CCS Rule Change Notice For:

RULES FOR CLASSIFICATION OF SEA-GOING STEEL SHIPS

Version: 2022. RCN No.1

Effective date: Jan.1, 2022

Beijing

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CCS Rule Change Notice For:

RULES FOR CLASSIFICATION OF SEA-GOING STEEL SHIPS

PART ONE PROVISIONS OF CLASSIFICATION

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CHAPTER 4 SURVEYS DURING CONSTRUCTION

Appendix 2 SHIPBUILDING AND REPAIR QUALITY STANDARD

1 Shipbuilding and Remedial Quality Standards for New Construction

1.1 Scope

It is intended that these standards provide guidance where established and recognized shipbuilding or national standards accepted by CCS do not exist.

1.1.3 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 CCS in each case. In assessing the criticality of hull structure and structural components, reference is made to References 1.1, 1.2, 1.3, 1.11, 1.13,1.14,1.15, and 1.16 and 1.17 to this Section.

1.3 Qualification of personnel and procedures

1.3.3 Qualification of NDENDT operators

1.3.3.1 Personnel performing non-destructive examination testing for the purpose of assessing quality of welds in connection with new construction covered by this standard, are to be qualified in accordance with CCS 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.

1.4 Materials

1.4.2 Surface Conditions

1.4.2.3 Remedial of Defects

(1) Defects are to be remedied by grinding and/or welding in accordance with IACS Rec.12 UR W11 (Reference 1.131.6 to this Section).

References:

1.1 IACS Recommendation No.76 “Bulk Carriers - Guidelines for Surveys, Assessment and Repair of Hull Structure”

1.2 TSCF “Guidelines for the inspection and maintenance of double hull tanker structures”

1.3 TSCF “Guidance manual for the inspection and condition assessment of tanker structures”

1.4 IACS UR W7 “Hull and machinery steel forgings”

1.5 IACS UR W8 “Hull and machinery steel castings”

1.6 IACS UR W11 “Normal and higher strength hull structural steel”

1.7 IACS UR W13 “Thickness tolerances of steel plates and wide flats”

1.8 IACS UR W14 “Steel plates and wide flats with specified minimum through thickness properties (“Z” quality)”

1.9 IACS UR W17 “Approval of consumables for welding normal and higher strength hull structural steels”

1.10 IACS UR W28 “Welding procedure qualification tests of steels for hull construction and marine structures”

1.11 IACS UR Z10.1 “Hull surveys of oil tankers”, Z10.2 “Hull surveys of bulk carriers”, Z10.3 “Hull surveys of chemical tankers”, Z10.4 “Hull surveys of double hull oil tankers” and Z10.5 “Hull surveys of double skin bulk carriers” Annex I

1.12 IACS UR Z23 “Hull survey for new construction”

1.13 IACS Recommendation No.12 “Guidelines for surface finish of hot rolled plates and wide flats”

1.141.13 IACS Recommendation No.20 UR W33 “Non-destructive testing of ship hull steel welds”

1.151.14 IACS Recommendation No.96 “Double Hull Oil Tankers - Guidelines for Surveys, Assessment and Repair of Hull Structures”

1.16 1.15 IACS Recommendation No.55 “General Dry Cargo Ships - Guidelines For Surveys, Assessment and Repair of Hull Structures”

1.17 1.16 IACS Recommendation No.84 “Container Ships - Guidelines for Surveys, Assessment and Repair of Hull Structures”

2 Repair Quality Standard for Existing Ships

2.1 Scope

2.1.2 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 CCS in each case. In assessing the criticality of hull structure and structural components, reference is made to References 2.l, 2.2, 2.3, 2.6, 2.8,2.9,2.10, and 2.11 ~~and 2.12~~ to this Section.

2.1.3 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 References 2.l, 2.2, 2.3, 2.6, 2.8,2.9,2.10, and 2.11 ~~and 2.12~~ to this Section.

2.3 Qualification of personnel

2.3.3 Qualification of ~~NDE~~ NDT operators

2.3.3.1 Personnel performing non-destructive ~~examination~~ testing for the purpose of assessing quality of welds in connection with repairs covered by this standard, are to be qualified in accordance with CCS 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.

2.6 Repair quality standard

2.6.1 Welding, general requirements

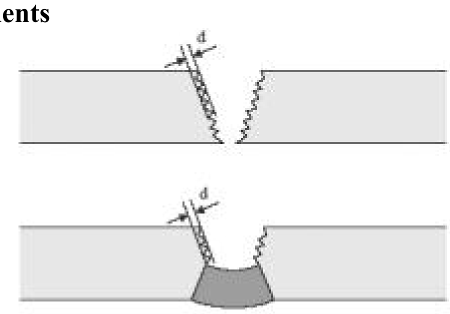


Figure 2.6.1 Groove roughness

Table 2.6.1

Item	Standard	Limit	Remark
Material Grade	Same as original or higher		See Section 2.4
Welding Consumables	IACS UR W17 (Reference 2.5 to this Section)	Approval according to equivalent international standard	
Groove / Roughness	See note and Figure 2.6.1	*d* < 1.5 mm	Grind smooth
Pre-Heating	See Table 2.5.1	Steel temperature not lower than 5℃	
Welding with water on the outside	See Section 2.5.3	Acceptable for normal and high strength steels	− Moisture to be removed by a heating torch
Alignment	As for new construction		
Weld Finish	IACS ~~Recommendation No.20~~UR W33 (Reference ~~2.9~~2.8 to this Section)		
~~NDE~~NDT	IACS ~~Recommendation No.20~~UR W33(Reference ~~2.9~~2.8to this Section)	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.

2.6.2 Renewal of plates

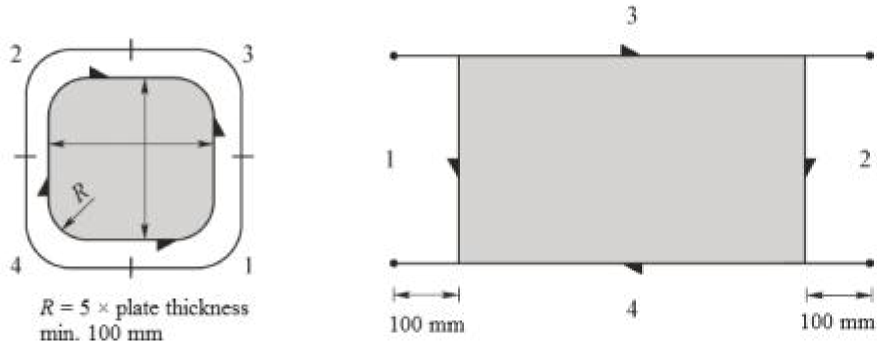


Figure 2.6.2 Welding sequence for inserts

Table 2.6.2

Item	Standard	Limit	Remark
Size Insert	Min 300 × 300 mm *R* = 5 × thickness Circular inserts: *Dmin* = 200 mm	Min 200 × 200 mm Min *R* = 100 mm	
Marterial Grade	Same as original or higher		See Section 2.4
Edge Preparation	As for new construction		In case of non-compliance increase the amount of ~~NDE~~NDT
Welding Sequence	See Figure 2.6.2, welding sequence: 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 No.20~~UR W33 (Reference ~~2.9~~2.8 to this Section)		
~~NDE~~NDT	IACS ~~Recommendation No.20~~UR W33 (Reference ~~2.9~~2.8 to this Section)		

2.6.3 Doublers on plating

Local doublers are normally only allowed as temporary repairs, except as original compensation for openings, within the main hull structure.

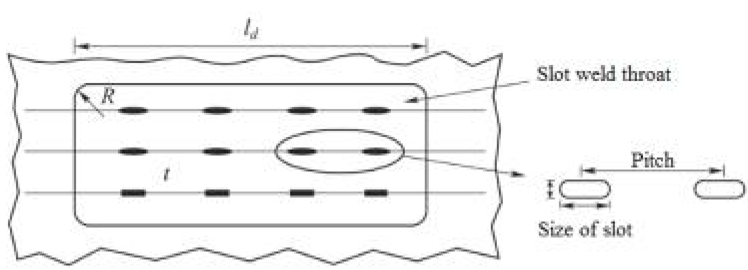


Figure 2.6.3 Doublers on plates

Table 2.6.3

Item	Standard	Limit	Remark
Existing Plating		General:: $t \geq 5$ 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 × 300 mm $R \geq 50$ mm	
Thickness of Doubler (t_d)	$t_d \leq t_p$ (t_p = original thickness of existing plating)	$t_d > t_p/3$	
Material Grade	Same as original plate		See Section 2.4
Edge Preparation	As for [newbuilding] new construction		Doublers welded on primary strength members: (L_e: leg length) when $t > L_e + 5$ mm, the edge to be tapered (1:4)
Welding	As for [newbuilding] new construction		Welding sequence similar to insert plates
Weld Size (throat thicknesss))	Circumferential and in slots: $0.6 \times t_d$		
Slot Welding	Normal size of slot: (80-100) $\times 2\ t_d$ Distance from doubler edge and between slots: $d \leq 15\ t_d$	Max pitch between slots 200 mm d_{max} = 500 mm	For doubler extended over several supporting elements, see Figure 2.6.3
~~NDE~~NDT	IACS ~~Recommendation No.20~~UR W33 (Reference ~~2.9~~2.8 to this Section)		

2.6.4 Renewal of internals/stiffeners

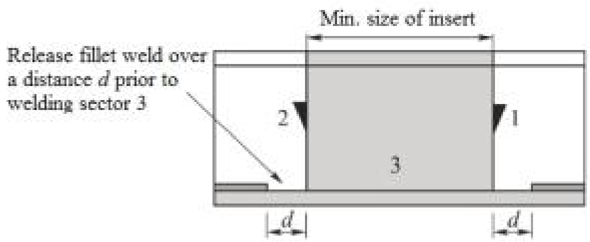


Figure 2.6.4 Welding sequence for inserts of stiffeners

Table 2.6.4

Item	**Standard**	**Limit**	**Remark**
Size Insert	Min. 300 mm	Min 200 mm	
Marterial Grade	Same as original or higher		See Section 2.4
Edge Preparation	As for new construction. Fillet weld stiffener web / plate to be released over min. d = 150 mm		
Welding Sequence	See Figure 2.6.4 Welding sequence is 1→2→3		
Alignment	As for new construction		
Weld Finish	IACS ~~Recommendation No.20~~UR W33 (Reference ~~2.9~~2.8 to this Section)		
~~NDE~~NDT	IACS ~~Recommendation No.20~~UR W33 (Reference ~~2.9~~2.8to this Section)		

2.6.7 Welding of pitting corrosion

Note:
Shallow pits may be filled by applying coating or pit filler. Pits can be defined as shallow when their depth is less than 1/3 of the original plate thickness.

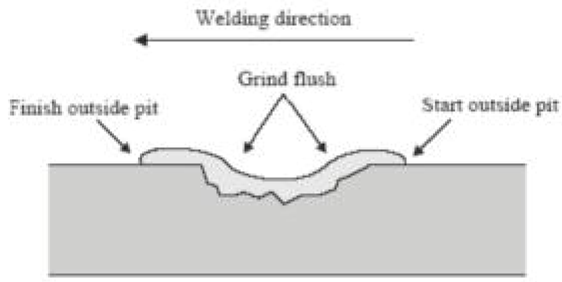


Figure 2.6.7 Welding of pits

Table 2.6.7

Item	Standard	Limit	Remark
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~~ UR W11 (Reference ~~2.8~~2.4 to this Section)
Cleaning	Heavy rust to be removed		
Pre-Heating	See Table 2.5.1	Required when ambient temperature < 5℃	Always use propane torch or similar to remove any moisture
Welding Sequence	Reverse direction for each layer		See also IACS ~~Recommendation 12~~ UR W11 (Reference ~~2.8~~2.4 to this Section)
Weld Finish	IACS ~~Recommendation No.20~~UR W33 (Reference ~~2.9~~2.8 to this Section)		
~~NDE~~NDT	IACS ~~Recommendation No.20~~UR W33 (Reference ~~2.9~~2.8 to this Section)	Min 10% extent	Preferably MPI

2.6.8 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.

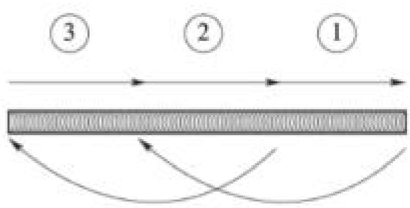


Figure 2.6.8.a Step back technique

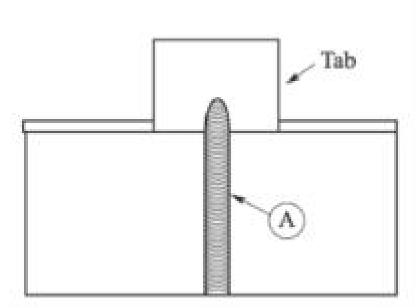


Figure 2.6.8.b End crack termination

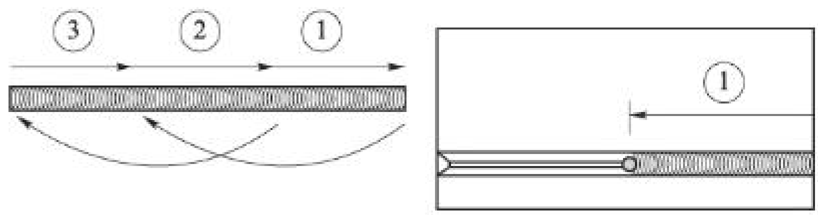


Figure 2.6.8.c Welding sequence for cracks with length less than 300 mm

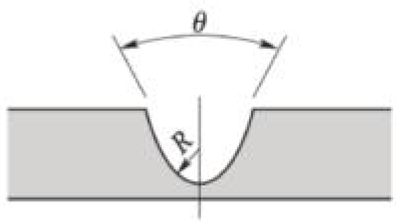


Figure 2.6.8.d Groove preparation (U-groove left and V-groove right)

Table 2.6.8

Item	Standard	Limit	Remark
Groove Preparation	$\theta = 45^{o} \sim 60^{o}$ $r = 5$ mm		For through plate cracks as for newbuilding. See also Figure 2.6.8.d
Termination	Termination to have slope 1:3		For cracks ending on edges weld to be terminated on a tab. See Figure 2.6.8.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 Figure 2.6.8.c for sequence and direction	For cracks longer than 300 mm step-back technique should be used Figure 2.6.8.a	Always use low hydrogen welding consumables
Weld Finish	IACS ~~Recommendation No.20~~UR W33 (Reference ~~2.9~~2.8 to this Section)		
~~NDE~~NDT	IACS ~~Recommendation No.20~~UR W33 (Reference ~~2.9~~2.8 to	100 % MP or PE of groove	100% surface crack detection + UE or RE for butt joints

	this Section)		

References:

2.1 IACS Recommendation No.76 “Bulk Carriers - Guidelines for Surveys, Assessment and Repair of Hull Structure”
2.2 TSCF “Guidelines for the inspection and maintenance of double hull tanker structures”
2.3 TSCF “Guidance manual for the inspection and condition assessment of tanker structures”
2.4 IACS UR W 11 “Normal and higher strength hull structural steels”
2.5 IACS UR W 17 “Approval of consumables for welding normal and higher strength hull structural steels”
2.6 IACS Z 10.1 “Hull surveys of oil tankers”, Z 10.2 “Hull surveys of bulk carriers”, Z10.3 “Hull surveys of chemical tankers”, Z10.4 “Hull surveys of double hull oil tankers” and Z10.5 “Hull surveys of double skin bulk carriers” Annex I
2.7 IACS UR Z 13 “Voyage repairs and maintenance”
~~2.8 IACS Recommendation 12 “Guidelines for surface finish of hot rolled steel plates and wide flats”~~
~~2.9~~2.8 IACS ~~Recommendation 20~~UR W33 “Non-destructive testing of ship hull steel welds”
~~2.10~~2.9 IACS Recommendation No.96 “Double Hull Oil Tankers - Guidelines for Surveys, Assessment and Repair of Hull Structures”
~~2.11~~2.10 IACS Recommendation No.55 “General Dry Cargo Ships - Guidelines For Surveys, Assessment and Repair of Hull Structures”
~~2.12~~2.11 IACS Recommendation No.84 “Container Ships - Guidelines for Surveys, Assessment and Repair of Hull Structures”

Appendix 8 PROCEDURAL REQUIREMENTS FOR SERVICE SUPPLIERS

4. Application

4.1 This procedure applies to the approval of the following categories of service suppliers:

4.1.1 Statutory services

(9) Firms engaged in Commissioning Testing of Ballast Water Management System (BWMS).

5. Procedure for approval and certification

5.1 Submission of documents

5.1.1 The following documents are to be submitted to CCS for review. General requirements concerning suppliers are given in 5.2, and specific requirements as relevant, in Annex 1:

— For categories of service suppliers that require authorization certification from manufacturers, manufacturer's documentary evidence that the service supplier has been authorization certification or licensed to service the particular makes and models of equipment for which approval is sought are to be provided;

— Operators/technicians/inspectors documentation they have acknowledged the code of conduct

Annex 1 Special Requirements for Various Categories of Service Suppliers

8. Firms engaged in examination of ro-ro ships bow, stern, side and inner doors

8.4 Training of personnel - Operators carrying out non-destructive examination test (NDENDT) are to be qualified to a recognized national or international standard for the methods used.

8.6.1 For inspection of supporting securing and locking devices, hinges and bearings:

— equipment for measuring clearances (i.e. feeler gauges, vernier calipers, micrometers);

— non-destructive examination test (i.e. dye penetrant, magnetic particle inspection).

9. Firms engaged in annual performance testing of voyage data recorders (VDRs) and simplified voyage data recorders (S-VDRs)

9.1 Extent of engagement – Testing and servicing of voyage data recorders (VDRs) and simplified voyage data recorders (S-VDRs) in accordance with SOLAS regulation V/18.8 and IMO MSC.1/Circular 1222/Rev.1 − Guidelines on Annual Testing of Voyage Data Recorders (VDRs) and Simplified Voyage Data Recorders (S-VDRs), as applicable.

9.2 Extent of approval

9.2.2 Where the service supplier is also the manufacturer of the voyage data recorder (VDR) or simplified voyage data recorder (S-VDR) and has elected to apply IMO MSC.1/Circular 1222/Rev.1 − Guidelines on Annual Testing of Voyage Data Recorders (VDRs) and Simplified Voyage Data Recorders (S-VDRs) in its entirety for the purpose of acting as a service supplier engaged in annual performance testing, the following are to apply:

— The manufacturer is to demonstrate that IMO MSC.1/Circular 1222/Rev.1 − Guidelines on Annual Testing of Voyage Data Recorders (VDRs) and Simplified Voyage Data Recorders (S-VDRs) is applied in its entirety.

9.3 Procedures

9.3.2 Where the service supplier is also the manufacturer of the voyage data recorder (VDR) or simplified voyage data recorder (S-VDR) and has selected to apply IMO MSC.1/Circular 1222/Rev.1 − Guidelines on Annual Testing of Voyage Data Recorders (VDRs) and Simplified Voyage Data Recorders (S-VDRs) in its entirety for the purpose of acting as a service supplier engaged in annual performance testing, the following are to apply:

9.4 Reference documents

9.4.1 The service supplier is to have access to the following documents:

— IMO MSC.1/Circular 1222/Rev.1 − Guidelines on Annual Testing of Voyage Data Recorders (VDRs) and Simplified Voyage Data Recorders (S-VDRs) (11 December 2006);

9.6 Reporting − test report

9.6.2 Annual performance test of VDR and S-VDR should be recorded in the form of the model test report given in the Appendix to MSC.1/Circular 1222/Rev.1, signed and stamped by the service supplier and attached

to the annual performance test certificate.
9.6.3 Where the service supplier is also the manufacturer of the voyage data recorder (VDR) or simplified voyage data recorder (S-VDR) and has selected to apply IMO MSC.1/Circular 1222/Rev.1 − Guidelines on Annual Testing of Voyage Data Recorders (VDRs) and Simplified Voyage Data Recorders (S-VDRs) in its entirety for the purpose of acting as a service supplier engaged in annual performance testing, the manufacturer is to make arrangements for the following:

16. Firms engaged in survey using Remote Inspection Techniques (RIT) as an alternative means for Close-up Survey of the structure of ships and mobile offshore units

16.3 Training and qualification of operators – The supplier is responsible for the training and qualification of its operators to undertake the remote inspections. UAV Pilots are to be qualified and licenced in accordance with applicable national requirements or an equivalent industrial standard acceptable to the society.
Knowledge of the following is to be documented:

- Thickness measurement (TM) and non-destructive ~~examination~~ test (~~NDE~~NDT) in accordance with a recognised National or International Industrial ~~NDE~~NDT Standard when these are part of the service. Suppliers undertaking TMs are to hold separate approval as a'Firm engaged in thickness measurements on ships' (see Annex 1, Section 1).

17. Firms engaged in Watertight Cable Transit Seal Systems Inspection on Ships and Mobile Offshore Units.

17.1 Extent of engagement
17.1.1 Inspection of the watertight Cable Transit Seal Systems for compliance with the relevant approval certificates and product installation manuals, (types of penetrating cables, dimensions, fill ratio and insulation details, as applicable).
17.2 Extent of Approval
17.2.2 Any Service Supplier engaged in the inspections of watertight cable transit seal systems shall be qualified in these inspections for each make and type of equipment for which they provide the inspection, and provide manufacturers documentary evidence that they have been so authorized or they are certified in accordance with an established system for training and authorization.
Such qualification shall include, as a minimum:
(1)employment and documentation of personnel certified in accordance with a recognized national,international or industry standard as applicable, or an equipment manufacturer's established certification program. In either case, the certification program shall be based on the paragraph 17.3 for each make and type of equipment for which inspection is to be provided, and
(2)compliance with provisions of paragraphs 17.4, 17.5 and 17.6.
17.3 Qualifications and Training of Personnel
17.3.2 The education for initial certification of personnel shall be documented and addressed, as a minimum:
(1) Procedures and instructions for the inspection of the watertight cable transit seal systems
(2) Common problems found with the initial installation and in-service inspections of watertight cable transit seal systems
(4) Procedures for reporting on initial installation and in-service inspections of watertight cable transit seal systems in the Cable Transit Seal Systems Register.
17.3.3 The education and training for the personnel shall include practical technical training on actual inspection using the watertight cable transit seal systems for which the personnel are to be certified. The technical training shall include disassembly, reassembly and adjustment of the equipment. Classroom training shall be supplemented by field experience in the inspections for which certification is sought, under the supervision of an experienced senior certified person.
17.4 Reference Documents
The Service Supplier is to have access to the following documents:
17.4.2 Type Approval certificate showing any conditions that may be appropriate during the installation or maintenance of the watertight cable transit seal system.
17.6 Reporting
17.6.1 On completion of inspection, the Service Supplier will issue a report confirming the condition of the watertight Cable Transit Seal System. They will also record the results of their inspection in the Cable Transit

Seal System Register.

18. Firms engaged in Commissioning Testing of Ballast Water Management Systems (BWMS)

18.1 Extent of engagement - Sampling and Analysis of ballast water and Verification of the self-monitoring equipment during Commissioning Testing of Ballast Water Management Systems (BWMS), for Statutory purposes.

18.2 Procedure

18.2.1 Service suppliers are to have documented procedures including:

— Procedures for sampling collection and handling, analysis, assessment of BWMS correct operations and documenting and reporting. The procedures are to outline how the ballast water sampling and analysis is conducted with respect to each size class of organisms;

— Operating procedures for the ballast water test equipment specified including calibration, adjustment and maintenance.

18.2.2 Service Suppliers are to be familiar with the BWMS operation including features and limits of each treatment technology, and self-monitoring parameters.

18.2.3 Service Suppliers are to be accredited to relevant standards such as ISO/IEC 17025 or equivalent, as applicable.

18.2.4 Service Suppliers are to be independent of the BWMS manufacturer or supplier including shipyards.

18.3 Operators – Service Suppliers are expected to be able to perform both the biological sampling and assessment of self-monitoring parameters and has responsibility for document that the requirements to the operator are satisfied. Therefore, operators who conduct commissioning testing are to:

— demonstrate knowledge in the use of different ballast water testing equipment for the purpose of assessing biological efficacy;

— have documented evidence of sufficient engineering and biological knowledge to conduct the mmissioning testing;

— have knowledge of IMO BWM.2/Circ.70/Rev.1, as may be amended - 'Guidance for the Commissioning Testing of Ballast Water Management Systems' and IMO BWM.2/Circ.42/Rev.2 - 'Guidance on Ballast Water Sampling and Analysis for Trial Use in accordance with the BWM Convention and Guidelines (G2)', as may be amended;

— (*) be trained in the proper use of portable indicative analysis equipment. Review of training records and/or interviews should be conducted to confirm the equipment will be properly used during testing;

— (*) be familiar with and understand the design concepts of the Guidelines G2 sampling devices installed on the vessel's water ballast system. Personnel shall understand the need to maintain the G2 sampling devices clean and free of contaminants and the importance of controlling the ballast water sample flow rates from the G2 device (to avoid organism mortality in the sample);

— (*) be familiar with the technologies utilized by the indicative sampling equipment and understand water quality issues that are both conducive to successful use of the equipment and circumstances that could challenge the use of the equipment;

— (*) be trained in the proper disposal procedures for water samples following testing.

— (Δ) have knowledge of the system design limitations of the BWMS (as stated in the BWMS type approval certificate) and knowledge of the BWMS self-monitoring parameters, such as flow rate, pressure, TRO concentration, UV transmittance/intensity, etc, and how the BWMS notifies the operator in case he operates BWMS outside its system design limitations. This knowledge is relevant for evaluating whether the selfmonitoring equipment of the BWMS indicates correct operation of the BWMS. In case Service Supplier are not present during ballasting operations, the Service Supplier shall have knowledge of how to access the BWMS log to evaluate that the BWMS operated correctly during ballasting operations;

— (Δ) have the procedures and knowledge to be able to assess the applicable selfmonitoring parameters (e.g., flow rate, pressure, TRO, UV intensity, etc.) of the BWMS, taking into account the System Design Limitations of the BWMS;

Notes:

(1) the points marked with (*) are qualifications for operators performing sampling and analysis of ballast water;

(2) the points marked with (Δ) are the qualifications for operators performing verification of the self-monitoring equipment ;

(3) the points above without symbol are the common qualifications for service supplier.

18.4 Equipment and facilities

Equipment, procedures and methods for detailed analysis, where applicable, are to be in accordance with relevant International standard and/or accepted Industry standards. Laboratories conducting sample enumeration are to be accredited to ISO/IEC 17025 standard, or equivalent. Testing should be conducted using indicative analysis equipment accepted by Society. information and reference to the acceptance documents for the equipment used should be submitted to the Society in the report which includes the results from the commissioning test as per IMO BWM.2/Circ.70/Rev.1, as may be amended. In case the indicative analysis equipment used has not been previously accepted by the Society, the following information is to be submitted to the Society;

— Equipment information - type, model, technology used, evidence of calibration, detection range, Organism type/size classes that can be analyzed.
— Test results conduct for the verification of accuracy, detection range and repeatability.
— Certificate of standards, if available.

For indicative analysis equipment planned to be used, the equipment OEM instruction manuals shall be available. The manuals shall include, at least, clear guidance for the proper storage, handling, operation, maintenance, repair, and calibration.

Note: Each Service Supplier applicant will present the Surveyor their confidential internal procedures for conducting the indicative testing. Not all the equipment listed in the references will be used. For all equipment planned to be used, the instruction manuals shall be available. The Service Supplier will need to use specialty devices (e.g., sieves, screens, etc.) to separate the different organism sizes classes (i.e., ≥ 10 μm to < 50 μm, and ≥ 50 μm, and indicator microbes) to support analysis of each size class.

Equipment used for the analysis of other physical-chemical water parameters is to be suitable for the intended use. Indicative analysis equipment should be properly stored or transported to avoid damage and disturbance to calibrations, etc. when transporting from the Service Suppliers facilities to the vessels.

18.5 Sampling and Analysis

Service Suppliers are to follow relevant guidelines on sampling of ballast water. A standard operating procedure is to be defined for sampling of uptake water. Discharge sampling shall follow the IMO's 'Guidelines for Ballast Water Sampling (G2)'. The representative samples shall be analyzed as a minimum for the two size classes of organisms, namely ≥ 50 μm and ≥ 10 μm to < 50 μm, specified in IMO Circular BWM.2/ Circ.70/Rev.1 - Guidance for the Commissioning Testing of Ballast Water Management Systems using indicative analysis methods. Detailed analysis of all organism type/size classes or combination of detail and indicative analysis can also be performed. Service Suppliers shall maintain a record of:

— Operation of the BWMS during test period, including any recorded data or operator observations associated with the performance deviations, alarms or abnormal/unexpected operations.
— Applicable self-monitoring parameters.

In case the commissioning testing requires the Service Supplier's personnel to work in hazardous areas (e.g., pump room for tankers, etc.), the Service Supplier shall either have equipment certified for the spaces or provide the Surveyor with a list of vessels for which they would not be able to conduct testing.

18.6 Reporting

Service Suppliers are to provide reports detailing the results of sampling and analysis of ballast water and assessment of self-monitoring parameters during commissioning testing. The format is to be acceptable to Society. The report, as a minimum, will contain the following:

• Manufacturer's name
• Model name
• BWMS Technology limiting operating conditions and system design limitations
• Operation required, e.g., ballasting, de-ballast, circulation, one pass, in tank, etc
• Treatment rated capacity (TRC) in m3/h
• Relevant performance parameters (e.g. TRO, UV dose, UVI, flow rate or other relevant performance parameter).
• Alarms developed during operation.
• Installation location.
• Type Approval issued by and Certificate No
• Date installed
• Results of Sample analysis
• Pump flow rate, ballast tanks and volume

• Comments/Options: Filter and other major components, Process measurements.

18.7 Reference Documents

The Service Supplier is to have access to the following documents, as may be amended:

• IMO Resolution MEPC.300(72) 一 Code for Approval of Ballast Water Management Systems (BWMS Code)
• IMO Resolution MEPC.173(58) 一 Guidelines for Ballast Water Sampling (G2)
• IMO Circular BWM.2/Circ.42/Rev. 2 一 Guidance on Ballast Water Sampling and Analysis for Trial Use in accordance with the BWM Convention and Guidelines (G2)
• IMO Circular BWM.2/Circ.70/Rev.1 - Guidance for the Commissioning Testing of Ballast Water Management Systems
• IMO Circular BWM.2/Circ.61 - Guidance on Methodologies that may be used for Enumerating Viable Organisms for Type Approval of Ballast Water Management Systems
• IMO Circular BWM.2/Circ.69 - Guidance on System Design Limitations of Ballast Water Management Systems and their Monitoring
• IMO Resolution MEPC.279(70) - 2016 Guidelines for Approval of Ballast Water Management Systems (G8)
• IMO Resolution A.1120(30) – Survey Guidelines under the Harmonized System of Survey and veritifications (HSSC), 2017 (for BWMS that were Type Approved to the 2016 G8)

CCS Rule Change Notice For:

RULES FOR CLASSIFICATION OF SEA-GOING STEEL SHIPS

PART TWO HULL

CONTENTS

CHAPTER 2   HULL STRUCTURES

The existing Appendix 3 is replaced by the following:

Appendix 3   GUIDELINES FOR UR S11.2.1.3 FOR BALLAST LOADING CONDITIONS OF CARGO VESSELS INVOLVING PARTIALLY FILLED BALLAST TANKS

1. General guidance note regarding the use of UR S11.2.1.3

1.1   This document is intended for guidance and interpretation of UR S11.2.1.3 “Partially filled ballast tanks in ballast loading conditions”.

1.2   Case A and B are generally applicable for ballast loading conditions for any cargo vessel which might have one Ballast Water (BW) Tank (or one pair of BW Tanks) partially filled.

1.3   Case C is showing the conditions necessary for checking longitudinal strength for a conventional ore carrier with two pairs of large wing water ballast tanks partly filled during the ballast voyage.

1.4   Where applicable, similar considerations are to be given to other cargo vessels covered by UR S11 where ballast loading conditions involving partially filled ballast tanks may cause concerns for the longitudinal strength of the vessels.

1.5   This Appendix does not apply to CSR Bulk Carriers and Oil Tankers or to container ships to which UR S11A is applicable.

1.6   In the Figures, the conditions only intended for strength verification (not operational) are marked with a star (*), full tanks are marked with “Full”, empty tanks are marked with “Empty”, and consumables are marked with “cons.” .

2. Case A and B

2.1   Case A

Fig. 1 shows Case A, with a cargo vessel where partial filling of BW Tank no. 6 (P/S) is permitted and may take place at any time during the ballast voyage. Intermediate condition(s) should be specified as shown in the Figure, however filling/partial filling of BW Tank no. 6 (P/S) may be done at any step to keep acceptable trim and propeller immersion during the ballast voyage.

To obtain full operational flexibility regarding the filling level of BW Tank no. 6 (P/S), loading conditions A2 (full at departure)* and A8 (empty at arrival)* shall be added for strength verification. Additional conditions (full and empty BW Tank no. 6 (P/S)) related to the intermediate conditions A3-A6 are not necessary as A2* and A8* will be the most critical one.

2.2   Case B

Fig. 2 shows Case B, with a cargo vessel where partial filling of BW Tank no. 6 (P/S) to a given level (f6-int%) will be done after a specified % consumables is reached, see conditions B2 and B3. Before this % consumables (shown as 50% in this Figure) is reached, BW Tank no. 6 (P/S) shall be kept empty. When reaching a given level of consumables (shown as 20% in Figure 2), BW Tank no. 6 (P/S) shall be kept full, see conditions B5 and B6. Two additional intermediate conditions (B4* and B7*) shall be added for longitudinal strength verification.

In order to categorize a vessel according to Case B, clear operational guidance for partial filling of ballast tanks, in association with the consumption level as shown in Figure 2, is to be given in the loading manual. If such operational guidance is not given, Case A is to be applied.

Case A has no limitation of consumables, whereas Case B has limitation of consumables.

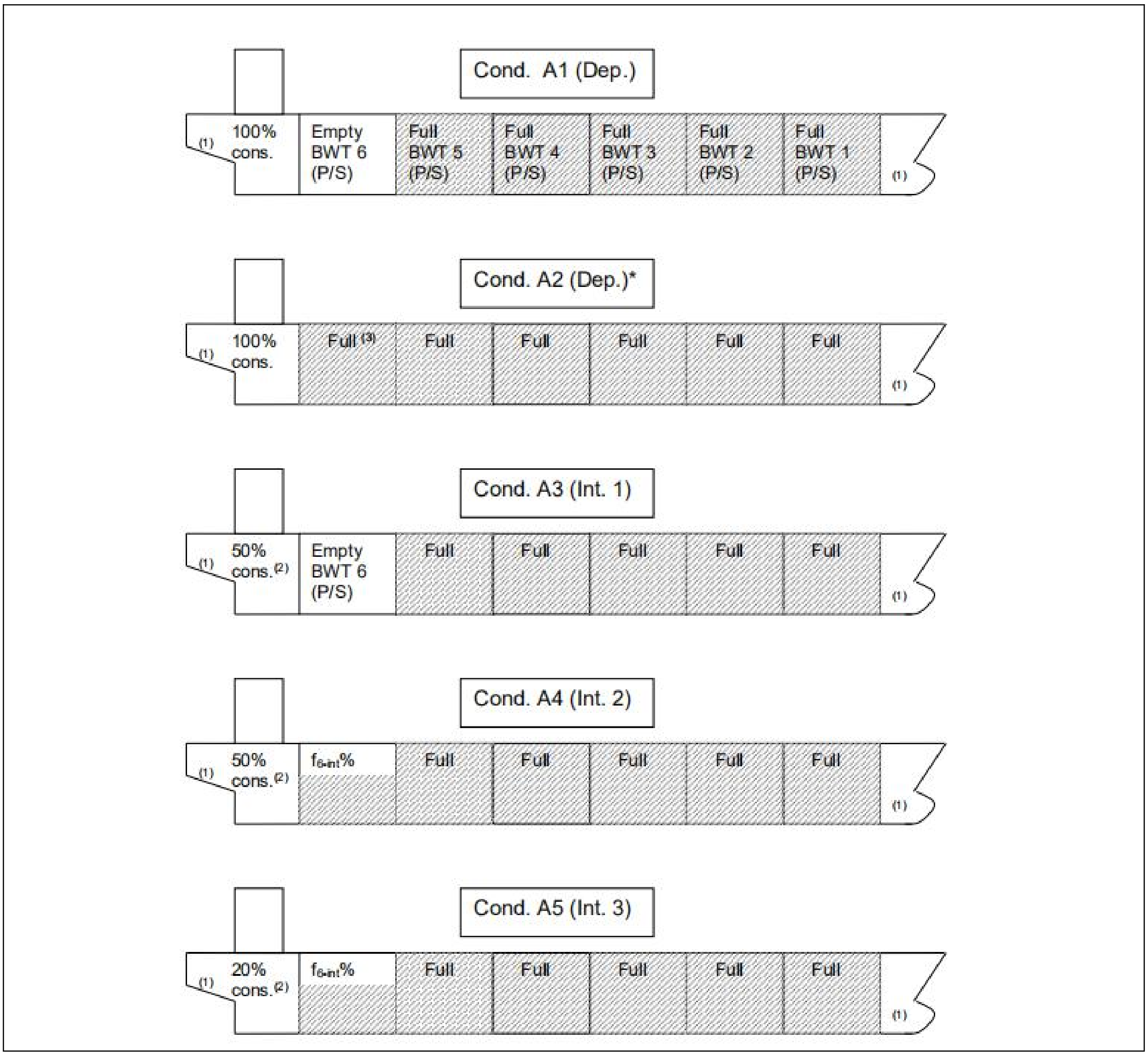
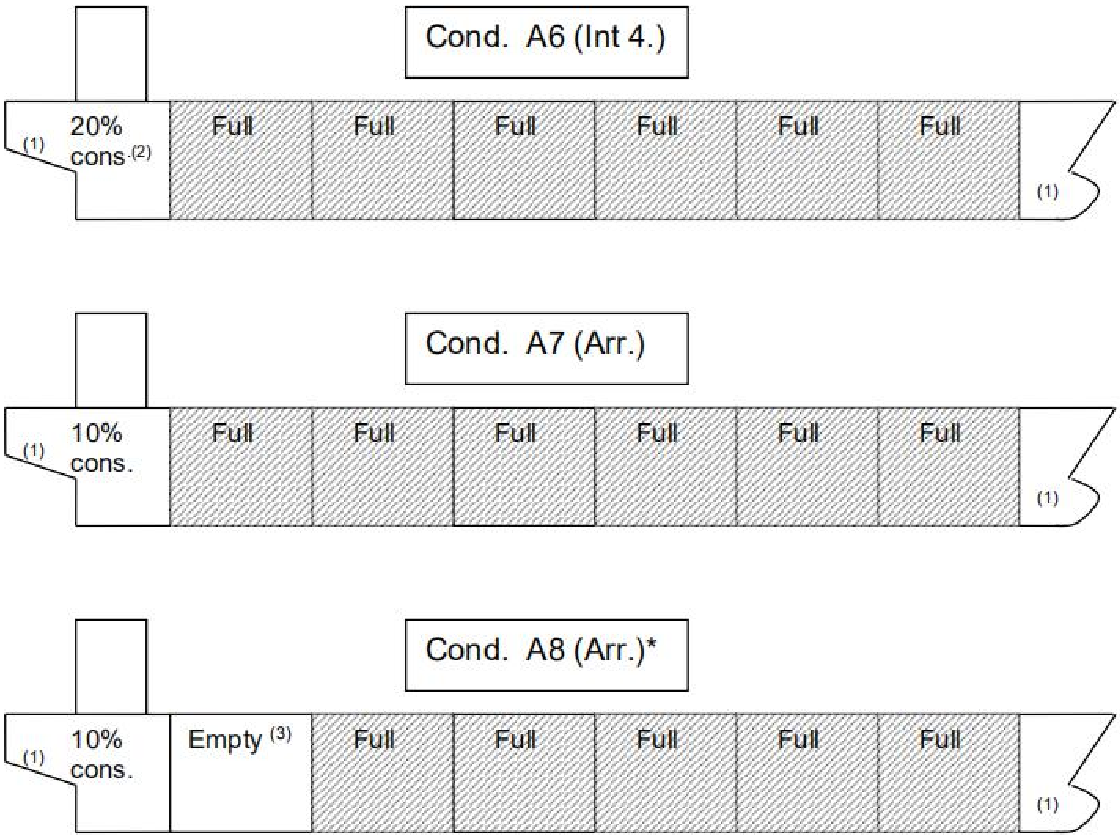


Figure 1 Case A, Partial filling of ballast tank no. 6 (P/S) is permitted at any stage during voyage. The intermediate conditions are specified, however other partial filling of BW Tank no. 6 (P/S) may be applied to keep acceptable trim and propeller immersion during the ballast voyage. Conditions only intended for strength verification (not operational) are marked: *



Notes

(1) For peak tanks intended to be partially filled, all combinations of full or partially filled at intended level for those tanks are to be investigated.

(2) The intermediate condition(s) to be specified incl. % consumables.

(3) For bulk carriers carrying ore and with large wing water ballast tanks full/empty may be replaced with maximum/minimum filling levels according to trim limitations given in S11.2.1.3.

Figure 1 (Continued)

Case A, Partial filling of ballast tank no. 6 (P/S) is permitted at any stage during voyage. The intermediate condition is specified, however other partial filling of BW Tank no. 6 (P/S) may be applied to keep acceptable trim and propeller immersion during the ballast voyage. Conditions only intended for strength verification (not operational) are marked: *

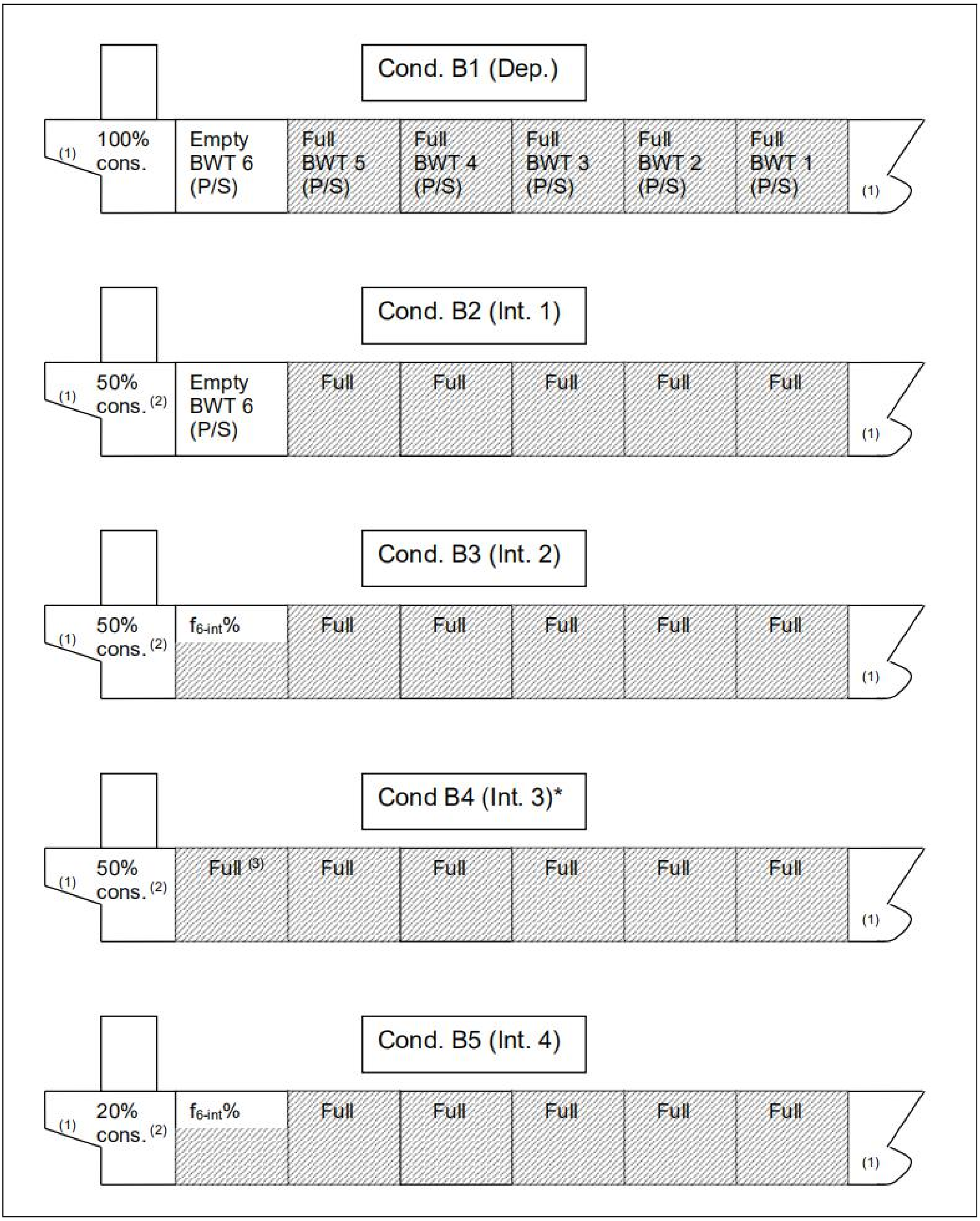
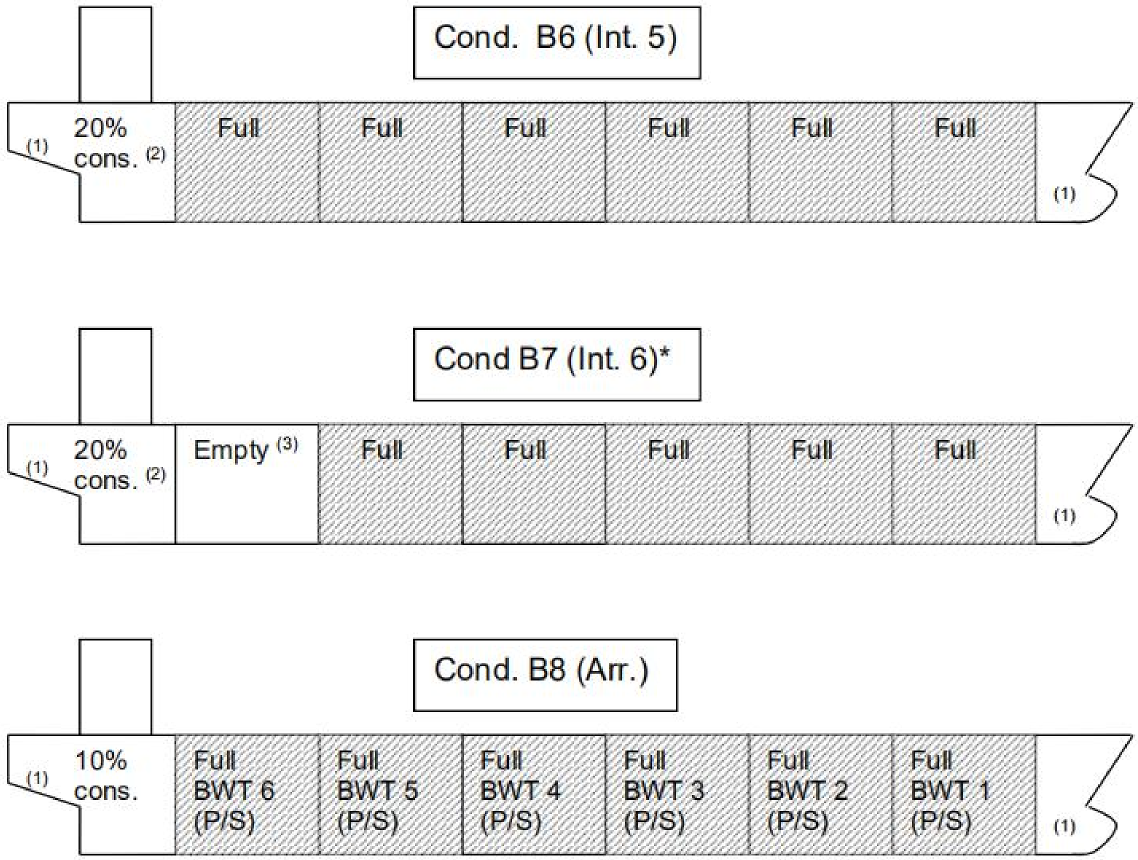


Figure 2 Case B, Partial filling of BW Tank no. 6 (P/S) only allowed during intermediate conditions, in this example between 50-20% consumables. Conditions only intended for strength verification (not operational) are marked: *



Notes

(1) For peak tanks intended to be partially filled, all combinations of full or partially filled at intended level for those tanks are to be investigated.

(2) The intermediate condition(s) to be specified incl. % consumables.

(3) For bulk carriers carrying ore and with large wing water ballast tanks full/empty may be replaced with maximum/minimum filling levels according to trim limitations given in S11.2.1.3.

Figure 2 (Continued)

Case B, Partial filling of BW Tank no. 6 (P/S) only allowed during intermediate conditions, in this example between 50-20% consumables. Conditions only intended for strength verification (not operational) are marked: *

3. Case C – Conventional (with usual arrangement of WBT) ore carrier with two pairs of partially filled ballast water tanks

Fig. 3(a) show the operational loading conditions, departure condition (C1), four intermediate conditions (C2-C5) and arrival condition (C6), for a conventional (with usual arrangement of WBT) ore carrier with partial filling of both BW tank no.1 (P/S) and 7 (P/S) during voyage.

Filling level in partially filled BW tanks nos.1 (P/S) and 7 (P/S) for the operational conditions during ballast voyage is given in Table 1.

Table 1

Loading condition	Consumables	Filling level, WBT 1(P/S)	Filling level, WBT 7(P/S)
C1–Departure	100%	f_{1dep}%	f_{7dep}%
C2–Intermediate 1	50%(1)	f_{1dep}%	f_{7dep}%
C3–Intermediate 2	50%(1)	f_{1int}%	f_{7int}%
C4–Intermediate 3	20%(1)	f_{1int}%	f_{7int}%
C5–Intermediate 4	20%(1)	f_{1arr}%	f_{7arr}%
C6–Arrival	10%	f_{1arr}%	f_{7arr}%

Note: (1) % consumables to be specified, indicated to 50% and 20 %.

Fig. 3(b) and Fig. 3(c) show the additional twelve loading conditions (C1-1 ~ C1-12) which shall be added for longitudinal strength verification of the departure condition (C1).

Fig. 3(d) and Fig. 3(i) show the additional 32 loading conditions (C2-1 ~ C2-12, C3-1 ~ C3-4, C4-1 ~ C4-12 and C5-1 ~ C5-4) which shall be added for longitudinal strength verification of the intermediate conditions (C2 ~ C5).

Fig. 3(j) and Fig. 3(k) show the additional twelve loading conditions (C6-1 ~ C6-12) which shall be added for longitudinal strength verification of the arrival condition (C6).

For the additional loading conditions, the maximum and the minimum filling level of BW tank are according to trim and propeller immersion limitations given in S11.2.1.3:

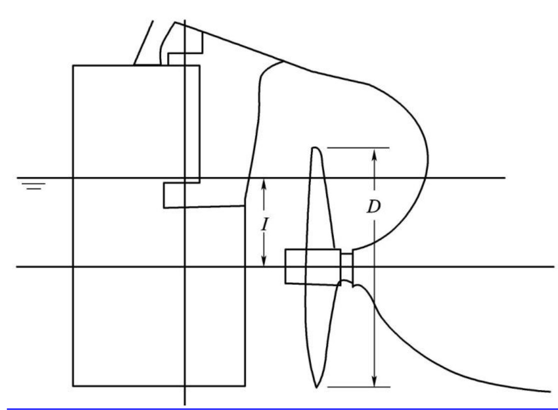
However, for conventional ore carriers with large wing water ballast tanks in cargo area, where empty or full ballast water filling levels of one or maximum two pairs of these tanks lead to the ship's trim exceeding one of the following conditions, it is sufficient to demonstrate compliance with maximum, minimum and intended partial filling levels of these one or maximum two pairs of ballast tanks such that the ship's condition does not exceed any of these trim limits. Filling levels of all other wing ballast tanks are to be considered between empty and full. The trim conditions mentioned above are:

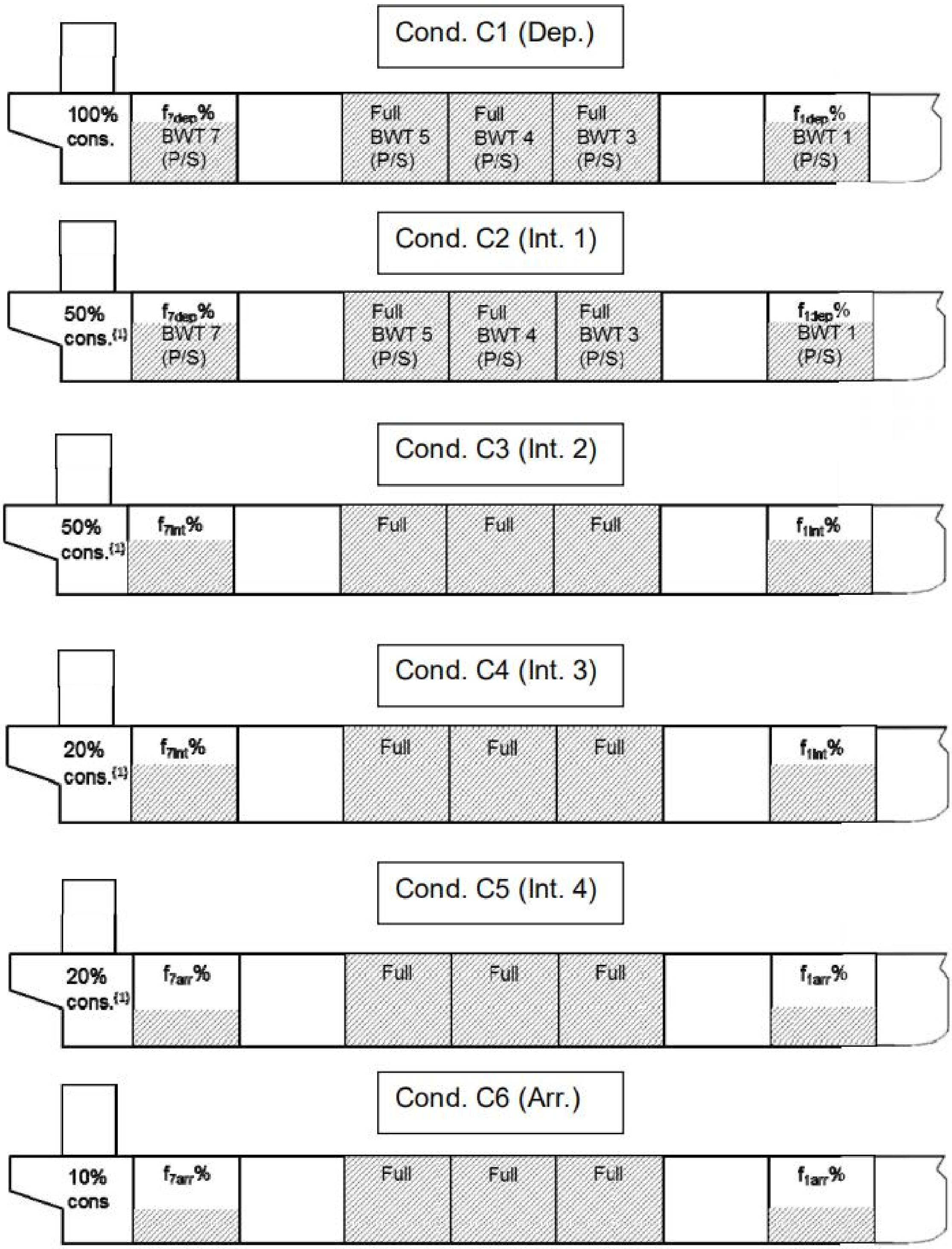
- trim by stern of 3% of the ship's length, or
- trim by bow of 1.5% of ship's length, or
- any trim that cannot maintain propeller immersion (I/D) not less than 25%, where;

I = the distance from propeller centerline to the waterline

D = propeller diameter

(see the following figure)





Notes

(1) The intermediate condition(s) to be specified incl. % consumables.

(2) Figures 3(b)-3(k): Maximum and minimum filling level of BW tank according to trim and propeller immersion limitations given in S11.2.1.3.

Figure 3(a) Case C, Ore Carrier. Partial filling of BW Tank no.1 (P/S) and 7 (P/S) during ballast voyage, operational conditions C1-C6.

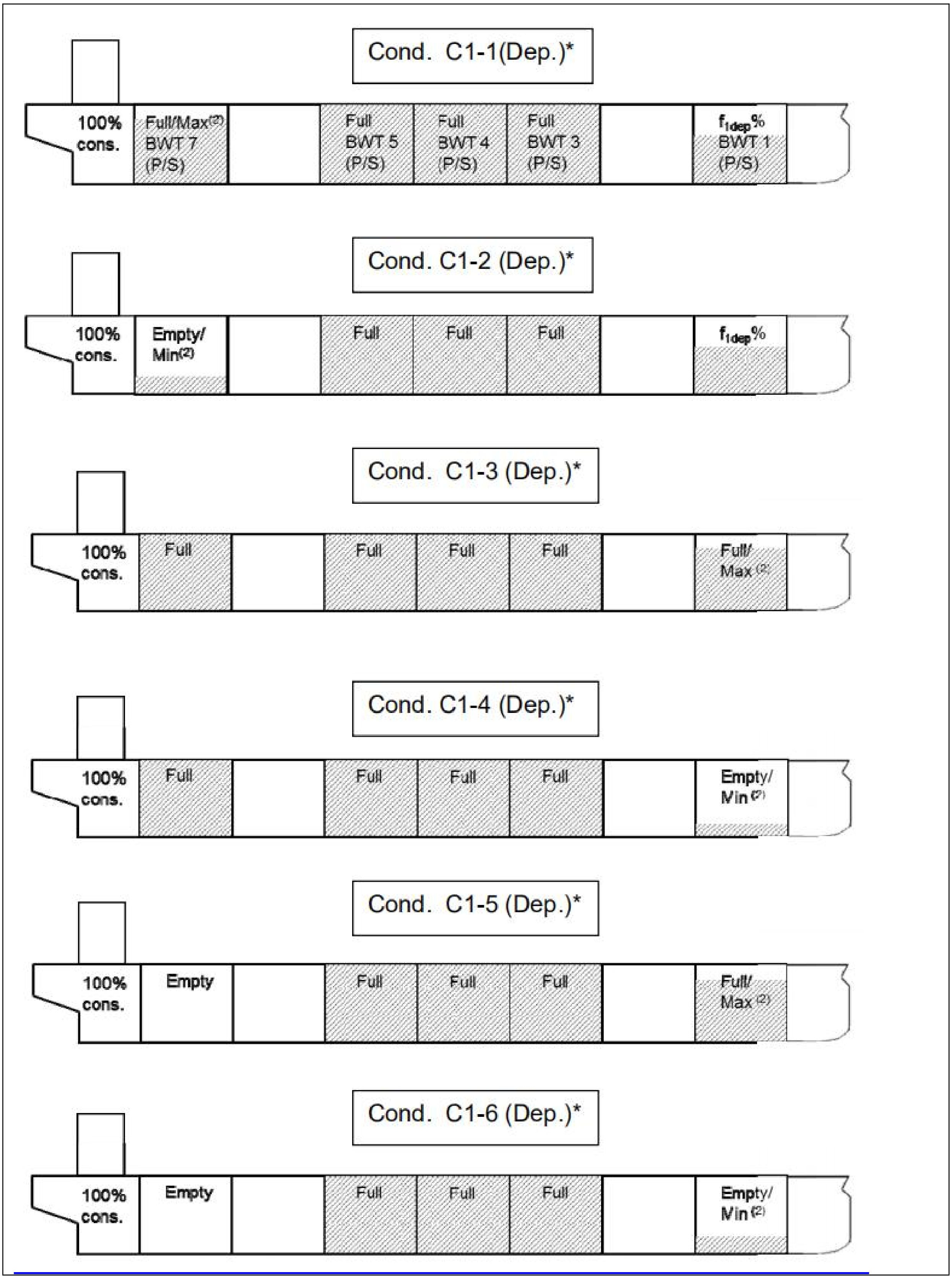


Figure 3(b) Case C, Ore Carrier. Partial filling of BW Tank no.1 (P/S) and 7 (P/S) during voyage. Departure conditions C1-1~C1-6, only intended for strength verification (not operational) are marked: *

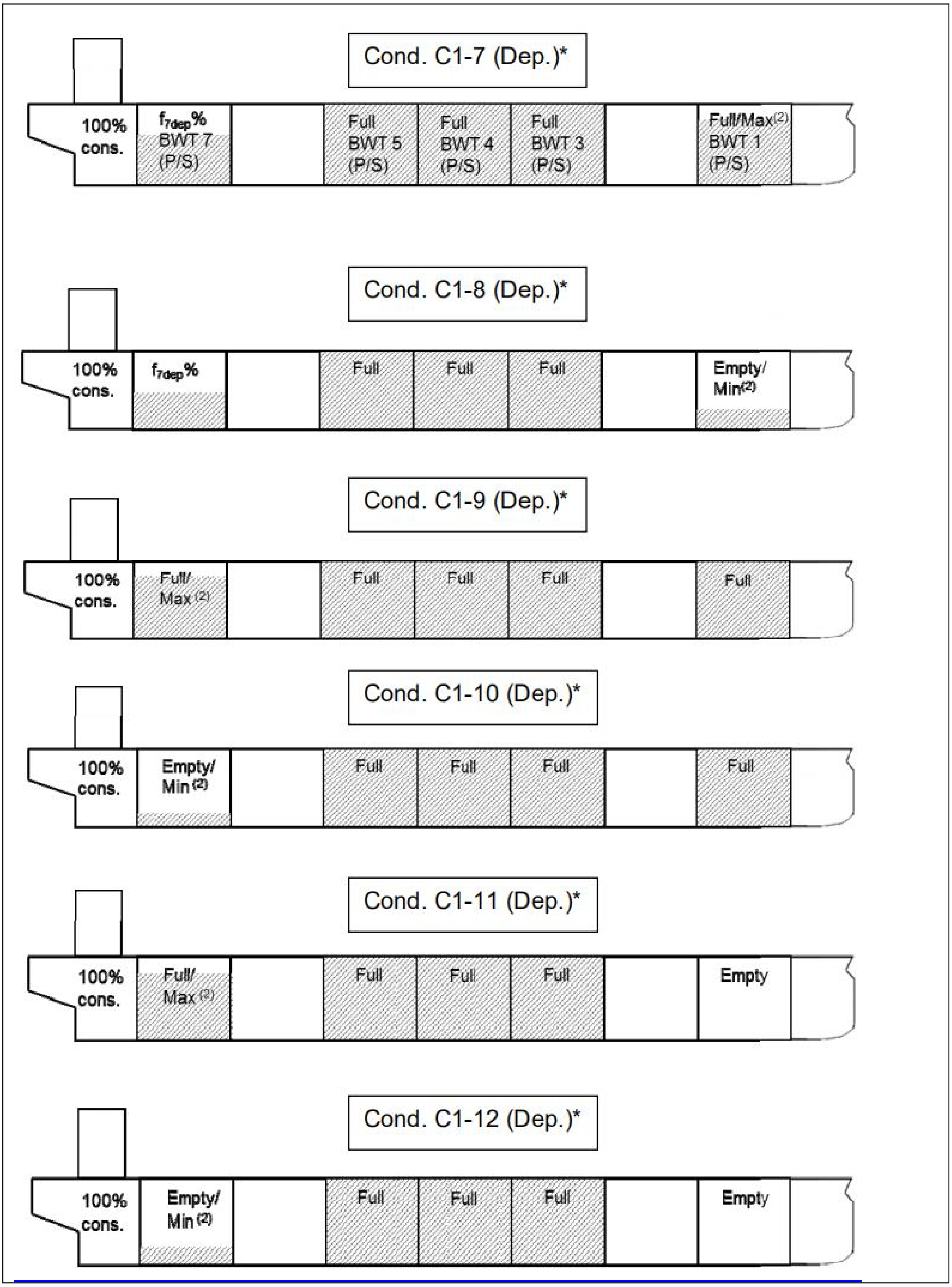


Figure 3(c) Case C, Ore Carrier. Partial filling of BW Tank no.1 (P/S) and 7 (P/S) during voyage. Departure conditions CD1-7~C1-12, only intended for strength verification (not operational) are marked: *

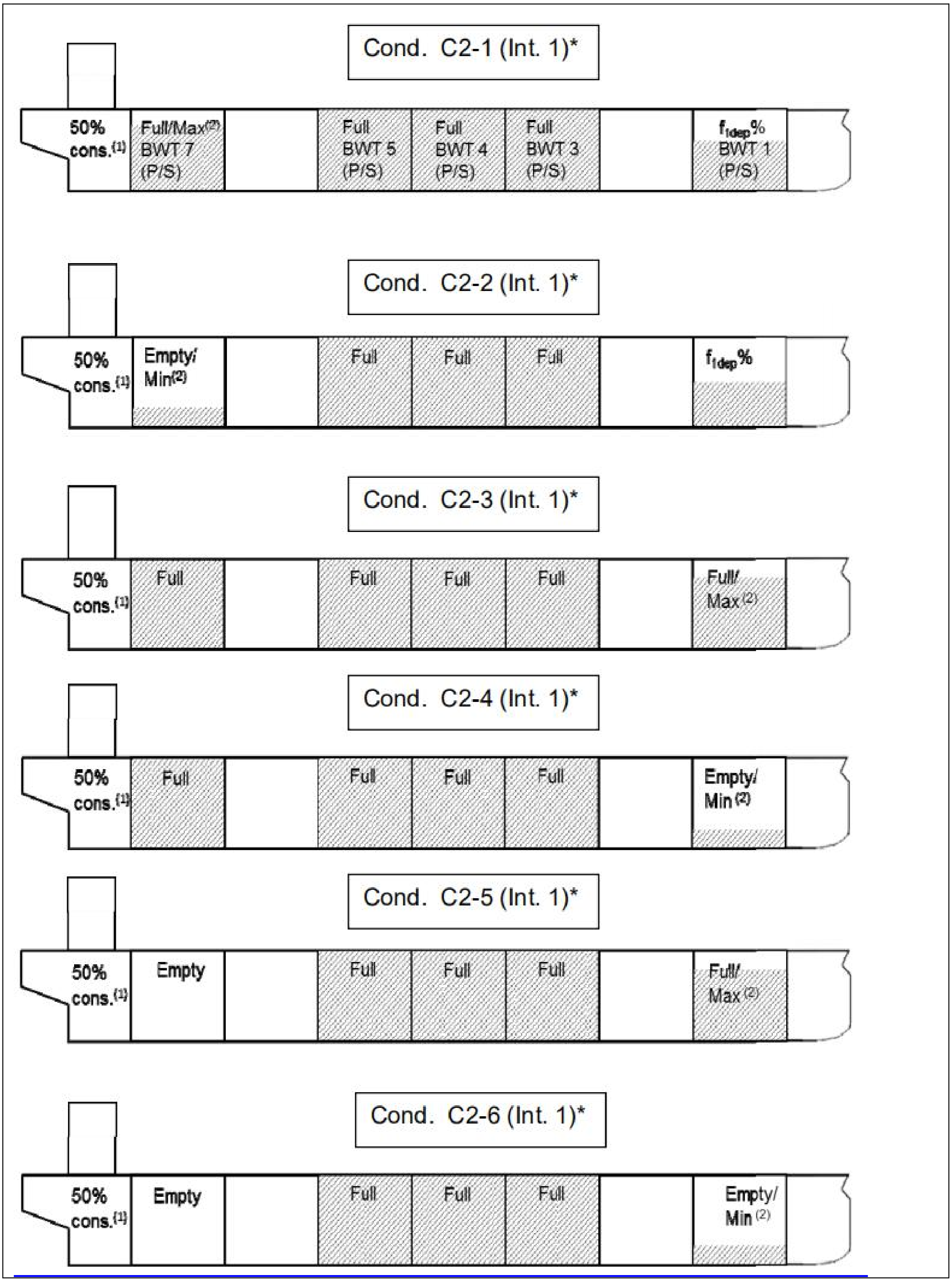


Figure 3(d) Case C, Ore Carrier. Partial filling of BW Tank no.1 (P/S) and 7 (P/S) during voyage. Intermediate conditions C2-1~C2-6, only intended for strength verification (not operational) are marked: *

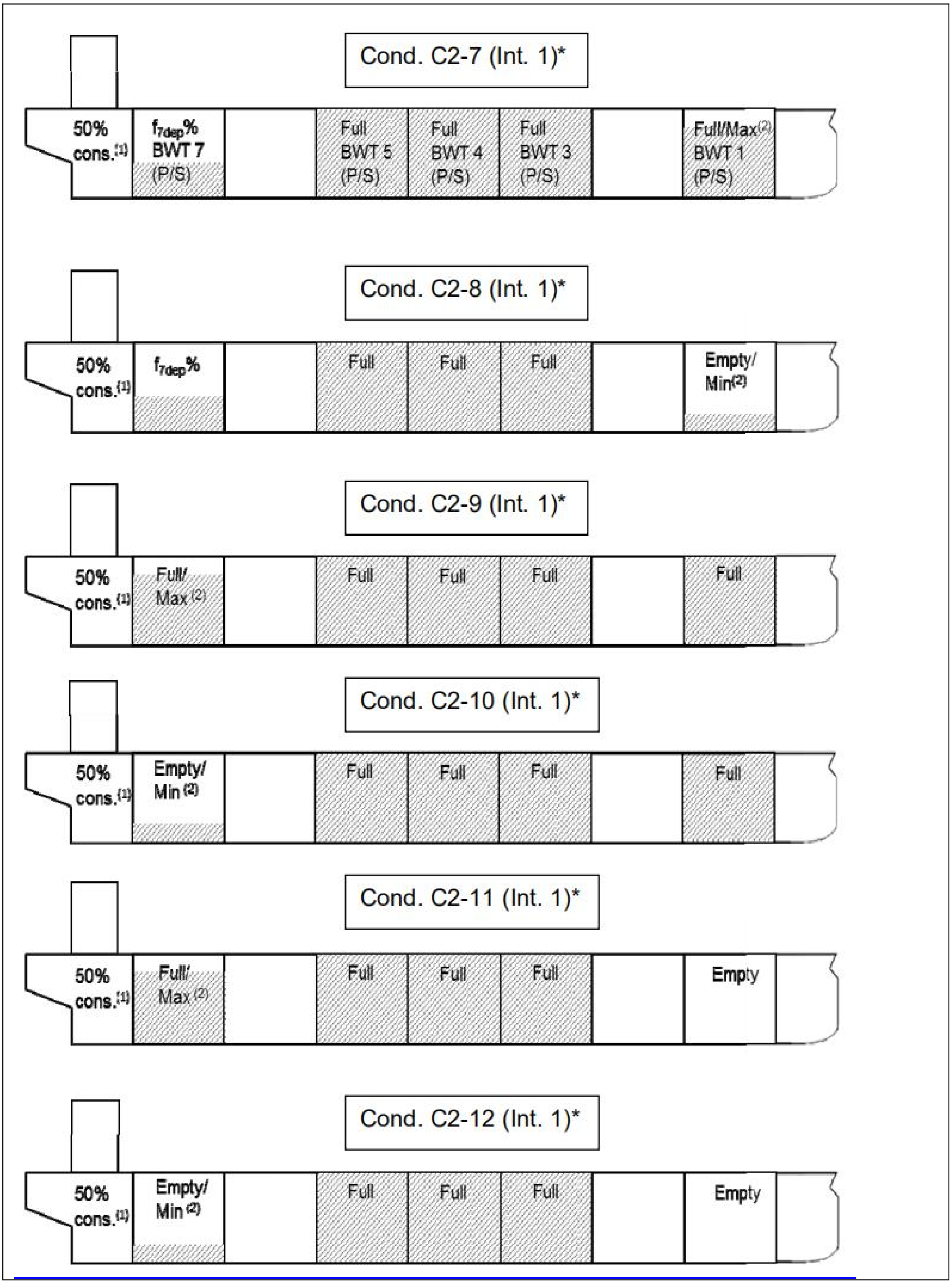


Figure 3(e) Case C, Ore Carrier. Partial filling of BW Tank no.1 (P/S) and 7 (P/S) during voyage. Intermediate conditions C2-7~C2-12, only intended for strength verification (not operational) are marked: *

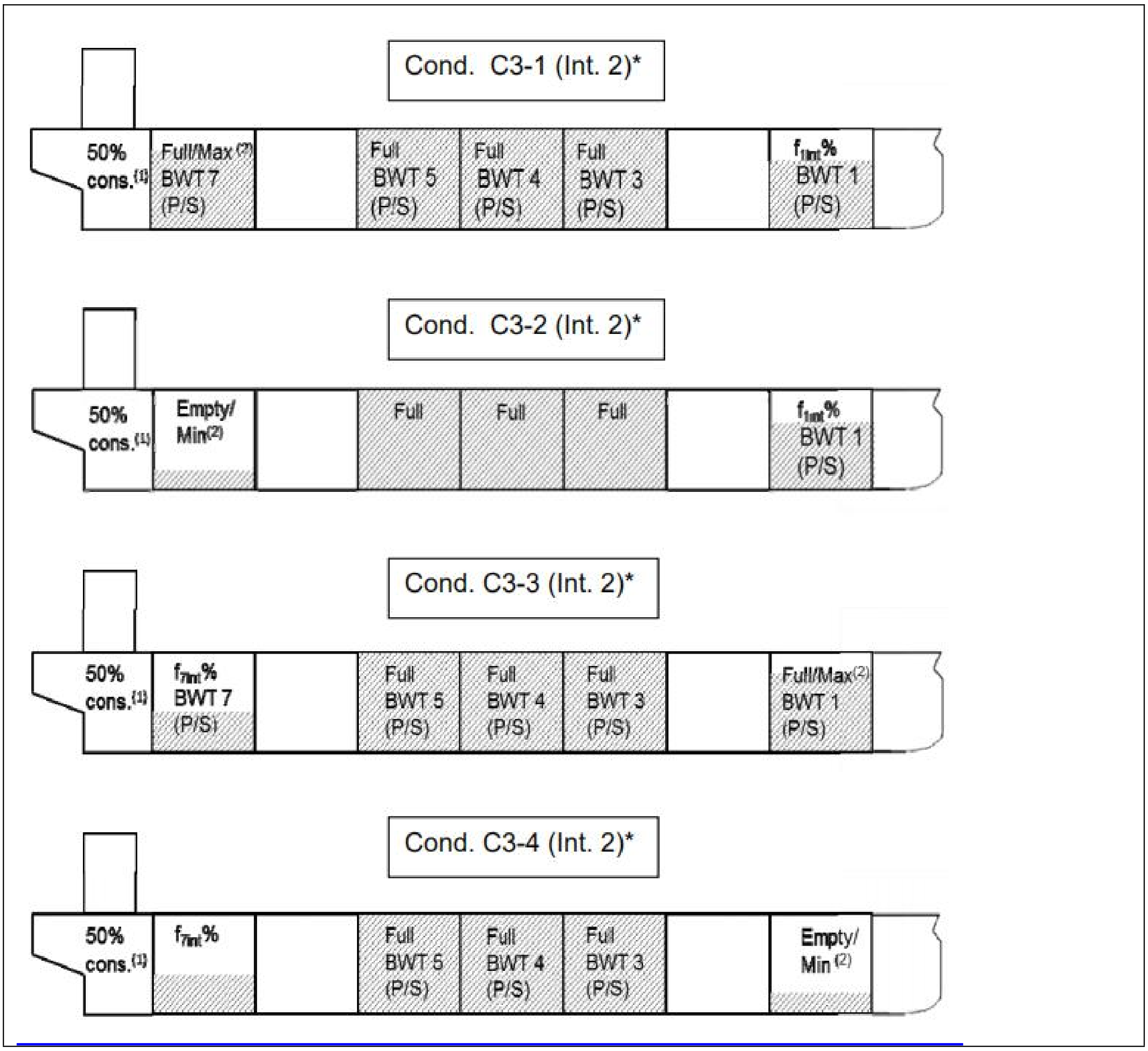


Figure 3(f) Case C, Ore Carrier. Partial filling of BW Tank no.1 (P/S) and 7 (P/S) during voyage. Intermediate conditions C3-1~C3-4, only intended for strength verification (not operational) are marked: *

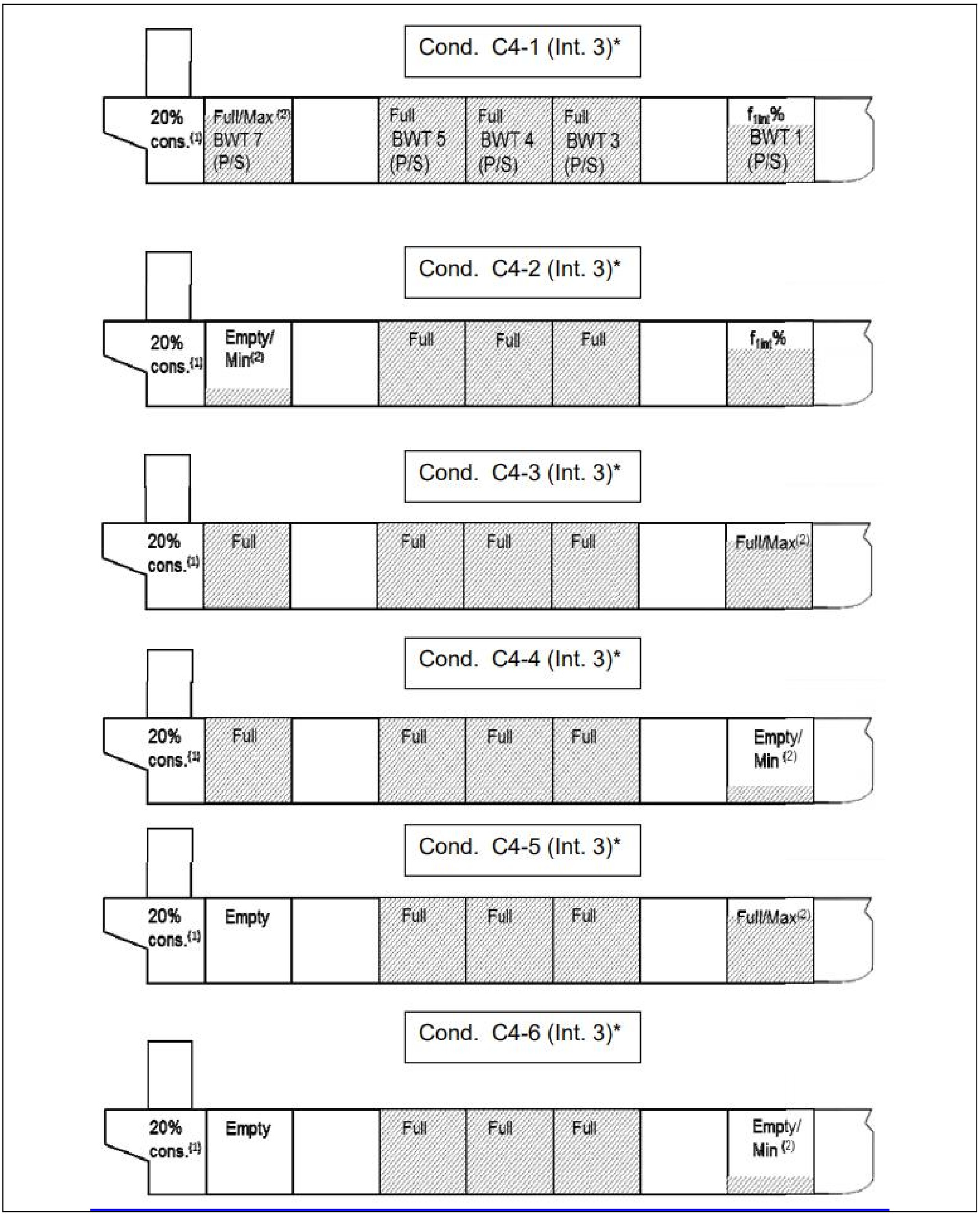


Figure 3(g) Case C, Ore Carrier. Partial filling of BW Tank no.1 (P/S) and 7 (P/S) during voyage. Intermediate conditions C4-1~C4-6, only intended for strength verification (not operational) are marked: *

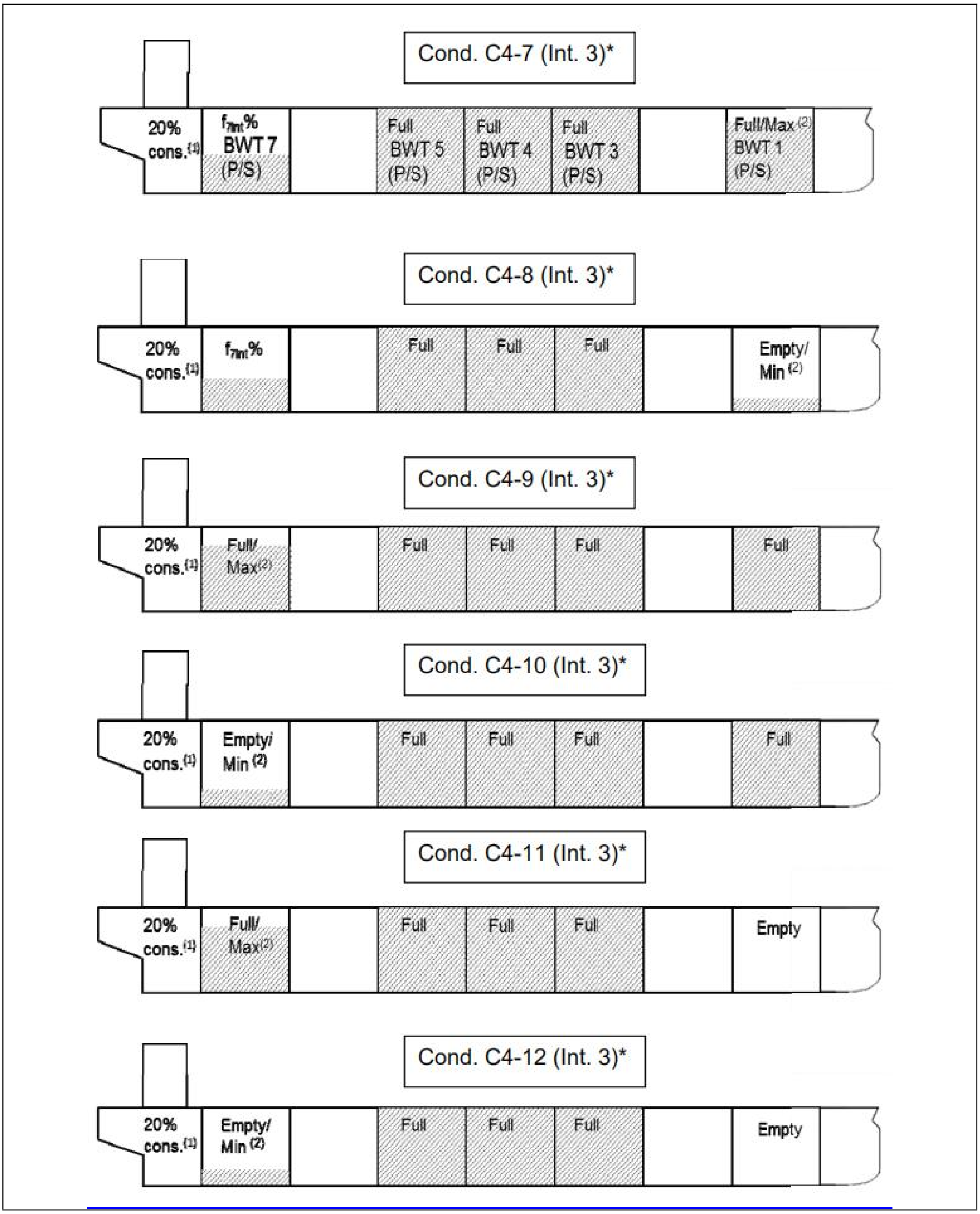


Figure 3(h) Case C, Ore Carrier. Partial filling of BW Tank no.1 (P/S) and 7 (P/S) during voyage. Intermediate conditions C4-7~C4-12, only intended for strength verification (not operational) are marked: *

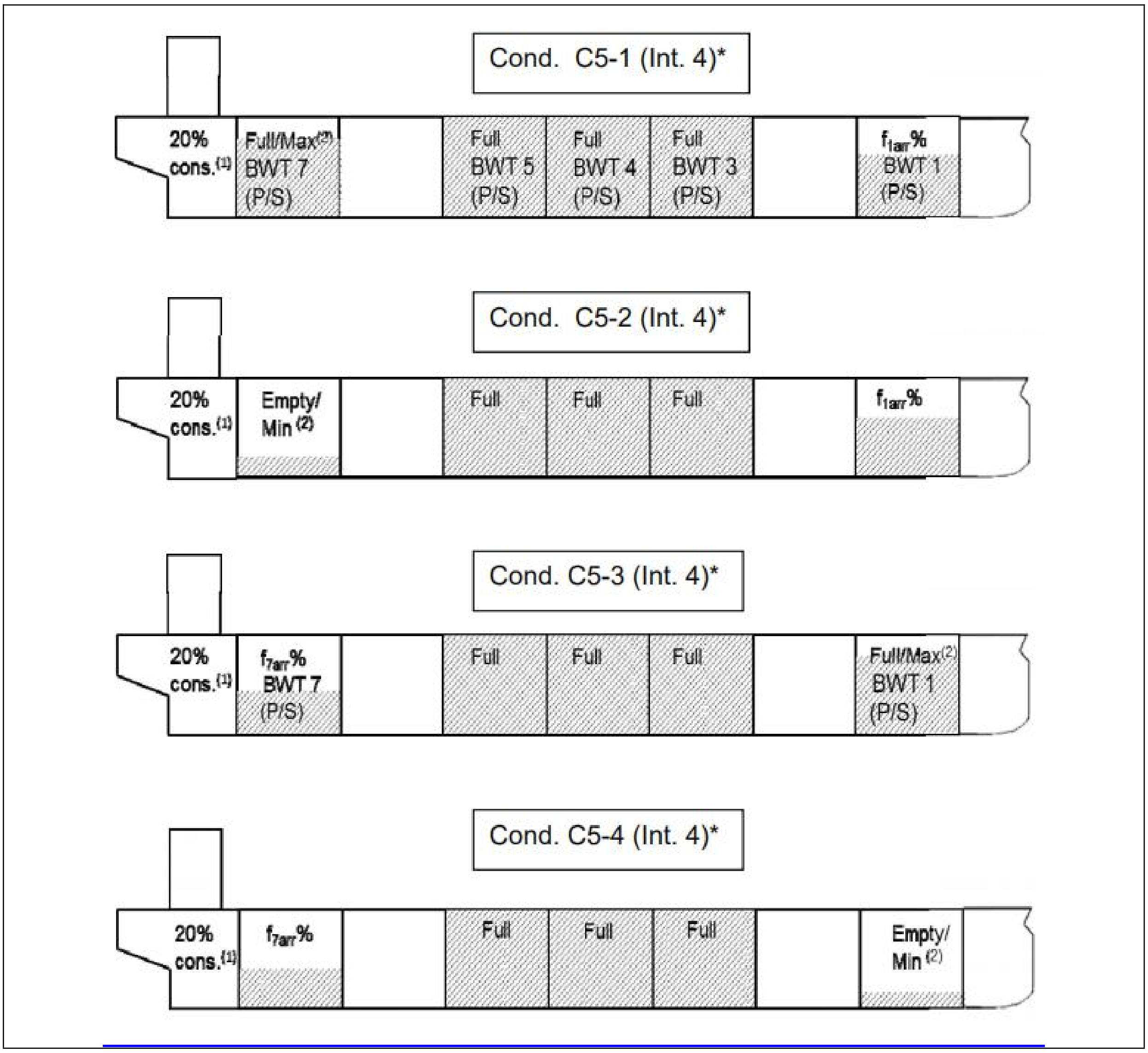


Figure 3(i) Case C, Ore Carrier. Partial filling of BW Tank no.1 (P/S) and 7 (P/S) during voyage. Intermediate conditions C5-1~C5-4, only intended for strength verification (not operational) are marked: *

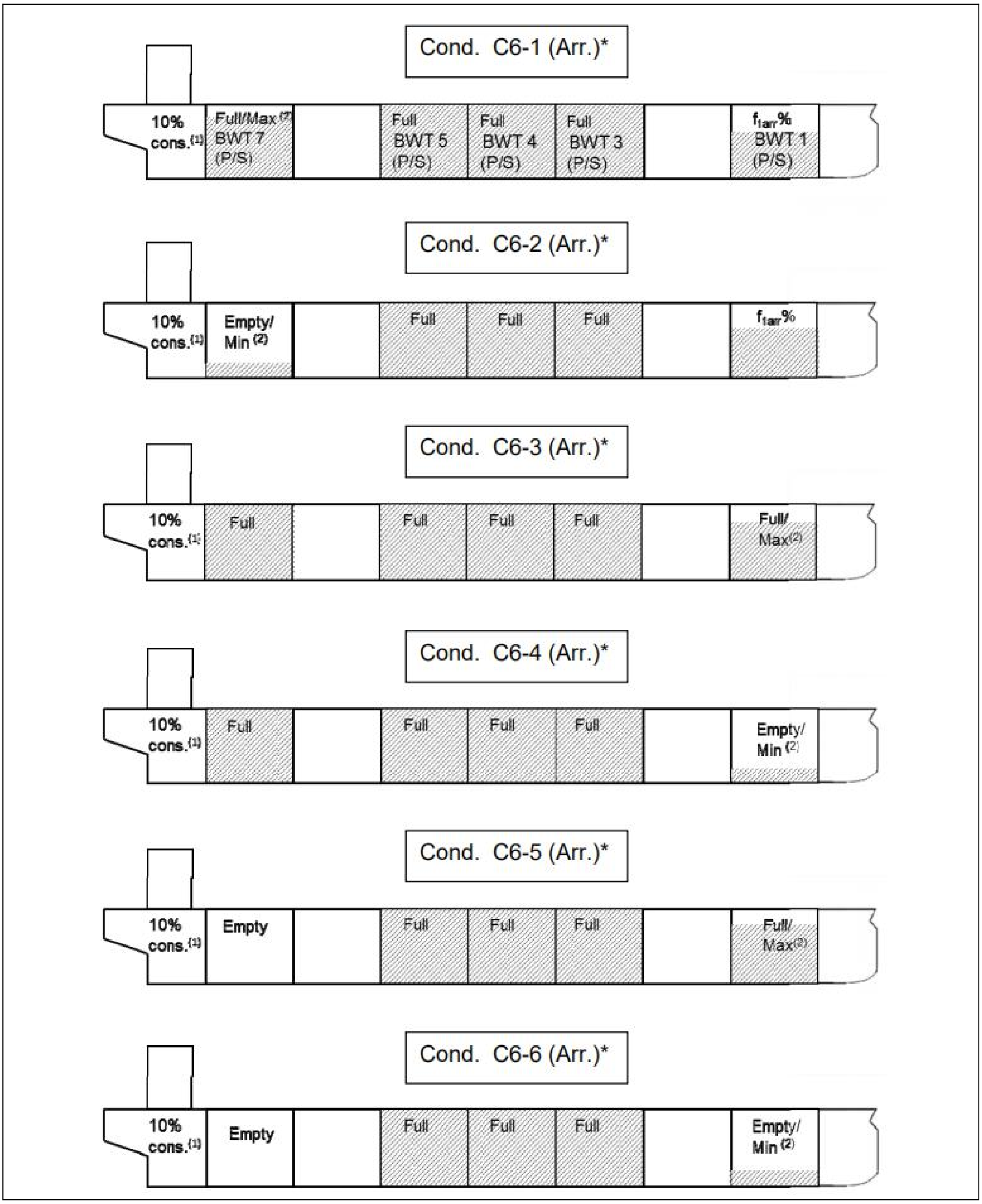


Figure 3(j) Case C, Ore Carrier. Partial filling of BW Tank no.1 (P/S) and 7 (P/S) during voyage. Arrival conditions C6-1~C6-6, only intended for strength verification (not operational) are marked: *

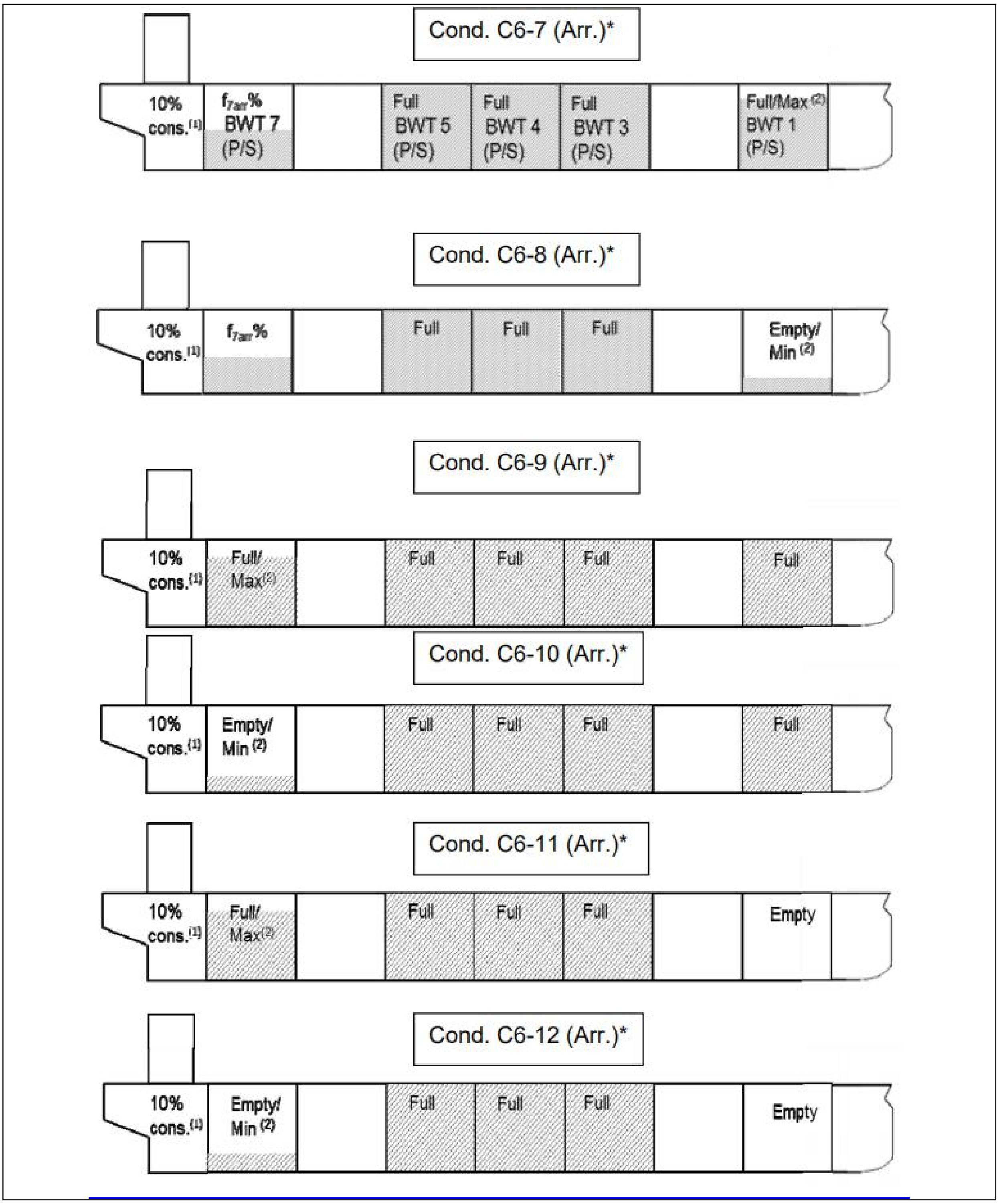


Figure 3(k) Case C, Ore Carrier. Partial filling of BW Tank no.1 (P/S) and 5 (P/S) during voyage. Arrival conditions C6-7~C6-12, only intended for strength verification (not operational) are marked: *

CHAPTER 3 EQUIPMENT AND OUTFITS

Section 2 ANCHORING AND MOORING EQUIPMENT

3.2.1 Equipment number

3.2.1.2 The equipment number N is to be obtained from the following formula:

$$N = \Delta^{\frac{2}{3}} + 2Bh + \frac{A}{10} \quad N = \Delta^{\frac{2}{3}} + 2(Bh + S_{fun}) + \frac{A}{10}$$

where: Δ — moulded displacement, in t, to the summer load waterline;

B — moulded breadth, in m;

h — effective height, in m, from the summer load waterline to the top of the uppermost house; the height h_i of the lowest tier is to be measured at the centreline from the upper deck or in a ship having a discontinuous upper deck, from the lowest line of the upper deck and the continuation of that line parallel to the raised part of the deck, see Figure 3.2.1.1(1), i.e.:

$$h = a + \sum h_i$$

where: a — vertical distance at hull side, in m, measured from the summer load waterline amidships to the upper deck;

h_i — height at the centreline, in m, of each tier of houses having a breadth greater than $B/4$; for the lowest tier h_1 is to be measured at centreline from the upper deck or from a notional deck line where there is local discontinuity in the upper deck, see Figure 3.2.1.1(1);

A — area, in m², in profile view of the hull, within the length of the vessel, and of superstructures and deckhouses and funnels above the summer load waterline, which are within the length of the vessel, and also having a breadth greater than $B/4$. The side projected area of the funnel is considered in A when A_{FS} is greater than zero. In this case, the side projected area of the funnel should be calculated between the upper deck, or notional deck line where there is local discontinuity in the upper deck, and the effective height h_F;

S_{fun} — effective front projected area of the funnel, in m², defined as:

$$S_{fun} = A_{FS} - S_{shield}$$

where: A_{FS} — front projected area of the funnel, in m², calculated between the upper deck at centreline, or notional deck line where there is local discontinuity in the upper deck, and the effective height h_F. A_{FS} is taken equal to zero if the funnel breadth is less than or equal to $B/4$ at all elevations along the funnel height;

h_F — effective height of the funnel, in m, measured from the upper deck at centreline, or notional deck line where there is local discontinuity in the upper deck, and the top of the funnel. The top of the funnel may be taken at the level where the funnel breadth reaches B/4;

S_{shield} — the section of front projected area A_{FS}, in m², which is shielded by all deck houses having breadth greater than $B/4$. If there are more than one shielded section, the individual shielded sections i.e $S_{shield1}$, $S_{shield\,2}$ etc as shown in Figure 3.2.1.2(3) to be added together. To determine S_{shield}, the deckhouse breadth is assumed B for all deck houses having breadth greater than $B/4$ as shown for $S_{shield1}$, $S_{shield2}$ in Figure 3.2.1.2(3).

When several funnels are fitted on the ship, the above parameters are taken as follows:

h_F — effective height of the funnel, in m, measured from the upper deck, or notional deck line where there is local discontinuity in the upper deck, and the top of the highest funnel. The top of the highest funnel may be taken at the level where the sum of each funnel breadth reaches $B/4$;

A_{FS} — sum of the front projected area of each funnel, in m^2, calculated between the upper deck, or notional deck line where there is local discontinuity in the upper deck, and the effective height h_F. A_{FS} is to be taken equal to zero if the sum of each funnel breadth is less than or equal to $B/4$ at all elevations along the funnels height;

A — Side projected area, in m^2, of the hull, superstructures, houses and funnels above the Summer Load waterline which are within the length of the ship. The total side projected area of the funnels is to be considered in the side projected area of the ship, A, when A_{FS} is greater than zero. The shielding effect of funnels in transverse direction may be considered in the total side projected area, i.e., when the side projected areas of two or more funnels fully or partially overlap, the overlapped area needs only to be counted once.

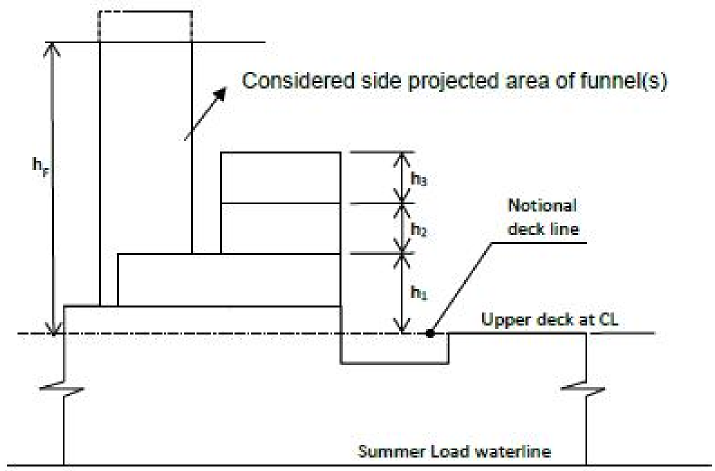


Figure 3.2.1.2(1)

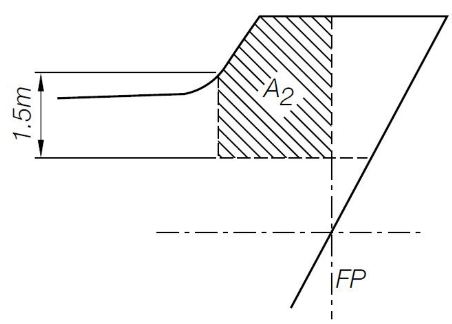


Figure 3.2.1.2(2)

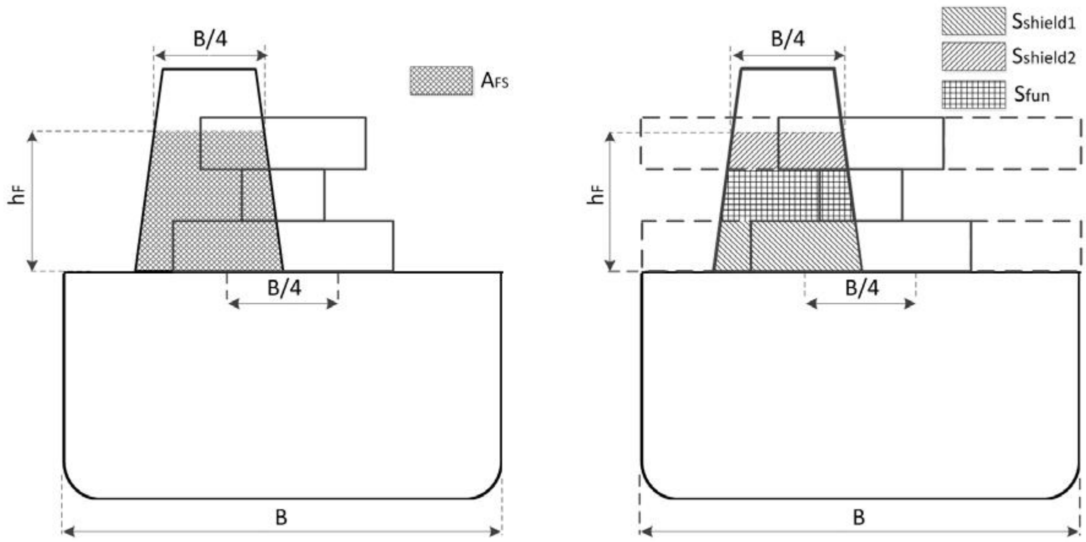


Figure 3.2.1.2(3)

Anchoring and Towing Equipment **Table 3.2.1.1(2)**

Serial NO.	Equipment No. N		Bower anchors		Stud link chain cable for bower anchors				Towlines		Mooring lines		
	Exceeding	Not exceeding	Number	Mass of each anchor (kg)	Total length (m)	Diameter			Min. length (m)	Ship design Min. breaking load (kN)	Number	Min. length each (m)	Ship design Min. breaking load (kN)
						CCS grade 1	CCS grade 2	CCS grade 3					
1	50	70	2	180	220	14	12.5		180	98~~.1~~	3	80	37
2	70	90	2	240	220	16	14		180	98~~.1~~	3	100	40
3	90	110	2	300	247.5	17.5	16		180	98~~.1~~	3	110	42
4	110	130	2	360	247.5	19	17.5		180	98~~.1~~	3	110	48
5	130	150	2	420	275	20.5	17.5		180	98~~.1~~	3	120	53
6	150	175	2	480	275	22	19		180	98~~.1~~	3	120	59
7	175	205	2	570	302.5	24	20.5		180	~~111.8~~112	3	120	64
8	205	240	2	660	302.5	26	22	20.5	180	~~129.4~~129	4	120	69
9	240	280	2	780	330	28	24	22	180	150	4	120	75
10	280	320	2	900	357.5	30	26	24	180	~~173.6~~174	4	140	80
11	320	360	2	1020	357.5	32	28	24	180	~~206.9~~207	4	140	85
12	360	400	2	1140	385	34	30	26	180	~~223.6~~224	4	140	96
13	400	450	2	1290	385	36	32	28	180	~~250.1~~250	4	140	107
14	450	500	2	1440	412.5	38	34	30	180	~~276.5~~277	4	140	117
15	500	550	2	1590	412.5	40	34	30	190	306~~.0~~	4	160	134
16	550	600	2	1740	440	42	36	32	190	338~~.3~~	4	160	143
17	600	660	2	1920	440	44	38	34	190	370~~.7~~	4	160	160
18	660	720	2	2100	440	46	40	36	190	406~~.0~~	4	160	171

Serial NO.	Equipment No. N		Bower anchors		Stud link chain cable for bower anchors				Towlines		Mooring lines		
	Exceeding	Not exceeding	Number	Mass of each anchor (kg)	Total length (m)	Diameter			Min. length (m)	Ship design Min. breaking load (kN)	Number	Min. length each (m)	Ship design Min. breaking load (kN)
						CCS grade 1	CCS grade 2	CCS grade 3					
19	720	780	2	2280	467.5	48	42	36	190	441~~.3~~	4	170	187
20	780	840	2	2460	467.5	50	44	38	190	~~480.0~~479	4	170	202
21	840	910	2	2640	467.5	52	46	40	190	~~517.8~~518	4	170	218
22	910	980	2	2850	495	54	48	42	190	559~~.0~~	4	170	235
23	980	1060	2	3060	495	56	50	44	200	603~~.1~~	4	180	250
24	1060	1140	2	3300	495	58	50	46	200	647~~.2~~	4	180	272
25	1140	1220	2	3540	522.5	60	52	46	200	691~~.4~~	4	180	293
26	1220	1300	2	3780	522.5	62	54	48	200	738~~.4~~	4	180	309
27	1300	1390	2	4050	522.5	64	56	50	200	~~785.5~~786	4	180	336
28	1390	1480	2	4320	550	66	58	50	200	~~835.5~~836	4	180	352
29	1480	1570	2	4590	550	68	60	52	220	888~~.5~~	5	190	352
30	1570	1670	2	4890	550	70	62	54	220	941~~.4~~	5	190	362
31	1670	1790	2	5250	577.5	73	64	56	220	1024	5	190	384
32	1790	1930	2	5610	577.5	76	66	58	220	1109	5	190	411
33	1930	2000	2	6000	577.5	78	68	60	220	1168	5	190	437
34	2000	2080	2	6000	577.5	78	68	60	220	1168			
35	2080	2230	2	6450	605	81	70	62	240	1259			
36	2230	2380	2	6900	605	84	73	64	240	1356			
37	2380	2530	2	7350	605	87	76	66	240	1453			
38	2530	2700	2	7800	632.5	90	78	68	260	1471			
39	2700	2870	2	8300	632.5	92	81	70	260	1471			
40	2870	3040	2	8700	632.5	95	84	73	260	1471			
41	3040	3210	2	9300	660	97	84	76	280	1471			
42	3210	3400	2	9900	660	100	87	78	280	1471			
43	3400	3600	2	10500	660	102	90	78	280	1471			
44	3600	3800	2	11100	687.5	105	92	81	300	1471			
45	3800	4000	2	11700	687.5	107	95	84	300	1471			
46	4000	4200	2	12300	687.5	111	97	87	300	1471			
47	4200	4400	2	12900	715	114	100	87	300	1471			
48	4400	4600	2	13500	715	117	102	90	300	1471			
49	4600	4800	2	14100	715	120	105	92	300	1471			
50	4800	5000	2	14700	742.5	122	107	95	300	1471			
51	5000	5200	2	15400	742.5	124	111	97	300	1471			
52	5200	5500	2	16100	742.5	127	111	97	300	1471			

Serial NO.	Equipment No. N		Bower anchors		Stud link chain cable for bower anchors				Towlines		Mooring lines		
	Exceeding	Not exceeding	Number	Mass of each anchor (kg)	Total length (m)	Diameter			Min. length (m)	Ship design Min. breaking load (kN)	Number	Min. length each (m)	Ship design Min. breaking load (kN)
						CCS grade 1	CCS grade 2	CCS grade 3					
53	5500	5800	2	16900	742.5	130	114	100	300	1471			
54	5800	6100	2	17800	742.5	132	117	102	300	1471			
55	6100	6500	2	18800	742.5		120	107					
56	6500	6900	2	20000	770		124	111					
57	6900	7400	2	21500	770		127	114					
58	7400	7900	2	23000	770		132	117					
59	7900	8400	2	24500	770		137	122					
60	8400	8900	2	26000	770		142	127					
61	8900	9400	2	27500	770		147	132					
62	9400	10000	2	29000	770		152	132					
63	10000	10700	2	31000	770			137					
64	10700	11500	2	33000	770			142					
65	11500	12400	2	35500	770			147					
66	12400	13400	2	38500	770			152					
67	13400	14600	2	42000	770			157					
68	14600	16000	2	46000	770			162					

3.2.4 Towlines and mooring lines

3.2.4.1 The number, length and breaking loads of mooring lines are to be marked on the mooring arrangement plan of the ship. The towlines listed in Table 3.2.1.1(2) are provided on board for the tug or for the use by other ships towing the ship. The lateral projected area of deck cargoes as given in the loading manual is to be taken into account during the calculation of equipment number for selection of towing lines. As an alternative method to 3.2.4, the number and strength of mooring lines may be determined by means of direct mooring analysis of Appendix 2 of this Chapter.

3.2.4.3 The strength of mooring lines and the number of head, stern, and breast lines (see Figure 3.2.4.2) for ships with an Equipment Number EN > 2000 are based on the side-projected area A_1. Side projected area A_1 is to be calculated similar to the side-projected area A according to 3.2.1.2 but considering the following conditions:

~~For oil tankers, chemical tankers, bulk carriers, and ore carriers the lightest b~~Ballast draft is to be considered for the calculation of the side-projected area A_1. ~~For other ships the lightest draft of usual loading conditions is to be considered if the ratio of the freeboard in the lightest draft and the full load condition is equal to or above two. Usual loading conditions mean loading conditions as given by the trim and stability booklet that are to be expected to regularly occur during operation and, in particular, excluding light weight conditions, propeller inspection conditions, etc.~~ For ship types with small change of draft, e.g. passenger ships and ro-ro ships, the summer load waterline may be used for the calculation of the side-projected area A_1.

Wind shielding of the pier can be considered for the calculation of the side-projected area A_1 unless the ship is intended to be regularly moored to jetty type piers. A height of the pier surface of 3 m over waterline may be assumed, i.e. the lower part of the side projected area with a height of 3 m above the waterline for the considered loading condition may be disregarded for the calculation of the side-projected area A_1.

Deck cargo as given by the ~~loading manual~~ nominal capacity condition (as defined in 3.6.2.10 of this Chapter) is to be included for the determination of side-projected area A_1. The summer load waterline may be used for the calculation of condition with deck cargo. Deck cargo may not need to be considered if a ~~usual light~~ ballast draft condition ~~without cargo on deck~~ generates a larger side-projected area A_1 than the full load condition with cargo on deck. The larger of both side-projected areas is to be chosen as side-projected area A_1.

(1) The mooring lines as given here under are based on a maximum current speed of 1.0 m/s and the following maximum wind speed, in m/s:

V_W	$= 25 - 0.002(A_1 - 2000)$	for passenger ships, ferries, and car carriers with 2000 m^2 < $A_1 \leqslant$ 4000 m^2
	$= 21$	for passenger ships, ferries, and car carriers with A_1 > 4000 m^2
	$= 25$	for other ships

The wind speed is considered representative of a 30 second mean speed from any direction and at a height of 10 m above the ground. The current speed is considered representative of the maximum current speed acting on bow or stern (±10°) and at a depth of one-half of the mean draft. Furthermore, it is considered that ships are moored to solid piers that provide shielding against cross current. Additional loads caused by, e.g., higher wind or current speeds, cross currents, additional wave loads, or reduced shielding from non-solid piers may need to be particularly considered. Furthermore, it is to be observed that unbeneficial mooring layouts can considerably increase the loads on single mooring lines.

Breast line: A mooring line that is deployed perpendicular to the ship, restraining the ship in the off-berth direction.

Spring line: A mooring line that is deployed almost parallel to the ship, restraining the ship in fore or aft direction.

Head/Stern line: A mooring line that is oriented between longitudinal and transverse direction, restraining the ship in the off-berth and in fore or aft direction. The amount of restraint in fore or aft and off-berth direction depends on the line angle relative to these directions.

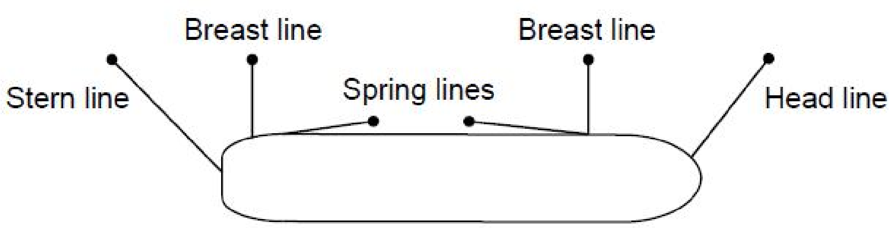


Figure 3.2.4.2 Breast line, spring line, head/stern line

(2) The ship design minimum breaking strength, in kN, of the mooring lines for ships with EN>2000 is not to be less than the value obtained from the following formula and to be limited to 1275 kN:

~~$MBL = 0.1 \cdot A_1 + 350$~~ $MBL_{SD} = 0.1 \cdot A_1 + 350$ kN

However, in this case the mooring lines are to be considered as not sufficient for the wind speed given in (1), the acceptable wind speed V_W^*, in m/s, can be estimated as follows:

~~$$V_W^* = V_W \sqrt{\frac{MBL^*}{MBL}}$$~~

$$V_W^* = V_W \sqrt{\frac{MBL_{SD}{}^*}{MBL_{SD}}}$$

where: V_w is the wind speed as per (1);

MBL_{SD}^* is the ship design minimum breaking strength of the mooring lines intended to be supplied, to be taken less than corresponding to an acceptable wind speed of 21 m/s:

$$MBL^* \geq \left(\frac{21}{V_W}\right)^2 \cdot MBL$$

$$MBL^*_{SD} \geq \left(\frac{21}{V_W}\right)^2 \cdot MBL_{SD}$$

~~MBL~~ MBL_{SD} — the breaking strength as recommended according to the formula in (2).

If lines are intended to be supplied for an acceptable wind speed V_W^* higher than V_W as per (1), the ship design minimum breaking strength is to be taken as:

$$MBL^* = \left(\frac{V_W^*}{V_W}\right)^2 \cdot MBL$$

$$MBL^*_{SD} = \left(\frac{V_W^*}{V_W}\right)^2 \cdot MBL_{SD}$$

(3) The total number of head, stern and breast lines for ships with EN>2000 is not to be less than:

$$n = 8.3 \cdot 10^{-4} \cdot A_1 + 6$$

For oil tankers, chemical tankers, bulk carriers, and ore carriers the total number of head, stern and breast lines is to be taken as:

$$n = 8.3 \cdot 10^{-4} \cdot A_1 + 4$$

The total number of head, stern and breast lines is to be rounded to the nearest whole number.

(4) The number of head, stern and breast lines may be increased or decreased in conjunction with an adjustment to the strength of the lines. The adjusted strength, MBL^{**}_{SD}, is to be taken as:

~~$MBL^* = 1.2 \cdot MBL \cdot n / n^* \leq MBL$~~ $MBL^{**}_{SD} = 1.2 \cdot MBL_{SD} \cdot n / n^{**} \leq MBL_{SD}$ for increased number of lines,

~~$MBL^* = MBL \cdot n / n^*$~~ $MBL^{**}_{SD} = MBL_{SD} \cdot n / n^{**}$ for reduced number of lines.

where: MBL_{SD} is MBL_{SD} or MBL^*_{SD} specified in (1) and (2) of this paragraph;

n^{**} is the increased or decreased total number of head, stern and breast lines;

n the number of lines for the considered ship type as calculated by the above formulas without rounding.

(5) The total number of spring lines is to be taken not less than:

Two lines where EN < 5000,

Four lines where EN ⩾ 5000.

The ship design minimum breaking strength of spring lines is to be the same as that of the head, stern and breast lines. If the number of head, stern and breast lines is increased in conjunction with an adjustment to the ship design minimum breaking strength of the lines, the number of spring lines is to be ~~likewise~~ increased in accordance with the following formula, but rounded up to the nearest even number.

$$n_S^* = MBL_{SD} / MBL^{**}_{SD} \cdot n_S$$

where: MBL_{SD} is MBL_{SD} or MBL^*_{SD} specified in (1) and (2) of this paragraph;

n_S is the number of spring lines;

n_S^* is the increased number of spring lines.

Section 6 SHIPBOARD FITTINGS AND SUPPORTING HULL STRUCTURES ASSOCIATED WITH TOWING AND MOORING ON CONVENTIONAL VESSELS

3.6.2 Definitions

3.6.2.10 The nominal capacity condition is defined as the theoretical condition where the maximum possible deck cargoes are included in the ship arrangement in their respective positions. For container ships the nominal capacity condition represents the theoretical condition where the maximum possible number of containers is included in the ship arrangement in their respective positions.
3.6.2.11 Ship Design Minimum Breaking Load (MBL_{SD}) means the minimum breaking load of new, dry mooring lines or tow line for which shipboard fittings and supporting hull structures are designed in order to meet mooring restraint requirements or the towing requirements of other towing service.
3.6.2.12 Line Design Break Force (LDBF) means the minimum force that a new, dry, spliced, mooring line will break at. This is for all synthetic cordage materials.

3.6.3 Towing

3.6.3.1 The strength of shipboard fittings used for normal towing or other towing operations at bow, sides and stern and their supporting hull structures are to comply with the requirements of 3.6.3.2 to 3.6.3.6 of this Section. For fittings intended to be used for, both, towing and mooring, 3.6.4 applies to mooring.

3.6.3.3 Load considerations

The minimum design load applied to supporting hull structures for shipboard fittings is to be:

(1) For normal towing operations, 1.25 times the intended maximum towing load (e.g. static bollard pull) as indicated on the towing and mooring arrangements plan.

(2) For other towing service, the ~~nominal~~ ship design minimum breaking load of the towline corresponding to equipment no. *N* in Table 3.2.1.1(2) is to be applied.

Note: Side projected area including ~~maximum stacks~~ that of deck cargoes as given by the ~~loading manual~~ ship nominal capacity condition is to be taken into account for selection of towing lines and the breaking loads of towing lines are used as the design loads.

(3) For fittings intended to be used for, both, normal and other towing operations, the greater of the design loads according to (1) and (2).

(4) When a safe towing load TOW greater than that determined according to 3.6.3.6 is requested by the applicant, then the design load is to be increased in accordance with the appropriate TOW/design load relationship.

(5) The design load is to be applied to fittings in all directions that may occur by taking into account the arrangement shown on the towing and mooring arrangements plan. Where the towing line takes a turn at a fitting the total design load applied to the fitting is equal to the resultant of the design loads acting on the line, however, the load need not be more than twice the design load.

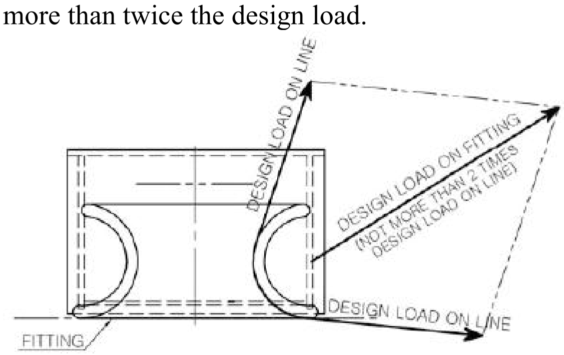


Figure 3.6.3.3(5)

3.6.3.4 Shipboard fittings may be selected from an accepted industry standard and at least based on the following loads.

(1) For normal towing operations, the intended towing load (e.g. static bollard pull) as indicated on the towing and mooring arrangements plan,

(2) For other towing service, the ~~minimum breaking strength~~ ship design minimum breaking load of the tow line according to Table 3.2.1.1(2) (see Notes in 3.6.3.3(2)),

(3) For fittings intended to be used for, both, normal and other towing operations, the greater of the loads according to (1) and (2).

Towing bitts (double bollards) may be chosen for the towing line attached with eye splice if the industry standard distinguishes between different methods to attach the line, i.e. figure-of-eight or eye splice attachment.

When the shipboard fitting is not selected from an accepted Industry standard, the design load used to assess its strength and its attachment to the ship is to be in accordance with 3.6.3.3 and 3.6.3.5. Towing bitts (double bollards) are required to resist the loads caused by the towing line attached with eye splice. For strength assessment beam theory or finite element analysis using net scantlings is to be applied, as appropriate. Corrosion additions are to be as defined in 3.6.6. A wear down allowance is to be included as defined in 3.6.7. At the discretion of the Society, load tests may be accepted as alternative to strength assessment by calculations.

3.6.3.5 Supporting hull structure

(1) Arrangement:

The reinforced members beneath shipboard fittings are to be effectively arranged for any variation of direction (horizontally and vertically) of the towing forces acting upon the shipboard fittings, see Figure 3.6.3.5(1) below for a sample arrangement. Proper alignment of fitting and supporting hull structure is to be ensured.

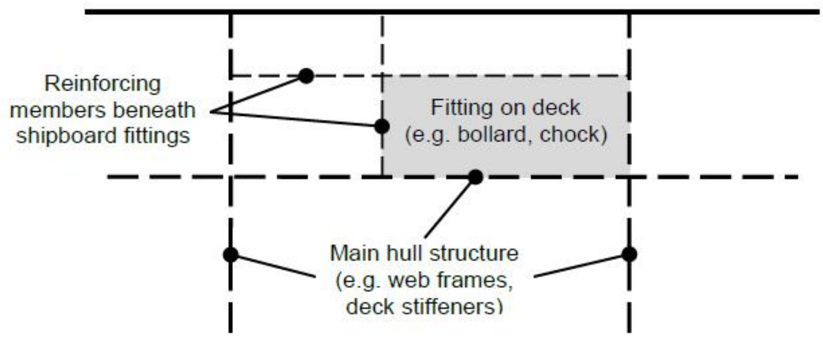


Figure 3.6.3.5(1)

(2) Acting point of towing force:

The acting point of the towing force on shipboard fittings is to be taken at the attachment point of a towing line or at a change in its direction. For bollards and bitts the attachment point of the towing line is to be taken not less than 4/5 of the tube height above the base, see Figure 3.6.3.5(2).

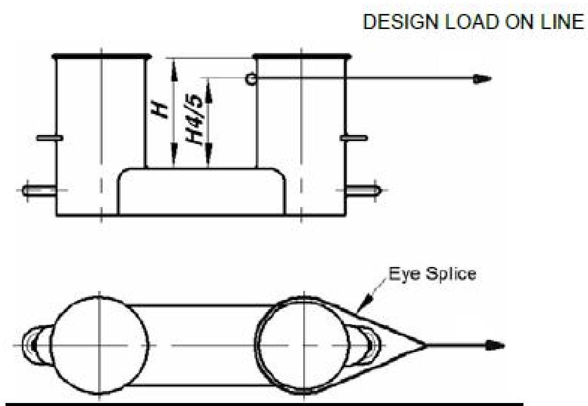


Figure 3.6.3.5(2)

(3) Allowable stresses:

Allowable stresses under the design load conditions as specified in 3.6.3.3 of this Section are as follows:

1) For strength assessment with beam theory or grillage analysis:

Normal stress: ~~100% of the specified minimum yield point of the material~~ $1.0R_{eH}$;

Shearing stress: ~~60% of the specified minimum yield point of the material~~ $0.6R_{eH}$;

Normal stress is the sum of bending stress and axial stress with the corresponding shearing stress acting perpendicular to the normal stress. No stress concentration factors being taken into account.
(2) For strength assessment with finite element analysis:
~~Equivalent~~ Von Mises stress: ~~100% of the specified minimum yield point of the material~~ $1.0 R_{eH}$.

For strength calculations by means of finite elements, the geometry is to be idealized as realistically as possible. The ratio of element length to width is not to exceed 3. Girders are to be modelled using shell or plane stress elements. Symmetric girder flanges may be modelled by beam or truss elements. The element height of girder webs must not exceed one-third of the web height. In way of small openings in girder webs the web thickness is to be reduced to a mean thickness over the web height. Large openings are to be modelled. Stiffeners may be modelled by using shell, plane stress, or beam elements. The mesh size of stiffeners is to be fine enough to obtain proper bending stress. If flat bars are modeled using shell or plane stress elements, dummy rod elements are to be modelled at the free edge of the flat bars and the stresses of the dummy elements are to be evaluated. Stresses are to be read from the centre of the individual element. For shell elements the stresses are to be evaluated at the mid plane of the element.
R_{eH} is the specified minimum yield stress of the material.
3.6.3.6 Safe Towing Load (TOW)
(1) The safe towing load (TOW) is the safe load limit of shipboard fittings used for towing purpose.
(2) TOW used for normal towing operations is not to exceed 80% of the design load per 3.6.3.3 (1).
(3) TOW used for other towing operations is not to exceed 80% of the design load according to 3.6.3.3 (2).
(4) For fittings used for both normal and other towing operations, the greater of the safe towing loads according to (2) and (3) is to be used.
~~(5) For fittings intended to be used for, both, towing and mooring, 3.6.4 applies to mooring.~~
(~~6~~5) TOW, in t, of each shipboard fitting is to be marked (by weld bead or equivalent) on the deck fittings used for towing. For fittings intended to be used for, both, towing and mooring, SWL, in t, according to 3.6.4.6 is to be marked in addition to TOW.
(~~7~~6) The above requirements on TOW apply for the use with no more than one line. If not otherwise chosen, for towing bitts (double bollards) TOW is the load limit for a towing line attached with eye-splice.
(~~8~~7) The towing and mooring arrangements plan mentioned in 3.6.5 is to define the method of use of towing lines.

3.6.4 Mooring

3.6.4.1 The strength of shipboard fittings used for mooring operations and of their supporting hull structures as well as the strength of supporting hull structures of winches and capstans is to comply with the requirements of 3.6.4.2 to 3.6.4.6 of this Section.
3.6.4.2 Shipboard fittings, winches and capstans for mooring are to be located on stiffeners and/or girders, which are part of the deck construction so as to facilitate efficient distribution of the mooring load. Other arrangements may be accepted (for chocks in bulwarks, etc.) provided the strength is confirmed adequate for the service. For fittings intended to be used for, both, mooring and towing, 3.6.3 applies to towing.
3.6.4.3 Load considerations
(1) The minimum design load applied to supporting hull structures for shipboard fittings is to be 1.15 times the ship design minimum breaking strength of the mooring line according to 3.2.4 of this Chapter.
Note: Side projected area including ~~maximum stacks~~ that of deck cargoes as given by the ship nominal capacity condition is to be taken into account for assessment of transverse wind load, tug arrangement and selection of mooring lines.
(2) The minimum design load applied to supporting hull structures for winches is to be 1.25 times the intended maximum brake holding load, where the maximum brake holding load is to be assumed not less than 80% of the ship design minimum breaking strength of the mooring line according to 3.2.4 of this Chapter. For supporting hull structures of capstans, 1.25 times the maximum hauling-in force is to be taken as design load.
(3) When a safe working load SWL greater than that determined according to 3.6.4.6 is requested by the applicant, then the design load is to be increased in accordance with the appropriate SWL/design load relationship.
(4) The design load is to be applied to fittings in all directions that may occur by taking into account the arrangement shown on the towing and mooring arrangements plan. Where the mooring line takes a turn at a fitting the total design load applied to the fitting is equal to the resultant of the design loads acting on the line,

refer to Figure 3.6.3.3(5). However, in no case does the design load applied to the fitting need to be greater than twice the design load on the line.

3.6.4.4 Shipboard fittings may be selected from an accepted industry standard and at least based on the ship design minimum breaking strength ~~of the mooring line~~ according to 3.2.4 of this Chapter.

Mooring bitts (double bollards) are to be chosen for the mooring line attached in figure-of-eight fashion if the industry standard distinguishes between different methods to attach the line, i.e. figure-of-eight or eye splice attachment.

When the shipboard fitting is not selected from an accepted Industry standard, the design load used to assess its strength and its attachment to the ship is to be in accordance with 3.6.4.3 and 3.6.4.5 of this Section. Mooring bitts (double bollards) are required to resist the loads caused by the mooring line attached in figure-of-eight fashion. It is to be observed that in this case either of the two posts of the mooring bitt can be subjected to a force twice as large as that acting on the mooring line. For strength assessment beam theory or finite element analysis using net scantlings is to be applied, as appropriate. Corrosion additions are to be as defined in 3.6.6. A wear down allowance is to be included as defined in 3.6.7. At the discretion of the classification society, load tests may be accepted as alternative to strength assessment by calculations.

3.6.4.5 Supporting hull structure

(1) Arrangement:

Arrangement of the reinforced members beneath shipboard fittings is to consider any variation of direction (horizontally and vertically) of the mooring forces acting upon the shipboard fittings, see Figure 3.6.3.5(1) for a sample arrangement. Proper alignment of fitting and supporting hull structure is to be ensured.

(2) Acting point of mooring force:

The acting point of the mooring force on shipboard fittings is to be taken at the attachment point of a mooring line or at a change in its direction. For bollards and bitts the attachment point of the mooring line is to be taken not less than 4/5 of the tube height above the base, see a) in Figure 3.6.4.5(2) a). If fins are fitted to the bollard tubes to keep the mooring line as low as possible, the attachment point of the mooring line may be taken at the location of the fins, see Figure 3.6.4.5(2) b).

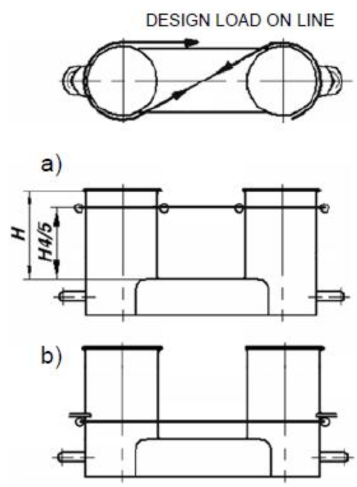


Figure 3.6.4.5(2)

(3) Allowable stresses:

Allowable stresses under the design load conditions as specified in 3.6.4.3 of this Section are as follows:

1) For strength assessment with beam theory or grillage analysis:

Normal stress: ~~100% of the specified minimum yield point of the material~~ $1.0R_{eH}$;

Shearing stress: ~~60% of the specified minimum yield point of the material~~ $0.6R_{eH}$;

Normal stress is the sum of bending stress and axial stress with the corresponding shearing stress acting perpendicular to the normal stress. No stress concentration factors being taken into account.

2) For strength assessment with finite element analysis:

Equivalent Von Mises stress: 100% of the specified minimum yield point of the material $1.0R_{eH}$.

For strength calculations by means of finite elements, the geometry is to be idealized as realistically as possible. The ratio of element length to width is not to exceed 3. Girders are to be modelled using shell or plane stress elements. Symmetric girder flanges may be modelled by beam or truss elements. The element height of girder webs must not exceed one-third of the web height. In way of small openings in girder webs the web thickness is to be reduced to a mean thickness over the web height. Large openings are to be modelled. Stiffeners may be modelled by using shell, plane stress, or beam elements. The mesh size of stiffeners is to be fine enough to obtain proper bending stress. If flat bars are modeled using shell or plane stress elements, dummy rod elements are to be modelled at the free edge of the flat bars and the stresses of the dummy elements are to be evaluated. Stresses are to be read from the centre of the individual element. For shell elements the stresses are to be evaluated at the mid plane of the element.

3.6.4.6 Safe Working Load (SWL)

(1) The Safe Working Load (SWL) is the safe load limit of shipboard fittings used for mooring purpose.

(2) Unless a greater SWL is requested by the applicant according to 3.6.4.3(3), the SWL is not to exceed the ship design minimum breaking strength of the mooring line according to 3.2.4 of this Chapter.

(3) The SWL, in t, of each shipboard fitting is to be marked (by weld bead or equivalent) on the deck fittings used for mooring. For fittings intended to be used for, both, mooring and towing, TOW, in t, according to 3.6.3.6 is to be marked in addition to SWL.

(4) The above requirements on SWL apply for the use with no more than one mooring line.

(5) The towing and mooring arrangements plan mentioned in 3.6.5 is to define the method of use of mooring lines.

3.6.5 Towing and mooring arrangements plan

(1) The SWL and TOW for the intended use for each shipboard fitting is to be noted in the towing and mooring arrangements plan available on board for the guidance of the Master. It is to be noted that TOW is the load limit for towing purpose and SWL that for mooring purpose. If not otherwise chosen, for towing bitts it is to be noted that TOW is the load limit for a towing line attached with eye-splice.

(2) Information provided on the plan is to include in respect of each shipboard fitting:

1) location on the ship;
2) fitting type;
3) SWL/TOW;
4) purpose (mooring/harbour towing/other towing); and
5) manner of applying towing or mooring line load including limiting fleet angles i.e. angle of change in direction of a line at the fitting.

The purposes and method for applying loads are to be taken into account in the determination of SWL and TOW of fittings and submitted for approval.

Furthermore, information provided on the plan is to include:

1) the arrangement of mooring lines showing number of lines (N);
2) the ship design minimum breaking load strength of each mooring line (MBL_{SD});
3) the acceptable environmental conditions for breaking strength of mooring lines ship design minimum breaking load for ships with Equipment Number EN > 2000, including 30 second mean wind speed from any direction and maximum current speed acting on bow or stern (±10°).

(3) The information as given in (2) is to be incorporated into the pilot card in order to provide the pilot proper information on harbour/other towing operations.

3.6.6 Corrosion addition

The total corrosion addition, t_c, in mm, is not to be less than the following values:

(1) For the supporting hull structure, 2 mm;

(2) For pedestals and foundations on deck which are not part of a fitting according to an accepted industry standard, 2.0 mm.

(3) For shipboard fittings not selected from an accepted industry standard, 2.0 mm.

3.7.2 Supporting structures for anchoring windlass and chain stopper

3.7.2.5 When checking the strength of supporting structures and foundations, a three-dimensional finite element model is to be applied as far as possible in the analysis to more exactly describe the distribution of structural response in all directions. Where a beam system is or plate girders are used, the model is to be reasonably simplified and be more conservative. The analysis is to be based on the theory of linear elasticity. The thicknesses of structural members in the model are ~~as-built~~ net ones. Corrosion allowance is in accordance with 1.6.5, Section 5, Chapter 1 of this PART.

3.7.2.7 For all loading conditions, the stresses taken in calculation for supporting structures and foundations are not to exceed ~~the permissible values given in Table 3.7.2.7.~~ the following permissible values:

~~**Permissible Stress**~~ ~~**Table 3.7.2.7**~~

~~Type of element~~	~~Permissible stress~~
~~Grillage~~	~~Direct stress:~~ $[\sigma]=1.00R_{eH}$ ~~Shear stress:~~ $[\tau]=0.6R_{eH}$
~~Plate element~~	~~Equivalent stress:~~ $[\sigma_e]=1.00R_{eH}$

~~where: R_{eH} — yield stress of material, in N/mm².~~

(1) For strength assessment by means of beam theory or grillage analysis:

Normal stress: 1.0 R_{eH}

Shear stress: 0.6 R_{eH}

The normal stress is the sum of bending stress and axial stress. The shear stress to be considered corresponds to the shear stress acting perpendicular to the normal stress. No stress concentration factors are to be taken into account.

(b) For strength assessment by means of finite element analysis:

Von Mises stress: 1.0 R_{eH}

For strength assessment by means of finite element analysis the mesh is to be fine enough to represent the geometry as realistically as possible. The aspect ratios of elements are not to exceed 3. Girders are to be modelled using shell or plane stress elements. Symmetric girder flanges may be modelled by beam or truss elements. The element height of girder webs must not exceed one-third of the web height. In way of small openings in girder webs, the web thickness is to be reduced to a mean thickness over the web height. Large openings are to be modelled. Stiffeners may be modelled using shell, plane stress, or beam elements. The mesh size of stiffeners is to be fine enough to obtain proper bending stress. If flat bars are modeled using shell or plane stress elements, dummy rod elements are to be modelled at the free edge of the flat bars and the stresses of the dummy elements are to be evaluated. Stresses are to be read from the centre of the individual element. For shell elements the stresses are to be evaluated at the mid plane of the element.

R_{eH} is the specified minimum yield stress of the material.

Appendix 2 DIRECT MOORING ANALYSES

1 General

1.1 As an alternative to the requirements for mooring lines in 3.2.4 of this Chapter, direct mooring analysis may be performed to determine the necessary mooring restraint, i.e. number and strength of mooring lines.

Direct analyses allow to optimize mooring equipment and arrangement for the individual ship and the port mooring facilities typical for the considered ship type and size.

2 Documentation

2.1 The calculations should be documented in a report. The report should include all assumptions made in calculations for the finally chosen mooring equipment, including lines, and its arrangement, reflected in the mooring arrangement plan.

3 Analysis methodology

3.1 Three dimensional quasi-static calculations should be performed to determine the acting mooring line forces. As a minimum, loads from wind and current should be accounted for in the analysis. Geometrical and material nonlinearities of mooring lines and fenders or breasting dolphins should be considered. An iterative calculation procedure should be applied to arrive at a converged solution with forces acting on mooring lines and on fenders or breasting dolphins being in equilibrium with forces and moments applied to the ship.

4 Environmental conditions

4.1 Mooring line forces should be calculated for environmental conditions given in 3.2.4.3 of this Chapter. Additional loads, e.g. wave loads or cross currents, or increased wind and current loads may be considered for certain ship types or for specific ports intended to be regularly called.

5 Steps to be taken in a direct mooring analysis

Direct assessment of mooring forces and determination of the necessary number and strength of mooring lines comprise the following steps:

(1) Determine port mooring facilities representative for the considered ship type and size

(2) Determine shipboard mooring equipment and arrangement

(3) Determine mooring line type(s) to be used

(4) Determine mooring layout(s) to be assessed

(5) Determine ship loading condition(s) to be assessed

(6) Select or determine wind and current drag coefficients

(7) Determine wind and current forces and moments

(8) Compute forces acting on all mooring line

(9) Determine necessary strength of mooring lines

(10) If strength of mooring lines should be altered, modify steps (2), (3) and/or (4) with or without changing the number of mooring lines and repeat steps (8) and (9)

5.1 Port mooring facilities

5.1.1 Characteristics of port mooring facilities have strong influence on the resulting mooring line forces. Mooring analysis should be performed for port mooring facilities representative for the considered ship type and size, i.e. type of berth, type and arrangement of hooks/bollards, type and arrangement of fenders or breasting dolphins and height of pier above waterline.

5.1.2 Fenders or breasting dolphins in many cases may not affect the critical mooring line loads. Hence, initially, generic fender or dolphin arrangements and infinitely stiff load deformation characteristics may be considered. If no fender or dolphin loads occur for load cases yielding the critical mooring line loads, more specific fender or dolphin arrangements and characteristics may be omitted.

5.1.3 If there are substantially different port mooring facilities typically encountered by the considered ship type, additional calculations should be performed to consider these variations.

5.2 Shipboard mooring equipment and arrangement

5.2.1 The mooring equipment and arrangement need to be chosen for the mooring analysis, i.e. location of mooring decks and location of mooring winches and fairleads. As a starting point, mooring equipment for the number of lines as determined by 3.2.4 of this Chapter may be chosen.

5.3 Mooring lines

5.3.1 The mooring analysis should apply the mooring line type(s) intended to be supplied with the vessel. The geometrical and material nonlinearities of the mooring lines should be considered by the mooring analysis. Load-deflection characteristics of mooring lines can be taken from data sheets of rope manufacturers. If given, characteristics of the broken-in ropes should be applied.

5.3.2 To achieve a good distribution of mooring line forces, mooring line type and characteristics should be at least same for lines in the same service, e.g. for head and stern lines, breast lines and spring lines. For very stiff mooring lines, e.g. made of steel or high modulus synthetic fibers, the use of elastic tails should be considered to enhance the elasticity in the mooring system and taken into account for the mooring analysis.

5.4 Mooring layout

5.4.1 For the assessment of forces acting on mooring lines, a realistic mooring layout needs to be assumed, i.e. for each mooring line it needs to be determined from which bollard or winch, along which path, through which fairlead it is led and to which shoreside hook or bollard it is connected. Inboard parts of the mooring lines (between fairlead and shipboard fixation point) contribute to the elongation behavior of the line and should be included in the analysis.

5.4.2 The maximum number of lines connected to one shore mooring point needs to be limited to not load the shore side mooring points unrealistically high. For multipurpose piers the number of lines per shore bollard should be limited to three. For other types of berths, the number mooring lines per shore mooring point is also limited, e.g., by the available number of hooks. Reasonable assumptions should be made based on typical berth types encountered by the considered ship type.

5.4.3 Alternative mooring layouts should also be assessed, considering possible and reasonable options to moor the ship to the assumed port mooring facilities. Also, a different position of the ship relative to the shoreside mooring bollards/hooks should be assessed to find the critical mooring line loads for the normal operation of the ship. Exemptions may be given to e.g. tankers, LNG carriers or ferries if typically moored in the same position relative to the shoreside mooring facilities.

5.5 Loading conditions

5.5.1 Mooring line forces should be calculated for loading conditions given in 3.2.4.3 of this Chapter.

5.6 Wind and current drag coefficients

5.6.1 To calculate the wind and current forces and moments acting on the ship, wind and current drag coefficients are needed for the considered ship type, size and loading condition. Drag coefficients should be as specific as possible for the considered ship and loading conditions.

5.6.2 There are different sources for drag coefficients. Some Industry Guidelines provide drag coefficients for tankers and LNG carriers which can be applied. Due to the similarity of hull forms and superstructures, these coefficients may also be used for bulk carriers and ore carriers. For other ship types drag coefficients may be taken from the literature, if available, or can be determined by CFD calculations or model tests. CFD calculations are to be justified with suitable validation and sensitivity studies.

5.6.3 There are some effects that can influence the drag coefficients, i.e. blockage (limited under keel clearance, solid quay walls), ship draft and wind shielding by solid quays and buildings or cargo stored on quays (e.g. container stacks). Effects from blockage and ship draft can only be accounted for by appropriate coefficients. Drag coefficient should be chosen or determined for realistic water depth to draft ratios and for the considered ship draft(s). Some Industry Guidelines provide current drag coefficients for ballast and loaded draft conditions and for different water depth to draft ratios. Wind shielding effects are typically not considered by the wind drag coefficients. The effect of wind shielding of solid quays may be considered by an equivalent reduction of the lateral wind area of the ship. Shielding by buildings or cargo stored on quays should not be considered as their presence is imponderable.

5.7 Calculation of wind and current forces and moments

5.7.1 Wind and current forces and moments can be calculated for the given environmental conditions with the geometrical particulars of the considered ship and the selected drag coefficients. Usually, the forces in longitudinal and transversal directions as well as the moment about the vertical ship axis (yaw) are calculated.

5.7.2 Wind forces and moments should be calculated for all directions in intervals of preferably 15°, but not more than 30°. Current forces and moments should be calculated for selected directions as per 3.2.4.3 of this Chapter. For ships regularly moored to non-solid piers or jetties, cross current may need to be considered in addition.

5.8 Calculation of mooring line forces

5.8.1 For all considered scenarios and all combinations of applied environmental conditions, the maximum mooring line force should be determined for groups of lines in the same service.

5.8.2 In case of all lines are intended to be attached to winches, brake rendering can be considered to better distribute line loads among all lines in a group of lines in the same service. Then, the average mooring line force of a group of lines may be determined and taken as mooring line force used to determine the necessary strength of the mooring lines according to section 5.9.

5.9 Strength of mooring lines

5.9.1 The necessary strength of mooring lines, i.e., the Ship Design Minimum Breaking Load (MBL_{SD}), results from the calculated maximum mooring line force ($F_{L,\ max}$) divided by the Work Load Limit (*WLL*) factor of mooring lines. The *WLL* factor and the resulting MBLSD for different mooring line materials are shown in the below table.

WLL factor and MBL_{SD} **Table 5.9.1**

Mooring line material	*WLL* factor	MBL_{SD}
Steel wire	0.55	$1.82 \times F_{L,max}$
Synthetic fibers	0.5	$2.0 \times F_{L,max}$

5.9.2 Preferably, all lines supplied to the ship should have the same characteristics and strength to avoid confusion of lines. However, for significantly different maximum calculated line loads, lines in different service may also have different strength and characteristics, e.g. for head and stern lines other than for spring lines.

CCS Rule Change Notice For:

RULES FOR CLASSIFICATION OF SEA-GOING STEEL SHIPS

PART THREE MACHINERY INSTALLATIONS

CONTENTS

Chapter 3 SHIP'S PIPING AND VENTILATING SYSTEMS

Section 11 VENTILATION

3.11.1 General requirements

3.11.4 Ventilation of emergency generator rooms

~~3.11.4.1 Emergency generator rooms are to be provided with ventilation openings for the admission of combustion air to engines and the removal of heat. These openings are usually provided with louvers which can be closed from the outside of the emergency generator rooms (when fire breaks out in emergency generator rooms). The louvers may be hand-operated or power-operated. Alternatively, the louvers may be of fixed type with a closing door which may be hand-operated or automatic.~~

3.11.4.~~2~~1 The following requirements apply to ventilation louvers which can be closed for emergency generator rooms and to closing appliances where fitted to ventilators serving emergency generator rooms:

(3) Power-operated ventilation louvers and closing appliances are to be of a fail-to-open type. Closed power-operated ventilation louvers and closing appliances are acceptable during normal operation of the vessel. Power-operated ventilation louvers and closing appliances are to open automatically whenever the emergency generator is starting / in operation.

CCS Rule Change Notice For:

RULES FOR CLASSIFICATION OF SEA-GOING STEEL SHIPS

PART NINE COMMON STRUCTURAL RULES FOR BULK CARRIERS AND OIL TANKERS

CONTENTS

PART 9-1 GENERAL HULL REQUIREMENTS

Chapter 1 RULE GENERAL PRINCIPLES

Section 3 VERIFICATION OF COMPLIANCE

2 DOCUMENTS TO BE SUBMITTED

2.2 Submission of plans and supporting calculations

2.2.3 Plans and instruments to be supplied onboard the ship

…Omitted

g) Towing and mooring arrangements plan~~, see Ch 11, Sec 3~~.

…Omitted

Chapter 8 BUCKLING

Section 2 SLENDERNESS REQUIREMENTS

3 STIFFENERS

3.1 Proportions of stiffeners

3.1.2 Net dimensions of angle, L2 and T-bars

The total flange breadth b_f in mm, for angle, L2 and T-bars is to satisfy the following criterion:

~~$b_f \geq 0.25 h_w$~~

$b_f \geq 0.2 h_w$

Chapter 11 SUPERSTRUCTURE, DECKHOUSES AND HULL OUTFITTING

Section 3 EQUIPMENT

~~SYMBOLS~~

~~For symbols not defined in this section, refer to Ch 1, Sec 4.~~

1 GENERAL

1.1 Application

1.1.1

~~The anchoring equipment specified in this section is intended for temporary mooring of a ship within a harbour or sheltered area when the ship is awaiting berth, tide, etc.~~ Anchoring equipment shall be considered by individual Society

CCS 1.1.1a Anchoring equipment is to comply with the requirements of PART TWO, Ch 3, Sec 2 of CCS Rules for Classification of Sea-going Steel Ships.

~~1.1.2~~

~~The equipment specified is not intended to be adequate to hold a ship off fully exposed coasts in rough weather or to stop a ship that is moving or drifting. In such a condition, the loads on the anchoring equipment increase to such a degree that its components may be damaged or lost.~~

1.1.3

The Equipment Number (*EN*) formula for the required anchoring equipment is based on an assumed maximum current speed of 2.5 m/s, maximum wind speed of 25 m/s and a scope minimum of chain cable of 6. The scope of chain cable is defined as the ratio between the length of chain paid out and the waters depth. For ships with length greater than 135 m, alternatively the required anchoring equipment can be considered applicable to a maximum current speed of 1.54 m/s, a maximum wind speed of 11 m/s and waves with maximum significant height of 2 m.

It is assumed that under normal circumstances a ship uses only one bow anchor and chain cable at a time.

2 DELETED

3 DELETED

Section 4 SUPPORTING STRUCTURE FOR DECK EQUIPMENT AND FITTINGS

SYMBOLS

For symbols not defined in this section, refer to Ch1, Sec 4.

SWL : Safe working load as defined in [4.1.4].
Normal stress: The sum of bending stress and axial stress with the corresponding shearing stress acting perpendicular to the normal stress

1 GENERAL

1.1 Application

1.1.1

Information pertaining to the supporting structure for deck equipment and fittings, as listed in this section, is to be submitted for approval.
This section includes scantling requirements to the supporting structure and foundations of the following pieces of equipment and fittings:

a) Anchor windlasses.
b) Anchoring chain stoppers.
c) Mooring winches.
d) Deck cranes, derricks and lifting masts.
e) Bollards and bitts, fairleads, stand rollers, chocks and capstans.

The supporting structure and foundations for deck equipment and fittings shall be considered by individual Society in addition to the requirements in this section.
CCS 1.1.1a In addition to the requirements of this section, the supporting structure and foundations for deck equipment and fittings are to comply with the requirements of PART TWO, Ch 3, Sec 6 of CCS Rules for Classification of Sea-going Steel Ships. The corrosion addition shall comply with the requirements of Ch 3, Sec 3 of this part.

3 DELETED

5 DELETED