РОССИЙСКИЙ МОРСКОЙ РЕГИСТР СУДОХОДСТВА
RUSSIAN MARITIME REGISTER OF SHIPPING

ПРИЛОЖЕНИЕ К ПРАВИЛАМ И РУКОВОДСТВАМ
РОССИЙСКОГО МОРСКОГО РЕГИСТРА СУДОХОДСТВА

ПРОЦЕДУРНЫЕ ТРЕБОВАНИЯ, УНИФИЦИРОВАННЫЕ ИНТЕРПРЕТАЦИИ И РЕКОМЕНДАЦИИ МЕЖДУНАРОДНОЙ АССОЦИАЦИИ КЛАССИФИКАЦИОННЫХ ОБЩЕСТВ

SUPPLEMENT TO RULES AND GUIDELINES
OF RUSSIAN MARITIME REGISTER OF SHIPPING

IACS PROCEDURAL REQUIREMENTS, UNIFIED INTERPRETATIONS AND RECOMMENDATIONS

НД № 2-020101-091-R-E

2016

Настоящее Приложение к правилам и руководствам Российского морского регистра судоходства содержит обязательные для применения процедурные требования и унифицированные интерпретации Международной ассоциации классификационных обществ (МАКО), а также рекомендации МАКО, ссылки на которые имеются в правилах и других нормативных документах Регистра.

Все материалы публикуются на английском языке.

Данный документ публикуется в электронном виде отдельным изданием и является обязательным Приложением к правилам Регистра.

The present Supplement to rules and guidelines of Russian Maritime Register of Shipping contains IACS Procedural Requirements and IACS Unified Interpretations compulsory for implementation, and IACS recommendations, which are referred to in the rules and other normative documents of the Register.

All materials are published in English.

The present document is published in electronic format as a separate edition and is a compulsory Supplement to the Register rules.

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1. Rec. No. 47 (Rev.7 June 2013) Shipbuilding and Repair Quality Standard

Применение: Правила классификационных освидетельствований судов в эксплуатации (2016), часть I (пункт 5.13), приложение 2 (пункт 5.1.12), приложение 3 (пункт 7).
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Application: Rules for the Classification Surveys of Ships in Service (2016), Part I (para 5.13), Appendix 2 (para 5.1.12), Appendix 3 (para 7).
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2. Rec. No. 76 (Corr.1 Sept 2007) IACS Guidelines for Surveys, Assessment and Repair of Hull Structure – Bulk Carriers

Применение: Правила классификационных освидетельствований судов в эксплуатации (2016), часть I (пункт 5.13), приложение 2 (пункт 5.1.12), приложение 3 (пункт 2).

Application: Rules for the Classification Surveys of Ships in Service (2016), Part I (para 5.13), Appendix 2 (para 5.1.12), Appendix 3 (para 2).

3. Rec. No. 96 (April 2007) Double Hull Oil Tankers – Guidelines for Surveys, Assessment and Repair of Hull Structures

Применение: Правила классификационных освидетельствований судов в эксплуатации (2016), часть I (пункт 5.13), приложение 2 (пункт 5.1.12), приложение 3 (пункт 10).

Application: Rules for the Classification Surveys of Ships in Service (2016), Part I (para 5.13), Appendix 2 (para 5.1.12), Appendix 3 (para 10).

4. Rec. No. 132 (Dec 2013) Human Element Recommendations for structural design of lighting, ventilation, vibration, noise, access & egress arrangements

Применение: Руководство по освидетельствованию условий труда и отдыха моряков на соответствие требованиям Конвенции 2006 года о труде в морском судоходстве (2013), пункты 2.21, 4.7.2.
Руководство по освидетельствованию жилых помещений экипажа (2013), пункты 2.14, 4.1.2.7.

Application: Guidelines on On-board Maritime Labour Convention, 2006 (MLC) Inspection (2013), paras 2.21, 4.7.2.

Guidelines on On-board Inspection for Crew Accomodation (2013), paras 2.14, 4.1.2.7.

5. Rec. No. 55 (March 1999) General Cargo Ships – Guidance for Surveys, Assessment and Repair of Hull Structure

Применение: Правила классификационных освидетельствований судов в эксплуатации (2016), часть I (пункт 5.13), приложение 2 (пункт 5.1.12), приложение 3 (пункт 6).

Application: Rules for the Classification Surveys of Ships in Service (2016), Part I (para 5.13), Appendix 2 (para 5.1.12), Appendix 3 (para 6).

ПРОЦЕДУРНЫЕ ТРЕБОВАНИЯ МАКО

IACS PROCEDURAL REQUIREMENTS

No. 38 (May 2013) Procedure for calculation and verification of the Energy Efficiency Design Index (EEDI)

Introduction

This procedure applies to all cases of Class Societies' involvement in conducting the survey and certification of EEDI in accordance with regulations 5, 6, 7, 8 and 9 of MARPOL Annex VI as a Verifier defined in the *"2012 Guidelines on Survey and Certification of the Energy Efficiency Design Index (EEDI)"* IMO Resolution MEPC 214(63).

1 Definition

"Industry Guidelines" means the Industry Guidelines for calculation and verification of the Energy Efficiency Design Index (EEDI) as first submitted to MEPC 64 that may be revised in order to remain in line with the relevant IMO Guidelines MEPC.212(63) and MEPC.214(63).

2 Scope of the Procedure

The scope of this procedure is defined in Part I of the Industry Guidelines and corresponds to the calculation and verification of EEDI of cargoships, without considering innovative energy efficient technologies, contracted for construction after 1 July 2013.

3 Calculation of EEDI

The procedure to compute the EEDI is documented in Part II of the Industry Guidelines. For the purpose of this Procedural Requirement, calculation of the EEDI is to be performed in accordance with IMO Guidelines MEPC.212(63) and Part II of the Industry Guidelines, as amended.

4 Verification of EEDI

The procedure to verify the EEDI is documented in Part III of the Industry Guidelines, together with Appendixes 1, 3, 4 and 5. For the purpose of this Procedural Requirement, verification of the EEDI is to be performed in accordance with IMO Guidelines MEPC.214(63) and Part III of the Industry Guidelines, as amended.
A sample of document to be submitted to the Verifier including additional information for verification is provided in Appendix 2 of the Industry Guidelines.

Attached:

First Industry Guidelines for calculation and verification of the Energy Efficiency Design Index (EEDI)

Note:

1. This Procedural Requirement applies from 1 July 2013.

2. The "contracted for construction" date means the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. For further details regarding the date of "contract for construction", refer to IACS Procedural Requirement (PR) No. 29.

End of Document

FIRST INDUSTRY GUIDELINES FOR CALCULATION AND VERIFICATION OF THE ENERGY EFFICIENCY DESIGN INDEX (EEDI)

TABLE OF CONTENTS

Part I - Scope of the Industry Guidelines

1 SCOPE OF THE GUIDELINES

1.1 Objective

The objective of these Industry Guidelines for calculation and verification of the Energy Efficiency Design Index (EEDI), hereafter designated as "the Industry Guidelines", is to provide details and examples of calculation of attained EEDI and to support the method and role of the verifier in charge of conducting the survey and certification of EEDI in compliance with the two following IMO Guidelines:

- 2012 Guidelines on the method of calculation of EEDI for new ships, Res. MEPC.212(63) adopted on 2 March 2012, referred to as the "IMO Calculation Guidelines" in the present document
- 2012 Guidelines on survey and certification of EEDI, Res. MEPC.214(63) adopted on 2 March 2012, referred to as the "IMO Verification Guidelines" in the present document

In the event that the IMO Guidelines are amended, then pending amendment of these Industry Guidelines, they are to be implemented in compliance with the amended IMO Guidelines.

1.2 Application

These Guidelines apply to new ships as defined in Regulation 2.23 of MARPOL Annex VI of 400 gross tonnage and above. The calculation and verification of EEDI are to be performed for each:

1. new ship before ship delivery
2. new ship in service which has undergone a major conversion
3. new or existing ship which has undergone a major conversion that is so extensive that the ship is regarded by the Administration as a newly constructed ship

The Industry Guidelines shall not apply to ships which have diesel-electric propulsion, turbine propulsion or hybrid propulsion systems.

1.3 Limited scope of the first issue of Industry Guidelines

This issue of the Industry Guidelines only applies to the following types of ships:

- Bulk carriers
- Gas carriers
- Tankers
- Containerships
- General cargo ships
- Refrigerated cargo carriers
- Combination carriers

which are not fitted with innovative energy efficient technologies.

The first issue of this document doesn't consider the EEDI verification after a major conversion. Guidelines on this subject will be developed subsequent to IMO's adoption of an interpretation of the definition of major conversion.

Part II - Explanatory notes on calculation of EEDI

2 INTRODUCTION

The attained Energy Efficiency Design Index (EEDI) is a measure of a ship's energy efficiency determined as follows:

$$EEDI = \frac{CO_2\ emission}{Transport\ work}$$

The CO_2 emission is computed from the fuel consumption taking into account the carbon content of the fuel. The fuel consumption is based on the power used for propulsion and auxiliary power measured at defined design conditions.

The transport work is estimated by the designed ship capacity multiplied by the ship's speed measured at the maximum summer load draught and at 75 per cent of the rated installed power.

3 EEDI FORMULA

The EEDI is provided by the following formula:

$$\frac{(\prod_{j=1}^{n} f_j).(\sum_{i=1}^{nME} P_{ME(i)}.C_{FME(i)}.SFC_{ME(i)}) + P_{AE}.C_{FAE}.SFC_{AE} + \{(\prod_{j=1}^{n} f_j).\sum_{i=1}^{nPTI} P_{PTI(i)} - \sum_{i=1}^{neff} f_{eff(i)}.P_{AEeff(i)}\}.C_{FAE}.SFC_{AE} - \sum_{i=1}^{neff} f_{eff(i)}.P_{eff(i)}.C_{FME}.SFC_{ME})}{f_i.f_c.Capacity.f_w.V_{ref}}$$

With the following Notes:

The global fi factor may also be written:
$f_i = (\prod_{i=1}^{m} f_i)$
where each individual f_i factor is explained under section 9 of this document.

If part of the normal maximum sea load is provided by shaft generators, the term $P_{AE}.C_{FAE}.SFC_{AE}$ may be replaced by:
$(P_{AE} - 0.75 * \sum_{i=1}^{nPTO} P_{PTO(i)}).C_{FAE}.SFC_{AE} + 0.75 * \sum_{i=1}^{nPTO} P_{PTO(i)}.C_{FME(i)}.SFC_{ME(i)}$
with the condition $0.75 * \sum_{i=1}^{nPTO} P_{PTO(i)} \leq P_{AE}$

Where the total propulsion power is limited by verified technical means as indicated under section 6, the term $(\sum_{i=1}^{nME} P_{ME(i)}.C_{FME(i)}.SFC_{ME(i)} + \sum_{i=1}^{nPTI} P_{PTI(i)}.C_{FAE}.SFC_{AE})$ is to be replaced by 75 percent of the limited total propulsion power multiplied by the average weighted value of ($SFC_{ME}.C_{FME}$) and ($SFC_{AE}.C_{FAE}$)

Due to the uncertainties in the estimation of the different parameters, the accuracy of the calculation of the attained EEDI cannot be better than 1%.
Therefore, the values of attained and required EEDI have to be reported with no more than three significant figures (for instance, 2.23 or 10.3) and the checking of Regulation 20, chapter 4 of MARPOL Annex VI has to be verified in accordance with this accuracy.

4 FUEL CONSUMPTION AND CO_2 EMISSION

The conversion factor C_F and the specific fuel consumption, SFC, are determined from the results recorded in the parent engine Technical File as defined in paragraph 1.3.15 of the NOx Technical Code 2008.

The fuel grade used during the test of the engine in the test bed measurement of SFC determines the value of the C_F conversion factor according to the table under 2.1of the IMO Calculation Guidelines.

SFC is the corrected specific fuel consumption, measured in g/kWh, of the engines. The subscripts ME(i) and AE(i) refer to the main and auxiliary engine(s), respectively. SFC_{AE} is the power-weighted average among $SFC_{AE(i)}$ of the respective engines *i*.

For main engines certified to the E2 or E3 test cycles of the NOx Technical Code 2008, the engine Specific Fuel Consumption ($SFC_{ME(i)}$) is that recorded in the test report included in a NOx Technical File for the parent engine(s) at 75% of MCR power.

For engines certified to the D2 or C1 test cycles of the NOx Technical Code 2008, the engine Specific Fuel Consumption ($SFC_{AE(i)}$) is that recorded in the test report included in a NOx Technical File for the parent engine(s) at 50% of MCR power or torque rating.

The SFC is to be corrected to the value corresponding to the ISO standard reference conditions using the standard lower calorific value of the fuel oil (42,700kJ/kg), referring to ISO 15550:2002 and ISO 3046-1:2002.

For LNG driven engines for which SFC is measured in kJ/kWh, the SFC value is to be converted to g/kWh using the standard lower calorific value of the LNG (48,000 kJ/kg), referring to the 2006 IPCC Guidelines.

For those engines which do not have a test report included in a NOx Technical File because its power is below 130 kW, the SFC specified by the manufacturer is to be used.

At the design stage, in case of unavailability of test reports in the NOx Technical File, the SFC value given by the manufacturer with the addition of the guarantee tolerance is to be used.

5 CAPACITY, POWER AND SPEED

5.1 Capacity

The capacity of the ship is computed as a function of the deadweight as indicated under 2.3 of the IMO Calculation Guidelines.
For the computation of the deadweight according to 2.4 of the IMO Calculation Guidelines, the lightweight of the ship and the displacement at the summer load draught are to be based on the results of the inclining test or lightweight check provided in the final stability booklet. At the design stage, the deadweight may be taken in the provisional documentation.

5.2 Power

The installed power for EEDI determination is taking into account the propulsion power and in general a fixed part of the auxiliary power, measured at the output of the main or auxiliary engine.
The total propulsion power is defined as 75% MCR of all main engines.

The total shaft propulsion power (power delivered to propellers P_S) is conventionally taken as follows:

$$\sum_{i=1}^{nME} P_{ME(i)} + \sum_{i=1}^{nPTI} (P_{PTI(i)} \cdot \eta_{PTI(i)}) \cdot \eta_{\overline{Gen}}$$

In this formula:

- The value of $P_{ME(i)}$ may be limited by verified technical means (see 6 below)
- The total shaft propulsion power may be limited by verified technical means. In particular an electronic engine control system may limit the total propulsion power, whatever the number of engines in function (see 6 below)

The auxiliary power can be nominally defined as a specified proportion of main engine power aiming to cover normal maximum sea load for propulsion and accommodation[1]. The nominal values are 2.5% of main engine power plus 250 kW for installed main engine power equal to or above 10 MW. 5% of P_{ME} will be accounted if less than 10 MW main engine power is installed. Alternatively, as explained below, the value for auxiliary power can be taken from the power balance table for the ship.

In addition, if shaft motors are installed, then in principle 75% of the shaft motor power is accounted for in the EEDI calculation. Detailed explanation about this is given in section 6.

For a ship where the P_{AE} value calculated by paragraph 2.5.6.1 or 2.5.6.2 of the IMO Calculation Guidelines is significantly different from the total power used at normal seagoing operations, as an option if the difference leads to a variation of the computed value of the EEDI exceeding 1%, the P_{AE} value could be estimated by the electric power (excluding propulsion) in conditions when the ship is engaged in a voyage at reference speed (V_{ref}) as given in the electric power table (EPT), divided by the average efficiency of the generator(s) weighted by power.

5.3 Speed V_{ref}

The speed V_{ref} is the ship speed, measured in knots, verified during sea trials and corrected to be given in the following conditions:

- in deep water
- assuming the weather is calm with no wind, no current and no waves
- in the loading condition corresponding to the Capacity
- at the total shaft propulsion power defined in 5.2 taking into account shaft generators and shaft motors

6 SHAFT GENERATOR AND SHAFT MOTOR

6.1 Introduction and background

Ships need electrical power for the operation of engine auxiliary systems, other systems, crew accommodation and for any cargo purposes. This electrical power can be generated by diesel-generator sets (gen-sets), shaft generators, waste heat recovery systems driving a generator and possibly by new innovative technologies, e.g. solar panels. Diesel-generator sets and shaft generators are the most common systems. While diesel-generator sets use a diesel engine powering a generator, a shaft generator is driven by the main engine. It is considered that due to the better efficiency of the main engine and efficiency of the shaft generator less CO_2 is emitted compared to gen-set operation.

The EEDI formula expresses the propulsion power of a vessel as 75% of the main engine power P_{ME}. It is also termed shaft power P_S, which corresponds to the ship's speed V_{ref} in the EEDI formula.
P_{AE} - the auxiliary power - is also included in the EEDI formula. However, this power demand is largely dependent on loading and trading patterns and it must also incorporate safety aspects, for example, the provision of a spare generator set. As noted in section 5, the auxiliary power can generally be taken into account as a fixed proportion of the main engine power (i.e. nominally 2.5% plus 250kW)[2].

The use of shaft generators is a well proven and often applied technology, particularly for high electrical power demands related to the payload e.g. reefer containers. Usually a ship design implements a main engine to reach the envisaged speed with some provision of sea margin. For the use of a shaft generator past practice and understanding was to install a

[1] by paragraph 2.5.6.1 or 2.5.6.2 of the IMO Calculation Guidelines
[2] c.f.: precise instruction in IMO Calculation Guidelines

bigger main engine to reach the same speed compared to the design without a shaft generator and to then have the excess power available from the main engine at any time for generation of electrical power. As a rule of thumb, one more cylinder was added to the main engine to cover this additional power demand.
The difficulty with this issue for calculation of the EEDI is that the excess power could be used to move the ship faster in the case where the shaft generator is not in use which would produce a distortion between ship designs which are otherwise the same.

The IMO Calculation Guidelines take these circumstances into account and offer options for the use of shaft generators. These options are described in detail, below.

Further, electric shaft motors operate similarly to shaft generators; sometimes a shaft generator can act as a shaft motor. The possible influence of shaft motors has also been taken into account in the IMO Calculation Guidelines and is also illustrated, below.

6.2 Main engine power without shaft generators

The main engines are solely used for the ship's propulsion. For the purpose of the EEDI, the main engine power is 75 % of the rated installed power MCR_{ME} for each main engine:

$$P_{ME(i)} = 0.75 \times MCR_{ME(i)}$$

6.3 Main engine power with shaft generators

Shaft generators produce electric power using power from the prime mover (main engine). Therefore the power used for the shaft generator is not available for the propulsion. Hence MCR_{ME} is the sum of the power needed for propulsion and the power needed for the shaft generator. Thus at least a part of the shaft generator's power should be deductible from the main engine power (P_{ME}).
The power driving the shaft generator is not only deducted in the calculation. As this power is not available for propulsion this yields a reduced reference speed. The speed is to be determined from the power curve obtained at the sea trial as explained in the schematic figure provided in paragraph 2.5 of the IMO Calculation Guidelines.

It has been defined that 75% of the main engine power is entered in the EEDI calculation. To induce no confusion in the calculation framework, it has therefore also been defined to take into account 75% of the shaft power take off / take in (as electrical power [kW] as displayed on the name plate of the shaft generator/motor).

For the calculation of the effect of shaft generators, two options are available.

6.3.1 Option 1

For this option, $P_{PTO(i)}$ is defined as 75% of the rated electrical output power MCR_{PTO} of each shaft generator. The maximum allowable deduction is limited by the auxiliary power P_{AE} as described in Paragraph 2.6 in the IMO Calculation Guidelines.
Then the main engine power P_{ME} is:

$$P_{PTO(i)} = 0.75 \times MCR_{PTO(i)}$$
$$\sum P_{ME(i)} = 0.75 \times \sum \left(MCR_{ME(i)} - P_{PTO(i)} \right) \quad with \quad 0.75 \times \sum P_{PTO(i)} \leq P_{AE}$$

This means, that only the maximum amount of shaft generator power that is equal to P_{AE} is deductible from the main engine power. In doing so, 75% of the shaft generator power must be greater than the auxiliary power calculated in accordance to Para. 2.6. of the IMO Calculation Guidelines.
Higher shaft generators output than P_{AE} will not be accounted for under option 1.

6.3.2 Option 2

The main engine power P_{ME} to be considered for the calculation of the EEDI is defined as 75% of the power to which the propulsion system is limited. This can be achieved by any verified technical means, e.g. by electronic engine controls.

$$P_{ME(i)} = 0.75 \times P_{Shaft,limit}$$

This option is to cover designs with the need for very high power requirements (e.g., pertaining to the cargo). With this option it is ensured that the higher main engine power cannot be used for a higher ship speed. This can be safeguarded by the use of verified technical devices limiting the power to the propulsor.

For example, consider a ship having a 15 MW main engine with a 3 MW shaft generator. The shaft limit is verified to 12 MW. The EEDI is then calculated with only 75% of 12 MW as main engine power as, in any case of operation, no more power than 12 MW can be delivered to the propulsor, irrespective of whether a shaft generator is in use or not.

It is to be noted that the guidelines do not stipulate any limits as to the value of the shaft limit in relation to main engine power or shaft generator power.

6.3.3 The use of specific fuel oil consumption and C_F-factor

Shaft generators are driven by the main engine, therefore the specific fuel oil consumption of the main engine is allowed to be used to the full extent if 75% of the shaft generator power is equal to P_{AE}.
In the case shaft generator power is less than P_{AE} then 75% of the shaft generator power is calculated with the main engine's specific fuel oil consumption and the remaining part of the total P_{AE} power is calculated with SFC of the auxiliaries (SFC_{AE}).

The same applies to the conversion factor C_F, if different fuels are used in the EEDI calculation.

6.4 Total shaft power with shaft motors

In the case where shaft motor(s) are installed, the same guiding principles as explained for shaft generators, above, apply. But in contrast to shaft generators, motors do increase the total power to the propulsor and do increase ships' speed and therefore must be included in the total shaft power within the EEDI calculation. The total shaft power is thus main engine(s) power plus the additional shaft motor(s) power:

$$\Sigma P_{ME(i)} + \Sigma P_{PTI(i),Shaft}$$

Where:

$$\sum P_{PTI(i),Shaft} = \sum \left(0.75 \cdot P_{SM,\max(i)} \cdot \eta_{PTI(i)}\right)$$

Similar to the shaft generators, only 75% of the rated power consumption $P_{SM,max}$ (i.e. rated motor output divided by the motor efficiency) of each shaft motor divided by the weighted average efficiency of the generator(s) $\eta_{\overline{Gen}}$ is taken into account for EEDI calculation.[3]

[3] The efficiency of shaft generators in the previous section has consciously not been taken into account in the denominator as inefficient generator(s) would increase the deductible power.

$$\sum P_{PTI(i)} = \frac{\sum \left(0.75 \cdot P_{SM,\max(i)}\right)}{\eta_{Gen}}$$

A power limitation similar to that described above for shaft generators can also be used for shaft motors. So if a verified technical measure is in place to limit the propulsion output, only 75% of limited power is to be used for EEDI calculation and also for that limited power V_{ref} is determined.

A diagram is inserted to highlight where the mechanical and electrical efficiencies or the related devices (PTI and Generator's) are located:

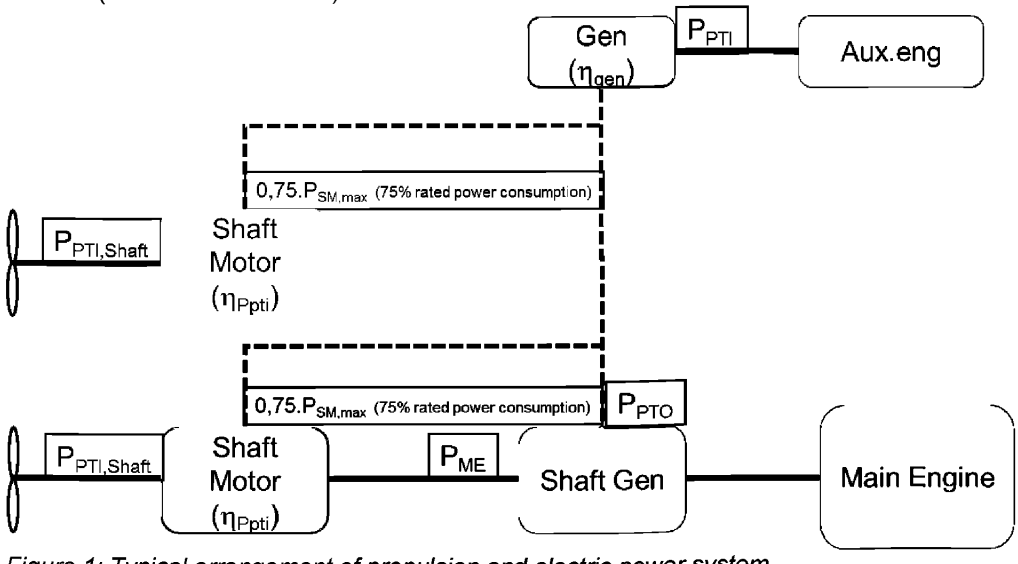


Figure 1: Typical arrangement of propulsion and electric power system

6.5 Calculation examples

For these calculation examples the ships' following main parameters are set as:

MCR_{ME} = 20,000 kW
Capacity = 20,000 DWT
$C_{F,ME}$ = 3.206
$C_{F,AE}$ = 3.206
SFC_{ME} = 190 g/kWh
SFC_{AE} = 215 g/kWh
v_{ref} = 20 kn (without shaft generator/motor)

6.5.1 One main engine, no shaft generator

$$MCR_{ME} = 20{,}000kW$$
$$P_{ME} = 0.75 \times MCR_{ME} = 0.75 \times 20{,}000kW = 15{,}000kW$$
$$P_{AE} = (0.025 \times 20{,}000) + 250kW = 750kW$$

$$EEDI = ((15{,}000 \times 3.206 \times 190) + (750 \times 3.206 \times 215))/(20 \times 20{,}000)$$
$$= 24.1\, gCO_2/tnm$$

6.5.2 One main engine, 0.75 x P_{PTO}<P_{AE}, option 1

$$
\begin{aligned}
MCR_{PTO} &= 500kW \\
P_{PTO} &= 500kW \times 0.75 = 375kW \\
MCR_{ME} &= 20{,}000kW \\
P_{ME} &= 0.75 \times (MCR_{ME} - P_{PTO}) = 0.75 \times (20{,}000kW - 375kW) = 14{,}719kW \\
P_{AE} &= (0.025 \times MCR_{ME}) + 250kW = 750kW \\
v_{ref} &= 19.89kn: \quad \text{The speed at } P_{ME} \text{ determined from the power curve} \\
EEDI &= ((P_{ME} \times C_{F,ME} \times SCF_{ME}) + (0.75 \times P_{PTO} \times C_{F,ME} \times SCF_{ME}) + ((P_{AE} - 0.75 \times P_{PTO}) \times C_{F,AE} \times SFC_{AE}))/(DWT \times v_{ref}) \\
&= 23.8\ gCO_2/tnm \quad \approx 1\%
\end{aligned}
$$

6.5.3 One main engine, 0.75 x P_{PTO}=P_{AE}, option 1

$$
\begin{aligned}
MCR_{PTO} &= 1{,}333kW \\
P_{PTO} &= 1{,}333kW \times 0.75 = 1{,}000kW \\
MCR_{ME} &= 20{,}000kW \\
P_{ME} &= 0.75 \times (MCR_{ME} - P_{PTO}) = 0.75 \times (20{,}000kW - 1{,}000kW) = 14{,}250kW \\
P_{AE} &= (0.025 \times MCR_{ME}) + 250kW = 750kW \\
v_{ref} &= 19.71kn: \quad \text{The speed at } P_{ME} \text{ determined from the power curve} \\
EEDI &= ((P_{ME} \times C_{F,ME} \times SCF_{ME}) + (0.75 \times P_{PTO} \times C_{F,ME} \times SCF_{ME}))/(DWT \times v_{ref}) \\
&= 23.2\ gCO_2/tnm \quad \approx 4\%
\end{aligned}
$$

6.5.4 One main engine with shaft generator, 0.75 x P_{PTO}> P_{AE}, option 1

$$
\begin{aligned}
MCR_{PTO} &= 2{,}000kW \\
0.75 \times P_{PTO} &= 0.75 \times 2{,}000kW \times 0.75 = 1{,}125kW > P_{AE} \Rightarrow P_{PTO} = P_{AE}/0.75 = 1{,}000kW \\
MCR_{ME} &= 20{,}000kW \\
P_{ME} &= 0.75 \times (MCR_{ME} - P_{PTO}) = 0.75 \times (20{,}000kW - 1{,}000kW) = 14{,}250kW \\
P_{AE} &= (0.025 \times MCR_{ME}) + 250kW = 750kW \\
v_{ref} &= 19.71kn: \quad \text{The speed at } P_{ME} \text{ determined from the power curve} \\
EEDI &= ((P_{ME} \times C_{F,ME} \times SCF_{ME}) + (0.75 \times P_{PTO} \times C_{F,ME} \times SCF_{ME}))/(DWT \times v_{ref}) \\
&= 23.2\ gCO_2/tnm \quad \approx 4\%
\end{aligned}
$$

6.5.5 One main engine with shaft generator, 0.75 x P_{PTO}> P_{AE}, option 2

$$
\begin{aligned}
MCR_{PTO} &= 2{,}000kW \\
MCR_{ME} &= 20{,}000kW \\
P_{Shaft,limit} &= 18{,}000kW \\
P_{ME} &= 0.75 \times (P_{Shaft,limit}) = 0.75 \times (18{,}000kW) = 13{,}500kW \\
P_{AE} &= (0.025 \times MCR_{ME}) + 250kW = 750kW \\
v_{ref} &= 19.41kn: \quad \text{The speed at } P_{ME} \text{ determined from the power curve} \\
EEDI &= ((P_{ME} \times C_{F,ME} \times SFC_{ME}) + (P_{AE} \times C_{F,ME} \times SFC_{ME}))/(DWT \times v_{ref}) \\
&= 22.4\ gCO_2/tnm \quad \approx 7\%
\end{aligned}
$$

6.5.6 One main engine, one shaft motor

$$MCR_{ME} = 18{,}000kW$$
$$P_{ME} = 0.75 \times MCR_{ME} = 0.75 \times 18{,}000kW = 13{,}500kW$$
$$P_{AE} = \left\{0.025 \times \left(MCR_{ME} + \frac{P_{PTI}}{0.75}\right)\right\} + 250kW = \left\{0.025 \times \left(18{,}000 + \frac{1612.9}{0.75}\right)\right\} + 250kW = 754kW$$
$$P_{SM,max} = 2{,}000kW$$
$$P_{PTI} = 0.75 \times P_{SM,max} / \eta_{\overline{Gen}} = 1{,}612.9kW$$
$$\eta_{PTI} = 0.97$$
$$\eta_{\overline{Gen}} = 0.93$$
$$P_{Shaft} = P_{ME} + P_{PTI,Shaft} = P_{ME} + (P_{PTI} \cdot \eta_{PTI}) \cdot \eta_{\overline{Gen}} = 13{,}500kW + (1612.9 \cdot 0.97) \cdot 0.93 = 14{,}955kW$$
$$v_{ref} = 20kn$$

$$EEDI = \left(\left(P_{ME} \times C_{F,ME} \times SFC_{ME}\right) + \left(P_{AE} \times C_{F,AE} \times SFC_{AE}\right) + \left(P_{PTI} \times C_{F,AE} \times SFC_{AE}\right)\right) / \left(DWT \times v_{ref}\right)$$
$$= 24.6\ gCO_2 / tnm \quad \approx -2\%$$

7 WEATHER FACTOR f_w

f_w is a non-dimensional coefficient indicating the decrease of speed in representative sea conditions of wave height, wave frequency and wind speed (e.g. Beaufort Scale 6), and is taken as 1.0 for the calculation of attained EEDI.

When a calculated f_w is used, the attained EEDI using calculated f_w is to be presented as "attained $EEDI_{weather}$" in order to clearly distinguish it from the attained EEDI under regulations 20 and 21 in MARPOL Annex VI.
Guidelines for the calculation of the coefficient f_w for the decrease of ship speed in respective sea conditions will be developed.

8 CORRECTION FACTOR FOR SHIP SPECIFIC DESIGN ELEMENTS f_j

Except in the cases listed below, the value of the f_j factor is 1.0.

For Finnish-Swedish ice class notations or equivalent notations of the Classification Societies, the f_j correction factor is indicated in Table 1 under 2.8.1 of the IMO Calculation Guidelines.[4]

For shuttle tankers with propulsion redundancy defined as oil tankers between 80,000 and 160,000 deadweight equipped with dual-engines and twin-propellers and assigned the class notations covering dynamic positioning and propulsion redundancy, the f_j factor is to be 0.77.

The total shaft propulsion power of shuttle tankers with redundancy is usually not limited by verified technical means.

9 CAPACITY FACTOR f_i

Except in the cases listed below, the value of the f_i factor is 1.0.

For Finnish-Swedish ice class notations or equivalent notations of the Classification Societies, the f_i correction factor is indicated in Table 2 under 2.11.1 of the IMO Calculation Guidelines.[4]

[4] Tables 1 and 2 in IMO Calculation Guidelines refer to Finnish/Swedish ice classed ships usually trading in the Baltic Sea. Justified alternative values for f_i and f_j factors may be accepted for ice-classed ships outside this scope of application (e.g. very large ships or POLAR CLASS)

For a ship with voluntary structural enhancement, the f_{iVSE} factor is to be computed according to 2.11.2 of the IMO Calculation Guidelines.

For bulk carriers and oil tankers built in accordance with the Common Structural Rules and assigned the class notation CSR, the f_{iCSR} factor is to be computed according to 2.11.3 of the IMO Calculation Guidelines.

f_i capacity factors can be cumulated (multiplied), but the reference design for calculation of f_{iVSE} is to comply with the ice notation and/or Common Structural Rules as the case may be.

10 CUBIC CAPACITY CORRECTION FACTOR fc

Except in the cases listed below, the value of the fc factor is 1.0.

For chemical tankers as defined in regulation 1.16.1 of MARPOL Annex II, the f_c factor is to be computed according to 2.12.1 of the IMO Calculation Guidelines.

For gas carriers as defined in regulation 1.1 of IGC Code having direct diesel driven propulsion, the f_c factor is to be computed according to 2.12.2 of the IMO Calculation Guidelines.

11 INNOVATIVE ENERGY EFFICIENT TECHNOLOGIES

Innovative energy efficient technologies are not taken into account in the first version of this document (see 1.3)

12 EXAMPLE OF CALCULATION

12.1 List of input parameters for calculation of EEDI

The input parameters used in the calculation of the EEDI are provided in Table 1.

The values of all these parameters are to be indicated in the EEDI Technical File and the documents listed in the "source" columnare to be submitted to the verifier.

Symbol	Name	Usage	Source	Scope
	Service notation	Capacity, f_i, f_j and f_c factors		For the ship
	Class notations	fj for shuttle tanker, f_{iCSR}	Classification file	
	Ice notation	fi, fj for ice class		
Lpp	Length between perpendiculars (m)	fi, fj for ice class		
Δ	Displacement @ summer load draught (t)	deadweight	final stability file	
LWT	Ligthweight (t)	deadweight, f_{iVSE}, f_{iCSR}, fc	Sheets of Submitter calculation for $lightweight_{referencedesign}$ lightweight check report	
P_{AE}	Auxiliary engine power (kW)	EEDI	Note: Computed from engines & PTIs powers or electric power table	
V_{ref}	Reference speed (knot)	EEDI	Sea trial report	
Cube	Total cubic capacity of the cargo tanks (m3)	f_c for chemical tankers and gas carriers	Tonnage file	
MCR	Rated installed power (kW)	power	EIAPP certificate or nameplate (if less than 130 kW)	Per engine (nME + nGEN)
MCR_{lim}	Limited rated output power after PTO in (kW)	P_{ME} with PTO option 2	Verification file	

Symbol	Name	Usage	Source	Scope
	Fuel grade	C_F, SFC	NOX Technical File of the parent engine	
SFC	Corrected specific fuel consumption (g/kWh)	EEDI	NOx Technical File of the parent engine	
MCR_{PTO}	Rated electrical output power (kW)	P_{ME}		Per shaft generator (nPTO)
$P_{SM,max}$	Rated power consumption (kW)	EEDI		Per shaft motor (nPTI)
η_{PTI}	efficiency	power		
η_{GEN}	efficiency	power		Per generator (nGEN)
$P_{SHAFTlim}$	Limited shaft propulsion power (kW)	Limited power where means of limitation are fitted	Verification file	Per shaftline (nSHAFT)

Table 1: input parameters for calculation of EEDI

12.2 Sample calculation of EEDI

A sample calculation of EEDI is provided in Appendix 2.

Part III - Verification of EEDI

13 VERIFICATION PROCESS

Attained EEDI is to be computed in accordance with the IMO Calculation Guidelines and Part II of the present Industry Guidelines. Survey and certification of the EEDI are to be conducted on two stages:

1. preliminary verification at the design stage
2. final verification at the sea trial

The flow of the survey and certification process is presented in Figure 2.

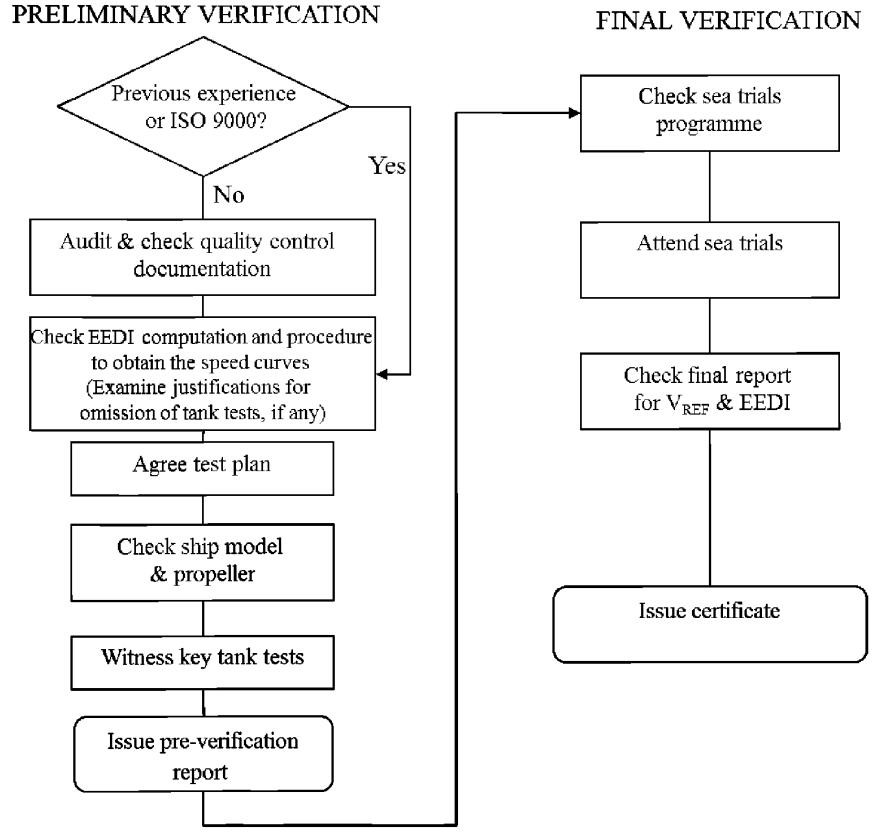


Figure 2: Flow of survey and certification process by verifier

14 DOCUMENTS TO BE SUBMITTED

A sample of document to be submitted to the verifier including additional information for verification is provided in Appendix 2.

The following information is to be submitted by the submitter to the verifier at the design stage:

EEDI Technical File	EEDI Technical File as defined in the IMO Verification Guidelines. See example of the EEDI Technical File in Appendix 1 of IMO Verification Guidelines.
NOx Technical File	Copy of the NOx Technical File and documented summary of the SFC correction for each type of main and auxiliary engine with copy of EIAPP certificate. Note: if the NOx Technical File has not been approved at the time of the preliminary verification, the SFC value with the addition of the guarantee tolerance is to be provided by Manufacturer. In this case, the NOx Technical File is to be submitted at the final verification stage.

Electric Power Table	If P_{AE} is significantly different from the values computed using the formula in 2.5.6.1 or 2.5.6.2 of the IMO Calculation Guidelines
Ship lines and model particulars	- Lines of ship - Report including the particulars of the ship model and propeller model
Verification file of power limitation technical arrangement	If the propulsion power is voluntarily limited by verified technical means
Power curves	Power-speed curves predicted at full scale in sea trial condition and EEDI condition
Description of the towing tank test facility and towing tank test organisation quality manual	If the verifier has no recent experience with the towing tank test facility and the towing tank test organization quality system is not ISO 9001 certified. - Quality management system of the towing tank test including process control, justifications concerning repeatability and quality management processes - Records of measuring equipment calibration as described in Appendix 3 - Standard model-ship extrapolation and correlation method (applied method and tests description)
Gas fuel oil general arrangement plan	If gas fuel is used as the primary fuel of the ship fitted with dual fuel engines. Gas fuel storage tanks (with capacities) and bunkering facilities are to be described.
Towing Tank Tests Plan	Plan explaining the different steps of the towing tank tests and the scheduled inspections allowing the verifier to check compliance with the items listed in Appendix 1 concerning tank tests
Towing Tank Tests Report	- Report of the results of the towing tank tests at sea trial and EEDI condition as required in Appendix 4 - Values of the experience-based parameters defined in the standard model-ship correlation method used by the towing tank test organization/shipyard - Reasons for exempting a towing tank test, only if applicable - Numerical calculations report and validation file of these calculations, only if calculations are used to derive power curves
Ship reference speed V_{ref}	Detailed calculation process of the ship speed, which is to include the estimation basis of experience-based parameters such as roughness coefficient, wake scaling coefficient

Table 2: documents to be submitted at the design stage

The following information is to be submitted by the submitter to the verifier at the final verification stage (and before the sea trials for the programme of sea trials):

Programme of sea trials	Description of the test procedure to be used for the speed trial, with number of speed points to be measured and indication of PTO/PTI to be in operation, if any.
Sea trials report	Report of sea trials with detailed computation of the corrections allowing determination of the reference speed V_{ref}
Final stability file	Final stability file including lightweight of the ship and displacement table based on the results of the inclining test or the lightweight check
Final power curves	Final power curve in the EEDI condition showing the speed adjustment methodology
Revised EEDI Technical File	Including identification of the parameters differing from the calculation performed at the initial verification stage
Ship lines	Lines of actual ship

Table 3: documents to be submitted at the final verification stage

In line with the IMO Verification Guidelines (4.1.2), it is recognized that the documents listed above may contain confidential information of submitters, which requires Intellectual Property Rights (IPR) protection. In the case where the submitter wants a non-disclosure agreement with the verifier, the additional information is to be provided to the verifier upon mutually agreed terms and conditions.

15 PRELIMINARY VERIFICATION AT THE DESIGN STAGE

15.1 Scope of the verifier work

For the preliminary verification of the EEDI at the design stage, the verifier:

- Review the EEDI Technical File, check that all the input parameters (see 12.1 above) are documented and justified and check that the possible omission of a towing tank test has been properly justified
- Check that the ITTC procedures and quality system are implemented by the organization conducting the towing tank tests. The verifier should possibly audit the quality management system of the towing tank if previous experience is insufficiently demonstrated
- Witness the towing tank tests according to a test plan initially agreed between the submitter and the verifier
- Check that the work done by the towing tank test organisation is consistent with the present Guidelines. In particular, the verifier will check that the power curves at full scale are determined in a consistent way between sea trials and EEDI loading conditions, applying the same calculation process of the power curves and considering justifiable differences of experience based parameters between the two conditions
- Issue a pre-verification report

15.2 Definitions

Experience-based parameters means parameters used in the determination of the scale effects coefficients of correlation between the towing tank model scale results and the full scale predictions of power curves.
This may include:

1. Hull roughness correction
2. Wake correction factor
3. Air resistance correction factor (due to superstructures and deck load)
4. Appendages correction factor (for appendages not present at model scale)
5. Propeller cavitation correction factor
6. Propeller open-water characteristics correction
7. C_P and C_N (see below)
8. ΔC_{FC} and Δw_C (see below)

Ship of the same type means a ship of which hull form (expressed in the lines such as sheer plan and body plan) excluding additional hull features such as fins and of which principal particulars are identical to that of the base ship.

Definition of survey methods directly involving the verifier: Review and Witness.
Review means the act of examining documents in order to determine identification and traceability and to confirm that requested information are present and that EEDI calculation process conforms to relevant requirements.

Witness means the attendance at scheduled key steps of the towing tank tests in accordance with the agreed Test Plan to the extent necessary to check compliance with the survey and certification requirements.

15.3 Towing tank tests and numerical calculations
There are two loading conditions to be taken into account for EEDI: EEDI loading condition and sea trial condition.
The speed power curves for these two loading conditions are to be based on towing tank test measurements. Towing tank test means model towing tests, model self-propulsion tests and model propeller open water tests.
Numerical calculations may be accepted as equivalent to model propeller open water tests.

A towing tank test for an individual ship may be omitted based on technical justifications such as availability of the results of towing tank tests for ships of the same type according to 4.2.5 of the IMO Verification Guidelines.

Numerical calculations may be submitted to justify derivation of speed power curves, where only one parent hull form have been verified with towing tank tests, in order to evaluate the effect of additional hull features such as fore bulb variations, fins and hydrodynamic energy saving devices.
These numerical tests may include CFD calculation of propulsive efficiency at reference speed V_{ref} as well as hull resistance variations and propeller open water efficiency.
In order to be accepted, these numerical tests are to be carried out in accordance with defined quality and technical standards (ITTC 7.5-03-01-04 at its latest revision or equivalent). The comparison of the CFD-computed values of the unmodified parent hull form with the results of the towing tank tests must be submitted for review.

15.4 Qualification of verifier personnel
Surveyors of the verifier are to confirm through review and witness as defined in 15.2 that the calculation of EEDI is performed according to the relevant requirements listed in 1.1. The surveyors are to be qualified to be able to carry out these tasks and procedures are to be in place to ensure that their activities are monitored.

15.5 Review of the towing tank test organisation quality system
The verifier is to familiarize with the towing tank test organization test facilities, measuring equipment and quality system for consideration of complying with the requirements of 15.6 prior to the test attendance when the verifier has no recent experience of the towing tank test facilities and the towing tank test organization quality control system is not certified according to a recognized scheme (ISO 9001 or equivalent).

In this case, the following additional information relative to the towing tank test organization is to be submitted to the verifier:

1. descriptions of the towing tank test facility; this includes the name of the facility, the particulars of towing tanks and towing equipment, and the records of calibration of each monitoring equipment as described in Appendix 3
2. quality manual containing at least the information listed in the ITTC Sample quality manual (2002 issue) Records of measuring equipment calibration as described in Appendix 3
3. standard model-ship extrapolation and correlation method (applied method and tests description)

15.6 Review and Witness
The verifier is to review the EEDI Technical File, using also the other documents listed in table 2 and submitted for information in order to verify the calculation of EEDI at design stage. This review activity is described in Appendix 1. Since detailed process of the towing tank tests depends on the practice of each submitter, sufficient information is to be included in the document submitted to the verifier to show that the principal scheme of the towing tank test process meets the requirements of the reference documents listed in Appendix 1 and Appendix 4.

Prior to the start of the towing tank tests, the submitter is to submit a test plan to the verifier. The verifier reviews the test plan and agrees with the submitter which scheduled inspections will be performed with the verifier surveyor in attendance in order to perform the verifications listed in Appendix 1 concerning the towing tank tests.

Following the indications of the agreed test plan, the submitter will notify the verifier for the agreed tests to be witnessed. The submitter will advise the verifier of any changes to the

activities agreed in the Test Plan and provide the submitter with the towing tank test report and results of trial speed prediction.

15.7 Model-ship correlation

Model-ship correlation method followed by the towing tank test organization or shipyard is to be properly documented with reference to the 1978 ITTC Trial prediction method given in ITTC Recommended Procedure 7.5-02-03-1.4 rev.02 of 2011 or subsequent revision, mentioning the differences between the followed method and the 1978 ITTC trial prediction method and their global equivalence.
Considering the formula giving the total full scale resistance coefficient of the ship with bilge keels and other appendages:

$$C_{TS} = \frac{S_S + S_{BK}}{S_S}.[(1+k).C_{FS} + \Delta C_F + C_A] + C_R + C_{AAS} + C_{AppS}$$

The way of calculating the form factor k, the roughness allowance ΔC_F, the correlation allowance C_A, the air resistance coefficient C_{AAS} and the appendages coefficient C_{AppS} are to be documented (if they are taken as 0, this has to be indicated also), as indicated in Appendix 4.

The correlation method used is to be based on thrust identity and the correlation factors is to be according to method 1 ($C_P - C_N$) or method 2 (ΔC_{FC} - Δw_C) of the 1978 ITTC Trial prediction method. If the standard method used by the towing tank test organization doesn't fulfil these conditions, an additional analysis based on thrust identity is to be submitted to the verifier.
The verifier will check that the power-speed curves obtained for the EEDI condition and sea trial condition are obtained using the same calculation process and properly documented as requested in Appendix 4 "Witnessing of model test procedures". In particular, the verifier will compare the differences between experience based coefficients Cp and ΔC_{FC} between the EEDI condition (∇_{full}) and sea trial condition if different from EEDI condition (∇) with the indications given in Figures 3.1 and 3.2 extracted from a SAJ-ITTC study on a large number of oil tankers. If the difference is significantly higher than the values reported in the Figures, a proper justification of the values is to be submitted to the verifier.

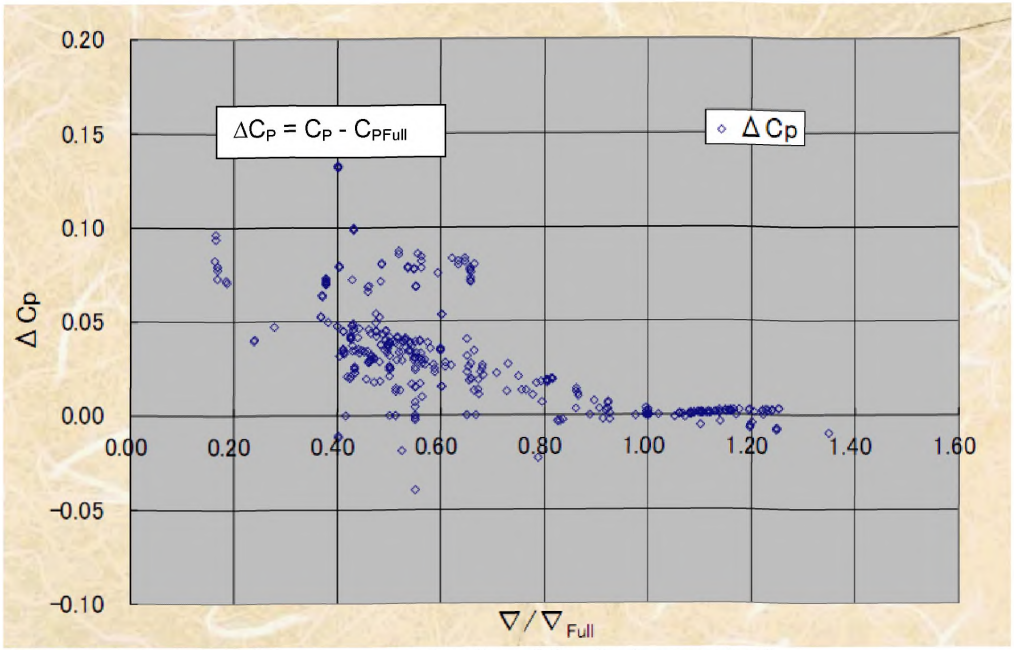


Figure 3.1: Variation of C_P- C_{PFull} as a function of the displacement ratio

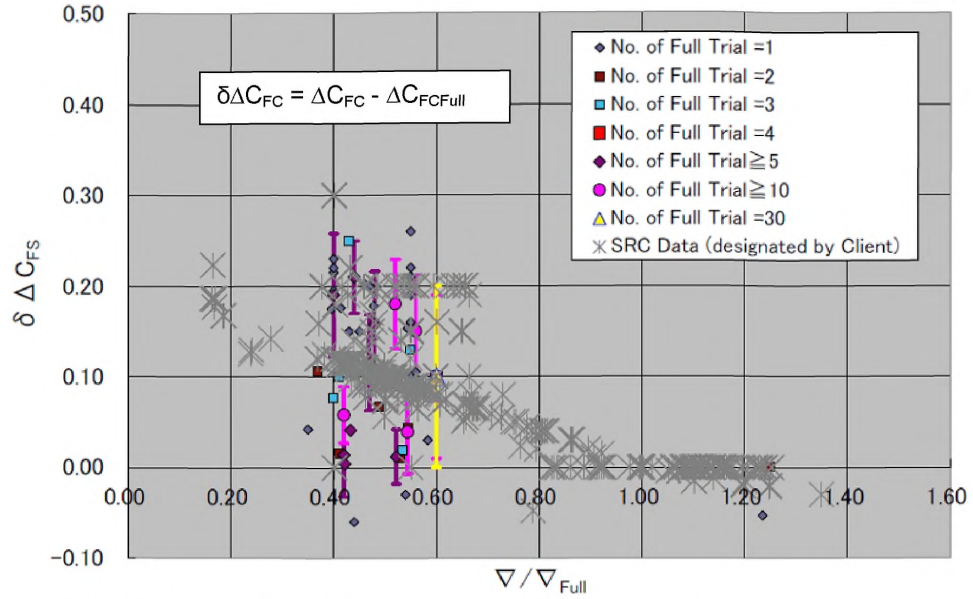


Figure 3.2: Variation of ΔC_{FC} as a function of the displacement ratio

15.8 Pre-verification report

The verifier issues the report on the "Preliminary Verification of EEDI" after it has verified the attained EEDI at the design stage in accordance with paragraphs 4.1 and 4.2 of the IMO Verification Guidelines.

A sample of the report on the “Preliminary Verification of EEDI” is provided in Appendix 5.

16 FINAL VERIFICATION AT SEA TRIAL

16.1 Sea trial procedure

For the verification of the EEDI at sea trial stage, the verifier shall:

- Examine the programme of the sea trial to check that the test procedure and in particular that the number of speed measurement points comply with the requirements of the IMO Verification Guidelines.
- Perform a survey to ascertain the machinery characteristics of some important electric load consumers and producers included in the EPT, if the power P_{AE} is directly computed from the EPT data's.
- Attend the sea trial and notes the main parameters to be used for the final calculation of the EEDI, as given under 4.3.3 of the IMO Verification Guidelines
- Review the sea trial report provided by the submitter and check that the measured power and speed have been corrected according to ITTC Recommended Procedure 7.5-04-01-01.2 or the equivalent (see note).
- Check that the power curve estimated for EEDI condition further to sea trial is obtained by power adjustment.
- Review the revised EEDI Technical File.
- Issue or endorse the International Energy Efficiency Certificate

Note: For application of the present Guidelines the following procedures are considered wholly or partly (according to their scope) equivalent to ITTC Recommended Procedure 7.5-04-01-01.2 :

1. ISO 15016:2002
2. BSRA Standard method of speed trials analysis – BSRA report 486 / 1976

Table 5 lists the data which are to be measured and recorded during sea trials:

Symbol	Name	Measurement	Remark
	Time and duration of sea trial		
	Draft marks readings		
	Air and sea temperature		
	Main engine setting	Machinery log	
Ψ_0	Course direction (rad)	Compass	
V_G	Speed over ground (m/s)	GPS	
n	Propeller rpm (rpm)	Tachometer	
P_S	Power measured (kW)	Torsion meter or strain gauges (for torque measurement) or any alternative method that offer an equivalent level of precision and accuracy of power measurement	
V_{WR}	Relative wind velocity (m/s)	Wind indicator	
Ψ_{WR}	Relative wind direction (rad)	See above	
T_m	Mean wave period (seas and swell) (s)	Visual observation by multiple observers supplemented by hindcast data or wave measuring devices (wave buoy, wave radar, etc.)	
$H_{1/3}$	Significant wave height (seas and swell) (m)	See above	
χ	Incident angle of waves (seas and swell) (rad)	See above	
δ_R	Rudder angle (rad)	Rudder	
β	Drift angle (rad)	GPS	

Table 5: Measured data during sea trials

Prior to the sea trial, the programme of the sea trials and , if available, additional documents listed in table 3 are to be submitted to the verifier in order for the verifier to check the procedure and to attend the sea trial and perform the verifications included in Appendix 1 concerning the sea trial.

The ship speed is to be measured at sea trial for at least three points of which range includes the total propulsion power defined in 5.2 according to the requirements of the IMO Verification Guidelines 4.3.6. This requirement applies individually to each ship, even if the ship is a sistership of a parent vessel.

16.2 Estimation of the EEDI reference speed V_{Ref}

The adjustment procedure is applicable to the most complex case where sea trials cannot be conducted in EEDI loading condition. It is expected that this will be usually the case for cargo ships like bulk carriers for instance.

The adjustment procedure uses the graphical construction described in Figure 4 that can be described by the following general procedure, applied only to EEDI functioning point (75% of MCR):

Compute for each corrected power value measured during sea trial the ratio $P_{measured}$ / $P_{tanktestpredicted}$. These ratios are put on the curve obtained from the model tests in EEDI condition to obtain the curve of the trial results for EEDI condition.

Reference is made to paragraph 3 of Appendix 2 (Figure 3.1) where an example is provided.

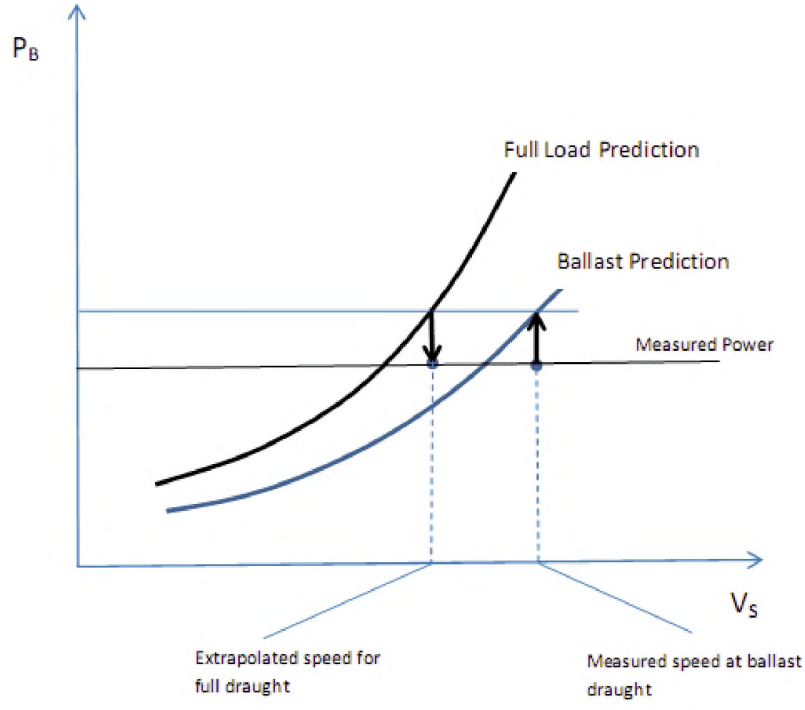


Figure 4: Extrapolation from Measured Values at sea trial draught to EEDI Draught

16.3 Revision of EEDI Technical File

The EEDI Technical File is to be revised, as necessary, by taking into account the results of sea trials. Such revision is to include, as applicable, the adjusted power curve based on the results of sea trial (namely, modified ship speed under the condition as specified in paragraph 2.2 of the IMO Calculation Guidelines), the finally determined deadweight/gross tonnage and the recalculated attained EEDI and required EEDI based on these modifications.

The revised EEDI Technical File is to be submitted to the verifier for the confirmation that the revised attained EEDI is calculated in accordance with regulation 20 of MARPOL Annex VI and the IMO Calculation Guidelines

17 VERIFICATION OF THE EEDI IN CASE OF MAJOR CONVERSION

Verification of the EEDI in case of major conversion is not taken into account in the first version of this document (see 1.3)

APPENDIX 1
Review and witness points

Table 4: Review and witness points

Ref.	Function	Survey method	Reference document	Documentation available to verifier	Remarks
01	EEDI Technical File	Review	IMO Verification Guidelines This document	Documents in table 2	
02	Limitation of power	Review	IMO Calculation Guidelines	Verification file of limitation technical means	Only If means of limitation are fitted
03	Electric Power Table	Review	Appendix 2 to IMO Calculation Guidelines Appendix 2 to IMO Verification Guidelines	EPT EPT-EEDI form	Only if PAE is significantly different from the values computed using the formula in 2.5.6.1 or 2.5.6.2 of the IMO Calculation Guidelines
04	Calibration of towing tank test measuring equipment	Review & witness	Appendix 3	Calibration reports	Check at random that measuring devices are well identified and that calibration reports are currently valid
05	Model tests – ship model	Review & witness	Appendix 4	Ship lines plan & offsets table Ship model report	Checks described in Appendix 4.1
06	Model tests – propeller model	Review & witness	Appendix 4	Propeller model report	Checks described in Appendix 4.2
07	Model tests – Resistance test, Propulsion test, Propeller open water test	Review & witness	Appendix 4	Towing tank tests report	Checks described in Appendix 4.3 Note: propeller open water test is not needed if a stock propeller is used. In this case, the open water characteristics of the stock propeller are to be annexed to the towing tank tests report.
08	Model-ship extrapolation and correlation	Review	ITTC 7.5-02-03-01.4 1978 ITTC performance prediction method (rev.02 of 2011 or subsequent revision) Appendix 4 This document 15.7	Documents in table 2	Check that the ship-model correlation is based on thrust identity with correlation factor according to method 1 ($C_P - C_N$) or method 2 ($\Delta C_{FC} - \Delta w_C$) Check that the power-speed curves obtained for the EEDI condition and sea trial condition are obtained using the same calculation process with justified values of experience-based parameters
09	Numerical calculations replacing towing tank tests	Review	ITTC 7.5-03-01-04 (latest revision) or equivalent	Report of calculations	
10	Electrical machinery survey prior to sea trials	Witness	Appendix 2 to IMO Verification Guidelines		Only if P_{AE} is computed from EPT
11	Programme of sea trials	Review	IMO Verification Guidelines	Programme of sea trials	Check minimum number of measurement points (3) Check the EEDI condition in EPT (if P_{AE} is computed from EPT)

Ref.	Function	Survey method	Reference document	Documentation available to verifier	Remarks
12	Sea trials	Witness	ISO 19019:2005 or ITTC 7.5-04-01-01.1 (latest revision)		Check: • Propulsion power, particulars of the engines • Draught and trim • Sea conditions • Ship speed • Shaft power & rpm Check operation of means of limitations of engines or shaft power (if fitted) Check the power consumption of selected consumers included in sea trials condition EPT (if P_{AE} is computed from EPT)
13	Sea trials – corrections calculation	Review	ITTC Recommended Procedure 7.5-04-01-01.2 or equivalent	Sea trials report	Check that the displacement and trim of the ship in sea trial condition has been obtained with sufficient accuracy Check compliance with ITTC Recommended Procedure 7.5-04-01-01.2 or equivalent
14	Sea trials – adjustment from trial condition to EEDI condition	Review	This document 16.2	Power curves after sea trial	Check that the power curve estimated for EEDI condition is obtained by power adjustment
15	EEDI Technical File – revised after sea trials	Review	IMO Verification Guidelines	Revised EEDI Technical File	Check that the file has been updated according to sea trials results

APPENDIX 2
Sample of document to be submitted to the verifier including additional information for verification

Caution

Protection of Intellectual Property Rights

This document contains confidential information (defined as additional information) of submitters. Additional information should be treated as strictly confidential by the verifier and failure to do so may lead to penalties. The verifier should note following requirements of IMO Verification Guidelines:

"*4.1.2 The information used in the verification process may contain confidential information of submitters, which requires Intellectual Property Rights (IPR) protection. In the case where the submitter want a non-disclosure agreement with the verifier, the additional information should be provided to the verifier upon mutually agreed terms and conditions.*"

Revision list

REV.	ISSUE DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED
B	01/05/2014	Final stage: sections 1 to 16	XYZ	YYY	ZZZ
A	01/01/2013	Design stage: sections 1 to 13	XXX	YYY	ZZZ

Content

1 GENERAL

This calculation of the Energy Efficiency Design Index (EEDI) is based on:

- Resolution MEPC.203(62) amendments to include regulations on energy efficiency in MARPOL Annex VI
- Resolution MEPC.212(63) 2012 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships

Calculations are being dealt with according to the Industry Guidelines on calculation and verification of EEDI, 2012 issue.

2 DATA

2.1 Main parameters

Parameter	Value	Reference
Owner	OWNER	
Builder	YARD	
Hull No.	12346	
IMO No.	94111XX	
Ship's type	Bulk carrier	
Ship classification notations	I HULL, MACH, Bulk Carrier CSR BC-A (holds 2 and 4 may be empty) ESP GRAB[20] Unrestricted Navigation AUT-UMS, GREEN PASSPORT, INWATERSURVEY, MON-SHAFT	
HULL PARTICULARS		
Length overall	191.0 m	
Length between perpendiculars	185.0 m	
Breadth, moulded	32.25 m	
Depth, moulded	17.9 m	
Summer load line draught, moulded	12.70 m	
Deadweight at summer load line draught	55 000 DWT	
Lightweight	11 590 tons	
Owner's voluntary structural enhancements	No	
MAIN ENGINE		
Type & manufacturer	BUILDER 6SRT60ME	
Specified Maximum Continuous Rating (SMCR)	9 200 kW x 105 rpm	
SFC at 75% SMCR	171 g/kWh	See paragraph 10.1
Number of set	1	
Fuel type	Diesel/Gas oil	
AUXILIARY ENGINES		
Type & manufacturer	BUILDER 5X28	
Specified Maximum Continuous Rating (SMCR)	650 kW x 700 rpm	
SFC at 50% SMCR	205 g/kWh	See paragraph 10.2
Number of set	3	
Fuel type	Diesel/Gas oil	
OVERVIEW OF PROPULSION SYSTEM AND ELECTRICITY SUPPLY SYSTEM		See section 4
SHAFT GENERATORS		
Type & manufacturer	None	
Rated electrical output power		
Number of set	0	
SHAFT MOTORS		

Parameter	Value	Reference
Type & manufacturer	None	
Rated power consumption		
Efficiency		
Number of set	0	
MAIN GENERATORS		
Type & manufacturer	BUILDER AC120	
Rated output	605 kWe	
Efficiency	0.93	
Number of set	3	
PROPULSION SHAFT		
Propeller diameter	5.9 m	
Propeller number of blades	4	
Voluntarily limited shaft propulsion power	No	
Number of set	1	
ENERGY SAVING EQUIPMENT		See section 9
Description of energy saving equipment	Propeller boss cap fins	
Power reduction or power output	None	

2.2 Preliminary verification of attained EEDI

Parameter	Value	Reference
TOWING TANK TEST ORGANIZATION		
Identification of organization	TEST corp.	See section 6.
ISO Certification or previous experience?	Previous experience	
TOWING TANK TESTS		
Exemption of towing tank tests	No	
Process and methodology of estimation of the power curves		See section 7
Ship model information		See subparagraph 7.2.1
Propeller model information		See subparagraph 7.2.2
EEDI & sea trial loading conditions	EEDI: mean draft: 12.7 m Trim 0 Sea trial (ballast): mean draft: 5.8 m Trim 2.6 m by stern	
Propeller open water diagram (model, ship)		See paragraph 7.4
Experience based parameters		See paragraph 7.3
Power curves at full scale		See section 3
Ship Reference speed	14.25 knots	
ELECTRIC POWER TABLE (as necessary, as defined in IMO EEDI Calculation Guidelines)	Significant difference from 2.5.6 of IMO EEDI Calculation Guidelines	See section 5
CALCULATION OF ATTAINED EEDI	5.06	See section 11
CALCULATION OF REQUIRED EEDI	5.27	See section 12
CALCULATION OF ATTAINED $EEDI_{weather}$	Not calculated	See section 13

2.3 Final verification of attained EEDI

Parameter	Value	Reference
SEA TRIAL LOADING CONDITION		
POWER CURVES		See section 3
Sea trial report with corrections		See section 15
Ship Reference speed	14.65 knots	
FINAL DEADWEIGHT		See section 14
Displacement	66 171 tons	
Lightweight	11 621 tons	
Deadweight	54 550 DWT	
FINAL ATTAINED EEDI	4.96	See section 16

3 POWER CURVES

The power curves estimated at the design stage and modified after the sea trials are given in Figure 3.1.

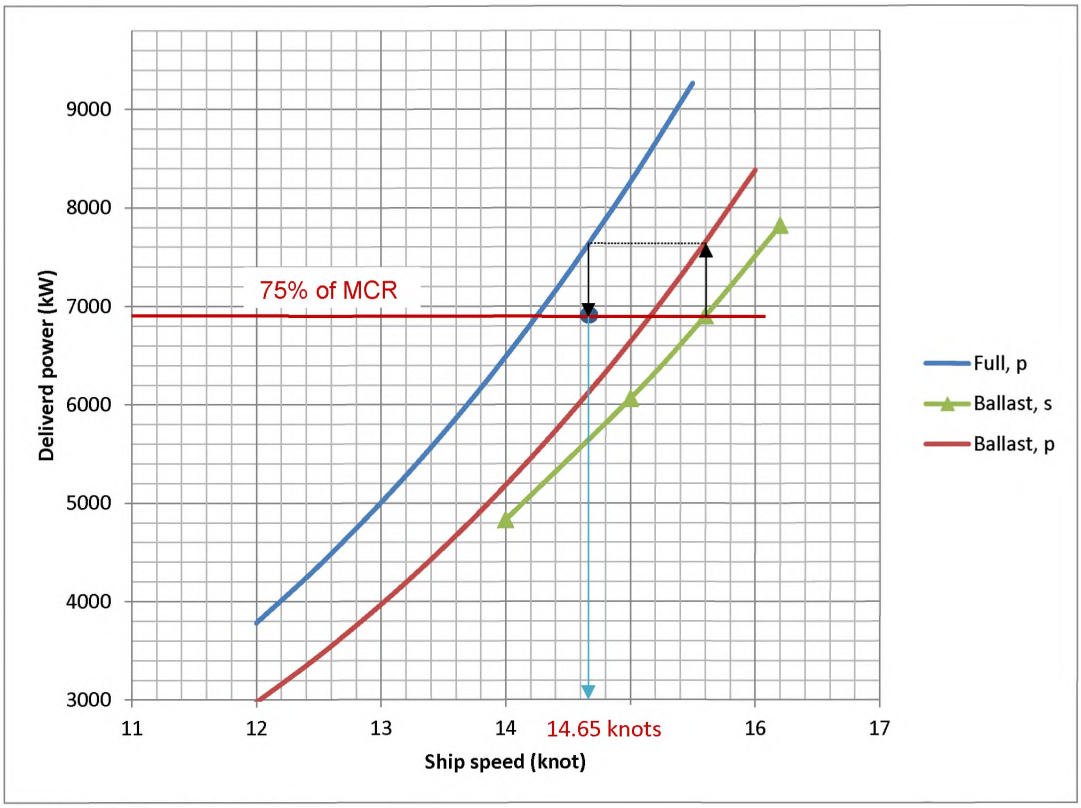


Figure 3.1: Power curves

4 OVERVIEW OF PROPULSION SYSTEM AND ELECTRIC POWER SYSTEM

Figure 4.1 shows the connections within the propulsion and electric power supply systems.

The characteristics of the main engines, auxiliary engines, electrical generators and propulsion electrical motors are given in table 2.1.

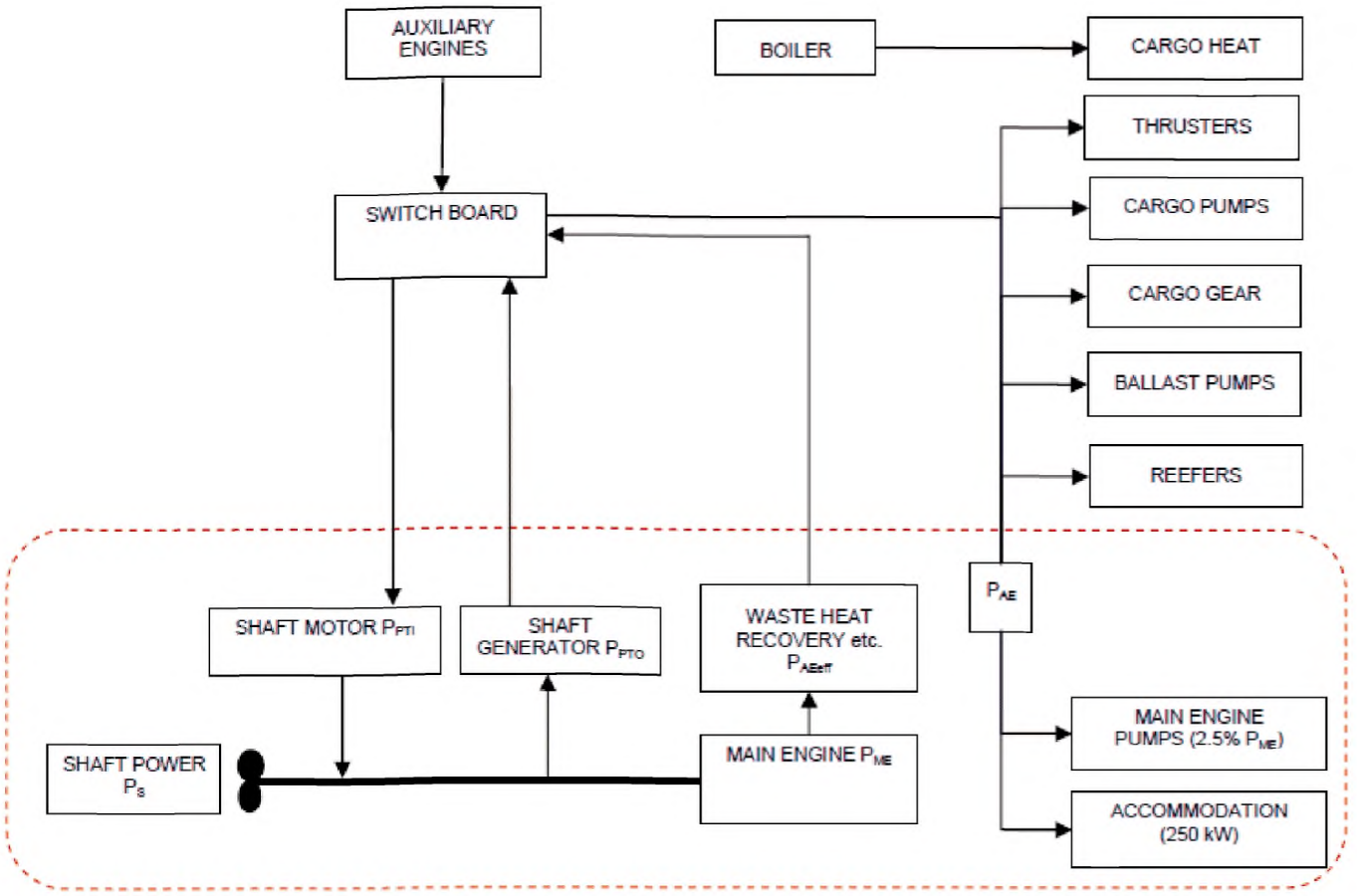


Figure 4.1 scheme of the propulsion and power generation systems

5 ELECTRIC POWER TABLE

The electric power for the calculation of EEDI is provided in table 5.1.

Id	Group	Description	Mech. Power "Pm"	El. Motor output	Efficien. "e"	Rated el. Power "Pr"	load factor "kl"	duty factor "kd"	time factor "kt"	use factor "ku"	Necessary power "Pload"
1	A	STEERING GEAR	N.A.	N.A.	N.A.	45,0	0,9	1	0,3	0,27	12.2
2	A	HULL CATHODIC PROTECTION	N.A.	N.A.	N.A.	10	1	1	1	1,00	10,0
3	A	CRANE	N.A.	N.A.	N.A.	10,00	0,2	1	1	0,20	2,0
4	A	COMPASS	N.A.	N.A.	N.A.	0,5	1	1	1	1,00	0,5
5	A	RADAR NO.1	N.A.	N.A.	N.A.	1,3	1	0,5	1	0,50	0,7
6	A	RADAR NO.2	N.A.	N.A.	N.A.	1,3	1	0,5	1	0,50	0,7
7	A	NAVIGATION EQUIPMENT	N.A.	N.A.	N.A.	5,0	1	1	1	1,00	5,0
8	A	INTERNAL COMM. EQUIPMENT	N.A.	N.A.	N.A.	2,5	1	1	0,1	0,10	0,2
9	A	RADIO EQUIPMENT	N.A.	N.A.	N.A.	3,5	1	1	0,1	0,10	0,4
10	A	MOORING EQ.	N.A.	N.A.	N.A.	7,0	1	1	0,1	0,10	0,7
11	B	MAIN COOLING SEA WATER PUMP NO.1	28,0	30	0,925	30,3	0,9	0,66	1	0,59	18,0
12	B	MAIN COOLING SEA WATER PUMP NO.2	28,0	30	0,925	30,3	0,9	0,66	1	0,59	18,0
13	B	MAIN COOLING SEA WATER PUMP NO.3	28,0	30	0,925	30,3	0,9	0,66	1	0,59	18,0
14	B	LT COOLING FW PUMP NO.1	28,0	30	0,925	30,3	0,9	0,66	1	0,59	18,0
15	B	LT COOLING FW PUMP NO.2	28,0	30	0,925	30,3	0,9	0,66	1	0,59	18,0
16	B	LT COOLING FW PUMP NO.3	28,0	30	0,925	30,3	0,9	0,66	1	0,59	18,0
17	B	M/E COOLING WATER PUMP NO.1	13,0	15	0,9	14,4	1	0,5	1	0,50	7,2
18	B	M/E COOLING WATER PUMP NO.2	13,0	15	0,9	14,4	1	0,5	1	0,50	7,2
19	C	MAIN LUB. OIL PUMP NO.1	55,0	90	0,94	58,5	0,9	0,5	1	0,45	26,3

Id	Group	Description	Mech. Power "Pm"	El. Motor output	Efficien. "e"	Rated el. Power "Pr"	load factor "kl"	duty factor "kd"	time factor "kt"	use factor "ku"	Necessary power "Pload"
20	C	MAIN LUB. OIL PUMP NO.2	55,0	90	0,94	58,5	0,9	0,5	1	0,45	26,3
21	C	H.F.O. TRANSFER PUMP	6,0	7,5	0,88	6,8	1	1	0,1	0,10	0,7
22	C	D.O. TRANSFER PUMP	6,0	7,5	0,88	6,8	1	1	0,1	0,10	0,7
23	C	L.O. TRANSFER PUMP	1,4	2,5	0,8	1,8	1	1	0,1	0,10	0,2
24	C	TECHNICAL FRESH WATER PUMP NO.1	2,5	3,5	0,85	2,9	1	0,5	0,1	0,05	0,1
25	C	TECHNICAL FRESH WATER PUMP NO.2	2,5	3,5	0,85	2,9	1	0,5	0,1	0,05	0,1
26	C	E/R SUPPLY FAN NO.1	14,0	20	0,9	15,5	0,9	1	1	0,90	14,0
27	C	E/R SUPPLY FAN NO.2	14,0	20	0,9	15,5	0,9	1	1	0,90	14,0
28	C	E/R SUPPLY FAN NO.3	14,0	20	0,9	15,5	0,9	1	1	0,90	14,0
29	C	E/R SUPPLY FAN NO.4	14,0	20	0,9	15,5	0,9	1	1	0,90	14,0
30	C	PURIFIER ROOM EXH.VENTILATOR	2,5	3	0,82	3,0	0,9	1	1	0,90	2,7
31	C	PUMP HFO SUPPLY UNIT NO.1	2,1	3	0,8	2,6	0,9	0,5	1	0,45	1,2
32	C	PUMP HFO SUPPLY UNIT NO.2	2,1	3	0,8	2,6	0,9	0,5	1	0,45	1,2
33	C	CIRC. PUMP FOR HFO SUPPLY UNIT NO.1	2,8	3,5	0,84	3,3	0,9	0,5	1	0,45	1,5
34	C	CIRC. PUMP FOR HFO SUPPLY UNIT NO.2	2,8	3,5	0,84	3,3	0,9	0,5	1	0,45	1,5
35	C	H.F.O. SEPARATOR NO.1	N.A.	N.A.	N.A.	6,5	0,9	0,5	0,9	0,41	2,6
36	C	H.F.O. SEPARATOR NO.2	N.A.	N.A.	N.A.	6,5	0,9	0,5	0,9	0,41	2,6
37	C	MAIN AIR COMPRESSER NO.1	N.A.	N.A.	N.A.	43,0	1	0,5	0,1	0,05	2,2
38	C	MAIN AIR COMPRESSER NO.2	N.A.	N.A.	N.A.	43,0	1	0,5	0,1	0,05	2,2
39	C	SERVICE AIR COMPRESSER	N.A.	N.A.	N.A.	22,0	1	1	0,1	0,10	2,2
40	C	VENT. AIR SUPPLY	N.A.	N.A.	N.A.	1,0	1	1	0,5	0,50	0,1
41	C	BILGE WATER SEPARATOR	N.A.	N.A.	N.A.	1,5	1	1	0,1	0,10	0,2
42	C	M/E L.O. SEPARATOR	N.A.	N.A.	N.A.	6,5	0,9	1	0,2	0,18	1,2
43	C	G/E L.O. SEPARATOR	N.A.	N.A.	N.A.	6,5	0,9	1	0,2	0,18	1,2
44	D	HYDROPHORE PUMP NO.1	2,8	4	0,84	3,3	1	0,5	0,1	0,05	0,2
45	D	HYDROPHORE PUMP NO.2	2,8	4	0,84	3,3	1	0,5	0,1	0,05	0,2
46	D	HOT WATER CIRCULATING PUMP NO.1	0,5	1,0	0,8	0,8	1	0,5	0,2	0,10	0,1
47	D	HOT WATER CIRCULATING PUMP NO.2	0,5	1,0	0,8	0,8	1	0,5	0,2	0,10	0,1
48	E	E/R WORKSHOP WELDING SPACE EXH.	0,5	0,8	0,8	0,6	0,9	1	1	0,90	0,6
49	F	ECR COOLER UNIT	N.A.	N.A.	N.A.	4,2	1	1	0,5	0,50	2,1
50	F	FAN FOR AIR CONDITIONING PLANT	N.A.	N.A.	N.A.	8,0	0,9	1	0,5	0,45	3,6
51	F	COMP. AIR CONDITIONING PLANT NO.1	N.A.	N.A.	N.A.	10,0	0,9	1	0,5	0,45	4,5
52	F	COMP. AIR CONDITIONING PLANT NO.2	N.A.	N.A.	N.A.	10,0	0,9	1	0,5	0,45	4,5
53	F	COMP. AIR CONDITIONING PLANT NO.3	N.A.	N.A.	N.A.	10,0	0,9	1	0,5	0,45	4,5
54	F	COMP. AIR CONDITIONING PLANT NO.4	N.A.	N.A.	N.A.	10,0	0,9	1	0,5	0,45	4,5
55	G	FAN FOR GALLEY AIR COND. PLANT	N.A.	N.A.	N.A.	1,5	0,9	1	0,5	0,45	0,7
56	G	COMP. FOR GALLEY AIR COND. PLANT	N.A.	N.A.	N.A.	3,5	0,9	1	0,5	0,45	1,6
57	G	REF. COMPRESSOR NO.1	N.A.	N.A.	N.A.	4,0	1	0,5	0,1	0,05	0,2
58	G	REF. COMPRESSOR NO.2	N.A.	N.A.	N.A.	4,0	1	0,5	0,1	0,05	0,2
59	G	GALLEY EQUIPMENT	N.A.	N.A.	N.A.	80,0	0,5	1	0,1	0,05	4,0
60	H	VAC. COLLECTION SYSTEM	2,4	3,0	0,8	3,0	1	1	1	1,00	3,0
61	H	GALLEY EXH.	1,2	1,5	0,8	1,5	1	1	1	1,00	1,5
62	H	LAUNDRY EXH.	0,1	0,15	0,8	0,1	1	1	1	1,00	0,1
63	H	SEWAGE TREATMENT	N.A.	N.A.	N.A.	4,5	1	1	0,1	0,10	0,5

Id	Group	Description	Mech. Power "Pm"	El. Motor output	Efficien. "e"	Rated el. Power "Pr"	load factor "kl"	duty factor "kd"	time factor "kt"	use factor "ku"	Necessary power "Pload"
64	H	SEWAGE DISCHARGE	3	7,5	0,88	3,4	0,9	1	0,1	0,09	0,3
65	I	ACCOMMODATION LIGHTING	N.A.	N.A.	N.A.	16,0	1	1	0,5	0,5	8,0
66	I	E/R LIGHTING	N.A.	N.A.	N.A.	18,0	1	1	1	1,00	18,0
67	I	NAVIGATION LIGHTING	N.A.	N.A.	N.A.	0,9	1	0,5	1	0,50	0,4
68	I	BACK. NAV. LIGHTING	N.A.	N.A.	N.A.	0,9	1	0,5	1	0,50	0,4
								TOTAL POWER			354,0
P_{AE} = Total Power / (average efficiency of generators) = 354/0.93 = 381 kW											

Table 5.1: Electric power table for calculation of PAE

6 TOWING TANK TEST ORGANIZATION QUALITY SYSTEM

Towing tank tests will be performed in TEST corp.

The quality control system of the towing tank test organization TEST corp. has been documented previously (see report 100 for the ship hull No. 12345) and the quality manual and calibration records are available to the verifier.

The measuring equipment has not been modified since the issue of report 100 and is listed in table 6.1.

	Manufacturer	Model	Series	Lab. Id.	status
Propeller dynamometer	B&N	6001	300	125-2	Calibrated 01/01/2011
...					

Table 6.1: List of measuring equipment

7 ESTIMATION PROCESS OF POWER CURVES AT DESIGN STAGE

7.1 Test procedure

The tests and their analysis are conducted by TEST corp. applying their standard correlation method (document is given in annex 1).

The method is based on thrust identity and references ITTC Recommended Procedure 7.5 - 02 - 03 -1.4 ITTC 1978 Trial Prediction Method (in its latest reviewed version of 2011), with prediction of the full scale rpm and delivered power by use of the $C_P - C_N$ correction factors.

The results are based on a Resistance Test, a Propulsion Test and use the Open Water Characteristics of the model propeller used during the tests and the Propeller Open Water Characteristics of the final propeller given in 7.4.

Results of the resistance tests and propulsion tests of the ship model are given in the report of TEST corp. given in annex 2.

7.2 Speed prediction

The ship delivered power P_D and rate of revolutions n_S are determined from the following equations:

$$P_D = C_P . P_{DS}$$
$$n_T = C_N . n_S$$

Where C_N and C_P are experience-based factors and P_{DS} (resp. n_S) are the delivered power (resp. rpm) obtained from the analysis of the towing tank tests.

The ship total resistance coefficient C_{TS} is given by:

$$C_{TS} = \frac{S_S + S_{BK}}{S_S}.[(1+k).C_{FS} + \Delta C_F] + C_R + C_{AAS} + C_{AppS}$$

Where:

S_S: ship hull wetted surface, here 9886 m^2

S_{BK}: wetted surface of bilge keels

k: form factor. Here 1+k = 1.38 over the speed range, determined according to ITTC standard procedure 7.5-02-02-01

C_{FS}: ship frictional resistance coefficient (computed according to ITTC 1957 formula)

ΔC_F: roughness allowance, computed according to Bowden-Davison formula. Here ΔC_F = 0.000339

C_R: residual resistance coefficient

C_{AAS}: air resistance coefficient

C_{AppS}: ship appendages (propeller boss cap fins) resistance coefficient, computed as provided in annex 2.

The air resistance coefficient is computed according to the following formula:

$$C_{AAS} = C_{DA}.\frac{\rho_A.A_{VS}}{\rho_S.S_S}$$

Where:

C_{DA} is the air drag coefficient, here 0.8

ρ_A and ρ_S are the air density and water density, respectively

A_{VS} is the projected wind area, here 820 m^2

$C_{AAS} = 7.9.10^{-5}$

The delivered power P_D results of the towing tank tests are summarized in table 7.1 for the EEDI condition (scantling draft) and in table 7.2 for the sea trial condition (light ballast draft).

Model reference: SX100 - model scale: 40					
Loading condition: EEDI loading condition (12.70 m draft)					
Resistance test: R001		Propulsion test: P001		Model propeller: Prop01	
Ship speed V (knot)	Wake factor w_{TM}-w_{TS}	Propeller thrust T_S (kN)	Propeller torque Q_S (kNm)	rpm on ship n_S	Delivered Power P_D (kW)
12	0.098	522	467	78	3781
12.5	0.093	578	514	82	4362
13	0.089	638	563	86	5004
13.5	0.081	701	615	90	5710
14	0.079	768	669	93	6486
14.5	0.086	838	727	97	7333
15	0.091	912	786	101	8257
15.5	0.099	990	849	105	9261
Experience-based factor C_P: 1.01					
Experience based factor C_N: 1.02					

Table 7.1: results of trial prediction in EEDI condition

Model reference: SX100 - model scale: 40					
Loading condition: Sea trial condition (5.80 m draft)					
Resistance test: R002		Propulsion test: POO2		Model propeller: Prop01	
Ship speed V (knot)	Wake factor w_{TM}-w_{TS}	Propeller thrust T_S (kN)	Propeller torque Q_S (kNm)	rpm on ship n_S	Delivered Power P_D (kW)
12	0,079	406	379	72	2974
12,5	0,081	451	418	76	3445
13	0,083	500	459	79	3968
13,5	0,085	551	503	83	4545
14	0,087	606	549	87	5181
14,5	0,088	664	597	90	5878
15	0,091	725	648	94	6641
15,5	0,089	790	701	98	7474
Experience-based factor C_P: 1.05					
Experience based factor C_N: 1.03					

Table 7.2: results of trial prediction in sea trial condition

The predicted results are represented on the speed curves given in Figure 3.1. The EEDI condition results are indexed (Full, p), the sea trial condition results (Ballast, p).

7.3 Ship and propeller models

The ship model is at scale λ = 40. The characteristics are given in table 7.3.

Identification (model number or similar)	SX 100
Material of construction	Wood
Principal dimensions	
Length between perpendiculars (L_{PP})	4.625 m
Length of waterline (L_{WL})	4.700 m
Breadth (B)	0.806 m
Draught (T)	0.317 m
Design displacement (Δ) (kg, fresh water)	1008.7 kg
Wetted surface area	6.25 m^2
Details of turbulence stimulation	Sand strips
Details of appendages	rudder
Tolerances of manufacture	+/- 2.5 mm on length +/- 1 mm on breadth

Table 7.3: characteristics of the ship model

The propeller model used during the tests is a stock model with the following characteristics:

Identification (model number or similar)	Prop01
Materials of construction	aluminium
Blade number	4
Principal dimensions	
Diameter	147.5 mm
Pitch-Diameter Ratio (P/D)	0.68
Expanded blade Area Ratio (A_E/A_0)	0.60
Thickness Ratio (t/D)	0.036
Hub/Boss Diameter (d_h)	25 mm
Tolerances of manufacture	Diameter (D): ± 0.10 mm Thickness (t): ± 0.10 mm Blade width (c): ± 0.20 mm Mean pitch at each radius (P/D): ± 0.5% of design value.

Table 7.4: characteristics of the stock propeller used during the tests

7.4 Open water characteristics of propeller

The open water characteristics of the stock model propeller are given in annex 2. The open water characteristics of the ship propeller are given in Figure 7.1.

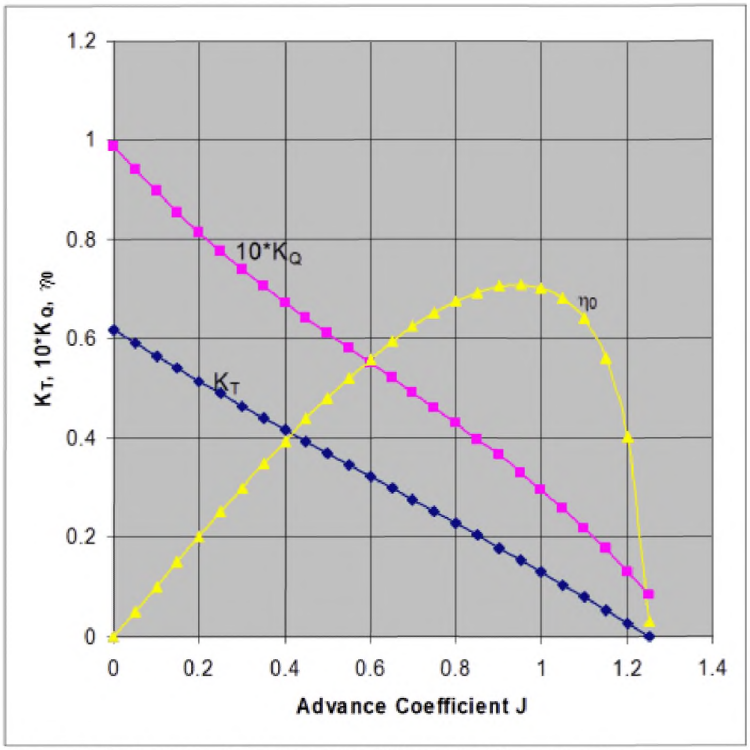


Figure 7.1: open water characteristics of ship propeller

8 LINES AND OFFSETS OF THE SHIP

The ships lines and offsets table are given in Annex 3.

9 DESCRIPTION OF ENERGY SAVING EQUIPMENT

9.1 Energy saving equipment of which effects are expressed as $P_{AEeff}(i)$ and/or $P_{eff}(i)$ in the EEDI calculation formula

None here.

9.2 Other energy saving equipment

The propeller boss cap fins are described in annex 4.

10 JUSTIFICATION OF SFC (DOCUMENTS ATTACHED TO NO_X TECHNICAL FILE OF THE PARENT ENGINE)

10.1 Main engine

The shop test report for the parent main engine is provided in annex 5.1. The SFOC has been corrected to ISO conditions.

10.2 Auxiliary engine

The technical file of the EIAPP certificate of the auxiliary engines is provided in annex 5.2. The SFOC has been corrected to ISO conditions.

11 CALCULATION OF ATTAINED EEDI AT DESIGN STAGE

11.1 Input parameters and definitions

The EEDI quantities and intermediate calculations are listed in table 11.1:

EEDI quantity	Value	Remarks
C_{FME}	3.206	Marine Diesel oil is used for shop test of the main engine
P_{ME}	6 900 kW	No shaft generator installed (P_{PTO} = 0) MCR is 9200 kW PME = 0.75x9200 = 6 900 kW
SFC_{ME}	171 g/kWh	According to parent engine shop test report in ISO conditions (see 10.1)
CF_{AE}	3.206	Marine diesel oil is used for shop test of the auxiliary engine
P_{PTI}	0	No shaft motor installed
P_{AE}	381 kW	MCR of the engine is 9200 kW, less than 10000kW $P_{AE} = 0.05.(\sum_{i=1}^{nME} MCR_{MEi} + \frac{\sum_{i=1}^{nPTI} P_{PTI(i)}}{0.75})$ P_{AE} = 0.05*9200 = 460 kW According to electric power table included in table 5.1, ∑Pload(i) = 354 kW The weighted average efficiency of generators = 0.93 (KWelec/kWmech) P_{AE} = ∑Pload(i) / 0.93 = 381 kW The difference (460 – 381) KW is expected to vary EEDI by slightly more than 1%, so 381 kW is considered.
SFC_{AE}	205 g/kWh	According to technical file of EIAPP certificate in ISO conditions (see 10.2)
P_{eff}	0	No mechanical energy efficient devices The propeller boss cap fins act by reducing ship resistance
P_{AEeff}	0	No auxiliary power reduction
f_{eff}		Not relevant here (see above)
f_j	1.0	The ship is a bulk carrier without ice notations. fj = 1.0
f_i	1.017	No ice notation f_{iICE} = 1.0 No voluntary structural enhancement for this ship f_{iVSE} = 1.0 The ship has the notation Bulk carrier CSR: f_{iCSR} = 1 + 0.08*LWT_{CSR} / DWT_{CSR} = 1+0.08*11590/55000 = 1.017 fi = f_{iICE} x f_{iVSE} x f_{iCSR} = 1.017
f_w	1.0	For attained EEDI calculation under regulation 20 and 21 of MARPOL Annex VI, f_w is 1.0
f_c	1.0	The ship is a bulk carrier f_c = 1.0
Capacity	55000	For a bulk carrier, Capacity is deadweight = 55 000 tons
V_{ref}	14.25 knots	At design stage, reference speed is obtained from the towing tank test report and delivered power in scantling draft (EEDI) condition is given in table 7.1 In table 7.1 P_D = 1.0 x P_{ME} = 6900 kW The reference speed is read on the speed curve corresponding to table 7.1 at intersection between curve *Full, p* and 6900 kW V_{ref} = 14.25 knots

Table 11.1: Parameters in attained EEDI calculation

11.2 Result

For this vessel, Attained EEDI is:

$$\frac{(\prod_{j=1}^{n} f_j).(\sum_{i=1}^{nME} P_{ME(i)}.C_{FME(i)}.SFC_{ME(i)}) + P_{AE}.C_{FAE}.SFC_{AE} + \{(\prod_{j=1}^{n} f_j).\sum_{i=1}^{nPTI} P_{PTI(i)} - \sum_{i=1}^{neff} f_{eff(i)}.P_{AEeff(i)}\}.C_{FAE}.SFC_{AE} - \sum_{i=1}^{neff} f_{eff(i)}.P_{eff(i)}.C_{FME}.SFC_{ME})}{f_i.f_c.Capacity.f_w.V_{ref}}$$

Attained EEDI = (6900*3.206*171+381*3.206*205) / (1.017*55000*14.25) = 5.06 g/t.nm

12 REQUIRED EEDI

According to MARPOL Annex VI, Chapter 4, Regulation 21, the required EEDI is:
(1-x/100) x reference line value
The reference line value = $a*b^{-c}$ where a, b, c are given for a bulk carrier as:
a= 961.79 b = deadweight of the ship c = 0.477

So reference line value = 5.27 g/t.nm
In Phase 0 (between 1 Jan 2013 and 31 Dec 2014) above 20000 DWT, x = 0
So Required EEDI = 5.27 g/t.nm

Figure 12.1 provides the relative position of attained EEDI with reference to required value.

As a conclusion, for this vessel:

- attained EEDI = 5.06 g/t.nm
- required EEDI = 5.27 g/t.nm
- **Regulation criteria is satisfied with 4% margin**

R

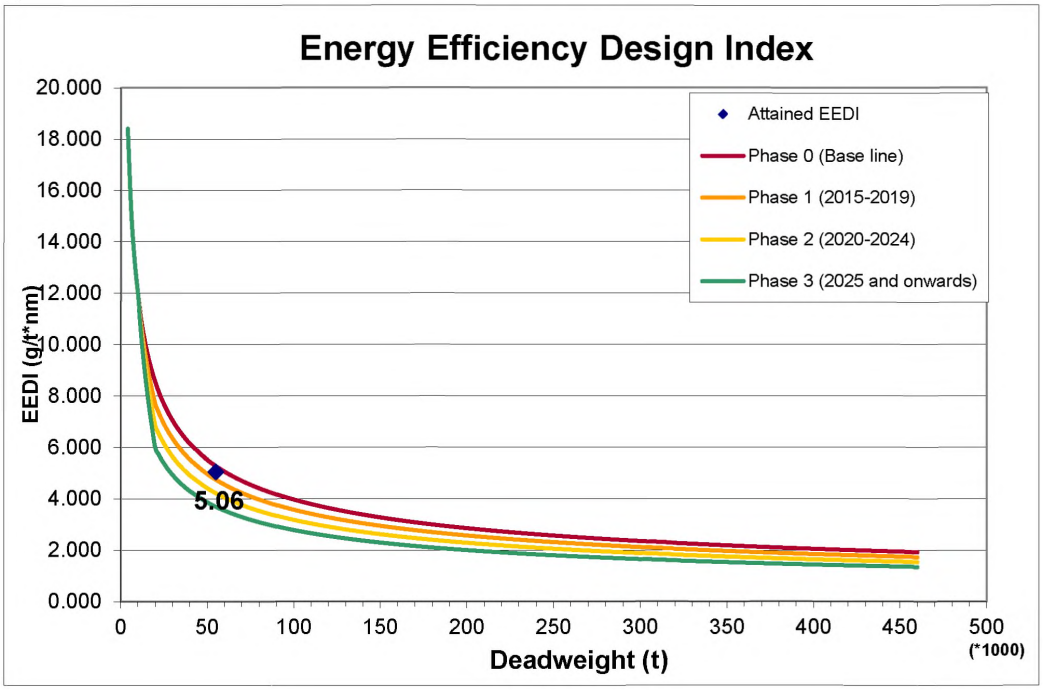


Figure 12.1: Required EEDI value

13 CALCULATION OF ATTAINED $EEDI_{WEATHER}$

Not calculated.

14 LIGHTWEIGHT CHECK REPORT

The lightweight check report is provided in annex 6. The final characteristics of the ship are:

Displacement	66 171 tons
Lightweight	11 621 tons
Deadweight	54 550 DWT

15 SEA TRIAL REPORT WITH CORRECTIONS

The sea trial report is provided in annex 7. The results of the sea trial after corrections by BSRA and ITTC standard methods are given on curve *Ballast,s* on Figure 3.1.

16 CALCULATION OF ATTAINED EEDI AT FINAL STAGE

16.1 Recalculated values of parameters

The EEDI quantities and intermediate calculations are listed in table 16.1. Parameters which have not been modified from the preliminary verification stage are marked "no change".

EEDI quantity	Value	Remarks
C_{FME}	3.206	No change
P_{ME}	6 900 kW	No change
SFC_{ME}	171 g/kWh	No change
CF_{AE}	3.206	No change
P_{PTI}	0	No change
P_{AE}	381 kW	The electric power table has been validated and endorsed (see the electric power table form in annex 8)
SFC_{AE}	205 g/kWh	No change
P_{eff}	0	No change
P_{AEeff}	0	No change
f_{eff}		No change
f_j	1.0	No change
f_i	1.017	Deadweight and lightweight are computed from lightweight check: $f_{iCSR} = 1 + 0.08*LWT_{CSR} / DWT_{CSR} = 1+0.08*11621/54550 = 1.017$ $fi = f_{iICE} \times f_{iVSE} \times f_{iCSR} = 1.017$ (unchanged)
f_c	1.0	No change
Capacity	54550 DWT	Deadweight has been computed from the lightweight check. See 14.
V_{ref}	14.65 knots	The reference speed in EEDI condition has been adjusted according to the delivered power adjustment methodology defined in Industry Guidelines. The reference speed is read on the speed curves diagram in Figure 3.1 V_{ref} = 14.65 knots

Table 11.1: Parameters in attained EEDI calculation (final stage)

16.2 Final result

Attained EEDI = (6900*3.206*171+381*3.206*205) / (1.017*54550*14.65) = 4.96 g/t.nm

Required EEDI in Phase 0: $961.79*54550^{-0.477}$ = 5.29 g/t.nm

Regulation criteria is satisfied with 6% margin

List of annexes to the Document

Annex 1	Standard model-ship extrapolation and correlation method
Annex 2	Towing tank tests report
Annex 3	Ship lines and offsets table
Annex 4	Description of energy saving equipment
Annex 5	5.1 NO_x Technical File of main engine(s)
	5.2 NO_x Technical File of auxiliary engines
Annex 6	Lightweight check report
Annex 7	Sea trials report
Annex 8	EPT-EEDI form

APPENDIX 3
Verifying the calibration of model test equipment

Quality Control System

The existence of a Quality Control System is not sufficient to guarantee the correctness of the test procedures; QS, including ISO 9000, only give documentary evidence what is to be and has been done. Quality Control Systems do not evaluate the procedures as such.
The Test institute is to have a quality control system (QS). If the QS is not certified ISO 9000 a documentation of the QS is to be shown. A Calibration Procedure is given in ITTC Recommended Procedures 7.6-01-01

1. Measuring Equipment

An important aspect of the efficient operation of Quality System according to measuring equipment is a full identification of devices used for the tests.
Measuring equipment instruments are to have their individual records in which the following data are to be placed:
- name of equipment
- manufacturer
- model
- series
- laboratory identification number (optionally)
- status (verified, calibration, indication)

Moreover the information about the date of last and next calibration or verification is to be placed on this record. All the data are to be signed by authorised officer.

2. Measuring Standards

Measuring standards used in laboratory for calibration purposes are to be confirmed (verified) by Weights and Measures Office at appropriate intervals (defined by the Weights and Measures Office).
All measuring standards used in laboratory for the confirmation purposes are to be supported by certificates, reports or data sheets for the equipment confirming the source, uncertainty and conditions under which the results were obtained.

3. Calibration

The calibration methods may differ from institution to institution, depending on the particular measurement equipment. The calibration shall comprise the whole measuring chain (gauge, amplifier, data acquisition system etc.).
The laboratory shall ensure that the calibration tests are carried out using certified measuring standards having a known valid relationship to international or nationally recognised standards.

a) Calibration Report

"Calibration reports" shall include:
- identification of certificate for measuring standards
- description of environmental conditions

- calibration factor or calibration curve
- uncertainty of measurement
- minimum and maximum capacity" for which the error of measuring instrument is within specified (acceptable) limits.

b) Intervals of Confirmation

The measuring equipment (including measuring standards) is to be confirmed at appropriate (usually periodical) intervals, established on the basis of their stability, purpose and wear. The intervals are to be such that confirmation is carried out again prior to any probable change in the equipment accuracy, which is important for the equipment reliability. Depending on the results of preceding calibrations, the confirmation period may be shortened, if necessary, to ensure the continuous accuracy of the measuring equipment.
The laboratory is to have specific objective criteria for decisions concerning the choice of intervals of confirmation.

c) Non - Conforming Equipment

Any item of measuring equipment
- that has suffered damage,
- that has been overloaded or mishandled,
- that shows any malfunction,
- whose proper functioning is subject to doubt,
- that has exceeded its designated confirmation interval, or
- the integrity of whose seal has been violated, is to be removed from service by segregation, clear labelling or cancelling.

Such equipment is not to be returned to service until the reasons for its nonconformity have been eliminated and it is confirmed again.
If the results of calibration prior to any adjustment or repair were such as to indicate a risk of significant errors in any of the measurements made with the equipment before the calibration, the laboratory shall take the necessary corrective action.

4. Instrumentation

Especially the documentation on the calibration of the following Instrumentation is to be shown.

a) Carriage Speed

The carriage speed is to be calibrated as a distance against time. Period between the calibrations is to be in accordance with the internal procedure of the towing tank test organisation.

b) Water Temperature

Measured by calibrated thermometer with certificate (accuracy 0.1°C).

c) Trim Measurement

Calibrated against a length standard. Period between the calibrations is to be in accordance with the internal procedure of the towing tank test organisation.

d) Resistance Test

Resistance Test is a force measurement. It is to be calibrated against a standard weight. Calibration normally before each test series.

e) Propulsion Test

During Self Propulsion Test torque, thrust and rate of revolutions are measured. Thrust and Torque are calibrated against a standard weight. Rate of revolution is normally measured by a pulse tachometer and an electronic counter which can be calibrated e.g. by an oscillograph.
Period between the calibrations is to be in accordance with the internal procedure of the towing tank test organisation.

f) Propeller Open Water Test

During Propeller Open Water Test torque, thrust and rate of revolutions are measured. Thrust and Torque are calibrated against a standard weight. Rate of revolution is normally measured by a pulse tachometer and an electronic counter which can be calibrated e.g. by an oscillograph.
Period between the calibrations is to be in accordance with the internal procedure of the towing tank test organisation.

Examples of documentation sheets are given in the Annexes 1 and 2:

ANNEX 1: SAMPLE OF MEASURING EQUIPMENT CARD

QM 4.10.5.1	Measurement Equipment Card	Laboratory Identification Number	

Equipment | Manufacturer | Model

Serial No. | Date of Purchase

Basic range

Work Instructions

Calibration Instructions

Verified at

Status

Calibrated ☐

Indication ☐

Verified ☐

Date of Check	Certificate. No.	Period	Date of Next Check	Responsible	Department	Approval

ANNEX 2: SAMPLE OF CALIBRATION CERTIFICATE.

QM 4.10.6.2	**CALIBRATION CERTIFICATE for** PROPELLER		**NO.**		
			LIN		
Calibration Instructions			Calibrated by :		
Date of calibration			Checked by :		
Measurement combination					
DYNAMOMETER LIN		Manufacturer		Model	
		Serial No		Date of purchased	
		Work instruction		Last calibration	
Cable					
AMPLIFIER L		Manufacturer		Model	
		Serial No		Date of purchased	
		Work instruction		Type of transducer	
		Excitation		Frequency of excit.	
	Thrust :	Amp. gain		Zero not load	
	Torque :	Amp. gain		Zero not load	
Cable					
A/C TRANSDUCER L		Manufacturer		Model	
		Serial No		Date of purchased	
		Work instruction		Certificate No	
MEASUREMENT STANDARDS		Mass		Certificate No	
		Length arm of force		Certificate No	
		Voltmeter		Certificate No	

QM
4.10.6.2

CALIBRATION RESULTS

Environmental condition

Place of test :				
Temperature :	initial		final	
Dampness :	initial		final	

Computation results of calibrations test

Executed program	procedure	certificate NO.

	Thrust	Torque
Drift :		
Non Linearity errors :		
Hysteresis :		
Precision errors :		
Total uncertainty :		
Calibration factor :		

Calibration requests :

Specified limits of	Thrust	Torque
errors :		
Maximum capacity :		
Minimum capacity :		

Note : tests and computations results are included in report

Prepared by : ..... Approved by : ..... Date : .....

APPENDIX 4
Review and witnessing of model test procedures

The Model Tests is to be witnessed by the verifier. Special attention is to be given to the following items:

1. Ship Model

Hydrodynamic Criteria

a) *Model Size:* The model should generally be as large as possible for the size of the towing tank taking into consideration wall, blockage and finite depth effects, as well as model mass and the maximum speed of the towing carriage (ITTC Recommended Procedure 7.5-02-02-01 Resistance Test).

b) *Reynolds Number:* The Reynolds Number is to be, if possible, above 2.5x 10^5.

c) *Turbulence Stimulator:* In order to ensure turbulent flow, turbulence stimulators have to be applied.

Manufacture Accuracy

With regard to accuracy the ship model is to comply with the criteria given in ITTC Recommended Procedure 7.5-01-01-01, Ship Models.
The following points are to be checked:

a) *Main dimensions*, L_{PP}, B

b) *Surface finish*, model is to be smooth. Particular care is to be taken when finishing the model to ensure that geometric features such as knuckles, spray rails, and boundaries of transom sterns remain well-defined

c) *Stations and Waterlines* The spacing and numbering of displacement stations and waterlines are to be properly defined and accurately marked on the model.

d) *Displacement* The model is to be run at the correct calculated displacement. The model weight is to be correct to within 0.2% of the correct calculated weight displacement. In case the marked draught is not met when the calculated displacement has been established the calculation of the displacement and the geometry of the model compared to the ship has to be revised. (Checking the Offsets).

Documentation in the report

Identification (model number or similar)
Materials of construction
Principal dimensions
Length between perpendiculars (L_{PP})
Length of waterline (L_{WL})
Breadth (B)
Draught (T)
For multihull vessels, longitudinal and transverse hull spacing
Design displacement (Δ) (kg, fresh water)
Hydrostatics, including water plane area and wetted surface area
Details of turbulence stimulation
Details of appendages
Tolerances of manufacture

2. Propeller Model

The Manufacturing Tolerances of Propellers for Propulsion Tests are given IN ITTC Recommended Procedures 7.5-01-01-01, Ship Models Chapter 3.1.2. Attention: Procedure 7.5 – 01-02-02 Propeller Model Accuracy is asking for higher standards which are applicable for cavitation tests and not required for self-propulsion tests.

Propeller Model Accuracy

Stock Propellers

During the "stock-propeller" testing phase, the geometrical particulars of the final design propeller are normally not known. Therefore, the stock propeller pitch (in case of CPP) is recommended to be adjusted to the anticipated propeller shaft power and design propeller revolutions. (ITTC Recommended Procedure 7.5-02-03-01.1 Propulsion/Bollard Pull Test).

Adjustable Pitch Propellers

Before the Tests the pitch adjustment is to be controlled.

Final Propellers

Propellers having diameter (D) typically from 150 mm to 300 mm is to be finished to the following tolerances:
Diameter (D) ± 0.10 mm
Thickness (t) ± 0.10 mm
Blade width (c) ± 0.20 mm
Mean pitch at each radius (P/D): ± 0.5% of de-sign value.

Special attention is to be paid to the shaping accuracy near the leading and trailing edges of the blade section and to the thickness distributions. The propeller will normally be completed to a polished finish.

Documentation in the report

Identification (model number or similar)
Materials of construction
Principal dimensions
Diameter
Pitch-Diameter Ratio (P/D)
Expanded blade Area Ratio (A_E/A_0)
Thickness Ratio (t/D)
Hub/Boss Diameter (d_h)
Tolerances of manufacture

3. Model Tests

a) Resistance Test

The Resistance Test is to be performed acc. to ITTC Recommended Procedure 7.5-02-02-01 Resistance Test.

Documentation in the report

Model Hull Specification:
- Identification (model number or similar)
- Loading condition
- Turbulence stimulation method
- Model scale
- Main dimensions and hydrostatics (see ITTC Recommended Procedure 7.5-01-01-01 Ship Models and chapter 2 of this paper).

Particulars of the towing tank, including length, breadth and water depth
Test date
Parametric data for the test:
- Water temperature
- Water density
- Kinematic viscosity of the water
- Form factor (even if (1+k) =1.0 is applicable, this is to be stated)
- ΔC_F or C_A

For each speed, the following measured and extrapolated data is to be given as a minimum:

- Model speed
- Resistance of the model
- Sinkage fore and aft, or sinkage and trim

b) Propulsion Test

The Propulsion Test is to be performed acc. to ITTC Recommended Procedure 7.5-02-03-01.1 Propulsion Test/Bollard Pull.

Documentation in the report

Model Hull Specification:
- Identification (model number or similar)
- Loading condition
- Turbulence stimulation method
- Model scale
- Main dimensions and hydrostatics (see ITTC Recommended Procedure 7.5-01-01-01 Ship Models and chapter 2 of this paper).

Model Propeller Specification
- Identification (model number or similar)
- Model Scale
- Main dimensions and particulars (see ITTC Recommended Procedure 7.5-01-01-01 Ship Models and chapter 3 of this paper)

Particulars of the towing tank, including length, breadth and water depth
Test date
Parametric data for the test:
- Water temperature
- Water density
- Kinematic viscosity of the water
- Form factor (even if (1+k) = 1.0 is applicable, this is to be stated)
- ΔC_F or C_A
- Appendage drag scale effect correction factor (even if a factor for scale effect correction is not applied, this is to be stated).

For each speed the following measured data and extrapolated data is to be given as a minimum:
- Model speed
- External tow force
- Propeller thrust,
- Propeller torque
- Rate of revolutions.
- Sinkage fore and aft, or sinkage and trim

- The extrapolated values are also to contain the resulting delivered power P_D.

c) Propeller Open Water Test

In many cases the Propeller Open Water Characteristics of a stock propeller will be available and the Propeller Open Water Test need not be repeated for the particular project. A documentation of the Open Water Characteristics (Open Water Diagram) will suffice.
In case of a final propeller or where the Propeller Open Water Characteristics is not available the Propeller Open Water Test is to be performed acc. to ITTC Recommended Procedure 7.5-02-03-02.1 Open Water Test.

Documentation in the report

Model Propeller Specification:
- Identification (model number or similar)
- Model scale
- Main dimensions and particulars (see recommendations of ITTC Recommended Procedure 7.5-01-01-01 Ship Models and chapter 3 of this paper)
- Immersion of centreline of propeller shaft in the case of towing tank

Particulars of the towing tank or cavitation tunnel, including length, breadth and water depth or test section length, breadth and height.
Test date
Parametric data for the test:
- Water temperature
- Water density
- Kinematic viscosity of the water
- Reynolds Number (based on propeller blade chord at 0.7*R*)

For each speed the following data is to be given as a minimum:
- Speed
- Thrust of the propeller
- Torque of the propeller
- Rate of revolution
- Force of nozzle in the direction of the propeller shaft (in case of ducted propeller)

Propeller Open Water Diagram

4. Speed Trial Prediction

The principal steps of the Speed Trial Prediction Calculation are given in ITTC Recommended Procedure 7.5 - 02 - 03 -1.4 ITTC 1978 Trial Prediction Method (in its latest reviewed version of 2011). The main issue of a speed trial prediction is to get the loading of the propeller correct and also to assume the correct full scale wake. The right loading of the propeller can be achieved by increasing the friction deduction by the added resistance (e.g. wind resistance etc.) and run the self-propulsion test already at the right load or it can be achieved by calculation as given in Procedure 7.5-02-03-1.4.
A wake correction is always necessary for single screw ships. For twin screw ships it can be neglected unless the stern shape is of twin hull type or other special shape.
The following scheme indicates the main components of a speed trial prediction. It it to be based on a Resistance Test, a Propulsion Test and an Open Water Characteristics of the used model propeller during the tests and the Propeller Open Water Characteristics of the final propeller.

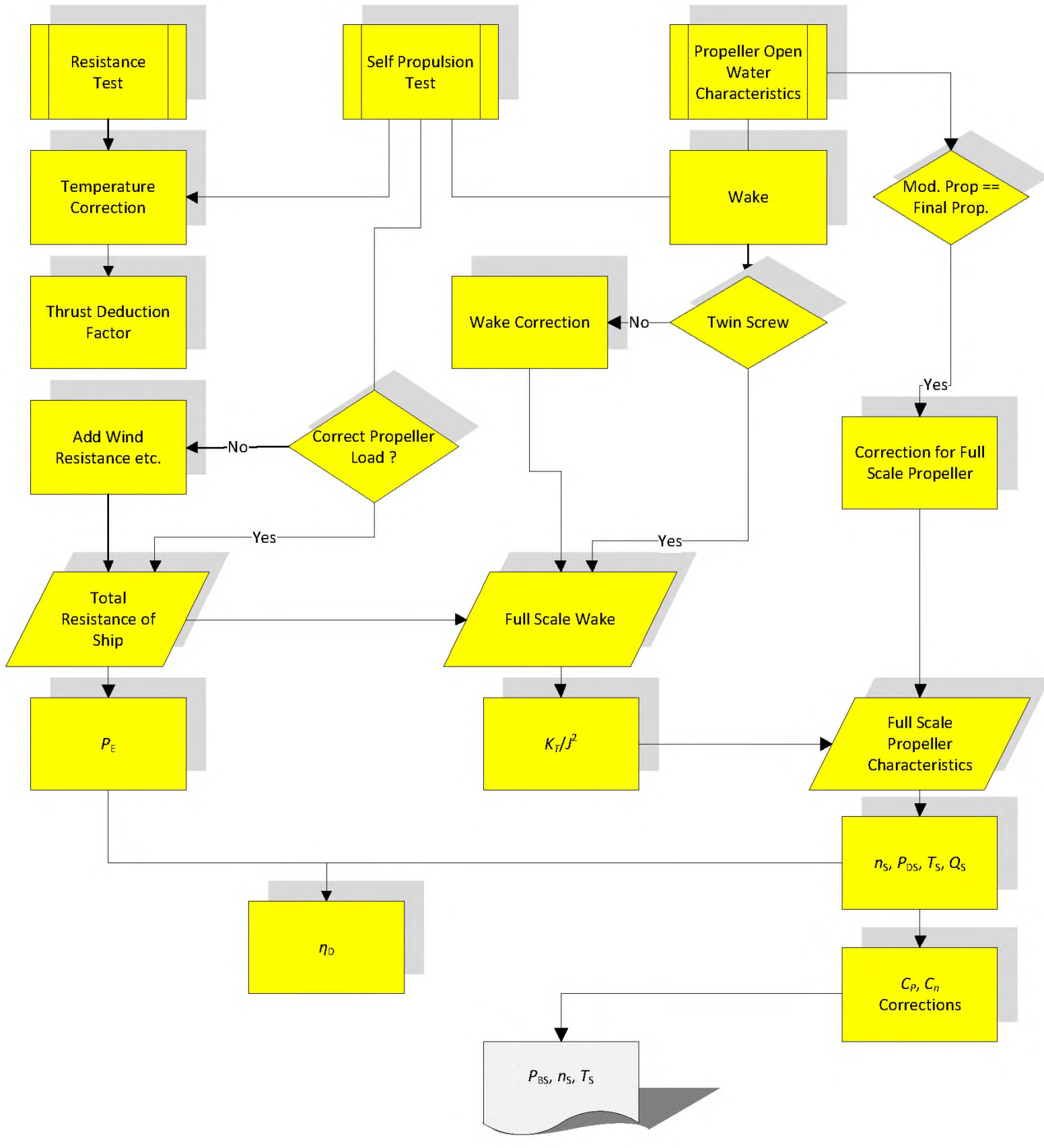
Documentation

Model Hull Specification:
- Identification (model number or similar)
- Loading condition
- Turbulence stimulation method
- Model scale
- Main dimensions and hydrostatics (see ITTC Recommended Procedure 7.5-01-01-01 Ship Models and chapter 2 of this paper).

Model Propeller Specification
- Main dimensions and particulars (see ITTC Recommended Procedure 7.5-01-01-01 Ship Models and chapter 3 of this paper)

Particulars of the towing tank, including length, breadth and water depth
Resistance Test Identification (Test No. or similar)
Propulsion Test Identification (Test No. or similar)
Open Water Characteristics of the model propeller
Open Water Characteristics of ship propeller
Ship Specification:
- Projected wind area
- Wind resistance coefficient
- Assumed BF
- C_P and C_n

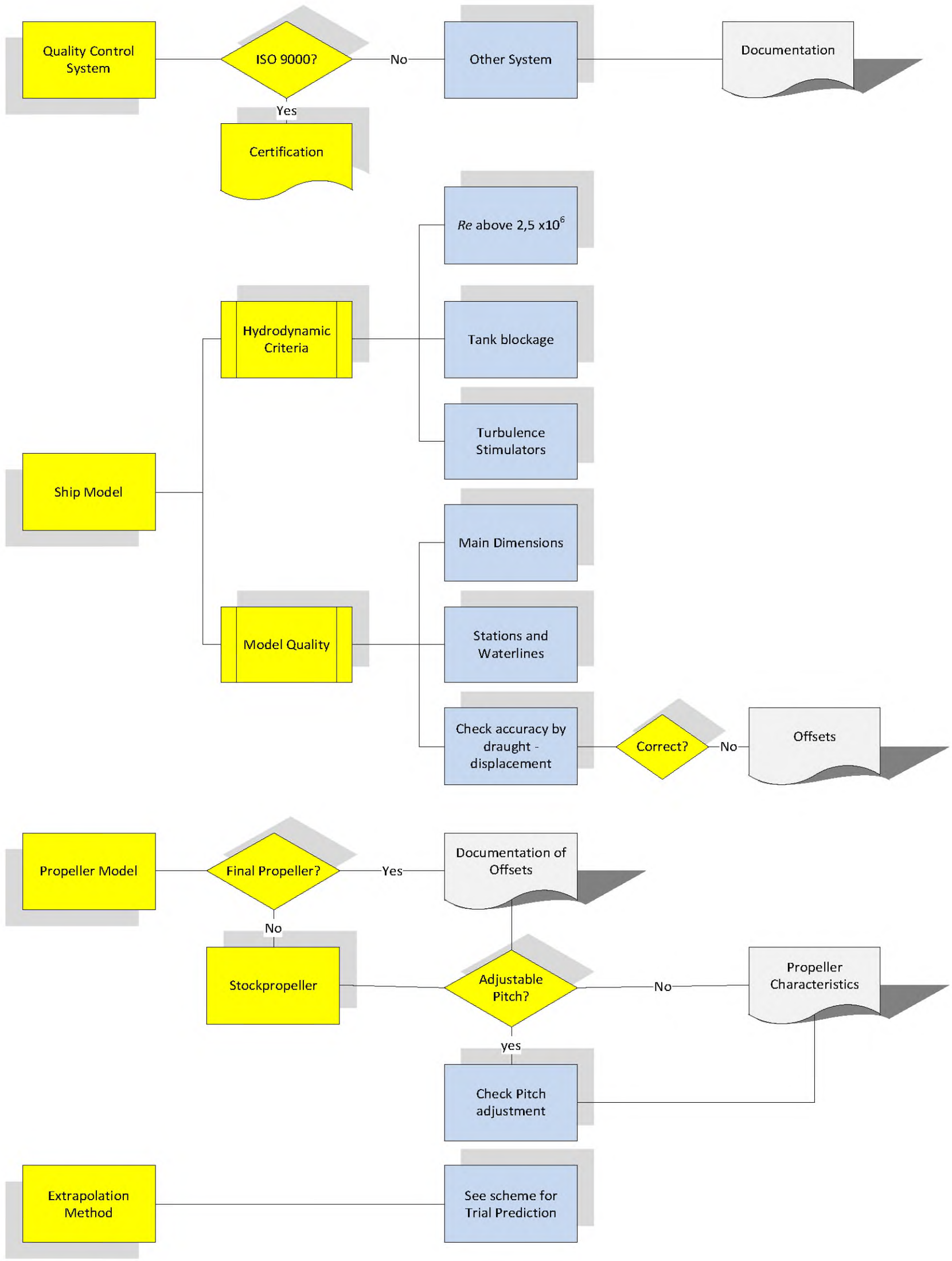
Principle Scheme for Speed Trial Prediction



For each speed the following *calculated data* is to be given as a minimum:
- Ship speed
- Model wake coefficient
- Ship wake coefficient
- Propeller thrust on ship
- Propeller torque on ship
- Rate of revolutions on ship
- Predicted power on ship (delivered power on Propeller(s) P_D)
- Sinkage fore and aft, or sinkage and trim

Scheme for review and witnessing Model Tests

Checking of Model Testing Procedure



APPENDIX 5
Sample report "Preliminary Verification of EEDI"

ATTESTATION
PRELIMINARY VERIFICATION OF ENERGY EFFICIENCY DESIGN INDEX (EEDI)
by *VERIFIER*

Statement N° EEDI/2012/XXX

Ship particulars:

Ship Owner: _____

Shipyard: _____

Ship's Name: _____

IMO Number: _____

Hull number: _____

Building contract date: _____

Type of ship: _____

Port of registry: _____

Deadweight: _____

Summary results of EEDI

Reference speed	VV.V knots
Attained EEDI	X.XX g/t.nm
Required EEDI	Y.YY g/t.nm

Supporting documents

Title	**ID and/or remarks**
EEDI Technical File	RRRR dated 01/01/2013

This is to certify:

1. That the attained EEDI of the ship has been calculated according to the *2012 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships*, IMO Resolution MEPC.212(63)

2. That the preliminary verification of the EEDI shows that the ship complies with the applicable requirements in regulation 20 and regulation 21 of MARPOL Annex VI amended by Resolution MEPC.203(62).

Completion date of preliminary verification of EEDI: xx/xx/xxxx

Issued at: _____ on: _____

Signature of the Verifier

УНИФИЦИРОВАННЫЕ ИНТЕРПРЕТАЦИИ МАКО

IACS UNIFIED INTERPRETATIONS

SC 191 (Nov 2004) (Rev.1 May 2005) (Rev.2 Oct 2005) (Corr. Dec 2005) (Rev.3 Mar 2006) (Rev.4 Sept 2011) (Corr.1 Nov 2011) (Rev.5 May 2013) (Rev.6 May 2014) (Corr.1 Sept 2014) (Rev.7 Jan 2015)

IACS Unified Interpretations (UI) SC 191 for the application of amended SOLAS regulation II-1/3-6 (resolution MSC.151(78)) and revised Technical provisions for means of access for inspections (resolution MSC.158(78))

Note:

1. This UI is to be applied by IACS Members and Associates when acting as recognized organizations, authorized by flag State Administrations to act on their behalf, unless otherwise advised, from 1 January 2005.

2. Rev.1 (May 2005) introduced new Annex to UI SC 191. Rev.1 is to be applied by IACS Members and Associates from 1 July 2005.

3. Rev.2 (Oct.2005) re-categorized the Annex to UI SC191 (Rev.1) as Recommendation No.91.

   Rev.2 (Oct.2005 / Corr. Dec. 2005) is to be applied by IACS Members and Associates to ships contracted for construction on or after 1 May 2006.

   Refer to IMO MSC/Circ. 1176.

4. The 'contracted for construction' date means the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. For further details about the date of 'contract for construction', refer to IACS Procedural Requirement (PR) No. 29.

5. Rev.3 is to be applied by IACS Members and Associates from 1 October 2006.

6. Rev.4 is to be applied by IACS Members to ships contracted for construction from 1 July 2012.

7. Rev.5 is to be applied by IACS Members to ships contracted for construction from 24 June 2013.

8. Rev.6 is to be applied by IACS Members to ships contracted for construction from 1 July 2015.

9. Rev.7 is to be applied by IACS Members to ships contracted for construction from 1 July 2016.

SC 191 (cont)

SOLAS regulation II-1/3-6, section 1

1 Application

1.1 Except as provided for in paragraph 1.2, this regulation applies to oil tankers of 500 gross tonnage and over and bulk carriers, as defined in regulation IX/1, of 20,000 gross tonnage and over, constructed on or after 1 January 2006.

1.2 Oil tankers of 500 gross tonnage and over constructed on or after 1 October 1994 but before 1 January 2005 shall comply with the provisions of regulation II-1/12-2 adopted by resolution MSC.27(61).

Interpretation

Oil tankers:

This regulation is only applicable to oil tankers having integral tanks for carriage of oil in bulk, which is contained in the definition of oil in Annex 1 of MARPOL 73/78. Independent oil tanks can be excluded.

Regulation II-1/3-6 is not normally applied to FPSO or FSO unless the Administration decides otherwise.

Technical Background

Means of Access (MA) specified in the Technical provisions contained in resolution MSC.158(78) are not specific with respect to the application to integral cargo oil tanks or also to independent cargo oil tanks. ESP requirements of oil tankers have been established assuming the target cargo oil tanks are integral tanks. The MA regulated under SOLAS regulation II-1/3-6 is for overall and close-up inspections as defined in regulation IX/1. Therefore it is assumed that the target cargo oil tanks are those of ESP, i.e. integral cargo tanks.

Regulation II-1/3-6 is applicable to FPSO or FSO if they are subject to the scope of ESP as contained in resolution A.1049(27) (2011 ESP Code), as amended.

Ref.

SOLAS regulation IX/1 and resolution A.1049(27) (2011 ESP Code), as amended.

SC 191 (cont)

SOLAS regulation II-1/3-6, paragraph 2.1

2.1 Each space shall be provided with a permanent means of access to enable, throughout the life of a ship, overall and close-up inspections and thickness measurements of the ship's structures to be carried out by the Administration, the company, as defined in regulation IX/1, and the ship's personnel and others as necessary. Such means of access shall comply with the requirements of paragraph 5 and with the Technical provisions for means of access for inspections, adopted by the Maritime Safety Committee by resolution MSC.133(76), as may be amended by the Organization, provided that such amendments are adopted, brought into force and take effect in accordance with the provisions of article VIII of the present Convention concerning the amendment procedures applicable to the Annex other than chapter 1.

Interpretation

Each space for which close-up inspection is not required such as fuel oil tanks and void spaces forward of cargo area, may be provided with a means of access necessary for overall survey intended to report on the overall conditions of the hull structure.

SC 191 (cont)

SOLAS regulation II-1/3-6, paragraph 2.2

2.2 Where a permanent means of access may be susceptible to damage during normal cargo loading and unloading operations or where it is impracticable to fit permanent means of access, the Administration may allow, in lieu thereof, the provision of movable or portable means of access, as specified in the Technical provisions, provided that the means of attaching, rigging, suspending or supporting the portable means of access forms a permanent part of the ship's structure. All portable equipment shall be capable of being readily erected or deployed by ship's personnel.

Interpretation

Some possible alternative means of access are listed under paragraph 3.9 of the Technical Provisions for means of access for inspection(TP). Always subject to acceptance as equivalent by the Administration, alternative means such as an unmanned robot arm, ROV's and dirigibles with necessary equipment of the permanent means of access for overall and close-up inspections and thickness measurements of the deck head structure such as deck transverses and deck longitudinals of cargo oil tanks and ballast tanks, are to be capable of:

- safe operation in ullage space in gas-free environment;
- introduction into the place directly from a deck access.

When considering use of alternative means of access as addressed by paragraph 3.9 of the TP, refer to IACS Recommendation No.91 "Guidelines for Approval/Acceptance of Alternative Means of Access".

Technical Background

Innovative approaches, in particular a development of robot in place of elevated passageways, are encouraged and it is considered worthwhile to provide the functional requirement for the innovative approach.

SC 191 (cont)

SOLAS regulation II-1/3-6, paragraph 2.3

2.3 The construction and materials of all means of access and their attachment to the ship's structure shall be to the satisfaction of the Administration. The means of access shall be subject to survey prior to, or in conjunction with, its use in carrying out surveys in accordance with regulation I/10.

Interpretation

Inspection

The MA arrangements, including portable equipment and attachments, are to be periodically inspected by the crew or competent inspectors as and when it is going to be used to confirm that the MAs remain in serviceable condition.

Procedures

1. Any Company authorised person using the MA shall assume the role of inspector and check for obvious damage prior to using the access arrangements. Whilst using the MA the inspector is to verify the condition of the sections used by close up examination of those sections and note any deterioration in the provisions. Should any damage or deterioration be found, the effect of such deterioration is to be assessed as to whether the damage or deterioration affects the safety for continued use of the access. Deterioration found that is considered to affect safe use is to be determined as "substantial damage" and measures are to be put in place to ensure that the affected section(s) are not to be further used prior effective repair.

2. Statutory survey of any space that contains MA shall include verification of the continued effectiveness of the MA in that space. Survey of the MA shall not be expected to exceed the scope and extent of the survey being undertaken. If the MA is found deficient the scope of survey is to be extended if this is considered appropriate.

3. Records of all inspections are to be established based on the requirements detailed in the ships Safety Management System. The records are to be readily available to persons using the MAs and a copy attached to the MA Manual. The latest record for the portion of the MA inspected is to include as a minimum the date of the inspection, the name and title of the inspector, a confirmation signature, the sections of MA inspected, verification of continued serviceable condition or details of any deterioration or substantial damage found. A file of permits issued is to be maintained for verification.

Technical Background

It is recognised that MA may be subject to deterioration in the long term due to corrosive environment and external forces from ship motions and sloshing of liquid contained in the tank. MA therefore is to be inspected at every opportunity of tank/space entry. The above interpretation is to be contained in a section of the MA Manual.

SC 191 (cont)

SOLAS regulation II-1/3-6, paragraph 3.1

3 Safe access to cargo holds, cargo tanks, ballast tanks and other spaces

3.1 Safe access* to cargo holds, cofferdams, ballast tanks, cargo tanks and other spaces in the cargo area shall be direct from the open deck and such as to ensure their complete inspection. Safe access to double bottom spaces or to forward ballast tanks may be from a pump-room, deep cofferdam, pipe tunnel, cargo hold, double hull space or similar compartment not intended for the carriage of oil or hazardous cargoes.

* Refer to the Revised recommendations for entering enclosed spaces aboard ships, adopted by the Organization by resolution A.1050(27).

Interpretation

Access to a double side skin space of bulk carriers may be either from a topside tank or double bottom tank or from both.

The wording "not intended for the carriage of oil or hazardous cargoes" applies only to "similar compartments", i.e. safe access can be through a pump-room, deep cofferdam, pipe tunnel, cargo hold or double hull space.

Technical Background

Unless used for other purposes, the double side skin space is to be designed as a part of a large U-shaped ballast tank and such space is to be accessed through the adjacent part of the tank, i.e. topside tank or double bottom/bilge hopper tank. Access to the double side skin space from the adjacent part rather than direct from the open deck is justified. Any such arrangement is to provide a directly routed, logical and safe access that facilitates easy evacuation of the space.

SC 191 (cont)

SOLAS regulation II-1/3-6, paragraph 3.2

3.2 Tanks, and subdivisions of tanks, having a length of 35 m or more shall be fitted with at least two access hatchways and ladders, as far apart as practicable. Tanks less than 35 m in length shall be served by at least one access hatchway and ladder. When a tank is subdivided by one or more swash bulkheads or similar obstructions which do not allow ready means of access to the other parts of the tank, at least two hatchways and ladders shall be fitted.

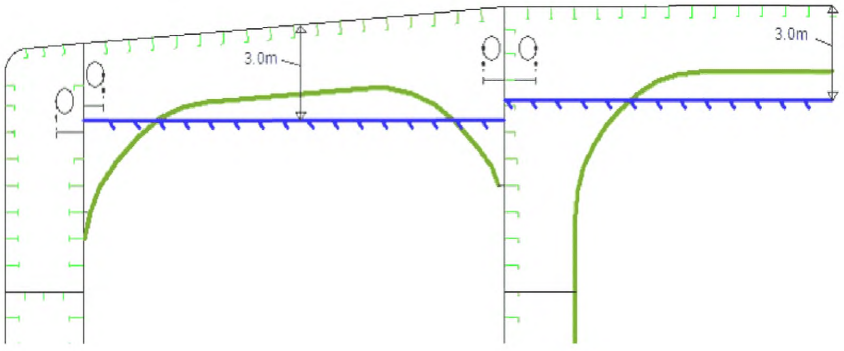
Interpretation

A cargo oil tank of less than 35 m length without a swash bulkhead requires only one access hatch.

Where rafting is indicated in the ship structures access manual as the means to gain ready access to the under deck structure, the term "*similar obstructions*" referred to in the regulation includes internal structures (e.g., webs >1.5m deep) which restrict the ability to raft (at the maximum water level needed for rafting of under deck structure) directly to the nearest access ladder and hatchway to deck. When rafts or boats alone, as an alternative means of access, are allowed under the conditions specified in resolution A.1049(27) (2011 ESP Code), as amended, permanent means of access are to be provided to allow safe entry and exit. This means:

a) access direct from the deck via a vertical ladder and small platform fitted approximately 2m below the deck in each bay; or

b) access to deck from a longitudinal permanent platform having ladders to deck in each end of the tank. The platform shall, for the full length of the tank, be arranged in level with, or above, the maximum water level needed for rafting of under deck structure. For this purpose, the ullage corresponding to the maximum water level is to be assumed not more than 3m from the deck plate measured at the midspan of deck transverses and in the middle length of the tank. (See Figure below). A permanent means of access from the longitudinal permanent platform to the water level indicated above is to be fitted in each bay (e.g., permanent rungs on one of the deck webs inboard of the longitudinal permanent platform).



SC 191 (cont)

SOLAS regulation II-1/3-6, paragraph 4.1

4 Ship structure access manual

4.1 A ship's means of access to carry out overall and close-up inspections and thickness measurements shall be described in a Ship structure access manual approved by the Administration, an updated copy of which shall be kept on board. The Ship structure access manual shall include the following for each space:

.1 plans showing the means of access to the space, with appropriate technical specifications and dimensions;

.2 plans showing the means of access within each space to enable an overall inspection to be carried out, with appropriate technical specifications and dimensions. The plans shall indicate from where each area in the space can be inspected;

.3 plans showing the means of access within the space to enable close-up inspections to be carried out, with appropriate technical specifications and dimensions. The plans shall indicate the positions of critical structural areas, whether the means of access is permanent or portable and from where each area can be inspected;

.4 instructions for inspecting and maintaining the structural strength of all means of access and means of attachment, taking into account any corrosive atmosphere that may be within the space;

.5 instructions for safety guidance when rafting is used for close-up inspections and thickness measurements;

.6 instructions for the rigging and use of any portable means of access in a safe manner;

.7 an inventory of all portable means of access; and

.8 records of periodical inspections and maintenance of the ship's means of access.

Interpretation

The access manual is to address spaces listed in paragraph 3 of the regulation II-1/3-6.

As a minimum the English version is to be provided.

The ship structure access manual is to contain at least the following two parts:

Part 1: Plans, instructions and inventory required by paragraphs 4.1.1 to 4.1.7 of regulation II-1/3-6. This part is to be approved by the Administration or the organization recognised by the Administration.

Part 2: Form of record of inspections and maintenance, and change of inventory of portable equipment due to additions or replacement after construction. This part is to be approved for its form only at new building.

The following matters are to be addressed in the ship structure access manual:

1. The access manual is to clearly cover scope as specified in the regulations for use by crews, surveyors and port State control officers.

SC 191 (cont)

2. Approval / re-approval procedure for the manual, i.e. any changes of the permanent, portable, movable or alternative means of access within the scope of the regulation and the Technical provisions are subject to review and approval by the Administration or by the organization recognised by the Administration.

3. Verification of MA is to be part of safety construction survey for continued effectiveness of the MA in that space which is subject to the statutory survey.

4. Inspection of MA by the crew and/or a competent inspector of the company as a part of regular inspection and maintenance (see interpretation for paragraph 2.3 of SOLAS regulation II-1/3-6).

5. Actions to be taken if MA is found unsafe to use.

6. In case of use of portable equipment plans showing the means of access within each space indicating from where and how each area in the space can be inspected.

Refer to IACS Recommendation No.90 "Ship Structural Access Manual"

SC 191 (cont)

SOLAS regulation II-1/3-6, paragraph 4.2

4.2 For the purpose of this regulation "critical structural areas" are locations which have been identified from calculations to require monitoring or from the service history of similar or sister ships to be sensitive to cracking, buckling, deformation or corrosion which would impair the structural integrity of the ship.

Interpretation

1) Critical structural areas are to be identified by advanced calculation techniques for structural strength and fatigue performance, if available, and feed back from the service history and design development of similar or sister ships.

2) Reference is to be made to the following publications for critical structural areas, where applicable:

- Oil tankers: Guidance Manual for Tanker Structures by TSCF;
- Bulk carriers: Bulk Carriers Guidelines for Surveys, Assessment and Repair of Hull Structure by IACS;
- Oil tankers and bulk carriers: resolution A.1049(27) (2011 ESP Code), as amended.

Technical Background

These documents contain the relevant information for the present ship types. However identification of critical areas for new double hull tankers and double side skin bulk carriers of improved structural design is to be made by structural analysis at the design stage, this information is to be taken in to account to ensure appropriate access to all identified critical areas.

SC 191 (cont)

SOLAS regulation II-1/3-6, paragraph 5.1

5 General technical specifications

5.1 For access through horizontal openings, hatches or manholes, the dimensions shall be sufficient to allow a person wearing a self-contained air-breathing apparatus and protective equipment to ascend or descend any ladder without obstruction and also provide a clear opening to facilitate the hoisting of an injured person from the bottom of the space. The minimum clear opening shall not be less than 600 mm x 600 mm. When access to a cargo hold is arranged through the cargo hatch, the top of the ladder shall be placed as close as possible to the hatch coaming. Access hatch coamings having a height greater than 900 mm shall also have steps on the outside in conjunction with the ladder.

Interpretation

The minimum clear opening of 600 mm x 600 mm may have corner radii up to 100 mm maximum. The clear opening is specified in MSC/Circ.686 to keep the opening fit for passage of personnel wearing a breathing apparatus. In such a case where as a consequence of structural analysis of a given design the stress is to be reduced around the opening, it is considered appropriate to take measures to reduce the stress such as making the opening larger with increased radii, e.g. 600 x 800 with 300 mm radii, in which a clear opening of 600 x 600 mm with corner radii up to 100mm maximum fits.

Technical Background

The interpretation is based upon the established Guidelines in MSC/Circ.686.

Ref.

Paragraphs 9 of Annex of MSC/Circ.686.

SC 191 (cont)

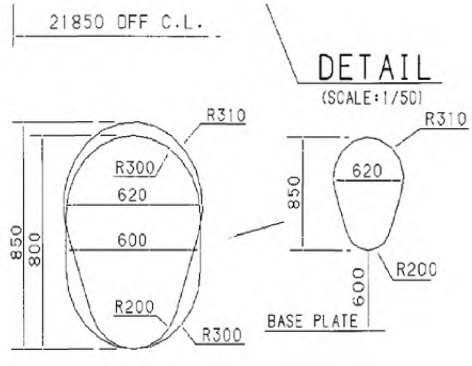
SOLAS regulation II-1/3-6, paragraph 5.2

5.2 For access through vertical openings, or manholes, in swash bulkheads, floors, girders and web frames providing passage through the length and breadth of the space, the minimum opening shall be not less than 600 mm x 800 mm at a height of not more than 600 mm from the bottom shell plating unless gratings or other foot holds are provided.

Interpretation

1. The minimum clear opening of not less than 600 mm x 800 mm may also include an opening with corner radii of 300 mm. An opening of 600mm in height x 800mm in width may be accepted as access openings in vertical structures where it is not desirable to make large opening in the structural strength aspects, i.e. girders and floors in double bottom tanks.

2. Subject to verification of easy evacuation of injured person on a stretcher the vertical opening 850 mm x 620 mm with wider upper half than 600 mm, while the lower half may be less than 600 mm with the overall height not less than 850 mm is considered an acceptable alternative to the traditional opening of 600 mm x 800 mm with corner radii of 300 mm.



3. If a vertical opening is at a height of more than 600 mm steps and handgrips are to be provided. In such arrangements it is to be demonstrated that an injured person can be easily evacuated.

Technical Background

The interpretation is based upon the established Guidelines in MSC/Circ.686 and an innovative design is considered for easy access by humans through the opening.

Ref.

Paragraphs 11 of Annex of MSC/Circ.686.

SC 191 (cont)

Technical Provision, resolution MSC.158(78), paragraph 1.3

1. Preamble

1.3 In order to address this issue, the Organization has developed these Technical provisions for means of access for inspections (hereinafter called the "Technical provisions"), intended to facilitate close-up inspections and thickness measurements of the ship's structure referred to in SOLAS regulation II-1/3-6 on Access to and within spaces in, and forward of, the cargo area of oil tankers and bulk carriers. The Technical provisions do not apply to the cargo tanks of combined chemical/oil tankers complying with the provisions of the IBC Code.

Interpretation

A "combined chemical/oil tankers complying with the provisions of the IBC Code" is a tanker that holds both a valid IOPP certificate as tanker and a valid certificate of fitness for the carriage of dangerous chemicals in bulk. i.e. a tanker that is certified to carry both oil cargoes under MARPOL Annex I and Chemical cargoes in chapter 17 of the IBC Code either as full or part cargoes.

The Technical provisions are to be applied to ballast tanks of combined chemical/oil tankers complying with the provisions of the IBC Code.

SC 191 (cont)

Technical Provision, resolution MSC.158(78), paragraph 1.4

1. Preamble

1.4 Permanent means of access which are designed to be integral parts of the structure itself are preferred and Administrations may allow reasonable deviations to facilitate such designs.

Interpretation

In the context of the above requirement, the deviation shall be applied only to distances between integrated PMA that are the subject of paragraph 2.1.2 of Table 1.

Deviations shall not be applied to the distances governing the installation of underdeck longitudinal walkways and dimensions that determine whether permanent access are required or not, such as height of the spaces and height to elements of the structure (e.g. cross-ties).

SC 191 (cont)

Technical Provision, resolution MSC.158(78), paragraph 3.1

3.1 Structural members subject to the close-up inspections and thickness measurements of the ship's structure referred to in SOLAS regulation II-1/ 3-6, except those in double bottom spaces, shall be provided with a permanent means of access to the extent as specified in table 1 and table 2, as applicable. For oil tankers and wing ballast tanks of ore carriers, approved alternative methods may be used in combination with the fitted permanent means of access, provided that the structure allows for its safe and effective use.

Interpretation

The permanent means of access to a space can be credited for the permanent means of access for inspection.

Technical Background

The Technical provisions specify means of access to a space and to hull structure for carrying out overall and close up surveys and inspections. Requirements of MA to hull structure may not always be suitable for access to a space. However if the MA for access to a space can also be used for the intended surveys and inspections such MA can be credited for the MA for use for surveys and inspections.

SC 191 (cont)

Technical Provision, resolution MSC.158(78), paragraph 3.3

3.3 Elevated passageways forming sections of a permanent means of access, where fitted, shall have a minimum clear width of 600 mm, except for going around vertical webs where the minimum clear width may be reduced to 450 mm, and have guard rails over the open side of their entire length. Sloping structure providing part of the access shall be of a non-skid construction. Guard rails shall be 1,000 mm in height and consist of a rail and intermediate bar 500 mm in height and of substantial construction. Stanchions shall be not more than 3 m apart.

Interpretation

1. Sloping structures are structures that are sloped by 5 or more degrees from horizontal plane when a ship is in upright position at even-keel.

2. Guard rails are to be fitted on the open side and should be at least 1,000 mm in height. For stand alone passageways guard rails are to be fitted on both sides of these structures. Guardrail stanchions are to be attached to the PMA. The distance between the passageway and the intermediate bar and the distance between intermediate bar and the top rail shall not be more than 500 mm.

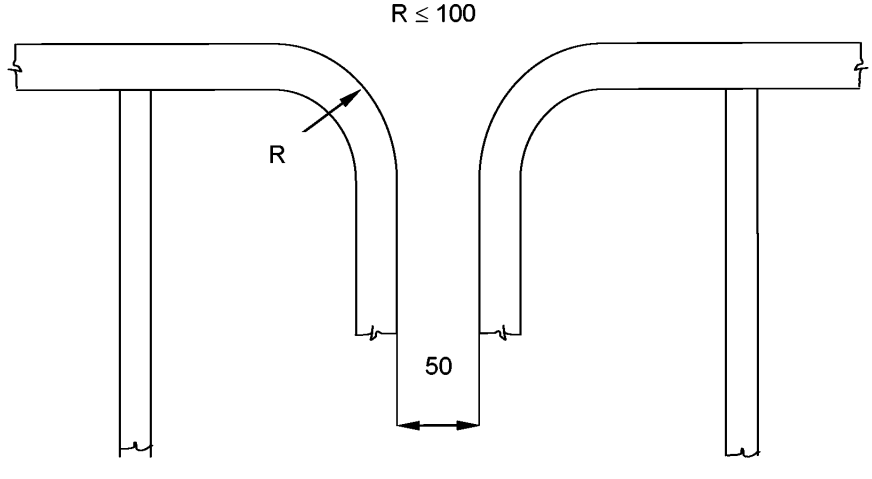
3. Discontinuous top handrails are allowed, provided the gap does not exceed 50 mm.

The same maximum gap is to be considered between the top handrail and other structural members (i.e. bulkhead, web frame, etc.).

The maximum distance between the adjacent stanchions across the handrail gaps is to be 350 mm where the top and mid handrails are not connected together and 550 mm when they are connected together.

The maximum distance between the stanchion and other structural members is not to exceed 200 mm where the top and mid handrails are not connected together and 300 mm when they are connected together.

When the top and mid handrails are connected by a bent rail, the outside radius of the bent part is not to exceed 100 mm (see Figure below).



SC 191 (cont)

4. Non-skid construction is such that the surface on which personnel walks provides sufficient friction to the sole of boots even if the surface is wet and covered with thin sediment.

5. "Substantial construction" is taken to refer to the as-designed strength as well as the residual strength during the service life of the vessel. Durability of passageways together with guard rails is to be ensured by the initial corrosion protection and inspection and maintenance during services.

6. For guard rails, use of alternative materials such as GRP is to be subject to compatibility with the liquid carried in the tank. Non-fire resistant materials are not to be used for means of access to a space with a view to securing an escape route at a high temperature.

7. Requirements for resting platforms placed between ladders are equivalent to those applicable to elevated passageways.

Ref.

Paragraph 10 of Annex to MSC/Circ.686

SC 191 (cont)

Technical Provision, resolution MSC.158(78), paragraph 3.4

3.4 Access to permanent means of access and vertical openings from the ship's bottom shall be provided by means of easily accessible passageways, ladders or treads. Treads shall be provided with lateral support for the foot. Where the rungs of ladders are fitted against a vertical surface, the distance from the centre of the rungs to the surface shall be at least 150 mm. Where vertical manholes are fitted higher than 600 mm above the walking level, access shall be facilitated by means of treads and hand grips with platform landings on both sides.

Interpretation

Where the vertical manhole is at a height of more than 600 mm above the walking level, it shall be demonstrated that an injured person can be easily evacuated.

SC 191 (cont)

Technical Provision, resolution MSC.158(78), paragraph 3.5

3.5 Permanent inclined ladders shall be inclined at an angle of less than 70°. There shall be no obstructions within 750 mm of the face of the inclined ladder, except that in way of an opening this clearance may be reduced to 600 mm. Resting platforms of adequate dimensions shall be provided normally at a maximum of 6 m vertical height. Ladders and handrails shall be constructed of steel or equivalent material of adequate strength and stiffness and securely attached to the structure by stays. The method of support and length of stay shall be such that vibration is reduced to a practical minimum. In cargo holds, ladders shall be designed and arranged so that the risk of damage from cargo handling gear is minimized.

MA for access to ballast tanks, cargo tanks and spaces other than fore peak tanks:

For oil tankers:

1. Tanks and subdivisions of tanks having a length of 35 m or more with two access hatchways:

First access hatchway: Inclined ladder or ladders are to be used.

Second access hatchway:

i. A vertical ladder may be used. In such a case where the vertical distance is more than 6 m, vertical ladders are to comprise one or more ladder linking platforms spaced not more than 6 m apart vertically and displaced to one side of the ladder.

The uppermost section of the vertical ladder, measured clear of the overhead obstructions in way of the tank entrance, is not to be less than 2.5 m but not exceed 3.0 m and is to comprise a ladder linking platform which is to be displaced to one side of a vertical ladder. However, the vertical distance of the upper most section of the vertical ladder may be reduced to 1.6 m, measured clear of the overhead obstructions in way of the tank entrance, if the ladder lands on a longitudinal or athwartship permanent means of access fitted within that range; or

ii. Where an inclined ladder or combination of ladders is used for access to the space, the uppermost section of the ladder, measured clear of the overhead obstructions in way of the tank entrance, is to be vertical for not less than 2.5 m but not exceed 3.0m and is to comprise a landing platform continuing with an inclined ladder. However, the vertical distance of the upper most section of the vertical ladder may be reduced to 1.6 m, measured clear of the overhead obstructions in way of the tank entrance, if the ladder lands on a longitudinal or athwartship permanent means of access fitted within that range. The flights of the inclined ladders are normally to be not more than 6 m in vertical height. The lowermost section of the ladders may be vertical for the vertical distance not exceeding 2.5 m.

2. Tanks less than 35 m in length and served by one access hatchway an inclined ladder or combination of ladders are to be used to the space as specified in 1.ii above.

3. In spaces of less than 2.5 m width the access to the space may be by means of vertical ladders that comprises one or more ladder linking platforms spaced not more than 6 m apart vertically and displaced to one side of the ladder. The uppermost section of the vertical ladder, measured clear of the overhead obstructions in way of the tank entrance, is not to be less than 2.5 m but not exceed 3.0 m and is to comprise a ladder linking platform which is to be displaced to one side of a vertical ladder. However, the vertical distance of the upper most section of the vertical ladder may be reduced to

SC 191 (cont)

1.6 m, measured clear of the overhead obstructions in way of the tank entrance, if the ladder lands on a longitudinal or athwartship permanent means of access fitted within that range. Adjacent sections of the ladder are to be laterally offset from each other by at least the width of the ladder (see paragraph 20 of MSC/Circ.686).

4. Access from deck to a double bottom space may be by means of vertical ladders through a trunk. The vertical distance from deck to a resting platform, between resting platforms or a resting platform and the tank bottom is not to be more than 6 m unless otherwise approved by the Administration.

MA for inspection of the vertical structure of oil tankers:

Vertical ladders provided for means of access to the space may be used for access for inspection of the vertical structure.

Unless stated otherwise in Table 1 of TP, vertical ladders that are fitted on vertical structures for inspection are to comprise one or more ladder linking platforms spaced not more than 6 m apart vertically and displace to one side of the ladder. Adjacent sections of ladder are to be laterally offset from each other by at least the width of the ladder (paragraph 20 of MSC/Circ.686).

Obstruction distances

The minimum distance between the inclined ladder face and obstructions, i.e. 750 mm and, in way of openings, 600 mm specified in TP 3.5 is to be measured perpendicular to the face of the ladder.

Technical Background

It is a common practice to use a vertical ladder from deck to the first landing to clear overhead obstructions before continuing to an inclined ladder or a vertical ladder displaced to one side of the first vertical ladder.

Ref.

For vertical ladders: Paragraph 20 of the annex to MSC/Circ.686.

SC 191 (cont)

Technical Provision, resolution MSC.158(78), paragraph 3.6

3.6 The width of inclined ladders between stringers shall not be less than 400 mm. The treads shall be equally spaced at a distance apart, measured vertically, of between 200 mm and 300 mm. When steel is used, the treads shall be formed of two square bars of not less than 22 mm by 22 mm in section, fitted to form a horizontal step with the edges pointing upward. The treads shall be carried through the side stringers and attached thereto by double continuous welding. All inclined ladders shall be provided with handrails of substantial construction on both sides fitted at a convenient distance above the treads.

Interpretation

1. Vertical height of handrails is not to be less than 890 mm from the center of the step and two course handrails need only be provided where the gap between stringer and top handrail is greater than 500 mm.

2. The requirement of two square bars for treads specified in TP, paragraph 3.6, is based upon the specification of construction of ladders in paragraph 3(e) of Annex 1 to resolution A.272(VIII), which addresses inclined ladders. TP, paragraph 3.4, allows for single rungs fitted to vertical surfaces, which is considered for a safe grip. For vertical ladders, when steel is used, the rungs are to be formed of single square bars of not less than 22 mm by 22 mm for the sake of safe grip.

3. The width of inclined ladders for access to a cargo hold is to be at least 450 mm to comply with the Australian AMSA Marine Orders Part 32, Appendix 17.

4. The width of inclined ladders other than an access to a cargo hold is to be not less than 400 mm.

5. The minimum width of vertical ladders is to be 350 mm and the vertical distance between the rungs is to be equal and is to be between 250 mm and 350 mm.

6. A minimum climbing clearance in width is to be 600 mm other than the ladders placed between the hold frames.

7. The vertical ladders are to be secured at intervals not exceeding 2.5 m apart to prevent vibration.

Technical Background

- TP, paragraph 3.6, is a continuation of TP, paragraph 3.5, which addresses inclined ladders. Interpretations for vertical ladders are needed based upon the current standards of IMO, AMSA or the industry.

- Interpretations 2 and 5 address vertical ladders based upon the current standards.

- Double square bars for treads become too large for a grip for vertical ladders and single rungs facilitate a safe grip.

- Interpretation 7 is introduced consistently with the requirement and the interpretation of TP, paragraph 3.4.

SC 191 (cont)

Ref.

- Annex 1 to resolution A.272(VIII).
- Australian AMSA Marine Orders Part 32, Appendix 17.
- ILO Code of Practice “Safety and Health in Dockwork” – Section 3.6 Access to Ship’s Holds.

SC 191 (cont)

Technical Provision, resolution MSC.158(78), paragraph 3.9.6

3.9.6 Portable ladders more than 5 m long may only be utilized if fitted with a mechanical device to secure the upper end of the ladder.

Interpretation

A mechanical device such as hooks for securing at the upper end of a ladder is to be considered as an appropriate securing device if a movement fore/aft and sideways can be prevented at the upper end of the ladder.

Technical Background

Innovative design is to be accepted if it fits the functional requirement with due consideration for safe use.

SC 191 (cont)

Technical Provision, resolution MSC.158(78), paragraph 3.10 and 3.11

3.10 For access through horizontal openings, hatches or manholes, the minimum clear opening shall not be less than 600 mm x 600 mm. When access to a cargo hold is arranged through the cargo hatch, the top of the ladder shall be placed as close as possible to the hatch coaming. Access hatch coamings having a height greater than 900 mm shall also have steps on the outside in conjunction with the ladder.

3.11 For access through vertical openings, or manholes, in swash bulkheads, floors, girders and web frames providing passage through the length and breadth of the space, the minimum opening shall be not less than 600 mm x 800 mm at a height of not more than 600 mm from the passage unless gratings or other foot holds are provided.

Interpretation

See interpretation for paragraphs 5.1 and 5.2 of SOLAS regulation II-1/3-6.

SC 191 (cont)

Technical Provision, resolution MSC.158(78), paragraph 3.13.1

3.13. For bulk carriers, access ladders to a cargo hold shall be:

.1 where the vertical distance between the upper surface of adjacent decks or between deck and the bottom of the cargo space is not more than 6 m, either a vertical ladder or an inclined ladder; and

Interpretation

Either a vertical or an inclined ladder or a combination of them may be used for access to a cargo hold where the vertical distance is 6 m or less from the deck to the bottom of the cargo hold.

SC 191 (cont)

Technical Provision, resolution MSC.158(78), paragraph 3.13.2 and paragraph 3.13.6

3.13. For bulk carriers, access ladders to a cargo hold shall be:

.1 ....omissis.....

.2 Where the vertical distance between the upper surface of adjacent decks or between deck and the bottom of the cargo space is more than 6 m, an inclined ladder or series of inclined ladders at one end of the cargo hold, except the uppermost 2.5 m of a cargo space measured clear of overhead obstructions and the lowest 6 m may have vertical ladders, provided that the vertical extent of the inclined ladder or ladders connecting the vertical ladders is not less than 2.5 m.

The second means of access at the other end of the cargo hold may be formed of a series of staggered vertical ladders, which should comprise of one or more ladder linking platforms spaced not more than 6 m apart vertically and displaced to one side of the ladder. Adjacent sections of ladder should be laterally offset from each other by at least the width of the ladder. The uppermost entrance section of the ladder directly exposed to a cargo hold should be vertical for a distance of 2.5 m measured clear of overhead obstructions and connected to a ladder-linking platform.

.3 ....omissis.....

.4 ....omissis.....

.5 ....omissis.....

.6 In double-side skin spaces of less than 2.5 m width, the access to the space may be by means of vertical ladders that comprise of one or more ladder linking platforms spaced mnot more than 6 m apart vertically and displaced to one side of the ladder. Adjacent sections of ladder should be laterally offset from each other by at least the width of the ladder.

. 7 ....omissis.....

Interpretation

Adjacent sections of vertical ladder need to be installed so that the following provisions are complied with:

- the minimum “lateral offset”. between two adjacent sections of vertical ladder, is the distance between the sections, upper and lower, so that the adjacent stringers are spaced of at least 200 mm, measured from half thickness of each stringer.

- adjacent sections of vertical ladder shall be installed so that the upper end of the lower section is vertically overlapped, in respect to the lower end of the upper section, to a height of 1500 mm in order to permit a safe transfer between ladders.

- no section of the access ladder shall be terminated directly or partly above an access opening.

Technical Background

The aims of the above are to:

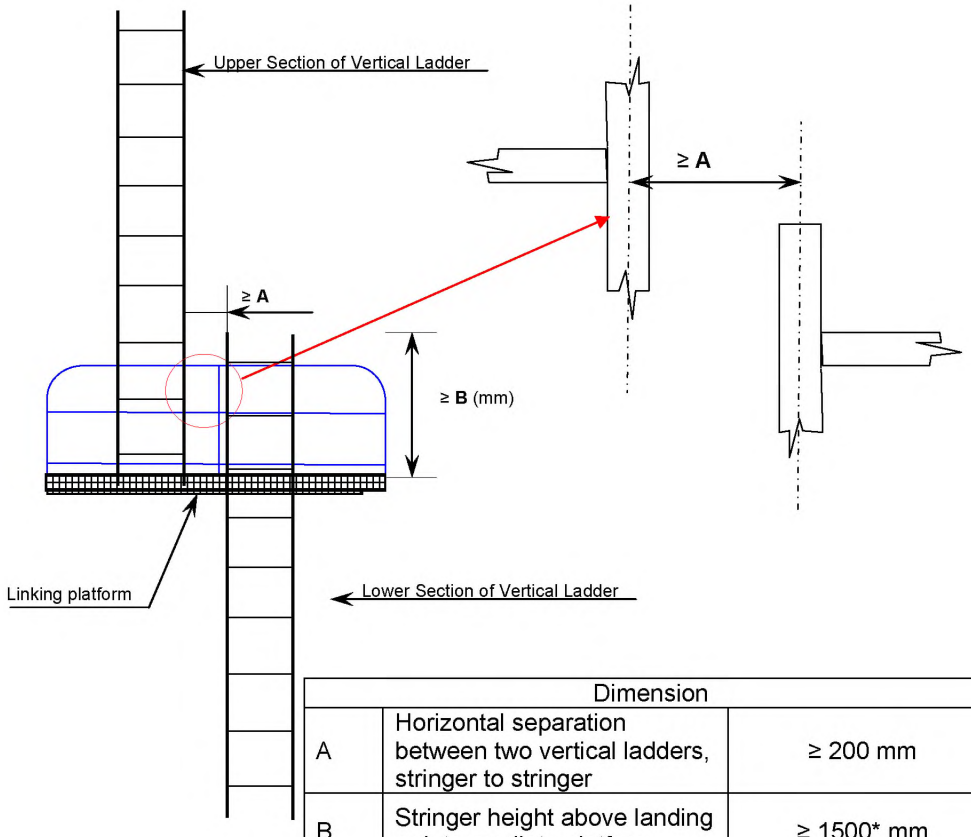
SC 191 (cont)

a. Reduce the risk of accidents due to tiredness by providing a rest platform at appropriate intervals.

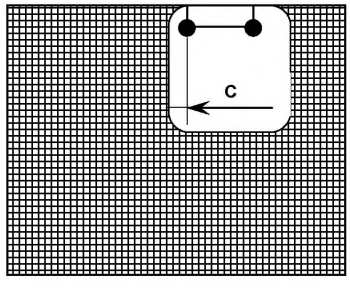
b. Reduce the risk of collateral injury from falling or dropping items of equipment by preventing the lateral overlap of two ladders.

SC 191 (cont)

Figure "A"
Vertical Ladder – Ladder through the linking platform

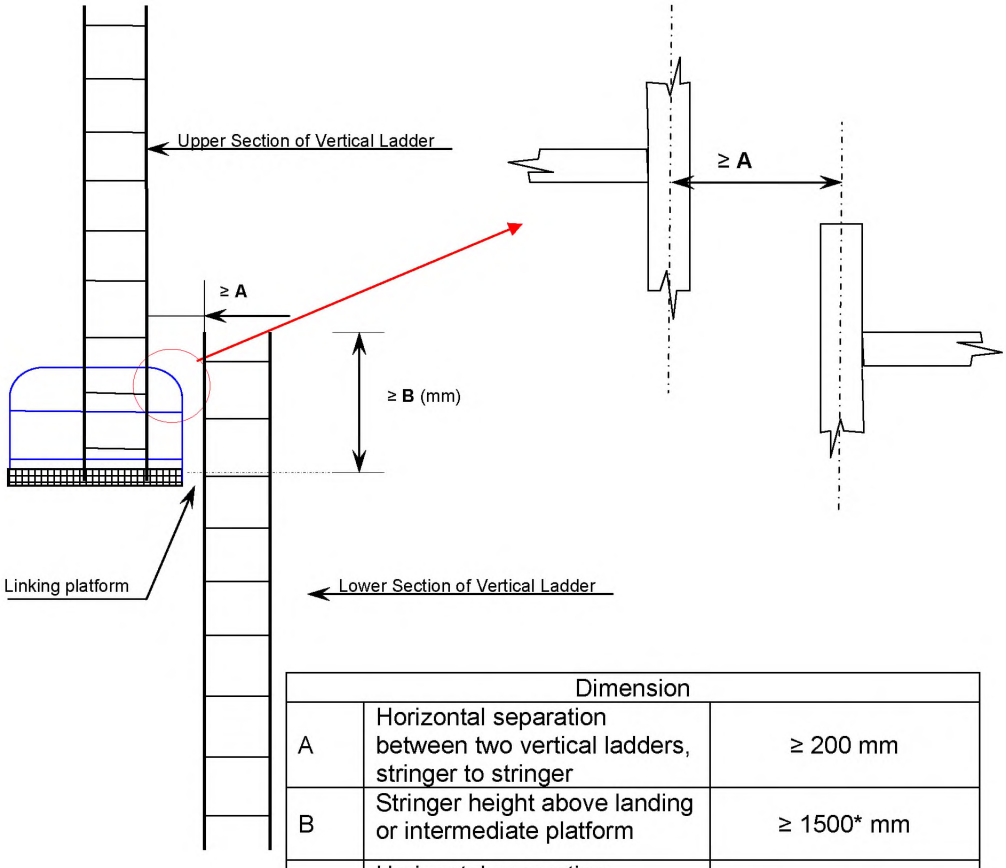


Dimension		
A	Horizontal separation between two vertical ladders, stringer to stringer	≥ 200 mm
B	Stringer height above landing or intermediate platform	≥ 1500* mm
C	Horizontal separation between ladder and platform	100 mm ≤C< 300 mm
*Note: the minimum height of the handrail stanchions of resting platform is of 1000 mm (Technical Provision, resolution MSC.158(78), paragraph 3.3)		

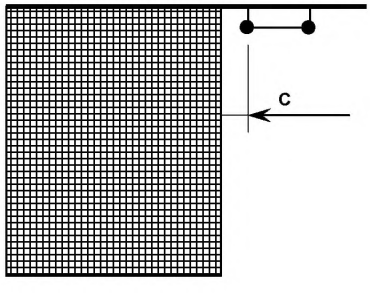


SC 191 (cont)

Figure "B"
Vertical Ladder – Side mount



Dimension		
A	Horizontal separation between two vertical ladders, stringer to stringer	≥ 200 mm
B	Stringer height above landing or intermediate platform	≥ 1500* mm
C	Horizontal separation between ladder and platform	100 mm ≤C< 300 mm
*Note: the minimum height of the handrail stanchions of resting platform is of 1000 mm (Technical Provision, resolution MSC.158(78), paragraph 3.3)		



SC 191 (cont)

Technical Provision, resolution MSC.158(78), paragraph 3.14

3.14 The uppermost entrance section from deck of the vertical ladder providing access to a tank should be vertical for a distance of 2.5 m measured clear of overhead obstructions and comprise a ladder linking platform, displaced to one side of a vertical ladder. The vertical ladder can be between 1.6 m and 3 m below deck structure if it lands on a longitudinal or athwartship permanent means of access fitted within that range.

Interpretation

Deck is defined as “weather deck”.

SC 191 (cont)

Table 1 – Means of access for oil tankers, resolution MSC.158(78), paragraph 1.1

1 Water ballast tanks, except those specified in the right column, and cargo oil tanks

Access to overhead structure

1.1 For tanks of which the height is 6 m and over containing internal structures, permanent means of access shall be provided in accordance with .1 to .6:

Interpretation

1. Sub-paragraphs .1, .2 and .3 define access to underdeck structure, access to the uppermost sections of transverse webs and connection between these structures.

2. Sub-paragraphs .4, .5 and .6 define access to vertical structures only and are linked to the presence of transverse webs on longitudinal bulkheads.

3. If there are no underdeck structures (deck longitudinals and deck transverses) but there are vertical structures in the cargo tank supporting transverse and longitudinal bulkheads, access in accordance with sub-paragraphs from .1 through to .6 is to be provided for inspection of the upper parts of vertical structure on transverse and longitudinal bulkheads.

4. If there is no structure in the cargo tank, section 1.1 of Table 1 is not to be applied.

5. Section 1 of Table 1 is also to be applied to void spaces in cargo area, comparable in volume to spaces covered by the regulation II-1/3-6, except those spaces covered by Section 2.

6. The vertical distance below the overhead structure is to be measured from the underside of the main deck plating to the top of the platform of the means of access at a given location.

7. The height of the tank is to be measured at each tank. For a tank the height of which varies at different bays, item 1.1 is to be applied to such bays of a tank that have height 6 m and over.

Technical Background

Interpretation 7: If the height of the tank is increasing along the length of a ship the permanent means of access is to be provided locally where the height is above 6 m.

Ref.

Paragraph 10 of the annex to MSC/Circ.686.

SC 191 (cont)

Table 1 – Means of access for oil tankers, resolution MSC.158(78), paragraph 1.1.2

1.1.2 at least one continuous longitudinal permanent means of access at each side of the tank. One of these accesses shall be at a minimum of 1.6 m to a maximum of 6 m below the deck head and the other shall be at a minimum of 1.6 m to a maximum of 3 m below the deck head;

Interpretation

There is need to provide continuous longitudinal permanent means of access when the deck longitudinals and deck transverses are fitted on deck but supporting brackets are fitted under the deck.

SC 191 (cont)

Table 1 – Means of access for oil tankers, resolution MSC.158(78), paragraph 1.1.3

1.1.3 access between the arrangements specified in .1 and .2 and from the main deck to either .1 or .2.

Interpretation

Means of access to tanks may be used for access to the permanent means of access for inspection.

Technical Background

As a matter of principle, in such a case where the means of access can be utilised for the purpose of accessing structural members for inspection there is no need of duplicated installation of the MA.

SC 191 (cont)

Table 1 – Means of access for oil tankers, resolution MSC.158(78), paragraph 1.1.4

1.1.4 continuous longitudinal permanent means of access which are integrated in the structural member on the stiffened surface of a longitudinal bulkhead, in alignment, where possible, with horizontal girders of transverse bulkheads are to be provided for access to the transverse webs unless permanent fittings are installed at the uppermost platform for use of alternative means as defined in paragraph 3.9 of the Technical provisions for inspection at intermediate heights;

Interpretation

The permanent fittings required to serve alternative means of access such as wire lift platform, that are to be used by crew and surveyors for inspection shall provide at least an equal level of safety as the permanent means of access stated by the same paragraph. These means of access shall be carried on board the ship and be readily available for use without filling of water in the tank.

Therefore, rafting is not to be acceptable under this provision.

Alternative means of access are to be part of Access Manual which is to be approved on behalf of the flag State.

For water ballast tanks of 5 m or more in width, such as on an ore carrier, side shell plating shall be considered in the same way as "longitudinal bulkhead".

SC 191 (cont)

Table 1 – Means of access for oil tankers, resolution MSC.158(78), paragraph 2.1

2 Water ballast wing tanks of less than 5 m width forming double side spaces and their bilge hopper sections

Access to the underdeck structure

2.1 For double side spaces above the upper knuckle point of the bilge hopper sections, permanent means of access are to be provided in accordance with .1 and .2:

Interpretation

Section 2 of Table 1 is also to be applied to wing tanks designed as void spaces.

Paragraph 2.1.1 represents requirements for access to underdeck structures, while paragraph 2.1.2 is a requirement for access for survey and inspection of vertical structures on longitudinal bulkheads (transverse webs).

Technical Background

Regulation II-1/3-6.2.1 requires each space to be provided with means of access. Though void spaces are not addressed in the technical provisions contained in resolution MSC.158(78) it is arguable whether MA is not required in void spaces. MA or portable means of access are necessary arrangement to facilitate inspection of the structural condition of the space and the boundary structure. Therefore the requirements of Section 2 of Table 1 is to be applied to double hull spaces even designed as void spaces.

SC 191 (cont)

Table 1 – Means of access for oil tankers, resolution MSC.158(78), paragraph 2.1.1

2. Wing water ballast tanks less than 5 m width forming double side spaces and their bilge hopper sections

Access to the underdeck structure

2.1.1 Where the vertical distance between horizontal uppermost stringer and deck head is 6 m or more, one continuous permanent means of access shall be provided for the full length of the tank with a means to allow passing through transverse webs installed a minimum of 1.6 m to a maximum of 3 m below the deck head with a vertical access ladder at each end of tank;

Interpretation

1. For a tank, the vertical distance between horizontal upper stringer and deck head of which varies at different sections, item 2.1.1 is to be applied to such sections that falls under the criteria.

2. The continuous permanent means of access may be a wide longitudinal, which provides access to critical details on the opposite side by means of platforms as necessary on web frames. In case the vertical opening of the web frame is located in way of the open part between the wide longitudinal and the longitudinal on the opposite side, platforms shall be provided on both sides of the web frames to allow safe passage through the web frame.

3. Where two access hatches are required by SOLAS regulation II-1/3-6.3.2, access ladders at each end of the tank are to lead to the deck.

Technical Background

Interpretation 1: The interpretation of varied tank height in item 1 of Table 1 is applied to the vertical distance between horizontal upper stringer and deck head for consistency.

SC 191 (cont)

Table 1 – Means of access for oil tankers, resolution MSC.158(78), paragraph 2.1.2

2.1.2 continuous longitudinal permanent means of access, which are integrated in the structure, at a vertical distance not exceeding 6 m apart; and

Interpretation

The continuous permanent means of access may be a wide longitudinal, which provides access to critical details on the opposite side by means of platforms as necessary on webframes. In case the vertical opening of the web is located in way of the open part between the wide longitudinal and the longitudinal on the opposite side, platforms shall be provided on both sides of the web to allow safe passage through the web.

A "reasonable deviation", as noted in TP, paragraph 1.4, of not more than 10% may be applied where the permanent means of access is integral with the structure itself.

SC 191 (cont)

Table 1 – Means of access for oil tankers, resolution MSC.158(78), paragraph 2.2

2.2 For bilge hopper sections of which the vertical distance from the tank bottom to the upper knuckle point is 6 m and over, one longitudinal permanent means of access shall be provided for the full length of the tank. It shall be accessible by vertical permanent means of access at both ends of the tank.

Interpretation

1. Permanent means of access between the longitudinal continuous permanent means of access and the bottom of the space is to be provided.

2. The height of a bilge hopper tank located outside of the parallel part of vessel is to be taken as the maximum of the clear vertical distance measured from the bottom plating to the hopper plating of the tank.

3. The foremost and aftmost bilge hopper ballast tanks with raised bottom, of which the height is 6 m and over, a combination of transverse and vertical MA for access to the upper knuckle point for each transverse web is to be accepted in place of the longitudinal permanent means of access.

Technical Background

Interpretation 2: The bilge hopper tanks at fore and aft of cargo area narrow due to raised bottom plating and the actual vertical distance from the bottom of the tank to hopper plating of the tank is more appropriate to judge if a portable means of access could be utilized for the purpose.

Interpretation 3: in the foremost or aftmost bilge hopper tanks where the vertical distance is 6 m or over but installation of longitudinal permanent means of access is not practicable permanent means of access of combination of transverse and vertical ladders provides an alternative means of access to the upper knuckle point.

SC 191 (cont)

Table 2 – Means of access for bulk carriers, resolution MSC.158(78), paragraph 1.1

1 Cargo holds

Access to underdeck structure

1.1 Permanent means of access shall be fitted to provide access to the overhead structure at both sides of the cross deck and in the vicinity of the centreline. Each means of access shall be accessible from the cargo hold access or directly from the main deck and installed at a minimum of 1.6 m to a maximum of 3 m below the deck.

Interpretation

1. Means of access shall be provided to the crossdeck structures of the foremost and aftermost part of the each cargo hold.

2. Interconnected means of access under the cross deck for access to three locations at both sides and in the vicinity of the centerline is to be acceptable as the three means of access.

3. Permanent means of access fitted at three separate locations accessible independently, one at each side and one in the vicinity of the centerline is to be acceptable.

4. Special attention is to be paid to the structural strength where any access opening is provided in the main deck or cross deck.

5. The requirements for bulk carrier cross deck structure is also to be considered applicable to ore carriers.

Technical Background

Pragmatic arrangements of the MA are provided.

SC 191 (cont)

Table 2 – Means of access for bulk carriers, resolution MSC.158(78), paragraph 1.3

1.3 Access to the permanent means of access to overhead structure of the cross deck may also be via the upper stool.

Interpretation

Particular attention is to be paid to preserve the structural strength in way of access opening provided in the main deck or cross deck.

SC 191 (cont)

Table 2 – Means of access for bulk carriers, resolution MSC.158(78), paragraph 1.4

1.4 Ships having transverse bulkheads with full upper stools with access from the main deck which allows monitoring of all framing and plates from inside, do not require permanent means of access of the cross deck.

Interpretation

"Full upper stools" are understood to be stools with a full extension between top side tanks and between hatch end beams.

SC 191 (cont)

Table 2 – Means of access for bulk carriers, resolution MSC.158(78), paragraph 1.5

1.5 Alternatively, movable means of access may be utilized for access to the overhead structure of cross deck if its vertical distance is 17 m or less above the tank top.

Interpretation

1. The movable means of access to the underdeck structure of cross deck need not necessarily be carried on board the vessel. It is sufficient if it is made available when needed.

2. The requirements for bulk carrier cross deck structure is also to be considered applicable to ore carriers.

SC 191 (cont)

Table 2 – Means of access for bulk carriers, resolution MSC.158(78), paragraph 1.6

Access to vertical structures

1.6 Permanent means of vertical access shall be provided in all cargo holds and built into the structure to allow for an inspection of a minimum of 25 % of the total number of hold frames port and starboard equally distributed throughout the hold including at each end in way of transverse bulkheads. But in no circumstance shall this arrangement be less than 3 permanent means of vertical access fitted to each side (fore and aft ends of hold and mid-span). Permanent means of vertical access fitted between two adjacent hold frames is counted for an access for the inspection of both hold frames. A means of portable access may be used to gain access over the sloping plating of lower hopper ballast tanks.

Interpretation

The maximum vertical distance of the rungs of vertical ladders for access to hold frames is to be 350 mm.

If safety harness is to be used, means are to be provided for connecting the safety harness in suitable places in a practical way.

Technical Background

The maximum vertical distance of the rungs of 350 mm is applied with a view to reducing trapping cargoes.

SC 191 (cont)

Table 2 – Means of access for bulk carriers, resolution MSC.158(78), paragraph 1.7

1.7 In addition, portable or movable means of access shall be utilized for access to the remaining hold frames up to their upper brackets and transverse bulkheads.

Interpretation

Portable, movable or alternative means of access also is to be applied to corrugated bulkheads.

SC 191 (cont)

Table 2 – Means of access for bulk carriers, resolution MSC.158(78), paragraph 1.8

1.8 Portable or movable means of access may be utilized for access to hold frames up to their upper bracket in place of the permanent means required in 1.6. These means of access shall be carried on board the ship and readily available for use.

Interpretation

Readily available means;-

Able to be transported to location in cargo hold and safely erected by ship's staff.

SC 191 (cont)

Table 2 – Means of access for bulk carriers, resolution MSC.158(78), paragraph 2.3

2.3 Three permanent means of access, fitted at the end bay and middle bay of each tank, shall be provided spanning from tank base up to the intersection of the sloping plate with the hatch side girder. The existing longitudinal structure may be used as part of this means of access.

Interpretation

If the longitudinal structures on the sloping plate are fitted outside of the tank a means of access is to be provided.

SC 191 (cont)

Table 2 – Means of access for bulk carriers, resolution MSC.158(78), paragraph 2.5

Bilge hopper tanks

2.5 For each bilge hopper tank of which the height is 6 m and over, one longitudinal continuous permanent means of access shall be provided along the side shell webs and installed at a minimum of 1.2 m below the top of the clear opening of the web ring with a vertical access ladder in the vicinity of each access to the tank.

Interpretation

1. The height of a bilge hopper tank located outside of the parallel part of vessel is to be taken as the maximum of the clear vertical height measured from the bottom plating to the hopper plating of the tank.

2. It is to be demonstrated that portable means for inspection can deployed and made readily available in the areas where needed.

SC 191 (cont)

Table 2 – Means of access for bulk carriers, resolution MSC.158(78), paragraph 2.5.2

Bilge hopper tanks

2.5.2 Alternatively, the longitudinal continuous permanent means of access can be located through the upper web plating above the clear opening of the web ring, at a minimum of 1.6 m below the deck head, when this arrangement facilitates more suitable inspection of identified structurally critical areas. An enlarged longitudinal frame can be used for the purpose of the walkway.

Interpretation

A wide longitudinal frame of at least 600 mm clear width may be used for the purpose of the longitudinal continuous permanent means of access. The foremost and aftermost bilge hopper ballast tanks with raised bottom, of which the height is 6 m and over, a combination of transverse and vertical MA for access to the sloping plate of hopper tank connection with side shell plating for each transverse web can be accepted in place of the longitudinal permanent means of access.

SC 191 (cont)

Table 2 – Means of access for bulk carriers, resolution MSC.158(78), paragraph 2.6

2.6 If no access holes are provided through the transverse ring webs within 600 mm of the tank base and the web frame rings have a web height greater than 1 m in way of side shell and sloping plating, then step rungs/grab rails shall be provided to allow safe access over each transverse web frame ring.

Interpretation

The height of web frame rings is to be measured in way of side shell and tank base.

Technical Background

In the bilge hopper tank the sloping plating is above the opening, while the movement of the surveyor is along the bottom of the tank. Therefore the measurement of 1 m is to be taken from the bottom of the tank.

End of Document

SC 226 (Nov 2008) (Rev.1 Dec 2012)

IACS Unified Interpretations (UI) ~~for~~ on the application of SOLAS regulations to conversions of Single-Hull Oil Tankers to Double-Hull Oil Tankers or Bulk Carriers ~~Single Hull Tanker to Double Hull Tanker or Bulk Carrier/Ore Carrier~~

Reference table of the clarification of the applicability of SOLAS regulations

No.	Reg.	Title/Content	Note
1	II-1/1.3	Alterations and modifications of a major character	As amended by MSC.216(82)
2	II-1/3.2, 2 & 3.2, 4	Protective coatings of dedicated seawater ballast tanks in all types of ships and double-side skin spaces of bulk carriers	As amended by MSC.216(82)
3	II-1/3-6	Access to and within spaces in, and forward of, the cargo area of oil tankers and bulk carriers	As amended by MSC.194(80)
4	II-1/3-8	Towing and Mooring Equipment	As amended by MSC.194(80)
5	II-1/Part B & Part B-1	~~Part B:~~ Subdivision and stability ~~Part B-1: Stability~~	As amended by MSC.216(82)
6	II-2/1.3	Repairs, alterations, modifications and outfitting	
7	III/1.4.2	Alterations and modifications of a major character	
8	III/31.1.8	Survival craft and rescue boats ~~Free fall lifeboats~~	
9	V/22	Navigation bridge visibility	
10	XII/4	Damage stability requirements applicable to bulk carriers	
~~11~~	XII/5.1 & 5.2	Structural strength of bulk carriers	
~~12~~	XII/6.1	Structural and other requirements for bulk carriers	
~~13~~	XII/6.2	Structural and other requirements for bulk carriers	
~~14~~	XII/6.3	Structural and other requirements for bulk carriers	As amended by MSC.216(82) Annex 1
~~15~~	XII/6.4	Structural and other requirements for bulk carriers	As amended by MSC.216(82) Annex 1
~~16~~	XII/7.1	Survey and maintenance of bulk carrier	
~~17~~	XII/7.2	Survey and maintenance of bulk carrier	
~~18~~	XII/8	Information on compliance with requirements for bulk carriers	
~~19~~	XII/9	Requirements for bulk carriers not being capable of complying with regulation 4.3 due to the design configuration of their cargo holds	
~~20~~	XII/10	Solid bulk cargo density declaration	
~~21~~	XII/11	Loading instrument	
~~22~~	XII/12	Hold, ballast and dry space water ingress alarms	
~~23~~	XII/13	Availability of pumping systems	
~~24~~	XII/14	Restrictions from sailing with any hold empty	

Note:

SC 226 (cont)

1. This UI is to be applied by IACS ~~Members and Associates~~Societies when acting as recognized organizations, authorized by flag State Administrations to act on their behalf, unless otherwise advised, from ~~1 January 2009~~1 January 2014.

SC 226 (cont)

SC226.1 Alterations and modifications of a major character SOLAS Chapter II-1 Reg. 1.3 (as amended by MSC.216(82))

SOLAS Chapter II-1, Reg. 1 'Application':

"3 All ships which undergo repairs, alterations, modifications and outfitting related thereto shall continue to comply with at least the requirements previously applicable to these ships. Such ships, if constructed before the date on which any relevant amendments enter into force, shall, as a rule, comply with the requirements for ships constructed on or after that date to at least the same extent as they did before undergoing such repairs, alterations, modifications or outfitting. Repairs, alterations and modifications of a major character and outfitting related thereto shall meet the requirements for ships constructed on or after the date on which any relevant amendments enter into force, in so far as the Administration deems reasonable and practicable."

Interpretation

1. The date on which a conversion occurs for the purposes of determining the applicability of requirements for ships constructed on or after the date on which any relevant amendments enters into force is to be:

   .1 the date on which the contract is placed for the conversion; or

   .2 in the absence of a contract, the date on which the work identifiable with the specific conversion begins; or

   .3 the completion date of the conversion, if that occurs more than three years after the date specified in subparagraph .1 above or 30 months after the date specified in subparagraph .2 above, either as applicable.

2 As for paragraph 1 above, the following applies:

   .1 Where the completion date of the conversion has been subject to delay beyond the period referred to in paragraph 1.3 above due to unforeseen circumstances beyond the control of the builder and the owner, the date on which contract is placed for the conversion or, if applicable, the date on which the work identifiable with the specific conversion begins may be accepted by the Administration in lieu of the completion date of the conversion. The treatment of such ships is to be considered by the Administration on a case-by-case basis, bearing in mind the particular circumstances.

   .2 It is important that ships accepted by the Administration under the provisions of subparagraph .1 above are also to be accepted as such by port States. In order to ensure this, the following practice is recommended to Administrations when considering an application for such a ship:

      .1 the Administration should thoroughly consider applications on a case-by-case basis, bearing in mind the particular circumstances. In doing so in the case of a ship converted in a foreign country, the Administration may require a formal report from the authorities of the country in which the ship was converted, stating that the delay was due to unforeseen circumstances beyond the control of the builder and the owner;

SC 226 (cont)

.2 when a ship is accepted by the Administration under the provisions of subparagraph .1 above, information on the conversion date annotated on the relevant certificates is to be footnoted to indicate that the ship is accepted by the Administration under the unforeseen delay in completion of the conversion provisions of this interpretation; and

.3 the Administration should report to the Organization on the identity of the ship and the grounds on which the ship has been accepted under the unforeseen delay in the completion of the conversion provisions of this interpretation.

~~The date on which such a modification occurs for purposes of determining the applicability of requirements for ships constructed on or after the date on which any relevant amendments enter into force shall be:~~

~~– the date on which the contract is placed for the conversion; or~~

~~– in the absence of a contract, the date on which the work identifiable with the specific conversion begins.~~

For conversions of single-hull oil tankers to double-hull oil tankers or bulk carriers, the following is to apply:

.1 Conversions of single-hull oil tankers to double-hull oil tankers or bulk carriers is to be regarded as modifications of a major character for the purposes of SOLAS chapter II-1.

.2 Repairs, alterations and modifications of a major character include:

.1 Substantial alteration of the dimensions of a ship, for example lengthening of a ship by adding a new midbody. The new midbody is to comply with SOLAS chapter II-1.

.2 A change of ship type, for example an oil tanker converted to a bulk carrier. Any structure, machinery and systems that are added or modified is to comply with SOLAS chapter II-1, taking into account the interpretation of SOLAS chapter II-1 regulations as contained herein.

~~• For Single-Hull Tanker to Double-Hull Tanker or Single-Hull Tanker to Bulk Carrier/Ore Carrier~~

~~i.e.~~

~~1 Conversions of single-hull tankers to double-hull tankers are regarded as modifications of a major character for the purposes of SOLAS chapter II-1.~~

~~2 Repairs, alterations and modifications of a major character include:~~

~~.1 Substantial alteration of the dimensions of a ship, for example:~~

~~Lengthening of a ship by adding a new midbody. The new midbody shall comply with SOLAS chapter II-1.~~

~~.2 A change of ship type, for example:~~

SC 226 (cont)

~~A tanker converted to a bulk carrier. Any structure, machinery and systems that are added or modified shall comply with SOLAS chapter II-1 taking into account the interpretation Reg. 3-2, 2 and Reg. 3-2, 4.~~

SC 226 (cont)

SC226.2 Protective coatings of dedicated seawater ballast tanks in all types of ships and double-side skin spaces of bulk carriers SOLAS Chapter II-1 Reg. 3-2, 2 and Reg. 3-2, 4 (as amended by MSC.216(82))

SOLAS Chapter II-1, Reg. 3-2:

"2 All dedicated seawater ballast tanks arranged in ships and double-side skin spaces arranged in bulk carriers of 150 m in length and upwards shall be coated during construction in accordance with the 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 the Maritime Safety Committee by resolution MSC.215(82), as may be amended by the Organization, provided that such amendments are adopted, brought into force and take effect in accordance with the provisions of article VIII of the present Convention concerning the amendment procedures applicable to the Annex other than chapter I."

and

"4 Maintenance of the protective coating system shall be included in the overall ship's maintenance scheme. The effectiveness of the protective coating system shall be verified during the life of a ship by the Administration or an organization recognized by the Administration, based on the guidelines developed by the Organization."*

Interpretation

1. For single-hull oil tanker conversion into double-hull oil tanker, SOLAS regulation II-1/3-2 as adopted by resolution MSC.216(82) is to apply to dedicated water ballast tanks if constructed with all structural members being entirely new. If converting existing spaces into water ballast tanks with part of the existing structural members remaining in place, revised SOLAS regulation II-1/3-2 (MSC.216(82)) need not be applied. However, dedicated sea water ballast tanks are to have an efficient corrosion prevention system such as hard protective coatings or equivalent and be of light colour.

2. For single-hull oil tanker conversion into bulk carrier, SOLAS regulation II-1/3-2 as adopted by resolution MSC.216(82) is to apply to dedicated water ballast tanks and double-side skin spaces of bulk carriers if constructed with all structural members being entirely new. If converting existing spaces into dedicated water ballast tanks or double-side skin space of bulk carriers with part of the existing structural members remaining in place, revised SOLAS regulation II-1/3-2 (MSC.216(82)) need not be applied. However, dedicated sea water ballast tanks are to have an efficient corrosion prevention system such as hard protective coatings or equivalent and be of light colour.

~~• For Single-Hull Tanker to Double-Hull Tanker~~

~~SOLAS II-1/3-2 (MSC.216(82)) only applies to dedicated water ballast tanks if constructed with all structural members being entirely new. If converting existing spaces into water ballast tanks with part of the existing structural members remaining in place, revised SOLAS II-1/3-2 (MSC.216(82)) need not be applied.~~

~~• For Single-Hull Tanker to Bulk Carrier/Ore Carrier~~

SC 226 (cont)

~~SOLAS II-1/3-2 (MSC.216(82)) only applies to dedicated water ballast tanks and double-side skin space of bulk carriers if constructed with all structural members being entirely new. If converting existing spaces into dedicated water ballast tanks or double-side skin space of Bulk Carrier with part of the existing structural members remains in place, revised SOLAS II-1/3-2 (MSC.216(82)) need not be applied.~~

SC 226 (cont)

SC226.3 Access to and within spaces in, and forward of, the cargo area of oil tankers and bulk carriers
SOLAS Chapter II-1 Reg. 3-6 (as amended by MSC.194(80))

Regulation texts are not inserted here.

Interpretation

1. For single-hull oil tanker conversion into double-hull oil tanker

1.1 Permanent means of access contained in table 1 of the Technical provisions for means of access for inspections (resolution MSC.158(78)) need not apply. However, if, in the course of conversion, substantial new structures are added, these new structures are to comply with the regulation.

1.2 The term "substantial new structures" means hull structures that are entirely renewed or augmented by new double bottom and/or double-side construction (e.g., replacing the entire structure within cargo area or adding a new double bottom and/or double-side section to the existing cargo area).

1.3 Additionally, an approved Ship Structure Access Manual is to be provided.

2. For single-hull oil tanker conversion into bulk carrier

2.1 Permanent means of access contained in table 2 of the Technical provisions for means of access for inspections (resolution MSC.158(78)) need not apply. However, if, in the course of conversion, substantial new structures are added, these new structures are to comply with the regulation.

2.2 The term "substantial new structures" means hull structures that are entirely renewed or augmented by new double bottom and/or double-side skin construction (e.g., replacing the entire structure within cargo area or adding a new double bottom and/or double-side section to the existing cargo area).

2.3 Additionally, an approved Ship Structure Access Manual is to be provided.

~~• For Single-Hull Tanker to Double-Hull Tanker~~

~~Permanent means of access contained in table 1 of the Technical provisions for means of access for inspections (resolution MSC.158(78)) need not apply. However, if, in the course of conversion, substantial new structures are added, these new structures shall comply with the regulation.~~

~~The term "substantial new structures" means hull structures that are entirely renewed or augmented by new double bottom and/or double side construction (e.g., replacing the entire structure within cargo area or adding a new double bottom and/or double side section to the existing cargo area).~~

~~Additionally, an approved access manual shall be provided.~~

~~• For Single-Hull Tanker to Bulk Carrier/Ore Carrier~~

~~Permanent means of access contained in table 2 of the Technical provisions for means of access for inspections (resolution MSC.158(78)) need not apply. However, if, in the course of~~

SC 226 (cont)

~~conversion, substantial new structures are added, these new structures shall comply with the regulation.~~

~~The term "substantial new structures" means hull structures that are entirely renewed or augmented by new double bottom and/or double-side skin construction (e.g., replacing the entire structure within cargo area or adding a new double bottom and/or double-side section to the existing cargo area).~~

~~Additionally, an approved access manual shall be provided.~~

SC 226 (cont)

SC226.4 Towing and Mooring Equipment
SOLAS Chapter II-1 Reg. 3-8 (as amended by MSC.194(80))

Regulation texts are not inserted here.

Interpretation

For single-hull oil tanker conversion into double-hull oil tanker or bulk carrier

This regulation is to be applied when equipment and fittings for mooring/towing are replaced, modified or the safe working load of the existing equipment and fittings is known. Where the latter cannot be ascertained, alternative compliance with SOLAS regulation II-1/3-8 is to be sought (e.g., the equipment is to be replaced, tested or modified).

- ~~For Single-Hull Tanker to Double-Hull Tanker or Single-Hull Tanker to Bulk Carrier/Ore Carrier~~

~~When existing equipment or fittings are only relocated, this regulation applies only to their supporting structures.~~

~~Except where equipment and fittings for mooring/towing are totally replaced or modified, indication of Safe Work Load and provision of towing and mooring arrangements plan is not required.~~

SC 226 (cont)

SC226.5 ~~Part B: Subdivision and stability; and Part B-1: Stability~~ Subdivision and stability
SOLAS Chapter II-1 Part B and Part B-1 (as amended by MSC.216(82) ~~– to be implemented from 1 January 2009)~~

~~Part~~	~~Reg.~~	~~Title~~	~~Applicable to~~
~~B~~	~~4~~	~~General~~	~~Cargo ships and passenger ships, but shall exclude those cargo ships which are shown to comply with subdivision and damage stability regulations in other instruments developed by the IMO.~~
~~B-1~~	~~5~~	~~Intact stability information~~	~~Cargo ships and passenger ships~~
~~B-1~~	~~5-1~~	~~Stability information to be supplied to the master~~	~~Cargo ships and passenger ships~~
~~B-1~~	~~6~~	~~Required subdivision index *R*~~	~~Cargo ships and passenger ships~~
~~B-1~~	~~7~~	~~Attained subdivision index *A*~~	~~Cargo ships and passenger ships~~
~~B-1~~	~~7-1~~	~~Calculation of the factor p_i~~	~~Cargo ships and passenger ships~~
~~B-1~~	~~7-2~~	~~Calculation of the factor s_i~~	~~Cargo ships and passenger ships~~
~~B-1~~	~~7-3~~	~~Permeability~~	~~Cargo ships and passenger ships~~

Regulation texts are not inserted here.

Interpretation

1. For single-hull oil tanker conversion into double-hull oil tanker

Oil tankers complying with damage stability requirements contained in Annex I to MARPOL 73/78 (except for combination carriers with type B freeboards) may be excluded from the damage stability requirements contained in SOLAS chapter II-1, part B-1.

2. For single-hull oil tanker conversion into bulk carrier

2.1 A bulk carrier which is assigned a B reduced freeboard complying with damage stability requirements contained in regulation 27 of the 1966 Load Line Convention, and resolutions A.320(IX) and A.514(13); or regulation 27 of the 1988 Load Line Protocol, may be excluded from the damage stability requirements contained in SOLAS chapter II-1, part B-1.

2.2 For a bulk carrier which is assigned a B freeboard, SOLAS chapter II-1, Parts B and B-1 are to be applied.

~~• For Single Hull Tanker to Double Hull Tanker~~

~~As Oil Tankers shall comply with MARPOL Annex I Reg. 27 (intact stability) and Reg. 28 (damage stability), SOLAS Part B, B-1 may be excluded.~~

SC 226 (cont)

- ~~For Single-Hull Tanker to Bulk Carrier/Ore Carrier~~

~~For Bulk Carrier/Ore Carrier which is assigned a B reduced freeboard, ICLL 1966 Reg.27 (damage stability) or ICLL Protocol 1988 Reg.27 (damage stability) is applicable. As such, SOLAS II-1 Parts B, B-1 may be excluded.~~

~~For Bulk Carrier/Ore Carrier which is assigned a B freeboard, SOLAS II-1 Part B, B-1 is applicable.~~

SC 226 (cont)

SC226.6 Repairs, alterations, modifications and outfitting SOLAS Chapter II-2 Reg. 1.3

SOLAS Chapter II-2, Reg. 1.3 'Repairs, alterations, modifications and outfitting':

"3.1 All ships which undergo repairs, alterations, modifications and outfitting related thereto shall continue to comply with at least the requirements previously applicable to these ships. Such ships, if constructed before 1 July 2002, shall, as a rule, comply with the requirements for ships constructed on or after that date to at least the same extent as they did before undergoing such repairs, alterations, modifications or outfitting.

3.2 Repairs, alterations and modifications which substantially alter the dimensions of a ship or the passenger accommodation spaces, or substantially increase a ship's service life and outfitting related thereto shall meet the requirements for ships constructed on or after 1 July 2002 in so far as the Administration deems reasonable and practicable."

Interpretation

~~The date on which a such a modification occurs for purposes of determining the applicability of requirements for ships constructed on or after the date on which any relevant amendments enter into force shall be:~~

- ~~the date on which the contract is placed for the conversion; or~~
- ~~in the absence of a contract, the date on which the work identifiable with the specific conversion begins.~~

For single-hull oil tanker conversion into double-hull oil tanker or bulk carrier, new and converted parts are to comply with the latest applicable requirements.

~~• For Single-Hull Tanker to Double-Hull Tanker~~

~~New and converted parts shall comply with the latest applicable requirements.~~

~~• For Single-Hull Tanker to Bulk Carrier/Ore Carrier~~

~~New and converted parts shall comply with the latest applicable requirements.~~

SC 226 (cont)

SC226.7 Alterations and modifications of a major character SOLAS Chapter III Reg. 1.4.2

SOLAS Chapter III, Reg. 1 'Application':

"4 For ships constructed before 1 July 1998, the Administration shall:

.1 .....; and

.2 ensure that when life-saving appliances or arrangements on such ships are replaced or such ships undergo repairs, alterations or modifications of a major character which involve replacement of, or any addition to, their existing life-saving appliances or arrangements, such life-saving appliances or arrangements, in so far as is reasonable and practicable, comply with the requirements of this chapter. However, if a survival craft other than an inflatable liferaft is replaced without replacing its launching appliance, or vice versa, the survival craft or launching appliance may be of the same type as that replaced."

Interpretation

~~The date on which a such a modification occurs for purposes of determining the applicability of requirements for ships constructed on or after the date on which any relevant amendments enter into force shall be:~~

- ~~the date on which the contract is placed for the conversion; or~~
- ~~in the absence of a contract, the date on which the work identifiable with the specific conversion begins.~~

For single-hull oil tanker conversion into double-hull oil tanker or bulk carrier, this to be considered as an alteration or modification of a major character.

- ~~For Single-Hull Tanker to Double-Hull Tanker~~

~~This shall be considered as a major conversion.~~

- ~~For Single-Hull Tanker to Bulk Carrier/Ore Carrier~~

~~This shall be considered as a major conversion.~~

SC 226 (cont)

SC226.8 Survival craft and rescue boats ~~Free-fall lifeboats~~
SOLAS Chapter III Reg. 31.1.8

SOLAS Chapter III, Reg. 31 'Survival craft and rescue boats':

"1.2 In lieu of meeting the requirements of paragraph 1.1, cargo ships may carry:

.1 one or more free-fall lifeboats, complying with the requirements of section 4.7 of the Code, capable of being free-fall launched over the stern of the ship of such aggregate capacity as will accommodate the total number of persons on board; and

.2 in addition, one or more inflatable or rigid liferafts complying with the requirements of section 4.2 or 4.3 of the Code, on each side of the ship, of such aggregate capacity as will accommodate the total number of persons on board. The liferafts on at least one side of the ship shall be served by launching appliances."

and

"1.8 Notwithstanding the requirements of paragraph 1.1, bulk carriers as defined in regulation IX/1.6 constructed on or after 1 July 2006 shall comply with the requirements of paragraph 1.2."

Interpretation

1. For single-hull oil tanker conversion into double-hull oil tanker, this regulation is not relevant.

2. For single-hull oil tanker conversion into bulk carrier, SOLAS regulation III/31.1.8 is to be met as for new ships, except where the space available for fitting and/or launching a free-fall lifeboat in accordance with regulation III/31.1.2.1 is not adequate, in which case the Administration is to be contacted to determine whether or not existing arrangement may be accepted.

~~• For Single-Hull Tanker to Double-Hull Tanker~~

~~Not relevant.~~

~~• For Single-Hull Tanker to Bulk Carrier/Ore Carrier~~

~~Not applicable.~~

SC 226 (cont)

SC226.9 Navigation bridge visibility SOLAS Chapter V Reg. 22

Regulation text is not inserted here.

Interpretation

For single-hull oil tanker conversion into double-hull oil tanker or bulk carrier, the level of visibility possessed by the ship prior to the conversion at the ballast loading condition is to be maintained after the conversion. Where a conversion involves the modification of structural arrangements used to establish minimum bridge visibility, the provisions of SOLAS regulation V/22 is to apply.

~~For Single-Hull Tanker to Double-Hull Tanker~~

~~In ballast loading condition, the visibility standard applicable to the ship prior to conversion is acceptable as equivalent to the ballast loading condition after the conversion. Visibility forward needs to comply with if any changes are made to the fore end structural arrangement. This need not only be related to the fitting of a full forecastle, but could also be affected by aspects such as increasing the sheer and/or step in the upper deck.~~

~~• For Single-Hull Tanker to Bulk Carrier/Ore Carrier~~

~~In ballast loading condition, the visibility standard applicable to the ship prior to conversion is acceptable as equivalent to the ballast loading condition after the conversion. Visibility forward needs to comply with if any changes are made to the fore end structural arrangement. This need not only be related to the fitting of a full forecastle, but could also be affected by aspects such as increasing the sheer and/or step in the upper deck.~~

SC 226 (cont)

SC226.10 Damage stability requirements applicable to bulk carriers

SOLAS regulation XII/4, structural strength of bulk carriers SOLAS regulation XII/5.1 and 5.2, structural and other requirements for bulk carriers SOLAS regulation XII/6.1, XII/6.2, XII/6.3 (MSC.216(82) Annex 1) and XII/6.4 (MSC.216(82) Annex 1), survey and maintenance of bulk carriers SOLAS regulation XII/7.1 and XII/7.2, information on compliance with requirements for bulk carriers SOLAS regulation XII/8, Requirements for bulk carriers not being capable of complying with regulation 4.3 due to the design configuration of their cargo holds SOLAS regulation XII/9, Solid bulk cargo density declaration SOLAS regulation XII/10, Loading instrument SOLAS regulation XII/11, Hold, ballast and dry space water ingress alarms SOLAS regulation XII/12, Availability of pumping systems SOLAS regulation XII/13, Restrictions from sailing with any hold empty SOLAS regulation XII/14

Regulation texts are not inserted here.

~~*"2 Bulk carriers of 150 m in length and upwards of double-side skin construction in which any part of longitudinal bulkhead is located within B/5 or 11.5 m, whichever is less, inboard from the ship's side at right angle to the centreline at the assigned Summer Load Line, designed to carry solid bulk cargoes having a density of 1,000 kg/m^3 and above, constructed on or after 1 July 2006, shall, when loaded to the Summer Load Line, be able to withstand flooding of any one cargo hold in all loading conditions and remain afloat in a satisfactory condition of equilibrium, as specified in paragraph 4."*~~

Interpretation

1. For single-hull oil tanker conversion into double-hull oil tanker, these regulations are not relevant.

2. For single-hull oil tanker conversion into bulk carrier, the provisions of chapter XII applicable for ships constructed on or after the date on which conversion occurs, are to be applied as for a new ship to the entire bulk carrier, i.e. all new and existing parts and spaces, as indicated in the table below.

Table of application of the Regulations of SOLAS Chapter XII to the conversions of Single Hull Tankers to Bulk Carriers/Ore Carriers

SC 226 (cont)

Regulation	Applicability	Note
4.1	Apply	
4.2	Apply, based on the Unified interpretations of SOLAS regulations XII/4.2 and XII/5.2 (MSC.1/Circ.1178).	
4.3	NA	
4.4	NA	This regulation is referred to within regulations 4.1 and 4.2
4.5	NA	
4.6	Apply	
4.7	Apply	
5.1	Apply	
5.2	Apply, based on the Unified interpretations of SOLAS regulations XII/4.2 and XII/5.2 (MSC.1/Circ.1178).	
6.1	NA	
6.2	Apply	
6.3	Apply	
6.4	Apply	
7.1	NA. However, SOLAS regulation XI-1/2 is applicable.	
7.2	Apply	
8.1	Apply	
8.2	NA	
8.3	NA	
9	NA	
10.1	Apply	
10.2	NA	
11.1	Apply	
11.2	NA	
11.3	Apply	
12.1	Apply	
12.2	Apply	
12.3	NA	
13.1	Apply	
13.2	NA	
14	NA	

~~• For Single Hull Tanker to Double Hull Tanker~~

~~Not relevant.~~

~~• For Single Hull Tanker to Bulk Carrier/Ore Carrier~~

~~When the breadth of wing tanks is less than B/5 or 11.5m, whichever is less, this requirement applies to the relevant cargo hold(s) in way of that wing tank.~~

SC 226 (cont)

~~SC226.11 Structural strength of bulk carriers SOLAS regulation XII/5.1 and 5.2~~

~~*"1 Bulk carriers of 150 m in length and upwards of single-side skin construction, designed to carry solid bulk cargoes having a density of 1,000 kg/m^3 and above constructed on or after 1 July 1999, shall have sufficient strength to withstand flooding of any one cargo hold to the water level outside the ship in that flooded condition in all loading and ballast conditions, taking also into account dynamic effects resulting from the presence of water in the hold, and taking into account the recommendations adopted by the Organization.*~~

~~*2 Bulk carriers of 150 m in length and upwards of double-side skin construction, in which any part of longitudinal bulkhead is located within B/5 or 11.5 m, whichever is less, inboard from the ship's side at right angle to the centreline at the assigned Summer Load Line, designed to carry bulk cargoes having a density of 1,000 kg/m^3 and above, constructed on or after 1 July 2006, shall comply with the structural strength provisions of paragraph 1."*~~

~~Interpretation~~

~~• For Single Hull Tanker to Double Hull Tanker~~

~~Not relevant.~~

~~• For Single Hull Tanker to Bulk Carrier/Ore Carrier~~

~~When the breadth of wing tanks is less than B/5 or 11.5m, whichever is less, this requirement applies to the relevant cargo hold(s) in way of that wing tank.~~

SC 226 (cont)

~~SC226.12 Structural and other requirements for bulk carriers SOLAS regulation XII/6.1~~

~~*"1 Bulk carriers of 150 m in length and upwards of single-side skin construction, carrying solid bulk cargoes having a density of 1,780 kg/m^3 and above, constructed before 1 July 1999, shall comply with the following requirements in accordance with the implementation schedule specified in regulation 3:"*~~

~~Interpretation~~

~~• For Single-Hull Tanker to Double-Hull Tanker~~

~~Not relevant.~~

~~• For Single-Hull Tanker to Bulk Carrier/Ore Carrier~~

~~This regulation is not applicable.~~

SC 226 (cont)

~~SC226.13 Structural and other requirements for bulk carriers~~
~~SOLAS regulation XII/6.2~~

~~*"2 Bulk carriers of 150 m in length and upwards constructed on or after 1 July 2006, shall comply in all areas with double-side skin construction with the following requirements:*~~

~~*.1 Primary stiffening structures of the double-side skin shall not be placed inside the cargo hold space.*~~

~~*.2 Subject to the provisions below, the distance between the outer shell and the inner shell at any transverse section shall not be less than 1,000 mm measured perpendicular to the side shell. The double-side skin construction shall be such as to allow access for inspection as provided in regulation II-1/3-6 and the Technical Provisions referring thereto.*~~

~~*.1 The clearances below need not be maintained in way of cross ties, upper and lower end brackets of transverse framing or end brackets of longitudinal framing.*~~

~~*.2 The minimum width of the clear passage through the double-side skin space in way of obstructions such as piping or vertical ladders shall not be less than 600 mm.*~~

~~*.3 Where the inner and/or outer skins are transversely framed, the minimum clearance between the inner surfaces of the frames shall not be less than 600 mm.*~~

~~*.4 Where the inner and outer skins are longitudinally framed, the minimum clearance between the inner surfaces of the frames shall not be less than 800 mm. Outside the parallel part of the cargo hold length, this clearance may be reduced where necessitated by the structural configuration, but, shall in no case be less than 600 mm.*~~

~~*.5 The minimum clearance referred to above shall be the shortest distance measured between assumed lines connecting the inner surfaces of the frames on the inner and outer skins."*~~

~~Interpretation~~

~~• For Single Hull Tanker to Double Hull Tanker~~

~~Not relevant.~~

~~• For Single Hull Tanker to Bulk Carrier/Ore Carrier~~

~~This regulation applies. For Permanent Means of Access, the requirements contained in table 2 of the Technical provisions for means of access for inspections (resolution MSC.158(78)) shall not apply to tankers converting from single hull to double hull. However, if, in the course of conversion, substantial new structures are added, these new structures shall comply with the regulation. The term "substantial new structures" means hull structures that are entirely renewed or augmented by new double bottom and/or double side construction (e.g., replacing the entire structure within cargo area or adding a new double bottom and/or double side section to the existing cargo area). Additionally, an approved access manual shall be provided.~~

SC 226 (cont)

~~SC226.14 Structural and other requirements for bulk carriers~~
~~SOLAS regulation XII/6.3 (MSC.216(82) Annex 1)~~

~~*"3 The double-side skin spaces, with the exception of top-side wing tanks, if fitted, shall not be used for the carriage of cargo."*~~

~~Interpretation~~

- ~~For Single-Hull Tanker to Double-Hull Tanker~~

~~Not relevant.~~

- ~~For Single-Hull Tanker to Bulk Carrier/Ore Carrier~~

~~This regulation applies.~~

SC 226 (cont)

~~SC226.15 Structural and other requirements for bulk carriers~~
~~SOLAS regulation XII/6.4 (MSC.216(82) Annex 1)~~

~~*"4 In bulk carriers of 150 m in length and upwards, carrying solid bulk cargoes having a density of 1,000 kg/m^3 and above, constructed on or after 1 July 2006:*~~

~~*.1 the structure of cargo holds shall be such that all contemplated cargoes can be loaded and discharged by standard loading/discharge equipment and procedures without damage which may compromise the safety of the structure;*~~

~~*.2 effective continuity between the side shell structure and the rest of the hull structure shall be assured; and*~~

~~*.3 the structure of cargo areas shall be such that single failure of one stiffening structural member will not lead to immediate consequential failure of other structural items potentially leading to the collapse of the entire stiffened panels."*~~

~~Interpretation~~

~~• For Single Hull Tanker to Double Hull Tanker~~

~~Not relevant.~~

~~• For Single Hull Tanker to Bulk Carrier/Ore Carrier~~

~~The newly constructed parts of converted bulk carriers of 150 m in length and upwards, carrying solid bulk cargoes having a density of 1,000 kg/m^3 and above, constructed on or after 1 July 2006 shall comply.~~

SC 226 (cont)

~~SC226.16 Survey and maintenance of bulk carriers~~
~~SOLAS regulation XII/7.1~~

~~*"1 Bulk carriers of 150 m in length and upwards of single-side skin construction, constructed before 1 July 1999, of 10 years of age and over, shall not carry solid bulk cargoes having a density of 1,780 kg/m^3 and above unless they have satisfactorily undergone either:*~~

~~*.1 a periodical survey, in accordance with the enhanced programme of inspections during surveys required by regulation XI-1/2; or*~~

~~*.2 a survey of all cargo holds to the same extent as required for periodical surveys in the enhanced programme of inspections during surveys required by regulation XI-1/2."*~~

~~Interpretation~~

~~• For Single Hull Tanker to Double Hull Tanker~~

~~Not relevant.~~

~~• For Single Hull Tanker to Bulk Carrier/Ore Carrier~~

~~This regulation is not applicable.~~

SC 226 (cont)

~~SC226.17 Survey and maintenance of bulk carriers~~
~~SOLAS regulation XII/7.2~~

~~*"2 Bulk carriers shall comply with the maintenance requirements provided in regulation II-1/3-1 and the Standards for owners' inspection and maintenance of bulk carrier hatch covers, adopted by the Organization by resolution MSC.169(79), as may be amended by the Organization, provided that such amendments are adopted, brought into force and take effect in accordance with the provisions of article VIII of the present Convention concerning the amendment procedures applicable to the Annex other than chapter I."*~~

~~Interpretation~~

~~• For Single Hull Tanker to Double Hull Tanker~~

~~Not relevant.~~

~~• For Single Hull Tanker to Bulk Carrier/Ore Carrier~~

~~This regulation shall be applied.~~

SC 226 (cont)

~~SC226.18 Information on compliance with requirements for bulk carriers SOLAS regulation XII/8~~

~~*"1 The booklet required by regulation VI/7.2 shall be endorsed by the Administration, or on its behalf, to indicate that regulations 4, 5, 6 and 7, as appropriate, are complied with.*~~

~~*2 Any restrictions imposed on the carriage of solid bulk cargoes having a density of 1,780 kg/m^3 and above in accordance with the requirements of regulations 6 and 14 shall be identified and recorded in the booklet referred to in paragraph 1.*~~

~~*3 A bulk carrier to which paragraph 2 applies shall be permanently marked on the side shell at midships, port and starboard, with a solid equilateral triangle having sides of 500 mm and its apex 300 mm below the deck line, and painted a contrasting colour to that of the hull."*~~

~~Interpretation~~

- ~~For Single Hull Tanker to Double Hull Tanker~~

~~Not relevant.~~

- ~~For Single Hull Tanker to Bulk Carrier/Ore Carrier~~

~~This regulation shall be applied.~~

SC 226 (cont)

~~SC226.19 Requirements for bulk carriers not being capable of complying with regulation 4.3 due to the design configuration of their cargo holds~~

~~SOLAS regulation XII/9~~

~~*"For bulk carriers constructed before 1 July 1999 being within the application limits of regulation 4.3, which have been constructed with an insufficient number of transverse watertight bulkheads to satisfy that regulation, the Administration may allow relaxation from the application of regulations 4.3 and 6, on condition that they shall comply with the following requirements:*~~

~~*.1 for the foremost cargo hold, the inspections prescribed for the annual survey in the enhanced programme of inspections during surveys required by regulation XI-1/2 shall be replaced by the inspections prescribed therein for the intermediate survey of cargo holds;*~~

~~*.2 they are provided with bilge well high water level alarms in all cargo holds, or in cargo conveyor tunnels, as appropriate, giving an audible and visual alarm on the navigation bridge, as approved by the Administration or an organization recognized by it in accordance with the provisions of regulation XI-1/1; and*~~

~~*.3 they are provided with detailed information on specific cargo hold flooding scenarios. This information shall be accompanied by detailed instructions on evacuation preparedness under the provisions of section 8 of the International Safety Management (ISM) Code and be used as the basis for crew training and drills."*~~

~~Interpretation~~

~~• For Single-Hull Tanker to Double-Hull Tanker~~

~~Not relevant.~~

~~• For Single-Hull Tanker to Bulk Carrier/Ore Carrier~~

~~This regulation is not applicable.~~

SC 226 (cont)

~~SC226.20 Solid bulk cargo density declaration~~
~~SOLAS regulation XII/10~~

~~*"1 Prior to loading bulk cargo on bulk carriers of 150 m in length and upwards, the shipper shall declare the density of the cargo, in addition to providing the cargo information required by regulation VI/2.*~~

~~*2 For bulk carriers to which regulation 6 applies, unless such bulk carriers comply with all relevant requirements of this chapter applicable to the carriage of solid bulk cargoes having a density of 1,780 kg/m^3 and above, any cargo declared to have a density within the range 1,250 kg/m^3 to 1,780 kg/m^3 shall have its density verified by an accredited testing organization."*~~

~~Interpretation~~

~~• For Single-Hull Tanker to Double-Hull Tanker~~

~~Not relevant.~~

~~• For Single-Hull Tanker to Bulk Carrier/Ore Carrier~~

~~This regulation shall be applied.~~

SC 226 (cont)

SC226.21 Loading instrument
SOLAS regulation XII/11

"Loading instrument
(Unless provided otherwise, this regulation applies to bulk carriers regardless of their date of construction)

1 Bulk carriers of 150 m in length and upwards shall be fitted with a loading instrument capable of providing information on hull girder shear forces and bending moments, taking into account the recommendation adopted by the Organization.

2 Bulk carriers of 150 m in length and upwards constructed before 1 July 1999 shall comply with the requirements of paragraph 1 not later than the date of the first intermediate or periodical survey of the ship to be carried out after 1 July 1999.

3 Bulk carriers of less than 150 m in length constructed on or after 1 July 2006 shall be fitted with a loading instrument capable of providing information on the ship's stability in the intact condition. The computer software shall be approved for stability calculations by the Administration and shall be provided with standard conditions for testing purposes relating to the approved stability information."

Interpretation

- For Single Hull Tanker to Double Hull Tanker

Not relevant.

- For Single Hull Tanker to Bulk Carrier/Ore Carrier

This regulation shall be applied.

SC 226 (cont)

~~SC226.22 Hold, ballast and dry space water ingress alarms~~
~~SOLAS regulation XII/12~~

~~*"Hold, ballast and dry space water ingress alarms*~~
~~*(This regulation applies to bulk carriers regardless of their date of construction)*~~

~~*1 Bulk carriers shall be fitted with water level detectors:*~~

~~*.1 in each cargo hold, giving audible and visual alarms, one when the water level above the inner bottom in any hold reaches a height of 0.5 m and another at a height not less than 15% of the depth of the cargo hold but not more than 2 m. On bulk carriers to which regulation 9.2 applies, detectors with only the latter alarm need be installed. The water level detectors shall be fitted in the aft end of the cargo holds. For cargo holds which are used for water ballast, an alarm overriding device may be installed. The visual alarms shall clearly discriminate between the two different water levels detected in each hold;*~~

~~*.2 in any ballast tank forward of the collision bulkhead required by regulation II-1/12, giving an audible and visual alarm when the liquid in the tank reaches a level not exceeding 10% of the tank capacity. An alarm overriding device may be installed to be activated when the tank is in use; and*~~

~~*.3 in any dry or void space other than a chain cable locker, any part of which extends forward of the foremost cargo hold, giving an audible and visual alarm at a water level of 0.1 m above the deck. Such alarms need not be provided in enclosed spaces the volume of which does not exceed 0.1% of the ship's maximum displacement volume.*~~

~~*2 The audible and visual alarms specified in paragraph 1 shall be located on the navigation bridge.*~~

~~*3 Bulk carriers constructed before 1 July 2004 shall comply with the requirements of this regulation not later than the date of the annual, intermediate or renewal survey of the ship to be carried out after 1 July 2004, whichever comes first."*~~

~~Interpretation~~

~~• For Single Hull Tanker to Double Hull Tanker~~

~~Not relevant.~~

~~• For Single Hull Tanker to Bulk Carrier/Ore Carrier~~

~~This regulation shall be applied.~~

SC 226 (cont)

~~SC226.23 Availability of pumping systems~~
~~SOLAS regulation XII/13~~

~~"*Availability of pumping systems*~~
~~*(This regulation applies to bulk carriers regardless of their date of construction)*~~

~~*1 On bulk carriers, the means for draining and pumping ballast tanks forward of the collision bulkhead and bilges of dry spaces any part of which extends forward of the foremost cargo hold shall be capable of being brought into operation from a readily accessible enclosed space, the location of which is accessible from the navigation bridge or propulsion machinery control position without traversing exposed freeboard or superstructure decks. Where pipes serving such tanks or bilges pierce the collision bulkhead, valve operation by means of remotely operated actuators may be accepted, as an alternative to the valve control specified in regulation II-1/12, provided that the location of such valve controls complies with this regulation.*~~

~~*2 Bulk carriers constructed before 1 July 2004 shall comply with the requirements of this regulation not later than the date of the first intermediate or renewal survey of the ship to be carried out after 1 July 2004, but, in no case, later than 1 July 2007."*~~

~~Interpretation~~

- ~~For Single-Hull Tanker to Double-Hull Tanker~~

~~Not relevant.~~

- ~~For Single-Hull Tanker to Bulk Carrier/Ore Carrier~~

~~This regulation shall be applied.~~

SC 226 (cont)

~~SC226.24 Restrictions from sailing with any hold empty~~
~~SOLAS regulation XII/14~~

~~*"Bulk carriers of 150 m in length and upwards of single-side skin construction, carrying cargoes having a density of 1,780 kg/m^3 and above, if not meeting the requirements for withstanding flooding of any one cargo hold as specified in regulation 5.1 and the Standards and criteria for side structures of bulk carriers of single-side skin construction, adopted by the Organization by resolution MSC.168(79), as may be amended by the Organization, provided that such amendments are adopted, brought into force and take effect in accordance with the provisions of article VIII of the present Convention concerning the amendment procedures applicable to the Annex other than chapter I, shall not sail with any hold loaded to less than 10% of the hold's maximum allowable cargo weight when in the full load condition, after reaching 10 years of age. The applicable full load condition for this regulation is a load equal to or greater than 90% of the ship's deadweight at the relevant assigned freeboard."*~~

~~Interpretation~~

~~• For Single Hull Tanker to Double Hull Tanker~~

~~Not relevant.~~

~~• For Single Hull Tanker to Bulk Carrier/Ore Carrier~~

~~This regulation is not applicable.~~

End of Document

SC234 Initial Statutory Surveys at New Construction

(Apr 2009) (Corr.1 Jul 2010) (Rev.1 Feb 2014) (Rev.2 Dec 2014)

1. Scope

The scope of this UI is to define the requirements for the initial statutory surveys at new construction as detailed in IMO Resolution A.1053(27), as amended by IMO Resolution A.1076(28), which are not addressed in UR Z23 for the following as applicable:-

(i) International Load Line Certificate (1966)

(ii) Cargo Ship Safety Equipment Certificate

(iii) International Oil Pollution Prevention Certificate

This UI only covers the survey activities required and does not cover the technical interpretations of the statutory requirements or approval of plans, designs and manuals required by the Regulations.

2. This UI does not cover the requirements for type approval or certification at vendor's works and for which evidence of acceptance is to be provided as indicated in the survey tables.

LL76

(Apr 2009) (Corr.1 Jul 2010) (Rev.1 Feb 2014) (Rev.2 Dec 2014)

MPC96

(Apr 2009) (Corr.1 Jul 2010) (Rev.1 Feb 2014) (Rev.2 Dec 2014)

Note:

1. This UI is to be uniformly implemented by IACS Societies on ships contracted for construction (as defined in IACS PR 29) from 1st July 2010.

2. Rev.1 of this UI is to be uniformly implemented by IACS Societies on ships contracted for construction (as defined in IACS PR 29) from 1 July 2014.

3. Rev.2 of this UI is to be uniformly implemented by IACS Societies on ships contracted for construction (as defined in IACS PR 29) from 1 July 2015.

~~3~~4. The "contracted for construction" date means the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. For further details regarding the date of "contract for construction", refer to IACS Procedural Requirement (PR) No. 29.

SC234 (cont)

LL76 (cont)

MPC96 (cont)

3. Definitions used in the survey tables

Survey Item	A description of the survey item considered
Origin of the Requirement	Applicable Statutory Regulation
Approved Drawings /Documentation	Indicates whether approved drawings/documentation is required
Conformity Verification	This verification may consist of an examination of the certificate, a check of the marks or, for products which require type approval, to verify conformity of the product with the approved prototype or certification with Flag Administration requirements
Survey during construction or installation	Indicates whether the witness by surveyor of construction and installation on board is required
Tightness Testing	Indicates whether tightness testing is required to be witnessed by the surveyor for survey item
Survey after construction or installation	Indicates whether the survey item is examined by the Surveyor after completion of its construction and installation on board
Function Test	Indicates whether a survey item or system is to be subjected to a functioning and/or performance test or trial in the presence of a Surveyor, to confirm its satisfactory operation and performance for its intended use after installation on board
Onboard Verification of documentation	Indicates whether the required documentation is to be verified on board by the surveyor
Series of Vessels	As defined by IACS PR 29

4. Application

This UI applies to all vessels for which the statutory certificates listed in paragraph 1 are to be issued at new construction by IACS Societies.

5. Interpretation of the survey requirements are given in Appendix 1

Table 1 – Safety Equipment

Table 2 – Load Line

Table 3 – MARPOL Annex 1

6. Specific flag administration requirements, if any, supersede the requirements contained in this UI.

7. Qualification and monitoring of personnel

The surveys required by this UI shall be carried out by exclusive surveyors of the classification society, as defined in PR5. The surveyors are to be qualified to be able to carry out the tasks and procedures are to be in place to ensure that their activities are monitored. Details are specified in PR6 and PR7.

SC234 (cont)

8. Inspection and test plan for new building activities

The shipbuilder is to provide inspection and test plans for the items which are required to be surveyed and/or tested prior to the commencement of the surveys and/or test.

LL76 (cont)

9. Product and Type Approval Certificates

MPC96 (cont)

The shipbuilder is to provide product and type approval certificates for the applicable items listed in Appendix 1 to be placed on board.

10. Proof of the consistency of surveys

The classification society is to be able to provide evidence, e.g. through records, check lists, inspection and test records, etc. that its surveyors have complied with the requirements of this UI.

Enclosure: Appendix 1

Appendix 1 to UIs SC234, LL76 & MPC96

1. Description

1	A.1053(27), as amended by Resolution A.1076(28), Requirements	
2	Survey Item	A description of the survey item considered
3	Origin of the Requirement	Applicable Statutory Regulation
4	Correspondence with Approved Drawings/Documentation	Indicates whether approved drawings/documentation is required
5	Conformity Verification	This verification may consist of an examination of the certificate, a check of the marks or, for type approved products, to verify conformity of the product with the approved prototype or certification with National Requirements
6	Survey during construction or installation	Indicates whether the witness by surveyor of fabrication and installation on board is required
7	Tightness Testing	Indicates whether tightness testing is required to be witnessed by the surveyor for survey item
8	Survey after construction or installation	Indicates whether the survey item is examined by the Surveyor after completion of its installation on board and/or
9	Function Test	Indicates whether a system is to be subjected to a functioning and/or performance test or trial in the presence of a Surveyor, to confirm its satisfactory operation and performance for its intended use after installation on board
10	Onboard Verification of documentation	Indicates whether the required documentation is to be verified on board by the surveyor

Table 1. Safety Equipment

	A.1053(27), as amended by Resolution A.1076(28), REQUIREMENT	SURVEY ITEM	ORIGIN OF THE REQUIREMENT	CORRESPONDENCE WITH APPROVED DRAWINGS / DOCUMENTATION	CONFORMITY VERIFICATION	INSPECTIONS DURING INSTALLATION	INSPECTION AFTER INSTALLATION	ONBOARD VERIFICATION OF DOCUMENTATION	FUNCTION TEST
(EI) 1.1.3.1	examining the fire pumps and fire main and the disposition of the hydrants, hoses and nozzles and the international shore connection and checking that each fire pump, including the emergency fire pump, can be operated separately so that two jets of water are produced simultaneously from different hydrants at any part of the ship whilst the required pressure is maintained in the fire main and testing that the emergency fire pump has the required capacity, and if the emergency fire pump is the main supply of water for any fixed fire-extinguishing system, checking that the emergency fire pump has the capacity for this system.[1] [1]Refer to the unified interpretation of chapter 12 of the FSS Code, MSC.1/Circ.1388	Fire Pumps	(SOLAS 74/00 reg.II-2/10.2 FSSC chs.2 and 12) (SOLAS 74/88 regs.II-2/4 and 19)	X	X		X		X
		Fire Mains		X					X
		Hydrants		X			X		
		Hoses and Nozzles		X	X		X		
		International Shore Connection		X			X		
(EI) 1.1.3.2	examining the provision and disposition of the fire extinguishers	Fire Extinguishers	(SOLAS 74/00 reg.II-2/10.3 FSSC ch.4) (SOLAS 74/88 reg.II-2/17)	X	X		X		
(EI) 1.1.3.3	examining the fire fighters' outfits and emergency escape breathing devices - EEBDs -	Fire Fighters' Outfits	(SOLAS 74/00 regs.II-2/10.10, 13.3.4 and 13.4.3 FSSC ch.3) (SOLAS 74/88 reg.II-2/17) (BCH Code ch.III Part E)	X	X		X		
		EEBDs - Emergency Escape Breathing Devices		X	X		X		
(EI) 1.1.3.4	checking the operational readiness and maintenance of fire-fighting systems	Operational Readiness and Maintenance of Fire-fighting System	(SOLAS 74/00 reg.II-2/14.1) (SOLAS 74/88 reg.II-2/21)					X	
(EI) 1.1.3.5	examining the fixed fire-fighting system for the machinery, cargo, vehicle, special category and ro-ro spaces, as appropriate, and confirming that the installation tests have been satisfactorily completed and that its means of operation are clearly marked	Fixed Fire fighting systems	(SOLAS 74/00/08 regs.II-2/10.4, 10.5, 10.7 and 20.6.1, FSSC chs.5 to 7)	X	X		X	X	X

	A.1053(27), as amended by Resolution A.1076(28), REQUIREMENT	SURVEY ITEM	ORIGIN OF THE REQUIREMENT	CORRESPONDENCE WITH APPROVED DRAWINGS / DOCUMENTATION	CONFORMITY VERIFICATION	INSPECTIONS DURING INSTALLATION	INSPECTION AFTER INSTALLATION	ONBOARD VERIFICATION OF DOCUMENTATION	FUNCTION TEST
			(SOLAS 74/88 regs.II-2/7 and 53)						
(EI) 1.1.3.6	checking that fixed carbon dioxide fire-extinguishing systems for the protection of machinery spaces and cargo pump-rooms, where applicable, are provided with two separate controls, one for opening of the gas piping and one for discharging the gas from the storage container, each of them located in a release box clearly identified for the particular space		(SOLAS 08 reg.II-2/10.4.1.5)	X			X		X
(EI) 1.1.3.7	examining the fire-extinguishing and special arrangements in the machinery spaces and confirming, as far as practicable and as appropriate, the operation of the remote means of control provided for the opening and closing of the skylights, the release of smoke, the closure of the funnel and ventilation openings, the closure of power-operated and other doors, the stopping of ventilation and boiler forced and induced draft fans and the stopping of oil fuel and other pumps that discharge flammable liquids	Remote means of opening and closing of Skylights	(SOLAS 74/00 regs.II-2/5.2, 8.3, 9.5 and 10.5) (SOLAS 74/88 regs.II-2/7 and 11)	X					X
		Fire Dampers and Funnel opening		X	X				X
		Closure of power operated and other doors		X	X				X
		remote stops for ventilation and boiler fans		X					X
		remote stops for FO pumps		X					X
(EI) 1.1.3.8	examining any fire detection and alarm system and any automatic sprinkler, fire detection and fire alarm system, and any sample extraction smoke detection system and confirming that installation tests have been satisfactorily completed	Fixed Fire Detection System	(SOLAS 74/00/10 regs.II-2/7.2, 7.3, 7.4, 7.5.1, 7.5.5, 19.3.3 and 20.4; FSSC ch.9 and 10) (SOLAS 74/88 regs.II-2/11, 13, 14, 53 and 54)	X	X		X		X
		Fire Alarm System		X	X		X		X
		Automatic Sprinkler		X	X	X	X		X
		Sample extraction smoke detection system		X	X		X		X
(EI) 1.1.3.9	examining the fire-extinguishing system for spaces containing paint and/or flammable liquids and deep-fat cooking equipment in accommodation and service spaces and confirming that installation tests have been satisfactorily completed and that its means of operation are clearly marked	Spaces containing Paint and/or flammable liquids: Fire Extinguishing System	(SOLAS 74/00 regs.II-2/10.6.3 and 10.6.4; FSSC chs.4 to 7) (SOLAS 74/88 reg.II-2/18.7) (BCH Code ch.III Part E)	X			X		
		Deep-Fat Cooking Equipment in Accommodation: Fire Extinguishing System		X			X		
(EI) 1.1.3.10	examining the arrangements for remote closing of valves for oil fuel, lubricating oil and other flammable oils and confirming, as far as practicable and as appropriate, the operation of the remote	Remote Closing Valves for: Oil Fuel	(SOLAS 74/00 reg.II-2/4.2.2.3.4) (SOLAS 74/88 reg.II-2/15.2.5)	X					X
		Remote Closing Valves for:		X					X

	A.1053(27), as amended by Resolution A.1076(28), REQUIREMENT	SURVEY ITEM	ORIGIN OF THE REQUIREMENT	CORRESPONDENCE WITH APPROVED DRAWINGS / DOCUMENTATION	CONFORMITY VERIFICATION	INSPECTIONS DURING INSTALLATION	INSPECTION AFTER INSTALLATION	ONBOARD VERIFICATION OF DOCUMENTATION	FUNCTION TEST
	means of closing the valves on the tanks that contain oil fuel, lubricating oil and other flammable oils	Lubricating Oil							
		Remote Closing Valves for: Other Flammable Oils		X					X
(EI) 1.1.3.11	examining the fire protection arrangements in cargo, vehicle and ro-ro spaces and confirming, as far as practicable and as appropriate, the operation of the means for closing the various openings	Fire Detection and Alarm system	(SOLAS 74/00 regs.II-2/10.7, 20.2.1, 20.3 and 20.6.2) (SOLAS 74/88 reg.II-2/53)	X	X		X		X
		Fixed Fire Extinguishing System		X					X
		Structural Fire Protection		X	X		X		
		Precaution against ignition of flammable vapours in closed vehicle spaces, closed ro-ro spaces and special category spaces		X			X		X
(EI) 1.1.3.11 *bis*	examining, where applicable, the alternative design and arrangements for fire safety or life-saving appliances and arrangements, in accordance with the test and inspection requirements, if any, specified in the approved documentation	Items of fire safety and/or life-saving appliances pertaining the Alternative Design	(SOLAS 00/06 regs. II-2/17 and III/38)	X	X		X		X
(EI) 1.1.3.12	examining, when appropriate, the special arrangements for carrying dangerous goods, including checking the electrical equipment and wiring, the ventilation, the provision of protective clothing and portable appliances and the testing of the water supply, bilge pumping and any water spray system	Water Supply	(SOLAS 74/00/08 reg.II-2/19 (except 19.3.8, 19.3.10 and 19.4) FSSC chs.9 and 10) (SOLAS 74/88 reg.II-2/54)	X					X
		Sources of Ignition		X	X		X		
		Detection System		X	X				X
		Ventilation		X			X		
		Bilge system		X					X
		Personnel Protection		X	X		X		
		Fire Extinguishers		X	X		X		
		Insulation of Machinery space boundaries		X	X		X		
		Water Spray System		X	X	X	X		X
(EI) 1.1.3.13	checking that the life-saving appliances are of international or vivid reddish orange, or a comparably highly visible colour on all parts where this will assist detection at sea		(LSA Code section 1.2.2.6)				X		
(EI) 1.1.3.14	checking the provision and disposition of the survival craft, where applicable, marine evacuation systems and rescue boats	Survival Craft Provision and Disposition	(SOLAS 74/88 regs.III/11 to 16 and 31; LSA Code section	X	X		X		
		Rescue Boat Provision and		X	X		X		

	A.1053(27), as amended by Resolution A.1076(28), REQUIREMENT	SURVEY ITEM	ORIGIN OF THE REQUIREMENT	CORRESPONDENCE WITH APPROVED DRAWINGS / DOCUMENTATION	CONFORMITY VERIFICATION	INSPECTIONS DURING INSTALLATION	INSPECTION AFTER INSTALLATION	ONBOARD VERIFICATION OF DOCUMENTATION	FUNCTION TEST
		Disposition	6.2)						
		Marine Evacuation Systems Provision and Disposition		X	X		X		
(EI) 1.1.3.15	deployment of 50% of the MES after installation	Deployment of Marine Evacuation Systems	(LSA Code paragraph 6.2.2.2)						X
(EI) 1.1.3.16	examining each survival craft, including its equipment. For liferafts provided for easy side to side transfer, verifying that they are less than 185 kg	Survival Craft Design	(SOLAS 74/88 reg.III/31 LSA Code sections 2.5, 3.1 to 3.3 and 4.1 to 4.9) (SOLAS 74/00 reg.III/31.1);		X		X		
		Survival Craft Engine			X				X
		Survival Craft Equipment			X		X		
(EI) 1.1.3.17	examining the embarkation arrangements for each survival craft and the testing of each launching appliance, including overload tests, tests to establish the lowering speed and the lowering of each survival craft to the water with the ship at its lightest sea-going draught, and, where applicable, launching underway at 5 knots, checking the recovery of each lifeboat	Survival Craft Launching and Recovery appliances	(SOLAS 74/00 regs.III/11, 12, 13, 16, 31 and 33 LSA Code section 6.1)		X		X		X
		Survival Craft Embarkation Arrangements			X		X		X
(EI) 1.1.3.18	examining the embarkation arrangements for each marine evacuation device, where applicable, and the launching arrangements, including inspection for lack of side shell opening between the embarkation station and waterline, review of distance to the propeller and other life-saving appliances and ensuring that the stowed position is protected from heavy weather damage, as much as practicable	MES Launching and Recovery appliances	(SOLAS 74/00 reg.III/15; LSA Code section 6.2)	X	X		X		X
		MES Embarkation Arrangements		X			X		
(EI) 1.1.3.19	examining each rescue boat, including its equipment. For inflatable rescue boats, confirming that they are stowed in a fully inflated condition	Rescue Boat Design	(SOLAS 74/88 regs.III/14 and 31; LSA Code sections 2.5, 5.1 and 6.1)		X		X		
		Rescue Boat Engine			X		X		X
		Rescue Boat Equipment			X		X		
(EI) 1.1.3.20	examining the embarkation and recovery arrangements for each rescue boat and testing each launching and recovery appliance, including overload tests, tests to establish the lowering and recovery speeds and ensuring that each rescue boat can be lowered to the water and recovered with the ship at its lightest sea-going	Rescue Boat Launching and Recovery appliances and Arrangements	(SOLAS 74/88 regs.III/14, 17 and 31; LSA Code section 6.1)		X		X		X

	A.1053(27), as amended by Resolution A.1076(28), REQUIREMENT	SURVEY ITEM	ORIGIN OF THE REQUIREMENT	CORRESPONDENCE WITH APPROVED DRAWINGS / DOCUMENTATION	CONFORMITY VERIFICATION	INSPECTIONS DURING INSTALLATION	INSPECTION AFTER INSTALLATION	ONBOARD VERIFICATION OF DOCUMENTATION	FUNCTION TEST
	draught, launching underway at 5 knots								
(EI) 1.1.3.21	testing that the engine of the rescue boat(s) and of each lifeboat, when so fitted, start satisfactorily and operate both ahead and astern	Test of engines of lifeboat and Rescue Boat	(SOLAS 74/00 reg.III/19)						X
(EI) 1.1.3.22	confirming that there are posters or signs in the vicinity of survival craft and their launching stations and containers, brackets, racks and other similar stowage locations for life-saving equipment	Posters or Signs	(SOLAS 74/88 regs.III/9 and 20)				X		
(EI) 1.1.3.23	examining the provision and stowage and checking the operation of portable onboard communications equipment, if provided, and two-way VHF radiotelephone apparatus and search and rescue locating devices	Two-way VHF radiotelephone apparatus	(SOLAS 74/88 regs.II-2/12.2 and III/6)		X		X		X
		Search and rescue locating devices			X		X		X
(EI) 1.1.3.24	examining the provision and stowage of the distress flares and the line-throwing appliance, checking the provision and operation of fixed on board communications equipment, if provided, and testing the means of operation of the general alarm system	Distress Flares and Line-Throwing Appliances	(SOLAS 74/00 regs.III/6 and 18; LSA Code sections 3.1, 7.1 and 7.2)		X		X		
		On board Communications equipment			X		X		X
		General Alarm System		X			X		X
(EI) 1.1.3.25	examining the provision, disposition and stowage of the lifebuoys, including those fitted with self-igniting lights, self-activating smoke signals and buoyant lines, lifejackets, immersion suits and anti-exposure suits	Lifebuoys	(SOLAS 74/00/06 regs.III/7 and 32 to 37; LSA Code sections 2.1, 2.5 and 3.3)	X	X		X		
		Lifebuoys fitted with self-igniting lights		X	X		X		
		Lifebuoys fitted with self-activating smoke signals		X	X		X		
		Lifebuoys fitted with buoyant lines		X	X		X		
		Lifejackets		X	X		X		
		Immersion suits		X	X		X		
		Anti-exposure suits		X	X		X		

	A.1053(27), as amended by Resolution A.1076(28), REQUIREMENT	SURVEY ITEM	ORIGIN OF THE REQUIREMENT	CORRESPONDENCE WITH APPROVED DRAWINGS / DOCUMENTATION	CONFORMITY VERIFICATION	INSPECTIONS DURING INSTALLATION	INSPECTION AFTER INSTALLATION	ONBOARD VERIFICATION OF DOCUMENTATION	FUNCTION TEST
(EI) 1.1.3.26	checking the lighting of the muster and embarkation stations and the alleyways, stairways and exits giving access to the muster and embarkation stations, including when supplied from the emergency source of power	Muster and Embarkation Station Lighting	(SOLAS 74/88 regs.II-1/43 and III/11)				X		X
		Alleyways and Stairways Lighting					X		X
		Exits giving Access to the Muster and Embarkation Stations Lighting					X		X
		Muster and Embarkation Station Lighting from Emergency Source of Power					X		X
		Alleyways and Stairways Lighting from Emergency Source of Power					X		X
		Exits giving Access to the Muster and Embarkation Stations Lighting from Emergency Source of Power					X		X
(EI) 1.1.3.27	examining the provision and positioning and checking the operation of, as appropriate, the navigation lights, shapes and sound signalling equipment	Navigation Lights	(International Regulations for Preventing Collisions at Sea (COLREG) in force, regs.20 to 24, 27 to 30 and 33)	X	X		X		X
		Shapes and Sounds signalling equipment			X		X		X
(EI) 1.1.3.28	checking that the minimum safe distances from the steering and standard magnetic compasses for all electrical equipment are complied with	Bridge	(SOLAS 74/00 regs.V/17 and 19)				X		
(EI) 1.1.3.29	checking the electromagnetic compatibility of electrical and electronic equipment on or in the vicinity of the bridge	Bridge	(SOLAS 74/00 reg.V/17)		X		X		

	A.1053(27), as amended by Resolution A.1076(28), REQUIREMENT	SURVEY ITEM	ORIGIN OF THE REQUIREMENT	CORRESPONDENCE WITH APPROVED DRAWINGS / DOCUMENTATION	CONFORMITY VERIFICATION	INSPECTIONS DURING INSTALLATION	INSPECTION AFTER INSTALLATION	ONBOARD VERIFICATION OF DOCUMENTATION	FUNCTION TEST
(EI) 1.1.3.30	checking, as appropriate, the provision and operation of the following ship borne navigational systems equipment								
(EI) 1.1.3.30 .1	the magnetic compass, including examining the sighting, movement, illumination and a pylorus or compass bearing device	Navigation Equipment: Magnetic Compass	(SOLAS 74/00 reg.V/19)		X		X		
		Navigation Equipment: Pylorus or Compass Bearing Device			X				X
(EI) 1.1.3.30 .2	nautical charts and nautical publications necessary for the intended voyage are available and have been updated, and, where an electronic chart display and information system (ECDIS) is used, the electronic charts have been updated and the required back-up system is provided and updated	Navigation Equipment: ECDIS including back-up arrangements	(SOLAS 74/00/09 reg.V/19)		X				X
		Nautical Charts and Nautical Publications						X	
(EI) 1.1.3.30 .3	global navigation satellite system receiver or terrestrial radio navigation system	Navigation Equipment: GNSS receiver			X				X
(EI) 1.1.3.30 .4	sound reception system, when bridge is totally enclosed	Navigation Equipment: Sound Reception System			X				X
(EI) 1.1.3.30 .5	means of communication to emergency steering position, where provided	Navigation Equipment: Means of communication with Emergency Steering Position		X	X				X
(EI) 1.1.3.30 .6	spare magnetic compass	Navigation Equipment: Spare Magnetic Compass			X		X		
(EI) 1.1.3.30 .7	daylight signalling lamp	Navigation Equipment: Daylight Signalling Lamp			X				X
(EI) 1.1.3.30 .8	echo sounding device	Navigation Equipment: Echo-sounding Device			X				X
(EI) 1.1.3.30 .9	radar(s), including examining the waveguide and cable runs for routeing and protection and the display unit confirming lighting, correct operation of all controls, and functions	Navigation Equipment: Radar Installations			X		X		X

	A.1053(27), as amended by Resolution A.1076(28), REQUIREMENT	SURVEY ITEM	ORIGIN OF THE REQUIREMENT	CORRESPONDENCE WITH APPROVED DRAWINGS / DOCUMENTATION	CONFORMITY VERIFICATION	INSPECTIONS DURING INSTALLATION	INSPECTION AFTER INSTALLATION	ONBOARD VERIFICATION OF DOCUMENTATION	FUNCTION TEST
(EI) 1.1.3.30 .10	electronic plotting aid, automatic tracking aid or automatic radar plotting aid as appropriate, using the appropriate test facilities	Navigation Equipment: Electronic Plotting Aid			X				X
		Navigation Equipment: Automatic Tracking aid(s) or Automatic Radar Plotting Aid			X				X
(EI) 1.1.3.30 .11	speed and distance measuring devices "through the water" and "over the ground"	Navigation Equipment: Speed and Distance measuring Device			X				X
(EI) 1.1.3.30 .12	transmitting heading device providing heading information to radar, plotting aids and automatic identification system equipment and voyage data recorder	Navigation Equipment: Transmitting Heading Device			X				X
(EI) 1.1.3.30 .13	automatic identification system	Navigation Equipment: AIS Automatic Identification System			X				X
(EI) 1.1.3.30 .14	gyrocompass, including examining the alignment of the master and all repeaters	Navigation Equipment: Gyro Compass			X				X
		Navigation Equipment: Gyro Compass Repeaters			X				X
(EI) 1.1.3.30 .15	rudder angle indicator	Navigation Equipment: Rudder Angle Indicator			X				X
(EI) 1.1.3.30 .16	propeller rate of revolution indicator	Navigation Equipment: Propeller rate of Revolution Indicator			X				X
(EI) 1.1.3.30 .17	propeller, operational mode, thrust, and pitch indicator	Navigation Equipment: Variable-Pitch propeller pitch and operational mode indicator			X				X
(EI) 1.1.3.30 .18	rate-of-turn indicator	Navigation Equipment: Rate of Turn Indicator			X				X
(EI) 1.1.3.30 .19	heading or track control system	Navigation Equipment: Heading or Track Control System			X				X

	A.1053(27), as amended by Resolution A.1076(28), REQUIREMENT	SURVEY ITEM	ORIGIN OF THE REQUIREMENT	CORRESPONDENCE WITH APPROVED DRAWINGS / DOCUMENTATION	CONFORMITY VERIFICATION	INSPECTIONS DURING INSTALLATION	INSPECTION AFTER INSTALLATION	ONBOARD VERIFICATION OF DOCUMENTATION	FUNCTION TEST
(EI) 1.1.3.30 .20	BNWAS	Navigation Equipment: BNWAS			X				X
(EI) 1.1.3.31	checking for the provision and operation of the voyage data recorder	VDR - Voyage Data Recorder	(SOLAS 74/00 reg.V/20)		X				X
(EI) 1.1.3.32	checking the record of the voyage data recorder annual performance test	VDR - Voyage Data Recorder	(SOLAS 74/00 reg.V/18)					X	
(EI) 1.1.3.33	checking navigation bridge visibility	Navigation Bridge Visibility	(SOLAS 74/00 reg.V/22)	X					
(EI) 1.1.3.34	checking that a valid conformance test report of the long-range identification and tracking system is available on board	Long-range identification and tracking system	(SOLAS 04 reg.V/19-1)					X	
(EI) 1.1.3.35	checking the provision of the pilot transfer arrangement, the access to the ship's deck and the associated equipment and lighting, checking the ~~and, as appropriate, the deployment or~~ operation of the pilot ladders and ~~hoists/pilot transfer~~ the combination arrangements	Pilot ladders and ~~hoists/pilot transfer~~ the combination arrangements	(SOLAS 74/00/10 reg.V/23)	X	X		X		X
(EI) 1.1.3.36	checking the provision of means of embarkation and disembarkation from ships for use in port and in port-related operations, such as gangways and accommodation ladders	Means of embarkation	(SOLAS 08 reg.II-1/3-9)	X			X		X
(EI) 1.1.3.37	checking, when appropriate, the provision of an appropriate instrument for measuring the concentration of gas or oxygen in the air together with detailed instructions for its use	Instrument for measuring concentration of gas or oxygen	(SOLAS 08 reg.VI/3)		X				
(EI) 1.1.4	Additional requirements for oil tankers								
(EI) 1.1.4.1	checking the deck foam system, including the supplies of foam concentrate, and testing that the minimum number of jets of water at the required pressure in the fire main is obtained (see (EI) 1.1.3.1) when the system is in operation	Deck Foam System: Foam Tanks	(SOLAS 74/00 reg.II-2/10.8; FSSC ch.15) (SOLAS 74/88 reg.II-2/61)	X			X		
		Deck Foam System: Monitors			X		X		X
		Deck Foam System: Applicators			X		X		X
		Deck Foam System: Foam Concentrates			X				
(EI) 1.1.4.2	examining the inert gas system and in particular:	Inert Gas System	(SOLAS 74/00 reg.II-2/4.5.5; FSSC ch.15)	X	X				

	A.1053(27), as amended by Resolution A.1076(28), REQUIREMENT	SURVEY ITEM	ORIGIN OF THE REQUIREMENT	CORRESPONDENCE WITH APPROVED DRAWINGS / DOCUMENTATION	CONFORMITY VERIFICATION	INSPECTIONS DURING INSTALLATION	INSPECTION AFTER INSTALLATION	ONBOARD VERIFICATION OF DOCUMENTATION	FUNCTION TEST
			(SOLAS 74/88 reg.II-2/62)						
(EI) 1.1.4.2.1	examining externally for any sign of gas or effluent leakage	Signs of Gas or effluent Leakage					X		X
(EI) 1.1.4.2.2	confirming the proper operation of both inert gas blowers	Inert Gas Blowers							X
(EI) 1.1.4.2.3	observing the operation of the scrubber-room ventilation system	Scrubber Room Ventilation							X
(EI) 1.1.4.2.4	checking the deck water seal for automatic filling and draining	Deck Water Seal					X		X
(EI) 1.1.4.2.5	examining the operation of all remotely operated or automatically controlled valves and, in particular, the flue gas isolating valves	Remote or Automatic Control Valves							X
		Flue Gas Isolating Valve					X		X
(EI) 1.1.4.2.6	observing a test of the interlocking feature of soot blowers	Interlocking of soot Blowers							X
(EI) 1.1.4.2.7	observing that the gas pressure-regulating valve automatically closes when the inert gas blowers are secured	Gas Pressure-Regulating Valve							X
(EI) 1.1.4.2.8	checking, as far as practicable, the following alarms and safety devices of the inert gas system using simulated conditions where necessary:								X
(EI) 1.1.4.2.8.1	high oxygen content of gas in the inert gas main	Test for Alarms and Safety Devices Inert Gas System							X
(EI) 1.1.4.2.8.2	low gas pressure in the inert gas main	Test for Alarms and Safety Devices Inert Gas System							X

	A.1053(27), as amended by Resolution A.1076(28), REQUIREMENT	SURVEY ITEM	ORIGIN OF THE REQUIREMENT	CORRESPONDENCE WITH APPROVED DRAWINGS / DOCUMENTATION	CONFORMITY VERIFICATION	INSPECTIONS DURING INSTALLATION	INSPECTION AFTER INSTALLATION	ONBOARD VERIFICATION OF DOCUMENTATION	FUNCTION TEST
(EI) 1.1.4.2. 8.3	low pressure in the supply to the deck water seal	Test for Alarms and Safety Devices Inert Gas System							X
(EI) 1.1.4.2. 8.4	high temperature of gas in the inert gas main	Test for Alarms and Safety Devices Inert Gas System							X
(EI) 1.1.4.2. 8.5	low water pressure or low water-flow rate	Test for Alarms and Safety Devices Inert Gas System							X
(EI) 1.1.4.2. 8.6	accuracy of portable and fixed oxygen-measuring equipment by means of calibration gas	Test for Alarms and Safety Devices Inert Gas System			X				X
(EI) 1.1.4.2. 8.7	high water level in the scrubber	Test for Alarms and Safety Devices Inert Gas System							X
(EI) 1.1.4.2. 8.8	failure of the inert gas blowers	Test for Alarms and Safety Devices Inert Gas System							X
(EI) 1.1.4.2. 8.9	failure of the power supply to the automatic control system for the gas regulating valve and to the instrumentation for continuous indication and permanent recording of pressure and oxygen content in the inert gas main	Test for Alarms and Safety Devices Inert Gas System							X
(EI) 1.1.4.2. 8.10	high pressure of gas in the inert gas main	Test for Alarms and Safety Devices Inert Gas System							X
(EI) 1.1.4.2. 9	checking the proper operation of the inert gas system on completion of the checks listed above	IGS Operation						X	
(EI) 1.1.4.3	examining the fixed fire-fighting system for the cargo pump room, confirming that the installation tests have been satisfactorily completed and that its means of operation are clearly marked and, when appropriate, checking the operation of the remote means for closing the various openings	Cargo Pump Room Fire Extinguishing	(SOLAS 74/00 reg.II-2/10.9; FSSC chs.5, 6, 7 and 8, as applicable)	X			X		
		Cargo Pump Room Means of Closing Various Opening					X		X

	A.1053(27), as amended by Resolution A.1076(28), REQUIREMENT	SURVEY ITEM	ORIGIN OF THE REQUIREMENT	CORRESPONDENCE WITH APPROVED DRAWINGS / DOCUMENTATION	CONFORMITY VERIFICATION	INSPECTIONS DURING INSTALLATION	INSPECTION AFTER INSTALLATION	ONBOARD VERIFICATION OF DOCUMENTATION	FUNCTION TEST
(EI) 1.1.4.4	examining the protection of the cargo pump-rooms and confirming that the installation tests have been satisfactorily completed	temperature sensing devices	(SOLAS 74/00 reg.II-2/4.5.10) (SOLAS 74/88 regs.II-2/55 to 58)	X	X				X
		Interlock between lighting and ventilation							X
		monitoring of hydrocarbon gas			X				X
		Bilge monitoring							X
(EI) 1.1.4.5	examining, for all tankers, the arrangements for cargo tank protection		(SOLAS 74/00/10 regs. II-2/4.5.3, 4.5.6, and 10.8; FSSC chs. 14 and 15) (SOLAS 74/88 regs. II-2/60 and 62);	X	X	X	X	X	X
		Inert gas plant		X	X	X	X	X	X
		Fixed deck foam fire-extinguishing systems		X	X	X	X	X	X
(EI) 1.1.4.6	checking, for all tankers, the provision of at least one portable instrument for measuring oxygen and one for measuring flammable vapour concentrations together with a sufficient set of spares, and suitable means for the calibration of these instruments (SOLAS 10 reg. II-2/4.5.7.1);	Portable instrument for Gas measurement and detection	(SOLAS 10 reg. II-2/4.5.7.1)		X			X	X
(EI) 1.1.4.7	examining the arrangements for gas measurement in double-hull spaces and double-bottom spaces, including the fitting of permanent gas sampling lines, where appropriate	Arrangements for gas measurement in double-hull spaces and double-bottom spaces	(SOLAS 10 reg. II-2/4.5.7.2)	X		X		X	X
(EI) 1.1.4.8	examining, for oil tankers of 20,000 tonnes deadweight and above, the fixed hydrocarbon gas detection systems for measuring hydrocarbon gas concentrations in all ballast tanks and void spaces of double-hull and double-bottom spaces adjacent to the cargo tanks, including the forepeak tank and any other tanks and spaces under the bulkhead deck adjacent to cargo tanks, and confirming that the installation tests have been satisfactorily completed	Arrangements for fixed hydrocarbon gas detection systems in double-hull and double-bottom spaces of oil tankers	(SOLAS 10 reg. II-2/4.5.7.3 and FSSC ch. 16)	X		X		X	X
(EI) 1.1.5.1	confirming that the fire control plans are permanently exhibited or, alternatively, emergency booklets have been provided and that a duplicate of the plans or the emergency booklet are available in a prominently marked enclosure external to the ship's deckhouse	Required Documentations	(SOLAS 74/00 reg.II-2/15.2.4) (SOLAS 74/88 reg.II-2/20)					X	
(EI) 1.1.5.2	confirming that maintenance plans have been provided	Required Documentations	(SOLAS 74/00 regs.II-2/14.2.2 and					X	

	A.1053(27), as amended by Resolution A.1076(28), REQUIREMENT	SURVEY ITEM	ORIGIN OF THE REQUIREMENT	CORRESPONDENCE WITH APPROVED DRAWINGS / DOCUMENTATION	CONFORMITY VERIFICATION	INSPECTIONS DURING INSTALLATION	INSPECTION AFTER INSTALLATION	ONBOARD VERIFICATION OF DOCUMENTATION	FUNCTION TEST
			14.4)						
(EI) 1.1.5.3	confirming that the training manuals and the fire safety operational booklets have been provided	Required Documentations	(SOLAS 74/00 regs.II-2/15.2.3, 16.2 and 16.3)					X	
(EI) 1.1.5.3 *bis*	confirming that, where applicable, the approved documentation for the alternative design and arrangement is on board	Items of fire safety and/or life-saving appliances pertaining the Alternative Design	(SOLAS 00/06 regs. II-2/17 and III/38)	X	X		X	X	X
(EI) 1.1.5.4	confirming, where appropriate, that the ship is provided with a document indicating compliance with the special requirement for carrying dangerous goods	Required Documentations	(SOLAS 74/00 reg.II-2/19.4) (SOLAS 74/88 reg.II-2/54(3))					X	
(EI) 1.1.5.5	confirming that emergency instructions are available for each person on board, that the muster list is posted in conspicuous places and they are in a language understood by the persons on board	Required Documentations	(SOLAS 74/00 regs.III/8 and 37)					X	
(EI) 1.1.5.6	confirming that the training manual and training aids for the life-saving appliances have been provided and are available in the working language of the ship	Required Documentations	(SOLAS 74/00 reg.III/35)					X	
(EI) 1.1.5.7	confirming that the instructions for on board maintenance of the life-saving appliances have been provided	Required Documentations	(SOLAS 74/88 reg.III/36)					X	
(EI) 1.1.5.8	confirming that a table or curve of residual deviations for the magnetic compass has been provided, and that a diagram of the radar installations shadow sectors is displayed	Required Documentations	(SOLAS 74/00 reg.V/19)					X	
(EI) 1.1.5.9	checking that operational and, where appropriate, maintenance manuals for all navigational equipment are provided	Required Documentations	(SOLAS 74/00 reg.V/16)					X	
(EI) 1.1.5.9 *bis*	checking that records are provided, identifying any pilot ladders placed into service	Required Documentations	(SOLAS 10 reg. V/23.2.4);		X		X	X	X
(EI) 1.1.5.10	checking that the charts and nautical publications necessary for the intended voyage are available and have been updated	Required Documentations	(SOLAS 74/88 reg.V/27)					X	
(EI) 1.1.5.11	checking that the International Code of Signals and an up-to-date copy of Volume III of the International Aeronautical and Maritime Search and Rescue (IAMSAR) Manual have been provided	Required Documentations	(SOLAS 74/00/02, reg.V/21)					X	
(EI) 1.1.5.12	checking that arrangements are provided to maintain records of navigational activities and daily reporting	Required Documentations	(SOLAS 74/00/03, reg.V/28)					X	

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(EI) 1.1.5.13	checking that the life-saving signals to be used by ships, aircraft or persons in distress are available	Required Documentations	(SOLAS 74/00, reg.V/29)					X	
(EI) 1.1.5.14	confirming that continuous synopsis record is provided	Required Documentations	(SOLAS 74/02, reg. XI-1/5)					X	
(EI) 1.1.6.1	confirming, when appropriate, that the instruction manuals for the inert gas system have been provided	Required Documentations	(FSSC ch.15 paragraph 2.4.4) (SOLAS 74/88, reg. II-2/62.21)					X	
(EI) 1.1.6.2	confirming that the operating and maintenance instructions for the fixed hydrocarbon gas detection system are provided	Required Documents	(SOLAS 10 reg. II-2/4.5.7.3 and FSSC ch. 16)					X	

Table 2. Load Line

	A.1053(27), as amended by A.1076(28), REQUIREMENT	SURVEY ITEM	ORIGIN OF THE REQUIREMENT	CORRESPONSENCE WITH APPROVED DRAWINGS / DOCUMENTATION	CONFORMITY VERIFICATION	SURVEY DURING CONSTRUCTION OR INSTALLATION	TIGHTNESS TEST	SURVEY AFTER CONSTRUCTION OR INSTALLATION	FUNCTION TEST	ON BOARD VERIFIATION OF DOCUMENTATION
(LI) 1.1.1	For the load line the examination of plans and designs should consist of:									
(LI) 1.1.1.2	examining the intact stability, and, where applicable, the damaged stability information and the loading and ballasting information that is to be supplied to the master, and, where not dispensed by the Administration, inclining experimental data	intact stability, and, where applicable, the damaged stability information and the loading and ballasting information	(LLC 66/88/08 regs.1 and 10; IS Code chs.1, 2 and 3)	X						X
(LI) 1.1.2	For the load line the survey during construction and after installation should consist of:									
(LI) 1.1.2.2	confirming that the deck line and load line mark are properly positioned	Positioning of Deck Line and Load Line Mark	(LLC 66/88 regs.4 to 9)	X				X		
(LI) 1.1.2.3	witnessing the inclining experiment or lightweight survey	Inclining Experiment	(LLC 66/88/03 reg.10)	X				X		
(LI) 1.1.2.4	examining the superstructure end bulkheads and the openings therein	Superstructure End Bulkheads	(LLC 66/88 regs.11 and 12)							
		Superstructure Openings		X	X		X	X		
(LI) 1.1.2.5	examining the means of securing the weather tightness of cargo hatchways, other hatchways and other openings on the freeboard and superstructure decks	Freeboard Deck - Means of Securing the weather tightness of Cargo Hatchways	(LLC 66/88 regs. 13 to 18)	X		X	X		X	
		Freeboard Deck - Means of Securing the weather tightness of Other Hatchways		X			X		X	
		Freeboard Deck - Means of Securing the weather tightness of Other Openings		X			X		X	
		Superstructure Deck - Means of Securing the weather tightness of Cargo Hatchways		X		X	X		X	
		Superstructure Deck - Means of		X			X		X	

	A.1053(27), as amended by A.1076(28), REQUIREMENT	SURVEY ITEM	ORIGIN OF THE REQUIREMENT	CORRESPONSENCE WITH APPROVED DRAWINGS / DOCUMENTATION	CONFORMITY VERIFICATION	SURVEY DURING CONSTRUCTION OR INSTALLATION	TIGHTNESS TEST	SURVEY AFTER CONSTRUCTION OR INSTALLATION	FUNCTION TEST	ON BOARD VERIFIATION OF DOCUMENTATION
		Securing the weather tightness of Other Hatchways								
		Superstructure Deck - Means of Securing the weather tightness of Other Openings		X			X		X	
(LI) 1.1.2.6	examining the ventilators and air pipes, including their coamings and closing appliances	Ventilators and air pipes including their coamings and closing appliances	(LLC 66/88 regs.19 and 20)	X	X			X		
(LI) 1.1.2.7	examining the watertight integrity of the closures to any openings in the ship's side below the freeboard deck	Closures to any openings in the ship's side below the freeboard deck	(LLC 66/88 reg.21)	X	X		X	X	X	
(LI) 1.1.2.8	examining the scuppers, inlets and discharges	Scuppers, Inlets and Discharger	(LLC 66/88/03 reg.22)	X	X			X		
(LI) 1.1.2.9	examining the garbage chutes	Garbage chute	(LLC 66/88/03, reg. 22-1)	X		X	X			
(LI) 1.1.2.10	examining the spurling pipes and cable lockers	Spurling Pipe	(LLC 66/88/03, reg. 22-2)	X		X	X			
		Cable Locker		X		X	X			
(LI) 1.1.2.11	examining the side scuttles and deadlights	Side Scuttles and Deadlights	(LLC 66/88 reg.23)	X	X		X	X		
(LI) 1.1.2.12	examining the bulwarks including the provision of freeing ports, special attention being given to any freeing ports fitted with shutters	Bulwarks	(LLC 66/88/03 reg.24, 25)	X				X		
		Freeing Ports		X				X		
		Freeing Ports fitted with shutters		X				X	X	
(LI) 1.1.2.13	examining the guardrails, gangways, walkways and other means provided for the protection of the crew and means for safe passage of crew	Guardrails	(LLC 66/88/03 reg.25, 25-1)	X				X		
		Gangways								
		Walkways								
		Other means								
(LI) 1.1.2.14	examining the special requirements for ships permitted to sail with type "A" or type "B-minus" freeboards	Machinery Casings	(LLC 66/88/03 reg.26, 27)	X			X	X		
		Gangway and Access								
		Hatchways								

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		Freeing arrangements								
(LI) 1.1.2.15	checking, when applicable, of the fittings and appliances for timber deck cargoes	Uprights	(LLC 66/88 regs.42 to 45)	X				X		
		Lashings		X						X
		Stability		X						X
		Protection of Crew		X				X		
(LI) 1.1.3.1	checking that the loading and ballasting information has been supplied to the master	Loading and Stability Manual	(LLC 66/88 reg.10)	X						X

Table 3. MARPOL Annex 1

	A.1053(27), as amended by A.1076(28), REQUIREMENT	SURVEY ITEM	ORIGIN OF THE REQUIREMENT	CORRESPONDENCE WITH APPROVED DRAWINGS/DOCUMENTATIONS	CONFORMITY VERIFICATION	SURVEY DURING CONSTRUCTION OR INSTALLATION	SURVEY AFTER CONSTRUCTION OR INSTALLATION	ON BOARD VERIFICATION OF DOCUMENTATION	FUNCTION TEST
Requirements for All Ships									
(OI) 1.1.3.1	confirming the satisfactory installation and operation of, as appropriate, oil filtering equipment and when appropriate the operation of the automatic means provided to stop the discharge of effluent and the satisfactory operation of the alarm - or other installation	oil filtering equipment Automatic Stopping Device Alarm	MARPOL 90/04 Annex I regs. 14 and 15	X	X			X	X
(OI) 1.1.3.2	confirming, when applicable, that the oil content meter and its recording device are operable and that there is a sufficient supply of consumables for the recording device on board	Oil Content Meter	MARPOL 90/04 Annex I regs. 14 and 15		X	X			X
		Recording Device			X	X			X
		Consumables						X	
(OI) 1.1.3.3	testing, where fitted, the automatic stopping device required for discharges in Special Areas	Stopping Device	MARPOL 90/04 Annex I reg. 15						X
(OI) 1.1.3.4	confirming the segregation of the oil fuel and water ballast system and the non-carriage of oil in forepeak tanks	Segregation of WB and Oil Carriage of Oil in FP Tank	MARPOL 90/04 Annex I reg. 16	X		X			
(OI) 1.1.3.5	confirming that the oily residue (sludge) tank and its discharge arrangements are satisfactory and, when the size of the sludge tank is approved on the basis of such installations, confirming the satisfactory operation of homogenizers, sludge incinerators or other recognised means for the control of sludge	Oily residue (sludge) tank	MARPOL 90/04/09 Annex I reg. 12	X			X		
		Discharge Arrangement		X			X		
		Approved Sludge Tank's Size		X			X		
		Incinerators/Homogenisers		X	X		X		X
(OI) 1.1.3.6	confirming the provision of the standard discharge connection	Standard Discharge Connection	MARPOL 90/04 Annex I reg. 13				X		
(OI) 1.1.3.7	confirming oil fuel tank protection arrangements	Tank Arrangements	MARPOL 90/04 Annex I reg. 12A	X		X			

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Additional Requirements for Oil Tankers									
(OI) 1.1.4.1	confirming that the arrangements of slop tanks or cargo tanks designated as slop tanks and associated piping systems are satisfactory	Slop Tanks	MARPOL 90/04 Annex I regs. 29 and 34	X			X		
		Cargo Tanks designated as slop tanks		X			X		
(OI) 1.1.4.2	confirming the satisfactory installation and operation of the oil discharge monitoring and control system, including any audible or visual alarms, the automatic and manual means to stop the discharge of effluent, the starting interlock and the accuracy of the flow meter and the applicable resolution's requirements for installation survey	Discharge Monitoring and Control System	MARPOL 90/04 Annex I regs. 31 and 34	X	X		X		X
		Audible and Visual Alarms					X		X
		Automatic and manual means to stop discharge of Effluent					X		X
		Starting Interlock					X		X
		Accuracy Flow Meter					X		X
(OI) 1.1.4.3	confirming that the oil content meter and its recording device are operable and that there is a sufficient supply of consumables for the recording device on board	Oil Content meter and recording device	MARPOL 90/04 Annex I regs. 31 and 34		X		X		X
(OI) 1.1.4.4	confirming that the approved oil/water interface detectors are on board and are operational	Oil/water interface detectors	MARPOL 90/04 Annex I reg. 32		X		X		
(OI) 1.1.4.5	confirming that the arrangements of pumps, pipes and valves are in accordance with the requirements for segregated ballast systems and that there are no cross-connections between the cargo and segregated ballast systems	Segregated Ballast Tanks: Pumps, Piping and Valves	MARPOL 90/04 Annex I reg. 18 and 19	X			X		
(OI) 1.1.4.6	where a portable spool piece is provided for the emergency discharge of segregated ballast by connecting the segregated ballast system to a cargo pump, confirming that non-return valves are fitted on the segregated ballast connections and that the spool piece is mounted in a conspicuous position in the pump room with a permanent notice restricting its use	Segregated Ballast Tanks: Emergency Discharge	MARPOL 90/04 Annex I reg. 18	X			X		

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(OI) 1.1.4.7	testing ballast pipelines that pass through cargo tanks and those cargo pipelines that pass through ballast tanks to ensure there is no cross contamination	Pipelines	MARPOL 90/04 Annex I reg. 18	X			X		
(OI) 1.1.4.8	confirming that the crude oil washing system is installed in accordance with the approved plans and, in particular:		MARPOL 90/04 Annex I regs. 18, 33 and 35	X					
(OI) 1.1.4.8.1	examining crude oil washing piping, pumps, valves and deck mounted washing machines for signs of leakage and to check that all anchoring devices for crude oil washing piping are intact and secure;	Piping, Pumps Valves & Anchoring Devices					X		
(OI) 1.1.4.8.2	carrying out pressure testing of the crude oil washing system to 1.5 times the working pressure;	Pressure Test					X		
(OI) 1.1.4.8.3	confirming in those cases where drive units are not integral with the tank washing machines, that the number of operational drive units specified in the Manual are on board;	Operational Drive Units					X		
(OI) 1.1.4.8.4	checking that, when fitted, steam heaters for water washing can be properly isolated during crude oil washing operations, either by double shut-off valves or by clearly identifiable blanks;	Steam Heaters					X		X
(OI) 1.1.4.8.5	checking that the prescribed means of communication between the deck watch keeper and the cargo control position is operational;	Means of Communication					X		X
(OI) 1.1.4.8.6	confirming that an overpressure relief device (or other approved arrangement) is fitted to the pumps supplying the crude oil washing system;	Overpressure Relief Device					X		X
(OI) 1.1.4.8.7	verifying that flexible hoses for supply of oil to the washing machines on combination carriers are of an approved type, are properly stored and are in good condition;	Flexible Hoses			X		X		

	A.1053(27), as amended by A.1076(28), REQUIREMENT	SURVEY ITEM	ORIGIN OF THE REQUIREMENT	CORRESPONDENCE WITH APPROVED DRAWINGS/DOCUMENTATIONS	CONFORMITY VERIFICATION	SURVEY DURING CONSTRUCTION OR INSTALLATION	SURVEY AFTER CONSTRUCTION OR INSTALLATION	ON BOARD VERIFICATION OF DOCUMENTATION	FUNCTION TEST
(OI) 1.1.4.9	verifying the effectiveness of the crude oil washing system and, in particular:	COW-Crude Oil Washing: Effectiveness	MARPOL 90/04 Annex I reg. 33						
(OI) 1.1.4.9.1	checking that the crude oil washing machines are operable and to observe the proper operation of the washing machines by means of the movement indicators and/or sound patterns or other approved methods;						X		X
(OI) 1.1.4.9.2	checking the effectiveness of the stripping system in appropriate cargo tanks by observing the monitoring equipment and by hand-dipping or other approved means;								X
(OI) 1.1.4.9.3	verifying by internal tank inspection after crude oil washing that the installation and operational procedures laid down in the Operations and Equipment Manual are satisfactory;								X
(OI) 1.1.4.10	confirming that, where there is a crude oil washing system, an inert gas system has been installed and tested in accordance with the requirements of SOLAS 74/88/2000 (see (EI) 1.1.4.2 in Annex 1);	COW-Crude Oil Washing: General			X		X		X
(OI) 1.1.4.11	confirming, as appropriate, that the arrangements for the prevention of oil pollution in the event of collision or stranding are in accordance with the approved plans	Pollution due to Collision or Stranding	MARPOL 90/04 Annex I regs. 19 to 22	X			X		
(OI) 1.1.4.12	confirming that the piping systems associated with the discharge of dirty ballast water or oil-contaminated water are satisfactory	Pumping, Piping and Discharge	MARPOL 90/04 Annex I reg. 30	X			X		
(OI) 1.1.4.13	confirming that the observation and discharge control positions for visually observing the discharge of oil-contaminated water, including the testing of the communication system between the two positions are satisfactory	Observation and Discharge Control	MARPOL 90/04 Annex I reg. 30				X		X

	A.1053(27), as amended by A.1076(28), REQUIREMENT	SURVEY ITEM	ORIGIN OF THE REQUIREMENT	CORRESPONDENCE WITH APPROVED DRAWINGS/DOCUMENTATIONS	CONFORMITY VERIFICATION	SURVEY DURING CONSTRUCTION OR INSTALLATION	SURVEY AFTER CONSTRUCTION OR INSTALLATION	ON BOARD VERIFICATION OF DOCUMENTATION	FUNCTION TEST
(OI) 1.1.4.14	confirming that the means of draining cargo pumps and cargo lines, including the provision of a stripping device and the connections for pumping to the slop or cargo tanks or ashore are satisfactory	Means of Draining and Stripping	MARPOL 90/04 Annex I reg. 30	X			X		
		means for pumping ashore / slop / cargo tanks		X			X		
(OI) 1.1.4.15	confirming that closing devices installed in the cargo transfer system and cargo piping, as appropriate, are satisfactory	Closing arrangements	MARPOL 90/04 Annex I regs. 23 & 26						X
(OI) 1.1.4.16	confirming that the subdivision and stability arrangements, in addition to the provision of (OI) 1.1.4.15, to prevent progressive flooding are satisfactory	Stability Manual Tank Arrangement	MARPOL 90/04 Annex I regs. 23 & 26	X			X	X	
(OI) 1.1.4.17	confirming the arrangements for cargo pump-room bottom protection (double bottom where required)	Tank Arrangements	MARPOL 90/04 Annex I reg. 22	X			X		
Requirements for All Ships									
(OI) 1.1.5.1	confirming that certificates for type approval for the oil filtering equipment and oil content meters are available	Type Approval Certificates	MARPOL 90/04 Annex I reg. 14		X			X	
(OI) 1.1.5.2	confirming that the Oil Record Book (Part I) has been provided	Oil Record Book	MARPOL 90/04 Annex I reg. 17					X	
(OI) 1.1.5.3	confirming that the shipboard oil pollution emergency plan or, in the case of a chemical/product tanker, a shipboard marine pollution emergency plan has been provided	SOPEP/SMPEP	MARPOL 90/04 Annex I reg. 37	X				X	
(OI) 1.1.5.4	confirming, as appropriate, that the Operating and Maintenance manuals for the 15ppm bilge separator and 15ppm bilge alarm are available	Operations Manual						X	
Additional Requirements for Oil Tankers									
(OI) 1.1.6.1	confirming that, if applicable, a Ship to Ship (STS) operations Plan approved by the Administration has been provided	STS operations plan	MARPOL Annex I Reg.41	X				X	

	A.1053(27), as amended by A.1076(28), REQUIREMENT	SURVEY ITEM	ORIGIN OF THE REQUIREMENT	CORRESPONDENCE WITH APPROVED DRAWINGS/DOCUMENTATIONS	CONFORMITY VERIFICATION	SURVEY DURING CONSTRUCTION OR INSTALLATION	SURVEY AFTER CONSTRUCTION OR INSTALLATION	ON BOARD VERIFICATION OF DOCUMENTATION	FUNCTION TEST
(OI) 1.1.6.2	confirming that, if applicable, a Crude Oil Washing Operations and Equipment Manual has been provided	COW-Crude Oil Washing: Operations & Equipment Manual	MARPOL 90/04 Annex I reg. 35	X				X	
(OI) 1.1.6.3	confirming that an operations manual for the oil discharge monitoring and control system has been provided together with any other documentation requested by the applicable resolution	ODM Operation Manual	MARPOL 90/04 Annex I reg. 31	X				X	
(OI) 1.1.6.4	confirming that certificates for type approval for the oil content meters, oil discharge monitoring and control system and oil/water interface detectors are available	Type Approval Certificates	MARPOL 90/04 Annex I regs. 31 and 32					X	
(OI) 1.1.6.5	confirming that an Oil Record Book (Part II) has been provided	Oil Record Book	MARPOL 90/04 Annex I reg. 36					X	
(OI) 1.1.6.6	confirming that the information and data concerning the loading and damage stability has been provided	Loading and Damage Stability Data	MARPOL 90/04 Annex I reg. 28	X				X	
(OI) 1.1.6.7	confirming that the shipboard oil pollution emergency plan or in the case of a chemical/product tanker a shipboard marine pollution emergency plan has been provided	SOPEP/SMPEP	MARPOL 90/04 Annex I reg. 37	X				X	
(OI) 1.1.6.8	confirming, for oil tankers of 5,000 deadweight and above delivered on/after 1 February 2002, that the intact stability has been approved	Stability Information	MARPOL 90/04 Annex I reg. 27	X				X	
(OI) 1.1.6.9	confirming, for oil tankers of 5,000 deadweight and above, that arrangements are in place to provide prompt access to shore-based damage stability and residual structural strength computerized calculation programmes	Shore based emergency support arrangements	MARPOL 90/04 Annex I reg. 37.4					X	
(OI) 1.1.7.1	after satisfactory survey, issuing the International Oil Pollution Prevention Certificate.				X			X	

End of document

SC 249 (Oct 2011) (Corr.1 Apr 2012) (Rev.1 Feb 2013)

Implementation of SOLAS II-1, Regulation 3-5 and MSC.1/Circ.1379

SOLAS Chapter II-1, Regulation 3-5

"From 1 January 2011, for all ships, new installation of materials which contain asbestos shall be prohibited."

MSC.1/Circ.1379

"In the context of this regulation, new installation of materials containing asbestos means any new physical installation on board. Any material purchased prior to 1 January 2011 being kept in the ship's store or in the shipyard for a ship under construction, should not be permitted to be installed after 1 January 2011 as a working part."

Unified Interpretations

SOLAS II-1, Regulation 3-5

1. Verification that *"new installation of materials which contain asbestos"* under SOLAS II-1/3-5 is not made on ships requires the Recognized Organization to review asbestos-free declarations and supporting documentation, for the structure, machinery, electrical installations and equipment covered by the SOLAS Convention, which is to be provided to the Recognized Organization by shipyards, repair yards, and equipment manufacturers taking into account appendix 8 of the 2011 Guidelines for the development of the inventory of hazardous materials (resolution MEPC.197(62)) for:

- new construction (keel laid, or at a similar stage of construction, on or after 1 July 2012);

- conversions (contract date for the conversion or, in the absence of a contract, the date on which the work identifiable with the specific conversion begins) on or after 1 July 2012;

NOTES:

1. This ~~UI~~ Unified Interpretation is to be uniformly implemented by IACS Societies ~~as soon as possible, but~~ not later than 1 July 2012.

2. Revision 1 of this Unified Interpretation is to be uniformly implemented by IACS Societies not later than 1 July 2013.

SC 249 (cont)

MSC.1/Circ.1379

2. The phrase *"new installation of materials containing asbestos"* in MSC.1/Circ.1379:

- means that material used (i.e., repaired, replaced, maintained or added) as a working part of the ship as per Annex 1 which is installed on or after 1 July 2012 is required to be documented with an asbestos-free declaration. The Recognized Organization will, in consultation with the Company's nominated person responsible to control asbestos-containing material onboard as per the Safety Management System in accordance with MSC/Circ.1045, audit this documentation during annual safety construction and safety equipment surveys; and

- does not preclude the stowage of material which contains asbestos onboard (e.g., spare parts existing on board as of 1 July 2012).

3. The phrase *"should not be permitted to be installed after 1 January 2011 as a working part"* in MSC.1/Circ.1379 means that replacement, maintenance or addition of materials used for the structure, machinery, electrical installations and equipment covered by the SOLAS Convention which contain asbestos is prohibited.

SC 249 (cont)

Annex 1

Structure and/or equipment	Component
Propeller shafting	Packing with low pressure hydraulic piping flange Packing with casing Clutch Brake lining Synthetic stern tubes
Diesel engine	Packing with piping flange Lagging material for fuel pipe Lagging material for exhaust pipe Lagging material turbocharger
Turbine engine	Lagging material for casing Packing with flange of piping and valve for steam line, exhaust line and drain line Lagging material for piping and valve of steam line, exhaust line and drain line
Boiler	Insulation in combustion chamber Packing for casing door Lagging material for exhaust pipe Gasket for manhole Gasket for hand hole Gas shield packing for soot blower and other hole Packing with flange of piping and valve for steam line, exhaust line, fuel line and drain line Lagging material for piping and valve of steam line, exhaust line, fuel line and drain line
Exhaust gas economizer	Packing for casing door Packing with manhole Packing with hand hole Gas shield packing for soot blower Packing with flange of piping and valve for steam line, exhaust line, fuel line and drain line Lagging material for piping and valve of steam line, exhaust line, fuel line and drain line
Incinerator	Packing for casing door Packing with manhole Packing with hand hole Lagging material for exhaust pipe
Auxiliary machinery (pump, compressor, oil purifier, crane)	Packing for casing door and valve Gland packing Brake lining
Heat exchanger	Packing with casing Gland packing for valve Lagging material and insulation

SC 249 (cont)

Valve	Gland packing with valve, sheet packing with piping flange Gasket with flange of high pressure and/or high temperature
Pipe, duct	Lagging material and insulation
Tank (fuel tank, hot water, tank, condenser), other equipments (fuel strainer, lubricant oil strainer)	Lagging material and insulation
Electric equipment	Insulation material
Ceiling, floor and wall in accommodation area	Ceiling, floor, wall
Fire door	Packing, construction and insulation of the fire door
Inert gas system	Packing for casing, etc.
Air-conditioning system	Sheet packing, lagging material for piping and flexible joint
Miscellaneous	Ropes Thermal insulating materials Fire shields/fire proofing Space/duct insulation Electrical cable materials Brake linings Floor tiles/deck underlay Steam/water/vent flange gaskets Adhesives/mastics/fillers Sound damping Moulded plastic products Sealing putty Shaft/valve packing Electrical bulkhead penetration packing Circuit breaker arc chutes Pipe hanger inserts Weld shop protectors/burn covers Fire-fighting blankets/clothing/equipment Concrete ballast

Note:

The above list ~~above~~ is taken from IMO Resolution MEPC.197(62), Appendix 5, paragraph 2.2.2.1.

End of Document

MPC2 Operational manuals for oil discharge monitoring and control systems

(1988) (Rev.1 Aug 2015)

(Annex I, Regulation 31.4)

31.4 Instructions as to the operation of the system shall be in accordance with an operational manual approved by the Administration. They shall cover manual as well as automatic operations and shall be intended to ensure that at no time shall oil be discharged except in compliance with the conditions specified in regulation 34 of this Annex.

Interpretation

For compliance with Regulation 31.4 of MARPOL - Annex I and Resolution MEPC.108(49) as amended by Resolution MEPC.240(65), the Oil Discharge Monitoring and Control System Operational Manual is to contain all the details necessary to operate and maintain the system and should include at least the following information. The information may be grouped as indicated, or in an equivalent manner.

Introduction : Particulars of the ship, together with the date on which the system was/is to be installed and index to remainder of manual.
Text of Regulations 31 and 34 to be quoted in full.

Section 1 : Manufacturer's equipment manuals for major components of the system. These may include installation, commissioning, operating and fault finding procedures for the oil content monitor.

Section 2 : Operations manual comprising a description of the ship's cargo ballast systems, designated overboard discharges with sampling points, normal operational procedures, automatic inputs, manual inputs (as applicable), starting interlock and discharge valve control (as applicable), override system, audible and visual alarms, outputs recorded and, where required for manual input, flow rate when discharging by gravity and when pumping ballast overboard. It should also include instructions for the discharge of oily water following mal-function of the equipment.
The above information is to be supported by copies of relevant approved diagrams.
Reference may be made to Section 1, where applicable.

Notes:

1. Revision 1 of this Unified Interpretation is to be uniformly implemented by IACS Societies for ships contracted for construction on or after 1 July 2016.

2. The "contracted for construction" date means the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. For further details regarding the date of "contract for construction", refer to IACS Procedural Requirement (PR) No. 29.

MPC 2
(cont)

Section 3 : Technical manual comprising fault finding schedules, maintenance record and electrical, pneumatic and hydraulic schematic diagrams and descriptions of the complete system.
Reference may be made to Section 1, where applicable.

Section 4 : Test and check-out procedures to include a functional test at installation and guidance notes for the Surveyors carrying out initial and in-service surveys.
Reference may be made to Section 1, where applicable.

Appendix I : Technical installation specification including location and mounting of components, arrangements for maintaining integrity of 'safe' zones, safety requirements for electrical equipment installed in hazardous zones supported by copies of approved drawings, sample piping layout and sample delay calculations, design and arrangements of sampling probes, flushing arrangements and zero setting.
Reference may be made to Section 1, where applicable.

Appendix II : Copy of Type Approval Certificate and Workshop Certificates for major components.

End of Document

MPC6 Calculation of the aggregate capacity of SBT

(1997)
(Rev.1
Aug
2015)

(Regulation 19.3.4)

19.3.4 The aggregate capacity of ballast tanks

On crude oil tankers of 20,000 tonnes deadweight and above and product carriers of 30,000 tonnes deadweight and above, the aggregate capacity of wing tanks, double bottom tanks, forepeak tanks and after peak tanks shall not be less than the capacity of segregated ballast tanks necessary to meet the requirements of regulation 18 of this Annex. Wing tanks or spaces and double bottom tanks used to meet the requirements of regulation 18 shall be located as uniformly as practicable along the cargo tank length. Additional segregated ballast capacity provided for reducing longitudinal hull girder bending stress, trim, etc. may be located anywhere within the ship.

Interpretation

1. Any ballast carried in localized inboard extensions, indentations or recesses of the double hull, such as bulkhead stools, should be excess ballast above the minimum requirement for segregated ballast capacity according to regulation 18.

2. In calculating the aggregate capacity under regulation 19.3.4, the following should be taken into account:

2.1 the capacity of engine-room ballast tanks should be excluded from the aggregate capacity of ballast tanks;

2.2 the capacity of ballast tank located inboard of double hull should be excluded from the aggregate capacity of ballast tanks (see figure 1).

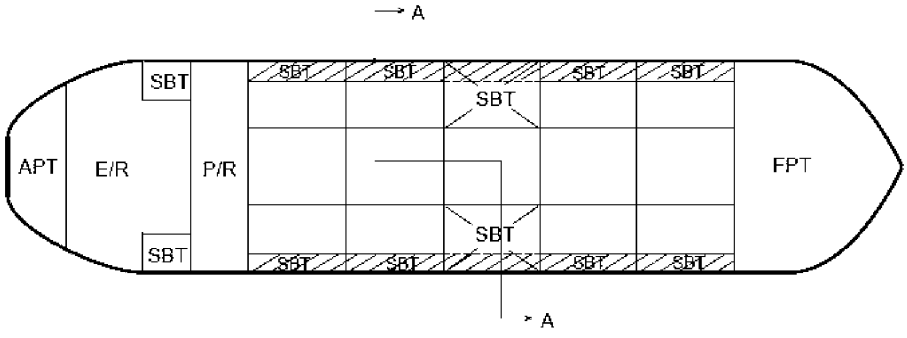
Notes:

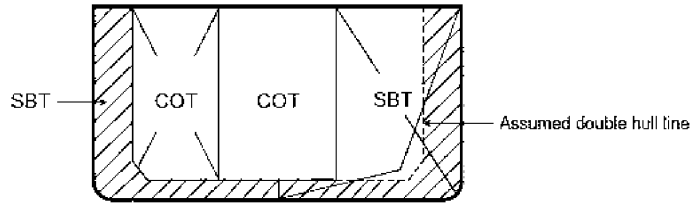
1. This IACS Unified Interpretation was submitted to IMO and is contained in MEPC/Circ. 316 of 25th July 1996.

2. Revision 1 of this Unified Interpretation is to be uniformly implemented by IACS Societies for ships contracted for construction on or after 1 July 2016.

3. The "contracted for construction" date means the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. For further details regarding the date of "contract for construction", refer to IACS Procedural Requirement (PR) No. 29.

MPC6
(cont)

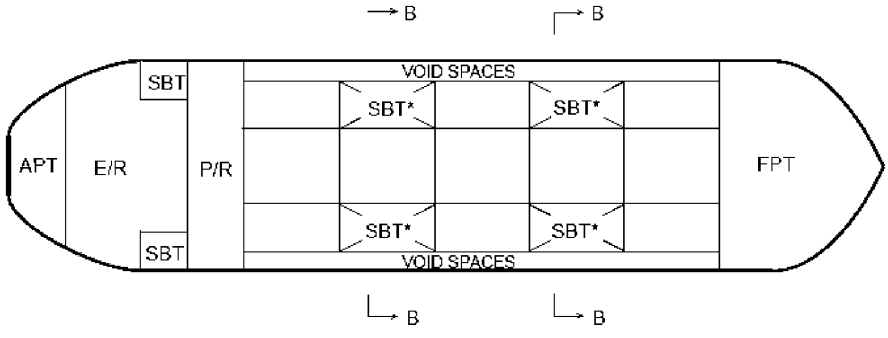


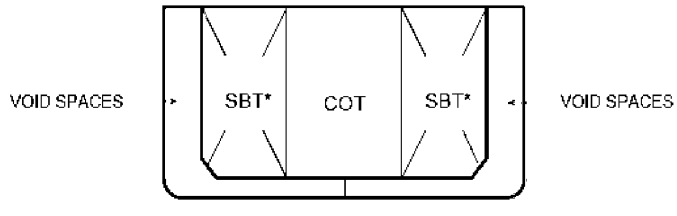


SECTION A-A

Fig. 1

MPC6 2.3 (cont) spaces such as void spaces located in the double hull within the cargo tank length should be included in the aggregate capacity of ballast tanks (see figure 2).





SECTION B-B

Fig. 2

End of Document

MODU 1 (May 2015)

IACS Unified Interpretations for the application of MODU Code Chapter 2 paragraphs 2.1, 2.2, 2.3, 2.4 and revised technical provisions for means of access for inspections (resolution MSC.158(78))

Note:

1. This Unified Interpretation is to be applied by IACS Societies on units contracted for construction from 1 July 2016, unless they are provided with written instructions to apply a different interpretation by the Administration on whose behalf they are authorized to act as a Recognized Organization.

2. The "contracted for construction" date means the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. For further details regarding the date of "contract for construction", refer to IACS Procedural Requirement (PR) No. 29.

MODU 1 (cont)

2009 MODU Code, section 2.2.2

2.2.2 Safe access to holds, tanks, ballast tanks and other spaces

2.2.2.1 Safe access to holds, cofferdams, tanks and other spaces should be direct from the open deck and such as to ensure their complete inspection. Safe access may be from a machinery space, pump-room, deep cofferdam, pipe tunnel, hold, double hull space or similar compartment not intended for the carriage of oil or hazardous materials where it is impracticable to provide such access from an open deck.

2.2.2.2 Tanks, and subdivisions of tanks, having a length of 35 m or more, should be fitted with at least two access hatchways and ladders, as far apart as practicable. Tanks less than 35 m in length should be served by at least one access hatchway and ladder. When a tank is subdivided by one or more swash bulkheads or similar obstructions which do not allow ready means of access to the other parts of the tank, at least two hatchways and ladders should be fitted.

Interpretation

This regulation is only applicable to integral tanks. Independent tanks can be excluded.

The wording "not intended for the carriage of oil or hazardous materials" applies only to "similar compartments", i.e. safe access can be through a pump-room, deep cofferdam, pipe tunnel, cargo hold or double hull space.

Technical Background

Means of Access (MA) specified in the Technical provisions contained in resolution MSC.158(78) are not specific with respect to the application to integral tanks or also to independent tanks. The MA regulated under 2.2.1.1 of the 2009 IMO MODU Code is for overall and close-up inspections and thickness measurements of the unit's structure. Independent tanks are not considered part of the unit's structure. Therefore it is assumed that the target tanks are integral tanks.

MODU 1 (cont)

2009 MODU Code, section 2.2.1.2

2.2.1.2 Where a permanent means of access may be susceptible to damage during normal operations or where it is impracticable to fit permanent means of access, the Administration may allow, in lieu thereof, the provision of movable or portable means of access, as specified in the Technical provisions, provided that the means of attaching, rigging, suspending or supporting the portable means of access forms a permanent part of the unit's structure. All portable equipment shall be capable of being readily erected or deployed by unit's personnel.

Interpretation

Some possible alternative means of access are listed under paragraph 3.9 of the MODU Technical Provisions for means of access for inspection (MODU TP). Always subject to acceptance as equivalent by the Administration, alternative means such as an unmanned robot arm, ROV's with necessary equipment of the permanent means of access for overall and close-up inspections and thickness measurements of the deck head structure such as deck transverses and deck longitudinals of ballast tanks and other tanks, holds and other spaces where gas hazardous atmosphere may be present, are to be capable of:

- safe operation in ullage space in gas-free environment;
- introduction into the place directly from a deck access.

When considering use of alternative means of access as addressed by paragraph 3.9 of the MODU TP, refer to IACS Recommendation No.91 "Guidelines for Approval/Acceptance of Alternative Means of Access".

Technical Background

Innovative approaches, in particular a development of robot in place of elevated passageways, are encouraged and it is considered worthwhile to provide the functional requirement for the innovative approach.

MODU 1 (cont)

2009 MODU Code, section 2.2.1.3

2.2.1.3 The construction and materials of all means of access and their attachment to the unit's structure should be to the satisfaction of the Administration. The means of access should be subject to inspection prior to, or in conjunction with, its use in carrying out surveys in accordance with section 1.6.

Interpretation

Note: This interpretation is to be contained in a section of the MA Manual.

Inspection

The MA arrangements, including portable equipment and attachments, are to be periodically inspected by the crew or competent inspectors as and when it is going to be used to confirm that the MAs remain in serviceable condition.

Procedures

1. Any Company authorised person using the MA shall assume the role of inspector and check for obvious damage prior to using the access arrangements. Whilst using the MA the inspector is to verify the condition of the sections used by close up examination of those sections and note any deterioration in the provisions. Should any damage or deterioration be found, the effect of such deterioration is to be assessed as to whether the damage or deterioration affects the safety for continued use of the access. Deterioration found that is considered to affect safe use is to be determined as "substantial damage" and measures are to be put in place to ensure that the affected section(s) are not to be further used prior effective repair.

2. Statutory survey of any space that contains MA shall include verification of the continued effectiveness of the MA in that space. Survey of the MA shall not be expected to exceed the scope and extent of the survey being undertaken. If the MA is found deficient the scope of survey is to be extended if this is considered appropriate.

3. Records of all inspections are to be established based on the requirements detailed in the MODU's Safety Management System. The records are to be readily available to persons using the MAs and a copy attached to the MA Manual. The latest record for the portion of the MA inspected is to include as a minimum the date of the inspection, the name and title of the inspector, a confirmation signature, the sections of MA inspected, verification of continued serviceable condition or details of any deterioration or substantial damage found. A file of permits issued is to be maintained for verification.

Technical Background

It is recognised that MA may be subject to deterioration in the long term due to corrosive environment and external forces from unit motions and sloshing of liquid contained in the tank. MA therefore is to be inspected at every opportunity of tank/space entry.

MODU 1 (cont)

2009 MODU Code, paragraph 2.2.2.2

2.2.2.2 Tanks, and subdivisions of tanks, having a length of 35 m or more, should be fitted with at least two access hatchways and ladders, as far apart as practicable. Tanks less than 35 m in length should be served by at least one access hatchway and ladder. When a tank is subdivided by one or more swash bulkheads or similar obstructions which do not allow ready means of access to the other parts of the tank, at least two hatchways and ladders should be fitted.

Interpretation

A tank of less than 35 m length without a swash bulkhead requires only one access hatch.

Where rafting is indicated in the access manual as the means to gain ready access to the under deck structure, the term *"similar obstructions"* referred to in the regulation includes internal structures (e.g., webs >1.5m deep) which restrict the ability to raft (at the maximum water level needed for rafting of under deck structure) directly to the nearest access ladder and hatchway to deck. When rafts or boats alone, as an alternative means of access are allowed, permanent means of access are to be provided to allow safe entry and exit. This means:

a) access direct from the deck via a vertical ladder and small platform fitted approximately 2m below the deck in each bay; or

b) access to deck from a longitudinal permanent platform having ladders to deck in each end of the tank. The platform shall, for the full length of the tank, be arranged in level with, or above, the maximum water level needed for rafting of under deck structure. For this purpose, the ullage corresponding to the maximum water level is to be assumed not more than 3m from the deck plate measured at the midspan of deck transverses and in the middle length of the tank. A permanent means of access from the longitudinal permanent platform to the water level indicated above is to be fitted in each bay (e.g. permanent rungs on one of the deck webs inboard of the longitudinal permanent platform).

MODU 1 (cont)

2009 MODU Code, section 2.2.3

2.2.3 Access manual

2.2.3.1 A unit's means of access to carry out overall and close-up inspections and thickness measurements should be described in an access manual which may be incorporated in the unit's operating manual. The manual should be updated as necessary, and an updated copy maintained on board. The access manual should include the following for each space:

.1.1 plans showing the means of access to the space, with appropriate technical specifications and dimensions;

.1.2 plans showing the means of access within each space to enable an overall inspection to be carried out, with appropriate technical specifications and dimensions. The plans should indicate from where each area in the space can be inspected;

.1.3 plans showing the means of access within the space to enable close-up inspections to be carried out, with appropriate technical specifications and dimensions. The plans should indicate the positions of critical structural areas, whether the means of access is permanent or portable and from where each area can be inspected;

.1.4 instructions for inspecting and maintaining the structural strength of all means of access and means of attachment, taking into account any corrosive atmosphere that may be within the space;

.1.5 instructions for safety guidance when rafting is used for close-up inspections and thickness measurements;

.1.6 instructions for the rigging and use of any portable means of access in a safe manner;

.1.7 an inventory of all portable means of access; and

.1.8 records of periodical inspections and maintenance of the unit's means of access.

Interpretation

The access manual is to address spaces listed in section 2.2.2.

As a minimum the English version is to be provided.

The access manual is to contain at least the following two parts:

Part 1: Plans, instructions and inventory required by paragraphs .1.1 to .1.7 of section 2.2.3.1. This part is to be approved by the Administration or the organization recognised by the Administration.

Part 2: Form of record of inspections and maintenance, and change of inventory of portable equipment due to additions or replacement after construction. This part is to be approved for its form only at new building.

The following matters are to be addressed in the access manual:

1. The access manual is to clearly cover scope as specified in the regulations for use by crews, surveyors and port State control officers.

MODU 1 (cont)

2. Approval / re-approval procedure for the manual, i.e. any changes of the permanent, portable, movable or alternative means of access within the scope of the regulation and the Technical provisions are subject to review and approval by the Administration or by the organization recognised by the Administration.

3. Verification of MA is to be part of safety construction survey for continued effectiveness of the MA in that space which is subject to the statutory survey.

4. Inspection of MA by the crew and/or a competent inspector of the company as a part of regular inspection and maintenance (see interpretation for section 2.2.1.3).

5. Actions to be taken if MA is found unsafe to use.

6. In case of use of portable equipment plans showing the means of access within each space indicating from where and how each area in the space can be inspected.

Refer to IACS Recommendation No.90 "Ship Structural Access Manual"

MODU 1 (cont)

2009 MODU Code, section 2.2.3.2

2.2.3.2 For the purpose of this paragraph "critical structural areas" are locations which have been identified from calculations to require monitoring or from the service history of similar or sister units to be sensitive to cracking, buckling, deformation or corrosion which would impair the structural integrity of the unit.

Interpretation

Critical structural areas are to be identified by advanced calculation techniques for structural strength and fatigue performance, if available, and feed back from the service history and design development of similar or sister units.

MODU 1 (cont)

2009 MODU Code, section 2.2.4.1

2.2.4 General technical specifications

2.2.4.1 For access through horizontal openings, hatches or manholes, the dimensions should be sufficient to allow a person wearing a self-contained air-breathing apparatus and protective equipment to ascend or descend any ladder without obstruction and also provide a clear opening to facilitate the hoisting of an injured person from the bottom of a confined space. The minimum clear opening should not be less than 600 mm x 600 mm. When access to a hold is arranged through a flush manhole in the deck or a hatch, the top of the ladder should be placed as close as possible to the deck or hatch coaming. Access hatch coamings having a height greater than 900 mm should also have steps on the outside in conjunction with the ladder.

Interpretation

The minimum clear opening of 600 mm x 600 mm may have corner radii up to 100 mm maximum. The clear opening is specified in MSC/Circ.686 to keep the opening fit for passage of personnel wearing a breathing apparatus. In such a case where as a consequence of structural analysis of a given design the stress is to be reduced around the opening, it is considered appropriate to take measures to reduce the stress such as making the opening larger with increased radii, e.g. 600 x 800 with 300 mm radii, in which a clear opening of 600 x 600 mm with corner radii up to 100mm maximum fits.

Technical Background

The interpretation is based upon the established Guidelines in MSC/Circ.686.

Ref.

Paragraphs 9 of Annex of MSC/Circ.686.

MODU 1 (cont)

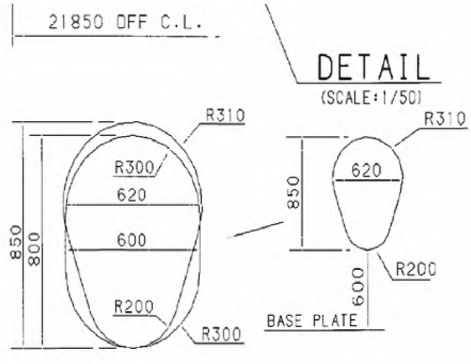
2009 MODU Code, section 2.2.4.2

2.2.4.2 For access through vertical openings, or manholes, in swash bulkheads, floors, girders and web frames providing passage through the length and breadth of the space, the minimum clear opening should be not less than 600 mm x 800 mm at a height of not more than 600 mm from the bottom shell plating unless gratings or other foot holds are provided.

Interpretation

1. The minimum clear opening of not less than 600 mm x 800 mm may also include an opening with corner radii of 300 mm. An opening of 600mm in height x 800mm in width may be accepted as access openings in vertical structures where it is not desirable to make large opening in the structural strength aspects, i.e. girders and floors in double bottom tanks.

2. Subject to verification of easy evacuation of injured person on a stretcher the vertical opening 850 mm x 620 mm with wider upper half than 600 mm, while the lower half may be less than 600 mm with the overall height not less than 850 mm is considered an acceptable alternative to the traditional opening of 600 mm x 800 mm with corner radii of 300 mm.



3. If a vertical opening is at a height of more than 600 mm steps and handgrips are to be provided. In such arrangements it is to be demonstrated that an injured person can be easily evacuated.

Technical Background

The interpretation is based upon the established Guidelines in MSC/Circ.686 and an innovative design is considered for easy access by humans through the opening.

Ref.

Paragraphs 11 of Annex of MSC/Circ.686.

MODU 1 (cont)

Appendix 1

Unified Interpretation of IMO Resolution MSC. 133(76), as amended by resolution MSC. 158(78), as applicable for MODUs

Note: This document has been derived from IMO Resolution 133(76) for the purpose of interpretation for Mobile Offshore Drilling Units.

1. Preamble

1.1 It has long been recognized that the only way of ensuring that the condition of a MODU's structure is maintained to conform to the applicable requirements is for all its components to be surveyed on a regular basis throughout their operational life. This will ensure that they are free from damage such as cracks, buckling or deformation due to corrosion, overloading, or contact damage and that thickness diminution is within established limits. The provision of suitable means of access to the hull structure for the purpose of carrying out overall and close-up surveys and inspections is essential and such means should be considered and provided for at the design stage.

1.2 MODUs should be designed and built with due consideration as to how they will be surveyed by flag State inspectors and classification society surveyors during their in-service life and how the crew will be able to monitor the condition of the MODU. Without adequate access, the structural condition of the MODU can deteriorate undetected and major structural failure can arise. A comprehensive approach to design and maintenance is required to cover the whole projected life of the MODU.

1.3 In order to address this issue these Technical provisions for means of access for inspections have been developed (hereinafter called the Technical provisions), intended to facilitate close-up inspections and thickness measurements of the MODU's structure referred to in 2009 MODU Code, paragraph 2.2 on Access.

1.4 Permanent means of access which are designed to be integral parts of the structure itself are preferred and Administrations may allow reasonable deviations to facilitate such designs.

Interpretation

In the context of the above requirement, the deviation shall be applied only to distances between integrated PMA that are the subject of paragraph 2.1.2 of Table 1.

Deviations should not be applied to the distances governing the installation of underdeck longitudinal walkways and dimensions that determine whether permanent access are required or not, such as height of the spaces and height to elements of the structure (e.g. cross-ties).

2. Definitions

For the purpose of these Technical provisions, the following definitions apply in addition to those provided in the 2009 MODU Code, as amended:

.1 Rung means the step of a vertical ladder or step on the vertical surface.

.2 Tread means the step of an inclined ladder or step for the vertical access opening.

MODU 1 (cont)

.3 Flight of an inclined ladder means the actual stringer length of an inclined ladder. For vertical ladders, it is the distance between the platforms.

.4 Stringer means:

.1 the frame of a ladder; or

.2 the stiffened horizontal plating structure fitted on the side shell, transverse bulkheads and/or longitudinal bulkheads in the space. For the purpose of ballast tanks of less than 5 m width, the horizontal plating structure is credited as a stringer and a longitudinal permanent means of access, if it provides a continuous passage of 600 mm or more in width past frames or stiffeners on the side shell or longitudinal or transverse bulkhead. Openings in stringer plating utilized as permanent means of access shall be arranged with guard rails or grid covers to provide safe passage on the stringer or safe access to each transverse web.

.5 Vertical ladder means a ladder of which the inclined angle is 70° and over up to 90°. A vertical ladder shall not be skewed by more than 2°.

.6 Overhead obstructions mean the deck or stringer structure including stiffeners above the means of access.

.7 Distance below deck head means the distance below the plating.

.8 Cross deck means the transverse area of the main deck which is located inboard and at both sides of a transverse bulkhead. Between large hatches/holds or between moonpool opening and hatches/holds of a drillship or column stabilized unit.

.9 Hold means any dry space other than a machinery space located within the hull of surface units and self-elevating units or within the upper hull, columns or pontoons of column-stabilized units. Dry storage spaces and void spaces are considered holds.

3. Technical provisions

3.1 Structural members subject to the close-up inspections and thickness measurements of the MODU's structure referred to in 2009 MODU Code, section 2.2, except those in double bottom spaces, shall be provided with a permanent means of access to the extent as specified in table 1. Approved alternative methods may be used in combination with the fitted permanent means of access, provided that the structure allows for its safe and effective use.

Interpretation

The permanent means of access to a space can be credited for the permanent means of access for inspection.

Technical Background

The Technical provisions specify means of access to a space and to hull structure for carrying out overall and close up surveys and inspections. Requirements of MA to hull structure may not always be suitable for access to a space. However if the MA for access to a space can also be used for the intended surveys and inspections such MA can be credited for the MA for use for surveys and inspections.

MODU 1 (cont)

3.2 Permanent means of access should as far as possible be integral to the structure of the MODU, thus ensuring that they are robust and at the same time contributing to the overall strength of the structure of the MODU.

3.3 Elevated passageways forming sections of a permanent means of access, where fitted, shall have a minimum clear width of 600 mm, except for going around vertical webs where the minimum clear width may be reduced to 450 mm, and have guard rails over the open side of their entire length. Sloping structures providing part of the access shall be of a non-skid construction. Guard rails shall be 1,000 mm in height and consist of a rail and an intermediate bar 500 mm in height and of substantial construction. Stanchions shall be not more than 3 m apart.

Interpretation

1. Sloping structures are structures that are sloped by 5 or more degrees from horizontal plane when a unit is in upright position at even-keel.

2. Guard rails are to be fitted on the open side. For stand alone passageways guard rails are to be fitted on both sides of these structures.

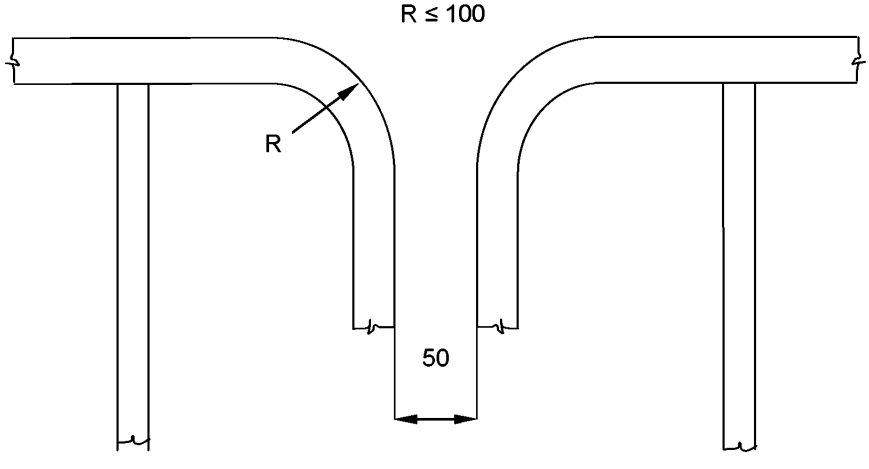
3. Discontinuous top handrails are allowed, provided the gap does not exceed 50 mm.

The same maximum gap is to be considered between the top handrail and other structural members (i.e. bulkhead, web frame, etc.).

The maximum distance between the adjacent stanchions across the handrail gaps is to be 350 mm where the top and mid handrails are not connected together and 550 mm when they are connected together.

The maximum distance between the stanchion and other structural members is not to exceed 200 mm where the top and mid handrails are not connected together and 300 mm when they are connected together.

When the top and mid handrails are connected by a bent rail, the outside radius of the bent part is not to exceed 100 mm (see Figure below).



MODU 1 (cont)

4. Non-skid construction is such that the surface on which personnel walks provides sufficient friction to the sole of boots even if the surface is wet and covered with thin sediment.

5. "Substantial construction" is taken to refer to the designed strength as well as the residual strength during the service life of the unit. Durability of passageways together with guard rails is to be ensured by the initial corrosion protection and inspection and maintenance during services.

6. For guard rails, use of alternative materials such as GRP is to be subject to compatibility with the liquid carried in the tank. Non-fire resistant materials are not to be used for means of access to a space with a view to securing an escape route at a high temperature.

7. Requirements for resting platforms placed between ladders are equivalent to those applicable to elevated passageways.

Ref.

Paragraph 10 of Annex to MSC/Circ.686

3.4 Access to permanent means of access and vertical openings from the MODU's bottom shall be provided by means of easily accessible passageways, ladders or treads. Treads shall be provided with lateral support for the foot. Where the rungs of ladders are fitted against a vertical surface, the distance from the centre of the rungs to the surface shall be at least 150 mm. Where vertical manholes are fitted higher than 600 mm above the walking level, access shall be facilitated by means of treads and hand grips with platform landings on both sides.

Interpretation

Where the vertical manhole is at a height of more than 600 mm above the walking level, it shall be demonstrated that an injured person can be easily evacuated.

3.5 Permanent inclined ladders shall be inclined at an angle of less than 70°. There shall be no obstructions within 750 mm of the face of the inclined ladder, except that in way of an opening this clearance may be reduced to 600 mm. Resting platforms of adequate dimensions shall be provided, normally at a maximum of 6 m vertical height. Ladders and handrails shall be constructed of steel or equivalent material of adequate strength and stiffness and securely attached to the structure by stays. The method of support and length of stay shall be such that vibration is reduced to a practical minimum. In holds, ladders shall be designed and arranged so that stores handling difficulties are not increased and the risk of damage from stores handling gear is minimized.

MA for access to ballast tanks and other tanks:

1. Tanks and subdivisions of tanks having a length of 35 m or more with two access hatchways:

First access hatchway: Inclined ladder or ladders are to be used.

Second access hatchway:

MODU 1 (cont)

i. A vertical ladder may be used. In such a case where the vertical distance is more than 6 m, vertical ladders are to comprise one or more ladder linking platforms spaced not more than 6 m apart vertically and displaced to one side of the ladder.

The uppermost section of the vertical ladder, measured clear of the overhead obstructions in way of the tank entrance, is not to be less than 2.5 m but not exceed 3.0 m and is to comprise a ladder linking platform which is to be displaced to one side of a vertical ladder. However, the vertical distance of the upper most section of the vertical ladder may be reduced to 1.6 m, measured clear of the overhead obstructions in way of the tank entrance, if the ladder lands on a longitudinal or athwartship permanent means of access fitted within that range; or

ii. Where an inclined ladder or combination of ladders is used for access to the space, the uppermost section of the ladder, measured clear of the overhead obstructions in way of the tank entrance, is to be vertical for not less than 2.5 m but not exceed 3.0m and is to comprise a landing platform continuing with an inclined ladder. However, the vertical distance of the upper most section of the vertical ladder may be reduced to 1.6 m, measured clear of the overhead obstructions in way of the tank entrance, if the ladder lands on a longitudinal or athwartship permanent means of access fitted within that range. The flights of the inclined ladders are normally to be not more than 6 m in vertical height. The lowermost section of the ladders may be vertical for the vertical distance not exceeding 2.5 m.

2. Tanks less than 35 m in length and served by one access hatchway an inclined ladder or combination of ladders are to be used to the space as specified in 1.ii above.

3. In double hull spaces of less than 2.5 m width the access to the space may be by means of vertical ladders that comprises one or more ladder linking platforms spaced not more than 6 m apart vertically and displaced to one side of the ladder. The uppermost section of the vertical ladder, measured clear of the overhead obstructions in way of the tank entrance, is not to be less than 2.5 m but not exceed 3.0 m and is to comprise a ladder linking platform which is to be displaced to one side of a vertical ladder. However, the vertical distance of the upper most section of the vertical ladder may be reduced to 1.6 m, measured clear of the overhead obstructions in way of the tank entrance, if the ladder lands on a longitudinal athwartship permanent means of access fitted within that range. Adjacent sections of the ladder are to be laterally offset from each other by at least the width of the ladder (see paragraph 20 of MSC/Circ.686).

4. Access from deck to a double bottom space may be by means of vertical ladders through a trunk. The vertical distance from deck to a resting platform, between resting platforms or a resting platform and the tank bottom is not to be more than 6 m unless otherwise approved by the Administration.

MA for inspection of the vertical structure:

Vertical ladders provided for means of access to the space may be used for access for inspection of the vertical structure.

Unless stated otherwise in Table 1 of MODU TP, vertical ladders that are fitted on vertical structures for inspection are to comprise one or more ladder linking platforms spaced not more than 6 m apart vertically and displace to one side of the ladder. Adjacent sections of ladder are to be laterally offset from each other by at least the width of the ladder (paragraph 20 of MSC/Circ.686).

MODU 1 (cont)

Obstruction distances

The minimum distance between the inclined ladder face and obstructions, i.e. 750 mm and, in way of openings, 600 mm specified in MODU TP 3.5 is to be measured perpendicular to the face of the ladder.

Technical Background

It is a common practice to use a vertical ladder from deck to the first landing to clear overhead obstructions before continuing to an inclined ladder or a vertical ladder displaced to one side of the first vertical ladder.

Ref.

For vertical ladders: Paragraph 20 of the annex to MSC/Circ.686.

3.6 The width of inclined ladders between stringers shall not be less than 400 mm. The treads shall be equally spaced at a distance apart, measured vertically, of between 200 mm and 300 mm. When steel is used, the treads shall be formed of two square bars of not less than 22 mm by 22 mm in section, fitted to form a horizontal step with the edges pointing upward. The treads shall be carried through the side stringers and attached thereto by double continuous welding. All inclined ladders shall be provided with handrails of substantial construction on both sides, fitted at a convenient distance above the treads.

Interpretation

1. Vertical height of handrails is not to be less than 890 mm from the centre of the step and two course handrails are to be provided.

2. The requirement of two square bars for treads specified in MODU TP, paragraph 3.6, is based upon the specification of construction of ladders in paragraph 3(e) of Annex 1 to resolution A.272(VIII), which addresses inclined ladders. MODU TP, paragraph 3.4, allows for single rungs fitted to vertical surfaces, which is considered for a safe grip. For vertical ladders, when steel is used, the rungs are to be formed of single square bars of not less than 22 mm by 22 mm for the sake of safe grip.

3. The width of inclined ladders for access to a hold is to be at least 450 mm to comply with the Australian AMSA Marine Orders Part 32, Appendix 17.

4. The width of inclined ladders other than an access to a hold is to be not less than 400 mm.

5. The minimum width of vertical ladders is to be 350 mm and the vertical distance between the rungs is to be equal and is to be between 250 mm and 350 mm.

6. A minimum climbing clearance in width is to be 600 mm other than the ladders placed between the hold frames.

7. The vertical ladders are to be secured at intervals not exceeding 2.5 m apart to prevent vibration.

MODU 1 (cont)

Technical Background

- MODU TP, paragraph 3.6, is a continuation of MODU TP, paragraph 3.5, which addresses inclined ladders. Interpretations for vertical ladders are needed based upon the current standards of IMO, AMSA or the industry.
- Interpretations 2 and 5 address vertical ladders based upon the current standards.
- Double square bars for treads become too large for a grip for vertical ladders and single rungs facilitate a safe grip.
- Interpretation 7 is introduced consistently with the requirement and the interpretation of MODU TP, paragraph 3.4.

Ref.

- Annex 1 to resolution A.272(VIII).
- Australian AMSA Marine Orders Part 32, Appendix 17.
- ILO Code of Practice "Safety and Health in Dockwork" – Section 3.6 Access to Ship's Holds.

3.7 For vertical ladders or spiral ladders, the width and construction should be in accordance with international or national standards accepted by the Administration.

3.8 No free-standing portable ladder shall be more than 5 m long.

3.9 Alternative means of access include, but are not limited to, such devices as:

.1 hydraulic arm fitted with a stable base;

.2 wire lift platform;

.3 staging;

.4 rafting;

.5 robot arm or remotely operated vehicle (ROV);

.6 portable ladders more than 5 m long shall only be utilized if fitted with a mechanical device to secure the upper end of the ladder;

Interpretation

A mechanical device such as hooks for securing at the upper end of a ladder is to be considered as an appropriate securing device if a movement fore/aft and sideways can be prevented at the upper end of the ladder.

Technical Background

Innovative design is to be accepted if it fits for the functional requirement with due consideration for safe use.

.7 other means of access, approved by and acceptable to the Administration.

MODU 1 (cont)

Means for safe operation and rigging of such equipment to and from and within the spaces shall be clearly described in the MODU's Structure Access Manual.

3.10 For access through horizontal openings, hatches or manholes, the dimensions shall be sufficient to allow a person wearing a self-contained air-breathing apparatus and protective equipment to ascend or descend any ladder without obstruction and also provide a clear opening to facilitate the hoisting of an injured person from the bottom of a confined space. The minimum clear opening shall not be less than 600 mm x 600 mm. When access to a hold is arranged through a flush manhole in the deck or a hatch, the top of the ladder shall be placed as close as possible to the deck or hatch coaming. Access hatch coamings having a height greater than 900 mm shall also have steps on the outside in conjunction with the ladder.

3.11 For access through vertical openings, or manholes, in swash bulkheads, floors, girders and web frames providing passage through the length and breadth of the space, the minimum clear opening shall be not less than 600 mm x 800 mm at a height of not more than 600 mm from the passage bottom plating unless gratings or other foot holds are provided.

Interpretation

See interpretation for sections 2.2.4.1and 2.2.4.2 of 2009 MODU Code.

3.12 The Administration may approve, in special circumstances, smaller dimensions for the openings referred to in paragraphs 3.10 and 3.11, if the ability to traverse such openings or to remove an injured person can be proved to the satisfaction of the Administration.

3.13 Access ladders to large holds and other similar spaces shall be:

.1 Where the vertical distance between the upper surface of adjacent decks or between deck and the bottom of the hold is not more than 6 m, either a vertical ladder or an inclined ladder.

Interpretation

Either a vertical or an inclined ladder or a combination of them may be used for access to a large hold where the vertical distance is 6 m or less from the deck to the bottom of the hold.

.2 Where the vertical distance between the upper surface of adjacent decks or between deck and the bottom of the hold is more than 6 m, an inclined ladder or series of inclined ladders at one end of the hold, except the uppermost 2.5 m of a hold measured clear of overhead obstructions and the lowest 6 m may have vertical ladders, provided that the vertical extent of the inclined ladder or ladders connecting the vertical ladders is not less than 2.5 m.

The second means of access at the other end of the hold may be formed of a series of staggered vertical ladders, which should comprise of one or more ladder linking platforms spaced not more than 6 m apart vertically and displaced to one side of the ladder. Adjacent sections of ladder should be laterally offset from each other by at least the width of the ladder. The uppermost entrance section of the ladder directly exposed to a hold should be vertical for a distance of 2.5 m measured clear of overhead obstructions and connected to a ladder-linking platform.

MODU 1 (cont)

Interpretation

Adjacent sections of vertical ladder need to be installed so that the following provisions are complied with (refer to figure A and figure B):

- The minimum "lateral offset". between two adjacent sections of vertical ladder, is the distance between the sections, upper and lower, so that the adjacent stringers are spaced of at least 200 mm, measured from half thickness of each stringer.

- Adjacent sections of vertical ladder shall be installed so that the upper end of the lower section is vertically overlapped, in respect to the lower end of the upper section, to a height of 1500 mm in order to permit a safe transfer between ladders.

- No section of the access ladder shall be terminated directly or partly above an access opening.

Technical Background

The aims of the above are to:

a. Ensure there is a rest platform at appropriate intervals, reducing the risk of accidents due to tiredness.

b. Reduce the risk of collateral injury from falling or dropping items of equipment, by preventing the lateral overlap of two ladders.

.3 A vertical ladder may be used as a means of access from a deck to a tank or space below, where the vertical distance is 6 m or less between the deck and the longitudinal means of access in the tank or the stringer or the bottom of the space immediately below the entrance. The uppermost entrance section from deck of the vertical ladder of the tank should be vertical for a distance of 2.5 m measured clear of overhead obstructions and comprise a ladder linking platform, unless landing on the longitudinal means of access, the stringer or the bottom within the vertical distance, displaced to one side of a vertical ladder.

.4 Unless allowed in .3 above, an inclined ladder or combination of ladders should be used for access to a tank or a space where the vertical distance is greater than 6 m between the deck and a stringer immediately below the entrance, between stringers, or between the deck or a stringer and the bottom of the space immediately below the entrance.

.5 In case of .4 above, the uppermost entrance section from deck of the ladder should be vertical for a distance of 2.5 m clear of overhead obstructions and connected to a landing platform and continued with an inclined ladder. The flights of inclined ladders should not be more than 9 m in actual length and the vertical height should not normally be more than 6 m. The lowermost section of the ladders may be vertical for a distance of not less than 2.5 m.

.6 In narrow spaces of less than 2.5 m width, the access to the space may be by means of vertical ladders that comprise of one or more ladder linking platforms spaced not more than 6 m apart vertically and displaced to one side of the ladder. Adjacent sections of ladder should be laterally offset from each other by at least the width of the ladder.

MODU 1 (cont)

Interpretation

Adjacent sections of vertical ladder need to be installed so that the following provisions are complied with (refer to figure A and figure B):

- The minimum "lateral offset". between two adjacent sections of vertical ladder, is the distance between the sections, upper and lower, so that the adjacent stringers are spaced of at least 200 mm, measured from half thickness of each stringer.

- Adjacent sections of vertical ladder shall be installed so that the upper end of the lower section is vertically overlapped, in respect to the lower end of the upper section, to a height of 1500 mm in order to permit a safe transfer between ladders.

- No section of the access ladder shall be terminated directly or partly above an access opening.

Technical Background

The aims of the above are to:

a. Ensure there is a rest platform at appropriate intervals, reducing the risk of accidents due to tiredness.

b. Reduce the risk of collateral injury from falling or dropping items of equipment, by preventing the lateral overlap of two ladders

.7 A spiral ladder is considered acceptable as an alternative for inclined ladders. In this regard, the uppermost 2.5 m can continue to be comprised of the spiral ladder and need not change over to vertical ladders.

3.14 The uppermost entrance section from deck of the vertical ladder providing access to a tank should be vertical for a distance of 2.5 m measured clear of overhead obstructions and comprise a ladder linking platform, displaced to one side of a vertical ladder. The vertical ladder can be between 1.6 m and 3 m below deck structure if it lands on a longitudinal or athwartship permanent means of access fitted within that range.

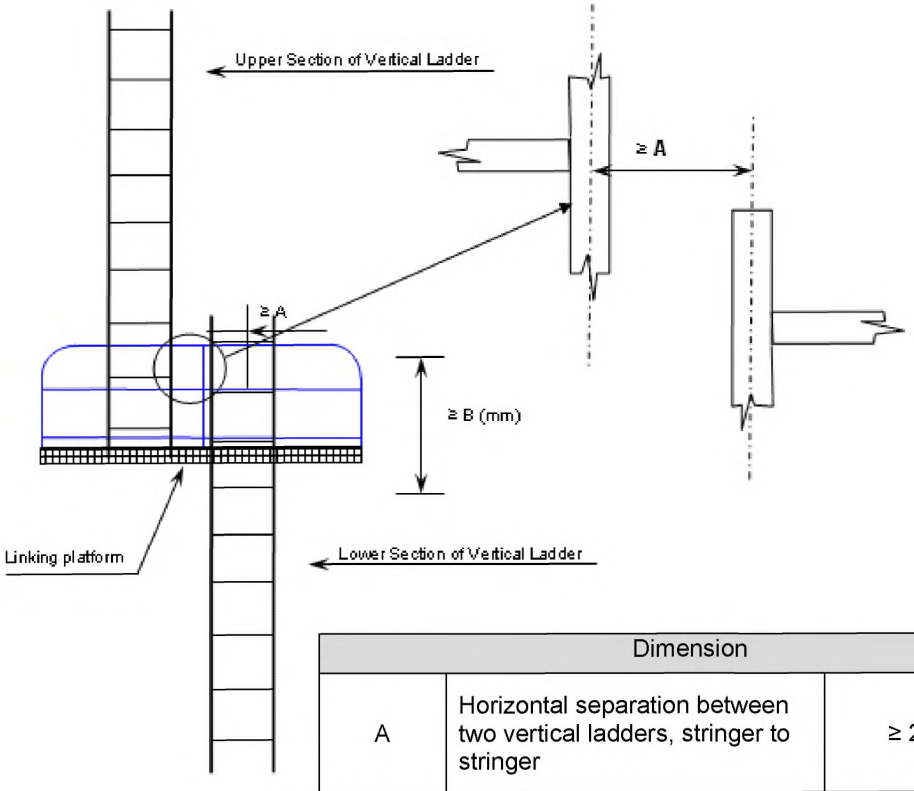
Interpretation

Deck is defined as "weather deck".

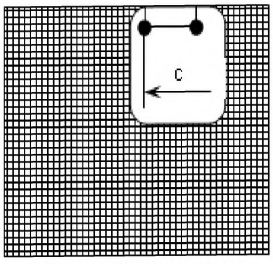
MODU 1 (cont)

Figure "A"

Vertical Ladder – Ladder through the linking platform



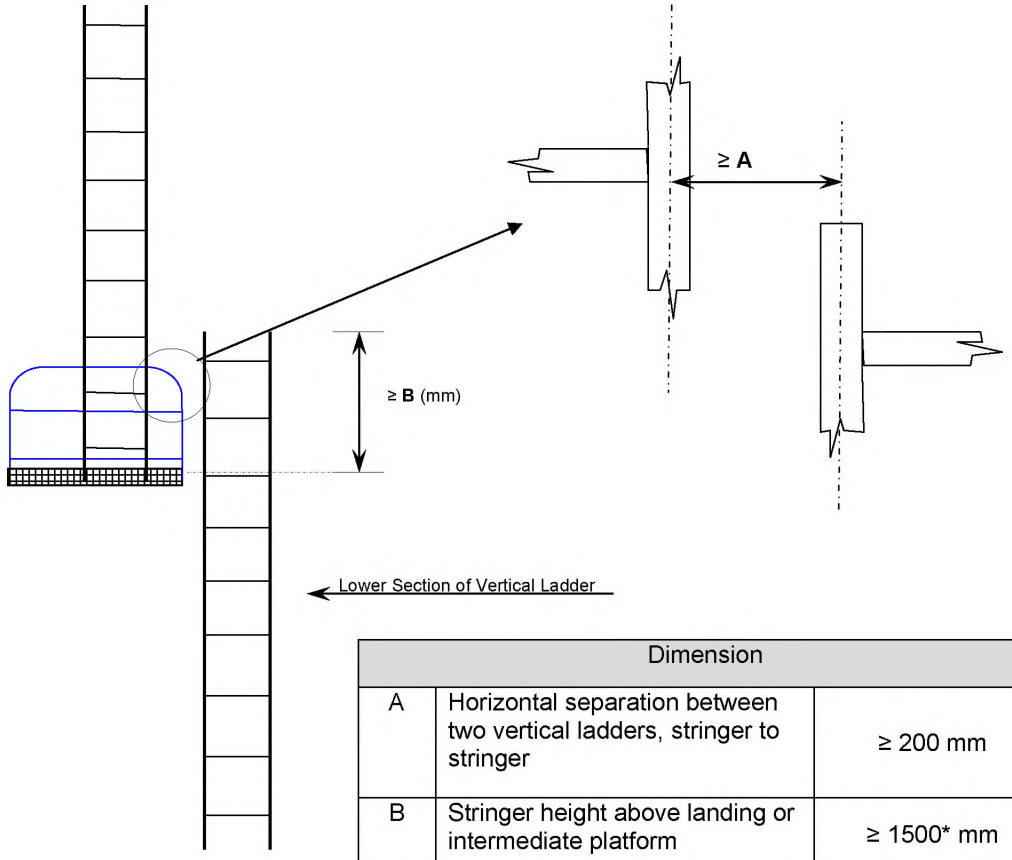
Dimension		
A	Horizontal separation between two vertical ladders, stringer to stringer	≥ 200 mm
B	Stringer height above landing or intermediate platform	≥ 1500* mm
C	Horizontal separation between ladder and platform	100 mm ≤C< 300 mm
*Note: the minimum height of the handrail stanchions of resting platform is of 1000 mm (Technical Provision, resolution MSC.158(78), paragraph 3.3)		



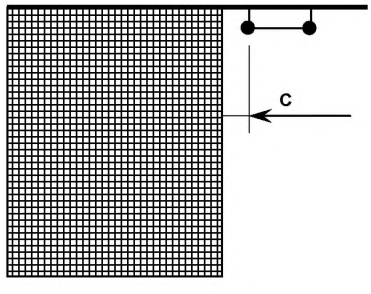
MODU 1 (cont)

Figure "B"

Vertical Ladder – Side mount



Dimension		
A	Horizontal separation between two vertical ladders, stringer to stringer	≥ 200 mm
B	Stringer height above landing or intermediate platform	≥ 1500* mm
C	Horizontal separation between ladder and platform	100 mm ≤C< 300 mm
*Note: the minimum height of the handrail stanchions of resting platform is of 1000 mm (Technical Provision, resolution MSC.158(78), paragraph 3.3)		



MODU 1 (cont)

Table 1 - Means of access

1 Water ballast tanks, except those specified in the right column, and other tanks	2 Water ballast tanks of less than 5 m width
Access to the underdeck and vertical structure	
1.1 For tanks of which the height is 6 m and over containing internal structures, permanent means of access shall be provided in accordance with .1 to .6:	2.1 For water ballast tanks of less than 5 m width (including double side spaces above the upper knuckle point of the bilge hopper sections in surface units), permanent means of access are to be provided in accordance with .1 to .3:
.1 continuous athwartship permanent access arranged at each transverse bulkhead on the stiffened surface, at a minimum of 1.6 m to a maximum of 3 m below the deck head;	.1 where the vertical distance between horizontal uppermost stringer and deck head is 6 m or more, one continuous longitudinal permanent means of access shall be provided for the full length of the tank with a means to allow passing through transverse webs installed at a minimum of 1.6 m to a maximum of 3 m below the deck head with a vertical access ladder at each end of the tank;
.2 at least one continuous longitudinal permanent means of access at each side of the tank. One of these accesses shall be at a minimum of 1.6 m to a maximum of 6 m below the deck head and the other shall be at a minimum of 1.6 m to a maximum of 3 m below the deck head;	.2 continuous longitudinal permanent means of access, which are integrated in the structure, at a vertical distance not exceeding 6 m apart; and
.3 access between the arrangements specified in .1 and .2 and from the deck above the tanks to either .1 or .2;	.3 plated stringers shall, as far as possible, be in alignment with horizontal girders of transverse bulkheads.
.4 continuous longitudinal permanent means of access which are integrated in the structural member on the stiffened surface of a longitudinal bulkhead, in alignment, where possible, with horizontal girders of transverse bulkheads are to be provided for access to the transverse webs unless permanent fittings are installed at the uppermost platform for use of alternative means, as defined in paragraph 3.9 of the MODU Technical provisions, for inspection at intermediate heights;	2.2 For pre-load tanks in self-elevating units, reference is made to 1.3.

MODU 1 (cont)

1 Water ballast tanks, except those specified in the right column, and other tanks	2 Water ballast tanks of less than 5 m width
Access to the underdeck and vertical structure	
.5 for MODUs having cross-ties which are 6 m or more above tank bottom, a transverse permanent means of access on the cross-ties providing inspection of the tie flaring brackets at both sides of the tank, with access from one of the longitudinal permanent means of access in .4; and	2.3 For ballast tanks in columns of column-stabilized units of which the vertical distance between each watertight flat or between horizontal stringers/non-tight flats is 6 m and over, one permanent means of access shall be provided for the full length of the tank in accordance with 2.1. (Note: In columns, longitudinal means the perimetral direction of the column and transversal means the radial direction of the column)
.6 alternative means as defined in paragraph 3.9 of the Technical provisions may be provided as an alternative to .4 for tanks other than ballast tanks of which the height is less than 17 m.	**For surface units (ship- or barge-type) and pontoons in column-stabilized units:** 2.4 For bilge hopper sections of which the vertical distance from the tank bottom to the upper knuckle point is 6 m and over, one longitudinal permanent means of access shall be provided for the full length of the tank. It shall be accessible by vertical permanent means of access at each end of the tank.
1.2 For tanks of which the height is less than 6 m, alternative means as defined in paragraph 3.9 of the Technical provisions or portable means may be utilized in lieu of the permanent means of access.	2.4.1 The longitudinal continuous permanent means of access may be installed at a minimum 1.6 m to maximum 3 m from the top of the bilge hopper section. In this case, a platform extending the longitudinal continuous permanent means of access in way of the webframe may be used to access the identified structural critical areas.
1.3 Pre-load tanks in self-elevating units are normally kept empty for a long duration when the unit is in elevated mode. For such tanks if due to their shape it is not practicable to fit permanent means of access mentioned in 1.1 above, the Administration may permit the provision of alternative means defined in paragraph 3.9 of the Technical provisions provided that the tank height is less than 17 m.	2.4.2 Alternatively, the continuous longitudinal permanent means of access may be installed at a minimum of 1.2 m below the top of the clear opening of the web ring allowing a use of portable means of access to reach identified structural critical areas.

MODU 1 (cont)

1 Water ballast tanks, except those specified in the right column, and other tanks	2 Water ballast tanks of less than 5 m width
Access to the underdeck and vertical structure	
1.4 For ballast tanks in columns of column-stabilized units, longitudinal means the perimetral direction of the column and transversal means the radial direction of the column.	2.5 Where the vertical distance referred to in 2.4 is less than 6 m, alternative means as defined in paragraph 3.9 of the Technical provisions or portable means of access may be utilised in lieu of the permanent means of access. To facilitate the operation of the alternative means of access, in-line openings in horizontal stringers shall be provided. The openings shall be of an adequate diameter and shall have suitable protective railings.
Fore and aft peak tanks in surface units 1.5 For fore and aft peak tanks with a depth of 6 m or more at the centre line of the collision and aft end bulkheads, a suitable means of access shall be provided for access to critical areas such as the underdeck structure, stringers, collision and aft end bulkheads and side shell structure.	
1.5.1 Stringers of less than 6 m in vertical distance from the deck head or a stringer immediately above are considered to provide suitable access in combination with portable means of access.	
1.5.2 In case the vertical distance between the deck head and stringers, stringers or the lowest stringer and the tank bottom is 6 m or more, alternative means of access as defined in paragraph 3.9 of the Technical provisions shall be provided.	

MODU 1 (cont)

3 Holds	4 Critical Structural Areas
Access to underdeck structure 3.1 For holds under main deck of which the height is 6 m and over, permanent means of access shall be fitted to provide access to the overhead structure at both sides of the cross deck and in the vicinity of the centreline. Each means of access shall be accessible from the hold access or directly from the main deck and installed at a minimum of 1.6 m to a maximum of 3 m below the deck.	4.1 Permanent means of access shall be fitted to provide access to overhead and vertical structures identified as critical structural areas as defined in 2009 MODU Code, paragraph 2.2.3.2 and located at a height of 6 m or more from the bottom of the space.
3.2 An athwartship permanent means of access fitted on the transverse bulkhead at a minimum 1.6 m to a maximum 3 m below the cross-deck head is accepted as equivalent to 3.1.	4.1.1 When permanent means of access to critical structural areas are not covered by sections 1, 2 and 3 above, continuous permanent access arranged at the bulkhead on the stiffened surface is to be provided at a maximum of 3 m below the critical structural area, but not higher than 1.6 m below the deck, throughout the extent of the critical structural area.
3.3 Access to the permanent means of access to overhead structure of the cross deck may also be via the uppermost stringer.	4.2 For critical structural areas located at a height of less than 6 m from the bottom of the space, alternative means of access as defined in paragraph 3.9 of the Technical provisions are to be provided.
3.4 Alternatively, movable means of access as defined in paragraph 3.9 of the MODU Technical provisions, may be utilized for access to the overhead structure of the cross deck if its vertical distance is 17 m or less above the bottom of the hold.	4.3 Suitable means of access into the interior of the horizontal braces in column stabilized units shall be provided. For access through vertical openings, the requirements of 3.11 of the Technical provisions shall be applied.

MODU 1 (cont)

Appendix 1 Unified Interpretation of IMO Resolution 133(76) as applicable for MODUs

Table 1 – Means of access, paragraph 1.1

1. Water ballast tanks, except those specified in the right column, and other tanks

Access to the underdeck and vertical structure

1.1 For tanks of which the height is 6 m and over containing internal structures, permanent means of access shall be provided in accordance with .1 to .6:

Interpretation

1. For tanks containing oil products other than crude oil (e.g. fuel oil, diesel oil, base oil) where lower corrosion is expected, section 1.1 of Table 1 is not to be applied. For tanks containing products considered corrosive (e.g. brine, drilling mud), section 1.1 is to be applied.

2. Sub-paragraphs .1, .2 and .3 define access to underdeck structure, access to the uppermost sections of transverse webs and connection between these structures.

3. Sub-paragraphs .4, .5 and .6 define access to vertical structures only and are linked to the presence of transverse webs on longitudinal bulkheads.

4. If there are no underdeck structures (deck longitudinals and deck transverses) but there are vertical structures in the tank supporting transverse and longitudinal bulkheads, access in accordance with sub-paragraphs from .1 through to .6 is to be provided for inspection of the upper parts of vertical structure on transverse and longitudinal bulkheads.

5. If there is no structure in the tank, section 1.1 of Table 1 is not to be applied.

6. The vertical distance below the overhead structure is to be measured from the underside of the main deck plating to the top of the platform of the means of access at a given location.

7. The height of the tank is to be measured at each tank. For a tank the height of which varies at different bays, item 1.1 is to be applied to such bays of a tank that have height 6 m and over.

Technical Background

Interpretation 7: If the height of the tank is increasing along the length of a unit, the permanent means of access is to be provided locally where the height is above 6 m.

Ref.

Paragraph 10 of the annex to MSC/Circ.686.

MODU 1 (cont)

Appendix 1 Unified Interpretation of IMO Resolution 133(76) as applicable for MODUs

Table 1 – Means of access, paragraph 1.1.2

1.1.2 at least one continuous longitudinal permanent means of access at each side of the tank. One of these accesses shall be at a minimum of 1.6 m to a maximum of 6 m below the deck head and the other shall be at a minimum of 1.6 m to a maximum of 3 m below the deck head;

Interpretation

There is need to provide continuous longitudinal permanent means of access when the deck longitudinals and deck transverses are fitted on deck but supporting brackets are fitted under the deck.

MODU 1 (cont)

Appendix 1 Unified Interpretation of IMO Resolution 133(76) as applicable for MODUs

Table 1 – Means of access, paragraph 1.1.3

1.1.3 access between the arrangements specified in .1 and .2 and from the main deck to either .1 or .2.

Interpretation

Means of access to tanks may be used for access to the permanent means of access for inspection.

Technical Background

As a matter of principle, in such a case where the means of access can be utilised for the purpose of accessing structural members for inspection there is no need of duplicated installation of the MA.

MODU 1 (cont)

Appendix 1 Unified Interpretation of IMO Resolution 133(76) as applicable for MODUs

Table 1 – Means of access, paragraph 1.1.4

1.1.4 continuous longitudinal permanent means of access which are integrated in the structural member on the stiffened surface of a longitudinal bulkhead, in alignment, where possible, with horizontal girders of transverse bulkheads are to be provided for access to the transverse webs unless permanent fittings are installed at the uppermost platform for use of alternative means as defined in paragraph 3.9 of the MODU Technical provisions for inspection at intermediate heights;

Interpretation

The permanent fittings required to serve alternative means of access such as wire lift platform, that are to be used by crew and surveyors for inspection shall provide at least an equal level of safety as the permanent means of access stated by the same paragraph. These means of access shall be carried on board the unit and be readily available for use without filling of water in the tank.

Therefore, rafting is not to be acceptable under this provision.

Alternative means of access are to be part of Access Manual which is to be approved on behalf of the flag State.

MODU 1 (cont)

Appendix 1 Unified Interpretation of IMO Resolution 133(76) as applicable for MODUs

Table 1 – Means of access paragraph 2.1

2. Water ballast tanks of less than 5 m width

Access to the underdeck and vertical structure

2.1 For water ballast tanks of less than 5 m width (including *double side spaces above the upper knuckle* point of the bilge hopper sections in surface units), permanent means of access are to be provided in accordance with .1 and .3:

Interpretation

Paragraph 2.1.1 represents requirements for access to underdeck structures, while paragraph 2.1.2 is a requirement for access for survey and inspection of vertical structures on longitudinal bulkheads (transverse webs).

Technical Background

MA or portable means of access are necessary arrangement to facilitate inspection of the structural condition of the space and the boundary structure.

MODU 1 (cont)

Appendix 1 Unified Interpretation of IMO Resolution 133(76) as applicable for MODUs

Table 1 – Means of access, paragraph 2.1.1

2. Water ballast tanks of less than 5 m width

2.1.1 where the vertical distance between horizontal uppermost stringer and deck head is 6 m or more, one continuous permanent means of access shall be provided for the full length of the tank with a means to allow passing through transverse webs installed a minimum of 1.6 m to a maximum of 3 m below the deck head with a vertical access ladder at each end of tank;

Interpretation

1. For a tank, the vertical distance between horizontal upper stringer and deck head of which varies at different sections, item 2.1.1 is to be applied to such sections that fall under the criteria.

2. The continuous permanent means of access may be a wide longitudinal, which provides access to critical details on the opposite side by means of platforms as necessary on web frames. In case the vertical opening of the web frame is located in way of the open part between the wide longitudinal and the longitudinal on the opposite side, platforms shall be provided on both sides of the web frames to allow safe passage through the web frame.

3. Where two access hatches are required by 2009 MODU Code, section 2.2.2.2, access ladders at each end of the tank are to lead to the deck.

Technical Background

Interpretation 1: The interpretation of varied tank height in item 1 of Table 1 is applied to the vertical distance between horizontal upper stringer and deck head for consistency.

MODU 1 (cont)

Appendix 1 Unified Interpretation of IMO Resolution 133(76) as applicable for MODUs

Table 1 – Means of access, paragraph 2.1.2

2.1.2 continuous longitudinal permanent means of access, which are integrated in the structure, at a vertical distance not exceeding 6 m apart; and

Interpretation

The continuous permanent means of access may be a wide longitudinal, which provides access to critical details on the opposite side by means of platforms as necessary on webframes. In case the vertical opening of the web is located in way of the open part between the wide longitudinal and the longitudinal on the opposite side, platforms shall be provided on both sides of the web to allow safe passage through the web.

A "reasonable deviation", as noted in MODU TP, paragraph 1.4, of not more than 10% may be applied where the permanent means of access is integral with the structure itself.

MODU 1 (cont)

Appendix 1 Unified Interpretation of IMO Resolution 133(76) as applicable for MODUs

Table 1 – Means of access, paragraph 2.2

For surface units (ship- or barge-type) and pontoons in column-stabilized units:

2.2 For bilge hopper sections of which the vertical distance from the tank bottom to the upper knuckle point is 6 m and over, one longitudinal permanent means of access shall be provided for the full length of the tank. It shall be accessible by vertical permanent means of access at both ends of the tank.

Interpretation

1. Permanent means of access between the longitudinal continuous permanent means of access and the bottom of the space is to be provided.

2. The height of a bilge hopper tank located outside of the parallel part of the unit is to be taken as the maximum of the clear vertical distance measured from the bottom plating to the hopper plating of the tank.

3. The foremost and aftmost bilge hopper ballast tanks with raised bottom, of which the height is 6 m and over, a combination of transverse and vertical MA for access to the upper knuckle point for each transverse web is to be accepted in place of the longitudinal permanent means of access.

Technical Background

Interpretation 2: The bilge hopper tanks at fore and aft of unit's hull narrow due to raised bottom plating and the actual vertical distance from the bottom of the tank to hopper plating of the tank is more appropriate to judge if a portable means of access could be utilized for the purpose.

Interpretation 3: in the foremost or aftmost bilge hopper tanks where the vertical distance is 6 m or over but installation of longitudinal permanent means of access is not practicable permanent means of access of combination of transverse and vertical ladders provides an alternative means of access to the upper knuckle point.

MODU 1 (cont)

Appendix 1 Unified Interpretation of IMO Resolution 133(76) as applicable for MODUs

Table 1 – Means of access, paragraph 3.1

3.1 Holds

Access to underdeck structure

3.1 For holds under main deck of which the height is 6 m or over, permanent means of access shall be fitted to provide access to the overhead structure at both sides of the cross deck and in the vicinity of the centreline. Each means of access shall be accessible from the hold access or directly from the main deck and installed at a minimum of 1.6 m to a maximum of 3 m below the deck.

Interpretation

1. Means of access shall be provided to the crossdeck structures of the foremost and aftermost part of the each hold.

2. Interconnected means of access under the cross deck for access to three locations at both sides and in the vicinity of the centreline is to be acceptable as the three means of access.

3. Permanent means of access fitted at three separate locations accessible independently, one at each side and one in the vicinity of the centreline is to be acceptable.

4. Special attention is to be paid to the structural strength where any access opening is provided in the main deck or cross deck.

Technical Background

Pragmatic arrangements of the MA are provided.

MODU 1 (cont)

Appendix 1 Unified Interpretation of IMO Resolution 133(76) as applicable for MODUs

Table 1 – Means of access, paragraph 3.3

3.3 Access to the permanent means of access to overhead structure of the cross deck may also be via the uppermost stringer.

Interpretation

Particular attention is to be paid to preserve the structural strength in way of access opening provided in the main deck or cross deck.

MODU 1 (cont)

Appendix 1 Unified Interpretation of IMO Resolution 133(76) as applicable for MODUs

Table 1 – Means of access, paragraph 3.4

3.4 Alternatively, movable means of access as defined in paragraph 3.9 of the MODU Technical provisions may be utilized for access to the overhead structure of cross deck if its vertical distance is 17 m or less above the bottom of the hold.

Interpretation

The movable means of access to the underdeck structure of cross deck need not necessarily be carried on board the unit. It is sufficient if it is made available when needed.

End of Document

РЕКОМЕНДАЦИИ МАКО

IACS RECOMMENDATIONS

No.47 Shipbuilding and Repair Quality Standard

(1996)
(Rev. 1, 1999)
(Rev.2, Dec. 2004)
(Rev.3, Nov. 2006)
(Rev.4, Aug. 2008)
(Rev.5, Oct. 2010)
(Rev.6, May 2012)
(Rev.7, June 2013)

Part A Shipbuilding and Remedial Quality Standard for New Construction

Part B Repair Quality Standard for Existing Ships

PART A - SHIPBUILDING AND REMEDIAL QUALITY STANDARDS FOR NEW CONSTRUCTION

REFERENCES

1. IACS "Bulk Carriers - Guidelines for Surveys, Assessment and Repair of Hull Structure"
2. TSCF "Guidelines for the inspection and maintenance of double hull tanker structures"
3. TSCF "Guidance manual for the inspection and condition assessment of tanker structures"
4. IACS UR W7 "Hull and machinery steel forgings"
5. IACS UR W8 "Hull and machinery steel castings"
6. IACS UR W11 "Normal and higher strength hull structural steel"
7. IACS UR W13 "Thickness tolerances of steel plates and wide flats"
8. IACS UR W14 "Steel plates and wide flats with specified minimum through thickness properties ("Z" quality)"
9. IACS UR W17 "Approval of consumables for welding normal and higher strength hull structural steels"
10. IACS UR W28 "Welding procedure qualification tests of steels for hull construction and marine structures"
11. IACS UR Z10.1 "Hull surveys of oil tankers" and Z10.2 "Hull surveys of bulk carriers" Annex I
12. IACS UR Z23 "Hull survey for new construction"
13. IACS Recommendation No. 12 "Guidelines for surface finish of hot rolled plates and wide flats"
14. IACS Recommendation No. 20 "Non-destructive testing of ship hull steel welds"

1. Scope

It is intended that these standards provide guidance where established and recognized shipbuilding or national standards accepted by the Classification Society do not exist.

1.1 This standard provides guidance on shipbuilding quality standards for the hull structure during new construction and the remedial standard where the quality standard is not met.

Whereas the standard generally applies to

- conventional merchant ship types,
- parts of hull covered by the rules of the Classification Society,
- hull structures constructed from normal and higher strength hull structural steel,

the applicability of the standard is in each case to be agreed upon by the Classification Society.

The standard does generally not apply to the new construction of

- special types of ships as e.g. gas tankers
- structures fabricated from stainless steel or other, special types or grades of steel

1.2 In this standard, both a "Standard" range and a "Limit" range are listed. The "Standard" range represents the target range expected to be met in regular work under normal circumstances. The "Limit" range represents the maximum allowable deviation from the "Standard" range. Work beyond the "Standard" range but within the "Limit" range is acceptable. In cases where no 'limit' value is specified, the value beyond the 'standard' range may be accepted subject to the consideration of the Classification Society.

1.3 The standard covers typical construction methods and gives guidance on quality standards for the most important aspects of such construction. Unless explicitly stated elsewhere in the standard, the level of workmanship reflected herein will in principle be acceptable for primary and secondary structure of conventional designs. A more stringent standard may however be required for critical and highly stressed areas of the hull, and this is to be agreed with the Classification Society in each case. In assessing the criticality of hull structure and structural components, reference is made to ref. 1, 2 and 3.

1.4 Details relevant to structures or fabrication procedures not covered by this standard are to be approved by the Classification Society on the basis of procedure qualifications and/or recognized national standards.

1.5 For use of this standard, fabrication fit-ups, deflections and similar quality attributes are intended to be uniformly distributed about the nominal values. The shipyard is to take corrective action to improve work processes that produce measurements where a skew distribution is evident. Relying upon remedial steps that truncate a skewed distribution of the quality attribute is unacceptable.

2. General requirements for new construction

2.1 In general, the work is to be carried out in accordance with the Classification Society rules and under the supervision of the Surveyor to the Classification Society

2.2 Welding operations are to be carried out in accordance with work instructions accepted by the Classification Society.

2.3 Welding of hull structures is to be carried out by qualified welders, according to approved and qualified welding procedures and with welding consumables approved by the Classification Society, see Section 3. Welding operations are to be carried out under proper supervision by the shipbuilder. The working conditions for welding are to be monitored by the Classification Society in accordance with UR Z23.

3. Qualification of personnel and procedures

3.1 Qualification of welders

3.1.1 Welders are to be qualified in accordance with the procedures of the Classification Society or to a recognized national or international standard. Recognition of other standards is subject to submission to the

Classification Society for evaluation. Subcontractors are to keep records of welders qualification and, when required, furnish valid approval test certificates.

3.1.2 Welding operators using fully mechanized or fully automatic processes need generally not pass approval testing provided that the production welds made by the operators are of the required quality. However, operators are to receive adequate training in setting or programming and operating the equipment. Records of training and operation experience shall be maintained on individual operator's files and records, and be made available to the Classification Society for inspection when requested.

3.2 Qualification of welding procedures

Welding procedures are to be qualified in accordance with URW28 or other recognized standard accepted by the Classification Society.

3.3 Qualification of NDE operators

Personnel performing non-destructive examination for the purpose of assessing quality of welds in connection with new construction covered by this standard, are to be qualified in accordance with Classification Society rules or to a recognized international or national qualification scheme. Records of operators and their current certificates are to be kept and made available to the Surveyor for inspection.

4. Materials

4.1 Materials for Structural Members

All materials, including weld consumables, to be used for the structural members are to be approved by the Classification Society as per the approved construction drawings and meet the respective IACS Unified Requirements. Additional recommendations are contained in the following paragraphs.

All materials used should be manufactured at a works approved by the Classification Society for the type and grade supplied.

4.2 Surface Conditions

4.2.1 Definitions

Minor Imperfections:	Pitting, rolled-in scale, indentations, roll marks, scratches and grooves
Defects:	Cracks, shells, sand patches, sharp edged seams and minor imperfections exceeding the limits of table 1
Depth of Imperfections or defects:	The depth is to be measured from the surface of the product

4.2.2 Acceptance without remedies

Minor imperfections, in accordance with the nominal thickness (t) of the product and the limits described in Table 1, are permissible and may be left as they are.

Imperfection surface area Ratio(%)	15～20%	5～15%	0～5%
t < 20 mm	0.2 mm	0.4 mm	0.5 mm
20 mm ≤ t < 50 mm	0.2 mm	0.6 mm	0.7 mm
50 mm ≤ t	0.2 mm	0.7 mm	0.9 mm

Table 1 Limits for depth of minor imperfection, for acceptance without remedies

Imperfection surface area Ratio (%) is obtained as influenced area / area under consideration (i.e. plate surface area) x 100%.
For isolated surface discontinuities, influenced area is obtained by drawing a continuous line which follows the circumference of the discontinuity at a distance of 20 mm. (Figure 1)
For surface discontinuities appearing in a cluster, influenced area is obtained by drawing a continuous line which follows the circumference of the cluster at a distance of 20 mm. (Figure 2)

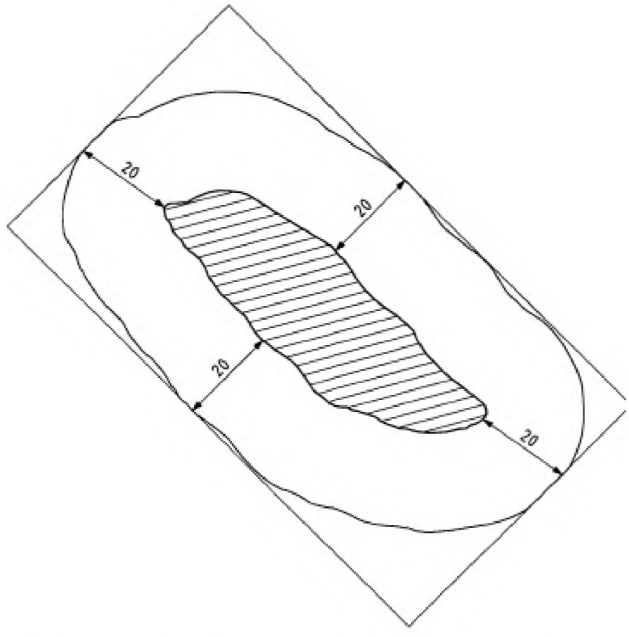


Figure 1 - Determination of the area influenced by an isolated discontinuity
(Ref. Nr. EN 10163-1:2004+AC:2007 E)

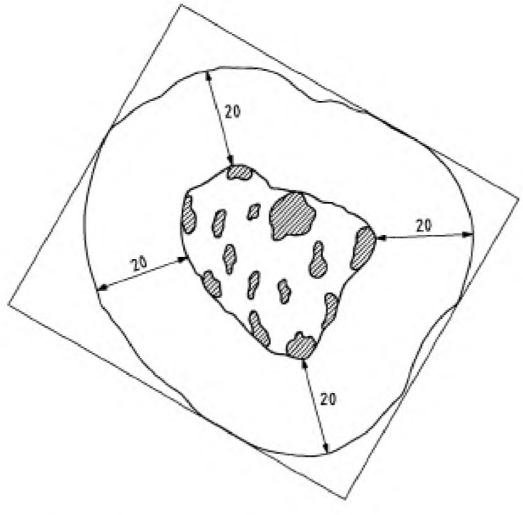


Figure 2 - Determination of the area influenced by clustered discontinuities
(Ref. Nr. EN 10163-1:2004+AC:2007 E)

4.2.3 Remedial of Defects

Defects are to be remedied by grinding and/or welding in accordance with IACS Rec.12.

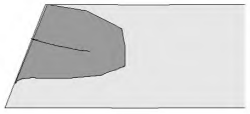
4.2.4 Further Defects

4.2.4.1 Lamination

Investigation to be carried out at the steelmill into the cause and extent of the detected laminations. Severe lamination is to be remedied by local insert plates. The minimum breadth or length of the plate to be replaced is to be:

- 1600 mm for shell and strength deck plating in way of cruciform or T-joints,
- 800 mm for shell, strength deck plating and other primary members,
- 300 mm for other structural members.

Local limited lamination may be remedied by chipping and/or grinding followed by welding in accordance with sketch (a). In case where the local limited lamination is near the plate surface, the remedial may be carried out as shown in sketch (b). For limitations see paragraph 4.2.2.



(a)

(b)

4.2.4.2 Weld Spatters

Loose weld spatters are to be removed by grinding or other measures to clean metal surface (see Table 9.13), as required by the paint system, on:

- shell plating
- deck plating on exposed decks
- in tanks for chemical cargoes
- in tanks for fresh water and for drinking water
- in tanks for lubricating oil, hydraulic oil, including service tanks

5. Gas Cutting

The roughness of the cut edges is to meet the following requirements:

Free Edges:

	Standard	**Limit**
Strength Members	150 μm	300 μm
Others	500 μm	1000 μm

Welding Edges:

	Standard	**Limit**
Strength Members	400 μm	800 μm
Others	800 μm	1500 μm

6. Fabrication and fairness

6.1 Flanged longitudinals and flanged brackets (see Table 6.1)
6.2 Built-up sections (see Table 6.2)

6.3 Corrugated bulkheads (see Table 6.3)
6.4 Pillars, brackets and stiffeners (see Table 6.4)
6.5 Maximum heating temperature on surface for line heating (see Table 6.5)
6.6 Block assembly (see Table 6.6)
6.7 Special sub-assembly (see Table 6.7)
6.8 Shape (see Table 6.8 and 6.9)
6.9 Fairness of plating between frames (see Table 6.10)
6.10 Fairness of plating with frames (see Table 6.11)
6.11 Preheating for welding hull steels at low temperature (See Table 6.12)

7. Alignment

The quality standards for alignment of hull structural components during new construction are shown in Tables 7.1, 7.2 and 7.3. The Classification Society may require a closer construction tolerance in areas requiring special attention, as follows:

- Regions exposed to high stress concentrations
- Fatigue prone areas
- Detail design block erection joints
- High tensile steel regions

8. Welding Joint Details

Edge preparation is to be qualified in accordance with URW28 or other recognized standard accepted by the Classification Society.

Some typical edge preparations are shown in Table 8.1, 8.2, 8.3, 8.4 and 8.6 for reference.

8.1 Typical butt weld plate edge preparation (manual and semi-automatic welding) for reference - see Table 8.1 and 8.2
8.2 Typical fillet weld plate edge preparation (manual and semi-automatic welding) for reference - see Table 8.3 and 8.4
8.3 Butt and fillet weld profile (manual and semi-automatic welding) - see Table 8.5
8.4 Typical butt weld plate edge preparation (Automatic welding) for reference - see Table 8.6
8.5 Distance between welds - see Table 8.7

9. Remedial

All the major remedial work is subject to reporting by shipbuilder to the Classification Society for approval in accordance with their work instruction for new building.

Some typical remedial works are shown in Tables 9.1 to 9.13.

9.1 Typical misalignment remedial - see Tables 9.1 to 9.3
9.2 Typical butt weld plate edge preparation remedial (manual and semi-automatic welding) - see Table 9.4 and 9.5
9.3 Typical fillet weld plate edge preparation remedial (manual and semi-automatic welding) - see Tables 9.6 to 9.8
9.4 Typical fillet and butt weld profile remedial (manual and semi-automatic welding) - see Table 9.9
9.5 Distance between welds remedial - see Table 9.10
9.6 Erroneous hole remedial - see Table 9.11
9.7 Remedial by insert plate - see Table 9.12
9.8 Weld surface remedial - see Table 9.13
9.9 Weld remedial (short bead) - see Table 9.14

TABLE 6.1 – Flanged Longitudinals and Flanged Brackets

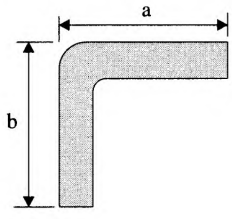
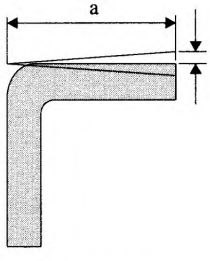
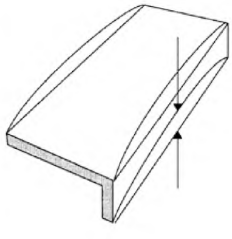
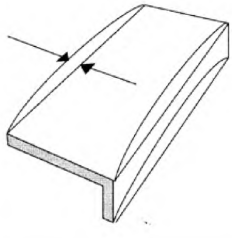
Detail	Standard	Limit	Remarks
Breadth of flange  compared to correct size	± 3 mm	± 5 mm	
Angle between flange and web  compared to template	± 3 mm	± 5 mm	per 100 mm of a
Straightness in plane of flange and web  	± 10 mm	± 25 mm	per 10 m

TABLE 6.2 – Built Up Sections

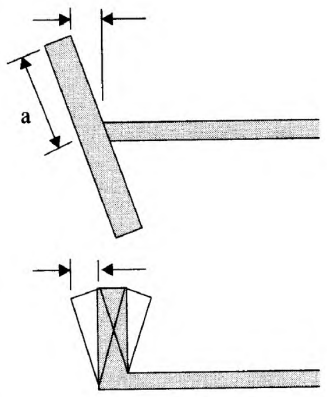
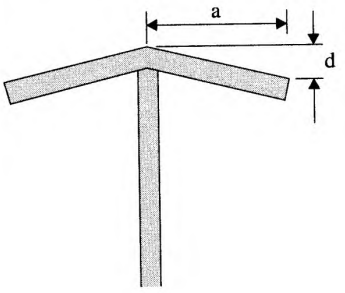
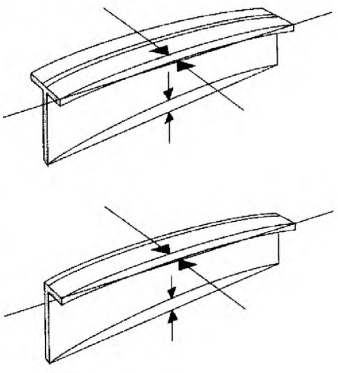
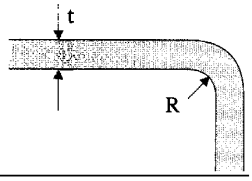
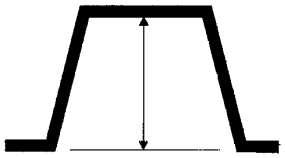
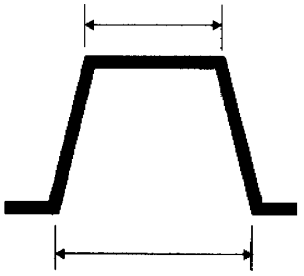
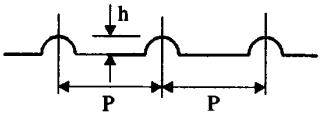
Detail	Standard	Limit	Remarks
Frames and longitudinal 	± 1.5 mm	± 3 mm	per 100 mm of a
Distortion of face plate 	$d \leq 3 + a/100$ mm	$d \leq 5 + a/100$ mm	
Distortion in plane of web and flange of built up longitudinal frame, transverse frame, girder and transverse web. 	± 10 mm	± 25 mm	per 10 m in length

TABLE 6.3 – Corrugated Bulkheads

Detail	Standard	Limit	Remarks
Mechanical bending 	R ≥ 3t mm R ≥ 4.5t mm for CSR ships [Note 1]	2t mm [Note 2]	Material to be suitable for cold flanging (forming) and welding in way of radius
Depth of corrugation 	± 3 mm	± 6 mm	
Breadth of corrugation 	± 3 mm	± 6 mm	
Pitch and depth of swedged corrugated bulkhead compared with correct value 	h : ± 2.5 mm Where it is not aligned with other bulkheads P : ± 6 mm Where it is aligned with other bulkheads P : ± 2 mm	h : ± 5 mm Where it is not aligned with other bulkheads P : ± 9 mm Where it is aligned with other bulkheads P : ± 3 mm	

Notes:

1. For CSR Bulk Carriers built under the "Common Structural Rules for Bulk Carriers" with the effective dates of 1 July 2010 and 1 July 2012, the standard is R≥2t mm.
2. For CSR ships, the allowable inside bending radius of cold formed plating may be reduced provided the following requirements are complied with.

When the inside bending radius is reduced below 4.5 times the as-built plate thickness, supporting data is to be provided. The bending radius is in no case to be less than 2 times the as-built plate thickness. As a minimum, the following additional requirements are to be complied with:

a) For all bent plates:

- 100% visual inspection of the bent area is to be carried out.
- Random checks by magnetic particle testing are to be carried out.

b) In addition to a), for corrugated bulkheads subject to lateral liquid pressure:

- The steel is to be of Grade D/DH or higher.

The material is impact tested in the strain-aged condition and satisfies the requirements stated herein. The deformation is to be equal to the maximum deformation to be applied during production, calculated by the formula $t_{as\text{-}built} /(2r_{bdg} + t_{as\text{-}built})$, where $t_{as\text{-}built}$ is the as-built thickness of the plate material and r_{bdg} is the bending radius. One sample is to be plastically strained at the calculated deformation or 5%, whichever is greater and then artificially aged at 250°C for one hour then subject to Charpy V-notch testing. The average impact energy after strain ageing is to meet the impact requirements specified for the grade of steel used.

TABLE 6.4 – Pillars, Brackets and Stiffeners

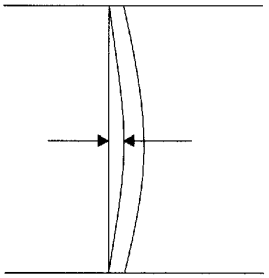
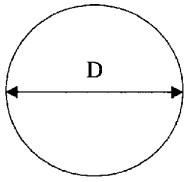
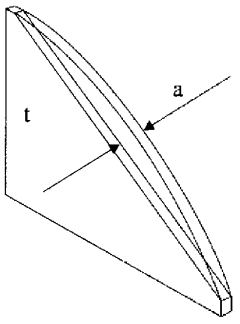
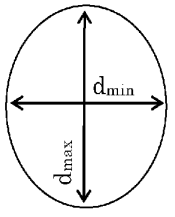
Detail	Standard	Limit	Remarks
Pillar (between decks) 	4 mm	6 mm	
Cylindrical structure diameter (pillars, masts, posts, etc.) 	± D/200 mm max. + 5 mm	± D/150 mm max. 7.5 mm	
Tripping bracket and small stiffener, distortion at the part of free edge 	a ≤ t/2 mm	t	
Ovality of cylindrical structure 		$d_{max} - d_{min} \leq 0.02 \times d_{max}$	

TABLE 6.5 – Maximum Heating Temperature on Surface for Line Heating

Item		Standard	Limit	Remarks
Conventional Process AH32-EH32 & AH36-EH36	Water cooling just after heating	Under 650°C		
TMCP type AH36-EH36 (Ceq.>0.38%)	Air cooling after heating	Under 900°C		
	Air cooling and subsequent water cooling after heating	Under 900°C (starting temperature of water cooling to be under 500°C)		
TMCP type AH32-DH32 & AH36-DH36 (Ceq. ≤ 0.38%)	Water cooling just after heating or air cooling	Under 1000°C		
TMCP type EH32 & EH36 (Ceq. ≤ 0.38%)	Water cooling just after heating or air cooling	Under 900°C		

NOTE:

$$Ceq = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15} (\%)$$

TABLE 6.6 – Block Assembly

Item	Standard	Limit	Remarks
Flat Plate Assembly			
Length and Breadth	± 4 mm	± 6 mm	
Distortion	± 10 mm	±20mm	
Squareness	± 5 mm	±10mm	
Deviation of interior members from plate	5 mm	10mm	
Curved plate assembly			
Length and Breadth	± 4 mm	± 8 mm	measured along the girth
Distortion	± 10 mm	± 20 mm	
Squareness	± 10 mm	± 15 mm	
Deviation of interior members from plate	5 mm	10 mm	
Flat cubic assembly			
Length and Breadth	± 4 mm	± 6 mm	
Distortion	± 10 mm	± 20 mm	
Squareness	± 5 mm	± 10 mm	
Deviation of interior members from plate	5 mm	10 mm	
Twist	± 10 mm	± 20 mm	
Deviation between upper and lower plate	± 5 mm	± 10 mm	
Curved cubic assembly			
Length and Breadth	± 4 mm	± 8 mm	measured along with girth
Distortion	± 10 mm	± 20 mm	
Squareness	± 10 mm	± 15 mm	
Deviation of interior members from plate	± 5 mm	± 10 mm	
Twist	± 15 mm	± 25 mm	
Deviation between upper and lower plate	± 7 mm	± 15 mm	

TABLE 6.7 – Special Sub-Assembly

Item	Standard	Limit	Remarks
Distance between upper/lower gudgeon	± 5 mm	± 10 mm	
Distance between aft edge of boss and aft peak bulkhead	± 5 mm	± 10 mm	
Twist of sub-assembly of stern frame	5 mm	10 mm	
Deviation of rudder from shaft center line	4 mm	8 mm	
Twist of rudder plate	6 mm	10 mm	
Flatness of top plate of main engine bed	5 mm	10 mm	
Breadth and length of top plate of main engine bed	± 4 mm	± 6 mm	

NOTE:

Dimensions and tolerances have to fulfill engine and equipment manufacturers' requirements, if any.

TABLE 6.8 – Shape

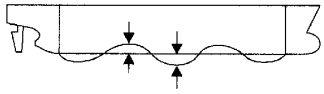
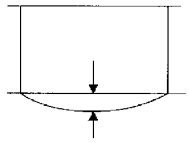
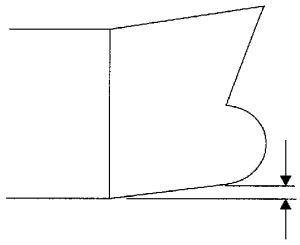
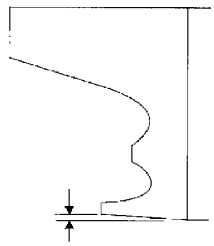
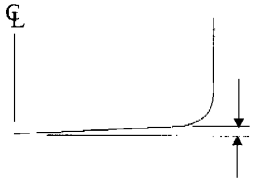
Detail	Standard	Limit	Remarks
Deformation for the whole length 	± 50 mm		per 100 m against the line of keel sighting
Deformation for the distance between two adjacent bulkheads 	± 15 mm		
Cocking-up of fore body 	± 30 mm		The deviation is to be measured from the design line.
Cocking-up of aft-body 	± 20 mm		
Rise of floor amidships 	± 15 mm		The deviation is to be measured from the design line.

TABLE 6.9 – Shape

Item	Standard	Limit	Remarks
Length between perpendiculars	±L/1000 mm where L is in mm		Applied to ships of 100 metre length and above. For the convenience of the measurement the point where the keel is connected to the curve of the stem may be substituted for the fore perpendicular in the measurement of the length.
Moulded breadth at midship	±B/1000 mm where B is in mm		Applied to ships of 15 metre breadth and above, measured on the upper deck.
Moulded depth at midship	±D/1000 mm where D is in mm		Applied to ships of 10 metre depth and above, measured up to the upper deck.

TABLE 6.10 – Fairness of Plating Between Frames

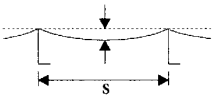
Item		Standard	Limit	Remarks
Shell plate	Parallel part (side & bottom shell)	4 mm	8 mm	
	Fore and aft part	5 mm		
Tank top plate		4 mm		
Bulkhead	Longl. Bulkhead Trans. Bulkhead Swash Bulkhead	6 mm		
Strength deck	Parallel part	4 mm	8 mm	
	Fore and aft part	6 mm	9 mm	
	Covered part	7 mm	9 mm	
Second deck	Bare part	6 mm	8 mm	
	Covered part	7 mm	9 mm	
Forecastle deck poop deck	Bare part	4 mm	8 mm	
	Covered part	6 mm	9 mm	
Super structure deck	Bare part	4 mm	6 mm	
	Covered part	7 mm	9 mm	
House wall	Outside wall	4 mm	6 mm	
	Inside wall	6 mm	8 mm	
	Covered part	7 mm	9 mm	
Interior member (web of girder, etc)		5 mm	7 mm	
Floor and girder in double bottom		5 mm	8 mm	

TABLE 6.11 – Fairness of Plating with Frames

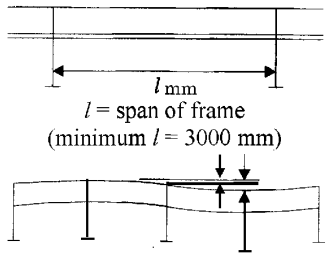
Item		Standard	Limit	Remarks
Shell plate	Parallel part	±2 *l* /1000 mm	±3 *l* /1000 mm	*l* = span of frame (mm) To be measured between on trans. space (min. *l* = 3000 mm)
	Fore and aft part	±3 *l* /1000 mm	±4 *l* /1000 mm	
Strength deck (excluding cross deck) and top plate of double bottom	-	±3 *l* /1000 mm	±4 *l* /1000 mm	
Bulkhead	-		±5 *l* /1000 mm	
Accommodation above the strength deck and others	-	±5 *l* /1000 mm	±6 *l* /1000 mm	
 To be measured between one trans. space.				

TABLE 6.12 – Preheating for welding hull steels at low temperature

Item		Standard		Limit	Remarks
		Base metal temperature needed preheating	Minimum preheating temperature		
Normal strength steels	A, B, D, E	Below -5 °C	20 °C [1)]		
Higher strength steels (TMCP type)	AH32 – EH32 AH36 – EH36	Below 0 °C			
Higher strength steels (Conventional type)		Below 0 °C			

(Note)
1) This level of preheat is to be applied unless the approved welding procedure specifies a higher level.

TABLE 7.1 – Alignment

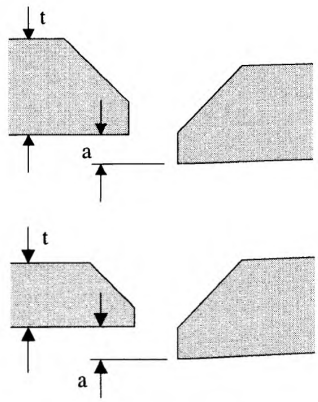
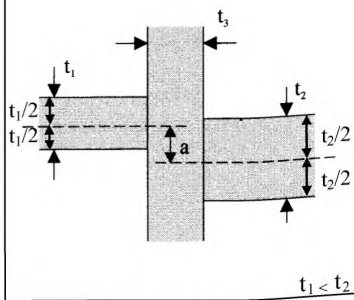
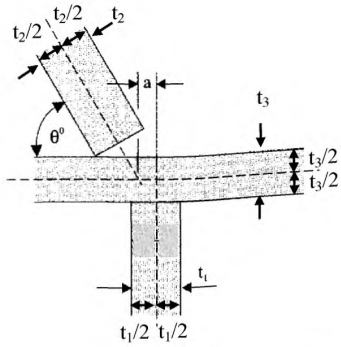
Detail	Standard	Limit	Remarks
Alignment of butt welds 		a ≤ 0.15t strength member a ≤ 0.2t other but maximum 4.0 mm	t is the lesser plate thickness
Alignment of fillet welds  $t_1 < t_2$		Strength member and higher stress member: $a \le t_1/3$ Other: $a \le t_1/2$	Alternatively, heel line can be used to check the alignment. Where t_3 is less than t_1, then t_3 should be substituted for t_1 in the standard.
Alignment of fillet welds 		Strength member and higher stress member: $a \le t_1/3$ Other: $a \le t_1/2$	Alternatively, heel line can be used to check the alignment. Where t_3 is less than t_1, then t_3 should be substitute for t_1 in the standard.

TABLE 7.2 – Alignment

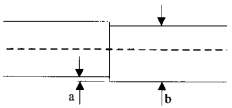
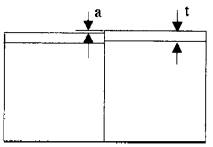
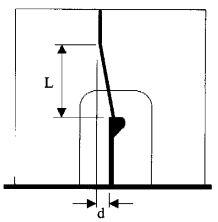
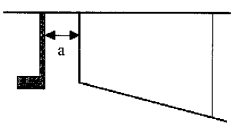
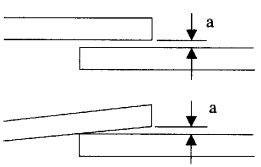
Detail	Standard	Limit	Remarks
Alignment of flange of T-longitudinal  b (mm)	Strength member a ≤ 0.04b (mm)	a = 8.0 mm	
Alignment of height of T-bar, L-angle bar or bulb  	Strength member a ≤ 0.15t Other a ≤ 0.20t	a = 3.0 mm	
Alignment of panel stiffener  	d ≤ L/50		
Gap between bracket/intercostal and stiffener  	a ≤ 2.0 mm	a = 3.0 mm	
Alignment of lap welds  	a ≤ 2.0 mm	a = 3.0 mm	

TABLE 7.3 – Alignment

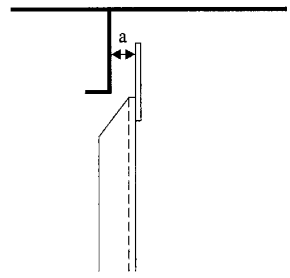
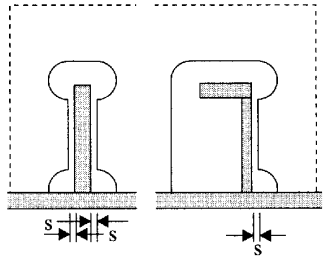
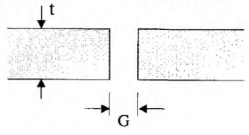
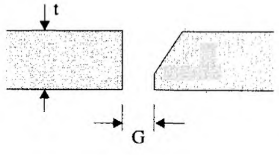
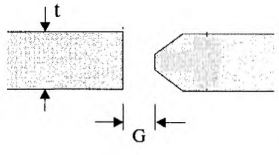
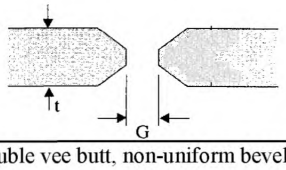
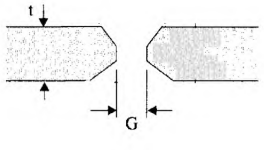
Detail	Standard	Limit	Remarks
Gap between beam and frame 	a ≤ 2.0 mm	a = 5.0 mm	
Gap around stiffener cut-out 	s ≤ 2.0 mm	s = 3.0 mm	

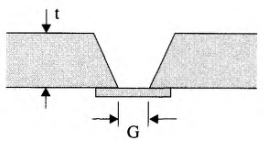
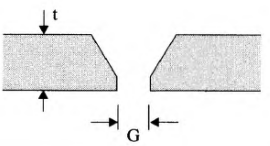
TABLE 8.1 – Typical Butt Weld Plate Edge Preparation (Manual Welding and Semi-Automatic Welding) for Reference

Detail	Standard	Limit	Remarks
Square butt $t \leq 5$ mm 	$G \leq 3$ mm	$G = 5$ mm	see Note 1
Single bevel butt $t > 5$ mm 	$G \leq 3$ mm	$G = 5$ mm	see Note 1
Double bevel butt $t > 19$ mm 	$G \leq 3$ mm	$G = 5$ mm	see Note 1
Double vee butt, uniform bevels 	$G \leq 3$ mm	$G = 5$ mm	see Note 1
Double vee butt, non-uniform bevel 	$G \leq 3$ mm	$G = 5$ mm	see Note 1

NOTE 1

Different plate edge preparation may be accepted or approved by the Classification Society in accordance with URW28 or other recognized standard accepted by the Classification Society.
For welding procedures other than manual welding, see paragraph 3.2 Qualification of weld procedures.

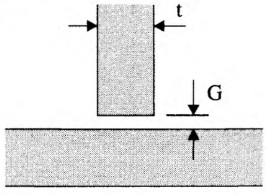
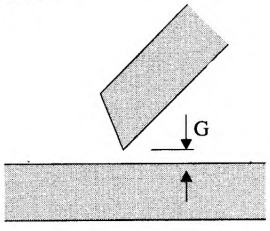
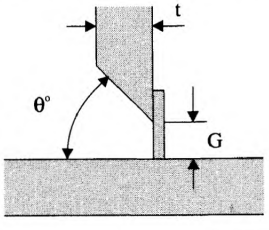
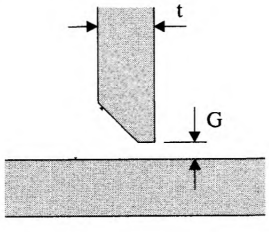
TABLE 8.2 – Typical Butt Weld Plate Edge Preparation (Manual Welding and Semi-Automatic Welding) for Reference

Detail	Standard	Limit	Remarks
Single Vee butt, one side welding with backing strip (temporary or permanent) 	G = 3 to 9 mm	G = 16 mm	see Note 1
Single vee butt 	G ≤ 3 mm	G = 5 mm	see Note 1

NOTE 1

Different plate edge preparation may be accepted or approved by the Classification Society in accordance with URW28 or other recognized standard accepted by the Classification Society.
For welding procedures other than manual welding, see paragraph 3.2 Qualification of welding procedures.

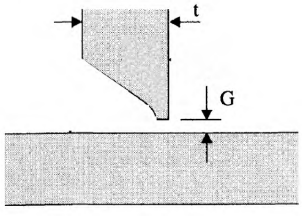
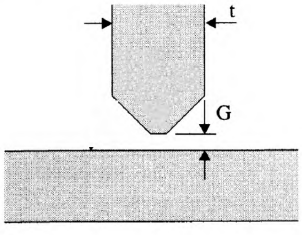
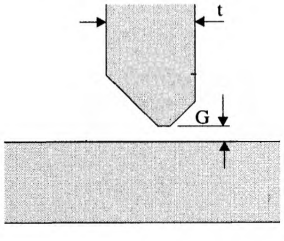
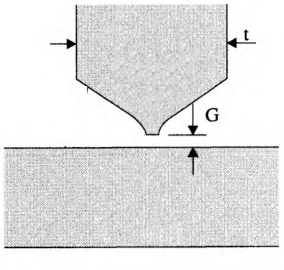
Table 8.3 – Typical Fillet Weld Plate Edge Preparation (Manual Welding and Semi-Automatic Welding) for Reference

Detail	Standard	Limit	Remarks
Tee Fillet 	G ≤ 2 mm	G = 3 mm	see Note 1
Inclined fillet 	G ≤ 2 mm	G = 3 mm	see Note 1
Single bevel tee with permanent backing 	G ≤ 4 to 6 mm θ° = 30° to 45°	G = 16 mm	Not normally for strength member also see Note 1
Single bevel tee 	G ≤ 3 mm		see Note 1

NOTE 1

Different plate edge preparation may be accepted or approved by the Classification Society in accordance with URW28 or other recognized standard accepted by the Classification Society.
For welding procedures other than manual welding, see paragraph 3.2 Qualification of welding procedures.

Table 8.4 – Typical Fillet Weld Plate Edge Preparation (Manual Welding and Semi-Automatic Welding) for Reference

Detail	Standard	Limit	Remarks
Single 'J' bevel tee 	G = 2.5 to 4 mm		see Note 1
Double bevel tee symmetrical t > 19 mm 	G ≤ 3 mm		see Note 1
Double bevel tee asymmetrical t > 19 mm 	G ≤ 3 mm		see Note 1
Double 'J' bevel tee symmetrical 	G = 2.5 to 4 mm		see Note 1

NOTE 1
Different plate edge preparation may be accepted or approved by the Classification Society in accordance with URW28 or other recognized standard accepted by the Classification Society.
For welding procedures other than manual welding, see paragraph 3.2 Qualification of welding procedures.

Table 8.5 – Butt And Fillet Weld Profile (Manual Welding and Semi-Automatic Welding)

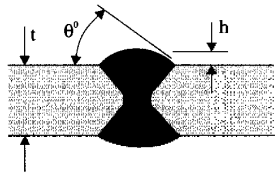
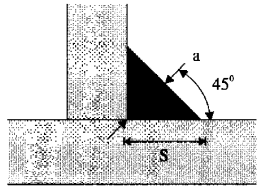
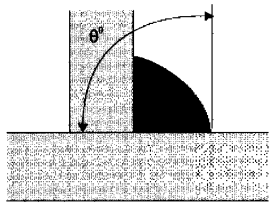
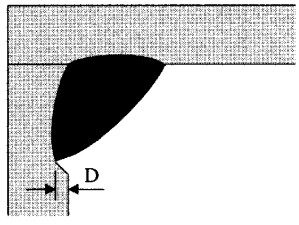
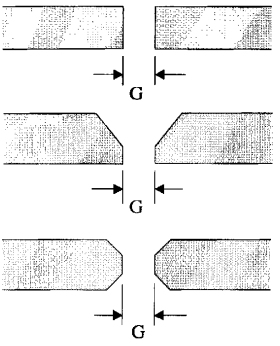
Detail	Standard	Limit	Remarks
Butt weld toe angle 	θ ≤ 60° h ≤ 6 mm	θ ≤ 90°	
Butt weld undercut 		D ≤ 0.5 mm for strength member D ≤ 0.8 mm for other	
Fillet weld leg length  s = leg length; a = throat thickness		$s \geq 0.9s_d$ $a \geq 0.9a_d$ over short weld lengths	s_d = design s a_d = design a
Fillet weld toe angle 		θ ≤ 90°	In areas of stress concentration and fatigue, the Classification Society may require a lesser angle.
Fillet weld undercut 		D ≤ 0.8 mm	

Table 8.6 – Typical Butt Weld Plate Edge Preparation (Automatic welding) for Reference

Detail	Standard	Limit	Remarks
Submerged Arc Welding (SAW)  	$0 \leq G \leq 0.8$ mm	G = 2 mm	See Note 1.

NOTE 1

Different plate edge preparation may be accepted or approved by the Classification Society in accordance with URW28 or other recognized standard accepted by the Classification Society.
For welding procedures other than manual welding, see paragraph 3.2 Qualification of welding procedures.

Table 8.7 – Distance Between Welds

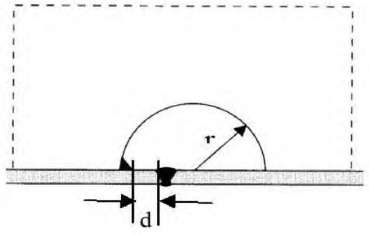
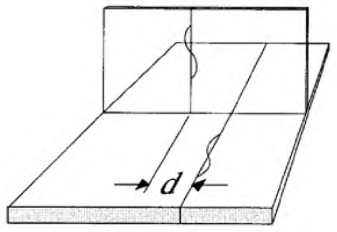
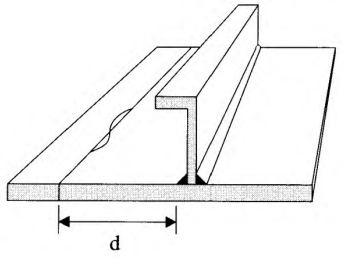
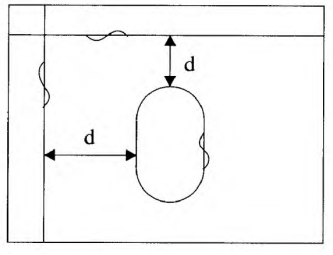
Detail	Standard	Limit	Remarks
Scallops over weld seams 		for strength member d ≥ 5mm for other d ≥ 0mm	The "d" is to be measured from the toe of the fillet weld to the toe of the butt weld.
Distance between two butt welds 		d ≥ 0 mm	
Distance between butt weld and fillet weld 		for strength member d ≥ 10 mm for other d ≥ 0 mm	The "d" is to be measured from the toe of the fillet weld to the toe of the butt weld.
Distance between butt welds 	for cut-outs d ≥ 30 mm		
	for margin plates d ≥ 300 mm	150 mm	

Table 9.1 – Typical Misalignment Remedial

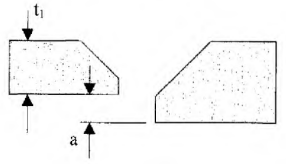
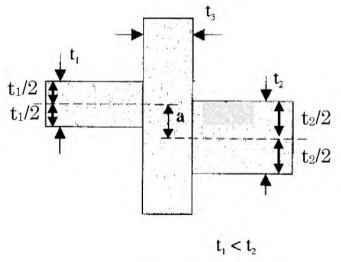
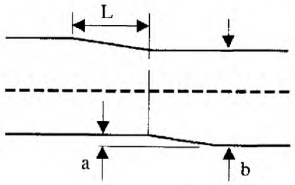
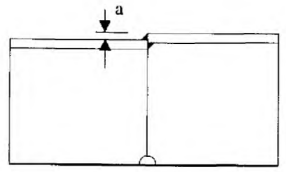
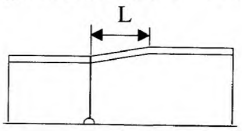
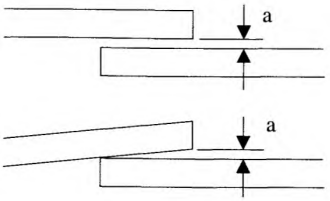
Detail	Remedial Standard	Remarks
Alignment of butt joints 	Strength member $a > 0.15t_1$ or $a > 4$ mm release and adjust Other $a > 0.2t_1$ or $a > 4$ mm release and adjust	t_1 is lesser plate thickness
Alignment of fillet welds 	Strength member and higher stress member $t_1/3 < a \leq t_1/2$ - generally increase weld throat by 10% $a > t_1/2$ - release and adjust over a minimum of 50a Other $a > t_1/2$ - release and adjust over a minimum of 30a	Alternatively, heel line can be used to check the alignment. Where t_3 is less than t_1 then t_3 should be substituted for t_1 in standard
Alignment of flange of T-longitudinal 	When $0.04b < a \leq 0.08b$, max 8 mm: grind corners to smooth taper over a minimum distance L = 3a When $a > 0.08b$ or 8 mm: release and adjust over a minimum distance L = 50a	
Alignment of height of T-bar, L-angle bar or bulb 	When 3 mm < a ≤ 6 mm: build up by welding When a > 6 mm: release and adjust over minimum L = 50a for strength member and L = 30a for other 	
Alignment of lap welds 	3 mm < a ≤ 5 mm: weld leg length to be increased by the same amount as increase in gap in excess of 3 mm a > 5 mm: members to be re-aligned	

Table 9.2 – Typical Misalignment Remedial

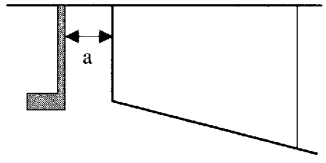
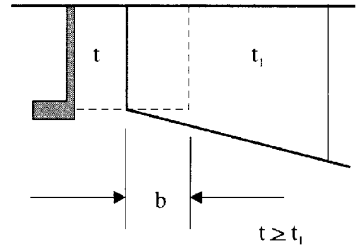
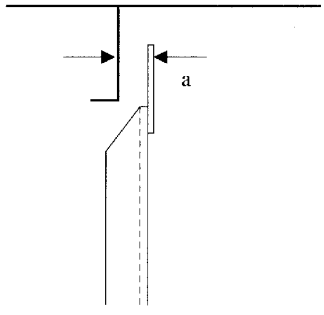
Detail	Remedial Standard	Remarks
Gap between bracket/intercostal and stiffener 	When 3 mm < a ≤ 5 mm: weld leg length to be increased by increase in gap in excess of 3 mm	
	When 5mm < a ≤ 10 mm: chamfer 30° to 40° and build up by welding with backing	
	When a > 10 mm: increase gap to about 50 mm and fit collar plate  b = (2t + 25) mm, min. 50 mm	
Gap between beam and frame 	3 mm < a ≤ 5 mm: weld leg length to be increased by the same amount as increase in gap in excess of 3 mm a > 5 mm release and adjust	

TABLE 9.3 – Misalignment Remedial

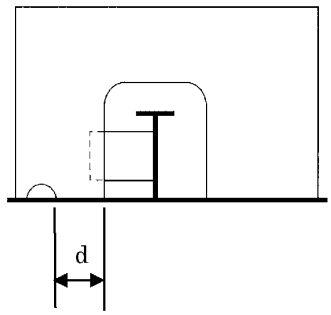
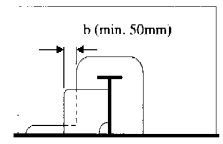
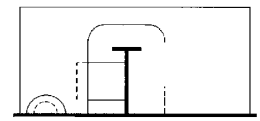
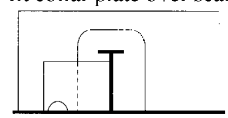
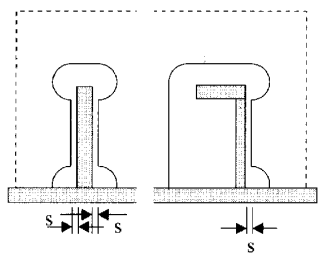
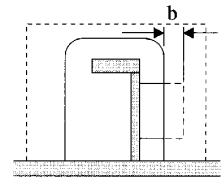
Detail	Remedial standard	Remarks
Position of scallop 	When d < 75 mm web plate to be cut between scallop and slot, and collar plate to be fitted  Or fit small collar over scallop  Or fit collar plate over scallop 	
Gap around stiffener cut-out 	When 3 mm < s ≤ 5 mm weld leg length to be increased by the same amount as increase in gap in excess of 2 mm	
	When 5 mm < s ≤ 10 mm nib to be chamfered and built up by welding	
	When s > 10 mm cut off nib and fit collar plate of same height as nib  20 mm ≤ b ≤ 50 mm	

TABLE 9.4 – Typical Butt Weld Plate Edge Preparation Remedial (Manual Welding and Semi-Automatic Welding)

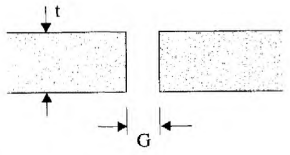
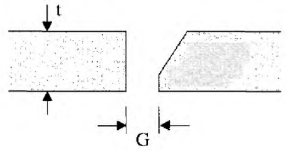
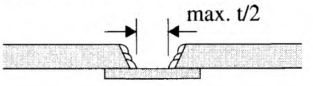
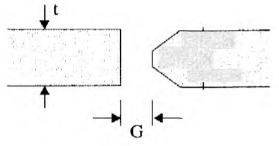
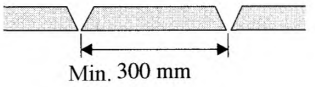
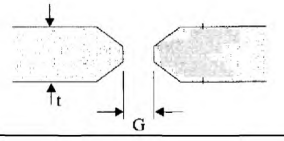
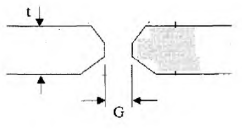
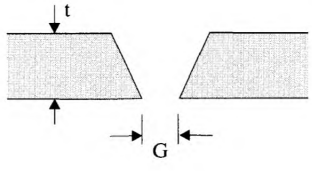
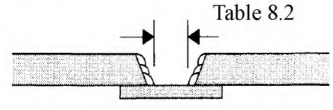
Detail	Remedial standard	Remarks
Square butt 	When G ≤ 10 mm chamfer to 45° and build up by welding When G > 10mm build up with backing strip; remove, back gouge and seal weld; or, insert plate, min. width 300 mm	
Single bevel butt 	When 5 mm < G ≤ 1.5t (maximum 25 mm) build up gap with welding on one or both edges to maximum of 0.5t, using backing strip, if necessary. Where a backing strip is used, the backing strip is to be removed, the weld back gouged, and a sealing weld made. 	
Double bevel butt 	Different welding arrangement by using backing material approved by the Classification Society may be accepted on the basis of an appropriate welding procedure specification. When G > 25 mm or 1.5t, whichever is smaller, use insert plate, of minimum width 300 mm 	
Double vee butt, uniform bevels 		
Double vee butt, non-uniform bevel 		

TABLE 9.5 – Typical Butt Weld Plate Edge Preparation Remedial (Manual Welding and Semi-Automatic Welding)

<table>
<tr><th>Detail</th><th>Remedial Standard</th><th>Remarks</th></tr>
<tr><td>Single vee butt, one side welding
 
</td><td rowspan="2">When 5 mm < G ≤ 1.5t mm (maximum 25 mm), build up gap with welding on one or both edges, to “Limit” gap size preferably to “Standard” gap size as described in Table 8.2.

Where a backing strip is used, the backing strip is to be removed, the weld back gouged, and a sealing weld made.

Different welding arrangement by using backing material approved by the Classification Society may be accepted on the basis of an appropriate welding procedure specification.
Limits see Table 8.2
 

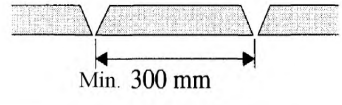
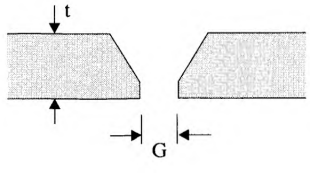
When G > 25 mm or 1.5t, whichever is smaller, use insert plate of minimum width 300 mm.
 
</td><td rowspan="2"></td></tr>
<tr><td>Single vee butt
 
</td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

TABLE 9.6 – Typical Fillet Weld Plate Edge Preparation Remedial (Manual Welding and Semi-Automatic Welding)

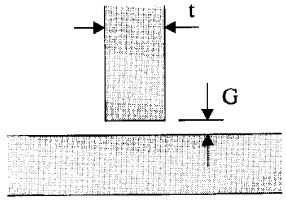
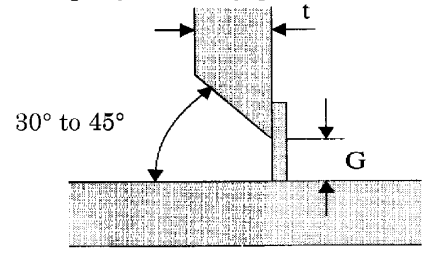
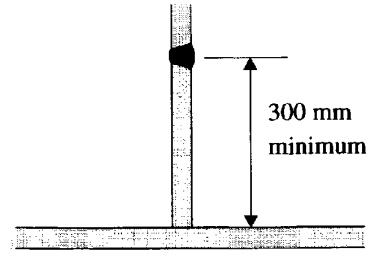
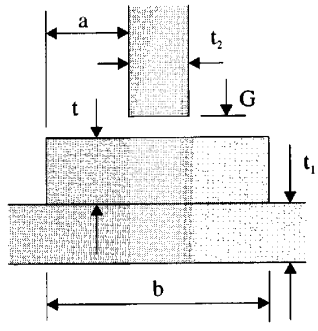
Detail	Remedial standard	Remarks
Tee Fillet 	3 mm < G ≤ 5 mm – leg length increased to Rule leg + (G-2)	
	5 mm < G ≤ 16 mm or G ≤ 1.5t - chamfer by 30° to 45°, build up with welding, on one side, with backing strip if necessary, grind and weld. 	
	G > 16 mm or G > 1.5t use insert plate of minimum width 300 mm 	
Liner treatment 	$t_2 \leq t \leq t_1$ G ≤ 2 mm a = 5 mm + fillet leg length	Not to be used in cargo area or areas of tensile stress through the thickness of the liner

TABLE 9.7 – Typical Fillet Weld Plate Edge Preparation Remedial (Manual Welding and Semi-Automatic Welding)

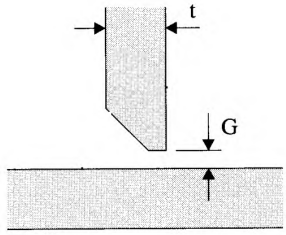
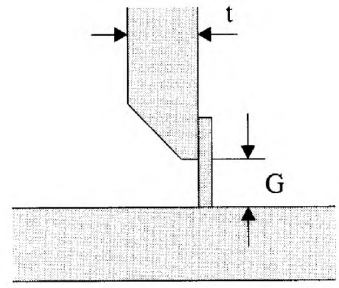
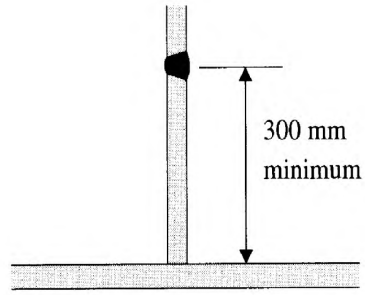
Detail	Remedial standard	Remarks
Single bevel tee 	3 mm < G ≤ 5 mm build up weld	
	5 mm < G ≤ 16 mm - build up with welding, with backing strip if necessary, remove backing strip if used, back gouge and back weld. 	
	G > 16 mm new plate to be inserted of minimum width 300 mm 	

TABLE 9.8 – Typical Fillet Weld Plate Edge Preparation Remedial (Manual Welding and Semi-Automatic Welding)

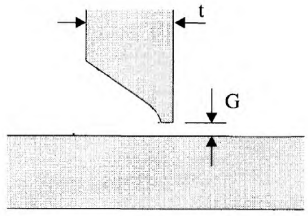
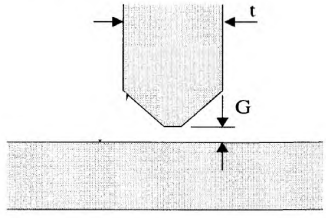
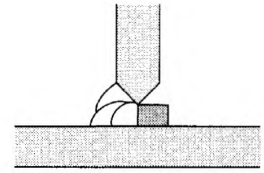
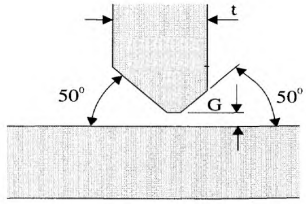
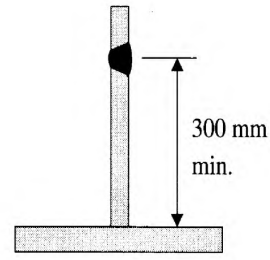
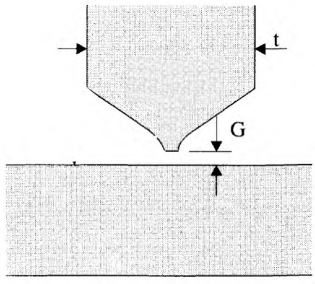
Detail	Remedial standard	Remarks
Single 'J' bevel tee 	as single bevel tee	
Double bevel tee symmetrical 	When 5 mm < G ≤ 16 mm build up with welding using ceramic or other approved backing bar, remove, back gouge and back weld. 	
Double bevel tee asymmetrical 	When G > 16 mm-insert plate of minimum height 300 mm to be fitted. 	
Double 'J' bevel symmetrical 		

TABLE 9.9 – Typical Fillet and Butt Weld Profile Remedial (Manual Welding and Semi-Automatic Welding)

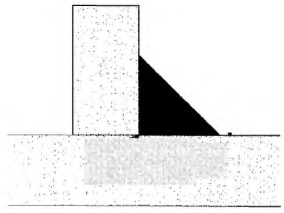
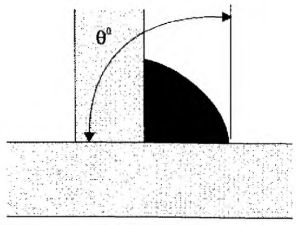
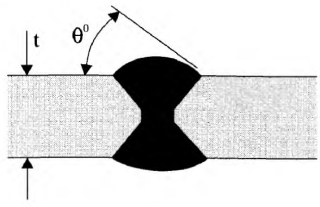
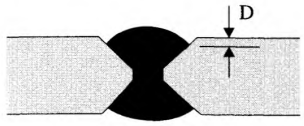
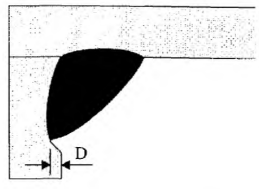
Detail	Remedial standard	Remarks
Fillet weld leg length 	Increase leg or throat by welding over	Minimum short bead to be referred Table 9.14
Fillet weld toe angle 	$\theta > 90°$ grinding, and welding, where necessary, to make $\theta \leq 90°$	
Butt weld toe angle 	$\theta > 90°$ grinding, and welding, where necessary, to make $\theta \leq 90°$	
Butt weld undercut 	For strength member, where $0.5 < D \leq 1$ mm, and for other, where $0.8 < D \leq 1$ mm, undercut to be ground smooth (localized only) or to be filled by welding Where D > 1 mm undercut to be filled by welding	
Fillet weld undercut 	Where $0.8 < D \leq 1$ mm undercut to be ground smooth (localized only) or to be filled by welding Where D > 1 mm undercut to be filled by welding	

TABLE 9.10 – Distance Between Welds Remedial

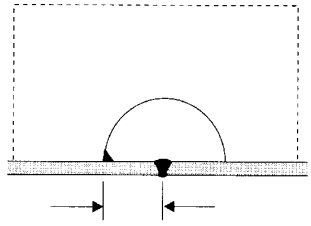
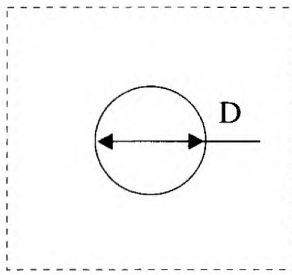
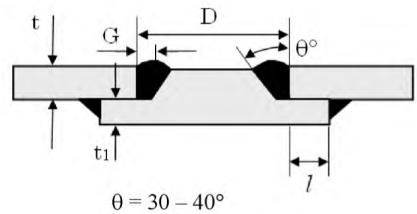
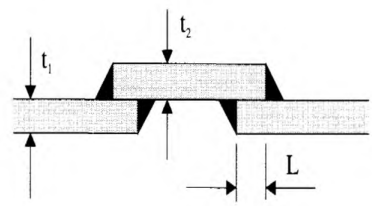
Detail	Remedial standard	Remarks
Scallops over weld seams 	Hole to be cut and ground smooth to obtain distance	

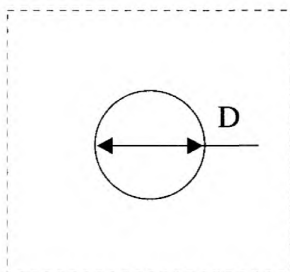
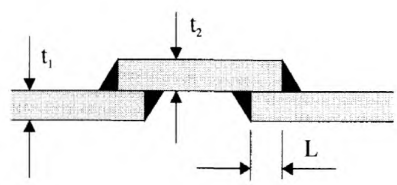
TABLE 9.11 – Erroneous Hole Remedial

<table>
<tr><th>Detail</th><th>Remedial standard</th><th>Remarks</th></tr>
<tr><td rowspan="2">Holes made erroneously D < 200 mm
 
</td><td>Strength member
open hole to minimum 75 mm dia.,
fit and weld spigot piece
 

θ = 30 – 40°
G = 4 – 6 mm
1/2t ≤ t1 ≤ t
l = 50 mm
Or
open hole to over 300 mm and fit insert plate</td><td rowspan="2">Fillet weld to be made after butt weld

The fitting of spigot pieces in areas of high stress concentration or fatigue is to be approved by the Classification Society.</td></tr>
<tr><td>Other
open hole to over 300 mm and fit insert plate

Or fit lap plate
 

t1 = t2 L = 50 mm, min</td></tr>
<tr><td>Holes made erroneously D ≥ 200 mm
 
</td><td>Strength member
open hole and fit insert plate</td><td rowspan="2"></td></tr>
<tr><td>Other
open hole to over 300 mm and fit insert plate
Or fit lap plate
 

t1 = t2 L = 50 mm, min</td></tr>
</table>

TABLE 9.12 – Remedial by Insert Plate

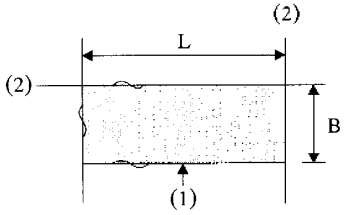
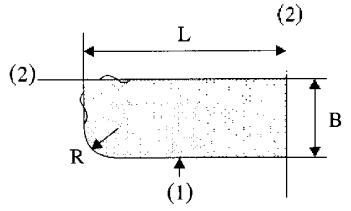
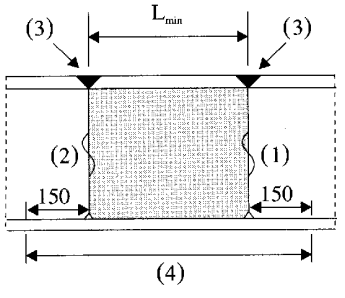
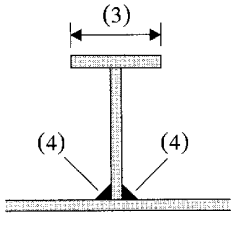
Detail	Remedial standard	Remarks
Remedial by insert plate   	L = 300 mm minimum B = 300 mm minimum R = 5t mm 100mm minimum (1) seam with insert piece is to be welded first (2) original seam is to be released and welded over for a minimum of 100 mm.	
Remedial of built section by insert plate   	$L_{min} \geq 300$ mm Welding sequence (1) →(2) →(3) →(4) Web butt weld scallop to be filled during final pass (4)	

TABLE 9.13 – Weld Surface Remedial

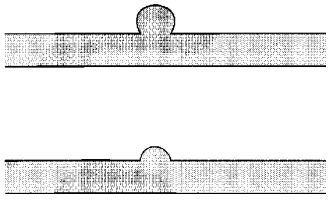
Detail	Remedial standard	Remarks
Weld spatter 	1. Remove spatter observed before blasting with scraper or chipping hammer, etc. 2. For spatter observed after blasting: a) Remove with a chipping hammer, scraper, etc. b) For spatter not easily removed with a chipping hammer, scraper, etc., grind the sharp angle of spatter to make it obtuse.	In principle, no grinding is applied to weld surface.
Arc strike (HT steel, Cast steel, Grade E of mild steel, TMCP type HT steel, Low temp steel)	Remove the hardened zone by grinding or other measures such as overlapped weld bead etc.	Minimum short bead to be referred Table 9.14

TABLE 9.14 – Welding Remedial by Short Bead

Detail	Remedial standard	Remarks
Short bead for remedying scar (scratch)	a) HT steel, Cast steel, TMCP type HT steel (Ceq > 0.36%) and Low temp steel (Ceq > 0.36%) Length of short bead ≥ 50 mm b) Grade E of mild steel Length of short bead ≥ 30 mm c) TMCP type HT steel (Ceq ≤ 0.36%) and Low temp steel (Ceq ≤ 0.36%) Length of short bead ≥ 10 mm	Preheating is necessary at 100 ± 25°C
Remedying weld bead	a) HT steel, Cast steel, TMCP type HT steel (Ceq > 0.36%) and Low temp steel (Ceq > 0.36%) Length of short bead ≥ 50 mm b) Grade E of mild steel Length of short bead ≥ 30 mm c) TMCP type HT steel (Ceq ≤ 0.36%) and Low temp steel (Ceq ≤ 0.36%) Length of short bead ≥ 30 mm	

NOTE:

1. When short bead is made erroneously, remove the bead by grinding.
2. $Ceq = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15} (\%)$

No. 47 Part B

Repair Quality Standard for Existing Ships

No. 47 (cont)

Part B - Shipbuilding and Repair Quality Standard for Existing Ships

CONTENTS:

REFERENCES

1. IACS "Bulk Carriers - Guidelines for Surveys, Assessment and Repair of Hull Structure"
2. TSCF "Guidelines for the inspection and maintenance of double hull tanker structures"
3. TSCF "Guidance manual for the inspection and condition assessment of tanker structures"
4. IACS UR W 11 "Normal and higher strength hull structural steels"
5. IACS UR W 13 "Thickness tolerances of steel plates and wide flats"
6. IACS UR W 17 "Approval of consumables for welding normal and higher strength hull structural steels"
7. IACS Z 10.1 "Hull surveys of oil tankers" and Z 10.2 "Hull surveys of bulk carriers" Table IV
8. IACS UR Z 13 "Voyage repairs and maintenance"
9. IACS Recommendation 12 "Guidelines for surface finish of hot rolled steel plates and wide flats"
10. IACS Recommendation 20 "Non-destructive testing of ship hull steel welds"

No. 47 (cont)

1. Scope

1.1 This standard provides guidance on quality of repair of hull structures. The standard covers permanent repairs of existing ships.

Whereas the standard generally applies to

- conventional ship types,
- parts of hull covered by the rules of the Classification Society,
- hull structures constructed from normal and higher strength hull structural steel, the applicability of the standard is in each case to be agreed upon by the Classification Society.

The standard does generally not apply to repair of

- special types of ships as e.g. gas tankers
- structures fabricated from stainless steel or other, special types or grades of steel

1.2 The standard covers typical repair methods and gives guidance on quality standard on the most important aspects of such repairs. Unless explicitly stated elsewhere in the standard, the level of workmanship reflected herein will in principle be acceptable for primary and secondary structure of conventional design. A more stringent standard may however be required for critical and highly stressed areas of the hull, and is to be agreed with the Classification Society in each case. In assessing the criticality of hull structure and structural components, reference is made to ref. 1, 2 and 3.

1.3 Restoration of structure to the original standard may not constitute durable repairs of damages originating from insufficient strength or inadequate detail design. In such cases strengthening or improvements beyond the original design may be required. Such improvements are not covered by this standard, however it is referred to ref. 1, 2 and 3.

No. 47 (cont)

2. General requirements for repairs and repairers

2.1 In general, when hull structure covered by classification is to be subjected to repairs, the work is to be carried out under the supervision of the Surveyor to the Classification Society. Such repairs are to be agreed prior to commencement of the work.

2.2 Repairs are to be carried out by workshops, repair yards or personnel who have demonstrated their capability to carry out hull repairs of adequate quality in accordance with the Classification Society's requirements and this standard.

2.3 Repairs are to be carried out under working conditions that facilitate sound repairs. Provisions are to be made for proper accessibility, staging, lighting and ventilation. Welding operations are to be carried out under shelter from rain, snow and wind.

2.4 Welding of hull structures is to be carried out by qualified welders, according to approved and qualified welding procedures and with welding consumables approved by the Classification Society, see Section 3. Welding operations are to be carried out under proper supervision of the repair yard.

2.5 Where repairs to hull which affect or may affect classification are intended to be carried out during a voyage, complete repair procedure including the extent and sequence of repair is to be submitted to and agreed upon by the Surveyor to the Classification Society reasonably in advance of the repairs. See Ref. 8.

No. 47 (cont)

3. Qualification of personnel

3.1 Qualification of welders

3.1.1 Welders are to be qualified in accordance with the procedures of the Classification Society or to a recognised national or international standard, e.g. EN 287, ISO 9606, ASME Section IX, ANSI/AWS D1.1. Recognition of other standards is subject to submission to the Classification Society for evaluation. Repair yards and workshops are to keep records of welders qualification and, when required, furnish valid approval test certificates.

3.1.2 Welding operators using fully mechanised of fully automatic processes need generally not pass approval testing, provided that production welds made by the operators are of the required quality. However, operators are to receive adequate training in setting or programming and operating the equipment. Records of training and production test results shall be maintained on individual operator's files and records, and be made available to the Classification Society for inspection when requested.

3.2 Qualification of welding procedures

Welding procedures are to be qualified in accordance with the procedures of the Classification Society or a recognised national or international standard, e.g. EN288, ISO 9956, ASME Section IX, ANSI/AWS D1.1. Recognition of other standards is subject to submission to the Classification Society for evaluation. The welding procedure should be supported by a welding procedure qualification record. The specification is to include the welding process, types of electrodes, weld shape, edge preparation, welding techniques and positions.

3.3 Qualification of NDE operators

3.3.1 Personnel performing non destructive examination for the purpose of assessing quality of welds in connection with repairs covered by this standard, are to be qualified in accordance with the Classification Society rules or to a recognised international or national qualification scheme. Records of operators and their current certificates are to be kept and made available to the Surveyor for inspection.

No. 47 (cont)

4. Materials

4.1 General requirements for materials

4.1.1 The requirements for materials used in repairs are in general the same as the requirements for materials specified in the Classification Society's rules for new constructions, (ref. 5).

4.1.2 Replacement material is in general to be of the same grade as the original approved material. Alternatively, material grades complying with recognised national or international standards may be accepted by the Classification Societies provided such standards give equivalence to the requirements of the original grade or are agreed by the Classification Society. For assessment of equivalency between steel grades, the general requirements and guidelines in Section 4.2 apply.

4.1.3 Higher tensile steel is not to be replaced by steel of a lesser strength unless specially approved by the Classification Society.

4.1.4 Normal and higher strength hull structural steels are to be manufactured at works approved by the Classification Society for the type and grade being supplied.

4.1.5 Materials used in repairs are to be certified by the Classification Society applying the procedures and requirements in the rules for new constructions. In special cases, and normally limited to small quantities, materials may be accepted on the basis of alternative procedures for verification of the material's properties. Such procedures are subject to agreement by the Classification Society in each separate case.

4.2 Equivalency of material grades

4.2.1 Assessment of equivalency between material grades should at least include the following aspects;

- heat treatment/delivery condition
- chemical composition
- mechanical properties
- tolerances

4.2.2 When assessing the equivalence between grades of normal or higher strength hull structural steels up to and including grade E40 in thickness limited to 50 mm, the general requirements in Table 4.1 apply.

4.2.3 Guidance on selection of steel grades to certain recognised standards equivalent to hull structural steel grades specified in Classification Societies' rules is given in Table 4.2

No. 47 (cont)

Items to be considered	Requirements	Comments
Chemical composition	- C; equal or lower - P and S; equal or lower - Mn; approximately the same but not exceeding 1.6% - Fine grain elements; in same amount - Detoxidation practice	The sum of the elements, e.g. Cu, Ni, Cr and Mo should not exceed 0.8%
Mechanical properties	- Tensile strength; equal or higher Yield strength; equal or higher - Elongation; equal or higher - Impact energy; equal or higher at same or lower temperature, where applicable	Actual yield strength should not exceed Classification Society Rule minimum requirements by more than 80 N/mm^2
Condition of supply	Same or better	Heat treatment in increasing order; - as rolled (AR) - controlled rolled (CR) - normalised (N) - thermo-mechanically rolled (TM)[1)] - quenched and tempered (QT)[1)] [1)] TM- and QT-steels are not suitable for hot forming
Tolerances	- Same or stricter	Permissable under thickness tolerances; - plates: 0.3 mm - sections: according to recognised standards

Table 4.1 Minimum extent and requirements to assessment of equivalency between normal or higher strength hull structual steel grades

No. 47 (cont)

Steel grades according to Classification Societies' rules (ref. 5)							Comparable steel grades			
Grade	Yield stress R_{eH} min. N/mm^2	Tensile strength R_m N/mm^2	Elongation A_5 min. %	Average impact energy Temp. °C	J, min. L	T	ISO 630-80 4950/2/3/ 1981	EN EN 10025-93 EN 10113-93	ASTM A 131	JIS G 3106
A	235	400-502	22	+20	-	-	Fe 360B	S235JRG2	A	SM41B
B				0	27	20	Fe 360C	S235J0	B	SM41B
D				-20	27	20	Fe 360D	S235J2G3	D	(SM41C)
E				-40	27	20	-	S275NL/ML	E	-
A 27	265	400-530	22	0			Fe 430C	S275J0G3	-	-
D 27				-20	27	20	Fe 430D	S275N/M	-	-
E 27				-40			-	S275NL/ML	-	-
A 32	315	440-590	22	0			-	-	AH32	SM50B
D 32				-20	31	22	-	-	DH32	(SM50C)
E 32				-40			-	-	EH32	-
A 36	355	490-620	21	0			Fe 510C	S355N/M	AH36	SM53B
D 36				-20	34	24	Fe 510D	S355N/M	DH36	(SM53C)
E 36				-40			E355E	S355NL/ML	EH36	-
A 40	390	510-650	20	0			E390CC	S420N/M	AH40	(SM58)
D 40				-20	41	27	E390DD	S420N/M	DH40	-
E 40				-40			E390E	S420NL/ML	EH40	-

Note: In selecting comparitable steels from this table, attention should be given to the requirements of Table 4.1 and the dimension requirements of the product with respect to Classification Sociey rules.

Table 4.2 Guidance on steel grades comparable to the normal and high strength hull structural steel grades given in Classification Society rules

No. 47 (cont)

5. General requirements to welding

5.1 Correlation of welding consumables with hull structural steels

5.1.1 For the different hull structural steel grades welding consumables are to be selected in accordance with IACS UR W17 (see Ref.6).

5.2 General requirements to preheating and drying out

5.2.1 The need for preheating is to be determined based on the chemical composition of the materials, welding process and procedure and degree of joint restraint.

5.2.2 A minimum preheat of 50° C is to be applied when ambient temperature is below 0° C. Dryness of the welding zone is in all cases to be ensured.

5.2.3 Guidance on recommended minimum preheating temperature for higher strength steel is given in Table 5.1. For automatic welding processes utilising higher heat input e.g. submerged arc welding, the temperatures may be reduced by 50° C. For re-welding or repair of welds, the stipulated values are to be increased by 25° C.

Carbon equivalent [1]	Recommended minimum preheat temperature (° C)		
	$t_{comb} \leq 50$ mm [2]	50 mm < $t_{comb} \leq 70$ mm [2]	$t_{comb} > 70$ mm [2]
Ceq ≤ 0.39	- -	50	
Ceq ≤ 0.41	- -	75	
Ceq ≤ 0.43	-	50	100
Ceq ≤ 0.45	50	100	125
Ceq ≤ 0.47	100	125	150
Ceq ≤ 0.50	125	150	175

Table 5.1 Preheating temperature

5.3 Dry welding on hull plating below the waterline of vessels afloat

5.3.1 Welding on hull plating below the waterline of vessels afloat is acceptable only on normal and higher strength steels with specified yield strength not exceeding 355 MPa and only for local repairs. Welding involving other high strength steels or more extensive repairs against water backing is subject to special consideration and approval by the Classification Society of the welding procedure.

5.3.2 Low-hydrogen electrodes or welding processes are to be used when welding on hull plating against water backing. Coated low-hydrogen electrodes used for manual metal arc welding should be properly conditioned to ensure a minimum of moisture content.

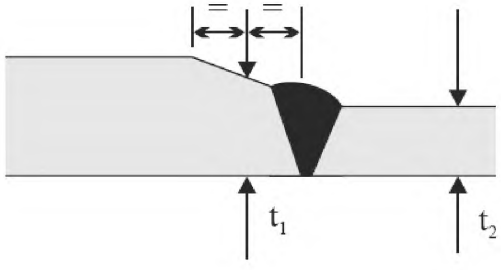
5.3.3 In order to ensure dryness and to reduce the cooling rate, the structure is to be preheated by a torch or similar prior to welding, to a temperature of minimum 5° C or as specified in the welding procedure.

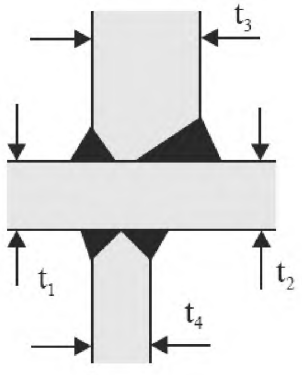
No. 47 (cont)

Notes:

1) $$Ceq = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15} (\%)$$

2) Combined thickness $t_{comb} = t_1 + t_2 + t_3 + t_4$, see figure





No. 47 (cont)

6. Repair quality standard

6.1 Welding, general

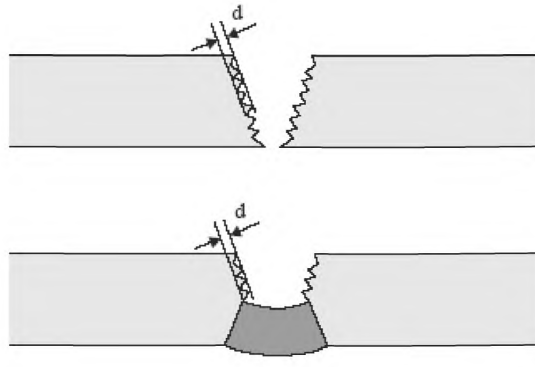


Fig 6.1 Groove roughness

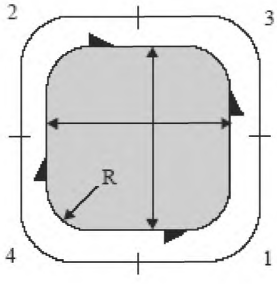
Item	Standard	Limit	Remarks
Material Grade	Same as original or higher		See Section 4
Welding Consumables	IACS UR W17 (ref. 6)	Approval according to equivalent international standard	
Groove / Roughness	See note and Fig 6.1	d < 1.5 mm	Grind smooth
Pre-Heating	See Table 5.1	Steel temperature not lower than 5°C	
Welding with water on the outside	See Section 5.3	Acceptable for normal and high strength steels	- Moisture to be removed by a heating torch
Alignment	As for new construction		
Weld Finish	IACS Recommendation 20 (ref. 10)		
NDE	IACS Recommendation 20 (ref. 10)	At random with extent to be agreed with attending surveyors	

Note:

Slag, grease, loose mill scale, rust and paint, other than primer, to be removed.

No. 47 (cont)

6.2 Renewal of plates



R = 5 x plate thickness
min. 100mm

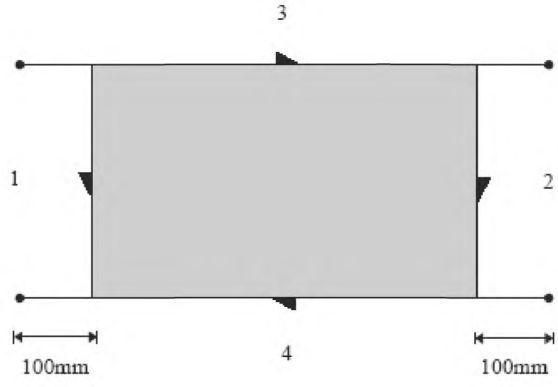


Fig 6.2 Welding sequence for inserts

Item	Standard	Limit	Remarks
Size Insert	Min. 300 x 300 mm R = 5 x thickness Circular inserts: D_{min} = 200 mm	Min. 200 x 200 mm Min R = 100 mm	
Marterial Grade	Same as original or higher		See Section 4.
Edge Preparation	As for new construction		In case of non compliance increase the amount of NDE
Welding Sequence	See Fig 6.2 Weld sequence is 1→2→3→4		For primary members sequence 1 and 2 transverse to the main stress direction
Alignment	As for new construction		
Weld Finish	IACS Recommendation 20 (ref. 10)		
NDE	IACS Recommendation 20 (ref. 10)		

No. 47 (cont)

6.3 Doublers on plating

Local doublers are normally only allowed as temporary repairs, except as original compensation for openings, within the main hull structure.

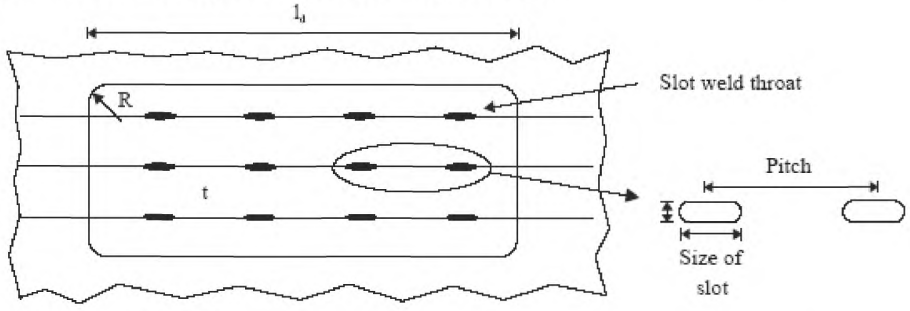


Fig 6.3 Doublers on plates

Item	Standard	Limit	Remarks
Existing Plating		General: t ≥ 5 mm	For areas where existing plating is less than 5 mm plating a permanent repair by insert is to be carried out.
Extent / Size	Rounded off corners.	min 300 x 300 mm R ≥ 50 mm	
Thickness of Doubler (td)	td ≤ tp (tp = original thickness of existing plating)	td > tp/3	
Material Grade	Same as original plate		See Section 4
Edge Preparation	As for [newbuidling] new construction		Doublers welded on primary strength members: (Le: leg length) when t > Le + 5 mm, the edge to be tapered (1:4)
Welding	As for [newbuidling] new construction		Welding sequence similar to insert plates.
Weld Size (throat thicknesss)	Circumferencial and in slots: 0.6 x td		
Slot Welding	Normal size of slot: (80-100) x 2 td Distance from doubler edge and between slots: d ≤ 15 td	Max pitch between slots 200 mm dmax = 500 mm	For doubler extended over several supporting elements, see Figure 6.3
NDE	IACS Recommendation 20 (ref. 10)		

No. 47 (cont)

6.4 Renewal of internals/stiffeners

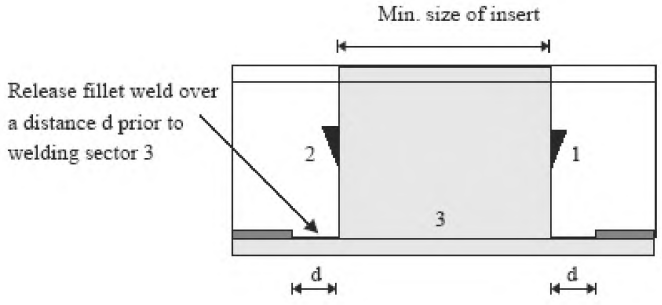


Fig 6.4 Welding sequence for inserts of stiffeners

Item	Standard	Limit	Remarks
Size Insert	Min. 300 mm	Min. 200 mm	
Marterial Grade	Same as original or higher		See Section 4.
Edge Preparation	As for new construction. Fillet weld stiffener web / plate to be released over min. d = 150 mm		
Welding Sequence	See Fig 6.4 Welding sequence is 1→2→3		
Alignment	As for new construction		
Weld Finish	IACS Recommendation 20 (ref. 10)		
NDE	IACS Recommendation 20 (ref. 10)		

No. 47 (cont)

6.5 Renewal of internals/stiffeners – transitions inverted angle/bulb profile

The application of the transition is allowed for secondary structural elements.

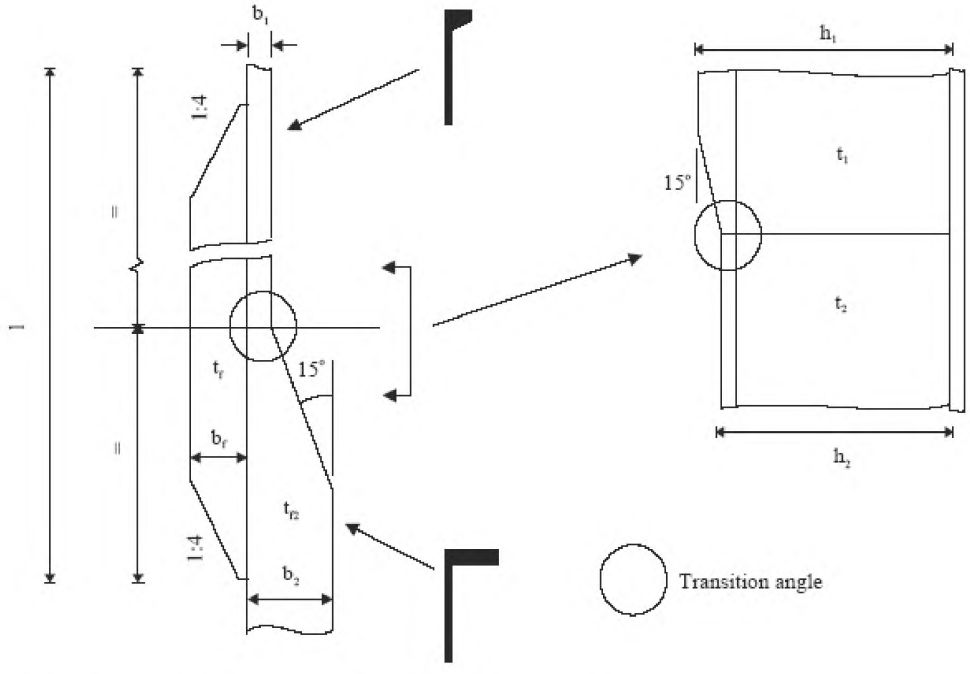


Fig 6.5 Transition between inverted angle and bulb profile

Item	Standard	Limit	Remarks
$(h_1 - h_2)$	≤ 025 x b1		
$\lvert t_1 - t_2 \rvert$	2 mm		Without tapering transition.
Transition Angle	15 degrees		At any arbitrary section
Flanges	$tf = tf_2$ $bf = bf_2$		
Length of Flatbar	$4 \times h_1$		
Material			See Section 4.

No. 47 (cont)

6.6 Application of Doubling Straps

In certain instances, doubling straps are used as a means to strengthen and reinforce primary structure. Where this has been agreed and approved, particular attention should be paid to:

- the end termination points of the straps, so that toe support is such that no isolated hard point occurs.
- in the case of application of symmetrical or asymmetrical-ended straps, the corners at the end of the tapering should be properly rounded.
- any butts between lengths of doubling straps, so that there is adequate separation of the butt weld from the primary structure below during welding, and so that a high quality root run under controlled circumstances is completed prior to completing the remainder of the weld. Ultrasonic testing should be carried out on completion to verify full penetration.

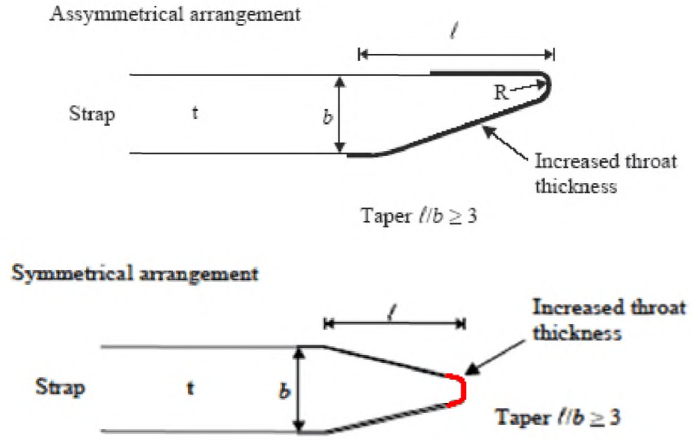


Fig 6.6 Application of Doubling Straps

Item	Standard	Limit	Remarks
Tapering	*l/b>3*		Special consideration to be drawn to design of strap terminations in fatigue sensitive areas.
Radius	0.1 x *b*	min 30 mm	
Material			See paragraph 2.0 General requirement to materials.
Weld Size			Depending on number and function of straps. Throat thickness to be increased 15 % toward ends.
Welding	Welding sequence from middle towards the free ends		See sketch. For welding of lengths > 1000 mm step welding to be applied.

No. 47 (cont)

6.7 Welding of pitting corrosion

Notes:

Shallow pits may be filled by applying coating or pit filler. Pits can be defined as shallow when their depth is less that 1/3 of the original plate thickness.

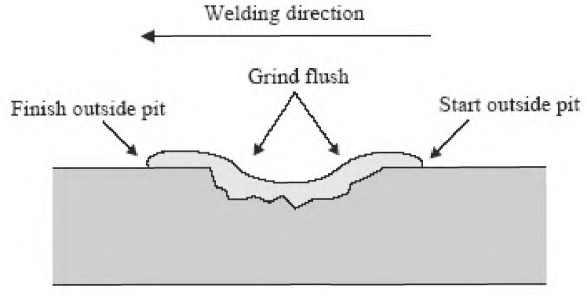


Fig 6.7 Welding of pits

Item	Standard	Limit	Remarks
Extent / Depth	Pits / grooves are to be welded flush with the original surface.	If deep pits or grooves are clustered together or remaining thickness is less than 6 mm, the plates should be renewed.	See also IACS Recommendation 12 (ref. 9)
Cleaning	Heavy rust to be removed		
Pre-Heating	See Table 5.1	Required when ambient temperature < 5°C	Always use propane torch or similar to remove any moisture
Welding Sequence	Reverse direction for each layer		See also IACS Recommendation 12 (ref. 9)
Weld Finish	IACS Recommendation 20 (ref. 10)		
NDE	IACS Recommendation 20 (ref. 10)	Min. 10% extent	Preferably MPI

Reference is made to TSCF Guidelines, Ref. 2 & 3.

No. 47 (cont)

6.8 Welding repairs for cracks

In the event that a crack is considered weldable, either as a temporary or permanent repair, the following techniques should be adopted as far as practicable. Run-on and run-off plates should be adopted at all free edges.

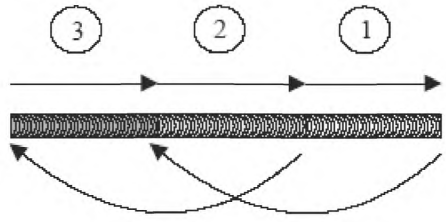


Fig 6.8.a Step back technique

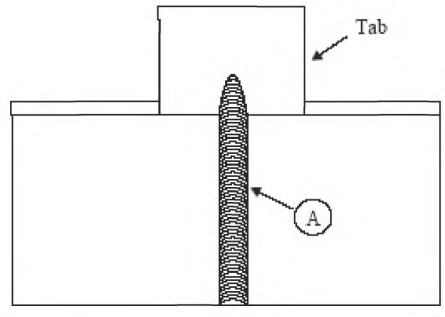


Fig 6.8.b End crack termination

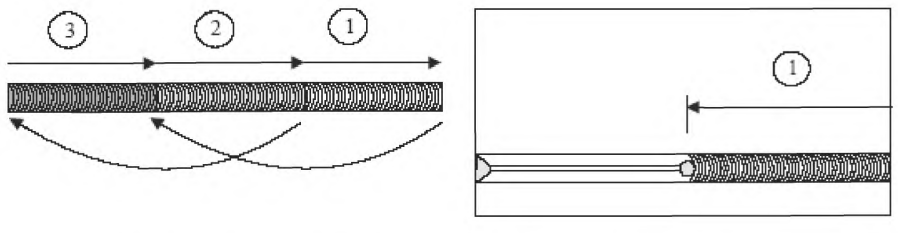


Fig 6.8.c Welding sequence for cracks with length less than 300 mm

No. 47 (cont)

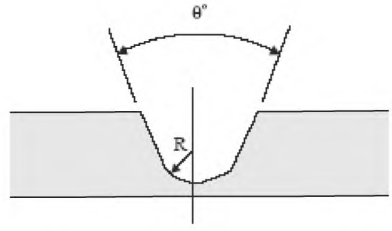


Fig 6.8.d Groove preparation (U-groove left and V-groove right)

Item	Standard	Limit	Remarks
Groove Preparation	θ = 45-60° r = 5 mm		For through plate cracks as for newbuilding. Also see Fig 6.8.d
Termination	Termination to have slope 1:3		For cracks ending on edges weld to be terminated on a tab see Fig 6.8.b
Extent	On plate max. 400 mm length. Vee out 50 mm past end of crack	On plate max 500 mm. Linear crack, not branched	
Welding Sequence	See Fig 6.8.c for sequence and direction	For cracks longer than 300 mm step-back technique should be used Fig 6.8.a	Always use low hydrogen welding consumables
Weld Finish	IACS Recommendation 20 (ref. 10)		
NDE	IACS Recommendation 20 (ref. 10)	100 % MP or PE of groove	100 % surface crack detection + UE or RE for butt joints

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