

2.2.3 Vessel Condition Assessment and Structural Monitoring Program

It consists of an agreed plan of time based on a condition assessment by Bureau Veritas surveyors combined with vessel staff inspection and monitoring of the vessels' structures and coating. This type of plan assists the client ensuring the structural integrity of the vessel is maintained through an appropriate monitoring program, whilst ensuring the inspection as well as maintenance records and reports for vessel structure are readily available.

2.2.4 Condition Assessment Report prior to docking or other repair period

This can be an extensive survey tailored to the client's requirements, for use with vessel docking repairs or, for use in life-extending projects.

2.2.5 General Vessel Inspection on an Annual Basis

It is tailored for vessel managers who require independent assessments of the vessel's condition to be included in their annual report to the vessel owners or shareholders.

Bureau Veritas CAP Inland experts have the flexibility to design a vessel specific condition assessment programme that suits the client's actual needs.

3 Industries Requirements for Inland Vessels

3.1 General

3.1.1 Many inland vessels today are required to have a condition assessment report and CAP Inland certificate, issued by an industry recognised CAP Inland provider, prior to being eligible for charter. The scope of such vessel condition assessments varies significantly, as the different interested parties have different requirements, depending on the vessel age, size and their specified minimum allowable vessel CAP rating.

3.2 Examples of charterer CAP requirements

3.2.1 Some charterers only require a CAP Inland for vessel's hull structure. Other charterers may require a CAP Inland for vessel's hull structure and hull machinery.

3.2.2 The vessel's age, which determines that a condition assessment must be carried out, can vary between 15 years to 20 years depending on the charterer.

3.2.3 For some charterers of tankers, the acceptable CAP rating may be CAP 2 or higher.

3.2.4 A comprehensive fatigue analysis may be required for larger inland vessels to identify potential stress hot-spots.

3.2.5 Limited areas of substantial corrosion within parts of the hull structure may not be acceptable.

3.2.6 Some charterers require that local structural areas shall have a CAP rating 2 or better for measured structure, visual condition or coating condition.

3.2.7 CAP Inland validity may vary between 2,5 years and 4 years depending on the charterer and the CAP rating itself.

4 Transparency and Class Obligation

4.1 General

4.1.1 The Bureau Veritas CAP Inland is designed to be highly transparent with the onus on clear and detailed report, photographic records and certification. Oil majors, charterers and receivers have the trust in the condition surveys held by Bureau Veritas' CAP Inland experts in the type of vessel, or vessel sub-system, being assessed.

4.1.2 Depending on the clients' requirements, the CAP Inland may be carried out independently from, or concurrently with, class surveys.

4.1.3 Should any findings below class minimum requirements be discovered and not be repaired, then the CAP Inland surveyor shall formally advise the client to use the Gap/defect list report (GAP). It should be pointed out that the vessel's operator is required to inform the vessel's Class Society of such findings.

5 CAP Inland Ratings

5.1 CAP 1 - Superior Condition

5.1.1 Examination and/or measurements carried out with the results showing either minimal or no deterioration from 'as new' condition. Superior maintenance condition exists. No preventive or corrective maintenance is required.

5.2 CAP 2 - Good Condition

5.2.1 Examination and/or measurements carried out with the results showing a level of deterioration from 'as new' condition. No preventive or corrective maintenance required.

5.3 CAP 3 - Acceptable Condition

5.3.1 Examination and/or measurements carried out with the results showing that the condition is acceptable according to class rules. No imminent corrective maintenance is required. Preventive maintenance may be required to halt deterioration.

5.4 CAP 4 - Poor Condition

5.4.1 Examination and/or measurements carried out with the results showing defects, deficiencies or condition below what is acceptable according to class rules. Imminent corrective maintenance is required.

6 CAP Inland Procedures

6.1 Request for CAP Inland Survey

6.1.1 A request for a vessel condition assessment or any tailor-made program needed by the client concerning CAP Inland is to be submitted using the request for CAP Inland form provided by the society.

6.1.2 The request can be made directly through the client's local Bureau Veritas district office, or online at BV Inland Navigation Management's website.

6.2 Planning of CAP Inland Survey

6.2.1 On receipt of a request for CAP (RFCAP), the local Bureau Veritas district office will contact the client to discuss his requirement and expectation for CAP Inland Rating in order to compile a cost efficient quotation.

6.2.2 On acceptance of quotation, the BV local office representative shall meet with the client's representative(s) to draft out the CAP Inland planning document (PLAN DOC) which sets out the scope and extent of CAP Inland surveys that are to be carried out.

6.2.3 The planning document is finalised onboard the vessel during meetings between the Lead CAP Inland surveyor and the client's representative.

6.3 Kick-off Meeting

6.3.1 CAP Inland surveys begin with a kick-off meeting held onboard the vessel. This meeting is held to familiarise all the concerning parties with Bureau Veritas' Condition Assessment Programme for the subject vessel.

6.3.2 Following points are to be discussed during the meeting:

a) Contents of the CAP Inland planning document

b) Scope of CAP Inland surveys

c) Inspection arrangements

d) Safety requirements

e) CAP Inland Gap / defects list (GAP)

f) Other relevant issues

6.4 CAP Inland Gap/Defect List GAP

6.4.1 During the condition assessment inspections, BV surveyor may find areas of hull structure, cargo containment system, hull fittings, machinery, etc., that are either defective or have been assessed at a rating below client's expectation. (e.g. a critical structural area may be assessed by the surveyor as being CAP 3 but the clients aim is CAP 1 for structure, i.e. a rating gap exists.)

6.4.2 All gap areas or defects are advised to the client's representative in writing and all photographic records are to be kept. If these items are upgraded/rectified then a follow up inspection is made and photographic records taken. These records form a part of the final CAP Inland report.

6.5 Closing Meeting

6.5.1 On the completion of CAP Inland surveys, minuted CAP Inland closing meeting is held and the results of the surveys and inspection are advised to the client's representative.

6.5.2 If the CAP Inland survey is carried out over several visits, then for each time that the surveyor completes his inspections, a meeting is held with the client's representative. The findings of each survey carried out are discussed and a gap / defect list, where applicable, is presented at this meeting.

6.5.3 Preliminary ratings for surveyed parts may be presented during the closing meeting(s) however the final CAP rating shall only be determined after final review in BV Inland Navigation Management or delegated office.

6.5.4 It is recommended that CAP Inland inspections are completed during a single visit. However, this may not be possible due to the vessel's schedule, or due to the type of vessel being surveyed. Should several visits be necessary, then the timeframe between the first inspection and the last inspection may not exceed 6 months. Where a vessel is in lay-up, subjected to an elongated repair timeframe or is being specially modified, then the CAP Inland timeframe between the first and the last visit may be extended on application to and agreement by BV Inland Navigation Management.

6.6 Condition Assessment Certification

6.6.1 Each Condition Assessment Certificate (CERT) details the scope of surveys carried out on each vessel or vessel sub system.

6.6.2 CAP Inland certificates issued by Bureau Veritas do not have validity. They are issued to certify that the vessel, or vessel sub-system, has a specific CAP rating on a specific date. Depending on the charterer, a Condition Assessment Certificate may be recognised by them to have a validity period of 2.5, 3 or 4 years.

6.7 Condition Assessment Reporting

6.7.1 On the completion of the condition assessment surveys, the lead CAP Inland surveyor provides a report that details the extent of surveys carried out, the condition of the vessel and vessel sub-systems at the time of survey, details of repairs and upgrades together with photographic records.

6.7.2 Where a structural condition assessment survey has been carried out and a critical area review has been undertaken, then a Structural Monitoring Plan (SMP) shall be proposed if any anomalies were found that would warrant monitoring. This plan shall include a list of items to be monitored, a proposed timeframe for monitoring and sketches/photographs, if applicable.

6.7.3 The BV CAP Inland report shall normally be issued within the period of one month to three months from the end of the survey, depending on the scope of the client's requirements for CAP Inland survey and certification. The CAP Inland report is provided with both paper and electronic copies according to the client's needs and requirements for reporting.

6.7.4 All BV condition assessment reports include an Executive Summary which gives an overview of the surveys carried out, the surveys' findings and the CAP rating(s) awarded.

6.7.5 The format of the condition assessment report varies depending on the scope of surveys and this format is normally agreed with the client prior to the commencement of the surveys. For an extensive CAP Inland, the following report layout is typical:

a) Cover page (Identifying the type of report with the vessel's photo.)
b) Bureau Veritas general conditions
c) CAP Inland report index of documents
d) Vessel's particulars
e) CAP Inland Certificate (CERT)
f) CAP Inland report Executive Summary (EXEC SUM)
g) Request for CAP Inland survey (RFCAP)
h) CAP Inland Planning Document (PLAN DOC)
i) Surveyor's CAP Inland survey report summary (REP SUM)
   - Gap/defects report (GAP)**
j) Vessel history report (VHR) **
   - Class Hull Condition Evaluation Report **
   - Class Ballast Tanks Protection Report **
   - Previous Structural and Condition Assessments carried out **
k) Structure & Fatigue Analysis (SFA)**
   - Areas to be monitored **
   - Repair proposal **
l) Critical Structure Area Review (CSAR) **
m) Hull Structure Report - with photos (HSR) **
n) Ultrasonic thickness measurements review (TMA) **
o) Structural Monitoring Plan (SMP) **
p) Cargo containment system report - with photos (CCR) **
q) Hull machinery, fittings and systems report - with photos (HMR) **
r) Propulsion & auxiliary machinery, fittings & systems report - with photos (PMR) **

Note 1: **: If not applicable these items are left empty

6.8 Safety During Surveys

6.8.1 The client is responsible for providing the necessary facilities for the safe execution of the CAP Inland surveys.

6.8.2 The client will assume, with respect to the BV CAP Inland surveyor(s), all the responsibility of an employer for his workforce, such as to meet the provision of applicable legislation. As a rule, the surveyor(s) have to be constantly accompanied during surveys by the client's personnel.

6.8.3 Tank and void spaces are to be made safe for access i.e. gas freed, ventilated and illuminated. Adequate ventilation and lighting is also to be provided for machinery spaces and accommodation areas if they are under survey.

6.8.4 In preparation for survey and to allow a thorough examination, all spaces, machinery, fittings and piping are to be cleaned, including removal from surfaces of all loose accumulated corrosion scale. Spaces are to be sufficiently clean and free from water, scale, dirt, oil residues, etc. to reveal corrosion, deformation, fractures, damages or other structural deterioration. However, those areas of structures whose renewal has already been decided and planned by the owner, need only be cleaned and de-scaled to a necessary extent allowing to determine the limits of the areas that are to be renewed.

6.8.5 Sufficient illumination is to be provided to reveal corrosion, deformation, fractures, damages or other deterioration.

6.8.6 Where soft coatings have been applied, safe access is to be provided for the surveyor to verify the effectiveness of the coating and to carry out an assessment of the conditions of internal structures which may include spot removal coating. When safe access cannot be provided, the soft coating is to be removed.

6.8.7 For overall survey, means of inspection are to be provided by the client to enable the surveyor to examine the hull structure in a safe and practical way.

6.8.8 For close-up survey, one or more of the following means for access, acceptable to the surveyor, is to be provided:

a) Permanent staging and passages through structures

b) Temporary staging and passages through structures

c) Lifts and movable platforms

d) Other equivalent means

6.8.9 Survey afloat or at anchorage may be accepted provided that the surveyor is given the necessary assistance from the personnel on board

6.8.10 Communication system is to be arranged between the survey party in the tank and the responsible officer on deck.

6.8.11 Explosimeter, oxygen meter, breathing apparatus, life line and whistles are to be at hand during the survey.

SECTION 2 HULL STRUCTURE

1 General

1.1 Concept of condition assessment of hull structure

1.1.1 Bureau Veritas' Condition Assessment Programme for hull structure makes use of modern techniques in survey and verification to extensively analyse, identify and report on the actual condition of the vessel's structure. CAP Inland structural surveys may be carried out either in dry-dock or with the vessel is afloat.

1.1.2 The concept of condition assessment programme for hull structure combines the results of expert examination from design data with an extensive vessel structural survey to produce a thorough assessment of the vessel's condition and the assignment of a CAP rating. The BV rating system for inland vessels is broadly defined in Sec 1, [5].

The range of structural CAP Inland surveys offered by Bureau Veritas varies depending on the client's requirements.

The extent of surveys required to be carried out and the subsequent reporting requirements, are discussed and agreed with the client prior to inputting the survey scope into the CAP Inland Planning document (PLAN DOC) (See Sec 1, [6.2]).

1.2 Scope of CAP Inland for hull structure surveys

1.2.1 For vessels that are less than 15 years of age, the scope of surveys shall be equivalent to the scope of overall surveys, close-up surveys and ultrasonic thickness gauging as required for the vessel's third class renewal survey, with an additional 30% increase in structural close-up surveys and an additional 30% increase in ultrasonic thickness gauging above that specified by the BV Inland Rules applicable at the time of the CAP Inland surveys.

1.2.2 For vessels that are 15 years of age or more, the scope of surveys shall be equivalent to the scope of overall surveys, close-up surveys and ultrasonic thickness gauging as required for the vessel's fourth class renewal survey, with an additional 30% increase in structural close-up surveys and an additional 30% increase in ultrasonic thickness gauging above that specified by the BV Inland Rules applicable at the time of the CAP Inland surveys.

1.2.3 A comprehensive structural analysis is recommended. A fatigue analysis may also be carried out, depending on the vessel characteristics and operating conditions.

1.2.4 A Vessel History Report (VHR) is collated based on the previous 10 years of the vessels service life to enable a review of the structural history of the vessel (See [3]).

1.2.5 A Critical Structural Area Review (CSAR) is carried out which assesses the results of structural computations and/or review the vessel history report, so that critical areas can be identified and included for inspection within the survey scope. A review report is provided (See [4]).

1.2.6 On the completion of all CAP Inland surveys, Structural Monitoring Plan (SMP) is compiled, in cooperation with the client, as an aid for future monitoring of the vessel's structure (See [11.2]).

2 CAP Inland Structure and Fatigue Analysis

2.1 General

2.1.1 CAP Inland Structural and Fatigue Analysis (SFA) is carried out using BV's calculation programs. These programs use direct engineering calculations and 2D/3D modelling to provide information regarding the strength of the vessel structure (hull girder, secondary stiffeners, plating, primary supporting members) and to estimate eventually the design fatigue life of structural details.

The Structural and Fatigue Analysis report calculations should be performed prior to the commencement of the physical onboard condition assessment survey in order to provide information on structural items that may require specific inspection during the close-up surveys as part of the CAP Inland surveys.

Note 1: The Vessel History Report is reviewed to identify repairs and/or modifications that may have been carried out so that these can be taken into consideration during calculations.

2.2 Structural Strength Calculations

2.2.1 Structural strength calculations are to be carried out using the 'Net Scantling' approach in accordance with Bureau Veritas' Rules for the classification of inland navigation vessels.

As a first step, Bureau Veritas' MARS Inland is employed to analyse the midship section in order to check the overall longitudinal strength of the vessel and the local strength of plates and stiffeners.

The analysis of the stress and buckling behaviour of the primary supporting members within the cargo area is then carried out on coarse 3D models using the finite element method. Fine mesh 3D models are carried out subsequently on areas where important gradient of stress are present in coarse modelling.

On completion of the structural strength calculations, the results are assessed against BV's rules to identify whether the following items fulfill the rules requirements:

a) Longitudinal Strength (Hull section modulus at deck and at bottom of the midship section are assessed against the strength criteria).

b) Local strength of plates

c) Local strength of secondary stiffeners

d) Buckling and Stress (The results are displayed with ratio of the actual value of stress over the permissible one). The following stresses are shown in ratio:

- Yielding and buckling criteria
- Longitudinal stress
- Transversal stress
- Shear stress
- Von Mises combined stress

2.3 Fatigue assessment

2.3.1 Depending on the vessel characteristics and operating conditions, the fatigue analysis may be included in the scope of a tailor-made condition assessment and carried out in accordance with Society's Rules, using the 'Notch Stress' approaches.

2.4 CAP Inland Structure and Fatigue Analysis Report (SFA)

2.4.1 On the completion of the structure analysis, a comprehensive report is issued which includes the following deliverables:

a) A report on the structural strength calculations and identifications of hot-spots.

b) If applicable according to [2.3], a report on fatigue analysis and identification of a 'List of structures found critical for fatigue'.

c) Recommendations on structural areas to be modified, if any, and/or a repair methodology is to be proposed.

d) Recommendations on structural areas to be monitored, if any, including the provision of sketches to identify the hot-spots areas.

Should this comprehensive analysis identify areas which require regular inspection or monitoring then the results are added to the scope of close-up surveys, included in the Structure Monitoring Plan (SMP) and are reported within the Critical Structural Areas Review (CSAR).

2.5 Alternative Structure Analysis

2.5.1 In some cases, clients may require an alternative Structure Analysis for a particular vessel due to the size of the vessel, type of the vessel, recurring damage in a specific location, or for a specific charterer's requirement.

In such cases, Bureau Veritas' experts are able to give advice on specific requirements and can assemble a tailor-made package of Structural Analysis which covers specific requirement in this regard.

3 Vessel History Report (VHR)

3.1 General

3.1.1 Investigation into the vessel's history is an important part of any condition assessment regime and should be performed prior to the commencement of the physical onboard condition assessment. The aim is to provide information on structural items that may require specific inspections during the close-up surveys as part of the surveys.

The vessel history may also identify instances of repairs and/or modifications that may have been executed and which affects the outcome of structural assessment calculations. The vessel's trading patterns may also influence such calculations.

3.1.2 In general, the vessel's previous ten years history is reviewed for the VHR.

3.1.3 For non-BV classed vessels, the client is requested to provide the CAP Inland surveyor with the access to class reports and vessel records covering this period.

3.2 Support Documents

3.2.1 The following documents should be provided for the VHR:

a) Class Hull Condition Evaluation Reports, where applicable, or copies of the vessels structural history based on previous class reports as well as memorandum, visas, recommendations, conditions of class for the timeframe that is being evaluated.

b) Class ballast tanks protection report and/or clients records.

c) Previous vessel structural and condition assessments which are carried out from non-BV sources.

4 Critical Structural Area Review (CSAR)

4.1 General

4.1.1 Critical structural areas are locations which have been found to be sensitive to cracking, buckling and corrosion which could impair the structural integrity of the vessel.

CSAR report examines the results from the analysis of structural assessment calculations from SFA and findings of the vessel's history from VHR. It also consists of Bureau Veritas' experience of similar or sister vessels in order to identify areas of the vessel which require specific and regular inspection and monitoring.

4.1.2 The deliverables from this review are to identify the following:

- Specific structural areas which require to be added to the CAP Inland survey planning document (PLAN DOC) to ensure that these critical areas are to be included for inspection during the close-up as part of the physical onboard condition assessment survey.
- Specific structural area which require monitoring on a regular basis from the vessel's management after the CAP Inland surveys and which require to be added in the Structural Monitoring Plan (SMP).

5 Vessel Section and Area(s) Under Consideration (AUC)

5.1 Definition

5.1.1 To facilitate the assessment, review and reporting of the vessel's structural condition, the vessel structure is broken into different "Sections" such as external hull, main deck, cargo tanks, cargo holds, ballast space, etc.

5.1.2 Each Section is then further subdivided into several "Sub-sections" or "Elements" which are small enough to be readily examined and evaluated by the surveyor, but not so small as to be structurally insignificant or too numerous to be practically reported on.

These Sub-sections are termed as Areas Under Consideration (AUC). The number of AUC's incorporated into a vessel Section will usually be a minimum of six, however, there can be more depending on the layout of the Section or depending on the surveyor's review.

5.2 AUC's Average Rating

5.2.1 During close-up and overall surveys, each AUC is individually assessed and given a rating for visual structure condition, wastage structure and coating condition. All individual AUC ratings are then combined to give a structural condition rating for the specific vessel section being surveyed and reported upon. An overall rating for the hull structure surveys is then computed by averaging the ratings attributed to the different surveyed sections of the hull structure, as explained in [10].

Fig 1 shows a hypothetical assessment to illustrate an example of vessel section and individual AUC's.

Figure 1 : Example of vessel section and AUC's

Vessel Section	No. 1 Centre Cargo Tank			
Areas Under Consideration (AUC)	Visual Structure	Visual Coatings	Measured Wastage	Average Ratings
Top plating and attachments	1	1	1	**1.0**
Portside longitudinal bulkhead	1	2	1	**1.3**
Starboard longitudinal bulkhead	1	2	1	**1.3**
Transverse bulkhead forward	1	1	1	**1.0**
Transverse bulkhead aft	1	1	1	**1.0**
Bottom plating and attachement	1	2	1	**1.3**
			Average Structural Rating	**1.2**
			Structural Condition Rating	**1**
			Revised Structural Rating	**N/A**

6 Visual Structure Condition

6.1 General

6.1.1 Visual structure condition of the AUC's are assessed during overall and close-up surveys and a rating from 1 to 4 is given to each AUC in each vessel section.

6.2 Overall Surveys

6.2.1 An overall survey of the hull structure is a survey intending to assess and report on the overall condition of the vessel's hull. Visual inspection of the condition of structure are carried out, whereby the surveyor inspect for evidence of damage, deformation, indents, buckling, cracks, leakages, pitting, grooving, erosion, coatings, breakdown, anodes wastage, etc. Depending on the vessel type, this type of inspection includes:

a) External examination of deck, deck openings, hatches, river chests, vessel's sides and bottom, including corrosion protection system.

b) Examination of under deck longitudinals through openings in deck and from access hatches and ladders.

c) Inspection of forecastle, chain lockers, cofferdam, fuel tanks, sludge tanks and tanks in machinery spaces adjacent to the vessel hull.

d) Examination of cargo spaces and containment systems, ballast spaces, cofferdams and void spaces.

e) Visual inspection of deck girders or transverse rings in way of deck from the access platforms.

f) Examination of cargo hold hatch covers and coamings (plating and stiffeners).

g) Inspection of condition of access ladders, stringers and platforms.

h) Examination of structure adjacent to each stringer/platform e.g. vessel sides, longitudinal and transverse bulkheads, bulkhead stiffeners, centre line bulkheads, swash bulkheads, transverse rings, brackets, etc.

i) Examination of tank/hold/containment bottom structure, plating, longitudinals, transverse rings, bilge area and under pipe suction bell-mouth.

j) Inspection of hot-spot areas (buckling, etc) identified during computer modelling of the vessel, if applicable.

k) Tank testing, usually undertaken during the vessel's renewal survey or when tank boundaries have been repaired. Where tank testing has been carried out this is to be reported in the CAP Inland report. The surveyor examines the bulkheads under test in the adjacent tanks or holds, voids or cofferdams. Tank testing is to be performed in compliance with BV's Inland Rules.

During the overall surveys, CAP Inland surveyor may determine to extend the scope of the close-up surveys.

6.2.2 During survey the CAP Inland surveyor is to take representative photographs of the structural condition to enable the client to gain an overview and insight into the hull's general condition. These photographs are attached to the hull structure report (HSR).

6.2.3 Defects found during the overall survey are advised to the owner's representative using the GAP document.

6.3 Close-up Surveys

6.3.1 A close-up survey is a survey where the details of structural components are within the close visual inspection range of surveyor i.e. normally within the reach of hand.

6.3.2 Depending on the vessel's age, the scope of close-up surveys should be at least equivalent to that required for either the vessel's third, or the vessel's fourth, class renewal survey, as per App 1.

The particular requirements for close-up surveys differ depending on the type of vessel. However, the scope of the close-up survey may be extended as deemed necessary by the surveyor, after consideration of the findings of the overall surveys and the Critical Structural Area Review (CSAR).

6.3.3 Vessels with reduced scantling are subject to special consideration. The areas with reduced scantling must be specially examined and subjected to close-up survey.

6.3.4 In cases where the scope of surveys is extended or reduced by the surveyor upon his findings, the report must reflect these changes together with proper justifications.

6.3.5 By definition, close-up surveys require access to parts of a tank/hold/void space which are normally not within reach and this means that safe access is to be provided as discussed in Sec 1, [6.8].

6.3.6 The following areas deserve special attention during the survey:

a) End of main girders, stringers and struts with associated brackets. Particular attention should be paid to the toes of brackets, bracket ends of shell, deck and bulkhead stiffeners.

b) Connections of shell, deck and bulkhead longitudinals to transverse web frames.

c) Discontinuities in the form of misalignment or abrupt change of section.

d) Plating in way of cut or openings.

e) Areas of substantial corrosion or other suspect areas.

f) Areas which show signs of damage or buckling.

g) Areas identified by the Critical Structural Area Review (CSAR) as having a previous history of recurring structural failures such as cracks, buckling, etc.

h) Areas identified for regular inspection/monitoring as per vessel's critical structure area monitoring plan SMP.

6.3.7 During the close-up surveys, the CAP Inland surveyor has to take representative photographs of areas identified by UTM, SFA, CSAR or SMP as requiring special inspection.

6.3.8 Should defects be found during the close-up surveys, then these defects will be advised to the client's representative in writing using GAP report and photographic records will be made. If these items are upgraded/rectified, a follow-up inspection will be made and photographs are taken to show the rectifications. These defects/rectifications are part of the final CAP Inland report and will be taken into consideration within the structural CAP ratings issued at the completion of the surveys.

6.3.9 Should structural modifications be carried out to the hull structure during the timeframe of the CAP Inland surveys then these modifications are also subject to close-up inspections and photographic records have to be taken. These modifications form part of the final CAP Inland report and will be taken into consideration within the structural CAP ratings issued at the completion of the surveys.

6.4 Visual Structure Condition Rating

6.4.1 In accordance with the rating criteria given in Sec 1, [5], the ratings for visual structure condition are defined in Tab 1.

Surveys are undertaken to assess the condition of structure as regards damages, indents, buckling, cracks, tightness, grooving, pitting; crevice corrosion, erosion corrosion, bacterial corrosion, stress corrosion and other type of defects.

Table 1 : Visual structure condition ratings

Rating	Description	Allowable margin for defects
1	Superior Condition	0 to 25%
2	Good Condition	25 to 75%
3	Acceptable Condition	75 to 100%
4	Poor Condition	More than 100%

7 Wastage of Structure - Ultrasonic Thickness Measurements (UTM)

7.1 General

7.1.1 Ultrasonic thickness measurements form a major element in the CAP Inland surveys of hull structure and the analysis of these measurements is a prominent factor to determine the amount of wastage of structure and subsequent assessment of CAP ratings.

7.1.2 Where a client wishes to submit a UTM report that has been accepted by another recognised society, or submits a UTM report previously accepted by BV which was carried out more than 6 months prior to CAP Inland survey, then these are to be reviewed on a case by case basis. In such a case, the date and scope of UTM gauging reports is to be highlighted in the Executive Summary of the CAP Inland report.

7.1.3 UTM supplier must be certified as a service supplier according to applicable Society's Rules.

7.2 Ultrasonic Thickness Measurements Scope

7.2.1 Depending on the age of the vessel, the scope of thickness measurements should be at least equivalent to the requirement either for the vessel's third, or vessel's fourth class renewal survey, as per App 1.

The additional measurement areas consistent with the 30% increase in scope above class the class minimum requirement are agreed with the client prior to survey commencement. The full scope of the agreed UTM measurement requirements is then to be included in the Planning Document (PLAN DOC).

7.2.2 The scope may be extended further, to other areas e.g. fuel tanks, pipelines, pipe supports, accommodation decks etc,. if deemed necessary by the surveyor, after consideration of findings during overall and close-up surveys.

7.3 Wastage of structure assessment

7.3.1 Rating

Wastage of structure ratings are assigned using a two-stage UTM based approach. Firstly, at the AUC level by using a combination of survey techniques to allow assessment of the vessel and secondly by rating the vessel as a whole based solely on the UT measurements.

Both approaches use the same UTM readings which are reviewed against permissible diminution of structure, according to the acceptance criteria defined in NR597 Requirement for Thickness Measurements Applicable to Inland Vessels.

In accordance with the general rating criteria given in Sec 1, [5], ratings are applied for wastage of structure as defined in Tab 2.

Table 2 : UTM CAP Ratings for wastage of structure

Rating	Description	% of permissible diminution
1	Superior Condition	0 to 25%
2	Good Condition	25 to 75%
3	Acceptable Condition	75 to 100%
4	Poor Condition	More than 100%

7.3.2 AUC Approach of UTM Assessment

In this approach, the UT measurements taken in way of each Area under Consideration (AUC) are assessed according to the criteria given in Tab 2 and a rating for structural wastage is applied for each AUC.

The ratings for structural wastage applied for each AUC are then combined with ratings for visual structure and for coatings condition to enable a combined structural rating to be given to each AUC, as explained in [10].

Note 1: Due to various circumstances such as inaccurate measurement, stray pits, etc., then there will be some deviations in UTM readings which means that some flexibility in assessment is required. Therefore an allowance of 10% of 'errant' readings may be allowed as long as these are randomly scattered and no repairs are deemed necessary by the surveyor.

7.3.3 Group Approach of UTM Assessment (Thickness measurement analysis report and global rating for UTM)

The group approach is where the full set of structural UTM readings are assessed on the basis of groups of structures (e.g. Transverse bulkheads are one group) and ratings are assigned for each group as per the criteria given in Tab 2 and the results assembled into a summarised report entitled Thickness Measurement Analysis report (TMA).

The cover page of this report contains a compilation of the groups of structure (e.g. main deck plating group, bottom plating group, side strakes group, transverse bulkheads group, etc.) with the structural ratings applied to each of these groups.

A Global rating for hull thickness measurement analysis is then computed from the average of the combined results from the groups, rounded to the nearest integer.

The Global rating for UTM is used as a guideline for the final CAP Inland structural rating for the vessel. i.e. The final CAP Inland Structural Rating cannot be better than the rating computed solely from the hull thickness measurement analysis.

7.4 Areas of substantial corrosion

7.4.1 Substantial corrosion is an extent of corrosion such that the assessment of the corrosion pattern indicates a wastage in excess of 75% of allowable margins, but within acceptable limits. i.e. a CAP 3.

7.4.2 If any individual AUC of the vessel shows a rating of 3 then the overall CAP rating awarded for the vessel's structure cannot be higher than CAP 2.

7.4.3 Areas of substantial corrosion shall be included in the surveyors' proposals to the client for regular inspection as part of the Structural Monitoring Plan (SMP).

Note 1: Some charterers make the stipulation that any areas of substantial corrosion must be repaired prior to their chartering a vessel i.e. they only accept a vessel with all assessed AUC of rating 2 or better.

7.5 Ultrasonic Thickness Measurements Reporting

7.5.1 The final CAP Inland contains thickness measurement analysis report TMA which is a summary and analysis of the UTM measurements which were used for assessment of wastage of hull structure. The groups of items considered in the calculations are also listed in this analysis report.

8 Vessel Structure Protective Coatings

8.1 Rating and evaluation guidance

8.1.1 During the overall and close-up surveys, the vessel's structural protective coatings are surveyed and reported upon.

During these surveys the condition of the coatings for the various AUC's are defined and ratings are then applied. (See [10.1.1] and Tab 3).

8.1.2 In a similar fashion to the methodology explained in [6] for Visual Structure, individual ratings are awarded for coatings' condition for each Area Under Consideration (AUC) within the survey. These ratings are then combined with individual ratings for Visual Structure and Wastage to give an overall average rating, which is then rounded to the nearest whole number to give a final individual rating for the specific tank, cargo hold, or other space being surveyed.

8.1.3 App 2 has been developed as assistance to surveyor when performing condition assessment surveys.

Note 1: Some charterers require that AUC's with a coatings rating of 3, should be repaired, prior to chartering the vessel.

Table 3 : Coating condition ratings criteria

CAP Rating	Coating Condition	Definition
1	Good	Condition with spot rusting on less than 3% of the area under consideration without visible failure of the coating. Rusting at edges or welds, must be on less than 20 % of edges or weld lines in the area under consideration.
2	Fair	Condition with breakdown of coating or rust penetration on less than 20 % of the area under consideration. Hard rust scale rust penetration must be less than 10 % of the area under consideration. Rusting at edges or welds must be on less than 50 % of edges or weld lines in the area under consideration.
3	Poor	Condition with breakdown of coating or rust penetration on more than 20% or hard rust scale on more than 10% of the area under consideration or local breakdown concentrated at edges or welds on more than 50 % of edges or weld lines in the area under consideration.
N/C	-	No protective coating fitted
N/A	-	Not applicable
Note 1: Soft Coatings or Semi Hard Coatings are not rated in the scope of this document, however where these are found to have been fitted then these are to be identified within the HSR report. **Note 2:** Spot rusting is rusting in spots without visible failure of coating. **Note 3:** Blistering is bubble formation scattered on the surface of a paint film, with diameter ranging from 3 - 4 mm to 20 - 30 mm.		

9 Anodes (Cathodic Protection)

9.1 Rating

9.1.1 Although it is not a class requirement that anodes are fitted in ballast tanks, cargo tanks and other areas of the vessel hull, some clients and charterers require that the condition of anodes to be reported. Therefore, during overall and close-up surveys, corrosion protective anodes (if fitted) are to be assessed according to each AUC where these are fitted and rating is given depending on the amount of wastage of anode found. See Tab 4.

Note 1: This rating is given for information purposes. The existence of, or lack of, anodes does not affect the overall CAP rating of the vessel.

Table 4 : Anodes condition assessment ratings criteria

Rating	Description	% of wastage
1	Superior Condition	0 to 25%
2	Good Condition	25 to 50%
3	Acceptable Condition	50 to 75%
4	Poor Condition	Above 75 or 0% conductivity
N/F	Anodes Not Fitted	
N/A	Not Applicable	

10 Condition Assessment of Hull Structure, CAP Rating

10.1 General

10.1.1 The Bureau Veritas rating system for condition assessment is broadly defined within Sec 1, [5].

10.1.2 To arrive at an overall rating for the vessel structure, the following elements pertaining to structure, structural strength and maintenance of structure are rated individually and collectively:

a) Visual inspection of structure:

For damage, deformation, indents, buckling, cracks, leakages, pitting, grooving, erosion, etc.

b) Visual inspection of protective coatings:

For coating breakdown, cracking, flaking, blistering, detachment, etc.

c) Wastage of structure:

Assessment based on ultrasonic thickness measurements (UTM) and the percentage of diminution of structure.

Individual ratings are awarded for each of the above elements. These individual ratings are combined into an overall rating for hull structure and then finally a CAP rating for the vessel structure condition is awarded.

10.2 Individual Structural Rating for AUC's

10.2.1 During CAP Inland surveys, individual ratings are awarded for Visual Structure condition, Coatings Condition and Wastage of Structure for each Area Under Consideration (AUC) surveyed. These ratings are then combined to give an average rating, rounded to the nearest first decimal point for each AUC.

10.2.2 Each AUC average rating is then tabulated and combined to give an overall average rating, which is then rounded to the nearest whole number to give a final individual rating for the specific vessel 'section' being surveyed.

10.2.3 The following example shows how the rating for a vessel section, such as a tank, hold or space, is computed.

a) Structural condition rating rounded to the nearest integer:

The example described in Fig 2 shows the type of table that is normally used to show the individual ratings for AUC's together with the overall rating for that vessel section.

In this example the hypothetical vessel section that is being rated is No. 1 Centre Cargo Tank and there are six AUC's.

In the example above the average rating for the tank is given as 1.2 and the final structural condition rating awarded for No. 1 Centre Cargo Tank (vessel section) is 1.

b) Revised structural rating:

The example described in Fig 3 makes use of the same type of table to assess the CAP rating for a side ballast tank.

In this example, the average reading is calculated as 1.2 which is then rounded to a structural condition rating of 1. However, as the connecting space has been awarded with a coating rating of 3 then a structural rating of 1 cannot be awarded.

This is because the final rating cannot be better than one rating grade better than the lowest rating. Therefore, the rating is revised upwards.

In this example, the best rating that can be applied to the No.3 side ballast tank is a rating of 2.

c) Structural condition rating rounded to the nearest integer:

The example described in Fig 4 makes use of the same type of table for assessing the structural rating of a tanker's deck.

In this case, the vessel's section is the main deck and it consists of six Areas Under Consideration (AUC).

Figure 2 : Illustration of structural condition rating - rounded to the nearest integer

Vessel Section	No. 1 Centre Cargo Tank			
Areas Under Consideration (AUC)	**Visual Structure**	**Visual Coatings**	**Measured Wastage**	**Average Ratings**
Top plating and attachments	1	1	1	**1.0**
Portside longitudinal bulkhead	1	2	1	**1.3**
Starboard longitudinal bulkhead	1	2	1	**1.3**
Transverse bulkhead forward	1	1	1	**1.0**
Transverse bulkhead aft	1	1	1	**1.0**
Bottom plating and attachement	1	2	1	**1.3**
			Average Structural Rating	**1.2**
			Structural Condition Rating	**1**
			Revised Structural Rating	**N/A**

Figure 3 : Illustration of revised structural rating

Vessel Section	No. 3 Side Ballast Tank			
Areas Under Consideration (AUC)	Visual Structure	Visual Coatings	Measured Wastage	Average Ratings
Plating and attachments	1	1	1	**1.0**
Side shell and attachments	1	2	1	**1.3**
Inner side plating	1	1	1	**1.0**
Transverse bulkhead forward	1	1	1	**1.0**
Transverse webframes	1	1	1	**1.0**
Inner bottom plating	2	3	1	**2.3**
Transverse bulkhead aft	1	1	1	**1.0**
Average Structural Rating				**1.2**
Structural Condition Rating				**1**
Revised Structural Rating				**2**

Figure 4 : Illustration of structural condition rating - rounded to the nearest integer

Vessel Section	Main Deck			
Areas Under Consideration (AUC)	Visual Structure	Visual Coatings	Measured Wastage	Average Ratings
Foscle Area	1	1	1	**1.0**
Main deck area fwd of central cofferdam	1	2	1	**1.0**
Main deck area iwo central cofferdam	2	2	2	**2.0**
Main deck area aft central cofferdam	2	2	1	**1.7**
Main deck area iwo accomodation	1	1	1	**1.0**
Poop deck area	2	2	2	**2.0**
Average Structural Rating				**1.5**
Structural Condition Rating				**2**
Revised Structural Rating				**N/A**

10.3 Overall Structural Condition Rating

10.3.1 To arrive at an overall rating for the vessel's structure, the ratings awarded for each vessel section are combined and an average rating is computed.

10.3.2 The example described in Fig 5 shows the type of table which is normally used to show the ratings awarded to individual vessel sections together with the overall rating for the vessel structure.

The average rating is calculated as 1.4 which is then rounded down to an overall structural condition rating of 1. However, as 'Cargo tank No. 3' has been awarded a rating of 3, an overall rating of 1 cannot be awarded. This is because the final rating cannot be better than one rating grade better than the lowest rating. In this case, the best Overall Structural Condition rating that can be applied to the tank vessel is a rating of 2.

Note 1: Some charterers would not charter this hypothetical vessel because there exists a vessel section with a rating 3. If this section (No. 3 cargo tank) is subsequently repaired/upgraded to a rating 2 or better during survey then the overall structural condition rating, for this hypothetical tank vessel, would be updated by the surveyor to a rating 1.

Figure 5 : Illustration of revised overall structural condition rating

Vessel Sections	Structure Rating	Vessel Sections	Structure Rating
Tanks		**Ballast Tanks**	
Cargo tank No. 1	1	Fore peak tank	2
Cargo tank No. 2	2	No. 1 (P) Side tank	2
Cargo tank No. 3	3	No. 1 (S) Side tank	2
Cargo tank No. 4	2	No. 2 (P) Side tank	2
Cargo tank No. 5	2	No. 2 (S) Side tank	2
Void SpaceS/CofferdamS		No. 3 (P) Side tank	2
Upper stool iwo tanks 2/3	1	No. 3 (S) Side tank	2
Upper stool iwo tanks 3/4	1	No. 4 (P) Side tank	2
Lower stool iwo tanks 2/3	1	No. 4 (S) Side tank	2
Lower stool iwo tanks 3/4	1	No. 5 (P) Side tank	2
Duct keel	1	No. 5 (S) Side tank	1
Fuel/Diesel Oil Tanks (Combined)	1	No. 1 (C) D/Bottom tank	1
Lube Oil Tanks (Combined)	1	No. 1 (P) D/Bottom tank	1
Fresh/Distilled Water Tanks (Combined)	1	No. 1 (S) D/Bottom tank	1
External Structure		No. 2 (P) D/Bottom tank	1
Main deck	1	No. 2 (S) D/Bottom tank	1
Outer hull	1	No. 3 (P) D/Bottom tank	1
Others		No. 3 (S) D/Bottom tank	1
		No. 4 (P) D/Bottom tank	1
		No. 4 (S) D/Bottom tank	1
		No. 5 (P) D/Bottom tank	1
		No. 5 (S) D/Bottom tank	1
		Aft peak tank	1

1 - Superior Condition	2 - Good Condition	Average Structural Rating	1.4
3 - Acceptable Condition	4 - Poor Condition	**Overall Structural Condition Rating**	**1**
N/S - Not Surveyed	N/A Not Applicable	**Revised Overall Structural Condition Rating**	**2**

10.4 CAP Rating Guidelines for Rating of Structure

10.4.1 The rating applied to an AUC for visual structure, visual coatings and wastage will be an integer, either 1, 2, 3, or 4. If no rating can be given then a comment is required to be made e.g. N/F (not fitted), N/S (not surveyed) or N/A (not applicable) etc.

Note 1: There is no rating 4 for coatings.

10.4.2 Each average structural rating calculated for an AUC is rounded to the nearest first decimal place e.g. average of 1.24 is rounded down to 1.2, 1.26 is rounded up to 1.3 and special note 1.25 is rounded up to 1.3.

10.4.3 Each average structural rating awarded to a vessel section or the vessel as a whole is rounded to the nearest integer e.g. 1.2 is rounded to 1, 1.6 is rounded to 2 and special note 1.5 is rounded to 2

10.4.4 Where indents are prominent enough that they are mentioned in class notes/memorandum then the rating awarded for visual structure within the AUC cannot be better than rating 2.

10.4.5 Any AUC's within ballast tanks which are awarded a coating rating of 3 shall be included in surveyors proposals to the client for regular inspection as part of the clients Structural Monitoring Plan (SMP).

10.4.6 Damage to plating and stiffening such as cracking and buckling caused by in line stress or fatigue shall automatically lead to a rating of 4 for the AUC. Depending on the structure detail, cause of defect and complementary aspects such as age of the vessel; reparation of such defects may not be sufficient for some charterers unless design modification is carried out. Suitable repairs/modifications are discussed with the client on a case by case basis in conjunction with the structural and eventual fatigue assessment and/or critical structure area review.

10.4.7 The average rating for anodes is given for information purposes and is not taken into consideration in determining the final CAP rating.

10.4.8 Irrespective of the average structural rating calculated for a vessel section, the rating awarded for that vessel section cannot be better than one rating grade better than the lowest rating applied to an AUC for coating, wastage or visual structure condition within that vessel section. (e.g. if one AUC is awarded a rating 3 for coating condition then the maximum rating that can be applied to that vessel section is a rating of 2.)

10.4.9 Irrespective of the average structural rating calculated for the vessel as a whole, the overall vessel structural rating awarded cannot be better than one rating grade better than the lowest rating applied to any vessel section.

10.4.10 Irrespective of the average structural rating calculated for a vessel section, or for the overall vessel structure, the best structural condition rating that can be awarded cannot be better than the lowest rating awarded to any AUC for visual structure or measured wastage in way of the main deck or of the vessel bottom plating.

10.4.11 Irrespective of the average rating calculated for a vessel section, a final overall structural rating of 4 is given to the vessel if there is an AUC that is awarded a rating of 4 for Visual Structure or Measured Wastage and it is left unrepaired.

10.4.12 The Global rating for UTM cannot be better than the rating found for the groups of items for main deck or bottom plating. (e.g. if the calculated average rating for all groups is 1.2 whereas the rating of the group main deck is assessed as 2, then the final Global rating for thickness measurement analysis cannot be better than rating 2.)

10.5 Final CAP Rating for Vessel Structure

10.5.1 The finalised CAP rating awarded for the vessel's structure is based on a comparison between the rating awarded for the overall vessel structure and the rating awarded as the global rating for Ultrasonic Thickness Measurement (UTM).

10.5.2 The finalised CAP rating for hull structure shall be the worst of the rating values as per the example given in Tab 5.

Table 5 : Final CAP Rating for Hull Structure

Overall Vessel Structural Rating	2
Global Rating for Ultrasonic Thickness Measurement	1
CAP RATING AWARDED FOR HULL STRUCTURE	2

11 Reporting

11.1 Hull Structure Report - with Photographs (HSR)

11.1.1 On the completion of the CAP Inland survey, the surveyor compiles a report for each vessel section and AUC surveyed. It includes:

a) Table for CAP rating awarded for hull structure, the table for compilation of the rating awarded for the overall structural condition and a set of individual vessel section reports, complete with photographic records of the surveys.

b) Details of areas to be monitored and areas with substantial corrosion.

11.2 Structural Monitoring Plan (SMP)

11.2.1 Following the completion of the surveys, the lead CAP Inland surveyor has to work closely with the client's representative to conjointly formulate a Structural Monitoring Plan (SMP) for the vessel.

11.2.2 The following items are suggested as being relevant, therefore, to be included in SMP. A plan and a monitoring timeframe should be drawn up for regular inspections of these:

a) Critical structural areas. (i.e. locations which have been found to be sensitive to cracking, buckling or corrosion which could impair the structural integrity of the vessel.)

b) Specific structural areas identified as part of SFA as being hot spots that require regular monitoring.

c) Ballast tank AUC's that have coatings rated as POOR condition.

d) Any additional monitoring areas which may be proposed following the CAP close-up surveys.

11.3 Special Structural Note regarding Cargo Containment Systems (CCR)

11.3.1 Where the containment system in question is part of the overall vessel then the containment system is surveyed and reported within the framework of the vessel's hull structure.

Where the containment system is not part of a generic vessel structure, then this is covered within the vessel specific annexes.

SECTION 3 HULL MACHINERY, FITTINGS AND SYSTEMS

1 General

1.1 Concept of CAP Inland for Hull Machinery, Fittings and Systems

1.1.1 Bureau Veritas' CAP Inland for Hull Machinery, Fittings and Systems is a risk-management tool designed to assess the overall maintenance condition as well as the actual operational condition of the hull equipment. This dual method approach provides the vessel owner/manager with a more robust assessment of their onboard assets that could be deduced by onboard testing and gives added values by providing an extremely thorough record of condition.

1.1.2 It is important that the BV CAP Inland surveyors assess and make use of the records of condition monitoring and planned maintenance systems, analyses and reports which are already part of the day-to-day and periodical equipment maintenance management. The vessel's records of vibration analysis, lubrication oil analysis, ultrasound, ultrasonic, infrared thermography and other periodical systems analysis are reviewed during this process.

1.2 Condition Assessment of Hull Machinery, Fittings and Systems Ratings

1.2.1 The rating system is broadly defined in Sec 1, [5].

The CAP rating that is awarded for the vessel's hull machinery, fittings and systems is based on a comparison between the rating awarded for the overall operational condition of the equipment and the global rating for maintenance which is awarded based on an audit of the vessel's Planned Maintenance System (PMS). The CAP rating shall be the worst of these rating values.

2 Operational Condition Surveys, Scope and Rating Criteria

2.1 General

2.1.1 Bureau Veritas doesn't make use of any weighting factors in order to calculate final ratings but instead it uses a 'Group' approach whereby similar Items Under Consideration (IUC) i.e. equipment and systems are amalgamated into hull groups. This allows for ease of reporting as well as providing a logical method for assessment of ratings whereby each group has an equal weight in the calculation of the overall operational condition rating.

2.1.2 Operational condition surveys consist of a Visual condition inspection, a Function test and depending on the equipment type, a review of vibration analysis and/or a hydraulic or lubricating oil analysis. These surveys may also be supplemented by ultrasonic thickness measurements, insulation testing and infrared thermography that the vessel's managers may have introduced.

2.1.3 In general the surveyor will not request to open up of the equipment for inspection of component parts, however, where equipment is found disassembled for maintenance during CAP Inland surveys, then this should be documented within the Hull Machinery, Fittings and Systems Report (HMR) and photographic records should be taken.

2.1.4 During operational surveys, CAP Inland surveyor may determine to extend the scope of the surveys e.g. the surveyor may request that a unit be disassembled for inspection where the inspected item show signs of deterioration in external condition or during function testing.

Defects found are advised to the owners' representative using the GAP document.

Table 1 : Visual Inspection Rating Criteria

Rating	Criteria
1	- Items and systems visually examined and/or measurements carried out with the results showing either minimal or no deterioration from 'as new' condition. - No deficiencies affecting safe operation exist. - Measurements are within 0-25% of allowable tolerances and/or recommendations. - Structure and supports show superficial reductions from 'as new' scantlings. - Good maintenance condition exists. - No system leakages exist. - No preventive or corrective maintenance is required.
2	- Items and systems visually examined and/or measurements carried out with the results showing a level of deterioration from 'as new' condition. - No deficiencies affecting safe operation exist. - Measurements are within 25-75% of allowable tolerances and/or recommendations. - Structure and supports show a level of deterioration from 'as new' scantlings. - Fair maintenance condition exists. - No system leakages exist. - No preventive or corrective maintenance is required.
3	- Items and systems visually examined and/or measurements carried out with the results showing deterioration from 'as new' condition but within that acceptable condition according to BV Rules for Inland Vessels. - No deficiencies affecting safe operation exist. - Measurements are within 75-100% of allowable tolerances and/or recommendations. - Structure and supports show reduction from 'as new' scantlings. - Poor maintenance condition exists. - No system leakages exist. - No imminent corrective maintenance is required. - Preventive maintenance may be required to halt deterioration.
4	- Items and systems visually examined and/or measurements carried out with the results showing significant deterioration from 'as new' condition below acceptable condition according to BV Rules for Inland Vessels. - Deficiencies affecting safe operation exist. - Measurements exceed tolerances and/or recommendations. - Structure and supports show significant reduction from 'as new' scantlings. - System leakages exist. - Corrective maintenance is required.

2.2 Visual Inspection

2.2.1 Visual inspections are carried out to assess the overall condition of each unit together with its appurtenances, bedplates and supports. Tab 1 explains the rating criteria for visual inspection.

The surveyor inspects (depending on the type of unit) for evidence of damage, deformation, cracks, leakages, coatings breakdown, corrosion, pitting, erosion, etc.

2.2.2 During these inspections the CAP Inland surveyor takes representative photographs which are attached to the Hull Machinery, Fittings and Systems Report (HMR) to provide a photographic record of the general condition of the machinery, fixtures and fittings.

2.3 Function Test

2.3.1 Function tests are carried out on equipment under operating conditions with the results assessed against the manufacturers' operational criteria, e.g. pumps and compressors have to have a test run and their performance has to be assessed, closing appliances are to be tested for full range of movement, machinery safety devices are to be tested and proved, alarms and instrumentation are to be actuated and inspected, pipelines are to be pressure tested, etc.

2.3.2 All hull machinery, fittings and systems' equipment is required to undergo function test. It is recognised that some vessel's systems such as CO2 flooding, bulk foam systems, etc., will not be able to have their performance fully tested however these can be assessed by supplemental means such as simulation, level testing and chemical analysis.

Function test are assessed prior to rating criteria in Tab 2.

2.4 Vibration Analysis

2.4.1 Vibration measurements are taken on rotating machinery and the results are compared to previous readings. The measurements are normally performed under the same operating and loading conditions as the original readings and a comparison made to observe the change in the vibration patterns. See Tab 3.

If there are important changes in vibration levels that infer significant deterioration of equipment, then the unit should be opened for examination of the rotating components.

2.4.2 Where no vibration history is available for review then Tab 4 may be applied.

Table 2 : Function Test Ratings Criteria

Rating	Criteria
1	- Items and systems and where applicable, their attached valves, operating devices and equipment, locking devices, fittings, instrumentation etc., are function tested with the results reaching rated values and/or full operation with either minimal or no deterioration from 'as new' condition. - Power output or power generation is able to maintain 96-100% of the designed value for sustainable/continuous rating. - Operating temperatures well within tolerances. - Attached safety devices, alarms, trips etc,. are function tested and proved 100% operational. - Piping systems reach required test pressure without leakages or pressure drop-off. - No preventive or corrective maintenance is required.
2	- Items and systems and where applicable, their attached valves, operating devices and equipment, locking devices, fittings, instrumentation etc., are function tested with the results showing a level of deterioration in rated values and/or full operation from 'as new' condition without affecting safe operation. - Power output or power generation is able to maintain 90- 95% of the designed value for sustainable/continuous rating. - Operating temperatures are within tolerances. - Attached safety devices, alarms, trips etc., are function tested and proved 100% operational. - Piping systems reach required test pressure without leakages or pressure drop-off. - No preventive or corrective maintenance is required.
3	- Items and systems and where applicable, their attached valves, operating devices and equipment, locking devices, fittings, instrumentation etc., are function tested with the results showing deterioration in rated values and/or full operation from 'as new' condition but within acceptable condition according to maker's, BV Inland class Rules requirements without affecting safe operation. - Power output or power generation is able to maintain 85-89% of the designed value for sustainable/continuous rating. - Operating temperatures are within tolerance but approaching the limits of tolerances or near to alarm condition. - Attached safety devices, alarms, trips etc., are function tested and proved 100% operational. - Piping systems reach required test pressure without leakages or pressure drop-off. - Preventive maintenance may be required to halt deterioration.
4	- Items and systems and where applicable, their attached valves, operating devices and equipment, locking devices, fittings, instrumentation etc., are function tested with the results showing significant deterioration from 'as new' condition below that acceptable condition according to maker's, BV Inland class Rules requirements. - Found with deficiencies which affect safe operation. - Power output or power generation is not able to maintain at least 85% of the designed value for sustainable/continuous rating. - Operating temperatures exceed tolerances or are in alarm condition. - Attached safety devices, alarms, trips etc., are function tested and are showing defects or deficiencies. - Piping systems do not reach required test pressure and/or leakages or pressure drop-off exists. - Corrective maintenance is required.

Table 3 : Vibration Analysis Ratings Criteria

Rating	Criteria
1	Analysis results close to 'as new' condition according to vibration records.
2	Analysis results within 25% to 74% of the allowable tolerance
3	Analysis results within 75% to 100% of the allowable tolerance
4	Analysis results outside the tolerance.

Table 4 : Vibration Analysis Rating Criteria (Where No Vibration History is Available)

Rating	Criteria		
	Speed (mm / s)		Bearings (g)
	> 100 Hz	< 100 Hz	
1	Up to 7	Up to 4	Up to 2
2	7 to 11	4 to 6	2 to 3
3	11 to 14	6 to 8	3 to 4
4	> 14	> 8	> 4

2.4.3 Where no vibration analysis is carried out for an item of rotating machinery, then the best average rating that may be awarded to that item is a rating of 2. i.e. irrespective of the results of any visual test, function test or lube analysis, a rating of 1 cannot be awarded for an item of rotating machinery if the vibration analysis is not carried out.

2.4.4 In general, vibration analysis reports may be accepted if carried out within three months prior to the start date of CAP Inland surveys. The surveyor may request re-measurement for any unit should vibration levels appear higher than expected during function tests.

2.5 Lubrication Oil and Hydraulic Oil Analysis

2.5.1 Where appropriate, lubricating and hydraulic oil samples are collected from respective systems and are to be tested for evidence of deterioration of the oil or of equipment parts and for suitability of the oil for continuous usage. The result of the analysis is rated based on Tab 5.

Systems and equipment that would normally be expected to have oil analysis carried out are usually fitted with sumps or 'top up' or 'header' tanks.

2.5.2 In the case where oil analysis are not carried out for a system which would normally be expected to have such analysis, then a rating of 1 cannot be awarded i.e. the best average rating that may be applied to that system or equipment is a rating 2.

Table 5 : Lubrication Analysis Ratings Criteria

Rating	Criteria
1	- Analysis results show either minimal or no deterioration from 'as new' condition as per the manufacturers new oil specification. - No presence of wear particles. - No contamination by water or foreign particles. - No corrective action or preventive measures are required.
2	- Analysis results show some deterioration from 'as new' oil condition. - Analysis shows minimal presence of wear particles. - Analysis shows minimal contamination by water or foreign particles. - No corrective action or preventive measures are required.
3	- Analysis results show that the lubricant or hydraulic oil is reaching the end of its useful life but is still suitable for continuous operation. - Analysis shows the presence of wear particles or contamination by water or foreign particles without affecting the safe operation of the system or equipment. - Preventive measures may be required to halt oil deterioration.
4	- Analysis results confirm that the oil system requires renewal. - Significant presence of wear particles. - Significant contamination by water or foreign particles. - Corrective action is required.

2.5.3 In general lube oil sample reports may be accepted if the analyses have been carried out within three months prior to the start date of CAP Inland surveys.

2.6 Ultrasonic Thickness Measurement

2.6.1 Ultrasonic thickness measurements (UTM) are taken on cargo, vapour, cargo stripping, ballast piping that passes through oil tanks, inert gas and on high pressure hydraulic lines.

2.6.2 Where possible the client should arrange for thickness measurements to be carried out in the presence of the CAP Inland surveyor however if the ultrasonic gauging has been conducted within the last 6 months prior to the CAP Inland survey then this may be taken into account provided that a BV class surveyor was present at the time of the gauging. The thickness measurements are evaluated based on the criteria in Tab 6.

Table 6 : Ultrasonic Thickness Measurement Ratings Criteria

Rating	Criteria
1	- Measurements show either minimal or no deterioration from 'as new' condition, i.e. reduction in thickness of between 0 - 25% of permissible diminution. - No corrective action or preventive measures are required.
2	- Measurements show deterioration from 'as new' condition of between 25-75% of permissible diminution. - No corrective action or preventive measures are required.
3	- Measurements show deterioration from 'as new' condition of between 75-100% of permissible diminution. - Preventive measures may be required to halt deterioration.
4	- Measurements show deterioration or wastage above the permissible diminution. - Corrective action is required.

2.6.3 Where a client wishes to submit a UTM report that has been accepted by another recognised society, or submits a UTM report that has been previously accepted by BV which was carried out more than 6 months prior to the CAP Inland survey, then these are to be reviewed on a case by case basis. In such case, the date and scope of UTM gauging reports is to be highlighted in the executive summary of the CAP Inland report.

Note 1: The UTM supplier must be certified as a service supplier in compliance with applicable Society's Rules.

2.6.4 The number of UTM measurements should be in a sufficient quantity to allow the CAP Inland surveyor to make a reasonable determination of the condition of the pipelines that are being measured. Where measurements are not carried out, or the quantity of measurements is insufficient to allow the surveyor to adequately assess the pipeline condition, then the best rating that can be awarded for that pipeline is a rating of 2, irrespective of the ratings applied for visual inspection or pressure testing.

2.6.5 The CAP Inland surveyor may extend the scope of the UTM measurements to other pipelines or hull machinery items that show evidence of deterioration during visual examination or are subjected to leaks during pressure testing.

The surveyor may also request that pipeline sections or machinery items be dismantled for internal visual inspection depending on measurement results.

2.7 Insulation Testing

2.7.1 Insulation Megger testing is to be carried out in accordance with class requirements and the rating criteria, in Tab 7 should be applied.

Note 1: The overall rating assigned for an item cannot be higher than the Megger test rating if a rating 4 is assigned for the megger results.

Table 7 : Insulation Megger Testing Ratings Criteria

Rating	Criteria
1	Over 100 Meg ohms.
2	20-100 Meg ohms.
3	Below 20 Meg ohms but above class minimum requirements.
4	Below class minimum requirements. Corrective action is required.

2.8 Infrared Thermography

2.8.1 Infrared Thermography assessment of the operational condition of electrical equipment and cabling may be included as part of the condition assessment as a supplement to function testing if the client requests this to be included in the CAP Inland report. Where this is carried out, a summary IRT report is to be attached to the HMR report for additional information on the equipment being assessed, however, the results of the IRT assessment will not be rated.

3 Hull Machinery Groups and Items Under Consideration (IUC)

3.1 General

3.1.1 To facilitate the assessment and reporting on the vessel's Hull Machinery, Fittings and Systems, similar Items under Consideration (IUC) (i.e. equipment and systems) are amalgamated into Hull Machinery Groups. This allows for ease of reporting as well as providing a logical method for assessment of ratings whereby each Hull Machinery Group has equal weight in the calculation of the overall operational condition rating.

3.1.2 Hull Machinery groups and IUC's are very dependent on the type of vessel which is being surveyed, so the examples of groups and IUC's given is not to be taken as comprehensive or exhaustive but is provided for illustration purposes.

3.2 List of Hull Machinery Groups

3.2.1 As listed in Tab 8, examples of hull groups may be added to, as necessary, by the attending CAP Inland surveyor depending on the type of vessel under survey.

4 Operational Condition Ratings Assessment

4.1 Operational Condition Rating of Hull Machinery Groups

4.1.1 During the hull equipment CAP Inland surveys individual IUC ratings are awarded for visual condition, function test and depending on the equipment, a vibration analysis and/or lubricating oil analysis. These ratings are then combined to give an average rating, rounded to the nearest first decimal point, for each IUC.

4.1.2 Each IUC average rating is then combined to give an overall average rating, which is then rounded to the nearest whole number to give an operational condition rating for the Hull Machinery Group being surveyed.

The example given in [4.1.3] and [4.1.4] demonstrates how the operational condition rating for a Hull Machinery Group is tabulated and computed from the individual IUC ratings.

4.1.3 Illustration of operational condition rating for 'Anchoring and Mooring Installation and Equipment':

In the example described by Fig 1, the hypothetical Hull Machinery Group that is being rated is the anchoring and mooring installation and equipment group and there are thirteen individual Items Under Consideration (IUC's) are shown.

The average operational rating for this hypothetical group is given as 1.1 and the operational condition rating awarded to the 'Anchoring and Mooring Installation and Equipment group is therefore a rating of 1.

Where analyses are not required to be carried out, these are left unrated and N/A is entered instead of a rating. N/A = Not Applicable. Where N/A is entered then this rating is omitted from the calculation for the average rating as can be seen in the following example:

4.1.4 Illustration of revised operational condition rating for ‘Hull and Cargo Machinery’:

The example described by Fig 2, makes use of the same type of table to assess the CAP rating for a hypothetical hull and cargo machinery group of IUC's.

In the previous example various items of rotating machinery have not undergone vibration analysis therefore these have been left unrated and N/T has been entered instead of a rating. N/T = Not Tested. Where no vibration analysis is carried out for an item of rotating machinery, then the best average rating that may be applied to that Item is a rating 2, irrespective of the results of any visual test, function test or lube analysis. Therefore, an average rating of 2 has been inserted in the table for those particular IUC's.

Also in this example the average operational rating is calculated as 1.4 which is then rounded to an operational condition rating of 1. Therefore, the rating is revised upwards. In this example, the best rating that can be applied to the 'Hull and Cargo Machinery' group is 2. However because the ‘Inert gas fans' have been awarded a rating of 3, an operational condition rating of 1 cannot be awarded because the final rating cannot be more than one rating grade better than the lowest rating awarded for an IUC.

Table 8 : List of Hull Machinery Groups

Hull Machinery Group		Items
01	Anchoring and Mooring Installation and Equipment **(1)**	Windlasses, gypsies and anchor chain stoppers, anchors and shackles, anchor chains, shackles and bitter end securing arrangement, mooring and winches, mooring wires and ropes, rope tails and shackles, fire wires, emergency towing equipment and bow stoppers, chocks, pedestal rollers, bollards and capstans, winch brake test equipment, etc.
02	Steering Gear and Rudder(s)	Steering gear, foundations and holding bolts, hydraulic pumps and telemotors, angle indicators, communications with bridge, auxiliary steering arrangement, steering gear room and drip trays, steering gear lubrication devices, oil drop tanks and other replenishing arrangements, auto start/stop function of steering power and control units, rudder locking device/hydraulic pump, rudder(s) structure, rudder bearings condition and clearances, leakage test, etc.
03	Hull and Cargo Machinery	Cranes, derricks, cargo pumps, stripping pumps, ballast pumps, bow thrusters, tank cleaning machines and attachments, machinery room ventilation systems, hydraulic pumps and tanks, bunker transfer pumps, inert gas generators and fans, deck air compressors, cargo compressors, re-liquefaction equipment, refrigeration equipment and pumps, etc.
04	Hull Electrical Equipment and Cabling	Lighting systems, electrical cabling, cable sealing, cable runs and junction boxes, Intrinsically safe electronics, electrical and electronic equipment start/stop and control systems, solenoids and valve/damper/door position indicators, motors, deck generators, air horns/typhoons, alarm indicators, transformers, switchboards, starter panels, electrical bonding for pipes and couplings, etc.
05	Hull and Cargo Fittings	Deck tanks, PV breakers, deck seals, tank level systems, hold or void space water detection equipment, tank cleaning heaters, cargo heaters, cargo hoses, butterworth hoses, gas devourers, gas freeing equipment, container mountings and sockets, deck and cargo hold fittings, chains, etc.
06	Closing Appliances	Hatch covers including hatch coamings, tank/hold/void space access and covers, cargo ventilation ducts and trunks, watertight doors and access hatches to accommodation, machinery rooms and store rooms, air pipes and vent heads, fire dampers and hatches for accommodation, machinery rooms and store rooms, PV valves, PV breakers, vapour locks, etc.
07	Hull Piping and Valves	Pipelines for cargo, ballast and tank cleaning, stripping, hydraulic, steam, fuel transfer, bilge, inert gas, vapour return, cargo heating coils, water spray systems and deck showers, including pipe supports and clamps, on deck, tanks, holds and machinery rooms, valves and relief valves, strainers and mud boxes, bilge and ballast eductors, cargo eductors, etc.
08	River Connections and Valves	River valves, overboard discharge valves and cocks, testing arrangements of river valves where fitted, river pipe attachments to the hull, including within engine and machinery spaces, etc.
09	Miscellaneous	Accommodation ladders, gangways, ladders and walkways on deck, hatches and on forecastle, foremast, light posts, kingposts, bulwarks and railings, deck and machinery houses and store rooms, bulkhead seals (e.g. between pump or compressor room and motor or engine room), spare propeller and mounting, general tools, chain blocks and associated lifting equipment etc.
10	Fire/Smoke/Gas Detection and Fire Fighting Systems	Pipelines, hoses, monitors, nozzles, applicators, valves and spanners for fire, foam, CO_2 and dry powder fire fighting systems on deck, tank, hold, machinery and store rooms, semi portable and portable fire fighting extinguishers, fire and smoke detection systems and alarms, portable gas detection equipment and oxygen meters, fixed gas detection systems for pump rooms, ballast tanks, etc., fire fighting suits, breathing apparatus and compressors, smoke hoods, etc.
11	Environmental Management	Consists of items such as, garbage containment and storage, garbage compactors, oil/chemical spill containment and pumping equipment, oil/chemical spill clean up equipment, etc.
(1) Results of winch and windlass brake testing is to be highlighted in the HMR report and copy of the test report is to be attached.		

Figure 1 : Illustration of operational condition rating

Vessel Name	Class Society	Register No.
FMas	Bureau Veritas	88F9283

Group	Anchoring & Mooring Installation & Equipment	Page	2	of	33

Sets	Items Under Consideration (IUC)	Visual Condition	Function Test	Analyses Vib^n.	Analyses Oil	Analyses UTM	Average Ratings
1	(P) Windlass, Mooring Winch and Gypsy	1	1	N/A	1	N/A	1.0
1	(S) Windlass, Mooring Winch and Gypsy	2	1	N/A	2	N/A	1.7
2	Chain Stoppers	1	1	N/A	N/A	N/A	1.0
2	Anchors and Shackles	1	1	N/A	N/A	N/A	1.0
2	Anchor Chains, Shackles and Bitter End	1	1	N/A	N/A	N/A	1.0
2	Main Deck Mooring Winches	1	1	N/A	1	N/A	1.0
3	Poop Deck Mooring Winches	1	1	N/A	1	N/A	1.0
14	Mooring Wire Ropes, Rope Tails and Shackles	1	1	N/A	N/A	N/A	1.0
4	Nylon Mooring Ropes	1	N/T	N/A	N/A	N/A	1.0
2	Fire Wires and Cradles	1	1	N/A	N/A	N/A	1.0
1	Forward E.T.A. Chafe Chain and Bowstopper	1	1	N/A	N/A	N/A	1.0
1	Aft E.T.A. Winch, Cable and Pick up Gear	1	N/T	N/A	N/A	N/A	1.0
2	Mooring Winch Brake Testing Equipment	1	1	N/A	N/A	N/A	1.0
Ratings:	1 - Superior Condition 2 - Good Condition 3 - Acceptable Condition			Average Operational Rating			1.1
	4 - Poor Condition N/A - Not Applicable N/T - Not Tested			**Operational Condition Rating**			**1**

If Rating is revised then reason to be advised below.

Revised Operational Condition Rating	N/A

Figure 2 : Illustration of revised operational condition rating

Vessel Name	Class Society	Register No.
FMas	Bureau Veritas	88F9283

Group	Hull and Cargo Machinery	Page	8	of	33

Sets	Items Under Consideration (IUC)	Visual Condition	Function Test	Analyses Vib^n.	Analyses Oil	Analyses UTM	Average Ratings
1	No. 1 Cargo Pump	1	1	2	N/A	N/A	1.3
1	No. 2 Cargo Pump	1	1	2	N/A	N/A	1.3
1	No. 3 Cargo Pump	1	1	2	N/A	N/A	1.3
1	Stripping Pump	2	1	N/A	N/A	N/A	1.5
1	No. 1 Ballast Pump	1	1	2	N/A	N/A	1.3
1	No. 2 Ballast Pump	1	1	1	N/A	N/A	1.0
10	Fixed Tank Cleaning Machines	1	1	N/A	N/A	N/A	1.0
14	Programmable Tank Cleaning Machines	1	1	N/A	N/A	N/A	1.0
2	Cargo Vacuum pumps and tanks	1	1	1	N/A	N/A	1.0
2	Hydraulic Pumps & Tanks for Fwd Deck Machinery	1	1	1	1	N/A	1.0
2	Hydraulic Pumps & Tanks for Aft Deck Machinery	2	1	N/T	2	N/A	2
1	Inert Gas Generator	2	1	N/T	N/A	N/A	2
2	Inert Gas Fans	3	3	3	N/A	N/A	3.0
2	Forward Fuel Oil Transfer Pumps	1	1	N/T	N/A	N/A	2
1	Deck Air Compressor	2	1	N/A	N/A	N/A	1.5
1	Deck Air Refrigfilter	2	2	N/A	N/A	N/A	2.0
2	Stores Cranes	1	1	N/A	N/A	N/A	1.0
1	Cargo Crane	1	1	N/A	1	N/A	1.0
2	Pump Room Ventilation System Fans	1	1	N/A	N/A	N/A	1.0
2	Focsle Ventilation System Fans	1	1	N/A	N/A	N/A	1.0
Ratings:	1 - Superior Condition 2 - Good Condition 3 - Acceptable Condition			Average Operational Rating			1.4
	4 - Poor Condition N/A - Not Applicable N/T - Not Tested			**Operational Condition Rating**			**1**

If Rating is revised then reason to be advised below.

Revised Operational Condition Rating	2

4.2 Overall Operational Condition Rating

4.2.1 To arrive at an overall operational condition rating for the hull machinery, fittings and systems the individual operational condition ratings awarded for each hull group are combined, an average operational condition rating is computed and a final rating formulated.

4.2.2 The example described in Fig 3, shows the type of table which is normally used to show the ratings awarded to individual hull groups together with the overall operational condition rating awarded.

In the example the average operational rating is calculated as 1.4 which is then rounded down to an overall operational condition rating of 1.

5 CAP Rating Guidelines for Hull Machinery, Fittings and Systems

5.1 General

5.1.1 The rating applied to an IUC visual condition, function test, vibration analysis, oil analysis and wastage (UTM) shall be an integer, either 1, 2, 3, or 4. If no rating can be given, then a comment is required to be made e.g. N/F (not fitted), N/T (not tested) or N/A (not applicable), etc.

5.1.2 Each average rating calculated for an IUC, or a hull group or for the 'Hull Machinery, Fittings and Systems' as a whole, is to be rounded to the nearest first decimal place e.g. an average of 1.24 is to be rounded down to 1.2, 1.26 is rounded up to 1.3 and special note 1.25 is rounded up to 1.3.

Figure 3 : illustration of overall operational condition rating

Vessel Name	Vessel Type	Date of Build
FMas Example	Tanker	1983
Class Society	Register No.	Deadweight
Bureau Veritas	88F9283	3000

This report indicates the condition of the hull machinery, fittings & systems at survey completion.

Hull Machinery Groups	Operation Rating	Hull Machinery Groups	Operation Rating
01 Anchoring and Mooring Installations and Equipment.	1	07 Hull and Cargo Piping and Valves	1
02 Steering Gear and Rudder(s)	2	08 Sea Connections and Valves	1
03 Hull and Cargo Machinery	2	09 Hull Miscellaneous	2
04 Hull Electrical Equipment and Cabling	1	10 Fire / Smoke / Gas Detection and Fire Fighting Systems / Equipment	1
05 Hull and Cargo Fittings	2	11 Life Saving Equipment and Fittings	1
06 Closing Appliances	2	12 Environmental Management	1

1 - Superior Condition	2 - Good Condition	Average Operational Rating	1.4
3 - Acceptable Condition	4 - Poor Condition	Overall Operational Condition Rating	1
N/S - Not Surveyed	N/A Not Applicable	Revised Overall Operational Condition Rating	N/A

5.1.3 The operational condition rating for each hull group or for the overall operational condition rating of 'Hull Machinery, Fittings and Systems' as a whole, is assigned by rounding it to the nearest integer e.g. 1.2 is rounded to 1, 1.6 is rounded to 2 and on a special note, 1.5 is rounded up to 2.

5.1.4 Where no function test or expected analysis are carried out for an IUC, then the best average rating that can be applied to that specific IUC is a rating of 2, i.e. irrespective of the results of other tests/analyses a rating of 1 cannot be awarded for an any item if a function test or an expected analysis is not carried out.

Where function test or expected analysis are not carried out, then this is to be highlighted in the HMR report.

5.1.5 Where function test and expected analysis is not carried out for IUC, then the best average rating that can be applied to that specific IUC is a rating of 3. This is also to be highlighted in that hull group part of the HMR report.

5.1.6 Irrespective of the average rating calculated for a hull group, the rating awarded for that hull group as a whole cannot be better than one rating grade better than the worst rating applied to an IUC for a function test or a required analysis (e.g. if one IUC is awarded a rating 3 for function test then the maximum rating that can be applied to that Hull Machinery Group is a rating of 2.) This is also to be highlighted in that hull group part of the HMR report.

5.1.7 If hull machinery, fittings and systems' IUC's that are critical to the safe operation of the vessel or for the safety of the crew, have been awarded a rating of 4, then the rating awarded for that hull group will also be a 4, except were the item is covered by redundancy and the secondary unit has a rating of 3 or better. (Critical items are IUC's such as anchors, anchor chains, windlasses, steering gear, rudder, PV valves, fire-fighting equipment, etc.)

5.1.8 Where the operational condition for an individual hull group is awarded a rating of 4 then the overall operational condition for the 'Hull Machinery, Fittings and Systems' as a whole is also awarded a rating of 4.

6 Global Rating for Maintenance

6.1 General

6.1.1 The global rating for maintenance for the hull machinery, fittings and systems is awarded based on the results of an audit of the vessel's planned maintenance system (PMS). In this article, the requirements for a PMS are reviewed and the scope of the audit of the PMS is discussed.

6.2 Scope of Audit

6.2.1 The CAP Inland surveyor will audit that part of the PMS system that specifically applies to the 'Hull Machinery, Fittings and Systems'. The audit will cover the equipment identified in the PMS system and the CAP Inland surveyor will not make any assessment whether the PMS system covers every item of critical equipment (unless specifically requested by the client to do so.)

The audit is to cover the timely implementation, frequency, scope and results of the maintenance.

6.2.2 Postponements and overdue items are to be included in the audit and reporting and follow-up actions are to be identified and reviewed.

6.3 Global Rating for Maintenance

6.3.1 The CAP Inland rating system is broadly defined in [2].

6.3.2 The global rating for maintenance for the vessel's hull machinery, fittings and systems is awarded as per criteria in Tab 9.

Table 9 : Global Rating Criteria for Maintenance Criteria of Hull Machinery, Fittings and Systems

Rating	Criteria
1	- Maintenance performed in a timely manner. Overdue or postponed items are few, have minor importance, do not affect class and they are documented. - No items postponed to dry dock unless the docking is imminent and these are planned in the repair specification. No items are subjected to class recommendations.
2	- Maintenance performed in a timely manner. Overdue or postponed items are few, have minor importance, do not affect class and they are documented. - Items postponed for docking are due within 3 months and are clearly planned in the repair specification. - No items are subjected to class recommendations.
3	- Maintenance performed generally in a timely manner with some overdue and postponed items which do not affect class. - Items postponed for docking are due within 3 months and are clearly planned in the repair specification. - Items are subjected to class recommendations but within the limit date.
4	- Maintenance generally performed with overdue items and postponed items some of which affect class. - Overdue Class recommendations.

7 CAP Rating for Hull Machinery, Fittings and Systems

7.1 Final CAP Rating

7.1.1 As stated in [2] the CAP rating awarded for the vessel's 'Hull Machinery, Fittings and Systems' is based on a comparison between the rating awarded for the Overall Operational Condition and that awarded for Global Rating for Maintenance.

7.1.2 The finalised CAP rating for hull machinery, fittings and systems, shall be the worst of these rating values as per example tabulated in Tab 10.

8 Reporting

8.1 Hull Machinery, Fittings and Systems Report - with Photographs (HMR)

8.1.1 On the completion of the CAP Inland survey, the surveyor compiles a report for each hull group and IUC surveyed. The report includes the table for compilation and computation of the overall operational condition rating to be awarded for hull machinery, fittings and systems and a set of individual hull group rating tables and reports, complete with photographic records of the surveys.

8.2 GAP Report

8.2.1 Should any IUC or component of an IUC be awarded a rating lower than the minimum rating expected by the client, then this is reported to the client using the GAP document.

Table 10 : FInal CAP Rating for Hull Machinery, Fittings and Systems

Overall Operational Structural Rating	2
Global Rating for Maintenance	1
CAP RATING AWARDED FOR HULL MACHINERY, FITTINGS AND SYSTEMS	2

SECTION 4 PROPULSION AND AUXILIARY MACHINERY, FITTINGS AND SYSTEMS

1 General

1.1 Concept of CAP Inland for Propulsion and Auxiliary Machinery, Fittings and Systems

1.1.1 Bureau Veritas' CAP Inland for propulsion and auxiliary machinery, fittings and systems is a risk-management tool designed to assess the overall maintenance condition as well as the actual operational condition of the propulsion and auxiliary equipment.

1.1.2 The BV CAP Inland surveyors assess and make use of the records of condition monitoring and planned maintenance systems, analyses and reports which are already part of the day to day maintenance management. The vessel's records of vibration analysis, lubricating oil analysis, ultrasound sound, ultrasonic, infrared and other systems' analyses are reviewed during this process.

1.2 Condition Assessment of Propulsion and Auxiliary Machinery, Fittings and Systems, Ratings

1.2.1 The CAP rating system is broadly defined in Sec 1, [5] and Sec 1, Tab 1.

The CAP rating is awarded for the vessel's propulsion and auxiliary machinery, fittings and systems based on a comparison between the rating awarded for the overall operational condition of the equipment and the global rating for maintenance which is awarded based on an audit of the vessel's planned maintenance system (PMS). The CAP rating shall be the worst of these rating values.

2 Operational Condition Surveys, Scope and Rating Criteria

2.1 General

2.1.1 Bureau Veritas does not make use of any weighting factors in order to calculate final ratings but instead, it uses a group approach whereby similar Items Under Consideration (IUC) i.e. equipment and systems are amalgamated into 'Engine Groups'. This makes it easy for reporting as well as providing a logical method for assessment of ratings whereby each group has equal weight in the calculation of the overall operational condition rating.

2.1.2 Operational condition surveys consist of a visual condition inspection, a function test and depending on the equipment type, a review of vibration analysis and/or a hydraulic or lubricating oil analysis. These surveys may also be supplemented by ultrasonic thickness measurements, insulation testing and infrared thermography that the vessel's managers may have introduced.

2.1.3 In general the surveyor will not request to open up equipment for inspection of component parts, however, where equipment is found disassembled for maintenance during CAP Inland surveys, then this should be documented within the Propulsion and Auxiliary, Fittings and Systems report (PMR) and a photographic record taken.

2.1.4 During the operational surveys, the surveyor may determine to extend the scope of the surveys e.g. the surveyor may request that a unit be disassembled for inspection where the item show signs of deterioration in external condition or during function testing.

Defects found during operational surveys are advised to the owners' representative using the GAP document.

2.2 Visual Inspection

2.2.1 Visual inspections are carried out to assess the overall condition of each unit together with its appurtenances, bedplates and supports. The surveyor inspects (depending on the type of unit) for evidence of damage, deformation, cracks, leakages, coatings breakdown, corrosion, pitting, erosion, etc.

2.2.2 During these inspections, the CAP Inland surveyor takes representative photographs which are attached to the Propulsion and Auxiliary Machinery, Fittings and systems Report (PMR) to provide photographic record of the general condition of the machinery, fixtures and fittings. The ratings of visual inspection is done according the criteria in Tab 1.

2.3 Function Test

2.3.1 Function tests are carried out on equipment under working conditions with the results assessed against the operational criteria from manufacturer, e.g. pumps and compressors are to be tested run and their performance assessed, closing appliances are to be tested for full range of movement, machinery safety devices are to be tested and proved, alarms and instrumentation are to be actuated and inspected, pipelines are to be pressure tested, etc.

2.3.2 All propulsion and auxiliary machinery, fittings and systems' equipment is required to undergo function test and to be rated according to Tab 2. It is recognised that some vessel's systems such as CO2 flooding, bulk foam systems, etc. will not be able to have their performance fully tested however these can be assessed by supplemental means such as simulation, level testing and chemical analysis.

Table 1 : Visual Inspection Rating Criteria

Rating	Criteria
1	- Items and systems visually examined and/or measurements carried out with the results showing either minimal or no deterioration from 'as new' condition. - No deficiencies affecting safe operation exist. - Measurements are within 0-25% of allowable tolerances and/or recommendations. - Structure and supports show superficial reductions from 'as new' scantlings. - Good maintenance condition exists. - No system leakages exist. - No preventive or corrective maintenance is required.
2	- Items and systems visually examined and/or measurements carried out with the results showing a level of deterioration from 'as new' condition. - No deficiencies affecting safe operation exist. - Measurements are within 25-75% of allowable tolerances and/or recommendations. - Structure and supports show a level of deterioration from 'as new' scantlings. - Fair maintenance condition exists. - No system leakages exist. - No preventive or corrective maintenance is required.
3	- Items and systems visually examined and/or measurements carried out with the results showing deterioration from 'as new' condition but within acceptable condition according to BV Inland class Rules. - No deficiencies affecting safe operation exist. - Measurements are within 75-100% of allowable tolerances and/or recommendations. - Structure and supports show reduction from 'as new' scantlings. - Poor maintenance condition exists. - No system leakages exist. - No imminent corrective maintenance is required. - Preventive maintenance may be required to halt deterioration.
4	- Items and systems visually examined and/or measurements carried out with the results showing significant deterioration from 'as new' condition below acceptable condition according to BV Inland class Rules. - Deficiencies affecting safe operation exist. - Measurements exceed tolerances and/or recommendations. - Structure and supports show significant reduction from 'as new' scantlings. - System leakages exist. - Corrective maintenance is required.

Table 2 : Function Test Rating Criteria

Rating	Criteria
1	- Items and systems and where applicable, their attached valves, operating devices and equipment, locking devices, fittings, instrumentation etc. are function tested with the results reaching rated values and/or full operation with either minimal or no deterioration from the 'as new' condition. - Power output or power generation is able to maintain 96-100% of the designed value for sustainable/continuous rating. - Operating temperatures are well within tolerances. - Attached safety devices, alarms, trips etc. are function tested and proved 100% operational. - Piping systems reach required test pressure without leakages or pressure drop-off. - No preventive or corrective maintenance is required.
2	- Items and systems and where applicable, their attached valves, operating devices and equipment, locking devices, fittings, instrumentation etc. are function tested with the results showing a level of deterioration in rated values and/or full operation from 'as new' condition without affecting safe operation. - Power output or power generation is able to maintain 90- 95% of the designed value for sustainable/continuous rating. - Operating temperatures are within tolerances. - Attached safety devices, alarms, trips, etc. are function tested and proved 100% operational. - Piping systems reach required test pressure without leakages or pressure drop-off. - No preventive or corrective maintenance is required.
3	- Items and systems and where applicable, their attached valves, operating devices and equipment, locking devices, fittings, instrumentation etc. are function tested with the results showing deterioration in rated values and/or full operation from 'as new' condition but within that acceptable according to maker's, BV Inland class Rules requirements without affecting safe operation. - Power output or power generation is able to maintain 85-89% of the designed value for sustainable/continuous rating. - Operating temperatures are within tolerance but approaching limits of tolerances or nearing alarm condition. - Attached safety devices, alarms, trips, etc. are function tested and proved 100% operational. - Piping systems reach required test pressure without leakages or pressure drop-off. - Preventive maintenance may be required to halt deterioration.
4	- Items and systems and where applicable, their attached valves, operating devices and equipment, locking devices, fittings, instrumentation etc,. are function tested with the results showing significant deterioration from 'as new' condition below that acceptable according to maker's, BV Inland class Rules requirements. - Found with deficiencies which affect safe operation. - Power output or power generation is not able to maintain at least 85% of the designed value for sustainable/continuous rating. - Operating temperatures exceed tolerances or are in alarm condition. - Attached safety devices, alarms, trips, etc. are function tested and are showing defects or deficiencies. - Piping systems do not reach required test pressure and/or leakages or pressure drop-off exists. - Corrective maintenance is required.

2.4 Vibration Analysis

2.4.1 Vibration measurements are taken on rotating machinery and the results are compared to previous readings. The measurements are normally performed under the same operating and loading conditions as the original readings and a comparison made to observe the change in the vibration patterns. Tab 3.

If there are important changes in vibration levels that infer significant deterioration of the equipment, then the unit should be opened for examination of the rotating components.

2.4.2 Where no vibration history is available for review, then Tab 4 may be applied.

2.4.3 Where no vibration analysis is carried out for an item of rotating machinery then the best average rating that may be applied to that Item is a rating 2, i.e. irrespective of the results of any visual test, function test or lube analysis, a rating of 1 cannot be awarded for an item of rotating machinery if vibration analysis is not carried out.

Table 3 : Vibration Analysis Ratings Criteria

Rating	Criteria
1	Analysis results close to the 'as new' condition according to vibration records.
2	Analysis results within 25% to 74% of the allowable tolerance
3	Analysis results within 75% to 100% of the allowable tolerance
4	Analysis results outside the tolerance.

Table 4 : Vibration Analysis Rating Criteria (Where No Vibration History is Available)

Rating	Criteria		
	Speed (mm / s)		Bearings (g)
	> 100 Hz	< 100 Hz	
1	Up to 7	Up to 4	Up to 2
2	7 to 11	4 to 6	2 to 3
3	11 to 14	6 to 8	3 to 4
4	> 14	> 8	> 4

2.4.4 In general, vibration analysis reports may be accepted if it is carried out within three months prior to the start date of CAP Inland surveys. The surveyor may request re-measurement for any unit if vibration levels appear higher than expected during function tests.

2.5 Lubicrating Oil / Hydraulic Oil Analysis

2.5.1 Where appropriate, lubricating and hydraulic oil samples are collected from respective systems and are to be tested for evidence of deterioration of the oil or of equipment parts and for suitability of the oil for continuous usage.

Systems and equipment that would be normally expected to have oil analysis carried out are usually fitted with sumps or 'top up' or 'header' tank. The result of the analysis then is then rated according to the Tab 5.

2.5.2 Where hydraulic oil or lubricating oil analyses are not carried out, for a system or for equipment which would normally be expected to have such analyses, then the best average rating that may be applied to that system or equipment is a rating 2, i.e. irrespective of the results of a visual test, function test or vibration analysis, a rating of 1 cannot be awarded if an oil analysis is not carried out.

2.5.3 In general lube oil sample reports may be accepted if they are carried out within three months prior to the start date of CAP Inland survey.

2.6 Ultrasonic Thickness Measurements

2.6.1 Although there is no requirement for UTM measurements for propulsion and auxiliary machinery, fittings and systems, the CAP Inland surveyor may request UTM measurements for machinery items that show evidence of deterioration during visual examination or are subject to leaks during pressure testing.

2.6.2 The surveyor may also request that pipeline sections or machinery items be disassembled for internal visual inspection depending on measurement results.

2.7 Insulation Testing

2.7.1 Insulation Megger testing is to be carried out in accordance with class requirements and the rating criteria in Tab 6 should be applied.

Note 1: The overall rating assigned for an item cannot be higher than the Megger test rating if a rating 4 is assigned for the megger results.

Table 5 : Lubrication Analysis Ratings Criteria

Rating	Criteria
1	- Analysis results show either minimal or no deterioration from 'as new' condition as per manufacturers new oil specification. - No presence of wear particles. - No contamination by water or foreign particles. - No corrective action or preventive measures are required.
2	- Analysis results show some deterioration from 'as new' oil condition. - Analysis shows minimal presence of wear particles. - Analysis shows minimal contamination by water or foreign particles. - No corrective action or preventive measures are required.
3	- Analysis results show that the lubricant or hydraulic oil is reaching the end of its useful life but is still suitable for continuous operation. - Analysis shows the presence of wear particles or contamination by water or foreign particles without affecting the safe operation of the system or equipment. - Preventive measures may be required to halt oil deterioration.
4	- Analysis results confirm that the system oil requires renewal. - Significant presence of wear particles. - Significant contamination by water or foreign particles. - Corrective action is required.

Table 6 : Insulation Megger Testing Ratings Criteria

Rating	Criteria
1	Over 100 Meg ohms.
2	20-100 Meg ohms.
3	Below 20 Meg ohms but above class minimum requirements.
4	Below class minimum requirements. Corrective action is required.

2.8 Infrared Thermography

2.8.1 Infrared Thermography assessment of the operational condition of electrical equipment and cabling may be included as part of the condition assessment as supplement to function testing when the client request this to be included in the CAP Inland report.

Where this is carried out, a summary IRT report is to be attached to the PMR report for additional information on the equipment being assessed, however, the results of the IRT assessment will not be rated.

3 Engine Groups and Item Under Consideration (IUC)

3.1 General

3.1.1 To facilitate the assessment and reporting on the vessel's propulsion and auxiliary machinery, fittings and systems, similar Items Under Consideration (IUC) (i.e. equipment and systems) are amalgamated into engine groups.

This makes it easier for reporting as well as providing a logical method for assessment of ratings where each group has equal weight in the calculation of the overall operational condition rating.

3.1.2 Engine groups and IUC's are very dependent on the type of vessel being surveyed so the examples of groups and IUC's given hereafter is not be taken as comprehensive or exhaustive but is provided for illustration purposes.

3.2 Examples of Engine Groups

3.2.1 Examples of engine groups, listed in Tab 7, may be added to, as necessary by the attending surveyor depending on the type of vessel under survey.

Table 7 : List of engine groups

Engine Group		Items
01	Engine Room, Auxiliary Machinery Spaces and Engine Store Rooms	Cleanliness of engine & machinery spaces and store rooms, condition of coatings, condition of floor plates, platforms and stairways, condition of bilges, condition of railings and hand rails condition of devices to protect crew against falls and dangers due to moving parts, hot surfaces and other hazards, condition of spare parts in storage etc.
02	Main Propulsion Installations	Diesel engines, crankcases, casing doors, safety devices and valves, safety systems including alarms and trips, flexible couplings, attached pumps, attached fixed & flexible piping and bellows pieces, bedplates, holding down and tie bolts, HP fuel pumps, turbo blowers and associated coolers, insulation, manoeuvring gears, clutches, turning gears, reduction gear(s), coupling bolts, main, thrust and steady bearings, intermediate shafts and bearings, torsion meter assemblies, instruments and gauges, safety valves, cooling and lubrication systems etc,
03	Tailshaft, Stern tube and Propeller Systems	Fixed and variable pitch propeller(s), tailshaft(s), stern tube bearings, sealing devices, and their associated lube oil systems, hydraulic systems instruments and gauges, safety valves and cooling systems
04	Auxiliary Engines	Diesel engines, cargo and ballast pump diesel engines and their associated casings, crankcases, safety devices and valves, safety systems including alarms and trips, vibration dampers, attached pumps, attached fixed & flexible piping and bellows pieces, bedplates, holding down bolts, fuel pumps, turbo blowers and associated coolers, insulation, reduction gear(s), coupling bolts, thrust and steady bearings, instruments and gauges, safety valves cooling systems etc,.
05	Oil Pumps and Purifiers	Fuel oil service pumps, bunker transfer pumps, diesel oil service pumps, lube oil service and transfer pumps, fuel oil separator and clarifiers, diesel oil purifiers and their attached, valves, instruments and gauges, safety valves, filters, strainers and bedplates etc,.
06	Fresh and River Water Pumps	Jacket cooling water pumps, feed water pumps, condensate pumps, centralised fresh water cooling systems circulating pumps, main and auxiliary circulating pumps, cargo condenser cooling pumps, scrubber pumps, deck seal pumps, river water service pumps, fire pumps, general service pumps, hydrophore pumps, hot water circulating pumps, air conditioning circulating FW pumps, and their attached, valves, instruments and gauges, safety valves, filters and strainers and bedplates, etc,
07	Compressors	Start air and emergency start air compressors, general service air compressors, control and instrument air compressors, air conditioning compressors, and their attached, valves, safety valves, instruments and gauges, safety valves and bedplates, etc.
08	Ventilation Fans	Forced draft fans, engine room exhaust air fans, engine room supply air fans, engine control room and workshop supply, exhaust and air conditioning units and fans, and their attached dampers, casings, etc.
09	Piping and valves	Fuel oil piping and valves, lube oil, hydraulic, compressed air, steam, river water, fresh water, bilge, ballast, feed water, gas burning supply, river chest vents, sewage and dirty water systems and mud boxes piping and valve systems, fixing clamps, vents, etc.
10	Boilers, Economisers and Thermal Oil Heaters **(1)**	High pressure boilers, low pressure boilers, economisers, exhaust gas economisers, low pressure steam generators, thermal oil heaters, and their attached furnaces, casings, exhaust gas uptakes, man-holes and doors, handholes and doors, mountings, cocks, piping and valves and cocks, level gauges, instruments and gauges, safety valves and bedplates etc.
11	Heat Exchangers (others)	Evaporators, Jacket water coolers, Lube oil coolers, lube oil heaters (for purifiers), fuel oil heaters, main condensers, cargo condensers, gas or steam air pre heaters, de-aerators, hot wells, hot water calorifiers, and their attached, valves, instruments and gauges, safety valves and bedplates, etc.
12	Miscellaneous Equipment	Air receivers and reservoirs, hyrophore bottles, air ejectors, vacuum pumps, chemical injection pumps, emulsifiers, deionization plants, and their attached valves, instruments and gauges, safety valves and bedplates, etc.
13	Communication, Order Transmission and Remote Control / Emergency Stop Systems	Communication and order transmission system between the navigation bridge and the machinery control positions, between the bridge and the alternative steering position, remote control system of the main engine(s), control system of adjustable pitch propeller(s), emergency stops for pumps, ventilators and sea valves, quick release valves and their attached, piping and valves, instrumentation and gauges, and supports, etc.
14	Generators and Switchboards	Alternators, main motor generators, auxiliary generators, shaft generators, lighting generators, main switchboards, emergency switchboards, distribution switchboards and their attached Instrumentation, controls systems, couplings, supports, bedplates, cabling, etc.
15	Motors and Associated Starters	Drive motors and starters for oil pumps, purifiers, river and fresh water pumps, compressors, rotary air pre-heaters, ventilation fans, fuel pumps, air conditioning, ballast pumps, cargo pumps: etc. and their attached instrumentation, controls systems, couplings, supports, bedplates, cabling, etc.
(1) For thermal oil heater that analysis of oil has to be carried out.		

Engine Group		Items
16	Electrical installations (others)	Lighting, emergency lighting, light switches, transformers, electrical cables, cable runs, cable seals, junction boxes, etc.
17	Automated installation	Main engine control systems, auxiliary control systems, monitoring, alarm and automatic shut-off systems, automatic start up and change over of generators, automatic start up of standby units, bilge alarms. boiler safety systems, automatic combustion control systems, engineers and UMS alarms systems, etc.
18	Fire / Smoke / Gas Detection and Fire Fighting Systems	Fire pipelines, hoses, monitors, nozzles, applicators, valves and spanners for water, foam, CO2 and dry powder fire fighting systems in the machinery spaces and store rooms, semi portable and portable fire fighting extinguishers, fire and smoke detection systems and alarms, gas detection equipment and oxygen meters, fire fighting suits, breathing apparatus, smoke hoods, fire doors, watertight doors, emergency escapes, emergency escape signs, etc.
19	Environmental Management	Incinerators, sludge pumps, bilge pumps, oily water separators, sewage tanks, and their attached valves, instruments and gauges, safety valves and bedplates, etc.
(1)	For thermal oil heater that analysis of oil has to be carried out.	

4 Operational Condition Ratings Assessment

4.1 Operational Condition Rating of Engine Groups

4.1.1 During the propulsion and auxiliary equipment CAP Inland surveys, individual IUC ratings are awarded for visual condition, function test and also for UTM, vibration analysis and/or lubricating oil analysis. These ratings are then combined to give an average rating, rounded to the nearest first decimal point, for each IUC.

4.1.2 Each IUC average rating is then combined to give an overall average rating, which is then rounded to the nearest whole number to give an operational condition rating for the engine group that is being surveyed.

4.1.3 The example described in Fig 1, demonstrates how the operational condition rating for an engine group is tabulated and computed from the individual IUC ratings. In this example the hypothetical engine group that is being rated is the Group 03 - Tailshaft, stern tube and propeller systems and there are eleven individual Items Under Consideration (IUC's) shown.

In the example the average operational rating for this hypothetical group is given as 1.1 and therefore the operational condition rating awarded to the 'Tailshaft, Stern tube and Propeller Systems' group is 1.

Note 1: Where analyses are not required to be carried out, then these are left unrated and N/A has been entered instead of a rating. N/A = Not Applicable. Where N/A is entered then this 'rating' is omitted from the calculation for the average rating as can be seen in the example below.

Figure 1 : Illustration of operational condition rating

Vessel Name	Class Society	Register No.
FMas Example	Bureau Veritas	88F9283

Hull Group	03 - Tailshaft, Stern Tube and Propeller Systems	Page		of	

Sets	Items Under Consideration (IUC)	Visual Condition	Function Test	Analyses Vib°.	Analyses Oil		Average Ratings
1	Tailshaft	1	1	1	N/A		1
1	Fwd stern tube bearing	1	1	N/A	N/A		1
1	Fwd simplex oil seals and liners	1	1	N/A	N/A		1
1	Aft stern tube bearing	2	1	N/A	N/A		1.5
1	Aft simplex oil seals and liners	1	1	N/A	N/A		1
1	Stern tube lube oil, piping and valves	1	1	N/A	1		1
1	Stern tube L.O. cooler	1	1	N/A	N/A		1
1	Upper and lower stern tube header tanks	1	1	N/A	N/A		1
1	Stern tube L.O. sump tank	1	1	N/A	N/A		1
1	Stern tube system instruments and gauges	1	1	N/A	N/A		1
1	Propeller	2	1	N/A	N/A		1.5
Ratings: 1 - Superior Condition 2 - Good Condition 3 - Acceptable Condition 4 - Poor Condition N/A - Not Applicable N/T - Not Tested				Average Operational Rating			1.1
				Operational Condition Rating			1
If Rating is revised then reason to be advised below.				Revised Operational Condition Rating			N/A

4.2 Overall Operational Condition Rating

4.2.1 To arrive at an overall operational condition rating for the propulsion and auxiliary machinery, fittings and systems the individual operational condition ratings awarded for each engine group are combined. An average operational condition rating is then computed and a final rating formulated.

4.2.2 The example described in Fig 2, shows the type of table which is normally used to show the ratings awarded to individual engine groups together with the overall operational condition rating awarded.

In this example the average rating is calculated as 1.6 which is then rounded upwards to an overall operational condition rating of 1.

5 CAP Rating Guidelines for Rating of Propulsion and Auxiliary Machinery, Fittings and Systems

5.1 General

5.1.1 The rating applied to an IUC visual condition, function test, vibration analysis, oil analysis and wastage (UTM) shall be an integer, either 1, 2, 3, or 4. If no rating can be given then a comment is required to be made e.g. N/F (not fitted), N/T (not tested) or N/A (not applicable), etc.

5.1.2 Each average rating calculated for an IUC, or an engine group or for the 'Propulsion and Auxiliary Machinery, Fittings and Systems' as a whole, is to be rounded to the nearest first decimal place e.g. an average of 1.24 is to be rounded down to 1.2, 1.26 is rounded up to 1.3 and special note 1.25 is rounded up to 1.3.

Figure 2 : Illustration of overall operation condition rating

Vessel Name	Vessel Type	Date of Build
Fmas Example	Tanker	1983
Class Society	Register No.	Deadweight
Bureau Veritas	88F9283	3000

Report indicates condition of Propulsion & Aux. Machinery, Fittings & Systems at Survey completion.

'Groups'	Operation Rating	Groups'	Operation Rating
01 Engine Room, Auxiliary Machinery Spaces and Engine Store Rooms:	2	12 Miscellaneous Equipment	2
02 Main Propulsion Installations	2	13 Communication, Order Transmission & Remote Control/Emergency Stops	1
03 Tailshaft, Stern Tube and Propeller Systems	1	14 Generators and Switchboards	2
04 Auxiliary Engines	2	15 Motors and Associated Starters	2
05 Oil Pumps and Purifiers	2	16 Electrical installations (others):	2
06 Fresh and Sea Water Pumps	2	17 Automated installation:	2
07 Compressors	2	18 Fire/Smoke/Gas Detection and Fire Fighting Systems:	1
08 Ventilation Fans	2	19 Environmental Management	1
09 Piping and valves	2	Other Groups (Please Insert Below)	
10 Boilers, Economisers and Thermal Oil Heaters	1		
11 Heat Exchangers (others):	1		

1 - Superior Condition	2 - Good Condition	Average Operational Rating	1.6
3 - Acceptable Condition	4 - Poor Condition	Overall Operational Condition Rating	2
N/S - Not Surveyed	N/A Not Applicable	Revised Overall Operational Condition Rating	N/A

5.1.3 The operational condition rating for each engine group, or for the overall operational condition rating for 'Propulsion and Auxiliary Machinery, Fittings and Systems' as a whole, is also assigned by rounding to the nearest integer, as above.

5.1.4 Where no function test or expected analysis are carried out for an IUC then the best average rating that can be applied to that specific IUC is a rating of 2, i.e. irrespective of the results of other tests/analyses a rating of 1 cannot be awarded for any item if a function test or an expected analysis is not carried out. Where no function test or expected analysis are carried out then this is to be highlighted in the PMR report.

5.1.5 Where no function test and expected analysis is carried out for any IUC, then the best average rating that can be applied to that specific IUC is a rating of 3. This is also to be highlighted in that engine group part of the PMR report.

5.1.6 Irrespective of the average rating calculated for an engine group, the rating awarded for that engine group as a whole, cannot be better than one rating grade better than the worst rating applied to an IUC for a function test or a required analysis (e.g. if one IUC is awarded a rating 3 for function test then the maximum rating that can be applied to that engine group is a rating of 2.) This is also to be highlighted in that 'Engine Group' as part of the PMR report.

5.1.7 If 'Propulsion and Auxiliary Machinery, Fittings and Systems' IUC's, that are critical to the safe operation of the vessel or for the safety of the crew, have been awarded a rating of 4, then the rating awarded for that engine group will also be a 4, except where the item is covered by redundancy and the secondary unit has a rating of 3 or better.

(Critical items are IUC's such as main engine, generators, fuel pumps, boilers, main cooling water pumps, lube oil pumps, fire alarm systems, fire fighting systems, etc.)

5.1.8 Where the operational condition for an individual engine group is awarded a rating of 4, then the overall operational condition for the 'Propulsion and Auxiliary Machinery, Fittings and Systems' as a whole is also awarded a rating of 4.

6 Global Rating for Maintenance

6.1 General

6.1.1 The global rating for maintenance for the propulsion and auxiliary machinery, fittings and systems is awarded based on the results of an audit of the vessel's planned maintenance system (PMS). The requirements for a PMS are reviewed and the scope of the audit of the PMS is discussed.

6.2 Scope of Audit

6.2.1 The surveyor will audit that part of the PMS system that covers the propulsion and auxiliary machinery, fittings and systems.

The audit is to cover the timely implementation, frequency, scope and results of the maintenance. Postponements and overdue items are to be included in the audit and reporting and follow-up actions are to be identified and reviewed.

6.3 Global Rating for Maintenance

6.3.1 The global rating for maintenance for the vessel's propulsion and auxiliary machinery, fittings and systems is awarded as per the criteria in Tab 8.

7 CAP Rating for Propulsion and Auxiliary Machinery, Fittings and Systems

7.1 Final Rating

7.1.1 As stated in [2], the CAP rating awarded for the vessel's propulsion machinery, fittings and systems is based on a comparison between the rating awarded for the overall operational condition and that awarded for the global rating for maintenance.

7.1.2 The finalised CAP rating for propulsion and auxiliary machinery, fittings and systems, shall be the worst of these rating values as the example in Tab 9.

Table 8 : Global Rating Criteria for Maintenance Criteria of Propulsion and Auxiliary Machinery, Fittings and Systems

Rating	Criteria
1	- Maintenance performed in a timely manner. Overdue or postponed items are few, have minor importance, do not affect class and they are documented. - No items postponed to dry dock unless the docking is imminent and these are planned in the repair specification. No items are subjected to class recommendations.
2	- Maintenance performed in a timely manner. Overdue or postponed items are few, have minor importance, do not affect class and they are documented. - Items postponed for docking are due within 3 months and are clearly planned in the repair specification. - No items are subjected to class recommendations.
3	- Maintenance performed generally in a timely manner with some overdue and postponed items not affecting class. - Items postponed for docking are due within 3 months and clearly planned in the repair specification. - Items are subjected to class recommendations but within the limited date.
4	- Maintenance generally performed with overdue items and postponed items some of which affect class. - Overdue Class recommendations.

Table 9 : Final CAP Ratings for Propulsion and Auxiliary Machinery, Fittings and Systems

Overall Operational Structural Rating	2
Global Rating for Maintenance	1
CAP RATING AWARDED FOR PROPULSION AND AUXILIARY MACHINERY, FITTINGS AND SYSTEMS	2

8 Reporting

8.1 Propulsion and Auxiliary Machinery, Fittings and Systems Report - with Photographs (PMR)

8.1.1 On the completion of the CAP Inland survey, the surveyor compiles a report for each Engine Group and IUC surveyed.

The report includes the table for compilation and computation of the overall operational condition rating to be awarded for propulsion and auxiliary machinery, fittings and systems and a set of individual engine group rating tables and reports, complete with photographic records of the surveys.

8.2 GAP Report

8.2.1 Should any IUC or component of an IUC be awarded a rating lower than the minimum rating expected by the client, then this is to be reported to the client using the GAP document.

APPENDIX 1 GUIDE FOR THICKNESS MEASUREMENTS

1 Definitions

1.1 Ballast tank

1.1.1 A ballast tank is a tank that is being primarily used for ballast water. A tank which is used for both cargo and ballast water will be treated as a ballast tank when substantial corrosion has been found in such tank, see [1.8].

1.2 Spaces

1.2.1 Spaces are separate compartments such as holds and tanks.

1.3 Overall survey

1.3.1 An overall survey is a survey intended to report on the overall condition of the hull structure and determine the extent of additional close-up surveys.

1.4 Close-up survey

1.4.1 A close-up survey is a survey where the details of structural components are within the close visual inspection range of the surveyor, i.e. normally within reach of hand.

1.5 Transverse section

1.5.1 A transverse section includes all longitudinal members contributing to longitudinal hull girder strength, such as plating, longitudinals and girders at the deck, side shell, bottom, inner bottom, longitudinal bulkheads, and plating in side tanks, as well as relevant longitudinals, as applicable for the different vessels. For a transversely framed vessel, a transverse section includes adjacent frames and their end connections in way of transverse sections.

1.6 Representative tanks or spaces

1.6.1 Representative tanks or spaces are those which are expected to reflect the condition of other tanks or spaces of similar type and service and with similar corrosion protection systems. When selecting representative tanks or spaces, the service and repair history on board and identifiable suspect areas should be taken into account.

1.7 Critical structural area

1.7.1 Critical structural areas are locations which have been identified from calculations to require monitoring, from the service history of the subject vessel or from similar vessels or sister vessels, if applicable, to be sensitive to cracking, buckling or corrosion which would impair the structural integrity of the vessel.

1.8 Substantial corrosion

1.8.1 Substantial corrosion is an extent of corrosion such that assessment of the corrosion pattern indicates a wastage in excess of 75% of allowable margins, but within acceptable limits.

1.9 Suspect areas

1.9.1 Suspect areas are locations showing substantial corrosion and/or are considered by the surveyor to be prone to rapid wastage.

1.10 Cargo area for vessels carrying liquid cargo in bulk

1.10.1 The cargo area is part of the vessel which contains cargo tanks, slop tanks and cargo/ballast pump rooms, cofferdams, ballast tanks and void spaces adjacent to cargo tanks and also deck areas throughout the entire length and breadth of the part of the vessel over the above-mentioned spaces.

2 Scope and extent of measurements

2.1 General

2.1.1 The thickness measurements required by the Rules consist of:

- systematic thickness measurements, i.e. measurements of different parts of the structure in order to assess the overall and local strength of the vessel
- measurements of suspect areas as defined in [1.9]
- additional measurements on areas determined as affected by substantial corrosion as defined in [1.8].

2.2 Number and location of measurements

2.2.1 Considering the extent of thickness measurements as indicated in [3], the locations of the points to be measured are given in App 3 for the most important items of the structure.

2.3 Extension of thickness measurement scope

2.3.1 The surveyor may extend the scope of the thickness measurement as deemed necessary. This applies especially to areas with substantial corrosion. When thickness measurements indicate substantial corrosion, as defined in [1.8] the number of thickness measurements is to be increased (see Tab 1), to determine the extent of substantial corrosion.

Table 1 : Guidance for additional thickness measurements in way of substantial corrosion areas

Structural member	Extent of measurements	Pattern of measurements
Plating	Suspect area and adjacent plates	7 point pattern over 1 square metre
Stiffeners	Suspect area	4 measurements each in line across web and flange

2.4 Transverse sections

2.4.1 Transverse sections shall be chosen where largest corrosion rates are suspected to occur or are revealed by deck plating measurements.

2.5 Ballast tanks

2.5.1 If applicable, in the case of major corrosion damages, the structural elements of ballast tanks are to be checked by thickness measurements.

2.6 Cargo system

2.6.1 Thickness measurements of piping and cargo collectors are to be taken.

2.7 Hull equipment

2.7.1 CAP Inland survey is to include the determination of the cross sectional areas of the anchor chain cables. The mean diameters of the anchor chain cables are to be determined by representative measurements, approximatively 3 links per length of 27,5 m, made at the ends of the links where the wear is the greatest. The weights of the anchors are to be checked in class renewal III and all subsequent class renewals.

3 Guidance for Thickness Measurements

3.1 Overall surveys

3.1.1 CAP Inland survey is to include an overall survey of all tanks and all spaces.

Thickness measurement of stainless steel hull structure and piping may be waived by the Society, except for clad steel plating.

The areas subject to overall surveys and thickness measurements are given in Tab 2 and Tab 3.

Locations of measurements for overall surveys are given in [4].

3.2 Close-up surveys

3.2.1 CAP Inland survey is to include a close-up examination of sufficient extent to establish the condition of cargo tanks and water ballast tanks. The areas subject to close-up surveys and thickness measurements are given in Tab 2 and Tab 3.

Table 2 : Scope and extent of thickness measurements - Tank vessels less than 15 years age

Tank vessel less than 15 years age	
SYSTEMATIC MEASUREMENTS	Substantial corrosion and suspect areas For additional thickness measurements in way of substantial corrosion and suspect areas, see [2.3].
	Within the cargo length area: • each deck plate • three transverse sections in two different tanks • each bottom / inner bottom plate • each side shell plate • at least 65% of transverse and longitudinal cargo tank bulkheads **(1)** • at least three points on each hatch cover and coaming plate to be taken either at each 1/4 extremity of plate or at representative areas of average corrosion **(1)**
	Outside the cargo length area, at least two points on one out of three plates, to be chosen on representative areas of average corrosion, for following items: • deck plates • side shell plates • bottom plates
	Collision bulkhead, forward machinery space bulkhead, aft peak bulkhead **(1)** **(2)**
	In engine room **(2)**: • river chests • river water manifold • duct keel or pipe tunnel plating and internals
	At least 30% within the cargo area and 15% outside the cargo area of internal structure such as ballast tanks, floors and longitudinals, transverse frames, web frames, deck beams, girders, etc. Measurements may be increased if the surveyor deems it necessary
CLOSE-UP SURVEYS	Within the cargo length area: • All web frames (complete transverse web frames ring including adjacent structural members) in all cargo and ballast tanks • All transverse bulkheads (transverse bulkhead complete, including girder system and adjacent structural members) in all cargo and ballast tanks
(1) Including plates and stiffeners. **(2)** Measurements may be waived or reduced after satisfactory visual examination, when such bulkheads form the boundaries of dry void spaces or river chests, etc. are found in good condition.	

Table 3 : Scope and extent of thickness measurements - Tank vessels with 15 years age and more

Tank vessels with 15 years age and more	
SYSTEMATIC MEASUREMENTS	Substantial corrosion and suspect areas For additional thickness measurements in way of substantial corrosion and suspect areas, see [2.3].
	Within the cargo length area: • each deck plate • four transverse sections in three different tanks **(1)** • each bottom / inner bottom plate • each side shell plate • at least three points on each plate of transverse and longitudinal cargo tank bulkheads **(2)** , to be taken either at each 1/4 extremity of plate or at representative areas of average corrosion • at least three points on each hatch cover and coaming plate to be taken either at each 1/4 extremity of plate or at representative areas of average corrosion **(2)**
	Outside the cargo length area: • each deck plate • each side shell plate • each bottom plate
	At least 65% of transverse and longitudinal bulkheads outside cargo length area **(2) (3)**
	In engine room **(3)**: • river chests • river water manifold • duct keel or pipe tunnel plating and internals
	At least 30% within the cargo area and 15% outside the cargo area of internal structure such as ballast tanks, floors and longitudinals, transverse frames, web frames, deck beams, girders, etc. Measurements may be increased if the Surveyor deems it necessary
CLOSE-UP SURVEYS	Within the cargo length area: • All web frames (complete transverse web frames ring including adjacent structural members) in all cargo and ballast tanks • All transverse bulkheads (transverse bulkhead complete, including girder system and adjacent structural members) in all cargo and ballast tanks

(1) The number of transverse sections may be reduced at the Surveyor's discretion for vessels of length under 40 m.

(2) Including plates and stiffeners.

(3) Measurements may be waived or reduced after satisfactory visual examination, when such bulkheads form the boundaries of dry void spaces or river chests, etc. are found in good condition.

4 Typical Areas for Thickness Measurements

4.1 Examples

4.1.1 Examples of typical areas for thickness measurements are listed below:

- Single hull tank vessels: See Fig 1and Fig 2
- Double hull tank vessel: See Fig 3 and Fig 4
- Double Hull Vessel Fitted with Independent Cargo Tank: See Fig 5
- Bulkheads: See Fig 6 to Fig 8
- Other Vessel Parts: See Fig 9.

Figure 1 : Locations of measurements on a transverse section of single hull vessel with integrated cargo tank (ordinary frame).

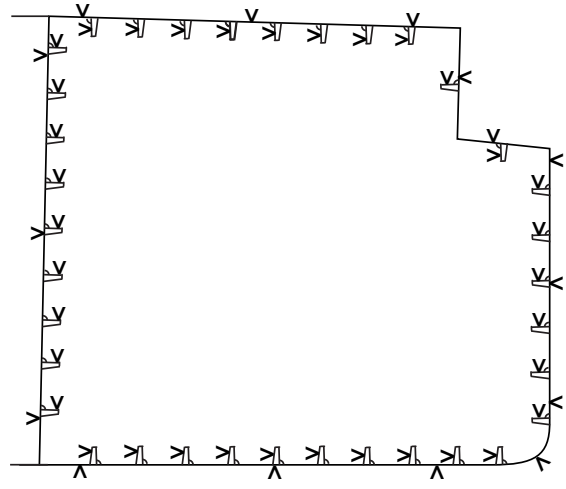


Figure 2 : Locations of measurements on a transverse section of single hull vessel with integrated cargo tank (web frame).

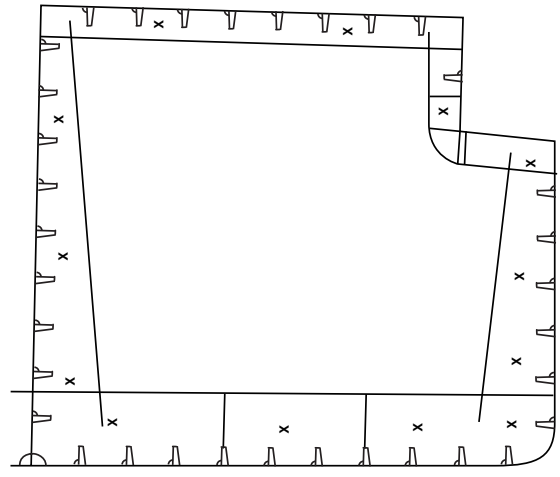


Figure 3 : Locations of measurements on a transverse section of double hull vessel with integrated cargo tank (ordinary frame)

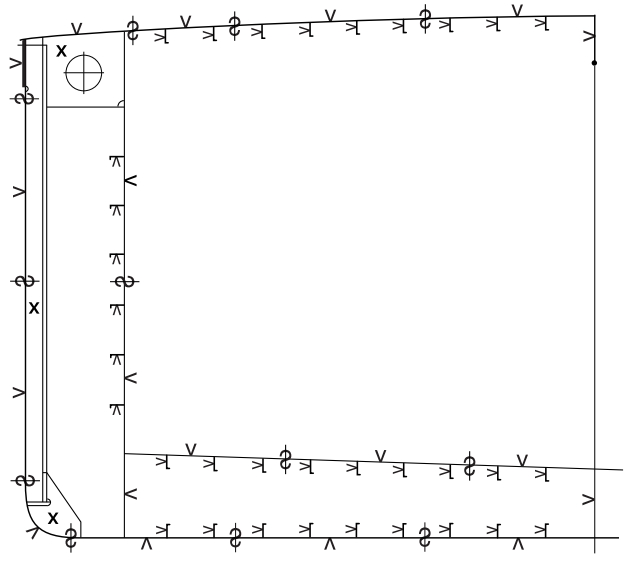


Figure 4 : Locations of measurements on a transverse section of double hull vessel with integrated cargo tank (web frame)

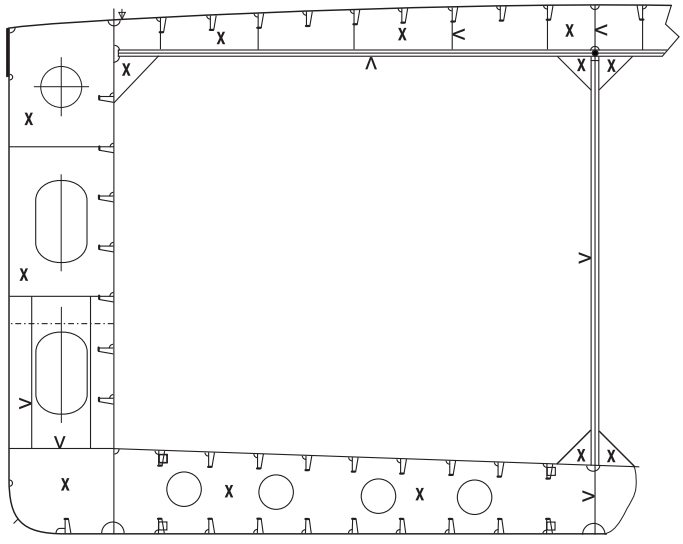


Figure 5 : Locations of measurements on transverse sections of an open deck double hull vessel with independent tank.

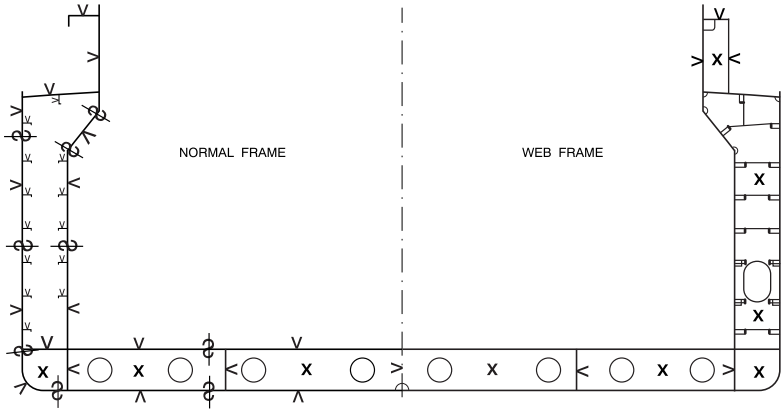


Figure 6 : Locations of measurements on a transverse corrugated bulkhead.

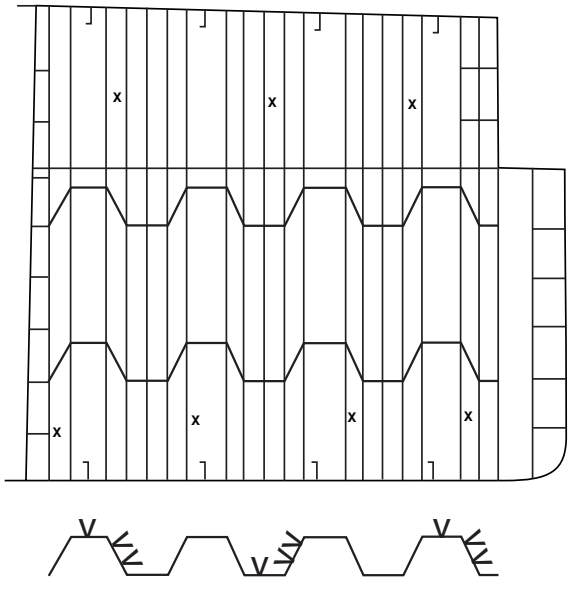


Figure 7 : Locations of measurements on a transverse corrugated bulkhead.

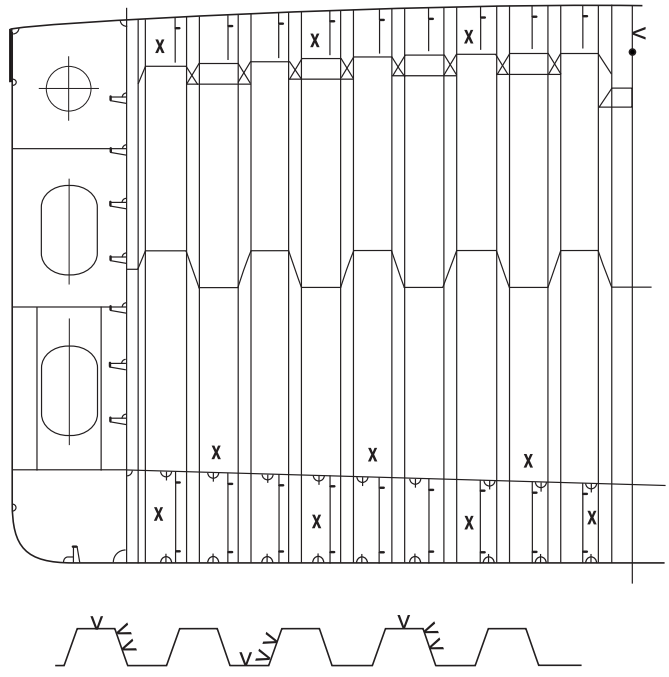


Figure 8 : Locations of measurements on a transverse plain bulkhead.

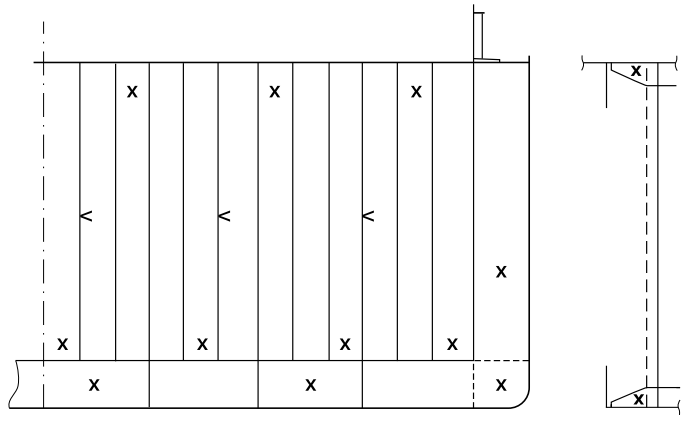
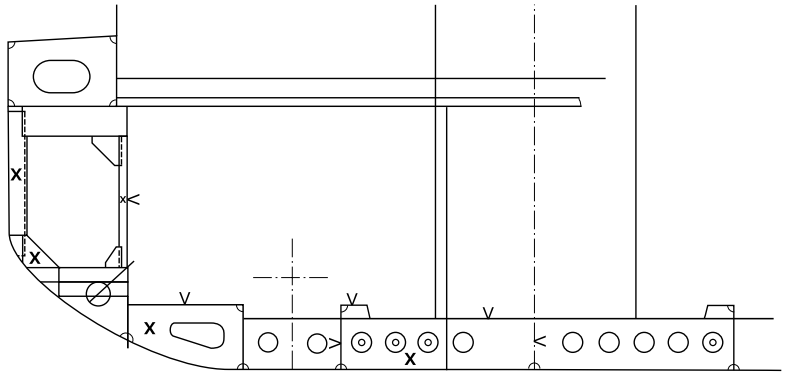


Figure 9 : Locations of measurements on aft vessel transverse section



5 Corrosion

5.1 Types of Corrosion

5.1.1 General Corrosion

General corrosion appears as non-protective, friable rust which can uniformly occur on tank internal surfaces that are uncoated (see Fig 10). The rust scale continually breaks off, exposing fresh metal to corrosive attack.

The anodic and cathodic areas on the same piece of steel change with time, so those areas that were once anodes become cathodes and vice versa. This process allows the formation of a relatively uniform corrosion of steel.

Figure 10 : Example of general corrosion

5.1.2 Pitting Corrosion

Pitting corrosion is one of the most common forms that can be noted in ballast tanks. It is a localised corrosion that occurs on bottom plating, other horizontal surfaces and at structural details that trap water, particularly the aft bays of tank bottoms (see Fig 11). For coated surfaces the attack produces deep and relatively small diameter pits that can lead to hull penetration (see Tab 4 and Fig 12).

Pitting of uncoated tanks, as it progresses, forms shallow but very wide scabby patches (e.g. 300m mm diameter); the appearance resembles a condition of general corrosion.

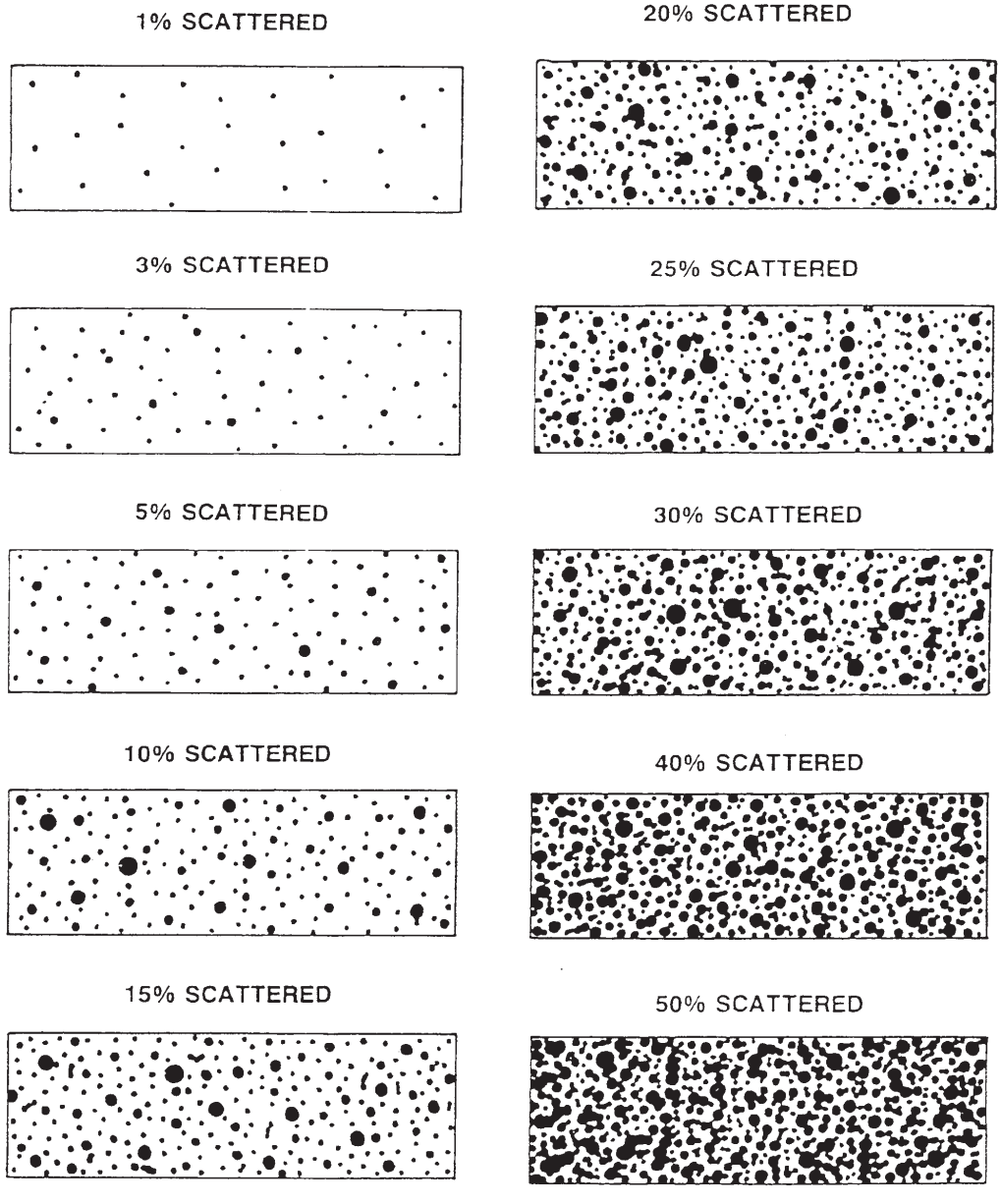
Pitting is caused by the action of a localised corrosion cell on a steel surface due to the breaking of the coating (if present), to the presence of contaminants or impurities on the steel (e.g. mill scale) or to impurities present in the steel.

Figure 11 : Example of pitting corrosion

Table 4 : Pitting Intensity and corresponding maximum average depth of pitting

Pitting Intensity %	Maximum Average Pitting Depth (% of as-built thickness)
Isolated	35
5	33.5
10	32.0
15	30.5
20	29.0
25	27.5
30	26
40	23
50	20

Figure 12 : Pitting intensity diagram (from 1% to 50% intensity)



5.1.3 Crevice Corrosion

Crevice corrosion is also a localised corrosion that appears as pitting. The most common case occurs in cracks and generally on steel surfaces covered by scales and deposits. Typical examples are vessel welding seams, pipe supports and bolts.

The phenomenon is due to the fact that a small area of steel (i.e. the crevice, the crack or the area covered by debris) lacks oxygen and becomes the anode of a corrosion cell, while the remaining free surface, abundantly oxygenated, becomes the cathode. Since the anodic area is very small compared to the cathodic one, the corrosion process is extremely fast.

5.1.4 Erosion Corrosion

Corrosion due to erosion occurs when abrasives (i.e. sand or mud) held in the sea water impinges, with a certain velocity, an existing corrosion cell. The abrasives remove the accumulation of corrosion products keeping the metal clean and the corrosion active.

Crude oil washing, or hot and cold seawater washing can be considered as a particular erosion corrosion form. The greasy or waxy layer that, covers the steel surfaces, act as a corrosion inhibitor is removed, together with corrosion product, by the washing process keeping the steel clean and the corrosion active.

5.1.5 Bacterial Corrosion

Bacterial corrosion, called Microbiologically influenced Corrosion (MIC) appears as scattered and/or localised pitting (See Fig 13).

MIC is a form of corrosion originated by the presence of microscopic one-celled living organism including bacteria, fungi and algae. The corrosive bacteria live in water layer on the bottom of cargo oil tanks as well as in the sediment of water ballast tank bottom. Sulphate Reducing Bacteria (SRB) and Acid Producing Bacteria (APB) are the two most important and well known groups of micro-organisms, which cause corrosion. SRB and APB live together with other species of bacteria in colonies on the steel surfaces helping each other to grow.

SRB's are anaerobic in nature and obtain their need of sulphur by a complex chemical reaction. During this reaction, the organism assimilates a small amount of sulphur, while the majority is released into the immediate environment as sulphide ions, which are hydrolysed as free H_2S. In this way, SRB gives rise to a corrosive process that supports the anodic dissolution of the steel. When bacteria have started to produce sulphide, the environmental condition becomes more favourable for growth, resulting in a population explosion.

APB's use the small quantity of oxygen of the water to metabolise hydrocarbons and produce organic acids such as propionic acid, acetic acid and other higher molecular acids. Since the APB's "consume" the residual oxygen present in the sediment, they produce, under the colonies, a suitable and ideal environment for the SRB's.

When active, the corrosion process originated by these bacteria can be extremely fast and can cause corrosion pits with a rate up to 1,5 – 3 mm per year, which is about five times higher than normally expected. Colonies of bacteria may appear like slimy black deposits on the steel surfaces.

5.1.6 Stress Corrosion

Steel subject to stress or fatigue can be affected by fractures, even small. These areas act as a crevice and, due to low aeration, will corrode as already described. Furthermore, a fracture can also cause micro cracking on the protective coating, giving rise to a very active corrosion cell.

Figure 13 : Example of steel surface affected by MIC

APPENDIX 2 GUIDE TO EVALUATION OF COATING CONDITION

1 General

1.1 Introduction

1.1.1 This appendix is developed to assist the surveyor to evaluate the condition of vessel structure protective coatings when performing CAP Inland surveys.

1.1.2 This appendix does not replace applicable rules, regulations, procedures and instructions. The contents of this Appendix is limited to referential information that surveyors may find useful in the course of their surveys, where access to more complete documents may be difficult.

2 Coating Condition

2.1 Ratings

2.1.1 The present definitions of coating conditions “GOOD”, “FAIR” and “POOR” are defined in the Society’s Rules. Tab 1 offers a clarification of these definitions in order to achieve unified assessment of coating conditions tabulated together with the equivalent CAP rating:

3 Critical Structural Area and Area Under Consideration

3.1 Critical Structural Area (CSA)

3.1.1 Definition

Critical structural areas are defined as locations which have been identified from calculations to require monitoring, from the service history of the subject vessel or from similar or sister ships (if available) to be sensitive to cracking, buckling or corrosion which would impair the structural integrity of the vessel.

Each CSA is to be closed-up surveyed during CAP surveys.

Table 1 : Coating Condition Rating Criteria

Rating	Description	Definition
1	GOOD	Condition with spot rusting is less than 3% of the area under consideration without visible failure of the coating. Rusting at edges or welds, must be less than 20% of edges or weld lines in the area under consideration.
2	FAIR	Condition with breakdown of coating or rust penetration is less than 20% of the area under consideration. Hard rust scale rust penetration must be less than 10% of the area under consideration. Rusting at edges or welds must be less than 50% of edges or weld lines in the area under consideration.
3	POOR	Condition with breakdown of coating or rust penetration is more than 20% or hard rust scale is more than 10% of the area under consideration or local breakdown concentrated at edges or welds is more than 50% of edges or weld lines in the area under consideration.
N/C	-	No protective coating fitted
N/A	-	Not applicable
Note 1: Soft Coatings or Semi Hard Coatings are not rated in the scope of this document. **Note 2:** Spot rusting is rusting in spots without visible failure of coating. **Note 3:** Blistering of coatings is identified as coating failure. (See [4] and [5] for information on blistering and for assessment ratings for coating blistering)		

3.2 Area Under Consideration (AUC)

3.2.1 Definition

The term Areas under Consideration is clarified in the context of Inland CAP surveys, as follows:

To facilitate the assessment of the vessel's structural condition, the vessel structure is broken down into sections such as external hull, main deck, tanks, holds, spaces, etc. Each section is then further subdivided into several subsections or elements which are small enough to be readily examined and evaluated by the surveyor, but not so small as to be structurally insignificant or too numerous to practically report on. These elements are termed Area(s) Under Consideration (AUC).

During close-up and overall surveys each AUC is individually assessed and given a rating for visual structure condition, for coatings condition and for wastage of structure. (Each AUC includes those structural items that are attached for stiffening or support e.g. longitudinals, brackets, etc.)

All individual AUC ratings are then combined to give a CAP rating for the specific vessel section being surveyed and reported upon.

A final CAP rating for the global hull structure is then computed by averaging the ratings attributed to the different surveyed sections of the hull structure.

3.2.2 Examples

Examples of some AUC's are given as follows:

- Main deck:
  As can be seen in Tab 2 the main deck of the vessel is broken-down into 6 Areas Under Consideration.
- Wing ballast tank:
  As can be seen in Tab 3 the tank is broken-down into 7 AUC's.
- Combined side and double bottom
  As can be seen in Tab 4 The tank is broken-down into 9 AUC's.
- Cargo tank:
  As can be seen in Tab 5 the tank is broken-down into 7 AUC's.

As shown in the example above there are no ratings given for the mid parts of the tanks. In this case the cargo tank is only partially coated from new. The top of the tank and the tank bottom are coated however the intermediate (middle) areas of the tanks are uncoated therefore the ratings are given as N/A in these areas.

In general, and no matter the shape of the vessel section, this method of tabulation of Areas Under Consideration (AUC) and collation of their ratings can be used.

Table 2 : Example of main deck AUC's

Areas Under Consideration for main deck	Coating Ratings
Foscle deck area	1
Deck forward of midships	1
Deck iwo midships	2
Deck aft midships	2
Deck iwo accommodation	1
Poop/sunken deck	2

Table 3 : Example of wing ballast tank AUC's

Areas Under Consideration for wing ballast tank	Coating Ratings
Under deck area	1
Forward bulkhead area	2
Aft bulkhead area	1
Longitudinal bulkhead area	2
Side shell area	1
Transverse web frames	2
Bottom area	2

Table 4 : Example of combined side and double bottom section AUC's

Areas Under Consideration for combined side and double bottom	Coating Ratings
Under deck area	1
Forward bulkhead area	2
Aft bulkhead area	1
Transverse webs	2
Side shell area	1
Tank top DB area	2
Longitudinal bulkhead, DB area	2
Longitudinal bulkhead, Side	1
Bottom area	1

Table 5 : Example of cargo tank AUC's

Areas Under Consideration for cargo tank	Coating Ratings
Under deck area	2
Forward bulkhead area	N/A
Aft bulkhead area	N/A
Transverse webs	N/A
Side shell area	N/A
Longitudinal bulkhead area	N/A
Bottom area	1

4 Types of Coating Failures

4.1 Cracking

4.1.1 Definition

Cracking of coating is defined as a break-down in which the cracks penetrate at least one layer and which may be expected to result ultimately in complete failure. Such cracks may result from:

- Over thicknesses of paint
- Plastic structure deformations exceeding the elongation properties of paint film
- Localised fatigue stress

Fig 1 shows photographic evidence of coating cracking:

Figure 1 : Example of coating cracking

4.2 Flaking

4.2.1 Definition

Flaking of coating is defined as the lifting of the paint from the underlying surface in the form of flakes or scales. The causes of a loss of adhesion may be the following ones:

- Unsatisfactory surface preparation,
- Incompatibility with underlayer
- Contamination between layers
- Excessive curing time between layers

Fig 2 shows photographic evidence of coating flaking.

Figure 2 : Example of coating flaking

4.3 Blistering

4.3.1 Definition

Blistering appears as a bubble formation scattered on the surface of a paint film with a diameter ranging from 3-4 mm to 20-30 mm. Blisters contain liquid, vapour or gas. Blistering is a localised loss of adhesion and lifting of the film, coming generally from osmosis due to one of the following causes:

- Solvent retention
- Improper coating application
- Soluble salt contamination under the paint film due to insufficient cleaning of the surface

4.3.2 Examples

It is to be noted that in most cases there is no corrosion in an unbroken blister and many years of protection can be obtained if these blisters are left untouched.

Due to a heavy overlap coating and poor workmanship, blisters have often been observed.

Blisters have sometimes been observed on flat plates and often are observed on areas of structure where access causes difficulties for painters to work on, such as the back of face plates e.g. Longitudinals, webs, etc.

Blisters is designated as coating failure (although Tab 6 shows that the blistered coating is still protecting the steelwork after 20 years.) The coating condition in the photo is in the transition stage between FAIR/POOR, but could still be designated as fair condition.

Although blistering of coating implies a coating failure this may not mean that these coatings are failing to provide protection to the steel surface. Blistering may be a coating failure, but may not mean a complete coating breakdown.

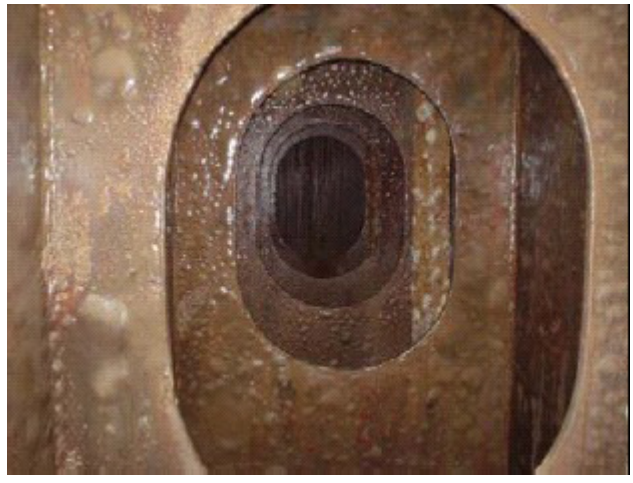
However, where blisters are burst, (e.g. exposing shop primer or rusting of the substrate) then in these areas this is a coating breakdown.

Table 6 : Examples of coating blistering

a) Coating blistering on flat plate after 5 years

b) Coating blistering after 8 years

c) Intact coating blistering after 20 years



4.3.3 Guideline for Assessment of Blistering

Tab 7 takes into consideration actual breakdown of the coating which allows the formation of rust.

This guideline should be read in conjunction with the information and definitions tabulated in [2].

Table 7 : Coating Condition Rating for Assessment of Blistering

Rating	Description	Definition
1	GOOD	Blistering is 20% or less in the area under consideration with spot rusting is less than 3% of the AUC and rusting at edges or welds must be less than 20% of edges or weld lines.
2	FAIR	Blistering is more than 20% of the AUC with rust penetration is less than 20% in the area under consideration. Hard rust scale rust penetration must be less than 10% of the AUC. Rusting at edges or welds must be less than 50% of edges or weld lines in the AUC.
3	POOR	Blistering is more than 20% of the AUC with rust penetration is more than 20% at the AUC, or hard rust scale is more than 10% of the AUC or, rusting at edges is more than 50% of edges or weld lines in the area under consideration.

5 Pictorial ISO Standards for Coatings

5.1 General Principles and Rating Schemes

5.1.1 The standards given in this article are ISO standards and are given for reference purposes only. The ratings given within these tables are NOT only CAP ratings but are ISO standard ratings (ISO 4628 Evaluation of degradation of paint coatings.)

5.1.2 Tab 8, Tab 9 and Tab 10 show ISO rating scheme tables of coatings

Table 8 : Intensity of deterioration rating criteria

Rating	Intensity of change
0	Unchanged, i.e. no perceptible change
1	Very Slight, i.e. just perceptible change
2	Slight, i.e. clearly perceptible change
3	Moderate, i.e. very clearly perceptible change
4	Considerable, i.e. pronounced change
5	Severe, i.e. intense change

Table 9 : Quantity of defects rating criteria

Rating	Quantity of Change (Relative to a test area of 1 to 2 dm^2)
0	None, i.e. no detectable defect
1	Very Few, i.e. some just significant defects
2	Few, i.e. small but significant amount of defects
3	Moderate, i.e. medium amount of defects
4	Considerable, i.e. serious amount of defects
5	Dense, i.e. dense pattern of defects

Table 10 : Size of defects rating criteria

Rating	Size of Defects
0	Not visible under x 10 magnification
1	Only visible under magnification up to x 10
2	Just visible with Normal Corrected Vision (NCV)
3	Clearly visible with NCV (up to 0,5 mm)
4	Clearly visible with NCV (0,5 to 5 mm)
5	Clearly visible with NCV (> 5 mm)

5.2 Designation of Degree of Blistering

5.2.1 Size and density of blistering defined in Tab 11.

5.3 Designation of Degree of Rusting

5.3.1 Degree of rusting is determined by the percentage of the area affected (see Tab 12). Fig 3 shows pictorial examples of degree of rusting.

5.4 Designation of Degree for Cracking

5.4.1 Degree of cracking is designated by the percentage of the area affected (see Tab 13). Fig 4 shows the degree of cracking determined.

5.5 Designation of Degree of Flaking

5.5.1 Degree of flaking is designated by the percentage of area affected or the size of flakes (see Tab 14).

Fig 5 shows different degree of flaked area according to flaking density.

Table 11 : Degree of blistering

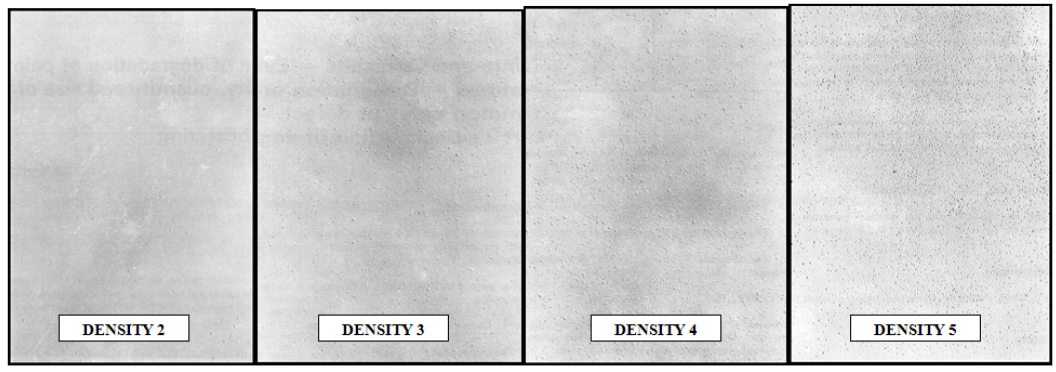
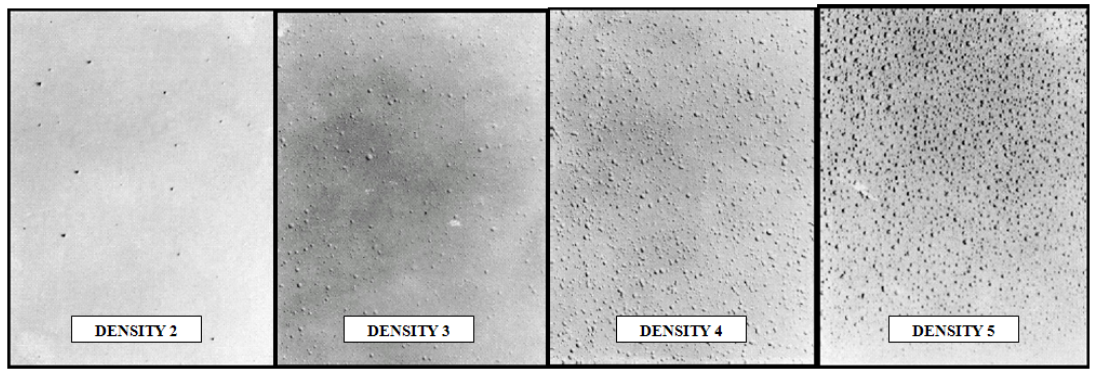
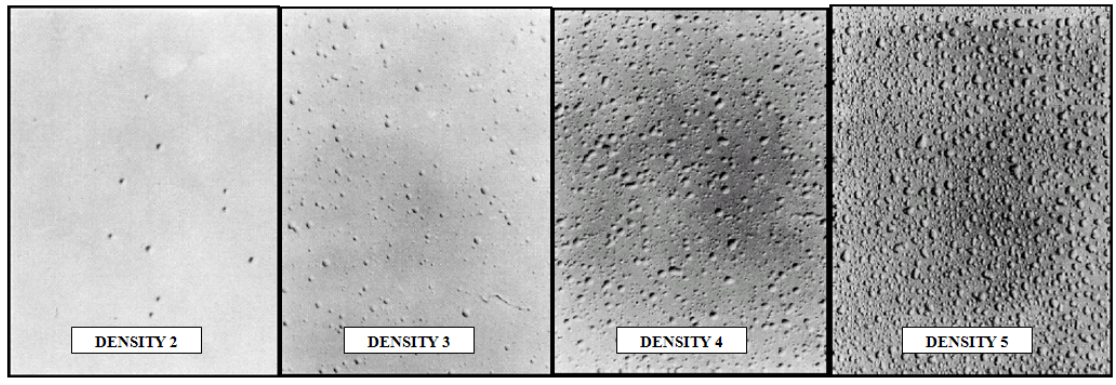
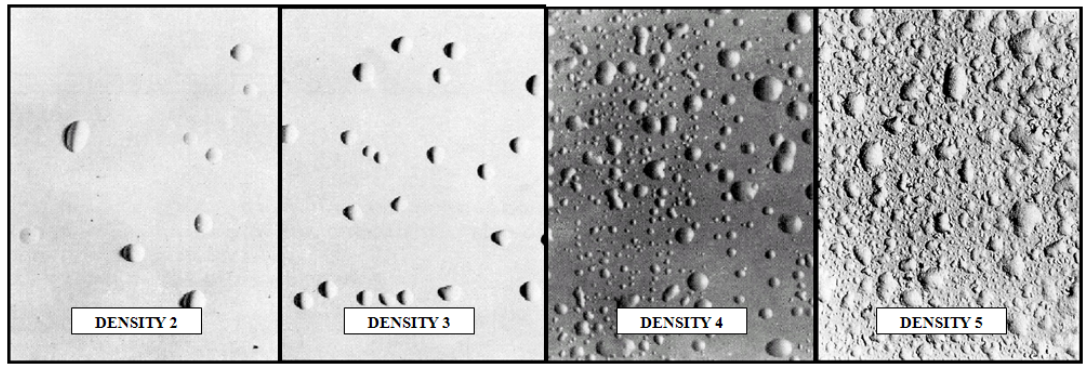
Size 2	
Size 3	
Size 4	
Size 5	

Table 12 : Rusting degree criteria

Degree	% Area
Ri 0	0
Ri 1	0.05
Ri 2	0.5
Ri 3	1
Ri 4	8
Ri 5	40/50

Figure 3 : Different density degree of rusting

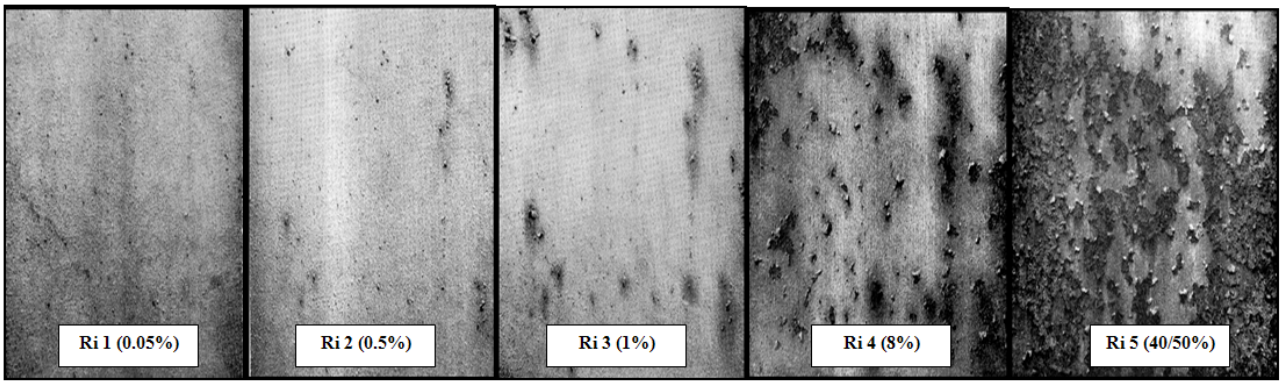


Table 13 : Cracking degree criteria

Degree	% Area
0	Not visible under x10 magnification
1	Only visible under magnification up to x 10
2	Just visible with normal corrected vision
3	Clearly visible with normal corrected vision
4	Large cracks generally up to 1 mm wide
5	Very large cracks greater than 1 mm wide

Figure 4 : Degree of cracking

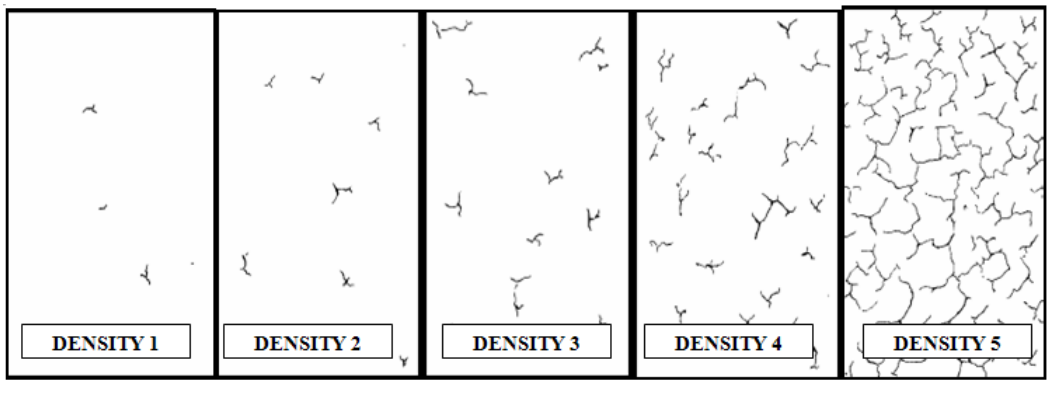
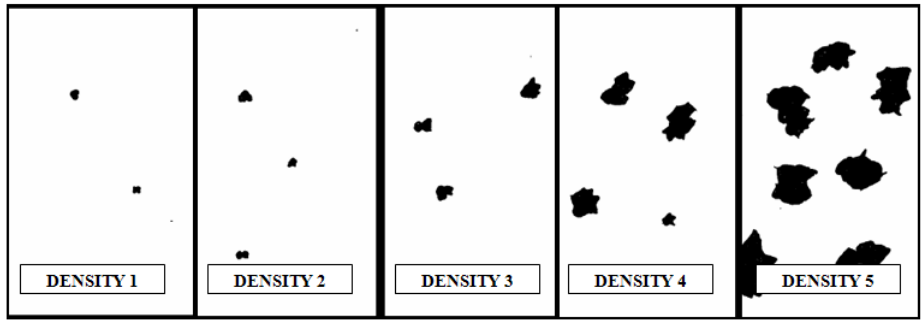


Table 14 : Degree of flaking regarding percentage of area affected or size of flakes

Rating	% Area	Size of Flaking
0	0	Not visible under x 10 magnification
1	0.1	Up to 1 mm
2	0.3	Up to 3 mm
3	1	Up to 10 mm
4	3	Up to 30 mm
5	15	Larger than 30 mm

Figure 5 : Density degree of flaking



6 Examples of Coating Assessment

6.1 General

6.1.1 The present Article [6] contains photographs of coatings breakdown allowing to define equivalence between the coatings conditions GOOD, FAIR, POOR and equivalent CAP Ratings 1, 2 or 3:

- Tab 15 shows examples of coating condition assessment for CAP 1
- Tab 16 shows examples of coating condition assessment for CAP 2
- Tab 17 shows examples of coating condition assessment for CAP 3.

Fig 6 is shown as reference to evaluate examples in Tab 15 to Tab 17.

Figure 6 : Assessment of coating breakdown

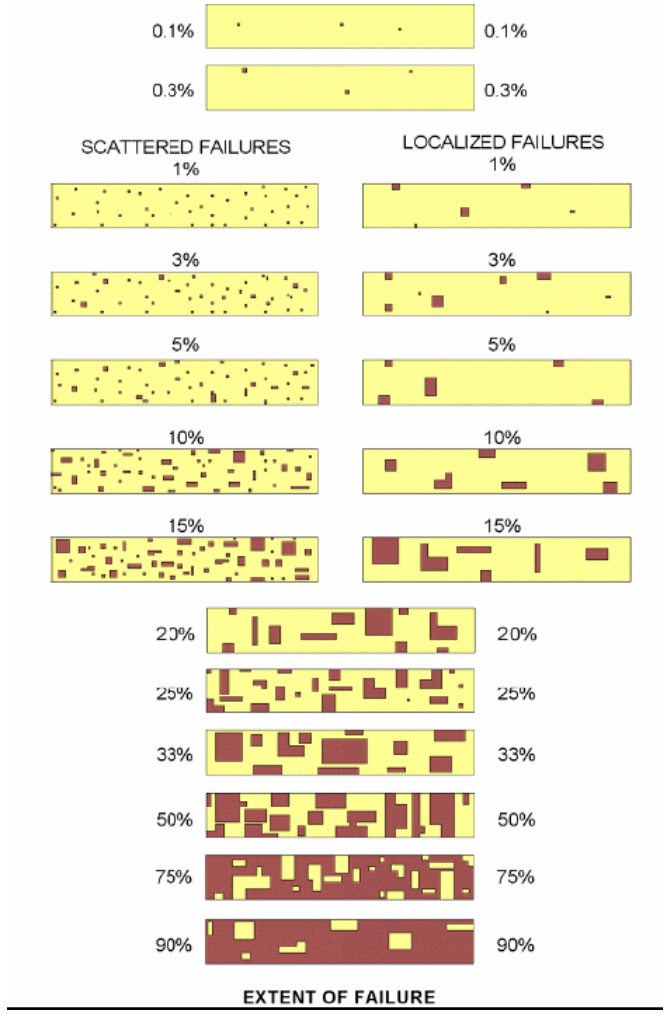
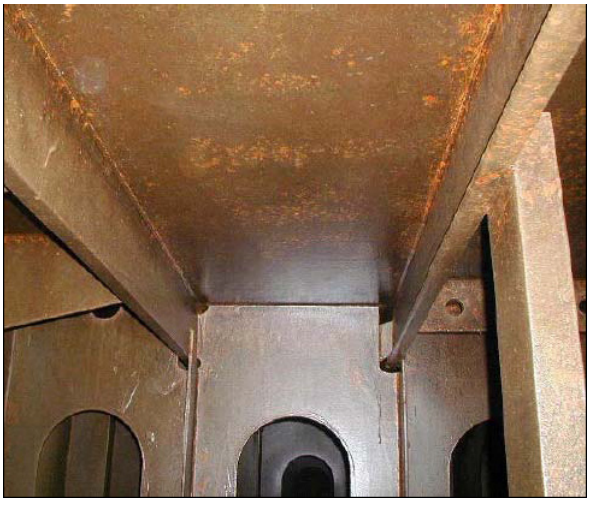


Table 15 : Examples of Coating Condition Assessment for CAP 1

<table>
<tr>
<td>Example 1
Analysis:
• Spot rusting: Scattered 1%
• Spot rusting: On edges and weld lines
• Localised corrosion: Less than 5%
Coating condition: GOOD condition
CAP Rating = 1
  </td>
<td>Example 2
Analysis:
• Spot rusting: Scattered less than 1%
• Localised corrosion: Local to coating breakdown 3%
• Area of hard rust scale: None
Coating condition: GOOD condition
CAP Rating = 1
  </td>
</tr>
<tr>
<td>Example 3
Analysis:
• Spot rusting: Scattered less than 1%
• Localised corrosion: Local to coating breakdown 3% on edges and weld lines of less than 5%
• Area of hard rust scale: None
Coating condition: GOOD condition
CAP Rating = 1
  </td>
<td>Example 4
Analysis:
• Spot rusting: Scattered less than 3%
• Localised corrosion: Local to coating breakdown on flat plates, edges and weld lines of less than 10%
• Area of hard rust scale: None
Coating condition: GOOD condition
CAP Rating = 1
  </td>
</tr>
</table>

Example 5

Analysis:

- Spot rusting: Scattered just less than 3%
- Localised corrosion: Local to coating breakdown on flat plates, edges and weld lines of less than 20%
- Area of hard rust scale: Just forming on deck longitudinals.
- This is in transition phase from POOR to Fair but Overall it is still in GOOD condition

Coating condition: GOOD condition

CAP Rating = 1

Table 16 : Examples of Coating Condition Assessment for CAP 2

Example 1

Analysis:

- Breakdown of coating/area rusted: Localised 15 - 20%.
- Local breakdown of coating or rust on edges or weld lines: 30 - 40%
- Area of hard rust scale is less than 10% or rusted area.
- Coatings FAIR for longitudinals close to bottom, however remaining surface is GOOD. Overall condition of coating is FAIR.

Coating condition: FAIR condition

CAP Rating = 2

Example 2

Analysis:

- Breakdown of coating/area rusted: Localised less than 10%.
- Local breakdown of coating, rust of edges and weld lines: around 10 - 15%
- Area of hard rust scale is less than 1%

Coating condition: FAIR condition

CAP Rating = 2

Example 3

Analysis:

- Breakdown of coating/area rusted: General 15 - 20%
- Local breakdown of coating, rust of edges and weld lines: Less than 50%
- Area of hard rust scale is less than 10%

Coating condition: FAIR condition

CAP Rating = 2

Example 4

Analysis:

- Breakdown of coating/area rusted: General about 20%
- Local breakdown of coating, rust of edges and weld lines: Localised 30 - 40%
- Area of hard rust scale is less than 3%
- This is a transition from FAIR to POOR but Overall it is still in FAIR condition.

Coating condition: FAIR condition

CAP Rating = 2

Example 5

Analysis:

- Breakdown of coating/area rusted: General about 20%
- Local breakdown of coating, rust of edges and weld lines: Localised 40 - 50%
- Area of hard rust scale is less than 5%
- This is a transition from FAIR to POOR but Overall it is still in FAIR condition.

Coating condition: FAIR condition

CAP Rating = 2

Table 17 : Examples of Coating Condition Assessment for CAP 3

Example 1

Analysis:

- Breakdown of coating/area rusted: Approximately 30%
- Local breakdown of coating, rust of edges and weld lines: Localised 30 - 40%
- Area of hard rust scale is less than 10%

Coating condition: POOR condition

CAP Rating = 3

Example 2

Analysis:

- Breakdown of coating/area rusted: General about 20%
- Local breakdown of coating, rust of edges and weld lines: Localised greater than 50%
- No sign of coating repairs
- This is a transition from FAIR to POOR but Overall it is still in POOR condition.

Coating condition: POOR condition

CAP Rating = 3

Example 3

Analysis:

- Breakdown of coating/area rusted: General over 30%
- Local breakdown of coating, rust of edges and weld lines: Greater than 50%
- Area of hard rust scale is less than 10%

Coating condition: POOR condition

CAP Rating = 3

Example 4

Analysis:

- Breakdown of coating/area rusted: General over 20% , significantly greater in way of bottom longitudinals.
- Local breakdown of coating, rust of edges and weld lines: About 50 - 60% iwo bottom longitudinals and less than 40% of the area under consideration
- Area of hard rust scale is more than 5%

Coating condition: POOR condition

CAP Rating = 3

Example 5 Analysis: • Breakdown of coating/area rusted: General over 30% • Local breakdown of coating, rust of edges and weld lines: Greater than 50% • Area of hard rust scale is more than 20% • No sign of coating repairs Coating condition: POOR condition CAP Rating = 3	

7 Definitions of Standard Terms

7.1

7.1.1 Tab 18 lists definitions of standard terms.

Table 18 : Definitions of standard terms

Term	Definition
Adhesion	The bonding strength; the attraction of a coating to the substrate.
Ageing	Progressive degradation of a coating in the long run.
Air Entrapment	The inclusion of air bubbles in liquid paint or a paint film.
Ambient temperature	The room temperature or temperature of surroundings.
Anode	The corroding part of an electrochemical corrosion cell such as sacrificial anode or impressed current anode. The electrode at which corrosion occurs.
Anticorrosive	Generic term defining paint used to protect metals from corrosion.
Bleeding	The appearance of a coloured substance on a newly painted surface from a previously painted substrate.
Blistering	Bubbling in coating films normally caused by osmosis.
Block Holding Primer (BHP)	Primer applied at block stage to reduce the amount of insitu secondary surface preparation. Not a pre-construction primer.
Blushing	Development of a milky appearance on a coating surface during drying process caused by humidity and/or from the precipitation of one or more solid components of the paint.
Breakdown of coating	Defects in the coatings like rust penetration, blistering, flaking and cracking.
Brittle failure	Cracking and/or other failure normally encountered with hard, low ductility glassy objects and films.
Brittleness	Degree of resistance to cracking or breaking by bending. Lack of resistance to cracking or breaking when bending
Bubbling	Coating defect, temporary or permanent, in which small bubbles of air or solvent or both are present in the applied film.
Cathode	The electrode at which corrosion does not usually occur.
Cathodic Protection	Corrosion prevention by sacrificial anodes or impressed current.
Checking	Defect with surface cracking and crocodiling.
Coating Breakdown	Failure of the coatings due to defects or mechanical damage.

Term	Definition
Coating system	A number of coats separately applied, in a predetermined order, at suitable intervals to allow for drying and curing, resulting in a completed job.
Coating, Lining	Terms used to define various products that are applied on steel to protect it from corrosion and/or to decorate it.
Coatings	Surface coverings; paints; barriers.
Cohesion	Property of holding together of a single material.
Compatibility	Attitude of a paint to be applied on another already dry coating.
Corrosion	Decay; oxidation; deterioration due to interaction with environment.
Corrosion prevention/protection system	A system designed to protect the substrate from corrosion.
Cracking of coating	Defect with fracture in the coating in at least one coat, often down to the substrate. Related expression is checking, which is surface cracking and crocodilling.
Corrosion rate	The rate usually in mm/year, at which the corrosion process proceeds.
Curtaining	Special form of sagging by which the film appears locally with high thickness and with flakes similar to drape curtains.
DFT	Dry film thickness.
Discoloration	Colour change of a coating after application, normally caused by exposure to sunlight or chemical atmospheres.
Dulling or Tarnishing	Loss of gloss of a coating.
Edging	Striping.
Enamel	A finish coat of paint that shows a smooth, gloss surface after drying.
Epoxy amine	Amine cured epoxy resin.
Epoxy resins	Film formers (binders) usually made from bisphenol-A and epichlorohydrin, resins containing the oxyrane ring.
Erosion	Gradual and irregular destruction of coating surface caused by a mechanical or also by a chemical-physical action.
Film integrity	Degree of continuity of film.
Film thickness	The thickness of a coating layer or a multilayer coating system. Minimum and maximum values are the only relevant numbers when dealing with corrosion protection.
Film	A layer of coating material applied on a surface. The film just applied, before evaporation of the solvents is called “wet film”; the dry paint film, after solvent evaporation, “dry film”.
Finish	Term used to define indifferently the final coat in a paint system or the general aspect of a painted surface after drying.
Flaking	Detachment of a coating from the surface, in the form of flakes.
Flooding-Floating	Differentiated separation of pigments on a coating surface
Galvanic corrosion	Corrosion of dissimilar metals in electrical contact.
Galvanising	Anticorrosive system which consists in dipping a steel structure, into melted zinc at a temperature of approximately 450°C.
Galvanized steel	Zinc plated steel applied in a molten bath of zinc.
General corrosion	Evenly distributed corrosion attack on steel surface.
Glazing	Coat intentionally applied with a small thickness.
Gloss	Aptitude of a surface to reflect the light in certain conditions.
Hard coating	A coating which chemically converts during its curing process. Hard coating can be either inorganic or organic. All conventional paints are included in this definition, e.g. epoxy, polyurethane, zinc silicate, vinyl, etc.
Osmosis	Transfer of liquid through a paint film or other membrane as the result of a solute/solvent couple.

Term	Definition
Osmotic blistering	Formation of blisters containing liquid through osmosis.
Product Data Sheet	Document published by paint manufacturer in which product characteristics, the method to use, instructions for application and storage are indicated.
Protective life	(also called useful life) Interval of time during which a paint system protects substrate from deterioration.
Paint system	The complete number and type of coats comprising a paint job. In a broader sense, surface preparation, pre-treatments, dry film thickness, and manner of application are included in the definition of a paint system.
Peeling	Disbonding of particles of a coating from substrate in the form of strips, due to loss of adhesion.
Pigments	Insoluble coloured particles dispersed in a coating material in order to define appearance, structure and functionality of the final film.
Pinholes	Presence of small holes in a coating that are formed during application or drying.
Pitting	Cavity in a metallic surface, due to localised corrosion.
Prime coat	First coat. preventive maintenance painting: Spot repair painting; touch-up or full coats of paint before rusting starts.
Primer	General term used to define the first coat of a paint system applied to provide adhesion and/or corrosion protection.
Repainting	Repetition of a complete painting operation including surface preparation.
Roller Application	Hand application of a coat of paint using an absorbing roller on a surface.
Sacrificial anode	Anode made from less noble metal than steel in the galvanic series, (usually zinc or aluminium). When immersed, the anode protects the steel by coming into solution.
Sags	Runs
Scattered breakdown of coating	Various kinds of evenly distributed defects in the coatings like rust penetration, blistering, flaking and cracking.
Semi-hard coating	Coating that, after drying, remain flexible and hard enough to be touched and walked upon without damaging them and that are not affected by water erosion during de-ballasting operations.
Service life	Interval of time during which a paint system protects substrate from deterioration.
Shop primer	An inexpensive, rust inhibiting primer designed to protect steel from general weathering immediately after plate fabrication and before final coating processes.
Soft coating	Defined as coatings that does not dry, but remain permanently soft.
Solvent entrapment	The encapsulation of solvent within a cured paint film.
Spontaneous degradation	Coating degradation that is controlled and directed internally: self-acting: developing without apparent external influence, force, cause, or treatment.
Spot repair	Preventive repainting of small areas.
Spot rusting	Rusting in spot without visible failure of coating.
Stripe Coating	Painting method used before a general coat on positions (weld, back, edge, corner etc.) where it is not easy to achieve the final thickness with the simple airless spray application.
Striping	Edge, weld, scallop painting prior to priming.
Substrate	Surface to be painted; in this context carbon steel, stainless steel, galvanized steel and all surfaces that can affect the corrosion rate or can corrode.
Touch-up painting	Spot repair painting usually conducted a few months after initial painting. Also, manual painting to correct thickness deficiencies.
Varnish, Lacquer	Non-pigmented coating material.
Wrinkling	Coating defect due to a non-homogeneous solidification of the paint film with wrinkling of the surface coat.
Zinc silicate	Inorganic zinc coating.

APPENDIX 3 REFERENCE CORROSION ADDITIONS

1 Net scantling approach

1.1 General

1.1.1 The scantlings obtained by applying the criteria specified in these Rules are net scantlings, i.e. those which provide the strength characteristics required to sustain the loads, excluding any addition for corrosion. Exceptions are the scantlings of:

- rudder structures and hull appendages in NR217 Rules for Inland Vessels, Pt B, Ch 7, Sec1
- massive pieces made of steel forgings, steel castings or iron castings

1.1.2 The required strength characteristics are:

- thickness, for plating including that which constitutes primary supporting members
- section modulus, shear sectional area, moments of inertia and local thickness, for ordinary stiffeners and, as the case may be, primary supporting members
- section modulus, moments of inertia and single moment for the hull girder.

1.1.3 The vessel is to be built at least with the gross scantlings obtained by reversing the procedure described in NR217 Rules for Inland Vessels, Pt B, Ch 2, Sec 5, [2.1].

2 Hull Structural Elements

2.1 Large Surfaces

2.1.1 The reference corrosion additions for large-surfaces (plate and web of profiles) are to be determined according [2.1.2] or [2.1.3], as applicable.

2.1.2 Reference Corrosion additions for steel other than stainless steel

The corrosion addition for each of the two sides of a structural member, t_{C1} or t_{C2}, is specified in Tab 1.

- for plating with a gross thickness greater than 10 mm, the total corrosion addition t_C, in mm, for both sides of the structural member is obtained by the following formula:

  $t_C = t_{C1} + t_{C2}$

- for plating with a gross thickness less than or equal to 10 mm, the smallest of the following values:
  - 20% of the gross thickness of the plating
  - $t_C = t_{C1} + t_{C2}$

For an internal member within a given compartment, the total corrosion addition t_C is to be determined as follows, where t_{C1} is the value of the corrosion addition specified in Tab 1 for one side exposure to that compartment:

- for plating/stiffener plating with a gross thickness greater than 10 mm, the total corrosion addition t_C, in mm, is twice the value of t_{C1}:

  $t_C = 2\ t_{C1}$

- for plating/stiffener plating with a gross thickness less than or equal to 10 mm, the smallest of the following values:
  - 20% of the gross thickness of the plating / stiffener plating
  - $t_C = 2\ t_{C1}$

Table 1 : Corrosion additions, in mm, for one side exposure (t_{C1} or t_{C2})

Compartment type		Corrosion addition (1)
Ballast tank		1,00
Cargo tank and fuel oil tank	Plating of horizontal surfaces	0,75
	Plating of non-horizontal surfaces	0,50
	Ordinary stiffeners and primary supporting members	0,75
Accommodation space		0,00
Compartments and areas other than those mentioned above		0,50
(1) Corrosion additions are applicable to all members of the considered item.		

2.1.3 Corrosion additions for stainless steel and aluminium alloys

For structural members made of stainless steel or aluminium alloys, the corrosion addition is to be taken equal to 0,25 mm, for one side exposure ($t_{C1} = t_{C2} = 0,25$ mm)

2.2 Isolated Areas

2.2.1 The reference corrosion additions to be considered for isolated areas are 1,25 t_C, where t_C is the value of corrosion addition to be determined according to [2.1].

2.3 Pits

2.3.1 Beyond the calculated corrosion additions t_C, and at the Surveyor's discretion, a maximum permissible locally limited reduction of thickness for isolated pits of 0,35, respectively of 0,2 times the as-built thickness for 50% scattered pits, may be accepted.

3 Other Equipment

3.1 Cargo system

3.1.1 The reference corrosion additions for large-surfaces of piping are defined in Tab 2 in relation with piping material and nature of media conveyed.

3.2 Anchor equipment

3.2.1 The reference corrosion addition for chain links is to be taken equal to 12% of its gross diameter.

The reference corrosion addition for anchors is to be taken equal to 10% its gross weight.

Table 2 : Reference corrosion additions for cargo system

Piping material	Reference Corrosion Addition
Steel pipes	
Cargo system for oil tankers	20%
Cargo systems for vessels carrying liquefied gases	0,3 mm
Non-ferrous metal pipes (1) (2)	
Copper	0,8 mm
Brass	0,8 mm
Copper-tin alloys	0,8 mm
Copper -nickel alloys <10% Ni	0,8 mm
Copper -nickel alloys ≥10% Ni	0,5 mm
Aluminium and aluminium alloys	0,5 mm
(1) The reference corrosion addition for other materials will be specially considered by the Society	
(2) In cases of media with high corrosive action, the reference corrosion addition may be defined by special considerations of the Society.	