GUIDE FOR ULTRASONIC THICKNESS MEASUREMENTS
OF SHIPS CLASSED WITH DET NORSKE VERITAS

APRIL 2009
FOREWORD

DET NORSKE VERITAS (DNV) is an autonomous and independent foundation with the objectives of safeguarding life, property and the environment, at sea and onshore. DNV undertakes classification, certification, and other verification and consultancy services relating to quality of ships, offshore units and installations, and onshore industries worldwide, and carries out research in relation to these functions.

Guidelines

Guidelines are publications which give information and advice on technical and formal matters related to the design, building, operating, maintenance and repair of vessels and other objects, as well as the services rendered by the Society in this connection. Aspects concerning classification may be included in the publication.

An updated list of Guidelines is available on request. The list is also given in the latest edition of Pt.0 Ch.1 of the "Rules for Classification of Ships" and the "Rules for Classification of High Speed, Light Craft and Naval Surface Craft".

The Society reserves the exclusive right to interpret, decide equivalence or make exemptions to this Guideline.

Amendments and Corrections

This document is valid until superseded by a new revision. Minor amendments and corrections will be published in a separate document normally updated twice per year (April and October).

For a complete listing of the changes, see the “Amendments and Corrections” document located at: http://webshop.dnv.com/global/, under category “Guidelines and Classification Notes”.

The electronic web-versions of the DNV Guidelines will be regularly updated to include these amendments and corrections.
This issue replaces the previous dated June 2005.

Main changes
- References, organizational as well as technical, throughout the document are updated.
- A new Section 6 is introduced, replacing the previous.
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1. Objective and applicability

This guideline is prepared by Det Norske Veritas for ship owners, operators, yards and service suppliers approved for thickness measurements of ship's structure, in order to facilitate cooperation through a common understanding of the procedures for UTM (ultrasonic thickness measurements) at Class Surveys. CAP is not covered by this guideline. A separate UTM specification for CAP may be downloaded at: http://cap.dnv.com.

This guideline applies to all types of steel ships classed with DNV.

Figure 1-1
Steel plates in the deck being replaced after UTM. Evenly corroded steel plates might look perfectly acceptable even at close-up distance. Thus, thickness measurements are an essential part of class surveys.

If you have any comments or questions to this guideline, please send an e-mail to: MGG893@dnv.com.

2. Terms and abbreviations

See also the Rules for Classification of Ships Pt.7 Ch.1 Sec.1 A100 for additional definitions.

Pro. No.402 Requirements forming the basis for accepting a service supplier to do ultrasonic thickness measurements onboard steel ships for class. Included in Appendix B.

Conditions Conditions are issued to ship owners by class, in order to impose improvements, additional surveys or other actions to ensure compliance with rule requirements.

CA A condition on behalf of a flag state (CA): Constitutes specific measures, repairs or surveys that shall be carried out within a specific time limit in order to retain the statutory certificate.

A CA will be issued only when the Society has been authorised to carry out a statutory surveys on behalf of the flag administration. (See the Rules for Classification of Ships Pt.1. Ch.1 A208).

CAP Condition Assessment Program. Voluntary hull condition survey, where a ship's hull, machinery or piping system is given one of the following ratings; 1 - Very good condition, 2 - Good condition, 3 - Satisfactory condition or 4 - Poor condition (below acceptable class standard).

CAS Condition Assessment Scheme. Increased survey/reporting scope, where the classification society will send a hull condition report to the flag state for their acceptance to let the ship continue trading. Applies to single skin tankers >15 years on their first intermediate or renewal survey after 5th of April 2005.

Category I Service suppliers approved to do thickness measurements for class onboard all DNV steel ships.

Category II Service suppliers approved to do thickness measurements for DNV onboard fishing vessels of all sizes and non-ESP ships below 500 GT.

Category II Extended Service suppliers approved to do thickness measurements for DNV onboard fishing vessels of all sizes and non-ESP ships of less than 100 m length, except general cargo ships above 500 GT (with MO Ref. 129).

CC Condition of Class: Constitutes a requirement that specific measures, repairs or surveys shall be carried out within a specific time limit in order to retain class. (See also the Rules for Classification of Ships Pt.1. Ch.1 Sec.1 A207 and Pt.1 Ch.1 Sec.3 B300).

C.N.72.1 Classification Notes. No.72.1 "Allowable Thickness Diminution for Hull Structure" ESP Enhanced Survey Program. Requirements for planning, execution and reporting for hull surveys of oil/chemical tankers, obo and bulk carriers.

Excessive corrosion An extent of corrosion that exceeds the allowable limit, so that steel must be replaced. Ref. Figure 2-1.

Extensive corrosion An extent of corrosion consisting of hard and/or loose scale, including pitting, over 70% or more of the area under consideration, accompanied by evidence of thickness diminution.

Figure 2-1
Extent of corrosion

Minimum thickness list List of minimum acceptable thickness values for the structural parts of a ship. An individual list will be made by DNV for each and every ship which is to be measured.

MGG Maritime Global Governance.
3. A few basics

1) All thickness measurements done onboard DNV ships, where the results are used by the class surveyor to evaluate the strength, shall be done by a DNV approved service supplier with a valid DNV certificate.

2) Thickness measurements done for class, as described in point 1, shall be done with a DNV surveyor onboard.

3) DNV have specific requirements to access and cleaning to be prepared for close-up surveys combined with UTM (See Sec.4.3 and 4.4). Access and cleaning is owner's responsibility.

4) Prior to every major thickness measurement project onboard, such as for intermediate or renewal survey, a meeting between DNV, the service supplier and the owner shall be held. If a thickness measurement project is divided up in separate smaller UTM jobs, a new meeting shall be held prior to each job.

5) Only multiple echo instruments may be used for UTM onboard all ships. This applies for both Category I and Category II UTM companies.

6) The Category I service suppliers shall provide two operators for all major thickness measurement jobs (Intermediate Survey and Renewal Survey) done onboard ships. For a definition of Category I and Category II companies, see Sec.2.

7) All operators in Category I companies doing measurements onboard DNV ships shall be qualified and registered at the certifying DNV station. They shall be able to communicate in English and to understand ship's main hull drawings. If subcontractors are used, they shall be subcontracted from another DNV certified company. Otherwise the operators will be rejected. For a definition of Category I and Category II companies, see Sec.2.

8) The surveyor onboard shall be kept continuously informed about discovered areas with under minimum thickness, and other structural defects such as cracks, grooving and buckling.

9) Based on the test results, it is up to the surveyors discretion to order additional measurements.

10) After 1st of January 2005, a DNV electronic reporting form shall be used for all the thickness measurement reports made by Category I UTM companies. The form can be downloaded from DNV's website at: http://www.dnv.com/industry-maritime/servicesolutions/consulting/technicalconsulting/cap.asp under "Downloads".

4. Procedure for class surveys and thickness measurements onboard ships

See the Rules for Classification of Ships Pt.7 Ch.1 Sec.3 B.

4.1 DNV surveyor to be onboard

A DNV surveyor shall be onboard, to the extent he or she finds necessary to control the process, when thickness measurements are done for class. Measurements which have not been carried out in co-operation with DNV can not be accepted. The UTM company shall inform the owner accordingly. See the Rules for Classification of Ships Pt.7 Ch.1 Sec.1 B200. This applies to all steel ships where the measurements will make the basis for the surveyor's decisions during class surveys. Thickness measurements which per our rules are required in connection with close-up examination (such as web frames and transverse bulkheads), shall always be taken with the surveyor in attendance.

When onboard the operator/supervisor shall have his certificate and identification papers readily available for verification. The operator shall notify the DNV surveyor of any structural deficiencies, such as cracks, indents, buckling or abnormal measurements detected.

4.2 Kick-off meeting

The Rules for Classification of Ships require a meeting for planning of the thickness measurements, including Owners representative, UTM company and DNV. See the Rules for Classification of Ships Pt.7 Ch.1 Sec.1 B104. See Appendix A for an agenda/Minutes of Meeting form to be used for these meetings. The meeting shall clarify initial scope of close-up examination and thickness measurements.

At the meeting, unless requested earlier, the surveyor will hand over the minimum thickness list. For ESP ships it may be found in the Survey Programme. The minimum thickness list is individual for each and every ship, and shall always be made by DNV. Upon receiving the minimum thickness list, the UTM operators shall enter the minimum thickness values into the UTM report template, prior to commencing thickness measurements, in order to facilitate the evaluation of the results on a day by day basis onboard.

4.3 Requirements to cleaning

Cleaning is the owner's responsibility. The Owners should ensure that efficient means for de-scaling is available at the survey, i.e. hydro or sandblasting equipment. When satisfactory de-scaling may not be arranged, the surveyor will only be able to provide a preliminary specification of necessary upgrading, without crediting the tank. A new survey will be carried out after de-scaling, additional thickness measurements may be required and the scope of repairs extended.
Figure 4-1
Optimal conditions for inspection: Grit blasted, dry and clean, with all sediments, loose coating and rust flakes removed. Thickness reductions and cracks are easily spotted with the naked eye.

Figure 4-2
What is sometimes presented for inspection: No cleaning whatsoever. Two men have been sent along to “hack away loose scale where needed”. This is not acceptable according to our rules, and the inspection should be rejected by the surveyor.

Please note that the Rules for Classification of Ships do have requirements to the cleanliness during surveys:

See the Rules for Classification of Ships Pt.7 Ch.1 Sec.1 B101:
“In preparation for survey and to allow for a thorough examination, all spaces and areas shall be cleaned including removal from surfaces of all loose accumulated corrosion scale. In tanks where soft coatings have been applied, representative areas, and those areas where it is obvious that further close-up examination is required, shall be cleaned free of soft coating.”

Guidance note:
Spaces should be sufficiently clean and free from water, scale, dirt, oil residues etc. to reveal corrosion, deformation, fractures, damage, or other structural deterioration. However, those areas of structure whose renewal has already been decided by the owner need only be cleaned and de-scaled to the extent necessary to determine the limits of the renewed areas. For more detailed information with regard to a tank where soft coatings have been applied, see IACS Recommendation No. 44.

Ref. IACS Unified Requirements Z7 Ch.5.1.3:
“In preparation for survey and thickness measurements, and to allow for a thorough examination, all spaces 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 structure whose renewal has already been decided by the owner need only be cleaned and de-scaled to the extent necessary to determine the limits of the renewed areas.”
4.4 Means of access

Access is the owner's responsibility.

See the Rules for Classification of Ships Pt.7 Ch.1 Sec.1 B102: "All spaces shall be made safe for access i.e. gas freed, ventilated and illuminated, and prepared for the surveyor to examine the structure in a safe and practical way. One or more of the following means for access, acceptable to the surveyor shall be provided:

— permanent staging and passages through structures
— temporary staging and passages through structures
— lifts and moveable platforms
— boats or rafts
— portable ladders
— other equivalent means."

If the depth of the webs is more than 1.5 m, rafts or boats alone may be allowed only:

a) When the coating of the under deck structure is in GOOD condition and there is no evidence of wastage; or
b) If a permanent means of access is provided in each bay to allow safe entry and exit. This means:

— access directly from deck via a vertical ladder and a small platform fitted approximately 2 m below the deck in each bay, or
— access to deck from a longitudinal permanent platform having ladders to deck in each end of the tank. The platform shall, for full length of the tank, be arranged in level with, or above, the maximum water level needed for rafting of under deck structure. For this purpose, the ullage corresponding to the maximum water level is to be assumed not more than 3 m from deck plate measured at the midspan of deck transverse and in the middle length of the tank.

If neither of the above conditions are met, then staging or "other equivalent means" of access shall be provided for the survey of the under deck areas."

The use of rafts or boats alone does not preclude the use of boats or rafts to move about within the tank during a survey.

Note:
Reference is made to IACS Recommendation No. 39 - Guide lines for the use of Boats or Rafts for close-up survey.

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Use of remote technique methods to facilitate the required internal examinations, including close-up examinations and thickness measurements, may be specially considered by the Society. The methods applied shall provide the information normally obtained from a survey carried out by the surveyor. In order to verify the results, confirmatory close-up examinations and thickness measurements at selected locations shall be carried out by the surveyor, not using the remote inspection technique method. Proposals for use of remote inspection technique methods shall be submitted to Society for acceptance in advance of the survey.

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One example of "other equivalent means" may be to use temporary, portable staging fitted between the flanges of two web frames, with partial filling of the tank (with a water level well
4.5 Execution of the Thickness Measurements on board.

Prior to commencing the thickness measurements, the surveyor will:

- Check type of equipment and verify that the equipment is calibrated according to recognized national / international standards and properly labelled.
- Witness calibration appropriate for size and type of material.
- Be satisfied with operator’s competence and documentation.

The operators shall keep the equipment and required certificates ready for inspection at commencement of measurements. For requirements to equipment and operators, see Sec.5.

The surveyor will direct the gauging operation by selecting locations such that readings taken represent, on average, the condition of the structure for that area.

Thickness measurements mainly to evaluate the extent of corrosion which may affect the hull girder strength (transverse sections), should be carried out in a systematic manner of all longitudinal, structural members. See Sec.7 for a figure showing correct pattern. The surveyor should be in attendance during this process. The location of the sections longitudinally shall be decided by the surveyor, and will normally be decided after deck and bottom plating has been measured, where required, in order to determine which areas have corroded the most. The sections should be placed where the upper and lower plating has corroded the most. One transverse section will normally be placed amidship.

Thickness measurements of structures in areas where close-up surveys are required should be carried out simultaneously with the close-up surveys in order to facilitate a meaningful survey. The surveyor may specially consider the extent of thickness measurements of certain structures, within spaces where the protective coating is found to be in GOOD condition, but there are restrictions to how much of the measurements may be reduced. In any case, clarify with the surveyor in each case.

The thickness measurement operators shall keep the surveyor continuously informed (e.g. at the end of each day of measurements) about measurement results and structural deficiencies found, such as excessive or substantial corrosion, cracks, indentstions or buckling. If doubler plates used as repairs are discovered inside oil tanks or on oil/water boundary plating or stiffeners, this shall also be informed to the surveyor.

Where thickness measurements indicate substantial corrosion or excessive diminution, the UTM company shall contact the DNV surveyor onboard in order to get directions for additional thickness measurements, in order to map the areas of substantial corrosion, and to identify structural members for repairs / renewals. The Rules for Classification of Ships Pt.7 Ch.1 Sec.4 D. (Tables of Close-Up Examinations and Thickness Measurements) and Appendix C of this document contain tables detailing how such areas shall be mapped.

Upon completion of the thickness measurements, the surveyor shall have confirmed that no further gauging is needed, before the job of taking measurements can be regarded as completed. The rule requirements detailed in Sec.6 are always to be considered the minimum scope for thickness measurements.

Upon completion of the thickness measurements onboard, the surveyor shall verify the preliminary thickness measurement report. The preliminary report should be kept until the final report has been verified and signed. For Category I ships a copy of the preliminary report shall be given to the attending surveyor or before leaving the ship.

See also 4.6 for reporting procedures.

4.6 Reporting

Procedures for reporting are given in DNV's "Standards for Certification" No. 2.9, Programme No.402A: "Approval of Firms Engaged in Ultrasonic Thickness Measurements of Ship's Structure". There are two different procedures, one for Category I ships and one for Category II. Which version which will apply for a particular UTM job, is depending on date of survey and ship type, and detailed in the first part of Sec.5.

For Category II/ Category II, Extended types of ships, the UTM report shall be the latest version of the electronic report form that can be found on: http://www.dnv.com/industry/maritime/publicationsanddownloads/downloads/index.asp, and "shall include a copy of the certificate of approval" for the UTM company. The front page should also inform about date and place of measurements, number of pages in the report and which company did the measurements. The front page should be stamped and signed by the DNV surveyor. In addition, a minimum thickness list shall be attached to the UTM report if the min. thickness values used are not included in the report itself.

Category I type of ships require the UTM company to write its reports using a standardised DNV format, available on the DNV web site at cap.dnv.com under "Downloads". The format is the same as the one being used by CAP and CAS.
Prior to commencement, the UTM company shall enter the original thickness and minimum thickness values for the structural parts to be measured into the report format. All these values will be stated in the minimum thickness list, which shall be prepared by DNV. The report shall also inform which parts of the structure has been replaced, and it should include a clear indication of which transverse sections have been measured, when applicable. The report shall be prepared onboard, with measurements being filled in on a daily basis, and made available for the surveyor upon request.

Upon completion of the measurements onboard, a digital copy of the preliminary report, with all measurements entered, shall be given to the attending surveyor before the UTM company leave the ship. Sketches showing the location of measurement points shall also be given to the surveyor, but need not be digital.

Final report shall be sent to DNV no later than 2 weeks after the measurements are finished. The final report shall consist of one digital copy and one paper copy or digital copy in non-editable form (e.g. a.pdf file). Content of the paper copy or the non-editable digital copy should be as for the preliminary report, with integrated sketches showing measurement points, but in addition it shall contain a front page with a stamp and signature from the operator and the attending surveyor. The front page shall inform about date and place of measurements, number of pages in the report and which company did the measurements. An example is given in Appendix D.

See Appendix E for a guide on how to calculate average corrosion in deck and bottom, where this is demanded by the surveyor.

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5. Requirements to the UTM company

UTM shall be carried out by an approved UTM company and with a DNV Surveyor present. The company shall have a valid DNV certificate, authorising the company to do measurements onboard the ship type in question (ref. below). The category of the company will be stated in the company’s certificate.

The requirements used as basis for certification of a UTM company, is given in "Standards for Certification" No. 2.9, Approval Programme No.402A, "Approval of Firms Engaged in Ultrasonic Thickness Measurements of Ship’s Structure". A reference to the program is found in Appendix B.

Some of the most important, requirements specific for Category I companies are given below:

1) Instruments using pulsed echo technique, either with oscilloscope or digital instruments using multiple echo are required. A confirmation from the manufacturer that the instruments satisfy this requirement shall be enclosed with the instrument record. This is the only new requirement which will apply to both Category I and Category II companies after January 2005. IACS UR Z17 Annex 1 (Section 1.4).

2) Each major class job (Intermediate Survey and Renewal Survey) is to be carried out by at least two qualified oper-
ators working together. Operators shall carry ID cards with a photo. An updated list of approved operators shall be kept at the approving DNV office, so that qualifications can be verified by attending surveyor. Readings taken by non-listed operators will be rejected. Subcontractors shall not be used, unless they come from another DNV certified company. Operators shall be able to speak English, understand ship’s drawings and be able to choose a representative position for each measurement.

3) For work procedures and reporting, see Sec.4.5 and 4.6.

Some main requirements for Category II/ Category II, Extended companies (Standards for Certification - No. 2.9 Approval programme No. 402 A):

— A record of the equipment used for thickness measurement shall be kept. The record shall contain information on maintenance and calibration. (After January 2005 multiple echo instruments must be used by both Category I and Category II companies).

— The supplier shall keep records of the approved operators. The record shall contain information on age, formal education, training and experience.

— The operator carrying out the measurements shall be certified to EN 473 Level I, ISO 9712 Level I or a corresponding standard and have passed the internal training scheme of the supplier.

— For work procedures and reporting, see Sec.4.5 and 4.6.

6. Extent of thickness measurements

The rule requirements to the extent of thickness measurements for ships are specified in the Rules for Classification of Ships Pt.7 Ch.1 Sec.4 Tables D. Each table will correspond to one specific ship type. All illustrations are given in Sec.6.1 to 6.15. The requirements vary with ship type, age and survey type, and may generally be divided in three groups:

1) Thickness measurements including requirements of shell plating and transverse sections, to help evaluate the overall strength of the ship. The requirements cannot be waived due to GOOD coating, but the extent of measurement points may be reduced to some extent. What may be reduced shall always be decided by the surveyor, who may also decide to increase the scope based on findings onboard. The requirements are given in Sec.6.1, 6.3, 6.5, 6.7, 6.9, 6.11, 6.13 and 6.15 below, depending on ship type. Measurement pattern (number of measurement points per structural part) is described in Sec.7.

2) Measurements for assessment of corrosion level i.w.o. close-up inspections. A guideline for initial extent of measurements is given in Sec.6.2, 6.4, 6.6, 6.8, 6.10, 6.12 and 6.14 below, pending on ship type. The requirements may be reduced in case original coating is in GOOD condition, to be decided by the surveyor. The surveyor may also decide to increase the scope based on findings onboard. Measurement pattern (number of measurement points per structural part) is described in Sec.7.

3) Mapping of areas found with Substantial Corrosion Areas found with Substantial Corrosion, as defined in the Rules for Classification of Ships Pt.7 Ch.1 Sec.1 A116, at previous surveys or through the measurements described in 1 and 2, should be subject to intensive measurements. The required measurement pattern is thoroughly defined in the Rules for Classification of Ships Pt.7 Ch.1 Sec.4 D.
6.1 All ships - Minimum thickness measurements

See the Rules for Classification of Ships for Classification of Ships Ch.1 Sec.4 Table D.

The following pictures are only to be used as guidelines. It is the relevant Rules for Classification of Ships that give the exact requirements.

<table>
<thead>
<tr>
<th>Renewal survey No.1</th>
<th>Age ≤ 5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suspect areas only.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Renewal Survey no.2</th>
<th>Age 5 - 10 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main deck plating.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Renewal Survey no.3</th>
<th>Age 10 - 15 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transverse sections in way of cargo area within 0.5 L amidship.</td>
<td></td>
</tr>
</tbody>
</table>

| Cargo hold hatch covers and coamings (plating and stiffeners). |
Internals in peak tank. All air pipes and ventilators

*Renewal Survey no.4*
*Age 15 > years*

Transverse sections in way of cargo area within 0.5 L amidship.

Main deck plating.

Hatch covers and coamings (plates and stiffeners).
Wind- and water strakes.

Strakes of transverse bulkheads in cargo spaces together with internals in way.

Keel plates and bottom plates.  Plating of sea chests and shell plating in way of overboard discharges.
Superstructure deck plating (poop, bridge and forecastle deck).

Internals of forepeak and aft peak tank

Air pipes and ventilators.
6.2 General dry cargo ships – Measurements i.w.o. close-up inspections

See the Rules for Classification of Ships Ch.1 Sec.4 Table D. The following pictures are only to be used as guidelines. It is the relevant Rules for Classification of Ships that give the exact requirements.

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<td>Cargo hold hatch covers and coamings (plating and stiffeners).</td>
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| Cargo hold transverse shell frames. |
| Cargo hold transverse bulkheads- plating, stiffeners and girders. |

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</tbody>
</table>
Deck plating and under deck structure inside line of hatch openings between cargo hold hatches.

Cargo hold transverse shell frames.

Cargo hold transverse bulkheads- plating, stiffeners and girders.

Ballast tanks transverse bulkheads, including stiffening system.

Ballast tanks transverse web frames with associated plating and frames.

Inner bottom plating.
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</tr>
<tr>
<td>Cargo hold transverse shell frames.</td>
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<td>Cargo hold transverse bulkheads- plating, stiffeners and girders.</td>
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<td>Ballast tanks transverse bulkheads, including stiffening system.</td>
</tr>
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<td>Ballast tanks transverse web frames with associated plating and frames.</td>
</tr>
<tr>
<td>Inner bottom plating.</td>
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</table>
6.3 General dry cargo ships - Minimum thickness measurements

See the Rules for Classification of Ships Pt.7 Ch.1 Sec.4 Table D. The following pictures are only to be used as guidelines. It is the relevant Rules for Classification of Ships that give the exact requirements.

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<tr>
<th>Renewal Survey no.3</th>
<th>Age 10 - 15 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transverse Sections in way of cargo area within 0.5 L amidship.</td>
<td></td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Main deck plating – and wind and water strakes.</td>
<td></td>
</tr>
</tbody>
</table>
Internals in forepeak tank.

All air pipes and ventilators on the fore deck (forward 25% of ship’s length),
All air pipes to day tanks and selected air pipes and ventilator coamings aft of forward 25% of the ship’s length.

Renewal Survey no. 4
Age 15+ years

Three complete sections.

Main deck plating.

All wind- and water strakes, port and starboard - full length.
All keel plates full length.
All bottom plates.

Duct keel and pipe tunnel.

Superstructure deck plating (poop, bridge and forecastle deck).

Internals of forepeak and aft peak tank

Plating of sea chests. Shell plating in way of overboard discharges as considered necessary by the attending surveyor.

All – on the fore deck (forward quarter length). All air pipes to day tanks. Selected air pipes and ventilator coamings aft of the forward quarter.
6.4 Single skin bulk carriers ESP - Measurements i.w.o. close-up inspections

See the Rules for Classification of Ships Pt.7 Ch.1 Sec.4 Table D. The following pictures are only to be used as guidelines. It is the relevant Rules for Classification of Ships that give the exact requirements.

Renewal Survey no.1
Age ≤ 5 years

Cargo hold hatch covers and coamings (plating and stiffeners).

Cargo hold transverse shell frames

Cargo hold transverse bulkheads – plating, stiffeners and girders, including internal structures of upper and lower stools, where fitted.
Ballast tanks transverse web frames with associated plating and longitudinals.

*Renewal Survey no. 2*
*Age 5 - 10 years*

Cargo hold hatch covers and coamings (plating and stiffeners).

Deck plating and the structure under the deck inside line of hatch openings between cargo holds hatches.
Cargo hold transverse shell frames

Cargo hold transverse bulkheads – plating, stiffeners and girders, including internal structures of upper and lower stools, where fitted.

Ballast tanks transverse bulkheads, including stiffening system.

Ballast tanks transverse web frames with associated plating and longitudinals.
Cargo hold hatch covers and coamings (plating and stiffeners).

Deck plating and the structure under deck inside line of hatch openings between cargo holds hatches.

Cargo hold transverse shell frames

Cargo hold transverse bulkheads – plating, stiffeners and girders, including internal structures of upper and lower stools, where fitted.
Ballast tanks transverse bulkheads, including stiffening system.

Ballast tanks transverse web frames with associated plating and longitudinals.

Cargo hold hatch covers and coamings (plating and stiffeners).

Deck plating and the structure under deck inside line of hatch openings between cargo holds hatches.
6.5 Single skin bulk carriers ESP - Minimum thickness measurements

See the Rules for Classification of Ships Pt.7 Ch.1 Sec.4 Table D. The following pictures are only to be used as guidelines. It is the relevant Rules for Classification of Ships that give the exact requirements.

<table>
<thead>
<tr>
<th>Renewal Survey no.1</th>
<th>Age ≤ 5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural members subjected to close-up examination according to the Rules for Classification of Ships.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Renewal Survey no.2</th>
<th>Age 5 – 10 years</th>
</tr>
</thead>
</table>

Transverse section within cargo area.
Wind- and water strakes.
Vertically corrugated transverse bulkhead between cargo hold no. 1 and 2.

Side shell frames and brackets.

Transverse sections in way of cargo area within 0.5 L amidship.

Main deck plating – and wind and water strakes.
Internals in peak tanks.

All air pipes and ventilators on the fore deck (forward 25% of ship’s length),
All air pipes to day tanks and selected air pipes and ventilator coamings aft of forward 25% of the ship’s length.

Vertically corrugated transverse bulkhead between cargo hold no. 1 and 2.

Side shell frames and brackets.
Transverse sections within the cargo area.

Main deck plating.

Wind- and water strakes.

Keel plates and bottom plates.

Duct keel and pipe tunnel.

Superstructure deck plating (poop, bridge and forecastle deck).
Internals of forepeak and aft peak tank

Sea chests and shell plating in way of overboard discharges.

Vertically corrugated transverse bulkhead between cargo hold no. 1 and 2.
6.6 Double skin bulk carriers ESP - i.w.o. close-up inspections

See the Rules for Classification of Ships Pt.7 Ch.1 Sec.4 Table D. The following pictures are only to be used as guidelines. It is the relevant Rules for Classification of Ships that give the exact requirements.

**Side shell frames and brackets.**

<table>
<thead>
<tr>
<th>Renewal Survey no.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age ≤ 5 years</td>
</tr>
</tbody>
</table>

**Cargo hold hatch covers and coamings - plating and stiffeners.**

**Ballast tanks transverse web frames with associated plating and longitudinals.**
Cargo hold transverse bulkheads – plating, stiffeners and girders, including internal structures of upper and lower stools, where fitted.

Renewal Survey no.2
Age 5 - 10 years

Cargo hold hatch covers and coamings (plating and stiffeners).

Deck plating and the structure under deck inside line of hatch openings between cargo holds hatches.
Ordinary transverse frames in double side tanks.

Ballast tanks transverse web frames with associated plating and longitudinals.

Cargo hold transverse bulkheads – plating, stiffeners and girders, including internal structures of upper and lower stools, where fitted.

Ballast tanks transverse bulkheads, including stiffening system.
Renewal Survey no. 3
Age 10 - 15 years

Cargo hold hatch covers and coamings (plating and stiffeners).

Deck plating and the structure under deck inside line of hatch openings between cargo hold hatches.

Ordinary transverse frames in double side tanks.
Ballast tanks transverse web frames with associated plating and longitudinals.

Cargo hold transverse bulkheads – plating, stiffeners and girders, including internal structures of upper and lower stools, where fitted.

Ballast tanks transverse bulkheads, including stiffening system.
Renewal Survey no.4
Age > 15 years

Cargo hold hatch covers and coamings (plating and stiffeners).

Deck plating and the structure under deck inside line of hatch openings between cargo holds hatches.

Ordinary transverse frames in double side tanks.
Ballast tanks transverse web frames with associated plating and longitudinals.

Cargo hold transverse bulkheads – plating, stiffeners and girders, including internal structures of upper and lower stools, where fitted.

Ballast tanks transverse bulkheads, including stiffening system.
6.7 Double skin bulk carriers ESP - Minimum thickness measurements

See the Rules for Classification of Ships Pt.7 Ch.1 Sec.4 Table D. The following pictures are only to be used as guidelines. It is the relevant Rules for Classification of Ships that give the exact requirements.

**Renewal Survey no.1**
*Age ≤ 5 years*

Structural members subjected to close-up examination according to the Rules for Classification of Ships.

**Renewal Survey no.2**
*Age 5 - 10 years*

Transverse section within cargo area.
Wind- and water strakes.

**Renewal Survey no.3**
*Age 10 - 15 years*

Transverse section within cargo area.

Main deck plating
Wind and water strakes.
Internals in peak tanks

Air pipes and ventilators.

Renewal Survey no.4
Age 15 > years

Transverse sections within the cargo area.

Main deck plating.
Wind- and water strakes.

Keel plates and bottom plates.

Sea chests and shell plating in way of overboard discharges.

Air pipes and ventilators.

Superstructure deck plating (poop, bridge and forecastle deck)
6.8 Single Hull Oil Tankers, Ore/Oil Ships ESP – Measurements in way of close-up.

See the Rules for Classification of Ships Pt.7 Ch.1 Sec.4 Table D. The following pictures are only to be used as guidelines. It is the relevant Rules for Classification of Ships that give the exact requirements.

**Renewal Survey no.1**

*Age ≤ 5 years*

Deck transverse including adjacent deck structural members.

*Transverse web frame rings including adjacent structural members.*

*Transverse bulkheads including girder system and adjacent structural members.*
Renewal Survey no.2
Age 5 - 10 years

Deck transverse including adjacent deck structural members.

Transverse web frame rings including adjacent structural members.

Transverse bulkheads including girder system and adjacent structural members.

Renewal Survey no.3
Age 10 - 15 years

Deck transverse including adjacent deck structural members.
Transverse web frame rings including adjacent structural members.

Transverse bulkheads including girder system and adjacent structural members.

Bottom transverse including adjacent bottom structural members.

Deck transverse including adjacent deck structural members.
Transverse web frame rings including adjacent structural members.

Transverse bulkheads including girder system and adjacent structural members.

Bottom transverse including adjacent bottom structural members.
6.9 Single Hull Oil Tankers, Ore/Oil Ships ESP -
Minimum thickness measurements

See the Rules for Classification of Ships Pt.7 Ch.1 Sec.4 Table D.
The following pictures are only to be used as guidelines. It is
the relevant Rules for Classification of Ships that give the ex-
act requirements.

<table>
<thead>
<tr>
<th>Renewal Survey no.1</th>
<th>Age ≤ 5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural members subjected to close-up examination according to the Rules for Classification of Ships.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Renewal Survey no.2</th>
<th>Age 5 - 10 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transverse section within cargo area.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Renewal Survey no.3</th>
<th>Age 10 - 13 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main deck plating</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wind- and water strakes.</th>
</tr>
</thead>
</table>

| Transverse sections within the cargo area. |
Main deck plating

Wind and water strakes.

Internals in peak tanks.

Air pipes and ventilators.
All air pipes to day tanks and selected air pipes and ventilator coamings aft of forward 25% of the ship’s length.
Renewal Survey no.4
Age 15+ years

Transverse sections within the cargo area.

Main deck plating.

Wind- and water strakes.

Keel plates and bottom plates. Sea chests and shell plating in way of overboard discharges.
Superstructure deck plating (poop, bridge and forecastle deck)

Internals in peak tanks

Air pipes and ventilators.
### 6.10 Double Hull Oil Tankers, Ore/Oil Ships ESP - Measurements i.w.o. close-up inspections

See the Rules for Classification of Ships Pt.7 Ch.1 Sec.4 Table D. The following pictures are only to be used as guidelines. It is the relevant Rules for Classification of Ships that give the exact requirements.

<table>
<thead>
<tr>
<th>Renewal Survey no.1</th>
<th>Age ≤ 5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Deck transverse including adjacent deck structural members.</td>
</tr>
<tr>
<td></td>
<td>Transverse double hull web frames, including adjacent structural members.</td>
</tr>
<tr>
<td></td>
<td>Transverse bulkheads including girder system and adjacent structural members.</td>
</tr>
</tbody>
</table>
Renewal Survey no.2
Age 5 - 10 years

Deck transverse including adjacent deck structural members.

Transverse double hull web frames, including adjacent structural members.

Transverse bulkheads including girder system and adjacent structural member
Renewal Survey no.3  
Age 10 - 15 years

Deck transverse including adjacent deck structural members.

Transverse double hull web frames, including adjacent structural members.

Transverse web frames including adjacent structural members.
Transverse bulkheads including girder system and adjacent structural members.

Renewal Survey no.4
Age 15 > years

— Deck transverse including adjacent deck structural members.
— Transverse double hull web frames including adjacent structural members.
— Transverse web frames including girder system and adjacent structural members.

Transverse bulkheads including adjacent bottom structural members.
### 6.11 Double Hull Oil Tankers, Ore/Oil Ships ESP - Minimum thickness measurements

See the Rules for Classification of Ships Pt.7 Ch.1 Sec.4 Table D. The following pictures are only to be used as guidelines. It is the relevant Rules for Classification of Ships that give the exact requirements.

<table>
<thead>
<tr>
<th>Renewal Survey no.1</th>
<th>Age ≤ 5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Transverse section within the cargo area." /></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Renewal Survey no.2</th>
<th>Age 5 - 10 years</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image2" alt="Transverse section within cargo area." /></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wind- and water strakes</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3" alt="Main deck plating." /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Renewal Survey no.3</th>
<th>Age 10 - 13 years</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image4" alt="Transverse sections within the cargo area." /></td>
<td></td>
</tr>
</tbody>
</table>

---

*DET NORSKE VERITAS*
Main deck plating

Wind- and water strakes.

Internals in peak tanks

Air pipes and ventilators.

Transverse sections within the cargo area.
Main deck plating.

Wind- and water strakes.

Keel plates and bottom plates.  Sea chests and shell plating in way of overboard discharges.

Superstructure deck plating (poop, bridge and forecastle deck)
6.12 Chemical tankers ESP - Measurements i.w.o. close-up inspections

Internals in peak tanks

Air pipes and ventilators.

See the Rules for Classification of Ships Pt.7 Ch.1 Sec.4 Table D. The following pictures are only to be used as guidelines. It is the relevant Rules for Classification of Ships that give the exact requirements.

Renewal Survey no.1
Age ≤ 5 years

Deck transverse including adjacent deck structural members.
Transverse web frame rings, including adjacent structural members.

Renewal Survey no.2
Age 5 - 10 years

Deck transverse including adjacent deck structural members.
Transverse web frame rings, including adjacent structural members.

Transverse bulkheads including girder system and adjacent structural members.

Renewal Survey no.3
Age 10 – 15 years

Deck transverse including adjacent deck structural members.

Transverse web frame rings including adjacent members.
Transverse bulkheads including girder systems and adjacent structural members.

Renewal Survey no.4
Age 15 ≥ years

Deck transverse including adjacent deck structural members.

Transverse web frame rings including adjacent members.

Transverse bulkheads including girder systems and adjacent structural members.
6.13 Chemical tankers ESP - Minimum thickness measurements

See the Rules for Classification of Ships Pt.7 Ch.1 Sec.4 Table D. The following pictures are only to be used as guidelines. It is the relevant Rules for Classification of Ships that give the exact requirements.

**Renewal Survey no.1**
*Age ≤ 5 years*

Transverse section within the cargo area.

**Renewal Survey no.2**
*Age 5 - 10 years*

Transverse web frame rings including adjacent members.

Transverse bulkheads including girder systems and adjacent structural members.
Main deck plating.

Renewal Survey no.3
Age 10 - 15 years

Transverse section within the cargo area.

Main deck plating.

Wind- and water strakes.
Internals in peak tanks

Air pipes and ventilators.

Renewal Survey no. 4
Age 15 > years

Transverse section within the cargo area.

Main deck plating.

Wind- and water strakes.
Keel plates and bottom plates. 

Superstructure deck plating (poop, bridge and forecastle deck)

Internals in peak tanks

Air pipes and ventilators.

Sea chests and shell plating in way of overboard discharges.
6.14 Liquefied Gas Tanker – Close-up examination

See the Rules for Classification of Ships Pt. 7 Ch. 1 Sec. 4 Table D. The following pictures are only to be used as guidelines. It is the relevant Rules for Classification of Ships that give the exact requirements.

**Renewal Survey no. 1**
*Age ≤ 5 years*

Ballast tank transverse bulkheads, including girder systems and adjacent structural members.

**Renewal Survey no. 2**
*Age 5 - 10 years*

Ballast tanks transverse web frames, including adjacent structural members.

Ballast tank transverse bulkheads, including girder systems and adjacent structural members.
Ballast tanks transverse web frames, including adjacent structural members,

Renewal Survey no.3  
Age 10 - 15 years

Ballast tank transverse bulkheads, including girder systems and adjacent structural members.

Ballast tanks transverse web frames, including adjacent structural members,
Ballast tank transverse bulkheads, including girder systems and adjacent structural members.

Ballast tanks transverse web frames, including adjacent structural members,
6.15 Liquefied Gas Tanker - Minimum thickness measurements

See the Rules for Classification of Ships Pt.7 Ch.1 Sec.4 Table D. The following pictures are only to be used as guidelines. It is the relevant Rules for Classification of Ships that give the exact requirements.
Renewal Survey no.3
Age 10 - 15 years

Transverse section within cargo area.

Main deck plating

Internals in peak tanks

Air pipes and ventilators.
Transverse sections within the cargo area.

Main deck plating

Wind- and water strakes.

Keel plates and bottom plates.
Sea chests and shell plating in way of overboard discharges. Air pipes and ventilators.

Superstructure deck plating (poop, bridge and forecastle deck)

Internals in peak tanks
7. Thickness measurement pattern

7.1 Number of measurement points per plate and averaging

Measurements shall be taken at the forward, middle and aft area of all plates, minimum 3 measurements per plate. This applies for e.g. deck, bottom and wind- and water strakes.

NB ! Requirements at CAP surveys may be stricter, e.g. one measurement in the middle of each plate and one in each corner, five in all.

Where plates cross ballast/cargo tank boundaries, separate measurements for the area of plating in way of each type of tank shall be recorded. Where patches of steel plates have been renewed earlier; be careful to check both the new and the old steel plates. There has been incidents where measurements were taken solely of the newest steel plates, and original plating close by was not measured, even though it was heavily corroded.

Figure 7-1
Measurement points in main deck, marked as black dots. Solid line is plate boundaries. Dotted line is bulkhead underneath. Full line is plate boundaries. Dotted line is bulkheads underneath.

Readings to be included in the UTM report shall be representative for the area measured, and shall normally be single point readings. If a single reading is not considered to be representative for an area, additional readings shall be carried out, with a comment in the report stating that these are additional readings. Alternatively, the average value of several readings in a small area may be included in the report together with a comment stating that this is an average value. In such cases all the readings to be averaged are to be taken within the affected area. The size of such a "small area", shall typically be the spacing of the stiffeners (longitudinals in tankers or side frames in bulk carriers), with the same length used both in the ship's transverse and longitudinal direction (Figure 7-2).

The average thickness of that area shall then be entered in the report, and used to compare with minimum thickness and substantial thickness values, even if single readings within that area are less.

Figure 7-2
The only reading noted in the report would be \((14.8 + 15.1 + 15.0 + 15.2 + 14.9 + 15.5 + 15.3)/7 = 15.1\)

The number of measurement points in the figure were just an example. How many points needs to be taken, in order to get a representative average, will depend on the thickness variations within that space.

Figure 7-3
Pitting corrosion

If there is pitting corrosion, this should be mapped separately, indicating minimum thickness measured, size of area affected, percentage of area covered by pits and average pitting depth. The surveyor shall be informed. The surveyor will use separate acceptance criteria to decide if the area in question needs to be renewed. Common location for pitting corrosion is the bottom plating underneath pipe suction bellmouths in ballast- and cargo tanks, and at the aft end of crude oil tanks.

The thickness of stiffeners may be "averaged" in the same manner as for plates, with the web height or the flange width, as applicable, being the length of each side in a quadratic area. A mean thickness is calculated for that area, as under Figure 7-2.
If there is grooving corrosion at the base of a stiffener, the affected area should be mapped, with absolute minimum thickness, average thickness of affected area and length of grooving noted down. The surveyor shall be informed. The surveyor will use separate acceptance criteria for grooving corrosion.

7.2 Transverse sections
The transverse sections measured should generally be within 0.5 L amidship and where the largest thickness reduction is expected to occur or is revealed from deck and bottom plating measurements.

The results are used for longitudinal strength evaluation and significant area reduction in deck or bottom i.e. above 5%, may require measurements of additional transverse sections. Further, if significant reduction is revealed in some areas, e.g. in the deck longitudinals, measurements may be extended to ensure satisfactory condition for deck longitudinal in other areas of the tank.

7.3 Bulkheads and web frames
See Figure 7-8, 7-9 and 7-14 for the bulkheads and Figure 7-11, 7-12 and 7-13 for the web frames. The figures apply whether the measurements are part of the systematic requirements or as part of the close-up inspection. At least one row of measurements should be taken in the upper part, in the lower part, and in addition one row between each of the stringers.

As figure 7-8 indicates, where there is a plate joint with different thickness in each of the abutting plates, measurements should be taken of each of the two abutting plates. For bulkheads or web frames not corresponding completely with any of the following figures, use the figures as guidance to work out a pattern for that particular design.

7.4 Measurements i.w.o. close-up inspections
The Rules for Classification of Ships specify minimum requirements to thickness measurements for assessment of general corrosion and required extent of measurements will be as found necessary by attending DNV Surveyor, to evaluate all corroded structure. Readings from initial measurements showing that more than 50% of corrosion margin is used, will normally require extended scope to confirm satisfactory condition for similar elements in the rest of the tanks. Proposed initial scope of measurements are indicated in the following figures, but final scope of measurements will to a large extent be decided on board.

7.5 Figures with location of measurement points All Ships - Transverse Section

Minimum density of readings at each transverse section
- Within 0.15 D from deck and bottom every longitudinal and girder shall be measured on the web and flange and every plate shall be measured one point between each longitudinal.
- Between deck and bottom area every longitudinal and girder shall be measured on the web and flange and every plate strake at least one point per strake.

See illustrations in Figure 7-5 for General Cargo, Figure 7-10 for Tankers and Figure 7-12 for Bulk Carriers.

Figure 7-4
Grooving corrosion

Figure 7-5
Transversely stiffened ships (such as bulk carriers and general cargo ships), shall also have random measurements taken of the adjacent, transverse frames forward and aft of the transverse section.
Where the original web plating has strakes with different thickness, measurements should be taken from each of the different strakes. Spot checks should be taken of plating/stiffeners in adjacent structure. At least one of each i.w.o. each boundary in each space (e.g. one measurement of plating, and one web and flange of a longitudinal, in the deck and upper side in the upper cargo hold).
Figure 7-8
All ships - Transverse and longitudinal bulkheads with vertical stiffeners (also applies to bulk carriers and tankers)

Figure 7-9
All Ships - Stringers on Transverse Bulkheads (From Tanker Structure Co-Operative Forum. See Sec.5)
Where the original web plating has strakes with different thickness, measurements should be taken from each of the different strakes. Spot checks should be taken of plating/stiffeners in adjacent structure. At least one representative reading of plating/stiffener i.w.o. each boundary in each tank (e.g. one measurement of plating, and one web and flange of a longitudinal, in the deck, side and bottom in the wing tank).

Transversely stiffened ships (such as bulk carriers and general cargo ships), shall also have random measurements taken of the adjacent, transverse frames forward and aft of the transverse section.
Where the original web plating has strakes with different thickness, measurements should be taken from each of the different strakes. Spot checks should be taken of plating/stiffeners in adjacent structure. At least one reading of plate/stiffener i.w.o. each boundary in each tank (e.g. one measurement of plating, and one web and flange of a longitudinal, in the deck, upper side and the slanted part in the bottom of a topside tank).
7.6 Mapping of areas with substantial corrosion

Areas found with Substantial Corrosion should be mapped applying gauging patterns in the Rules for Classification of Ships. Detailed requirements are given in Appendix C.

Figure 7-14
Bulk Carriers - Transverse, Corrugated Bulkhead
Appendix A
Kick-off meeting – Agenda and Minutes of Meeting

SURVEY MEETING #
(With reference to requirements of IACS PR19)

<table>
<thead>
<tr>
<th>NAME OF VESSEL</th>
<th>DATE</th>
<th>DNV ID No</th>
<th>LOCATION</th>
</tr>
</thead>
</table>

Scope:
A meeting was held in order to discuss the requirements for safe and efficient execution of surveys and thickness measurements to be carried out in conjunction with the COMMENCEMENT / COMPLETION* of ANNUAL / INTERMEDIATE / RENEWAL / ………………..* survey, on the date(s) noted above.

Attended by:

<table>
<thead>
<tr>
<th>Function</th>
<th>Company Name</th>
<th>Personnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner’s Representative</td>
<td></td>
<td>1. 2. 3.</td>
</tr>
<tr>
<td>Approved Thickness Measurement Company**</td>
<td></td>
<td>1. 2. 3.</td>
</tr>
<tr>
<td>Surveyors</td>
<td>Det Norske Veritas AS</td>
<td>1. 2. 3.</td>
</tr>
</tbody>
</table>

Minutes of meeting
The following general topics were discussed with details (comments) as follows:

Personal Safety:
((Means of access, gas freeing, safety equipment such as gas- and oxygen meters, means of communication, point of contact in the case of an accident, ballast pumping procedures etc.)

Comments:

Schedule for thickness measurement.
Comments:

Provisions for thickness measurements (cleaning, illumination, ventilation)
Comments:

Scope of the survey:
1) Mandatory extent of thickness measurements. See the Rules for Classification of Ships Pt.7 Ch.1 Sec.4 Table D.
2) Areas subject to close-up surveys and thickness measurements, including areas previously identified with substantial corrosion, as applicable. See Sec.6 and Sec.7.
3) Taking representative readings, of areas in general, and where uneven corrosion or pitting is found. Ref. first part of Sec.7.
4) Procedure for additional readings and/or mapping of new areas with substantial corrosion. See Sec.4.5 and Appendix D.
### Comments:

#### Availability onboard of drawings with original scantlings.

#### Comments:

- Allowable thickness diminution (Minimum thickness list to be provided by surveyor. UTM company shall enter the minimum thickness values into the UTM report template prior to commencement of measurements).

#### Communication:

- Measurements which shall be done during close-up inspection by surveyor.
- Reporting of thickness measurements on a regular basis (shall be agreed. E.g. end of the day. Ref. Sec.4.5).
- Prompt notification to the surveyor in case of findings like:
  - Excessive and/or extensive corrosion or pitting / grooving of any significance.
  - Structural defects like buckling, fractures and deformed structures.
  - Detached and / or holed structure.
  - Corrosion of welds.
  - Doubler plates e.g. inside cargo tanks (Ref. Sec.4.5)

#### Review of Thickness Measurement Firm’s documents.

- Equipment to be used (enter below).
- Personnel records of operators scheduled for thickness measurement onboard.

<table>
<thead>
<tr>
<th>Company Approval valid *</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
</table>

#### Equipment Used:

- (Name)

#### Comments:

#### SIGNED:

- Owner’s Representative (s)
- Representative (s) of Thickness Measurement Company
- DNV Surveyor (s)

#### Footnotes

- Survey meetings shall be held each time, if thickness measurements are carried out in several operations during the allowable period for the survey and / or by different thickness measurement firms.
- Delete as necessary.
- Only UTM Companies certified by DNV shall be used.
Appendix B
Approval Programme No. 402A May 2005: Approval of Firms Engaged in Ultrasonic Thickness Measurements of Ship’s Structure.

DNV has developed a separate issued programme for subject heading, available under Standard for Certification 2.9 Programme 402A. Located at http://www.dnv.com. Under "Your Industry" choose "Maritime" followed by "Publications & downloads" (upper right) and "Downloads" (lower left) and "Approval of firms engaged in UTM of ship’s structure".
Appendix C
Mapping of areas with substantial corrosion

C.1 Main Class (all ships) - Mapping of Substantial Corrosion

<table>
<thead>
<tr>
<th>Structural member</th>
<th>Extent of measurement</th>
<th>Pattern of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plating</td>
<td>Suspect area and adjacent plates</td>
<td>5 point pattern over 1 m²</td>
</tr>
<tr>
<td>Stiffeners</td>
<td>Suspect area</td>
<td>3 measurements each in line across web and flange</td>
</tr>
</tbody>
</table>

C.2 Bulk Carriers - Mapping of Substantial Corrosion

<table>
<thead>
<tr>
<th>Structural member</th>
<th>Extent of measurement</th>
<th>Pattern of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shell plating</td>
<td>1. Bottom and side shell plating</td>
<td>a) 5 point pattern for each panel between longitudinals</td>
</tr>
<tr>
<td></td>
<td>a) Suspect plate, plus four adjacent plates</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b) See other tables for particulars on gauging in way of tanks and cargo holds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Bottom and side shell longitudinals</td>
<td>3 measurements in line across web</td>
</tr>
<tr>
<td></td>
<td>a) Transverse band within 25 mm of welded connection to inner bottom</td>
<td>3 measurements on flange</td>
</tr>
<tr>
<td></td>
<td>b) Transverse band within 25 mm of welded connection to shelf plate</td>
<td></td>
</tr>
<tr>
<td>Transverse bulkheads in cargo holds</td>
<td>1. Lower stool</td>
<td>a) 5 point pattern over 1 m length</td>
</tr>
<tr>
<td></td>
<td>a) Transverse band within 250 mm of top of shedder plate or hopper plate</td>
<td>b) 5 point pattern over 1 m² of plating</td>
</tr>
<tr>
<td></td>
<td>b) Transverse band at approximately mid height</td>
<td>c) 5 point pattern over 1 m² of plating</td>
</tr>
<tr>
<td></td>
<td>c) Transverse band at part of bulkhead adjacent to upper deck or below upper stool shelf plate (for those ships fitted with upper stools)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Transverse bulkhead</td>
<td></td>
</tr>
</tbody>
</table>

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DET NORSKE VERITAS
### Deck structure, including hatch covers and coamings

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Cross deck strip plating</td>
<td>Suspect cross deck strip plating a) 5 point pattern between underdeck stiffeners over 1 m length</td>
</tr>
<tr>
<td>2.</td>
<td>Underdeck stiffeners a) Transverse members b) Longitudinal member</td>
<td>a) 5 point pattern at each end and mid span b) 5 point pattern on both web and flange</td>
</tr>
<tr>
<td>3.</td>
<td>Hatch covers a) Skirt each side and ends, 3 locations b) 3 longitudinal bands, outboard strakes (2) and centreline strake(1)</td>
<td>a) 5 point pattern at each location b) 5 point measurement each band</td>
</tr>
<tr>
<td>4.</td>
<td>Hatch coamings Each side and end of coaming, one band lower 1/3, one band upper 2/3 of coaming</td>
<td>5 point measurement each band i.e. end or side coaming</td>
</tr>
<tr>
<td>5.</td>
<td>Topside water ballast tanks a) Watertight transverse bulkheads i) lower 1/3 of bulkhead ii) upper 2/3 of bulkhead iii) stiffeners b) 2 representative swash transverse bulkheads i) lower 1/3 of bulkhead ii) upper 2/3 of bulkhead iii) stiffeners c) 3 representative bays of slope plating i) lower 1/3 of tank ii) upper 2/3 of tank d) Longitudinals, suspect and adjacent</td>
<td>a) i) 5 point pattern over 1 m² of plating ii) 5 point pattern over 1 m² of plating iii) 5 point pattern over 1 m length b) i) 5 point pattern over 1 m² of plating ii) 5 point pattern over 1 m² of plating iii) 5 point pattern over 1 m length c) i) 5 point pattern over 1 m² of plating ii) 5 point pattern over 1 m² of plating d) 5 point pattern both web and flange over 1 m length</td>
</tr>
<tr>
<td>6.</td>
<td>Main deck plating</td>
<td>Suspect plates and adjacent (4) 5 point pattern over 1 m² of plating</td>
</tr>
<tr>
<td>7.</td>
<td>Main deck longitudinals</td>
<td>Minimum of 3 longitudinals where plating measured 5 point pattern on both web and flange over 1 m length</td>
</tr>
<tr>
<td>8.</td>
<td>Web frames or transverses</td>
<td>Suspect plates 5 point pattern over 1 m²</td>
</tr>
</tbody>
</table>

### Double bottom and hopper structure

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Inner and double bottom plating</td>
<td>Suspect plate plus all adjacent plates 5 point pattern for each panel between longitudinals over 1 m length</td>
</tr>
<tr>
<td>2.</td>
<td>Inner and double bottom longitudinals</td>
<td>Three longitudinals where plates measured + 3 measurements in line across web and 3 measurements on flange</td>
</tr>
<tr>
<td>3.</td>
<td>Longitudinal girders or transverse floors b) Suspect plates</td>
<td>b) 5 point pattern over about 1 m²</td>
</tr>
<tr>
<td>4.</td>
<td>Watertight bulkheads (WT floors) a) lower 1/3 of tank b) upper 2/3 of tank</td>
<td>a) 5 point pattern over 1 m² of plating b) 5 point pattern alternate plates over 1 m² of plating</td>
</tr>
<tr>
<td>5.</td>
<td>Web frames</td>
<td>Suspect plate 5 point pattern over 1 m² of plating</td>
</tr>
<tr>
<td>6.</td>
<td>Bottom and shell longitudinals</td>
<td>Minimum of three longitudinals in way of suspect area a) 3 measurements in line across web b) 3 measurements on flange</td>
</tr>
</tbody>
</table>

### Cargo holds

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Side shell frames</td>
<td>Suspect frame and each adjacent frame a) At each end and mid span: 5 point pattern of both web and flange b) 5 point pattern within 25 mm of welded attachment to both shell and lower slope plate</td>
</tr>
</tbody>
</table>
### C.3 Single Hull Oil Tankers - Mapping of Substantial Corrosion

<table>
<thead>
<tr>
<th>Structural member</th>
<th>Extent of measurement</th>
<th>Pattern of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bottom structure</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Bottom plating</td>
<td>Minimum of 3 bays across tank, including aft bay. Measurements around and under all bell mouths</td>
<td>5 point pattern for each panel between longitudinals and webs</td>
</tr>
<tr>
<td>2. Bottom longitudinals</td>
<td>Minimum of 3 longitudinals in each bay where bottom plating measured</td>
<td>3 measurements in line across flange and 3 measurements on vertically web</td>
</tr>
<tr>
<td>3. Bottom girders and brackets</td>
<td>At fore and aft transverse bulkhead bracket toes and in centre of tanks</td>
<td>Vertical line of single measurements on web plating with one measurement between each panel stiffener, or a minimum of three measurements. Two measurements across face flat. 5 point pattern on girder/bulkhead brackets</td>
</tr>
<tr>
<td>4. Bottom transverse webs</td>
<td>3 webs in bays where bottom plating measured, with measurements at both ends and middle</td>
<td>5 points pattern over 2 m² area. Single measurements on face flat</td>
</tr>
<tr>
<td>5. Panel stiffening</td>
<td>Where available</td>
<td>Single measurements</td>
</tr>
<tr>
<td><strong>Deck structure</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Deck plating</td>
<td>Two bands across tank</td>
<td>Minimum of three measurements per plate per band</td>
</tr>
<tr>
<td>2. Deck longitudinals</td>
<td>Minimum of 3 longitudinals in each of two bays</td>
<td>3 measurements in line vertically on webs, and 2 measurements on flange (if fitted)</td>
</tr>
<tr>
<td>3. Deck girders and brackets</td>
<td>At fore and aft transverse bulkhead, bracket toes and in centre of tanks</td>
<td>Vertical line of single measurements on web plating with one measurement between each panel stiffener, or a minimum of three measurements. Two measurements across face flat. 5 point pattern on girder/bulkhead brackets</td>
</tr>
<tr>
<td>4. Deck transverse webs</td>
<td>Minimum of two webs with measurements at middle and both ends of span</td>
<td>5 points pattern over about 2 m² area. Single measurements on face flat</td>
</tr>
<tr>
<td>5. Panel stiffening</td>
<td>Where available</td>
<td>Single measurements</td>
</tr>
<tr>
<td><strong>Shell and longitudinal bulkheads</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Deckhead and bottom strakes, and strakes in way of stringer platforms</td>
<td>Plating between each pair of longitudinals in a minimum of 3 bays</td>
<td>Single measurement</td>
</tr>
<tr>
<td>2. All other strakes</td>
<td>Plating between every 3rd pair of longitudinals in same 3 bays</td>
<td>Single measurement</td>
</tr>
<tr>
<td>3. Longitudinals-deckhead and bottom strakes</td>
<td>Each longitudinal in same 3 bays</td>
<td>3 measurements across web and 1 measurement on flange</td>
</tr>
<tr>
<td>4. Longitudinals - all others</td>
<td>Every third longitudinal in same 3 bays</td>
<td>3 measurements across web and 1 measurement on flange</td>
</tr>
<tr>
<td>5. Longitudinals - bracket</td>
<td>Minimum of three at top middle and bottom of tank in same 3 bays</td>
<td>5 point pattern over area of bracket</td>
</tr>
<tr>
<td>6. Web frames and cross ties</td>
<td>3 webs with minimum of three locations on each web, including in way of cross tie connections</td>
<td>5 point pattern over about 2 m² area, plus single measurements on web frame and cross tie face flats</td>
</tr>
</tbody>
</table>
C.4 Double Hull Oil Tankers - Mapping of Substantial Corrosion

Rules for Classification of Ships Pt.7 Ch.2 Sec.3 Table G6
Requirements for extent of thickness measurement at those areas of substantial corrosion.
Renewal survey of single hull oil tankers, ore/oil ships within the cargo tank length (Continued)

<table>
<thead>
<tr>
<th>Transverse bulkheads and swash bulkheads</th>
<th>Plating between pair of stiffeners at three locations - approximately 1/4, 1/2 and 3/4 width of tank</th>
<th>5 points pattern between stiffeners over 1 m length</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Deckhead and bottom strakes, and strakes in way of stringer platforms</td>
<td>Plating between pair of stiffeners at mid-plane</td>
<td>Single measurement</td>
</tr>
<tr>
<td>2. All other strakes</td>
<td>Plating for each change of scantling at centre of panel and at flange or fabricated connection</td>
<td>5 point pattern over about 1 m² of plating</td>
</tr>
<tr>
<td>3. Strakes in corrugated bulkheads</td>
<td>Minimum of three typical stiffeners</td>
<td>For web, 5 point pattern over span between bracket connections (2 measurements across web at each bracket connection, and one at centre of span). For flange, single measurements at each bracket toe and at centre of span</td>
</tr>
<tr>
<td>4. Stiffeners</td>
<td>Minimum of three at top, middle and bottom of tank</td>
<td>5 point pattern over area of bracket</td>
</tr>
<tr>
<td>5. Brackets</td>
<td>Measurements at toe of bracket and at centre of span</td>
<td>For web, 5 point pattern over about 1 m². 3 measurements across face flat</td>
</tr>
<tr>
<td>6. Deep webs and girders</td>
<td>All stringers with measurements at both ends and middle</td>
<td>5 point pattern over 1 m² of area plus single measurements near bracket toes and on face flats</td>
</tr>
</tbody>
</table>

(IACS UR Z10.1)

Rules for Classification of Ships Pt.7 Ch.2 Sec.3 Table G7
Requirements for extent of thickness measurement at those areas of substantial corrosion.
Renewal survey of double hull oil tankers within the cargo area length

<table>
<thead>
<tr>
<th>Bottom, inner bottom and hopper structure</th>
<th>Extent of measurement</th>
<th>Pattern of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural member</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottom, inner bottom and hopper structure plating</td>
<td>Minimum of three bays across double bottom tank, including aft bay Measurements around and under all suction bell mouths</td>
<td>5-point pattern for each panel between longitudinals and floors</td>
</tr>
<tr>
<td>Bottom, inner bottom and hopper structure longitudinals</td>
<td>Minimum of three longitudinals in each bay where bottom plating measured</td>
<td>Three measurements in line across flange and three measurements on vertical web</td>
</tr>
<tr>
<td>Bottom girders, including the watertight ones</td>
<td>At fore and aft watertight floors and in centre of tanks</td>
<td>Vertical line of single measurements on girder plating with one measurement between each panel stiffener, or a minimum of three measurements</td>
</tr>
<tr>
<td>Bottom floors, including the watertight ones</td>
<td>Three floors in bays where bottom plating measured, with measurements at both ends and middle</td>
<td>5-point pattern over two square metre area</td>
</tr>
<tr>
<td>Hopper structure web frame ring</td>
<td>Three floors in bays where bottom plating measured</td>
<td>5-point pattern over one square metre of plating. Single measurements on flange</td>
</tr>
<tr>
<td>Hopper structure transverse watertight bulkhead or swash bulkhead</td>
<td>Lower 1/3 of bulkhead</td>
<td>5-point pattern over one square metre of plating</td>
</tr>
<tr>
<td></td>
<td>Upper 2/3 of bulkhead</td>
<td>5-point pattern over two square metre of plating</td>
</tr>
<tr>
<td></td>
<td>Stiffeners (minimum of three)</td>
<td>For web, 5-point pattern over span (two measurements across web at each end and one at centre of span). For flange, single measurements at each end and centre of span</td>
</tr>
</tbody>
</table>

Panel stiffening Where applicable Single measurements

(IACS UR Z10.4)

Rules for Classification of Ships Pt.7 Ch.2 Sec.3 Table G8
Requirements for extent of thickness measurement at those areas of substantial corrosion.
Renewal survey of double hull oil tankers within the cargo area length

<table>
<thead>
<tr>
<th>Deck structure</th>
<th>Extent of measurement</th>
<th>Pattern of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural member</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deck plating</td>
<td>Two transverse bands across tank</td>
<td>Minimum of three measurements per plate per band</td>
</tr>
<tr>
<td>Deck longitudinals</td>
<td>Every third longitudinal in each of two bands with a minimum of one longitudinal</td>
<td>Three measurements in line vertically on webs and two measurements on flange (if fitted)</td>
</tr>
</tbody>
</table>
### Rules for Classification of Ships Pt.7 Ch.2 Sec.3 Table G8

Requirements for extent of thickness measurement at those areas of substantial corrosion.

Renewal survey of double hull oil tankers within the cargo area length (Continued)

<table>
<thead>
<tr>
<th>Structural member</th>
<th>Extent of measurement</th>
<th>Pattern of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deck girders and brackets (usually in cargo tanks only)</td>
<td>At fore and all transverse bulkhead, bracket toes and in centre of tanks</td>
<td>Vertical line of single measurements on web plating with one measurement between each panel stiffener, or a minimum of three measurements. Two measurements across flange. 5-point pattern on girder/bulkhead brackets</td>
</tr>
<tr>
<td>Deck transverse webs</td>
<td>Minimum of two webs, with measurements at both ends and middle of span</td>
<td>5-point pattern over one square metre area. Single measurements on flange</td>
</tr>
<tr>
<td>Vertical web and transverse bulkhead in wing ballast tank (two metres from deck)</td>
<td>Minimum of two webs, and both transverse bulkheads</td>
<td>5-point pattern over one square metre area</td>
</tr>
<tr>
<td>Panel stiffening</td>
<td>Where applicable</td>
<td>Single measurements</td>
</tr>
</tbody>
</table>

(IACS UR Z10.4)

### Rules for Classification of Ships Pt.7 Ch.2 Sec.3 Table G9

Requirements for extent of thickness measurement at those areas of substantial corrosion.

Renewal survey of double hull oil tankers within the cargo area length

<table>
<thead>
<tr>
<th>Structural member</th>
<th>Extent of measurement</th>
<th>Pattern of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Side shell and longitudinal bulkhead plating:</td>
<td>Plating between each pair of longitudinal plating in a minimum of three bays (along the tank)</td>
<td>Single measurement</td>
</tr>
<tr>
<td>— upper strake and strakes in way of horizontal girders</td>
<td>Plating between every third pair of longitudinal plating in same three bays</td>
<td>Single measurement</td>
</tr>
<tr>
<td>— all other strakes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Side shell and longitudinal bulkhead longitudinal on:</td>
<td>Each longitudinal in same three bays</td>
<td>3 measurements across web and 1 measurement on flange</td>
</tr>
<tr>
<td>— upper strake</td>
<td>Every third longitudinal in same three bays</td>
<td>3 measurements across web and 1 measurement on flange</td>
</tr>
<tr>
<td>— all other strakes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Longitudinals - brackets</td>
<td>Minimum of three at top, middle and bottom of tank in same three bays</td>
<td>5-point pattern over area of bracket</td>
</tr>
<tr>
<td>Vertical web and transverse bulkheads (excluding deckhead area):</td>
<td>Minimum of two webs and both transverse bulkheads</td>
<td>5-point pattern over approx. two square metre area</td>
</tr>
<tr>
<td>— strakes in way of horizontal girders</td>
<td>Minimum of two webs and both transverse bulkheads</td>
<td>Two measurements between each pair of vertical stiffeners</td>
</tr>
<tr>
<td>— other strakes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horizontal girders</td>
<td>Plating on each girder in a minimum of three bays</td>
<td>Two measurements between each pair of longitudinal girder stiffeners</td>
</tr>
<tr>
<td>Panel stiffening</td>
<td>Where applicable</td>
<td>Single measurements</td>
</tr>
</tbody>
</table>

(IACS UR Z10.4)

### Rules for Classification of Ships Pt.7 Ch.2 Sec.3 Table G10

Requirements for extent of thickness measurement at those areas of substantial corrosion.

Renewal survey of double hull oil tankers within the cargo area length

<table>
<thead>
<tr>
<th>Structural member</th>
<th>Extent of measurement</th>
<th>Pattern of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deckhead and bottom strakes, and strakes in way of the horizontal stringers of transverse bulkheads</td>
<td>Plating between each pair of longitu- dinals in a minimum of three bays</td>
<td>Single measurement</td>
</tr>
<tr>
<td>All other strakes</td>
<td>Plating between every third pair of longitudinals in same three bays</td>
<td>Single measurement</td>
</tr>
<tr>
<td>Longitudinals on deckhead and bottom strakes</td>
<td>Each longitudinal in same three bays</td>
<td>Three measurements across web and one measurement on flange</td>
</tr>
<tr>
<td>All other longitu- dinals</td>
<td>Every third longitudinal in same three bays</td>
<td>Three measurements across web and one measurement on flange</td>
</tr>
<tr>
<td>Longitudinals - brackets</td>
<td>Minimum of three at top, middle and bottom of tank in same three bays</td>
<td>5-point pattern over area of bracket</td>
</tr>
<tr>
<td>Web frames and cross ties</td>
<td>Three webs with minimum of three locations on each web, including in way of cross tie connections</td>
<td>5-point pattern over approximately two square metre area of webs, plus single measurements on flanges of web frame and cross ties</td>
</tr>
</tbody>
</table>
### C.5 Tankers for Chemicals - Mapping of substantial corrosion

#### Rules for Classification of Ships Pt.7 Ch.2 Sec.3 Table G10

**Requirements for extent of thickness measurement at those areas of substantial corrosion.**

<table>
<thead>
<tr>
<th>Structural member</th>
<th>Extent of measurement</th>
<th>Pattern of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower end brackets (opposite side of web frame)</td>
<td>Minimum of three brackets</td>
<td>5-point pattern over approximately two square metre area of brackets, plus single measurements on bracket flanges</td>
</tr>
</tbody>
</table>

(IACS UR Z10.4)

#### Rules for Classification of Ships Pt.7 Ch.2 Sec.3 Table G11

**Requirements for extent of thickness measurement at those areas of substantial corrosion.**

**Renewal survey of double hull oil tankers within the cargo area length**

**Transverse watertight and swash bulkheads in cargo tanks**

<table>
<thead>
<tr>
<th>Structural member</th>
<th>Extent of measurement</th>
<th>Pattern of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper and lower stool, where fitted</td>
<td>— Transverse band within 25 mm of welded connection to inner bottom/deck plating — Transverse band within 25 mm of welded connection to shelf plate</td>
<td>5-point pattern between stiffeners over 1 m length</td>
</tr>
<tr>
<td>Deckhead and bottom strakes, and strakes in way of horizontal stringers</td>
<td>Plating between pair of stiffeners at three locations: approximately 1/4, 1/2 and 3/4 width of tank</td>
<td>5-point pattern between stiffeners over 1 m length</td>
</tr>
<tr>
<td>All other strakes</td>
<td>Plating between pair of stiffeners at middle location</td>
<td>Single measurement</td>
</tr>
<tr>
<td>Strakes in corrugated bulkheads</td>
<td>Plating for each change of scantling at centre of panel and at flange of fabricated connection</td>
<td>5-point pattern over about 1 m² of plating</td>
</tr>
<tr>
<td>Stiffeners</td>
<td>Minimum of three typical stiffeners</td>
<td>For web, 5-point pattern over span between bracket connections (two measurements across web at each bracket connection and one at centre of span). For flange, single measurements at each bracket toe and at centre of span</td>
</tr>
<tr>
<td>Brackets</td>
<td>Minimum of three at top, middle and bottom of tank</td>
<td>5-point pattern over area of bracket</td>
</tr>
<tr>
<td>Horizontal stringers</td>
<td>All stringers with measurements at both ends and middle</td>
<td>5-point pattern over 1 m² area, plus single measurements near bracket toes and on flanges</td>
</tr>
</tbody>
</table>

(IACS UR Z10.4)

#### Rules for Classification of Ships Pt.7 Ch.2 Sec.3 Table K4

**Requirements for extent of thickness measurements at those areas of substantial corrosion.**

**Renewal survey of chemical tankers**

<table>
<thead>
<tr>
<th>Structural member</th>
<th>Extent of measurement</th>
<th>Pattern of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double bottom and hopper structure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Inner bottom plating and bottom plating</td>
<td>Suspect plate plus all adjacent plates. Measurements around and under all bell mouths and pump wells</td>
<td>5 point pattern for each panel between longitudinals over 1 m length</td>
</tr>
<tr>
<td>2. Inner bottom and bottom longitudinals</td>
<td>Three longitudinals where plates measured</td>
<td>3 measurements in line across flange and 3 measurements on vertically webbed</td>
</tr>
<tr>
<td>3. Longitudinal girders or transverse floors</td>
<td>Suspect plates</td>
<td>5 point pattern over about 1 m²</td>
</tr>
<tr>
<td>a) Lower 1/3 of tank</td>
<td>5 point pattern over about 1 m²</td>
<td></td>
</tr>
<tr>
<td>b) Upper 2/3 of tank</td>
<td>5 point pattern alternate plates over 1 m² of plating</td>
<td></td>
</tr>
<tr>
<td>4. Watertight bulkheads (WT floors)</td>
<td></td>
<td>5 point pattern</td>
</tr>
<tr>
<td>a)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Web frames</td>
<td>Suspect plate</td>
<td></td>
</tr>
</tbody>
</table>

(IACS UR Z10.4)
<table>
<thead>
<tr>
<th>Rules for Classification of Ships Pt.7 Ch.2 Sec.3 Table K4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirements for extent of thickness measurements at those areas of substantial corrosion.</td>
</tr>
<tr>
<td>Renewal survey of chemical tankers (Continued)</td>
</tr>
</tbody>
</table>

### Deck structure 1)

1. **Deck plating**
   - Two bands across tank
   - Minimum of three measurements per plate per band

2. **Deck longitudinals**
   - Minimum of 3 longitudinals in each of two bays
   - 3 measurements in line vertically on webs, and 2 measurements on flange (if fitted)

3. **Deck girders and brackets**
   - At fore and aft transverse bulkhead, bracket toes and in centre of tanks
   - Vertical line of single measurements on web plating with one measurement between each panel stiffener, or a minimum of three measurements. Two measurements across face flat. 5 point pattern on girder/bulkhead brackets

4. **Deck transverse webs**
   - Minimum of two webs with measurements at middle and both ends of span
   - 5 point pattern over about 2 m² areas. Single measurements of face flat

5. **Panel stiffening**
   - Where available
   - Single measurements

### Shell and longitudinal bulk-heads

1. **Deckhead and bottom strakes, and strakes in way of stringer platforms**
   - Plating between each pair of longitudinals in a minimum of 3 bays.
   - Single measurements

2. **All other strakes**
   - Plating between every 3rd pair of longitudinals in same 3 bays
   - Single measurements

3. **Longitudinals - deckhead and bottom strakes**
   - Each longitudinal in same 3 bays
   - 3 measurements across web and 1 measurement on flange

4. **Longitudinals - all others**
   - Every third longitudinal in same 3 bays
   - 3 measurements across web and 1 measurement on flange

5. **Longitudinals - brackets**
   - Minimum of three at top middle and bottom of tank in same 3 bays
   - 5 point pattern over area of bracket

6. **Web frames and cross ties**
   - 3 webs with minimum of three locations on each web, including in way of cross tie connections
   - 5 point pattern over about 2 m² area, plus single measurements on web frame and cross tie face flats

---

1) For tanks where Substantial Corrosion covers more than 20% of the deck surface, the whole deck structure including longitudinals and web frames above this tank, should be mapped as if they were areas with substantial corrosion.

(IACS UR Z10.3)
Appendix D
Example of UTM report front page

See "General Particulars". Located at http://www.dnv.com. Under "Your Industry", choose "Maritime" followed by "Publications & downloads" (upper right) and "Downloads" (lower left) and "Electronic UTM report template."

Ultrasonic Thickness Measurement Report
Report number:

General particulars:
Ship's name:
Type of ship:
Class identity no.:
Port of registry:
Deadweight:
Date of build:
Classification society:
Measurements performed by:
Thickness measurement company certified by:
Certificate no.:
Certificate valid from:………………..To:…………..……

Place of measurements:
First date of measurements:
Last date of measurements:
Type of survey:
Type of measurement equipment:
Qualification of operator:

UTM-WORK PERFORMED BY:
___________________________________________
Name of Operator 1
___________________________________________
Signature of Operator 1
___________________________________________
Name of Operator 2
___________________________________________
Signature of Operator 2

VERIFIED & EVALUATED BY:
______________________________________________
Name of class surveyor
______________________________________________
Signature of Class surveyor

Company official stamp: Classification society official stamp:

Date: Date:
Appendix E
Calculation of average thickness reduction in deck and bottom. Verification of longitudinal strength

E.1 General
This Appendix is a guideline on how to verify a ship's longitudinal strength, i.e. estimate average corrosion reduction in deck and bottom, as required for vessels having had a transverse section measured with UTM as part of the renewal survey scope. The calculation shall either be made by attending surveyor, or by the service supplier doing the thickness measurements, with the surveyor verifying the results.

It is not necessary to calculate the ship's section modulus or the cross section's moment of inertia in order to verify the longitudinal strength. For a quick approximation, a quick "adding up" of cross section areas, as shown in the following example, is sufficient for the verification of the longitudinal strength in the field. Only if the calculated reduction percentage gets close to 10% (or 5%, if so stated in the heading of the minimum thickness list), is it necessary to contact MTPNO864 for a more accurate approximation of actual loss of longitudinal strength. It is of no less importance that the surveyors carry out this approximation whenever a complete, transverse section is measured, as it forms the very basis for the minimum thickness list.

If the steel in plates or longitudinals is mild steel or high strength steel has no influence on the result. The thickness reduction of HS steel and mild steel may be added into one figure.

The ship's main drawings shall be used to find as-built thickness values where no minimum thickness list is available.

For tankers above 130 m length, DNV will upon request send electronically an Excel sheet for average corrosion calculation/reporting, including original thickness values for applicable area.

E.2 Example
For illustration, only half of the ship's breadth is included in the calculation below. When doing such verification in real life, however, one should calculate the average thickness reduction over the whole breadth, from side to side (see Figure E-2). In the bottom one should calculate over the whole breadth, from bilge to bilge. As shown below, it is enough to calculate the average area reduction for the deck (or the bottom) itself, even if some of the minimum thickness lists mention the upper or lower 15% of the sides and longitudinal bulkhead as "upper area" or "lower area". However, it's not wrong to include the upper or lower 15%, either.

```
Figure E-1
```

### Plates, Plates:

<table>
<thead>
<tr>
<th>Plates</th>
<th>Plate A</th>
<th>Plate B</th>
<th>Plate C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>4 m</td>
<td>4 m</td>
<td>3 m</td>
</tr>
<tr>
<td>( t_{\text{orig}} )</td>
<td>16 mm</td>
<td>15 mm</td>
<td>14 mm</td>
</tr>
<tr>
<td>( t_{\text{measured}} )</td>
<td>15 mm</td>
<td>14.5 m</td>
<td>13 mm</td>
</tr>
</tbody>
</table>

**Total original area, Plates:**

\[
4000 \text{ mm} \cdot 16 \text{ mm} + 4000 \text{ mm} \cdot 15 \text{ mm} + 3000 \text{ mm} \cdot 14 \text{ mm} = 166000 \text{ mm}^2
\]

**Measured area, Plates:**

\[
4000 \text{ mm} \cdot 15.0 \text{ mm} + 4000 \text{ mm} \cdot 14.5 \text{ mm} + 3000 \text{ mm} \cdot 13 \text{ mm} = 157000 \text{ mm}^2
\]

### Profiles:

<table>
<thead>
<tr>
<th>Profiles</th>
<th>Original dimensions</th>
<th>Measured thickness, web</th>
<th>Measured thickness, flange</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>300 \cdot 14 + 150·20</td>
<td>12.8</td>
<td>19.0</td>
</tr>
<tr>
<td>L2</td>
<td>300 \cdot 14 + 150·20</td>
<td>12.5</td>
<td>18.8</td>
</tr>
<tr>
<td>L3</td>
<td>300 \cdot 14 + 150·20</td>
<td>13.0</td>
<td>18.9</td>
</tr>
<tr>
<td>L4</td>
<td>300 \cdot 14 + 150·20</td>
<td>11.5</td>
<td>19.2</td>
</tr>
<tr>
<td>L5</td>
<td>300 \cdot 14 + 150·20</td>
<td>12.0</td>
<td>17.0</td>
</tr>
<tr>
<td>L6</td>
<td>300 \cdot 14 + 150·20</td>
<td>13.5</td>
<td>20.2</td>
</tr>
<tr>
<td>L7</td>
<td>300 \cdot 14 + 150·20</td>
<td>14.0</td>
<td>20.0</td>
</tr>
<tr>
<td>L8</td>
<td>300 \cdot 14 + 150·20</td>
<td>14.0</td>
<td>18.8</td>
</tr>
<tr>
<td>L9</td>
<td>300 \cdot 14 + 150·20</td>
<td>14.5</td>
<td>19.5</td>
</tr>
<tr>
<td>L10</td>
<td>300 \cdot 14 + 150·20</td>
<td>13.0</td>
<td>19.0</td>
</tr>
<tr>
<td>L11</td>
<td>250 \cdot 16 \text{ mm (HP Bulb)}</td>
<td>15.2</td>
<td>N/A</td>
</tr>
<tr>
<td>L12</td>
<td>250 \cdot 16 \text{ mm (HP Bulb)}</td>
<td>14.9</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Total original area, Profiles:**

\[
300 \cdot 14 + 150 \cdot 20 + 300 \cdot 14 + 150 \cdot 20 + 300 \cdot 14 + 150 \cdot 20 + 300 \cdot 14 + 150 \cdot 20 + 300 \cdot 14 + 150 \cdot 20 + 300 \cdot 14 + 150 \cdot 20 + 300 \cdot 14 + 150 \cdot 20 + 300 \cdot 14 + 150 \cdot 20 + 250 \cdot 16 (\text{approx}) + 250 \cdot 16 (\text{approx}) = 80000 \text{ mm}^2
\]

**Total measured area, Profiles:**

\[
300 \cdot (12.8 + 12.5 + 13.0 + 11.5 + 12.0 + 13.5 + 14.0 + 14.0 + 14.5 + 13.0 + 150 \cdot (19.0 + 18.8 + 18.9 + 19.2 + 17.0 + 20.2 + 20.0 + 18.8 + 19.5 + 19.0)) + 250 \cdot 15.2 + 250 \cdot 14.9 = 75325 \text{ mm}^2
\]

**Total original area = Total original area plates + Total original area profiles**

\[
= 166000 \text{ mm}^2 + 80000 \text{ mm}^2 = 246000 \text{ mm}^2
\]

**Total measured area = Total measured area plates + Total measured area profiles**

\[
= 157000 \text{ mm}^2 + 75325 \text{ mm}^2 = 232325 \text{ mm}^2
\]

**Total area reduction**

\[
\frac{246000 \cdot 232325}{246000} \cdot 100\% = 5.6\%
\]

If this was the only section to be measured in a ship with a maximum average corrosion limit of 10%, there would not be any problem. The surveyor could just state "average corrosion verified to be below 10%" in the inspection report. However, if the ship’s minimum thickness list has maximum 5% average corrosion in the deck area stated on the front page, then the surveyor shall be notified immediately. The ship could have so much corrosion, that it would need to have the minimum thickness list revised. The bottom should be verified the same way.
Figure E-2
Areas to be verified
Appendix F
Guidelines for measurements of side frames in bulk carriers

Annex V - Guidelines for the Gauging of Side Shell Frames and Brackets in Single Side Skin Bulk Carriers required to comply with the Rules for Classification of Ships Pt.7 Ch.2 Sec.1).

F.1 General
Single Skin Bulk carriers which are to comply with the new rules will be identified with a Memo to Owner. The new rules require increased control of the side frame scantlings. To assist the Surveyor, a new minimum thickness lists will be prepared for all ships where this requirement is applicable.

F.2 Zones of Side Shell Frames and Brackets
For the purpose of steel renewal, sand blasting and coating, four zones A, B, C and D are defined, as shown in Figure F-1. Zones A & B are considered to be the most critical zones.

F.3 Pitting and grooving
Pits can grow in a variety of shapes, some of which would need to be ground before assessment.

Pitting corrosion may be found under coating blisters, which must be removed before inspection.

To measure the remaining thickness of pits or grooving the normal ultrasonic transducer (generally 10 mm diameter) will not suffice. A miniature transducer (3 to 5 mm diameter) must be used. Alternatively the gauging firm must use a pit gauge to measure the depth of the pits and grooving and calculate the remaining thickness.

F.3.1.1 Assessment based upon Area
This is the method specified in S31.2.5 and is based upon the intensity determined from Figure F-2 below.

If pitting intensity is higher than 15% in an area (see Figure F-2), then thickness measurements are to be taken to check the extent of the pitting corrosion. The 15% is based upon pitting or grooving on only one side of the web.

In cases where pitting is evident as defined above (exceeding 15%) then an area of 300 mm diameter or more, at the most pitted part of the frame, is to be cleaned to bare metal, and the thickness measured in way of the five deepest pits within the cleaned area. The least thickness measured in way of any of these pits is to be taken as the thickness to be recorded.

The minimum acceptable remaining thickness in any pit or groove is equal to:
- 75% of the as built thickness, for pitting or grooving in the cargo hold side frame webs and flanges
- 70% of the as built thickness, for pitting or grooving in the side shell, hopper tank and topside tank plating attached to the cargo hold side frame, over a width up to 30 mm from each side of it.

F.4 Gauging methodology
Numbers of side frames to be measured are equivalent to those of Renewal Survey or Intermediate Survey corresponding to the ship’s age. Representative thickness measurements are to be taken for each zone as specified below.

Special consideration to the extent of the thickness measurements may be given by the Classification Society, if the structural members show no thickness diminution with respect to the as built thicknesses and the coating is found in “as-new” condition (i.e., without breakdown or rusting).

Where gauging readings close to the criteria are found, the number of hold frames to be measured is to be increased.

The Planning Document for vessels where the Rules for Classification of Ships Pt.7 Ch.2 Sec.1 apply, will include an additional $T_{min}$ list valid for the side frames, or the list will be provided separately.

If renewal or other measures according to S31 are to be applied on individual frames in a hold, then all frames in that hold are to be gauged.

There is a variety of construction methods used for side shell frames in bulk carriers. Some have faceplates (T sections) on the side shell frames, some have flanged plates and some have bulb plates. The use of faceplates and flanged sections is considered similar for gauging purposes in that both the web and faceplate or web and flange plate are to be gauged.

If bulb plate has been used, then the web of the bulb plate is to be gauged in the normal manner and the sectional modulus has to be specially considered if required. The provided $T_{min}$ list will normally indicate cases where sectional modulus may be
a problem.

F.4.1 Gaugings of Web plating for Zones A, B & D
The gauging pattern for Zones A, B & D are to be a five point pattern. See figure F-3. The 5 point pattern is to be over the depth of the web and the same area vertically. The gauging report is to reflect the average reading.

F.4.2 Gaugings of Web plating for Zone C
Depending upon the condition of the web in way of Zone C, the web may be measured by taking 3 readings over the length of Zone C and averaging them. The average reading is to be compared with the allowable thickness. If the web plating has general corrosion then this pattern should be expanded to a five point pattern as noted above.

F.4.3 Gaugings of flanges for all Zones
At least 2 readings on the flange/faceplate are to be taken in way of section a) and b), see Figure F-4. At least one reading of the attached shell plating is to be taken on each side of the frame (i.e. fore and aft) in way of section a) and section b).

At least 2 readings on the flange/faceplate are to be taken in way of one selected section within each of the zones C and D. At least one reading of the attached shell plating is to be taken on each side of the frame (i.e. fore and aft) in way of the selected sections.
Appendix G
Glossary

G.1 Bulk carriers

Figure G-1
Bulk carrier

Figure G-2
Bulk carrier
G2 Tankers

Figure G-3
Bulk carrier

Figure G-4
Tanker
After Peak Bulkhead is a term applied to the first main transverse watertight bulkhead forward of the stern, or is the compartment in the narrow part of the stern aft of the last watertight bulkhead.

Bay is the area between adjacent transverse frames.

Breast Hook is a triangular plate bracket joining port and starboard side structural members at the stem.

Bulkhead Deck is the uppermost continuous deck to which transverse watertight bulkheads and shell are carried.

Bulwark is fore- and aft vertical plating immediately above the upper edge of the sheer strake.

Butt Joint is a joint between two structural members lying in the same plane. Typically a butt joint is used to describe the welded connection between two plates in the transverse direction.

Cargo Area or Cargo Length Area is that part of the vessel that contains cargo holds and cargo / slop tanks and adjacent areas including ballast tanks, fuel tanks, cofferdams, void spaces and also including deck areas throughout the entire length and breadth of the part of the ship over the mentioned spaces.

Carlings are supports, usually made of flat plate, welded in a fore and aft direction between transverse deck beams to prevent distortion of the plating.

Coaming is the vertical boundary of a hatch or skylight.

Cofferdams are spaces between two bulkheads or decks primarily designed as a safeguard against leakage of oil from one compartment to another.

Collision Bulkhead is the foremost main transverse watertight bulkhead.

Companion Way is a weathertight entrance leading from a ship's deck to spaces below.

Cross Deck is the area between cargo hatches.

Deep Tank is a tank extending from the bottom or inner bottom up to or higher than the lowest deck.

Duct Keel is a keel built of plates in box form extending the length of the cargo hold. It is used to house ballast and other piping leading forward which otherwise would have to run through the cargo holds.

Extensive Corrosion is an extent of corrosion consisting of hard and/or loose scale, including pitting, over 70% or more of the area under consideration, accompanied by evidence of thickness diminution.

Excessive corrosion See Sec.2.

Fatigue is the tendency of materials to fracture under many repetitions of a stress considerably less than the ultimate static strength.

Forecastle is a short superstructure situated at the bow.

Forepeak is the area of the ship forward of the collision bulkhead.

Freeboard Deck is normally the uppermost complete deck exposed to weather and sea, which has permanent means of closing all openings in the weather part thereof.

Freeing Port is an opening in the bulwarks to allow water shipped on deck to run freely overboard.

Galvanizing is the deposition of zinc on to the surface of steel to provide corrosion protection by both protecting the steel from contact with the environment and giving sacrificial protection.

Girder is a collective term for primary supporting structural members.
Gunwale is the upper edge of the ship’s sides.

Gusset is a triangular plate, usually fitted to distribute forces at a strength connection between two structural members.

Indent is deformation of structural members caused by out of plane loads like bottom slamming and bow impact forces, contact with other objects etc.

Independent Tank is a self-supporting tank and while connected to the ship’s main structure, is not dependent on this structure.

Keel is the main structural member of backbone of a vessel running longitudinal along centreline of bottom. Usually a flat plate stiffened by a vertical plate on its centreline inside the shell.

Lap Joint is a joint between two structural members that overlap each other.

Loose Scale is sheets of rust falling off if the surveyor hits the structure with his test hammer. Loose scale can best be removed by hand or power tool cleaning or a combination of these.

Midship Section is the cross section through the ship, midway between the forward and after perpendiculars.

Pipe Tunnel is the void space running in the midships fore and aft lines between the inner bottom and shell plating forming a protective space for bilge, ballast and other lines extending from the engine room to the holds.

Pinholing is tiny, deep holes exposing substrate.

Poop is the space below an enclosed superstructure at the extreme end of a vessel.

Poop Deck is the first deck above the shelter deck at after end of a vessel.

Port Light is another term for side light or side scuttle.

Scale is product of the corrosion process of steel with a porous surface layer or flakes, in volume greater than the metal from which it was formed.

Scantlings are the dimensions of a ship’s structural members as girders, stiffeners and plates.

Scupper is any opening for carrying off water from a deck, either directly or through piping.

Scuttle is a small opening in a deck or elsewhere, usually fitted with a cover or lid or a door as for access to a compartment.

Seam is a joint between two structural members lying in the same plane. Typically a seam is used to describe the welded connection of two plates in the longitudinal direction.

Semi-hard Coating is a coating that dries or converts in such a way that it stays flexible although hard enough to touch and walk upon.

Shedder Plates are slanted plates fitted in dry cargo holds to prevent undesired pockets of cargo. The term is also commonly applied to slanted plates that are fitted to improve the structural stability of corrugated bulkheads and framing members.

Sheer Strake is the top strake of a ship’s side shell plating.

Shop primer is a rust preventing paint for temporary protection of steel immediately after blasting for protection of the material surface from corrosion during construction and until the final paint system is applied.

Single Bottom Structure is the shell plating with stiffeners and girders below the upper turn of bilge.

Soft Coating is a coating that remains soft so that it wears off at low mechanical impact or when touched; often based on oils (vegetable or petroleum) or lanolin (sheep wool grease). Application of soft coating does generally not allow relaxation of the annual hull survey requirements of ballast tanks.

Spaces are separate compartments including holds and tanks.

Stay is a term for bulwarks and hatch coaming brackets.

Stem is the piece of bar or plating at which a vessel’s outside plating terminates at her forward end.

Stern Frame is the heavy strength member in single or triple screw vessels, combining the rudder post.

Stiffener is a collective term for secondary supporting structural members.

Stool is a structure supporting cargo hold and tank bulkheads.

Strake is a course, or row, of shell, deck, bulkhead, or other plating.

Strength Deck is normally the uppermost continuous deck. After special consideration of its effectiveness, another deck may be defined as strength deck.

Stress Concentration or Stress Raiser is a term used of any notch, crack, hole, corner, groove, attachment or other interruption to smooth flow of stress and strain in structures introduces a concentration of stress.

Stress Corrosion is local corrosion that may occur when a metallic material is simultaneously exposed to both tensile stresses and a corrosive medium. Tensile stresses may be residual stresses from welding or cold-working or applied working stresses.

Stringer Plate is the outside strake of deck plating.

Structural Testing or Tank Testing is a hydrostatic test carried out to demonstrate the structural adequacy of design and tightness of tank boundaries.

Substantial Corrosion See Sec.2.

Superstructure is a decked structure on the freeboard deck extending from side to side of the ship.

Suspect Areas are locations showing substantial corrosion and/or which are considered by the Surveyor to be prone to rapid wastage.

Topside Wing Ballast tanks are ballast tanks in bulk carriers that normally stretch along the length of the ship’s side and occupy the upper corners of the cargo hold.

Void is an enclosed empty space in a vessel, i.e., cofferdam.

Transverse Section includes, for thickness measurement purposes, all longitudinal members such as plating, longitudinal and girders at the deck, side, bottom, inner bottom and longitudinal bulkheads. For transversely framed ships, a transverse section includes adjacent frames and their end connections in way of transverse section. Also called Girth belt.

Wash Bulkhead is a perforated or partial bulkhead in a tank.

Watertight Bulkhead is a collective term for transverse bulkheads required for subdivision of the hull into watertight compartments.

Weathertight means that in any sea condition water will not penetrate into the vessel.

Weld Metal Corrosion is a preferential corrosion of the weld deposit due to an electrolytic action between the weld metal and base metal.

Wind and Water Strakes are the strakes of a ship’s side shell plating between the ballast and deepest load waterline.