

- .5 the tank or space must contain clean ballast water only. Even a thin sheen of oil on the water is not acceptable;
- .6 at no time should the water level be allowed to be within 1 m of the deepest under-deck web face flat so that the survey team is not isolated from a direct escape route to the tank hatch. Filling to levels above the deck transverses should only be contemplated if a deck access manhole is fitted and open in the bay being examined, so that an escape route for the survey party is available at all times. Other effective means of escape to the deck may be considered;
- .7 if the tanks (or spaces) are connected by a common venting system, or inert gas system, the tank in which the boat or raft should be used should be isolated to prevent a transfer of gas from other tanks (or spaces).

5.5.5 Rafts or boats alone may be allowed for inspection of the under-deck areas for tanks or spaces if the depth of the webs is 1.5 m or less.

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

- .1 when the coating of the under-deck structure is in GOOD condition and there is no evidence of wastage; or
- .2 if a permanent means of access is provided in each bay to allow safe entry and exit. This means of access should be direct from the deck via a vertical ladder with a small platform fitted approximately 2 m below the deck. Other effective means of escape to the deck may be considered.

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

5.5.7 The use of rafts or boats alone in 5.5.5 and 5.5.6 does not preclude the use of boats or rafts to move about within a tank during a survey.

5.6 *Survey planning meeting*

5.6.1 Proper preparation and close co-operation between the attending surveyor(s) and the owner's representatives on board prior to and during the survey are an essential part in the safe and efficient conduct of the survey. During the survey on-board safety meetings should be held regularly.

5.6.2 Prior to commencement of any part of the renewal and intermediate survey, a survey planning meeting should be held between the attending

surveyor(s), the owner's representative in attendance, the thickness measurement company operator (as applicable) and the master of the ship for the purpose to ascertain that all the arrangements envisaged in the survey programme are in place, so as to ensure the safe and efficient conduct of the survey work to be carried out.

5.6.3 The following is an indicative list of items that should be addressed in the meeting:

- .1 schedule of the ship (i.e., the voyage, docking and undocking manoeuvres, periods alongside, cargo and ballast operations etc.);
- .2 provisions and arrangements for thickness measurements (i.e., access, cleaning/ de-scaling, illumination, ventilation, personal safety);
- .3 extent of the thickness measurements;
- .4 acceptance criteria (refer to the list of minimum thicknesses);
- .5 extent of close-up survey and thickness measurement considering the coating condition and suspect areas/areas of substantial corrosion;
- .6 execution of thickness measurements;
- .7 taking representative readings in general and where uneven corrosion/pitting is found;
- .8 mapping of areas of substantial corrosion;
- .9 communication between attending surveyor(s), the thickness measurement company operator(s), and owner representative(s) concerning findings.

6 **Documentation on board**

6.1 *General*

6.1.1 The owner should obtain, supply and maintain on board the ship documentation as specified in 6.2 and 6.3, which should be readily available for the surveyor. The condition evaluation report referred to in 6.2 should include a translation into English.

6.1.2 The documentation should be kept on board for the lifetime of the ship.

6.2 *Survey report file*

6.2.1 A survey report file should be a part of the documentation on board consisting of:

- .1 reports of structural surveys (annex 8);
- .2 condition evaluation report (annex 9); and
- .3 thickness measurement reports (annex 10).

6.2.2 The survey report file should be available also in the owner's and the Administration offices.

6.3 *Supporting documents*

The following additional documentation should be available on board:

- .1 main structural plans of cargo and ballast tanks;
- .2 previous repair history;
- .3 cargo and ballast history;
- .4 extent of use of inert gas plant and tank cleaning procedures;
- .5 inspections by ship's personnel with reference to:
 - .5.1 structural deterioration in general;
 - .5.2 leakages in bulkheads and piping;
 - .5.3 condition of coating or corrosion prevention system, if any. A guidance for reporting is shown in annex 5;
- .6 survey programme as required by 5.1 until such time as the renewal survey has been completed,

and any other information that would help to identify critical structural areas and/or suspect areas requiring inspection.

6.4 *Review of documentation on board*

Prior to survey, the surveyor should examine the completeness of the documentation on board and its contents as a basis for the survey.

7 **Procedures for thickness measurements****7.1** *General*

7.1.1 The required thickness measurements, if not carried out by the recognized organization acting on behalf of the Administration, should be witnessed by a surveyor of the recognized organization. The surveyor should be on board to the extent necessary to control the process.

7.1.2 The thickness measurement company should be part of the survey planning meeting to be held prior to commencing the survey.

7.1.3 In all cases the extent of the thickness measurements should be sufficient as to represent the actual average condition.

7.2 *Certification of thickness measurement company*

The thickness measurements should be carried out by a qualified company certified by an organization recognized by the Administration according to principles stated in annex 7.

7.3 *Reporting*

7.3.1 A thickness measurement report should be prepared and submitted to the Administration. The report should give the location of measurements, the thickness measured as well as corresponding original thickness. Furthermore, the report should give the date when the measurements were carried out, type of measuring equipment, names of personnel and their qualifications and be signed by the operator. The thickness measurement report should follow the principles as specified in the recommended procedures for thickness measurements set out in annex 10.

7.3.2 The surveyor should verify and countersign the thickness measurement reports.

8 **Reporting and evaluation of survey****8.1** *Evaluation of survey report*

8.1.1 The data and information on the structural condition of the ship collected during the survey should be evaluated for acceptability and continued structural integrity of the ship.

8.1.2 In case of oil tankers of 130 m in length and upwards (as defined in the International Convention on Load Lines in force), the ship's longitudinal strength should be evaluated by using the thickness of structural members

measured, renewed and reinforced, as appropriate, during the renewal survey of safety construction carried out after the ship reached 10 years of age, in accordance with the criteria for longitudinal strength of the ship's hull girder for oil tankers specified in annex 12.

8.1.3 The analysis of data should be carried out and endorsed by the Administration and the conclusions of the analysis should form a part of the condition evaluation report.

8.1.4 The final result of the evaluation of the ship's longitudinal strength required in 8.1.2, after renewal or reinforcement work of structural members, if carried out as a result of initial evaluation, should be reported as a part of the condition evaluation report.

8.2 Reporting

8.2.1 Principles for survey reporting are shown in annex 8.

8.2.2 When a survey is split between different survey stations, a report should be made for each portion of the survey. A list of items examined and/or tested (pressure-testing, thickness measurements etc.) and an indication of whether the item has been credited, should be made available to the next attending surveyor(s), prior to continuing or completing the survey.

8.2.3 A condition evaluation report of the survey and results should be issued to the owner as shown in annex 9 and placed on board the ship for reference at future surveys. The condition evaluation report should be endorsed by the Administration.

Annex 1 Requirements for close-up survey at renewal surveys

Age ≤ 5 years	5 < Age ≤ 10 years	10 < Age ≤ 15 years	Age > 15 years
1	2	3	4
(A) ONE WEB FRAME RING - in a ballast wing tank, if any, or a cargo wing tank used primarily for water ballast (B) ONE DECK TRANSVERSE - in a cargo tank (D) ONE TRANSVERSE BULKHEAD - in a ballast tank (D) ONE TRANSVERSE BULKHEAD - in a cargo wing tank (D) ONE TRANSVERSE BULKHEAD - in a cargo centre tank	(A) ALL WEB FRAME RINGS - in a ballast wing tank, if any, or a cargo wing tank used primarily for water ballast (B) ONE DECK TRANSVERSE - in each of the remaining ballast tanks, if any (B) ONE DECK TRANSVERSE - in a cargo wing tank (B) ONE DECK TRANSVERSE - in two cargo centre tanks (C) BOTH TRANSVERSE BULKHEADS in a wing ballast tank, if any, or a cargo wing tank used primarily for water ballast	(A) ALL WEB FRAME RINGS - in all ballast tanks (A) ALL WEB FRAME RINGS - in a cargo wing tank (A) A minimum of 30% of all web frame rings in each remaining cargo wing tank (see note 1) (C) ALL TRANSVERSE BULKHEADS - in all cargo and ballast tanks (E) A minimum of 30% of deck and bottom transverse including adjacent structural members in each cargo centre tank (see note 1) (F) As considered necessary by the Administration	As for ships referred to in column 3 Additional transverse included as deemed necessary by the Administration

Age ≤ 5 years	5 < Age ≤ 10 years	10 < Age ≤ 15 years	Age > 15 years
1	2	3	4
	(D) ONE TRANSVERSE BULKHEAD – in each remaining ballast tank (D) ONE TRANSVERSE BULKHEAD – in a cargo wing tank (D) ONE TRANSVERSE BULKHEAD – in two cargo centre tanks		

Note 1: The 30% should be rounded up to the next whole integer.

- (A) Complete transverse web frame ring including adjacent structural members
- (B) Deck transverse including adjacent deck structural members
- (C) Transverse bulkheads complete – including girder system and adjacent members
- (D) Transverse bulkhead lower part– including girder system and adjacent structural members
- (E) Deck and bottom transverse including adjacent structural members
- (F) Additional complete transverse web ring frame

Annex 2 Requirements for thickness measurements at renewal surveys

Age ≤ 5 years	5 < Age ≤ 10 years	10 < Age ≤ 15 years	Age > 15 years
1	2	3	4
1 One section of deck plating for the full beam of the ship within the cargo area (in way of a ballast tank, if any, or a cargo tank used primarily for water ballast) 2 Measurements of structural members subject to close-up survey according to annex 1, for general assessment and recording of corrosion pattern 3 Suspect areas	1 Within the cargo area: .1 each deck plate .2 one transverse section 2 Measurements of structural members subject to close-up survey according to annex 1, for general assessment and recording of corrosion pattern 3 Suspect areas 4 Selected wind and water strakes outside the cargo area	1 Within the cargo area: .1 each deck plate .2 two transverse sections 2 Measurements of structural members subject to close-up survey according to annex 1, for general assessment and recording of corrosion pattern 3 Suspect areas 4 Selected wind and water strakes outside the cargo area 5 All wind and water strakes within the cargo area	1 Within the cargo area: .1 each deck plate .2 three transverse sections .3 each bottom plate 2 Measurements of structural members subject to close-up survey according to annex 1, for general assessment and recording of corrosion pattern 3 Suspect areas 4 Selected wind and water strakes outside the cargo area 5 All wind and water strakes within the cargo area

Annex 3
Requirements for tank pressure testing at renewal surveys

Age ≤ 5 years	5 < Age ≤ 10 years	10 < Age ≤ 15 years	Age > 15 years
1	2	3	4
<ol style="list-style-type: none"> 1 Cargo tank boundaries facing ballast tanks, void spaces, pipe tunnels, fuel oil tanks, pump-rooms or cofferdams 2 Representative tanks for fresh water, fuel oil and lubrication oil 	<ol style="list-style-type: none"> 1 Cargo tank boundaries facing ballast tanks, void spaces, pipe tunnels, fuel oil tanks, pump-rooms or cofferdams 2 All cargo tank bulkheads which form the boundaries of segregated cargoes 3 Representative tanks for fresh water, fuel oil and lubrication oil 	<ol style="list-style-type: none"> 1 Cargo tank boundaries facing ballast tanks, void spaces, pipe tunnels, fuel oil tanks, pump-rooms or cofferdams 2 All remaining cargo tank bulkheads 3 Representative tanks for fresh water, fuel oil and lubrication oil 	<ol style="list-style-type: none"> 1 Cargo tank boundaries facing ballast tanks, void spaces, pipe tunnels, fuel oil tanks, pump-rooms or cofferdams 2 All remaining cargo tank bulkheads 3 All fresh water fuel oil and lubrication oil tanks

Annex 4
Requirements for extent of thickness measurements
at areas of substantial corrosion

Renewal survey within the cargo area

BOTTOM STRUCTURE

Structural member	Extent of measurement	Pattern of measurement
1 Bottom plating	Minimum of three bays across tank, including aft bay. Measurements around and under all bell mouths	Five-point pattern for each panel between longitudinals and webs
2 Bottom longitudinals	Minimum of three longitudinals in each bay where bottom plating measured	Three measurements in line across flange and three measurements on vertical web
3 Bottom 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. Five-point pattern on girder/bulkhead brackets
4 Bottom transverse webs	Three webs in bays where bottom plating measured, with measurements at both ends and middle	Five-point pattern over 2 m ² area. Single measurements on face flat.
5 Panel stiffening	Where fitted	Single measurements

DECK STRUCTURE

Structural member	Extent of measurement	Pattern of measurement
1 Deck plating	Two bands across tank	Minimum of three measurements per plate per band
2 Deck longitudinals	Minimum of three longitudinals in each of two bays	Three measurements in line vertically on webs, and two 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. Five-point pattern on girder/bulkhead brackets
4 Deck transverse webs	Minimum of two webs with measurements at middle and both ends of span	Five-point pattern over about 2 m ² area. Single measurements on face flat
5 Panel stiffening	Where available	Single measurements

SHELL AND LONGITUDINAL BULKHEADS

Structural member	Extent of measurement	Pattern of measurement
1 Deckhead and bottom strakes, and strakes in way of stringer platforms	Plating between each pair of longitudinals in a minimum of three bays	Single measurement
2 All other strakes	Plating between every third pair of longitudinals in same three bays	Single measurement
3 Longitudinals - deckhead and bottom strakes	Each longitudinal in same three bays	Three measurements across web and one measurement on flange
4 Longitudinals - all others	Every third longitudinal in same three bays	Three measurements across web and one measurement on flange
5 Longitudinals - bracket	Minimum of three at top, middle and bottom of tank in same three bays	Five-point pattern over area of bracket
6 Web frames and cross ties	Three webs with minimum of three locations on each web, including in way of cross tie connections	Five-point pattern over about 2 m ² area, plus single measurements on web frame and cross tie face flats

TRANSVERSE BULKHEADS AND SWASH BULKHEADS

Structural member	Extent of measurement	Pattern of measurement
1 Deckhead and bottom strakes, and strakes in way of stringer platforms	Plating between pair of stiffeners at three locations – approximately quarter, half and three-quarters width of tank	Five-point pattern between stiffeners over 1 m length
2 All other strakes	Plating between pair of stiffeners at middle location	Single measurement
3 Strakes in corrugated bulkheads	Plating for each change of scantling at centre of panel and at flange or fabricated connection	Five-point pattern over about 1 m ² of plating
4 Stiffeners	Minimum of three typical stiffeners	For web, five-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
5 Brackets	Minimum of three at top, middle and bottom of tank	Five-point pattern over area of bracket
6 Deep webs and girders	Measurements at toe of bracket and centre of span	For web, five-point pattern over about 1 m ² area. Three measurements across face flat
7 Stringer platforms	All stringers with measurements at both ends and middle	Five-point pattern over 1 m ² area plus single measurements near bracket toes and on face flats

Annex 5

Owner's inspection report
Structural condition

Ship's name:							
Owners's inspection report – Structural condition							
For tank no:							
Grade of steel: deck: side:							
bottom: longitudinal bulkhead:							
Elements	Cracks	Buckles	Corrosion	Coating condition	Pitting	Modification/repair	Other
Deck:							
Bottom:							
Side:							
Longitudinal bulkheads:							
Transverse bulkheads:							
Repairs carried out due to:							
Thickness measurements carried out (dates):							
Results in general:							
Overdue surveys:							
Outstanding conditions of class:							
Comments:							
Date of inspection:							
Inspected by:							
Signature:							

Annex 6A

Survey programme

Basic information and particulars

Name of ship:
IMO number:
Flag State:
Port of registry:
Gross tonnage:
Deadweight (metric tonnes):
Length between perpendiculars (m):
Shipbuilder:
Hull number:
Recognized Organization (RO):
RO ship identity:
Date of delivery of the ship:
Owner:
Thickness measurement company:

1 Preamble

1.1 Scope

1.1.1 The present survey programme covers the minimum extent of overall surveys, close-up surveys, thickness measurements and pressure testing within the cargo area, ballast tanks, including fore and aft peak tanks, required by the Guidelines.

1.1.2 The arrangements and safety aspects of the survey should be acceptable to the attending surveyor(s).

1.2 Documentation

All documents used in the development of the survey programme should be available on board during the survey as required by section 6.

2 Arrangement of tanks and spaces

This section of the survey programme should provide information (either in the form of plans or text) on the arrangement of tanks and spaces that fall within the scope of the survey.

3 List of tanks and spaces with information on their use, extent of coatings and corrosion protection system

This section of the survey programme should indicate any changes relating to (and should update) the information on the use of the tanks of the ship, the extent of coatings and the corrosion protective system provided in the survey planning questionnaire.

4 Conditions for survey

This section of the survey programme should provide information on the conditions for survey, e.g., information regarding cargo hold and tank cleaning, gas freeing, ventilation, lighting etc.

5 Provisions and method of access to structures

This section of the survey programme should indicate any changes relating to (and should update) the information on the provisions and methods of access to structures provided in the survey planning questionnaire.

6 List of equipment for survey

This section of the survey programme should identify and list the equipment that will be made available for carrying out the survey and the required thickness measurements.

7 Survey requirements

7.1 Overall survey

This section of the survey programme should identify and list the spaces that should undergo an overall survey for the ship in accordance with 2.4.1.

7.2 Close-up survey

This section of the survey programme should identify and list the hull structures that should undergo a close-up survey for the ship in accordance with 2.4.2.

8 Identification of tanks for tank testing

This section of the survey programme should identify and list the tanks that should undergo tank testing for the ship in accordance with 2.6.

9 Identification of areas and sections for thickness measurements

This section of the survey programme should identify and list the areas and sections where thickness measurements should be taken in accordance with 2.5.1.

10 Minimum thickness of hull structures

This section of the survey programme should specify the minimum thickness for hull structures of the ship that are subject to the Guidelines (indicate either (a) or preferably (b), if such information is available):

- (a) Determined from the attached wastage allowance table and the original thickness to the hull structure plans of the ship;
- (b) Given in the following table(s):

Area or location	Original as-built thickness (mm)	Minimum thickness (mm)	Substantial corrosion thickness (mm)
Deck			
Plating			
Longitudinals			
Longitudinal girders			
Bottom			
Plating			
Longitudinals			
Longitudinal girders			
Ship side			
Plating			
Longitudinals			
Longitudinal girders			

Area or location	Original as-built thickness (mm)	Minimum thickness (mm)	Substantial corrosion thickness (mm)
Longitudinal bulkhead			
Plating			
Longitudinals			
Longitudinal girders			
Inner bottom			
Plating			
Longitudinals			
Longitudinal girders			
Transverse bulkheads			
Plating			
Stiffeners			
Transverse web frames, floors and stringers			
Plating			
Flanges			
Stiffeners			
Cross ties			
Flanges			
Webs			

Note: The wastage allowance tables should be attached to the survey programme.

11 Thickness measurement company

This section of the survey programme should identify changes, if any, relating to the information on the thickness measurement company provided in the survey planning questionnaire.

12 Damage experience related to the ship

This section of the survey programme should, using the tables provided below, provide details of the hull damages for at least the last three years in way of the cargo and ballast tanks and void spaces within the cargo area. These damages are subject to survey.

Hull damages sorted by location for the ship

Tank or space number or area	Possible cause, if known	Description of the damages	Location	Repair	Date of repair

Hull damages for sister or similar ships (if available) in the case of design related damage

Tank or space number or area	Possible cause, if known	Description of the damages	Location	Repair	Date of repair

13 Areas identified with substantial corrosion from previous surveys

This section of the survey programme should identify and list the areas of substantial corrosion from previous surveys.

14 Critical structural areas and suspect areas

This section of the survey programme should identify and list the critical structural areas and the suspect areas, if such information is available.

15 Other relevant comments and information

This section of the survey programme should provide any other comments and information relevant to the survey.

Appendices**Appendix 1 – List of plans**

Paragraph 5.1.3.2 requires that main structural plans of cargo and ballast tanks (scantling drawings), including information on regarding use of high tensile steel (HTS), to be available. This appendix of the survey programme should identify and list the main structural plans which form part of the survey programme.

Appendix 2 – Survey planning questionnaire

The survey planning questionnaire (annex 6B), which has been submitted by the owner, should be appended to the survey programme.

Appendix 3 – Other documentation

This part of the survey programme should identify and list any other documentation that forms part of the plan.

Prepared by the owner in co-operation with the Administration for compliance with 5.1.3.

Date:
(name and signature of authorized owner's representative)

Date:
(name and signature of authorized representative of the Administration)

Annex 6B

Survey planning questionnaire

The following information will enable the owner in co-operation with the Administration to develop a survey programme complying with the requirements of the Guidelines. It is essential that the owner provides, when completing the present questionnaire, up-to-date information. The present questionnaire, when completed, should provide all information and material required by the resolution.

Particulars

Ship's name:

IMO number:

Flag State:

Port of registry:

Owner:

Recognized Organization (RO):

Gross tonnage:

Deadweight (metric tonnes):

Date of delivery:

Information on access provision for close-up surveys and thickness measurement

The owner should indicate, in the table below, the means of access to the structures subject to close-up survey and thickness measurement. A close-up survey is an examination where the details of structural components are within the close visual inspection range of the attending surveyor, i.e., preferably within reach of hand.

Tank No.	Structure	C (Cargo)/ B (Ballast)	Temporary staging	Rafts	Ladders	Direct access	Other means (please specify)
F.P.	Fore peak						
A.P.	Aft peak						
	Underdeck						
	Side shell						
	Bottom transverse						
	Longitudinal						
	Transverse						
	Underdeck						
	Bottom transverse						
	Transverse						

History of cargo with H₂S content or heated cargo for the last three years together with indication as to whether cargo was heated and, where available, Marine Safety Data Sheets (MSDS)*

Owner's inspections

Using a format similar to that of the table below (which is given as an example), the owner should provide details of the results of their inspections for the last three years on all cargo and ballast tanks and void spaces within the cargo area, including peak tanks.

Tank No.	Corrosion protection (1)	Coating extent (2)	Coating condition (3)	Structural deterioration (4)	Tank damage history (5)
Cargo centre tanks					
Cargo wing tanks					
Slop					
Ballast tanks Aft peak Fore peak					
Miscellaneous spaces					

Note: Indicate tanks which are used for oil/ballast.

* Refer to resolution MSC.150(77) on Recommendation for material safety data sheets for MARPOL Annex I cargoes and marine fuel oils.

- 1) HC = hard coating; SC = soft coating; A = anodes; NP = no protection
- 2) U = upper part; M = middle part; L = lower part; C = complete
- 3) G = good; F = fair; P = poor; RC = recoated (during the last three years)
- 4) N = no findings recorded; Y = findings recorded, description of findings should be attached to this questionnaire
- 5) DR = Damage & Repair; L = Leakages; CV = Conversion (Description to be attached to this questionnaire)

Name of owner's representative:
Signature:.....
Date:

Reports of port State control inspections

List the reports of port State control inspections containing hull structural related deficiencies, relevant information on rectification of the deficiencies:

Safety management system

List non-conformities related to hull maintenance, including the associated corrective actions:

Name and address of the approved thickness measurement company:

Annex 7

Procedures for certification of a company engaged in thickness measurement of hull structures

1 Application

This guidance applies for certification of the company which intends to engage in the thickness measurement of hull structures of ships.

2 Procedures for certification

Submission of documents

2.1 The following documents should be submitted to an organization recognized by the Administration for approval:

- .1 outline of the company, e.g., organization and management structure;
- .2 experience of the company on thickness measurement of hull structures of ships;
- .3 technicians' careers, i.e., experience of technicians as thickness measurement operators, technical knowledge and experience of hull structure, etc. Operators should be qualified according to a recognized industrial NDT Standard;
- .4 equipment used for thickness measurement such as ultrasonic testing machines and their maintenance/calibration procedures;
- .5 a guide for thickness measurement operators;
- .6 training programmes for technicians for thickness measurement; and
- .7 measurement record format in accordance with recommended procedures for thickness measurements (see annex 10).

Auditing of the company

2.2 Upon reviewing the documents' submitted with satisfactory results, the company should be audited in order to ascertain that the company is duly organized and managed in accordance with the documents submitted, and eventually is capable of conducting thickness measurement of the hull structure of ships.

2.3 Certification is conditional upon an on board demonstration of thickness measurement as well as satisfactory reporting.

3 Certification

3.1 Upon satisfactory results of both the audit of the company referred to in 2.2 and the demonstration tests referred to in 2.3, the Administration or organization recognized by the Administration should issue a certificate of approval as well as a notice to the effect that the thickness measurement operation system of the company has been certified.

3.2 Renewal/endorsement of the certificate should be made at intervals not exceeding three years by verification that original conditions are maintained.

4 Report of any alteration to the certified thickness measurement operation system

In cases where any alteration to the certified thickness measurement operation system of the company is made, such an alteration should be immediately reported to the organization recognized by the Administration. Re-audit should be made where deemed necessary by the organization recognized by the Administration.

5 Withdrawal of the certification

The certification may be withdrawn in the following cases:

- .1 where the measurements were improperly carried out or the results were improperly reported;
- .2 where the surveyor found any deficiencies in the approved thickness measurement operation system of the company;
- .3 where the company failed to report any alteration referred to in 4 to the organization recognized by the Administration as required.

Annex 8

Survey reporting principles

As a principle, for oil tankers subject to the Guidelines, the surveyor should include the following contents in his report for survey of hull structure and piping systems, as relevant for the survey.

1 General

1.1 A survey report should be generated in the following cases:

- .1 in connection with commencement, continuation and/or completion of periodical hull surveys, i.e., annual, intermediate and renewal surveys, as relevant;
- .2 when structural damages/defects have been found;
- .3 when repairs, renewals or modifications have been carried out; and
- .4 when condition of class (recommendation) has been imposed or deleted.

1.2 The reporting should provide:

- .1 evidence that prescribed surveys have been carried out in accordance with applicable requirements;
- .2 documentation of surveys carried out with findings, repairs carried out and condition of class (recommendation) imposed or deleted;
- .3 survey records, including actions taken, which should form an auditable documentary trail. Survey reports should be kept in the survey report file required to be on board;
- .4 information for planning of future surveys; and
- .5 information which may be used as input for maintenance of classification rules and instructions.

1.3 When a survey is split between different survey stations, a report should be made for each portion of the survey. A list of items surveyed, relevant findings and an indication of whether the item has been credited, should be made available to the next attending surveyor, prior to continuing or completing the survey. Thickness measurement and tank testing carried out should also be listed for the next surveyor.

2 Extent of the survey

2.1 Identification of compartments where an overall survey has been carried out.

2.2 Identification of locations, in each tank, where a close-up survey has been carried out, together with information of the means of access used.

2.3 Identification of locations, in each tank, where thickness measurement has been carried out.

Note: As a minimum, the identification of location of close-up survey and thickness measurement should include a confirmation with description of individual structural members corresponding to the extent of requirements stipulated in this part of Annex B based on type of periodical survey and the ship's age.

Where only partial survey is required, i.e., one web frame ring/one deck transverse, the identification should include location within each ballast tank and cargo hold by reference to frame numbers.

2.4 For areas in tanks where protective coating is found to be in good condition and the extent of close-up survey and/or thickness measurement has been specially considered, structures subject to special consideration should be identified.

2.5 Identification of tanks subject to tank testing.

2.6 Identification of piping systems on deck, including crude oil washing (COW) piping, and ballast piping within cargo and ballast tanks, pipe tunnels, cofferdams and void spaces where:

- .1 examination, including internal examination of piping with valves and fittings and thickness measurement, as relevant, has been carried out; and
- .2 operational test to working pressure has been carried out.

3 Result of survey

3.1 Type, extent and condition of protective coating in each tank, as relevant (rated GOOD, FAIR or POOR), including identification of tanks fitted with anodes.

3.2 Structural condition of each compartment with information on the following, as relevant:

- .1 Identification of findings, such as:
 - .1.1 corrosion with description of location, type and extent;
 - .1.2 areas with substantial corrosion;
 - .1.3 cracks/fractures with description of location and extent;
 - .1.4 buckling with description of location and extent; and
 - .1.5 indents with description of location and extent.
- .2 Identification of compartments where no structural damages/defects are found. The report may be supplemented by sketches/photographs.
- .3 Thickness measurement report should be verified and signed by the surveyor controlling the measurements on board.
- .4 Evaluation result of longitudinal strength of the hull girder of oil tankers of 130 m in length and upwards and over 10 years of age. The following data should be included, as relevant:
 - .4.1 measured and as-built transverse sectional areas of deck and bottom flanges;
 - .4.2 diminution of transverse sectional areas of deck and bottom flanges; and
 - .4.3 details of renewals or reinforcements carried out, as relevant (see 4.2).

4 Actions taken with respect to findings

4.1 Whenever the attending surveyor is of the opinion that repairs are required, each item to be repaired should be identified in a numbered list. Whenever repairs are carried out, details of the repairs effected should be reported by making specific reference to relevant items in the numbered list.

4.2 Repairs carried out should be reported with identification of:

- .1 compartment;
- .2 structural member;
- .3 repair method (i.e., renewal or modification), including:
 - .3.1 steel grades and scantlings (if different from the original);
 - .3.2 sketches/photographs, as appropriate;

- .4 repair extent; and
- .5 non-destructive tests (NDT).

4.3 For repairs not completed at the time of survey, condition of class/recommendation should be imposed with a specific time limit for the repairs. In order to provide correct and proper information to the surveyor attending for survey of the repairs, condition of class/recommendation should be sufficiently detailed with identification of each item to be repaired. For identification of extensive repairs, reference may be given to the survey report.

Annex 9
Condition Evaluation Report
Issued upon completion of renewal survey

General particulars

Ship's name:	Class/Administration identity number: Previous class/Administration identity number(s): IMO number:
Port of registry:	National flag: Previous national flag(s):
Deadweight (metric tonnes):	Gross tonnage: National: ITC (1969):
Date of build:	Classification notation:
Date of major conversion:	
Type of conversion:	Owner: Previous owner(s):

1 The survey reports and documents listed below have been reviewed by the undersigned and found to be satisfactory.

2 The renewal survey has been completed in accordance with the present Guidelines on (date)

Condition evaluation report completed by	Name Signature	Title
Office	Date	
Condition evaluation report verified by	Name Signature	Title
Office	Date	

Attached reports and documents:

- 1)
- 2)
- 3)
- 4)
- 5)
- 6)

Contents of condition evaluation report

- Part 1 - General particulars: - See front page
- Part 2 - Report review: - Where and how survey was done
- Part 3 - Close-up survey: - Extent (which tanks)
- Part 4 - Cargo and ballast piping system: - Examined
- Operationally tested
- Part 5 - Thickness measurements: - Reference to thickness measurement report
- Summary of where measured
- Separate form indicating the spaces with substantial corrosion, and corresponding:
- thickness diminution
- corrosion pattern
- Part 6 - Tank corrosion prevention system: - Separate form indicating:
- location of coating/anodes
- condition of coating (if applicable)
- Part 7 - Repairs: - Identification of spaces/areas
- Part 8 - Condition of class/flag State requirements:
- Part 9 - Memoranda: - Acceptable defects
- Any points of attention for future surveys, e.g., for suspect areas
- Extended annual/intermediate survey due to coating breakdown
- Part 10 - Conclusion: - Statement on evaluation/verification of survey report

Extract of thickness measurements

Reference is made to the thickness measurement report:

Position of substantially corroded tanks/areas ¹ or areas with deep pitting ³	Thickness diminution [%]	Corrosion pattern ²	Remarks: (e.g., ref. attached sketches)

Notes:

- ¹ Substantial corrosion, i.e., 75%-100% of acceptable margins wasted.
- ² P = Pitting
C = Corrosion in general
- ³ Any bottom plating with a pitting intensity of 20% or more, with wastage in the substantial corrosion range or having an average depth of pitting of $\frac{1}{3}$ or more of actual plate thickness should be noted.

Tank corrosion prevention system

Tank nos. ¹	Tank corrosion prevention system ²	Coating condition ³	Remarks

Notes:

- 1 All segregated ballast tanks and combined cargo/ballast tanks should be listed.
- 2 C = Coating A = Anodes NP = No protection
- 3 Coating condition according to the following standard:
- GOOD condition with only minor spot rusting.
- FAIR condition with local breakdown of coating at edges of stiffeners and weld connections and/or light rusting over 20% or more of areas under consideration, but less than as defined for POOR condition.
- POOR condition with general breakdown of coating over 20% or more of areas or hard scale at 10% or more of areas under consideration.

If coating condition POOR is given, extended annual surveys should be introduced. This should be noted in part 7 of the Contents of condition evaluation report.

Evaluation result of longitudinal strength of the hull girder of oil tankers of 130 m in length and upwards and of over 10 years of age
(of sections 1, 2 and 3 below, only one applicable section should be completed)

1 This section applies to ships regardless of the date of construction: Transverse sectional areas of deck flange (deck plating and deck longitudinals) and bottom flange (bottom shell plating and bottom longitudinals) of the ship's hull girder have been calculated by using the thickness measured, renewed or reinforced, as appropriate, during the renewal survey of the Cargo Ship Safety Construction Certificate or the Cargo Ship Safety Certificate (SC renewal survey) most recently conducted after the ship reached 10 years of age, and found that the diminution of the transverse sectional area does not exceed 10% of the as-built area, as shown in the following table:

Table 1 - Transverse sectional area of hull girder flange

		Measured	As-built	Diminution
Transverse section 1	Deck flange	cm ²	cm ²	cm ² (%)
	Bottom flange	cm ²	cm ²	cm ² (%)
Transverse section 2	Deck flange	cm ²	cm ²	cm ² (%)
	Bottom flange	cm ²	cm ²	cm ² (%)
Transverse section 3	Deck flange	cm ²	cm ²	cm ² (%)
	Bottom flange	cm ²	cm ²	cm ² (%)

2 This section applies to ships constructed on or after 1 July 2002: Section moduli of transverse section of the ship's hull girder have been calculated by using the thickness of structural members measured, renewed or reinforced, as appropriate, during the SC renewal survey most recently conducted after the ship reached 10 years of age in accordance with the provisions of paragraph 2.1.1 of annex 12, and are found to be within their diminution limits determined by the Administration, taking into account the recommendations adopted by the Organization,* as shown in the following table:

* Refer to resolution MSC.108(73) on Recommendations on compliance with the requirements of paragraph 2.2.1.1 of annex 12 to annex B to resolution A.744(18).

Table 2 – Transverse section modulus of hull girder

		Z_{act} (cm ³) ¹	Z_{req} (cm ³) ²	Remarks
Transverse section 1	Upper deck			
	Bottom			
Transverse section 2	Upper deck			
	Bottom			
Transverse section 3	Upper deck			
	Bottom			

Notes:

1 Z_{act} means the actual section moduli of the transverse section of the ship's hull girder calculated by using the thickness of structural members measured, renewed or reinforced, as appropriate, during the SC renewal survey, in accordance with the provisions of paragraph 2.1.1 of annex 12.

2 Z_{req} means the diminution limit of the longitudinal bending strength of ships, as calculated in accordance with the provisions of paragraph 2.1.1 of annex 12.

The calculation sheets for Z_{act} should be attached to this report.

3 This section applies to ships constructed before 1 July 2002: Section moduli of transverse sections of the ship's hull girder have been calculated by using the thickness of structural members measured, renewed or reinforced, as appropriate, during the SC renewal survey most recently conducted after the ship reached 10 years of age in accordance with the provisions of paragraph 2.2.1.2 of annex 12, and found to meet the criteria required by the Administration or the recognized classification society and that Z_{act} is not less than Z_{mc} (defined in note 2 below) as specified in appendix 2 to annex 12, as shown in the following table.

Describe the criteria for acceptance of the minimum section moduli of the ship's hull girder for ships in service required by the Administration or the recognized classification society.

Table 3 – Transverse section modulus of hull girder

		Z_{act} (cm ³) ¹	Z_{mc} (cm ³) ²	Remarks
Transverse section 1	Upper deck			
	Bottom			
Transverse section 2	Upper deck			
	Bottom			
Transverse section 3	Upper deck			
	Bottom			

Notes:

1 As defined in note 1 of table 2.

2 Z_{mc} means the diminution limit of minimum section modulus calculated in accordance with the provisions of paragraph 2.1.2 of annex 12.

Annex 10*Recommended procedures for thickness measurements***General**

1 These procedures should be used for recording thickness measurements as required by annexes 2 and 4.

2 Reporting forms TM1-T, TM2-T, TM3-T, TM4-T, TM5-T and TM6-T, set out in appendix 2, should be used for recording thickness measurements and the maximum allowable diminution should be stated.

3 Appendix 3 contains guidance diagrams and notes relating to the reporting forms and the requirements for thickness measurement.

4 The reporting forms should, where appropriate, be supplemented by data presented on structural sketches.

**Appendix 1
GENERAL PARTICULARS**

Ship's name:
 IMO number:
 Class/Administration identity number:
 Port of registry:
 Gross tonnage:
 Deadweight:
 Date of build:
 Classification society:

Name of company performing thickness measurement:

Thickness measurement company certified by:

Certificate number:

Certificate valid from: to

Place of measurement:

First date of measurement:

Last date of measurement:

Periodical survey/intermediate survey* due:

Details of measurement equipment:

Qualification of operator:

Report number: consisting of pages

Name of operator: Name of surveyor:

Signature of operator: Signature of surveyor:

Company official stamp: Administration:
 Official stamp

* Delete as appropriate.

Appendix 2

Report on thickness measurement of all deck plating, all bottom shell plating or side shell plating (TM1-T)

STRAKE POSITION	No. or letter	Org. thk. mm	Gauged				Forward reading				Aft reading				Mean diminution %		Max. allow. dimin. (mm)
			P		S		Diminution P		Diminution S		Diminution P		Diminution S		%	S	
			mm	%	mm	%	mm	%	mm	%	mm	%	mm	%			
12th forward																	
11th																	
10th																	
9th																	
8th																	
7th																	
6th																	
5th																	
4th																	
3rd																	
2nd																	
1st																	
Amidships																	
1st aft																	
2nd																	
3rd																	
4th																	
5th																	
6th																	
7th																	
8th																	
9th																	
10th																	
11th																	
12th																	

Ship's name Class identity no. Report no. IMO number

Operator's signature Surveyor's signature Notes - see following page

Notes:

- 1** This report should be used for recording the thickness measurement of:
 - .1 All strength deck plating within the cargo area.
 - .2 All keel, bottom shell plating and bilge plating within the cargo area.
 - .3 Side shell plating including selected wind and water strakes outside the cargo area.
- 2** The strake position should be clearly indicated as follows:
 - .1 For strength deck plating, indicate the number of the strake of plating inboard from the stringer plate.
 - .2 For bottom plating, indicate the number of the strake of plating outboard from the keel plate.
 - .3 For side shell plating, give number of the strake of plating below shear strake and letter as shown on shell expansion.
- 3** For oil tankers, all deck plating strakes should be recorded, for ore/oil ships only the deck plating strakes outside line of openings should be recorded.
- 4** Measurements should be taken at the forward and aft areas of all plates and where plates cross ballast/cargo tank boundaries, separate measurements for the area of plating in way of each type of tank should be recorded.
- 5** The single measurements recorded should represent the average of multiple measurements.

**Report on thickness measurement of shell and deck plating
(one, two or three transverse sections) (TM2-T(1))**

Ship's name Class identity no. Report no. IMO number

STRAKE POSITION	STRENGTH DECK AND SHEERSTRAKE PLATING														
	FIRST TRANSVERSE SECTION AT FRAME NUMBER					SECOND TRANSVERSE SECTION AT FRAME NUMBER					THIRD TRANSVERSE SECTION AT FRAME NUMBER				
	No. or letter	Org. thk. mm	Max. allow. dimi. mm	Gauged P S	Diminution P S mm %	No. or letter	Org. thk. mm	Max. allow. dimi. mm	Gauged P S	Diminution P S mm %	No. or letter	Org. thk. mm	Max. allow. dimi. mm	Gauged P S	Diminution P S mm %
Stringer plate															
1st strake inboard															
2nd															
3rd															
4th															
5th															
6th															
7th															
8th															
9th															
10th															
11th															
12th															
13th															
14th															
centre strake															
sheer strake															
TOPSIDE TOTAL															

Operator's signature Surveyor's signature Notes - see following page

Notes:

- 1 This report should be used for recording the thickness measurement of strength deck plating and sheerstrake plating transverse sections:
One, two or three sections within the cargo area comprising structural items (1), (2) and (3) as shown on the diagrams of typical transverse section indicating longitudinal and transverse members, in appendix 3.
- 2 For oil tankers all deck plating strakes should be recorded, for ore/oil ships only the deck plating strakes outside line of openings should be recorded.
- 3 The topside area comprises deck plating, stringer plate and sheerstrake (including rounded gunwales).
- 4 The exact frame station of measurement should be stated.
- 5 The single measurements recorded should represent the average of multiple measurements.

**Report on thickness measurement of shell and deck plating
(one, two or three transverse sections) (TM2-T(2))**

Ship's name Class identity no. Report no. IMO number

STRAKE POSITION	SHELL PLATING																	
	FIRST TRANSVERSE SECTION AT FRAME NUMBER			SECOND TRANSVERSE SECTION AT FRAME NUMBER			THIRD TRANSVERSE SECTION AT FRAME NUMBER											
No. or letter	Org. thk. mm	Max. allow. dimm. mm	Gauged P S	Diminution P mm	Diminution S %	No. or letter	Org. thk. mm	Max. allow. dimm. mm	Gauged P S	Diminution P mm	Diminution S %	No. or letter	Org. thk. mm	Max. allow. dimm. mm	Gauged P S	Diminution P mm	Diminution S %	
1st below sheerstrake																		
2nd																		
3rd																		
4th																		
5th																		
6th																		
7th																		
8th																		
9th																		
10th																		
11th																		
12th																		
13th																		
14th																		
15th																		
16th																		
17th																		
18th																		
19th																		
20th																		
keel strake																		
BOTTOM TOTAL																		

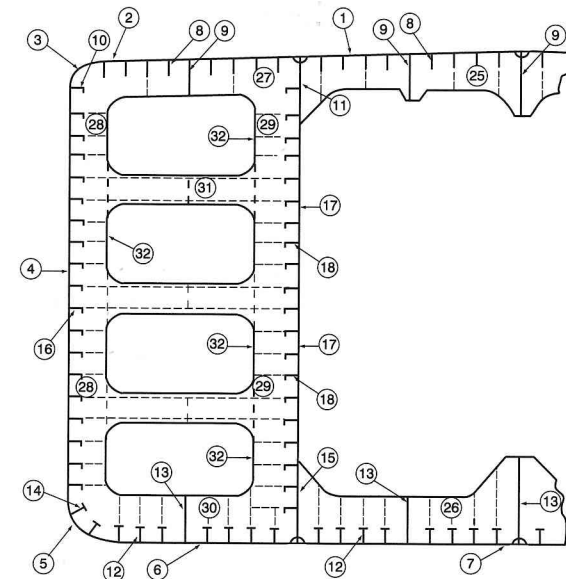
Operator's signature Surveyor's signature Notes - see following page

Notes:

- 1 This report should be used for recording the thickness measurement of miscellaneous structural members including structural items (36), (37) and (38) shown in appendix 3.
- 2 The single measurements recorded should represent the average of multiple measurements.

Appendix 3 GUIDANCE ON THICKNESS MEASUREMENT

Typical transverse section of oil tanker indicating longitudinal and transverse members



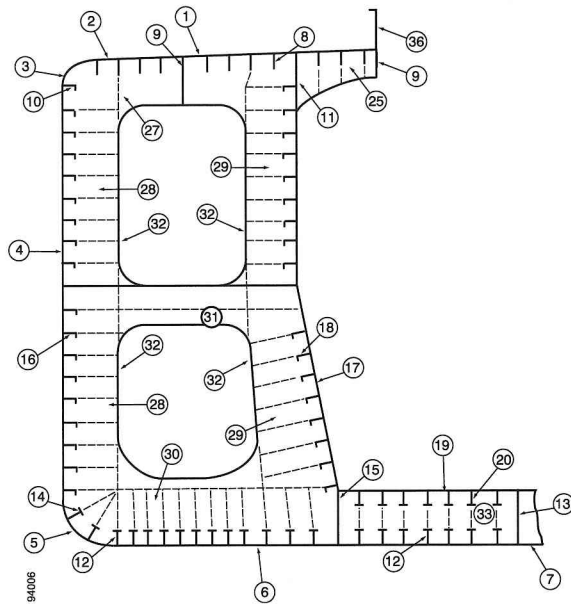
REPORT ON TM2-T (1) & (2)
① Strength deck plating
② Stringer plate
③ Sheerstrake
④ Side shell plating
⑤ Bilge plating
⑥ Bottom shell plating
⑦ Keel plate

REPORT ON TM6-T
③⑥ Hatch coamings
③⑦ Deck plating between hatches
③⑧ Hatch covers
③⑨
④⑩

REPORT ON TM3-T
⑧ Deck longitudinals
⑨ Deck girders
⑩ Sheerstrake longitudinals
⑪ Longitudinal bulkhead top strake
⑫ Bottom longitudinals
⑬ Bottom girders
⑭ Bilge longitudinals
⑮ Longitudinal bulkhead lower strake
⑯ Side shell longitudinals
⑰ Longitudinal bulkhead plating (remainder)
⑱ Longitudinal bulkhead longitudinals
⑲ Inner bottom plating
⑳ Inner bottom longitudinals
㉑
㉒
㉓
㉔

REPORT ON TM4-T
㉕ Deck transverse centre tank
㉖ Bottom transverse centre tank
㉗ Deck transverse wing tank
㉘ Side shell vertical web
㉙ Longitudinal bulkhead vertical web
㉚ Bottom transverse wing tank
㉛ Struts
㉜ Transverse web face plate
㉝ D.B. floors
㉞
㉟

**Typical transverse section of ore/oil ship
indicating longitudinal and transverse members**



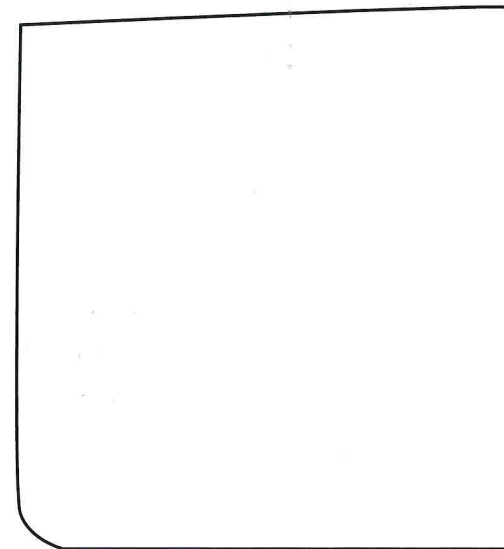
REPORT ON TM2-T (1) & (2)	
1	Strength deck plating
2	Stringer plate
3	Sheerstrake
4	Side shell plating
5	Bilge plating
6	Bottom shell plating
7	Keel plate

REPORT ON TM3-T	
8	Deck longitudinals
9	Deck girders
10	Sheerstrake longitudinals
11	Longitudinal bulkhead top strake
12	Bottom longitudinals
13	Bottom girders
14	Bilge longitudinals
15	Longitudinal bulkhead lower strake
16	Side shell longitudinals
17	Longitudinal bulkhead plating (remainder)
18	Longitudinal bulkhead longitudinals
19	Inner bottom plating
20	Inner bottom longitudinals
21	
22	
23	
24	

REPORT ON TM4-T	
25	Deck transverse centre tank
26	Bottom transverse centre tank
27	Deck transverse wing tank
28	Side shell vertical web
29	Longitudinal bulkhead vertical web
30	Bottom transverse wing tank
31	Struts
32	Transverse web face plate
33	D.B. floors
34	
35	

REPORT ON TM6-T	
36	Hatch coamings
37	Deck plating between hatches
38	Hatch covers
39	
40	

**Transverse section outline
(To be used for longitudinal and transverse members
where typical oil tanker or oil/ore ship sections are not applicable)**



REPORT ON TM2-T (1) & (2)	
1	Strength deck plating
2	Stringer plate
3	Sheerstrake
4	Side shell plating
5	Bilge plating
6	Bottom shell plating
7	Keel plate

REPORT ON TM6-T	
36	Hatch coamings
37	Deck plating between hatches
38	Hatch covers
39	
40	

REPORT ON TM3-T	
8	Deck longitudinals
9	Deck girders
10	Sheerstrake longitudinals
11	Longitudinal bulkhead top strake
12	Bottom longitudinals
13	Bottom girders
14	Bilge longitudinals
15	Longitudinal bulkhead lower strake
16	Side shell longitudinals
17	Longitudinal bulkhead plating (remainder)
18	Longitudinal bulkhead longitudinals
19	Inner bottom plating
20	Inner bottom longitudinals
21	
22	
23	
24	

REPORT ON TM4-T	
25	Deck transverse centre tank
26	Bottom transverse centre tank
27	Deck transverse wing tank
28	Side shell vertical web
29	Longitudinal bulkhead vertical web
30	Bottom transverse wing tank
31	Struts
32	Transverse web face plate
33	D.B. floors
34	
35	

Typical transverse sections showing all longitudinal members to be reported on TM2-T and TM3-T

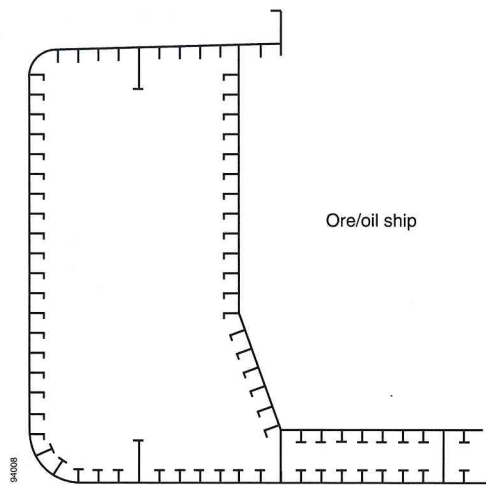
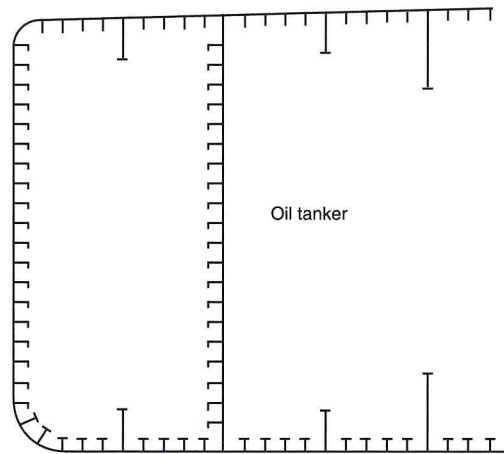
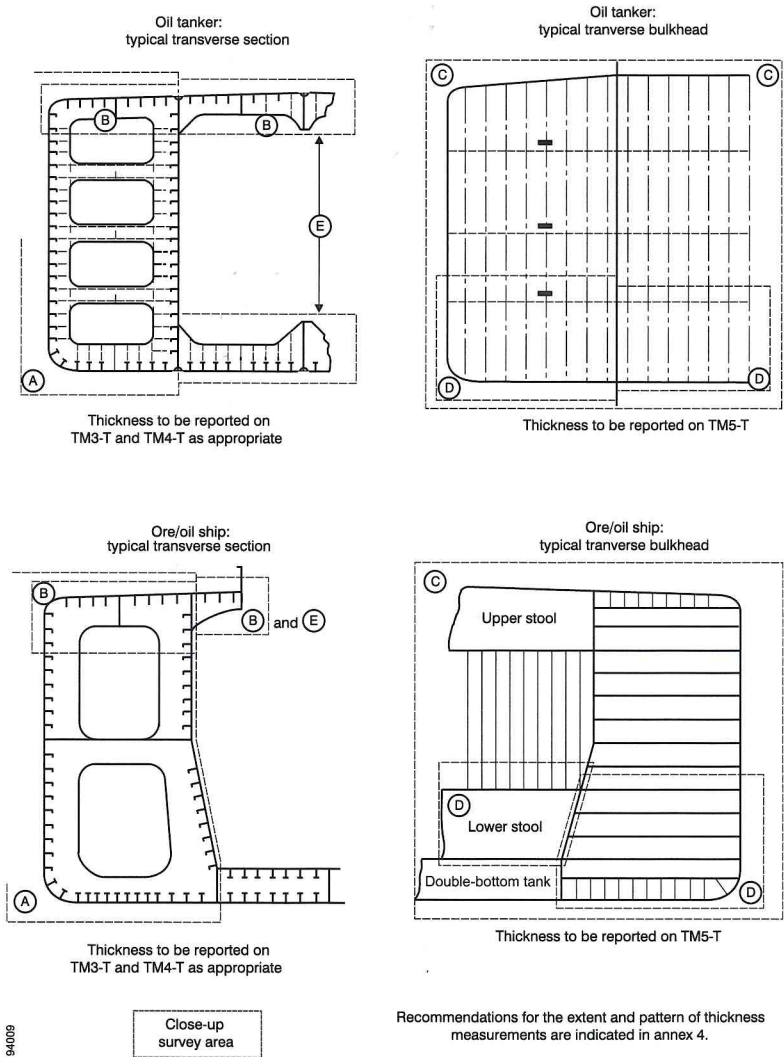


Table 1 - Close-up survey requirements

(Transverse sections of oil tankers and ore/oil ships showing typical areas for thickness measurement in association with close-up survey requirements)



Annex 11

Guidelines for technical assessment in conjunction with the planning of enhanced surveys for oil tankers

RENEWAL SURVEY

1 Introduction

These guidelines contain information and suggestions concerning technical assessments which may be of use in conjunction with the planning of enhanced special surveys of oil tankers. As indicated in 5.1.6, these Guidelines are a recommended tool which may be invoked at the discretion of an Administration, when considered necessary and appropriate, in conjunction with the preparation of the required survey programme.

2 Purpose and principles

2.1 Purpose

The purpose of the technical assessments described in these Guidelines is to assist in identifying critical structural areas, nominating suspect areas and in focusing attention on structural elements or areas of structural elements which may be particularly susceptible to, or evidence a history of, wastage or damage. This information may be useful in nominating locations, areas and tanks for thickness measurement, close-up survey and tank testing.

2.2 Minimum requirements

These Guidelines may not be used to reduce the requirements of annexes 1, 2 and 3 for close-up survey, thickness measurement and tank testing, respectively, which, in all cases, should be complied with as a minimum.

2.3 Timing

As with other aspects of survey planning, the technical assessments described in these Guidelines should be carried out by the owner or operator in co-operation with the Administration well in advance of the commencement of the renewal survey, i.e., prior to commencing the survey and normally at least 12 to 15 months before the survey's completion due date.

2.4 Aspects to be considered

Technical assessments, which may include quantitative or qualitative evaluation of relative risks of possible deterioration, of the following aspects of a particular ship may be used as a basis for the nomination of tanks and areas for survey:

- design features such as stress levels on various structural elements, design details and extent of use of high-tensile steel (HTS);
- former history with respect to corrosion, cracking, buckling, indents and repairs for the particular ship as well as similar vessels, where available; and
- information with respect to types of cargo carried, use of different tanks for cargo/ballast, protection of tanks and condition of coating, if any.

Technical assessments of the relative risks of susceptibility to damage or deterioration of various structural elements and areas should be judged and decided on the basis of recognized principles and practices, such as may be found in references 1 and 2.

3 Technical assessment

3.1 General

3.1.1 There are three basic types of possible failure which may be the subject of technical assessment in connection with planning of surveys: corrosion, cracks and buckling. Contact damages are not normally covered by the survey plan since indents are usually noted in memoranda and assumed to be dealt with as a normal routine by surveyors.

3.1.2 Technical assessments performed in conjunction with the survey planning process should, in principle, be as shown schematically in figure 1 which depicts, schematically, how technical assessments can be carried out in conjunction with the survey planning process. The approach is basically an evaluation of the risk based on the knowledge and experience related to design and corrosion.

3.1.3 The design should be considered with respect to structural details which may be susceptible to buckling or cracking as a result of vibration, high stress levels or fatigue.

3.1.4 Corrosion is related to the ageing process, and is closely connected with the quality of corrosion protection at newbuilding, and subsequent maintenance during the service life. Corrosion may also lead to cracking and/or buckling.

3.2 Methods

3.2.1 Design details

3.2.1.1 Damage experience related to the ship in question and similar ships, where available, are the main source of information to be used in the process of planning. In addition, a selection of structural details from the design drawings should be included.

Typical damage experience to be considered will consist of:

- number, extent, location and frequency of cracks; and
- location of buckles.

3.2.1.2 This information may be found in the survey reports and/or the owner's files, including the results of the owner's own inspections. The defects should be analysed, noted and marked on sketches.

3.2.1.3 In addition, general experience should be utilized. For example, reference should be made to reference 1, which contains a catalogue of typical damages and proposed repair methods for various tanker structural details.

3.2.1.4 Such figures should be used together with a review of the main drawings, in order to compare with the actual structure and search for similar details which may be susceptible to damage. An example is shown in figure 2.

3.2.1.5 The review of the main structural drawings, in addition to using the above-mentioned figures, should include checking for typical design details where cracking has been experienced. The factors contributing to damage should be carefully considered.

3.2.1.6 The use of HTS is an important factor. Details showing good service experience where ordinary, mild steel has been used may be more susceptible to damage when HTS, and its higher associated stresses, are utilized. There is extensive and, in general, good experience, with the use of HTS for longitudinal material in deck and bottom structures. Experience in other locations, where the dynamic stresses may be higher, is less favourable, e.g., side structures.

3.2.1.7 In this respect, stress calculations of typical and important components and details, in accordance with relevant methods, may prove useful and should be considered.

3.2.1.8 The selected areas of the structure identified during this process should be recorded and marked on the structural drawings to be included in the survey programme.

3.2.2 Corrosion

3.2.2.1 In order to evaluate relative corrosion risks, the following information is generally to be considered:

- usage of tanks and spaces;
- condition of coatings;
- condition of anodes;
- cleaning procedures;
- previous corrosion damage;
- ballast use and time for cargo tanks;
- corrosion risk scheme (see reference 2, table 3.1);
- location of heated tanks.

3.2.2.2 Reference 2 gives definitive examples which can be used for judging and describing coating condition, using typical pictures of conditions.

3.2.2.3 The evaluation of corrosion risks should be based on information in reference 2, together with the age of the ship and relevant information on the anticipated condition as derived from the information collected in order to prepare the survey programme.

3.2.2.4 The various tanks and spaces should be listed with the corrosion risks nominated accordingly.

3.2.3 Locations for close-up survey and thickness measurement

3.2.3.1 On the basis of the table of corrosion risks and the evaluation of design experience, the locations for initial close-up survey and thickness measurement (sections) may be nominated.

3.2.3.2 The sections subject to thickness measurement should normally be nominated in tanks and spaces where corrosion risk is judged to be the highest.

3.2.3.3 The nomination of tanks and spaces for close-up survey should, initially, be based on highest corrosion risk, and should always include ballast tanks. The principle for the selection should be that the extent is increased by age or where information is insufficient or unreliable.

References

- 1 TSCF, *Guidance Manual for the Inspection and Condition Assessment of Tanker Structures*, 1986.
- 2 TSCF, *Condition Evaluation and Maintenance of Tanker Structures*, 1992.

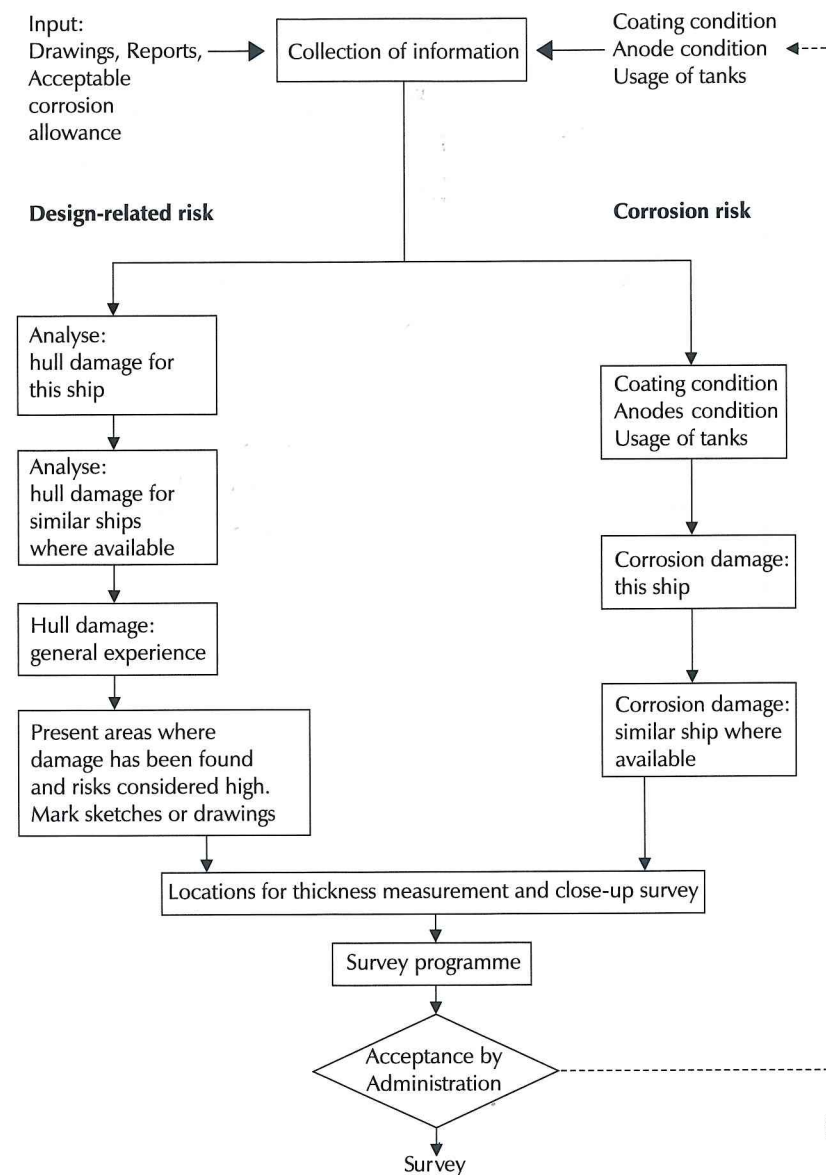


Figure 1 – Planning process: technical assessment and the survey

LOCATION: Connection of longitudinals to transverse webs		
EXAMPLE NO. 1 Web and flat bar fractures at cut-outs for longitudinal stiffener connections		
TYPICAL DAMAGE	PROPOSED REPAIR	
<p>view A-A</p>	<p>view A-A</p>	
<p>Note* one or more fractures may occur</p> <p>web and flat bar cropped and part renewed or alternatively welded</p>		
<p>FACTORS CONTRIBUTING TO DAMAGE</p> <ol style="list-style-type: none"> 1 Asymmetrical connection of flat bar stiffener resulting in high peak stresses at the heel of the stiffener under fatigue loading. 2 Insufficient area of connection of longitudinal to web plate. 3 Defective weld at return around the plate thickness. 4 High localized corrosion at areas of stress concentration such as flat bar stiffener connections, corners of cut-out for the longitudinal and connection of web to shell at cut-outs. 5 High shear stress in the web of the transverse. 6 Dynamic seaway loads/ship motions. 		
FIGURE 1	TANKER STRUCTURE CO-OPERATIVE FORUM SUBJECT: CATALOGUE OF STRUCTURAL DETAILS	FIGURE 1

Figure 2 – Typical damage and repair example (reproduced from reference 1)

Annex 12

Criteria for longitudinal strength of hull girder for oil tankers

1 General

1.1 These criteria should be used for the evaluation of the longitudinal strength of the ship's hull girder as required by 8.1.2.

1.2 In order that the ship's longitudinal strength to be evaluated can be recognized as valid, fillet welding between longitudinal internal members and hull envelopes should be in sound condition so as to keep the integrity of longitudinal internal members with hull envelopes.

2 Evaluation of longitudinal strength

On oil tankers of 130 m in length and upwards and over 10 years of age, the longitudinal strength of the ship's hull girder should be evaluated in compliance with the requirements of this annex on the basis of the thickness measured, renewed or reinforced, as appropriate, during the renewal survey of the Cargo Ship Safety Construction Certificate or Cargo Ship Safety Certificate (SC renewal survey).

The condition of the hull girder for longitudinal strength evaluation should be determined in accordance with the methods specified in appendix 3.

2.1 Calculation of transverse sectional areas of deck and bottom flanges of hull girder

2.1.1 The transverse sectional areas of deck flange (deck plating and deck longitudinals) and bottom flange (bottom shell plating and bottom longitudinals) of the ship's hull girder should be calculated by using the thickness measured, renewed or reinforced, as appropriate, during the SC renewal survey.

2.1.2 If the diminution of sectional areas of either deck or bottom flange exceeds 10% of their respective as-built area (i.e., original sectional area when the ship was built), either one of the following measures should be taken:

- .1 to renew or reinforce the deck or bottom flanges so that the actual sectional area is not less than 90% of the as-built area; or

- .2 to calculate the actual section of moduli (Z_{act}) of transverse section of the ship's hull girder by applying the calculation method specified in appendix 1, by using the thickness measured, renewed or reinforced, as appropriate, during the SC renewal survey.

2.2 Requirements for transverse section modulus of hull girder

2.2.1 The actual section moduli of the transverse section of the ship's hull girder, calculated in accordance with paragraph 2.1.2.2, should satisfy either of the following provisions, as applicable:

- .1 for ships constructed on or after 1 July 2002, the actual section moduli (Z_{act}) of the transverse section of the ship's hull girder calculated in accordance with the requirements of paragraph 2.1.2.2 should be not less than the diminution limits determined by the Administration, taking into account the recommendations adopted by the Organization;* or
- .2 for ships constructed before 1 July 2002, the actual section moduli (Z_{act}) of the transverse section of the ship's hull girder calculated in accordance with the requirements of paragraph 2.1.2.2 should meet the criteria for minimum section modulus for ships in service required by the Administration or recognized classification society, provided that in no case Z_{act} should be less than the diminution limit of the minimum section modulus (Z_{mc}) as specified in appendix 2.

Appendix 1

CALCULATION CRITERIA OF SECTION MODULI OF MIDSHIP SECTION OF HULL GIRDER

1 When calculating the transverse section modulus of the ship's hull girder, the sectional area of all continuous longitudinal strength members should be taken into account.

* Refer to resolution MSC.108(73), Recommendation on compliance with the requirements of paragraph 2.2.1.1 of annex 12 to annex B to resolution A.744(18).

2 Large openings, i.e., openings exceeding 2.5 m in length or 1.2 m in breadth, and scallops, where scallop welding is applied, are always to be deducted from the sectional areas used in the section modulus calculation.

3 Smaller openings (manholes, lightening holes, single scallops in way of seams, etc.) need not be deducted, provided that the sum of their breadths or shadow area breadths in one transverse section does not reduce the section modulus at deck or bottom by more than 3% and provided that the height of lightening holes, draining holes and single scallops in longitudinals or longitudinal girders does not exceed 25% of the web depth, for scallops of maximum 75 mm.

4 A deduction-free sum of smaller opening breadths in one transverse section in the bottom or deck area of $0.06 (B - \Sigma b)$ (where B = breadth of ship, Σb = total breadth of large openings) may be considered equivalent to the above reduction in sectional modulus.

5 The shadow area will be obtained by drawing two tangent lines with an opening angle of 30° .

6 The deck modulus is related to the moulded deck line at side.

7 The bottom modulus is related to the base line.

8 Continuous trunks and longitudinal hatch coamings should be included in the longitudinal sectional area provided they are effectively supported by longitudinal bulkheads or deep girders. The deck modulus is then to be calculated by dividing the moment of inertia by the following distance, provided this is greater than the distance to the deck line at side:

$$y_t = y (0.9 + 0.2 \frac{x}{B})$$

where:

y = distance from neutral axis to top of continuous strength member;

x = distance from top of continuous strength member to centreline of the ship;

x and y to be measured to the point giving the largest value of y_t .

9 Longitudinal girders between multi-hatchways will be considered by special calculations.

Appendix 2

DIMINUTION LIMIT OF MINIMUM LONGITUDINAL STRENGTH OF SHIPS IN SERVICE

1 The diminution limit of the minimum section modulus (Z_{mc}) of oil tankers in service is given by the following formula:

$$Z_{mc} = cL^2 B (C_b + 0.7)k \text{ (cm}^3\text{)}$$

where:

L = Length of ship. L is the distance, in metres, on the summer load waterline from the fore-side of stem to the after-side of the rudder post, or the centre of the rudder stock if there is no rudder post. L is not to be less than 96%, and need not be greater than 97%, of the extreme length on the summer load waterline. In ships with unusual stern and bow arrangement, the length L may be specially considered.

B = Greatest moulded breadth in metres.

C_b = Moulded block coefficient at draught d corresponding to summer load waterline, based on L and B . C_b is not to be taken less than 0.6.

$$C_b = \frac{\text{moulded displacement (m}^3\text{) at draught } d}{LB_d}$$

$$c = 0.9c_n$$

$$c_n = 10.75 - \left(\frac{300-L}{100}\right)^{1.5} \quad \text{for } 130 \text{ m} \leq L \leq 300 \text{ m}$$

$$c_n = 10.75 \quad \text{for } 300 \text{ m} \leq L \leq 350 \text{ m}$$

$$c_n = 10.75 - \left(\frac{L-350}{150}\right)^{1.5} \quad \text{for } 350 \text{ m} \leq L \leq 500 \text{ m}$$

k = material factor, e.g.

$$k = 1.0 \text{ for mild steel with yield stress of } 235 \text{ N/mm}^2 \text{ and over}$$

$$k = 0.78 \text{ for high-tensile steel with yield stress of } 315 \text{ N/mm}^2 \text{ and over}$$

$$k = 0.72 \text{ for high-tensile steel with yield stress of } 355 \text{ N/mm}^2 \text{ and over.}$$

2 Scantlings of all continuous longitudinal members of the ship's hull girder based on the section modulus requirement in 1 above should be maintained within $0.4L$ amidships. However, in special cases, based on

consideration of type of ship, hull form and loading conditions, the scantlings may be gradually reduced towards the end of $0.4L$ part, bearing in mind the desire not to inhibit the ship's loading flexibility.

3 However, the above standard may not be applicable to ships of unusual type or design, e.g., for ships of unusual main proportions and/or weight distributions.

Appendix 3

SAMPLING METHOD OF THICKNESS MEASUREMENTS FOR LONGITUDINAL STRENGTH EVALUATION AND REPAIR METHODS

1 Extent of longitudinal strength evaluation

Longitudinal strength should be evaluated within $0.4L$ amidships for the extent of the hull girder length that contains tanks therein and within $0.5L$ amidships for adjacent tanks which may extend beyond $0.4L$ amidships, where tanks means ballast tanks and cargo tanks.

2 Sampling method of thickness measurement

2.1 Pursuant to the requirements of section 2.5, transverse sections should be chosen such that thickness measurements can be taken for as many different tanks in corrosive environments as possible, e.g., ballast tanks sharing a common plane boundary with cargo tanks fitted with heating coils, other ballast tanks, cargo tanks permitted to be filled with sea water and other cargo tanks. Ballast tanks sharing a common plane boundary with cargo tanks fitted with heating coils and cargo tanks permitted to be filled with seawater should be selected where present.

2.2 The minimum number of transverse sections to be sampled should be in accordance with annex 2. The transverse sections should be located where the largest thickness reductions are suspected to occur or are revealed from deck and bottom plating measurements prescribed in 2.3 and should be clear of areas which have been locally renewed or reinforced.

2.3 At least two points should be measured on each deck plate and/or bottom shell plate required to be measured within the cargo area in accordance with the requirements of annex 2.

2.4 Within $0.1D$ (where D is the ship's moulded depth) of the deck and bottom at each transverse section to be measured in accordance with the

requirements of annex 2, every longitudinal and girder should be measured on the web and face plate, and every plate should be measured at one point between longitudinals.

2.5 For longitudinal members other than those specified in 2.4 to be measured at each transverse section in accordance with the requirements of annex 2, every longitudinal and girder should be measured on the web and face plate, and every plate should be measured at least in one point per strake.

2.6 The thickness of each component should be determined by averaging all of the measurements taken in way of the transverse section on each component.

3 Additional measurements where the longitudinal strength is deficient

3.1 Where one or more of the transverse sections are found to be deficient in respect of the longitudinal strength requirements given in this annex, the number of transverse sections for thickness measurement should be increased such that each tank within the 0.5L amidships region has been sampled. Tank spaces that are partially within, but extend beyond, the 0.5L region, should be sampled.

3.2 Additional thickness measurements should also be performed on one transverse section forward and one aft of each repaired area to the extent necessary to ensure that the areas bordering the repaired section also comply with the requirements of the Guidelines.

4 Effective repair methods

4.1 The extent of renewal or reinforcement carried out to comply with this annex should be in accordance with 4.2.

4.2 The minimum continuous length of a renewed or reinforced structural member should be not less than twice the spacing of the primary members in way. In addition, the thickness diminution in way of the butt joint of each joining member forward and aft of the replaced member (plates, stiffeners, girder webs and flanges, etc.) should not be within the substantial corrosion range (75% of the allowable diminution associated with each particular member). Where differences in thickness at the butt joint exceed 15% of the lower thickness, a transition taper should be provided.

4.3 Alternative repair methods involving the fitting of straps or structural member modification should be subject to special consideration. In considering the fitting of straps, it should be limited to the following conditions:

- .1** to restore and/or increase longitudinal strength;
- .2** the thickness diminution of the deck or bottom plating to be reinforced should not be within the substantial corrosion range (75% of the allowable diminution associated with the deck plating);
- .3** the alignment and arrangement, including the termination of the straps, is in accordance with a standard recognized by the Administration;
- .4** the straps are continuous over the entire 0.5L amidships length; and
- .5** continuous fillet welding and full penetration welds are used at butt welding and, depending on the width of the strap, slot welds. The welding procedures applied should be acceptable to the Administration.

4.4 The existing structure adjacent to replacement areas and in conjunction with the fitted straps, etc., should be capable of withstanding the applied loads, taking into account the buckling resistance and the condition of welds between the longitudinal members and hull envelope plating.