RULES

PUBLICATION 16/P

LOADING GUIDANCE INFORMATION

January
2022

Publications P (Additional Rule Requirements) issued by Polski Rejestr Statków complete or extend the Rules and are mandatory where applicable.

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GDAŃSK

Publication No. 16/P – Loading Guidance Information – January 2022, is an extension of the requirements contained in *Part II – Hull, July 2020* of the *Rules for the Classification and Construction of Sea-going Ships.*

This publication was approved by the Board of Polish Register of Shipping on 3 December 2021 and enters into force on 1 January 2022.

The present publication replaces *Publication No. 16/P – Loading Guidance Information, 2020, as amended..*

PRS/RP, 12/2022

CONTENTS

I REQUIREMENTS FOR LOADING CONDITIONS, LOADING MANUALS AND LOADING INSTRUMENTS*

This Requirement satisfies Regulation 10(1) of the *International Convention on Load Lines, 1966*.

1 GENERAL

1.1 Application

These requirements apply to all classed sea-going ships of 65 m in length and above which are contracted for construction on or after 1st July 1998, and contain minimum requirements for loading guidance information. (see also relevant parts of Publication No. 84/P – Requirements concerning the construction and strength of the hull and hull equipment of sea-going bulk carriers of 90 m in length and above and Publication No. 85/P – Requirements concerning the construction and strength of the hull and hull equipment of sea-going, double hull oil tankers of 150 m in length and above for ships contracted for construction in 2006 till 2015.

For bulk carriers of 90 m in length and above and for double hull oil tankers of 150 m in length and above contracted for construction on or after 1 July 2015, the relevant requirements specified in Common Structural Rules (CSR) shall be applied

Note:
For ships which are contracted for construction before 1st July 1998, the relevant provisions of this *Publication* prior edition apply. Requirements of Chapter II also apply to bulk carriers, ore carriers and combination carriers of 150 m length and above.

1.2 Definitions

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

Loading instrument: an instrument, which is either analog or digital, by means of which it can be easily and quickly ascertained that, at specified read-out points, the still water bending moments, shear forces, and the still water torsional moments and lateral loads, where applicable, in any load or ballast condition will not exceed the specified permissible values. An operational manual is always to be provided for the loading instrument. Single point loading instruments are not acceptable.

Category I Ships:

- Ships with large deck openings where combined stresses due to vertical and horizontal hull girder bending and torsional and lateral loads have to be considered;
- Ships liable to carry non-homogeneous loadings, where the cargo and/or ballast may be unevenly distributed. Ships less than 120 metres in length, when their design takes into account uneven distribution of cargo or ballast, belong to Category II;
- Chemical tankers and gas carriers.

* Recommendations given in the following documents should also be taken into account while applying requirements of PRS *Publication No. 16/P*:
  - IMO MSC/Circ. 854 Guidelines for Shipboard Loading and Stability Computer Programs,
  - IMO MSC/Circ. 891 Guidelines for the On-Board Use and Application of Computers.

Category II Ships:

Ships with arrangement giving small possibilities for variation in the distribution of cargo and ballast, and ships on regular and fixed trading pattern where the Loading Manual gives sufficient guidance, and in addition the exception given under Category I.

1.3 Annual and Special Survey

At each Annual and Special Survey, it is to be checked that the approved loading guidance information is available on board.

The loading instrument is to be checked for accuracy at regular intervals by the ship's Master by applying test loading conditions.

At each Special Survey this checking is to be done in the presence of the Surveyor.

2 LOADING CONDITIONS, LOADING MANUALS AND LOADING INSTRUMENTS

2.1 General

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

In addition, an approved loading instrument is to be supplied for all ships of Category I of 100 m in length and above.

2.2 Conditions of Approval of Loading Manuals

The approved loading manual is to be based on the final data of the ship. The manual is to include the design loading and ballast conditions upon which the approval of the hull scantlings is based.

Annex I/1 contains, as guidance only, a list of the loading conditions which normally should be included in the loading manual.

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

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

2.3 Condition of Approval of Loading Instruments

The loading instrument is subject to approval, which is to include:
- verification of type approval, if any,
- verification that the final data of the ship has been used,
- acceptance of number and position of read-out points,
- acceptance of relevant limits for all read-out points,
- checking of proper installation and operation of the instrument on board, in accordance with agreed test conditions, and that a copy of the operation manual is available.

Recommendations on the approval of loading instruments are given in Chapter III.

In case of modifications implying changes in the main data of the ship, the loading instrument is to be modified accordingly and approved.

The operation manual and the instrument output must be prepared in a language understood by the users. If this language is not English, a translation into English is to be included.

The operation of the loading instrument is to be verified upon installation. It is to be checked that the agreed test conditions and the operation manual for the instrument is available on board.

ANNEX I/1

GUIDANCE ON CONDITIONS

1. The loading manual should contain the design loading and ballast conditions, subdivided into departure and arrival conditions, and ballast exchange at sea conditions, where applicable, upon which the approval of the hull scantlings is based.

2. In particular the following loading conditions should be included:

2.1 Cargo ships, container ships, roll-on/roll-off and refrigerated carriers, ore carriers and bulk carriers:
- Homogeneous loading conditions at maximum draught,
- Ballast conditions,
- Special loading conditions, e.g. container or light load conditions at less than the maximum draught, heavy cargo, empty holds or non-homogeneous cargo conditions, deck cargo conditions, etc., where applicable,
- Short voyage or harbour conditions, where applicable,
- Docking condition afloat,
- Loading and unloading transitory conditions, where applicable.

2.2 Oil tankers:
- Homogeneous loading conditions (excluding dry and clean ballast tanks) and ballast or part-loaded conditions for both departure and arrival,
- Any specified non-uniform distribution of loading,
- Mid-voyage conditions relating to tank cleaning or other operations where these differ significantly from the ballast conditions,
- Docking condition afloat,
- Loading and unloading transitory conditions.

2.3 Chemical tankers:
- Conditions as specified for oil tankers,
- Conditions for high density or heated cargo and segregated cargo where these are included in the approved cargo list.

2.4 Liquefied gas carriers:
- Homogeneous loading conditions for all approved cargoes for both arrival and departure,
- Ballast conditions for both arrival and departure,
- Cargo condition where one or more tanks are empty or partially filled or where more than one type of cargo having significantly different densities is carried, for both arrival and departure,
- Harbour condition for which an increased vapour pressure has been approved,

Docking condition afloat.

2.5 Combination carriers:

Conditions as specified in 2.1 and 2.2, above.

II ADDITIONAL REQUIREMENTS FOR LOADING CONDITIONS, LOADING MANUALS AND LOADING INSTRUMENTS FOR BULK CARRIERS, ORE CARRIERS AND COMBINATION CARRIERS

1 APPLICATION

Bulk carriers, ore carriers and combination carriers (see *the Rules for the Classification and Construction of Sea-going Ships*, *Part II – Hull,* Chapter 20) of 150 m length and above, which are contracted for construction before 1st July 1998 are to be provided with an approved loading instrument of a type to the satisfaction of PRS not later than their entry into service or 1st January 1999, whichever occurs later.

In addition, bulk carriers of 150 m length and above where one or more cargo holds are bounded by the side shell only, which were contracted for construction before 1st July 1998 are to be provided, with an approved loading manual with typical loading sequences where the vessel is loaded from commencement of cargo loading to reaching full deadweight capacity, for homogeneous conditions, relevant part load conditions and alternate conditions where applicable. Typical unloading sequences for these conditions shall also be included. Annex II/1 contains, as guidance only, an example of a Loading Sequence Summary Form. Annexes II/2 and II/4 contain guidance for loading and unloading sequences for existing bulk carriers.

Bulk carriers, ore carriers and combination carriers of 150 m length and above, which are contracted for construction on or after 1st July 1998, are to be provided with an approved loading manual and approved computer-based loading instrument, in accordance with paras. 2, 3 and 4. Annexes II/3 and II/4 contain guidance for loading and unloading sequences for new bulk carriers.

For bulk carriers contracted for construction in 2006 till 2015, which *Publication No. 84/P – Requirements concerning the construction and strength of the hull and hull equipment of sea-going bulk carriers of 90 m in length and above* refers to, the requirements of relevant parts shall be applied.

For bulk carriers of 90 m in length and above contracted for construction on or after 1 July 2015, the relevant requirements specified in Common Structural Rules (CSR) shall be applied

2 DEFINITIONS

2.1 ***Loading Manual***: a document which describes:

a) the loading conditions on which the design of the ship has been based, including permissible limits of still water bending moments and shear forces;
b) the results of the calculations of still water bending moments, shear forces and where applicable, limitations due to torsional loads;
c) for bulk carriers, envelope results and permissible limits of still water bending moments and shear forces in the hold flooded condition according to appropriate requirements;
d) the cargo hold(s) or combination of cargo holds that might be empty at full draught. If no cargo hold is allowed to be empty at full draught, this is to be clearly stated in the loading manual;
e) maximum allowable and minimum required mass of cargo and double bottom contents of each hold as a function of the draught at mid-hold position;
f) maximum allowable and minimum required mass of cargo and double bottom contents of any two adjacent holds as a function of the mean draught in way of these holds. This mean draught may be calculated by averaging the draught of the two mid-hold positions. The latest date for implementation for requirements in 2.1(f) is 1st July 1999;

g) maximum allowable tank top loading together with specification of the nature of the cargo for cargoes other than bulk cargoes;
h) maximum allowable load on deck and hatch covers. If the vessel is not approved to carry load on deck or hatch covers, this is to be clearly stated in the loading manual;
i) the maximum rate of ballast change together with the advice that a load plan is to be agreed with the terminal on the basis of the achievable rates of change of ballast.

2.2 ***Loading Instrument***: an approved digital system as defined in Chapter I. In addition to the requirements in Chapter I, it shall ascertain as applicable that:

a) the mass of cargo and double bottom contents in way of each hold as a function of the draught at mid-hold position;
b) the mass of cargo and double bottom contents of any two adjacent holds as a function of the mean draught in way of these holds (the latest date for implementation: 1st July 1999);
c) the still water bending moment and shear forces in the hold flooded conditions (according to the requirements in the *Rules for the Classification and Construction of Sea-going Ships, Part II – Hull*, Sub-chapter 20.6) are within permissible values.

3 CONDITIONS OF APPROVAL OF LOADING MANUALS

In addition to the requirements given in Chapter I, para. 2.2, the following conditions, subdivided into departure and arrival conditions as appropriate, are to be included in the Loading Manual:

a) alternate light and heavy cargo loading conditions at maximum draught, where applicable;
b) homogeneous light and heavy cargo loading conditions at maximum draught;
c) ballast conditions. For vessels having ballast holds adjacent to topside wing, hopper and double bottom tanks, it shall be strengthwise acceptable that the ballast holds are filled when the topside wing, hopper and double bottom tanks are empty;
d) short voyage conditions where the vessel is to be loaded to maximum draught but with limited amount of bunkers;
e) multiple port loading/unloading conditions;
f) deck cargo conditions, where applicable;
g) typical loading sequences where the vessel is loaded from commencement of cargo loading to reaching full deadweight capacity, for homogeneous conditions, relevant part load conditions and alternate conditions where applicable. Typical unloading sequences for these conditions shall also be included. The typical loading/unloading sequences shall also be developed to not exceed applicable strength limitations. The typical loading sequences shall also be developed paying due attention to loading rate and the deballasting capability. Annex II/1 contains, as guidance only, an example of a Loading Sequence Summary Form;
h) typical sequences for change of ballast at sea, where applicable.

4 CONDITIONS OF APPROVAL OF LOADING INSTRUMENTS

The loading instrument is subject to approval. In addition to the requirements given in I/2.3, the approval is to include as applicable:

a) acceptance of hull girder bending moment limits for all read-out points,
b) acceptance of hull girder shear force limits for all read-out points,
c) acceptance of limits for mass of cargo and double bottom contents of each hold as a function of draught,
d) acceptance of limits for mass of cargo and double bottom contents in any two adjacent holds as a function of draught. The latest date for implementation for requirements in 4(d) is 1st July 1999.

ANNEX II/1

GUIDANCE ON TYPICAL LOADING SEQUENCE SUMMARY FORM

ANNEX II/2

EXISTING BULK CARRIERS

GUIDANCE FOR LOADING/UNLOADING SEQUENCES

1. Provisions of II.1 require that bulk carriers of 150 m length and above, where one or more cargo holds are bounded by the side shell only, which were contracted for construction before 1st July 1998, are to be provided, with an approved loading manual with typical loading sequences where the ship is loaded from commencement of cargo loading to reaching full deadweight capacity, for homogeneous conditions, relevant part loaded conditions and alternate conditions where applicable. Typical unloading sequences shall be included.

2. This requirement will necessitate shipowners and operators to prepare and submit for approval typical loading and unloading sequences.

3. The minimum acceptable number of typical sequences is:
- one homogeneous full load condition,
- one part load condition where relevant, such as block loading or two port unloading,
- one full load alternate hold condition, if the ship is approved for alternate hold loading.

4. The shipowner/operator should select actual loading/unloading sequences, where possible, which may be port specific or typical.

5. The sequence may be prepared using the onboard loading instrument. The selected loading conditions should be built up step by step from commencement of cargo loading to reaching full deadweight capacity. Each time the loading equipment changes position to a new hold defines a step. Each step is to be documented and submitted to the PRS. The printout from the loading instrument is generally acceptable. This allows the actual bending moments and shear forces to be verified and prevent the permissible values being exceeded. In addition, the local strength of each hold may need to be considered during the loading.

6. For each loading condition a summary of all steps is to be included. This summary is to highlight the essential information for each step such as:
- How much cargo is filled in each hold during the different steps,
- How much ballast is discharged from each ballast tank during the different steps,
- The maximum still water bending moment and shear force at the end of each step,
- The ship's trim and draught at the end of each step.

7. The approved typical loading/unloading sequences, may be included in the approved loading
manual or take the form of an addendum prepared for purposes of complying with PRS requirements. A copy of the approved typical loading/unloading sequences is to be placed onboard the ship.

ANNEX II/3

NEW BULK CARRIERS

GUIDANCE FOR LOADING/UNLOADING SEQUENCES

1. Provisions of II.1 require that Bulk Carriers, Ore Carriers and Combination Carriers of 150 m length and above, which are contracted for construction on or after 1st July 1998, are to be provided with an approved loading manual with typical loading sequences where the ship is loaded from commencement of cargo loading to reaching full deadweight capacity, for homogeneous conditions, relevant part loaded conditions and alternate conditions where applicable. The typical unloading sequences shall be developed paying due attention to the loading rate, the deballasting capacity and the applicable strength limitations.

2. The shipbuilder will be required to prepare and submit for approval typical loading and unloading sequences.

3. The typical loading sequences as relevant should include:
- alternate light and heavy cargo load condition,
- homogeneous light and heavy cargo load condition,
- short voyage condition where the ship is loaded to maximum draught but with limited bunkers,
- multiple port loading / unloading condition,
- deck cargo condition,
- block loading.

4. The loading / unloading sequences may be port specific or typical.

5. The sequence is to be built up step by step from commencement of cargo loading to reaching full deadweight capacity. Each time the loading equipment changes position to a new hold defines a step. Each step is to be documented and submitted to the PRS. In addition to longitudinal strength, the local strength of each hold is to be considered.

6. For each loading condition a summary of all steps is to be included. This summary is to highlight the essential information for each step such as:
- How much cargo is filled in each hold during the different steps,
- How much ballast is discharged from each ballast tank during the different steps,
- The maximum still water bending moment and shear at the end of each step,
- The ship's trim and draught at the end of each step.

ANNEX II/4

GUIDANCE FOR LOADING/UNLOADING SEQUENCES FOR BULK CARRIERS (OPERATIONAL RECOMMENDATIONS)

Introduction

1. To be of practical use to the ship's officers, any acceptable loading or unloading sequence must, in addition to meeting strength and stability requirements, satisfy operational and commercial requirements as far as possible. Therefore, the following notes have been developed. It is recommended that they be taken into account when compiling the typical loading and unloading sequences described in Annexes II/2 and II/3.

Loading

2. Deballasting can present difficulties. The process should always be started and finished as early as possible in the loading process and should be planned to proceed in the most favourable circumstances.

3. The easiest ballast tanks to drain should be left until last in the deballasting sequence. In order to take into account the effects of draft, heel and trim and the characteristics of the tanks, the preferred deballasting sequence (subject to the strength requirements of the individual ship) is:
- ballast holds,
- double bottoms,
- topside tanks,
- peak tanks.

4. A good stern trim should be maintained as far as possible throughout deballasting and final stripping of ballast.

5. The ship should never be allowed to go "by the head" during deballasting, as the ballast suctions and sounding pipes of most bulk carriers are not designed to cope with this eventuality.

6. Departure draft, when laden, is usually even keel or close thereto. As this trim does not favour the stripping of ballast tanks it should be reached as late as possible in the loading process (See Item 2, above).

7. When loading a homogeneous cargo, one draft survey only will normally be required to interrupt the loading. The purpose of this draft survey, made after some 85-95% of the cargo has been loaded, is to make an accurate calculation of the tonnage remaining to be loaded and to calculate how it is to be distributed between a forward and an after hold, to achieve the desired final trim. Operational factors will influence which specific forward and after holds are used for the trimming.

8. Draft surveys will normally also be made before commencement and after completion of loading but these surveys need not be included in the loading sequence.

If several grades of cargo are loaded it may be necessary to hold a draft survey before commencement and after completion of each grade and, in addition when 85-95% of the grade has been loaded, if the ship is to control the tonnage loaded.

9. If the ship has a ballast hold or ballast holds loading of those holds should be programmed as late as possible in the loading sequence to allow the maximum time for deballasting, cleaning, drying, opening the bilges and closing ballast lines.

Unloading

10. A trim by the stern is easily achieved and is to be preferred throughout unloading to avoid disruption to the ship's machinery and domestic services. Airdraft and strength requirements both usually require that the trim by the stern should not be excessive.

11. Holds which are to be ballasted for the ensuing voyage, or to reduce airdraft whilst unloading, should be the first to be completely unloaded, to allow maximum time for cleaning holds, closing bilges and opening ballast lines.

12. When a full homogeneous cargo is being unloaded, there is no need for a draft survey to interrupt the unloading at any stage, although draft surveys may be required before the start and at the completion of unloading.

13. Unlike deballasting (see above), the tank sequence is not critical when taking on ballast as it is not significantly affected by heel or trim. The sequence will be governed by strength and airdraft considerations and possibly by the desire to avoid taking sediment-laden ballast in double bottom tanks from which the sediment will be most difficult to remove.

III RECOMMENDATIONS ON LOADING INSTRUMENTS

1 INTRODUCTION

1.1 These recommendations may be used by PRS in conjunction with other requirements and procedures when approving loading instruments for ships not yet fitted with an approved loading instrument. In justifiable cases PRS may accept equivalent solutions.

1.2 These recommendations are applicable to a loading instrument which is a computer based system consisting of a calculation program and the computer hardware on which it runs. Recommendations pertaining to the calculation program's system and functional specifications are contained in paras. 3.1 and 4, respectively. Recommendations pertaining to the computer hardware specification for type approval are contained in para. 3.2, see also para. 1.8 of the present Chapter.

1.3 The loading instrument is not a substitute for the approved loading manual.

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

1.5 Ships having undertaken major alterations or conversions affecting longitudinal strength, such as lengthening or removal of decks, should be treated as new ships for the purpose of these recommendations.

1.6 The loading instrument approval process includes the following procedures for each ship:
.1 Data verification which results in Endorsed Test Conditions;
.2 Approval of computer hardware, where necessary;
.3 Installation Testing which results in a Program Installation Test Certificate.

1.7 The loading instrument's calculation program may receive general approval from PRS and be issued with a Certificate of Approval. In such cases, some stages of the data verification procedure may be waived for each specific ship as specified in 2.1.7.

1.8 Hardware approval is intended to ensure that either a single computer is type approved or that there are two nominated computers available in case of failure of one. If two nominated computers are available, type approval may be waived but both should be subject to installation testing.

In addition, computers which are to be a part of a ship's network should be approved in accordance with PRS relevant requirements.

1.9 The calculation program may be issued with a Program Installation Test Certificate after a satisfactory installation test of the loading instrument has been carried out onboard the ship in accordance with the recommendations in section 2.3.

2 APPROVAL PROCESS

2.1 Data Verification Approval – Endorsed Test Conditions

2.1.1 PRS should verify the computational results and actual ship data used by the calculation program for the particular ship on which the program will be installed.

2.1.2 PRS should advise the applicant of a minimum of four loading conditions, taken from the ship's approved loading manual, which are to be used as the test conditions. Within the range of these test conditions each compartment should be loaded at least once. These test conditions normally cover the range of load draughts from the deepest envisaged loaded condition to the light ballast condition.

2.1.3 Read-out points should be selected at the position of the transverse bulkheads or other obvious boundaries. Additional read-out points may be required between bulkheads of long holds or tanks or between container stacks.

2.1.4 Where the still water torsion moments are required to be calculated, one test condition should demonstrate such a calculation.

2.1.5 It is important that the data contained in the loading program is consistent with the data specified in the approved loading manual.

Particular attention is drawn to the final lightship weight and centres of gravity derived from the inclining experiment or lightweight check.

2.1.6 PRS should verify that the following data, submitted by the applicant, is consistent with the as-built ship:

.1 Identification of the calculation program including version number.
.2 Main dimensions, hydrostatic particulars and, if applicable, the ship profile.
.3 The position of the forward and after perpendiculars, and if appropriate, the calculation method to derive the forward and after draughts at the actual position of the ship's draught marks.
.4 Ship lightweight and lightweight distribution along the ship's length.
.5 Lines plans and/or offset tables, or Bonjean data at 21 stations in the length between perpendiculars.
.6 Compartment definitions, including frame spacing, and centres of volume, together with capacity tables(sounding/ullage tables), if appropriate.
.7 Deadweight definitions for each loading condition.

2.1.7 The data verification procedure should be considered complete when:

.1 The loading program's system specification is found to be satisfactory. See para. 3.1.
.2 The functionality of the program has been clearly described and the calculation methods and principles are to the satisfaction of PRS.
.3 The loading program's functional specification is found to be satisfactory. See para. 4.
.4 The computational accuracy of the loading program is within acceptable tolerances. See para. 2.5 for recommended tolerances.
.5 The actual ship's data as described in para. 2.1.5 is satisfactory.
.6 A clear and concise operation manual in accordance with 2.4 has been reviewed and found satisfactory.
.7 Details of the minimum hardware specification have been stated.
.8 Submitted test conditions have been endorsed.

2.1.8 When a calculation program has an approval in accordance with para. 2.2, the data verification procedure should be considered complete when:

.1 It has been ascertained that the General Approval is applicable for the ship considered.
.2 The details specified on the valid Certificate of Approval correspond to the calculation program's identification and version number.

.3 The computational accuracy of the calculation program is within acceptable tolerances. See para. 2.5.
.4 The actual ship's data as described in 2.1.5 is satisfactory.
.5 A clear and concise operation manual in accordance with para. 2.4 has been reviewed and found satisfactory.
.6 Details of the minimum hardware specification and operating system software have been stated.
.7 Submitted test conditions have been endorsed.

2.1.9 PRS should send the endorsed test conditions to the local surveyor with instructions to carry out an installation test. Where the ship is in service, the endorsed test conditions should be sent to the shipowner who should arrange for the test conditions to be placed onboard and arrangements for an installation test, witnessed by PRS surveyor, should be made.

2.2 General Approval – Certificate of Approval of the Calculation Program

2.2.1 The loading instrument's calculation program may be generally approved in accordance with the Recommendations of this section. Upon satisfactory completion, the calculation program may be issued with a Certificate of Approval.

2.2.2 A Certificate of Approval is only valid for the identified, specified version of the calculation program.

2.2.3 Upon application to the PRS Head Office for general approval of the calculation program, PRS should provide the applicant with test data from at least two different ship types. For calculation programs based on the input of hull form data, test data should be provided for three different ship types. This data should be used by the applicant to run the calculation program for the test ships. The results obtained (together with the hydrostatic data and cross-curve data developed by the program, if appropriate) should be submitted to PRS for the assessment of the program's computational accuracy. PRS should perform parallel calculations using the same input data and compare these results against the submitted program's results.

2.2.4 Certificate of Approval may be issued if:
.1 The loading program's system specification is found to be satisfactory. See para. 3.1.
.2 The functionality of the loading program has been clearly described and the calculation methods and principles are to the satisfaction of PRS.
.3 The loading program's functional specification is found to be satisfactory. See para. 4.
.4 The computational accuracy of the loading program is within acceptable tolerances. See para. 2.5.
.5 A clear and concise operation manual is submitted for review.
.6 Details of the minimum hardware specification have been stated.

2.2.5 The Certificate of Approval should specify, in detail, what calculations the program is approved for as well as important limitations.

2.2.6 The Certificate of Approval should remain valid for a period not exceeding five years. The Certificate of Approval would be revalidated upon confirmation from the manufacturers of the calculation program that the calculation algorithms remain unchanged.

2.2.7 The Certificate of Approval should become invalid if the calculation algorithms have been modified by the manufacturer without the agreement by PRS. In such cases, the revised calculation program should be treated as a new calculation program.

2.3 Installation Testing – Program Installation Test Certificate

2.3.1 Installation tests should be performed soon after the loading instrument has been installed onboard the ship.

2.3.2 During the installation test one of the ship's senior officers should operate the loading instrument and calculate the test conditions. This operation should be witnessed by PRS surveyor. The results obtained from the loading instrument should be identical to the results stated in the endorsed test conditions. Should the numerical output from the loading instrument be at variance with the endorsed test conditions, no certification should be issued.

2.3.3 An installation test should also be carried out on the second nominated computer, which would be used in the event of failure of the first computer. The results obtained from the loading instrument should be identical to the results stated in the endorsed test conditions. Should the numerical output from the loading instrument be at variance with the endorsed test conditions, no certification should be issued. Where the installation test is carried out on a type approved computer, a second nominated computer and test are not required.

2.3.4 Where the hardware is not type approved, it should be demonstrated that the Program Installation Test is acceptable on both the first and second nominated computers prior to the issue of a Program Installation Test Certificate.

2.3.5 After completion of satisfactory installation tests, PRS surveyor should attach the endorsed test conditions to the previously reviewed operations manual. PRS should then issue the Program Installation Test Certificate.

2.4 Operation Manual

2.4.1 A uniquely identified ship specific operation manual should be submitted to PRS for review.

2.4.2 The operation manual should be written in a concise and unambiguous manner. The use of illustrations and flowcharts is recommended.

2.4.3 The operation manual should contain:

- **.1** A general description of the program denoting identification of the program and its version number stated;
- **.2** Where applicable, a copy of the Certificate of Approval, or equivalent, signifying approval of the calculation program;
- **.3** Details of the hardware specification needed to run the loading program;
- **.4** A description of error messages and warnings likely to be encountered and unambiguous instructions for subsequent actions to be taken by the user in each case;
- **.5** Light shipweight and co-ordinates of its centre of gravity;
- **.6** Full deadweight description of each test condition;
- **.7** A list of the permissible still water shear forces and still water bending moments assigned by PRS in addition to the permissible cargo torque, where applicable;
- **.8** Where applicable, the shear force correction factors;
- **.9** Where applicable, local permissible limits for single and two adjacent hold loading as a function of the appropriate draught and the maximum weight for each hold;
- **.10** An example of a calculation procedure supported by illustrations and sample computer output;
- **.11** Example computer output of each screen display, completed with explanatory text.

2.5 Acceptable Tolerances

2.5.1 The computational accuracy of the calculation program should be within the acceptable tolerance band, specified in Table 2.5.1, of the results at each read- out point obtained by PRS using an independent program or the approved loading manual with identical input.

Table 2.5.1
Tolerance Band for the Comparison of Computational Accuracy

Computation	Tolerance (Percentage of the approved value)
Still water shear force	±5%
Still water bending moment	±5%
Still water torsion moment	±5%

2.6 Hardware Approval

2.6.1 Where the loading instrument's hardware is to be type approved, the hardware specification should be in accordance with para. 3.2, also see para.1.8.

3 SYSTEM SPECIFICATION

3.1 Calculation Program

3.1.1 It is recommended that the design and preparation of the calculation program should be in accordance with appropriate international quality standards, e.g. ISO 90003:2018 or equivalent.

3.1.2 The software should be written to ensure the user cannot alter the critical ship data files containing the following information:

.1 Light shipweight and lightship weight distribution and associated centres of gravity;
.2 Structural limitations imposed by PRS;
.3 Geometric hull form data;
.4 Hydrostatic data;
.5 Compartment definitions including frame spacing, and centres of volume, together with capacity tables (sounding/ullage tables), if appropriate.

3.1.3 Any changes made to the software, which may affect the longitudinal strength aspects, should be made by the manufacturer or his appointed representative and PRS should be informed immediately of any changes. Failure to advise of any modifications to the calculation program may invalidate the certificate issued. In cases where the certificate is considered invalid by PRS, the modified calculation program should be re-assessed in accordance with the approval procedure.

3.2 Stand-alone Computer Hardware

3.2.1 PRS may issue a Certificate of Type Approval for the shipboard hardware, used by the calculation program, when the hardware has been deemed to satisfy the recommendations specified in para. 3.2.2. PRS may stipulate additional requirements.

3.2.2 The manufacturer should submit details of the hardware to be installed onboard. The following information should be submitted for review:

.1 The hardware specification;
.2 Relevant design drawings with materials specified, catalogues, data sheets, calculations and functional descriptions;

.3 Proposed test programme to demonstrate that the performance provisions of the specified standards maybe fulfilled;
.4 Certificates and reports for relevant tests previously obtained for the product.

3.2.3 When considering the information described in para. 3.2.2, PRS may recognise valid certificates or reports issued by another certification body or accredited laboratory.

3.2.4 Performance and environmental testing should be carried out in the presence of PRS Surveyor according to the type testing conditions for type approval detailed in the rules concerning environmental testing of ship's equipment. The following tests should be successfully completed:
.1 Visual inspection,
.2 Performance test,
.3 Electric power supply variations,
.4 Dry heat,
.5 Damp heat,
.6 Vibration,
.7 Inclination,
.8 Insulation resistance,
.9 Cold temperatures,
.10 Electromagnetic compatibility tests.

3.2.5 PRS should be advised of any alterations in the hardware specifications.

4 FUNCTIONAL SPECIFICATION

4.1 General

4.1.1 The computational functions to be encompassed by the calculation program depend upon the specific requirements which are given in the PRS' *Rules* and Regulations.

4.1.2 The calculation program should be user-friendly and designed such that it limits possible input errors by the user.

4.1.3 The forward, midship and after draughts, at the respective perpendiculars, should be calculated and presented as screen and hardcopy output to the user in a clear and unambiguous manner.

4.1.4 It is recommended that the forward, midship and after draughts, at the actual position of the ship's draught marks should be calculated and presented as screen and hard copy output to the user in a clear and unambiguous manner. Provision should be made available for the introduction of a longitudinal deflection.

4.1.5 The displacement should be calculated for the specified load condition and corresponding draught readings and presented as screen and hardcopy output to the user.

4.1.6 The loading instrument should be capable of producing print-outs of the results in both numerical and graphical form. The numeric values should be in both absolute values and as the percentage of the allowable value. This print-out should include a description of the corresponding load condition.

4.1.7 All screen and hardcopy output data should be presented in a clear and unambiguous manner with an identification of the calculation program (version number should be stated).

4.2 Hull Girder Forces and Moments

4.2.1 The loading program should be capable of calculating the following hull girder forces and moments in accordance with PRS' *Rules*:

.1 Still Water Shear Force (SWSF) including the shear force correction, where applicable.
.2 Still Water Bending Moment (SWBM).
.3 Still Water Torsion Moment (SWTM), where applicable.
.4 For ships with relatively large deck openings, additional considerations such as torsional loads should be considered.

4.2.2 The data which should be provided to PRS is specified in Table 4.2.2.

Table 4.2.2

Calculation	Data to be provided to/or accepted by PRS
Still Water Shear Force (SWSF)	1. The read-out points (frame locations) for the SWSF calculations. These points are normally selected at the position of the transverse bulkhead or other obvious boundaries. Additional read-out points may be specified between the bulkheads of long holds or tanks or between container stacks. 2. Shear force correction factors and method of application. 3. The permissible sea-going and harbour SWSF limits at the read-out points specified in (1). Where appropriate, additional sets of permissible SWSF values may be specified.
Still Water Bending Moment (SWBM)	1. The read-out points (frame locations) for the SWBM calculations. These points are normally selected at the position of the transverse bulkhead, mid-hold or other obvious boundaries. 2. The permissible sea-going and harbour SWBM limits at the read-out points specified in (1). Where appropriate, additional sets of permissible SWBM values may be specified.
Still Water Torsion Moment (SWTM), where applicable	1. The read-out points (frame locations) for the SWTM calculations. 2. The permissible limits at the read-out points specified in (1).

4.2.3 The calculated forces and moments should be displayed in both graphical and tabular format, including the percentage of permissible values. The screen and hardcopy output should display the calculated forces or moments, and the corresponding permissible limit, at each specified read-out point.

Alternative limits, e.g. vertical still water bending and torsion may be considered in accordance with PRS' *Rules*.

4.3 Permissible Limits

4.3.1 The user should be able to view the following PRS imposed structural limitations in a clear and unambiguous manner:

.1 All permissible still water shear forces and still water bending moments:
.2 Where applicable, the permissible still water torsion moments;
.3 Where applicable, all local loading limits for both one hold and adjacent hold loading;
.4 Cargo hold weight;
.5 Ballast tank/hold capacities;
.6 Filling restrictions.

4.3.2 It should be readily apparent to the user when any of the imposed structural limits have been exceeded.

5 IN SERVICE VERIFICATION

5.1 General

5.1.1 Where an installed shipboard loading instrument is required and has no Program Installation Test Certificate or record of having previously been examined by PRS, the attending surveyor should advise PRS Head Office accordingly.

5.2 Scope of Survey

5.2.1 When testing the loading instrument, the results obtained from the calculation program should be identical to the results stated in the endorsed test conditions. Should the numerical output from the loading instrument be at variance with the endorsed test conditions, a condition of class should be imposed on the ship and the owners advised accordingly. The calculation program should be tested on all specified computers (type approved or nominated).

IV GUIDANCE FOR BALLAST LOADING CONDITIONS OF CARGO VESSELS INVOLVING PARTIALLY FILLED BALLAST TANKS

1 GENERAL GUIDANCE NOTES

1.1 The present Part provides guidance regarding interpretation of the requirements specified in paragraph 15.4.2.4, *Part II – Hull* of the *Rules for the Classification and Construction of Sea-going Ships.* The contents of this Part IV is equivalent to Annex1 in IACS UR S11, Rev.10.

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 IACS UR S11 where ballast loading conditions involving partially filled ballast tanks may cause concerns for the longitudinal strength of the vessels.

1.5 This part IV 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 (*).

2 CASES A AND B

2.1 Case A

Fig. 2.1 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. 2.2 shows Case B, with a cargo vessel where partial filling of BW Tank no. 6 (P/S) to a given level ($\mathbf{f_{6\text{-}p\%}}$) 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.

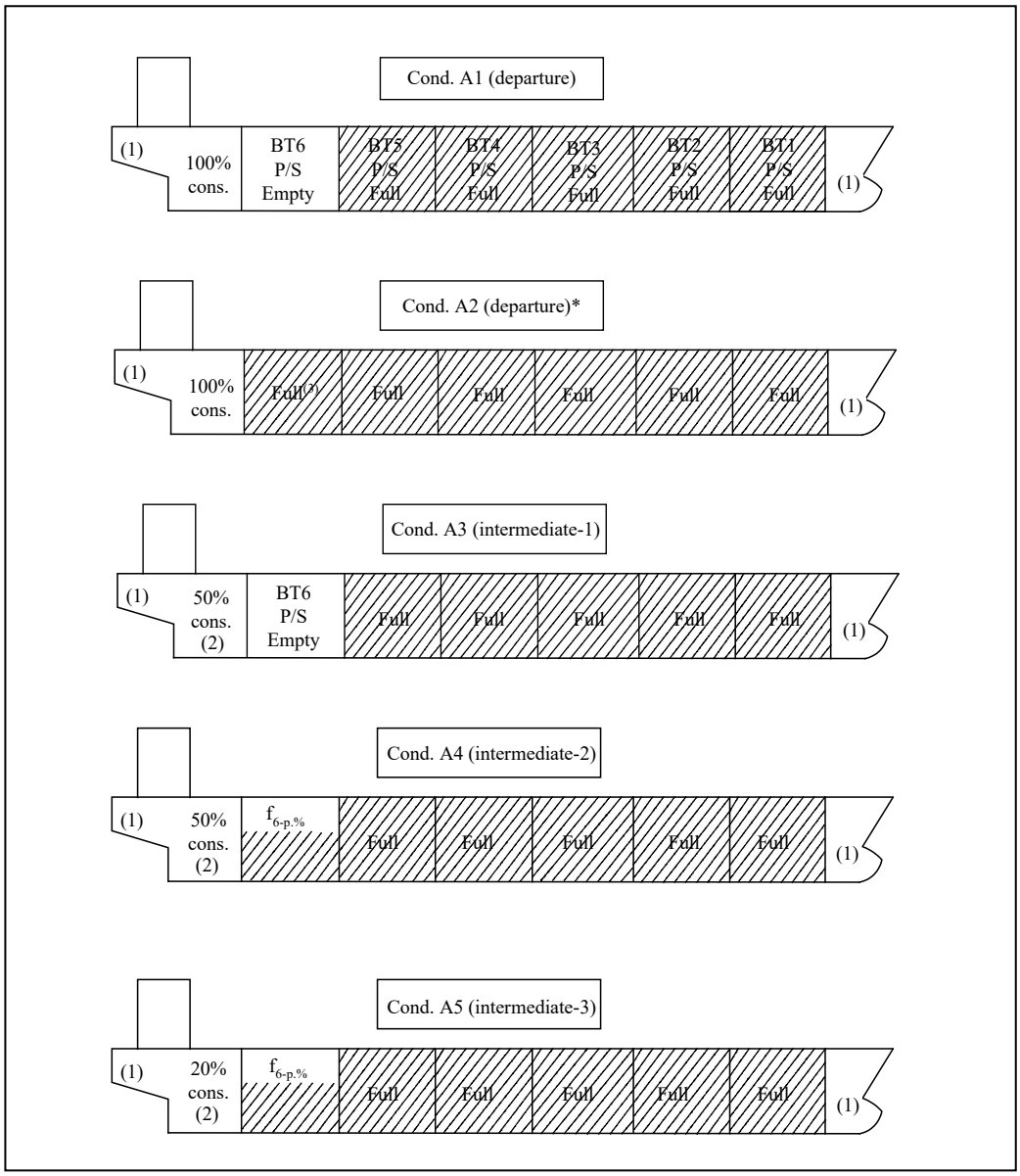
When reaching a given level of consumables (shown as 20% in Figure 2.2), BW Tank no. 6 (P/S) shall be kept full, see conditions B5 and B6.

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 2.2, is to be given in the loading manual.

If such operational guidance is not given, Case A is to be applied.

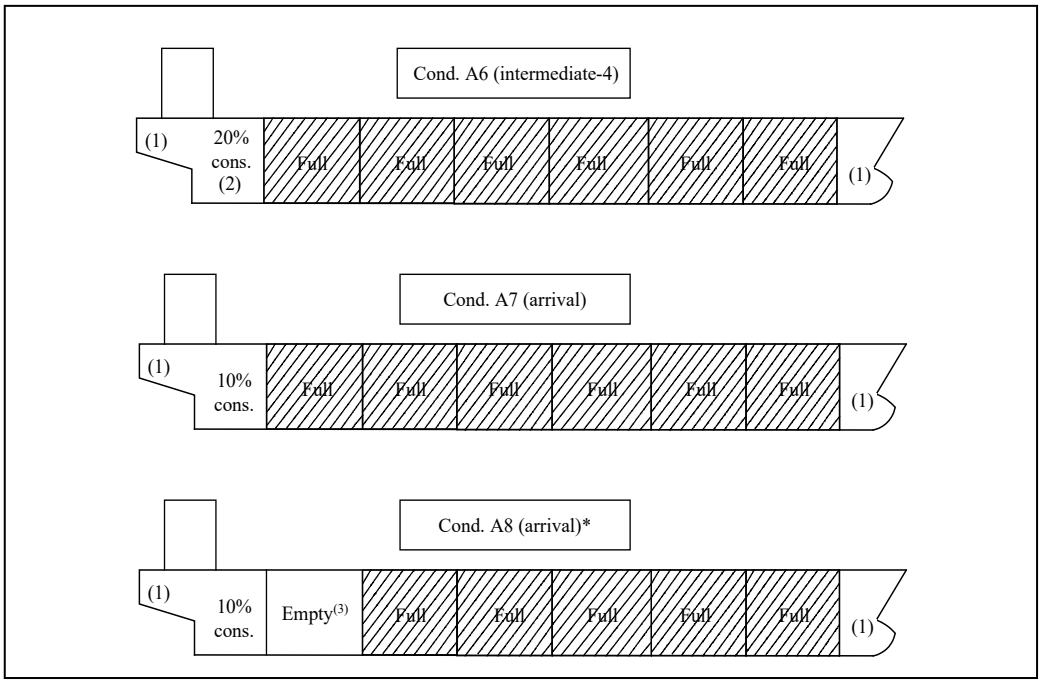
Case A has no limitation of consumables, whereas Case B has limitation of consumables.



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: *.

Fig. 2.1



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

Symbols:

P – port (side)
S – starboard side

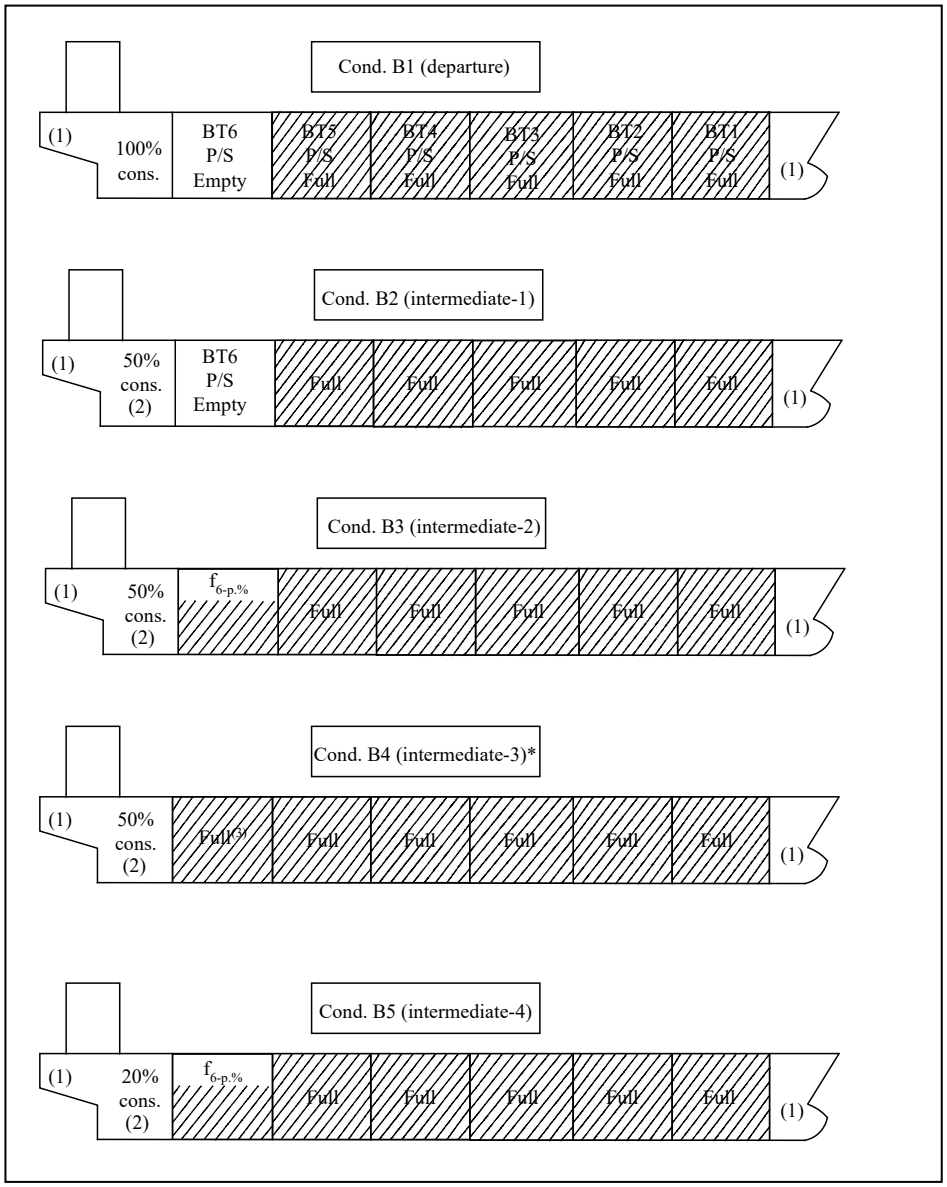
Notes

(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 specified in paragraph 15.4.2.4, *Part II – Hull*.

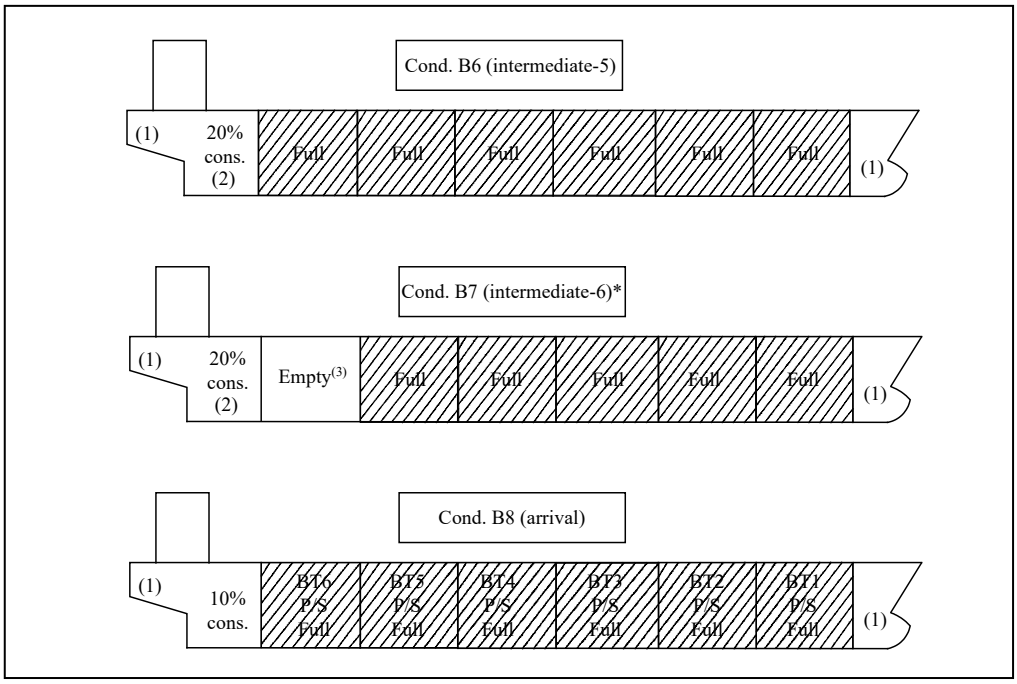
Fig. 2.1 (cont.)



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: *

Fig. 2.2



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: *

Symbols:

P – port (side)
S – starboard side

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 specified in paragraph 15.4.2.4, *Part II – Hull*.

Fig. 2.2 (cont.)

3 CASE C – CONVENTIONAL (WITH USUAL ARRANGEMENT OF WBT)ORE CARRIER WITH TWO PAIRS OF PARTIALLY FILLED BALLAST WATER TANKS

Fig. 3(a) shows the operational loading conditions, departure condition (C1), four intermediate conditions (C2 to 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.

The operational loading conditions, described in Table 3.1, are:
– C1 – departure condition;
– C2 to C5 – intermediate conditions;
– C6 – arrival condition.

Table 3.1
Filling level in partially filled BW tanks nos.1 (P/S) and 7 (P/S) for the operational conditions during ballast voyage

Loading condition	Consumables	Filling level, WBT No.1 (P/S)	Filling level, WBT No. 7 (P/S)
C1 – departure	100%	$f_{1dep\%}$	$f_{7dep\%}$
C2 – intermediate – 1	50% (i)	$f_{1dep\%}$	$f_{7dep\%}$
C3 – intermediate – 2	50% (i)	$f_{1int\%}$	$f_{7int\%}$
C4 – intermediate – 3	20% (i)	$f_{1int\%}$	$f_{7int\%}$
C5 – intermediate – 4	20% (i)	$f_{1arr\%}$	$f_{7int\%}$
C6 – arrival	10%	$f_{1arr\%}$	$f_{7arr\%}$

Notes:
(i) – % consumables to be specified (in the above example – 50% and 20% is assumed).

Fig. 3(b) and Fig. 3(c) show the additional twelve loading conditions (C1-1 to 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 to C2-12, C3-1 to C3-4, C4-1 to C4-12 and C5-1 to C5-4) which shall be added for longitudinal strength verification of the intermediate conditions (C2 to C5).

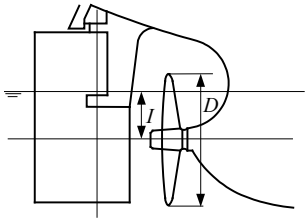
Fig. 3(j) and Fig. 3(k) show the additional twelve loading conditions (C6-1 to C6-12) which shall be added for longitudinal strength verification of the arrival condition (C6).

For the additional loading conditions, the maximum and the minimum filling level of BW tanks are according to trim and propeller immersion limitations specified in paragraph 15.4.2.4, *Part II – Hull*.

The limitations, specified in paragraph in paragraph 15.4.2.4, *Part II – Hull*, relating to conventional ore carriers, are given below.

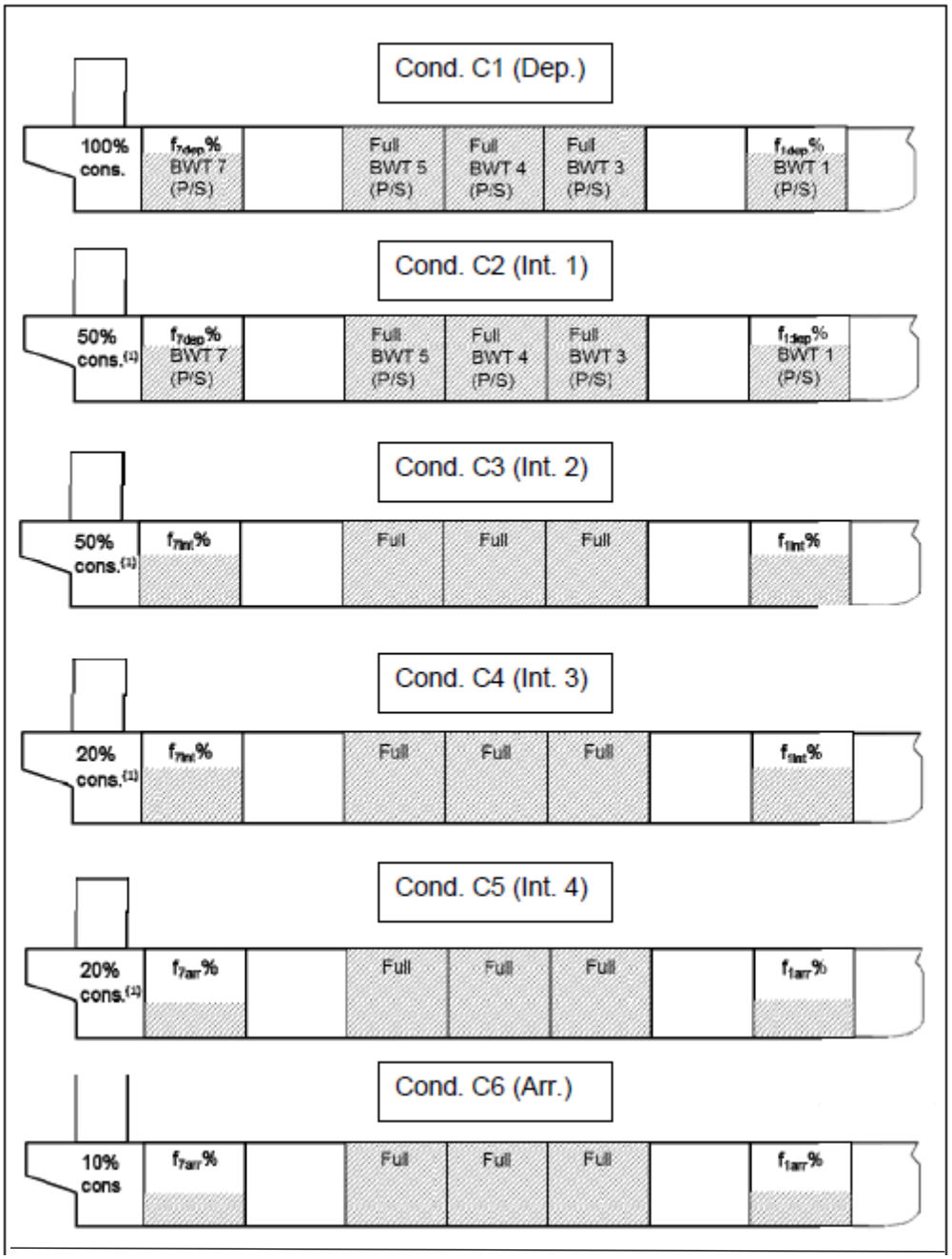
However, for conventional ore carriers with large wing water ballast tanks in cargo area, where empty or full ballast water filling levels of one or maximum two pairs of these tanks (located symmetrically with respect to the ship' s plane of symmetry) lead to the ship's trim exceeding one of the following 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. illing 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 the ship's length, or
– any trim where propeller immersion ratio I/D < 0.25 (I, D – see Fig. 15.4.2.4 from *Part II – Hull*).



I – the distance from propeller centre line to the waterline
D – propeller diameter

Fig. 15.4.2.4 from *Part II – Hull*

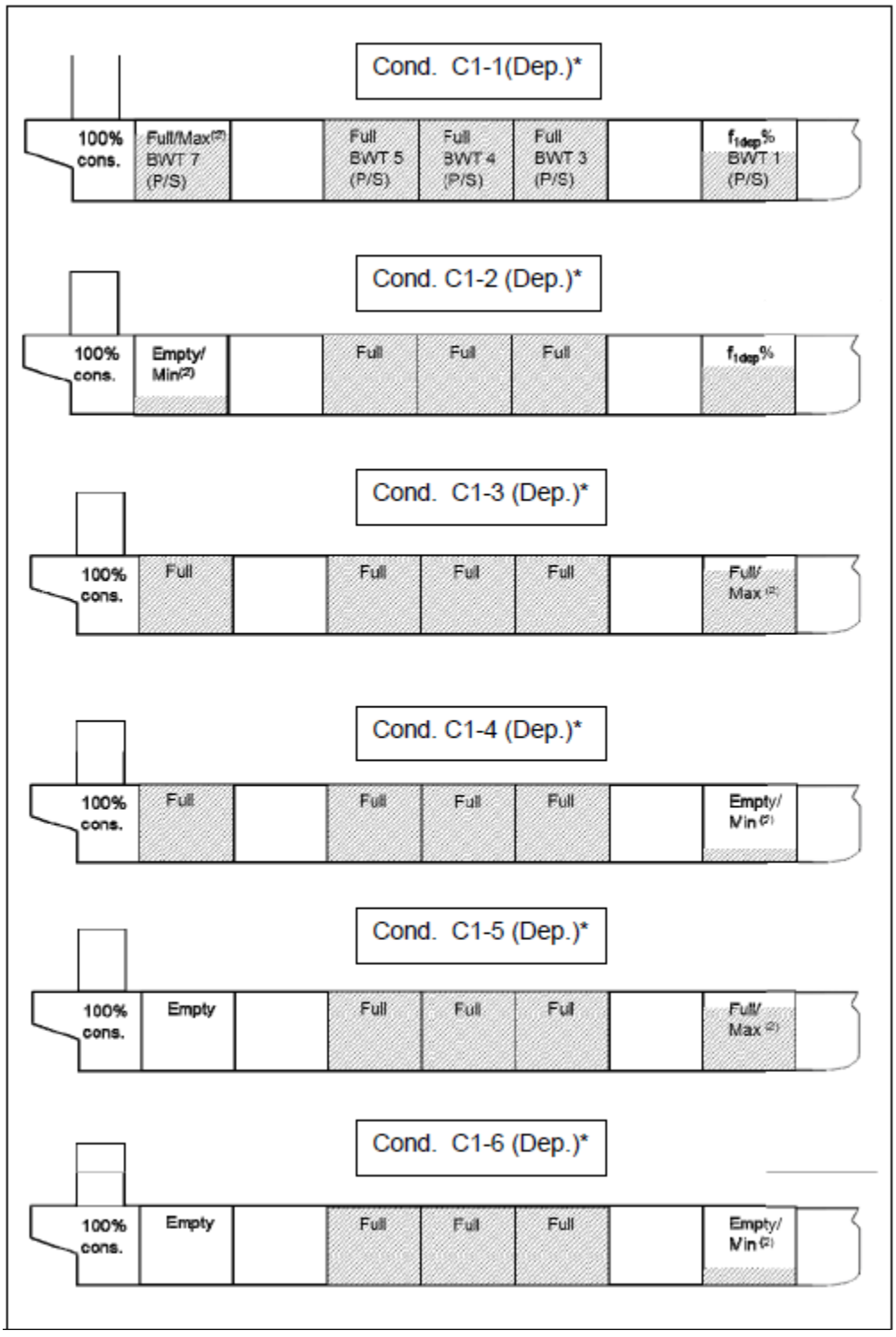


Notes:

(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 specified in paragraph 15.4.2.4, *Part II – Hull*.

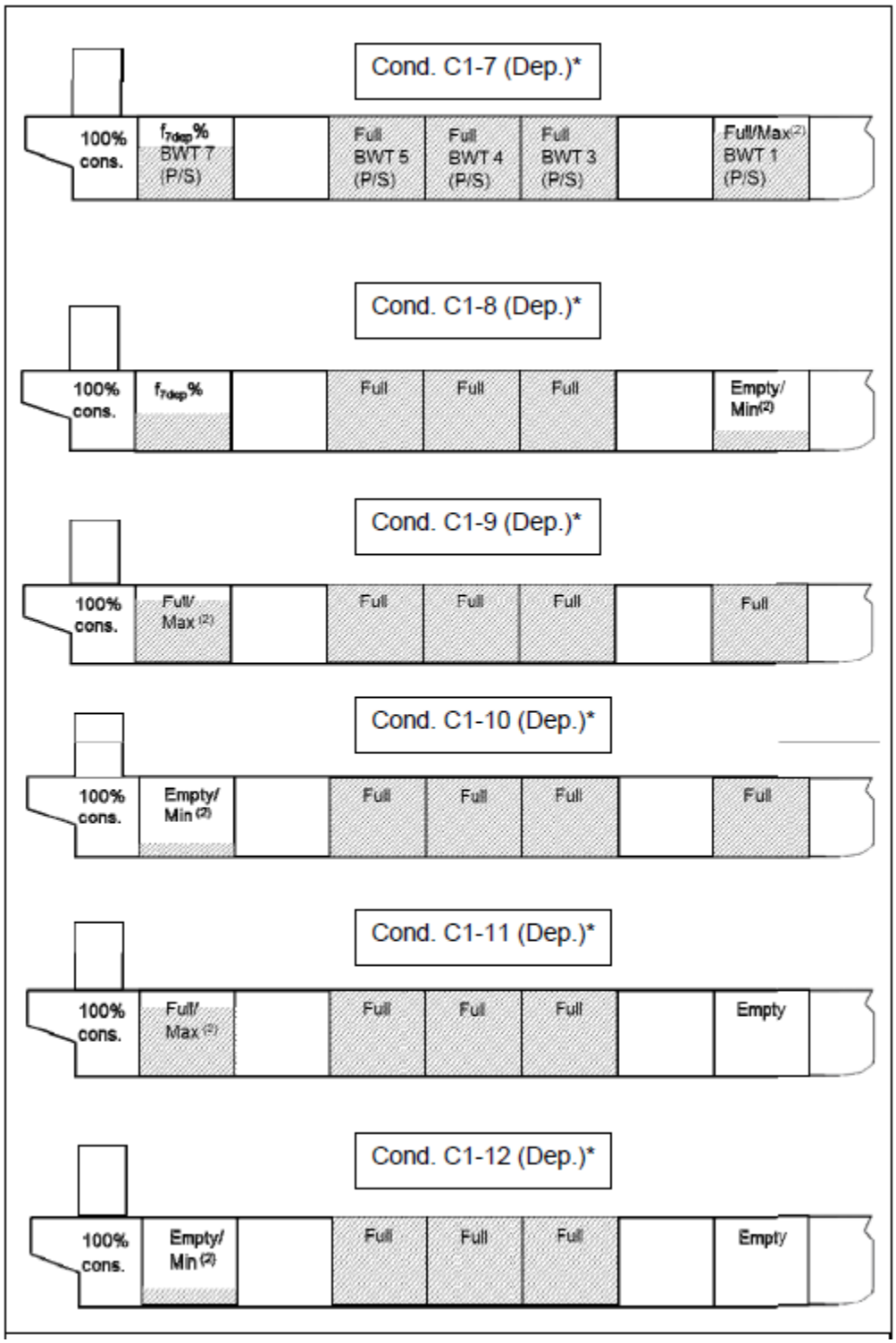
Fig. 3(a)
Case C, Ore Carrier. Partial filling of BW Tank no.1 (P/S) and 7 (P/S) during ballast voyage, operational conditions C1-C6



Notes

(1) The intermediate condition(s) to be specified incl. % consumables.
(2) Figures 3(b) to 3(k): Maximum and minimum filling level of BW tank according to trim and propeller immersion limitations specified in paragraph 15.4.2.4, *Part II – Hull*.

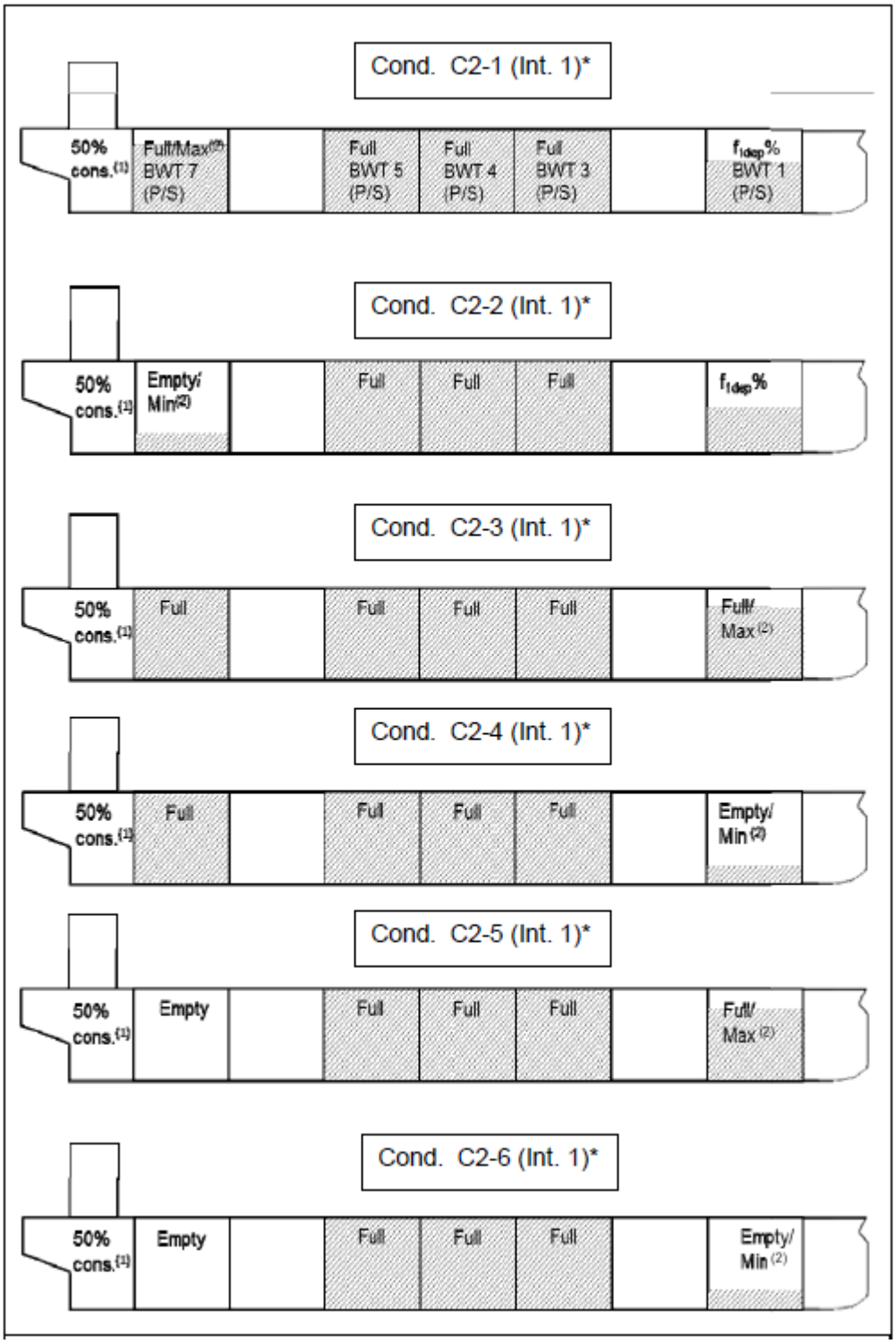
Fig. 3(b)
Case C, Ore Carrier. Partial filling of BW Tank no.1 (P/S) and 7 (P/S) during voyage.
Departure conditions C1-1to C1-6, only intended for strength verification (not operational) are marked: *



Notes

(1) The intermediate condition(s) to be specified incl. % consumables.
(2) Figures 3(b) to 3(k): Maximum and minimum filling level of BW tank according to trim and propeller immersion limitations specified in paragraph 15.4.2.4, *Part II – Hull*.

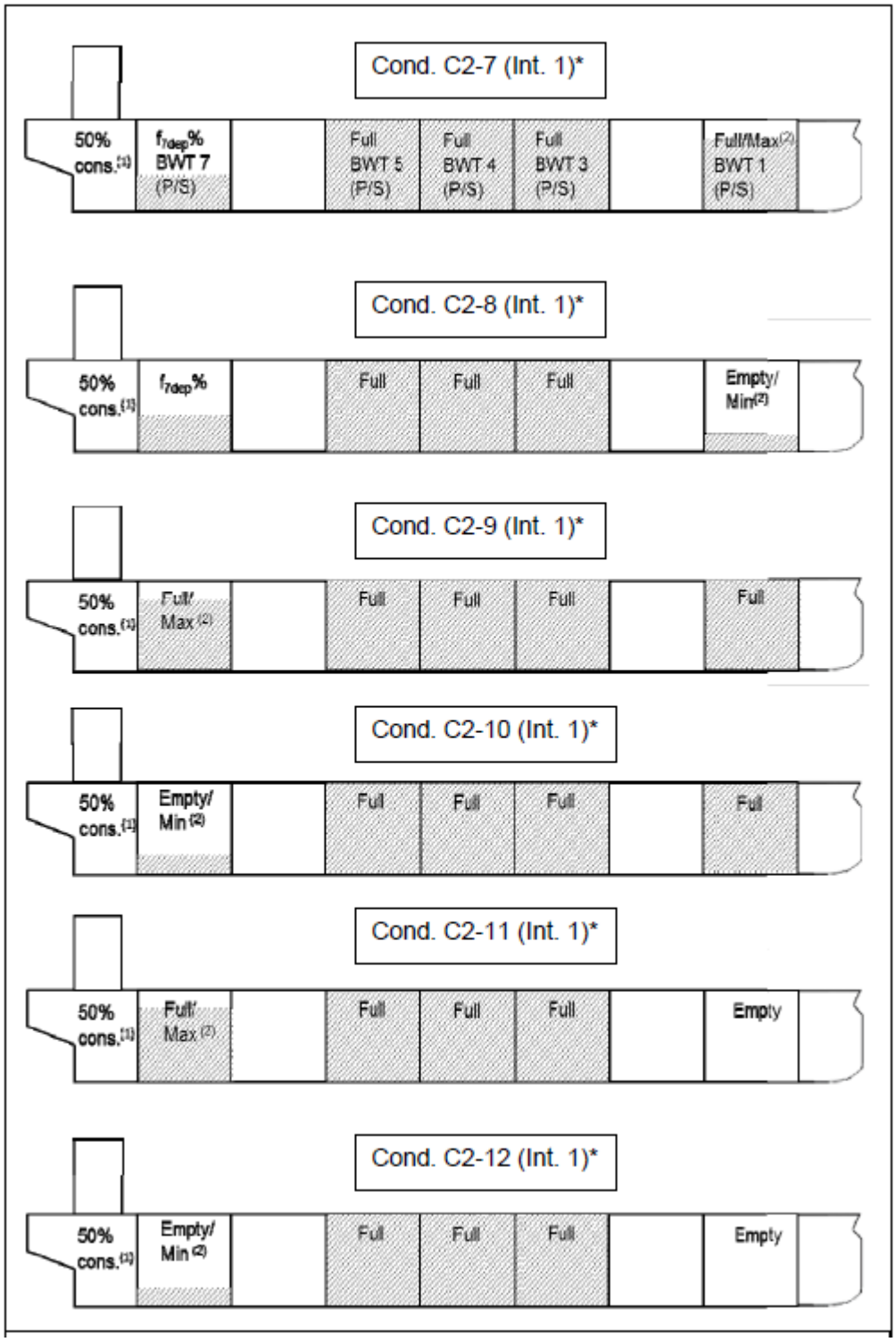
Fig. 3(c)
Case C, Ore Carrier. Partial filling of BW Tank no.1 (P/S) and 7 (P/S)during voyage.
Departure conditions C1-7 to C1-12, only intended for strength verification (not operational) are marked: *



Notes

(1) The intermediate condition(s) to be specified incl. % consumables.
(2) Figures 3(b) to 3(k): Maximum and minimum filling level of BW tank according to trim and propeller immersion limitations specified in paragraph 15.4.2.4, *Part II – Hull.*

Fig. 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 to C2-6, only intended for strength verification (not operational) are marked: *

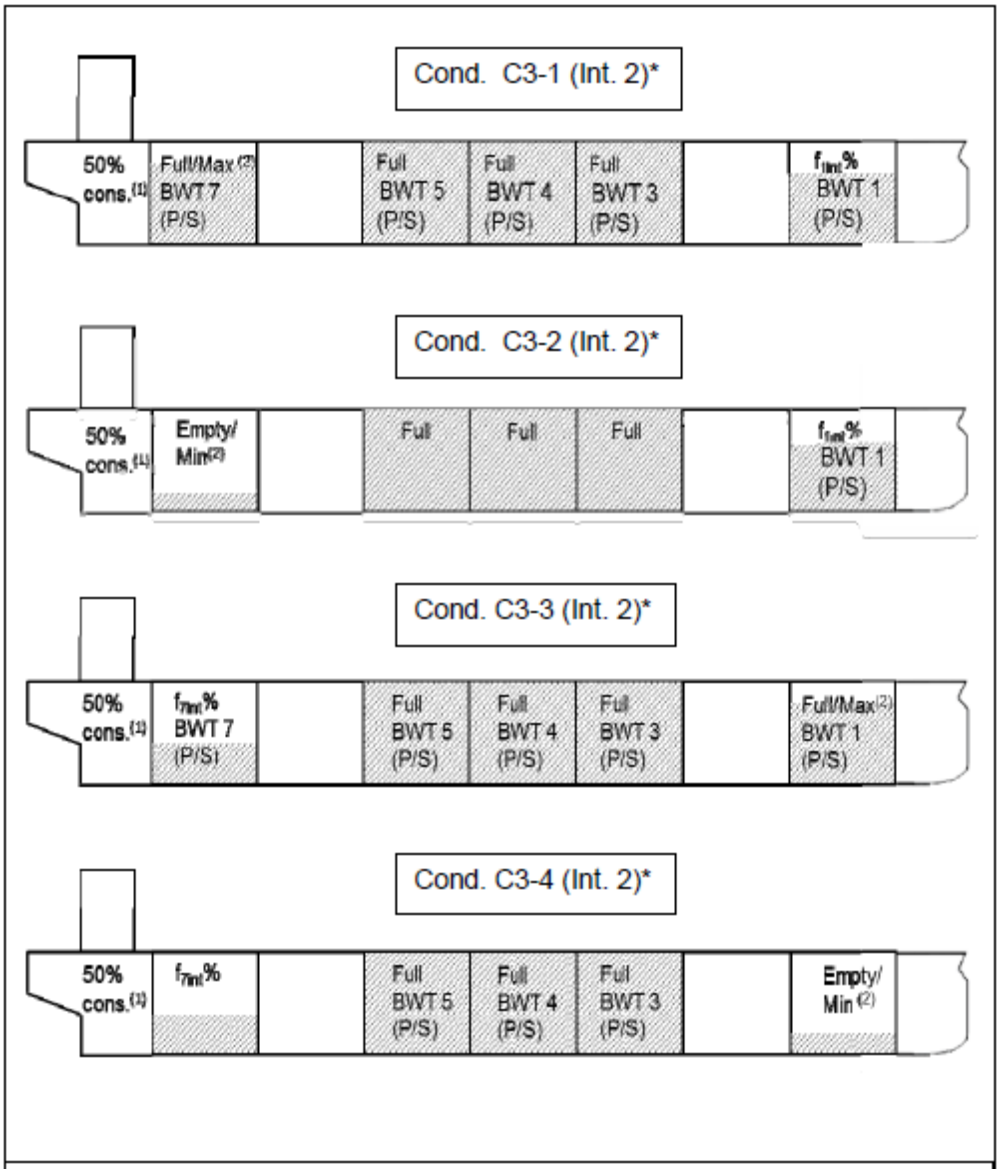


Notes

(1) The intermediate condition(s) to be specified incl. % consumables.
(2) Figures 3(b) to 3(k): Maximum and minimum filling level of BW tank according to trim and propeller immersion limitations specified in paragraph 15.4.2.4, *Part II – Hull*.

Fig. 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 to C2-12, only intended for strength verification (not operational) are marked: *

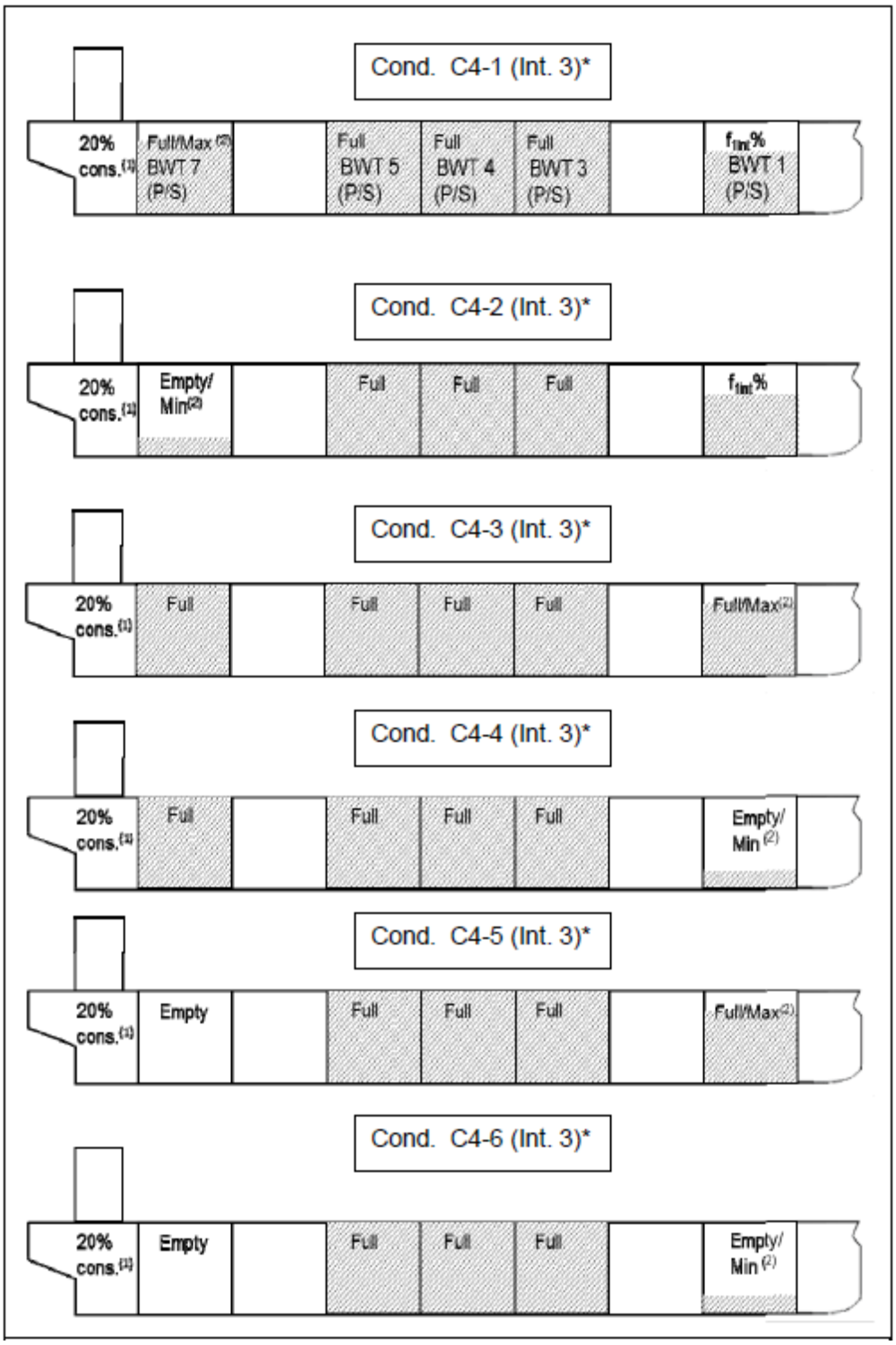


Notes

(1) The intermediate condition(s) to be specified incl. % consumables.
(2) Figures 3(b) to 3(k): Maximum and minimum filling level of BW tank according to trim and propeller immersion limitations specified in paragraph 15.4.2.4, *Part II – Hull*.

Fig..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 to C3-4, only intended for strength verification (not operational) are marked: *



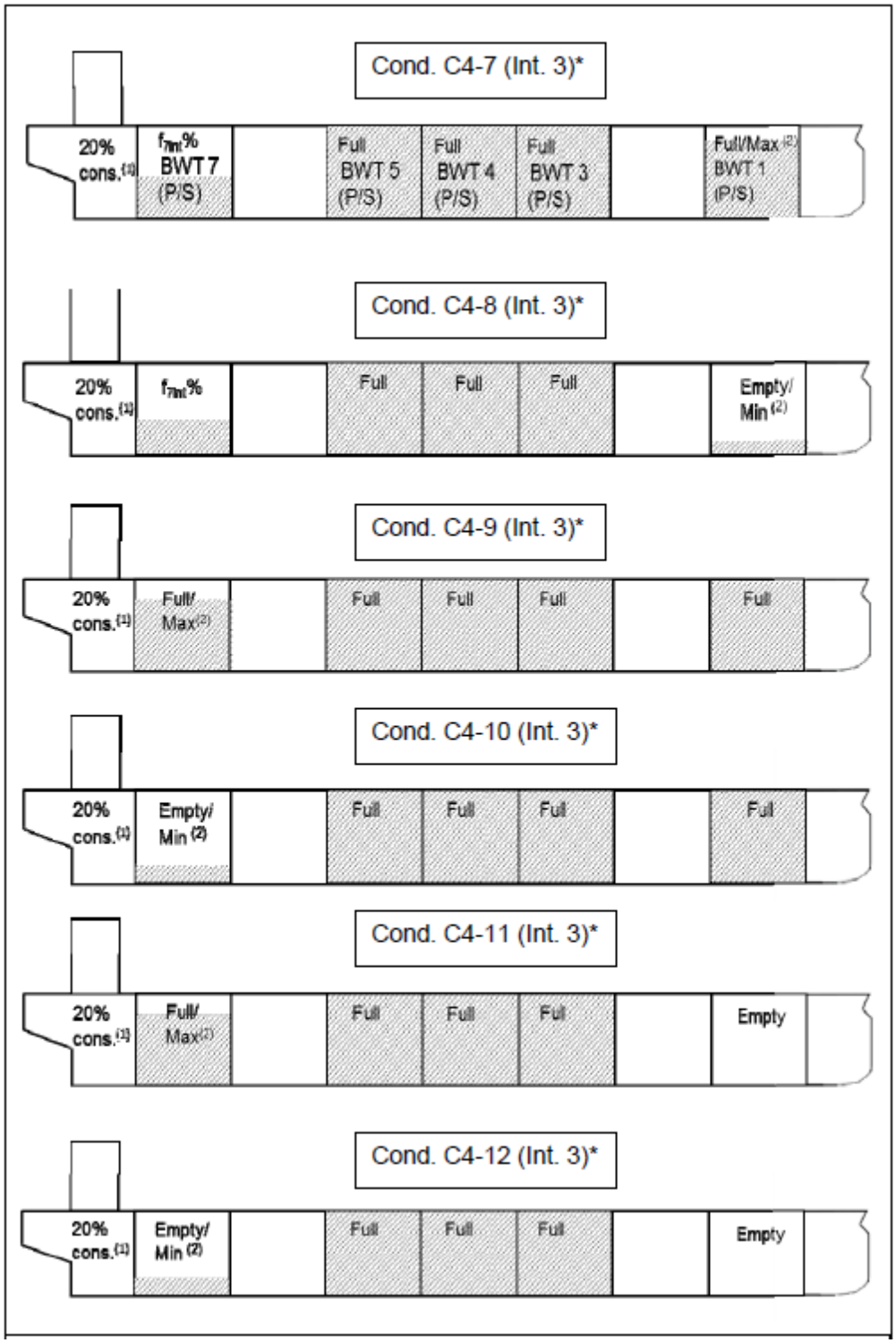
Notes

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

(2) Figures 3(b) to 3(k): Maximum and minimum filling level of BW tank according to trim and propeller immersion limitations specified in paragraph 15.4.2.4, *Part II – Hull*.

Fig. 3(g)

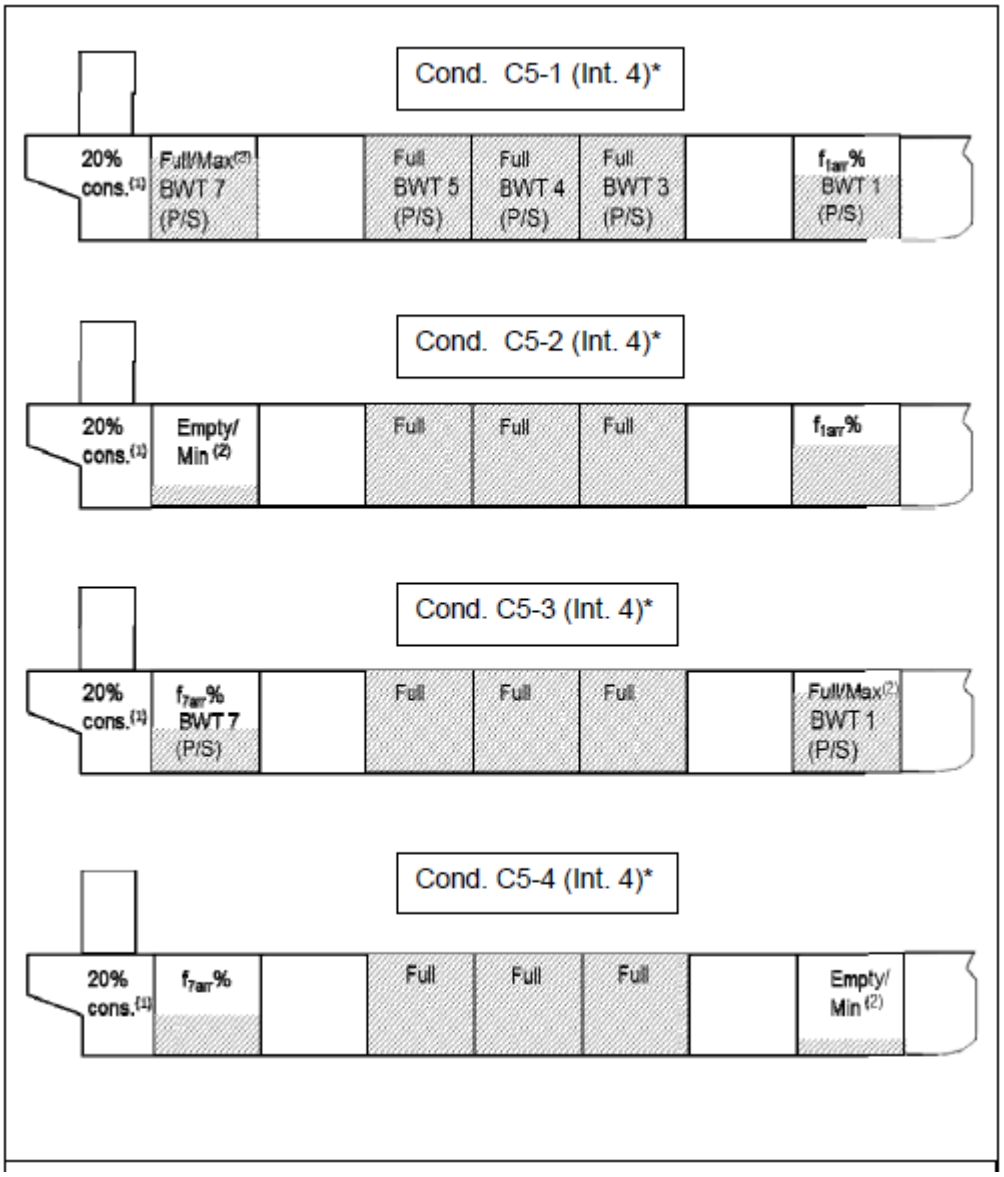
Case C, Ore Carrier. Partial filling of BW Tank no.1 (P/S) and 7 (P/S) during voyage.
Intermediate conditions C4-1 to C4-6, only intended for strength verification (not operational) are marked: *



Notes

(1) The intermediate condition(s) to be specified incl. % consumables.
(2) Figures 3(b) to 3(k): Maximum and minimum filling level of BW tank according to trim and propeller immersion limitations specified in paragraph 15.4.2.4, *Part II – Hull*.

Fig. 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 to C4-12, only intended for strength verification (not operational) are marked: *

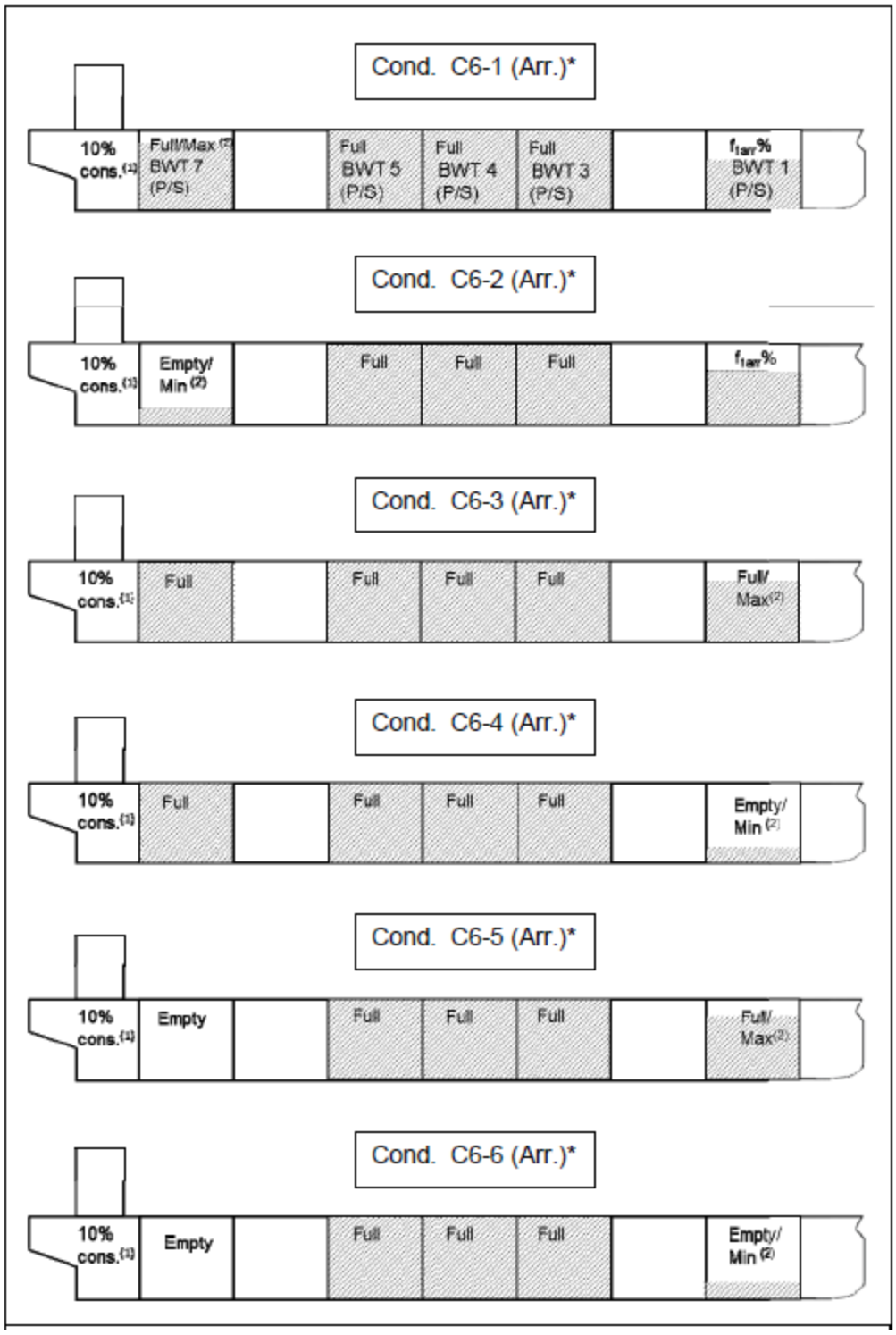


Notes

(1) The intermediate condition(s) to be specified incl. % consumables.
(2) Figures 3(b) to 3(k): Maximum and minimum filling level of BW tank according to trim and propeller immersion limitations specified in paragraph 15.4.2.4, *Part II – Hull*.

Fig. 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 to C5-4, only intended for strength verification (not operational) are marked: *

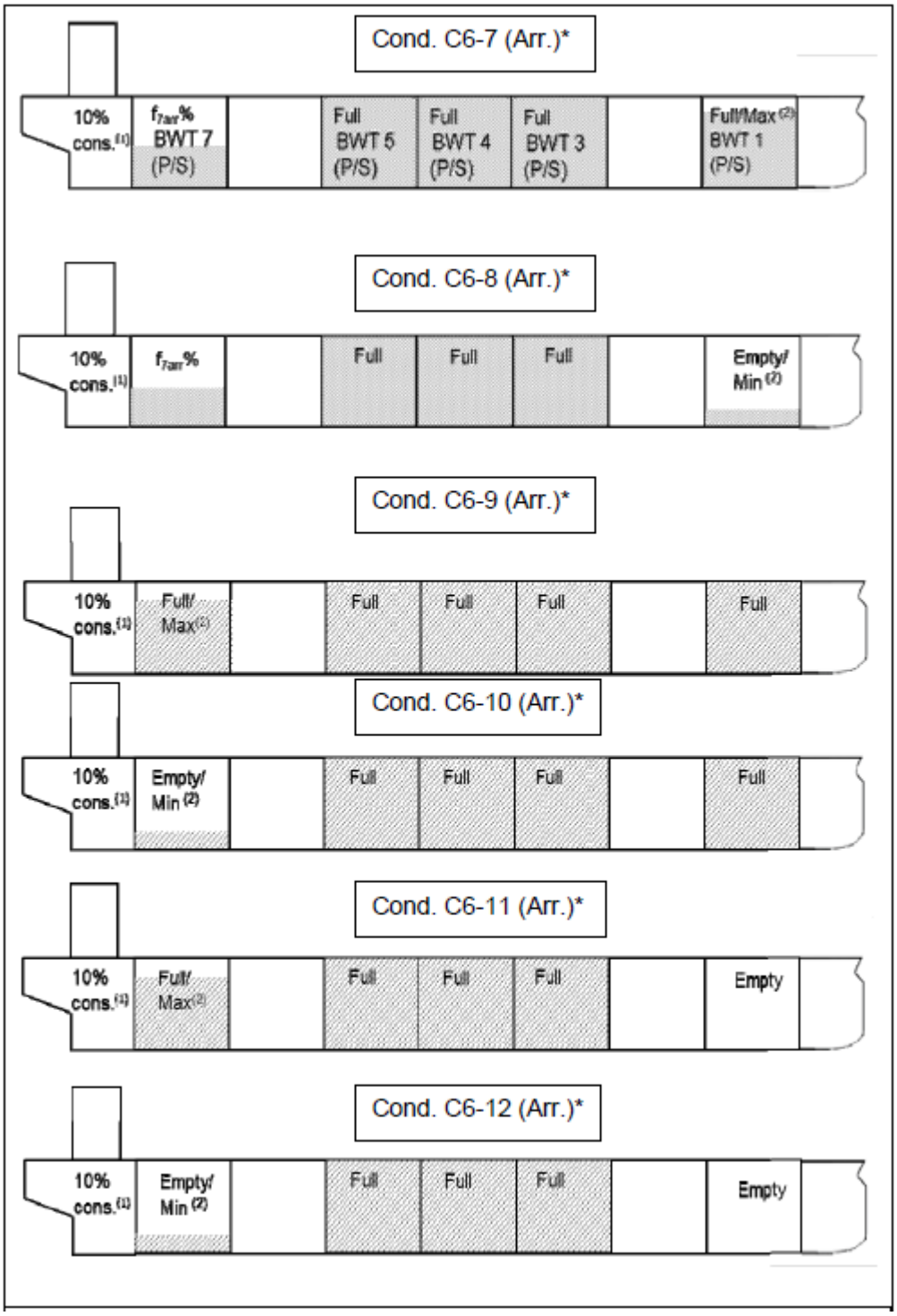


Notes

(1) The intermediate condition(s) to be specified incl. % consumables.
(2) Figures 3(b) to 3(k): Maximum and minimum filling level of BW tank according to trim and propeller immersion limitations specified in paragraph 15.4.2.4, *Part II – Hull*.

Fig. 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 to C6-6, only intended for strength verification (not operational) are marked:*



Notes

(1) The intermediate condition(s) to be specified incl. % consumables.
(2) Figures 3(b) to 3(k): Maximum and minimum filling level of BW tank according to trim and propeller immersion limitations specified in paragraph 15.4.2.4, *Part II – Hull*.

Fig. 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 to C6-12, only intended for strength verification (not operational) are marked: *

List of amendments effective as of 1 January 2021

Item	*Title/Subject*	*Source*
IV	Guidance for Ballast Loading Conditions of Cargo Vessels Involving Partially Filled Ballast Tanks	IACS UR S11, Rev.10