Amendments to the "Tasneef Rules for the Classification of Ships"

RFC/002/AMN/012
Effective from 1/7/2021

Reasons of the amendments:

Part A – Classification and Surveys

Chapter/Section/Paragraph amended	Reason
Ch 1, Sec 2, [6.14.55] and Tab 3 Ch 5, Sec 1, Tab 1 Ch 5, Sec 12, [1.1.1] and [34]	to correct the name of the additional class notation SUSTAINABLE SHIP (Prop.130)
Ch 3, Sec 1, [1.7.4], [1.10.1], [1.10.3], Fig 1 (new), Tab 1, [2.3.1], [3.3.3]	to introduce **IACS UR Z23** (Rev 7 - Oct 2020) "Hull Survey for New Construction"
Ch 3, Sec 1, [1.10.3], Tab 1, [2.3.1] Ch 3, Sec 3, [2.7] (new) Ch 3, Sec 5, [2.7] (new)	to introduce **IACS UR Z28** (New Oct 2020) "Surveys of Watertight Cable Transits"
Ch 3, Sec 3, [3.3] (new) Ch 3, Sec 5, [3.6] (new)	to introduce **IACS UR Z18** (Rev 9 - Apr 2020) "Survey of Machinery"
Ch 3, Sec 6, [2.2.1] and [2.2.2]	to align the requirements for the scope of bottom survey in dry condition (for all ships) at the renewal survey to those for the bottom survey for the maintenance of class in Ch 2, Sec 2, [7.1.6] where a bottom survey in dry condition is required to be part of the class renewal survey for ESP ships, liquified gas carriers and general dry cargo ships
Ch 4, Sec 5, [6.3.1]	to correct a typo in a cross reference (Prop.24)

Part B – Hull and Stability

Chapter/Section/Paragraph amended	Reason
Ch 2, Sec 1, [6.1.5] (new)	to require cable transits seal systems in watertight bulkheads and decks to be type approved regarding watertightness, due to the introduction of **IACS UR Z28** (New Oct 2020) "Surveys of Watertight Cable Transits"
Ch 2, Sec 2, [2.1.3]	to better specify - for clarity and uniform implementation - the coating requirements for deck between spaces containing flammable liquids and accommodation/service spaces to allow omission of a separating cofferdam (Prop.146)
Ch 4, Sec 1, Tab 6 (new), Fig 1, Tab 9, Tab 10, references to tables have been updated	to introduce **IACS UR S6** (Rev 9 Corr 1 – Mar 2021) "Use of Steel Grades for Various Hull Members - Ships of 90 m in Length and Above" and correct some editorials/typos
Ch 8, Sec 5, [3.6.2], [3.6.3]	to align the formulas of net section modulus and net shear sectional area of primary supporting members subjected to lateral pressure in flooding conditions for ships less than 90 m in length to the formulas for ships above 90 in length (Prop.140)

Ch 9, Sec 8, [1.4.1]	to correct a typo
Ch 11, Sec 2, [4.5.5]	to introduce **IACS UR L5** (Rev 4 – June 2020) “Computer Software for Onboard Stability Calculations”

Part C – Machinery, Systems and Fire Protection

Chapter/Section/Paragraph amended	Reason
Ch 1, Sec 2, [4.7.8], [4.7.9], Tables 4, 5 and 6, [7.4.1]	to address a DEKRA finding raised during a VCA in Rostock relevant to testing of diesel engines by: • specifying that it is the manufacturer’s responsibility to set alarms so that they start before dangerous working conditions are reached; • clarifying that separate sensors are to be installed when more set points leading to different actions are required; and • requiring checking the presence of alarm/safeguard sensors and their functionality (if possible) at workshop testing. (Prop.139)
Ch 2, Sec 1, [2.1.2], [2.1.3] (new), [2.1.4] (new), [2.1.5] (new), Tab 1 (deleted), Tab 1 (new), Tab 2 (new)	to better clarify and group the documents relevant to electrical installations to be submitted for approval and/or information and to improve the requirements for requesting a Failure Mode and Effect Analysis (FMEA) (Prop.102)
Ch 2, Sec 2, Tab 4	to align note (3) of Tab 4 “Inclination of ship” in Ch 2 Sec 2 to note (3) in the analogous Tab 1 in Ch 1 Sec 1 where UR M46 Rev.2 had been introduced (Prop.113)
Ch 4, Sec 1, [5.2.4]	to introduce **IACS UR F7** (Rev 3 - June 2020 and Corr 1 - Nov.2020) “Portable instruments for measuring oxygen and flammable vapour concentrations”

Part D – Materials and Welding

Chapter/Section/Paragraph amended	Reason
Ch 2, Sec 1, [10.5.1], [10.5.2], [10.6.1], [10.6.3]	to introduce **IACS UR S33** (Rev 3 – Feb 2020) "Requirements for Use of Extremely Thick Steel Plates in Container Ships"
Ch 4, Sec 1, Tab 18 and 19	to allow the use of glass panes of windows of 4 and 5 mm, as done for pleasure and commercial yachts, and provide the test pressures and loads in line with those used for yachts (Prop.129)
Ch 4, Sec 2, [1] Ch 5, Sec 4, [7]	to introduce **IACS UR W24** (Rev 4 - July 2020) “Cast Copper Alloy Propellers”
Ch 4, Sec 2, [3] Ch 5, Sec 4, [7]	to introduce **IACS UR W27** (Rev 2 - July 2020 and Corr 1 – Sept 2020) "Cast Steel Propellers”

Part E – Service Notations

Chapter/Section/Paragraph amended	Reason
Ch 7, Sec 4, [4.5.3]	to modify the requirements on “Protection against tank overload” for cargo tanks of oil tankers to eliminate the possibility of using a protection system never applied according to our experience (Prop.24)
Ch 8, Sec 15, [8.1.1]	to delete a requirement for cargo tanks of chemical tankers designed for the carriage of cargoes with a vapour pressure greater than 0,1013 MPa (1,013 bar) absolute at 37,8°C, since it is already covered by paragraph 15.14.1 of the IBC Code without any need of additional class requirements (Prop.24)

Ch 9, Sec 1, [1.1.1] a)	to clarify that liquefied gas carriers are to comply with the requirements of all the chapters of the IGC Code (Prop.24)
Ch 11, Sec 4, [1.1.1]	to delete a wrong cross reference relevant to damage stability calculations that are not covered by class requirements but by SOLAS Chapter II-1 regulations (Prop.24)
Ch 14, Sec 2, [2.8.2](new), Fig 2 (new), [2.8.5] (renumbered as 2.8.6), [2.9.1]	to introduce **IACS UR M79** (Rev 1 - Feb 2020) "Towing winch emergency release Systems"

Part F – Additional Class Notations

Chapter/Section/Paragraph amended	Reason
Ch 3, Sec 1, [4.1.12] (new), [4.1.13] (new)	to address a DEKRA finding raised during a VCA in Rostock relevant to testing of diesel engines by amending the requirements for the Unattended Machinery Spaces (AUT-UMS) additional class notation to: • specify that it is the manufacturer's responsibility to set alarms so that they start before dangerous working conditions are reached; and • clarify that separate sensors are to be installed when more set points leading to different actions are required. (Prop.139)
Ch 13, Sec 36, [1.1.1], [4.1.1], [5.1], Tab 1	to correct the name of the additional class notation SUSTAINABLE SHIP (Prop.130)

SECTION 2 CLASSIFICATION NOTATIONS

1 General

1.1 Purpose of the classification notations

1.1.1 The classification notations give the scope according to which the class of the ship has been based and refer to the specific rule requirements which are to be complied with for their assignment. In particular, the classification notations are assigned according to the type, service and navigation of the ship and other criteria which have been provided by the Interested Party, when applying for classification.

The Society may change the classification notations at any time, when the information available shows that the requested or already assigned notations are not suitable for the intended service, navigation and any other criteria taken into account for classification.

Note 1: Reference should be made to Sec 1, [1.3] on the limits of classification and its meaning.

1.1.2 The classification notations assigned to a ship are indicated on the Certificate of Classification, as well as in the Register of Ships published by the Society.

1.1.3

Ships and units, other than those covered in Parts B, C, D, E and F, are to comply with specific Rules published by the Society, which also stipulate the relevant classification notations.

1.1.4 The classification notations applicable to existing ships conform to the Rules of the Society in force at the date of assignment of class, as indicated in Ch 2, Sec 1. However, the classification notations of existing ships may be updated according to the currrent Rules, as far as applicable.

1.2 Types of notations assigned

1.2.1 The types of classification notations assigned to a ship are the following:

a) main class symbol
b) construction marks
c) service notations with additional service features, as applicable
d) navigation notations
e) operating area notations (optional)
f) additional class notations (optional)

The different classification notations and their conditions of assignment are listed in [2] to [6] below, according to their types.

1.2.2 As an example, the classification notations assigned to a ship may be as follows (the kind of notation shown in brackets does not form part of the classification notation indicated in the Register of Ships and on the Certificate of Classification):

C ✠ HULL ✠ MACH

(main class symbol, construction marks)

oil tanker-chemical tanker-ESP-Flash point > 60°C

(service notation and additional service features)

Unrestricted navigation

(navigation notation)

✠ SYS - NEQ

(additional class notation).

2 Main class symbol

2.1 Main class symbol

2.1.1 The main class symbol expresses the degree of compliance of the ship with the rule requirements as regards its construction and maintenance. There is one main class symbol, which is compulsory for every classed ship.

2.1.2

The main class symbol C is assigned to ships built in accordance with the requirements of the Rules or other rules recognised as equivalent, and maintained in a condition considered satisfactory by the Society. The period of class (or interval between class renewal surveys) assigned to a ship is maximum 5 years; see Ch 2, Sec 2, [4].

Except for special cases, class is assigned to a ship only when the hull, propulsion and auxiliary machinery installations, and equipment providing essential services have all been reviewed in relation to the requirements of the Rules.

Note 1: The symbol **C** with the 5 year class period is to be understood as being the highest class granted by the Society.

Note 2: The symbol **C** may be followed by the additional construction feature **light ship** in case of ships or other units having restricted navigation notations and generally having length not greater than 50 m as well as speed greater than 15 knots, whose hull scantlings and outfitting comply with the applicable requirements of Chapters 3 and 6 of the "Rules for the Classification of High Speed Craft", issued separately by the Society.

3 Construction marks

3.1 General

3.1.1 The construction mark identifies the procedure under which the ship and its main equipment or arrangements have been surveyed for initial assignment of the class. The procedures under which the ship is assigned one of the construction marks are detailed in Ch 2, Sec 1.

is barrier free passage in public spaces on board and in escape routes to muster stations.

The requirements for the assignment of this additional class notation are given in Pt F, Ch 13, Sec 32.

6.14.50 BIOSAFE SHIP *(15/6/2020)*

The additional class notation **BIOSAFE SHIP** is assigned to:

- Cruise ships and ro-ro passenger ships with sleeping facilities for passengers
- Passenger ships, high-speed passenger craft and ro-ro passenger ships in short sea voyages
- Cargo ships

designed and provided with systems, components and operative procedures to control and prevent possible on board infection outbreak.

The requirements for the assignment of this additional class notation are given in Pt F, Ch 13, Sec 33.

6.14.51 REMOTE SURVEYABLE SHIP (REMOTE) *(5/6/2020)*

The additional class notation **REMOTE** is assigned to ships deemed by the Society eligible to remotely carry out the largest scope of class surveys, including periodical surveys, on the basis of:

- their age and service;
- their records of maintenance and operation; and,
- the specific arrangements and qualified personnel available on board to facilitate remote surveys (see Note 1).

The requirements for the assignment of this additional class notation are given in Pt F, Ch 13, Sec 34.

Note 1: Remote Survey: a survey carried out by the Society without the physical attendance of the Surveyor on board,

6.14.52 LPG Fuelled *(1/5/2021)*

The additional class notation **LPG FUELLED** is assigned to ships operating with LPG as fuel for their internal combustion engines or boilers, complying with the design and constructional requirements of Pt C, Ch 1, App 13

6.14.53 NH3 Fuelled *(1/5/2021)*

The additional class notation **NH3 FUELLED** is assigned to ships operating with Ammonia as fuel for their internal combustion engines or boilers, complying with the design and constructional requirements of Pt C, Ch 1, App 13.

6.14.54 NH3 FUELLED READY (X1, X2, X3) *(1/5/2021)*

The additional class notation **NH3 FUELLED READY (X1, X2, X3…)** is assigned to ships whose design is in compliance with Pt C, Ch 1, App 13, and the relevant systems and arrangement are partially installed on board, thus easing a future ship conversion into a NH3 Fuelled Ship.

The requirements for the assignment of this additional class notation are given in Pt F, Ch 13, Sec 35.

6.14.55 SUSTAINABLE SHIP ~~(nn)~~ *(1/7/2021)*

The additional class notation **SUSTAINABLE SHIP ~~(nn)~~** is assigned to ships complying with the sustainability criteria given in Pt F, Ch 13, Sec 36 relevant to:

a) design and provision of systems, components and procedural means to control and prevent the emission of polluting substances into the sea, the air and, more in general, the environment (reference is made to **GREEN PLUS** additional class notation)

b) underwater noise limitation (reference is made to **DOLPHIN** additional class notations)

c) noise and vibration limitation on board (reference is made to **COMF-NOISE** and **COMF-VIB** additional class notations)

d) compliance with **COMF-NOISE-PORT(X)** additional class notation

e) compliance with **MLCDESIGN** additional class notation

f) compliance with **BIOSAFE SHIP** additional class notation

g) achievement of EEDI and EEXI values 40% lower than those in Phase 0 EEDI reference lines (see Note 1) in MARPOL Annex VI, according to the 2030 target in Initial IMO strategy on reduction of GHG emissions from ships (Res. MEPC.304(72)).

Note 1: For ro-ro cargo ships and ro-ro passenger ships, reference is made to Phase 2 EEDI reference lines

7 Other notations

7.1

7.1.1 The Society may also define other notations by means of provisional requirements and guidelines, which may then be published in the form of tentative rules.

Table 3 : List of additional class notations *(1/7/2021)*

Additional class notation	Reference for definition	Reference	Remarks
AIR LUBRICATION SYSTEM (AIR LUB)	[6.14.48]	Pt F, Ch 13, Sec 31	
AIR-MON	[6.14.34]	Pt F, Ch 13, Sec 22	

(1) A construction mark is added to this notation.
(2) This notation may be completed by the specific notations **-PRECOOLING**, **-QUICKFREEZE** and/or **-AIRCONT** (see [6.9.5]).
(3) This notation may be completed by the specific notations **-MIDSHIP** and **-TRANSFER** (see [6.14.7]).
(4) When ships are assigned the notations **CLEAN-SEA** and **CLEAN-AIR**, the two separate notations are superseded by the cumulative additional class notation **GREEN STAR 3 DESIGN** (see [6.8.4]).
(5) This notation may be completed by the specific features: **sequential, flow-through, dilution**.
(6) This notation may be completed by the specific notation **-HULL** (see [6.10.4]).

Additional class notation	Reference for definition	Reference	Remarks
PERSONS WITH REDUCED MOBILITY (PMR-ITA)	[6.14.49]	Pt F, Ch 13, Sec 32	
PMA	[6.14.14]	NA	
PMS	[6.13.2]	Pt F, Ch 12, Sec 1	
PMS-CM(PROP)	[6.13.3]	Pt F, Ch 12, Sec 2	
PMS-CM(HVAC)	[6.13.4]	Pt F, Ch 12, Sec 3	
PMS-CM(CARGO)	[6.13.5]	Pt F, Ch 12, Sec 4	
PMS-CM(ELE)	[6.13.6]	Pt F, Ch 12, Sec 5	
PMS-CM(FDS)	[6.13.7]	Pt F, Ch 12, Sec 6	
PMS-CM	[6.13.8]	Pt F, Ch 12, Sec 7	
POLAR CLASS	[6.11.1]	Part F, Chapter 10	
REF-CARGO	[6.9.2]	Pt F, Ch 8, Sec 2	**(1) (2)**
REF-CONT	[6.9.3]	Pt F, Ch 8, Sec 3	**(1) (2)**
REF-STORE	[6.9.4]	Pt F, Ch 8, Sec 4	**(1) (2)**
REMOTE SURVEYABLE SHIP (REMOTE)	[6.14.51]	Pt F, Ch 13, Sec 34	
RISK MITIGATION (...)	[6.14.33]	NA	
ROUTE DEPENDENT LASHING (start date - end date)	[6.14.5]	Pt F, Ch 13, Sec 5	
< **SAHARA** **SAHARA**	[6.14.32]	Pt F, Ch 13, Sec 20	
SELF-UNLOADING	[6.14.27]	NA	
SPM	[6.14.4]	Pt F, Ch 13, Sec 4	
SPS	[6.14.26]	NA	
SRTP	[6.14.22]	NA	
STAR	[6.2.4]	Part F, Chapter 1	This cumulative notation supersedes the notations **STAR-HULL** and **STAR-MACH**, when both are assigned
STAR-HULL	[6.2.2]	Pt F, Ch 1, Sec 1	
STAR-MACH	[6.2.3]	Pt F, Ch 1, Sec 2	
STRENGTHBOTTOM-NAABSA	[6.14.1]	Pt F, Ch 13, Sec 1	
SUSTAINABLE SHIP ~~(nn)~~	[6.14.55]	Pt F, Ch 13, Sec 36	
SYS-COM	[6.5.4]	Pt F, Ch 4, Sec 3	
SYS-IBS	[6.5.3]	Pt F, Ch 4, Sec 2	**(1)**
SYS-NEQ **SYS-NEQ-1**	[6.5.2]	Pt F, Ch 4, Sec 1	**(1)**
TAS	[6.14.28]	NA	
TEMPORARY REFUGE (RISKS)	[6.14.39]	NA	
VCS	[6.14.7]	Pt F, Ch 13, Sec 7	**(3)**
WINTERIZATION (temp)	[6.12.1]	Part F, Chapter 11	

(1) A construction mark is added to this notation.

(2) This notation may be completed by the specific notations **-PRECOOLING**, **-QUICKFREEZE** and/or **-AIRCONT** (see [6.9.5]).

(3) This notation may be completed by the specific notations **-MIDSHIP** and **-TRANSFER** (see [6.14.7]).

(4) When ships are assigned the notations **CLEAN-SEA** and **CLEAN-AIR**, the two separate notations are superseded by the cumulative additional class notation **GREEN STAR 3 DESIGN** (see [6.8.4]).

(5) This notation may be completed by the specific features: **sequential, flow-through, dilution**.

(6) This notation may be completed by the specific notation **-HULL** (see [6.10.4]).

SECTION 1 SURVEY FOR NEW CONSTRUCTION

1 Hull

1.1 General

1.1.1 Scope *(1/7/2016)*

The scope of this Article [1] includes the following main activities:

a) Examination of the parts of the ship covered by classification Rules and by applicable statutory regulations for hull construction, to obtain appropriate evidence that they have been built in compliance with the Rules and regulations, taking account of the relevant approved drawings.

b) Appraisal of the manufacturing, construction, control and qualification procedures, including welding consumables, weld procedures, weld connections and assemblies, with indication of relevant approval tests.

c) Witnessing inspections and tests as required in the classification Rules used for ship construction including materials, welding and assembling, with specification of the items to be examined and/or tested, the methods (e.g. by hydrostatic, hose or leak testing, non-destructive examination, verification of geometry) and who is to carry out such inspections and tests.

Appraisal of materials and equipment used for ship construction and their inspection at works is not included in this Article [1]. Details of requirements for hull and machinery steel forgings and castings and for normal and higher strength hull structural steel are given in Pt D, Ch 2, Sec 3, Pt D, Ch 2, Sec 4 and Pt D, Ch 2, Sec 1, [2] respectively. Acceptance of these items is verified through the survey process carried out at the Manufacturer's works and the issuing of the appropriate certificates.

In addition to above, for Tankers and Bulk Carriers subject to SOLAS Chapter II-1 Part A-1 Regulation 3-10 (Goal-based ship construction standards for bulk carriers and oil tankers), see also Sec 2.

1.2 Definitions

1.2.1 Hull structure

The hull structure (see Note 1) is defined as follows:

a) hull envelope including all internal and external structures,

b) superstructures, deckhouses and casings,

c) welded foundations, e.g. main engine seatings,

d) hatch coamings, bulwarks,

e) all penetrations fitted and welded into bulkheads, decks and shell,

f) the fittings of all connections to decks, bulkheads and shell, such as air pipes and ship side valves - all items of ILLC 1966, as amended,

g) welded attachments to shell, decks and primary members, e.g. crane pedestals, bitts and bollards, but only as regards their interaction on the hull structure.

Note 1: A glossary of hull terms and hull survey terms can be found in IACS Recommendation 82.

1.2.2 Documents

Reference to documents also includes electronic transmission or storage.

1.2.3 Survey methods *(1/7/2016)*

The survey methods which the Surveyor is directly involved in are as follows:

a) Patrol is defined as the act of checking on an independent and unscheduled basis that the applicable processes, activities and associated documentation of the shipbuilding functions identified in Tab 1 continue to conform to classification and statutory requirements.

b) Review is defined as the act of examining documents in order to determine traceability and identification, and to confirm that processes continue to conform to classification and statutory requirements.

c) Witness is defined as the attendance at scheduled inspections in accordance with the agreed Inspection and Test Plans to the extent necessary to check compliance with the survey requirements.

1.3 Application

1.3.1 Classification items

This Article [1] covers the survey of all new construction of steel ships intended for classification and for international voyages except for:

a) those defined in SOLAS I/3

b) high speed craft as defined in I/1.3.1 of the 2000 High Speed Craft Code

c) Mobile Offshore Drilling Units as defined in I/1.2.1 of the MODU Code.

1.3.2 Statutory items

This Article [1] covers all delegated statutory items relevant to the hull structure and coating, i.e. Load Line and SOLAS Safety Construction.

comments made in the appropriate column. If the Society has appointed a Surveyor for a specific newbuilding project then this Surveyor is to attend the kick-off meeting. The builder should agree to undertake ad hoc investigations during construction as may be requested by Class where areas of concern arise and to keep the Society advised of the progress of any such investigation. Whenever an investigation is undertaken, the builder is to be requested, in principle, to agree to suspend relevant construction activities if warranted by the severity of the problem.

1.7.2 Delegated statutory requirements

The records are to take note of specific published Administration requirements and interpretations of delegated statutory requirements.

1.7.3 Construction progress records *(1/7/2016)*

The shipyard shall be requested to advise of any changes to the activities agreed at the kick-off meeting and these are to be documented in the survey plan. For instance, if the shipbuilder chooses to use or change subcontractors, or to incorporate any modifications necessitated by changes in production or inspection methods, rules and regulations, structural modifications, or in the event where increased inspection requirements are deemed necessary as a result of a substantial non-conformance or otherwise.

1.7.4 Fabrication quality standard *(1/7/2021)*

Shipbuilding quality standards for the hull structure during new construction are to be reviewed and agreed during the kick-off meeting. Structural fabrication is to be carried out in accordance with IACS Recommendation 47, "Shipbuilding and Repair Quality Standard", or a ~~r~~Recognised ~~f~~Fabrication ~~s~~Standard (RFS) which has been accepted by the Society prior to the commencement of fabrication/construction. The work is to be carried out in accordance with the Rules and under survey of the Society.

The Society may accept an RFS as an alternative to IACS Rec. 47 provided that a) or b) below is complied with as applicable:

a) Where a RFS is well established and has well documented history (3 or more years prior to the new vessel contract) of successful application to similar designs as the new vessel and that history is for the same Shipyard as the new vessel. Then the Shipyard is to create a summary document referencing the RFS to be used in construction and highlighting any limitations to usage of the selected RFS. This summary document is to be included with the "record of kick-off meeting" for the vessel.

   The summary document is also to be included in the SCF, (for Tankers and Bulk Carriers subject to SOLAS Chapter II-1 Part A-1 Regulation 3-10 per Tab 2 Tier II Item 11), as applicable.

b) Where a RFS is new or revised or otherwise not as per a) the following steps are to be carried out:

   1) The tolerances and fabrications standards of the RFS are to be compared with those of IACS Rec. 47. Any standards that are less stringent than those of IACS Rec. 47 are to be identified.

   2) The tolerances and fabrication standards of the RFS identified in [1.7.4] b) 1) are to be assessed to determine the acceptability for use and/or any restrictions for usage for the subject (or proposed) design. Details of how the acceptability for use and/or restrictions are to be recorded, and.

   3) A summary document including the outcomes of b) 1) and b) 2) is to be compiled. This document is to also include a reference to the RFS, details of the tolerance and fabrication standards not analysed as part of b) 2) and any limitations to the usage of the RFS.

The summary document is to be included with the "record of the kick-off meeting" of the vessel. The summary document is also to be included in the SCF, (for Tankers and Bulk Carriers subject to SOLAS Chapter II-1 Part A-1 Regulation 3-10 per Tab 2 Tier II Item 11), as applicable.

1.7.5 Other attendees at the kick-off meeting

The kick-off meeting may be attended by other parties, such as the Owner or Administrations, subject to agreement by the shipbuilder.

1.7.6 Special cases of kick-off meeting *(1/7/2016)*

In the event of series ship production, production (see Note 1), the requirement for a kick off meeting [1.7.1] may be waived for the second and subsequent ships provided that no changes to the specific activities agreed in the kick off meeting for the first ship are introduced. If any changes are introduced, these are to be agreed in a new dedicated meeting and documented in a record of such meeting.

Note 1: Series Ship Production: vessels in the series subsequent to the first one (prototype), i.e. sister ships built in the same shipyard.

1.8 Examination and test plan for newbuilding activities

1.8.1 Plans to be provided

The shipbuilder is to provide plans of the items which are intended to be examined and tested. These plans need not be submitted for approval and examination at the time of the kick-off meeting. They are to include:

a) proposals for the examination of completed steelwork - generally referred to as the block plan and including details of joining blocks together at the pre-erection and erection stages or at other relevant stages;

b) proposals for fit-up examinations where necessary;

c) proposals for testing of the structure (leak and hydrostatic) as well as for all watertight and weathertight closing appliances;

d) proposals for non-destructive examination;

e) any other proposals specific to the ship type or to the statutory requirements.

1.8.2 Submittal of plans to the Surveyors *(1/7/2016)*

The plans and any modifications to them are to be submitted to the Surveyors in sufficient time to allow review before the relevant survey activity commences.

In addition to above, for Tankers and Bulk Carriers subject to SOLAS Chapter II-1 Part A-1 Regulation 3-10 see also [2].

1.9 Proof of the consistency of surveys

1.9.1 Evidence for survey planning and activities

Inspection and test records, checklists etc are to be kept in order to provide evidence that the Society's Surveyors have complied with the requirements of the newbuilding survey planning and duly participated in the relevant activities shown in the shipbuilder's examination and test plans.

1.9.2 Recording of patrolling activities *(1/7/2016)*

In addition, the classification society is to maintain records of deficiencies found during the patrolling activities required in Table 1 and described in [1.2.3].

Records shall include the date when deficiency was found, description of the deficiency and the date the deficiency was cleared.

1.10 Ship Construction File

1.10.1 *(1/7/2021)*

The purposes of this paragraph are applicable to all ships except the Tankers and Bulk Carriers subject to SOLAS Chapter II-1 Part A-1 Regulation 3-10 for which ~~the~~ [2.3] ~~of Appendix 2~~ is to be applied.

1.10.2 Document provider

The shipbuilder is to deliver documents for the Ship Construction File. In the event that items have been provided by another Party such as the Shipowner, and where separate arrangements have been made for document delivery excluding the shipbuilder, that Party has the responsibility.

The Ship Construction File is to be reviewed for content in accordance with the requirements of [1.10.3].

1.10.3 Contents of the Ship Construction File *(1/7/2021)*

It is recognised that the purpose of documents held in the Ship Construction File on board the ship is to facilitate surveys and repairs and maintenance, and, therefore, in addition to those listed in Tab 1, such documents are to include, but not be limited to, the following:

a) as-built structural drawings including scantling details, material details and, as applicable, wastage allowances, location of butts and seams, cross-section details and locations of all partial and full penetration welds, areas identified for close attention and rudders;

b) manuals required for classification and statutory requirements, e.g. loading and stability, bow doors, inner doors, side shell doors and stern doors - operations and maintenance manuals (Pt B, Ch 9, Sec 5 and Pt B, Ch 9, Sec 6);

c) ship structure access manual, as applicable;

d) copies of certificates of forgings and castings welded into the hull (Pt D, Ch 2, Sec 3 and Pt D, Ch 2, Sec 4);

e) details of equipment forming part of the watertight and weathertight integrity of the ship;

f) a Cable Transit Seal Systems Register (Register), to be prepared by the shipbuilder for watertight cable transits. The Register can be in either a hard copy or digitized media. For an example of a register see Fig 1 - "Recommendatory Sample - Cable Transit Seal Systems Register". It is to include a marking / identification system, documentation referencing manufacturer manual(s) for each type of cable transit installed, the Type Approval certification for each type of transit system, applicable installation drawings, and a recording of each installed transit documenting the as built condition after final inspection in the shipyard. This is to include sections to record any inspection, modification, repair and maintenance.

   For manned vessels the Register is to be held onboard of the vessel. For unmanned vessels, if a suitable storage location does not exist onboard, the Register may be held ashore. The Register is to be readily available for the attending surveyor.

g) tank testing plan including details of the test requirements (Pt B, Ch 12, Sec 3);

h) corrosion protection specifications (Pt B, Ch 11, Sec 1 and Pt E, Ch 4, Sec 3, [11]);

i) details for the in-water survey, if applicable, information for divers, clearance measurement instructions etc, tank and compartment boundaries;

j) docking plan and details of all penetrations normally examined at dry-docking;

k) Coating Technical File, for ships subject to compliance with the IMO Performance Standard for Protective Coatings (PSPC), as a class requirement under the Common Structural Rules.

1.11 Shipyard review record

1.11.1 Contents of the shipyard review record

The shipyard review record is to contain the following information, for which the Society form "Shipyard review record" is to be filled in as appropriate:

a) name and location of shipyard

b) details of any management systems

c) construction facilities

d) shipyard control of qualified welders

e) features of construction procedure

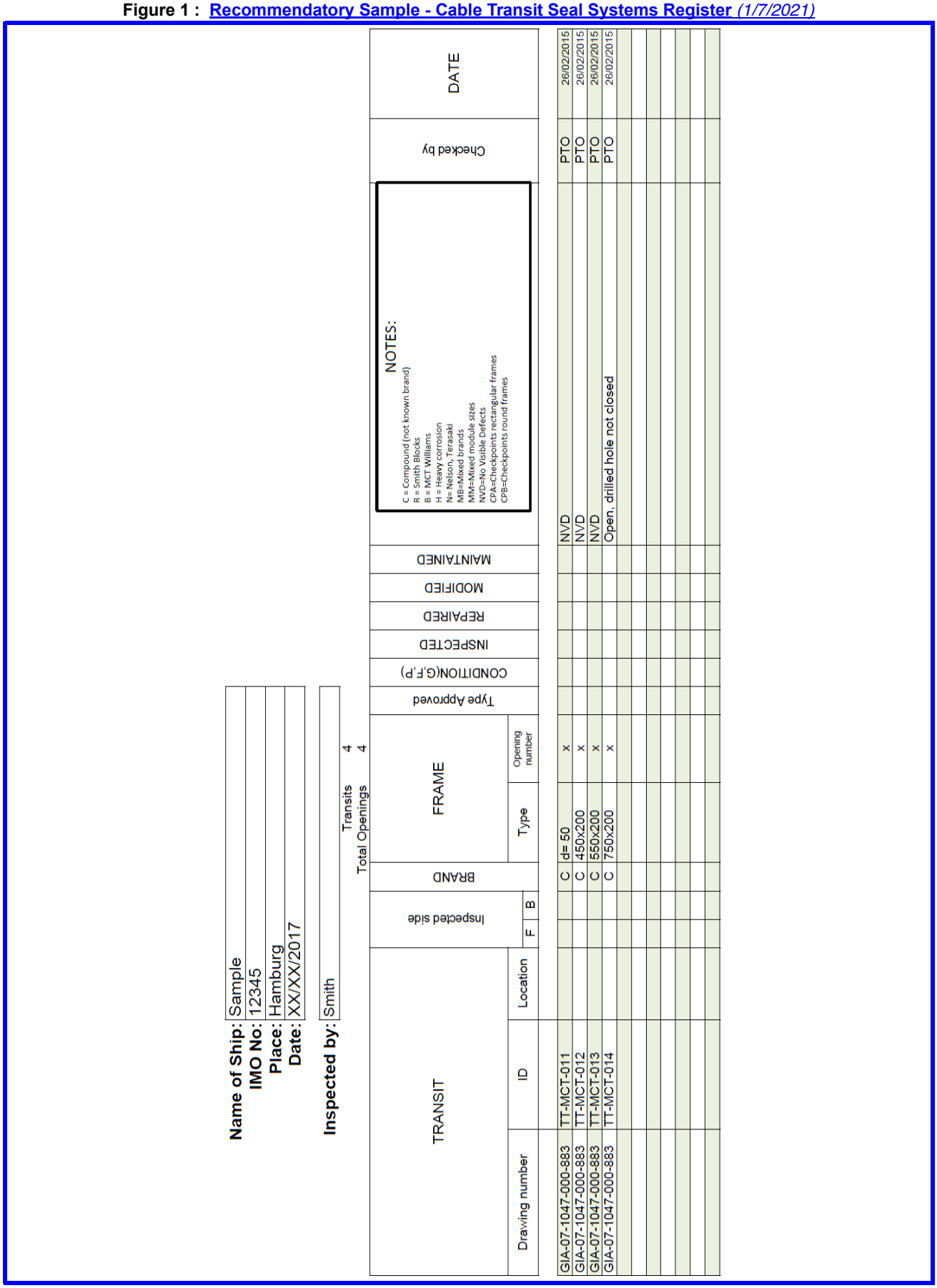
f) quality control system

g) measures for safety and health

h) control system of non-destructive examination (NDE)

i) quality control on production line.

Figure 1 : Recommendatory Sample - Cable Transit Seal Systems Register *(1/7/2021)*



Name of Ship: Sample
IMO No: 12345
Place: Hamburg
Date: XX/XX/2017

Inspected by: Smith

Transits 4
Total Openings 4

NOTES:
C = Compound (not known brand)
R = Smith Blocks
B = MCT Williams
H = Heavy corrosion
N= Nelson, Terasaki
MB=Mixed brands
MM=Mixed module sizes
NVD=No Visible Defects
CPA=Checkpoints rectangular frames
CPB=Checkpoints round frames

TRANSIT			Inspected side		BRAND	FRAME		Type Approved	CONDITION(G,F,P)	INSPECTED	REPAIRED	MODIFIED	MAINTAINED		Checked by	DATE
Drawing number	ID	Location	F	B		Type	Opening number									
GIA-07-1047-000-883	TT-MCT-011				C	d= 50	x							NVD	PTO	26/02/2015
GIA-07-1047-000-883	TT-MCT-012				C	450x200	x							NVD	PTO	26/02/2015
GIA-07-1047-000-883	TT-MCT-013				C	550x200	x							NVD	PTO	26/02/2015
GIA-07-1047-000-883	TT-MCT-014				C	750x200	x							Open, drilled hole not closed	PTO	26/02/2015

Table 1 : New construction survey activities *(1/7/2021)*

No.	Shipbuilding quality control function	Survey Requirements for Classification	Survey Method required for Classification	Society Rule reference	Statutory requirements and relevant reference	Documentation available to Surveyor during construction	Documentation for Ship Construction File	Specific activities	Society proposals for the project
1	Welding:								
1.1	Welding consumables	Approved by Society separately at the Manufacturer's	Review approval status and patrol, verify storage, handling and treatment in accordance with Manufacturer's requirements	Pt D, Ch 5, Sec 2		Consumable specification and approval status	Not required	Identify consumables against approved list	
								Verify temporary and permanent storage facilities	E.g. kept dry, covered, where applicable heated
								Verify traceability	E.g. random batch number checking
1.2	Welder qualification	Qualified welders	Review of welder certification and patrol	Guide for Welding		Shipyard's records with individual's identification	Not required	Verify welder qualification standard, e.g. class or recognised standard approval	
								Verify welder approved for weld position	
								Verify validity of qualification certificate	

No.	Shipbuilding quality control function	Survey Requirements for Classification	Survey Method required for Classification	Society Rule reference	Statutory requirements and relevant reference	Documentation available to Surveyor during construction	Documentation for Ship Construction File	Specific activities	Society proposals for the project
1.4	Welding- surface discontinuities	Substantially free from significant indications, satisfactory profile and size	Visual examination, surface detection techniques, review of documents and patrol of operator	- Guide for welding - Rules for carrying out non-destructive examinations of welding		Shipbuilder's and recognised standards and Rules as applicable, welding and N~~D T~~DE plans, ND~~T~~E reports, operator qualifications	Not required	Identify workstations where ND~~T~~E is carried out, e.g. panel line butt welds, castings into hull structure	
								Verify ND~~T~~E carried out in accordance with approved plans where applicable	
								Verify suitability of ND~~T~~E methods	
								Verify operators suitably qualified, particularly where subcontractors have been employed	
								Verify ND~~T~~E is carried out according to the acceptable process	
								Review ND~~T~~E records	

No.	Shipbuilding quality control function	Survey Requirements for Classification	Survey Method required for Classification	Society Rule reference	Statutory requirements and relevant reference	Documentation available to Surveyor during construction	Documentation for Ship Construction File	Specific activities	Society proposals for the project
1.5	Welding - embedded discontinuities	NDT is to be carried out by qualified operators capable of ensuring that welds are substantially free from significant indications	Radiography and ultrasonic testing, review of documents and patrol of operator, examination of films	- Guide for Welding - Rules for carrying out non-destructive examinations of welding		Shipbuilder's and recognised standards and Rules as applicable, welding and NDT plans, NDT reports, operator qualifications	Not required	Identify workstations where NDT is carried out, e.g. panel line butt welds, castings into hull structure	
								Verify NDT carried out in accordance with approved plans, where applicable	
								Verify suitability of NDT methods	
								Verify operators suitably qualified, particularly where subcontractors have been employed	
								Verify that records have been completed and in accordance with recognised standards, e.g. IQI and sensitivity recorded	

No.	Shipbuilding quality control function	Survey Requirements for Classification	Survey Method required for Classification	Society Rule reference	Statutory requirements and relevant reference	Documentation available to Surveyor during construction	Documentation for Ship Construction File	Specific activities	Society proposals for the project
1.5 Cont'd	Welding - embedded discontinuities							Verify that reports and radiographs have been evaluated correctly by the shipbuilder. Systematic review of radiographs carried out by the Surveyor	
								Verify equipment calibration is satisfactory and in accordance with Manufacturer's and recognised standards and requirements	
								Verify NDT~~T~~E is carried out according to the acceptable process	

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No.	Shipbuilding quality control function	Survey Requirements for Classification	Survey Method required for Classification	Society Rule reference	Statutory requirements and relevant reference	Documentation available to Surveyor during construction	Documentation for Ship Construction File	Specific activities	Society proposals for the project
12	watertight cable transit seal systems	compliance with approved drawings, visual examination of fitting, check alignment and securing	patrol of the process and witness of the completed item		Reg. II-1/13 and 13-1 of SOLAS as amended	ship-builder's inspection records, manufacturer's specification	Cable Transit Seal Systems Register	Verify that correct welding and fit up requirements, including as specified in reference 1, 2.4 and 2.5 of this table have been adopted	
								Verify watertight cable transit seal systems have been installed in accordance with the manufacturer's requirements and are type approved	
								Verify the format and content of the Register to confirm it contains a list of the watertight cable transits, applicable cable transit information and sections to maintain in-service maintenance and survey records.	

No.	Shipbuilding quality control function	Survey Requirements for Classification	Survey Method required for Classification	Society Rule reference	Statutory requirements and relevant reference	Documentation available to Surveyor during construction	Documentation for Ship Construction File	Specific activities	Society proposals for the project
								Verify that, where specified, appropriate specialized tools have been used	

2 Requirements for Tankers and Bulk Carriers subject to SOLAS Chapter II-1 Part A-1 Regulation 3-10

2.1 Examination and test plan for newbuilding activities

2.1.1 Plans to be provided *(1/7/2016)*

The shipbuilder is to provide plans of the items which are intended to be examined and tested in a document known as the Survey Plan, taking into account the ship type and design. This Survey Plan shall be reviewed at the time of the kick off meeting, and are to include:

a) a set of requirements, including specifying the extent and scope of the construction survey(s) and identifying areas that need special attention during the survey(s), to ensure compliance of construction with mandatory ship construction standards including:

1) Types of surveys (visual, non-destructive examination, etc.) depending on location, materials, welding, casting, coatings, etc.

2) Establishment of a construction survey schedule for all assembly stages from the kick-off meeting, through all major construction phases, up to delivery.

3) Inspection/survey plan, including provisions for critical areas identified during design approval.

4) Inspection criteria for acceptance.

5) Interaction with shipyard, including notification and documentation of survey results.

6) Correction procedures to remedy construction defects.

7) List of items that would require scheduling or formal surveys.

8) Determination and documentation of areas that need special attention throughout ship's life, including criteria used in making the determination.

b) a description of the requirements for all types of testing during survey, including test criteria.

2.2 Design Transparency

2.2.1 *(1/7/2016)*

For ships subject to compliance with IMO Res. MSC.287(87), IMO Res. MSC.290(87), IMO Res. MSC.296(87) and IMO MSC.1/Circ.1343, readily available documentation is to include the main goal-based parameters and all relevant design parameters that may limit the operation of the ship.

2.3 Ship Construction File (SCF)

2.3.1 Classification items *(1/7/2021)*

A Ship Construction File (SCF) with specific information on how the functional requirements of the Goal-based Ship Construction Standards for Bulk Carriers and Oil Tankers have been applied in the ship design and construction is to be provided upon delivery of a new ship, and kept on board the ship and/or ashore and updated as appropriate throughout the ship's service. The contents of the Ship Construction File are to conform to the requirements below:

a) The following design specific information is to be included in the Ship Construction File (SCF):

1) Areas requiring special attention throughout the ship's life. (including critical structural areas).

2) All design parameters limiting the operation of a ship.

3) Any alternatives to the rules, including structural details and equivalency calculations.

4) "As built" drawings and information which are verified to incorporate all alterations approved by the recognized organization or flag State during the construction process including scantling details, material details, location of butts and seams, cross section details and locations of all partial and full penetration welds.

5) Net (renewal) scantlings for all the structural constituent parts, as built scantlings and voluntary addition thicknesses.

6) Minimum hull girder section modulus along the length of the ship which has to be maintained throughout the ship's life, including cross section details such as the value of the area of the deck zone and bottom zone, the renewal value for the neutral axis zone.

7) A listing of materials used for the construction of the hull structure, and provisions for documenting changes to any of the above during the ship's service life.

8) Copies of testing certificates of forgings and castings welded into the hull (Pt D, Ch 5, Sec 4).

9) Details of equipment forming part of the watertight and weather tight integrity of the ship.

10) A Cable Transit Seal Systems Register (Register), to be prepared by the shipbuilder for watertight cable transits. The Register can be in either a hard copy or digitized media. For an example of a register see Fig 1 - Recommendatory Sample - Cable Transit Seal Systems Register. It is to include a marking / identification system, documentation referencing manufacturer manual(s) for each type of cable transit installed, the Type Approval certification for each type of transit system, applicable installation drawings, and a recording of each installed transit documenting the as built condition after final inspection in the shipyard. This is to include sections to record any inspection, modification, repair and maintenance.

For manned vessels the Register is to be held onboard of the vessel. For unmanned vessels, if a suitable storage location does not exist onboard, the

Register may be held ashore. The Register is to be readily available for the attending surveyor.

11) Tank testing plan including details of the test requirements (Pt B, Ch 12, Sec 3).

12) Details for the in-water survey, when applicable, information for divers, clearances measurements instructions etc., tank and compartment boundaries.

13) Docking plan and details of all penetrations normally examined at dry-dock.

14) Coating Technical File, for ships subject to compliance with the IMO Performance Standard for Protective Coatings (PSPC2).

b) Refer to Tab 2 for details of information to be further included. This information has to be kept on board the ship and/or ashore and updated as appropriate throughout the ship's life in order to facilitate safe operation, maintenance, survey, repair and emergency measure.

c) It is to be noted that parts of the content of the SCF may be subject to various degrees of restricted access and that such documentation may be appropriately kept ashore.

d) The SCF has to include the list of documents constituting the SCF and all information listed in Tab 2, which is required for a ship's safe operation, maintenance, survey, repair and in emergency situations. Details of specific information that is not considered to be critical to safety might be included directly or by reference to other documents.

e) When developing an SCF, all of the columns in Tab 2 ~~of this Appendix~~ have to be reviewed to ensure that all necessary information has been provided.

f) It may be possible to provide information listed in the annex under more than one Tier II (see Note 1) functional requirement as a single item within the SCF, for example, the Coating Technical File required by the PSPC (see Note 2) is relevant for both "Coating life" and "Survey during construction".

Note 1: Tier II items means the functional requirements included in the International Goal-based Ship Construction Standards for Bulk Carriers and Oil Tankers (GBS), adopted by IMO Res. MSC 287(87).

Note 2: Performance standard for protective coatings for dedicated seawater ballast tanks in all types of ships and double-side skin spaces of bulk carriers, adopted by IMO Res. MSC 215(82), as amended and Performance standard for protective coatings for cargo oil tanks of crude oil tankers, adopted by IMO Res. MSC 288(87), as amended.

g) The SCF has to remain with the ship and, in addition, be available to its classification society and flag State throughout the ship's life. Where information not considered necessary to be on board is stored ashore, procedures to access this information should be specified in the onboard SCF. The intellectual property provisions within the SCF should be duly complied with.

h) The SCF should be updated throughout the ship's life at any major event, including, but not limited to, substantial repair and conversion, or any modification to the ship structure.

Table 2 : List of Information to be Included in the Ship Construction File (SCF) *(1/7/2016)*

Tier II Items	Information to be included	Further explanation of the content	Example documents	Normal storage location
DESIGN				
Notes: **(1)** "SCF-specific" means documents to be developed especially to meet the requirements of the GBS guidelines (MSC.1/Circ.1343). **(2)** "Key construction plans" means plans such as midship section, main O.T. and W.T. transverse bulkheads, construction profiles/plans, shell expansions, forward and aft sections in cargo tank (or hold) region, engine-room construction, forward construction and stern construction drawings. **(3)** "Yard plans" means a full set of structural drawings, which include scantling information of all structural members. **(4)** "Hull form" means a graphical or numerical representation of the geometry of the hull. Examples would include the graphical description provided by a lines plan and the numerical description provided by the hull form data stored within an onboard computer. **(5)** "Lines plan" means a special drawing which is dedicated to show the entire hull form of a ship. **(6)** "Equivalent (to Lines plan)" means a set of information of hull form to be indicated in key construction plans for SCF purposes. Sufficient information should be included in the drawings to provide the geometric definition to facilitate the repair of any part of the hull structure. **(7)** "Normal storage location" means a standard location where each SCF information item should be stored. However, those items listed as being on board in the table above should be on board as a minimum to ensure that they are transferred with the ship on a change of owner. **(8)** "Shore archive" is to be operated in accordance with applicable international standards.				

3 Machinery and systems

3.1 General

3.1.1 Scope

The scope of this article [3] includes the following main activities:

a) Examination of the parts of the ship covered by classification Rules and by applicable delegated statutory regulations for machinery construction, to obtain appropriate evidence that they have been built in compliance with the Rules and regulations, taking account of the relevant approved drawings.

b) Appraisal of the manufacturing, construction, control and qualification procedures, including welding consumables, weld procedures, weld connections and assemblies, with indication of relevant approval tests (e.g for piping systems).

c) Witnessing inspections and tests as required in the classification Rules for machinery and systems including materials, welding and assembly, the inspection and testing methods (e.g. by hydrostatic, leak testing, non-destructive examination, verification of geometry) and by whom.

Appraisal of materials and equipment used for machinery and systems and their inspection at works is not included in this Article [3]. Details of requirements for machinery and systems and equipment are given in:

- Part C, Chapter 1 for machinery equipment and piping systems,
- Part C, Chapter 2 for electrical systems,
- Part C, Chapter 3 for automation systems,
- Part D for materials and welding,
- Part B for anchoring and mooring system,
- Part E requirements for the specific Service Notations,
- Part F requirements for the Additional Class Notations.

3.2 Definitions

3.2.1 Machinery

The Machinery components are generally defined as follows:

a) Main and auxiliary engines, turbines and boilers

b) Reduction gears, main thrust, intermediate shafts, tail-shafts and propellers

c) Main and auxiliary systems for steering

d) Pumps and other machinery items

e) Systems in machinery spaces and in cargo areas

f) Electrical equipment and installations

g) Fire protection, detection and extinction (limited to the items covered by Classification, see Note 1 in Ch 1, Sec 1, [1.1.2])

h) Automation systems

i) Machinery system for mooring and anchoring

j) Machinery systems required by specific Service Notation

k) Machinery systems required by specific Additional Class Notations.

3.2.2 Documents

Reference to documents also includes electronic transmission or storage.

3.2.3 Survey methods

The survey methods involving the Surveyor directly are as follows:

a) Patrol is defined as the act of checking on an independent and unscheduled basis that the applicable processes, activities and associated documentation of the shipbuilding functions continue to conform to classification and delegated statutory requirements.

b) Review is defined as the act of examining documents in order to determine traceability and identification, and to confirm that processes continue to conform to classification and delegated statutory requirements.

c) Witness is defined as the attendance at scheduled inspections and tests in accordance with the agreed Inspection and Test Plans or equivalent to the extent necessary to check compliance with the survey requirements.

3.3 Application

3.3.1 Classification items

This Article [3] covers the survey of all new construction of steel ships intended for classification and for international voyages except for:

a) those defined in SOLAS I/3

b) high speed craft as defined in I/1.3.1 of the 2000 High Speed Craft Code

c) Mobile Offshore Drilling Units as defined in I/1.2.1 of the MODU Code.

3.3.2 Delegated statutory items

This Article [3] covers all delegated statutory items relevant to the machinery items, i.e. SOLAS Safety Construction.

3.3.3 Location of construction *(1/7/2021)*

This Article [~~2~~3] applies to the machinery items, as defined in [3.2.1] whether constructed and/or installed:

a) at the shipbuilder's facilities

b) by subcontractors/suppliers at the shipbuilder's facilities

c) by subcontractors/suppliers at their own facilities or at other remote locations

d) by machinery item manufacturers at the shipbuilder's facilities

e) by machinery item manufacturers at their own facilities or at other remote locations.

3.4 Personnel

3.4.1 Qualification and monitoring of exclusive Surveyors

The Society's Surveyors are to confirm through patrol, review and witness, as defined in [3.2.3], that machinery items are built and installed using approved plans in

SECTION 3 ANNUAL SURVEY

1 General

1.1

1.1.1 The requirements of this Section apply to annual surveys of all ships. The specific requirements for annual surveys related to service notations and additional class notations assigned to ships are addressed in Chapter 4 and Chapter 5, respectively.

1.1.2 At the time of annual surveys, the ship is to be generally examined. The survey is to include a visual inspection of the hull, equipment and machinery of the ship and some tests thereof, so far as necessary and practicable in order to verify that the ship is in a satisfactory and efficient general condition and is properly maintained.

1.1.3 Owners are reminded that, in compliance with the requirements in Ch 2, Sec 2, [11.4], any modification to the ship's hull, equipment and machinery affecting its classification is to be made known to the Society.

2 Hull

2.1 Scope

2.1.1

The survey is to consist of an examination for the purpose of ensuring, as far as practicable, that the hull, hatch covers, hatch coamings, closing appliances, equipment and related piping are maintained in a satisfactory condition.

2.2 Hull and hull equipment

2.2.1 *(1/7/2015)*

The survey is to include a general external examination and testing, where appropriate, verifying the efficient condition of the following items, as applicable:

- outer shell plating above the waterline, relevant shell doors and accessible parts of the rudder(s)
- plating of freeboard deck and exposed decks, superstructures, with their openings and means of closure
- openings on exposed decks, with their coamings and their means of closure and securing arrangements (for cargo hatchways see [2.3])
- sidescuttles and deadlights, garbage chutes and other openings with their means of closure
- bulwarks, guard rails, freeing ports, gangways and lifelines, ladders
- scuppers and sanitary discharges, valves on discharge lines and their controls
- the means provided to minimise water ingress through the spurling pipes and chain lockers
- the arrangements for closing openings in the shell plating below the freeboard deck
- ventilators, air pipes, overflow pipes and gas vent pipes, with their means of closure and flame screens, where required. In particular:
  - examination of the weld connection between air pipes and deck plating
  - examination of flame screens on vents to all bunker tanks
  - examination of ventilators, including closing devices, if any.
- external examination of all air pipe heads installed on exposed decks including all automatic air pipe heads installed on exposed decks (see Note 2). This requirement is not applicable to passenger ships
- the special requirements for ships permitted to sail with type "A" or type "B-minus" freeboards
- fittings and appliances for timber deck cargoes, where applicable
- freeboard marks on the ship's sides
- deck equipment such as lifeboat davit foundations, bollards, fairleads, hawse pipes, etc., masts and associated rigging, including lightning conductors
- equipment of chain cables for anchors, windlass, mooring lines and mooring winches, where required
- confirmation that the towing and mooring equipment is properly marked with any restriction associated with its safe operation (for ships built after 1/1/2007)
- deck fittings, their pedestals, if any, and the hull structures associated with towing and mooring
- watertight bulkheads, their watertight doors and associated local and remote controls, and their watertight penetrations
- main and auxiliary steering arrangements, including their associated equipment and control systems, and manoeuvring gear
- accessible cargo holds, in particular in areas likely to be damaged by cargo handling
- confirmation that the drainage from enclosed cargo spaces situated on the freeboard deck is satisfactory
- engine room and other dry spaces
- where fitted, helicopter deck and its supporting structure, safety net and arrangements for the prevention of sliding

2.7 Watertight Cable Transits

2.7.1 *(1/7/2021)*

The Register (see Sec 1, [1.10.3] f)) is to be reviewed to confirm it is being maintained and as far as practicable the transits are to be examined to confirm their satisfactory condition.

2.7.2 *(1/7/2021)*

Where there are records entered since the last annual survey of any disruption to the cable transits or installation of new cable transits, the satisfactory condition of those transits, in accordance with the manufacturer's requirements and in accordance with the requirements of type approval, is to be confirmed by review of records and, if deemed necessary, by examination.

It is to be confirmed that, where specified, appropriate specialized tools have been used.

The results are to be recorded in the Register against the specific cable transit.

3 Machinery and systems

3.1 General machinery installations

3.1.1 *(1/7/2015)*

The survey of general machinery installations is to cover the following items:

- general examination of machinery and boiler spaces with particular attention to the fire and explosion hazards
- general examination of the machinery, steam, hydraulic, pneumatic and other systems and their associated fittings, for confirmation of their proper maintenance
- testing of the means of communication and order transmission between the navigating bridge and the machinery control positions and other control stations
- confirmation that the rudder angle indicator on the bridge is in working order
- examination, as far as practicable, of the bilge pumping systems and bilge wells, including operation of the pumps, remote reach rods and level alarms, where fitted
- visual examination of the condition of any expansion joints in sea water systems
- external examination of pressure vessels other than boilers and their appurtenances, including safety devices, foundations, controls, relieving gear, high pressure piping, insulation and gauges
- visual examination of mechanical components used for cooling and maintaining an ambient temperature lower than 45°C (see Pt C, Ch 2, Sec 2, [1.2.2])
- confirmation that no new materials containing asbestos have been installed on board.

3.1.2

When the ship is equipped with a refrigerating plant (whether or not covered by an additional class notation), the annual survey is to include the external examination of:

- pressure vessels of the installation to the same extent as indicated in [3.1.1]
- refrigerant piping, as far as practicable
- for refrigerating machinery spaces using ammonia as refrigerant:
  - ventilation system including functional test
  - bilge system including functional test
  - electrical equipment, confirming its proper maintenance
  - gas detection system
  - breathing apparatus and protective clothing.

3.1.3 When the ship is equipped with thruster installations, the annual survey is to include:

- an external examination of the machinery installation
- an operating test of the complete installation.

3.2 Boilers

3.2.1 For main and auxiliary boilers, the annual survey consists of an external examination of boilers and their appurtenances, including safety devices, foundations, controls, relieving, high pressure and steam escape piping, insulation and gauges.

3.2.2 For thermal oil heaters, a functional test while in operation is to be carried out, during which the following items are checked:

- the heater for detection of leakages
- the condition of the insulation
- the operation of indication, control and safety devices
- the condition of remote controls for shut-off and discharge valves

A satisfactory analysis of the quality of oil is to be made available to the Surveyor.

3.2.3 For exhaust gas thermal oil heaters, in addition to the requirements of [3.2.2], a visual examination and a tightness testing to the working pressure of the heater tubes are to be carried out.

3.3 Towing winch emergency release systems

3.3.1 *(1/7/2021)*

Operation of the towing winch emergency release system is to be confirmed with the reference to the documented instructions for surveys provided by the manufacturer.

Operation of the winch emergency release system under no load condition is to be verified.

Where practical, activation of the emergency release system may be confirmed by observation of the winch brake.

3.3.2 *(1/7/2021)*

The function of the alarms associated with the emergency release system is to be verified, as far as practicable and reasonable.

3.3.3 *(1/7/2021)*

The condition of the emergency release system is to be visually examined to confirm it remains in satisfactory condition.

3.3.4 *(1/7/2021)*

The means of emergency release of the towline in the event of a blackout is to be examined, and where additional sources of energy are arranged for this purpose, the sources of energy are to be visually inspected and operationally tested.

3.3.5 *(1/7/2021)*

It is to be verified that the performance capabilities and operating instructions of the emergency release system are documented and made available on board the ship on which the winch has been installed.

3.4 Electrical machinery and equipment

3.4.1

The survey of electrical machinery and equipment is to cover the following items:

- general examination, visually and in operation, as feasible, of the electrical installations for power and lighting, in particular main and emergency generators, electric motors, batteries, switchboards, switchgears, cables and circuit protective devices, indicators of electrical insulation and automatic starting, where provided, of emergency sources of power
- checking, as far as practicable, the operation of emergency sources of power and, where they are automatic, also including the automatic mode.

3.4.2

The survey is also to cover electrical components used for cooling and maintaining an ambient temperature lower than 45°C (see Pt C, Ch 2, Sec 2, [1.2.2]).

3.4.3 The survey is also to cover the bridge control of propulsion machinery, and related arrangements (alarms and safety devices), when fitted.

The survey of an automated installation covered by an additional class notation is detailed in Chapter 5.

3.4.4 *(1/1/2020)*

Additionally, on board ships where harmonic filters are installed on main busbars of electrical distribution system, harmonic distortion levels of main busbar are to be measured under seagoing conditions, as close to the periodical machinery survey as possible, so as to give a clear representation of the condition of the entire plant to the surveyor. Harmonic distortion readings are to be carried out when the greatest amount of distortion is indicated by the measuring equipment. An entry showing which equipment was running and/or filters in service is to be recorded in the log so this can be replicated for the next periodical survey.

Records of all the above measurements are to be made available to the surveyor at each periodical survey.

Note 1: harmonic filters installed for single application frequency drives such as pump motors are excluded from this requirement.

3.5 Fire protection, detection and extinction

3.5.1 *(17/2015)*

The survey of fire prevention includes the examination of arrangements for gaseous fuel for domestic purposes, such as movable cooking appliances, the so-called "flambé carte".

SECTION 5 CLASS RENEWAL SURVEY

1 General

1.1

1.1.1 The requirements of this Section apply to class renewal surveys of all ships. The specific requirements for class renewal surveys related to service notations and additional class notations assigned to ships are addressed in Chapter 4 and Chapter 5, respectively.

1.1.2 *(1/7/2015)*

The class renewal survey is to include, in addition to the requirements of the annual survey, examination, tests and checks to show that the hull structures, main and auxiliary machinery, systems, equipment and related piping, as required in [2.2.8], are in satisfactory condition or restored to such condition as to allow the ship to operate for the new period of class to be assigned, provided that the ship is properly maintained and operated and other surveys for maintenance of class are duly carried out during this period.

The examinations of the hull are to be supplemented by thickness measurements and testing as required in [2.4.3], [2.4.4] and [2.5.1], to ensure that the structural integrity remains effective. The aim of the examination is to discover substantial corrosion, significant deformation, fractures, damages or other structural deterioration.

1.1.3 The Owner is to provide the necessary facilities to enable this class renewal survey. The conditions for survey as detailed in Ch 2, Sec 2, [2.5] to Ch 2, Sec 2, [2.8] are to be met.

1.1.4 When the ship is under the continuous survey system for machinery and/or hull, the scope of the class renewal survey as described in this Section is carried out on a continuous basis over the period of class according to the procedure laid down in Ch 2, Sec 2, [4.3].

When the machinery installation is surveyed under the Planned Maintenance System, a specific program of survey replaces the scope of the class renewal survey of machinery and systems as laid down in [3] below, according to the procedure laid down in Ch 2, Sec 2, [4.4].

1.1.5

A survey-planning meeting is to be held prior to the commencement of the survey.

2 Hull and hull equipment

2.1 Bottom survey

2.1.1

The class renewal survey is to include a bottom survey as laid down in Sec 6, [2.2].

2.2 Decks, hatch covers and equipment

2.2.1 Decks are to be examined, particular attention being given to the areas where stress concentration or increased corrosion are likely to develop, such as hatch corners and other discontinuities of structure.

Deck erections such as hatch coamings, deckhouses and superstructures are to be examined.

The sheathing of wood-sheathed steel decks may be removed, at the Surveyor's discretion, in the case of doubt as to the condition of plating underneath.

Due attention is to be given to the examination in way of end and side openings and related shell and inner doors.

2.2.2 *(1/7/2016)*

The survey of hatch covers and coamings is to include:

- a thorough inspection of the items listed in Sec 3, [2.3], including close-up survey of hatch cover plating and hatch coaming plating. Subject to cargo hold hatch covers of approved design which structurally have no access to the internals, close-up survey shall be done of accessible parts of hatch covers structures.
- checking of the satisfactory operation of all mechanically operated hatch covers including stowage and securing in open condition, proper fit, locking and efficiency of sealing in closed position, operational testing of hydraulic and power components, wires, chains and link drives.
- checking of the effectiveness of sealing arrangements of all hatch covers by means of hose testing or equivalent.
- thickness measurements of coaming and attached stiffeners, hatch cover plating and stiffeners (see Tab 2).

2.2.3

The survey of hull equipment is to cover the following points:

- windlass and chain stoppers, with disassembly as deemed necessary to verify the condition of the equipment and control and safety devices, hawse pipes
- steering arrangements, including steering gear, control and indication devices, operational tests and disassembly as deemed necessary; in the case of chain and rod gears, chains, rods, sheaves, pins and rollers are to be examined for wear
- connection of masts and standing rigging to the hull structure as well as condition of structure underneath
- deck fittings, their pedestals, if any, and the hull structures associated with towing and mooring, with disassembly where applicable and as deemed necessary.

2.7 Watertight Cable Transits

2.7.1 *(1/7/2021)*

The requirements for Special Survey may be undertaken by the attending Surveyor or by a firm approved as a service supplier according to Rules for the certification of Service Supplier.

2.7.2 *(1/7/2021)*

All transits are to be examined to confirm their satisfactory condition and the Register (see Sec 1, [1.10.3] f)) is to be reviewed to confirm it is being maintained. The Special Survey is to be recorded in the Register, in which a single record entry will be sufficient to record the survey of all transits.

2.7.3 *(1/7/2021)*

From review of the Register, where there are records entered since the last special survey of any disruption to the cable transits or installation of new cable transits (except which are reviewed and examined at previous annual surveys), the satisfactory condition of those transits, in accordance with the manufacturer's requirements and in accordance with the requirements of type approval, is to be confirmed by the attending Surveyor by review of records and examination of the transits.

It is to be confirmed that, where specified, appropriate specialized tools have been used.

The results are to be recorded in the Register against each of those cable transits.

2.7.4 *(1/7/2021)*

In case the cable transits have been examined by an approved service supplier, the attending surveyor is to review the Register in order to ascertain that it has been properly maintained by the Shipowner and correctly endorsed by the service supplier.

3 Machinery and systems

3.1 General

3.1.1 The survey items listed below are to be covered to the satisfaction of the Surveyor. However, other survey alternatives deemed equivalent by the Surveyor in relation to the characteristics and general condition of the ship concerned may also be accepted.

Note 1: Attention is drawn to the requirement Ch 2, Sec 2, [2.5.1] regarding safe execution of surveys, in particular as regards health hazards related to asbestos.

3.3 Reduction gears, main thrust and intermediate shaft(s)

3.3.1 Reduction gears complete with all wheels, pinions, shafts, couplings, bearings and gear teeth, including incorporated clutch arrangements, are to be opened up, as deemed necessary by the Surveyor, for visual inspection. For complicated assemblies, gears and roller bearings may be inspected without dismantling.

3.3.2 All shafts, thrust blocks and bearings are to be examined.

3.4 Pumps and other machinery items

3.4.1 General

The items listed in [3.4.2] are to be opened up, as deemed necessary by the Surveyor, for visual inspection. Their parts and components are to be pressure tested as appropriate and considered necessary by the Surveyor. A working test is also to be carried out, including testing of alarms and safety devices if deemed necessary by the Surveyor.

3.4.2 Items to be surveyed

a) Air compressors with their intercoolers, filters and/or oil separators and safety devices

b) Heat exchangers, ventilation fans for boilers and other equipment used for essential services

c) Piston pumps and centrifugal pumps for sea water, bilge and salt water ballast

d) Screw pumps, gear pumps and centrifugal pumps other than those listed in c) above (opening up is not required)

e) Mechanical components used for cooling and maintaining an ambient temperature lower than 45°C (see Pt C, Ch 2, Sec 2, [1.2.2]).

3.5 Systems in machinery spaces

3.5.1 Valves, cocks and strainers of the bilge and ballast systems are to be opened up, thoroughly or partly as deemed necessary by the Surveyor, for visual inspection, and, together with the piping and safety devices, examined and tested under working conditions.

3.5.2 The fuel oil, lubricating oil, hydraulic oil, thermal oil, and feed and cooling water systems, together with pressure filters, heaters and coolers used for essential services, are to be opened up and examined or tested, as considered necessary by the Surveyor. Safety devices for the foregoing items are to be examined.

3.5.3 The compressed air system together with its valves, fittings and safety devices is to be examined, as considered necessary by the Surveyor.

3.5.4

Compressed air receivers and other pressure vessels for essential services are to be cleaned internally and examined internally and externally. Where the above receivers or vessels cannot be examined internally, they are to be hydrostatically tested to 1,5 times the working pressure. Their fittings, valves and safety devices are to be opened up, as deemed necessary by the Surveyor, for visual inspection and pressure tested as appropriate.

3.5.5 Steel pipes for superheated steam having a temperature of the steam at the superheater outlet exceeding 450°C are to be examined and tested in accordance with [3.5.7] to [3.5.8] at each class renewal survey.

3.5.6 Steel pipes for saturated steam or superheated steam having a temperature of the steam at the superheater outlet not exceeding 450°C are to be examined and tested in accordance with [3.5.7] and [3.5.8] at each class renewal survey for ships over 5 years of age. When the ship is 5 years of age or less, the inspection may be limited to a check of the satisfactory general condition of pipes.

3.5.7 The examination and hydrostatic test of steel pipes for main steam machinery, and steel pipes for auxiliary steam machinery having internal diameter 75 mm and over, are to be carried out on a number of pipes selected by the Surveyor after the lagging in way is removed.

3.5.8 Representative pipe lengths connected with bolted flanges are to be internally and externally examined, and hydrostatically tested to 1,1 times the working pressure at ambient temperature. Bolts and butt-welded joints between flanges and pipes are to be submitted to a non-destructive test for crack detection.

3.5.9 Non-structural tanks located in machinery spaces are to be externally examined; the relevant fittings, with particular regard to the remote control shut-off valves under hydrostatic head, are to be externally examined to check the efficiency of manoeuvres and the absence of cracks or leakage.

3.5.10

When the ship is equipped with a refrigerating plant (whether or not covered by an additional class notation), the class renewal survey is to include:

- examination and test at the design pressure of the parts of the plant under pressure
- for refrigerating machinery spaces using ammonia as refrigerant:
  - examination of valves and pumps of the bilge system to the same extent as indicated in [3.4]
  - examination and test of the electrical equipment to the same extent as indicated in [3.6.10]
  - test of the gas detection system.

3.6 Towing winch emergency release systems

3.6.1 *(1/7/2021)*

The annual survey requirements are to be carried out, with the additional instructions for special survey provided by the manufacturer, as appropriate, being followed.

3.6.2 *(1/7/2021)*

The full functionality of the emergency release system is to be tested to the satisfaction of the surveyor. Testing may be conducted either during a bollard pull test or by applying the load against a strong point on the deck of the tug or the shore that is certified to the appropriate load.

3.6.3 *(1/7/2021)*

The emergency release system is to be tested at a towline load that is equal to the lesser of 30% of the maximum design load or 80% of vessel bollard pull in both a normal power condition and power blackout condition to the satisfaction of the surveyor.

3.7 Electrical equipment and installations

3.7.1 An electrical insulation resistance test is to be performed on the electrical equipment and cables. If needed, for the purpose of this test, the installation may be subdivided or equipment which may be damaged disconnected.

3.7.2 The prime movers of generators are to be surveyed in accordance with [3.2] and their governors tested. All generators are to be presented for inspection, clean and with covers opened and examined under working conditions.

3.7.3 Main and emergency switchboards, section boards and distribution boards are to be cleaned and doors or covers opened for examination of their fittings. The condition of overcurrent protective devices and fuses is to be checked. Circuit-breakers of generators are to be tested, as far as practicable, to verify that protective devices including preference tripping relays, if fitted, operate satisfactorily. The tightening of busbar connections is to be checked.

3.7.4 Electrical cables and cable runs are to be examined at random, in particular in places where deterioration is likely to occur; terminal boxes of essential services are also to be subjected to a random check.

3.7.5

The motors and starters concerning essential services together with associated control and switchgear, including electrical components used for cooling and maintaining an ambient temperature lower than 45°C (see Pt C, Ch 2, Sec 2, [1.2.2]), are to be examined and, if considered necessary by the Surveyor, checked, as far as practicable, under working conditions.

3.7.6 Navigation light indicators are to be tested under working conditions, and correct operation on the failure of supply or failure of navigation lights verified.

3.7.7 The emergency sources of electrical power, their automatic arrangements and associated circuits are to be tested.

3.7.8 Emergency lighting, transitional emergency lighting, supplementary emergency lighting, general emergency alarm and public address systems are to be tested as far as practicable.

3.7.9 The visible condition of electrical equipment and installations is also to be checked as regards precautions against shock, fire and other hazards of electrical origin.

3.7.10 A general examination of the electrical equipment in areas where there may be flammable gas or vapour and/or combustible dust is to be carried out to ensure that the integrity of the electrical equipment of a safety type has not been impaired owing to corrosion, missing bolts, etc., and that there is not an excessive build-up of dust on or in dust-protected electrical equipment. Cable runs are to be examined for sheath and armouring defects, where practicable, and to ensure that the means of supporting the cables are in satisfactory condition.

The proper condition of bonding straps for the control of static electricity is to be checked. Alarms and interlocks associated with pressurised equipment or spaces are to be tested for correct operation.

Note 1: Owners are reminded that maintenance, repairs or renewal of certified electrical equipment of a safe type remains their responsibility or that of their representatives.

3.8 Controls

3.8.1 Where remote and/or automatic controls, not covered by an additional class notation related to automated installation, are fitted for essential machinery, they are to be tested to demonstrate that they are in satisfactory condition.

SECTION 6 BOTTOM SURVEY

1 General

1.1

1.1.1

The bottom survey may be carried out in dry condition, such as in dry dock or on a slipway, or through an in-water survey.

The conditions for acceptance of a bottom in-water survey in lieu of a bottom survey in dry condition are laid down in Ch 2, Sec 2, [7.1.4] and [3].

2 Bottom survey in dry condition

2.1 General requirements

2.1.1

When a ship is in dry condition, it is to be placed on blocks of sufficient height and with the necessary staging to permit the examination of elements such as shell plating including bottom and bow plating, stern frame and rudder, sea chests and valves, propeller, etc.

2.1.2

The outer shell plating is to be visually examined for excessive corrosion, or deterioration due to chafing or contact with the ground or for any undue deformation or buckling. Due attention is to be given to the plating of end structures (stem and sternframe), and to the connection between the bilge strakes and the bilge keels. Significant plate unevenness or other deterioration which does not necessitate immediate repairs is to be recorded.

2.1.3

Sea chests and their gratings, sea connections and overboard discharge valves and cocks and their fastenings to the hull or sea chests are to be examined. Valves and cocks need not be opened up more than once in a class renewal survey period unless considered necessary by the Surveyor.

2.1.4

Visible parts of the propeller(s), stern bush(es), propeller shaft boss, brackets and tightness system(s) are to be examined. The clearances of the propeller shaft(s) (or wear down gauge) are to be checked and recorded. For controllable pitch propellers, the Surveyor is to be satisfied with the fastenings and tightness of hub and blade sealing.

Visible parts of side thrusters are to be examined. Other propulsion systems which also have manoeuvring characteristics (such as directional propellers, vertical axis propellers, water jet units) are to be examined externally with focus on the condition of gear housing, propeller blades, bolt locking and other fastening arrangements. Sealing arrangement of propeller blades, propeller shaft and steering column are to be verified.

Dismantling is to be carried out, if considered necessary, notably where leakages are detected.

2.1.5

Visible parts of the rudder(s), rudder pintles, rudder stock and couplings as well as the sternframe are to be examined. If considered necessary by the Surveyor, the rudder(s) is (are) to be lifted or the inspection plates removed for the examination of pintles.

The clearances in the rudder bearings and the rudder lowering are to be checked and recorded.

Where applicable, a pressure test of the rudder may be required as deemed necessary by the Surveyor.

2.2 Bottom survey held within the scope of class renewal survey

2.2.1 *(1/7/2021)*

The bottom survey held within the scope of the class renewal survey is to include the requirements in [2.1] for ships with **ESP** notation and ships subject to the requirements of Ch 4, Sec 6 and Ch 4 Sec 8.

2.2.2 *(1/7/2021)*

The bottom survey held within the scope of the class renewal survey is to be carried out in compliance with [1.1] for ships ~~without **ESP** notation~~other than those described in [2.2.1].

3 Bottom in-water survey

3.1 General

3.1.1 An in-water survey may normally be carried out if the ship has been granted the additional class notation **INWATERSURVEY** as defined in Ch 1, Sec 2, [6.14.3]. Upon application by the Owner and in special circumstances, the Society may also authorise such bottom in-water survey for ships not assigned with the additional class notation **INWATERSURVEY**.

3.1.2

The bottom in-water survey is to provide the information normally obtained from a bottom survey carried out in dry condition. Special consideration is to be given to ascertaining rudder bearing clearances and stern bush clearances of oil stern bearings based on a review of the operating history, on board testing and stern oil sample reports. These considerations are to be included in the proposals for in-water survey, which are to be submitted in advance of the survey so that satisfactory arrangements can be agreed on with the Society.

SECTION 5 CHEMICAL TANKERS

1 General

1.1 Application

1.1.1

The requirements of this Section apply to all self-propelled ships which have been assigned the service notation **chemical tanker ESP**.

Self-propelled ships which have been assigned the service notation c**hemical tanker**, without integral cargo tanks and having independent cargo tanks within the hull, are to be surveyed, as far as applicable, according to the provisions given for ships having the service notation **liquefied gas carrier**, as far as hull surveys are concerned, as laid down in Sec 6.

1.1.2 The requirements for hull surveys apply to the surveys of the hull structure and piping systems in way of cargo tanks, pump rooms, cofferdams, pipe tunnels and void spaces within the cargo area and all salt water ballast tanks. These requirements, however, do not apply to independent tanks on deck. They are additional to the requirements applicable to the remainder of the ship, given in Chapter 3 according to the relevant surveys.

1.1.3 The requirements contain the minimum extent of examination, thickness measurements and tank testing. When substantial corrosion, as defined in Ch 2, Sec 2, [2.2.9], and/or structural defects are found, the survey is to be extended and is to include additional close-up surveys when necessary.

1.1.4 *(1/1/2019)*

When, in any survey, thickness measurements are required :

- the procedure detailed in Ch 2, Sec 2, [2.3] is to be applied
- the thickness measurement firm is to be part of the survey planning meeting held prior to commencing the survey.

1.1.5 *(1/1/2019)*

When close-up surveys are required, consideration maybe given by the Surveyor to allow the use of Remote Inspection Techniques (RIT), according to the provisions of Ch 2, Sec 2, [2.3.3] and Ch 2, Sec 2, [2.6].

1.1.6 The requirements for machinery surveys apply to surveys of the machinery and equipment in the cargo area or dedicated to cargo service systems and are additional to those given in Chapter 3 for all ships.

1.2 Documentation on board

1.2.1 General

The Owner is to obtain, supply and maintain documentation on board as specified in [1.2.2] and [1.2.3], which is to be readily available for examination by the Surveyor. The documentation is to be kept on board for the lifetime of the ship.

1.2.2 Survey Report File

A survey report file is to be a part of the documentation on board consisting of:

- reports of structural surveys
- hull condition evaluation report (summarising the results of class renewal surveys)
- thickness measurement reports.

The survey report file is also to be available in the Owner's management office.

1.2.3 Supporting documents

The following additional supporting documentation is to be available on board:

- survey program, as required in [6.1], until such time as the class renewal survey or the intermediate survey, as applicable, has been completed
- main structural plans of cargo and ballast tanks
- previous repair history
- cargo and ballast history
- extent of use of inert gas system and tank cleaning procedures
- ship's personnel reports on:
  - structural deterioration/defects in general
  - leakage in bulkheads and piping systems
  - condition of coatings or corrosion prevention systems, if any
- any other information that may help to identify critical structural areas and/or suspect areas requiring inspection.

1.2.4 Prior to survey, the Surveyor examines the documentation on board and its contents, which are used as a basis for the survey.

1.3 Reporting and evaluation of surveys

1.3.1 The data and information on the structural condition of the ship collected during survey are evaluated for acceptability and structural integrity of the ship's cargo area.

1.3.2

For ships subject to the requirements of this Section, the surveys of hull structure and piping systems are reported in conformance to the Survey Reporting Principles laid down in App 1.

1.3.3 A hull condition evaluation report (summarising the results of class renewal surveys) is issued by the Society to the Owner, who is to place it on board the ship for refer-

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installed on board oil tankers is fitted, the requirements given in Sec 3, [5.2] for intermediate survey of oil tankers are to be complied with.

5.2.2 For ships over 10 years old at the time of the intermediate survey due date and fitted with another type of inert gas producing system, the main parts such as the inert gas generator, deck water seal or equivalent back flow arrangement, segregation devices, as fitted are to be overhauled for examination and alarms are to be tested.

Inert gas producer isolating valves, when fitted, are to be dismantled for examination.

6 Class renewal survey - Hull items

6.1 Survey program and preparation for hull survey

6.1.1

The Owner, in co-operation with the Society, is to work out a specific survey program prior to the commencement of any part of:

- the class renewal survey
- the intermediate survey for chemical tanker over 10 years of age.

The survey program at intermediate surveys may consist of the survey program at the previous class renewal survey supplemented by the condition evaluation report of that class renewal survey and later relevant survey reports.

The survey program is to be worked out taking into account any amendments to the survey requirements implemented after the last class renewal survey carried out.

The survey program is to be in a written format based on the information in [6.8].

Prior to the development of the survey program, the Survey Planning Questionnaire is to be completed by the Owner based on the information set out in [6.9], and forwarded to the Society.

6.1.2 *(1/1/2019)*

In developing the survey program, the following documentation is to be collected and consulted with a view to selecting tanks, areas and structural elements to be examined:

a) survey status and basic ship information

b) information included in the documentation on board, as described in [1.2.2] and [1.2.3]

c) main structural plans of cargo and ballast tanks (scantling drawings), including information on use of high tensile steels (HTS) and stainless steels

d) Condition Evaluation Report or Executive Hull Summary

e) relevant previous damage and repair history

f) relevant previous survey and inspection reports from both the Society and the Owner

g) information on the use of ship tanks, typical cargoes and other relevant data

h) details of the inert gas plant and tank cleaning procedures

i) information and other relevant data regarding conversion or modification of the ship's cargo and ballast tanks since the time of construction

j) description and history of the coating and corrosion protection system (previous class notations), if any

k) inspections by the Owner's personnel during the last 3 years with reference to structural deterioration in general, leakages in tank boundaries and piping, and condition of the coating and corrosion protection system, if any (guidance for reporting is shown in Tab 1)

l) information regarding the relevant maintenance level during operation, including Port State Control reports of inspection containing hull related deficiencies, Safety Management System non-conformities relating to hull maintenance, including the associated corrective action(s); and

m) any other information that will help identify suspect areas and critical structural areas.

6.1.3 *(1/1/2019)*

The survey program is to take account of and comply, at least, with the requirements for close-up surveys, thickness measurements, tank testing and pipe testing given in Tab 3, Tab 4, [6.5] and [6.6.3], respectively. In addition, the survey program is to include at least:

a) basic ship information and particulars

b) main structural plans (scantling drawings), including information on the use of high tensile steels (HTS), clad steels and stainless steels

c) plan of tanks

d) list of tanks including information on their use, corrosion prevention and condition of coating

e) conditions for survey, with regard to tanks and spaces which are to be safe for access, i.e. cleaned, gas freed, ventilated and illuminated

f) provisions and methods for access to structures

g) equipment for surveys

h) nomination of tanks, spaces and areas for close-up surveys according to [6.3]

i) nomination of sections and areas for thickness measurements according to [6.4]

j) nomination of tanks for tank testing according to [6.5]; and the pipes that are to undergo pipe testing according to [6.6.3]

k) identification of the thickness measurement firm

l) damage experience related to the ship in question

m) critical structural areas and suspect areas, where relevant.

6.1.4 The survey program is also to include the maximum acceptable structural corrosion diminution levels applicable to the ship. The Society will advise the Owner of this information.

6.3 Overall and close-up surveys

6.3.1 *(1/7/2021)*

Each class renewal survey is to include an overall survey of all tanks and all spaces. For fuel oil, lube oil and fresh water tanks, however, the requirements given in Ch 3, Sec 5, Tab ~~1~~5 are to be complied with.

6.3.2 The survey of stainless steel tanks may be carried out as an overall survey supplemented by close-up survey as deemed necessary by the Surveyor.

6.3.3 Each class renewal survey is to include a close-up examination of sufficient extent to establish the condition of cargo tanks and salt water ballast tanks. The minimum requirements for close-up surveys are given in Tab 3.

6.3.4

The Surveyor may extend the close-up survey as deemed necessary, taking into account the maintenance of the tanks under survey, the condition of the corrosion prevention system and also in the following cases:

- where tanks have structural arrangements or details which have suffered defects in similar spaces or on similar ships according to available information
- where tanks have structures approved with reduced scantlings due to an approved corrosion control system.

6.3.5

For areas in tanks where hard protective coatings are found to be in good condition, as defined in Ch 2, Sec 2, [2.2.13], the extent of close-up surveys required according to Tab 3 may be specially considered.

SECTION 1 GENERAL

1 General

1.1

1.1.1 The purpose of this Chapter is to give details on the scope of surveys of specific equipment and systems fitted on board the ship, which are covered by an additional class notation. Unless otherwise specified in Ch 1, Sec 2, [6], the scope of these surveys provides the requirements to be complied with for the maintenance of the relevant additional class notation.

1.1.2 These specific requirements are additional to those laid down in Chapter 3 and Chapter 4. These surveys are to be carried out at intervals as described in Ch 2, Sec 2, as far as possible concurrently with the surveys of the same type, i.e. annual, intermediate or class renewal survey.

1.1.3 The equipment and systems are also to be submitted to occasional survey whenever one of the cases indicated in Ch 2, Sec 2, [11] occurs.

1.1.4 Where specific requirements are given in this Chapter for the class renewal survey, they are additional to the applicable requirements for the annual survey.

1.1.5 For the assignment of the additional class notations, ships are to be submitted to an admission to class survey as described in Ch 2, Sec 1, [2] and Ch 2, Sec 1, [3] for new and existing installations, respectively, as applicable.

2 Additional class notations subject to additional surveys

2.1

2.1.1 The specific requirements detailed in this Chapter are linked to the additional class notation(s) assigned to the ship. Where a ship has more than one additional class notation, the specific requirements linked to each additional class notation are applicable as long as they are not contradictory.

2.1.2 Tab 1 indicates which additional class notations are subject to specific requirements, and in which Section and/or Article they are specified.

Table 1 : Additional class notations for which specific survey requirements are applicable *(1/7/2021)*

Additional class notation	Section or Article applicable in this Chapter	Type of surveys affected by these specific requirements	Remarks
STAR **STAR-HULL** **STAR-MACH**	Sec 2	See Remarks	The scope and periodicity of surveys are stipulated by specific requirements given in Pt F, Ch 1, Sec 1, [5] and Pt F, Ch 1, Sec 2, [4]
Availability of machinery: **AVM-APS** **AVM-IAPS** **AVM-DPS** **AVM-IPS**	Sec 3	annual survey class renewal survey	
Automated machinery systems: **AUT-UMS** **AUT-CCS** **AUT-PORT**	Sec 4	annual survey class renewal survey	
Integrated ship systems: **SYS-NEQ** **SYS-NEQ-1** **SYS-COM** **SYS-IBS**	Sec 5	annual survey class renewal survey	
Monitoring equipment: **MON-HULL** **MON-SHAFT**	Sec 6	annual survey class renewal survey tailshaft survey	

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Additional class notation	Section or Article applicable in this Chapter	Type of surveys affected by these specific requirements	Remarks
HELIDECK **HELIDECK H**	Sec 11	annual survey class renewal survey	
Other notations **STRENGTHBOTTOM-NAABSA** **GRABLOADING - GRAB [X]** **SPM** **DYNAPOS** **VCS** **COVENT** **CARGOCONTROL** **COAT-WBT** **DIVINGSUPPORT** **HVSC** **FIRE** **SELF-UNLOADING** **TAS** **EFFICIENT SHIP (S,DWT)** **MOORING** **CARGO HANDLING** **< SAHARA, SAHARA** **COMF NOISE** **RISK MITIGATION (...)** **AIR MON** **DANGEROUS GOODS** **INF 1, INF 2, INF 3** **INERTGAS A, INERTGAS B, INERTGAS C** **GAS FUELLED** **GAS FUELLED (Main)** **GAS FUELLED (Aux)** **MAN OVERBOARD DETECTION SYSTEM** **CYBER RESILIENCE** **DIGITAL SHIP** **AIR LUBRICATION SYSTEM** **PERSONS WITH REDUCED MOBILITY (PMR-ITA)** **BIOSAFE SHIP** **REMOTE SURVEYABLE SHIP (REMOTE)** **SUSTAINABLE SHIP ~~(nn)~~**	Sec 12	As applicable in accordance with the related Articles in Sec 12	

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SECTION 12 OTHER NOTATIONS

1 General

1.1

1.1.1 *(1/7/2021)*

The requirements of this Section apply to ships which have been assigned one of the following additional class notations described in Ch 1, Sec 2, [6.14]:

STRENGTHBOTTOM-NAABSA

GRABLOADING

GRAB [X]

SPM

DYNAPOS

VCS

COVENT

CARGOCONTROL

COAT-WBT

DIVINGSUPPORT

HVSC

FIRE

SELF-UNLOADING

TAS

EFFICIENT SHIP (S, DWT)

MOORING

CARGO HANDLING

< **SAHARA, SAHARA**

COMF NOISE, **COMF-NOISE-PORT**

RISK MITIGATION

AIR MON

DANGEROUS GOODS

INF 1, **INF 2**, **INF 3**

INERTGAS A, **INERTGAS B**, **INERTGAS C**

GAS FUELLED, **GAS FUELLED (Main)**, **GAS FUELLED (Aux)**

MAN OVERBOARD DETECTION SYSTEM

CYBER RESILIENCE

DIGITAL SHIP

AIR LUBRICATION SYSTEM

PERSONS WITH REDUCED MOBILITY (PMR-ITA)

BIOSAFE SHIP

REMOTE

SUSTAINABLE SHIP ~~**(nn)**~~

2 STRENGTHBOTTOM-NAABSA

2.1 Dry-docking survey

2.1.1 The reinforced area of bottom plating and internal associated structures are to be visually examined for possible deformations, fractures or other damage. If deemed necessary, thickness measurements may be required.

3 GRABLOADING and GRAB [X]

3.1 Class renewal survey

3.1.1 The reinforced area of double bottom plating and adjacent associated structures are to be visually examined for possible deformations, fractures or other damage. If deemed necessary, thickness measurements may be required.

4 SPM

4.1 Annual survey

4.1.1 The Owner or his representative is to declare to the attending Surveyor that no significant alterations have been made without the prior approval of the Society.

4.1.2 The annual survey is to include:

- a general examination of all components of the installation (bow chain stoppers, bow fairleads, pedestal roller fairleads, winches and capstans) to verify their satisfactory condition
- an examination of the hull structures supporting and adjacent to the installation to verify that no deformations or fractures have developed.

4.2 Class renewal survey

4.2.1 The class renewal survey is to include:

- a close-up examination of all components of the installation (bow chain stoppers, bow fairleads, pedestal roller fairleads, winches and capstans) to verify their satisfactory condition
- a close-up examination of the hull structures supporting and adjacent to the installation to verify that no deformations or fractures have developed.

Where deemed necessary by the Surveyor, non-destructive tests for measuring thickness deterioration or checking for fractures or other defects may be required.

33 REMOTE

33.1 Annual and class renewal survey

33.1.1 *(5/6/2020)*

For maintaining the additional class notation **REMOTE**, the devices for live-streaming and the Connectivity Kit are to be surveyed periodically (yearly) and found to be available on board and operational. The presence on board of at least one of the ship's Officers provided with the Certificate of Competency requested in Pt F, Ch 13, Sec 34, [2.4] is also to be ascertained.

34 SUSTAINABLE SHIP ~~(nn)~~

34.1 Annual and class renewal survey

34.1.1 *(15/5/2021)*

For maintaining the additional class notation **SUSTAINABLE SHIP ~~(nn)~~**, the survey is, as far as practicable, to include the checks in:

- [33] for the **BIOSAFE SHIP** additional class notation;
- Sec 7, [4] for the Environmental Index defined in the **GREEN PLUS** additional class notation; and
- [20] with reference to **COMF-NOISE** and **COMF-NOISE-PORT(X)** additional class notations.

SECTION 1 SUBDIVISION ARRANGEMENT

1 Number and arrangement of transverse watertight bulkheads

1.1 Number of watertight bulkheads

1.1.1 General

All ships, in addition to complying with the requirements of [1.1.2], are to have at least the following transverse watertight bulkheads:

- one collision bulkhead
- one after peak bulkhead
- two bulkheads forming the boundaries of the machinery space in ships with machinery amidships, and a bulkhead forward of the machinery space in ships with machinery aft. In the case of ships with an electrical propulsion plant, both the generator room and the engine room are to be enclosed by watertight bulkheads.

1.1.2 Additional bulkheads

For ships not required to comply with subdivision regulations, transverse bulkheads adequately spaced and in general not less in number than indicated in Tab 1 are to be fitted.

Additional bulkheads may be required for ships having to comply with subdivision or damage stability criteria (see Part E for the different types of ships).

Table 1 : Number of bulkheads

Length (m)	Number of bulkheads for ships with aft machinery **(1)**	Number of bulkheads for other ships
L < 65	3	4
65 ≤ L < 85	4	5
85 ≤ L < 105	4	5
105 ≤ L < 120	5	6
120 ≤ L < 145	6	7
145 ≤ L < 165	7	8
165 ≤ L < 190	8	9
L ≥ 190	to be defined on a case by case basis	
(1) After peak bulkhead and aft machinery bulkhead are the same.		

2 Collision bulkhead

2.1 Arrangement of collision bulkhead

2.1.1

A collision bulkhead is to be fitted which is to be watertight up to the freeboard deck. This bulkhead is to be located at a distance from the forward perpendicular FP_{LL} of not less than 0,05 L_{LL} or 10 m, whichever is the less, and not more than 0,08 L_{LL} or 0,05 L_{LL} + 3 m, whichever is the greater.

2.1.2

Where any part of the ship below the waterline extends forward of the forward perpendicular, e.g. a bulbous bow, the distances, in metres, stipulated in [2.1.1] are to be measured from a point either:

- *at the midlength of such extension, or*
- *at a distance 0,015 L_{LL} forward of the forward perpendicular, or*
- *at a distance 3 metres forward of the forward perpendicular; whichever gives the smallest measurement.*

2.1.3

The bulkhead may have steps or recesses provided they are within the limits prescribed in [2.1.1] or [2.1.2].

No door, manhole, ventilation duct or any other opening is to be fitted in the collision bulkhead below the freeboard deck.

2.1.4 The Society may, on a case by case basis, accept a distance from the collision bulkhead to the forward perpendicular FP_{LL} greater than the maximum specified in [2.1.1] and [2.1.2], provided that subdivision and stability calculations show that, when the ship is in upright condition on full load summer waterline, flooding of the space forward of the collision bulkhead will not result in any part of the freeboard deck becoming submerged, or in any unacceptable loss of stability.

2.1.5

Where a long forward superstructure is fitted, the collision bulkhead is to be extended weathertight to the next deck above the freeboard deck. The extension need not be fitted directly above the bulkhead below provided it is located within the limits prescribed in [2.1.1] or [2.1.2] with the exemption permitted by [2.1.6] and that the part of the deck which forms the step is made effectively weathertight.The extension is to be so arranged as to preclude the possibility of the bow door causing damage to it in the case of damage to, or detachment of, a bow door.

2.1.6

Where bow doors are fitted and a sloping loading ramp forms part of the extension of the collision bulkhead above the freeboard deck, the part of the ramp which is more than 2,3 m above the freeboard deck may extend forward of the limit specified in [2.1.1] or [2.1.2]. The ramp is to be weath-

ertight over its complete length. Ramps not meeting the above requirements are to be disregarded as an extension of the collision bulkhead.

2.1.7 *The number of openings in the extension of the collision bulkhead above the freeboard deck is to be restricted to the minimum compatible with the design and normal operation of the ship. All such openings are to be capable of being closed weathertight.*

3 After peak, machinery space bulkheads and stern tubes

3.1

3.1.1 General

An after peak bulkhead, and bulkheads dividing the machinery space from the cargo and passenger spaces forward and aft, are also to be fitted and made watertight up to the bulkhead deck for passenger ships and to the freeboard deck for other ships. The after peak bulkhead may, however, be stepped below the bulkhead deck, provided the degree of safety of the ship as regards subdivision is not thereby diminished.

3.1.2 Sterntubes

Sterntubes are to be enclosed in a watertight space (or spaces) of moderate volume. Other measures to minimise the danger of water penetrating into the ship in case of damage to sterntube arrangements may be taken at the discretion of the Society.

For ships less than 65 m, where the after peak bulkhead in way of the sterntube stuffing box is not provided, sterntubes are to be enclosed in watertight spaces of moderate volume.

4 Number and arrangement of tank bulkheads

4.1 Bulkheads in ships intended for the carriage of liquid cargoes

4.1.1 The number and location of transverse and longitudinal watertight bulkheads in ships intended for the carriage of liquid cargoes (tankers and similar) are to comply with the subdivision requirements to which the ship is subject.

5 Height of transverse watertight bulkheads

5.1

5.1.1 Transverse watertight bulkheads other than the collision bulkhead and the after peak bulkhead are to extend watertight up to the freeboard deck. In exceptional cases at the request of the Owner, the Society may allow transverse watertight bulkheads to terminate at a deck below that from which freeboard is measured, provided that this deck is at an adequate distance above the full load waterline.

5.1.2 Where it is not practicable to arrange a watertight bulkhead in one plane, a stepped bulkhead may be fitted. In this case, the part of the deck which forms the step is to be watertight and equivalent in strength to the bulkhead.

6 Openings in watertight bulkheads and decks

6.1 General

6.1.1 *The number of openings in watertight subdivisions is to be kept to a minimum compatible with the design and proper working of the ship. Where penetrations of watertight bulkheads and internal decks are necessary for access, piping, ventilation, electrical cables, etc., arrangements are to be made to maintain the watertight integrity. The Society may permit relaxation in the watertightness of openings above the freeboard deck, provided that it is demonstrated that any progressive flooding can be easily controlled and that the safety of the ship is not impaired.*

6.1.2 No door, manhole ventilation duct or any other opening is permitted in the collision bulkhead below the subdivision deck.

6.1.3 Lead or other heat sensitive materials may not be used in systems which penetrate watertight subdivision bulkheads, where deterioration of such systems in the event of fire would impair the watertight integrity of the bulkheads.

6.1.4 Valves not forming part of a piping system are not permitted in watertight subdivision bulkheads.

6.1.5 *(1/7/2021)*

The cable transits seal systems in watertight bulkheads and decks are to be type approved regarding watertightness. The pressure for which these cable transits seal systems are to be certified is to be greater than or equal to the one taken for the determination of the scantlings of the structural plate where they are located.

6.1.6 The requirements relevant to the degree of tightness, as well as the operating systems, for doors or other closing appliances complying with the provisions in [6.2] and [6.3] are specified in Tab 2.

6.2 Openings in the watertight bulkheads below the freeboard deck

6.2.1 Openings used while at sea

Doors provided to ensure the watertight integrity of internal openings which are used while at sea are to be sliding watertight doors capable of being remotely closed from the bridge and are also to be operable locally from each side of the bulkhead. Indicators are to be provided at the control position showing whether the doors are open or closed, and an audible alarm is to be provided at the door closure. The power, control and indicators are to be operable in the event of main power failure. Particular attention is to be paid to minimise the effect of control system failure. Each power-operated sliding watertight door is to be provided with an individual hand-operated mechanism. The possibility of opening and closing the door by hand at the door itself from both sides is to be assured.

SECTION 2 COMPARTMENT ARRANGEMENT

1 Definitions

1.1 Cofferdam

1.1.1 A cofferdam means an empty space arranged so that compartments on each side have no common boundary; a cofferdam may be located vertically or horizontally. As a rule, a cofferdam is to be properly ventilated and of sufficient size to allow for inspection.

1.2 Machinery spaces of category A

1.2.1 *Machinery spaces of category A are those spaces or trunks to such spaces which contain:*

- *internal combustion machinery used for main propulsion; or*
- *internal combustion machinery used for purposes other than propulsion where such machinery has in the aggregate a total power output of not less than 375 kW; or*
- *any oil fired boiler or fuel oil unit.*

2 Cofferdams

2.1 Cofferdam arrangement

2.1.1 Cofferdams are to be provided between compartments intended for liquid hydrocarbons (fuel oil, lubricating oil) and those intended for fresh water (drinking water, water for propelling machinery and boilers) as well as tanks intended for the carriage of liquid foam for fire extinguishing.

2.1.2 Cofferdams separating fuel oil tanks from lubricating oil tanks and the latter from those intended for the carriage of liquid foam for fire extinguishing or fresh water or boiler feed water may not be required when deemed impracticable or unreasonable by the Society in relation to the characteristics and dimensions of the spaces containing such tanks, provided that:

- the thickness of common boundary plates of adjacent tanks is increased, with respect to the thickness obtained according to Ch 7, Sec 1, by 2 mm in the case of tanks carrying fresh water or boiler feed water, and by 1 mm in all other cases
- the sum of the throats of the weld fillets at the edges of these plates is not less than the thickness of the plates themselves
- the structural test is carried out with a head increased by 1 m with respect to Ch 12, Sec 3, [2].

2.1.3 *(1/7/2021)*

Spaces intended for the carriage of flammable liquids are to be separated from accommodation and service spaces by means of a cofferdam. Where accommodation and service spaces are arranged immediately above such spaces, the cofferdam may be omitted only where the deck is not provided with access openings and is coated with a layer of material ~~recognized as suitable by the Society.~~which will not give rise to smoke or toxic or explosive hazards at elevated temperatures. These properties shall be determined in accordance with the Fire Test Procedure Code for the type of coating, either primary deck covering or paint, provided.

The cofferdam may also be omitted where such spaces are adjacent to a passageway, subject to the conditions stated in [2.1.2] for fuel oil or lubricating oil tanks.

2.1.4 Cofferdams are only required between fuel oil double bottoms and tanks immediately above where the inner bottom plating is subjected to the head of fuel oil contained therein, as in the case of a double bottom with its top raised at the sides.

Where a corner to corner situation occurs, tanks are not be considered to be adjacent.

Adjacent tanks not separated by cofferdams are to have adequate dimensions to ensure easy inspection.

3 Double bottoms

3.1 General

3.1.1 Double bottom

a) *A double bottom shall be fitted extending from the collision bulkhead to the afterpeak bulkhead, as far as this is practicable and compatible with the design and proper working of the ship.*

b) *Where a double bottom is required to be fitted the inner bottom shall be continued out to the ship's sides in such a manner as to protect the bottom to the turn of the bilge. Such protection will be deemed satisfactory if the inner bottom is not lower at any part than a plane parallel with the keel line and which is located not less than a vertical distance h measured from the keel line, as calculated by the formula:*

h = B / 20

However, in no case is the value of h to be less than 760 mm, and need not be taken as more than 2,000 mm.

c) *Small wells constructed in the double bottom in connection with drainage arrangements of holds, etc., shall not extend downward more than necessary. A well extending to the outer bottom is, however, permitted at the after end of the shaft tunnel. Other wells (e.g., for lubricating oil under main engines) may be permitted by the Society if satisfied that the arrangements give protection*

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SECTION 1 MATERIALS

1 General

1.1 Characteristics of materials

1.1.1 The characteristics of the materials to be used in the construction of ships are to comply with the applicable requirements of Part D.

1.1.2 Materials with different characteristics may be accepted, provided their specification (manufacture, chemical composition, mechanical properties, welding, etc.) is submitted to the Society for approval.

1.2 Testing of materials

1.2.1 Materials are to be tested in compliance with the applicable requirements of Part D.

1.3 Manufacturing processes

1.3.1 The requirements of this Section presume that welding and other cold or hot manufacturing processes are carried out in compliance with current sound working practice and the applicable requirements of Part D. In particular:

- parent material and welding processes are to be approved within the limits stated for the specified type of material for which they are intended
- specific preheating may be required before welding
- welding or other cold or hot manufacturing processes may need to be followed by an adequate heat treatment.

2 Steels for hull structure

2.1 Application

2.1.1 Tab 1 gives the mechanical characteristics of steels currently used in the construction of ships.

2.1.2 Higher strength steels other than those indicated in Tab 1 are considered by the Society on a case by case basis.

2.1.3 When steels with a minimum guaranteed yield stress R_{eH} other than 235 N/mm^2 are used on a ship, hull scantlings are to be determined by taking into account the material factor k defined in [2.3].

2.1.4 Characteristics of steels with specified through thickness properties are given in Pt D, Ch 2, Sec 1, [9].

2.2 Information to be kept on board

2.2.1 A plan is to be kept on board indicating the steel types and grades adopted for the hull structures. Where steels other than those indicated in Tab 1 are used, their mechanical and chemical properties, as well as any workmanship requirements or recommendations, are to be available on board together with the above plan.

2.2.2 It is also recommended that a plan is kept on board indicating the hull structures built in normal strength steel of grades D or E.

Table 1 : Mechanical properties of hull steels *(1/1/2017)*

Steel grades	Minimum yield stress R_{eH}, in N/mm^2	Ultimate minimum tensile strength R_m, in N/mm^2
A-B-D-E t ≤ 100mm	235	400 - 520
AH32-DH32-EH32 t ≤ 100mm FH32 t ≤ 50mm	315	440 - 590
AH36-DH36-EH36 t ≤ 100mm FH36 t ≤ 50mm	355	490 - 620
AH40-DH40-EH40 FH40 t ≤ 50mm	390	510 - 650
EH47	460	570 - 720
Note 1: Reference in Part D: Pt D, Ch 2, Sec 1, [2]		

2.3 Material factor k

2.3.1 General *(1/7/2017)*

Unless otherwise specified, the material factor k has the values defined in Tab 2, as a function of the minimum guaranteed yield stress R_{eH}.

For intermediate values of R_{eH} , k may be obtained by linear interpolation.

Steels with a yield stress lower than 235 N/mm^2 or greater than 460 N/mm^2 are considered by the Society on a case by case basis.

Table 2 : Material factor k *(1/7/2017)*

R_{eH} , in N/mm^2	k
235	1
315	0,78
355	0,72
390	0,68 **(1)**
460	0,62
(1) 0,66 provided that a fatigue assessment of the structure is performed to verify compliance with Pt B, Ch 7, Sec 4	

2.4 Grades of steel

2.4.1 *(1/7/2021)*

Materials in the various strength members are not to be of lower grade than those corresponding to the material classes and grades specified in Tab 3 to Tab ~~6~~7. General requirements are given in Tab 3, while additional minimum requirements for ships with length exceeding 150 m and 250 m are given in Tab 4 and Tab 5.

2.4.2 *(1/7/2021)*

The material grade requirements for hull members of each class depending on the thickness are defined in Tab ~~6~~7.

Table 3 : Material Classes and Grades for ships in general

Structural member category	Material class/grade
SECONDARY: • Longitudinal bulkhead strakes, other than that belonging to the Primary category • Deck plating exposed to weather, other than that belonging to the Primary or Special category • Side plating	• Class I within 0,4L amidships • Grade A/AH outside 0,4L amidships
PRIMARY: • Bottom plating, including keel plate • Strength deck plating, excluding that belonging to the Special category • Continuous longitudinal plating of strength members above strength deck, excluding hatch coamings • Uppermost strake in longitudinal bulkhead • Vertical strake (hatch side girder) and uppermost sloped strake in top wing tank	• Class II within 0,4L amidships • Grade A/AH outside 0,4L amidships
SPECIAL: • Sheerstrake at strength deck **(1)** • Stringer plate in strength deck **(1)** • Deck strake at longitudinal bulkhead, excluding deck plating in way of inner-skin bulkhead of double hull ships **(1)**	• Class III within 0,4L amidships • Class II outside 0,4L amidships • Class I outside 0,6L amidships
• Strength deck plating at outboard corners of cargo hatch openings in container carriers and other ships with similar hatch opening configurations	• Class III within 0,4L amidships • Class II outside 0,4L amidships • Class I outside 0,6L amidships • Min. Class III within cargo region
• Strength deck plating at corners of cargo hatch openings in bulk carriers, ore carriers, combination carriers and other ships with similar hatch opening configurations	• Class III within 0,6L amidships • Class II within rest of cargo region
• Bilge strake in ships with double bottom over the full breadth and length less than 150 m **(1)**	• Class II within 0,6L amidships • Class I outside 0,6L amidships
• Bilge strake in other ships **(1)**	• Class III within 0,4L amidships • Class II outside 0,4L amidships • Class I outside 0,6L amidships
• Longitudinal hatch coamings of length greater than 0,15L including coaming top plate and flange • End brackets and deck house transition of longitudinal cargo hatch coamings	• Class III within 0,4L amidships • Class II outside 0,4L amidships • Class I outside 0,6L amidships • Not to be less than Grade D/DH
(1) Single strakes required to be of Class III within 0,4L amidships are to have breadths not less than 800+5L (mm), but need not be greater than 1800 (mm), unless limited by the geometry of the ship's design.	

Table 4 : Minimum Material Grades for ships with length exceeding 150 m and single strength deck

Structural member category	Material grade
• Longitudinal plating of strength deck where contributing to the longitudinal strength • Continuous longitudinal plating of strength members above strength deck	Grade B/AH within 0,4L amidships
Single side strakes for ships without inner continuous longitudinal bulkhead(s) between bottom and the strength deck	Grade B/AH within cargo region

Table 5 : Minimum Material Grades for ships with length exceeding 250 m

Structural member category	Material grade
Sheerstrake at strength deck **(1)**	Grade E/EH within 0,4L amidships
Stringer plate in strength deck **(1)**	Grade E/EH within 0,4L amidships
Bilge strake **(1)**	Grade D/DH within 0,4L amidships
(1) Single strakes required to be of Grade E/EH and within 0,4L amidships are to have breadths not less than 800+5L (mm), but need not be greater than 1800 (mm), unless limited by the geometry of the ship's design.	

Table 6 : Minimum Material Grades for single-side skin bulk carriers subjected to SOLAS regulation XII/6.4 *(1/7/2021)*

Structural member category	Material grade
Lower bracket of ordinary side frame (1), (2)	Grade D/DH
Side shell strakes included totally or partially between the two points located to 0,125 ℓ above and below the intersection of side shell and bilge hopper sloping plate or inner bottom plate (2)	Grade D/DH
(1) The term "lower bracket" means webs of lower brackets and webs of the lower part of side frames up to the point of 0,125 ℓ above the intersection of side shell and bilge hopper sloping plate or inner bottom plate. **(2)** The span of the side frame, ℓ, is defined as the distance between the supporting structures.	

Table 7 : Material grade requirements for classes I, II and III

Class	I		II		III	
Gross thickness, in mm	NSS	HSS	NSS	HSS	NSS	HSS
t ≤ 15	A	AH	A	AH	A	AH
15 < t ≤ 20	A	AH	A	AH	B	AH
20 < t ≤ 25	A	AH	B	AH	D	DH
25 < t ≤ 30	A	AH	D	DH	D	DH
30 < t ≤ 35	B	AH	D	DH	E	EH
35 < t ≤ 40	B	AH	D	DH	E	EH
40 < t ≤ 50	D	DH	E	EH	E	EH
Note 1: "NSS" and "HSS" mean, respectively: "Normal Strength Steel" and "Higher Strength Steel".						

2.4.3 *(1/7/2021)*

For strength members not mentioned in Tab 3 to Tab ~~5~~7, grade A/AH may generally be used.

2.4.4

The steel grade is to correspond to the as-built plate thickness and material class.

2.4.5 Steel grades of plates or sections of gross thickness greater than the limiting thicknesses in Tab 1 are considered by the Society on a case by case basis.

2.4.6 In specific cases, such as [2.4.7], with regard to stress distribution along the hull girder, the classes required within 0,4L amidships may be extended beyond that zone, on a case by case basis.

2.4.7 The material classes required for the strength deck plating, the sheerstrake and the upper strake of longitudinal bulkheads within 0,4L amidships are to be maintained for an adequate length across the poop front and at the ends of the bridge, where fitted.

2.4.8 Rolled products used for welded attachments on hull plating, such as gutter bars and bilge keels, are to be of the same grade as that used for the hull plating in way.

Where it is necessary to weld attachments to the sheerstrake or stringer plate, attention is to be given to the appropriate choice of material and design, the workmanship and weld-

ing and the absence of prejudicial undercuts and notches, with particular regard to any free edges of the material.

2.4.9 In the case of grade D plates with a nominal thickness equal to or greater than 36 mm, or in the case of grade DH plates with a nominal thickness equal to or greater than 31 mm, the Society may, on a case by case basis, require the impact test to be carried out on each original "rolled unit", where the above plates:

- either are to be placed in positions where high local stresses may occur, for instance at breaks of poop and bridge, or in way of large openings on the strength deck and on the bottom, including relevant doublings, or
- are to be subjected to considerable cold working.

2.4.10 In the case of full penetration welded joints located in positions where high local stresses may occur perpendicular to the continuous plating, the Society may, on a case by case basis, require the use of rolled products having adequate ductility properties in the through thickness direction, such as to prevent the risk of lamellar tearing (Z type steel, see Part D).

2.4.11 In highly stressed areas, the Society may require that plates of gross thickness greater than 20 mm are of grade D/DH or E/EH.

2.4.12 For certain uses, grade B steel with controlled toughness at 0°C may be required for plates of gross thickness less than 25 mm.

2.4.13

Plating materials for sternframes, rudders, rudder horns and shaft brackets are, in general, not to be of lower grades than corresponding to Class II. For rudder and rudder body plates subjected to stress concentrations (e.g. in way of lower support of semi-spade rudders or at upper part of spade rudders), Class III is to be applied.

2.5 Grades of steel for ships exposed to low air temperatures

2.5.1 *(1/7/2019)*

For ships intended to operate in areas with low air temperatures (below -10°C), e.g. regular service during winter seasons to Arctic or Antarctic waters, the materials in exposed structures are to be selected based on the design temperature t_D, to be taken as defined in [2.5.2].

2.5.2 *(1/1/2017)*

The design temperature t_D is to be taken as the lowest mean daily average air temperature in the area of operation, where:

Mean : Statistical mean over observation period

Average : Average during one day and night

Lowest : Lowest during one year

Fig 1 illustrates the temperature definition.

For seasonally restricted service, the lowest value within the period of operation applies.

For the purpose of issuing a Polar Ship Certificate in accordance with the Polar Code, the design temperature t_D shall be no more than 13°C higher than the Polar Service Temperature (PST) of the ship.

In the Polar Regions, the statistical mean over observation period is to be determined for a period of at least 10 years.

Figure 1 : ~~Commonly used definitions of temperatures~~ *~~(1/1/2017)~~*

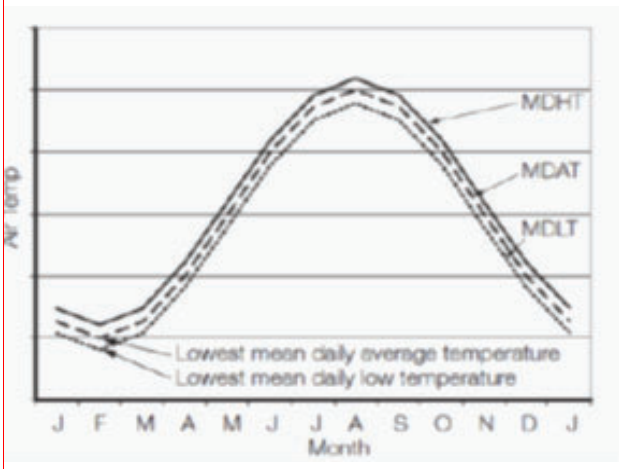
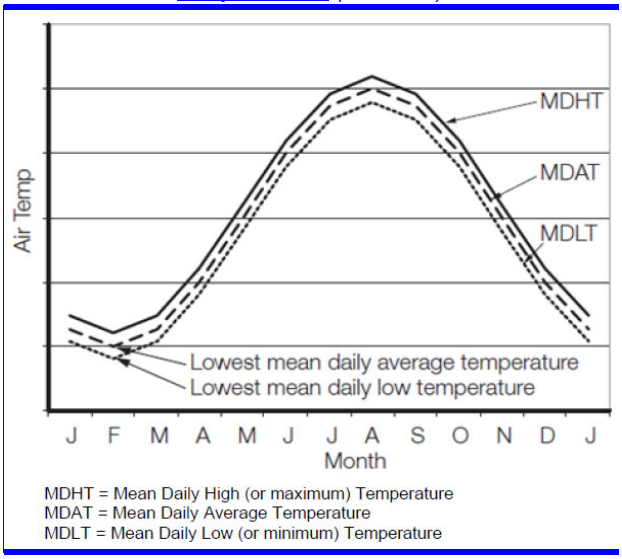


Figure 2 : Commonly used definitions of temperatures *(1/7/2021)*



2.5.3 *(1/7/2021)*

For the purpose of the selection of steel grades to be used for the structural members above the lowest ballast waterline and exposed to air (including the structural members covered by the Note 6 of Tab ~~7~~8 and the cargo tank boundary plating exposed to cold cargo covered by the Note 7 of Tab ~~7~~8, for which [2.5.6] is applicable), these are divided into categories (SECONDARY, PRIMARY and SPECIAL), as indicated in Tab ~~7~~8.

Tab ~~7~~8 also specifies the classes (I, II and III) of the materials to be used for the various categories of structural members.

For non-exposed structures (except as indicated in Note 6 of Tab ~~7~~8 and structures below the lowest ballast waterline, [2.4] applies.

2.5.4 *(1/7/2021)*

Materials may not be of a lower grade than that indicated in Tab ~~8~~9 to Tab 1~~0~~1 depending on the material class, structural member gross thickness and design temperature t_D.

For design temperatures t_D < -55°C, materials will be specially considered by the Society on a case by case basis.

2.5.5 Single strakes required to be of class III or of grade E/EH of FH are to have breadths not less than (800+5L) mm, but not necessarily greater than 1800 mm.

2.5.6 *(1/7/2021)*

For ships other than liquefied gas carriers, intended to be loaded with liquid cargo having a temperature below -10°C, e.g. loading from cold onshore storage tanks during winter conditions, the material grade of cargo tank boundary plating is defined in Tab ~~8~~9 based on the following:

- t_c design minimum cargo temperature in °C
- steel grade corresponding to Class I.

The design minimum cargo temperature, t_c is to be specified in the loading manual.

2.6 Grades of steel within refrigerated spaces

2.6.1 *(1/7/2021)*

For structural members within or adjacent to refrigerated spaces, when the design temperatures is below 0°C, the materials are to be of grade not lower than those indicated in Tab 1~~1~~2, depending on the design temperature, the structural member gross thickness and its category (as defined in Tab 3).

2.6.2 Unless a temperature gradient calculation is carried out to assess the design temperature and the steel grade in the structural members of the refrigerated spaces, the temperatures to be assumed are specified below:

- temperature of the space on the uninsulated side, for plating insulated on one side only, either with uninsulated stiffening members (i.e. fitted on the uninsulated side of plating) or with insulated stiffening members (i.e. fitted on the insulated side of plating)
- mean value of temperatures in the adjacent spaces, for plating insulated on both sides, with insulated stiffening members, when the temperature difference between the adjacent spaces is generally not greater than 10 °C (when the temperature difference between the adjacent spaces is greater than 10°C, the temperature value is established by the Society on a case by case basis)
- in the case of non-refrigerated spaces adjacent to refrigerated spaces, the temperature in the non-refrigerated spaces is to be conventionally taken equal to 0°C.

2.6.3 Situations other than those mentioned in [2.6.1] and [2.6.2] or special arrangements will be considered by the Society on a case by case basis.

2.6.4 *(1/7/2021)*

Irrespective of the provisions of [2.6.1], [2.6.2] and Tab 1~~1~~2, steel having grades lower than those required in [2.4], Tab 3 to Tab ~~6~~7, in relation to the class and gross thickness of the structural member considered, may not be used.

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Table 9 : Material grade requirements for class I at low temperatures *(1/7/2021)*

Gross thickness, in mm	-11°C / -15°C		-16°C / -25°C		-26°C / -35°C		-36°C / -45°C		-46°C / -55°C	
	NSS	HSS	NSS	HSS	NSS	HSS	NSS	HSS	NSS	HSS
t ≤ 10	A	AH	A	AH	B	AH	D	DH	D	DH
10 < t ≤ 15	A	AH	B	AH	D	DH	D	DH	D	DH
15 < t ≤ 20	A	AH	B	AH	D	DH	D	DH	E	EH
20 < t ≤ 25	B	~~DH~~AH	D	DH	D	DH	D	DH	E	EH
25 < t ≤ 30	B	~~DH~~AH	D	DH	D	DH	E	EH	E	EH
30 < t ≤ 35	D	DH	D	DH	D	DH	E	EH	E	EH
35 < t ≤ 45	D	DH	D	DH	E	EH	E	EH	ϕ	FH
45 < t ≤ 50	D	DH	E	EH	E	EH	ϕ	FH	ϕ	FH

Note 1:"NSS" and "HSS" mean, respectively, "Normal Strength Steel" and "Higher Strength Steel".
Note 2:"ϕ" = not applicable.

Table 10 : Material grade requirements for class II at low temperatures *(1/7/2021)*

Gross thickness, in mm	-11°C / -15°C		-16°C / -25°C		-26°C / -35°C		-36°C / -45°C		-46°C / -55°C	
	NSS	HSS	NSS	HSS	NSS	HSS	NSS	HSS	NSS	HSS
t ≤ 10	A	AH	B	AH	D	DH	D	DH	E	EH
10 < t ≤ 20	B	AH	D	DH	D	DH	E	EH	E	EH
20 < t ≤ 30	D	DH	D	DH	E	EH	E	EH	ϕ	FH
30 < t ≤ 40	D	DH	E	EH	E	EH	ϕ	FH	ϕ	FH
40 < t ≤ 45	E	~~DH~~EH	E	EH	ϕ	FH	ϕ	FH	ϕ	ϕ
45 < t ≤ 50	E	~~DH~~EH	E	EH	ϕ	FH	ϕ	FH	ϕ	ϕ

Note 1:"NSS" and "HSS" mean, respectively, "Normal Strength Steel" and "Higher Strength Steel".
Note 2:"ϕ" = not applicable.

Table 11 : Material grade requirements for class III at low temperatures *(1/7/2019)*

Gross thickness, in mm	-11°C / -15°C		-16°C / -25°C		-26°C / -35°C		-36°C / -45°C		-46°C / -55°C	
	NSS	HSS	NSS	HSS	NSS	HSS	NSS	HSS	NSS	HSS
t ≤ 10	B	AH	D	DH	D	DH	E	EH	E	EH
10 < t ≤ 20	D	DH	D	DH	E	EH	E	EH	ϕ	FH
20 < t ≤ 25	D	DH	E	EH	E	EH	E	FH	ϕ	FH
25 < t ≤ 30	D	DH	E	EH	E	EH	ϕ	FH	ϕ	FH
30 < t ≤ 35	E	EH	E	EH	ϕ	FH	ϕ	FH	ϕ	ϕ
35 < t ≤ 40	E	EH	E	EH	ϕ	FH	ϕ	FH	ϕ	ϕ
40 < t ≤ 50	E	EH	ϕ	FH	ϕ	FH	ϕ	~~ϕ~~ϕ	ϕ	ϕ

Note 1:"NSS" and "HSS" mean, respectively, "Normal Strength Steel" and "Higher Strength Steel".
Note 2:"ϕ" = not applicable.

4.3.3 Aluminium alloys of series 5000 in 0 condition (annealed) or in H111 condition (annealed flattened) are not subject to a drop in mechanical strength in the welded areas.

4.3.4 Aluminium alloys of series 5000 other than condition 0 or H111 are subject to a drop in mechanical strength in the welded areas.

The mechanical characteristics to consider are normally those of condition 0 or H111.

Higher mechanical characteristics may be taken into account, provided they are duly justified.

4.3.5 Aluminium alloys of series 6000 are subject to a drop in mechanical strength in the vicinity of the welded areas.

The mechanical characteristics to be considered are normally indicated by the supplier.

4.4 Material factor k

4.4.1 *(1/7/2021)*

The material factor k for aluminium alloys is to be obtained from the following formula:

$$k = \frac{235}{\eta R_{p0,2}}$$

where:

η : Joint coefficient for the welded assembly, corresponding to the aluminium alloy considered, given in Tab 1~~2~~3

$R_{p0,2}$: Minimum guaranteed yield stress, in N/mm^2, of the parent material in delivery condition.

4.4.2 In the case of welding of two different aluminium alloys, the material factor k to be considered for the scantlings is the greater material factor of the aluminium alloys of the assembly.

5 Other materials and products

5.1 General

5.1.1 Other materials and products such as parts made of iron castings, where allowed, products made of copper and copper alloys, rivets, anchors, chain cables, cranes, masts, derrick posts, derricks, accessories and wire ropes are generally to comply with the applicable requirements of Part D.

5.1.2 The use of plastics or other special materials not covered by these Rules is to be considered by the Society on a case by case basis. In such cases, the Society states the requirements for the acceptance of the materials concerned.

5.1.3 Materials used in welding processes are to comply with the applicable requirements of Part D.

5.2 Iron cast parts

5.2.1 As a rule, the use of grey iron, malleable iron or spheroidal graphite iron cast parts with combined ferritic/perlitic structure is allowed only to manufacture low stressed elements of secondary importance.

5.2.2 Ordinary iron cast parts may not be used for windows or sidescuttles; the use of high grade iron cast parts of a suitable type will be considered by the Society on a case by case basis.

Table 13 : Joint coefficient for aluminium alloys *(1/7/2021)*

Aluminium alloy	η
Alloys without work-hardening treatment (series 5000 in annealed condition 0 or annealed flattened condition H111)	1
Alloys hardened by work hardening (series 5000 other than condition 0 or H111)	$R'_{p0,2}/R_{p0,2}$
Alloys hardened by heat treatment (series 6000) **(1)**	$R'_{p0,2}/R_{p0,2}$
(1) When no information is available, coefficient η is to be taken equal to the metallurgical efficiency coefficient β defined in Tab 1~~3~~4.	
Note 1:	
$R'_{p0,2}$: Minimum guaranteed yield stress, in N/mm^2, of material in welded condition (see [4.3]).	

Table 14 : Aluminium alloys Metallurgical efficiency coefficient β

Aluminium alloy	Temper condition	Gross thickness, in mm	β
6005 A (Open sections)	T5 or T6	$t \leq 6$	0,45
		$t > 6$	0,40
6005 A (Closed sections)	T5 or T6	All	0,50
6061 (Sections)	T6	All	0,53
6082 (Sections)	T6	All	0,45

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SECTION 5 PRIMARY SUPPORTING MEMBERS

Symbols

For symbols not defined in this Section, refer to the list at the beginning of this Chapter.

p_S : Still water pressure, in kN/m^2, see [3.4.2] and [3.4.4]

p_W : Wave pressure, in kN/m^2, see [3.4.2] and [3.4.4]

p_{SF}, p_{WF} : Still water and wave pressures, in kN/m^2, in flooding conditions, defined in Ch 8, Sec 1, [5.8]

σ_{X1} : Hull girder normal stress, in N/mm^2, defined in [3.4.5]

s : Spacing, in m, of primary supporting members

ℓ : Span, in m, of primary supporting members, measured between the supporting members, see Ch 4, Sec 3, [4.1]

h_W : Primary supporting member web height, in mm

b_p : Width, in m, of the plating attached to the primary supporting member, for the yielding check, as defined in Ch 4, Sec 3, [4.2]

w : Net section modulus, in cm^3, of the primary supporting member, with an attached plating of width b_p, to be calculated as specified in Ch 4, Sec 3, [4.3]

A_{Sh} : Net shear sectional area, in cm^2, of the primary supporting member, to be calculated as specified in Ch 4, Sec 3, [4.3]

m : Boundary coefficient, to be taken equal to:

- m = 10 in general
- m = 12 for bottom and side girders

$$\chi = \left(1 + 50\frac{\ell}{h_W}\right)^3$$

1 General

1.1 Application

1.1.1 Ships less than 65 m in length

For ships less than 65 m in length, the criteria in App 1 may be used for the strength check of primary supporting members, as an alternative to those contained in this Section.

1.1.2 Analysis criteria

The requirements of this Section apply for the yielding and buckling checks of primary supporting members and analysed through an isolated beam structural model.

1.1.3 Direct calculations

Direct calculations may be required by the Society when deemed necessary on the basis of the ship's structural arrangement and load conditions. When required, these analyses are to be carried out according to the applicable requirements in Ch 7, Sec 3, Ch 7, App 1 or Ch 7, App 2.

1.2 Net scantlings

1.2.1 As specified in Ch 4, Sec 2, [1], all scantlings referred to in this section are net, i.e. they do not include any margin for corrosion.

The gross scantlings are obtained as specified in Ch 4, Sec 2.

1.3 Partial safety factors

1.3.1 The partial safety factors to be considered for checking primary supporting members are specified in Tab 1.

2 Minimum net thicknesses

2.1 General

2.1.1 The net thickness of plating which forms the webs of primary supporting members, with the exception of double bottom girders and floors for which specific requirements are given in [2.2], is to be not less than the lesser of:

- the value obtained, in mm, from the following formula:

  $t_{MIN} = (3,7 + 0,015Lk^{1/2})\, c_T$

- the thickness of the attached plating

where c_T is a coefficient equal to:

$$c_T = 0,7 + \frac{3T}{L} \quad \text{for } L \le 25\,m$$

$$c_T = 0,85 + \frac{2T}{L} \quad \text{for } 25\,m < L \le 40\,m$$

$$c_T = 1,0 \quad \text{for } L > 40\,m$$

c_T may not be taken greater than 1,0.

Table 1 : Primary supporting members - Partial safety factors

Partial safety factors covering uncertainties regarding:	Symbol	Yielding check		Buckling check of pillars (see [4.1])
		General (see [3.4] and [3.5])	Watertight bulkhead primary supporting members **(1)** (see [3.6])	
Still water hull girder loads	γ_{S1}	Not applicable	Not applicable	1,00
Wave hull girder loads	γ_{W1}	Not applicable	Not applicable	1,15
Still water pressure	γ_{S2}	1,00	1,00	Not applicable
Wave pressure	γ_{W2}	1,20	1,05	Not applicable
Material	γ_m	1,02	1,02	1,02
Resistance	γ_R	1,02 in general 1,15 for bottom and side girders	1,02 **(2)**	1,50

(1) Applies also to primary supporting members of bulkheads or inner side which constitute boundary of compartments not intended to carry liquids.

(2) For primary supporting members of the collision bulkhead, γ_R =1,25

2.2 Double bottom

2.2.1 The net thickness of plating which forms primary supporting members of the double bottom is to be not less than the values given in Tab 2.

3 Yielding check

3.1 General

3.1.1 The requirements of this Article apply for the yielding check of primary supporting members subjected to lateral pressure or to wheeled loads and, for those contributing to the hull girder longitudinal strength, to hull girder normal stresses.

3.1.2 The yielding check is also to be carried out for primary supporting members subjected to specific loads, such as concentrated loads.

3.2 Bracket arrangement

3.2.1 The requirements of this Article apply to primary supporting members with 45° brackets at both ends of length not less than $0,1\ell$.

In the case of a significantly different bracket arrangement, the section modulus and shear sectional area are considered by the Society on a case by case basis.

3.3 Load point

3.3.1 Lateral pressure

Unless otherwise specified, lateral pressure is to be calculated at mid-span of the primary supporting member considered.

3.3.2 Hull girder normal stresses

For longitudinal primary supporting members contributing to the hull girder longitudinal strength, the hull girder normal stresses are to be calculated in way of the face plate of the primary supporting member considered.

For bottom and deck girders, it may generally be assumed that the hull girder normal stresses in the face plate are equal to 0,75 times those in the relevant plating.

3.4 Load model

3.4.1 General

The still water and wave lateral loads induced by the sea and the various types of cargoes and ballast in intact conditions are to be considered, depending on the location of the primary supporting member under consideration and the type of compartments adjacent to it, in accordance with Sec 1, [1.4].

Primary supporting members of bulkheads or inner side which constitute the boundary of compartments not intended to carry liquids are to be subjected to the lateral pressure in flooding conditions.

3.4.2 Lateral pressure in intact conditions

Lateral pressure in intact conditions is constituted by still water pressure and wave pressure.

Still water pressure (p_S) includes:

- the still water sea pressure, defined in Sec 1, [4]
- the still water internal pressure, defined in Sec 1, [5.1] to Sec 1, [5.7] for the various types of cargoes and for ballast.

Wave pressure (p_W) includes:

- the wave pressure, defined in Sec 1, [4]
- the inertial pressure, defined in Sec 1, [5.1] to Sec 1, [5.7] for the various types of cargoes and for ballast.

$$w = \gamma_R \gamma_m \beta_b \frac{\gamma_{S2} \lambda_{bS} p_S + \gamma_{W2} \lambda_{bW} p_W}{m(R_y - \gamma_R \gamma_m \sigma_A)} s \ell^2 10^3$$

$$A_{Sh} = 10 \gamma_R \gamma_m \beta_s \frac{\gamma_{S2} \lambda_{sS} p_S + \gamma_{W2} \lambda_{sW} p_W}{R_y} s \ell$$

where:

β_b, β_s : Coefficients defined in [3.5.2]

$$\lambda_{bS} = 1 + 0{,}2 \frac{p_{Sd} - p_{Su}}{p_{Sd} + p_{Su}}$$

$$\lambda_{bW} = 1 + 0{,}2 \frac{p_{Wd} - p_{Wu}}{p_{Wd} + p_{Wu}}$$

$$\lambda_{sS} = 1 + 0{,}4 \frac{p_{Sd} - p_{Su}}{p_{Sd} + p_{Su}}$$

$$\lambda_{sW} = 1 + 0{,}4 \frac{p_{Wd} - p_{Wu}}{p_{Wd} + p_{Wu}}$$

p_{Sd} : Still water pressure, in kN/m^2, at the lower end of the primary supporting member considered

p_{Su} : Still water pressure, in kN/m^2, at the upper end of the primary supporting member considered

p_{Wd} : Wave pressure, in kN/m^2, at the lower end of the primary supporting member considered

p_{Wu} : Wave pressure, in kN/m^2, at the upper end of the primary supporting member considered

σ_A : Axial stress, to be obtained, in N/mm^2, from the following formula:

$$\sigma_A = 10 \frac{F_A}{A}$$

F_A : Axial load (still water and wave) transmitted to the vertical primary supporting members by the structures above. For multideck ships, the criteria in [4.1.1] for pillars are to be adopted.

A : Net sectional area, in cm^2, of the vertical primary supporting members with attached plating of width b_p.

3.6 Net section modulus and net shear sectional area of primary supporting members subjected to lateral pressure in flooding conditions

3.6.1 General

The requirements in [3.6.1] to [3.6.3] apply to primary supporting members of bulkheads or inner side which constitute the boundary of compartments not intended to carry liquids.

These primary supporting members are to be checked in flooding conditions as specified in [3.6.2] and [3.6.3], depending on the type of member.

3.6.2 Longitudinal and transverse primary supporting members *(1/7/2021)*

The net section modulus w, in cm^3, and the net shear sectional area A_{Sh}, in cm^2, of longitudinal or transverse primary supporting members are to be not less than the values obtained from the following formulae:

$$w = \gamma_R \gamma_m \beta_b \frac{\gamma_{S2} p_{SF} + \gamma_{W2} p_{WF}}{16 c_P (R_y - \gamma_m \sigma_{X1})} s \ell^2 10^3$$

$$A_{Sh} = 10 \gamma_R \gamma_m \beta_s \frac{\gamma_{S2} p_{SF} + \gamma_{W2} p_{WF}}{R_y} s \ell$$

$$w = \gamma_R \gamma_m \beta_b \frac{\gamma_{S2} p_{SF} + \gamma_{W2} p_{WF}}{12 c_P (R_y - \gamma_m \sigma_{X1})} s \ell^2 10^3$$

$$A_{Sh} = 10 \gamma_R \gamma_m \beta_s \frac{\gamma_{S2} p_{SF} + \gamma_{W2} p_{WF}}{R_y} s \ell$$

where:

β_b, β_s : Coefficients defined in [3.5.2]

c_P : Ratio of the plastic section modulus to the elastic section modulus of the primary supporting members with an attached shell plating b_p, to be taken equal to 1,16 in the absence of more precise evaluation.

3.6.3 Vertical primary supporting members *(1/7/2021)*

The net section modulus w, in cm^3, and the net shear sectional area A_{Sh}, in cm^2, of vertical primary supporting members are to be not less than the values obtained from the following formulae:

$$w = \gamma_R \gamma_m \beta_b \frac{\gamma_{S2} \lambda_{bS} p_{SF} + \gamma_{W2} \lambda_{bW} p_{WF}}{16 c_P R_y} s \ell^2 10^3$$

$$A_{Sh} = 10 \gamma_R \gamma_m \beta_s \frac{\gamma_{S2} \lambda_{sS} p_{SF} + \gamma_{W2} \lambda_{sW} p_{WF}}{R_y} s \ell$$

$$w = \gamma_R \gamma_m \beta_b \frac{\gamma_{S2} \lambda_{bS} p_{SF} + \gamma_{W2} \lambda_{bW} p_{WF}}{12 c_P R_y} s \ell^2 10^3$$

$$A_{Sh} = 10 \gamma_R \gamma_m \beta_s \frac{\gamma_{S2} \lambda_{sS} p_{SF} + \gamma_{W2} \lambda_{sW} p_{WF}}{R_y} s \ell$$

where:

β_b, β_s : Coefficients defined in [3.5.2]

c_P : Ratio defined in [3.6.2]

$$\lambda_{bS} = 1 + 0{,}2 \frac{p_{SFd} - p_{SFu}}{p_{SFd} + p_{SFu}}$$

$$\lambda_{bW} = 1 + 0{,}2 \frac{p_{WFd} - p_{WFu}}{p_{WFd} + p_{WFu}}$$

$$\lambda_{sS} = 1 + 0{,}4 \frac{p_{SFd} - p_{SFu}}{p_{SFd} + p_{SFu}}$$

$$\lambda_{sW} = 1 + 0{,}4 \frac{p_{WFd} - p_{WFu}}{p_{WFd} + p_{WFu}}$$

p_{SFd} : Still water pressure, in kN/m^2, in flooding conditions, at the lower end of the primary supporting member considered

p_{SFu} : Still water pressure, in kN/m^2, in flooding conditions, at the upper end of the primary supporting member considered

p_{WFd} : Wave pressure, in kN/m^2, in flooding conditions, at the lower end of the primary supporting member considered.

p_{WFu} : Wave pressure, in kN/m^2, in flooding conditions, at the upper end of the primary supporting member considered

SECTION 8 MOVABLE DECKS AND INNER RAMPS - EXTERNAL RAMPS

1 Movable decks and inner ramps

1.1 Application

1.1.1 The requirements of this Article apply to movable decks and inner ramps.

1.2 Materials

1.2.1 The decks and inner ramps are to be made of steel or aluminium alloys complying with the requirements of Part D. Other materials of equivalent strength may be used, subject to a case by case examination by the Society.

1.3 Net scantlings

1.3.1 As specified in Ch 4, Sec 2, [1], all scantlings referred to in this Section are net, i.e. they do not include any margin for corrosion.

The gross scantlings are obtained as specified in Ch 4, Sec 2.

1.4 Plating

1.4.1 *(1/7/2021)*

The net thickness of plate panels subjected to wheeled loads is to be not less than the value obtained from Ch 7, Sec 1, [4.3], where nP_0 is not to be taken less than 5~~0~~ kN.

1.5 Supporting structure

1.5.1 General

The supporting structure of movable decks and inner ramps is to be verified through direct calculation, considering the following cases:

- movable deck stowed in upper position, empty and locked, at sea
- movable deck in service, loaded, in lower position, resting on supports or supporting legs and locked, at sea
- movable inner ramp in sloped position, supported by hinges at one end and by a deck at the other, with possible intermediate supports, loaded, at harbour
- movable inner ramp in horizontal position, loaded and locked, at sea.

1.5.2 Loading cases

The scantlings of the structure are to be verified in both sea and harbour conditions for the following cases:

- loaded movable deck or inner ramp under loads according to the vehicle distribution indicated by the Designer
- loaded movable deck or inner ramp under uniformly distributed loads corresponding to a pressure, in kN/m^2, taken equal to:

$$p = \frac{n_V P_V + P_P}{A_P}$$

- empty movable deck under uniformly distributed masses corresponding to a pressure, in kN/m^2, taken equal to:

$$p = \frac{P_P}{A_P}$$

where:

n_V : Maximum number of vehicles loaded on the movable deck

P_V : Mass of a vehicle, in kN

P_P : Mass of the movable deck, in kN

A_P : Effective area of the movable deck, in m^2.

Table 1 : Movable decks and inner ramps
Still water and inertial pressures

Ship condition	Load case	Still water pressure p_S and inertial pressure p_W, in kN/m^2
Still water condition		$p_S = p$
Upright sea condition	"a"	No inertial pressure
	"b"	$p_{W,X} = p\frac{a_{X1}}{g}$ in x direction $p_{W,Z} = p\frac{a_{Z1}}{g}$ in z direction
Inclined sea condition (negative roll angle)	"c" "d"	$p_{W,Y} = p\frac{C_{FA}a_{Y2}}{g}$ in y direction $p_{W,Z} = p\frac{C_{FA}a_{Z2}}{g}$ in z direction
Harbour condition **(1)**	during lifting	$p_{W,X} = 0{,}035p$ in x direction $p_{W,Y} = 0{,}087p$ in y direction $p_{W,Z} = 0{,}2p$ in z direction
	at rest	$p_{W,X} = 0{,}035p$ in x direction $p_{W,Y} = 0{,}087p$ in y direction $p_{W,Z} = 0$ in z direction

(1) For harbour conditions, a heel angle of 5° and a trim angle of 2° are taken into account.

Note 1:

p : Pressure, in kN/m^2, to be calculated according to [1.5.2] for the condition considered.

C_{FA} : Combination factor, to be taken equal to:
- $C_{FA} = 0{,}7$ for load case "c"
- $C_{FA} = 1{,}0$ for load case "d"

SECTION 2 LOADING MANUAL AND LOADING INSTRUMENTS

1 Definitions

1.1 Perpendiculars

1.1.1 Forward perpendicular

The forward perpendicular is the perpendicular to the waterline at the forward side of the stem on the summer load waterline

1.1.2 After perpendicular

The after perpendicular is the perpendicular to the waterline at the after side of the rudder post on the summer load waterline. For ships without rudder post, the after perpendicular is the perpendicular to the waterline at the centre of the rudder stock on the summer load waterline.

1.1.3 Midship perpendicular

The midship perpendicular is the perpendicular to the waterline at half the distance between forward and after perpendiculars.

2 Loading manual and loading instrument requirement criteria

2.1 Ship categories

2.1.1 Category I ships

- Ships with large deck openings where combined stresses due to vertical and horizontal hull girder bending and torsional and lateral loads need to be considered
- Ships liable to carry non-homogeneous loadings, where the cargo and/or ballast may be unevenly distributed; exception is made for ships less than 120 metres in length, when their design takes into account uneven distribution of cargo or ballast: such ships belong to Category II
- Ships having the service notation **chemical tanker ESP** or **liquefied gas carrier**.

2.1.2 Category II ships

- Ships whose arrangement provides small possibilities for variation in the distribution of cargo and ballast
- Ships on a regular and fixed trading pattern where the loading manual gives sufficient guidance
- the exception given under Category I.

2.2 Requirement criteria

2.2.1 All ships

An approved loading manual is to be supplied for all ships, except those of Category II less than 90 m in length in which the deadweight does not exceed 30% of the displacement at the summer loadline draught.

For ships with length less than 65 m, the Society may waive the above-mentioned request for an approved loading manual at its discretion taking into account the ship's service and arrangement.

In addition, an approved loading instrument is to be supplied for all ships of Category I equal to or greater than 100 m in length.

The loading instrument is ship specific onboard equipment and the results of the calculations are only applicable to the ship for which it has been approved.

An approved loading instrument may not replace an approved loading manual.

2.2.2 Bulk carriers, ore carriers and combination carriers equal to or greater than 150 m in length

Ships with one of the service notations **bulk carrier ESP**, **ore carrier ESP** or **combination carrier ESP**, and equal to or greater than 150 m in length, are to be provided with an approved loading manual and an approved computer-based loading instrument, in accordance with the applicable requirements of this Section.

3 Loading manual

3.1 Definitions

3.1.1 All ships

A loading manual is a document which describes:

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

3.1.2 Bulk carriers, ore carriers and combination carriers equal to or greater than 150 m in length

In addition to [3.1.1], for ships with one of the service notations **bulk carrier ESP**, **ore carrier ESP** or **combination carrier ESP**, and equal to or greater than 150 m in length, the loading manual is also to describe:

- for ships with the service notation **bulk carrier ESP**: envelope results and permissible limits of still water bending moments and shear forces in the hold flooded condition, as applicable according to Pt E, Ch 4, Sec 3, [5.1.1].

- the cargo hold(s) or combination of cargo holds which might be empty at full draught. If no cargo hold is allowed to be empty at full draught, this is to be clearly stated in the loading manual.
- maximum allowable and minimum required mass of cargo and double bottom contents of each hold as a function of the draught at mid-hold position
- maximum allowable and minimum required mass of cargo and double bottom contents of any two adjacent holds as a function of the mean draught in way of these holds. This mean draught may be calculated by averaging the draught of the two mid-hold positions.
- maximum allowable tank top loading together with specification of the nature of the cargo for cargoes other than bulk cargoes
- maximum allowable load on deck and hatch covers. If the ship is not approved to carry load on deck or hatch covers, this is to be clearly stated in the loading manual.
- the maximum rate of ballast change together with the advice that a load plan is to be agreed with the terminal on the basis of the achievable rates of change of ballast.

3.2 Conditions of approval

3.2.1 All ships

The approved loading manual is to be based on the final data of the ship. The manual is to include the design (cargo and ballast) loading conditions, subdivided into departure and arrival conditions as appropriate, upon which the approval of the hull scantlings is based, defined in Ch 5, Sec 2, [2.1.2].

In the case of modifications resulting in changes to the main data of the ship, a new approved loading manual is to be issued.

3.2.2 Bulk carriers, ore carriers and combination carriers equal to or greater than 150 m in length

In addition to [3.2.1], for ships with one of the service notations **bulk carrier ESP**, **ore carrier ESP** or **combination carrier ESP**, and equal to or greater than 150 m in length, the following loading conditions, subdivided into departure and arrival conditions as appropriate, are also to be included in the loading manual:

- alternate light and heavy cargo loading conditions at maximum draught, where applicable
- homogeneous light and heavy cargo loading conditions at maximum draught
- ballast conditions.

  For ships with ballast holds adjacent to topside wing, hopper and double bottom tanks, it may be acceptable that the ballast holds are filled when the topside wing, hopper and double bottom tanks are empty. Partial filling of the peak tanks is not acceptable in the design ballast conditions, unless effective means are provided to prevent accidental overfilling.
- short voyage conditions where the ship is to be loaded to maximum draught but with a limited amount of bunkers
- multiple port loading/unloading conditions
- deck cargo conditions, where applicable
- typical loading sequences where the ship is loaded from commencement of cargo loading to reaching full deadweight capacity, for homogeneous conditions, relevant part load conditions and alternate conditions where applicable. Typical unloading sequences for these conditions are also to be included.

  The typical loading/unloading sequences are also to be developed to not exceed applicable strength limitations. The typical loading sequences are also to be developed paying due attention to the loading rate and deballasting capability.
- typical sequences for change of ballast at sea, where applicable.

3.2.3 Language

The loading manual is to be prepared in a language understood by the users. If this is not English, a translation into English is to be included.

4 Loading instrument

4.1 Definitions

4.1.1 All ships

A loading instrument is an instrument which is either analog or digital and by means of which it can be easily and quickly ascertained that, at specified read-out points, the still water bending moments, shear forces and still water torsional moments and lateral loads, where applicable, in any load or ballast condition, do not exceed the specified permissible values.

An operational manual is always to be provided for the loading instrument.

Single point loading instruments are not acceptable.

4.1.2 Bulk carriers, ore carriers and combination carriers equal to or greater than 150 m in length

For ships with one of the service notations **bulk carrier ESP**, **ore carrier ESP** or **combination carrier ESP**, and equal to or greater than 150 m in length, the loading instrument is an approved digital system as defined in [4.1.1]. In addition to [4.1.1], it is also to ascertain as applicable that:

- the mass of cargo and double bottom contents in way of each hold as a function of the draught at mid-hold position
- the mass of cargo and double bottom contents of any two adjacent holds as a function of the mean draught in way of these holds
- the still water bending moment and shear forces in the hold flooded conditions

do not exceed the specified permissible values.

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approval of any original stability calculation software is no longer valid. The software is to be modified accordingly and re-approved.

4.5.3 Calculation systems

A passive system requires manual data entry, an active system replaces the manual entry with sensors reading and entering the contents of tanks, etc., and a third system, an integrated system, controls or initiates actions based on the sensor supplied inputs and is not within the scope of these requirements.

4.5.4 Types of stability software *(1/7/2018)*

Four types of calculations performed by stability software are acceptable depending upon a vessel's stability requirements:

- Type 1: software calculating intact stability only (for vessels not required to meet a damage stability criterion)
- Type 2: software calculating intact stability and checking damage stability on the basis of a limit curve (e.g. for vessels applicable to SOLAS Part B-1 damage stability calculations, etc.) checking all the stability requirements (intact and damage stability) on the basis of a limit curve
- Type 3: software calculating intact stability and damage stability by direct application of pre-programmed damage cases based on the relevant Conventions or Codes or each loading condition (for some tankers etc.)
- Type 4: Software calculating damage stability associated with an actual loading condition and actual flooding case, using direct application of user defined damage, for the purpose of providing operational information for safe return to port (SRtP).

Damage stability of both Type 3 and Type 4 stability software shall be based on a hull form model, that is, directly calculated from a full three-dimensional geometric model.

4.5.5 Functional requirements *(1/7/2021)*

a) General requirements for any type of stability software

1) The calculation program is to present relevant parameters of each loading condition in order to assist the Master in his judgement on whether the ship is loaded within the approval limits. The following parameters are to be presented for a given loading condition:
   - deadweight data;
   - lightship data;
   - trim;
   - draft at the draft marks and perpendiculars;
   - summary of loading condition displacement, VCG, LCG and, if applicable, TCG;
   - downflooding angle and corresponding downflooding opening (not applicable for Type 2 software which uses limit curve for checking all the stability requirements. However, if intact stability criteria are given in addition to the limit curve, downflooding angle and the corresponding downflooding opening shall be indicated);
   - compliance with stability criteria: listing of all calculated stability criteria, the limit values, the values obtained and the conclusions (criteria fulfilled or not fulfilled)) (not applicable for Type 2 software which uses limit curve for checking all the stability requirements. However, if intact stability criteria are given in addition to the limit curve, the limit values, the obtained values and the conclusion shall be indicated).
2) A clear warning is to be given on screen and in hard copy printout if any of the loading limitations are not complied with.

   Loading limitations shall include, but may not be limited to:
   - Trim, draught, liquid densities, tank filling levels, initial heel;
   - Use of limit KG/GM curves in conjunction with above for Type 2;
   - Restrictions to the stowage height for timber where timber load lines are assigned.
3) Type 3 software is to include pre-defined relevant damage cases for both sides of the ship according to the applicable rules for automatic check of a given loading condition.
4) The date and time of a saved calculation are to be part of the screen display and hard copy printout.
5) Each hard copy printout is to contain identification of the calculation program, including version number.
6) Units of measurement are to be clearly identified and used consistently within a loading calculation.
7) For Type 3 and Type 4 software, the system shall be pre-loaded with a detailed computer model of the complete hull, including appendages, all compartments, tanks and the relevant parts of the superstructure considered in the damage stability calculation, wind profile, down-flooding and up-flooding openings, cross-flooding arrangements, internal compartment connections and escape routes, as applicable and according to the type of stability software.
8) For Type 1 and Type 2 software, in case a full three dimensional model is used for stability calculations, the requirements of the computer model are to be as per item 7) above to the extent as applicable and according to the type of stability software.

b) Further requirements for Type 4 stability software:

1) The normal (Type 1, 2 and 3) and SRtP (Type 4) software need not be "totally separated". Where the normal and SRtP software are not totally separated:
   - the function of switching between normal software and Type 4 software shall be provided
   - the actual intact loading condition is to be the same for both functions (normal operation and SRtP); and
   - the SRtP module needs only to be activated in case of an incident.

   Approval of Type 4 (SRtP) software is for stability only.
2) In passenger ships which are subject to SRtP and have an onboard stability computer and shore-based support, such software need not be identical.

SECTION 2 DIESEL ENGINES

1 General

1.1 Application

1.1.1 *(1/7/2019)*

Diesel engines listed below are to be designed, constructed, installed, tested and certified in accordance with the requirements of this Section, under the supervision and to the satisfaction of the Society's Surveyors:

a) main propulsion engines

b) engines driving electrical generators and other auxiliaries essential for safety and navigation and cargo pumps in tankers, when they develop a power of 110 kW and over.

All other engines are to be designed and constructed according to sound marine practice, with the equipment required in [4.3.4], [4.5.2], [4.7.2] [4.7.3], [4.7.5] and [4.7.8] and delivered with the relevant works' certificate (see Pt D, Ch 1, Sec 1, [4.2.3]).

Additional requirements for control and safety systems for dual fuel engines supplied with high pressure methane gas are given in App 2.

Additional requirements for trunk piston engines supplied with low pressure natural gas are given in App 12.

In addition to the requirements of this Section, those given in Sec 1 apply.

1.2 Type approval certificate

1.2.1 *(1/7/2016)*

For each type of engine that is required to be certified, a type approval certificate is to be obtained by the engine designer.

The type approval process consists of:

- drawing and specification approval,
- conformity of production,
- approval of type testing programme,
- type testing of engines,
- review of the obtained type testing results,
- evaluation of the manufacturing arrangements,
- issue of a type approval certificate upon satisfactorily meeting the Rule requirements.

1.3 Engine certificate

1.3.1 *(1/7/2016)*

Each diesel engine manufactured for a shipboard application per [1.1.1] is to have an engine certificate:

The certification process consists of:

- the engine builder/licensee obtaining design approval of the engine application specific documents, if any, by submitting a comparison list of the production drawings to the previously approved engine design drawings referenced in [1.2.1]
- forwarding the relevant production drawings and comparison list for the use of the Surveyors at the manufacturing plant and shipyard if necessary
- engine's components testing and engine works trials
- the issuance of an engine certificate upon satisfactorily meeting the Rule requirements.

1.4 Documentation

1.4.1 Document flow for obtaining a type approval certificate *(1/7/2016)*

a) For the initial engine type, the engine designer is to submit to the Society the documentation in accordance with requirements in Tab 1 and Tab 2.

b) Upon review and approval of the submitted documentation (evidence of approval), it will be re-turned to the engine designer.

c) The engine designer arranges for a Surveyor to attend an engine type test

d) Upon satisfactory testing and examination of relevant reports, the Society issues a type approval certificate.

1.4.2 Document flow for engine certificate *(1/7/2016)*

a) The engine type must have a type approval certificate. For the first engine of a type, process and the engine certification process (ECP) may be performed simultaneously.

b) Engines to be installed in specific applications may require the engine designer/licensor to modify the design or performance requirements. The modified drawings are forwarded by the engine designer to the engine builder/licensee to develop production documentation for use in the engine manufacture in accordance with Tab 3.

c) The engine builder/licensee develops a comparison list of the production documentation to the documentation listed in Tab 1 and Tab 2.. An example comparison list is provided in App 9. If there are differences in the technical content on the licensee's production drawings/documents compared to the corresponding licensor's drawings, the licensee must obtain agreement to such differences from the designer using the template in App 10.

If the designer agreement is not confirmed, the engine is to be regarded as a different engine type and is to be

4.7.6 Overspeed protective devices of auxiliary engines driving electric generators *(1/7/2016)*

In addition to the speed governor, auxiliary engines of rated power equal to or greater than 220 kW driving electric generators are to be fitted with a separate overspeed protective device, with a means for manual tripping, adjusted so as to prevent the rated speed from being exceeded by more than 15%.

This device is to automatically shut down the engine.

4.7.7 Use of electronic governors *(1/1/2017)*

a) Type approval

Electronic governors and their actuators are to be type approved by the Society, according to Ch 3, Sec 6.

b) Electronic governors for main propulsion engines

If an electronic governor is fitted to ensure continuous speed control or resumption of control after a fault, an additional separate governor is to be provided unless the engine has a manually operated fuel admission control system suitable for its control.

A fault in the governor system is not to lead to sudden major changes in propulsion power or direction of propeller rotation.

Alarms are to be fitted to indicate faults in the governor system.

The acceptance of electronic governors not in compliance with the above requirements will be considered by the Society on a case by case basis, when fitted on ships with two or more main propulsion engines.

c) Electronic governors for auxiliary engines driving electric generators

In the event of a fault in the electronic governor system the fuel admission is to be set to “zero”.

Alarms are to be fitted to indicate faults in the governor system.

d) The acceptance of electronic governors fitted on engines driving emergency generators will be considered by the Society on a case by case basis, anyway, a back-up pre-programmed governor is to be provided for immediate replacement in case of failure of the governor in use; if practicable, the backup governor is to be in place, fixed to the engine in a position near to the governor in use, and arranged so that the exchange is quick, easy and error-free; special consideration is to be given to the governor power supply.

4.7.8 Alarms and safeguards for emergency diesel engines *(1/7/2021)*

a) These requirements apply to diesel engines required to be immediately available in an emergency (i.e. emergency generating set engine, emergency fire pump engine, etc.) and capable of being controlled remotely or automatically operated.

b) Information demonstrating compliance with these requirements is to be submitted to the Society. The information is to include instructions to test the alarm and safety systems.

c) The alarms and safeguards are to be fitted in accordance with Tab 6. It is the responsibility of the Manufacturer to set the alarms and safeguards so that they activate when the controlled parameter deviates from normal values but before reaching hazardous conditions.

d) The safety and alarm systems are to be designed to 'fail safe'. The characteristics of the 'fail safe' operation are to be evaluated on the basis not only of the system and its associated machinery, but also the complete installation, as well as the ship.

e) Regardless of the engine output, if shutdowns additional to those specified in Tab 6, except for the overspeed shutdown, are provided, they are to be automatically overridden when the engine is in automatic or remote control mode during navigation.

f) The alarm system is to function in accordance with Part F, Chapter 3 with the additional requirement that grouped alarms are to be arranged on the bridge.

g) In addition to the fuel oil control from outside the space, a local means of engine shutdown is to be provided.

h) Local indications of at least those parameters listed in are Tab 6 to be provided within the same space as the diesel engines and are to remain operational in the event of failure of the alarm and safety systems.

4.7.9 Summary tables *(1/7/2021)*

Diesel engines are to be equipped with monitoring equipment as detailed in Tab 4 and Tab 5, for main propulsion and auxiliary services, respectively.

For ships classed for restricted navigation, the acceptance of a reduction in the monitoring equipment required in Tab 4 and Tab 5 may be considered.

The alarms are to be visual and audible.

The indicators are to be fitted at a normally attended position (on the engine or at the local control station).

It is the responsibility of the Manufacturer to set the alarms and safeguards so that they activate when the controlled parameter deviates from normal values but before reaching hazardous conditions.

In the case of diesel engines required to be immediately available in an emergency and capable of being controlled remotely or automatically operated, Tab 6 applies.

Table 4 : Monitoring of main propulsion diesel engines *(1/7/2021)*

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Main Engine			Auxiliary	
Identification of system parameter	Alarm	Indication	Slow-down	Shut-down	Control	Stand by Start	Stop
Fuel oil pressure after filter (engine inlet)		local					
Fuel oil viscosity before injection pumps or fuel oil temperature before injection pumps (For engine running on heavy fuel)		local					
Leakage from high pressure pipes where required	H						
Lubricating oil to main bearing and thrust bearing pressure **(5)**	L	local					
	LL			X			
Lubricating oil to cross-head bearing pressure when separate **(5)**	L	local					
	LL			X			
Lubricating oil to camshaft pressure when separate **(5)**	L	local					
	LL			X			
Turbocharger lubricating oil inlet pressure		local					
Lubricating oil inlet temperature		local					
Thrust bearing pads or bearing outlet temperature	H	local					
Cylinder fresh cooling water system inlet pressure	L	local **(3)**					
Cylinder fresh cooling water outlet temperature or, when common cooling space without individual stop valves, the common cylinder water outlet temperature		local					
Piston coolant inlet pressure on each cylinder **(1)**	L	local					
Piston coolant outlet temperature on each cylinder **(1)**		local					
Piston coolant outlet flow on each cylinder **(1) (2)**	L						
Scavenging air receiver pressure		local					
Scavenging air box temperature (Detection of fire in receiver)		local					
Exhaust gas temperature		local **(4)**					
Engine speed / direction of speed (when reversible) **(5)**		local					
	H			X			
Fault in the electronic governor system	X						

(1) Not required, if the coolant is oil taken from the main cooling system of the engine

(2) Where outlet flow cannot be monitored due to engine design, alternative arrangement may be accepted

(3) For engines of 220 kW and above

(4) Indication is required after each cylinder, for engines of 500 kW/cylinder and above

(5) To ensure independency of safety functions from control and monitoring functions, a separate sensor is to be installed for each row of the table.

Table 5 : Monitoring of diesel engines used for auxiliary services *(1/7/2016)*

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Engine			Auxiliary	
Identification of system parameter	Alarm	Indication	Slow-down	Shut-down	Control	Stand by Start	Stop
Fuel oil viscosity or temperature before injection **(2)**		local					
Fuel oil pressure **(2)**		local					
Fuel oil leakage from pressure pipes	H						
Lubricating oil pressure	L	local		X **(1)**			
Pressure or flow of cooling water, if not connected to main system	L	local					
Temperature of cooling water or cooling air		local					
Engine speed **(4)**		local					
	H			X **(3)**			
Fault in the electronic governor system	X						

(1) Not acceptable to emergency generator set
(2) Where heavy fuel is used
(3) Only requested for diesel engines having rating of 220 kW and above
(4) To ensure independency of safety functions from control and monitoring functions, a separate sensor is to be installed for each row of the table.

Table 6 : Monitoring of diesel engines required to be immediately available in an emergency and capable of being controlled remotely or automatically operated *(1/7/2021)*

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Engine			Auxiliary	
Identification of system parameter	Alarm	Indication	Slow-down	Shut-down	Control	Stand by Start	Stop
Fuel oil leakage from pressure pipes	H						
Lubricating oil pressure	L	local					
Lubricating oil temperature **(1)**	H	local					
Pressure or flow of cooling water **(1)**	L	local					
Oil mist concentration in crankcase **(2)**	H	local					
Temperature of cooling water or cooling air	H	local					
Engine speed **(3)**		local					
	H **(1)**			X **(1)**			
Fault in the electronic governor system	X						

(1) Requested only for diesel engines having rating of 220 kW and above.
(2) Requested only for diesel engines having rating of 2250 kW and above or cylinder bore of 300 mm and above
(3) To ensure independency of safety functions from control and monitoring functions, a separate sensor is to be installed for each row of the table.

Table 9 : Symbols used in Table 8 *(1/7/2016)*

Symbol	Description
C	chemical composition
CD	crack detection by MPI or DP
CH	crosshead engines
D	cylinder bre diameter (mm)
GJL	gray cast iron
GJS	spheroidal graphite cast iron
GS	cast steel
M	mechanical properties
SC	society certificate
TR	test report
UT	ultrasonic testing
W	work certificate
X	visual examination of accessible surfaces by the Surveyor

7.3 Hydrostatic tests

7.3.1 *(1/7/2016)*

In addition to what indicated in Tab 5, pressure pipes, valves and other fittings (used for water, lubricating oil, fuel oil, compressed air and other fluid), are to be subjected to hydrostatic tests at 1,5 times the maximum working pressure, but not less than 0,4 MPa.

7.4 Workshop inspections and testing

7.4.1 *(1/7/2021)*

In addition to the type test, diesel engines are to be subjected to works trials, which are to be witnessed by the Surveyor except where an Alternative Inspection Scheme has been granted or where otherwise decided by the Society on a case by case basis.

Engines which are to be subjected to trials on the test bed at the Manufacturer's works and under the Society's supervision are to be tested in accordance with the scope as specified below.

Exceptions to this require the agreement of the Society.

Before any official testing, the engines shall be run-in as prescribed by the engine manufacturer.

Adequate test bed facilities for loads as required in [7.4.4] shall be provided. All fluids used for testing purposes such as fuel, lubrication oil and cooling water are to be suitable for the purpose intended, e.g. they are to be clean, preheated if necessary and cause no harm to engine parts. This applies to all fluids used temporarily or repeatedly for testing purposes only.

On occasion of the workshop testing, engines are to be inspected for:

- Jacketing of high-pressure fuel oil lines including the system used for the detection of leakage.
- Screening of pipe connections in piping containing flammable liquids.
- Insulation of hot surfaces by taking random temperature readings that are to be compared with corresponding readings obtained during the type test. This shall be done while running at the rated power of engine. Use of contact thermometers may be accepted at the discretion of the attending Surveyor. If the insulation is modified subsequently to the Type Approval Test, the Society may request temperature measurements as required in [6.10.9].
- Presence of sensors for the alarms and safeguards required in Tab 4, 5 and 6 as applicable; and relevant functionality as far as possible.

These inspections are normally to be made during the works trials by the manufacturer and the attending surveyor, but at the discretion of the Society parts of these inspections may be postponed to the shipboard testing.

Engines for which an Alternative Inspection Scheme has been agreed with the Manufacturer are to be subjected to trials at the Manufacturer's works in accordance with a procedure previously accepted on a case-by-case basis by the Society and recorded in the documentation relevant to the admission to the Alternative Inspection Scheme.

7.4.2 Objectives *(1/7/2016)*

The purpose of the works trials is to verify design premises such as power, safety against fire, adherence to approved limits (e.g. maximum pressure), and functionality and to establish reference values or base lines for later reference in the operational phase.

SECTION 1 GENERAL

1 Application

1.1 General

1.1.1 The requirements of this Chapter apply to electrical installations on ships. In particular, they apply to the components of electrical installations for:

- primary essential services
- secondary essential services
- essential services for special purposes connected with ships specifically intended for such purposes (e.g. cargo pumps on tankers, cargo refrigerating systems, air conditioning systems on passenger ships)
- services for habitability.

The other parts of the installation are to be so designed as not to introduce any risks or malfunctions to the above services.

1.1.2

As stated in Note 1 to Pt A, Ch 1, Sec 1, [1.1.2], the statutory requirements of the SOLAS Convention and/or national safety regulations, as applicable, regarding fire protection, detection and extinction (hereinafter referred to as "fire protection statutory requirements") are no longer mandatory for the purpose of classification, except where the Society carries out surveys relevant to fire protection statutory requirements on behalf of the flag Administration. In such cases, fire protection statutory requirements are considered a matter of class and therefore compliance with these requirements is also verified by the Society for classification purposes.

1.1.3 *(1/7/2019)*

The Society may consider modified requirements for installations of ships having navigation notation "sheltered area" or "special navigation" in an area at not more than 6 miles from the shore.

1.2 References to other regulations and standards

1.2.1 The Society may refer to other regulations and standards when deemed necessary. These include the IEC publications, notably the IEC 60092 series.

1.2.2 When referred to by the Society, publications by the International Electrotechnical Commission (IEC) or other internationally recognised standards, are those currently in force at the date of agreement for ship classification.

2 Documentation to be submitted

2.1

2.1.1 The documents listed in Tab 1 are to be submitted.

The list of documents requested is to be intended as guidance for the complete set of information to be submitted, rather than an actual list of titles.

The Society reserves the right to request the submission of additional documents in the case of non-conventional design or if it is deemed necessary for the evaluation of the system, equipment or components.

Unless otherwise agreed with the Society, documents for approval are to be sent in triplicate if submitted by the Shipyard and in four copies if submitted by the equipment supplier.

Documents requested for information are to be sent in duplicate.

In any case, the Society reserves the right to require additional copies when deemed necessary.

2.1.2 *(1/7/2021)*

In addition to the documentation listed in Tab 1, a FMEA, carried out according to the Tasneef "Guide for Failure mode and Effect Analysis" or other equivalent methods, and a Test Program, identifying the tests to be carried out in order to verify the assumptions and conclusions of the FMEA, may be requested ~~are to be submitted~~ for approval for the following systems where applicable (see Note 1):

- ~~systems required to remain operational after a casualty for passenger ship subjected to SOLAS requirements for a safe return to port;~~
- control and power systems to power-operated fire doors and status indication for all fire doors;
- control and power systems to power-operated watertight doors and their status indication;
- steering gear control system;
- electric propulsion control system;
- public address and general alarm system;
- remote emergency stop/shutdown arrangements for systems which may support the propagation of fire ~~(see Note 1)~~ and/or explosion;
- control and power system and position indication circuits for bow doors, stern doors, side doors, inner doors.

~~The Society may waive this requirement where the modes of failure and their consequences are clearly identifiable from the relevant drawings.~~

The FMEA may be ~~required~~requested by the Society for other systems on a case by case basis, depending on their influence on the overall ship safety.

Note 1: ~~where required by [1.1.2].~~where the modes of failure and their consequences are clearly identifiable from the relevant drawings the Society may waive this request.

2.1.3 *(1/7/2021)*

Where the Society carries out surveys relevant to fire protection statutory requirements on behalf of the flag Administration (see [1.1.2]) the additional documents listed in Tab. 2 are to be submitted.

2.1.4 *(1/7/2021)*

When an alteration or addition to an existing installation is proposed, updated plans are to be submitted for approval. As a minimum a technical specification, schematic diagrams and a proposed list of tests to be carried out onboard at the presence of the Tasneef Surveyor are to be included.

2.1.5 *(1/7/2021)*

Where computer based systems are implemented and used to control the electrical installation, or to provide safety functions in accordance with the requirements of this Chapter (e.g. electric propulsion, steering gear, emergency safety systems etc.), the arrangements are to satisfy the applicable requirements of Chapter 3.

3 Definitions

3.1 General

3.1.1 Unless otherwise stated, the terms used in this Chapter have the definitions laid down by the IEC standards.

The definitions given in the following requirements also apply.

3.2 Essential services

3.2.1 Essential services are those services essential for propulsion and steering, and the safety of the ship, and services to ensure minimum comfortable conditions of habitability and necessary for special purposes connected with ships specifically intended for such purposes (e.g. cargo pumps on tankers, cargo refrigerating systems, air conditioning systems on passenger ships).

Table 1 : Documents to be submitted *(1/7/2021)*

No.	I/A (1)	Documents to be submitted	Notes
		GENERAL	
1	A	Operation description of main, emergency and transitional electrical power systems (if applicable) under normal and foreseeable abnormal operating conditions.	
2	A	Single line diagram of main and emergency power and lighting systems.	The drawing is to include the single line diagram of: • the main switchboard and all the feeders connected to the main switchboard • the emergency switchboard and all feeders connected to the emergency switchboard • interconnector feeder between main switchboard and emergency switchboard • the main and emergency source of electrical power (i.e. generators and/or batteries and any additional source of power) • any distribution boards and motor control centers (MCC) • the main and emergency lighting distribution • transformers, converters and similar appliance which constitute an essential part of the electrical supply system • uninterruptible power system units (UPS) when providing an alternative power supply to essential services and/or when providing an alternative power supply or transitional power supply, if any, to the emergency services.
3	A	Electrical power balance (main and emergency supply).	The load balance of the main supply is to include the operating modes in which the ship is intended to operate.

(1) A: to be submitted for approval
I: to be submitted for information

No.	I/A (1)	Documents to be submitted	Notes
4	I	Calculation of short-circuit currents for installation in which the sum of rated power of the energy sources which may be connected contemporaneously to the network is greater than 500 kVA.	The calculation is to include the short circuit currents at: • the main switchboard(s) • the emergency switchboard • all the distribution boards and MCC including those fed from transformers. Document is to include details of circuit breaker and fuse operating times and discrimination curves (2).
5	A	List of circuits including, for each supply and distribution circuit, data concerning the nominal current, the cable type, length and cross-section, nominal and setting values of the protective and control devices.	Main switchboard, emergency switchboards, each distribution board, motor control centers (MCC) and UPS and/or battery distribution.
6	A	Single line diagram and detailed functional diagram of the main switchboard	
7	A	Single line diagram and detailed functional diagram of the emergency switchboard.	
8	A	Single line diagram and detailed functional diagram of distribution boards, and 100kW and over motor control centers and single starters.	Main distribution boards are intended as distribution boards which are supplied directly or through transformer by main or emergency switchboard
9	A	Diagram and arrangement of main and emergency lighting	
10	A	Diagram and arrangement of the general emergency alarm system, the public address system and other intercommunication systems.	
11	A	A functional diagram of the distribution board specially reserved for the navigation lights.	
12	I	Schedule for recording of the type, location and maintenance cycle of batteries used for essential and emergency services.	Reference is to be made to the requirements of Sec 3 [11.1.1].
13	A	Single line diagram for electric propulsion installation, including power supply circuits.	For control alarm and safety system see Chapter 3.
14	A/I	For BATTERY POWERED SHIP documents required by Tab 1 of Ch 2, App 2.	
15	A	A functional diagram of the electric power circuits for steering gear	Reference is to be made to the requirements of Ch 1, Sec 11 [2.3], [2.4], [3] & [4]. For control alarm and safety system see Chapter 3
16	A	Electrical diagram of local application fixed gas fire-extinguishing systems.	Reference is to be made to the requirements of Ch 4, Sec 1, [7.1.2]
17	A	Electrical diagrams of power control and position indication circuits of watertight doors	Reference is to be made to the requirements of: • Pt B, Ch 2, Sec 1 [6] • Pt E, Ch 11, Sec 2

(1) A: to be submitted for approval
I: to be submitted for information

No.	I/A (1)	Documents to be submitted	Notes
18	I	General arrangement plan of the ship showing location of main items of the electrical system	The plan is to include: • main switchboard(s) and emergency switchboard • main source of power including battery rooms, if any • emergency source of power and transitional source of power (where required by the applicable rules) • distribution boards supplying primary and secondary essential services • UPS or batteries serving primary and secondary essential services and emergency services • major equipment serving propulsion (e.g. motors, transformers, converter, etc.)
19	A	A functional diagram of uninterruptible power supply (UPS) for primary essential services, emergency services and 50kVA and over secondary essential services.	Reference is to be made to Sec 7 [3].
20	A	Plan of hazardous areas, where applicable	Reference is to be made to: - Ch 2, Sec 3 [10] and - service notations in relation to the type and/or service of the ship: • Pt E, Ch 1, Sec 4 for ro-ro cargo ships • Pt E, Ch 7, Sec 6 for oil tankers and fls tankers • Pt E, Ch 8, Sec 10 for chemical tankers • Pt E, Ch 9, Sec 10 for liquefied gas carrier • Pt E, Ch 12, Sec 5 for ro-ro passenger ships • Pt E, Ch 17, Sec 4 for oil recovery ships • Pt E, Ch 19, Sec 5 for barge oil-non propelled ship • Pt E, Ch 24, Sec 9 for Compressed Natural Gas Carrier • Pt E, Ch 25, Sec 6 for oil carrier-assisted propulsion • Pt E, Ch 26, Sec 5 for palm-oil carrier assisted propulsion • Pt E, Ch 28, Sec 4 for chemical recovery ship • Pt E, Ch 29, Sec 4 for well stimulation
DOCUMENTS REQUESTED IN RELATION TO THE TYPE AND SERVICES OF THE SHIP			
21	A	Diagram of alarm, monitoring and safety system of inert gas system, where applicable.	Reference is to be made to the requirements of Ch 4, Sec 1 [9]
22	A	Document giving certification details of types of cables and safety characteristics of the equipment installed in hazardous areas, as applicable.	Reference is to be made to Sec 3 [10].
23	A	Diagrams of tank level indicator systems, high level alarm systems and overflow control systems, where applicable.	Reference is to be made to the requirements of Pt E, Ch 7, Sec 4 and sec 5
24	A	Single line diagrams of the power supply to well stimulation equipment.	Reference is to be made to the requirements of Pt E, Ch 29, Sec 4.

(1) A: to be submitted for approval
I: to be submitted for information

No.	I/A (1)	Documents to be submitted	Notes
25	A	Electrical diagrams of power control and position indication circuits for bow doors, stern doors, side doors, inner doors, television system and alarm systems for ingress of water.	Reference is to be made to the requirements of Pt E, Ch 1, Sec 2; Ch 11, Sec 3; Ch 12, Sec 2.
26	A	Diagrams of the supplies to the supplementary emergency lighting systems for ro-ro passenger ships.	Reference is to be made to the requirements of Pt E, Ch 12, Sec 5 [2]

(1) A: to be submitted for approval
I: to be submitted for information

Table 2 : Documents requested in relation to the type and services of the ship (2) *(1/7/2021)*

No.	(1)	Documents to be submitted
1	A	Electrical diagram of the automatic fire detection and alarm systems and manually operated call points.
2	A	Electrical diagram of the fixed gas fire-extinguishing systems.
3	A	Electrical diagram of the sprinkler systems.
4	A	Electrical diagram of power control and position indication circuits for fire doors.
5	A	Diagram of the remote stop system (ventilation, fuel pumps, etc.).
6	A	Diagram of power, control and indication circuits for electrically operated low location lighting (LLL).

(1) A: to be submitted for approval

(2) Reference is to be made to the requirements of "Rules for Fire Protection, Detection and Extinction for the Issue and Maintenance of SOLAS Certificates" or "Rules for Fire Protection, Detection and Extinction for the Issue and Maintenance of Statutory Certificates other than SOLAS Certificates", as applicable.

Table 3 : ~~Documents to be submitted~~ *~~(1/1/2021)~~*

~~No.~~	~~I/A (1)~~	~~Documents to be submitted~~
~~1~~	~~A~~	~~Single line diagram of main and emergency power and lighting systems.~~
~~2~~	~~A~~	~~Electrical power balance (main and emergency supply).~~
~~3~~	~~I~~	~~Calculation of short circuit currents for each installation in which the sum of rated power of the energy sources which may be connected contemporaneously to the network is greater than 500 kVA (kW).~~
~~4~~	~~A~~	~~List of circuits including, for each supply and distribution circuit, data concerning the nominal current, the cable type, length and cross-section, nominal and setting values of the protective and control devices.~~
~~5~~	~~A~~	~~Single line diagram and detailed diagram of the main switchboard.~~
~~6~~	~~A~~	~~Single line diagram and detailed diagram of the emergency switchboard.~~
~~7~~	~~A~~	~~Diagram of main distribution boards, and 100kW and over motor control centers and single starters. (2)~~
~~8~~	~~A~~	~~Diagram of the general emergency alarm system, of the public address system and other intercommunication systems (see [1.1.2]).~~
~~9~~	~~A~~	~~Detailed diagram of the navigation light switchboard.~~
~~10~~	~~I~~	~~Schedule for recording of the type, location and maintenance cycle of batteries used for essential and emergency services.~~
~~11~~	~~A (3)~~	~~Selectivity and coordination of the electrical protection.~~
~~12~~	~~A (4)~~	~~Single line diagram.~~
~~13~~	~~A (4)~~	~~Principles of control system and its power supply.~~

(1) ~~A: to be submitted for approval~~
~~I: to be submitted for information~~

(2) ~~Main distribution boards are intended as distribution boards which are supplied directly or through transformer by main or emergency switchboard(s).~~

(3) ~~for high voltage installations~~

(4) ~~for electric propulsion installations.~~

No.	I/A (1)	Documents to be submitted
14	A (4)	Alarm and monitoring system including: • list of alarms and monitoring points • power supply diagram.
15	A (4)	Safety system including: • list of monitored parameters for safety system • power supply diagram.

(1) A: to be submitted for approval
I: to be submitted for information
(2) Main distribution boards are intended as distribution boards which are supplied directly or through transformer by main or emergency switchboard(s).
(3) for high voltage installations
(4) for electric propulsion installations.

3.3 Primary essential services

3.3.1 Primary essential services are those which need to be in continuous operation to maintain propulsion and steering.

Examples of equipment for primary essential services are the following:

- Steering gear
- Pumps for controllable pitch propellers
- Scavenging air blowers, fuel oil supply pumps, fuel valve cooling pumps, lubricating oil pumps and cooling water pumps for main and auxiliary engines and turbines necessary for the propulsion
- Forced draught fans, feed water pumps, water circulating pumps, condensate pumps, oil burning installations, for steam plants or steam turbines ship, and also for auxiliary boilers on ship where steam is used for equipment supplying primary essential services
- Azimuth thrusters which are the sole means for propulsion/steering with lubricating oil pumps, cooling water pumps
- Electrical equipment for electric propulsion plant with lubricating oil pumps and cooling water pumps
- Electric generators and associated power sources supplying the above equipment
- Hydraulic pumps supplying the above equipment
- Viscosity control equipment for heavy fuel oil
- Control, monitoring and safety devices/systems for equipment for primary essential services
- Speed regulators dependent on electrical energy for main or auxiliary engines necessary for propulsion.

The main lighting system for those parts of the ship normally accessible to and used by personnel and passengers is also considered (included as) a primary essential service.

3.4 Secondary essential services

3.4.1 Secondary essential services are those services which need not necessarily be in continuous operation to maintain propulsion and steering but which are necessary for maintaining the vessel's safety.

Examples of equipment for secondary essential services are the following:

- Windlasses
- Fuel oil transfer pumps and fuel oil treatment equipment
- Lubrication oil transfer pumps and lubrication oil treatment equipment
- Preheaters for heavy fuel oil
- Sea water pumps
- Starting air and control air compressors
- Bilge, ballast and heeling pumps
- Fire pumps and other fire-extinguishing medium pumps
- Ventilation fans for engine and boiler rooms
- Services considered necessary to maintain dangerous cargo in a safe condition
- Navigation lights, aids and signals
- Internal safety communication equipment
- Fire detection and alarm systems
- Electrical equipment for watertight closing appliances
- Electric generators and associated power supplying the above equipment
- Hydraulic pumps supplying the above equipment
- Control, monitoring and safety for cargo containment systems
- Control, monitoring and safety devices/systems for equipment for secondary essential services.

3.4.2 Services for habitability are those which need to be in operation to maintain the vessel's minimum comfort conditions for people on board.

Examples of equipment for maintaining conditions of habitability:

- Cooking
- Heating
- Domestic refrigeration
- Mechanical ventilation
- Sanitary and fresh water
- Electric generators and associated power sources supplying the above equipment.

3.5 Safety voltage

3.5.1 A voltage which does not exceed 50 V a.c. r.m.s. between conductors, or between any conductor and earth,

3.22 Final sub-circuit

3.22.1 That portion of a wiring system extending beyond the final required overcurrent protective device of a board.

3.23 Motor control centre (MCC)

3.23.1 *(1/1/2021)*

A switchgear and controlgear assembly which is supplied by main or emergency switchboards and is intended to control and distribute electrical energy.

Note 1: It is possible for the MCC to be a section or sections of the main switchboard.

3.24 Hazardous areas

3.24.1 Areas in which an explosive atmosphere is present, or may be expected to be present due to the presence of vapours, gases, flammable dusts or explosives in quantities such as to require special precautions for the construction, installation and use of electrical apparatus.

3.24.2 Hazardous areas are classified in zones based upon the frequency and the duration of the occurrence of explosive atmosphere.

3.24.3 Hazardous areas for explosive gas atmosphere are classified in the following zones:

- Zone 0: an area in which an explosive gas atmosphere is present continuously or is present for long periods
- Zone 1: an area in which an explosive gas atmosphere is likely to occur in normal operation
- Zone 2: an area in which an explosive gas atmosphere is not likely to occur in normal operation and if it does occur, is likely to do only infrequently and will exist for a short period only.

3.25 Certified safe-type equipment

3.25.1 Certified safe-type equipment is electrical equipment of a type for which a national or other appropriate authority has carried out the type verifications and tests necessary to certify the safety of the equipment with regard to explosion hazard when used in an explosive gas atmosphere.

3.26 Environmental categories

3.26.1 *(1/7/2021)*

Electrical equipment is classified into environmental categories according to the temperature range, vibration levels, and resistance to chemically active substances and to humidity.

The designation of the environmental categories is indicated by the EC Code in Tab ~~2~~3

The first characteristic numeral indicates the temperature range in which the electrical equipment operates satisfactorily, as specified in Tab ~~3~~4

The second characteristic numeral indicates the vibration level in which the electrical equipment operates satisfactorily, as specified in Tab ~~4~~5.

3.26.2 The tests for verifying the additional and supplementary letters and the characteristic numeral of the environmental categories are defined in Ch 3, Sec 6.

3.27 Navigation Light (NL)

3.27.1 *(1/7/2015)*

Navigation Light (NL) means the following lights:

- *masthead light, sidelights, sternlight, towing light, all-round light, flashing light as defined in Rule 21 of COLREGs (see Note 1),*
- *all-round flashing yellow light required for air-cushion vessels by Rule 23 of COLREGs,*
- *manoeuvring light required by Rule 34(b) of COLREGs.*

Note 1:

COLREGs means Convention on the International Regulations for Preventing Collisions at Sea, 1972, including their annexes.

Table 4 : EC Code

Code letter	First characteristic numeral	Second characteristic numeral	Additional letter	Supplementary letter
EC	(numerals 1 to 4)	(numerals 1 to 3)	(letter S) **(1)**	(letter C) **(2)**

(1) The additional letter S indicates the resistance to salt mist (exposed decks, masts) of the electrical equipment.

(2) The supplementary letter C indicates the relative humidity up to 80% (air conditioned areas) in which the electrical equipment operates satisfactorily.

Table 5 : First characteristic numeral *(1/7/2017)*

First characteristic numeral	Brief description of location	Temperature range °C	
1	Air conditioned areas	+ 5	+ 40
2	Enclosed spaces	+ 5	+ 45
3a	Electronic equipment inside consoles, housing, etc..	+ 5	+ 55
3b	Close to combustion engines, boilers and similar	+ 5	+ 70
4	Exposed decks, masts	- 25	+ 45

SECTION 2 GENERAL DESIGN REQUIREMENTS

1 Environmental conditions

1.1 General

1.1.1 The electrical components of installations are to be designed and constructed to operate satisfactorily under the environmental conditions on board.

In particular, the conditions shown in the tables in this Article are to be taken into account.

Note 1: The environmental conditions are characterised by:

- one set of variables including climatic conditions (e.g. ambient air temperature and humidity), biological conditions, conditions dependent upon chemically active substances (e.g. salt mist) or mechanically active substances (e.g. dust or oil), mechanical conditions (e.g. vibrations or inclinations) and conditions dependent upon electromagnetic noise and interference, and
- another set of variables dependent mainly upon location on vessels, operational patterns and transient conditions.

1.2 Ambient air temperatures

1.2.1 *(1/7/2017)*

For ships classed for unrestricted navigation, the reference ambient air temperature ranges are shown in Tab 1 in relation to the various locations of installation.

1.2.2

Where electrical equipment is installed within environmentally controlled spaces, the ambient temperature for which the equipment is to be suitable may be reduced from 45° and maintained at a value not less than 35° provided:

- the equipment is not for use for emergency services.
- temperature control is achieved by at least two cooling units so arranged that in the event of loss of one cooling unit, for any reason, the remaining unit(s) is (are) capable of satisfactorily maintaining the design temperature.
- the equipment is able to be initially set to work safely up to a 45° ambient temperature until such time as the lower ambient temperature is achieved; the cooling equipment is to be rated for a 45 ° ambient temperature.
- audible and visual alarms are fitted, at a continually manned control station, to indicate any malfunction of the cooling units.

1.2.3

In accepting an ambient temperature less than 45° it is to be ensured that electrical cables are adequately rated throughout their length for the maximum ambient temperature to which they are exposed.

1.2.4

The equipment used for cooling and maintaining the lower ambient temperature is to be classified for a secondary essential service.

1.2.5 For ships classed for service in specific zones, the Society may accept different ambient air temperature (e.g. for ships operating outside the tropical belt, the maximum ambient air temperature may be assumed as equal to + 40 °C instead of + 45 °C).

Table 1 : Ambient air temperature *(1/7/2017)*

Location	Temperature range, in °C	
Enclosed spaces	+ 5	+ 45
Electronic equipment inside console, housing, etc.	+ 5	+ 55
Fitted on combustion engines, boilers and similar	+ 5	+ 70
Exposed decks	- 25	+ 45

1.3 Humidity

1.3.1 For ships classed for unrestricted service, the humidity ranges shown in Tab 2 are applicable in relation to the various locations of installation.

Table 2 : Humidity

Location	Humidity
General	95% at 55 °C
Air conditioned areas	Different values may be considered on a case by case basis

1.4 Cooling water temperatures

1.4.1 The temperatures shown in Tab 3 are applicable to ships classed for unrestricted service.

1.4.2 For ships classed for service in specific zones, the Society may accept different values for the cooling water temperature (e.g. for ships operating outside the tropical belt, the maximum cooling water temperature may be assumed as equal to + 25 °C instead of + 32 °C).

Table 3 : Water temperature

Coolant	Temperature range, in °C	
Sea water	0	+ 32

1.5 Salt mist

1.5.1 The applicable salt mist content in the air is to be 1 mg/m^3.

1.6 Inclinations

1.6.1 The inclinations applicable are those shown in Tab 4.

The Society may consider deviations from these angles of inclination taking into consideration the type, size and service conditions of the ships.

1.7 Vibrations

1.7.1 In relation to the location of the electrical components, the vibration levels given in Tab 5 are to be assumed.

1.7.2 The natural frequencies of the equipment, their suspensions and their supports are to be outside the frequency ranges specified.

Where this is not possible using a suitable constructional technique, the equipment vibrations are to be dumped so as to avoid unacceptable amplifications.

2 Quality of power supply

2.1 Voltage and frequency variation

2.1.1

All electrical appliances supplied from the main or emergency systems are to be so designed and manufactured that they are capable of operating satisfactorily under the normally occurring variations in voltage and frequency.

2.1.2

Unless otherwise stated in national or international standards, all equipment is to operate satisfactorily with the variations from its rated value shown in Tab 6 to Tab 8 subject to the following conditions.

a) For alternating current components, the voltage and frequency variations shown in Tab 6 are to be assumed.

b) For direct current components supplied by d.c. generators or converted by rectifiers, the voltage variations shown in Tab 7 are to be assumed.

c) For direct current components supplied by electrical batteries, the voltage variations shown in Tab 8 are to be assumed.

2.1.3

Any special system, e.g. electronic circuits, whose function cannot operate satisfactorily within the limits shown in Tab 6, Tab 7 and Tab 8 is not to be supplied directly from the system but by alternative means, e.g. through stabilised supply.

2.2 Harmonic distortions

2.2.1 For components intended for systems without substantially static converter loads and supplied by synchronous generators, it is assumed that the total voltage harmonic distortion does not exceed 5%, and the single harmonic does not exceed 3% of the nominal voltage.

2.2.2 For components intended for systems fed by static converters, and/or systems in which the static converter load predominates, it is assumed that:

- the single harmonics do not exceed 5% of the nominal voltage up to the 15th harmonic of the nominal frequency, decreasing to 1% at the 100th harmonic (see Fig 1), and that
- the total harmonic distortion does not exceed 10%.

Table 4 : Inclination of ship *(1/7/2021)*

Type of machinery, equipment or component	Angles of inclination, in degrees **(1)**			
	Athwartship		Fore-and-aft	
	static	dynamic **(4)**	static	dynamic **(5)**
Machinery and equipment relative to main electrical power installation	15	22,5	5	7,5
Machinery and equipment relative to the emergency power installation and crew and passenger safety systems of the ship (e.g. emergency source of power, emergency fire pumps, etc.)	22,5 **(2)**	22,5 **(2)**	10	10
Switchgear and associated electrical and electronic components and remote control systems **(3)**	22,5	22,5	10	10

(1) Athwartship and fore-and-aft angles may occur simultaneously in their most unfavourable combination.
(2) In the case of gas carriers or chemical tankers, the emergency power supply must also remain operable with the ship flooded to a final athwartship inclination up to a maximum of 30°.
(3) No undesired switching operations or functional changes ~~may~~are to occur~~ up to an angle of inclination of 45°~~.
(4) The period of dynamic inclination may be assumed equal to 10 s.
(5) The period of dynamic inclination may be assumed equal to 5 s.

SECTION 1 REQUIREMENTS FOR FIRE PROTECTION, DETECTION AND EXTINCTION

1 General

1.1 Purpose and application

1.1.1

This Section applies to cargo ships and passenger ships for which classification is requested.

Note 1: As from 1 January 2007, the statutory requirements of the SOLAS Convention and/or national safety regulations, as applicable, regarding fire protection, detection and extinction (hereinafter referred to as "fire protection statutory requirements") are no longer mandatory for the purpose of classification except where the Society carries out surveys relevant to fire protection statutory requirements on behalf of the flag Administration. In such cases, fire protection statutory requirements are considered a matter of class and therefore compliance with these requirements is also verified by the Society for classification purposes.
In general, only IACS Unified Requirements in force related to fire protection, detection and extinction have been retained as Rule requirements within the scope of classification and are contained in this Chapter 4.

1.1.2

[2]; [3]; [4]; [5.1]; [5.3]; [6]; [7]; [8] apply to all ships.

1.1.3

[5.2]; [8]; [9] apply to cargo ships only.

1.1.4

Requirements for tankers in this Section apply to tankers carrying oil having a flashpoint not exceeding 60°C (closed cup test).

1.1.5

Unless otherwise stated, for materials and design criteria of piping and relevant accessories reference is to be made to Ch 1, Sec 10.

2 Documentation to be submitted

2.1

2.1.1

The Interested Party is to submit to the Society the documents listed in Tab 1.

Table 1 : Documentation to be submitted

No.	I/A **(1)**	Document **(2)**
1	A	Ventilation systems in cargo area of tankers, excluding cargo tanks
2	A	Automatic fire detection systems in unattended machinery spaces
3	A	Arrangement of local application fixed fire-extinguishing systems **(2)** and inert gas systems
4	A	Gas detection systems on tankers
5	A	Fixed fire-extinguishing system in scavenge spaces of two-stroke crosshead type engines, according to the requirements of Ch 1, Sec 2, [4.4.1]
6	A	Electrical diagram of local application fixed gas fire-extinguishing systems
7	I	General arrangement plan

(1) A : to be submitted for approval, in four copies I : to be submitted for information, in duplicate.

(2) Plans are to be schematic and functional and to contain all information necessary for their correct interpretation and verification such as:

- service pressures
- capacity and head of pumps and compressors, if any
- materials and dimensions of piping and associated fittings
- volumes of protected spaces
- surface areas of protected zones for pressure water-spraying systems
- type, number and location of nozzles of extinguishing media for gas and pressure water-spraying systems.

All or part of the information may be provided, instead of on the above plans, in suitable operation manuals or in specifications of the systems.

- Combination carrier/OOC
- Flammable liquid substances tanker
- Liquefied gas carrier
- Oil recovery ship
- Oil tanker.

3.29 Vehicle spaces

3.29.1

Vehicle spaces are cargo spaces intended for the carriage of motor vehicles with fuel in their tanks for their own propulsion.

3.30 Weather decks

3.30.1

A weather deck is a deck which is completely exposed to the weather from above and from at least two sides.

4 Type approved products

4.1

4.1.1

The following materials, equipment, systems or products in general used for fire protection are to be type approved by the Society, except for special cases for which acceptance may be given for individual ships on the basis of suitable documentation or ad hoc tests:

a) Flexible pipes and expansion bellows of non-conventional material for any type of fluid

b) Nozzles for fixed pressure water-spraying fire-extinguishing systems for machinery spaces and boiler rooms

c) Sensing heads for automatic fire alarm and fire detection systems.

d) Fixed fire detection and fire alarm systems

e) Explosive mixture detecting systems

f) Portable explosive mixture detecting apparatus

g) Fixed instruments for measuring the oxygen content for inert gas systems serving cargo tanks

h) Portable instruments for measuring the oxygen content for inert gas systems serving cargo tanks.

5 Probability of ignition

5.1 Arrangements for gaseous fuel for domestic purposes

5.1.1

In general gaseous fuel systems may only be considered for cargo ships.

However, this does not preclude the use, on passenger ships, of movable cooking appliances - the so-called "flambé carts" - providing they meet the following requirements:

a) Constructional requirements:

1) In addition to the main gas supply valve, the flambe carts are equipped with an emergency gas shut-off valve which can be activated:

   - manually by the operator, either by pulling on a metallic wire loop or using a rod pull type lever;
   - automatically with a mechanical (in general gravity type) tip over device which will shut off the gas flow from the gas cylinder should the cart accidentally tip over.

2) The regulation system ensures a pressure of about 0,0001 MPa downstream from the regulator itself.

3) A pressure gauge is fitted between the gas cylinder and the regulation system, to indicate the gas pressure inside the cylinder.

4) Special materials are used for the low pressure hose (between the regulation system and the stove) so that, in case of fire, the hose melts and closes on itself acting as an automatic check valve.

5) The gas cylinder is safely secured on its cradle inside the cart.

6) A safely re-ignition system is provided to automatically relight the burner if the flame goes out when the gas valve is "on".

7) At least two of the four swivel castors are equipped with brakes, to block the cart in position.

b) Operational requirements.

Flambé carts complying with the constructional requirements listed under item a) above may be used in public spaces (restaurant, buffet, etc.) on passenger ships under the following conditions, the implementation of which is the Owner's responsibility:

1) The carts are safely secured, specially when they are left unmanned in the space where they are used.

2) The number of carts permitted in a public space is such that the free volume at ambient temperature and atmospheric pressure of the natural gas contained in the cylinders of all the carts is less than 2% of the gross volume of the public space.

3) No spare full gas cylinders are permitted on board.

Empty bottles are replaced only when the ship is in the harbour.

5.2 Cargo area of tankers

5.2.1 Restriction on boundary openings

Where driven shafts pass through pump room bulkhead or deck plating, gas-tight glands are to be fitted. The glands are to be efficiently lubricated from outside the pump room. The seal parts of the glands are to be of material that will not initiate sparks. The glands are to be constructed and fitted in accordance with the relevant Rules for fittings attached to watertight bulkheads and, if a bellows piece is incorporated in the design, it is to be pressure tested before fitting.

5.2.2 Ventilation systems in cargo pump rooms

Discharges and air inlets are to be located at a vertical distance of at least 2,4 m from the open deck. Air discharges are also to be arranged at a horizontal distance of not less than 3 m from any other opening leading to the served spaces.

The ventilation system capable of providing the required air changes per hour is to comply with the following as applicable:

a) in order to avoid air stagnation zones, air exhaust ports inside the pump room are to be adequately distributed and the various landings are to consist of open gratings or perforated flats;

b) inlet ducts are generally to end at the top of the room and outlet ducts are to extend below the floor plates, with suction ports at the level of the upper edge of ordinary floors or bottom longitudinals;

c) in addition, suction ducts are to be provided with an emergency intake at approximately 2 m above the pump room lower grating, with a shutter capable of being opened or closed both at lower grating level and from the weather deck level, so that suction normally occurs through the lower suction ports and, in the event of the pump room flooding, through those at the top branched from the emergency intake;

d) an arrangement involving a specific ratio of areas of upper emergency and lower main ventilator openings, which can be shown to result in at least the required 20 air changes per hour through the lower inlets, can be adopted without the use of shutters.

When the lower access inlets are closed then at least 15 air changes per hour are to be obtained through the upper inlets.

5.2.3 Ventilation systems in spaces other than the cargo pump room

Hose lockers and enclosed or partially enclosed spaces adjacent to cargo tanks are to be independently ventilated, in general by mechanical ventilation (exhaust) where such spaces are normally attended by the crew. In general, the arrangement of inlets and outlets serving these spaces is to comply with the provisions set out in [5.2.2] a).

5.2.4 Gas measurements *(1/7/2021)*

a) Portable instruments

Every oil tanker is to be provided with at least two portable gas detectors capable of measuring flammable vapour concentrations in air (%LEL) and at least two portable O_2 analysers. Alternatively, at least two gas detectors, each capable of measuring both oxygen and flammable vapour concentrations in air (%LEL), are to be provided.

In addition, for tankers fitted with inert gas systems, at least two portable gas detectors are to be capable of measuring concentrations of flammable vapours in inerted atmosphere (% gas by volume).

b) Arrangement for gas measurement in double hull and double bottom spaces.

Gas analysing units with non-explosion proof measuring equipment associated to the fixed gas sampling line system may be located in areas outside cargo areas, e.g. in the cargo control room, navigation bridge or engine room, when mounted on the forward bulkhead facing the cargo area provided the following requirements are observed:

- sampling lines are not to run through gas-safe spaces, except where permitted under the last bullet below;
- the gas sampling pipes are to be equipped with flame arresters. Sample gas is to be led to the atmosphere with outlets arranged in a safe location;
- bulkhead penetrations of sample pipes between safe and dangerous areas are to be approved by the Society and to have the same fire integrity as the division penetrated. A manual isolating valve is to be fitted in each of the sampling lines at the bulkhead on the gas-safe side;
- the gas detection equipment, including sample piping, sample pumps, solenoids, analysing units etc., is to be located in a reasonably gas-tight enclosure (e.g. a fully enclosed steel cabinet with a gasketed door), which is to be monitored by its own sampling point. At gas concentration above 30% of the lower flammable limit (LFL) inside the enclosure, the entire gas analysing unit is to be automatically shut down;

  and

- where the enclosure cannot be arranged directly on the bulkhead facing the cargo area, sample pipes are to be of steel or other equivalent material and without detachable connections, except for the connection points for isolating valves at the bulkhead and analysing units, and are to be routed along the shortest path.

5.2.5 Safety aspects of double hull spaces, double bottoms and duct keels under cargo oil tanks

Pipe ducts in the double bottom are to comply with the following requirements:

a) In general, they are not to communicate with the engine room. When access is provided from a pump room, a watertight door is to be fitted complying with the requirements of Pt B, Ch 2, Sec 1, [6.2.1] and, in addition, with the following:

1) in addition to operation from the bridge, the watertight door is to be capable of being manually closed from outside the main pump room entrance; and

2) the watertight door is to be kept closed during normal operation of the ship except when access to the pipe tunnel is required.

b) For double bottoms and ducts keels, provision is to be made for at least two exits to the open deck arranged as far apart from each other as practicable. One of these exits fitted with a watertight closure may lead to the cargo pump room;

c) In the duct, provision is to be made for adequate mechanical ventilation.

SECTION 1 ROLLED STEEL PLATES, SECTIONS AND BARS

1 General

1.1 Application

1.1.1 General

The requirements of this Section apply to hot rolled plates, strips, sections and bars intended for hull, structural applications, boilers, pressure vessels and parts of machinery.

Article [1] specifies the requirements common to all the above-mentioned steel products, while the appropriate specific requirements are indicated in Articles [2] to [9].

1.1.2 Weldability

Steels in accordance with these Rules are weldable subject to the use of suitable welding processes and, where appropriate, to any conditions stated at the time of approval.

1.1.3 Products with through thickness properties

For products intended for welded construction which may be subject to particular stress in the thickness direction, it is suggested, and may be required, that the material satisfies the through thickness properties indicated in Article [9].

For steels specified in Article [9], a further symbol Z is to be added to the steel designation.

1.2 Manufacture

1.2.1 Steel is to be manufactured by the electric furnace, basic oxygen or open hearth processes.

The use of other processes may be specially approved by the Society.

1.2.2 The steel is to be cast in ingot moulds or by a continuous casting process.

Provision is to be made for sufficient discard such as to ensure:

- at both ends of the ingots, the soundness of the material
- at the transitory zones of continuous casting material, a homogeneous chemical composition along the longitudinal axis.

1.3 Approval

1.3.1

The manufacturing process is to be approved by the Society for individual steelmakers, grade of steel and products, as specified in the applicable Articles.

The suitability of each grade of steel for forming and welding is to be demonstrated during the initial approval tests at the steelworks. Approval of the steel works is to follow a scheme accepted by the Society.

Provisions for the approval are given in the "Rules for the approval of Manufacturers of materials".

1.4 Quality of materials

1.4.1 All products are to have a workmanlike finish and to be free from surface or internal defects which may impair their proper workability and use.

1.4.2

The responsibility for storage and maintenance of the delivered product(s) with acceptable level of surface conditions rests with the shipyard before the products are used in fabrication.

1.5 Visual, dimensional and non-destructive examinations

1.5.1 Visual, dimensional and, as appropriate, non-destructive examinations are to be performed by the Manufacturer on the materials supplied prior to delivery, as required.

The general provisions indicated in Ch 1, Sec 1, [3.6] and specific requirements for the various products as specified in the relevant Articles of this Section apply.

In the case of doubt about defects [1.4.1], suitable methods of non-destructive examinations may be required by the Surveyor.

1.5.2

The thickness of the plates and strips is to be measured at locations of a product or products as defined in the Articles relevant to the various products. In any case, the distance of the locations from the transverse or longitudinal edges of the product is to be not less than 10 mm.

Automated method or manual method is applied to the thickness measurements.

The procedure and the records of measurements are to be made available to the Surveyor and copies provided on request.

The tolerances on nominal thickness are indicated in the Articles relevant to the various products.

The tolerances on nominal thickness are not applicable to areas repaired by grinding, which are to be in accordance with a recognised standard.

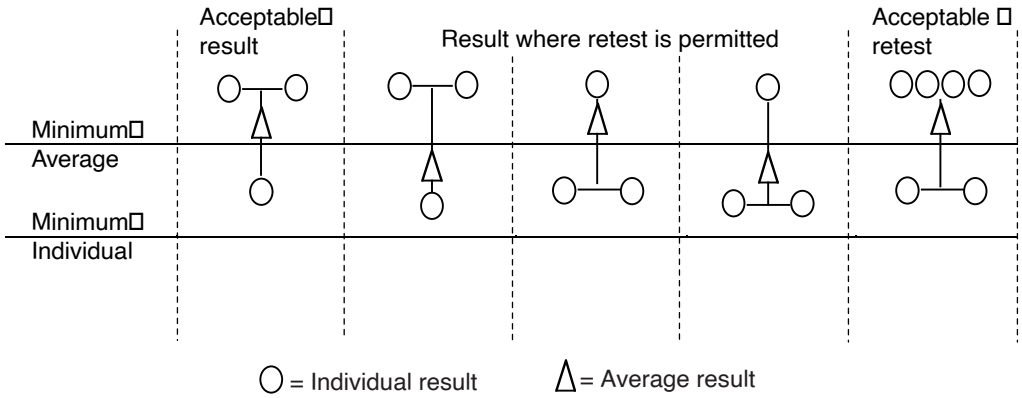
The responsibility for verification and maintenance of the production within the required tolerances rests with the Manufacturer. The Surveyor may require to witness some measurements.

1.6 Rectification of surface defects

1.6.1 Rectification of surface defects by grinding

Defects which need to be repaired may be removed by grinding.

Figure 11 : Diagram showing acceptance / rejection and retest criteria



10 Extremely Thick Steel Plates in container ships

10.1 Application

10.1.1 *(1/1/2017)*

The requirements of this Article [10] apply to steel plates for container ships incorporating extremely thick steel plates having steel grade and thickness in accordance with [10.2] and [10.3].

10.1.2 *(1/1/2017)*

This Article identifies when measures for the prevention of brittle fracture of extremely thick steel plates are required for longitudinal structural members.

10.1.3 *(1/1/2021)*

This Article defines the following methods to apply to the extremely thick plates of container ships for preventing the crack initiation and propagation:

a) Non-Destructive Testing (NDT) during construction detailed in [10.5]

b) Periodic NDT after delivery detailed in [10.6]

c) Brittle crack arrest design detailed in [10.7].

10.1.4 *(1/1/2021)*

This Article gives the basic concepts for application of extremely thick steel plates to longitudinal structural members in the upper deck.

10.1.5 *(1/1/2021)*

For the application of this Article, the upper deck region means the upper deck plating, hatch side coaming plating, hatch coaming top plating and their attached longitudinals.

10.1.6

The application of the measures specified in [10.5], [10.6] and [10.7] is to be in accordance with App 1.

10.2 Steel grades

10.2.1 *(1/1/2021)*

This Article is to be applied when any of YP36, YP40 and YP47 steel plates are used for the longitudinal structural members in the upper deck region.

Note 1: YP36, YP40 and YP47 refers to the minimum specified yield strength of steel of 355, 390 and 460 N/mm^2, respectively.

10.2.2 *(1/1/2021)*

In case YP47 steel plates are used for longitudinal structural members in the upper deck region, the steel plates are to be of EH47 grade as specified in [10].

10.3 Thickness

10.3.1

For steel plates with thickness of over 50mm and not greater than 100mm, the measures for prevention of brittle crack initiation and propagation specified in this [10.5], [10.6] and [10.7] are to be taken.

10.3.2

For steel plates with thickness exceeding 100mm, appropriate measures for prevention of brittle crack initiation and propagation are to be agreed with the Society.

10.4 Hull structure (for purpose of design)

10.4.1 Material factor k *(1/1/2021)*

For the material factors of YP36 and YP40 refer to Part B.

The material factor of YP47 steel for the assessment of hull girder strength is to be taken as k = 0.62.

10.4.2 Fatigue assessment *(1/1/2021)*

The fatigue assessment of the longitudinal structural members is to be performed in accordance with the Society's procedures.

10.4.3 Details of construction design *(1/1/2021)*

Special consideration is to be paid to the construction details where extremely thick steel plates are applied to structural members such as connections between outfitting and hull structures. Connections details are to be in accordance with the Society's requirements.

10.5 Non-Destructive Testing during construction (Measure No 1 of -Appendix 1)

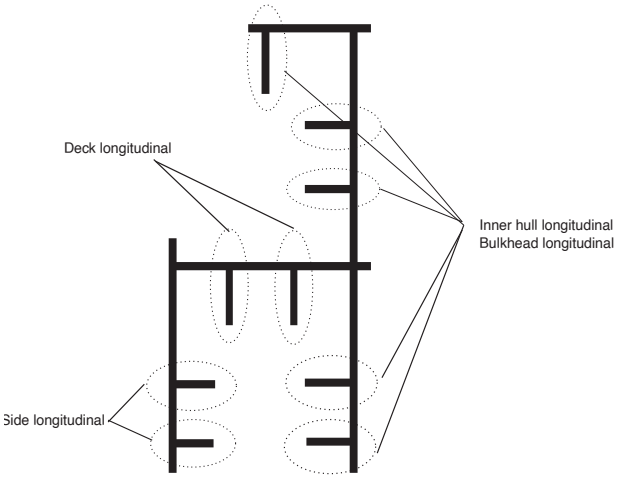
10.5.1 General *(1/7/2021)*

a) Where non-destructive testing (NDT) during construction is required in App 1, the NDT is to be in accordance with b) and [10.5.2]. Enhanced NDT as specified

in [10.7.3] e) is to be carried out in accordance with an appropriate standard.

b) Ultrasonic testing (UT) in accordance with the Tasneef Rules for carrying out non-destructive examinations of weldingIACS Rec.20 is to be carried out on all block-to-block butt joints of all upper flange longitudinal structural members in the cargo hold region. Upper flange longitudinal structural members include the topmost strakes of the inner hull/bulkhead, the sheer strake, main deck, coaming plate, coaming top plate, and all attached longitudinal stiffeners. These members are defined in Fig 12.

Figure 12 : Upper flange longitudinal structural members



10.5.2 Acceptance criteria of UT *(1/7/2021)*

Acceptance criteria of UT are to be in accordance with IACS Rec.20the Tasneef Rules for carrying out non-destructive examinations of welding.

The acceptance criteria may be adjusted under consideration of the appertaining brittle crack initiation prevention procedure and where this is more severe than that found in IACS Rec.20the Tasneef Rules for carrying out non-destructive examinations of welding, the UT procedure is to be amended accordingly to a more severe sensitivity.

10.6 Periodic NDT after delivery (Measure No.2 of Appendix 1)

10.6.1 General *(1/7/2021)*

a) Where periodic NDT after delivery is required, the NDT is to be in accordance with item b), [10.6.2] and [10.6.3].

b) The procedure of the NDT is to be in accordance with IACS Rec.20the Tasneef Rules for carrying out non-destructive examinations of welding, irrespective of the applicability clause for new building in Chapter 1, [1.1.1] of the Tasneef Rules for carrying out non-destructive examinations of welding.

10.6.2 Timing of UT

Where UT is carried out, the frequency of survey is to be agreed with the Society.

10.6.3 Acceptance criteria of UT *(1/7/2021)*

Where UT is carried out, acceptance criteria of UT are to be in accordance with IACS Rec.20the Tasneef Rules for carrying out non-destructive examinations of welding, irrespective of the applicability clause for new building in Chapter 1, [1.1.1] of the Tasneef Rules for carrying out non-destructive examinations of welding.

10.7 Brittle crack arrest design (Measures No.3, 4 and 5 of Appendix 1)

10.7.1 General *(1/1/2021)*

The brittle crack arrest steel method detailed in [10.7] may be used when the measures No. 3, 4 and 5 of App 1 are applied and the steel grade material of the upper deck is not higher than YP40. Otherwise other means for preventing the crack initiation and propagation is to be agreed with the Society.

Measures for the prevention of brittle crack propagation are to be taken within the cargo hold region. A brittle crack arrest design means a design using these measures.

The measures given in [10.7] generally apply to the block-to-block joints but it should be noted that cracks can initiate and propagate away from such joints. Therefore, appropriate measures should also be considered for the cases specified in [10.7.2] b) 2).

Brittle crack arrest steels are defined in [11.4.2].

10.7.2 Functional requirements of brittle crack arrest design *(1/1/2021)*

The purpose of the brittle crack arrest design is to arrest propagation of a crack at a proper position and to prevent large scale fracture of the hull girder.

a) The locations of most concern for brittle crack initiation and propagation are the block-to-block butt weld joints either on hatch side coaming or on upper deck plating. Other locations in block fabrication where joints are aligned may also present higher opportunity for crack initiation and propagation along butt weld joints.

b) Both of the following cases are to be considered:

1) where the brittle crack runs straight along the butt joint, and

2) where the brittle crack initiates in the butt joint but deviates away from the weld and into the plate, or where the brittle crack initiates from any other weld (see the figure below for definition of other welds) and propagates into the plate.

SECTION 1 EQUIPMENT

1 Anchors

1.1 Application

1.1.1 General

The requirements of this Article apply to anchors and associated components (heads, shanks and shackles) made of cast or forged steel, or fabricated by welding from rolled steel.

1.1.2 Modified testing procedure for anchors of small mass

For anchors having mass lower than 100 kg, or 75 kg in the case of high holding power anchors, continuously produced by Manufacturers who have been approved by the Society for this purpose, a batch testing procedure is admitted, with random execution of the checks required for normal testing.

The composition of the batches is to be judged appropriate as regards the homogeneity of material, manufacturing, heat treatment and dimensions.

1.2 Design - Manufacture

1.2.1 General

Anchors are to be manufactured by recognised Manufacturers, according to approved plans or recognised standards; see Pt B, Ch 10, Sec 4, [3.2].

For approval and/or acceptance of high holding power (HHP) and super high holding power (SHHP) anchors , the type tests indicated in Pt B, Ch 10, Sec 4, [3.2] are to be carried out.

Steel forgings and castings for anchors is to comply with the applicable requirements of Ch 2, Sec 3 and Ch 2, Sec 4, respectively, and are to be manufactured by recognised Manufacturers.

1.2.2 Tolerances

If not otherwise specified on standards or on drawings demonstrated to be appropriate, the following assembly and fitting tolerances are to be applied.

The clearance either side of the shank within the shackle jaws is to be in accordance with Tab 1 depending on the anchor mass.

The shackle pin is to be a push fit in the eyes of the shackle, which are to be chamfered on the outside to ensure a good tightness when the pin is clenched over on fitting.

The shackle pin to hole tolerance is to be no more than 0,5mm for pins up to 57mm and 1,0 mm for pins of larger diameter.

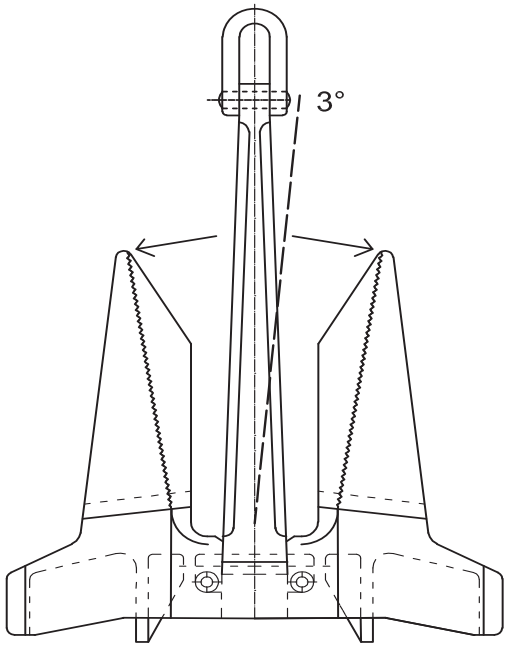
The trunnion pin is to be a snug fit within the chamber and be long enough to prevent horizontal movement. The gap is to be no more than 1% of the chamber length.

The lateral movement of the shank is not to exceed 3 degrees (see Fig 1).

Table 1

Anchor mass (t)	Clearance (mm)
Up to 3	3
Over 3 up to 5	4
Over 5 up to 7	6
Over 7	12

Figure 1



1.2.3 Welded anchors

Welded anchors are to be manufactured in accordance with approved procedures.

1.2.4 Heat treatment

Components for forged or cast anchors are to be properly heat treated in accordance with the applicable requirements of Ch 2, Sec 3 and Ch 2, Sec 4, respectively.

Fabricated anchors may require stress relief after welding depending upon weld thickness.

Stress relief is to be carried out as indicated in the approved welding procedure.

Stress relief temperatures are not to exceed the tempering temperature of the base material.

Alternative types of test pieces and testing procedures, in accordance with recognised standards, may be considered by the Society.

The measured breaking load is to be not less than those of the standards listed in [5.3.1].

If the test piece breaks at the terminals (clamp or splice), the test requirements are considered to have been met if the measured break occurs at a load not less that 90% of the minimum breaking load given by the reference standard. It is not to be assumed that the actual breaking load of the specimen is represented by multiplying the result by 10/9.

The value of elongation A, for which no minimum requirements are given, is used only for determination of the equivalence between synthetic and natural fibre ropes with the formula given in Pt B, Ch 10, Sec 4, [3.5.7], and therefore for definition of the minimum breaking load of the synthetic fibre ropes for mooring, in relation to the Equipment Number of the ship.

5.4.5 Breaking test on individual yarns

When the breaking test on full size test pieces cannot be performed, alternative test procedures may be considered and, if used, they are to be reported in the relevant testing documentation.

To this end, the procedure outlined in Annex B to ISO Standard 2307 is appropriate.

5.5 Identification, marking and certification

5.5.1 Upon satisfactory completion of the required tests and examinations, the ropes, packed in the required length for supply, are to be tagged with lead seals stamped with the Society's brand and further indications, as necessary for identification with the respective test certificates.

5.5.2 The certificates are to contain the essential elements relevant to the rope characteristics, the results of the test and the stamps and markings mentioned in [5.5.1].

Special marking and certification procedures may be agreed upon for supplies by Manufacturers granted the use of an alternative testing procedure.

6 Side scuttles, windows and their glass panes

6.1 Application

6.1.1 The requirements of this Article apply to fixed frames, window frames, dead covers and glass panes.

The types of sidescuttles and windows which, in relation to their position, are to be tested are indicated in Pt B, Ch 9, Sec 9.

6.2 Manufacture

6.2.1 General

Sidescuttles and windows which are subject to inspection are to be manufactured in accordance with approved plans or standards and specifications recognised by the Society.

Manufacturing procedures are to be of appropriate type, to the Surveyor's satisfaction.

6.2.2 Frame materials

Materials are to be of appropriate type and properties, as required in the approved plans or applicable standards.

They are to comply with the requirements of Chapter 2, in relation to the type of material and the nature of the product.

Subject to approval for each case or application, the following types of material and products are generally regarded as appropriate:

- hull steel plates, shapes and bars having R_m in the range 400-490 N/mm^2
- steel forgings and castings
- brass plates, shapes, bars and castings
- light alloy castings and semi-finished products, of category Al-Mg or Al-Mg-Si.

Subject to approval in individual cases, nodular cast iron of type GS400 or GS370 may also be used.

6.2.3 Glass panes

The glass panes are to be of appropriate type and quality, manufactured in accordance with suitable procedures, to the satisfaction of the Society, by recognised Manufacturers.

6.2.4 Quality of materials

The product is to be free from detrimental defects.

6.3 Inspections and tests

6.3.1 Frame material tests

Materials are to comply with the applicable requirements and to be tested or certified accordingly; depending on the individual cases, they are also to be submitted to the following additional tests :

a bend test, as indicated below, depending on the type of material:

- brass products: $d \leq 1\ s \quad \alpha \geq 60°$
- light alloy products: $d \leq 3\ s \quad \alpha \geq 60°$
- cast iron: $d \leq 4\ s \quad \alpha \geq 60°$

where:

s : Thickness of the specimen (which, as far as possible, should be equal to the thickness of the product)

d : Diameter of the mandrel

α : Required bend angle, which is to be attained without cracks or other defects.

For castings, as an alternative to the bend test performed on specimens, it may be agreed to perform a bend test directly on a completed piece. Such test may also be required by

the Surveyor as an additional random check. When this test is performed as an alternative to that on specimens, the number of pieces tested is to be one for every batch of not more than 50 equal pieces (25 in the case of cast iron products) originating from the same heat.

These tests are to be performed on a mandrel having a diameter equal to twice the thickness of the piece (but not less than 50 mm in the case of cast iron products); the required bend angles which are to be attained without cracks or other defects depending upon the material and the finished product are as follows:

- steel castings:

  fixed frames, window frames and dead covers: $\alpha \geq 20°$
- brass castings:

  fixed frames and window frames: $\alpha \geq 10°$

  dead covers: $\alpha \geq 15°$
- light alloy castings:

  fixed frames and window frames: $\alpha \geq 6°$

  dead covers: $\alpha \geq 15°$
- malleable or nodular cast iron: $\alpha \geq 15°$.

6.3.2 Glass panes

Glass panes are to be in toughened safety glass in accordance with ISO 21005 standards. The acceptance of ordinary glass is subject to special approval by the Society in each case.

The glass Manufacturer is to certify the homogeneity of the batches submitted for tests, as regards material, manufacturing procedure, heat treatment and suitability to meet the specified test requirements.

Glass panes are to be tested as specified in the following items a) or b).

a) a hydrostatic test of one glass pane for each batch of 100 (or fraction of 100) glass panes equal in shape and dimensions and manufactured with continuity and using the same procedure and treatments; the pane is to be tested with a load uniformly distributed on the net area, at the test pressures indicated in Tab 18, in relation to the diameter and thickness of the pane.

   The test pressure is to be applied for at least one minute; the glass pane is not to break.

   In the case of glass panes having shape other than circular, the test is to be performed on a disk obtained from a glass pane for each batch homogeneous as regards dimensions, manufacturing procedure and heat treatment and with a total surface of 25m² or fraction thereof. The disk, for the test and possible re-tests, is to be taken before the tempering process and treated with the glass panes of the batch which it represents.

   If a test produces unsatisfactory results, the test is to be repeated in duplicate on two new glass panes from the same batch; for the acceptance of the batch, both new tests are to be satisfactory; in the case of tempered glass panes of non-circular shape, in order not to have to reject the batch in the case of unsatisfactory test results, it is recommended that two additional disks should be taken for possible re-testing from the batch before the tempering treatment.

b) a punch test in accordance with ISO 614 as an alternative to the hydrostatic test mentioned in a).

   This test method is applicable both to non-opening and opening sidescuttles and rectangular windows; when tested, the glass edges are to be not less than 25mm from the inner edge of the rubber ring (see Fig 9).

   The test consists of applying to the glass pane, which is supported by a steel plate with a circular hole, the required load through a rounded steel shaft acting along the centre of the hole.

   The test is to be performed on 4 glass panes for each batch homogeneous as specified in a).

   In the case of batches of 4 glass panes or less, the test is to be performed on each glass pane.

   In the case of matt glass panes obtained by a special treatment of one of the surfaces of a transparent glass pane, the test is to be performed after the treatment and the load is to be applied to the surface which has not been treated.

   The required test loads are indicated in Tab 19, in relation to the thickness of the glass pane and the diameter of the hole in the support plate.

   The test is to be performed using the equipment and the procedure specified in ISO 614 Standard (see Fig 9).

Table 18 : Hydrostatic test pressure for glass panes of sidescuttles and windows *(1/7/2021)*

Thickness of glass pane (mm)	Pressure (N/mm²) for a glass pane net diameter (mm) of:					
	200	250	300	350	400	450
4	0,33	0,21	-	-	-	-
5	0,33	0,21	-	-	-	-
6	0,33	0,21	-	-	-	-
8	0,58	0,37	0,26	0,19	-	-
10	0,92	0,58	0,41	0,30	0,23	0,18
12	1,32	0,84	0,59	0,43	0,33	0,26
15	-	1,32	0,92	0,67	0,51	0,41
19	-	-	1,47	1,08	0,83	0,65

Table 19 : Punch test load *(1/7/2021)*

Thickness of glass pane (mm) (tolerance: 0 +2)	Test loads (N) for a hole diameter in support plate of:	
	200 mm	150 mm
4	1500	1600
5	2400	2600
6	3400	3500
8	6500	6700
10	10200	11000
12	15500	16500

SECTION 2 VARIOUS FINISHED PRODUCTS

1 Cast copper alloy propellers and propellers blades

1.1 Application

1.1.1 *(1/7/2021)*

The requirements of this Article are applicable to the ~~moulding, casting,~~manufacture, inspection and repair procedures of ~~new~~ cast copper alloy propellers, blades and bosses.

1.1.2 ~~**These requirements may also be applied for the repair and inspection of propellers which become damaged during service.**~~

1.1.3 *(1/7/2021)*

Where the use of alternative alloys is proposed, particulars of chemical composition, mechanical properties and heat treatment are to be submitted for approval.

1.1.4 *(1/7/2021)*

The requirements of this Article may also be used for the repair of propellers damaged in service, subject to prior agreement with the Society.

1.2 Manufacture

1.2.1 *(1/7/2021)*

All propellers and propeller components~~All castings~~ are to be manufactured ~~at~~by foundries approved by the Society~~.~~: the conditions for approval are indicated in the "Rules for the approval of Manufacturers of materials".

1.2.2 These castings are to be manufactured and tested in accordance with the appropriate requirements of Chapter 1 and Chapter 2 and the specific requirements of this Article.

1.2.3 Pouring *(1/7/2021)*

The pouring must be made into dried moulds using degassed liquid metal. The pouring is to be controlled so as to avoid turbulences of flow. Special devices and/or procedures must prevent slag flowing into the mould.

1.2.4 Stress relieving *(1/7/2021)*

Subsequent stress relieving heat treatment may be performed to reduce the residual stresses. For this purpose, the manufacturer shall submit a specification containing the details of the heat treatment to the Society for approval. For stress relieving temperatures and holding times see Tab 4 and Tab 5.

1.3 Quality of castings

1.3.1 Freedom from defects *(1/7/2021)*

All castings must have a workmanlike finish and are to be free from surface or internal defects which would be prejudicial to their proper application in service~~liable to impair their use~~. Minor casting defects which may still be visible after machining, such as small sand and slag inclusions, small cold shots and scabs, are to be trimmed off by the Manufacturer in accordance with [1.12].

1.3.2 Removal of defects *(1/7/2021)*

Casting defects which may impair the serviceability of the castings, e.g. major non-metallic inclusions, shrinkage cavities, blow holes and cracks, are not permitted. They may be removed by one of the methods described in [1.12]- and repaired within the limits and restrictions for the severity zones. ~~A f~~Full description and documentation ~~must~~are to be available for the surveyor.

1.4 Condition of supply

1.4.1 At the option of the Manufacturer, castings may be supplied in the "as cast" or heat treated condition.

1.5 Dimensions, dimensional and geometrical tolerances

1.5.1 *(1/7/2021)*

The verification of dimensions, the dimensional and geometrical tolerances is the responsibility of the Manufacturer. The report on the relevant examinations is to be submitted to the Surveyor, who may require checks to be made in his presence.

1.5.2 *(1/7/2021)*

Static balancing is to be carried out on all propellers in accordance with the approved drawing.

Dynamic balancing is required for propellers running above 500 rpm.

1.6 Chemical composition and metallurgical characteristics

1.6.1 Chemical composition *(1/7/2021)*

Typical copper propeller alloys are grouped into the four types CU1, CU2, CU3, and CU4 depending on their chemical composition as given in Tab 1. Copper alloys whose chemical composition deviates from the typical values of Tab 1 are to be specially approved by the Society.

1.6.2 The Manufacturer is to maintain records of the chemical analyses of the production casts, which are to be made available to the Surveyor so that he can satisfy himself that the chemical composition of each casting is within the specified limits.

1.6.3 Metallurgical characteristics *(1/7/2021)*

For copper-based alloys CU1 and CU2, in order to ensure adequate cold ductility and corrosion fatigue resistance, the proportion of beta phase is to be kept low. For this purpose, the zinc equivalent defined by the following formula is not to exceed a value of 45 %:

Zinc equivalent (%) = 100 - [(100 x %Cu / 100 +A)]

in which A = %Sn + 5 x %Al - 0,5 x %Mn - 0,1 x %Fe - 2,3 x %Ni. ~~is the algebraic sum of the following values :~~

~~1 . %Sn~~

~~5 . %Al~~

~~-0,5 . %Mn~~
~~-0,1 . %Fe~~
~~-2,3 . %Ni~~

Note 1: The negative sign in front of the element Mn, Fe and Ni signifies that these elements tend to reduce the proportion of beta phase.

The micro structure of alloy types CU 1 and CU 2 is to be verified by determining the proportion of alpha phase. For this purpose, at least one specimen is to be taken from each heat. The proportion of alpha phase is to be determined as the average value of 5 counts.

Note 2: The main constituents of the microstructure in the copper-based alloys categories CU 1 and CU 2 are alpha and beta phase.

Important properties such as ductility and resistance to corrosion fatigue are strongly influenced by the relative proportion of beta phase (too high a percentage of beta phase having a negative effect on these properties).

To ensure adequate cold ductility and corrosion fatigue resistance, the proportion of beta phase is to be kept low. The concept of the zinc equivalent should be used as control since it summarizes the effect of the tendency of various chemical elements to produce beta phase in the structure.

1.6.4 *(1/7/2021)*

In addition to [1.~~5~~6.3], the CU1 and CU2 type alloys are to contain an alpha phase component of at least 25%; this is to be checked on a test bar by the Manufacturer.

1.7 Mechanical properties and tests

1.7.1 Standardized alloys *(1/7/2021)*

The ~~requirements relevant to the~~ mechanical properties are ~~shown~~to comply with the values given in Tab 2.

The values given in ~~–~~Tab 2 are applicable to test specimens taken from separately cast samples in accordance with Fig 1, or with ~~any other~~a recognised ~~national~~ standard.

It is to be noted that these properties are generally not representative of the mechanical properties of the propeller casting itself, which may be up to 30% lower than that of a separately cast test coupon.

~~For integrally cast test specimens, the requirements are to be specially agreed with the Society; wherever possible, the test samples are to be located on the blades in an area lying between 0,5 to 0,6 R, where R is the radius of the propeller. The test sample material is to be removed from the casting by non thermal procedures~~.

Table 1 : Typical chemical composition of cast copper alloys for propeller and propeller blade ~~castings~~ *(1/7/2021)*

Alloy Type	~~CHEMICAL COMPOSITION (%)~~ Cu (%)	Sn (%)	Zn (%)	Pb (%)	Ni (%)	Fe (%)	Al (%)	Mn (%)
CU1	52 - 62	max. 1,5	35 - 40	max. 0,5	max. 1,0	0,5 - 2,5	0,5 - 3,0	0,5 - 4,0
CU2	50 - 57	max. 1,5	33 - 38	max 0,5	3,0 - 8,0	0,5 - 2,5	0,5 - 2,0	1,0 - 4,0
CU3	77 - 82	max. 0,1	max. 1,0	max 0,03	3,0 - 6,0	2,0 - 6,0	7,0 - 11,0	0,5 - 4,0
CU4	70 - 80	max. 1,0	max. 6,0	max 0,05	1,5 - 3,0	2,0 - 5,0	6,5 - 9,0	8,0 - 20,0

Table 2 : Mechanical properties of cast copper alloys for propellers and propeller blade castings

Alloy type	Proof stress $R_{p\,0,2}$ (N/mm²) min.	Tensile strength R_m (N/mm²) min.	Elongation A5 (%) min.
CU1	175	440	20
CU2	175	440	20
CU3	245	590	16
CU4	275	630	18

Note 1: The values shown are related to specimens taken from separately cast samples as per Fig 1 or recognised national standards.

Note 2: The 0,2% proof stress values are to be determined for all keyless type propeller castings. For other types of propeller casting, these values are given for information purposes only and, unless expressly required, their determination may be omitted during testing.

1.7.2 Other alloys *(1/7/2021)*

The mechanical properties of alloys not meeting the ~~limiting~~ minimum values of Tab 2 are to comply with the requirements of the relevant specification to be approved by the Society.

1.7.3 Tensile tests and specimens *(1/7/2021)*

Tensile tests and specimens are to be in accordance with Ch 1, Sec 2.

Generally, the specimens are to be taken from separately cast sample pieces in accordance with [1.8]. The test samples are to be cast in moulds made of the same material as the mould for the propeller and they are to be cooled down under the same conditions as the propeller. At least one tensile test specimen is to be taken from each ladle.

If propellers are subjected to a heat treatment the test samples are to be heat treated together with them.

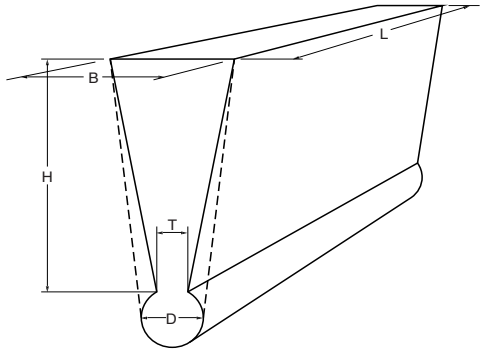
Where test specimens are to be taken from integrally cast test samples, this is to be the subject of special agreement with the Society. Wherever possible, the test samples are to be located on the blades in an area lying between 0,5 to 0,6 R, where R is the radius of the propeller. The test sample material is to be removed from the casting by non thermal procedures.

1.8 Sampling and testing

1.8.1 Test samples are to be provided from each cast used for the manufacture of propeller blade casting.

1.8.2 The test samples are to be of keel block type, in accordance with the dimensions in Fig 1, and are to be cast in moulds made from the same type of materials as used for the castings.

Figure 1 : Keel block test sample casting



H=100mm ; B=50mm ; L>150mm ; T=15mm ; D=25mm

1.8.3 Where castings are supplied in the heat treated condition, the test samples are to be heat treated together with the casting which they represent.

1.8.4 At least one tensile test specimen is to be taken from each ladle.

1.8.5 The resuts of all tensile tests are to comply with the requirements given in Tab 2.

1.8.6 *(1/7/2021)*

Metallographic examination of alloy types CU1 and CU2 is to be verified by determining the proportion of alpha phase. For this purpose, at least one specimen is to be taken from each heat. The proportion of alpha phase is to be determined as the average value of 5 counts. The requirements of [1.~~5~~6.4] are to be fulfilled.

~~1.9 Visual and dimensional examination~~

~~**1.9.1** Propeller castings are to be visually inspected during the various stages of manufacture.~~

~~**1.9.2** All finished castings are to be presented for examination by the Surveyor, and this is to include the bore and the examination of internal surfaces where applicable.~~

~~**1.9.3** The dimensions, the dimensional and geometrical tolerances and their verification are the responsibility of the Manufacturer. The report on the relevant examinations is to be submitted to the Surveyor, who may require checks to be made in his presence.~~

~~**1.9.4** Static balancing is to be carried out on all propellers. Dynamic balancing is required for propellers running above 500 rpm.~~

~~**1.9.5**~~

~~The Surveyor may require areas to be etched (e.g. by iron chloride) for the purpose of investigating weld repairs.~~

1.~~10~~9 Inspection~~,~~ ~~definition of skew and S~~severity zones ~~Non-destructive examinations~~

1.~~10~~9.1 Propeller castings are to be cleaned and adequately prepared for inspection.

1.~~10~~9.2 All finished propellers are to be presented for a com-prehensive visual inspection by the Surveyor.

1.~~10~~9.3 Definition of skew *(1/7/2021)*

The skew of a propeller is defined as follows:

The maximum skew angle of a propeller blade is defined as the angle, in the projected view of the blade, between a line drawn through the blade tip and the shaft centreline and a second line through the shaft centreline which acts as a tangent to the locus of the mid-points of the helical blade section; see Fig 2.

High skew propellers have a skew angle greater than 25°, low skew propellers a skew angle of up to 25°.

1.~~10~~9.4 Severity zones *(1/7/2021)*

For the purpose of the requirements of this Section, in order to relate the degree of inspection to the criticality of defects in propeller blades and to help reduce the risk of failure by fatigue cracking after repair, propellers and propeller blades are divided in order of importance into three severity zones, A, B and C.

Zone A is the region supporting the highest operating stresses and which, therefore, requires the highest degree of inspection. Generally, the blade thicknesses are greatest in this area giving the greatest degree of restraint in repair welds and this in turn leads to the highest residual stresses in and around any repair welds. High residual tensile stresses frequently lead to fatigue cracking during subsequent service so that relief of these stresses by heat treatment is essential for any welds made in this zone. Welding is generally not permitted in Zone A and will only be allowed after special consideration by the Society. Every effort should be made to rectify a propeller which is either defective or damaged in this area without recourse to welding even to the extent of reducing the scantlings, if this is acceptable. If a repair using welding is agreed, postweld stress relief heat treatment is mandatory.

Zone B is a region where the operating stresses may be high. Welding should preferably be avoided but generally is allowed subject to prior approval from the Society. Complete details of the defect / damage and the intended repair procedure are to be submitted for each instance in order to obtain such approval.

Zone C is a region in which the operating stresses are low and where the blade thicknesses are relatively small so that repair welding is safer and, if made in accordance with an approved procedure is freely permitted.

1.~~10~~9.5 Low-skew propellers

Zone A is in the area on the pressure side of the blade, from and including the fillet to 0,4R, and bounded on either side by lines at a distance 0,15 times the chord length C_R from the leading edge and 0,2 times C_R from the trailing edge, respectively (see Fig 3).

Where the hub radius (R_B) exceeds 0,27R, the other boundary of zone A is to be increased to $1,5R_B$.

Zone A also includes the parts of the separate cast propeller hub which lie in the area of the windows as described in Fig 5 and

the flange and fillet area of controllable pitch and built-up propeller blades as described in Fig 6.

Zone B is on the pressure side, the remaining area up to 0,7R and on the suction side the area from the fillet to 0,7R (see Fig 3).

Zone C is the area outside 0,7R on both sides of the blade. It also includes the surface of the hub of a mono-block propeller and all the surfaces of the hub of a controllable pitch propeller other than those designated Zone A above.

1.~~10~~9.6 High-skew propellers

Zone A is the area on the pressure face contained within the blade root-fillet and a line running from the junction of the leading edge with the root fillet to the trailing edge at 0,9R and passing through the mid-point of the blade chord at 0,7 R and a point situated at 0,3 of the chord length from the leading edge at 0,4 R. It also includes an area along the trailing edge on the suction side of the blade from the root to 0,9 R and with its inner boundary at 0,15 of the chord length from the trailing edge.

Zone B constitutes the whole of the remaining blade surface.

Zone A and B are illustrated in Fig 4.

Figure 2 : Definition of skew angle

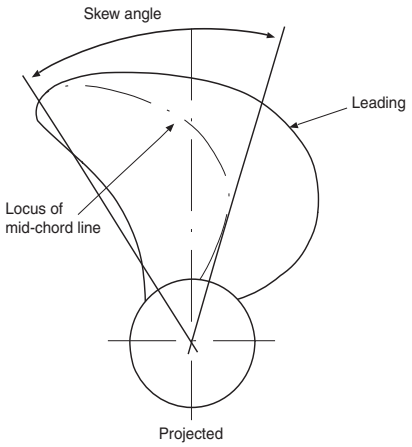


Figure 3 : Severity zones for integrally cast low skew propellers

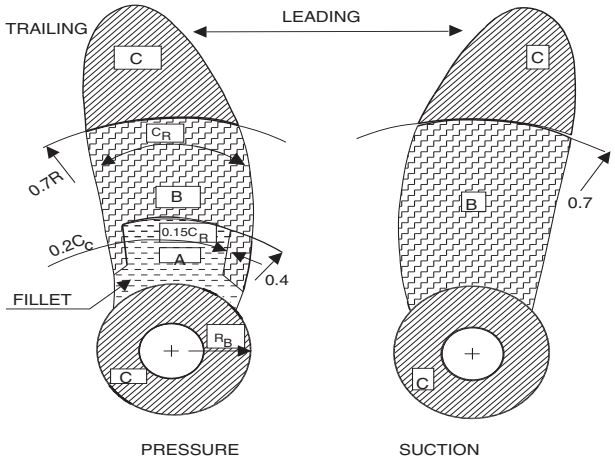


Figure 4 : Severity zones in blades with skew angles > 25°

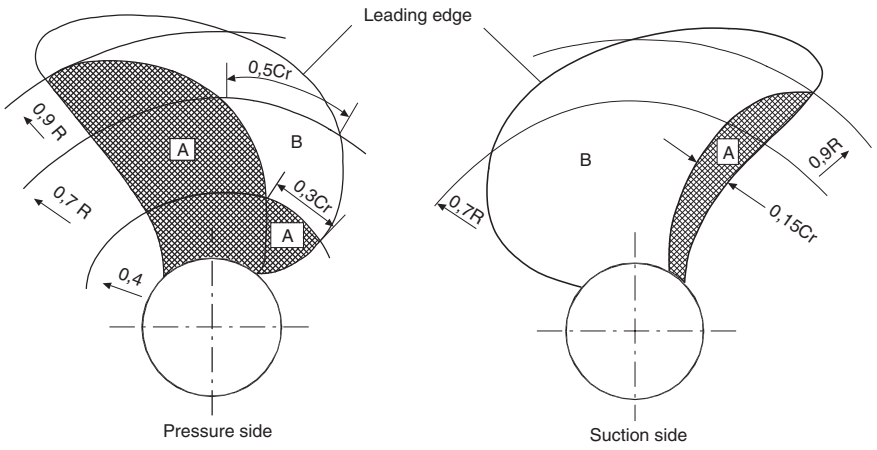


Figure 5 : Severity zones for controllable pitch propeller boss

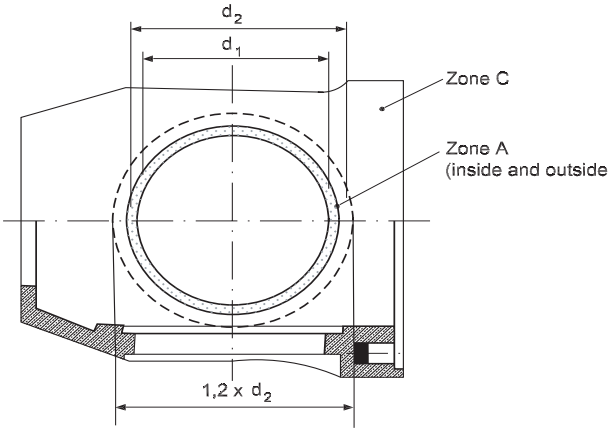
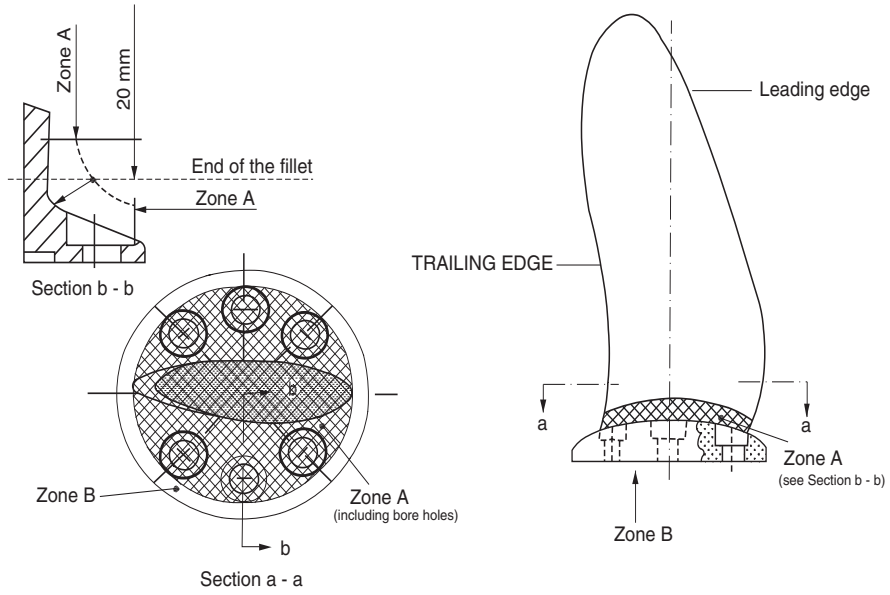


Figure 6 : Severity zones for controllable pitch and built-up propeller



Note: The remaining surface of the propeller blades of a controllable pitch propeller is to be divided into the severity zones as given for solid cast propellers (cf. Fig 3 and Fig 4)

1.110 Non-destructive testing (NDT) ~~Dye penetrant examination~~

1.110.1 Qualification of personnel involved in NDT *(1/7/2021)*

The qualification of personnel involved in NDT is to be in accordance with Ch 1, App 1.

1.110.2 Visual testing *(1/7/2021)*

All finished castings are to be 100% visually inspected by the manufacturer. Castings are to be free from cracks, hot tears or other imperfections which, due to their nature, degree or extent, will interfere with the use of the castings. A general visual examination is to be carried out by the Surveyor, and this is to include the examination of internal surfaces where applicable.

1.110.3 Liquid penetrant testing *(1/7/2021)*

Propeller castings are to be cleaned and adequately prepared. The liquid penetrant testing procedure~~dye penetrant examination~~ is to be submitted to the Society and is to be ~~carried out~~ in accordance with ISO 3452-1:2013 or a recognised standard ~~or an approved procedure~~. The acceptance criteria are specified in [1.11].

The severity zones A as defined above are to be subjected to a ~~dye~~liquid penetrant ~~examination~~testing in the presence of the Surveyor.

In zones B and C the ~~dye~~liquid penetrant ~~examination~~testing is to be performed by the Manufacturer and may be witnessed by the Surveyor upon his request.

If repairs have been made either by grinding, straightening or by welding, the repaired areas are additionally to be subjected to the ~~dye~~liquid penetrant ~~examination~~testing ~~irrespective~~independent of their location and/or severity zone.

~~1.11.4~~

~~In the dye penetrant examination an indication is the presence of detectable bleed-out of the penetrant liquid from the material~~

~~discontinuities appearing at least 10 minutes after the developer has been applied.~~

~~A distinction is made between circular, linear and aligned indications; see Fig 7.~~

~~The reference area is defined as an area of 100 cm^2 which may be square or rectangular with the major dimension not exceeding 250 mm.~~

~~**1.11.5**~~

~~The surface is to be divided into reference areas of 100 cm^2 as given in [1.10.3]. The indications detected are, with respect to their size and number, not to exceed the values given in Tab 3. The area is to be taken in the most unfavourable location relative to the indication being evaluated.~~

~~**1.11.6**~~

~~In addition to the above acceptance criteria, small defects, such as pores less than 1 mm in diameter, may generally be disregarded except where they occur in closely spaced groups.~~

1.10.4 ~~4.11~~ Radiographic and ultrasonic ~~examination~~testing *(1/7/2021)*

When required by the Society or when deemed necessary by the manufacturer~~serious doubts arise suggesting that the casting is not free from internal defects~~, further non-destructive ~~inspections~~testing~~,~~ (e.g. radiographic and/or ultrasonic tests~~,~~) are to be carried out ~~upon request of the Surveyor~~. The acceptance criteria or applied quality levels are to be agreed between the Manufacturer and the Society in accordance with a recognised standard.

Note 1: due to the attenuating effect of ultrasound within cast copper alloys, ultrasonic testing may not be practical in some cases, depending on the shape/type/thickness, and graingrowth direction of the casting. In such cases, effective ultrasound penetration into the casting should be practically demonstrated on the item. This would normally be determined by way of back-wall reflection, and/or target features within the casting.

Note 2: ~~The absorption of X-rays and gamma-rays is stronger in copper-based alloys than in steel. For bronze propellers, 300 kV X-rays can normally be used up to 50 mm and Co60 gamma-rays up to 160 mm thickness. Due to the limited thicknesses that can be radiographed as well as for other practical reasons radiography is generally not a realistic method to check the thickest parts of large propellers.~~

~~As a general rule, ultrasonic testing of CU 1 and CU 2 is not feasible due to the high damping capacity of these materials. For CU 3 and CU 4, ultrasonic inspection of subsurface defects is possible.~~

1.11 Acceptance criteria for liquid penetrant testing

1.11.1 Definitions of liquid penetrant indications *(1/7/2021)*

For the purpose of this Article the following definitions applies:

Indication: In the liquid penetrant testing an indication is the presence of detectable bleed-out of the penetrant liquid from the material discontinuities appearing at least 10 minutes after the developer has been applied.

Relevant indication: Only indications which have any dimension greater than 1,5mm shall be considered relevant for the categorization of indications.

Non-linear indication: an indication with a largest dimension less than three times its smallest dimension (i.e. $l < 3\ w$).

Linear indication: an indication with a largest dimension three or more times its smallest dimension (i.e. $l \geq 3\ w$).

Aligned indication:

- Non-linear indications form an alignment when the distance between indications is less than 2mm and at least three indications are aligned. An alignment of indications is considered to be a unique indication and its length is equal to the overall length of the alignment.
- Linear indications form an alignment when the distance between two indications is smaller than the length of the longest indication.

Illustration of liquid penetrant indication is given in Fig 7.

1.11.2 Acceptance standard *(1/7/2021)*

The surface is to be divided into reference areas of 100 cm^2. Each reference area may be square or rectangular with the major dimension not exceeding 250mm. The area is to be taken in the most unfavourable location relative to the indication being evaluated.

The relevant indications detected are to, with respect to their size and number, not exceed the values given in the Tab 3.

In addition to the above acceptance criteria, small defects, such as pores less than 1 mm in diameter, may generally be disregarded except where they occur in closely spaced groups.

~~Figure 7 : Shape of indications~~

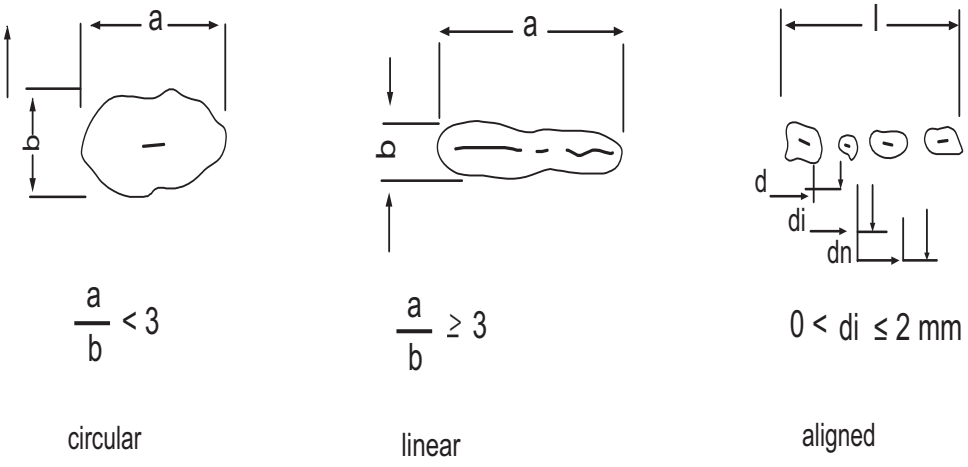


Figure 8 : Shape of indications *(1/7/2021)*

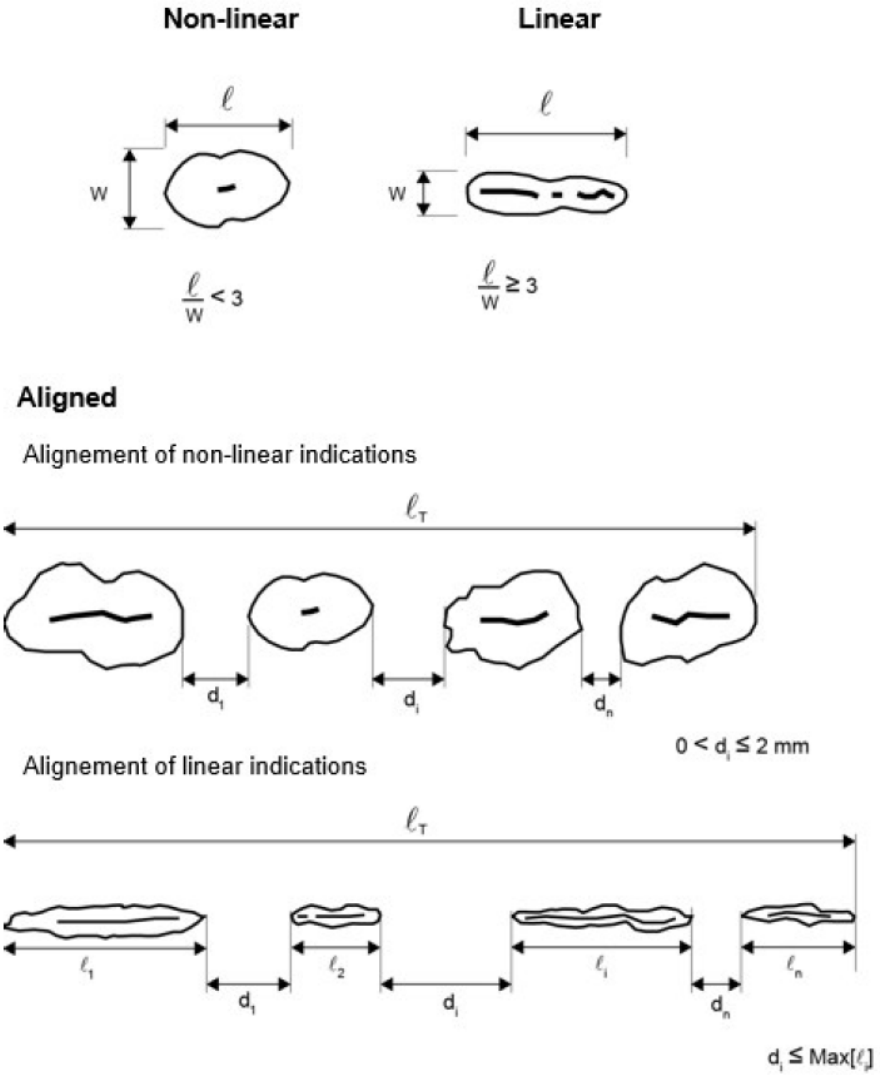


Table 3 : Allowable number and size of relevant indications in a reference area of 100 cm² depending on severity zones(1)

Severity zones	Max. total number of indications	Type of indication	Max. number of each type (1) (2)	Max. acceptable value for "a" or "l" of indications, in mm
A	7	~~Circular~~ Non-linear	5	4
		Linear	2	3
		Alligned	2	3
B	14	~~Circular~~ Non-linear	10	6
		Linear	4	6
		Alligned	4	6
C	20	~~Circular~~ Non-linear	14	8
		Linear	6	6
		Alligned	6	6

(1) Singular ~~circular~~non-linear indications less than 2 mm for zone A and less than 3 mm for the other zones ~~may be disregarded~~ are not considered relevant.

(2) The total number of ~~circular~~non-linear indications may be increased to the maximum total number, or part thereof, represented by the absence of linear~~/~~ or aligned indications.

Areas which are prepared for welding are independent of their location always to be assessed according to zone A. The same applies to the welded areas after being finished machined and/or grinded.

1.12 Repair ~~procedures~~of defects

1.12.1 General *(1/7/2021)*

Indications exceeding the acceptance standard of items ~~[1.10.4]and [1.10.5]~~Tab 3, cracks, shrinkage cavities, sand, slag and other non-metallic inclusions, blow holes and other discontinuities which may impair the safe service of the propeller are defined as defects and are to be repaired.

1.12.2 Repair procedures *(1/7/2021)*

In general the repairs are to be carried out by mechanical means, e.g. by grinding, chipping or milling. Welding may be applied, subject to the agreement of the Society, if the relevant requirements detailed hereafter are satisfied.

1.12.3 *(1/7/2021)*

After milling or chipping, grinding is to be applied for such defects which are not to be welded. Grinding is to be carried out in such a manner that the contour of the ground depression is as smooth as possible in order to avoid stress concentrations or to minimize cavitation corrosion. Complete elimination of the defective material is to be verified by ~~dye~~liquid penetrant ~~examination~~testing.

1.12.4

Localised pores on the end face or bore of a propeller boss, which themselves do not affect the strength of the casting, can be filled with a suitable plastic filler after the appropriate preparation of the defective area. The foundry is to keep records and details of all castings which have been rectified.

1.12.5 Repair of defects in zone A *(1/7/2021)*

In zone A, repair welding will generally not be allowed unless specially approved by the Society.

In some cases the propeller designer may submit technical documentation to propose a modified zone A based on detailed hydrodynamic load and stress analysis for consideration by the Society.

Grinding can be carried out to an extent which maintains the blade thickness of the approved drawings.

The possible repair of defects which are deeper than those referred to above will be specially considered by the Society.

1.12.6 Repair of defects in zone B *(1/7/2021)*

In zone B, defects that are not deeper than $d_B = (t/40)$, in mm (where t is the minimum local thickness in mm according to the Rules) or 2 mm, whichever is the greater, are to be removed by grinding. Those defects that are deeper than allowable for removal by grinding may be repaired by welding.

1.12.7 Repair of defects in zone C *(1/7/2021)*

In zone C, repair welds are generally permitted.

1.12.8

All weld repairs are to be documented by means of sketches or photographs showing the location and major dimensions of the grooves prepared for welding. Weld repairs are to be undertaken only when they are considered to be necessary and with the prior agreement of the Surveyor. Welding of areas less than 5 cm^2 and depths of less than 2 mm is to be avoided.

1.12.9 Welding repair procedure *(1/7/2021)*

Before welding is started, Manufacturer ~~the company concerned~~ is to prepare and submit to the Society a detailed welding procedure specification covering the weld preparation, welding position, welding parameters, ~~welding consumables~~filler metals, preheating and post-weld heat treatment and inspection procedures.

All weld repairs are to be carried out in accordance with qualified procedures, and, by welders who are qualified to a recognized standard. Welding Procedure Qualification Tests are to be

carried out in accordance with Ch 5, Sec 4, [7] and witnessed by the Surveyor.

Defects to be repaired by welding are to be ground to sound material according to [1.12.3]

The welding grooves are to be prepared in such a manner which will allow a good fusion of the groove bottom.

The resulting ground areas are to be examined in the presence of the Surveyor by liquid penetrant testing in order to verify the complete elimination of defective material.

Metal arc welding is to be used for all types of welding repair on cast copper alloy propellers.

Arc welding with coated electrodes and gas-shielded metal arc process (GMAW) are generally to be applied. Argon-shielded tungsten welding (GTAW) should be used with care due to the higher specific heat input of this process.

Recommended filler metals, pre-heating and stress relieving temperatures are listed in Tab 4.

All propeller alloys are generally to be welded in the downhand (flat) position. Where this cannot be done, gas-shielded metal arc welding should be carried out.

The section to be welded is to be clean and dry. Flux-coated electrodes are to be dried before welding according to the maker's instructions.

To minimize distortion and the risk of cracking, interpass temperatures are to be kept low.

This is especially the case with CU 3 alloys.

Slag, undercuts and other defects are to be removed before depositing the next run.

All welding work is to be carried out in a shop free from draughts and adverse weather.

With the exception of alloy type CU 3 castings, all weld repairs are to be stress relief heat treated, in order to avoid stress corrosion cracking. However, stress relief heat treatment of alloy type CU 3 castings is required after major repairs in zone B (and zone A when specially approved) or if a welding consumable depositing a metal susceptible to stress corrosion cracking is used (e.g. with chemical composition of alloy type CU 4).

In such cases, the propeller is to be either stress relief heat treated in the temperature range 450 to 500°C or annealed in the temperature range 650-800°C, depending on the extent of repair (see Tab 4).

The Soaking times are to be in accordance with Tab 5. The heating and cooling are to be suitably controlled to minimise residual stresses. The cooling rate after any stress relieving heat treatment is not to exceed 50°C/h until a temperature of 200°C is reached.

Table 4 : Recommended filler metals and heat treatments

Alloy type	Filler metal	Preheat temperature °C [min]	Interpass temperature °C [max]	Stress relief temperature °C	Hot straightening temperature °C
CU1	Al-bronze **(1)** Mn-bronze	150	300	350-500	500-800
CU2	Al-bronze Ni-Mn-bronze	150	300	350-550	500-800
CU3	Al-bronze Ni-Al-bronze **(2)** Mn-Al-bronze	50	250	450-500	700-900
CU4	Mn-Al-bronze	100	300	450-600	700-850

(1) Ni-Al-bronze and Mn-Al-bronze are acceptable.
(2) Stress relieving not required, if filler metal Ni-Al-bronze is used.

Table 5 : Soaking times for stress relief heat treatment of copper alloy propellers *(1/7/2021)*

Stress relief temperature (°C)	Alloy Grade C~~u~~U 1 and C~~u~~U 2		Alloy Grade C~~u~~U 3 and C~~u~~U 4	
	Hours per 25 mm of thickness	Maximum recomended total hours	Hours per 25 mm of thickness	Maximum recomended total hours
350	5	15	-	-
400	1	5	-	-
450	1/2	2	5	15
500	1/4	1	1	5
550	1/4	1/2	1/2 **(1)**	2 **(1)**
600	-	-	1/4 **(1)**	1 **(1)**

(1) 550°C and 600°C applicable to C~~u~~U 4 alloys only.

1.12.10 *(1/7/2021)*

Areas which are prepared for welding are to be subjected to ~~dye~~liquid penetrant ~~examination~~testing and, irrespective of their location, they are always to be assessed in accordance with criteria for zone A.

1.12.11

~~Welding is preferably to be carried out in the downhand (flat) position. Where this cannot be done, gas-shielded metal arc welding should be carried out. Adequate preheating is to be carried out with care to avoid local overheating.~~

~~The section to be welded is to be clean and dry. Flux coated electrodes are to be dried before welding according to the maker's instructions.~~

~~To minimize distortion and the risk of cracking, interpass temperatures are to be kept low.~~

~~This is especially the case with CU 3 alloys.~~

~~Slag, undercuts and other defects are to be removed before depositing the next run.~~

1.12.12

~~All weld repairs are to be made by qualified welders following qualified procedures.~~

~~Before welding is started, Welding Procedure Qualification Tests are to be carried out and witnessed by the Surveyors. Each welder / operator is to demonstrate his ability to carry out the proposed welding using the same process, consumable and position which are to be used in actual repair (the scope of the tests is given in Ch 5, Sec 4, [7]).~~

1.12.11

The area of any single repair and the maximum total area in any zone or region are generally to be kept within the following limits, where S, in cm^2, is the blade area surface or, for zones outside the blades, the area of the relevant zone (here after “other zones”):

- Zone A: no repairs
- Zone B and C, single: 0,006S or $60cm^2$, whichever is the greater
- Zone B (leading edge), total: 0,008S or $100cm^2$, whichever is the greater
- Zone B+C, total: 0,02S or $200cm^2$, whichever is the greater
- Other zone, single area: 0,015S or $20cm^2$, whichever is the greater
- Other zones, total for each zone: 0,05S or $50cm^2$, whichever is the greater. Other zones means in particular the following surfaces:
  a) for integrally cast propellers:
     - within the bore
     - outer surfaces of the boss to the start of the fillet radius
     - forward and aft end faces of the boss
  b) for separately cast propeller blades:
     - surfaces of the flange to the start of the fillet radius.

Where repairs exceeding the above limits are proposed, their type, procedure and extent are to be individually examined by the Society before commencement of the repair, and any conditions will be specified.

1.12.14

~~Companies wishing to carry out welding work on propellers must have at their disposal the necessary workshops, lifting gear, welding equipment, preheating and, where necessary, annealing facilities, testing devices as well as certified welders and expert welding supervisors to enable them to perform the work properly.~~

~~All welding work is to be carried out in a shop free from draughts and adverse weather.~~

~~Proof shall be furnished to the Surveyor that these conditions are satisfied before welding work begins.~~

1.12.12 *(1/7/2021)*

Metal arc welding with electrodes or filler wire used in the qualification procedure tests is to be employed. The welding consumables are to be stored and handled in accordance with the Manufacturer's recommendations. The grooves prepared for welding are to be ground smooth and complete elimination of the defective material is to be verified by ~~dye~~liquid penetrant ~~examination~~testing. Slag, undercuts and other imperfections are to be removed before depositing the next run.

1.12.16

~~With the exception of alloy type Cu 3 castings, all weld repairs are to be stress relief heat treated, in order to avoid stress corrosion cracking. However, stress relief heat treatment of alloy type Cu 3 castings is required after major repairs in zone B (and zone A when specially approved) or if a welding consumable depositing a metal susceptible to stress corrosion cracking is used (e.g. with chemical composition of alloy type Cu 4).~~

~~In such cases, the propeller is to be either stress relief heat treated in the temperature range 450 to 500°C or annealed in the temperature range 650-800°C, depending on the extent of repair (see Tab 4).~~

1.12.13 *(1/7/2021)*

Stress relief heat treatment is to be within the temperature range given in Tab 4.

~~Soaking times are to be in accordance with Tab 5. The heating and cooling are to be suitably controlled to minimise residual stresses. The cooling rate after any stress relieving heat treatment is not to exceed 50°C/h until a temperature of 200°C is reached.~~

1.12.14 *(1/7/2021)*

When welding operations, including stress relief heat treatment, are completed, welded areas in finished machined and/or grinded condition are to be subjected to visual inspection and ~~dye~~liquid penetrant ~~examination~~testing and assessed in accordance with criteria for zone A.

1.12.15 Repair documentation *(1/7/2021)*

The foundry is to ~~keep full~~maintain records of inspections, ~~detailing the~~ welding ~~procedure,~~ and any subsequent heat treatment ~~and extent and location of repairs made on~~traceable to each casting. These records are to be available for review by the Surveyor and copies are to be handed over to the Surveyor upon his request.

Before welding is started, full details of the extent and location of the repair, the proposed welding procedure, heat treatment and subsequent inspection procedures are to be submitted to the Society for approval.

1.12.20

~~Metal arc welding is recommended for all types of repair on bronze propellers.~~

~~For material thickness less than 30 mm, gas welding may give a satisfactory weldment for CU 1 and CU 2 materials.~~

~~Arc welding with coated electrodes and gas-shielded metal arc process (GMAW) are generally to be applied. Argon-shielded tungsten welding (GTAW) should be used with care due to the higher specific heat input of this process.~~

~~Adequate pre-heating is to be carried out with care to avoid local overheating.~~

~~Recommended filler metals, pre-heating and stress relieving temperatures are listed in Tab 4.~~

1.13 Straightening

1.13.1 Application of load

For hot and cold straightening purposes, static loading only is to be used.

1.13.2 Hot straightening *(1/7/2021)*

Weld repaired areas may be subject to hot straightening, provided it can be demonstrated that weld properties are not impaired by the hot straightening operations.

Hot straightening of a bent propeller blade or a pitch modification is to be carried out after heating the bent region and approximately 500 mm wide zone on either side of it to the suggested temperature range given in Tab 4.

The heating is to be slow and uniform and concentrated flames, such as oxyacetylene and oxy-propane, are not to be used. Sufficient time is to be allowed for the temperature to become fairly uniform through the full thickness of the blade section. The temperature is to be maintained within the suggested range throughout the straightening operation. A thermocouple instrument or temperature indicating crayons is/are to be used for measuring the temperature.

1.13.3 Cold straightening *(1/7/2021)*

Cold straightening is to be used for minor repairs of tips and edges only. Cold straightening on castings made of alloy type C~~u~~U 1, C~~u~~U 2 and C~~u~~U 4 are always to be followed by a stress relief heat treatment; see Tab 5.

1.14 Identification and marking

1.14.1 Identifications *(1/7/2021)*

The Manufacturer is to adopt a system for the~~of~~ identification of all castings, which will enable ~~all castings~~the material to be traced back to its original cast~~their heats~~. On request, the Surveyor ~~shall~~is to be given full facilities for so tracing the casting~~proof of this~~.

1.14.2 Marking *(1/7/2021)*

In addition to the indications required in Ch 1, Sec 1, [4.1.1], each finished casting propeller~~all castings~~ which have been tested and inspected with satisfactory results ~~are~~is to be marked by the manufacturer at least with the following details:

a) Manufacturer‘s mark

b) grade of cast material or corresponding abbreviated designation

c) heat number, casting number or another mark enabling the manufacturing process to be traced back

d) ~~specimen number~~

e) date of final inspection

f) number of the Society’s test certificate

g) ice class symbol, where applicable

h) skew angle for high skew propellers.

1.15 Manufacturer’s certificates

1.15.1

For each propeller, the Manufacturer is to supply the Surveyor with a certificate containing the following details:

a) purchaser and order number

b) shipbuilding project number, if known

c) description of casting with drawing number

d) diameter, number of blades, pitch, direction of turning

e) grade of alloy and chemical composition of each heat

f) heat or casting number

g) final weight

h) results of non-destructive tests and details of test procedure, where applicable

i) portion of alpha-structure for CU1 and CU2 alloys

j) results of the mechanical tests

k) casting identification number

l) skew angle for high skew propellers; see [1.9.3].

2 Pressure bottles

2.1 Application

2.1.1 General

The requirements of this Article apply to seamless pressure bottles in carbon, carbon manganese and alloy steels, and to welded bottles in carbon and carbon manganese steels.

Seamless bottles are mainly used for carbon dioxide systems and welded bottles for portable fire extinguishers.

Steel grades to be used for the manufacture are to comply with those specified in Chapter 2 as applicable or with recognised standards.

The steel is to be killed and for certain applications, for example low temperature applications, fine grained steel is to be used.

2.1.2 Mass production

In the case of small bottles mass produced by Manufactures who have been approved by the Society for this purpose, alternative testing procedures to those indicated in [2.3.1] may be accepted.

2.1.3 Materials other than steel

The requirements relevant to bottles in material other than steel are to be considered on a case-by-case basis, with criteria and procedures as similar as possible to those specified in this Article.

2.2 Manufacture

2.2.1 Bottles are to be manufactured according to approved plans.

The manufacturing process of seamless bottles is to be approved for the individual Manufacturers.

The approval of the manufacturing process is also required for welded bottles intended for portable fire extinguishers having thickness of the cylindrical shell less than 3 mm.

Provisions for approval are given in the document, "Rules for the Approval of Manufacturers of Materials".

The materials used in the bottle manufacture are to be tested or provided with a Manufacturer's certificate of conformity.

2.3 Inspection and tests

2.3.1 General

The following inspections and tests are to be performed:

a) sectioning of one bottle from each batch formed of 200 pieces or fraction thereof, homogeneous as regards dimensions, manufacturing process and heat treatment for the execution of :

- thickness measurements of the shell on three transverse sections in way of neck, middle and bottom end
- 1 tensile test on longitudinal test specimen, 2 bending tests to be performed along the curvature and, for thicknesses ≥ 5 mm, 3 Charpy V-notch impact tests on longitudinal specimens, to be performed at -20°C. For low temperature applications, the test temperature is to be specified in the individual cases.

b) hardness tests to be performed on bottles of quenched and tempered steel and, at the discretion of the Surveyor, also in other cases

c) external and internal visual examination (direct examination or, in the case of insufficient size of openings, examination by auxiliary means), dimensional check, determination of tare and capacity (such examinations are to be performed by the Manufacturer with checks at the Surveyor's discretion)

d) hydrostatic test on each bottle; test pressure as required by the relevant Rules or by the particular requirements applicable in the individual cases

e) non-destructive checks as indicated on the plans at the time of the approval of the manufacturing process

f) for welded bottles, additional tests on welded joints as specified at the time of the approval of the manufacturing process or indicated on the approved plans.

2.3.2 Tensile test

In the tensile test, the values of the yield strength R_{eH} and $R_{p0,2}$, the tensile strength R_m and the elongation A (%) are to comply with the values specified for the corresponding steel.

The value of A (%) min, for thicknesses equal to or greater than 3 mm, is to be not less than the value calculated with the following formula, and in no case less than 14% :

$$A \geq \frac{2500}{0{,}224 \cdot R_m}$$

where R_m is the value, in N/mm^2, of the tensile strength determined by the tensile test.

This requirement for A (%) min may be reduced by 15% for thicknesses less than 3 mm down to 2 mm, and by 30% for thicknesses less than 2 mm.

2.3.3 Bend test

In the bending test, the angle to which the specimen is to be bent without showing defects is 180°; a mandrel having a diameter not exceeding "n" times the thickness of the specimen, depending on the minimum specified tensile strength R_m for the steel, as specified in Tab 6, is to be used.

Table 6 : Coef. n for determination of the max. allowed mandrel diameter in bend test

R_m (N/mm^2)	n
≤ 430	2
431 - 510	3
511 - 590	4
591 - 690	5
691 - 790	6
791 - 890	7
> 890	8

2.3.4 Impact test

In the Charpy V-notch impact test, the value of the absorbed energy, determined as an average of three tests, is to be not less than the value indicated in Tab 7 depending on the minimum tensile strength of the steel.

Table 7 : Impact test - requirements

Steel types	Tensile strength (N/mm^2)	Average impact energy at -20°C min. KV (J/cm^2)
Carbon and carbon- manganese	≤ 510	34
Alloy steels quenched and tempered	> 510	49

2.4 Identification, marking and certification

2.4.1 The Manufacturer is to adopt a system of identification which will enable all finished bottles to be traced to the original materials and their manufacturing.

All bottles which have been tested and inspected with satisfactory results are to be marked with the following details:

a) Manufacturer's name or trade mark

b) Society's brand

c) place and date of testing

d) production number or other marking enabling the traceability

e) test pressure

f) additional optional marks such as file number and code of the local inspection office, Surveyor's personal stamp.

Special marking and certification procedures may be agreed upon for supplies by Manufacturers granted the use of an alternative testing procedure.

2.4.2 The testing documentation indicated in Ch 1, Sec 1, [4.2.1] is required and is to include all the information, as appropriate.

The testing or works' certificate of the material used is to be enclosed with the testing documentation.

Where applicable, the reports relevant to the non-destructive examination, pressure test and heat treatment are to be enclosed with the testing documentation.

2.4.3 Before signing the Society's inspection certificate, the Surveyor is to be provided by the Manufacturer with a written declaration stating that the bottles have been manufactured by a process approved by the Society, they comply with the applicable requirements and they have been satisfactorily tested in accordance with the Society's Rules.

3 Cast steel propellers and propeller blades

3.1 Application

3.1.1 *(1/7/2021)*

The requirements of this Article are applicable to the ~~moulding~~ manufacture~~, casting~~, inspection and repair procedure of cast steel propellers, blades and bosses.

3.1.2

Where the use of alternative alloys is proposed, particulars of chemical composition, mechanical properties and heat treatment are to be submitted for approval.

3.1.3

These requirements may also be used for the repair and inspection of propellers which become damaged during service, subject to prior agreement with the Society.

3.2 Manufacture

3.2.1 *(1/7/2021)*

All propellers and propeller components~~, blades and bosses~~ are to be manufactured ~~at~~by foundries approved by the Society~~.~~; the conditions for approval are indicated in the "Rules for the approval of Manufacturers of materials". ~~The scope of the procedure tests involved in the approval is to be agreed.~~

3.2.2

These castings are to be manufactured and tested in accordance with the appropriate requirements of Chapter 1 and Chapter 2 and the specific requirements of this Article.

3.3 Quality of castings

3.3.1 Freedom from defects *(1/7/2021)*

All castings are to have a workmanlike finish and are to be free from surface and internal defects which would be prejudicial to their proper application in service~~liable to impair their in service performance~~.

Minor casting defects which may still be visible after machining such as small sand and slag inclusions, small cold shuts and scabs shall be trimmed off by the manufacturer in accordance with [3.12].

3.3.2 Removal of defects *(1/7/2021)*

Casting defects which may impair the serviceability of the castings, e.g. major non-metallic inclusions, shrinkage cavities, blow holes and cracks, are not permitted. They may be removed by one of the methods described in [3.12] and repaired within the limits and restrictions for the severity zones. Full description and documentation is to be available for the surveyor.

3.4 Condition of supply

3.4.1

Martensitic castings are to be supplied in the austenitized and tempered condition. Austenitic castings are to be solution treated.

3.5 Dimensions, dimensional and geometrical tolerances

3.5.1 *(1/7/2021)*

The verification of dimensions, the dimensional and geometrical tolerances is the responsibility of the Manufacturer. The report on the relevant examinations is to be submitted to the Surveyor, who may require checks to be made in his presence.

3.5.2

Static balancing is to be carried out on all propellers in accordance with the approved drawings.

Dynamic balancing may be necessary for propellers running above 500 rpm.

3.6 Chemical composition

3.6.1 *(1/7/2021)*

Typical cast steel propeller alloys are grouped into four types depending on their chemical composition as given in Tab 8.

Table 8 : Typical chemical composition of steel propeller castings

Alloy type	C Max. (%)	Mn Max. (%)	Cr (%)	Mo **(1)** Max. (%)	Ni (%)
Martensitic (12Cr 1Ni)	0,15	2,0	11,5-17,0	0,5	Max. 2,0
Martensitic (13Cr 4Ni)	0,06	2,0	11,5-17,0	1,0	3,5-5,0

Alloy type	C Max. (%)	Mn Max. (%)	Cr (%)	Mo **(1)** Max. (%)	Ni (%)
Martensitic (16Cr 5Ni)	0,06	2,0	15,0-17,5	1,5	3,5-6,0
Austenitic (19Cr 11Ni)	0,12	1,6	16,0-21,0	4,0	8,0-13,0
(1) Minimum values are to be in accordance with recognised national or international standards					

Cast steel whose chemical composition deviate from the typical values of Tab 8 is to be specially approved by the Society.

The Manufacturer is to maintain records of the chemical analyses of the production casts, which are to be made available to the Surveyor so that he can satisfy himself that the chemical composition of each casting is within the specified limits.

3.7 Mechanical properties

3.7.1 *(1/7/2021)*

The requirements relevant to the mechanical properties are shown in Tab 9. These values refer to the test specimens machined from integrally cast test bars attached to the hub or on the blade. The thickness of test coupon is to be in accordance with a recognized standard.

Where possible, the test bars attached on the blades are to be located in an area lying between 0,5 to 0,6R, where R is the radius of the propeller.

The test bars are not to be detached from the castings until the final heat treatment has been carried out. Removal is to be by non-thermal procedures.

Table 9 : Mechanical Properties for steel propeller castings

Alloy type	Proof stress $R_{p0,2}$ min. (N/mm²)	Tensile strength R_m min. (N/mm²)	Elongation A_5 min. (%)	Red. of area Z min. (%)	Charpy V-notch **(1)** Energy min. (J)
12Cr 1Ni	440	590	15	30	20
13Cr 4Ni	550	750	15	35	30
16Cr 5Ni	540	760	15	35	30
19Cr 11Ni	180 **(2)**	440	30	40	-
(1) Tests to be made at -10°C for Ice Class Notations IAS, IA and IB only **(2)** $R_{p1,0}$ value is 205 N/mm²					

3.7.2

Separately cast test bars may be used subject to the prior approval of the Society. The test bars are to be cast from the same heat as the castings represented and heat treated with the castings which they represent.

3.8 Sampling

3.8.1

At least one set of mechanical tests according to Ch 1, Sec 2, [2.1.3] is to be made on material representing each casting.

3.8.2 *(1/7/2021)*

As an alternative to [3.~~7~~8.1], where a number of small propellers of about the same size, and less than 1m in diameter, are made from one cast and heat treated in the same furnace charge, a batch testing procedure may be adopted using separately cast test samples of suitable dimensions. At least one set of mechanical tests is to be provided for each multiple of five castings in the batch.

~~3.9 Visual and dimensional examination~~

~~3.9.1~~

~~All finished castings are to be 100% visually inspected by the Surveyor. The Surveyor may require areas to be etched for the purpose of investigating weld repairs.~~

~~3.9.2~~

~~The castings are to be free from cracks, hot tears or other imperfections which, due to their nature, degree or extent, will interfere with the use of the castings.~~

~~3.9.3~~

~~The dimensions, the dimensional and geometrical tolerances and their verification are the responsibility of the Manufacturer. The report on the relevant examinations is to be submitted to the Surveyor, who may require checks to be made in his presence.~~

~~3.9.4~~

~~Static balancing is to be carried out on all propellers in accordance with the approved drawings.~~

~~Dynamic balancing may be necessary for propellers running above 500 rpm.~~

3.9 Definition of skew, severity zones

3.9.1 *(1/7/2021)*

In order to relate the degree of inspection to the criticality of imperfections in propeller blades and to help reduce the risk of failure by fatigue cracking after repair, propeller blades are divided into three Severity Zones designated A, B and C. In addition, a distinction is made between low skew and high skew propellers as defined in [1.9].

3.10 Non-destructive testing ~~examinations – Severity Zones~~

3.10.1 Qualification of personnel involved in NDT *(1/7/2021)*

Refer to Ch 1, App 1. ~~All finished castings are to be submitted to non-destructive testing in accordance with the requirements given in [3.9.2]to [3.9.9]].~~

~~3.9.2~~

~~In order to relate the degree of non-destructive testing to the criticality of imperfections, propeller blades are divided into three Severity Zones designated A, B and C. In addition, a distinction is made between low skew and high skew propellers. See [1.9].~~

3.10.2 Visual testing *(1/7/2021)*

All finished castings are to be 100% visually inspected by the Manufacturer.

Castings are to be free from cracks, hot tears or other imperfections which, due to their nature, degree or extent, will interfere with the use of the castings. A general visual examination is to be carried out by the Surveyor.

3.10.3 Liquid penetrant testing *(1/7/2021)*

Liquid penetrant testing procedure is to be submitted to the Society and is to be in accordance with ISO 3452-1:2013 or a recognized standard. The acceptance criteria are specified in [3.11].

For all propellers, separately cast blades and hub, the surface covered by severity Zones A, B and C are to be ~~dye~~liquid penetrant tested. Testing of Zone A is to be undertaken in the presence of the Surveyor. In Zones B and C the ~~dye~~ liquid penetrant inspection is to be performed by the Manufacturer and may be witnessed by the Surveyor at his request.

If repairs have been made by grinding or by welding, the repaired areas are additionally to be subjected to ~~dye~~liquid penetrant testing irrespective of their location and/or severity zone. Weld repairs are, irrespective of their location, always to be assessed according to Zone A.

3.10.4 Magnetic particle testing *(1/7/2021)*

Magnetic particle testing may be used in lieu of liquid penetrant testing for examination of martensitic stainless steels castings.

Magnetic particle testing procedure is to be submitted to the Society and is to be in accordance with ISO 9934-1:2016 or a recognized standard.

3.10.5 Radiographic and ultrasonic testing *(1/7/2021)*

When required by the Society or when deemed necessary by the manufacturer, further non-destructive testing (e.g. radiographic and/or ultrasonic testing) are to be carried out. The acceptance criteria or applied quality levels are then to be agreed between the manufacturer and the Society in accordance with a recognized standard.

Note 1: due to the attenuating effect of ultrasound within austenitic steel castings, ultrasonic testing may not be practical in some cases, depending on the shape/type/thickness, and grain-growth direction of the casting.

~~**3.10.6** -~~

~~Where serious doubts arise that the casting is not free from internal defects, further non-destructive inspections, e.g. radiographic and/or ultrasonic tests, are to be carried out. The acceptance criteria are to be agreed between the Manufacturer and the Society.~~

~~**3.10.7** -~~

~~In the dye penetrant inspection an indication is the presence of detectable bleed-out of the penetrant liquid from the material discontinuities appearing at least 10 minutes after the developer has been applied. The following definitions apply:~~

- ~~Linear indication: an indication in which the length is at least three times the width;~~
- ~~Nonlinear indication: an indication of circular or elliptical shape with a length less than three times the width;~~
- ~~Aligned indications: three or more indications in a line, separated by 2 mm or less edge to edge;~~
- ~~Open indication: an indication that can be detected by use of contrast dye penetrant;~~
- ~~Non-open indication: an indication that cannot be detected by the use of contrast dye penetrant;~~
- ~~Relevant indication: an indication that is caused by a condition or type of discontinuity that requires an evaluation. Only indications which have any dimension greater than 1.5mm are to be considered relevant.~~

~~**3.10.8** -~~

~~For the purpose of evaluating indications, the surface is to be divided into reference areas of 100 cm^2, which may be square or rectangular with the major dimension not exceeding 250 mm. The area is to be taken in the most unfavorable location relative to the indication being evaluated.~~

~~**3.10.9** -~~

~~With respect to their size and number, the indications detected are not to exceed the values given in Tab 10.~~

~~**3.10.10** -~~

~~The foundry is to keep records of inspections traceable to each casting. These records are to be reviewed by the Surveyor. The foundry is also to provide the Surveyor with a statement confirming that non-destructive tests have been carried out with satisfactory results.~~

3.11 Acceptance criteria for liquid penetrant testing and magnetic particle testing

3.11.1 Definitions of liquid penetrant indications *(1/7/2021)*

For the purpose of this Article the following definitions applies:

Indication: in the liquid penetrant testing an indication is the presence of detectable bleed-out of the penetrant liquid from the material discontinuities appearing at least 10 minutes after the developer has been applied.

Relevant indication: only indications which have any dimension greater than 1.5mm are to be considered relevant for the categorization of indications.

Non-linear indication: an indication with a largestdimension less than three times its smallest dimension (i.e. $l < 3$ w);

Linear indication: an indication with a largest dimension three or more times its smallest dimension (i.e. $l \geq 3$ w).

Aligned indications:

- Non-linear indications form an alignment when the distance between indications is less than 2mm and at least three indications are aligned. An alignment of indications is considered to be a unique indication and its length is equal to the overall length of the alignment.
- Linear indications form an alignment when the distance between two indications is smaller than the length of the longest indication.

Illustration of liquid penetrant indications is given in Fig. 7.

3.11.2 Acceptance standard *(1/7/2021)*

The surface to be inspected is to be divided into reference areas of 100 cm^2, which may be square or rectangular with the major dimension not exceeding 250 mm.

The area is to be taken in the most unfavorable location relative to the indication being evaluated.

With respect to their size and number, the indications detected are not to exceed the values given in Tab 10.

Areas which are prepared for welding are independent of their location always to be assessed according to zone A. The same applies to the welded areas after being finished machined and/or grinded.

3.12 Repair of defects~~procedures~~

3.12.1 *(1/7/2021)*

Defective castings are to be repaired in accordance with the requirements given in [3.1~~0~~2.2] to [3.1~~0~~2.7] and, where applicable, the requirements given in [3.1~~0~~2.8] ~~to [3.10.14]~~.

3.12.2 *(1/7/2021)*

In general the repairs are to be carried out by mechanical means, e.g. by grinding, chipping or milling. The resulting grooves are to be blended into the surrounding surface so as to avoid any sharp contours. The local surface is to be subsequently subjected to ~~dye~~liquid penetrant ~~examination~~testing or magnetic particle testing, if applicable, to ensure that the defects have been completely eliminated.

3.12.3 *(1/7/2021)*

Weld repairs are to be carried out only where deemed necessary and accepted by the Surveyor. ~~All weld repairs are to be documented by means of sketches or photographs showing the location and major dimensions of the grooves prepared for welding. The documentation is to be presented to the Surveyor prior to repair welding.~~

3.12.4

The weld grooves are to be suitably shaped to allow good access for welding and ground smooth, and complete elimination of the defective material is to be verified by liquid penetrant testing. Welds having an area less than 5 cm^2 are to be avoided.

3.12.5 *(1/7/2021)*

Repair by grinding in Severity ~~Z~~zone A is allowed to an extent to maintain the required thickness of the blade.

In Zone A, repairs by welding are in general not permitted unless specially considered by the Society.

Therefore where such a repair is proposed, the extent and procedure are to be submitted in detail for acceptance.

In some cases the propeller designer is to submit technical documentation to propose a modified zone A based on detailed hydrodynamic load and stress analysis for consideration by the Society.

3.12.6 *(1/7/2021)*

Defects in severity ~~Z~~zone B that are not deeper than t/40 ("t" is the minimum local thickness according to the Rules) or 2 mm, whichever is the greater, are to be removed by grinding. Defects that are deeper may be repaired by welding subject to the prior approval of the Society.

3.12.7 *(1/7/2021)*

Repair by welding is generally permitted in Severity ~~Z~~zone C.

3.12.8 Welding repair procedure *(1/7/2021)*

Before welding is started, Manufacturer is to submit to the Classification Society a detailed welding procedure specification ~~is to be submitted~~ covering the weld preparation, welding positions, welding parameters, filler metals, welding consumables, preheating, post-weld heat treatment and inspection procedures.

All weld repairs are to be carried out in accordance with qualified procedures, and, ~~made~~ by ~~qualified~~ welders who are qualified to a recognized standard~~using qualified procedures~~. Welding Procedure Qualification Tests are to be carried out in accordance in Ch 5, Sec 4 and witnessed by the Surveyor. ~~The requirements for welding procedure qualification tests are given in Ch 5, Sec 4.~~

Defects to be repaired by welding are to be ground to sound material according to [3.11].

The welding grooves are to be prepared in such a manner which will allow a good fusion of the groove bottom.

The resulting ground areas are to be examined in the presence of the Surveyor by liquid penetrant testing in order to verify the complete elimination of defective material.

~~The metal welding electrode or filler wire used in the procedure tests is to be used. The welding consumables are to be stored and handled in accordance with the Manufacturer's recommendations.~~

All welding work is to be carried out in a shop free from draughts and influence of the weather.

The metal arc welding with electrodes or filler wire used in the procedure tests is to be used. The welding consumables are to be stored and handled in accordance with the Manufacturer's recommendations.

Slag, undercuts and other imperfections are to be removed before depositing the next run.

The martensitic steels are to be furnace re-tempered after weld repair. Subject to prior approval, however, local stress relieving may be considered for minor repairs.

On completion of heat treatment the weld repairs and the adjacent material are to be ground smooth. All weld repairs are to be submitted to liquid penetrant ~~examination~~ testing.

Table 10 : Allowable number and size of indications depending on severity zones

Severity zone	Max. total number of indications	Indication type	Max. number for each type **(1) (2)**	Max. dimension of indication (mm)
A	7	Non - linear	5	4
		Linear	2	3
		Aligned	2	3
B	14	Non - linear	10	6
		Linear	4	6
		Aligned	4	6
C	20	Non - linear	14	8
		Linear	6	6
		Aligned	6	6

(1) Single non-linear indications less than 2mm in Zone A and less than 3mm in other zones may be disregarded.

(2) The total number of non-linear indications may be increased to the maximum total number, or part thereof, represented by the absence of linear or aligned indications.

3.12.9 Repair documentation *(1/7/2021)*

The foundry is to ~~keep~~maintain ~~full~~ records of inspections~~detailing the~~, welding ~~procedure,~~and any subsequent heat treatment, ~~inspection and extent and location of repairs made~~treaceable to each casting. ~~These records are to be reviewed by the Surveyor.~~

Before welding is started, full details of the extent and location of the repair, the proposed welding procedure, heat treatment and subsequent inspection procedures are to be submitted to the Society for approval.

3.13 Identification and marking

3.13.1 *(1/7/2021)*

The Manufacturer is to adopt a system ~~of~~for the identification of all castings, which enable the material to be traced to its original cast. The Surveyor is to be given full facilities for so tracing the castings when required. Each finished casting propeller is to be marked by the Manufacturer at least with the following particulars:~~which will be able to suitably identify, prior to the final inspection by the Surveyor, each individual casting as follows:~~

a) Manufacturer's mark

b) grade of cast material or corresponding abbreviated designation

c) heat number, casting number or another mark enabling the full history of the casting to be traced back

d) number of the Society's certificate

e) ice class symbol where applicable

f) skew angle for high skew propellers.

3.13.2

When the casting has been accepted the Society stamp is to be put on with the date of the final inspection of the casting.

3.14 Document and ~~C~~certification

3.14.1 *(1/7/2021)*

The Manufacturer is to supply the Surveyor with an inspection certificate containing the following details for each casting which has been accepted:

a) Purchaser's name and ~~heat~~order number

b) shipbuilding or ship identification, if known

c) description of the casting with drawing number

d) diameter, number of blades, pitch, direction of turning

e) type of alloy, heat ~~or casting~~ number and chemical composition

f) casting identification number

g) final ~~mass~~weight

h) skew angle for high skew propellers

i) details of time and temperature of heat treatment

j) results of mechanical tests~~.~~

3.14.2 *(1/7/2021)*

The Manufacturer is to provide a statement of the results of non-destructive tests and details of test procedures and, where applicable, records of weld repairs as required by [3.1~~0~~2.~~14~~9].

SECTION 4 APPROVAL OF WELDING PROCEDURES

1 General

1.1 Application

1.1.1 General

This Section specifies in Articles [2], [3] and [4] the requirements for the approval of welding procedures for steel materials, and in Article [6] those for aluminium alloys.

The requirements relevant to materials not covered herein are defined on a case-by-case basis following, as far as applicable, the criteria specified in this Section.

Provisions for approval of laser welding procedures of hull structural steels are given in Sec 5.

1.1.2 Special requirements

In the case of applications involving the storage and transport of liquefied gases, the requirements of Pt E, Ch 9, Sec 6 apply.

1.2 Welding procedure

1.2.1 Welding processes

The approval of the welding processes is, as a rule, required for the processes indicated below together with their relevant numbering according to ISO 4063:

- metal arc welding with covered electrode: 111
- submerged arc welding with wire electrode: 121
- flux-cored wire metal arc welding without gas shield: 114
- metal arc inert gas welding (MIG welding): 131
- metal arc active gas welding (MAG welding): 135
- flux-cored wire metal arc welding with active gas shied: 136
- flux-cored wire metal arc welding with inert gas shield: 137
- tungsten inert gas arc welding (TIG welding): 141
- plasma arc welding: 15.

1.2.2 Welding consumables

Consumables approved in accordance with the requirements of Sec 2 are to be used within the limits of their approval.

When non-approved welding consumables are used, the requirements relevant to the qualification of the welding procedures are established on a case-by-case basis.

In any event, tests on a deposited metal sample are required.

Requirements relevant to the grade of welding consumables to be used are given in Sec 2 and, in particular for welding of hull structural steels, in Part B, Chapter 12.

1.2.3 Welding procedure specification *(1/1/2015)*

A welding procedure specification is to be prepared by the Manufacturer and proposed for approval; this document is also referred to as preliminary welding specification (pWPS) and may be modified and amended during the procedure tests as deemed necessary.

In its final version, the welding procedure specification (WPS) is to include all the parameters characterising the welding process (according to ISO 15614 or other recognized standard).

In particular the following parameters are to be included, as applicable:

a) type of welding process and equipment, as appropriate
b) type of joint, preparation and backing material, if any
c) base metal and thickness range
d) filler metal
e) welding position
f) minimum preheat and maximum interpass temperature
g) post-weld heat treatment if applicable
h) shielding gas as applicable
i) welding parameters
j) other information relevant to the welding techniques as applicable.

1.2.4 Welding procedure approval

Welding procedure tests, according to the proposed pWPS, are to be carried out for the approval of the welding procedure.

The test pieces are to be chosen so as to cover all the production welds in accordance with the approval range of parameters given in [2.7].

The tests for approval of the welding procedure (welding and testing) are to be witnessed by the Surveyor.

The actual parameters used for welding the approval test pieces and the results of the inspections and tests carried out are to be recorded in the WPQR (welding procedure qualification record).

The WPQR is generally prepared by the shipyard or welding shops and is to be signed for validation by the Surveyor.

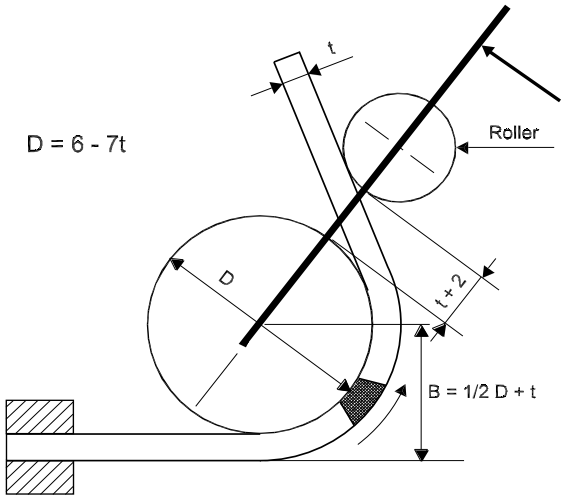
1.2.5 Certificate of approval of the welding procedure

Upon the satisfactory completion of the approval tests, a certificate of approval of the welding procedure is generally issued by the Society to the individual users, stating the conditions of the approval of the WPS such as thickness range, positions, steel grades and additional conditions for the application of the process, as deemed necessary, on the basis of the indications already given in the WPS.

6.3.3 Welding positions

The test pieces are to be welded in the most unfavourable of the welding positions used in construction (vertical and overhead positions, as applicable).

Figure 13 : Wrap around bend test



The fixed edge of the test specimen is to be clamped to avoid sliding. The whole welded zone (weld and heat affected zone), in the case of transverse bending, is to be entirely positioned in the bent zone.

7 Approval of welding procedure~~s~~ qualification tests for repair of propellers

7.1 General

7.1.1 *(1/7/2021)*

The provisions of this Article apply to the approval of welding procedure~~s~~ qualification tests to be used for repair by welding of cast copper alloy or cast steel propellers or propeller blades, as applicable.

7.1.2 *(1/7/2021)*

The welding of the procedure qualification test sample is to be carried out in accordance with the pWPS prepared by the company wishing to carry out welding work and under the general conditions of production welding which they represent. ~~Filler metal, preheating and, stress relieving heat treatment are to be the same as adopted in the repair work.~~

For the welding procedure approval the welding procedure qualification tests are to be carried out with satisfactory results. The qualification tests are to be carried out with the same welding process, filler metal, preheating and stress-relieving treatment as those intended applied by the actual repair work. WPS is to refer to the test results achieved during welding procedure qualification testing.

Welding procedures qualified at a manufacturer are valid for welding in workshops under the same technical and quality management.

7.2 Test piece ~~Assembly~~ and welding of sample

7.2.1 *(1/7/2021)*

For cast copper alloy propellers~~A~~ a butt weld test sample of minimum 30mm thickness is to be welded in the flat position. The test assembly, consisting of cast samples, is to be of a size sufficient to ensure a reasonable heat distribution and according to~~Dimensions of test samples and types and dimensions of the test specimens to be prepared are shown in~~ Fig 14 and Fig 15 for cast copper alloy propellers and cast steel propellers, respectively.

Figure 14 : ~~Test sample for cast copper alloy propellers~~

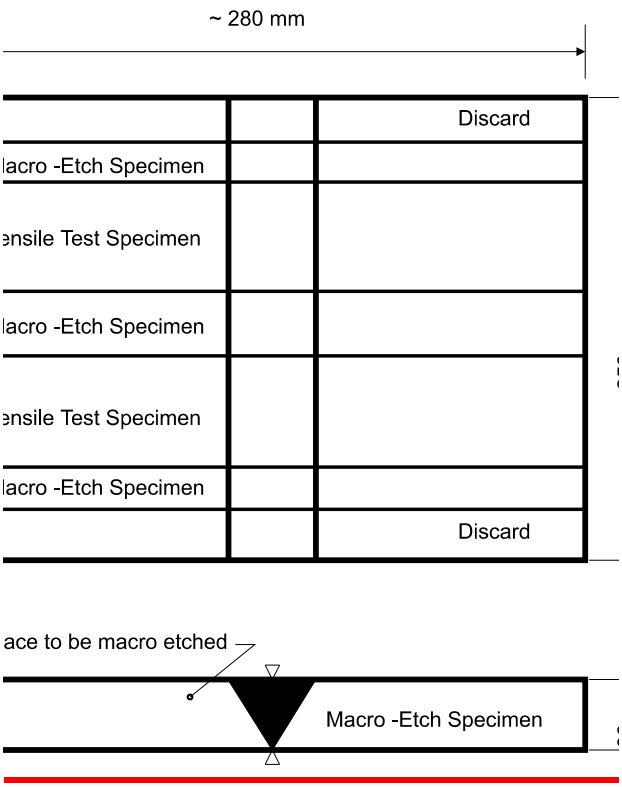
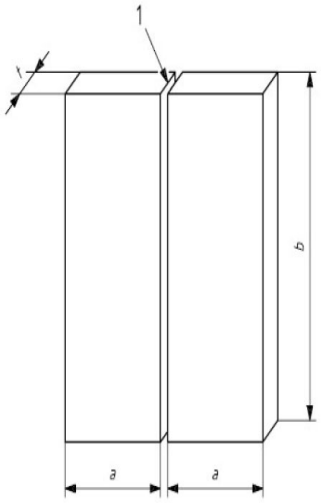


Figure 15 : Test piece for welding repair procedure for cast copper alloy propellers *(1/7/2021)*



1: Joint preparation and fit-up as detailed in the preliminary welding procedure specification
a: minimum value 150mm
b: minimum value 300mm
t: material thickness.

Figure 16 : ~~Test sample for cast steel propellers~~

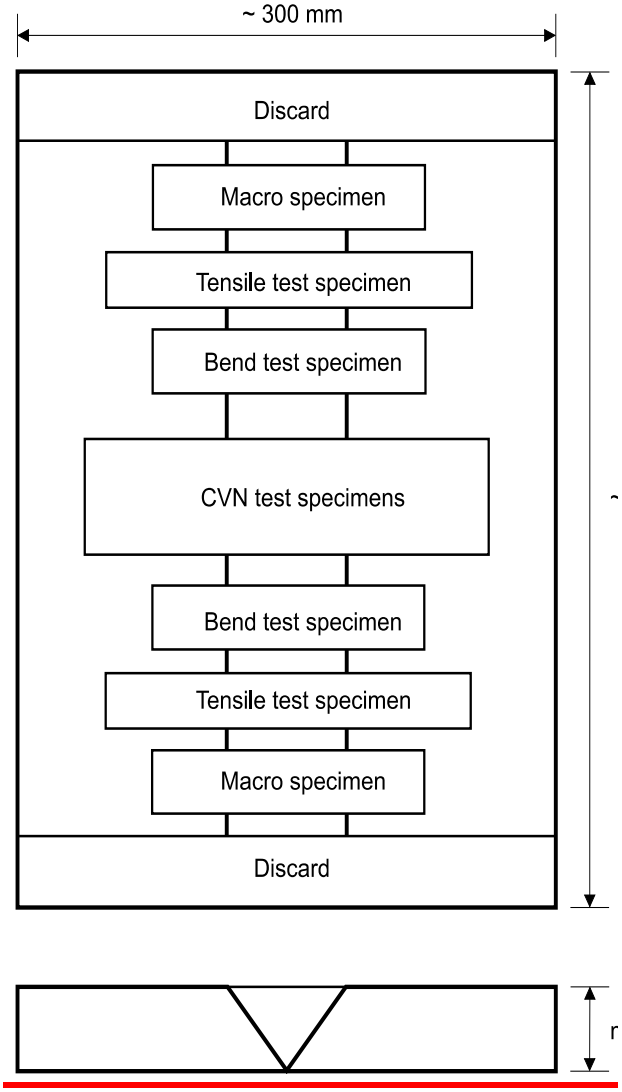
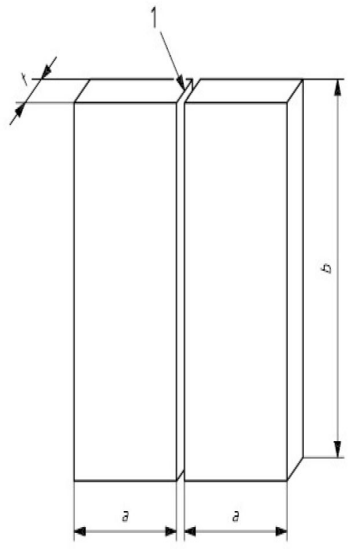


Figure 17 : Test piece for welding repair procedure for cast steel propellers *(1/7/2021)*



1: Joint preparation and fit-up as detailed in the preliminary Welding Procedure Specification
a: minimum value 150mm
b: minimum value 350mm
t: material thickness

The dimensions and shape of the groove is to be representative of the actual repair work.

7.2.2 *(1/7/2021)*

Preparation and welding of test pieces are to be carried out in accordance with the general condition of repair welding work which it represents.

7.2.3 *(1/7/2021)*

Welding of the test assemblies and testing of test specimens are to be witnessed by the Surveyor.

7.2.4

The cleaning of the parts to be welded is to be carried out with appropriate procedures which are to be followed in the repair work.

7.3 Examination and tests

7.3.1 *(1/7/2021)*

Test assembly is to be examined non-destructively and destructively in accordance with Tab 12, Fig 16 and Fig 17:

Table 12 : Type of tests and extent of testing *(1/7/2021)*

Type of test[1]	Extent of testing
Visual testing	100% as per [7.3.2]
Liquid penetrant testing[2]	100% as per [7.3.2]
Transverse tensile test	Two specimens as per article [7.3.4]
Bend test[3], for cast steel propellers only	Two root and two face specimens as per [7.4.1]
Macro examination	Three specimens as per article [7.3.3]
Impact test, for cast steel propellers only	Two sets of three specimens as per [7.4.2]
Hardness test, for cast steel propellers only	As per [7.4.3]

(1) bend or fracture test are at the discretion of the Society.
(2) magnetic particle testing may be used in lieu of liquid penetrant testing for martensitic stainless steels.
(3) for t ≥12mm, the face and root bend may be substituted by 4 side bend test specimens.

Figure 18 : Test Specimen for cast copper alloy propellers *(1/7/2021)*

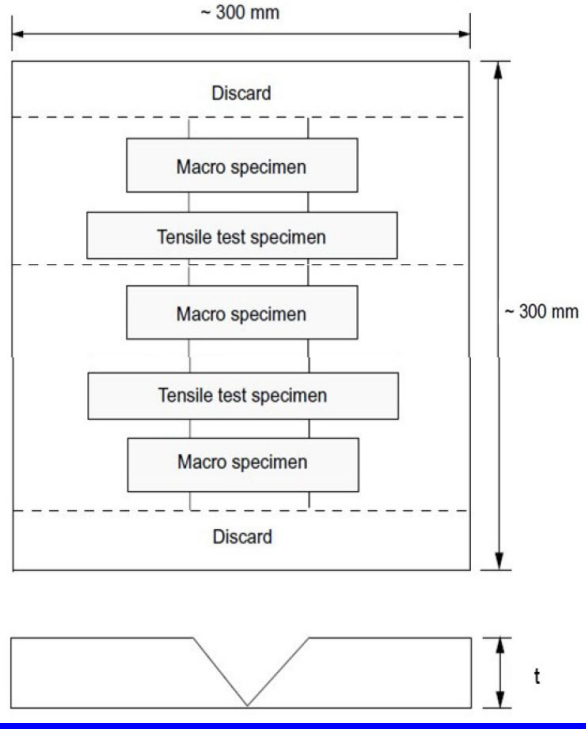
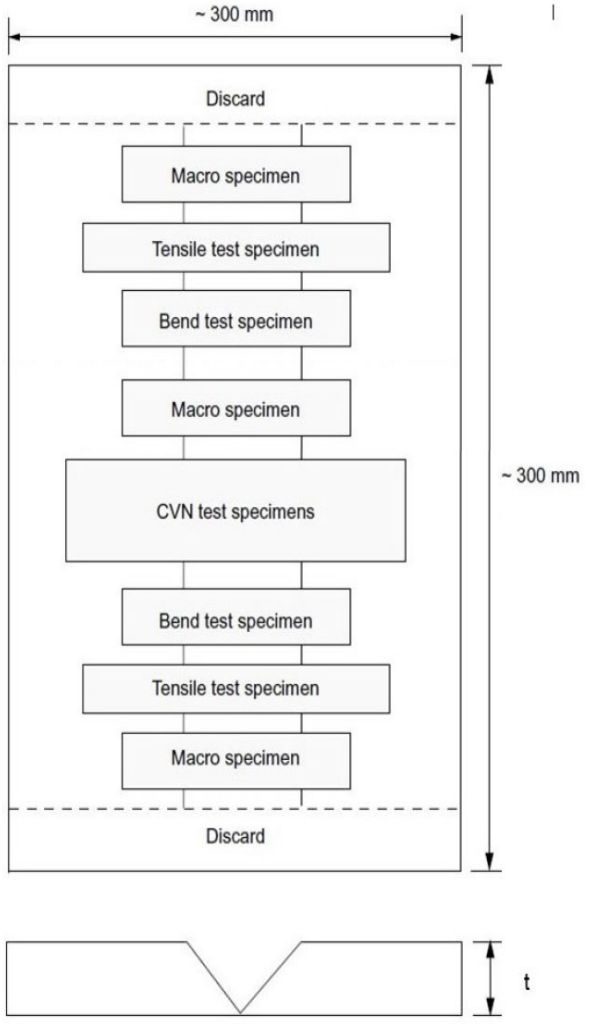


Figure 19 : Test Specimen for cast steel propellers *(1/7/2021)*



7.3.2 Non-destructive ~~examination~~testing *(1/7/2021)*

~~Prior to sectioning, the test assembly is to be visually inspected and 100% tested by liquid penetrant examination.~~ Test assembly is to be examined by visual and liquid penetrant testing prior to the cutting of test specimen. In case, that any post-weld heat treatment is required or specified, non-destructive testing is to be performed after heat treatment.

No cracks are permitted. The evaluation of the imperfections detected by liquid penetrant testing, or magnetic particle testing if applicable, is to be assessed in accordance with Ch 4, Sec 2, [1.10] and [3.10] for cast copper alloy propellers and cast steel propellers respectively.

7.3.3 Macroscopic examination *(1/7/2021)*

Three test specimens~~macro etch samples should~~are to ~~-~~be prepared (see Fig 1~~4~~6 and Fig 17).

The test specimens are to be prepared and etched on one side to clearly reveal the weld metal, the fusion line, the HAZ, the build up of the runs and the unaffected parent metal. The ~~sections~~test specimens are to be examined by eye (aided by low power hand lens if necessary) for any imperfections present in the weld metal and the HAZ. Cracks and lack of fusion are not permitted~~, or crack-like i~~Imperfections~~,~~ such as slag inclusions ~~and~~or pores greater than 3 mm are not permitted.

Note 1: a suitable etchant for this purpose is:

- 5 g iron (III) chloride
- 30 ml hydrochloric acid (cone)
- 100 ml water.

7.3.4 Transverse tensile test *(1/7/2021)*

Two flat transverse tensile test specimens are to be prepared in accordance with Ch 1, Sec 2, [2.1.9]. Alternatively tensile test specimens according to recognized standards acceptable to the Society may be used. The tensile strength is to be not lower than:

- for cast steel propellers: the specified minimum value of the base material;
- for cast copper alloy propellers: the values specified in Tab 1~~2~~3.

The location of the fracture is to be reported (i.e. weld metal, HAZ or base material).

Table 13 : Required tensile strength values for cast copper alloy propellers

ALLOY TYPE	TENSILE STRENGTH, N/mm² (minimum)
CU 1	370
CU 2	410
CU 3	500
CU 4	550

7.4 Additional test for cast steel propellers

7.4.1 Bend tests *(1/7/2021)*

Transverse bend tests for butt joints~~Two side bend test specimens~~ are to be ~~prepared~~ in accordance with Ch 1, Sec 2, [3] or, according to a recognized standard. The ~~former~~mandrel diameter is to be 4 x thickness except for austenitic steels, in which case the ~~former~~mandrel is to be 3 x thickness. The bending angle is to be 180° and ~~W~~when visually inspected after ~~bending~~testing, the test specimens are not to reveal any open defects in any direction greater than 3 mm~~are to show no surface imperfections~~ and greater than 2mm in length.

Defects appearing at the corners of a test specimen during testing are to be investigated case by case.

Two root and two face bend specimens are to be tested. For thickness 12 mm and over, four side bend specimens may alternatively be tested.

7.4.2 Impact tests *(1/7/2021)*

Impact tests are not required, except where the base material is impact tested. Two sets of Charpy V- notch test specimens, one set with the notch positioned in the centre of the weld and one set with the notch positioned in the HAZ (i.e. the mid-point of the notch is to be at 1mm to 2mm from the

fusion line)~~positioned in the fusion line,~~ are to be prepared in accordance with Ch 1, Sec 2.

The test temperature and the impact energy are to comply with the requirement specified for the base material.

7.4.3 Hardness tests *(1/7/2021)*

The macro-section representing the start of welding is to be used for HV 10~~One of the macro sections is to be used for HV5~~ hardness testing. A row of indentations is to be made 2 mm below the surface. At least three individual indentations are to be made in the weld metal, both sides of the HAZ and both sides of the base material. The values are to be reported for information.

7.5 Re-testing

7.5.1 *(1/7/2021)*

If the test piece fails to comply with any of the requirements in [7], reference is made to re-test procedures given in [2.5].

7.6 Test record

7.6.1 *(1/7/2021)*

Welding conditions for test assemblies and test results are to be recorded in welding procedure qualification record. Forms of welding procedure qualification records can be taken from the Society's rules or from relevant standards.

7.6.2 *(1/7/2021)*

A statement of the results of assessing each test piece, including repeat tests, is to be made for each welding procedure qualification records. The relevant items listed for the WPS are to be included.

7.6.3 *(1/7/2021)*

The welding procedure qualification record is to be signed by the Surveyor witnessing the test and is to include the Society´s identification.

7.7 Range of approval

7.7.1 General *(1/7/2021)*

All the conditions of validity stated below are to be met independently of each other.

Changes outside of the ranges specified are to require a new welding procedure test.

A qualification of a WPS obtained by a manufacturer is valid for welding in workshops or sites under the same technical and quality control of that manufacturer.

7.7.2 Base metal *(1/7/2021)*

For cast copper alloy propellers, the range of qualification related to base metal is given in Tab 14.

For cast steel propellers, the range of qualification related to base metal is limited to steel grade tested.

Table 14 : Range of qualification for base metal for cast copper alloy propellers

Copper alloy material grade used for qualification	Range of approval
CU 1	CU1
CU 2	CU1; CU2
CU 3	CU3
CU 4	CU4

7.7.3 Thickness *(1/7/2021)*

The qualification of a WPS carried out on a weld assembly of thickness t is valid for the thickness range given in Tab 15 and Tab 16 for cast copper alloy propellers and cast steel propellers respectively

Table 15 : Range of qualification for thickness for cast copper alloy propellers

Thickness of the test piece, t (mm)	Range of approval
30 ≤ t	≥ 3 mm

Table 16 : Range of qualification for thickness for cast steel propellers

Thickness of the test piece, t (mm)	Range of approval
15 < t ≤ 30	3mm to 2t
t > 30	0,5t to 2t or 200mm, whichever is the greater

7.7.4 Welding position *(1/7/2021)*

Approval for a test made in any position is restricted to that position.

7.7.5 Welding process *(1/7/2021)*

The approval is only valid for the welding process used in the welding procedure test. Single run is not qualified by multi-run butt weld test.

7.7.6 Filler metal *(1/7/2021)*

The approval is only valid for the filler metal used in the welding procedure test.

7.7.7 Heat input *(1/7/2021)*

The upper limit of heat input approved is 25% or 15%, for cast copper alloy propellers and cast steel propellers respectively, greater than that used in welding the test piece.

The lower limit of heat input approved is 25% or 15%, for cast copper alloy propellers and cast steel propellers respectively, lower than that used in welding the test piece.

7.7.8 Preheating and interpass temperature *(1/7/2021)*

The minimum preheating temperature is not to be less than that used in the qualification test.

The maximum interpass temperature is not to be higher than that used in the qualification test.

7.7.9 Post-weld heat treatment *(1/7/2021)*

The heat treatment used in the qualification test is to be specified in pWPS. Soaking time may be adjusted as a function of thickness.

SECTION 4 MACHINERY AND CARGO SYSTEMS FOR OIL TANKER ESP, OIL TANKER ESP CSR, FLS TANKER

1 General

1.1 Application

1.1.1

The requirements of this Section apply to ships having the service notations:

- **oil tanker ESP**
- **oil tanker ESP CSR**
- **FLS tanker**

intended to carry products having any flashpoint.

The requirements in [2.1.3], [2.3.1], [2.3.5], [2.3.6], [2.3.7], [2.4.3], [3.4.6], [4.6.1] c) and d), [4.6.3] b), [4.6.4], [5] and [6.3.2], derived from MARPOL Annex I regulations, apply only to ships having the service notation **oil tanker ESP** or **oil tanker ESP CSR** (named oil tankers in this Section).

The requirements in [8.2] apply to ships having the service notation FLS tanker intended to carry substances of pollution category Z.

Some departures from these requirements may be accepted for ships of less than 500 gross tonnage as indicated in Tab 1.

1.2 Documents to be submitted

1.2.1

The documents listed in Tab 2 are to be submitted for approval in four copies.

2 Piping systems other than cargo piping system

2.1 General

2.1.1 Materials

a) Materials are to comply with the provisions of Pt C, Ch 1, Sec 10.

b) Spheroidal graphite cast iron may be accepted for bilge and ballast piping.

2.1.2 Independence of piping systems

a) Bilge, ballast and scupper systems serving spaces located within the cargo area:

- are to be independent from any piping system serving spaces located outside the cargo area
- are not to lead outside the cargo area.

b) Fuel oil systems are to:

- be independent from the cargo piping system
- have no connections with pipelines serving cargo or slop tanks.

2.1.3 Passage through cargo tanks and slop tanks

a) Unless otherwise specified, bilge, ballast and fuel oil systems serving spaces located outside the cargo area are not to pass through cargo tanks or slop tanks. They may pass through ballast tanks or void spaces located within the cargo area.

b) Where expressly permitted, ballast pipes passing through cargo tanks are to fulfil the following provisions:

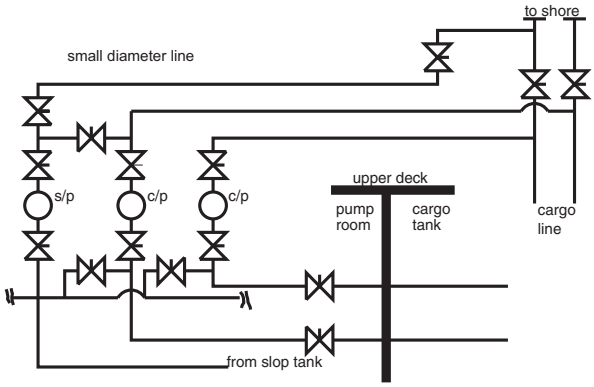
- they are to have welded or heavy flanged joints the number of which is kept to a minimum
- they are to be of extra-reinforced wall thickness as per Pt C, Ch 1, Sec 10, Tab 5
- they are to be adequately supported and protected against mechanical damage.

2.1.4 Pumps

One or more driven pumps are to be fitted, in a suitable space forward of cargo tanks, for bilge, ballast and, where relevant, fuel oil services.

Note 1: On ships of less than 500 gross tonnage, such pumps may be omitted provided that the above services are ensured by means of equivalent arrangements, subject to the approval of the Society.

Figure 1 : Connection of small diameter line to the manifold valve



3.4.7 Cleaning and gas-freeing

a) The cargo piping system is to be so designed and arranged as to permit its efficient cleaning and gas-freeing.

b) Requirements for inert gas systems are given in Part C, Chapter 4.

3.5 Integrated cargo and ballast systems design

3.5.1 Functional requirements

The operation of cargo and/or ballast systems may be necessary, under certain emergency circumstances or during the course of navigation, to enhance the safety of tankers.

As such, measures are to be taken to prevent cargo and ballast pumps becoming inoperative simultaneously due to a single failure in the integrated cargo and ballast system, including its control and safety systems. The same criteria apply to control systems of cargo and ballast valves.

3.5.2 Design features

The following design features are, inter alia, to be fitted:

a) the emergency stop circuits of the cargo and ballast systems are to be independent from the circuits for the control systems. A single failure in the control system circuits or the emergency stop circuits is not to render the integrated cargo and ballast system inoperative;

b) manual emergency stops of the cargo pumps are to be arranged such that they do not cause the shutdown of the power pack making ballast pumps inoperable;

c) the control systems are to be provided with backup power supply, which may be satisfied by a duplicate power supply from the main switchboard. The failure of any power supply is to provide audible and visible alarm activation at each location where the control panel is fitted.

d) in the event of failure of the automatic or remote control systems, a secondary means of control is to be made available for the operation of the integrated cargo and ballast system. This is to be achieved by manual overriding and/or redundant arrangements within the control systems.

4 Cargo tanks and fittings

4.1 Application

4.1.1

The provisions of Article [4] apply to cargo tanks and slop tanks.

4.2 Cargo tank venting

4.2.1 Principle

Cargo tanks are to be provided with venting systems *entirely distinct from the air pipes of the other compartments of the ship. The arrangements and position of openings in the cargo tank deck from which emission of flammable vapours can occur are to be such as to minimise the possibility of flammable vapours being admitted to enclosed spaces containing a source of ignition, or collecting in the vicinity of deck machinery and equipment which may constitute an ignition hazard.*

4.2.2 Design of venting arrangements *(1/1/2015)*

The venting arrangements are to be so designed and operated as to ensure that neither pressure nor vacuum in cargo tanks exceeds design parameters and be such as to provide for:

a) the flow of the small volumes of vapour, air or inert gas mixtures caused by thermal variations in a cargo tank in all cases through pressure/vacuum valves, and

b) the passage of large volumes of vapour, air or inert gas mixtures during cargo loading and ballasting, or during discharging,

c) a secondary means of allowing full flow relief of vapour, air or inert gas mixtures to prevent overpressure or underpressure in the event of failure of the arrangements in b). Alternatively, pressure sensors may be fitted in each tank protected by the arrangement required in b), with a monitoring system in the ship's cargo control room or the position from which cargo operations are normally carried out. Such monitoring equipment is also to provide an alarm facility which is activated by detection of overpressure or underpressure conditions within a tank.

The setting of the overpressure alarm is to be above the pressure setting of the P/V-valve and the setting of the underpressure alarm shall be below the vacuum setting of the P/V-valve. The alarm settings are to be within the design pressures of the cargo tanks. The settings are to be fixed and not arranged for blocking or adjustment in operation, except for ships that carry different types of cargo and use P/V valves with different settings, one setting for each type of cargo.

4.2.3 Combination of venting arrangements *(1/1/2015)*

a) The venting arrangements in each cargo tank may be independent or, where the cargo is homogenous or, for multiple cargoes, where the vapours are compatible and do not require isolation, they may be combined with other cargo tanks or be incorporated into the inert gas piping.

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4.4.3 Tankers fitted with an inert gas system

a) In tankers fitted with an inert gas system, the gauging devices are to be of the closed type.

b) Use of indirect gauging devices will be given special consideration.

4.4.4 Tankers not fitted with an inert gas system

a) In tankers not fitted with an inert gas system, the gauging devices are to be of the closed or restricted types. Ullage openings may be used only as a reserve sounding means and are to be fitted with a watertight closing appliance.

b) Where restricted gauging devices are used, provisions are to be made to:

- avoid dangerous escape of liquid or vapour under pressure when using the device
- relieve the pressure in the tank before the device is operated.

c) Where used, sounding pipes are to be fitted with a a self-closing blanking device.

4.5 Protection against tank overload

4.5.1 General

a) Provisions are to be made to guard against liquid rising in the venting system of cargo or slop tanks to a height which would exceed the design head of the tanks. This is to be accomplished by high level alarms or overflow control systems or other equivalent means, together with gauging devices and cargo tank filling procedures.

Note 1: For ships having the service notation **FLS tanker**, only high level alarms are permitted.

b) Sufficient ullage is to be left at the end of tank filling to permit free expansion of liquid during carriage.

c) High level alarms, overflow control systems and other means referred to in a) are to be independent of the gauging systems referred to in [4.4].

4.5.2 High level alarms

a) High level alarms are to be type approved.

b) High level alarms are to give an audible and visual signal at t he control station, where provided.

4.5.3 Other protection systems *(1/7/2021)*

a) Where the tank level gauging systems, cargo and ballast pump control systems and valve control systems are centralised in a single location, the provisions of [4.5.1] may be complied with by the fitting of a level gauge for the indication of the end of loading, in addition to that required for each tank under [4.4]. The readings of both gauges for each tank are to be as near as possible to each other and so arranged that any discrepancy between them can be easily detected.

b) ~~Where a tank can be filled only from other tanks, the provisions of [4.5.1] are considered as complied with.~~

4.6 Tank washing systems

4.6.1 General

a) Adequate means are to be provided for cleaning the cargo tanks.

b) For ships having the service notation FLS tanker carrying category Z substances, see [8].

c) Every crude oil tanker of 20 000 tonnes deadweight and above is to be fitted with a cargo tank cleaning system using crude oil washing and complying with App 2.

d) Crude oil washing systems fitted on oil tankers other than crude oil tankers of 20 000 tonnes deadweight or above are to comply with the provisions of App 2 related to safety.

4.6.2 Washing machines

a) Tank washing machines are to be of a type approved by the Society.

b) Washing machines are to be made of steel or other electricity conducting materials with a limited propensity to produce sparks on contact.

4.6.3 Washing pipes

a) Washing pipes are to be built, fitted, inspected and tested in accordance with the applicable requirements of Pt C, Ch 1, Sec 10, depending on the kind of washing fluid, water or crude oil.

b) Crude oil washing pipes are also to satisfy the requirements of Article [3.3].

4.6.4 Use of crude oil washing machines for water washing operations

Crude oil washing machines may be connected to water washing pipes, provided that isolating arrangements, such as a valve and a detachable pipe section, are fitted to isolate water pipes.

4.6.5 Installation of washing systems

a) Tank cleaning openings are not to be arranged in enclosed spaces.

b) The complete installation is to be permanently earthed to the hull.

5 Prevention of pollution by cargo oil

5.1 General

5.1.1 Application *(1/7/2015)*

Unless otherwise specified, the provisions of [5.2] apply only to oil tankers of 150 gross tonnage and above.

5.1.2 Provisions for oil tankers of less than 150 gross tonnage

The control of discharge for **oil tankers** of less than 150 gross tonnage is to be effected by the retention of oil on board with subsequent discharge of all contaminated washings to reception facilities unless adequate arrangements are made to ensure that the discharge of any effluent into the sea, where allowed, is effectively monitored to ensure that the total quantity of oil discharged into the sea does not

SECTION 15 SPECIAL REQUIREMENTS

1 Ammonium nitrate solution (93% or less)

1.1 Ammonia injection

1.1.1 Injection procedure

IBC CODE REFERENCE: Ch 15, 15.2.6

Gaseous ammonia may be injected into the cargo while the latter is circulated by the cargo pump.

1.2 Cargo pumps

1.2.1 Seal

IBC CODE REFERENCE: Ch 15, 15.2.7

The seal for the centrifugal pump is to be a stuffing box provided with a lantern ring. Fresh water under pressure is to be injected into the stuffing box at the location of the lantern ring (see Fig 1).

2 Hydrogen peroxide solutions

2.1 Hydrogen peroxide solutions over 60% but not over 70%

2.1.1 Water spray system

IBC CODE REFERENCE: Ch 15, 15.5.10

It is specified that, for the purpose of evaluating the estimated size of the cargo spill in the case of failure, cargo piping/hose failure is to be assumed to be total.

3 Propylene oxide and mixtures of ethylene oxide/propylene oxide with an ethylene oxide content of not more than 30% by mass

3.1 Tank cleaning

3.1.1

IBC CODE REFERENCE: Ch 15, 15.8.3

Until an amendment in this respect is prepared at IMO, it is specified that the initial wording of the text of paragraph 15.8.3 of the IBC Code "Before loading, ..." is to be intended as follows: "Before initial loading of these products and before each loading of these products subsequent to loading of other products....."

3.2 Joints in cargo lines

3.2.1

IBC CODE REFERENCE: Ch 15, 15.8.12

Screwed connections are only allowed for accessory and instrumental lines with an external diameter of 25 mm or less.

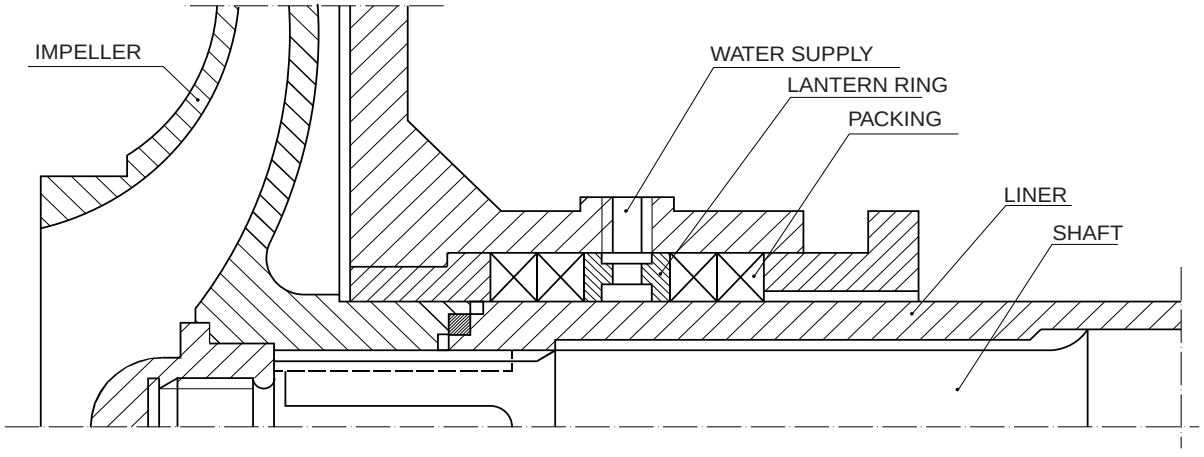
3.3 Oxygen content in tank vapour spaces

3.3.1 Analysing equipment

IBC CODE REFERENCE: Ch 15, 15.8.28

Analysing equipment to determine oxygen and propylene oxide contents is to be of a type recognised as suitable by the Society. When portable analysers are used, there are to be at least two. When a fixed system is installed, a portable analyser is also to be provided.

Figure 1 : Seal



3.4 Valves at cargo hose connections

3.4.1 Shut-off valve closing time

IBC CODE REFERENCE: Ch 15, 15.8.30

The closing time of shut-off valves provided at each cargo hose connection is to take account of the loading/unloading rate and is to be such as to avoid dangerous overpressure in cargo piping and hoses.

4 Sulphur (molten)

4.1 Fire-fighting system

4.1.1 Cargo tank protection

IBC CODE REFERENCE: Ch 15, 15.10

Cargo tanks are to be protected by a fixed CO_2 extinguishing system in accordance with Part C, Chapter 4, or a steam extinguishing system. In the latter case, tank drying arrangements are to be provided to prevent corrosion after use of steam.

4.1.2 CO_2 nozzles

IBC CODE REFERENCE: Ch 15, 15.10

Under normal service conditions, CO_2 tank feed nozzles are to be blanked off by means of a breaking disk to prevent pipes from being chocked by sulphur. Nozzles are to be located at the upper part of the tank, above liquid level.

5 Acids

5.1 Lining

5.1.1

IBC CODE REFERENCE: Ch 15, 15.11.2

"Lining" is an acid-resistant material that is applied to the tank or piping system in a solid state with a defined elasticity property.

5.2 Electrical arrangements

5.2.1

IBC CODE REFERENCE: Ch 15, 15.11.15

In enclosed spaces adjacent to cargo tanks, electrical materials and equipment complying with the provisions of paragraph 10.1.2 of the IBC Code are allowed.

5.3 Leak detection system

5.3.1 Leak detectors

IBC CODE REFERENCE: Ch 15, 15.11.7

There are to be at least two leak detection apparatuses designed and calibrated to detect leakage of cargo into spaces adjacent to cargo tanks. The apparatuses may consist of a pH-meter, a gas detector suitable for the detection of hydrogen/air mixtures, of a type deemed suitable by the Society, or of other suitable systems. These apparatuses may be fixed or portable; if a fixed system is installed, a portable apparatus is also to be provided.

6 Toxic products

6.1 Return line to shore installation

6.1.1 Valving on connection to shore installation

IBC CODE REFERENCE: Ch 15, 15.12.2

The above-mentioned systems are to be fitted with a shut-off valve and a blank flange in way of the vapour return line to the shore installation.

7 Cargoes protected by additives

7.1 Prevention of blockage by polymerisation

7.1.1 Arrangements

IBC CODE REFERENCE: Ch 15, 15.13.6

In addition to being designed so as to avoid internal obstructions due to polymer formation, the above-mentioned systems are to be fitted with pressure/vacuum valves and devices to prevent the passage of flame which are accessible for inspection and maintenance.

8 Cargoes with a vapour pressure greater than 0,1013 MPa (1,013 bar) absolute at 37,8°C

8.1 General

8.1.1 System for maintaining cargo temperature below boiling point *(1/7/2021)*

IBC CODE REFERENCE: Ch 15, 15.14.1

a) Any system installed for the purpose of keeping the cargo temperature below its boiling point is to be constructed to the satisfaction of the Society.

b) ~~Whenever cargo tanks are designed specifically for the carriage of products dealt with in paragraph 15.7 of the IBC Code, they are to be capable of withstanding the vapour pressure of such products corresponding to 45°C.~~

8.2 Return of expelled gases

8.2.1 Valving of shore connection

IBC CODE REFERENCE: Ch 15, 15.14.4

The above-mentioned systems are to be fitted with a shut-off valve and a blank flange in way of the vapour return line to the shore installation.

9 Special cargo pump room requirements

9.1 Clarification

9.1.1

IBC CODE REFERENCE: Ch 15, 15.18

As far as concerns the possibility of allowing the arrangement of cargo pump rooms below deck in specific cases, it

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SECTION 1 GENERAL

1 Scope

1.1 Applicability

1.1.1 IGC Code requirements and the Society's Rules *(1/7/2021)*

a) ~~These s~~Ships which are intended for the carriage of liquefied gases are to comply with the requirements ~~of Chapter 2~~ of the latest version of the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk, as amended. In these Rules reference to this Code and its amendments is made by the wording "IGC Code".

Accordingly, for ships for which the service notation **liquefied gas carrier**, in accordance with Pt A, Ch 1, Sec 2, [4.5.5], is requested, the IGC Code requirements are to be considered as rule requirements, with the exception indicated in [1.1.2].

When the additional service feature **LNG BUNKER** is requested, the ship is to be in compliance with the requirements in App 1.

When the additional service feature **REGASIFICATION SYSTEM** is requested, the ship is to be fitted with a regasification system in compliance with the requirements in App 2.

b) The requirements of this Chapter supplement those of the IGC Code, as amended. These requirements include additional mandatory class requirements, as well as the Society's interpretations of the IGC Code, which are also to be considered mandatory for class.

c) This Chapter and the IGC Code refer to ships carrying those products which are listed in the table in Chapter 19 of the IGC Code and in Section 19 of this Chapter.

d) This Chapter and the IGC Code include requirements for the carriage of cargo in containment systems incorporating integral, membrane or independent tank types as detailed in Chapter 4 of the IGC Code and in Sec 4.

e) In general, this Chapter applies to cargo containment and handling systems and to the interfaces between these systems and the remainder of the ship, which is to comply with the applicable Sections of the hull and machinery Rules.

1.1.2 IGC Code requirements not within the scope of classification *(1/1/2021)*

The following requirements of the IGC Code are not within the scope of classification:

- Chapter 1, Section 1.3 - Equivalents
- Chapter 1, Section 1.4 - Surveys and certification
- Chapter 2, Section 2.2.8 - Conditions of loading
- Chapter 2, Section 2.3 - Damage assumptions
- Chapter 2, Section 2.5 - Flood assumptions
- Chapter 2, Section 2.6 - Standard of damage
- Chapter 2, Section 2.7 - Survival requirements
- Chapter 11 - Fire protection and extinction
- Chapter 14 - Personnel protection
- Chapter 18 - Operating requirements (apart for few exceptions stated in Sec 18).

These requirements are applied by the Society when acting on behalf of the flag Administration, within the scope of delegation (see [1.1.7]).

1.1.3 Carriage of products not listed in the Code

The requirements of the IGC Code and the additional requirements of this Chapter are also applicable to new products, which may be considered to come within the scope of these rules, but are not at present listed in the table in Chapter 19 of the IGC Code.

1.1.4 Particularly hazardous products

For the carriage in bulk of products which are not listed in the table in Chapter 19 of the IGC Code, presenting more severe hazards than those covered by the IGC Code, the Society reserves the right to establish requirements and/or conditions additional to those contained in these rules.

1.1.5 Correspondence of the IGC Code with Part E Chapter 9 of the Rules

All the requirements of this Chapter are cross referenced to the applicable Chapters, Sections or paragraphs of the IGC Code, as appropriate.

1.1.6 Equivalencies

As far as the requirements for class are concerned, the following wording in the IGC Code is to be given the meanings indicated in Tab 1.

Table 1

IGC Code word	Meaning for Classification only
Administration	Society
IBC Code or Chemical Code	Part E Chapter 8 of the Rules
Recognised Standard	Rules
should be	is to be or are to be (as applicable)

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SECTION 4 MACHINERY AND SYSTEMS

1 Bilge system

1.1 General

1.1.1 *(1/7/2021)*

a) *The bilge pumping system required in Pt C, Ch 1, Sec 10, [6] shall be capable of operation under all practicable conditions after a casualty, whether the ship is upright or listed. For this purpose, wing suctions shall generally be fitted except in narrow compartments at the end of the ship where one suction may be sufficient. In compartments of unusual form, additional suctions may be required.*

b) *Arrangements shall be made whereby water in the compartment may find its way to the suction pipes.*

c) *Where, for particular compartments, the Society is satisfied that the provisions of drainage may be undesirable, it may allow such provision to be dispensed with if damage stability calculations ~~carried out in accordance with Sec 3, [1]~~ show that the survival capability of the ship will not be impaired.*

1.2 Bilge pumps

1.2.1 Number and capacity of bilge pumps

Any passenger ship shall be provided with at least three power bilge pumps connected to the bilge main, one of which may be driven by the propulsion machinery. Where the bilge pump numeral is 30 or more one additional independent power pump shall be provided.

The bilge pump numeral shall be calculated as follows:

where P_1 is greater than P:

$$\text{bilge pump numeral} = 72 \cdot \left[\frac{M + 2P_1}{V + P_1 - P}\right]$$

in other cases:

$$\text{bilge pump numeral} = 72 \cdot \left[\frac{M + 2P}{V}\right]$$

where:

L : *the length of the ship (metres), as defined in the International Convention on Load Lines in force;*

M : *the volume of the machinery space (cubic metres), that is below the bulkhead deck; with the addition thereto of the volume of any permanent oil fuel bunkers which may be situated above the inner bottom and forward of, or abaft, the machinery space.* For the purpose of this item *machinery spaces are spaces between the watertight boundaries of a space containing the main and auxiliary propulsion machinery, including boilers, generators and electric motors primarily intended for propulsion. In the case of unusual arrangements, the Administration may define the limits of the machinery spaces;*

P : *the whole volume of the passenger and crew spaces below the bulkhead deck (cubic metres), which are provided for the accommodation and use of passengers and crew, excluding baggage, store, provision and mail rooms;*

V : *the whole volume of the ship below the bulkhead deck (cubic metres);*

P_1 : *KN,*

where:

N : *the number of passengers for which the ship is to be certified; and*

K : *0,056 L*

However, where the value of KN is greater than the sum of P and the whole volume of the actual passenger spaces above the bulkhead deck, the figure to be taken as P_1 is that sum or two-thirds KN, whichever is the greater.

Each of the above pumps is to have a capacity not less than that required in Pt C, Ch 1, Sec 10, [6.7.4].

For use of ejectors in lieu of bilge pumps, see Pt C, Ch 1, Sec 10, [6.7.2].

1.2.2 Location of bilge pumps

Where practicable, the power bilge pumps shall be placed in separate watertight compartments and so arranged or situated that these compartments will not be flooded by the same damage. If the main propulsion machinery, auxiliary machinery and boilers are in two or more watertight compartments, the pumps available for bilge service shall be distributed as far as is possible throughout these compartments.

1.2.3 Availability of pumps

On a ship of 91,5 m in length and upwards or having a bilge pump numeral of 30 or more, as stated in *[1.2.1], the arrangements shall be such that at least one power bilge pump will be available for use in all flooding conditions which the ship is required to withstand, as follows:*

a) *one of the required bilge pumps shall be an emergency pump of a reliable submersible type having a source of power situated above the bulkhead deck, or*

b) *the bilge pumps and their sources of power shall be so distributed throughout the length of the ship that at least one pump in an undamaged compartment will be available.*

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SECTION 2 HULL AND STABILITY

1 General

1.1 Application

1.1.1 *(1/7/2016)*

The requirements of this Section apply to ships with one of the following service notations:

- **tug**, mainly intended for towing services, which are to comply with the requirements in [2]
- **salvage tug**, having specific equipment for salvage services, which are to comply with the requirements in [2] and [3]
- **escort tug**, mainly intended for escort services such as for steering, braking and otherwise controlling escorted ships, which are to comply with the requirements in [2] and [4].

Ships with the additional service feature **barge combined** (units designed to be connected with barges) are to comply with the applicable requirements in Sec 3.

Ships with the additional service feature **rescue** (units specially equipped for the rescue of shipwrecked persons and for their accommodation) are to comply with the requirements given in [2.11].

Ships with the additional service feature **standby vessel** (unit specially intended to perform rescue and standby services) are to comply with the requirements given in [2.12].

2 Tugs, salvage tugs and escort tugs

2.1 General

2.1.1 In general, tugs are completely decked ships provided with an ample drift surface and, where intended for service outside sheltered areas, with a forecastle or half forecastle, or at least with a large sheer forward.

Tugs of unusual design are to be considered by the Society on a case-by-case basis.

2.2 Stability

2.2.1 Openings *(1/1/2021)*

a) Openings which cannot be closed weathertight:

Openings in the hull, superstructures or deckhouses which cannot be closed weathertight are to be considered as unprotected openings and, consequently, as down-flooding points for the purpose of stability calculations (the lower edge of such openings is to be taken into account).

b) Ventilation openings of machinery space and emergency generator room:

It is recognised that for tugs, due to their size and arrangement, compliance with the requirements of ICLL Reg. 17(3) for ventilators necessary to continuously supply the machinery space and the emergency generator room may not be practicable. Lesser heights of the coamings of these particular openings may be accepted if the openings:

- are positioned as close to the centreline and as high above the deck as practicable in order to maximise the down-flooding angle and to minimise exposure to green water
- are provided with weathertight closing appliances in combination with suitable arrangements, such as separators fitted with drains
- are equipped with efficient protective louvers and mist eliminators
- have a coaming height of not less than 900 mm above the deck
- are considered as unprotected openings and, consequently, as down-flooding points for the purpose of stability calculations.

2.2.2 Stability booklet *(1/1/2021)*

The stability booklet for ships engaged in harbour, coastal or ocean going towing operations and/or escort operations is to contain additional information on:

- maximum bollard pull
- details on the towing arrangement, including location and type of the towing point(s) such as towing hook, staple, fairlead or any other point serving that purpose
- recommendations on the use of roll reduction systems
- If any wire, etc. is included as part of the lightship weight, clear guidance on the quantity and size is to be given
- maximum and minimum draught for towing and escort operations
- instructions on the use of the quick-release device

2.2.3 Intact stability

The stability of the ship for the loading conditions in Pt B, Ch 3, App 2, [1.2.11] is to be in compliance with the requirements in Pt B, Ch 3, Sec 2.

2.2.4 Additional intact stability criteria *(1/1/2021)*

All the loading conditions reported in the trim and stability booklet which are intended for towing operations are also to be checked in order to investigate the ship's capability to withstand the effect of the transverse heeling moments induced by the combined action of the towline force and the thrust vector (self-tripping, see [2.2.5]), and induced by the hydrodynamic resistance of the hull (tow-tripping, see [2.2.6]).

2.6 Rudder and bulwarks

2.6.1 Rudder

For tugs, the rudder stock diameter is to be increased by 5% with respect to that calculated according to Pt B, Ch 10, Sec 1, [4].

2.6.2 Bulwarks

The bulwarks are to be sloped inboard to avoid distortions likely to occur during contact. Their height may be reduced where required by operational necessities.

2.7 Equipment

2.7.1 Equipment number for tugs with the navigation notation "unrestricted navigation"

For tugs with the navigation notation **unrestricted navigation**, the equipment number EN is to be obtained from the following formula:

$EN = \Delta^{2/3} + 2\,(a\,B + \Sigma h_n b_n) + 0{,}1\,A$

where:

Δ : Moulded displacement of the tug, in t, to the summer load waterline

a : Freeboard amidships from the summer load waterline to the upper deck, in m

h_n : Height, in m, at the centreline of tier "n" of superstructure or deckhouse having a breadth greater then B/4. Where a house having a breadth greater than B/4 is above a house with a breadth of B/4 or less, the upper house is to be included and the lower ignored.

b_n : Breadth, in m, of the widest superstructure or deckhouse of each tier having a breadth greater than B/4

A : Area, in m^2, in profile view, of the parts of the hull, superstructures and houses above the summer load waterline which are within the length L_E and also have a breadth greater than B/4

L_E : Equipment length, in m, equal to L without being taken less than 96% or greater than 97% of the total length of the summer load waterline.

Fixed screens or bulwarks 1,5 m or more in height are to be regarded as parts of houses when determining h and A. In particular, the hatched area shown in Fig ~~2~~3 is to be included.

The height of hatch coamings and that of any deck cargo may be disregarded when determining h and A.

For tugs where the vertical extent of the superstructure is much greater than usual, the Society may require an increased equipment number EN.

2.7.2 Equipment number for tugs with the navigation notation coastal area or sheltered area

For tugs with the navigation notation **coastal area** or **sheltered area**, the equipment number EN is to be obtained from the following formula:

$EN = 2{,}51\,(L\,B\,D)^{2/3}$

For tugs where the vertical extent of the superstructure is much greater than usual, the Society may require an increased equipment number EN.

For tugs with total block coefficient C_B less than 0,60, at a draught T equal to 0,85 D, the equipment number EN is to be obtained from the following formulae:

$EN = 1{,}76\,(L\,B\,D)^{2/3}$

For tugs where the vertical extent of the superstructure is much greater than usual, the Society may require an increased equipment number EN.

2.7.3 Anchors, chain cables and ropes *(1/1/2017)*

Tugs with notation **unrestricted navigation** or **summer navigation** with equipment number EN calculated according [2.7.1], are to be provided with equipment in anchors, chain cables and ropes obtained from Pt B, Ch 10, Sec 4.

Tugs with notation **unrestricted navigation** or **summer navigation** with equipment number EN calculated according g [2.7.1] equal to or less than 205, may reduce the number of anchor to one, and the mass of that anchor can be reduced to half of the mass indicated in Pt B, Ch 10, Sec 4, Tab 1. In the case only one anchor is adopted, the total lenght of anchor chain cable may be reduced to half of that indicated in Pt B, Ch 10, Sec 4, Tab 1. No reduction is forseen for chain cable diameter.

Tugs with the navigation notation **coastal area** or **sheltered area** with equipment number EN calculated according [2.7.2], are to be provided with equipment in anchors, chain cables and ropes obtained from Tab 1 and Tab 2.

2.7.4 Additional equipment

Tugs are to be fitted with the additional equipment specified in Tab 3.

2.8 Towing arrangements

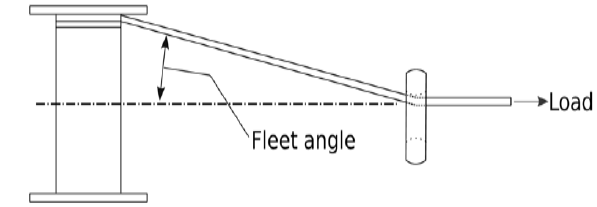
2.8.1 General

In general, towing hooks and winches are to be arranged in way of the ship's centreline, in such a position as to minimise heeling moments in normal working conditions.

2.8.2 Definitions *(1/7/2021)*

- Emergency release system: refers to the mechanism and associated control arrangements that are used to release the load on the towline in a controlled manner under both normal and black out conditions
- Maximum design load: is the maximum load that can be held by the winch as defined by the manufacturer (the manufacturer's rating)
- Fleet angle: is the angle between the applied load (towline force) and the towline as it is wound onto the winch drum.

Figure 2 : Towline 'fleet angle' *(1/7/2021)*



2.8.3 Hooks and winches *(1/1/2020)*

The hook and the winch materials are to comply with the applicable requirements of Part D.

The maximum towing force T, in kN, defined in [2.2.5], is to be specified in the structural arrangement plans of the hook and the winch.

The hooks and the winches are to be subjected to a static test, where the testing force C_T is to be not less than that obtained from Tab 4 as a function of T.

Winches may be equipped with a device for automatic adjustment of the tow.

All towing winches are to be fitted with an emergency release system.

Figure 3 : Effective area of bulwarks or fixed screens to be included in the Equipment Number

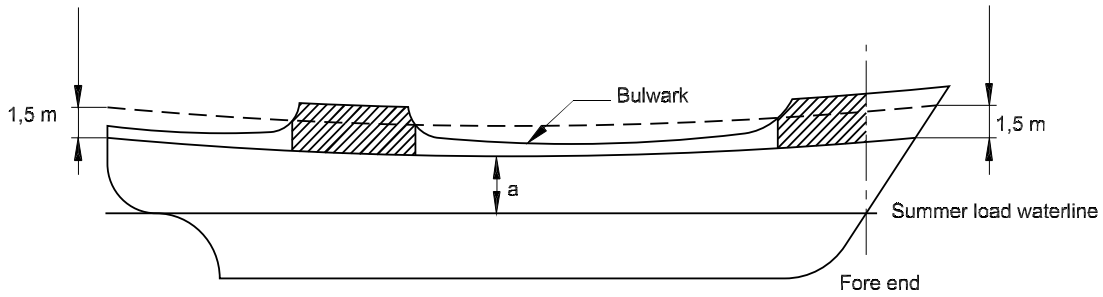


Table 1 : Equipment for tugs with the navigation notation coastal area or sheltered area

Equipment number EN A< EN ≤ B		Stockless anchors		Stud link chain cables for anchors		
A	B	N **(1)**	Mass per anchor, in kg	Total length, in m **(2)**	Diameter, in mm	
					mild steel	high strength steel
0	55	1	70	110,0	14,0 **(3)**	-
55	64	1	74	110,0	14,0 **(3)**	-
64	74	1	83	110,0	14,0 **(3)**	-
74	84	1	90	110,0	14,0 **(3)**	-
84	94	1	99	110,0	14,0	12,5
94	104	1	105	110,0	14,0	12,5
104	114	1	110	110,0	14,0	12,5
114	124	1	115	110,0	14,0	12,5
124	139	1	122	110,0	14,0	12,5
139	159	1	130	137,5	14,0	12,5
159	179	1	140	137,5	14,0	12,5
179	199	1	157	165,0	14,0	12,5
199	205	2	173	165,0	14,0	12,5
205	219	2	346	165,0	26,0	22,0
219	244	2	384	192,5	26,0	22,0
244	264	2	420	192,5	28,0	24,0
264	289	2	466	220,0	30,0	26,0
289	314	2	500	247,5	30,0	26,0
314	334	3	540	275,0	32,0	28,0
334	364	3	575	302,5	34,0	30,0
364	389	3	690	302,5	34,0	30,0
389	414	3	770	330,0	36,0	32,0
414	444	3	885	330,0	36,0	32,0
444	474	3	1000	357,5	38,0	34,0
474	504	3	1130	357,5	38,0	34,0
504	534	3	1270	385,0	40,0	34,0
534	569	3	1420	385,0	40,0	34,0
569	600		1540	440,0	42,0	36,0

(1) The third anchor is intended as a spare and is not required for the purpose of classification.

(2) Where the total length required for chain cables is less than 220 m, one only of the two anchors may be linked with the chain cable and arranged in a hawse pipe. In this case, the second anchor is to be stowed such that it can be easily joined to the chain cable and dropped overboard in the event of loss of the first anchor.

(3) These diameters are applicable to studless chain cables.

2.8.4 Hook quick-release device

The quick-release device is to be capable of being operated from a remote control device on the bridge, or as near as practicable, while the hook is under load. It is required that, in the case of a critical situation, the towline can be immediately released regardless of the angle of heel and the direction of the towline.

The quick-release device is to be tested both at maximum towing pull T and testing force C_T, defined above. The force necessary to open the hook under load is to be not greater than 150 N.

After installation on board, an unhooking trial under load is to be carried out by means of the above remote control device. This trial may be performed with a test load less than the maximum towing pull T.

2.8.5 Winch towline release *(1/1/2020)*

The in-board end of the towline is to be attached to the winch drum with a weak link or similar arrangement that is designed to release the towline at low load.

2.8.6 Winch emergency release system requirements *(1/7/2021)*

a) Performance requirements

1) The emergency release system is to operate across the full range of towline load, fleet angle and ship heel angle under all normal and reasonably foreseeable abnormal conditions (these may include, but are not limited to, the following: vessel electrical

failure, variable towline load (for example due to heavy weather), etc.).

2) The emergency release system shall be capable of operating with towline loads up to at least 100 per cent of the maximum design load.

3) The emergency release system is to function as quickly as is reasonably practicable and within a maximum of three seconds after activation.

4) The emergency release system is to allow the winch drum to rotate and the towline to pay out in a controlled manner such that, when the emergency release system is activated, there is sufficient resistance to rotation to avoid uncontrolled unwinding of the towline from the drum. Spinning (free, uncontrolled rotation) of the winch drum is to be avoided, as this could cause the towline to get stuck and disable the release function of the winch.

5) Once the emergency release is activated, the towline load required to rotate the winch drum is to be no greater than:
   - the lesser of five tonnes or five per cent of the maximum design load when two layers of towline are on the drum, or
   - 15 per cent of the maximum design load where it is demonstrated that this resistance to rotation does not exceed 25 per cent of the force that will result in listing sufficient for the immersion of the lowest unprotected opening.

6) Emergency release of the towline is to be possible in the event of a blackout. For this purpose, where additional sources of energy are required, such sources are to comply with [2.8.6] a) 7)~~An alternative source of energy is to be provided such that normal operation of the emergency release system can be sustained under dead ship conditions~~.

7) The ~~alternative~~ sources of energy required by [~~2.8.5~~2.8.6] a) 6) ~~is~~are to be sufficient to achieve the most onerous of the following conditions (as applicable):
   - sufficient for at least three attempts to release the towline (i.e. three activations of the emergency release system). Where the system provides energy for more than one winch it is to be sufficient for three activations of the most demanding winch connected to it.
   - Where the winch design is such that the drum release mechanism requires continuous application of power (e.g. where the brake is applied by spring tension and released using hydraulic or pneumatic power), sufficient power is to be provided to operate the emergency release system (e.g. hold the brake open and allow release of the towline) in the event of a blackout~~in a dead ship situation~~ for a minimum of five minutes. This may be reduced to the time required for the full length of the towline to feed off the winch drum at the load specified in ~~a)5)~~[2.8.6] a) 5) if this is less than five minutes.

b) Operational requirements

1) Emergency release operation must be possible from the bridge and from the winch control station on deck. The winch control station on deck is to be in a safe location. A position in close proximity to the winch is not regarded as "safe location", unless it is documented that the position is at least protected against towline break or winch failure.

2) The emergency release control is to be located ~~in~~ close ~~proximity~~ to ~~the~~an emergency stop button for winch operation, if provided, and ~~both should~~shall be clearly identifiable, clearly visible, easily accessible and positioned to allow safe operability.

3) The emergency release function is to take priority over any emergency stop function. Activation of the winch emergency stop from any location is not to inhibit operation of the emergency release system from any location.

4) Emergency release system control buttons are to require positive action to cancel, the positive action may be made at a different control position from the one where the emergency release was activated. It must always be possible to cancel the emergency release from the bridge regardless of the activation location and without manual intervention on the working deck.

5) Controls for emergency use are to be protected against accidental use.

6) Indications are to be provided on the bridge for all power supply and/or pressure levels related to the normal operation of the emergency release system. Alarms are to activate automatically if any level falls outside of the limits within which the emergency release system is fully operational.

7) Wherever practicable, control of the emergency release system is to be provided by a hard-wired system, fully independent of programmable electronic systems.

8) Computer based systems that operate or may affect the control of emergency release systems are to meet the requirements for Category III systems as given in Pt C, Ch 2, Sec 3.

9) Components critical for the safe operation of the emergency release system are to be identified by the manufacturer.

10) ~~The method for annual survey of the winch is to be documented.~~

11) ~~Where necessary for conducting the annual survey of the winch, adequately sized strong points are to be provided on deck.~~

2.8.7 Connection with the hull structures

The scantlings of the structures intended to connect the towing arrangements to the hull are to be in accordance with Part B, Chapter 7 or Part B, Chapter 8, as applicable, where the load to be considered is the maximum towing pull T defined in [2.2.5].

Table 3 : Additional equipment for tugs

Arrangement or equipment	Navigation notation		
	Unrestricted navigation	**Coastal area**	**Sheltered area**
Fender	Requested	Requested	Requested
Towing hook or winch	Requested	Requested	Requested
Tow bar **(1)**	Requested	Requested	Not requested
No. of towlines of suitable diameter **(2)**	2	2	1
Length, in m, of towlines of suitable diameter **(2)**	200	150	100
No. of line throwing appliances (with 4 charges)	1	Not requested	Not requested
Crew accommodation spaces	Requested	Requested	Not requested

(1) The Society may not require the tow bar depending on the characteristics of the ship under consideration and where any obstructions on the deck area aft do not interfere with the towline during towing operations.

(2) The suitability of the towline diameter is left to the judgement of the interested parties.

Table 4 : Testing force C_T

Towing pull T, in kN	Testing force C_T, in kN
T < 400	2 T
400 ≤ T ≤ 1200	T + 400
T > 1200	1,33 T

2.9 Test requirements

2.9.1 General *(1/7/2021)*

a) All testing defined in [2.~~9~~8.6] is to be witnessed by a Society surveyor

b) For each emergency release system or type thereof, the performance requirements in [2.8.~~5~~6] a) are to be verified either at the manufacturer's works or as part of the commissioning of the towing winch when it is installed on board. Where verification solely through testing is impracticable (e.g. due to health and safety), testing may be combined with inspection, analysis or demonstration in agreement with the Society.

c) The performance capabilities, ~~and~~as well as instructions for operati~~ng~~on, instructions of the emergency release system are to be documented by the manufacturer and made available on board the ship on which the winch has been installed.

d) Instructions for surveys of the emergency release system are to be documented by the manufacturer, agreed by the Society and made available on board the ship on which the winch has been installed.

e) Where necessary for conducting the annual and special surveys of the winch, adequately sized strong points are to be provided on deck.

2.9.2 Installation trials *(1/1/2020)*

a) The full functionality of the emergency release system is to be tested as part of the shipboard commissioning trials to the satisfaction of the surveyor. Testing may be conducted either during a bollard pull test or by applying the towline load against a strong point on the deck of the tug that is certified to the appropriate load.

b) Where the performance of the winch in accordance with [~~2.8.5~~2.8.6] a) has previously been verified, the load applied for the installation trials is to be at least the lesser of 30% of the maximum design load or 80% of vessel bollard pull.

2.10 Construction and testing

2.10.1 Bollard pull test

At the request of the interested parties, tugs may be subjected to a bollard pull test. The value of the bollard pull is indicated in a statement to be kept on board together with the ship documents.

The bollard pull test is to be carried out in the presence of a Surveyor of the Society according to the Rules for the certification of the bollard pull of tugs.

In the case of sister ships, the Society may assign the bollard pull on the basis of the results obtained from the tests carried out on the prototype ship.

2.11 Additional arrangements and equipment for tugs with additional service feature "rescue"

2.11.1

Tugs with additional service feature "rescue" are to be provided with at least the arrangements and equipment indicated in [2.11.2].

2.11.2 *(1/1/2017)*

a) a "RESCUE ZONE" area on each side of the ship's main deck where the relevant bulwark is lower than in the other part of the ship or provided with a gate in order to facilitate the embarkation of the shipwrecked persons. This zone is to be clearly identified by such wording written in at least 500 mm high/200 mm wide letters

4.1.2 Characteristics of escort tugs

For classification purposes, the following characteristic is to be specified by the Designer:

- the maximum steering force T_Y, in kN, applied by the tug on the stern of the escorted ship, which is the transverse component of the maximum dynamic towing pull T with respect to the longitudinal axis of the escorted ship. This maximum force is generated at some value of the angle α between the line of pull and the direction of the escorted ship, see Fig ~~3~~4. This force is to be calculated at speeds V, to be defined by the Designer and in general to be comprised between 8 and 10 knots.

  If the tug escort service is carried out within a certain speed range, the maximum steering forces T_Y at the minimum and maximum service speeds V_{MIN} e V_{MAX}, respectively, are to be calculated by the Designer.

T_Y is to be obtained on the basis of the results of full-scale tests (see [4.5]), to be carried out at speed V or, as applicable, at speeds V_{MIN} and V_{MAX}, defined above or alternatively may be evaluated by computer model simulation as indicated in [4.6.1].

Table 5 : Additional equipment for salvage tugs

Arrangement or equipment	Number of items
Fixed or movable drainage pumps having approximately the same capacity **(1) (2) (3)**	2 or more pumps of total capacity ≥ 400 m³/h
Fire pumps each capable of throwing two simultaneous jets of water having a horizontal reach not less than 30 m **(4)**	2 pumps, each having a capacity ≥ 60 m³/h
Breathing apparatuses for divers	2
Gas masks with filter	2
Cargo boom	1, with service load ≥ 1 t
Power operated winch capable of producing an adequate pull	1
Water stops to stop leaks of approximately 1 x 2 m	4
Complete set of equipment for flame cutting with at least 25 metres of flexible piping	1
Drain hoses	at least 20 m per pump
Fire hoses	10
Connections for fire main	at least 3
Power operated diver's compressor, with associated equipment **(5)**	1
Additional towline equipment, at least equal to that required for tugs in Tab 3	1
Lamps for underwater operation	2
Floodlight of power ≥ 500 W	1
Working lamps	2
Winding drums with wire ropes	see **(6)**
Electrical cables, each not less than 100 metres long and capable of supplying at least 50 kW	3
Tackles with lifting capacity of 1 t	2
Tackles with lifting capacity of 3 t	2
Radar with a range not less than 24 nautical miles	1
Echo-sounding device with a range of 100 m	1

(1) For each pump fitted on board, a suction strainer and, in the case of non self-priming pumps, a foot valve, are also to be provided.

(2) Where portable pumps are used, they are to be capable of effectively operating even with transverse and longitudinal inclinations up to 20°.

(3) These pumps are additional to the drain pumps intended for the drainage service of the ship.

(4) These pumps may be the same required for drainage purposes provided they have an adequate head.

(5) As an alternative, a compressor for recharging the oxygen tanks of divers may be provided together with two complete sets of equipment for divers.

(6) Winding drums fitted on board are to be capable of housing wire ropes of suitable size and length not normally less than 350 m.

Arrangement or equipment	Number of items
Hydraulic jackets with lifting capacity of 10 t	2
Hydraulic jackets with lifting capacity of 20 t	2
Portable electrical drill with a set of twist bits having diameters up to 20 mm	1

(1) For each pump fitted on board, a suction strainer and, in the case of non self-priming pumps, a foot valve, are also to be provided.

(2) Where portable pumps are used, they are to be capable of effectively operating even with transverse and longitudinal inclinations up to 20°.

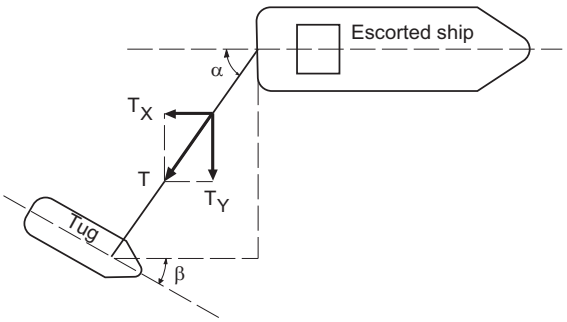
(3) These pumps are additional to the drain pumps intended for the drainage service of the ship.

(4) These pumps may be the same required for drainage purposes provided they have an adequate head.

(5) As an alternative, a compressor for recharging the oxygen tanks of divers may be provided together with two complete sets of equipment for divers.

(6) Winding drums fitted on board are to be capable of housing wire ropes of suitable size and length not normally less than 350 m.

Figure 4 : Typical escort configuration



4.1.3 Documentation

In addition to the documents defined in Pt B, Ch 1, Sec 3, the following plans are to be submitted to the Society for information:

- towing arrangement plan, including towline components with relevant minimum breaking loads
- preliminary calculation of maximum steering forces T_Y at speeds V or V_{MAX}, as applicable according to [4.1.2], including the propulsion force which is needed for equilibrating hydrodynamic forces acting on the tug and the towline pull
- preliminary stability calculation.

4.1.4 Propulsion forces

The hydrodynamic forces acting on the tug, the towline pull and the tug propulsion force are to be so designed that these forces are in equilibrium.

However, the engine is to ensure a sufficient thrust for manoeuvring the tug quickly for any angular position β, where β is defined in Fig ~~3~~4.

4.1.5 Loss of propulsion

In the case of propulsion loss, the heeling moment due to the remaining forces is to lead to a safe equilibrium position of the tug with reduced heel.

4.2 Stability

4.2.1 Intact stability

A stability analysis of the tug is to be carried out taking into account the heeling moment caused by the forces acting on the tug, as shown in Fig ~~4~~5.

The stability analysis is to consider:

- all potential attitudes of the escort tug relative to the direction of line pull,
- the maximum line pull,
- the resultant combination of heel and trim on the escort tug.

The stability analysis is to include the effects of fenders, skegs, and other appendages on both the reserve buoyancy and the lateral resistance of the escort tug:

The two following intact stability criteria are to be complied with:

$A \geq 1{,}25\ B$

$C \geq 1{,}4\ D$

where:

A : Righting lever curve area, in m·rad, measured from the heeling angle θ_C to a heeling angle of 20° (see Fig ~~5~~6)

B : Heeling arm curve area, in m·rad, measured from the heeling angle θ_C to a heeling angle of 20° (see Fig ~~5~~6)

C : Righting lever curve area, in m·rad, measured from the angle 0° heel to the heeling angle θ_D (see Fig ~~6~~7)

D : Heeling arm curve area, in m·rad, measured from the angle 0° heel to the heeling angle θ_D (see Fig ~~6~~7)

θ_C : Heeling angle of equilibrium, corresponding to the first intersection between heeling and righting arms, to be obtained when the maximum steering force T_Y, defined in [4.1.2], is applied from the tug

θ_D : Heeling angle, to be taken as the lesser of:

- the angle of downflooding
- 40°.

The heeling arm curve is to be obtained from the full scale tests (see [4.5]), for the maximum steering force T_Y.

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4.5.3 Data to be collected during tests

During the tests, all data needed to define the characteristics of the tug are to be collected, e.g. the relative position ship-tug, their heading and speed, the towline length, the towline angle α (see Fig ~~3~~4), the maximum towing pull T, the ship rudder position, the heeling angle of the tug and any other parameter used in the preliminary calculation.

4.6 Alternative to full-scale tests

4.6.1 Maximum steering force

The maximum steering force T_Y that the tug applies on the assisted ship is to be evaluated by a computer model programme that considers a quasi-steady solution, in which the horizontal forces and moments are balanced. The programme is also to consider the hydrodynamic forces on the escort tug's hull and underwater appendages, the forces acting on the rudder and the thrusts of the propellers.

4.7 Inclinometer

4.7.1 *(1/1/2021)*

Escort tugs are to be equipped with a calibrated heeling angle measurement system (inclinometer). The measured heeling angle is to be displayed in the wheelhouse next to the control desk or another appropriate location.

...OMISSIS...

SECTION 1 UNATTENDED MACHINERY SPACES (AUT-UMS)

1 General

1.1 Application

1.1.1 The additional class notation **AUT-UMS** is assigned in accordance with Pt A, Ch 1, Sec 2, [6.4.2] to ships fitted with automated installations enabling periodically unattended operation of machinery spaces, and complying with the requirements of this Section.

Note 1: Machinery spaces are defined in Pt C, Ch 1, Sec 1, [1.4.2].

1.1.2 *The arrangements provided shall be such as to ensure that the safety of the ship in all sailing conditions, including manoeuvring, is equivalent to that of a ship having the machinery spaces manned.*

1.2 Exemptions

1.2.1 For ships whose gross tonnage is less than 500 and propulsive power less than 1 MW, the requirements laid down in [1.3] and [5.4.3] do not apply.

1.2.2 For ships whose gross tonnage is less than 500 and propulsive power less than 1 MW, the requirements laid down in [4] do not apply. An alarm signal is to be activated in the following circumstances:

a) for diesel engine propulsion plant
   - lubricating oil system low pressure
   - cylinder coolant high temperature
   - cylinder coolant low pressure or low flow rate
   - cylinder coolant make up tank low level
   - sea water cooling low pressure or low flow rate

b) for auxiliary internal combustion engines intended for electricity production of a power higher than 37 kW, supplying essential services:
   - cylinder coolant high temperature
   - lubricating oil system low pressure.

1.2.3 For ships whose gross tonnage is less than 500 and propulsive power less than 1 MW, automatic stop is to be provided for lubricating oil failure of engines, reduction gears, clutches and reversing gears. A possible override of this automatic stop is to be available at the control stations, and an indication is to be provided at each control station, when override is activated.

1.2.4 The requirements laid down in [3.3.1] do not apply to cargo ships of less than 1 600 tons gross tonnage, insofar as the arrangements of the machinery space access make it unnecessary.

1.2.5 Fishing vessels of less than 45m in length are exempted from the application of:

- alarm system requirements given in [5.2.3] and [5.4.2]
- fire detection system requirements given in [3.2] insofar as the location of the spaces considered allows people on board to detect fire outbreaks easily, and
- requirement [3.4.4].

1.2.6 Fishing vessels of less than 75 m in length are exempted from the application of the requirements laid down in [1.3.2], [3.1.3] and [3.3.1].

1.3 Communication system

1.3.1 *A reliable means of vocal communication shall be provided between the main machinery control room or the propulsion machinery control position as appropriate, the navigation bridge and the engineer officers' accommodation.*

This means of communication is to be foreseen in collective or individual accommodation of engineer officers.

1.3.2 Means of communication are to be capable of being operated even in the event of failure of supply from the main source of electrical power.

2 Documentation

2.1 Documents to be submitted

2.1.1 In addition to those mentioned in Pt C, Ch 3, Sec 1, Tab 1, the documents in Tab 1 are required.

Table 1 : Documents to be submitted

No.	(1)	Document
1	A	Means of communication diagram
2	A	Technical description of automatic engineer's alarm and connection of alarms to accommodation and bridge, when applicable
3	A	System of protection against flooding
4	A	Fire detection system: diagram, location and cabling
(1) A : to be submitted for approval		

3 Fire and flooding precautions

3.1 Fire prevention

3.1.1 The requirements regarding piping and arrangements of fuel oil and lubricating oil systems given in Pt C, Ch 1, Sec 10 are applicable.

3.1.2 Fuel oil and lubricating oil purifiers and the auxiliary equipment and its fittings containing hot fuel oil are to be grouped in a special room or in locations ventilated by

3.4.3 Where the bilge pumps are automatically controlled, they are not be started when the oil pollution level is higher than accepted in Pt C, Ch 1, Sec 10.

3.4.4 *The location of controls of any valve serving a sea inlet, a discharge below the waterline or a bilge injection system shall be so sited as to allow adequate time for operation in case of influx of water to the space, having regard to the time likely to be required in order to reach and operate such controls. If the level to which the space could become flooded with the ship in the fully loaded condition so requires, arrangements shall be made to operate the controls from a position above such level.*

3.4.5 Bilge level alarms are to be given at the main control station, the engineers' accommodation area and the navigating bridge.

4 Control of machinery

4.1 General

4.1.1 *Under all sailing conditions, including manoeuvring, the speed, direction of thrust and, if applicable, the pitch of the propeller shall be fully controllable from the navigation bridge.*

4.1.2 All manual operations or services expected to be carried out with a periodicity of less than 24 h are to be eliminated or automated, particularly for: lubrication, topping up of make up tanks and filling tanks, filter cleaning, cleaning of centrifugal purifiers, drainage, load sharing on main engines and various adjustments. Nevertheless, the transfer of operation mode may be effected manually.

4.1.3 *A centralised control position shall be arranged with the necessary alarm panels and instrumentation indicating any alarm.*

4.1.4 Parameters for essential services which need to be adjusted to a preset value are to be automatically controlled.

4.1.5 *The control system shall be such that the services needed for the operation of the main propulsion machinery and its auxiliaries are ensured through the necessary automatic arrangements.*

4.1.6 *It shall be possible for all machinery essential for the safe operation of the ship to be controlled from a local position, even in the case of failure in any part of the automatic or remote control systems.*

4.1.7 *The design of the remote automatic control system shall be such that in the case of its failure an alarm will be given. Unless impracticable, the preset speed and direction of thrust of the propeller shall be maintained until local control is in operation.*

4.1.8 Critical speed ranges, if any, are to be rapidly passed over by means of an appropriate automatic device.

4.1.9 Propulsion machinery is to stop automatically only in exceptional circumstances which could cause quick critical damage, due to internal faults in the machinery. The design of automation systems whose failure could result in an unexpected propulsion stop is to be specially examined. An overriding device for cancelling the automatic shutdown is to be considered.

4.1.10 Where the propulsive plant includes several main engines, a device is to be provided to prevent any abnormal overload on each of them.

4.1.11 *Where standby machines are required for other auxiliary machinery essential to propulsion, automatic changeover devices shall be provided.*

4.1.12 *(1/7/2021)*

It is the responsibility of the Manufacturer to set the alarms and safeguards so that they activate when the controlled parameter deviates from normal values but before reaching hazardous conditions.

4.1.13 *(1/7/2021)*

Control and monitoring functions tables 2 to 28 are to be intended as requiring a separate sensor for each row of the table.

4.2 Diesel propulsion plants

4.2.1 *(1/1/2015)*

When a diesel engine is used for the propulsion plant, monitoring and control of equipment is to be performed respectively according to Tab 2 for crosshead engines or Tab 3 for trunk piston engines.

4.3 Steam propulsion plants

4.3.1 For steam propulsion plants, control and monitoring functions of steam turbines are required according to Tab 4.

4.3.2 Turbine spinning is to take place automatically at regular intervals when the shaft line is stopped during manoeuvring.

4.3.3 Spinning is not allowed until the equipment is in a safe position.

4.3.4 Lubrication of gear and turbines is to be automatically ensured until the plant is stopped (driven oil pump or gravity tank).

4.3.5 If a special crash astern sequence is provided, it is to be carried out through a separate device or by placing the control gear in a special position; precautions are to be taken to avoid its unintended use.

According to the type of plant, this control may be achieved by:

- cancelling the low vacuum shutdown device
- shutting off the steam to the ahead turbine
- opening the turbine cylinder drain valves, the astern stop valve and the astern manoeuvring valve.

SECTION 36 SUSTAINABLE SHIP ~~(nn)~~

1 General

1.1 Application

1.1.1 *(1/7/2021)*

The additional class notation **SUSTAINABLE SHIP** ~~(nn)~~ is assigned, in accordance with Pt A, Ch 1, Sec 2, [6.14.55], to ships complying with the criteria in [5], having regard to:

a) design and provision of systems, components and procedural means to control and prevent the emission of polluting substances into the sea, the air and, more in general, the environment (reference is made to **GREEN PLUS** additional class notation)

b) underwater noise limitation (reference is made to **DOLPHIN** additional class notations)

c) noise and vibration limitation on board (reference is made to **COMF-NOISE** and **COMF-VIB** additional class notations)

d) compliance with **COMF-NOISE-PORT(X)** additional class notation

e) compliance with **MLCDESIGN** additional class notation

f) compliance with **BIOSAFE SHIP** additional class notation

g) achievement of EEDI and EEXI values 40% lower than those in Phase 0 EEDI reference lines (see Note 1) in MARPOL Annex VI, according to the 2030 target in Initial IMO strategy on reduction of GHG emissions from ships (Res. MEPC.304(72)).

Note 1: For ro-ro cargo ships and ro-ro passenger ships, reference is made to Phase 2 EEDI reference lines.

~~The (nn) suffix gives an index of the ship's sustainability characteristics according to [4] and [5].~~

A Certificate of Compliance may be issued to ships not classed with the Society, fulfilling the requirements of this section.

2 Definitions

2.1

2.1.1 *(15/5/2021)*

Definitions are those given in:

- Pt F, Ch 6, Sec 1 (**COMF-NOISE** additional class notation)
- Pt F, Ch 6, Sec 2 (**COMF-VIB** additional class notation)
- Pt F, Ch 6, Sec 4 (**COMF-NOISE-PORT(X)** additional class notation)
- Pt F, Ch 7, Sec 1 (**GREEN PLUS** additional class notation)
- Pt F, Ch 13, Sec 13 (**MLCDESIGN** additional class notation)
- Pt F, Ch 13, Sec 25 (**DOLPHIN** additional class notations)
- Pt F, Ch 13, Sec 33 (**BIOSAFE SHIP** additional class notation)
- MARPOL Annex VI.

3 Documents to be submitted

3.1

3.1.1 *(15/5/2021)*

The list of plans and documents to be submitted is given in the relevant paragraphs of:

- Pt F, Ch 6, Sec 1 (**COMF-NOISE** additional class notation)
- Pt F, Ch 6, Sec 2 (**COMF-VIB** additional class notation)
- Pt F, Ch 6, Sec 4 (**COMF-NOISE-PORT(X)** additional class notation)
- Pt F, Ch 7, Sec 1 (**GREEN PLUS** additional class notation)
- Pt F, Ch 13, Sec 13 (**MLCDESIGN** additional class notation)
- Pt F, Ch 13, Sec 25 (**DOLPHIN** additional class notations)
- Pt F, Ch 13, Sec 33 (**BIOSAFE SHIP** additional class notation).

The Society reserves the right to request the submission of additional documents in the case of non-conventional design or when it is deemed necessary for the evaluation of the systems and components.

4 Sustainable index calculation

4.1

4.1.1 *(1/7/2021)*

The sustainable index ~~(nn)~~ is obtained by adding up the values of the contributions for each criteria the ship complies with, according to Tab 1.

5 Assignment criteria

5.1

5.1.1 *(1/7/2021)*

The compliance with the requirements for the assignment of **MLCDESIGN** and **BIOSAFE SHIP** additional class notations is a prerequisite for the assignment of **SUSTAINABLE SHIP** ~~(nn)~~ additional class notation.

5.1.2 *(1/7/2021)*

The **SUSTAINABLE SHIP** ~~(nn)~~ notation is assigned to ships complying with the minimum requirements for assignment

specified in Tab 1. The relevant sustainable index ~~(nn)~~ is calculated in accordance with [4].

Examples:

- A ship in full compliance with the requirements of **GREEN PLUS**, **DOLPHIN**, **COMF-NOISE**, **COMF-VIB**, **COMF-NOISE-PORT(X)**, **MLCDESIGN**, **BIOSAFE SHIP** additional class notations and having an EEXI value 40% lower than those in EEDI reference lines in MARPOL Annex VI is a **SUSTAINABLE SHIP** with sustainable index ~~(~~100~~)~~.
- A ship, having an environmental index, as defined in the **GREEN PLUS** requirements, equal to 63; a documented compliance to the contractual ship specification regarding noise or vibration levels; full compliance with the requirements of **MLCDESIGN** and **BIOSAFE SHIP** additional class notations, is a **SUSTAINABLE SHIP** with sustainable index ~~(~~20~~)~~.

Table 1 : Criteria for the assignment of SUSTAINABLE SHIP ~~(nn)~~ *(1/7/2021)*

		Minimum requirements for assignment	Sustainable index ~~(nn)~~
a) design and provision of systems, components and procedural means to control and prevent the emission of polluting substances into the sea, the air and, more in general, the environment (reference is made to **GREEN PLUS** additional class notation)	60 < E.I. ≤ 80 **(1)**	X	5
	80 < E.I. ≤ 100 **(1)**		10
	E.I. > 100**(1)**		20
b) underwater noise limitation (reference is made to **DOLPHIN** additional class notations)			20
c) ensuring comfort having regard to noise and vibration on board	Documented compliance regarding **noise or vibration** measurements with the contractual ship specification	X	5
	Documented compliance regarding **noise and vibration** measurements with the contractual ship specification		10
	Compliance with **COMF-NOISE** additional class notation		10
	Compliance with **COMF-VIB** additional class notation		10
d) compliance with **COMF-NOISE-PORT(X)** additional class notation			10
e) compliance with **MLCDESIGN** additional class notation		X	5
f) compliance with **BIOSAFE SHIP** additional class notation		X	5
g) achievement of EEDI and EEXI values 40% lower than those in Phase 0 EEDI reference lines in MARPOL Annex VI **(2)**			20

(1) E.I. is the **GREEN PLUS** Environmental Index

(2) For ro-ro cargo ships and ro-ro passenger ships, reference is made to Phase 2 EEDI reference lines