DNV·GL

RULES FOR CLASSIFICATION

Ships

Edition July 2020
Amended October 2020

Part 5 Ship types

Chapter 10 Vessels for special operations

DNV GL AS

FOREWORD

DNV GL rules for classification contain procedural and technical requirements related to obtaining and retaining a class certificate. The rules represent all requirements adopted by the Society as basis for classification.

Any comments may be sent by e-mail to *rules@dnvgl.com*

CHANGES – CURRENT

This document supersedes the July 2019 edition of DNVGL-RU-SHIP Pt.5 Ch.10.
Numbering and/or title of items containing changes are highlighted in red colour.

Amendments October 2020, entering into force 1 January 2021

Topic	*Reference*	*Description*
Accidental drop of load from crane	Sec.2 [3.1.3]	New subsection requiring that ship and crane interactions shall be taken into consideration for dropped load from crane.

Changes July 2020, entering into force 1 January 2021

Topic	*Reference*	*Description*
Improvement of remote sounding requirements	Sec.5 [3.3]	Requirement modified to give more specific requirements to redundancy, segregation and type.
Removed rating numbers for class entries of escort tugs	Sec.11 Table 1	Modified description of purpose for qualifier **O**.
	Sec.11 [6.1.3]	Changed the text so that the rating numbers for vessels with qualifier **O** will be replaced by '-'.

Editorial corrections

In addition to the above stated changes, editorial corrections may have been made.

CONTENTS

SECTION 1 GENERAL

Symbols

For symbols and definitions not defined in this chapter, see Pt.3 Ch.1 Sec.4.

1 Introduction

1.1 Introduction

1.1.1 These rules provide requirements to vessels performing special operations including sub-sea lifting, cable and pipe laying services, heavy lift and transport, diving support, seismographic research services, well stimulation, fire-fighting, icebreaking, dredging and towing and escort services.

1.2 Scope

1.2.1 The rules in this chapter give requirements to hull strength, systems and equipment, safety and availability, stability and load line and the relevant procedural requirements applicable to vessels performing special operations.

1.3 Application

1.3.1 The requirements in this chapter shall be regarded as supplementary to those given for the assignment of main class Pt.2, Pt.3 and Pt.4.

2 Class notations

2.1 Ship type notations

2.1.1 Vessels built in compliance with the requirements as specified in Table 1 will be assigned the class notations as follows:

Table 1 Ship type notations

Class notation	*Purpose*	*Qualifier*	*Description*	*Design requirements, rule reference*
Crane vessel	Vessels specially intended for lifting operations.	<none>		Sec.1 and Sec.2
Cable laying vessel	Vessels specially intended for laying cables on the sea bottom	<none>		Sec.1 and Sec.3
Pipe laying vessel	Vessels specially intended for laying pipelines on the sea bottom	<none>		Sec.1 and Sec.4

Class notation	*Purpose*	*Qualifier*	*Description*	*Design requirements, rule reference*
Semi-submersible heavy transport vessel	Specially intended for loading and unloading cargo by submerging the freeboard deck through ballast operations	<none>		Sec.1 and Sec.5
Diving support vessel	Vessels arranged for support of diving operations applying rope and/or umbilical connection between the submerged bell and the diving support vessel	**SAT**	Equipped with a saturation diving system classified by the Society in compliance with DNVGL-RU-OU-0375 *Diving systems*.	Sec.1 and Sec.6
		Surface	Equipped with a surface diving system classified by the Society in compliance with DNVGL-RU-OU-0375 *Diving systems*.	
		(Ready)	Vessel prepared for installation of diving system with the supported interfaces listed in the appendix of class.	
		(OCS)	IACS Classed saturation diving system installed as per Sec.6 [1.8]	
Seismic vessel	Vessels designed for seismographic research	<none>		Sec.1 and Sec.7
		A	Advanced design for seismographic research. Vessels with class notation qualifier **A** shall hold the following additional class notations: — **RP(+)** or **RP(3,x%,+)**, see Pt.6 Ch.2; or **DYNPOS(AUTR)** or **DYNPOS(AUTRO)**, see Pt.6 Ch.3; or **DYNPOS(ER)**, see Pt.6 Ch.3 — **E0** or **ECO**, see Pt.6 Ch.2 — **NAUT(OSV)**, see Pt.6 Ch.3	
Well stimulation vessel	Arranged and equipped for stimulation of wells for production of oil and/or gas	<none>		Sec.1 and Sec.8

Class notation	*Purpose*	*Qualifier*	*Description*	*Design requirements, rule reference*
Fire fighter	Fire fighting on board ships and on offshore and onshore structures	<none>		Sec.1 and Sec.9
		I	Active protection, giving it the capability to withstand higher heat radiation loads from external fires	
		I+	Active and passive protection, giving it the capability to withstand the higher heat radiation loads also when the active protection fails. In addition, the vessel incorporates a longer throw length	
		II	Continuous fighting of large fires and cooling of structures. May be assigned in combination with **Fire fighter(I)**	
		III	Continues fighting of large fires and cooling of structures with larger water pumping capacity and more comprehensive fire fighting equipment than for **II**. May be assigned in combination with **Fire fighter(I)**	
		Capability	Vessels with special fire fighting capabilities	
Icebreaker	Vessels primarily designed for ice breaking operations	<none>		Sec.1 and Sec.10
Tug	Ships primarily designed for towing and/or pushing operations or assisting other vessels or floating objects in manoeuvring	<none>		Sec.1 and Sec.11

Class notation	*Purpose*	*Qualifier*	*Description*	*Design requirements, rule reference*
Escort tug	Vessel specially intended for active escort towing. This includes steering, braking and otherwise controlling a vessel in restricted waters during speeds of up to 10 knots by means of a permanent towline connection with the stern of the escorted vessel	**F**	Escort rating numbers based on full scale test	Sec.1 and Sec.11
		N	Escort rating numbers based on numerical calculations	
		O	Escort rating numbers established by a society other than DNV GL	
		(F_S, t, v)	**(F_S, t, v)** are escort rating numbers, where: **F_S** indicates maximum transverse steering pull in ton, exerted by the escort tug on the stern of the assisted vessel **t** is the time in seconds required for the change of the tug's position from one side to the corresponding opposite side **v** is the speed in knots at which this pull may be attained	
Dredger	Vessels which are self-propelled or non-self-propelled and which are designed for all common dredging methods (e.g. bucket dredging, grab dredging etc.)	<none>		Sec.1 and Sec.12
		Suction	Vessels which are self-propelled or non-self-propelled and which are designed for suction dredging	
Pusher	Vessels primarily designed for pushing			Sec.1 and Sec.13

2.2 Additional notations

2.2.1 The following additional notations, as specified in Table 2, are typically applied to vessels performing special operations:

Table 2 Additional notations

Class notation	*Description*	*Application*	*Rule reference*
NAUT	Requirements for bridge design, instrumentation, location of equipment and bridge procedures for enhanced safety for manoeuvring of the ship	All ships	Pt.6 Ch.3
SPS	Ships carrying special personnel who are neither crew members nor passengers	Case by case	Pt.6 Ch.5 Sec.7
Clean	Vessel designed for controlling and limiting operational emissions and discharges	All ships	Pt.6 Ch.7 Sec.2
DYNPOS	Vessel equipped with dynamic positioning system	All ships	Pt.6 Ch.3 Sec.2 Pt.6 Ch.3 Sec.3
COMF	Comfort class covering requirements for noise and vibration and indoor climate	All ships	Pt.6 Ch.8 Sec.1
HELDK	Requirements to helicopter landing area or erected platform covering basic strength requirements and safety	All ships	Pt.6 Ch.5 Sec.5
Crane	Requirements to certification of crane	All ships except for **Crane vessel**	Pt.6 Ch.5 Sec.3
SF	Compliance with the damage stability requirements of IMO Res.MSC.235(82) (*Guidelines for the Design and Construction of Offshore Supply Vessels, 2006*), alternatively as amended by IMO Res. MSC.335(90) (*Amendments to the Guidelines for the Design and Construction of Offshore Supply Vessels, 2006*)	**Offshore service vessel**	Pt.6 Ch.5 Sec.6
Strengthened(DK)	Decks strengthened for heavy cargo	All ships	Pt.6 Ch.1 Sec.2

3 Definitions

3.1 Terms

3.1.1

Table 3 Definitions of terms

Terms	*Definition*
cargo deck on semi-submersible heavy transport vessel	the deck being submerged for carrying the cargo, as well as its horizontal extension
exposed surfaces	superstructures, casings and other buoyant volumes above the cargo deck, or its horizontal extension, that may become damaged if coming in contact with the cargo at any stage during loading or unloading operations The cargo deck is also to be considered as an exposed surface.
maximum submerged draught	the maximum draught to which the vessel is allowed to be submerged
semi-submersible heavy transport vessel	a vessel designed to load and unload deck cargo by temporarily submerging its cargo deck through ballast operations
temporarily submerged condition	any ballasting or de-ballasting with the load line mark submerged
transit condition	the condition from when the vessel has completed loading, with the cargo properly secured, to when the vessel has reached its intended destination and preparation for unloading can commence
control stand	is a station in which one or more of the following control or indicating functions are centralized: 1) indication and operation of all vital life support conditions, including pressure control 2) visual observation, communication systems including telephones, audio-recording and microphones to public address systems 3) disconnection of all electrical installations and Insulation monitoring 4) provisions for calibration of and comparison between gas analysing 5) indication of temperature and humidity in the inner area 6) alarms for abnormal conditions of environmental control systems 7) fixed fire detection and fire alarm systems 8) ventilation fans 9) automatic sprinkler, fire detection and fire alarm systems 10) launch and recovery systems, including interlock safety functions 11) operation and control of the hyperbaric evacuation system
fore ship substructure	fore ship substructure includes bow area B and bow intermediate ice belt BIi as defined in Pt.6 Ch.6 Sec.6 Figure 1
towline	rope/wire used for towing
escort service	the service includes steering, braking and otherwise controlling the assisted vessel. The steering force is provided by the hydrodynamic forces acting on the tug's hull.
escort test speed	this is the speed at which the full scale measurements shall be carried out, normally 8 knots and/or 10 knots

Terms	Definition
escort tug	the tug performing the escort service, while assisted vessel is the vessel being escorted
bollard pull (BP)	maximum continuous pull obtained at static pull test on sea trial
dredger	means all hopper dredgers, hopper barges and similar vessels which may be self-propelled or non-self-propelled and which are designed for all common dredging methods (e.g. bucket dredging, suction dredging, grab dredging etc.).

3.1.2 For symbols and definitions concerning diving vessels, refer to the Society's documents: DNVGL-RU-OU-0375 and DNVGL-OS-E402

4 Documentation

4.1 Documentation requirements

4.1.1 General

For general requirements to documentation, including definition of the info codes, see DNVGL-CG-0550 Sec.6.

For a full definition of the documentation types, see DNVGL-CG-0550 Sec.5.

4.1.2 Crane vessel

Documentation shall be submitted as required by Table 4.

Table 4 Documentation requirements - Crane vessel

Object	*Documentation type*	*Additional description*	*Info*
Cranes	Z030 - Arrangement plan	Including: — main dimensions — limiting positions of movable parts — dynamic load charts including safe working loads and corresponding arms — location on board during operation and in parked position. — plan of rack bar (toothed bar) with details of support, if applicable.	FI
	H050 - Structural drawing	Crane pedestals including design loads and reaction forces: — during operation — in stowed position.	AP
	H050 - Structural drawing	Crane supporting structures including design loads and reaction forces: — during operation — in stowed position.	AP
	I200 - Control and monitoring system documentation		AP

Object	*Documentation type*	*Additional description*	*Info*
Lifting operational and planning manual	Z220 - Vessel operation manual	For contents, see International Code on Intact Stability, 2008, Part B, paragraph 3.9.	AP
AP = For approval; FI = For information ACO = As carried out; L = Local handling; R = On request; TA = Covered by type approval; VS = Vessel specific			

4.1.3 Cable laying vessel

Documentation shall be submitted as required by Table 5.

Table 5 Documentation requirements - Cable laying vessel

Object	*Documentation type*	*Additional description*	*Info*
Cable laying equipment	C010 - Design criteria	Including: — safe working loads/brake rendering loads — load directions and points of exertion — dynamic amplification factors — description of operational features.	FI
	Z030 - Arrangement plan		FI
Cable laying equipment supporting structures	H050 - Structural drawing	Including footprint loads from pipe laying equipment.	AP
	C010 - Design criteria	Stowed cable supporting structure: Maximum weight of stowed cables.	FI
	H050 - Structural drawing	Stowed cable supporting structure.	AP
AP = For approval; FI = For information ACO = As carried out; L = Local handling; R = On request; TA = Covered by type approval; VS = Vessel specific			

If an anchoring system for position-keeping is installed, additional documentation shall be submitted as required by Table 6.

Table 6 Additional document requirements for ships with anchoring system for position keeping

Object	*Documentation type*	*Additional description*	*Info*
Anchoring arrangement	C010 – Design criteria	Applicable if anchoring system is used for position keeping. Including anchor line forces.	FI
	Z030 – Arrangement plan	Applicable if anchoring system is used for position keeping. Including limiting anchor line angles.	FI
	H050 - Structural drawing	Anchoring system for position keeping: Including supporting structure for winches and force transmitting structures at points where the anchor lines change direction.	AP
		Anchor racks for stowage for mooring anchor during voyage at sea.	AP

Object	*Documentation type*	*Additional description*	*Info*
AP = For approval; FI = For information ACO = As carried out; L = Local handling; R = On request; TA = Covered by type approval; VS = Vessel specific			

4.1.4 Pipe laying vessel

Documentation shall be submitted as required by Table 7.

Table 7 Documentation requirements - Pipe laying vessel

Object	*Documentation type*	*Additional description*	*Info*
Pipe laying arrangement	C010 – Design criteria	Including: — safe working loads/brake rendering loads — load directions and points of exertion — dynamic amplification factors — description of operational features.	FI
	Z030 – Arrangement plan		FI
Pipe laying equipment supporting structures	H050 – Structural drawing	Including footprint loads from pipe laying equipment.	AP
Pipe reel	C010 – Design criteria	Including maximum weight of reel with pipe, including water if the pipe shall be hydraulically tested on board.	FI
	H050 – Structural drawing	Pipe reel supporting structure.	AP
Pipe stowage equipment	C010 – Design criteria	Including maximum weight of stowed pipes.	FI
	H050 – Structural drawing	Stowed pipe supporting structure.	AP
AP = For approval; FI = For information ACO = As carried out; L = Local handling; R = On request; TA = Covered by type approval; VS = Vessel specific			

If an anchoring system for position-keeping is installed, additional documentation shall be submitted as required by Table 8.

Table 8 Additional document requirements for ships with anchoring system for position keeping

Object	*Documentation type*	*Additional description*	*Info*
Anchoring arrangement	C010 – Design criteria	Applicable if anchoring system is used for position keeping. Including anchor line forces.	FI
	Z030 – Arrangement plan	Applicable if anchoring system is used for position keeping. Including limiting anchor line angles.	FI
	H050 – Structural drawing	Anchoring system for position keeping: Including supporting structure for winches and force-transmitting structures at points where the anchor lines change direction.	AP
AP = For approval; FI = For information ACO = As carried out; L = Local handling; R = On request; TA = Covered by type approval; VS = Vessel specific			

4.1.5 Semi-submersible heavy transport vessel

Documentation shall be submitted as required by Table 9.

Table 9 Documentation requirements - Semi-submersible heavy transport vessel

Object	*Documentation type*	*Additional description*	*Info*
Ship hull structure	Z100 – Specification	Maximum submerged draught, maximum transit draught and minimum transit draught with cargo.	FI
	H084 - Wave load analysis		FI
Stability	B030 – Internal watertight integrity plan		FI
	B070 – Preliminary damage stability calculation	Stability calculations in accordance with Sec.5 [4] for transit and temporarily submerged conditions.	AP
	B130 – Final damage stability calculation		AP
External watertight and weathertight integrity	Z265 – Calculation report	Reserve buoyancy calculations.	FI
Escape routes	G120 – Escape route drawing		AP
Fire water system	S010 – Piping diagram (PD)		AP
	S030 – Capacity analysis		AP
	Z030 – Arrangement plan		AP
Helicopter deck foam fire extinguishing system	G200 – Fixed fire extinguishing system documentation		AP
Machinery spaces fixed water spaying fire extinguishing system	G200 – Fixed fire extinguishing system documentation		AP
Cargo holds water spraying fire extinguishing system	G200 – Fixed fire extinguishing system documentation		AP
Navigation systems	Z090 - Equipment list		AP
Navigation bridge	N010 – Bridge design drawing		AP
	N020 – Vertical field of vision drawing		AP
	N030 – Horizontal field of vision drawing		AP
	Z090 – Equipment list		AP
Internal communication systems	Z030 – Arrangement plan		AP
Vessel operation	Z250 – Procedure	Submersion operation, including generic ballasting sequence during submersion and re-emersion.	FI

Object	Documentation type	Additional description	Info
AP = For approval; FI = For information ACO = As carried out; L = Local handling; R = On request; TA = Covered by type approval; VS = Vessel specific			

4.1.6 Diving support vessel

Documentation shall be submitted as required by Table 10.

Table 10 Documentation requirements - DSV

Object	Documentation type	Additional description	Info
Damage stability	B030 – Internal watertight integrity plan		FI
	B070 – Preliminary damage stability calculation		AP
	B130 – Final damage stability calculation		AP
	B130 – Final damage stability calculation	Stability calculations showing recovery of bell after damage.	
Cables and umbilicals	E030 – Cable selection philosophy		AP
Explosion (Ex) protection	E170 – Electrical schematic drawing	Single line diagrams for all intrinsically safe circuits, for each circuit including data for verification of the compatibility between the barrier and the field components.	AP
	Z030 – Arrangement plan	Electrical equipment in hazardous areas. Where relevant, based on an approved hazardous area classification drawing where location of electric equipment in hazardous area is added (except battery room, paint stores and gas bottle store).	AP
	E250 – Explosion protected equipment maintenance manual		AP
Structural fire protection arrangements	G060 – Structural fire protection drawing		AP
	G061 – Penetration drawing		AP
Fire detection and alarm system	I200 – Control and monitoring system		AP
	Z030 – Arrangement plan		AP
Fire water system	S010 – Piping diagram (PD)		AP
	Z030 – Arrangement plan		AP
Ventilation systems	S030 – Capacity analysis		AP

Object	Documentation type	Additional description	Info
	S012 – Ducting diagram (DD)		AP
AP = For approval; FI = For information ACO = As carried out; L = Local handling; R = On request; TA = Covered by type approval; VS = Vessel specific			

Table 11 Documentation requirements - DSV(Ready) and DSV(OCS)

Object	Documentation type	Additional description	Info
Arrangement	Z030 – Arrangement plan	Vessel GA with dive system arrangement (Ready & OCS).	FI
	Z030 – Arrangement plan	Block diagram of the dive system showing quantified vessel supplies and demarcation lines showing limit of dive system class. (Ready & OCS).	FI
Interface Details	S010 – Piping diagram (PD)	Interface drawings for fresh, gray and black water (Ready & OCS).	AP
	E170 – Electrical schematic drawing	Interface drawings for the electrical system including required capacity and support of emergency services for the diving system (Ready & OCS).	AP
	E170 – Electrical schematic drawing	Interface drawings for the communication system (Ready & OCS).	AP
	S010 – Piping diagram (PD)	Interface for fire extinguishing systems (Ready & OCS).	AP
	E170 – Electrical schematic drawing	Interface drawings for the communication system (Ready & OCS).	AP
	S010 – Piping diagram (PD)	compressed air system (Ready & OCS).	AP
	S010 – Piping diagram (PD)	Cooling systems SW/FW (Ready & OCS).	AP
Escape including HES	G120 – Escape route drawing	Updated safety plan including escape routes for critical dive personnel involved in launching or manning the HES (Ready & OCS).	AP
Details of Other Class Societies Scope	Z281 – Vessel certificate	All class and statutory certificates (OCS).	FI
	Z300 – Declaration	Current class status of the dive system (OCS).	FI
	Z261 – Test report	Thermal balance test of the HES (OCS)	AP
	Z261 – Test report	Launch test of HES including height (OCS).	AP
	Z261 – Test report	Stored energy system HES (OCS).	AP
	Z300 – Declaration	Evidence of a review by the diving systems class society for installation on the vessel. Normally this should include stamped drawings (OCS).	AP
Installation	Z162 – Installation manual	Mobilisation plan (Ready).	AP

Object	Documentation type	Additional description	Info
AP = For approval; FI = For information ACO = As carried out; L = Local handling; R = On request; TA = Covered by type approval; VS = Vessel specific			

4.1.7 Seismic vessel

Documentation shall be submitted as required by Table 12.

Table 12 Documentation requirements - Seismic vessel

Object	Documentation type	Additional description	Info
Seismic handling equipment	C010 – Design criteria	Design loads (safe working load, fleet angles, brake rendering load and wire breaking load as relevant). Self weights of equipment in operational and in transit modes.	FI
	Z030 – Arrangement plan	Heavy machinery in hangar and on deck and equipment for handling and storage and mooring at sea.	FI
	Z265 – Calculation report	Hangar: Design loads and racking calculations covering operational and transit modes.	FI
Seismic equipment supporting structures	H050 – Structural drawing	Including foundations. Design loads, footprint loads and fastening details.	AP
Work boat davits, Work boat winches	C060 – Mechanical component documentation	Including: Safe working load, heel/trim if applicable and dynamic factor if above 1.5.	AP
	Z161 – Operation manual		FI
	Z162 – Installation manual		FI
	Z163 – Maintenance manual		FI
Work boat davits and winches supporting structures	H050 – Structural drawing	Including foundations. Design loads, footprint loads and fastening details.	AP
AP = For approval; FI = For information ACO = As carried out; L = Local handling; R = On request; TA = Covered by type approval; VS = Vessel specific			

4.1.8 Well stimulation vessel

Documentation shall be submitted as required by Table 13.

Table 13 Documentation requirements - Well stimulation vessel

Object	Documentation type	Additional description	Info
Cargo compartments	Z030 – Arrangement plan	Tanks for well stimulation.	FI
Cargo tank arrangements, independent	H050 – Structural drawing	Acid tanks, including lining specification.	AP
	H050 – Structural drawing	Support and staying.	AP

Object	*Documentation type*	*Additional description*	*Info*
	C050 – Non-destructive testing (NDT) plan	Acid tanks.	FI
Cargo independent tank arrangements type C	H050 – Structural drawing	Including supports and anti-flotation arrangement.	AP
Damage stability	B030 – Internal watertight integrity plan		FI
	B070 – Preliminary damage stability calculation		AP
	B130 – Final damage stability calculation		AP
Ventilation systems for hazardous cargo areas	S012 – Ducting diagram (DD)	Closed and semi-enclosed spaces containing acid tanks, pipes, pumps and mixing units.	AP
Cargo piping system	C030 – Detailed drawing	Drawings and particulars including stress analysis of nitrogen vaporiser.	FI
	S010 – Piping diagram (PD)	Acid, nitrogen and liquid additives.	AP
Cargo piping	S070 – Pipe stress analysis	Piping for liquid nitrogen and other high pressure piping.	FI
Cargo hoses	Z100 – Specification	High pressure flexible hoses with end connections.	FI
Cargo main pumping arrangement	C030 – Detailed drawing	Including mixers.	FI
Cargo handling arrangement	Z161 – Operation manual	Well stimulation procedures.	AP
Cargo compartments over- and under pressure prevention arrangements	S010 – Piping diagram (PD)		AP
Emergency shut down (ESD) system	I200 – Control and monitoring system documentation		AP
Hydrogen gas detection and alarm system, fixed	I200 – Control and monitoring system documentation		AP
Oxygen indication system, fixed sample extraction	I200 – Control and monitoring system documentation		AP
Toxic gases detection and alarm system	I200 – Control and monitoring system documentation	Hydrogen chloride.	AP
Cargo tanks level monitoring system	I200 – Control and monitoring system documentation		AP
Cargo tanks overflow protection system	I200 – Control and monitoring system documentation		AP
Hazardous area classification	G080 – Hazardous area classification drawing		AP
Explosion (EX) protection	E250 – Explosion protected equipment maintenance manual		AP

Object	Documentation type	Additional description	Info
	E170 – Electrical schematic drawing	Single line diagrams for all intrinsically safe circuits, for each circuit including data for verification of the compatibility between the barrier and the field components.	AP
	Z030 – Arrangement plan	Electrical equipment in hazardous areas. Where relevant, based on an approved hazardous area classification drawing where location of electric equipment in hazardous area is added (except battery room, paint stores and gas bottle store).	AP
AP = For approval; FI = For information ACO = As carried out; L = Local handling; R = On request; TA = Covered by type approval; VS = Vessel specific			

4.1.9 Fire fighter

Documentation shall be submitted as required by Table 14.

Table 14 Documentation requirements - Fire fighter

Object	Documentation type	Additional description	Relevance for qualifier	Info
Sea chest	Z030 – Arrangement plan	Fire fighting pumps.	All	AP
Structural fire protection arrangements	G060 – Structural fire protection drawing	Outer boundaries, including external doors and windows.	**I+**	AP
Fire fighting systems	Z161 – Operation manual Z163 – Maintenance manual	FIFI operation.	All	AP
Fire water supply and distribution arrangement	S010 – Piping diagram S030 – Capacity analysis Z030 – Arrangement plan		All	AP
External surface protection water spraying fire extinguishing system	G200 – Fixed fire extinguishing system documentation		**I**, **I+**	AP
Fire fighting vessel fire extinguishing system	H050 – Structural drawing	Supporting structure for pumps, pump drivers and monitors.	All	AP
Fire fighting vessel monitor water spraying fire extinguishing system	G200 – Fixed fire extinguishing system documentation	Including specification of height and length of throw. Including location of pumps, pump drivers, monitors, hose connections and hose stations.	All	AP
	I100 – System diagram	Control system for fire fighting monitors.	All	AP

Object	*Documentation type*	*Additional description*	*Relevance for qualifier*	*Info*
Portable foam generator	Z100 – Specification	Foam generator and containers for storage of foam concentrate.	**II**, **III**	AP
Fire-fighter's outfit	Z030 – Arrangement plan		All	AP
Breathing air compressor unit	Z030 – Arrangement plan		All	AP
Flood light	Z030 – Arrangement plan Z100 – specification		All	AP
AP = For approval; FI = For information ACO = As carried out; L = Local handling; R = On request; TA = Covered by type approval; VS = Vessel specific				

4.1.10 Icebreaker

Documentation shall be submitted as required by Table 15.

Table 15 Documentation requirements - Icebreaker

Object	*Documentation type*	*Additional description*	*Info*
Technical information	Z100 – Specification	Including: — description of main propulsion, steering, emergency and essential auxiliaries including operational limitations and information on essential main propulsion load control functions — description detailing how main, emergency and auxiliary systems are located and protected to prevent problems from freezing, ice and snow and evidence of their capability to operate in intended environmental conditions.	FI
Hull structure	H110 – Preliminary loading manual	Including: — UIWL and LIWL — ship's displacement at UIWL — loading conditions with respect to strength and stability — design speed — ramming speed — instruction for filling of ballast tanks — astern operation in ice — design temperature, see guidance note.	AP
Propulsion torque and thrust transmission arrangement	C040 – Design analysis	Ice load response simulation.	AP
Propeller arrangements	C040 – Design analysis	Finite element analysis of blade stresses introduced by ice loads.	AP
AP = For approval; FI = For information ACO = As carried out; L = Local handling; R = On request; TA = Covered by type approval; VS = Vessel specific			

Guidance note:

The design temperature reflects the lowest mean daily average air temperature in the intended area of operation. An extreme air temperature about 20°C below this may be tolerable to the structures and equipment from a material point of view. For calculations where the most extreme temperature over the day is relevant, the air temperature may be set 20°C lower than the design temperature in the notation.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

4.1.11 Tug

Documentation shall be submitted as required by Table 16.

Table 16 Documentation requirements - Tug

Object	*Document type*	*Additional description*	*Info*
Towing arrangement	Z030 – Arrangement plan	Including: — towline paths showing extreme sectors and wrap on towing equipment towline points of attack — maximum expected *BP* — maximum design load for each component — emergency release capabilities.	FI
	Z253 – Test procedure for quay and sea trial	Bollard pull.	AP, L
	Z253 – Test procedure for quay and sea trial	Winch and other equipment required by the class notation.	AP, L
Towing winch	C010 – Design criteria	Including: — design force *T* and the expected maximum *BP* — hoisting capacity, rendering and braking force of the winch — release capabilities (response time and intended remaining holding force after release).	FI
	C020 – Assembly or arrangement drawing		FI
	C030 – Detailed drawing		AP
	C040 – Design analysis	Strength calculation of the drum with flanges, shafts with couplings, framework and brakes.	FI
	C050 – Non-destructive testing (NDT) plan		AP
Towing hook	C010 – Design criteria	The expected maximum *BP* shall be stated.	FI
	C020 – Assembly or arrangement drawing		FI
	C030 – Detailed drawing	Including emergency release mechanism.	AP
	C040 – Design analysis		FI
	C050 – Non-destructive testing (NDT) plan		AP

Object	Document type	Additional description	Info
Towing winch supporting structure, Towing hook supporting structure	H050 – Structural drawing	The design force *T* and the expected maximum *BP* shall be stated. Including footprint. Applicable for equipment with static force > 50 kN or bending moment > 100 kNm.	AP
AP = For approval; FI = For information ACO = As carried out; L = Local handling; R = On request; TA = Covered by type approval; VS = Vessel specific			

4.1.12 Escort tug

Documentation shall be submitted as required in [4.1.11] and Table 17.

Table 17 Documentation requirements - Escort tug

Object	Documentation type	Additional description	Info
Vessel	Z253 – Test procedure for quay and sea trial	Applicable for qualifier F only.	FI
	Z263 – Report from quay and sea trial	Applicable for qualifier F only.	FI
Towing arrangement	Z030 – Arrangement plan	Including layout of vessels and towline path with theta-beta angles.	FI
	Z265 – Calculation report	Towing forces, including F_W, F_S and F_B as described in Sec.11 Figure 1.	FI
Tow line	Z100 – Specification	Minimum breaking strength/safe working load for tow line and associated components, fixations and supporting structures.	FI
AP = For approval; FI = For information ACO = As carried out; L = Local handling; R = On request; TA = Covered by type approval; VS = Vessel specific			

4.1.13 Dredgers

Documentation shall be submitted as required by Table 18.

Table 18 Documentation requirements - Dredger

Object	Documentation type	Additional description	Info
Dredging equipment supporting structure	H050 – Structural drawing	Including design loads.	AP
Dredging arrangement	Z030 – Arrangement plan	Including dredging equipment and installations.	FI
AP = For approval; FI = For information ACO = As carried out; L = Local handling; R = On request; TA = Covered by type approval; VS = Vessel specific			

4.1.14 Pusher

Documentation shall be submitted as required by Table 19.

Table 19 Documentation requirements - Pusher

Object	*Documentation type*	*Additional description*	*Info*
Pushing arrangement	Z030 – Arrangement plan	Pusher/barge unit.	FI
Pushing arrangement	H080 – Strength analysis	In connection equipment and on contact areas.	FI
Pusher-barge connection arrangement on pusher	Z030 – Arrangement plan		FI
Pusher-barge connection on pusher	H050 – Structural drawing		AP
AP = For approval; FI = For information ACO = As carried out; L = Local handling; R = On request; TA = Covered by type approval; VS = Vessel specific			

5 Certification

5.1 Certification requirements

5.1.1 General

For a definition of the certificate types, see DNVGL-CG-0550 Sec.4 and DNVGL-CG-0550 Sec.3.

5.1.2 Crane vessel

Products shall be certified as required by Table 20

Table 20 Certification required for Crane vessel

Object	*Certificate type*	*Issued by*	*Certification standard**	*Additional description*
Crane	PC	Society	DNVGL-ST-0378	In agreement with the Society the crane may be certified based on other internationally recognised standards. Cranes certified by other Societies may be accepted based on special consideration.
* Unless otherwise specified the certification standard is the rules				

5.1.3 Cable laying vessel

Equipment subjected to cable loads when the vessel is in operation shall be certified as required by Table 21. Cable handling equipment which is not used while the vessel is in operation, e.g. spooling towers, need not be certified.

Table 21 Certification required for Cable laying vessel

Object	*Certificate type*	*Issued by*	*Certification standard**	*Additional description*
Cable laying equipment	PC	Society	DNVGL-ST-0378	DNVGL-RP-0232 provides guidance and clarifications with respect to certification and verification of design, materials, fabrication, safety, testing of cable laying equipment and systems.
Electrical equipment	PC	Society		Associated electrical equipment (motors, frequency converters, switchgear and control gear) serving an item that is required to be delivered with the Society's product certificate is also required to have a DNV GL product certificate. Such electrical equipment is regarded as important equipment, see Pt.4 Ch.8 Sec.1 [2.3.2].
* Unless otherwise specified the certification standard is the rules				

5.1.4 Pipe laying vessel

Equipment subjected to pipe loads when the vessel is in operation shall be certified as required by Table 22. Pipe handling equipment which is not used while the vessel is in operation, e.g. spooling towers, need not be certified.

Table 22 Certification required for Pipe laying vessel

Object	*Certificate type*	*Issued by*	*Certification standard**	*Additional description*
Pipe laying equipment	PC	Society	DNVGL-ST-0378	DNVGL-RP-0232 provides guidance and clarifications with respect to certification and verification of design, materials, fabrication, safety, testing of pipe laying equipment and systems.
Electrical equipment	PC	Society		Associated electrical equipment (motors, frequency converters, switchgear and control gear) serving an item that is required to be delivered with a the Society's product certificate is also required to have a DNV GL product certificate. Such electrical equipment is regarded as important equipment, see Pt.4 Ch.8 Sec.1 [2.3.2].
* Unless otherwise specified the certification standard is the rules				

5.1.5 Seismic vessel

Products shall be certified as required by Table 23.

Table 23 Certification requirements for Seismic vessel

Object	*Certificate type*	*Issued by*	*Certification standard**	*Additional description*
Work boats	PC	Society	DNVGL-ST-0342	
Wide tow equipment	PC	Society	DNVGL-ST-0378	
Handling and towing booms	PC	Society		
Work boat davits	PC	Society	DNVGL-ST-0498	
	MC	Society		Or material certificate 3.1 according to ISO 10474
Work boat winches	PC	Society		
	MC	Society		Or material certificate 3.1 according to ISO 10474
Electrical equipment	PC	Society		Associated electrical equipment (motors, frequency converters, switchgear and control gear) serving an item that is required to be delivered with the Society's product certificate is also required to have a DNV GL product certificate. Such electrical equipment is regarded as important equipment, see Pt.4 Ch.8 Sec.1 [2.3.2].
* Unless otherwise specified the certification standard is the rules				

5.1.6 Well stimulation vessel

Products shall be certified as required by Table 24.

Table 24 Certification requirements for Well stimulation vessel

Object	*Certificate type*	*Issued by*	*Certification standard**	*Additional description*
Cargo tank level measurement system	PC	Society		
Cargo tank overflow protection system				
Emergency shut-down system				
Electrical equipment	PC	Society		Associated electrical equipment (motors, frequency converters, switchgear and control gear) serving an item that is required to be delivered with the Society's product certificate is also required to have a DNV GL product certificate. Such electrical equipment is regarded as important equipment, see Pt.4 Ch.8 Sec.1 [2.3.2].

Object	Certificate type	Issued by	Certification standard*	Additional description
* Unless otherwise specified the certification standard is the rules				

5.1.7 Fire fighter
Products shall be certified as required by Table 25.

Table 25 Certification requirements for Fire fighter

Object	Certificate type	Issued by	Certification standard*	Additional description
Fire fighting pumps and their prime movers	PC	Society		
Compressor for recharging the breathing air cylinders	PC	Society		
Pipes and valves	MC	Manufacturer		
Foam concentrate suitable for its intended use	TR	Recognized test laboratory	MSC/Circ.670 or MSC.1/Circ.1312 as applicable	
* Unless otherwise specified the certification standard is the rules				

5.1.8 Tug and Escort tug
Products shall be certified as required by Table 26.

Table 26 Certification requirements for Tug and Escort tug

Object	Certificate type	Issued by	Certification standard*	Additional description
Towing winch	PC	Society		
Towing hook				
Towing hook	MC	Society	Material certificate type 3.1 according to ISO 10474 may be accepted for standard items if the manufacturer is approved by the Society	For load transmitting elements, including slip device.
Winch				Including drum and flanges.
Shafts for drum				
Brake				
Couplings		Manufacturer		
Winch frame				
Gear shaft and wheels				
Tow ropes				Including breaking force.
* Unless otherwise specified the certification standard is the rules				

5.1.9 Pusher

Products shall be certified as required by Table 27.

Table 27 Certification requirements for Pusher

Object	*Certificate type*	*Issued by*	*Certification standard**	*Additional description*
Pusher - barge connection on pusher	PC	Society		Locking devices in type I connection system.
	PC	Manufacturer		Steel wire ropes or other means of flexible connections.
Pusher - barge connection on barge	PC	Society		Locking devices in type I connection system.
	PC	Manufacturer		Steel wire ropes or other means of flexible connections.
* Unless otherwise specified the certification standard is the rules				

6 Testing

6.1 Testing during newbuilding

6.1.1 Class notations which require additional testing during newbuilding are given below:

— **Crane vessel** (given in Sec.2 [1.4])
— **Semi-submersible heavy transport vessel** (given in Sec.5 [1.4])
— **Diving support vessel** (given in Sec.6 [1.4])
— **Seismic vessel** (given in Sec.7 [5.1])
— **Well stimulation vessel** (given in Sec.8 [3.1] and Sec.8 [3.2])
— **Fire fighter** (given in Sec.9 [1.4])
— **Tug** (given in Sec.11 [1.5])
— **Escort tug(F, (F_s, t, v))**. Escort tug (given in Sec.11 [6.8]).

SECTION 2 CRANE VESSEL

Symbols

For symbols not defined in this section, see Sec.1 [3.1].

φ_1 = heeling angle of equilibrium during crane operation, in deg

φ_2 = allowable limit heeling angle, equal to lesser of φ_F or φ_R, or the second intercept of the righting lever curve with the heeling lever curve, in deg

φ_3 = maximum (dynamic) heeling angle, in deg

φ_C = static heeling angle of equilibrium after loss of load, in deg

φ_F = angle of down flooding,as defined in Pt.3 Ch.15, in deg

φ_R = angle of vanishing stability, in deg.

1 Introduction

1.1 Introduction

1.1.1 These rules provide requirements for vessels intended for lifting operations, and for that purpose are equipped with crane(s) or similar lifting appliance(s) and comprise heavy lift ships, crane ships, crane barges, floating cranes, or similar floating structures, with special attention on safety against capsizing.

1.2 Scope

1.2.1 These rules include requirements for hull strength, systems and equipment, stability and floatability applicable to crane vessels, including the crane(s) itself with respect to structural strength, safety equipment and functionality.

1.3 Application

1.3.1 Vessels built in compliance with the relevant requirements in this section may be given the class notation **Crane vessel**.

1.4 Testing requirements

1.4.1 Cranes

After completed installation on board, functional testing of the crane shall be carried out as specified in DNVGL-ST-0378 *Offshore and platform lifting appliances*.

2 Hull

2.1 General

2.1.1 The hull structural strength is in general to be as required for the main class taking into account necessary strengthening for supporting the crane during operation and in parked position at sea.

3 Systems and equipment

3.1 Crane with substructure

3.1.1 The crane shall be delivered with the Society's certificates in compliance with DNVGL-ST-0378 . In agreement with the Society the crane may be certified based on other internationally recognised standards. Cranes certified by other societies may be accepted based on special consideration.

3.1.2 Devices for locking the crane in parked position at sea will be specially considered taking into account environmental load conditions as indicated for the main class of the vessel.

3.1.3 An accidental drop of hoisted load shall not lead to hazardous situation taking into account the interaction between the crane and the vessel.

4 Stability

4.1 Requirements for lifting operations

4.1.1 General

The vessel's stability shall be assessed when the vessel is subjected to forces related to lifting operations and shall comply with the requirements of this section.

In general, it is assumed that operations for heavy cargo transfer are carried out at zero speed over ground.

Alternative standards which provide an equivalent safety standard to this section may be applied, subject to prior consent by the Society.

4.1.2 Intact stability criteria

The loading conditions intended for lifting operations shall comply with the requirements of the International Code on Intact Stability, 2008, Part B, paragraph 2.9, as applicable by paragraph 2.9.1.2.

If a stability pontoon is used, the residual freeboard of the pontoon as well as the draft of the pontoon shall be not less than 0.60 m. The benefit of a stability pontoon shall only be used during lifting operations in calm water conditions.

Guidance note:

A stability pontoon is a pontoon attached to the hull during heavy lift operations, for the purpose of increasing stability.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

Accidental drop of load criterion in the International Code on Intact stability, 2008, Part B, paragraph 2.9.5, shall be applied in all cases where counter ballasting is utilised, except where the drop of load criterion in paragraph 2.9.7 is applied as part of the alternative stability criteria.

Model tests or direct calculations that demonstrate the survivability of the ship after accidental drop of load may be accepted as alternatives to the above drop of load criteria, see the International Code on Intact Stability, 2008, Part B, paragraph 2.9.8. For lifting in sheltered waters, simplified roll motion analysis according to [4.6.1] or Reynolds-averaged Navier-Stokes (RANS) simulation of roll motion according to [4.6.2] may be applied as such direct calculations, subject to prior consent by the Society.

In case hatch covers/stern ramps/side doors/etc. are open during cargo transfer, the respective flooding points shall be considered as unprotected openings for all criteria. Additionally it shall be ensured that the centre of gravity of any heavy item, e.g. hatch covers, crane beam, stability pontoons, etc. are corrected for the actual position. When calculating stability, transverse centres of gravity shall be considered. To calculate the vessel’s vertical and lateral center of gravity during lifting operation, consider the suspension point at the crane top to be the center of gravity of the lifted load.

4.1.3 Damage stability criteria

The damage stability criteria applicable to the ship shall be complied with at all times including when the crane is in use. This includes the statutory damage stability requirements and damage stability requirements of voluntary class notations when applicable.

Alternatively, where lifting shall be carried out within clearly defined environmental and operational limitations as set forth in the International Code on Intact Stability, 2008), Part B, paragraph 2.9.4 and the associated intact stability criteria are applied, the alternative damage stability criteria as set forth in [4.5] may be applied, subject to prior consent by the Society and the Administration.

4.2 Loading conditions

4.2.1 Standard loading conditions

In addition to the standard loading conditions for cargo ships in Pt.3 Ch.15 Sec.1 [4.3.4], standard loading conditions given in the International Code on Intact Stability, 2008, Part B, paragraph 3.4.1.9 and 3.4.10, shall apply, including the assumptions of paragraph 3.4.2.9.

4.3 Stability manual

4.3.1 Additional information in stability manual

The vessel's stability manual shall additionally contain information as given in the International Code on Intact Stability, 2008, Part B, paragraph 3.6.5.

4.4 Operational and planning manual

4.4.1 To assist the master an operational and planning manual containing guidelines for planning and performing specific operations shall be provided with contents according to the International Code on Intact Stability, 2008 , Part B, paragraph 3.9.

4.5 Alternative damage stability criteria during heavy crane lift

4.5.1 The flooding scenario given in [4.5.2] and survival criteria given in [4.5.3] may be applied:

— in lieu of the damage stability criteria according to Pt.3 Ch.15 and additional class notations
— for the crane loading conditions
— when operational and environmental limitations are imposed as set forth in the International Code on Intact Stability, 2008 Part B, paragraph 2.9.4.

4.5.2 Accidental flooding of any one compartment bounded by the shell or which contains pipe systems leading to the sea shall be investigated for the relevant loading conditions. In addition, column-stabilised crane units shall be able to withstand the flooding of any watertight compartment fully or partially below the waterline in question, which is a pump room or a room containing machinery with a sea water cooling system.

4.5.3 In the flooded condition the following criteria shall be complied with:

— the maximum angle of heel shall be less than 15°, or 17° in case deck edge is not immersed
— in sheltered waters an angle of heel of 20° is acceptable
— no immersion of openings through which progressive flooding may occur
— the area under the *GZ*-curve shall not be less than 0.015 metre-radians.

Other concepts may be applied if deemed appropriate for the vessel, subject to prior consent by the Society.

4.6 Alternative methods for analysing stability after accidental drop of load

4.6.1 Simplified roll motion analysis

The dynamic heel angle after a sudden loss of hook load may be estimated by performing a simplified time-domain numerical simulation of the ship's roll motion. With the ship at equilibrium, start the analysis by releasing the hook load, simulating a sudden failure of the lifting gear. To represent the roll motion as a one-degree-of-freedom system, numerically solve its motion equation:

$$\left(I_{roll} + I'_{roll}\right) \cdot \varphi'' + B \cdot \varphi' + C\left(\varphi\right) \cdot \varphi = 0$$

where:

I_{roll}	=	mass roll moment of inertia of the ship in loading condition after loss of hook load, in kNm-s^2
I'_{roll}	=	added mass roll moment of inertia of the ship in loading condition after loss of hook load, in kNm-s^2
φ''	=	roll acceleration, in deg/s^2
φ'	=	roll velocity, in deg/s
φ	=	roll motion, in deg
B	=	linearised roll damping coefficient
$C(\varphi)\varphi$	=	roll restoring moment, in kNm, as a function of roll angle
	=	GZ (φ) $\Delta_L g$
$GZ\,(\varphi)$	=	righting arm as a function of roll angle after loss of hook load, in m
ΔL	=	ship displacement after loss of hook load, in t.

The linearised roll damping coefficient may be taken as two percent of critical damping. If a stability pontoon is situated on the side of the vessel opposite the hook load, a damping coefficient of five percent may be applied.

Higher damping coefficients are acceptable if respective results of roll decay tests or validated numerical calculations are provided.

The righting moment curve shall not be linearised; that is, the actual *GZ* curve after loss of hook load as a function of roll angle shall be used. The influence of the stability pontoon shall be considered. The initial working list, φ_1, shall be accounted for.

The maximum list, φ_3, which occurs during the roll motion, shall not exceed the smaller of φ_F with a safety margin of 3° or φ_R with a safety margin of 7°:

$$\varphi_3 < \min\,(\varphi_F - 3°,\ \varphi_R - 7°)$$

4.6.2 Reynolds-averaged Navier-Stokes (RANS) simulation of roll motion

The dynamic heel angle after sudden loss of hook load may also be assessed by carrying out non-linear numerical simulations using a RANS equations solver. The RANS simulations shall account for not only the ship's hull and the stability pontoon, but also those parts of the superstructure that contribute to the righting moment. The predicted time-dependent dynamic behaviour of the floating ship after a sudden loss of hook load yields the maximum list, φ_3, which shall not exceed the smaller of φ_F with a safety margin of 2° or φ_R with a safety margin of 7°:

$$\varphi_3 < \min\,(\varphi_F - 2°,\ \varphi_R - 7°)$$

An example of a RANS simulation is set out in DNVGL-CG-0157 Sec.2 *Stability documentation for approval*.

SECTION 3 CABLE LAYING VESSEL

1 Introduction

1.1 Introduction

1.1.1 These rules provide requirements for vessels intended for laying cables on the sea bottom.

1.2 Scope

1.2.1 These rules include requirements for hull strength, systems and equipment applicable to cable laying vessels, including:

— hull structural details related to the cable laying operation
— equipment and installations for cable laying
— supporting structures for equipment applied in the cable laying operations
— equipment for anchoring and mooring related to the cable laying operations
— equipment for positioning during cable laying.

1.3 Application

1.3.1 Vessels built in compliance with the relevant requirements in this section may be given the class notation **Cable laying vessel**.

2 Hull

2.1 Hull structural strength

The hull structural strength shall in general be as required for the main class taking into account necessary strengthening of supporting structures for equipment applied in the cable laying operations.

2.2 Special hull configuration

For catamarans, semi-submersibles and other special hull configurations, the hull structural strength will be specially considered.

3 Equipment

3.1 Equipment for mooring and anchoring

3.1.1 The equipment for mooring and anchoring, i.e. anchors, chain cables windlass, mooring ropes, shall in general be as required for the main class.

3.1.2 For catamarans, semi-submersibles and other special hull configurations, the equipment will be specially considered.

3.1.3 Equipment for positioning during cable laying will be specially considered.

SECTION 4 PIPE LAYING VESSEL

1 Introduction

1.1 Introduction

1.1.1 These rules provide requirements for vessels intended for laying pipelines on the sea bottom.

1.2 Scope

1.2.1 These rules include requirements for hull strength, systems and equipment applicable to pipe laying vessels, including:

- hull structural details related to the pipe laying operations
- supporting structures for equipment applied in the pipe laying operations
- equipment for anchoring and mooring
- equipment and installations for pipe laying
- equipment for positioning during pipe laying.

1.3 Application

1.3.1 Vessels built in compliance with the relevant requirements in this section may be given the class notation **Pipe laying vessel**.

2 Hull

2.1 Hull structural strength

The hull structural strength shall be as required for the main class taking into account necessary strengthening of supporting structures for equipment applied in the pipe laying operations.

2.2 Special hull configuration

For catamarans, semi-submersibles and other special hull configurations, the hull structural strength will be specially considered.

3 Equipment

3.1 Equipment for mooring and anchoring

3.1.1 The equipment for mooring and anchoring, i.e. anchors, chain cables, windlass, mooring ropes, shall in general be as required for the main class.

3.1.2 For catamarans, semi-submersibles and other special hull configurations, the equipment will be specially considered.

3.1.3 Equipment for positioning during pipe laying will be specially considered.

SECTION 5 SEMI-SUBMERSIBLE HEAVY TRANSPORT VESSEL

1 Introduction

1.1 Introduction

1.1.1 These rules provide requirements for vessels intended for loading or unloading of deck cargo by submerging the cargo deck through ballast operations.

1.2 Scope

1.2.1 These rules include requirements for hull strength, systems and equipment, stability and load line, fire safety and lifesaving, navigation and communication applicable to semi-submersible heavy transport vessels.

1.3 Application

1.3.1 Vessels built in compliance with the relevant requirements in this section will be assigned the mandatory ship type notation **Semi-submersible heavy transport vessel**.

The additional notation **Strengthened(DK)** is mandatory for vessels assigned the notation **Semi-submersible heavy transport vessel**.

1.4 Testing requirements

1.4.1 Sea trial

A sea trial including submersion to maximum submerged draft and function testing of all equipment related to submersion shall be performed before final certificates are issued.

2 Hull

2.1 Hull girder strength

2.1.1 A direct wave load analysis shall be carried out to establish the vertical wave bending moments M_{wv} and vertical wave shear forces Q_{wv}.

Guidance note:

DNVGL-CG-0130 provides method to carry out direct wave load analysis.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

2.1.2 Temporarily submerged conditions (float-on/ float-off) are special operations taking place at limited sea states. The global wave loads shall be taken as 50% of the values given in [2.1.1] unless otherwise specified.

The temporarily submerged conditions shall be reviewed for both static (S) and static + dynamic (S + D) per design load scenario 6 and 7, see Pt.3 Ch.4 Sec.7 Table 1. Relevant acceptance criteria are given in Pt.3 Ch.1 Sec.2 Table 1 and Pt.3 Ch.6 Sec.2 [2].

2.1.3 Non-submerged loading and unloading with the vessel moored at quay (skid-on/ skid-off) are special operations taking place at very limited sea states. This will be evaluated per design load scenario 6 provided the operation is carried out in conditions with a significant wave height not exceeding 0.5 m. This condition will be stated in the appendix to the class certificate.

2.1.4 Due to the low depth of the hull girder, special attention should be paid to the requirement to moment of inertia given in Pt.3 Ch.5 Sec.2 [1.5]. This requirement shall be satisfied over a minimum of 0.25 L in the midship area.

2.2 Local strength

2.2.1 External hull boundaries shall be able to withstand the sea pressure at maximum submerged draught. In temporarily submerged conditions, the dynamic part of the sea pressure shall be taken as 50% of the values according to Pt.3 Ch.4 Sec.5 [1.3], unless otherwise documented.(applicable values for accelerations and motions in temporarily submerged condition will be considered in a similar manner or may be disregarded based on a case-by-case evaluation).

2.2.2 The design pressure for internal watertight bulkheads, including doors, hatches, pipe penetrations and other piercings, shall be based on the deepest equilibrium waterline in damaged transit or damaged submerged condition, as applicable, depending on relevant damage scenario. Damage stability requirements in transit and submerged conditions are given in [4.1] and [4.3], respectively. Flooding scenarios related to access openings in submerged conditions, see [5.4.5], shall also be taken into account.

2.2.3 Bolted connections between buoyancy towers and hull are subject to special consideration.

2.2.4 The boundaries of the ballast tanks shall be designed according to the pressures given in Pt.3 Ch.4 Sec.6 [1] and where the height of the air pipes exceed the deepest waterline in damaged submerged condition and maximum submerged draught.

Guidance note:

Other levels may be accepted case-by-case as basis for the evaluation provided automatic stop of ballast pumps or automatic closing of valve in the ballast filling line is arranged for prevention of over-pumping of tanks. Such means should be activated by a remote level gauging system or equivalent. In addition, an independent visual and audible high level or high-pressure alarm should be arranged. The alarm should be activated prior to stop of pumps or closing of valve. Arrangements for functional testing of the automatic stop or closing and alarm systems should be provided.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

2.3 Integrated high-pressure tanks

2.3.1 Ballast tanks emptied by means of air overpressure are subject to special consideration. The strength of such tanks shall minimum satisfy the static acceptance criteria AC-I according to the design load sets given in Pt.3 Ch.6 Sec.2 Table 1 with corresponding permissible stresses as given in Pt.3 Ch.6 Sec.4 and Pt.3 Ch.6 Sec.5, with full tank and maximum overpressure, e.g. de-ballasting condition. The air overpressure shall normally not be taken greater than 70 kN/m^2.

For primary supporting members net loading, internal minus external pressure, shall be applied, see Pt.3 Ch.6 Sec.2 [2].

Guidance note:

In designs where air overpressure is applied for emptying integrated ballast tanks, exemptions from the rules for pressure vessels in Pt.4 Ch.7 may be granted on a case-by-case basis when the air overpressure is greater than 70 kN/m^2, provided that satisfactory alternative safety measures are presented. Examples of such safety measures are increased safety margin by lowering the allowable stress levels, installation of cofferdams, reduced size of ballast tanks, pressure monitoring systems, increased NDT during construction, and more thorough inspections in the operation phase.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

2.4 Primary supporting members

2.4.1 Direct strength analysis

A partial ship structural analysis, seePt.3 Ch.7 Sec.3, shall be performed for strength assessment of the cargo area. The extent of the analysis shall be agreed with the Society case by case.

2.4.2 Loading conditions

The loading conditions need to be determined case by case to cover the most demanding of static, static + dynamic and accidental flooding conditions including:

— permissible local and distributed loads as specified in the loading manual
— transit condition considering extreme combination of deck loads and tank loads for AC-II
— operational including submerged conditions for AC-II with reduced dynamic loads
— de-ballasting condition, e.g. full tank with maximum overpressure, for AC-I.

2.4.3 Buckling check of plate panels

The normal stresses and shear stress taken from strength assessment to be applied for buckling capacity calculation of deck plate panels shall be corrected as given in Pt.3 Ch.8 and DNVGL-CG-0128 *Buckling*.

2.5 Fatigue strength

2.5.1 For vessels with $L \geq 150$ m, the fatigue strength requirements in Pt.3 Ch.9 are applicable. Due concern shall be taken to use loading conditions describing the intended operational pattern of the actual vessel.

2.5.2 Additional fatigue analysis may be required for details considered prone to failure or considered particular critical for watertight integrity.

3 Systems and equipment

3.1 Additional anchors

3.1.1 Anchors and associated equipment in excess of that required in Pt.3 Ch.11 Sec.1 Table 1 need not be certified.

3.2 Watertight seals for propeller axle and rudder stock

3.2.1 Watertight seal on propeller axle and rudder stock shall be approved for the maximum submerged draught.

3.3 Sounding systems for ballast tanks

The ballast tanks used during lifting operations shall be equipped with two remote sounding systems. The sounding systems shall be able to measure the level in each tank continuously, e.g. remote sounding based on the air-bubble principle is not acceptable.

4 Stability

4.1 Stability requirements in transit condition

4.1.1 The intact stability requirements of *The International Code on Intact Stability* (2008 IS Code) Part A, Ch. 2.2 and 2.3 apply. The windage area in loading conditions shall include deck cargo.

4.1.2 If the vessel's characteristics render compliance with *The International Code on Intact Stability* (2008 IS Code) Part A, Ch. 2.2 impracticable, then the alternative criteria for maximum righting lever in the explanatory notes to IMO 2008 IS Code may be used.

4.1.3 For intact stability the buoyancy provided by a part of large deck cargo such as semi-submersible units, jack-up units, barges or ships may be taken into account, provided that the securing arrangement is separately approved. The watertight integrity of the cargo shall be defined and taken into account in the calculations.

4.1.4 The damage stability standard shall be in accordance with SOLAS Ch.II-1 or ICLL 1966 Reg.27, including IACS UI LL65, as applicable.

4.1.5 Ships with B-60 or B-100 freeboard

B-60 freeboard requires one-compartment damage, while B-100 requires two-compartment damage in accordance with Reg.27 of the ICLL 1966. The calculations shall be carried out assuming the damaged tanks empty and for representative loads, such as a semi-submersible unit and a jack-up unit, as far as applicable. Damage extent shall be taken according to ICLL Reg. 27. The buoyancy of watertight volumes of the deck cargo not located within the damage extent for each damage case may be taken into account. In all cases, transverse penetration shall be taken from the ship’s side.

4.1.6 Ships with ordinary B freeboard

If, in addition to the SOLAS limit curves, it is desired to take the buoyancy of the deck cargo into account, calculations as for ICLL Reg. 27 corresponding to B-60 damage may be considered equivalent, i.e. same approach as the case of ships with reduced freeboard.

Guidance note:

As there are no international rules or interpretations regarding whether the buoyancy of deck cargo may be taken into account in order to make these operations feasible, the flag state shall be approached for acceptance of the application of the requirements given in [4.1.3] and [4.1.5] for statutory purposes.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

4.2 Intact stability criteria in temporarily submerged conditions

4.2.1 All loading and unloading sequences shall have acceptable stability. The buoyancy provided by a part of large deck cargo such as semi-submersible units, jack-up units, barges or ships may be taken into account, provided that proper environmental limitations have been defined.

4.2.2 The *GM* at equilibrium shall not be less than 0.3 m. The positive range of the *GZ* curve shall be minimum 15° in conjunction with a height of not less than 0.1 m within this range. The maximum righting arm shall occur at an angle of heel not less than 7°. Unprotected openings shall not be immersed within this range. It may be required to calculate the stability about additional axis to determine the most onerous result.

4.2.3 Whenever free liquid surface exists in a tank, the effect shall be considered. The calculations shall account for the real filling of the tanks, i.e. in particular the location of air pipes needs to be taken into account. If the complete filling of the tanks is dependent on certain trim or heel during the submerging sequence this shall be clearly stated in the stability manual.

4.3 Damage stability in temporarily submerged conditions

4.3.1 The risks of accidental flooding of any one compartment on the ship shall be considered. Damage to be considered is that which might occur following an uncontrolled movement of the deck cargo during loading or off-loading leading to puncture of exposed surfaces. This study shall cover all relevant phases of the loading/off-loading sequence as required by [4.2.1].

4.3.2 Accidental flooding of watertight compartment described in [5.4.4] shall be considered in addition if this would result in a more severe condition.

4.3.3 The permeability μ of a damaged compartment shall be assumed to be 0.95 except for full ballast tanks, where μ = 0. For machinery spaces, μ = 0.85.

4.3.4 In the final stage of flooding after damage, the positive range of the *GZ* curve shall be minimum 7° in conjunction with a height of not less than 0.05 m within this range. Unprotected openings shall not be immersed within this range unless the space concerned is assumed to be flooded. The angle of heel after flooding shall not exceed 15°. The final waterline after flooding shall be below the lower edge of any weathertight opening through which progressive flooding may take place unless the space concerned is assumed to be flooded. It may be required to calculate the stability about additional axis to determine the most onerous result.

4.3.5 The stability at intermediate stages of flooding after damage shall not be significantly less than in the final stage.

4.3.6 The flooding of any damaged compartment shall not render vital safety functions inoperative.

4.3.7 For the purpose of damage stability calculations, a damage extent of 5 m horizontally along the surface shall be assumed for all exposed surfaces except the cargo deck. Watertight bulkheads may be considered to remain intact provided that the distance between adjacent bulkheads exceeds 5 m. The damage penetration into the structure shall be assumed to be equal to 0.76 m and the vertical extent of damage is assumed to be from the cargo deck or its horizontal extension upwards without limit. For the cargo deck a damage extent of 5 × 5 m shall be assumed. Watertight bulkheads may be considered to remain intact provided that the distance between adjacent bulkheads exceeds 5 m. The damage penetration into the cargo deck shall be assumed to be equal to 0.76 m.

5 Openings and closing appliances

5.1 Freeboard assignment transit draught

5.1.1 Freeboard will be calculated and assigned according to ICLL 1966 and standard procedures. Compliance with requirements for weathertight and watertight closing appliances shall be documented with a freeboard plan.

5.2 Temporarily submerged conditions

5.2.1 Requirements for reserve buoyancy and water- and weathertight integrity given in [5.3] and [5.4] shall be complied with in the maximum submerged draught condition.

Guidance note:

International load line exemption certificate

Independent of class approval, an exemption from ICLL 1966, Article 12 *Submersion* will have to be applied for as the load line mark will be submerged during cargo operations. This exemption may only be granted by the flag administration and should be based on an application from the owner. The flag administration will normally require the Society to give their comments to the application. The Society will give recommendation/comments based on the compliance with the requirements in this section.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

5.3 Reserve buoyancy

5.3.1 The ratio of reserve buoyancy shall not be less than:

— 4.5% for the vessel
— 1.5% for the forward and aft end buoyancy structures considered separately.

5.3.2 The reserve buoyancy requirements in [5.3.1] shall be documented by a calculation according to the principles given in a) to d).

a) Ratio of reserve buoyancy is the reserve buoyancy divided by the volume displacement of the vessel at maximum submerged draught with no trim.
b) Reserve buoyancy is defined as the volume providing buoyancy, positioned above the waterline with no trim at maximum submerged draught. In the calculation of the total reserve buoyancy for the vessel, no buoyancy shall be assumed above the lowest of the zero trim waterlines corresponding to:

   — the position of the lowest opening which can not be closed and secured to prevent water from entering the buoyant volume
   — the uppermost point of the deck limiting the buoyancy structure forward
   — the uppermost point of the deck limiting the buoyancy structure aft.

c) Calculations for end structures considered separately need only take account of openings and decks in the end under consideration. Trim shall be taken into account if it is consistent with practice to operate the vessel with trim and the maximum draught at the perpendicular is larger than the mean maximum submerged draught. Reserve buoyancy is then defined as the volume providing buoyancy for the end under consideration, above the waterline with no trim at maximum perpendicular draught.
d) Openings which can not be closed and secured to prevent water from entering the buoyant volume shall be considered as down flooding points in the reserve buoyancy calculation. These openings shall include all air pipes, but need not include weathertight doors, hatches, ventilators, side scuttles and small windows with deadlights. This is provided that the relevant opening will be closed and secured during submerged stages, and that the closing appliance has been found to be adequate and of at least the same strength as the bulkhead or deck where it is fitted.

The calculation shall be submitted as a separate document and not be part of the stability documentation.

5.3.3 As an alternative to the requirements in [5.3.1], the reserve buoyancy may be evaluated based on real intact and flooded scenarios with the intact vessel at maximum submerged draught, including trim when relevant. In intact scenarios, ship movements shall be evaluated to determine the risk of submergence of decks limiting buoyancy structures. In flooded scenarios, the freeboard to a deck limiting a buoyancy structure shall not be less than 1 m.

Guidance note:

Intact scenarios should consider ship movements in defined worst operating sea condition(s) and as the result of forces transferred from cargo.

Flooded scenarios should at least cover the effect of filling additional tank space by mistake and the effect of tanks and dry spaces being flooded due to valve failure. The possibility of spaces being flooded progressively should be taken into account where necessary. Partial flooding stages should be considered where this may give a more severe waterline.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

5.4 Requirements for water- and weathertight integrity

5.4.1 All openings below the first deck above the maximum submerged draught shall be arranged with watertight closing appliances.

5.4.2 Access openings which are submerged at the maximum submerged draught shall be protected by two watertight doors or hatches in series. A leakage detection device shall be provided in the compartment between the two doors or hatches. Drainage of this compartment to bilges controlled by a readily accessible screw-down valve shall be arranged.

5.4.3 A watertight closing appliance shall be provided for any internal opening leading to the compartment required by [5.4.2].

5.4.4 The effect of flooding the watertight compartment required by [5.4.2] shall be investigated in the stability calculations for all stages where the outer door or hatch is submerged.

5.4.5 Bulkheads bounding the compartment required by [5.4.2] shall be of sufficient strength to withstand the water pressure that could occur after flooding. Doors and hatches shall be approved and pressure tested.

5.4.6 All openings between the first and second deck above the maximum submerged draught shall comply with ICLL 1966 position 2 requirements for weathertight closing.

5.4.7 Scuppers shall be of substantial thickness below the first deck above the maximum submerged draught.

5.5 Miscellaneous requirements

5.5.1 On-board instruction manuals and check lists containing operating procedures for submerging shall list the closing appliances which shall be closed before operation commences. Examples are watertight doors and hatches, closing appliances as given in [5.4.2] and [5.4.3], and closing valves in sanitary discharges. Signboards shall be fitted at the relevant closing appliance.

5.5.2 Guard rails shall be arranged so that they do not interfere with cargo operations. Removable guard rails with steel wire rope may be acceptable, provided that the arrangement is according to ICLL 1966 and scantlings are found sufficient. Wires should have steel cores of not less than 10 mm in diameter and be plastic coated.

5.5.3 In order to provide access to the ends of the vessel when deck cargo covers the whole breadth of the vessel, an under-deck passage way in compliance with Pt.3 Ch.11 Sec.3 [3.2.2] item a) shall be provided.

6 Fire safety and lifesaving appliances

6.1 Fire extinguishing equipment

6.1.1 The cargo deck shall be protected by fixed fire-fighting equipment consisting of water monitors or fire hydrants with hoses, or a combination thereof.

6.1.2 If water monitors are selected in lieu of fire hydrants, then the monitors shall be capable of covering the cargo deck area and may be positioned fore and/or aft of the cargo area, as applicable. The fire monitors shall also comply with [6.1.1] to [6.1.6].

6.1.3 The main control station for the system shall be suitably located outside the cargo deck area, adjacent to the accommodation spaces and readily accessible and operable in the event of fire in the areas protected. For monitors arranged at the end of the cargo area opposite to the accommodation spaces, remote control of the monitor(s) from the bridge will be required. Alternatively, these monitors shall be of oscillating type capable of sweeping the protected area.

6.1.4 The protected area shall be within 75% of the water monitor throw in still air conditions taking into account the distance from the monitor to the farthest extremity of the protected area forward of that monitor.

6.1.5 The capacity of each monitor shall not be less than 1250 litres/minute. The additional water supply to the monitors shall be based on one monitor operated at a time, and shall be in addition to the requirements given in SOLAS Reg. II-2/10.2.2.4.

6.1.6 Fixed arrangement for possible dispersion of the monitor water jet shall be delivered as part of each monitor.

6.1.7 Fire hydrants arranged with two hydrants at both port and starboard side just aft and forward of the cargo area, with sufficient number of hoses to reach the entire cargo area with two jets of water from these hydrants, will be accepted as equivalent to the position of hydrants required by SOLAS Reg. II-2/10.2.1.5. For SOLAS convention ships, this equivalent arrangement is subject to acceptance by the flag administration. These will ensure flexibility during fire-fighting operations, and will cover areas screened from the monitors.

6.2 Escape ways

6.2.1 The under-deck passage way required by [5.5.3] shall not be used as an escape way in submerged conditions.

6.2.2 If buoyancy towers are manned during cargo handling operations, then these shall be provided with escape ways to the life saving appliances. Such arrangement will be subject to special consideration, depending on the design.

6.3 Location of survival craft

6.3.1 If buoyancy towers are manned during cargo handling operations, then these shall be fitted with life saving appliances, such as life buoys or rafts. The type and arrangement of such appliances will be subject to special consideration, depending on the design.

Guidance note:
Survival craft forward of wide deck cargo should be specially considered by the body approving the life saving arrangement, to ensure that they are positioned in a way such as to avoid damage from the cargo.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

7 Navigation and communication

7.1 Navigation

7.1.1 In cases where the cargo is partially blocking the view from the bridge, a secondary look-out point (crows nest) shall be arranged.

Guidance note:

Unless the secondary look-out point is fully duplicated, manning of both wheel house and look-out point will normally be required by the flag administration during transport.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

Equipment in the secondary look-out point shall at least include:

— conning position with un-obscured view to the sea surface looking forward over an arc of 225° (see SOLAS Reg. V/22)
— a gyro bearing repeater
— rudder, propeller, thrust, pitch and operational mode indicators
— external communication system, one VHF
— internal communication system for communication with main bridge.

Guidance note:

Acceptance of alternative solutions may be granted by the flag administration.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

SECTION 6 DIVING SUPPORT VESSELS

1 Introduction

1.1 Introduction

These rules provide requirements for vessels intended for diving support services with particular focus on the ability to maintain position safely during diving operations through built-in redundancy.

1.2 Scope

These rules include requirements for hull strength, arrangements and support systems for diving systems and diving equipment as applicable to diving support vessels.

1.3 Application

1.3.1 Vessels built in compliance with the relevant requirements in this section and arranged for support of diving operations applying rope and/or umbilical connection between the submerged bell may be given the ship type notation **DSV** with the qualifiers listed in Table 1.

Table 1 Overview of qualifiers

Class notation	*Description*	*Qualifier*	*Description*
DSV	Diving support vessel	**Surface**	Equipped with a surface diving system classified by the Society in compliance with DNVGL-RU-OU-0375 *Diving systems*.
		SAT	Equipped with a saturation diving system classified by the Society in compliance with DNVGL-RU-OU-0375 *Diving systems*.
		Ready	Vessel prepared for installation of diving systems with the supported interfaces listed in the appendix of class.
		OCS	IACS classed saturation diving system installed as per [1.8].

1.3.2 The qualifiers **Surface** and **SAT** may be combined, i.e. **DSV(Surface, SAT)**.

1.3.3 When a vessel with notation **DSV(Ready)** has a dive system mobilized onboard, the qualifier **Ready** will be replaced by either **SAT** for a DNV GL classed system or **OCS** for a system classed by another IACS member. Likewise, the notation will revert to **DSV(Ready)** upon demobilisation of the system.

1.3.4 Requirements for surveying of diving systems in service are given Pt.7 Ch.1 Sec.6.

1.3.5 Requirements in this section are in general applicable unless referred to a specific qualifier.

1.3.6 Operational limitations, especially the limitations on wave height for diving operations, are listed in the appendix of class ,see Pt.1 Ch.1 Sec.3 [1.1.2].

Guidance note:

These requirements are specifically intended for vessels but may be applied to offshore units, fixed offshore installations or on an onshore site as applicable.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

1.3.7 For saturation diving systems on DNV GL classed vessels it is mandatory for the vessel to carry either the **DSV(SAT)** or **DSV(OCS)** class notations.

Guidance note:

Applicable standards may be those of a recognized classification society which has rules for diving systems acceptable to the administration as stated in 2.1.4 of the IMO *Code of Safety for Diving Systems*, 1995 (Res. 831(19)).

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

1.3.8 For surface oriented diving systems the following minimum requirements apply when in use:

a) All pressure components requiring certification shall be certified by a recognised authority.
b) Certified pressure components shall be tested according to schedules defined in these rules.

1.4 Survey and testing requirements

1.4.1 General

This subsection covers survey and testing requirements as applicable for newbuilding and mobilisation.

1.4.2 When a diving system is built and installed according to these rules, the following shall be documented:

a) Design and scantlings comply with the approved plans and the requirements in these rules and other specified recognized standards, codes, and national regulations.
b) Materials and components are certified according to these rules and the terms of delivery.
c) All work is carried out in accordance with the specified fabrication tolerances and required quality of welds.
d) Piping systems conducting gas in life support systems are cleaned in accordance with an approved cleaning procedure.
e) Gas cylinders are clean and sealed.
f) All required tests are carried out.

1.4.3 The inspection shall be carried out during the assembly and during installation. The extent and method of examination shall be agreed prior to the work being carried out.

1.4.4 For integrated systems, the builder shall follow the quality plan as approved under the diving system installation, see DNVGL-RU-OU-0375.

1.4.5 Test plan for testing after completed installation and mobilisation

A comprehensive test plan for the fully installed system shall be submitted for approval. This plan shall include testing details for, as a minimum:

a) pressure tests
b) purity tests gas leakage tests
c) handling systems
d) life support systems
e) safety systems
f) electrical systems
g) instrumentation
h) environmental control systems after installation onboard
i) sea trials.

1.5 Verbal forms and definitions

For verbal forms and definitions, see Pt.1 Ch.1 Sec.1, DNVGL-RU-OU-0375 and DNVGL-OS-E402.

1.6 Marking and signboards

1.6.1 Pressure vessels, gas containers and piping systems

Pressure vessels, gas containers and piping systems shall be consistently colour coded.

There shall be a chart posted in the control room explaining the colour code.

1.6.2 Handling system

The handling system shall, in an easily visible place, be fitted with a nameplate giving the following particulars:

a) identification number
b) static test load
c) functional test load
d) working weight
e) surveyor's mark and identification.

The above loads shall be specified for each transportation system involved.

1.7 DSV(Ready)

1.7.1 General

DSV(Ready) is intended to allow simplified mobilisations of transportable saturation diving systems. Either by pre-approving the installation of a specific dive system or by preparing vessel supplies to support an assumed capacity of dive system.

At a minimum **DSV(Ready)** shall either cover a specific dive system, or include at least one of the services under 6, 7 or 8.

DSV(Ready) will not be issued for vessels prepared for surface systems only.

As diving systems vary significantly in layout, the requirements under 3 will normally be handled upon mobilization and in connection with assigning either the **OCS** or **SAT** qualifier.

1.7.2 Preparation for a specific dive system

All services provided by the vessel shall be redundant to the extent required by the dive system philosophy.

Test and mobilization program shall also be submitted for approval.

Hull structure/arrangement may be pre-approved.

Preparations for a surface orientated system may be included while preparing for a known saturation system, both will be listed specifically within the appendix.

1.8 Handling of diving systems in class with other class societies

1.8.1 General

The requirements in this subsection are applicable for vessels with qualifier **OCS**.

The applicable class society for the diving system has the responsibility for the conditions of the diving system and shall also handle all statutory issues related to the diving system.

The owner of the diving system shall clearly define the interfaces and capacities required by the diving system prior to the installation. In cases were a diving system has capacity requirements in excess of what the vessel is designed for or if the technical solution is insufficient with respect to support of essential services for the diving system as defined in Pt.3 Ch.4 Sec.6 [2.3], a solution meeting these requirements shall be commonly designed by the owners and relevant documentation shall be sent to the society for approval.

The society will verify that the interfaces, required capacity and technical solutions are within the capabilities built into the vessel and that the technical solutions and possible additional requirements are dealt with in such a way that the vessel systems are not compromised.

Compliance shall be verified by the Society on a case by case basis.

1.8.2 Documentation and information

The following class documents and information shall be submitted by the owner(s):

a) diving system class certificate issued by a recognised classification society
b) current class status of the diving system
c) drawings and load calculations in accordance to the requirements given in Pt.3 Ch.11 Sec.2
d) interface drawings for fresh water including required capacity for the diving system
e) interface drawings for grey and black water including required capacity for the diving system
f) interface drawings for fire extinguishing system including required capacity for the diving system
g) interface drawings for the electrical system including required capacity and support of emergency services for the diving system as defined in DNVGL-OS-E402 Ch.3 Sec.4 [1.5] item b)
h) interface drawings for the communication system as given in [7.2]
i) evidence of review by the diving system class society for installation on the vessel. Normally this should include stamped drawings, for info or approved as relevant
j) vessel general arrangement drawing with dive system arrangements
k) block diagram of the dive system showing quantified vessel supplies and demarcation lines showing the limits of the dive system class
l) details of intended area of operation including environmental conditions and contingency planning
m) details of instrumentation and alarm system integration.

1.8.3 Statutory documentation and information required

The following statutory documents and information shall be submitted by the owner(s):

a) IMO diving system safety certificate (DSS-C), see IMO *Code of Safety for diving systems* adopted 23 November 1995 as res. A.831(19), as required by the vessel's maritime administration
b) updated safety plan including escape routes for critical dive personnel involved in launching or manning of HES
c) show that the launching system for the hyperbaric evacuation system (HES) has sufficient stored energy for launch
d) thermal balance test of the HES.

2 General requirements

2.1 Location and arrangement of the diving system onboard

2.1.1 The diving system shall be so located that diving operations shall not be affected by propellers, thrusters or anchors.

Guidance note:

Some national regulations will limit the length of the umbilical so that the diver, or his umbilical, cannot be drawn into the propellers or thrusters. Requirements for the use of wet-bell may also apply in some regions.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

Where, due to the requirements of diving operations, systems are sited in hazardous areas, the electrical equipment shall comply with the requirements for such equipment in hazardous areas. Diving systems should not be permitted in hazardous areas designated as zone 0.

Guidance note:

The above implies that the location of a **DSV(SAT)** or **DSV(Surface)** diving system on a ship, mobile unit, fixed offshore structure or land site, shall be in a safe area with respect to explosive gas-air mix. Safe areas are in this context areas not defined as hazardous zones in IEC 60079-10-1 *Explosive atmospheres - Part 10-1: Classification of areas - Explosive gas atmospheres*, and IMO (MODU) code, chapter 6, as follows:

a) Zone 0: in which an explosive gas-air mixture is continuously present or present for long periods.

b) Zone I: in which an explosive gas-air mixture is likely to occur in normal operation.

c) Zone 2: in which an explosive gas-air mixture is not likely to occur, and if it occurs it will only exist for a short time.

Upon special consideration and agreement in each case, diving systems as covered by the qualifiers **SAT** and **Ready** may be located in spaces which normally would be defined as zone 2.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

2.1.2 When any part of the diving system is sited on deck, particular consideration should be given to providing reasonable protection from the sea, icing or any damage which may result from other activities on board the ship or floating structure. This includes the hyperbaric evacuation system (HES).

2.1.3 Diving systems situated on open decks shall not be located in the vicinity of ventilation openings from machinery spaces, exhausts or ventilation outlets from galley.

Guidance note:

Dive systems should not be exposed to temperatures outside the range they have been certified for. This shall be specially considered when the diving system is not positioned in a temperature controlled environment, e.g. open deck.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

2.1.4 The diving system should not be installed close to sources of noise that may expose divers to harmful noise. Personnel in the outer area shall have the possibility to communicate in an acceptable way where 75 dB(A) should be the noise limit. If the diving support vessel does not carry the class notation **COMF(V-crn)**, the diver's accommodation area (inner area) shall be subject to the relevant vibration and noise measurements applicable to the remaining accommodation. The noise limit 60 dB(A) shall not be exceeded, while 55 dB(A) is recommended.

2.1.5 The diving system and breathing gas storage facilities shall not be sited in machinery spaces if the machinery is not associated with the diving system.

2.2 External and internal environmental conditions

2.2.1 General

Systems and components shall be designed for the environmental conditions expected at their installed location (on the diving support vessel or otherwise) and their geographic site of operation.

Additional requirements for various systems and components may be given elsewhere in the rules. Consideration shall be taken to external environment in terms of toxic, e.g. H_2S and hydro carbon gas. Where diving systems shall be operated in known geographical locations were such gases exist, contingencies shall be provided and operational response to mitigate exposed risk.

The effects of environmental phenomena relevant for the particular location and operation in question shall be taken into account.

Guidance note:

Environmental phenomena that might impair proper functioning of the system or cause a reduction of the reliability and safety of the system shall be considered, (including fixed and land-based installations):

- temperature
- wind, tide, waves, current
- ice, earthquake, soil conditions
- marine growth and fouling.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

2.2.2 External environmental conditions

Design inclinations shall be according to Table 2.

Table 2 Design inclinations

Chambers and other surface installations	*Roll*	*Permanent list*	*Pitch*	*Trim*
On a ship	+/-22.5°	+/-15°	+/- 10°	+/-5°
On a mobile offshore unit		+/-15°		+/-15°

Range of ambient temperature: -10°C to 55°C, unless otherwise specified. For greater temperature ranges, temperature protection shall be provided.

Humidity: 100%.

Atmosphere contaminated by salt (NaCl): Up to 1 mg salt per 1 m^3 of air, at all relevant temperatures and humidity conditions.

2.2.3 System design principles

Diving systems shall be operated in such a manner that they:

a) Fulfil the specified operational requirements.
b) Fulfil the defined safety objective and have the required support capabilities during planned operational conditions.
c) Have sufficient safety margin against accidental loads or unplanned operational conditions.
d) Cater for the possibility of changes in the operating conditions and criteria during the lifetime of the system.

Any re-qualification deemed necessary due to changes in the design conditions, shall take place in accordance with provisions set out in each section of the rules.

For systems supplying the diving system, redundancy requirements shall be taken from the design philosophy of the diving system. The redundancy requirements may exceed the minimum required for notations such as **DYNPOS** and include static component failure such as piping.

Parameters that could jeopardise the safety of the divers, and/or violate the integrity of the diving system, shall be monitored and evaluated with a frequency that enables remedial actions to be carried out before personal harm is done or the system is damaged.

Instrumentation may be required when visual inspection or simple measurements are not considered practical or reliable, and available design methods and previous experience are not sufficient for a reliable prediction of the performance of the system.

The various pressures in a diving system shall not exceed the design pressures of the components during normal steady-state operation.

Guidance note:

As a minimum the monitoring and inspection frequency should be such that the diving system, and consequently the diving operation, shall not be endangered due to any realistic degradation or deterioration that may occur between two consecutive inspection intervals.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

3 Hull

3.1 Supporting structure for diving system equipment

3.1.1 General

Provisions shall be made to ensure that the diving system installations and auxiliary equipment are securely fastened to the ship or floating structure and that adjacent equipment is similarly secured. Consideration shall be given to the relative movement between the components of the system. In addition, the fastening arrangements shall be able to meet any required survival conditions of the ship or floating structure. When the diving system is taken onboard and mobilised for use, the equipment related to the diving system shall be permanently attached to the hull structure, e.g. by welding, bolted connection or similar.

Guidance note:

Fitting by means of lashing is not considered as permanent fitting.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

All supporting structure(s) shall be according to Pt.3 Ch.11 Sec.2 with additional requirements as given below.

Guidance note:

Foundations are generally understood to be part of the diving system, whereas the supporting structures structural supports are generally understood to be part of the ship's structure/hull.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

In addition to [3.1.1], foundation supporting structures supporting diving system equipment shall have scantlings based on the supported mass.

The forces $F_{U\text{-}x}$, $F_{U\text{-}y}$ and $F_{U\text{-}z}$, in kN, due to the unit load for the static plus dynamic (S+D) design load scenarios shall be derived for each dynamic load case as given in Pt.3 Ch.4 Sec.5 [2.3.2] for exposed decks.

For non-exposed decks and platforms the design forces shall be as given in Pt.3 Ch.4 Sec.6 [2.3].

The forces $F_{U\text{-}x}$, $F_{U\text{-}y}$, in kN, in longitudinal and transverse direction shall in no case be taken less than $0{,}5gm_U$.

Acceptable stresses, in N/mm^2, for the supporting structure resulting from bending moments and shearing forces calculated for the load given above, shall be according to AC-I for primary supporting members given in Pt.3 Ch.6 Sec.6 [2.1] or Pt.3 Ch.6 Sec.6 [2.2], depending on calculation method used.

In case of direct strength calculations the equivalent von Mises stress, in N/mm^2, shall satisfy:

$$\sigma_{vm} \leq 0.9\, R_{eH}$$

The supporting structures and foundations shall be calculated for values of accelerations determined as shown in Pt.3 Ch.4 Sec.3 or other recognized standards. Design loads for external sea pressure on deck mounted diving system modules essential to the diving operations, shall be calculated according to Pt.3 rules for deck housing sides and ends, including supporting structures.

The supporting structures of other equipment, not categorised under [3.1.2] or [3.1.3], shall be considered. Drawings showing the deck structure below the foundation shall be submitted for approval when the static forces exceed 50 kN or when the resulting bending moments at deck exceed 100 kNm. The drawings shall clearly indicate the relevant forces and bending moments acting on the supporting structure.

3.1.2 Supporting structures and foundations for pressure vessels for human occupancy and for gas storage

Pressure vessel(s) exposed to static and dynamic loads while allowing contraction and expansion of the pressure vessel(s) under pressure and temperature variations, shall be supported in a proper manner. The stress level in the pressure vessel(s), connected pipes, the supporting structures and foundations shall be kept within acceptable level. Deflections allowed for by the required stiffness of supporting structure shall be given as a design input to the pressure vessel manufacturer(s).

Assessment of deflection shall include design still water and wave bending moment at the applicable longitudinal position. If heavy deck loads or crane operation can influence local deck deflections under the chamber system it shall be included in deck deflection study. Extent of model shall be discussed with class on case by case basis.

Where chockfast or similar is used to support pressure vessels for human occupancy (PVHOs), this shall be fitted with a clear sliding surface toward the chamber support to avoid undue stresses caused by expansion contraction. The sliding surface shall be the levelled surface. A report after installation shall be submitted showing the chockfast is within manufacturers guidance for thickness and surface pressure at all points within the chamber complex.

The pressure vessels with supports shall be designed for a static inclination of 30° without exceeding the allowable stresses as specified in [3.1.1].

Suitable supporting structures and foundations shall be provided to withstand a collision force acting on the pressure vessels corresponding to one half the weights of the pressure vessels in the forward direction and one quarter the weight of the pressure vessels in the aft direction.

Unless removal of the pressure vessel(s) is a simple operation, the supporting structure(s) shall be able to sustain the static load of the pressure vessel(s) during periodic hydro testing or it shall be possible to shore/support the supporting structure(s) in order to avoid unacceptable deflections.

The collision loads and the hydro testing loads mentioned above need not to be combined with each other or with wave-induced loads.

Guidance note:

Typically the chambers and large gas storage tubes will expand and contract considerably in service due to pressure variations. All supporting structures and foundations for these pressure vessels should allow for this movement.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

3.1.3 Supporting structures and foundations for handling systems and lifting appliances

Supporting structures and foundations for handling systems and lifting appliances shall be determined according to Pt.3 Ch.11 Sec.2 or according to other recognized standards. Interfaces between the handling system structure and the vessel shall be especially considered. Drawings showing scantlings and joint configuration including maximum design loads shall be approved including (but not limited to) supporting structures for winches, sheaves and dampers.

The dynamic coefficient shall as a minimum be taken as 2.2 when the lifting appliance is used for handling manned objects such as surface bells, baskets or hyperbaric evacuation systems. For other lifting appliances, not used for lifting people, the dynamic coefficient shall as a minimum be 1.5.

The side structure of the moon pool shall be strengthened with respect to possible impact loads from diving equipment guided through the moon pool.

Design loads for supporting structure(s) of bell launch and recovery systems shall be based on DNVGL-OS-E402 or Pt.3 Ch.11 Sec.2 whichever is greater.

Guidance note:

All lifting appliances used in the operation of the diving system should be considered offshore lifting appliances.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

4 Stability and floatation

The diving support vessel shall comply with the damage stability requirements given in Pt.6 Ch.5 Sec.7 for additional class notation **SF** or Pt.6 Ch.5 Sec.7 for additional class notation **SPS**.

Essential diving equipment on or above main deck shall remain accessible and operable in any stage of flooding as required for compliance with the above. Equipment below the main deck for special purpose ships will be considered protected if side divisions are equivalent to that required under class notation **SF**.

Guidance note:

For the purpose of stability calculations, essential diving equipment should be treated similar to the requirements to control stations in SOLAS II-1/7-2.5.3.2, i.e. defined as flooding points and located above the worst intermediate or final damaged waterline.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

Examination and approval of stability documents carried out by national administrations having equivalent stability requirements to the above may be accepted as a basis for assignment of class notation **DSV***. In such cases the stability manual approved by the national authorities shall be submitted as documentation of compliance with the rule requirements.*

In order to recover the bell after side damage in accordance with the extents given in class notation **SF**, the final list and trim in these conditions shall be below the design limits of list and trim for the LARS system. Ballasting post damage may be used as a means to achieve this.

5 Position keeping

5.1 General

5.1.1 The diving support vessel shall be able to keep its position safely during diving operations. This implies a system with built in redundancy for position keeping. The position keeping system may be a mooring system with anchors or a dynamic positioning system.

5.1.2 For diving support vessels, equipped with a dynamic positioning system, the class notation **DYNPOS(AUTR)** or higher is mandatory. Alarms shall be initiated and set accordingly.

Guidance note:

In this context, equipment class 2 in accordance with IMO MSC/ Circ.645 of 6 June 1994 *Guidelines for Vessels with dynamic positioning systems* may be considered as an alternative to **AUTR** dependent on region and operation. Some diving operations may require a higher class, which then should be stated in the contract.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

5.1.3 For mooring systems with anchors, the notation **POSMOOR-V** or higher is mandatory.

5.1.4 Between the operation centre for the positioning system and the dive operation centre there shall be:

a) redundant communication systems
b) a manually operated alarm system.

6 Life support

6.1 Piping

6.1.1 General

Gases vented from the diving system shall be vented to the open air away from sources of ignition, personnel or any area where the presence of those gases could be hazardous. Means shall be provided to prevent any dangerous accumulation of gases. The discharge from overpressure relief devices and exhaust shall be led to a location where hazard is not created.

Piping systems carrying mixed gas or oxygen under high pressure shall not be arranged inside accommodation spaces, engine rooms or similar compartments. Piping systems shall comply with the technical requirements for class I piping in Pt.4 Ch.6.

All high-pressure piping shall be well protected against mechanical damage.

Piping for gas and electrical cables shall be separated.

All filters/strainers shall be arranged so that they can be isolated without interrupting the supply to essential systems.

Diving system sanitary and drainage systems connected to ship systems shall be designed to avoid an unintentional pressure rise in the ship system in case of malfunction or rupture of the diving systems.

Piping systems intended to be used in breathing gas and oxygen systems shall be cleaned and tested for purity in accordance with an approved test method. The minimum acceptable cleanliness levels, as defined in ASTM G93 *Standard Practice for Cleaning Methods and Cleanliness Levels for Materials and Equipment Used in Oxygen-Enriched Environments*, shall be:

1) ASTM Level B for non volatile residue in oxygen lines
2) ASTM Level D for non volatile residue in breathing gas lines
3) ASTM Level 175 for particulate contamination.

6.1.2 Oxygen systems

The discharge from overpressure relief devices and exhaust from O_2 systems shall be ducted to a safe place and not close to a source of ignition, engine room exhaust or ventilation from galley.

6.2 Gas storage

6.2.1 General

Where gas mixtures with oxygen content less than 20% are stored in enclosed spaces, there shall be two oxygen analysers with an audio-visual low level alarm in addition to the ventilation requirements in [6.2.3]. These analysers shall be mounted such that one is reading the upper levels and the other is reading the lower levels of the enclosed space.

6.2.2 Capacity

There shall be a permanently installed gas storage plant or suitable space for portable gas containers. The requirements with respect to the capacity of stored gas are defined in DNVGL-OS-E402 Ch.3 Sec.3 [2].

For the qualifier **Ready** the capacity of the permanently installed gas storage plant shall be the basis for the size of the diving system that can be installed on board.

Guidance note:

The capacity will be stated in the appendix to class. For diving systems with larger capacity, the total gas capacity may be increased using portable gas containers, provided that suitable space for storage is provided.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

6.2.3 Oxygen gas storage

Oxygen bottles shall be installed in a well ventilated location. If stored in a room instead of open deck, the room shall be separated from adjacent spaces,shall be ventilated according to [8.1.3] and shall be fitted with an audio-visible oxygen alarm, at a manned control station.

Oxygen bottles shall not be stored near flammable substances. Oxygen shall not be stored or ducted in any form close to combustible substances or hydraulic equipment. Working decks are considered sources of combustible substances

For diving support vessels with class notation **Fire fighter**, the oxygen gas bottles shall be specially protected from heat that may radiate from a fire that is being extinguished.

7 Power provisions, control and communications

7.1 Electrical systems

7.1.1 Objective

General requirements for electrical systems are given in Pt.4 Ch.8 and DNVGL-OS-E402. The purpose of this section is to specify additional requirements for electrical systems and equipment serving diving systems. Emphasis is therefore placed on the special needs associated with the design and manufacture of diving systems.

Guidance note:

For the qualifier **Ready** the capacity of the installed main and emergency source of power will be stated in the appendix to class.

Diving systems being installed may be supplied using a separate power generator and own distribution system provided that the systems meet the requirements as defined in Pt.4 Ch.8.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

7.1.2 Capacity

7.1.3 Design philosophy of electrical systems serving diving systems

All electrical equipment and installation, including power supply arrangements, shall be designed for the environment in which they will operate to minimize the risk of fire, explosion, electrical shock and emission of toxic gases to personnel, and galvanic action of the surface compression chamber or diving bell. Electrical cables and piping for gas shall be separated.

In the event of failure of the main source of electrical power supply to the diving system an independent source of electrical power should be available for the safe termination of the diving operation.

It is admissible to use the ship's emergency source of electrical power as an emergency source of electrical power if it has sufficient electrical power capacity to supply the diving system and the emergency load for the vessel at the same time.

The alternative source of electrical power shall be located outside the machinery casings to ensure its functioning in the event of fire or other casualty causing failure to the main electrical installation.

Interface between diving system and the ship or floating structure shall be provided with suitable electric lighting. Primary and emergency lighting in all critical handling areas shall be provided.

7.2 Communication

7.2.1 General

The communication system shall be arranged for a fixed direct two-way communication between the control stands and:

a) diving system handling positions
b) dynamic position control centre
c) bridge, ship's command centre or drilling floor

d) crane
e) ROV control stand.

This fixed communication systems shall also be arranged for direct two-way voice communication between the dive control room and, for the qualifier **SAT** the SAT control room.

7.2.2 Testing
The communication system shall be functionally tested after installation.

8 Fire protection

8.1 Fire prevention

8.1.1 Objective
General requirements for fire protection are given in the rules Pt.4 Ch.10. The purpose of this section is to specify additional requirements for fire protection of areas containing diving equipment with auxiliaries and systems to be connected to the diving compression chambers and diving bells.

8.1.2 Application and scope
These requirements apply to all systems. However, some systems may be located on open deck. In these cases the requirements for insulation against adjacent spaces and requirements for sprinkler systems shall be evaluated on a case by case basis.

8.1.3 Arrangement and materials
Enclosed outer area shall have A-60 class towards other enclosed spaces. Outer area may be subdivided into several spaces by A-0 class. There shall be no direct access between categories A machinery spaces outside of outer area. At least one of the required escape routes from spaces not being part of outer area shall be independent of outer area. All doors between outer area and other adjacent enclosed spaces shall be of self-closing type.

Piping and cables essential for the operation of the diving system are regarded as part of the system and shall be laid in separate structural ducts insulated to A-60 class standard where these transit from other spaces as main switch board room or engine room into outer area.

Outer area in the ship or floating structure shall be arranged in spaces or locations which are adequately ventilated. When situated in enclosed spaces the outer area shall be fitted with separate mechanical ventilation with minimum 8 air changes per hour.

Insulation materials used in connection with the diving system shall be of fire-retardant type in order to minimize the risk of fire and sources of ignition.

8.2 Fire detection and alarm systems

When situated in enclosed spaces, the outer area shall be equipped with automatic fire detection and alarm systems complying with SOLAS Reg. II-2/7.1 and FSS Code Ch 9 as mandated by Pt.4 Ch.11 Sec.4. The section or loop of detectors covering the outer area shall not cover other spaces. Fire detection panels shall be placed on the bridge, with repeater panel at dive control room and in engine control room and provisions shall be made for warning of faults. A visual repeater, showing the alarm condition, shall be placed at the saturation- and diving control stand.

8.3 Fire extinguishing

Interior spaces containing diving equipment such as surface compression chambers, diving bells, gas storage, compressors and control stands shall be covered with a suitable fixed fire extinguishing system. When situated in enclosed spaces, the outer area shall be equipped with a fixed, manually actuated fire extinguishing system with such a layout as to cover the complete system. Release positions for these systems shall be at the dive control room, bridge and/or other positions as required case by case.

Coverage shall be sufficient to cover at least the largest area enclosed by A-0 class.

The extinguishing system shall be either:

a) a pressure water spraying system approved for use in machinery spaces of cat. A
b) an equivalent fixed gas fire extinguishing system in accordance with the FSS Code and IMO MSC/circ. 848, amended by MSC/Circ. 1267.

If a gas system is selected, the agent shall be of a type not hazardous to humans in the concentration foreseeable in the protected space. The concentration shall be below the NOAEL as defined in IMO MSC/Circ.848/1267.

Guidance note:

Where sea water is used as the extinguishing agent it is recommended to arrange a fresh water flushing system for maintenance purposes.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

When pressure vessels are situated in enclosed spaces, a manually actuated water spray system having an application rate of 10 l/m^2/per minute of the horizontal projected area should be provided to cool and protect such pressure vessels in the event of external fire. For equivalent water-mist fire-extinguishing systems with application rate less than 5 l/min/m^2, an additional object protection of 5 l/min/m^2 is accepted as equivalent to 10 l/min/m^2.

Release positions for these systems shall be at the dive control room, bridge and/or other positions as required case by case. The arrangement of zones shall follow the physical arrangement of the dive system release in one area should not hamper the operation of other areas.

Where water is used as the fire extinguishing medium the IP rating of essential controls shall be considered.

Guidance note:

Release of fire fighting within the hanger should not also release within control rooms or areas on other decks.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

When the outer area is subdivided by A0 or higher divisions, the extinguishing capacity shall be sized to be able to activate all zones within the largest subdivision enclosed by the A0 or higher class divisions.

When pressure vessels are situated on open decks, fire hoses may be considered as providing the necessary protection.

When situated on open deck, the outer area shall be provided with fire extinguishing equipment, which shall be considered in each case.

Hyperbaric evacuation systems shall be provided with fire extinguishing systems enabling launching of the hyperbaric evacuation unit in the event of a fire. Release of the Object protection for hyperbaric evacuation systems shall be available at a central control stand

8.4 Miscellaneous equipment

8.4.1 Fire-fighter’s outfit

A complete set of fire-fighter's outfit complying with Pt.4 Ch.11 Sec.2 for each person required for operation of the diving system during a fire shall be located at the main control stands. The sets are additional to other sets on board. Breathing apparatus are required for control stations manned during recovery of bell or launching of hyperbaric evacuation unit.

Guidance note:

Fire-fighter's outfit is recommended in consideration of the time it may take for recovery of the divers from the water, into the bell and all the way up to the hyperbaric evacuation system. The operator(s) of the diving system may be exposed to hot environments which render evacuation impossible unless they are protected whilst performing their work.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

8.4.2 Portable fire extinguishers

Portable fire extinguishers shall be of approved type and comply with the provisions of the FSS Code.

Portable fire extinguishers shall be distributed throughout the space containing the diving system so that no point in the space is more than 10 m walking distance from an extinguisher.

One of the portable fire extinguishers shall be fitted near each entrance.

A portable fire extinguisher shall be fitted at the control stand.

Spare charges or extinguishers shall be provided on board as follows:

— 100% for the first 10, and
— 50% for remaining extinguishers.

9 Hyperbaric evacuation

9.1 General

9.1.1 General

An evacuation system shall be provided having sufficient capacity to evacuate all divers under pressure, in the event of the ship having to be abandoned, and shall be in accordance with the provisions of the *Guidelines and Specifications for Hyperbaric Evacuation Systems* adopted by the IMO organization by resolution A.692(17).

Hyperbaric evacuation systems shall comply with these statutory requirements as interpreted in DNV-RP-E403.

Guidance note:

As life saving appliances are governed by statutory regulations, there may be overriding requirements for hyperbaric evacuation systems (HES). Consequently, it is important to inform the Society at an early stage what flag administration is intended for the diving support vessel.

It is the Society's intention to apply SOLAS requirements for hyperbaric evacuation systems as far as is practical. This includes the launching arrangement.

In the cases where the system does not comply with the prescriptive requirements in SOLAS, the Society shall verify evaluations and tests that show substantially equivalent conformance with the recommendations. This is in accordance with recommendations given in SOLAS Ch. III Part A Regulation 4.

Guidelines and Specifications for Hyperbaric Evacuation Systems, adopted by the IMO organization by Resolution A.692(17) on 6 November 1991, shall be included as normative references under SOLAS. The Society interpretations to these guidelines are given in DNV-RP-E403 *Hyperbaric Evacuation Systems*.

Yards, owners or designers will have to carry out engineering analyses according to the new SOLAS Ch. III, Reg. 38 as amended by IMO Res. 216(82).

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

SECTION 7 SEISMOGRAPHIC RESEARCH VESSELS

1 Introduction

1.1 Introduction

1.1.1 These rules provide requirements for vessels intended for seismographic research operations with particular focus on the robust design of the seismic equipment hangar; the ability to maintain propulsion power and vessel manoeuvrability through adapted bridge design and navigation systems.

1.2 Scope

1.2.1 These rules include requirements for hull strength, systems and equipment applicable to seismographic research vessels.

1.3 Application

1.3.1 Vessels built in compliance with the relevant requirements in [4] of this section may be given the class notation **Seismic vessel**.

Vessels built in compliance with the relevant additional requirements in [5] of this section may be given the class notation **Seismic vessel(A)**.

Qualifier **A** is optional.

Vessels with qualifier **A** shall hold the following additional class notations:

— **RP(+)** or **RP(3,x%,+)**, see Pt.6 Ch.2;
  or **DYNPOS(AUTR)** or **DYNPOS(AUTRO)**, see Pt.6 Ch.3;
  or **DYNPOS(ER)**, see Pt.6 Ch.3
— **E0** or **ECO**, see Pt.6 Ch.2
— **NAUT(OSV)**, see Pt.6 Ch.3

2 Racking of seismic hangar

2.1 Transverse racking

2.1.1 General

A transverse racking strength assessment shall be carried out for the seismic hangar following the requirements given in this subsection. Special attention shall be given to the connections between transverse structural members to the bulkhead deck or the uppermost deck level with high racking rigidity.

Intersections between horizontal and transverse members shall be assessed in areas subjected to high racking deformations, i.e. response caused by roll motion acting on the cargo at multiple decks combined with self-weight of structure and equipment.

2.1.2 Scope of racking calculations in way of seismic hangar

Transverse strength is provided by the deep vertical web frames in the ship's side and/or transverse bulkheads in the forward area of the seismic hangar. For vessels with length L < 120 m, a simplified racking assessment model using beam elements (grillage analysis) will be accepted for the evaluation of the adequacy of the transverse strength for the ultimate limit state (ULS).

Fatigue assessment will not be required if the dynamic nominal stress is less than 80 N/mm^2.

Under special consideration finite element analysis based on partial ship structural model may be required on a case by case basis. Acceptable calculation and modelling methods are given in Pt.3 Ch.7.

For vessels with length $L \geq 120$ m, calculation scope based on FE partial ship structural analysis shall be applied. A separate fatigue limit state analysis (FLS) shall be carried out according to Ch.3 Sec.2 [4].

3 Loads

3.1 Loads for racking strength assessment of seismic hangar in transit condition

3.1.1 Loading condition for racking

The loading condition, which in combination with relevant dynamic load cases defined in [3.1.3] results in the maximum racking moment about the bulkhead, shall be chosen for the ULS transverse strength analysis. The design racking moment shall be calculated according to [3.1.2].

The actual *GM* value for this design load case shall be determined and applied since it has a significant influence on the dynamic load cases. In no case shall the *GM* value for the design still water loading condition be smaller than 0.05*B*.

3.1.2 Racking moment calculation (screening of highest design load)

The racking moment is calculated using both cargo and fully loaded equipment weight (m_c) and the self-weight (m_s) to obtain the total mass. If not specified by the designer, an average minimum distributed load equal to 0.2 t/m^2 shall be applied for the accommodation decks, in addition to the self-weight. For unloaded weather decks, it is sufficient to include the load corresponding to the self-weight if no deadweight is specified. The transverse force on each deck level is obtained as the total mass times the transverse acceleration corresponding to the relevant equivalent design wave (EDW) given in [3.1.3]. Thus, the racking moment in kNm, may be estimated as:

$$M_R = \sum_i \left(m_{c,i} + m_{s,i}\right) a_{y,i} \left(z_i - z_{main}\right)$$

where:

$m_{c,i}$ = mass on deck number *i*, in t

$m_{s,i}$ = self-weight of deck number *i*, in t

$a_{y,i}$ = transverse acceleration at deck number *i*, in m/s^2, for the dynamic load cases specified in [3.1.3]

z_i = vertical distance above base line for deck number *i*, in m

z_{main} = vertical position above base line for bulkhead deck, in m.

Guidance note:

A high racking moment is achieved if the load is located on the upper decks. However this result in lower *GM* values and thus also lower transverse accelerations which will reduce the racking moment. Usually, several loading conditions for racking analysis should be reviewed using the simplified racking moment calculation described in this paragraph.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

3.1.3 Dynamic load cases

The design wave load cases which shall be used to evaluate the transverse strength of the ship structure is the beam sea load cases BSR (1P/2P) and/ or BSR (1S/2S). For ship structures with symmetrical arrangement of racking constraining elements, only BSR(1P/2P) or BSR(1S/2S) needs to be examined.

3.1.4 Load combinations in transit condition for ULS

The loading condition from [3.1.1] shall be combined with the dynamic load cases as described in [3.1.3]. The external sea pressure shall be applied according to Pt.3 Ch.4 Sec.5 Table 8. Load combination factors for hull girder loads and accelerations shall be applied according to Pt.3 Ch.4 Sec.2 Table 3 with the internal cargo, equipment and steel weight loads.

Transverse accelerations shall not be taken less than 0.5g.

3.1.5 FE load application

The deck load may generally be applied as distributed vertical and transverse loads based on load combination as described in [3.1.4].

The steel self-weight shall be included.

3.2 Loads for primary supporting members

3.2.1 Design load sets for prescriptive rule check

Design load sets and load combinations of static and dynamic loads for tank and watertight boundary structure, external shell envelope structure e.g. bottom structure, side shell primary members and deck structure is given in Pt.3 Ch.6 Sec.2 Table 2.

3.2.2 Load sets and load combinations for direct analysis

The load pattern described in Table 1 shall be assessed to ensure that the primary support members have sufficient strength.

Table 1 Load patterns

Transit condition					*Seismic operational condition*				
Load pattern	*Description*[1)]	*Strength members*	*Acceptance criteria*	*Draught*	*Load pattern*	*Description*[1)]	*Strength members*	*Acceptance criteria*	*Draught*
LC 1[5)]	Fully loaded seismic equipment in stored position. Deck load as specified by designer	— pillars — side structure — deck structure	AC-II	T_{SC}	LC 1[2)] [5)]	Normal operation of seismic equipment on each hangar deck. Weight of the equipment may be reduced by the weight of deployed cables. Deck load as specified by designer.	— pillars — side structure — deck structure	AC-I	T_{BAL}
LC 2[5)]			AC-I	T_{BAL}	LC2[3)] [6)]	Maximum transverse loading of seismic equipment. Weight of the equipment may be reduced by the weight of deployed cables. Sea pressure need not be included.	— side structure — deck structure		
					LC3[4)] [6)]	Maximum vertical loading of seismic equipment. Weight of the equipment may be reduced by the weight of deployed cables. Sea pressure need not be included.	— pillars — side structure — deck structure		

1) Special load case to evaluate strength of individual strength members under heavy seismic equipment. Load distribution/combination shall be based on information from a seismic equipment load plan as specified by designer.

2) Combinations of equipment loads shall include maximum operational loads on seismographic handling equipment, e.g. winches, towing points, which are assumed to be at least one line with breaking load and remaining lines with safe working load times the dynamic factor.

3) In case of maximum transverse loading, safe working load on towing points times dynamic factor shall be combined with maximum breaking strength on at least one line in the most unfavourable position (normally the outermost line). If the design specification should include combinations with more than one piece of equipment with breaking load then this shall be included in the load specification of the seismic equipment hangar.

4) For maximum vertical loading the breaking load is normally to be applied to the mid-span line and combined with SWL times dynamic factor for the remaining lines. If the design specification should include combinations with more than one piece of equipment with breaking load then this shall be included in the load specification of the seismic equipment hangar.

5) For the lowermost deck on semi- enclosed hangars, the design load shall be taken as the greater value of the rule sea pressure and specified deck load when below 2 t/m^2 in combination with sea pressure. The sea pressure does not need to exceed 60 kN/m^2, when it is used in combination with the deck load. For the remaining decks on semi enclosed hangars, the design load shall be taken as the greater value of the rule sea pressure and deck load. For open weather deck located 1.7C_W meter or more, see Pt.3 Ch.4 Sec.4, above the Summer Load Waterline, the design load shall be taken as the greater value of the rule sea pressure and deck load.

6) Deck load to be as specified by the designer or minimum rule values with no dynamic factors, i.e. mass times gravity. Self-weight of storage winches or other equipment not used during operation shall be included with vertical load component, i.e. 1.0g.

3.2.3 Design load sets for beam analysis

Relevant design load sets for transit condition are described in the rules Pt.3 Ch.6 Sec.2 Table 2 and Pt.3 Ch.6 Sec.8 Table 1 shall be applied to the model.

For internal decks in transit condition for load pattern LC1, the UDL design load sets applies and the $P_{dl\text{-}d}$ may be based on envelope acceleration according to Pt.3 Ch.4 Sec.3 [3.3]. The following design load sets then applies:

a) UDL-1h: ($P_{dl\text{-}s}$ + $P_{dl\text{-}d}$) combined with maximum hull girder vertical bending moment in hogging, i.e. $M_{wv\text{-}h}$ + $M_{sw\text{-}h}$ based on HSM-2

b) UDL-1s: ($P_{dl\text{-}s}$ + $P_{dl\text{-}d}$) combined with maximum hull girder vertical bending moment in sagging, i.e. $M_{wv\text{-}s}$ + $M_{sw\text{-}s}$ based on HSM-2.

Optionally, the accelerations for the considered dynamic load case may be applied. Then the number of applicable load sets will double, in order to maximize both local pressure and hull girder vertical bending moment, as described in Pt.3 Ch.6 Sec.2 Table 2.

3.2.4 Breaking load need not to be taken greater than the force causing the winch to render.

3.2.5 A design dynamic factor of not less than 1.3 shall be applied to the static SWL of the seismic handling equipment.

4 Hull local scantling

4.1 Primary supporting members being part of seismic equipment hangar

4.1.1 General

The strength of primary structural members that form part of a grillage system, such as deck girders, side web frames, pillars, floors and girders in double bottom shall be determined by direct strength analysis either by the use of a beam- or FE part ship model.

4.1.2 Beam analysis

Beam analysis may be accepted in order to evaluate bending and shear stresses in webs and flanges of grillage structure under lateral loads such as decks, double bottom and side structure under cargo or liquid pressure, e.g. sea pressure, tank pressure etc. The effective plate breadth in bending of the primary strength members shall be calculated according to Pt.3 Ch.3 Sec.7 [1.3].

4.1.3 Buckling check of plate panels

The normal stresses and shear stresses taken from strength assessment to be applied for buckling capacity calculation of plate panels, as given in Pt.3 Ch.8 Sec.4, shall be corrected as given in DNVGL-CG-0128 Sec.3 [2.2].

Buckling strength shall be considered for panels with high in-plane stresses, e.g. decks and ship sides, with acceptance criteria given in Ch.8 Sec.4. For buckling assessment fully effective plate flange may be used.

4.1.4 Acceptable stress level

Acceptable stresses, in N/mm^2, for the supporting structure resulting from bending moments and shearing forces calculated for the loads given above, shall be according to AC-I and AC-II for primary supporting members given in Pt.3 Ch.6 Sec.6 [2.2].

In case of direct strength calculations the equivalent von Mises stress, in N/mm^2, shall satisfy:

$$\sigma_{vm} \leq 0.8\, R_{eH}$$

4.2 Supporting structures for seismic handling equipment

4.2.1 Local structural strength in way of the equipment foundation shall be in compliance with Pt.3 Ch.11 Sec.2.

4.2.2 In case the winch is supported by two deck levels, then local support at one deck level shall be capable of bearing all vertical loads from the winch.

4.2.3 When part of the equipment is acting as structural hull support, i.e. winch frame providing pillar support for the decks, it shall comply with the strength requirements as for the main structure with respect to the design loads and rule acceptance criteria.

4.2.4 In cases when equipment is being used as hull structural support this shall be stated in memorandum to owner (MO) and appendix to classification certificate.

4.3 Strengthening for side-by-side mooring

4.3.1 The SWL for the mooring bollard shall be at least three (3) times the minimum breaking load of the mooring lines according to the vessel's equipment letter, or based upon the designer's specification for the minimum breaking load to be used for side-by-side mooring lines.

4.3.2 The mooring line specification and restrictions on operation of the mooring bollards shall be stated in the appendix to classification certificate and in a memorandum to owner.

4.3.3 The strength of supporting deck structure shall be based on the mooring bollard's SWL times 1.5.

4.3.4 Acceptable stresses, in N/mm^2, for the scantlings of the supporting deck structure resulting from bending moment *M*, in kNm, and shear force *Q*, in kN, calculated for the load given above are:

σ_b = bending stress, in N/mm^2, taken as:

$$\sigma_b = \frac{1000\,M}{Z}$$

$$\sigma_b \leq 0.7\,R_{eH}$$

τ = average shear stress, in N/mm^2, taken as:

$$\tau = \frac{10Q}{A_{shr}}$$

$$\tau \leq 0.7\,\tau_{eH}$$

A_{shr} = net shear area, in cm^3

Z = net section modulus, in cm^3.

In case of direct strength calculations the equivalent von Mises stress, in N/mm^2, shall satisfy:

$$\sigma_{vm} \leq 0.8\,R_{eH}$$

5 Systems and equipment

5.1 High pressure air system

5.1.1 The piping system shall comply with the requirements in Pt.4 Ch.6. In addition, the requirements specified in [5.1.2] to [5.1.11] shall be fulfilled.

5.1.2 High pressure pipes shall not be installed in the vicinity of gangways or other spaces which are in normal use by personnel. If this cannot be avoided, shielding or equivalent arrangement shall be applied.

Any manifold and pressure relief valve shall be shielded to safeguard any operator. The pressure relief valves shall be arranged for venting to exhaust or overboard.

Guidance note:

Example of appropriate shielding may be punched steel shields. The shielding may also be removable in order for accessing de-pressurized equipment.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

5.1.3 Pipes should be inclined relative to the horizontal. Water pockets in the pipeline shall be avoided as far as practicable. If this cannot be avoided, means of drainage shall be arranged.

5.1.4 All manifolds and other locations where liquid may accumulate shall be arranged with possibilities for efficient drainage. Automated drains shall be arranged for air receivers, with additional possibility for manual operation.

5.1.5 Lubricating oil points for the air guns shall not be located in the vicinity of manifolds. If this cannot be avoided, there shall be arranged automatic shut-down of lubrication pumps when the high pressure air system is not pressurized.

5.1.6 All valves shall be automatically operated in order to prevent adiabatic compression or water hammer in the system. Alternatively, the system shall always be de-pressurized before operating any valves.

Guidance note 1:

Opening time of a valve should be at least 10 seconds.

Controlled pressure adjustment before opening a high pressure valve may, in some cases serve as an equivalent to automatically operated valves. By adjusting the system pressure to 1:8 of design pressure, the risk of generating high temperatures through adiabatic compression is negligible.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

Guidance note 2:

In cases where automatic operation is not possible to install, each valve should be permanently marked with warning against rapid opening.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

5.1.7 Air intakes for the compressors shall be so located as to minimize the intake of oil or water contaminated air.

5.1.8 Pipes from air compressors with automatic start shall be fitted with a separator or similar device to prevent condensate and HP piping shall be done in a way to prevent condensate from draining back into compressors.

5.1.9 Cylinder banks shall be located in areas which are not in normal use by personnel. The area shall be arranged for high pressure air to expand in case of an explosion.

Guidance note:

Proper shielding of connected piping and valves may be considered as an equivalent solution if designated areas cannot be arranged.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

5.1.10 There shall be at least one burst disc installed at the manifold, and one at the cylinder bank. The discs shall be directed away from working areas.

5.1.11 The piping shall be hydrostatically tested for at least 30 minutes in the presence of a surveyor after installation on board with the following test pressure:

$$PH = 1.5\,P$$

where:

PH = test pressure in bar
P = design pressure in bar as defined in Pt.4 Ch.6 Sec.7.

The test pressure need not exceed the design pressure by more than 70 bar.

SECTION 8 WELL STIMULATION VESSELS

1 Introduction

1.1 Introduction

1.1.1 These rules provide requirements for vessels intended for stimulation of wells for production of oil and or gas.

1.2 Scope

1.2.1 These rules include requirements for tank systems and equipment, piping systems, control and monitoring systems applicable to well stimulation vessels, including:

— personnel protective equipment
— intact and damage stability of the vessel.

Guidance note:

Arrangements involving return of fluids from the well are not covered by the rules.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

1.3 Application

1.3.1 Vessels built in compliance with the relevant requirements in this section may be given the class notation **Well stimulation vessel**.

2 Hull

2.1 General

2.1.1 The hull structural strength shall be as required for the main class taking into account necessary strengthening of supporting structures for the well stimulation equipment during transit and operation.

2.1.2 All load effects caused by heavy well stimulation deck equipment shall be taken into account in the structural design for both transit and operational condition.

3 Arrangement

3.1 Tanks and pumping arrangement

3.1.1 Tanks for acid and liquefied nitrogen shall be located at a minimum distance of 760 mm from the vessel's side and bottom.

3.1.2 Tanks and pumping arrangements shall not be located within accommodation areas or machinery spaces.

3.1.3 Tanks and piping systems for the well stimulation plant shall be separated from the machinery and ship piping systems.

3.1.4 Remote control of the well stimulation processing plant shall be arranged from a position outside the area where the well stimulation systems are located.

3.1.5 Tanks and pumping arrangements for liquid additives having flashpoint below 60°C shall comply with relevant requirements of Pt.6 Ch.5.

Arrangement of pump room for LFL (low flashpoint liquids) substances adjacent to the LFL tanks and without separating cofferdams may be considered in each case.

3.1.6 Requirements for tanks and pumping arrangements for chemicals other than acids dealt with under [7] will be considered in each case with due regard to the properties of the chemicals and applicable requirements of Ch.6.

3.2 Tank venting

3.2.1 Outlets from safety valves of nitrogen tanks shall be lead to open deck. Outlet pipes shall be arranged and supported in order to allow thermal expansion during release of cold gas. Penetrations of decks or bulkheads shall be such that the structures are thermally isolated from the cold pipes.

3.2.2 Vent outlets from acid tanks shall be lead to open deck. The outlets shall have a minimum height of 4 m above the deck and located at a minimum horizontal distance of 5 m from openings to accommodation and service spaces.

3.2.3 Vent outlets from acid tanks shall have pressure/vacuum valves. The outlets shall be provided with flame screens.

3.3 Access openings

3.3.1 Enclosed spaces containing tanks, piping, pumps and blenders for uninhibited acid shall have entrances direct from open deck or through air locks from other spaces. The air lock shall have independent mechanical ventilation.

3.4 Acid spill protection

3.4.1 Floors or decks under acid storage tanks and pumps and piping for uninhibited acid shall have a lining of corrosion resistant material extending up to a minimum height of 500 mm on the bounding bulkheads or coamings. Hatches or other openings in such floors or decks shall be raised to a minimum height of 500 mm above.

3.4.2 Flanges or other detachable pipe connections shall be covered by spray shields.

3.4.3 Portable shield covers for connecting flanges of loading manifold shall be provided. Drip trays of corrosion resistant material shall be provided under loading manifold for acid.

3.5 Drainage

3.5.1 Spaces housing tanks and pumping and piping for acids or additives shall have a separate drainage system not connected to the drainage system for other areas.

3.5.2 Drainage arrangement for acids shall be of corrosion resistant materials.

4 Ventilation

4.1 Ventilation of spaces containing installations for storage or handling of acid

4.1.1 The spaces shall have an independent mechanical ventilation with a capacity of minimum 30 air changes per hour.

4.2 Ventilation of other spaces containing equipment for well stimulation

4.2.1 Spaces containing installations for liquid nitrogen and liquids containing inhibited acid shall have a mechanical ventilation system with a minimum capacity of 20 air changes per hour. The ventilation system shall be independent of the ventilation system for the accommodation.

4.2.2 Ventilation of spaces for storage and handling of dry and liquid additives will be considered in each case depending on the flammability, toxicity and reactivity properties of the additives to be used.

5 Electrical equipment, instrumentation and emergency shut-down system

5.1 Electrical equipment or other ignition sources in enclosed spaces containing acid tanks and acid pumping arrangements

5.1.1 Only equipment certified as safe for operation in hydrogen/air atmosphere shall be used.

5.2 Vapour detection

5.2.1 Vapour detection and alarm systems for hydrogen or hydrogen chloride gas shall be provided in enclosed or semi-enclosed spaces containing installations for uninhibited acid.

5.2.2 Spaces containing tanks and piping for liquid nitrogen shall be equipped with oxygen deficiency monitoring.

5.3 Gauging and level detection

5.3.1 Tanks for liquefied nitrogen shall have gauging and level detection arrangements in accordance with Ch.7 Sec.13.

5.3.2 Tanks for hydrochloric acid shall have a closed gauging system. A high level alarm shall be provided. The alarm shall be activated by a level sensing device independent of the gauging system.

5.3.3 Spaces containing equipment and storage tanks for the well stimulation system shall be provided with detection and alarm system for liquid leakages.

5.4 Emergency shut-down system

5.4.1 Emergency stop of all pumps in the oil well stimulation system shall be arranged from one or more positions located outside the area accommodating the system.

5.4.2 Emergency shut-off valves shall be provided in liquid nitrogen outlet lines from each nitrogen tank. The shut off valves shall be remotely controlled from one or more positions outside the area accommodating the oil well stimulation system.

5.4.3 Emergency de-pressurising and disconnection of the transfer hose shall be arranged from the central control position and from the bridge.

6 Liquid nitrogen system

6.1 Materials

6.1.1 The materials shall be in accordance with Ch.7 Sec.6.

6.2 Storage tanks

6.2.1 The design and testing of the tanks for liquid nitrogen shall be in accordance with Ch.7 Sec.22 as required for independent cylindrical tanks type C.

6.3 Pumping and piping

6.3.1 The requirements of Ch.7 Sec.5 apply.

7 Acid system

7.1 Materials

7.1.1 In general Ch.6 Sec.2 applies.

7.1.2 Storage tanks, pumping and piping for uninhibited acid shall be of corrosion resistant material or shall have internal lining of corrosion resistant material.

7.2 Storage tanks

7.2.1 The rules in Ch.6 Sec.5 apply.

7.3 Pumping and piping

7.3.1 The rules in Pt.4 Ch.6 apply.

7.3.2 The flexible hose with end connectors shall be in accordance with a recognised standard.

8 Personnel protection

8.1 Decontamination showers and eye washes

8.1.1 Decontamination showers and eye washes shall be fitted at convenient locations.

8.1.2 The showers and eye washers shall be operable also under freezing conditions. Temperature control of the water shall be provided in order to avoid excessive temperatures.

8.2 Personnel protective equipment

8.2.1 Protective equipment shall be kept onboard in suitable locations as required by the IMO *International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk* (IBC Code) Res. MSC.4(48) as amended, for carriage of hydrochloric acid.

9 Intact and damage stability

9.1 General

9.1.1 The vessel shall comply with the requirements for intact and damage stability given in Ch.9 Sec.2 [5] and Pt.6 Ch.5 Sec.6 (**SF** notation).

10 Operation manual

10.1 General

10.1.1 The vessel shall have an approved operation manual readily available on board. The manual shall give instructions and information on safety aspects related to well stimulation processing.

10.1.2 The operation manual shall give particulars on:

— protective equipment
— storage and handling of fluids and dry additives
— transfer operations
— emergency shut-down and disconnection.

SECTION 9 FIRE FIGHTERS

1 Introduction

1.1 Introduction

1.1.1 These rules provide requirements for vessels capable of fighting fires onboard ships and on offshore and onshore structures. The vessels shall be able to operate as additional fire-fighting stations by providing water to combat fire and to support ongoing rescue operations.

1.2 Scope

1.2.1 The requirements for fire fighter vessels encompass the following:

— the vessel's fire fighting capability
— the vessel's stability and its ability to keep its position when the fire fighting water monitors are in operation
— the vessel's passive and active heat radiation protection against external fires.

1.2.2 Arrangements for survivor rescue and recovery is not part of the **Fire fighter** notation.

1.2.3 Granting of **Fire fighter** notation is based on the assumption that the following has been complied with when operating the vessel as a fire fighter:

— the instructions laid down in the operation manual for fire fighting are being followed
— the vessel will carry a sufficient quantity of fuel oil for continuous fire fighting operations, with all fixed water monitors in use for a period of not less than: 24 hours for class notation qualifiers **I** and **I+**, and 96 hours for class notation qualifiers **II** and **III**
— foam-forming liquid for at least 30 minutes continuous foam production for the fixed foam monitors is stored onboard vessels with class notation qualifier **III**
— foam-forming liquid for at least 30 minutes continuous foam production by the mobile generator is stored in suitable containers onboard vessels with class notation qualifiers **II** or **III**
— the crew operating the fire fighting systems and equipment has been trained for such operations, including the use of air breathing apparatus
— the skill of the crew is maintained by exercises (drills).

1.3 Application

1.3.1 Vessels built in compliance with the relevant requirements specified in this section may be given the class notation **Fire fighter** with one or more of the following class notation qualifiers **I**, **I+**, **II** or **III**.

1.3.2 The class notation qualifiers **I** and **I+** imply that the vessel has been built for early stage fire fighting and for support of rescue operations onboard or close to structures or ships on fire.

1.3.3 To meet its objectives, a **Fire fighter(I)** vessel shall be designed with active protection, giving it the capability to withstand higher heat radiation loads from external fires. In addition, the vessel includes a sufficient set of fire fighting equipment.

1.3.4 Class notation qualifier **I+** differentiates itself from **I** with a higher reliability and capability. In addition to active protection as named in [1.3.3], the vessel shall have passive protection, giving it the capability to withstand the higher heat radiation loads also when the active protection fails. In addition, the vessel incorporates a longer throw length.

1.3.5 The class notation qualifiers **II** and **III** imply that the vessel has been built for continuous fighting of large fires from a safe distance and for the cooling of structures on fire.

1.3.6 Qualifier **III** requires a larger water pumping capacity and more comprehensive fire fighting equipment when compared to the **II**.

1.3.7 If a vessel has been fitted with a fire fighting systems and equipment in accordance with the class notation qualifiers **II** or **III** and has also been designed with passive and/or active heat radiation protection in accordance with the class notation **I+** or **I**, then a combination of the two notations may be given.

1.3.8 A detailed scope for the different class notation qualifiers follows from the content of this chapter by an indication or a statement in wording to which class notation qualifier the requirements applies to. Without such an indication or statement, the requirement is applicable for any class notation qualifier.

Guidance note:

[3.1] Active fire protection (Qualifiers **I** and **I+**) indicates that the paragraph is applicable for class notation qualifiers **I** and **I+** only.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

1.3.9 Vessels not fully in compliance with this section or not specifically built for the services intended to be covered by this section but which have special fire fighting capabilities in addition to their regular service, may be specially considered and reviewed under the intent of this section as they relate to fire fighting. Such vessels, complying as a minimum with [9] of this section, may be given the class notation **Fire fighter (Capability)**. The standard applied, with relevant data on the extent of this special fire fighting capability will be entered into the appendix to the class certificate and such special fire fighting systems will be subject to annual surveys.

1.4 Testing requirements

1.4.1 Testing shall be carried out to verify that the vessel, fitted with fire fighting systems and equipment, is able to operate as intended and has the required capacities. The height and length of throw of the water monitors shall be demonstrated. The angle of list, with water monitors in operation in the most unfavourable position, shall also be measured.

1.4.2 For class notation qualifiers **I** and **I+**, fire main capacities shall be tested as follows:

— The static pressure measured at the fire hydrant manifold shall be not less than 0.25 N/mm^2 with four (4) jets of water from hoses simultaneously engaged to one of the fire hydrant manifolds required in [7.1].
— In a separate test, both water monitors shall be tested in operations simultaneously with the active heat radiation protection system in operation for not less than one (1) hour or until the temperature of the dedicated fire fighter pumps' prime movers are stabilised.

1.4.3 For class notation qualifier **II**, the number of hoses simultaneously engaged shall be not less than six (6) and for class notation qualifier **III** not less than eight (8) for the test specified in [1.4.2].

2 Basic requirements

2.1 Operation manual

2.1.1 The following information shall be included in an approved operation manual kept onboard:

— line of responsibility and delegation of tasks
— description of each fire fighting system and the equipment covered by the classification
— safety precautions and start-up procedures

— instructions for use, testing and maintenance of the fire fighting installations and the equipment (or may be only referred to)
— instructions for operation of the vessel during fire fighting
— plan and records for periodically testing and drills.

2.2 Manoeuvrability

2.2.1 The vessel shall have side thrusters and propulsion machinery of sufficient power for adequate manoeuvrability during fire fighting operations.

2.2.2 Side thruster(s) and main propeller(s) shall be able to keep the vessel at a standstill in calm waters at all combinations of capacity and direction of throw of the water monitors, and the most unfavourable combination shall not require more than 80% of the available propulsion force in any direction.

2.2.3 If the system design is such that, in any operating combination, it will be possible to overload the power supply, a power management system shall be arranged. This system shall include alarm at 80% of available power and automatic action at 100% available power.

2.2.4 The operation of the side thruster(s) and the main propeller(s) shall be simple and limited to the adjustment of:

— resultant thrust vector for the vessel
— possible adjustment of the turning moment
— possible adjustment of heading (gyro stabilised).

Operation shall be arranged at the workstation where the monitors are controlled.

2.2.5 It shall be visually indicated when this workstation has control. Failure in the control system shall initiate an alarm.

2.3 Searchlights

2.3.1 As an aid for operations in darkness, at least two adjustable searchlights shall be fitted onboard, capable of providing an illumination level of 50 lux in clear air, within an area not less than 10 m diameter, to a distance of 250 m.

3 Protection of the vessel against external heat radiation

3.1 Active fire protection (class notation qualifiers **I** and **I+**)

3.1.1 The vessel shall be protected by a permanently in stalled water-spraying system. Water shall be applied by means of sprinkler nozzles, monitor nozzles and water shield nozzles or a combination thereof. Vertical sides of superstructures shall be protected by spray nozzles.

3.1.2 The fixed water-spraying system shall provide protection for all outside vertical areas of hull, superstructures and deckhouses including foundations for water monitors, essential external equipment for fire fighting operations and external life rafts and lifeboats and rescue boats. Water spray may be omitted for bulwark and rails.

3.1.3 The arrangement for the water-spraying system shall be such that necessary visibility from the wheelhouse and the control station for remote control of the fire fighting water monitors can be maintained during the water spraying.

3.1.4 The pipelines and nozzles shall be so arranged and protected that they will not be exposed to damage during the operations for which the vessel is intended.

3.1.5 The fixed water-spraying system shall have a capacity not less than 10 l/min/m^2 of the areas to be protected. For areas internally insulated to class A-60, a capacity of 5 l/min/m^2 may be accepted.

3.1.6 The pumping capacity for the fixed water-spraying system shall be sufficient to deliver water at the required pressure for simultaneous operation of all nozzles in the total system.

3.1.7 The pumps for the fire fighting water monitors may also serve the water-spraying system, provided the pump capacity is increased by the capacity required for the water spraying system. A connection with shut-off valve is then to be fitted between the fire main for the monitors and the main pipeline for the water spraying system. Such arrangements shall allow for separate as well as simultaneous operation of both the fire fighting water monitors and the water spray system.

3.1.8 All pipes for the fixed water-spraying systems shall be protected against corrosion both externally and internally, by hot galvanizing or equivalent. Drainage plugs shall be fitted to avoid damages by freezing water.

3.1.9 The spray nozzles shall provide an effective and even distribution of water spray over the areas to be protected. The spray nozzles are subject to the Society's approval for their purpose.

3.2 Passive fire protection - class notation qualifier **I+** only

3.2.1 Hull and superstructure shall be constructed of steel. External doors and hatches shall be of steel. Windows in boundary of superstructure/deckhouse, including bridge shall comply with A-0 class. External platforms and exposed piping systems shall be of steel.

4 Water monitor system

4.1 Capacities

4.1.1 The requirements for the various class notations are given in Table 1.

Table 1 Water monitor system capacities

Class notation	***Fire fighter (I)*** and ***(I+)***	***Fire fighter (II)***			***Fire fighter (III)***	
Number of monitors	2	2	3	4	3	4
Capacity of each monitor (m^3/h)	1200	3600	2400	1800	3200	2400
Number of pumps	1-2	2-4			2-4	
Total pump capacity (m^3/h)	2400	7200			9600	
Length of throw (m) 1)	120	180	150		180	150
Height of throw (m) 2)	50	110	80		110	90
Fuel oil capacity in hours 3)	24	96			96	

1)	For class notation qualifier **I**, measured horizontally from the monitor outlet to the mean impact area. For **I+**, **II** and **III**, measured horizontally from the mean impact area to the nearest part of the vessel when all monitors are in satisfactory operation simultaneously.
2)	Measured vertically from sea level to mean impact area at a horizontal distance of at least 70 m from the nearest part of the vessel.
3)	Capacity for continuous operation of all monitors, to be included in the total capacity of the vessel's fuel oil tanks.

4.2 Arrangement

4.2.1 The monitors shall play either forward or aft. The horizontal angular movement of each monitor shall be at least 90°, with minimum play across the vessels centre line of 30°. The necessary angular movement in the vertical direction is determined by the required height of throw of the water jet.

The monitors shall be so positioned that they will have a free line for the water jet over the horizontal area covered.

4.2.2 At least two of the water monitors shall have a fixed arrangement making dispersion of the water jet possible.

4.2.3 The monitors shall be so arranged that the required length and height of throw can be achieved with all monitors operating simultaneously along the centre line of the vessel.

4.3 Monitor control

4.3.1 The activating and the manoeuvring of the monitors shall be remotely controlled. The remote control station shall be arranged in a protected control room with a good general view.

The valve control shall be designed to avoid water hammer.

4.3.2 As a minimum, there shall be arranged two independent control systems such that a single failure will not disable more than 50% of the monitors installed. Failure in any remote control system shall initiate an alarm at the workstation from where the monitors are controlled.

4.3.3 Open and closed indication of remotely controlled valves, if fitted, shall be indicated at the remote control station.

4.3.4 Where an electrical control system is applied, each control unit shall be provided with overload and short-circuit protection, giving selective disconnection of the circuit in case of failure.

Where a hydraulic or pneumatic control system is applied, the control power units shall be duplicated.

4.3.5 In addition to the remote control, local and manual control of each monitor shall be arranged.

Guidance note:

It is advised that the local and manual control devices are automatically disconnected when remote operation is applied.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

4.3.6 All shut-off and control equipment shall be clearly marked.

4.4 Design and support of monitors

4.4.1 The monitors and their foundations shall be capable of withstanding the loads to which they may be subjected on the open deck, dynamic loads resulting from the vessel's movement at sea, as well as the reaction forces from the water jet.

4.4.2 The monitors shall be able to give a solid water jet, so that the impact area will be concentrated and limited. The materials applied shall be selected with due regard to the corrosive properties of seawater and saline air. The monitors shall be of a design approved by the Society.

5 Foam monitor system - class notation qualifier III

5.1 Capacities

5.1.1 In addition to the water monitors, the vessel shall be equipped with 2 foam monitors, each of a capacity not less than 5000 litres/minute with a foam expansion ratio of maximum 15 to 1.

5.1.2 The foam system, together with the arrangement and location of the monitors, shall give a height of throw at least 50 m above sea level when both monitors are used simultaneously with maximum foam generation.

5.1.3 The foam concentrate tank shall have capacity for at least 30 minutes of maximum foam generation from both foam monitors. When determining the necessary quantity of foam concentrate, the admixture is assumed to be 5%.

5.2 Arrangement

5.2.1 The arrangement shall comply with the same principles as given under [4.2.1].

5.2.2 The foam generating system shall be of a fixed type with separate foam concentrate tank, foam-mixing unit and pipelines to the monitors. The water supply to the system may be taken from the main pumps for the water monitors. In such cases it may be necessary to reduce the main pump pressure to ensure correct water pressure for maximum foam generation.

5.3 Monitor control

5.3.1 The foam monitors shall be remotely controlled. This also concerns the operation of the valves necessary for control of water and foam concentrate. The remote control of the foam monitors shall be arranged from the same location as the control of the water monitors and the control system shall comply with the same principles as given in [4.3.2] to [4.3.4]. Local/manual control of each monitor shall also be arranged.

5.3.2 All shut-off and remote control equipment shall be clearly marked.

5.4 Monitor design

5.4.1 The foam monitors shall be of a design approved by the Society.

6 Pumps and piping

6.1 General

6.1.1 The arrangement shall be such that the water monitors will be able to deliver an even jet of water without pulsations of significance.

6.1.2 The requirements for pumping and piping systems given for systems covered by the main class, as well as the requirements for standard water extinguishing appliances and equipment for fire extinguishing on open decks given for main class, shall be complied with as far as applicable to systems fighting fires outside the vessel.

6.2 Pumps

6.2.1 The pumps for the fire fighting system and the machinery driving the pumps shall be adequately protected, and shall be so located that they will be easily accessible during operation and maintenance.

6.3 Seawater inlets and sea chests

6.3.1 Seawater suctions for fire fighting pumps shall not be arranged for other purposes. The seawater suction valve, the pressure valve and the pump motor shall be operable from the same position. Valves with nominal diameter exceeding 450 mm shall be power actuated as well as manually operable.

6.3.2 An interlock shall prevent start or engagement of the gear for the fire fighting pumps when the water inlet valve is closed and the pressure valve is open.

Alternatively, warning by means of audible and visual alarm shall be given if starting of the fire fighting pumps or engaging gears for the pumps is carried out with the inlet valve closed and the pressure valve open. This alarm shall be given at all control positions for the start or engagement of the gear for the fire fighting pumps.

6.3.3 Suitable means for filling the water monitors' supply piping downstream of the pressure valves and up through the monitors whilst the pressure valves are in the closed position, shall be arranged.

6.3.4 Seawater inlets and sea chests shall be of a design ensuring an even and sufficient supply of water to the pumps. The location of the seawater inlets and sea chests shall be such that the water supply is not impeded by the ship's motions or by the water flow to and from bow thrusters, side thrusters, azimuth thrusters or main propellers.

6.3.5 Strums shall be fitted to the sea chest openings in the shell plating. The design maximum water velocity through the strum holes shall not exceed 2 m/s.

6.4 Piping systems

6.4.1 The piping system from the pumps to the water monitors shall be separate from the piping system to the hose connections required for the mobile fire fighting equipment.

6.4.2 The piping systems shall have arrangements to avoid overheating of the pumps at low delivery rates.

6.4.3 Suctions lines shall be designed to avoid cavitation in the water flow. The lines shall be as short and as straight as practicable. Pumps shall preferably be located below the water line.

The net positive suction head (NPSH) for the pump system shall be designed according to the following formula:

NPSH available – 1 meter water column > NPSH required

For pumps located above water line an approved self-priming system shall be provided.

Guidance note:

NPSH available is the ship specific available net suction head (expressed in meter water column - mwc) as function of the elevation of the pump in relation to the waterline deduced for the pressure losses in the sea chest and supply piping up to the inlet flange of the pump.

NPSH required is the net suction head (expressed in mwc) required by the pump in question in order to prevent cavitation.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

6.4.4 All piping from seawater inlets to water monitors shall be internally protected against corrosion to a degree at least corresponding to hot galvanizing. Paint is accepted as external corrosion protection of piping exposed to weather.

The part of pipes passing through fuel oil tanks shall have thickness as for ballast pipes passing through fuel oil tanks in accordance with Pt.4 Ch.6 Sec.6 Table 2. The corrosion protection of the pipes within the tank shall be to the same level as the internal tank structure, while internal corrosion protection may be excluded for this part. A system for drainage of the pipes within the fuel tank shall be arranged. Instruction shall be included in the operation manual for draining of these pipes upon completion of a fire fighting operation.

6.4.5 The piping layout shall be in accordance with good marine practice with large radius bends, and shall be satisfactorily protected against damage.

7 Mobile fire fighting equipment

7.1 Fire hydrants manifolds and hoses for external use

7.1.1 In addition to the fire hydrants required for onboard use, fire hydrant manifolds shall be provided on the port and starboard sides of the weather deck. The hose connections shall therefore point outwards.

7.1.2 Vessels with class notation qualifiers **I** and **I+** shall have one fire hydrant manifold arranged on the port side and one on the starboard side, each with at least four (4) hose connections.

7.1.3 For vessels with class notation qualifier **II** the number of additional hose connections at each of the fire hydrant manifolds positioned on the port and starboard sides shall be not less than six (6). For vessels with class notation qualifier **III** the number shall be not less than eight (8).

7.1.4 In addition to the required number of hoses for onboard use, at least 8 × 15 m fire hoses of 50 mm diameter and four (4) combined 16 mm jet and water spray nozzles shall be kept onboard in a readily available position for vessels with class notation qualifiers **I** and **I+**. For those with class notation qualifier **II**, the number shall be increased to 12 hoses and 6 nozzles and for class notation qualifier **III** to 16 hoses and eight (8) nozzles.

Table 2 Overview of additional hydrant manifolds, hose connections and nozzles

Class notation qualifier	*Number of fire hydrant manifolds*		*Number of hose connections at each manifold*	*Total number of hose connections*	*Number of additional hoses [1)]*	*Number of additional nozzles [2)]*
	Port	*Starboard*				
I, **I+**	1	1	4	8	8	4
II	1 or 2	1 or 2	6	12	12	6
			3	12	12	6
III	1 or 2	1 or 2	8	16	16	8
			4	16	16	8

Class notation qualifier	Number of fire hydrant manifolds		Number of hose connections at each manifold	Total number of hose connections	Number of additional hoses 1)	Number of additional nozzles 2)
	Port	Starboard				
1) Length 15 m, diameter 50 mm 2) Combined 16 mm spray/jet						

7.1.5 The pressure in the fire hydrant manifold shall be not less than 2.5 bar and maximum 5 bar when tested as described in [1.4] with one length of hose fitted with a standard 16 mm nozzle fully open on each hose connection on one fire hydrant manifold.

7.1.6 The pumps for monitors and/or water spray system may be used for supply of water to the fire hydrant manifolds required by [7.1.1] provided pump capacity is increased so that all connected consumers can be simultaneously served. In such case connections with shut-off valves shall be fitted between the fire main for the monitors and/or water spray system in order to allow for separate as well as simultaneous operation of fire fighting water monitors and/or the water spray system as well as hoses connected to the fire hydrant manifolds.

Valves shall be arranged for independent supply to the fire hydrant manifolds without having the monitor and/or the water spray in use.

7.1.7 Hoses and nozzles shall be of a design approved by the Society.

7.2 Foam generator

7.2.1 Vessels with class notation qualifier **II** and **III** shall have a mobile high expansion foam generator with a capacity of not less than 100 m^3/minute for fighting of external fires.

7.2.2 Foam concentrate shall be stored in containers, each of about 20 litres, suitable for mobile use. The stored capacity of foam concentrate shall be sufficient for 30 minutes continuous foam production.

8 Fire fighter’s outfit

8.1 Number and extent of the outfits

8.1.1 Vessels with class notation qualifiers **I** and **I+** shall have at least four (4) sets of fire fighter's outfits.

8.1.2 Vessels with class notation qualifier **II** shall have six (6) fire-fighter's outfits, and vessels with class notation qualifier **III** shall have eight (8) fire-fighter's outfits.

8.1.3 The equipment for the fire fighter’s outfits shall be as specified for main class except that each breathing apparatus shall have a total air capacity of at least 3600 litres including the spare cylinders.

8.2 Location of the fire fighter’s outfits

8.2.1 The fire fighter's outfits shall be placed in at least two separate fire stations of which one shall have access from the open deck. The entrance to the fire station shall be clearly marked. The room shall be arranged for ventilation and heating.

8.2.2 The arrangement of the fire station shall be such that all equipment will be easily accessible and ready for immediate use.

8.3 Compressed air supply

8.3.1 A high pressure compressor with accessories suitable for recharging the breathing air cylinders, shall be installed onboard in the safest possible location. The capacity of the compressor shall be at least 75 litres/minute. The air intake for the compressor shall be equipped with a filter.

9 Stability and watertight integrity

9.1 General requirements

9.1.1 For vessels with a length L_{LL} of 24 m and above, the stability shall be assessed when the water monitors are in operation at full capacity in the most unfavourable direction with respect to stability. A calculation showing the point of balance between the reaction forces from the water monitors and the forces from the vessel's propulsion machinery and its side thrusters shall be presented.

The monitor heeling moment shall be calculated based on the assumption in [9.1.2]. The criterion in [9.1.3] shall be complied with.

9.1.2 Monitor heeling moment

The heeling force F from the water monitor(s) shall be assumed in the transverse direction, based on full capacity as given in Table 1.

The monitor heeling arm a shall be taken as the vertical distance between the centre of side thruster(s) and the centre line of the monitor(s).

9.1.3 Criterion

The monitor heeling lever, calculated as $F \cdot a$/displacement, shall not exceed 0.5 times the maximum GZ corresponding to maximum allowable VCG.

If the maximum GZ occurs after 30°, the GZ at 30° shall be used instead of the maximum GZ.

Additional information on the monitor capacity, position, heeling force and moment as well as plotting the monitors' heeling lever on the GZ diagram of the most unfavourable loading conditions shall be included in the stability manual.

SECTION 10 ICEBREAKER

Symbols

For symbols and definitions not defined in this chapter, see Pt.3 Ch.1 Sec.4.

1 General

1.1 Objective

The rules in this section provide requirements for ships intended to operate mainly as icebreaker and may make several consecutive attempts to break ice at maximum ramming speed.

1.2 Scope

These rules provide requirements for hull structure, stability and machinery.

1.3 Application

These rules apply to vessels designed, strengthened, and equipped with machinery to break ice by consecutive ramming to provide e.g. escort and ice management services.

Vessels built in compliance with the requirement in this section and that are assigned a polar class notation **PC(x)** (see Pt.6 Ch.6 Sec.6), may be assigned the class notation **Icebreaker**.

2 General principles

Vessels with class notation **Icebreaker** shall be able to carry out ice management and assist other vessels in ice conditions described in Pt.6 Ch.6 Sec.6 Table 1 and may make several consecutive attempts to break ice.

3 Structural arrangement

3.1 Bow form

Ice knife may be required fitted in the bow to avoid excessive beaching and submersion of the deck in the aft ship. This requirement will be based on consideration of design speed, stability and the freeboard. See Figure 1.

Vessels with class notation **Icebreaker** shall have a bow shape so that the bow will ride up on the ice when encountering pressure ridges or similar ice features which will not break during the first ramming.

Guidance note:

At the UIWL the angle between the stem and the waterline should be 22°-35°. The bow-lines in the fore body below the waterline should be as much as possible parallel to the stem.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

3.2 Stem and stern region

The stem reinforcement in Pt.6 Ch.6 Sec.6 [5.8] shall be extended vertically from the keel to the horizontal line *x* m above the UIWL, and horizontally to a line 0.06 *L* aft of the stem line or 0.125 *B* outboard from the centre line, whichever is reached first. See Figure 1.

The fore boundary of the stern region shall be at least 0.04 *L* fore of the aftermost point where the hull lines are parallel to the centre line at upper ice waterline (UIWL), see Figure 1.

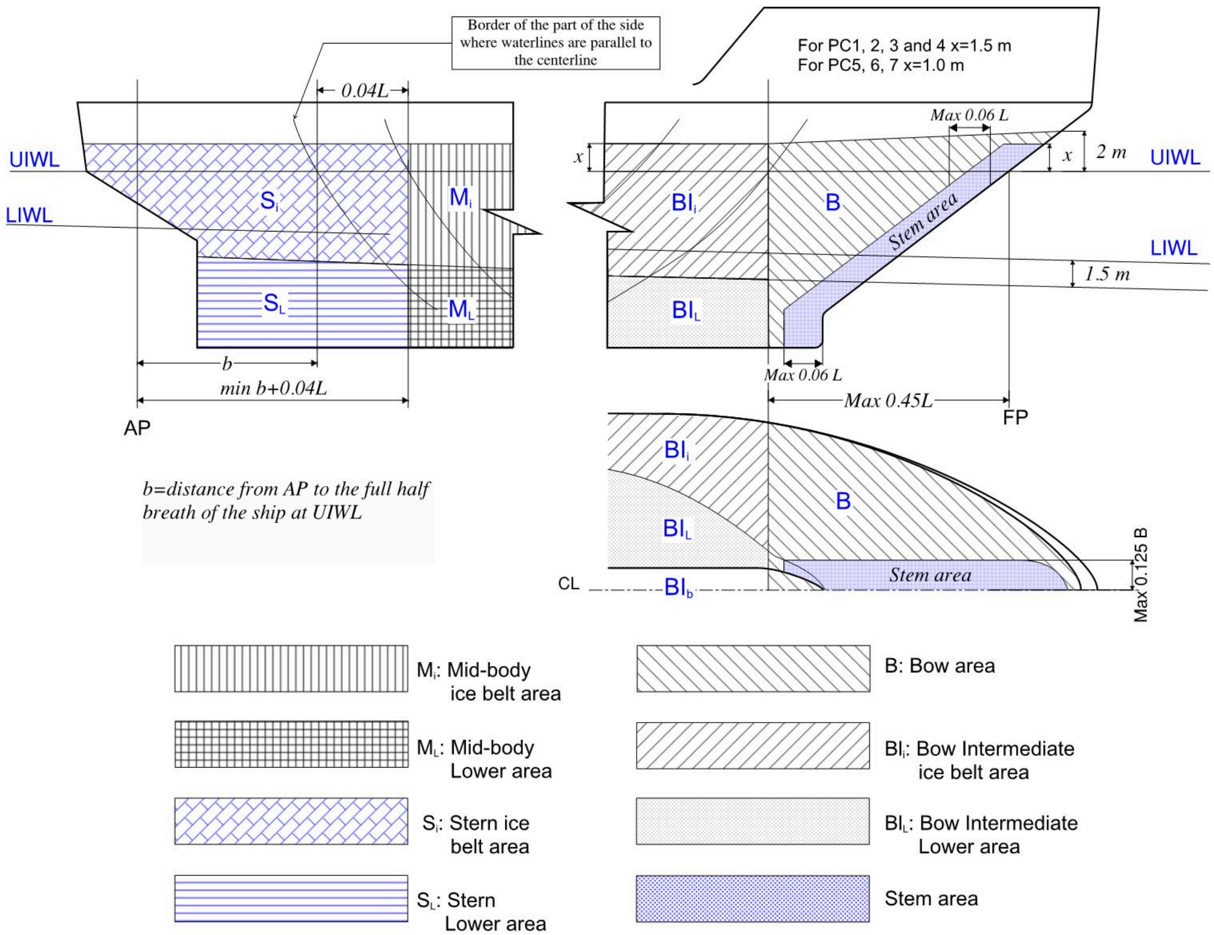

Figure 1 Stem and stern region for an icebreaker

3.3 Position of collision bulkhead

The distance from the vertical ram bow, i.e. forward ice knife, to the collision bulkhead shall be at least 2*s*, in m, where *s* is the frame spacing. See Figure 2.

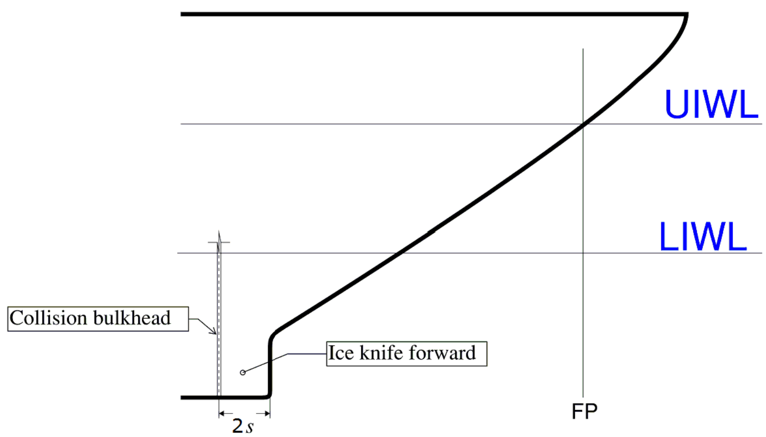

Figure 2 Position of collision bulkhead

In the case where the maximum distance x_c from the perpendicular FE to the collision bulkhead as specified in Pt.3 Ch.2 Sec.2 [4] is exceeded, the following shall be submitted:

— Floatability and stability calculations showing that, with the ship fully loaded to summer draught on even keel, flooding of the space forward of the collision bulkhead will not result in any other compartments being flooded, nor in an unacceptable loss of stability.

4 Material requirements

4.1

Material in fore ship substructure in vessels with class notations **Icebreaker DAT(t)** shall be of class II. See Pt.6 Ch.6 Sec.5.

4.2

All material requirement defined in Pt.6 Ch.6 Sec.5 Table 5 for structural members within 0.4 L amidship, shall be extended to 0.2 L aft of amidships and 0.3 L forward of amidships, as applicable.

5 Loads

5.1 Hull area factors

The area factors (AF) reflecting the relative magnitude of the ice load expected in that area for each **PC** polar class notation are listed in Table 1 and Table 2.

Table 1 and Table 2 in this section shall be used as an alternative to Pt.6 Ch.6 Sec.6 Table 6 and Pt.6 Ch.6 Sec.6 Table 7, respectively.

Table 1 Hull area factors (AF) for ships with class notation Icebreaker

Hull area		*Area*	*Polar class*						
			PC(1)	***PC(2)***	***PC(3)***	***PC(4)***	***PC(5)***	***PC(6)***	***PC(7)***
Bow (B)	All	B	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Bow intermediate (BI)	Icebelt	BI_i	0.90	0.85	0.85	0.85	0.85	1.00*	1.00*
	Lower	BI_l	0.70	0.65	0.65	0.65	0.65	0.65	0.65
	Bottom	BI_b	0.55	0.50	0.45	0.45	0.45	0.45	0.45
Midbody (M)	Icebelt	M_i	0.70	0.65	0.55	0.55	0.55	0.55	0.55
	Lower	M_l	0.50	0.45	0.40	0.40	0.40	0.40	0.40
	Bottom	M_b	0.30	0.30	0.25	0.25	0.25	0.25	0.25
Stern (S)	Icebelt	S_i	0.95	0.90	0.80	0.80	0.80	0.80	0.80
	Lower	S_l	0.55	0.50	0.45	0.45	0.45	0.45	0.45
	Bottom	S_b	0.35	0.30	0.30	0.30	0.30	0.30	0.30
Notes: * See Pt.6 Ch.6 Sec.6 [4.1.3].									

Table 2 Hull area factors (AF) for ships with class notation Icebreaker with thrusters/podded propulsion

Hull area		*Area*	*Polar class*						
			PC(1)	***PC(2)***	***PC(3)***	***PC(4)***	***PC(5)***	***PC(6)***	***PC(7)***
Bow (B)	All	B	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Bow intermediate (BI)	Icebelt	BI_i	0.90	0.85	0.85	0.80	0.80	1.00*	1.00*
	Lower	BI_l	0.70	0.65	0.65	0.65	0.55	0.55	0.50
	Bottom	BI_b	0.55	0.50	0.50	0.45	0.35	0.30	0.25
Midbody (M)	Icebelt	M_i	0.70	0.65	0.55	0.55	0.55	0.55	0.55
	Lower	M_l	0.55	0.45	0.40	0.40	0.40	0.40	0.40
	Bottom	M_b	0.30	0.30	0.25	0.25	0.25	0.25	0.25
Stern (S)	Icebelt	S_i	0.95	0.90	0.80	0.80	0.80	0.80	0.80
	Lower	S_l	0.70	0.65	0.60	0.60	0.60	0.60	0.60
	Bottom	S_b	0.35	0.30	0.30	0.30	0.30	0.30	0.30

Notes:
* See Pt.6 Ch.6 Sec.6 [4.1.3].

6 Hull local scantlings

6.1 General

Local scantlings shall be checked according to requirement in Pt.6 Ch.6 Sec.6 considering the area factors AF listed in Table 1 and Table 2.

7 Overall strength of substructure in fore ship

7.1 General

The design vertical ice force F_{IB} at the bow as stipulated in Pt.6 Ch.6 Sec.6 [6] may have a decisive effect on primary structural systems in the foreship. Hence, strength of primary structural members in way of the stem shall be assessed for design ramming force. The load is assumed to be evenly distributed in such a manner that local pressures will not exceed those stipulated for local members directly exposed to the load as given in Pt.6 Ch.6 Sec.6 [4.6.1]

7.2 Design vertical ice force at the stem

7.2.1 The design vertical ramming force at the bow in MN, shall be taken as:

$$F_{IB} = \min\left(F_{IB,R}; F_{IB,2}\right)$$

Where:

$F_{IB,R}$ = $F_{IB,1} \cdot K_{VR}$

$F_{IB,1}$ *and* $F_{IB,2}$ = as given in Pt.6 Ch.6 Sec.6 [6.2]

K_{VR} = $\frac{V_{ram}}{CF_R}$, not to be lower than 1

V_{ram} = design speed in m/s when ramming may occur

CF_R = speed class factor from Table 3.

Table 3 Speed class factors

Polar Class	CF_R
PC(1)	5.7
PC(2)	4.4
PC(3)	3.5
PC(4)	2.75
PC(5)	2.25
PC(6)	2.25
PC(7)	2

7.2.2 Ramming speed V_{ram} shall be stated in the appendix to the classification certificate.

7.2.3 The design vertical ramming force shall be applied with its center on the stem line as a patch or line load as shown by Figure 3. The most unfavorable design draught forward shall be assumed for the application of the load.

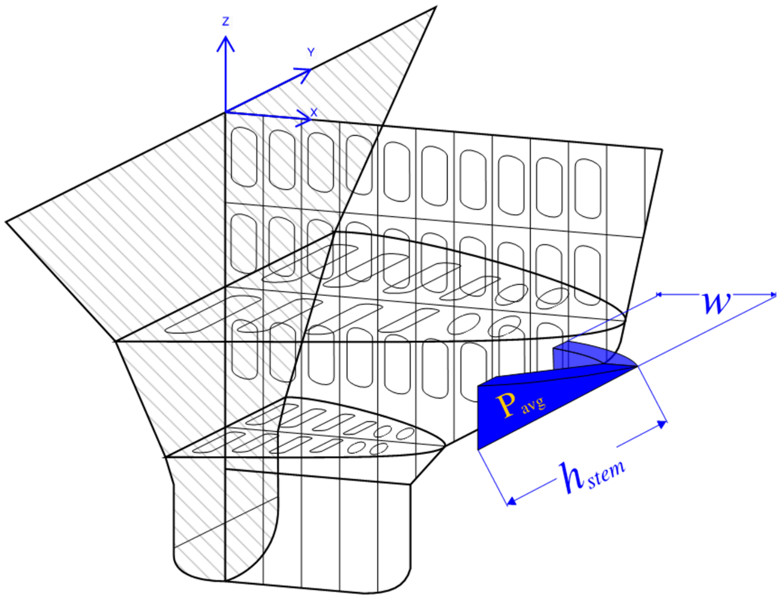

Figure 3 Ice pach on the stem due to ramming

7.2.4 The extent of load distribution along the stem can be calculated as follow:

$$h_{stem} = \left(\frac{F_{IB}}{P_{avg}}\right)^{\frac{1}{1+e_b}} \cdot \left(\frac{1+e_b}{2C}\right)^{\frac{1}{1+e_b}} . B^{\left(\frac{e_b-1}{e_b+1}\right)} \cdot \frac{1}{\cos(\gamma_{stem})}$$

where:

F_{IB} = design vertical ice force as given in [7.2] , in MN

P_{avg} = average patch pressure as given in Pt.6 Ch.6 Sec.6 [4.6.1]

γ_{stem} = stem angle to be measured between the horizontal axis and the stem tangent at the upper ice waterline, [^{o}]

B = ship molded breadth [m]

C = $\frac{1}{2\left(\frac{L_B}{B}\right)^{e_b}}$

L_B = bow length used in the equation $y = \frac{B}{2} \cdot \left(\frac{x}{L_B}\right)^{e_b}$ measured from the stem to the full half breath of the ship at the UIWL, in m, see Figure 4 and Figure 5

e_b = bow shape exponent which best describes the waterplane. (see Figure 4 and Figure 5)

= 1 for a simple wedge bow form.

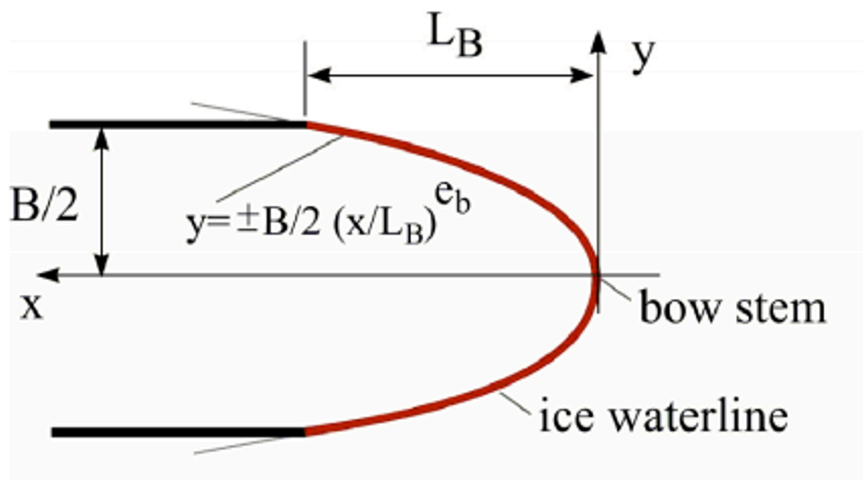

Figure 4 Bow shape definition

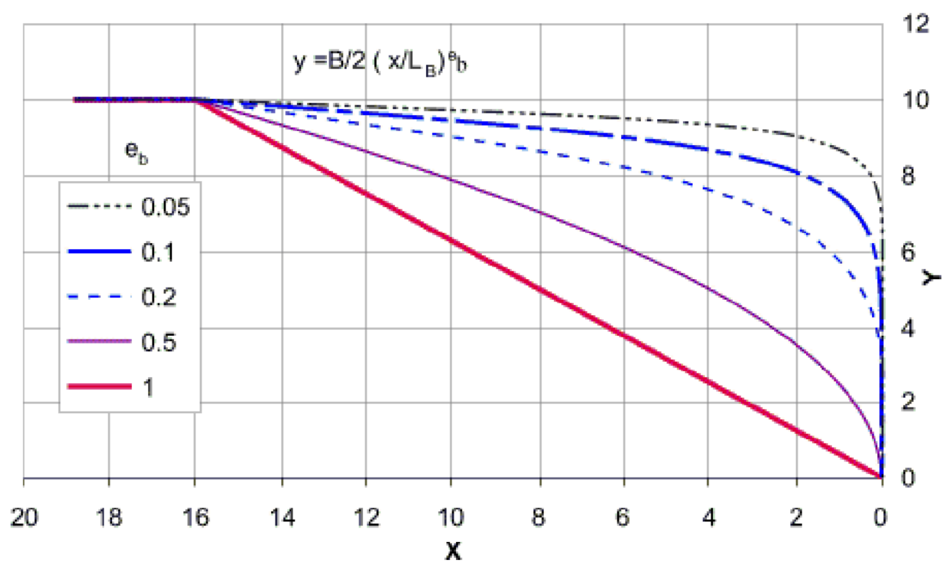

Figure 5 Illustration of e_b effect on the bow shape for B=20 and L_B=16

7.3 Direct calculations and acceptance criteria

Recognized structural idealization and calculation methods shall be applied.

Direct calculations and acceptance criteria according to Pt.6 Ch.6 Sec.6 [8] shall be used for evaluation of the fore ship sub-structural strength.

8 Longitudinal hull girder strength

8.1 Design vertical shear force and bending moment

Vertical shear and bending moment along the hull girder shall be calculated as required in Pt.6 Ch.6 Sec.6 [6.3] and Pt.6 Ch.6 Sec.6 [6.4] with F_{IB} calculated according to [7.2] in this section.

8.2 Longitudinal strength acceptance criteria

Longitudinal strength criteria in Pt.6 Ch.6 Sec.6 Table 9 shall be satisfied with $\eta = 0.6$.

9 Stability

9.1 General

9.1.1 Vessels with a freeboard length L_{LL} of 24 meters and above and class notation **Icebreaker** shall comply with the requirements of Pt.3 Ch.15 and IMO *Polar Code* Chapter 4 *Subdivision and Stability*, as well as the requirements of this subsection.

9.2 Intact stability

9.2.1 The initial metacentric height *GM* shall not be less than 0.5 m.

9.3 Requirements for watertight integrity

9.3.1 As far as practicable, tunnels, ducts or pipes which may cause progressive flooding in case of damage, shall be avoided in the damage penetration zone. If this is not possible, arrangements shall be made to prevent progressive flooding to volumes assumed intact. Alternatively, these volumes shall be assumed flooded in the damage stability calculations.

9.3.2 The scantlings of tunnels, ducts, pipes, doors, staircases, bulkheads and decks, forming watertight boundaries, shall be adequate to withstand pressure heights corresponding to the deepest equilibrium waterline in damaged condition.

10 Machinery

10.1 Propeller ice interaction

Ice interaction loads in this section are intended to cover all typical operational ice loads for icebreakers and shall be applied in addition to, or instead of those specified in Pt.6 Ch.6 Sec.6 [11].

10.2 Design ice loads for open propeller

10.2.1 Maximum backward blade force, F_b in kN, for open propellers

when $D < D_{limit}$:

$$F_b = 38 \cdot S_{ice} \cdot (n \cdot D)^{0.7} \cdot \left(\frac{EAR}{Z}\right)^{0.3} \cdot D^2$$

when $D \geq D_{limit}$:

$$F_b = 33 \cdot S_{ice} \cdot (n \cdot D)^{0.7} \cdot \left(\frac{EAR}{Z}\right)^{0.3} \cdot \left(H_{ice}\right)^{1.4} \cdot D$$

where D_{limit}, in m, is given as:

$$D_{\text{limit}} = 0.85 \cdot \left(H_{ice}\right)^{1.4}$$

where:

S_{ice} = Ice strength index for blade ice force and shall be taken as 1.2 for **PC(1)** to **PC(3)**. See Pt.6 Ch.6 Sec.6 [11.2] for requirements for other polar class notations.

Definition of the other parameters is given in Pt.6 Ch.6 Sec.6 [11.2] and Pt.6 Ch.6 Sec.6 [11.3].

10.2.2 Axial loads on propeller hub

Axial ice loads on pulling type propeller hub shall be calculated assuming a nominal ice crushing pressure of 8 MPa for multi-year ice (**PC(1)** to **PC(3)**) and 4 MPa for first-year ice (**PC(6)** and **PC(7)**). For **PC(4)** and **PC(5)** an intermediate value of 6 MPa shall be used.

Propeller hub and affected parts in the propeller and shaft line shall have safety factor 1.5 against yield strength.

Guidance note:

A method for calculating these loads is described in DNVGL-CG-0041.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

10.2.3 Maximum spindle torque for controllable pitch propellers

The maximum spindle torque Q_{sex} due to a blade failure load acting at 0.8*R* shall be determined.

It is assumed that the force that causes blade failure typically reduces when moving from the propeller centre towards the leading and trailing edges. At a certain distance from the blade centre of rotation the maximum spindle torque will occur. This maximum spindle torque in kNm, shall be defined by an appropriate stress analysis or using equation below:

$$Q_{sex} = \max\left(c_{LE0.8}; 0.8\, c_{TE0.8}\right) C_{spex}\, F_{ex}$$

where:

C_{spex} = $C_{sp} \cdot C_{fex}$

C_{sp} = ratio between the distance from spindle axis to the position giving maximum spindle torque, and the distance between spindle axis and leading or trailing edge, all at 0.8 *R* chord

C_{fex} = ratio between load at position of maximum spindle torque and blade failure load

$c_{LE0.8}$ = leading edge portion of the chord length at 0.8 *R*

$c_{TE0.8}$ = trailing edge portion of the chord length at 0.8 *R*

F_{ex} = blade failure load, in kN, as defined in Pt.6 Ch.6 Sec.6 [11.6].

If the values C_{sp} and C_{fex} are not known, the following approximation may be used:

$$C_{spex} \approx 0.7 \cdot \left(1 - \left(4 \cdot \frac{EAR}{Z}\right)^3\right)$$

If the values C_{spex} is below 0.3, a value of 0.3 shall be used for C_{spex}.

10.3 Design ice loads for propulsion line

Dynamic torsional analysis of ice impacts on the propeller shall be carried out for all propulsion plants.

The propeller ice torque excitation for shaft line transient dynamic analysis (time domain) is defined as a sequence of blade impacts which are of half sine shape and occur at the blade. The torque due to a single blade ice impact as a function of the propeller rotation angle, in kNm, is then defined as:

$$Q(\varphi) = C_q \cdot Q_{\max} \cdot \sin\left(\varphi \cdot \left(\frac{180}{\alpha_i}\right)\right)$$

when φ rotates from 0 to α_i plus integer revolutions, or:

$$Q(\varphi) = 0$$

when φ rotates from α_i to 360 plus integer revolutions.

Where:

φ = rotation angle starting when the first impact occurs
Q_{max} = maximum propeller ice torque (also referred to as T_{max} in Pt.6 Ch.6 Sec.6).

The parameters C_q and α_i are given in Table 4. α_i is the duration of propeller blade/ice interaction expressed in propeller rotation angle.

Table 4

Torque excitation	*Propeller-ice interaction*	C_q	α_i *(deg.)*			
			Z = 3	*Z = 4*	*Z = 5*	*Z = 6*
Excitation case 1	Single ice block	1.0	90	90	72	60
Excitation case 2	Single ice block	1.0	135	135	135	135
Excitation case 3	Two ice blocks (phase shift 360 deg/(2·Z)	0.5	45	45	36	30
Excitation case 4	Single ice block	1.0	45	45	36	30

The total ice torque is obtained by summing the torque of single blades, taking into account the phase shift 360 deg/Z. At the beginning and at the end of the milling sequence (within calculated duration) linear ramp functions shall be used to increase C_q to its maximum within one propeller revolution and vice versa to decrease it to zero.

The number of propeller revolutions during a milling sequence shall be obtained from the formula:

$$N_Q = 2\ H_{ice}$$

The number of impacts is $Z \cdot N_Q$ for blade order excitation.

The dynamic simulation shall be performed for all excitation cases at bollard condition with corresponding propeller speed and maximum available output of the engine.

10.4 Fatigue evaluation of propulsion line

For the evaluation of fatigue, the number of load cycles shall be multiplied by a factor 3 to account for the assumed operational profile of icebreakers:

$$N_{ice} = 3\, k_1\, k_2\, N_{class}\, n$$

Definition of parameters is given in Pt.6 Ch.6 Sec.6 [12.1].

10.5 Steering system

Additional fast acting torque relief arrangements (acting at 15% higher pressure than set pressure of safety valves) shall be fitted in order to provide effective protection of the rudder actuator in case of the rudder being pushed rapidly hard over against the rudder stops. The rudder turning speed to be assumed for each ice class is shown in Table 5.

The arrangement shall be designed such that steering capacity can be speedily regained.

Table 5 Turning speeds for dimensioning of fast acting torque relief arrangements

Ice class	***PC(1) and PC(2)***	***PC(3) to PC(5)***	***PC(6) and PC(7)***
Turning speeds in deg/s	40	20	15

SECTION 11 TUGS AND ESCORT VESSELS

Symbols

For symbols and definitions not defined in this chapter, see Pt.3 Ch.1 Sec.4.

1 Introduction

1.1 Introduction

1.1.1 These rules provide requirements for vessels intended for towing and/or escort services in harbour and open waters and pushing of floating structures.

1.2 Scope

1.2.1 The following subjects are covered in this section:

— design and testing requirements for towing equipment
— hull arrangement and supporting structure
— stability and watertight integrity.

1.3 Application

1.3.1

Vessels built in compliance with the relevant requirements given in [1] to [5] may be given the class notation **Tug**.

1.3.2

Vessels built in compliance with the relevant requirements given in [1] to [6] may be given the class notation **Escort tug** with the qualifiers as specified in Table 1.

1.4 Class notations

Ships built in compliance with the requirements as specified in Table 1 may be assigned the additional notations and qualifiers as given below.

Table 1 Additional class notations for tugs and escort vessels

Class Notation	*Qualifier*	*Purpose*	*Application*
Tug Mandatory: No Design requirements: [1] to [5] FiS survey requirements: Pt.7 Ch.1 Sec.2, Pt.7 Ch.1 Sec.3, Pt.7 Ch.1 Sec.4 and Pt.7 Ch.1 Sec.6 [32]	<None>	Towing of other vessels by towlines	

Class Notation	Qualifier	Purpose	Application
Escort tug Mandatory: No Design requirements: [1] to [6] FiS survey requirements: Pt.7 Ch.1 Sec.2, Pt.7 Ch.1 Sec.3, Pt.7 Ch.1 Sec.4 and Pt.7 Ch.1 Sec.6 [32]	**F**	Steering and manoeuvring operations of other vessels by towlines Escort rating numbers based on full scale test	One of the qualifiers **F**, **N** or **O** is mandatory Only one of the qualifiers **F**, **N** or **O** may be assigned
	N	Steering and manoeuvring operations of other vessels by towlines Escort rating numbers based on numerical calculations	
	O	Steering and manoeuvring operations of other vessels by towlines Escort rating numbers established by a society other than DNV GL	
	(F_S, t, v)	**(F_S, t, v)** are escort rating numbers, where: **F_S** indicates maximum transverse steering pull in metric tonnes, exerted by the escort tug on the stern of the assisted vessel **t** is the time in seconds required for the change of the tug's position from one side to the corresponding opposite side **v** is the speed in knots at which this pull may be attained	Mandatory qualifier Maximum two sets of escort rating numbers may be assigned For escort tugs with the qualifier **O**, the escort rating number values are replaced by '-'

1.5 Testing requirements

1.5.1 Workshop testing

Towing hook and quick release:

Towing hooks with a mechanical quick release, the movable towing arm and other load transmitting elements shall be subjected to a test force *PL* with the aid of an approved testing facility. In connection with this test, the quick release shall be tested likewise; the release force shall be measured and shall not exceed 150 N, see [3.5.3].

When towing hooks are provided with a pneumatic quick release, both the pneumatic and the mechanical quick release required by [3.5.4] shall be tested.

Also towing hooks with a hydraulic quick release shall be tested, but the quick release itself need not be subjected to the test load. If a cylinder tested and approved by the Society is employed as a loaded gear component, during the load test the cylinder may be replaced by a load transmitting member not pertaining to the gear, the operability of the gear being restored subsequently. The operability of the quick release shall be proved with the towline loosely resting on the hook.

Following each satisfactory testing at manufacturer's, a test certificate will be issued by the attending surveyor and shall be handed on board, together with the towing hook.

Towing winches:

The winch power unit shall be subjected to a test bed trial at the manufacturer's. A works test certificate shall be presented on the occasion of the final inspection of the winch, see [1.5.2] under *Towing hooks on board*.

Components exposed to pressure shall be pressure-tested to a test pressure PD of:

$$PD = 1.5\,P$$

where:

P = admissible working pressure or opening pressure of the safety valves, in bar. However, with working pressures exceeding 200, it is acceptable that test pressure does not exceed P by more than 100 bar.

Tightness tests shall be carried out at the relevant components.

Upon completion, towing winches shall be subjected to a final inspection and an operational test to the rated load. The hauling speed shall be determined during an endurance test under the rated tractive force. During these trials, in particular the braking and safety equipment shall be tested and adjusted.

The brake shall be tested to a test load equal to the rated holding capacity, but at least equal to the bollard pull.

If manufacturers do not have at their disposal the equipment required, a testonfirming the design winch capacity, and including adjustment of the overload protection device, may be carried out after installation on board, see [1.5.2].

In that case only the operational trials without applying the prescribed loads will be carried out at the manufacturers.

Accessory towing gear components and towlines:

Accessories subjected to towing loads, where not already covered by [1.5.1], are generally to be tested to test force PL at the manufacturer.

For all accessories certificates, CG 3, and for the towline, CG 4, shall be submitted.

The Society reserve the right of stipulating an endurance test to be performed of the towing gear components, where considered necessary for assessment of their operability.

Following each satisfactory testing at manufacturer's workshop, a test certificate will be issued by the attending surveyor and shall be handed on board, together with the towing winch.

1.5.2 On board testing

Towing gear testing requirements:

The installed towing gear shall be tested on the tug using the bollard pull (BP) test to simulate the towline pull.

The winch and other equipment made mandatory in this section shall be function tested according to approved procedure in order to verify:

— the ability for the arrangement and equipment to operate within the specified limitations, towline paths, towline sectors etc. specified by the arrangement drawing
— the correct function of the normal operation modes
— the correct function of the emergency operation modes, including emergency release mechanism and dead ship operations.

Bollard pull test:

In general a BP test should be carried out before entering into service of the vessel. The test may be witnessed and certified by DNV GL. Based upon the results of the test a bollard pull certificate will be issued.

The expected BP may be preliminarily applied for design approval purposes prior to sea trial. If sea trial reveals that the expected BP is exceeded by more than 10%, such design approvals shall be re-considered.

The following test procedure should be adhered to and possible deviations shall be recorded in the bollard pull certificate:

1) Approved test programme shall be submitted prior to the testing.
2) During testing of continuous static BP the main engine(s) shall be run at the manufacturer's recommended maximum continuous rating (MCR).
3) During testing of overload pull, the main engines shall be run at the manufacturer's recommended maximum rating that can be maintained for a minimum of 1 hour. The overload test may be omitted.
4) The propeller(s) fitted when performing the test shall be the propeller(s) used when the vessel is in normal operation.
5) All auxiliary equipment such as pumps, generators and other equipment, which are driven from the main engine(s) or propeller shaft(s) in normal operation of the vessel shall be connected during the test.
6) The vessel shall be trimmed at even keel or at a trim by stern not exceeding 2% of the vessel's length.
7) The vessel shall be able to maintain a fixed course for not less than 10 minutes while pulling as specified in items 2 or 3 above.
8) The test shall be performed with a fair wind speed not exceeding 5 m/s.
9) The co-current at the test location shall not exceed 1 knot.
10) The load cell used for the test shall be approved by the Society and be calibrated at least once a year. The accuracy of the load cell shall be ± 2% within a temperature range and a load range relevant for the test.
11) An instrument giving a continuous read-out and also a recording instrument recording the bollard pull graphically as a function of the time shall both be connected to the load cell.
12) The arrangement of bollard, towline and load cell shall ensure a force reading in horizontal direction by means of minimizing the influence from friction and force components in vertical direction.
13) The figure certified as the vessel's continuous static BP shall be the towing force recorded as being maintained without any tendency to decline for a duration of not less than 10 minutes.
14) Certification of BP figures recorded when running the engine(s) at overload, reduced r.p.m. or with a reduced or an increased number of engines or propellers operating may be given and noted on the certificate. The angular position of turn able propulsion devices shall be recorded.
15) Both the load cell reading, engine power, and other essential parameters shall be continuously available to the surveyor.
16) The recorded load cell readings shall be made available to the surveyor immediately upon completion of the test.

Towing hooks on board:

For all towing hooks (independent of the magnitude of the test force PL, as defined in Table 3), the quick release shall be tested with an upward towline direction against the horizontal line of 60° or 45° respectively as outlined in [3.5.5]. If the towline will never be operated in such upward direction due to the tug is equipped with a towrope guidance at stern, then this release test may be carried out in the maximum occurring upward direction.

In addition, the towing hook shall be load tested with a load equal to BP.

The surveyor certifies the initial on board test by an entry into the test certificate for towing hooks.

Towing winches on board:

After installation on board, the safe operation of the winch(es) from all control stands shall be checked. It shall be proved that for both cases a) with the drum brake engaged and b) during hoisting and pay out, the emergency release mechanism for the drum operates well under both normal and dead ship operation modes. These checks may be combined with the bollard pull test.

The towing winch shall be subjected to a trial during the bollard pull test to a test load corresponding to the holding power of the winch.

2 Hull arrangement and strength

2.1 Draught for scantlings

2.1.1 For determining the scantlings of strength members based on the ship's draught, the latter shall not be taken less than 0.85 D.

2.2 Fore body, bow structure

2.2.1 On tugs for ocean towage, strengthening in way of the fore body, i.e. stringers, tripping brackets etc. shall conform to the indications given in Pt.3 Ch.10 Sec.1. The stringers shall be effectively connected to the collision bulkhead. Depending on the type of service expected, additional strengthening may be required.

2.2.2 For harbour tugs frequently engaged in berthing operations, the bow shall be suitably protected by fendering and be structurally strengthened.

2.2.3 The bulwark shall be arranged with an inward inclination in order to reduce the probability and frequency of damages. Square edges shall be chamfered.

2.2.4 The bow structure of tugs in pushing operation for maneuvering at narrow, sheltered waters shall be strengthened as noted in [2.2.5], [2.2.6] and [2.2.7].

2.2.5 Forward of the collision bulkhead stringers shall be arranged on the ship's side not more than 2 m apart. The stringers shall be connected to the collision bulkhead by brackets forming gradual transition to the bulkhead.

2.2.6 The design push force and the extent of the push force area shall be marked on the foreship drawings. Based on this design push force times a dynamic factor of 1.3 and based on net scantlings, the stresses in the supporting structures shall not exceed:

- Normal stress = $0.67\ R_{eH}$
- Shear stress = $0.67\ \tau_{eH}$
- Equivalent stress = $0.75 R_{eH}$

2.2.7 The frames shall be connected to the stringers by lugs or brackets at every frame.

2.2.8 For pusher tugs for inland navigation, see rules for inland navigation vessels DNVGL-RU-INV Pt.5 Ch.6.

2.3 Side structure

2.3.1 The side structure of areas frequently subjected to impact loads shall be reinforced by increasing the section modulus of side frames by 20%. Besides, fendering may be necessary to reduce indenting damages of the shell plating.

2.3.2 A continuous and suitable strong fender shall be arranged along the upper deck, extending the whole length of the vessel.

2.4 Engine room casing, superstructures and deckhouses

2.4.1 The gross plate thickness of the casing walls and casing tops shall not be less than 5 mm. The gross thickness of the coamings shall not be less than 6 mm. The coamings shall extend to the lower edges of the beams.

2.4.2 The stiffeners of the casing shall be connected to the beams of the casing top and shall extend to the lower edge of the coamings.

2.4.3 The following requirements shall be observed for superstructures and deckhouses of tugs assigned for the restricted services areas **R0** to **R4** or for unlimited range of service:

— The plate thickness of the external boundaries of superstructures and deckhouses shall be increased by 1 mm above the thickness as required in Pt.3 Ch.6 Sec.8 [3].
— The section modulus of stiffeners shall be increased by 50% above the values as required in Pt.3 Ch.6 Sec.8 [3].

2.5 Foundations of towing gear

2.5.1 The substructure of the towing hook attachment and the foundations of the towing winch, and of any guiding elements such as towing posts or fairleads, where provided, shall be thoroughly connected to the ship's structure, considering all possible directions of the towline, see [3.5.5].

2.5.2 The stresses in the supporting structure, foundations and fastening elements shall not exceed the permissible stresses shown in Table 2 (based on the gross thickness), assuming a load equal to the test load of the towing hook in case of hook arrangements, see [3.3.3], and a load of the winch holding capacity in case of towing winches, see also [3.5.5] and [3.7.3].

Table 2 Permissible stresses

Type of stress	*Permissible stress*
Axial and bending tension and axial and bending compression with box type girders and tubes	$\sigma = 0.83\ R_{eH}$
Axial and bending compression with girders of open cross sections or with girders consisting of several members	$\sigma = 0.72\ R_{eH}$
Shear	$\tau = 0.48\ R_{eH}$
Equivalent stress	$\sigma_{vm} = 0.85\ R_{eH}$

2.6 Deck structure

2.6.1 On tugs for ocean towage, the deck, particularly in the forward region, shall be suitably protected or strengthened against sea impact.

2.6.2 Depending on the towline arrangement, the deck in the aft region shall be strengthened (beams, plate thickness), if considerable chafing and/or impact shall be expected. See also [3.3.2].

2.7 Stern frame

2.7.1 The cross sectional area of a solid stern frame shall be 20% greater than required according to Pt.3 Ch.10 Sec.6 [2]. For fabricated stern frames, the thickness of the propeller post plating shall be increased by 20% compared to the requirements given in Pt.3 Ch.10 Sec.6 [2]. The section modulus Z_1 of the sole piece shall be increased by 20% compared to the modulus determined according to Pt.3 Ch.14 Sec.1 [5].

3 Systems and equipment

3.1 Anchoring and mooring equipment

3.1.1 Equipment number

Tugs shall have anchoring and mooring equipment corresponding to its equipment number, see Pt.3 Ch.11 Sec.1 [3.1]. The term 2 BH in the formula may, however, be substituted by:

$$2(aB + \Sigma\, h_i\, b_i)$$

where:

b_i = breadth, in m, of the widest superstructure or deckhouse of each tier having a breadth greater than $B/4$.

3.1.2 General requirements

For tugs with restricted service the equipment specified in Pt.3 Ch.11 Sec.1 Table 1 may be reduced in accordance with Pt.3 Ch.11 Sec.1 Table 3. No reductions are given for class notations **R0** and **R1**. For tugs in the service range **RE**, see rules for classification: DNVGL-RU-INV.

For tugs engaged only in berthing operations, one anchor is sufficient, if a spare anchor is readily available on land.

3.1.3 Tugs operating as pusher units

The anchoring equipment for tugs operating as pusher units will be considered according to the particular service. Normally, the equipment is intended to be used for anchoring the tug alone, the pushed unit being provided with its own anchoring equipment.

3.2 Steering gear/steering arrangement

3.2.1 Steering stability

Steering stability, i.e. stable course maintaining capability of the tug, shall be ensured under all normally occurring towing conditions. Rudder size and rudder force shall be suitable in relation to the envisaged towing conditions and speed.

3.2.2 Rudder movement

For tugs exceeding 500 gross tons the time required to put the rudder from 35° port to 30° starboard or vice versa shall not exceed 28 seconds when the vessel is running ahead at maximum service speed. Special rudder arrangements may be considered in the particular case, see also [3.2.3].

3.2.3 Special steering arrangements

Steering units and arrangements not explicitly covered by the rules mentioned above, and combinations of such units with conventional rudders, will be considered from case to case.

3.2.4 Tugs operating as pusher units

For tugs operating as pusher units, the steering gear shall be designed to guarantee satisfying steering characteristics in both cases, tug alone and tug with pushed object.

3.3 Towing gear/towing arrangement

3.3.1 Design standard

The equipment shall meet the requirements in this section. Alternatively equipment complying with recognized standard may be accepted on a case-by-case basis, provided such specifications give equivalence to the requirements of this section and is fulfilling the intention.

Towing arrangement drawing with the content listed under documentation requirement in Sec.1 [4] shall be posted on bridge.

3.3.2 General requirements

The towing gear shall be arranged in such a way as to minimise the danger of capsizing; the towing hook/ working point of the towing force shall be placed as low as practicable, see [5.1].

With direct-pull (hook-towline), the towing hook and its radial gear shall be designed such as to permit adjusting to any foreseeable towline direction.

The attachment point of the towline shall be arranged closely behind the centre of buoyancy.

On tugs equipped with a towing winch, the arrangement of the equipment shall be such that the towline is led to the winch drum in a controlled manner under all foreseeable conditions (directions of the towline).

Towline protection sleeves or other adequate means shall be provided to prevent the directly pulled towlines from being damaged by chafing/abrasion.

3.3.3 Definition of loads

The design force T_b, in kN, corresponds to the towline pull (or the bollard pull, if the towline pull is not defined) as specified. The design force may be verified by a bollard pull test, see [1.5.2].

The test force *PL* is used for dimensioning as well as for testing the towing hook and connected elements. The test force is related to the design force as shown in Table 3.

Table 3 Design force T_b and test force *PL*

Design force T_b *kN*	*Test force PL* *kN*
$T_b \leq 500$	2.00 T_b
$500 < T_b \leq 1\,500$	$T_b + 500$
$1\,500 < T_b$	1.33 T_b

The minimum breaking force of the towline is based on the design force, see [3.6.3].

The winch holding capacity shall be based on the minimum breaking force, see [3.7.3], the rated winch force is the hauling capacity of the winch drive when winding up the towline, see [1.5.1].

For forces at the towing hook foundation see [3.5.5].

3.4 Materials for equipment

3.4.1 Towing hook with attachment shall be made of rolled, forged or cast steel in accordance with Pt.2.

3.4.2 Towing winch materials shall comply with relevant specifications given in Pt.2.

3.4.3 For forged and cast steel with minimum specified tensile strength above 650 N/mm^2, specifications of chemical composition and mechanical properties shall be submitted for approval for the equipment in question.

3.4.4 Plate material in welded parts shall be of the grades as given in Pt.3 Ch.11 Sec.1 Table 11.

3.4.5 When R_{eH} is greater than 80% of R_m, the following value shall be used as R_{eH} in calculations for structural strength as given in [3.7]:

$$R_{eH} = \min(R_{eH};\ 0.8\ R_m)$$

3.4.6 Fabrication of towing hook with attachments is generally to be in accordance with the Society's document DNVGL-ST-0378

3.5 Towing hook and quick release

3.5.1 The towing hook shall be fitted with an adequate device guaranteeing slipping, i.e. emergency release, of the towline in case of an emergency. Slipping shall be possible from the bridge as well as from at least one other place in the vicinity of the hook itself, from where in both cases the hook can be easily seen.

3.5.2 The towing hook shall be equipped with a mechanical, hydraulic or pneumatic quick release. The quick release shall be designed such as to guarantee that unintentional slipping is avoided.

3.5.3 A mechanical quick release shall be designed such that the required release force under test force *PL* does not exceed neither 150 N at the towing hook nor 250 N when activating the device on the bridge. In case of a mechanical quick release, the releasing rope shall be guided adequately over sheaves. If necessary, slipping should be possible by downward pulling, using the whole body weight.

3.5.4 Where a pneumatic or hydraulic quick release is used, a mechanical quick release shall be provided additionally.

3.5.5 Dimensioning of towing hook and towing gear

The dimensioning of the towing gear is based on the test force *PL*, see [3.3.3].

The towing hook, the towing hook foundation, the corresponding substructures and the quick release shall be designed for the following directions of the towline:

- For a test force $PL \leq 500$ kN:
  - in the horizontal plane, directions from abeam over astern to abeam
  - in the vertical plane, from horizontal to 60° upwards.
- For a test force $PL > 500$ kN:
  - in the horizontal plane, as above
  - in the vertical plane, from horizontal to 45° upwards.

Assuming the test force *PL* acting in any of the directions described in [3.5.5], the permissible stresses in the towing equipment elements defined above shall not exceed the values shown in Table 2.

For the towing hook foundation it shall be additionally proven that the permissible stresses given in Table 2 are not exceeded assuming a load equal to the minimum breaking force F_{min}, in kN, of the towline.

3.6 Towlines

3.6.1 All wire ropes should have as far as possible the same lay.

3.6.2 The length of the towline shall be chosen according to the tow formation (masses of tug and towed object), the water depth and the nautical conditions. Regulations of flag state authorities shall be observed.

3.6.3 The required minimum breaking force F_{min}, in kN, of the towline shall be determined by the following formula:

$$F_{\min} = K\,T_b$$

where:

K = Utility factor, to be taken as:

$K = 2.5$	for $T_b \leq 200$ kN
$K = 2.625 - \frac{T_b}{1600}$	for 200 kN < T_b < 1000 kN
$K = 2.0$	for $T_b \geq 1000$ kN

T_b = Design force, in kN, as defined in [3.3.3].

3.6.4 For ocean towages, at least one spare towline with attachments shall be available on board.

3.7 Towing winch

3.7.1 Arrangement and control

The towing winch, including towline guiding equipment, shall be arranged such as to guarantee safe guiding of the towline in all directions according to [3.5.5].

The winch shall be capable of being safely operated from all control stands. Apart from the control stand on the bridge, at least one additional control stand shall be provided on deck. The winch control station on deck shall be in a safe location. From each control stand the winch drum shall be freely visible; where this is not ensured, the winch shall be provided with a self-rendering device.

Each control stand shall be equipped with suitable operating and control elements. The arrangement and the working direction of the operating elements shall be analogous to the direction of motion of the towline.

Operating levers shall, when released, automatically return to the stop position. They shall be capable of being secured in the stop position.

It is recommended that, on vessels for ocean towage, the winch is fitted with equipment for measuring the pulling force in the towline.

If, during normal operating conditions, the power for the towing winch is supplied by a main engine shaft generator, another generator shall be available to provide power for the towing winch in case of main engine or shaft generator failure.

3.7.2 Winch drum

Specific requirements for winch drums:

1) The towline shall be fastened on the winch drum by a breaking link.
2) The winch drum shall be capable of being declutched from the drive.
3) The diameter of the winch drum shall be not less than 14 times the towline diameter. However, for all towline types, the towline bending radius should not be less than specified by the towline manufacturer.
4) To ensure security of the rope end fastening, at least three (3) dead turns shall remain on the drum.
5) At the ends, drums shall have disc sheaves whose outer edges shall surmount the top layer of the rope at least by 2.5 rope diameters, if no other means is provided to prevent the rope from slipping off the drum.
6) If a multi-drum winch is used, then each winch drum shall be capable of independent operation.
7) Items 3 to 4 above are not applicable to towlines of austenitic steels and fibre ropes. In case these towline materials are utilized, dimensioning of the winch drum is subject to the Society's approval.
8) The in-board end of the towline shall be attached to the winch drum with a weak link or similar arrangement that is designed to release the towline at low load.

3.7.3 Holding capacity/dimensioning

The holding capacity of the towing winch (towline in the first layer) shall correspond to 80% of the minimum breaking load F_{min} of the towline.

When dimensioning the towing winch components, which - with the brake engaged - are exposed to the pull of the towline (rope drum, drum shaft, brakes, foundation frame and its fastening to the deck), a design tractive force equal to the holding capacity shall be assumed. When calculating the drum shaft the dynamic stopping forces of the brakes shall be considered. The drum brake shall not give way under this load.

3.7.4 Brakes

If the drum brakes are power-operated, manual operation of the brake shall be provided additionally.

Drum brakes shall be capable of being quickly released from the control stand on the bridge, as well as from any other control stand. The emergency release shall be functional under all working conditions, including failure of the power drive.

The operating levers for the brakes shall be secured against unintentional operation.

Following operation of the emergency release device, normal operation of the brakes shall be restored immediately.

Following operation of the emergency release device, the winch driving motor shall not start again automatically.

Towing winch brakes shall be capable of preventing the towline from paying out when the vessel is towing at the design force T_b and shall not be released automatically in case of power failure.

3.7.5 Tricing winches

Control stands for the tricing winches shall be located at safe distance off the sweep area of the towing gear. Apart from the control stands on deck, at least one other control stand shall be available on the bridge.

Tricing winches are not subject to classification. In order to assess the supporting structure, maximum reaction forces and its locations shall be provided.

3.8 Towing winch emergency release mechanism

3.8.1 Scope

Emergency release system refers to the mechanism and associated control arrangements that are used to release the load on the towline in a controller manner under both normal and dead-ship conditions.

Guidance note:

For definitions of 'girting' and 'fleet angle' refer to IACS M79 - Towing winch emergency release systems.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

3.8.2 General

The winch shall be designed to allow drum release in an emergency, and in all operational modes.

After an emergency release the winch brakes shall be in normal function without delay. It shall always be possible to carry out the emergency release sequence (emergency release and/or application of brake), even during a black-out.

3.8.3 Performence general

The emergency release system is to function as quickly as is reasonably practicable and within a maximum of three seconds after activation. The emergency release system shall allow the winch drum to rotate and the towline to pay out in a controlled manner such that, when the emergency release system is activated, there is sufficient resistance to rotation to avoid uncontrolled unwinding of the towline from the drum. Spinning (free, uncontrolled rotation) of the winch drum shall be avoided, as this could cause the towline to get stuck and disable the release function of the winch.

3.8.4 Performence requirements

Once the emergency release is activated, the towline load required to rotate the winch drum shall be no greater than:

1) the lesser of 49 kN or 5% of the holding capacity of the towing winch when two layers of towline are on the drum, or
2) 15% of the holding capacity of the towing winch where it is demonstrated that this resistance to rotation shall not exceed 25% of the force that will result in listing sufficient for the immersion of the lowest unprotected opening.

3.8.5 Source of energy

An alternative source of energy shall be provided such that normal operation of the emergency release system can be sustained under dead-ship conditions. The alternative source of energy shall be sufficient to achieve the most onerous of the following conditions (as applicable):

1) sufficient for at least three attempts to release the towline (i.e. three activations of the emergency release system). Where the system provides energy for more than one winch it shall be sufficient for three activations of the most demanding winch connected to it.
2) Where the winch design is such that the drum release mechanism requires continuous application of power (e.g. where the brake is applied by spring tension and released using hydraulic or pneumatic power) sufficient power shall be provided to operate the emergency release system (e.g. hold the brake open and allow release of the towline) in a dead-ship situation for a minimum of five minutes.

Guidance note:

This may be reduced to the time required for the full length of the towline to feed off the winch drum at the load in [3.8.4] if this is less than five minutes.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

3.8.6 Operational requirements

Emergency release operation shall be possible from all control stands.

The emergency release control shall be located in close proximity to the emergency stop button for winch operation and both shall be clearly identifiable, clearly visible, easily accessible and positioned to allow safe operability.

The emergency release function shall take priority over any emergency stop function. Activation of the winch emergency stop from any location shall not to inhibit operation of the emergency release system from any location.

Emergency release system control buttons shall have positive action to cancel.

Guidance note:

The positive action may be made at a different control position from the one where the emergency release was activated.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

It shall always be possible to cancel the emergency release from the bridge regardless of the activation location and without manual intervention on the working deck.

Control handles, buttons, etc. for emergency release shall be protected against accidental operation.

Indications shall be provided on the bridge for all power supply and/or pressure levels related to the normal operation of the emergency release system. Alarms shall be activated automatically if any level falls outside of the limits within which the emergency release system is fully operational.

Wherever practicable, control of the emergency release system shall be provided by a hard-wired system, fully independent of programmable electronic systems.

Computer based systems that operate or may affect the control of emergency release systems shall meet the requirements for category III systems of UR E22.

Components critical for the safe operation of the emergency release system shall be identified by the manufacturer.

The method for annual survey of the winch shall be documented.

The performance capabilities and operating instructions of the emergency release system shall be documented and made available on board.

3.9 Marking

3.9.1 Equipment shall be marked to enable them to be readily related to their specifications and manufacturer. When the Society's product certificate is required, the equipment shall be clearly marked by the Society for identification.

4 Fire safety and escape routes

4.1 Emergency exit from engine room

4.1.1 In the engine room an emergency exit shall be provided on or near the centerline of the vessel, which can be used at any inclination of the ship. The cover shall be weather tight and shall be capable of being opened easily from outside and inside. The axis of the cover shall run in athwart ship direction.

4.2 Companionways

4.2.1 Companionways to spaces below deck see [5.2.1].

4.3 Rudder compartment

4.3.1 Where, for larger ocean going tugs, an emergency exit is provided from the rudder compartment to the upper deck, the arrangement, sill height and further details shall be designed according to the requirements given in [5.2.3].

4.4 Access to bridge

4.4.1 Safe access to the bridge shall be ensured for all anticipated operating and heeling conditions, also in heavy weather during ocean towage.

4.5 Fire safety

4.5.1 Structural fire protection measures shall be as outlined in Pt.4 Ch.10, as applicable according to the size of the vessel.

4.5.2 Additional or deviating regulations of the competent administration shall be observed.

5 Stability and openings and closing appliances

5.1 General stability requirements

5.1.1 The requirements in this section apply to vessels with freeboard length L_{LL} of 24 m and above.

5.1.2 Vessels with a freeboard length L_{LL} less than 24 m should as far as practicable comply with the requirements given in this section. Other stability requirements may however be applied provided the Society upon consideration in each case finds these requirements to be appropriate for the vessel.

5.1.3 The vessel's stability shall be assessed when the vessel is subjected to forces related to towing operations, based on the requirements of [5.1.4].

Guidance note:

It is acceptable that compliance is demonstrated for actual loading conditions only. The approval will then be limited to the presented loading conditions. These initial conditions shall also comply with the applicable intact and damage stability criteria before applying the heeling moment.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

5.1.4 Stability criteria, stern freeboard and towing heeling levers

Vessels engaged in harbour, coastal or ocean-going towing shall in the applicable loading conditions in the stability manual comply with the criteria of the International Code on Intact Stability, 2008 (effective from 2020-01-01), Part B, paragraphs 2.8.4.2, 2.8.4.3 and 2.8.6.2, assuming towing heeling levers according to paragraph 2.8.2.

5.1.5 Loading conditions

In addition to the standard loading conditions for cargo ships in Pt.3 Ch.15 Sec.1 [4.3.4], standard loading conditions given in the International Code on Intact Stability, 2008 (effective from 2020-01-01), Part B, paragraph 3.4.1.8, shall apply, including the assumptions of paragraph 3.4.2.9.

5.1.6 Additional information in stability manual

The vessel's stability manual shall contain detailed information on the calculated heeling levers with all applied parameters. The heeling lever curves shall be plotted together with the GZ curve for all intended towing conditions. The manual shall additionally contain information as given in the International Code on Intact Stability, 2008 (effective from 2020-01-01), Part B, paragraph 3.6.4.

5.2 Openings and closing appliances

5.2.1 In general, openings and closing appliances shall be in compliance with the requirements of Pt.3 Ch.12 except as otherwise specified in this subsection.

5.2.2 Side scuttles and windows

Side scuttles in the ship's sides and in sides of superstructures on freeboard deck shall at least satisfy the requirements for type B side scuttles as per ISO 1751.

For windows in a wheelhouse in the second tier, Type E windows as per ISO 3903 are required when direct access to spaces below is provided. Glass thicknesses for intermediate sizes, not covered by ISO 3903, shall be determined using ISO 21005.

5.2.3 Weather deck openings

Skylights in freeboard deck shall be arranged with coamings not less than 900mm high and scantlings shall be as for exposed casings.

Skylights leading to machinery spaces shall be of steel and not contain glass panels.

5.2.4 Tugs with L<24m and tugs in domestic trade

Ventilators necessary to continuously supply the machinery space shall be positioned as close to the centreline as possible, and have coamings exceeding 1.8m at the centreline of the vessel, linearly increased to 4.5m at the ship's side above the lower part of the weather deck. Weathertight closing appliances are not mandatory, under the conditions described above.

6 Additional requirements for escort tugs

6.1 General

6.1.1 The escort rating number **(F_S, t, v)** should be established by full scale measurement tests. Alternatively, numerical calculations by suitable software, possible in combination with model tests, may be accepted. Requirements to the full scale testing and numerical calculations are outlined in [6.8].

6.1.2 Escort rating numbers based on full scale test will have a qualifier **F**, while escort rating numbers based on calculations confirmed by the Society will have a qualifier **N**. Escort rating numbers established by other class societies (e.g. due to class entry of the vessel) will have a qualifier **O**.

6.1.3 Escort rating number **(F_S, t, v)** is defined in [6.2.4]. If one or more of these parameters are established without DNV GL involvement, the value will be replaced by '**-**'.

6.1.4 Full scale measurement test may be commenced either before delivery or anytime during the operational life of the vessel. The class notation and the appendix to the class certificate will then be updated to reflect the results of the test.

6.2 Hull arrangement

6.2.1 The hull of the tug shall be designed to provide adequate hydrodynamic lift and drag forces when in indirect towing mode. Due attention shall be paid to the balance between hydrodynamic forces, towline pull and propulsion forces, as well as sudden loss of thrust.

6.2.2 The vessel shall be designed so that forces are in equilibrium with a minimum use of propulsive force except for providing forward thrust and balancing transverse forces during escorting service.

6.2.3 The escort rating number (**F_S, t, v**) shall be determined by numerical calculations or full scale trials, performed within acceptable limits set by stability and winch criteria specified in these rules, and further described in DNVGL-CG-0155. A test certificate indicating the escort rating number may be issued on completion of successful full scale trials. If trials take place at both 8 and 10 knots, the escort rating number will consist of 6 parts.

6.2.4 **F_S** indicates maximum transverse steering pull, in metric tonnes, exerted by the escort tug on the stern of the assisted vessel with the intention of controlling it, **t** is the time required for the change of the tug's position from one side to the corresponding opposite side, and **v** is the speed at which this pull may be attained (see Figure 1).

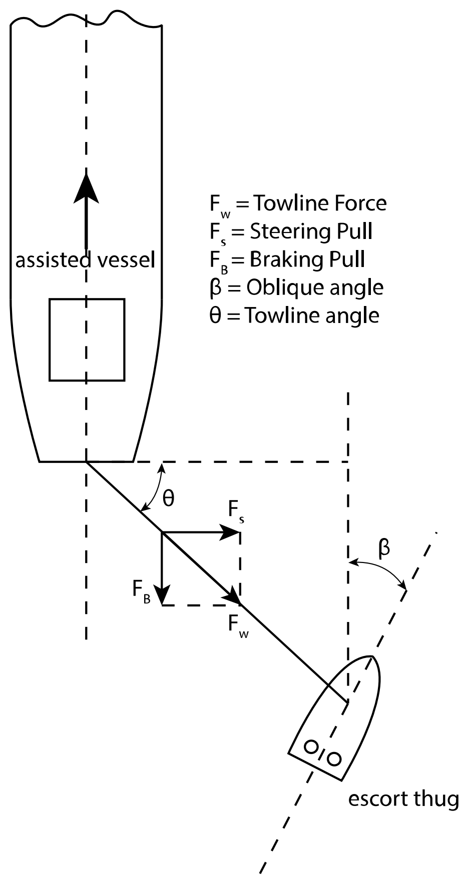

Figure 1 Typical escort configuration

6.3 Equipment

6.3.1 Towing winch

The towing winch shall have a hydraulic load reducing system in order to prevent overload caused by dynamic oscillation in the towing line. Normal escort operation shall not be based on use of brakes on the towing winch, but the hold function shall be provided by the gearbox and the hydraulic system instead. The towing winch shall pay out towing line before the pull reaches 110% of the rated towline force F_W in t.

6.3.2 The winch, crucifix etc. and their supporting structures for vessels with notation **Escort tug** shall also comply with the requirements for **Tug** notation based on towline force F_W, see Figure 1, instead of design force T_b as given in Table 3.

6.4 Propulsion system

6.4.1 The propulsion system shall be able to provide ample thrust for manoeuvring at higher speeds for the tug being in any oblique angular position and to catch up with the assisted vessel. The design speed of the escort tug shall therefore be at least 20% higher than the escort speed **v** defined in [6.1.4].

6.4.2 The propulsion system shall also have sufficient thrust so that the tug can maneuver safely aft of the escorted vessel when transferring the tow line etc.

6.4.3 In case of loss of propulsion, the remaining forces shall be so balanced that the resulting turning moment will turn the escort tug to a safer position with reduced heel.

6.5 General stability requirements

6.5.1 The general stability criteria in [5.1] shall be complied with, in addition to stability criteria given below.

6.6 Additional stability criteria

6.6.1 Stability criteria, stern freeboard and heeling lever for escort operation

Vessels engaged in escort operations shall in the applicable loading conditions in the stability manual comply with the criteria of the International Code on Intact Stability, 2008 , Part B, paragraphs 2.8.4.4 and 2.8.6.2, assuming heeling levers according to paragraph 2.8.3.

6.7 Load line

6.7.1 Freeboard

Freeboard shall be arranged so as to avoid excessive trim at higher heeling angles. Bulwark shall be fitted all around exposed weather deck.

6.8 Methods for establishing the escort rating number **(F_S, t, v)**

6.8.1 Requirements to full scale measurement tests are given in [6.9] and in DNVGL-CG-0155, while requirements to numerical calculations are described in [6.10] and in DNVGL-CG-0155. These tests are additional to the tests given in [1.5].

6.8.2 The presented steering pull $\mathbf{F_s}$ is intended to represent the force the escort tug can exert under normal sea trial conditions. If the vessel is intended to operate in higher sea conditions the expected pull may be lower.

6.9 Full scale testing requirements for notation **Escort tug (F, (F_S, t, v))**

6.9.1 The following tests shall be undertaken:

— Measurement of maximum transverse steering pull $\mathbf{F_s}$, in metric tonnes: The escort tug will connect its towing line wire to the assisted vessel's stern and follow it with the wire slack, both ships travelling at the same speed. The tug will then position itself at an agreed angle of attack relative to the flow of water and the resulting towline tension $\mathbf{F_s}$ shall be recorded. These readings combined with the respective θ-β angles combinations shall be then used to establish $\mathbf{F_s}$.
— Manoeuvre test: The escort tug will shift its position from a steering position minimum 30° from one side of the assisted vessel (i.e. θ is max 60°) to the mirror position in the opposite side and **t** will be the time required.

The escort test speed should be 8 knots and/or 10 knots. A surveyor will attend the test for the purpose of witnessing compliance with the agreed test program.

6.9.2 Approved escort departure and escort arrival loading conditions from the stability manual shall define the way the tug will be loaded for the trial.

6.9.3 Recordings during full scale trials

At least the following data shall be recorded continuously in real time mode during trials for later analysis.

Assisted vessel:

— speed relative to the sea
— time for the manoeuvre test
— weather condition (speed and direction) and sea state
— position
— heading
— rudder angle
— towline angle θ.

Active escort tug:

— towline tension F_w
— towline length
— oblique angle β
— heeling angle of tug
— weather condition (speed and direction) and sea state.
— heading
— speed relative to the sea.

6.9.4 Sea trials exceeding critical heeling angle from approved stability calculations shall not be accepted.

6.10 Numerical calculations for notation **Escort tug (N, (F_S, t, v))**

6.10.1 The calculations shall be based on hydrodynamic loads established by model tests or CFD calculations relevant for the actual vessel design.

6.10.2 The calculations shall be done by suitable software/calculation method for which the results have been aligned with results from full scale measurement tests.

6.10.3 The documentation shall contain information about the actual propulsion system and the available thrust in the given directions.

SECTION 12 DREDGERS

Symbols

For symbols not defined in this chapter, see Pt.3 Ch.1 Sec.4.

1 Introduction

1.1 Introduction

1.1.1 These rules provide requirements for vessels intended for dredging operations in harbour and open waters.

1.2 Scope

1.2.1 The following subjects are covered in this section:

— hull structural details related to the dredging operations
— supporting structures for the dredging equipment.

Guidance note:

The Society may on request supervise the construction and testing of the following items nor covered by the classification:

— equipment for anchoring and mooring during dredging
— equipment and installations for dredging.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

1.3 Application

1.3.1 Vessels built in compliance with the relevant requirements in this section may be given the class notation **Dredger**, or **Dredger(Suction)**.

Requirements for split hopper barges used in dredging operations are found in Ch.11.

The requirements of the *Guidelines for the Assignment of Reduced Freeboards for Dredgers* (DR-68) developed by the joint working group on dredgers operating at reduced freeboards apply.

1.3.2 Dredgers intended for unusual dredging methods and/or of unusual form will be specially considered.

1.3.3 Dredgers engaged in international service shall comply with the requirements of the ICLL.

1.3.4 Dredgers with a restricted service area operating exclusively in national waters shall comply, as far as possible, with the requirements of the ICLL. The height of companionway coamings above deck shall not be less than 300 mm.

Guidance note:

For dredgers with a restricted service area according to Pt.1 Ch.2 Sec.5 operating exclusively in national waters, a special dredger freeboard is assigned by some administrations.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

2 Hull arrangement and strength

2.1 General requirements

2.1.1 Local structures and deviations from the principal design dimensions associated with the attachment of the dredging gear, shall be ignored when determining the principal dimensions in accordance with Pt.3 Ch.1 Sec.4 [3.1].

2.1.2 The thickness of main structural members which are particularly exposed to abrasion by a mixture of spoil and water, e.g. where special loading and discharge methods are employed, shall be adequately strengthened. Upon approval by the Society such members may alternatively be constructed of special abrasion resistant materials.

2.2 Hull girder strength

2.2.1 For dredgers of 100 m in length and more, the scantlings of the longitudinal hull structure shall be determined on the basis of longitudinal bending moments and shear forces calculations according to Pt.3 Ch.5 Sec.1.

For dredgers classed for particular service areas, dispensations of Pt.3 Ch.5 Sec.1 may be approved.

2.2.2 For dredgers of less than 100 m in length, the minimum midship section modulus according to Pt.3 Ch.5 Sec.1 [2.2] shall be fulfilled.

For dredgers less than 100 m in length, the submittal of longitudinal strength calculations may in some cases be waived upon request.

2.3 Hull local scantlings

2.3.1 The thickness of the bottom shell plating of dredgers intended or expected to operate while aground, shall be increased by 20% above the value required in Pt.3 Ch.6 Sec.3 and Sec.4.

2.3.2 Where hopper doors are fitted on the vessel's centreline or where there is a centreline well for dredging gear (bucket ladder, suction tube etc.), a plate strake shall be fitted on each side of the well or door opening. The width shall not be less than 50% of the rule width of the flat keel, and the thickness shall not be less than that of the rule flat keel.

The same applies where the centreline box keel is located above the base line at such a distance that it cannot serve as a docking keel.

In this case, thickness of the bottom plating of the box keel, equal to the rule bottom shell plating, is acceptable.

2.3.3 The flat bottom plating of raked ends which deviate from common ship forms, shall have a thickness not less than that of the rule bottom shell plating within 0.4 L amidships, up to 500 mm above the maximum load waterline. The shell plating above that shall have a thickness not less than the rule side shell plating.

The reinforcements required in [2.3.1] shall be observed.

2.3.4 The corners of hopper door openings and of dredging gear wells shall comply with Pt.3 Ch.3 Sec.5 [5]. The design of structural details and welded connections in this area shall be carried out with particular care.

2.4 Single bottom - transversely stiffened

2.4.1 Abreast of hoppers and centreline dredging wells, the floors shall be dimensioned in accordance with Pt.3 Ch.6. The depth, in mm, of floor shall satisfy the following formula:

$$h \geq \max(45B - 45; 180)$$

2.4.2 Floors, longitudinal girders etc. below dredging machinery and pump seats shall be adequately designed for the additional loads.

2.4.3 Where floors are additionally stressed by the reactions of the pressure required for closing the hopper doors, their section modulus and their depth shall be increased accordingly.

2.4.4 Where the unsupported span of floors exceeds 3 m, one side girder shall be fitted with web net thickness, in mm, and flange sectional net area, in cm^2, shall satisfy:

$$t_w \geq 3.5 + 0.04\,L$$

$$A_f \geq 5 + 0.2\,L$$

Towards the ends, the web thickness and the sectional area of the flange may be reduced by 10%.

2.4.5 Floors in line with the hopper lower cross members fitted between hopper doors shall be connected with the hopper side wall by brackets of approx. equal legs. The brackets shall be flanged or fitted with face bars and shall extend to the upper edge of the cross members.

2.4.6 Floors of dredgers intended or expected to operate while aground shall be stiffened by vertical buckling stiffeners the spacing of which is such as to guarantee that the reference degree of slenderness λ for the plate field is less than 1.0. For λ see the Society's document DNVGL-CG-0128 Sec.3 [2.2.2].

2.5 Single bottom - longitudinally stiffened

2.5.1 The spacing of primary supporting bottom transverses is generally not to exceed 3.6 m. The gross offered section modulus, in cm^3, and gross offered web cross sectional area, in cm^2, shall not be less than determined by the following formulas:

$$Z_{gr} = e\ \ell^2\ |P|\ k$$

$$A_{gr} = k \cdot\ 0.061 \cdot e \cdot \ell \cdot |P|$$

where:

e = spacing, in m, of bottom transverses between each other or from bulkheads.

ℓ = unsupported span, in m, any longitudinal girders not considered.

P = design pressure for the considered design load set, see Pt.3 Ch.6 Sec.2 [2], calculated at the load calculation point defined in Pt.3 Ch.3 Sec.7 [2.2], in kN/m^2.

The web depth shall not be less than the depth of floors according to [2.4.1].

2.5.2 The bottom longitudinals shall be determined in accordance with Pt.3 Ch.6 Sec.5 [1].

2.5.3 Where the centerline box keel cannot serve as a docking keel, brackets shall be fitted on either side of the centre girder or at the longitudinal bulkheads of dredging wells and of hopper spaces. The brackets shall extend to the adjacent longitudinals and longitudinal stiffeners. Where the spacing of bottom transverses is less than 2.5 m, one bracket shall be fitted. For larger spacings, two brackets shall be fitted.

The thickness of the brackets shall at least to be equal to the web thickness of the adjacent bottom transverses. The brackets shall be flanged or fitted with face bars.

2.5.4 Where longitudinal bulkheads and the side shell are framed transversely, the brackets according to [2.5.3] shall be fitted at every frame and shall extend to the bilge.

2.5.5 The bottom transverses shall be stiffened by means of flat bar stiffeners at every longitudinal.

2.5.6 The bottom structure of dredgers intended or expected to operate while aground shall be dimensioned as follows:

— the spacing of the bottom transverses according to [2.5.1] shall not exceed 1.8 m. The webs shall be stiffened according to [2.4.6]
— the section modulus of the bottom longitudinals according to [2.5.2] shall be increased by 50%.

2.5.7 The requirements of [2.4.2] to [2.4.5] shall be applied analogously.

2.6 Double bottom

2.6.1 Fitting of double bottoms adjacent to the hopper spaces, is not required.

2.6.2 In addition to the requirements given in Pt.3 Ch.3 Sec.5 [6] and Pt.3 Ch.6, plate floors shall be fitted in way of hopper spaces intended to be unloaded by means of grabs.

2.6.3 Where brackets are fitted in accordance with [2.6.6], the requirements according to [2.5.3] and [2.5.4] shall be observed where applicable.

2.6.4 The bottom structure of dredgers intended or expected to operate while aground shall be strengthened as follows:

— Where transverse framing system is adopted, plate floors shall be fitted at every frame and the spacing of the side girders shall be reduced to half the spacing of what is required in [2.6.5].
— When the longitudinal framing system is adopted, and the longitudinal girders are fitted instead of longitudinals, the spacing of floors may be greater than five (5) times the mean longitudinal frame spacing, proven that adequate strength of the structure is proved. The required net plate thickness, t in mm, of the longitudinal girders shall not be less than obtained from the following formula:

$$t = \max\left(\left(5 + 0.03L\right)\sqrt{k}; 6.0\sqrt{k}\right)$$

Where applicable, [2.5.6] shall be applied analogously.

The net thickness of bottom plating shall be increased by 10%, compared to the plate thickness requirement given in Pt.3 Ch.6.

2.6.5 Bottom side girder arrangement

The distance of the side girders from each other and from centre girder and ship's side respectively shall not be greater than:

— 1.8 m in the engine room within the engine seatings
— 4.5 m where one side girder is fitted in the other parts of double bottom
— 4.0 m where two side girders are fitted in the other parts of double bottom
— 3.5 m where three side girders are fitted in the other parts of double bottom.

2.6.6 Brackets

Where the ship's sides are framed transversely flanged brackets having same thickness as of the floors shall be fitted between the plate floors at every transverse frame, extending to the outer longitudinals at the bottom and inner bottom.

One bracket shall be fitted at each side of the centre girder between the plate floors where the plate floors are spaced not more than 2.5 m apart. Where the floor is greater, two brackets shall be fitted.

2.7 Hopper and well construction

2.7.1 Plating

The net plate thickness, in mm, shall not be less than determined by the following formula:

$$t = \max\left(1.21b\sqrt{|P|k};t_{\min}\right)$$

where:

b = breadth of plate panel, in mm, as defined in Pt.3 Ch.3 Sec.7 [2.1.1]

t_{min} = minimum plate thickness, in mm, as defined in Pt.3 Ch.6 Sec.3 [1], Pt.3 Ch.6 Sec.3 [2] and Pt.3 Ch.6 Sec.3 [3]

P = design pressure on hopper and well constructions for the considered design load set, see Pt.3 Ch.6 Sec.2 [2], calculated at the load calculation point defined in Pt.3 Ch.3 Sec.7 [2.2], in kN/m^2.

2.7.2 Stiffeners

The net section modulus, in cm^3, of stiffeners shall not be less than required in Pt.3 Ch.6 Sec.5.

2.7.3 The strength shall not be less than that of the ship's sides. Particular attention shall be paid to adequate scarfing at the ends of longitudinal bulkheads of hopper spaces and wells.

The top and bottom strakes of the longitudinal bulkheads shall be extended through the end bulkheads, or else scarfing brackets shall be fitted in line with the walls in conjunction with strengthening at deck and bottom.

Where the length of wells does not exceed 0.1 *L* and where the wells and/or ends of hopper spaces are located beyond 0.6 *L* amidships, special scarfing is, in general, not required.

2.7.4 In hoppers fitted with hopper doors, transverse girders shall be fitted between the doors the spacing of which is normally not to exceed 3.6 m.

2.7.5 Primary supporting members

The depth of the transverse girders spaced in accordance with [2.7.4] shall not be less than 2.5 times the depth of floors as defined in [2.7.6]. The web plate thickness shall not be less than the thickness of the side shell plating. The top and bottom edges of the transverse girders shall be fitted with face plates. The thickness of the face plates shall be at least 50% greater than the rules web thickness.

Where the transverse girders are constructed as watertight box girders, the scantlings shall not be less than required according to [2.7.1] to [2.7.4]. At the upper edge, a plate strengthened by at least 50% shall be fitted.

2.7.6 The depth, in mm, of floors plates is defined as:

$$h \geq \max(45B - 45; 180)$$

2.7.7 Vertical stiffeners spaced not more than 900 mm apart shall be fitted at the transverse girders.

2.7.8 The transverse bulkheads at the ends of the hoppers shall extend from board to board.

2.7.9 Regardless of whether the longitudinal or the transverse framing system is adopted, web frames in accordance with Pt.3 Ch.6 Sec.6 shall be fitted in line with the transverse girders according to [2.7.4].

The density of the spoil shall be considered when determining the scantlings.

2.7.10 Strong beams shall be fitted transversely at deck level in line with the web frames according to [2.7.9]. The scantlings shall be determined, for the actual loads complying with an equivalent stress, in N/mm^2, of:

$$\sigma_{vm} \leq 0.65 R_{eH}$$

The maximum reactions of hydraulically operated rams for hopper door operation are, for instance, to be taken as actual load.

The strong beams shall be supported by means of pillars according to Pt.3 Ch.6 Sec.6 [3] at the box keel, if fitted.

2.7.11 On bucket dredgers, the ladder wells shall be isolated by transverse and longitudinal cofferdams at the bottom, of such size as to prevent the adjacent compartments from being flooded in case of any damage to the shell by dredging equipment and dredged objects. The cofferdams shall be accessible.

2.8 Box keel

2.8.1 Bottom plating

- Where the box keel can serve as a docking keel, the requirements for flat plate keels according to Pt.3 Ch.6 Sec.3 [1.1] and Pt.3 Ch.3 Sec.5 [6] apply.
- Where the box keel cannot serve as a docking keel (see also [2.3.2]), the requirements for bottom plating according to Pt.3 Ch.6 Sec.3 [1.1] and Pt.3 Ch.6 Sec.4 [1] apply.

2.8.2 Plating other than bottom plating

- Outside the hopper space, the requirements for bottom plating according to Pt.3 Ch.6 Sec.3 [1.1] and Pt.3 Ch.6 Sec.4 [1] apply.
- Within the hopper space the requirements for hopper space plating according to [2.7.1] apply. The thickness of the upper portion particularly subjected to damage shall be increased by not less than 50%.

2.8.3 Floors

The requirements according to [2.4.1] and [2.4.2] respectively apply.

2.8.4 Stiffeners

The requirements for hopper stiffeners according to [2.7.2] apply.

2.8.5 Primary supporting members

Strong webs of plate floors shall be fitted within the box keel in line with the web frames according to [2.7.9] to ensure continuity of strength across the vessel.

2.8.6 With regard to adequate scarphing at the ends of a box keel, [2.7.3] shall be observed.

3 Systems and equipment

3.1 Stern frame

3.1.1 Where dredgers with stern wells for bucket ladders and suction tubes are fitted with two rudders, the stern frame scantlings shall be determined in accordance with Pt.3 Ch.10 Sec.6 [2].

3.2 Rudder stock

3.2.1 Where dredgers are fitted with auxiliary propulsion and their speed does not exceed 5 kn at maximum draught, the value V_0 = 7 kn shall be taken for determining the rudder stock diameter.

3.3 Anchoring and mooring equipment

3.3.1 The equipment of anchors, chain cables, wires and recommended ropes for dredgers for unrestricted service area having normal ship shape of the underwater part of the hull shall be determined in accordance with Pt.3 Ch.11 Sec.1.

When calculating the equipment number according to Pt.3 Ch.11 Sec.1 [3], bucket ladders and gallows need not to be included. For dredgers of unusual design of the underwater part of the hull, the determination of the equipment requires special consideration.

The equipment for dredgers for restricted service area shall be determined according to the service notations given in Pt.3 Ch.11 Sec.1 [3.2].

3.3.2 The equipment of non self-propelled dredgers shall be determined as for barges, in accordance with Ch.11 Sec.3.

3.3.3 Considering rapid wear and tear, it is recommended to strengthen the anchor chain cables which are also employed for positioning of the vessel during dredging operations.

3.3.4 Dredgers intended to work in conjunction with other vessels shall be fitted with strong fenders.

4 Fire safety

4.1 Closed hopper spaces

4.1.1 On dredgers with closed hopper spaces suitable structural measures shall be taken in order to prevent accumulation of inflammable gas-air mixture in the hopper vapour space. The requirements given in Pt.4 Ch.8 *Electrical installations*, shall be observed.

5 Openings and closing appliances

5.1 General requirements

5.1.1 Where a dredger freeboard is assigned in accordance with [1.3.3], the length L_{LL}, draught T_{LL} and block coefficient $C_{B\text{-}LL}$ according to Pt.3 Ch.1 Sec.4 [3.1] shall be determined for this freeboard.

5.2 Bulwark, overflow arrangements

5.2.1 Bulwarks shall not be fitted in way of hoppers where the hopper weirs discharge onto the deck instead of into enclosed overflow trunks. Even where overflow trunks are provided, it is recommended not to fit bulwarks.

If bulwarks are fitted, freeing ports shall be provided throughout their length. They shall be of sufficient width to permit undisturbed overboard discharge of any spoil spilling out of the hopper in the event of rolling.

5.2.2 Dredgers without restricted service range notation shall be fitted with overflow trunks on either side suitably arranged and of sufficient size to permit safe overboard discharge of excess water during dredging operations.

The construction shall be such as not to require cut-outs at the upper edge of the sheer strake. Where overflow trunks are carried through the wing compartments, they shall be arranged such as to pierce the sheer strake at an adequate distance from the deck.

5.2.3 Dredgers with restricted service area notation may have overflow arrangements which permit discharge of excess water during dredging operations onto the deck.

SECTION 13 PUSHERS

Symbols

For symbols and definitions not defined in this chapter, see Pt.3 Ch.1 Sec.4.

1 Introduction

1.1 General

These rules provide requirements for ships specially intended for pushing.

1.2 Scope

The rules in this section give requirements for hull strength, and systems and equipment, applicable to a pusher.

1.3 Application

1.3.1 Vessels built in compliance with the relevant requirements in this section may be given the class notation **Pusher**.

1.3.2 A pusher vessel intended for operation in combination with a number of barges/pontoons specially designed to accommodate the pusher will be subject to special consideration. Additional requirements to the barge/pontoon is given in Ch.11.

1.3.3 For a pusher/barge or a pusher/pontoon combination the identification numbers of the barges/ pontoons associated with the pusher will be given in the appendix to classification certificate.

2 Definitions

2.1 Terms

Table 1 Definitions of terms

Term	*Definition*
type I pusher barge/ pontoon unit	The connection between the pusher and the barge/pontoon is assumed to be rigid, i.e. it should be designed to transmit the static and dynamic shearing forces and bending moments in such a manner that the combination behaves like one integrated structure
type II pusher barge/ pontoon unit	The connection between the pusher is free to heave and/or pitch relatively to the barge/ pontoon. This type of connection will normally not be applicable under severe sea conditions or in ice-infested waters.

3 Subdivision arrangement design

3.1 Subdivision arrangement

3.1.1 Watertight bulkhead arrangement

The pusher shall have a number of transverse bulkheads corresponding to its own length, as given in Pt.3 Ch.2 Sec.2 [4].

4 Hull

4.1 General

4.1.1 The pusher shall be regarded as a separate unit and the hull structural strength is in general to be as required for the main class.

4.1.2 When the pusher is connected as an integrated part of a combined system (pusher/barge unit or pusher/pontoon unit), the hull scantlings of exposed parts of the pusher shall satisfy the main class rules for aft structures as calculated for the combined unit.

4.1.3 Pushers being part of a flexible system, type II, shall be equipped also for towing the barge/pontoon.

4.2 Draught for scantlings

For determining the scantlings of strength members based on the vessel's draught, the latter shall not be taken less than 0.85 D.

4.3 Structure in the forebody

4.3.1 The structure in the forebody shall be satisfactorily reinforced to sustain the reaction forces occurring during the pushing operation. For complex structures stress analysis shall be carried out to show that the stress level will be within acceptable limits.

4.3.2 In combined pusher/barge or pusher/pontoon systems the connection forces and allowable stresses shall comply with the requirements given in Ch.11 Sec.2 [10.4].

4.3.3 In combined pusher/barge or pusher/pontoon systems the deflections of the structure during operation shall be limited to avoid hammering when pusher/barge or pusher/pontoon units are heeled.

5 Equipment

5.1 Rudder

The design rudder force on which scantlings shall be based, shall be calculated as indicated for the main class. The speed of the vessel is however not to be taken less than V = 10 knots.

5.2 Steering gear

The steering gear shall be capable of bringing the rudder from 35 degrees on one side to 30 degrees on the other side in 20 seconds, when the vessel is running ahead at maximum service speed. For the combined pusher/barge unit, the requirement is 28 seconds.

5.3 Anchoring and mooring

Pushers shall have anchoring and mooring equipment corresponding to its equipment number, see Pt.3 Ch.11 Sec.1 [3.1]. The term 2 BH in the formula may, however, be substituted by:

$$2(aB + \Sigma\, h_i b_i)$$

where:

b_i = breadth, in m, of the widest superstructure or deckhouse of each tier having a breadth greater than $B/4$.

SECTION 14 SLOP RECEPTION VESSEL

1 Introduction

1.1 Introduction

1.1.1 These rules provide requirements for vessels intended to serve as floating facilities for reception and processing of oily water and oil residues.

1.2 Scope

1.2.1 These rules include requirements for hull strength, systems and equipment and procedures applicable to vessels serving as a floating facility for reception and processing of oily water and oil residues.

1.2.2 The classification of the facility will be based upon the following assumptions:

— That oily water and oil residues originating from oil with flash point below 60°C are considered to maintain a flash point below 60°C and that such liquids are not transferred to the facility's engine room.
— That transfer of oily water and oil residues between delivery vessel and the facility is only done under favorable weather conditions.
— That the facility is operated by qualified personnel.
— That a two-way communication system is provided between the delivery vessel and the facility during the transfer operation, ensuring reliable and direct contact with the personnel controlling the transfer pump.

1.2.3 The above basic assumptions will be stated in the appendix to the classification certificate.

1.3 Application

1.3.1 The rules in this chapter apply to newbuildings as well as to conversions of existing vessels to serve as floating facilities for reception and processing of oily water and oil residues. The subsequent requirements shall be regarded as supplementary to the requirements for main class and relevant requirements as given in Ch.5 for ships intended for carriage of oil with flashpoint below 60°C.

1.3.2 Facilities designed and built, surveyed and tested in compliance with the requirements in this section and other relevant requirements may be given the class notation **Slop reception vessel**.

1.3.3 The classification is aimed at safety against hazards to the personnel, the facility and the environment.

1.3.4 The assignment of class will be based upon:

— approval of documentation i.e specifications, plans, calculations, etc.
— approval of the instruction manuals for the facility
— inspection during manufacturing of materials and equipment
— inspection during construction, installation and testing of the facility
— inspection upon completion, including testing of the separating system for proper function.

Guidance note:

In addition to the requirements of the Society, relevant requirements in the regulations of national authorities will have to be complied with in connection with the registration and or location of the facility.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

1.3.5 In addition to the relevant parts of the documentation as required for oil tankers in Ch.5 Sec.1 [4.2], the following shall be submitted for approval:

— drawings and specification for the separating system
— drawing of the fendering arrangement
— specification of transfer hoses
— drawings of deck lightning arrangement
— instruction manuals for the facility.

1.3.6 The following control and monitoring systems shall be approved by the Society:

— oil separating system
— fire extinguishing system
— fire detection system
— inert gas system.

For requirements to documentation, see Pt.4 Ch.9.

1.3.7 The following control and monitoring system shall be certified according to Pt.4 Ch.9:

— oil separating system
— fire detection system
— inert gas system.

2 Hull strength and arrangement

2.1 General requirements

2.1.1 In addition to the hull strength requirements of the rules for main class, the following shall be given special consideration:

— Additional openings in strength members. The local strength shall be considered in connection with openings and cut-outs in deck, bulkheads, etc.
— Loading conditions. The longitudinal strength shall be satisfactory for all relevant loading conditions and conditions during transfer to new location. In addition to a loading manual, the facility shall be equipped with a loading instrument.
— Tank pressure. The local strength shall be considered for increased internal pressure in the tanks caused by the separating process.

2.1.2 An efficient fender arrangement, effectively supported by hull strength members, shall be fitted. The fenders shall be able to keep the hulls of the delivery vessel and the reception facility apart at a safe distance, at least 3 meters. The fenders shall efficiently prevent steel to steel contact, in order to avoid risk for sparks.

2.1.3 The vessel shall comply with all requirements of MARPOL Annex I as applicable for an oil tanker, unless alternative acceptance is obtained from the flag and port state(s) in the area in which the vessel is going to operate. The requirements to double hull and segregated ballast are however considered to be minimum requirements. It is recognized that for vessels primarily operating within port limits or MARPOL Annex I special areas, certain requirements, such as those to oil discharge monitoring systems may not be applicable, provided all tank washings and oily mixtures are discharged to shore or alternative means for preventing discharge of oil to sea are provided.

2.2 Transfer arrangement for transfer of oily water and oil residues

2.2.1 The minimum bursting pressure for the hose assembly shall be 20 bar. The maximum allowable working pressure shall be at least 8 bar.

2.2.2 Hose diameters shall be sufficient for the maximum specified transfer rate for the facility in order to avoid excessive pressure drop. Hoses shall be suspended by suitable equipment. Excessive bending of the hoses shall be avoided.

2.2.3 A pressure gauge shall be fitted in the transfer line, before the reception tanks.

2.2.4 It shall be possible to drain or close mechanical loading arms or hoses before disconnection. Coamings of suitable height shall be arranged below manifolds and hose connections in order to minimize spill.

2.3 Lightning

2.3.1 Deck lighting shall be arranged. Adequate illumination shall be provided:

— for the transfer area to facilitate control and handling of the equipment
— for the fire extinguishing equipment
— for visual observation of possible oil in the processed water being discharged to the sea (see [2.4.4]).

2.4 Separating system

2.4.1 The separating system shall be designed to reduce the oil content in the water being discharged into the sea to a concentration not exceeding 15 parts per million or any other lower value specified by the builder/owner. The actual design performance will be stated in the appendix to the classification certificate for the facility.

2.4.2 Precautions shall be taken to avoid overpressuring of the process tanks. When the separating system is arranged for pumping oil/water into a tank or series of tanks which by the design of the process piping arrangement will operate in the full condition, an overflow pipe with sectional area at least 25% greater than the area of the filling pipe shall be arranged from the first tank to another tank with surplus capacity.

2.4.3 Means for locating the oil/water interface in the tanks shall be provided.

2.4.4 Visual control of oil content in the processed water being discharged into the sea shall be possible by observing the sea surface at the outlet. Visual inspection of the surface in the last separating tank may alternatively be accepted.

2.4.5 Discharges of processed water from the separating process shall take place above waterline.

2.4.6 The maximum flow rate through the separating tanks shall be specified in the instruction manuals for the types of oil in question (different gravities, etc.).

2.4.7 Arrangements for handling and storage of sediments and separated oil residues shall comply with applicable requirements for cargo systems on oil tankers as given in Ch.5 of the rules.

2.5 Oil content monitoring

2.5.1 Automatic monitoring of oil content in the processed water shall be arranged. When the specified limit is exceeded, automatic stop of the discharge and an alarm shall be activated.

2.5.2 The oil content meter shall be type tested in accordance with relevant IMO specifications and guidelines (Res. MEPC.107(49) or revised version of the same).

2.5.3 The oil content monitor shall be located outside gas dangerous spaces or zones unless the monitor is certified safe.

2.6 Protection against fire and explosion

2.6.1 Precautions shall be taken to prevent hydrocarbon gas from the delivery vessel to enter gas-safe spaces or zones on the facility and vice versa. The location and the periodical closing of doors and air intakes for ventilating systems, etc., shall be considered as well as the provision of air locks.

2.6.2 Means for preventing sparks from the funnel of the facility to reach gas dangerous spaces or zones (i.e. spark arrester) shall be provided.

2.6.3 The fire protection, extinguishing and detection arrangements shall in general comply with the relevant requirements of Ch.5 for oil tankers.

2.6.4 A fixed deck foam system in accordance with SOLAS Ch. II-2 Reg.10.8 and FSS Code Ch.14 shall be installed.

2.6.5 An inert gas system complying with the rules for the class notation **Inert** shall be arranged for supplying inert gas to all tanks which may contain hydrocarbon gases under normal operating conditions.

2.6.6 The capacity of the inert gas plan shall be at least 25% greater than the maximum discharge rate for processed water.

2.6.7 Electrical installations shall comply with applicable requirements in Ch.5.

2.6.8 Oil residues with flash point above 60°C originating from engine rooms may be transferred to tanks within the facility’s engine room, and may be burnt or incinerated within the engine room.

3 Operational instructions and log book

3.1 Instruction materials

3.1.1 Instruction manuals for the facility shall be prepared and kept onboard. The manuals are subject to approval by the Society. The manuals shall contain necessary information on:

— operation
— maintenance
— testing
— identification of faults
— repair.

For the following equipment and systems:

— fire detection and extinguishing equipment
— inert gas system
— O_2-content analyzer
— oily water and oil residues transfer arrangement
— oil content monitoring system
— other equipment onboard necessary for a safe and pollution-free operation

— the complete separating system, including possible limitations (pumping rates, types of oil, etc.).

3.1.2 The instruction manuals shall also contain relevant information about the operational procedures to be applied onboard, such as:

— mooring
— safety actions (required closing of doors and ventilating intakes, etc.) to be carried out before commencing the transfer between the delivery vessel and the facility
— general procedures for operation of the separating system and the inert gas system.

3.1.3 The operational procedures shall include the following:

— The O_2-content of storage and separating tanks which are not completely filled, shall be checked upon discharge, and in any case at least twice a week.
— Two-way communication between the reception facility and the delivery vessel shall be established before the transfer commences.
— Before discharge into the sea is begun, visual inspection of the surface (see [2.4.4]) shall be carried out and the automatic oil content monitor checked and started.

3.1.4 The maintenance procedures shall include:

— Intervals for checking and maintenance of the exhaust spark arrestors.

3.2 Safety and oily water/oil residues log book

Guidance note:

For the purpose of record keeping and for documentation versus local/national authorities it is recommended that the following guidelines are complied with:

1) General.

The facility should be provided with a safety and oily water/oil residues log book.

The officer in charge of the operations concerned should be responsible for the entries in the log book. The log book should be kept onboard available for inspection.

The log book entries should be kept onboard for a period of at least three years.

2) Entries in the log book.

The log book should be arranged for entries of the following which should be recorded without delay:

- before the transfer operations are commenced:
  - what will be transferred
  - stipulated pumping rate
  - total volume to be transferred
  - safety actions carried out
  - rate of transfer
  - total volume to be transferred
  - weather conditions during transfer
- volume and the exact time when processed water is discharged into the sea
- exact time when the oil content in the processed water being discharged into the sea exceeds the specified limit
- internal transfer of oily water and oil residues
- use of the inert gas plant
- result and the exact time of checking O2-content in the tanks
- inspection and testing of fire detection and extinguishing equipment
- inspection and maintenance of the inert gas plant
- inspection and maintenance of the exhaust spark arrester
- inspection and maintenance of the transfer arrangement
- inspection and maintenance of the oil content monitor.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

SECTION 15 REFRIGERATED CARGO VESSELS

1 Introduction

1.1 Introduction

1.1.1 These rules provide requirements for vessels intended to carry refrigerated cargoes.

1.2 Scope

1.2.1 These rules include the class notations and references to the requirements for refrigerated cargo vessels.

1.3 Application

1.3.1 The rules, as relevant, in this chapter apply to ships with refrigerating plants for:

— carriage of refrigerated dry cargo
— carriage of fruit or vegetables under a controlled atmosphere
— carriage in bulk of refrigerated fruit juices and similar liquid cargoes

when a class notation in [1.4] is requested.

1.4 Class notations

1.4.1 Ships designed, built, equipped and tested under the supervision of the Society in compliance with the requirements of this chapter and the requirements to class notation **RM(X°C/Y°C sea)** in Pt.6 Ch.4 Sec.9 may be given one of the additional class notations in [1.4.2] and [1.4.3].

1.4.2 Ships primarily constructed for the for carriage of refrigerated dry cargo may be given the class notation **Reefer RM(X°C/Y°C sea)**.

1.4.3 Ships primarily constructed for the carriage of fruit juices and similar cargoes in bulk in refrigerated tanks shall be given the class notation **Refrigerated fruit juice carrier RM(X°C/Y°C sea)** provided they also comply with relevant parts of the rules in Ch.6 (e.g. for cargo handling systems and independent cargo tanks).

Guidance note:

For dry cargo ships having a partial cargo carrying capacity for refrigerated cargo or fishing vessels with refrigerating plant for cooling or freezing catches of fish, the class notation **RM(X°C/Y°C sea)** as specified in Pt.6 Ch.4 Sec.9 may be assigned.

For ships built and fully equipped for carriage of bananas and fruit in general under a controlled cargo chamber atmosphere in at least 50% of the ship's total refrigerated cargo chamber volume may be given the class notation **CA** as specified in the rules Pt.6 Ch.4 Sec.9 may be assigned.

For ships built and equipped for carriage of bananas and fruit in general under a controlled cargo chamber atmosphere in at least 50% of the ship's total refrigerated cargo chamber volume except that a nitrogen generating unit and possibly parts of the alarm and monitoring equipment have not been permanently installed may be given the class notation **CA(port.)** as specified in the rules Pt.6 Ch.4 Sec.9 may be assigned.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

2 Operational performance

2.1 General

2.1.1 The ship shall be designed, arranged and equipped to make it suitable for cooling down and/or carrying cargo, freezing catches of fish etc. as relevant according to the design operating conditions specified by the builders and subsequently to be stated in the appendix to the classification certificate. The builders' and possible subcontractors' specifications of the ship's operational performances and abilities will together with the specific requirements of this chapter be used as basis for assignment of class.

SECTION 16 TANKER FOR POTABLE WATER

1 General

1.1 Objective

These rules establishes requirements for vessels intended to carry potable water in bulk.

1.2 Scope

The rules in this chapter provide requirements to material, tank arrangement and piping systems with the objective of assuring transport in bulk of potable water with minimal risk of contaminating the cargo or otherwise reduce delivered quality.

Guidance note:

The quality of the water loaded may comply with the directive 98/83/EC of the European Union or with a quality standard specified by the receiving country or port.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

1.3 Application

These rules apply to vessels dedicated to the transportation of potable water. The requirements shall be regarded as supplementary to those given for the assignment of main class.

1.4 Class notation

Vessels complying with the requirements of this section may be assigned the class notation **Tanker for potable water**.

1.5 Assumption

It is assumed that cargo tanks are not used for any other purpose than transport of potable water except under emergency conditions.

2 Documentation

2.1 General

2.1.1
The following plans and particulars shall be submitted:

Table 1 Documentation

Object	*Documentation type*	*Additional description*	*Info*
General arrangement	Z010 - General arrangement plan	Including: - Cargo hatches, Butterworth hatches and any other opening to cargo tank. - Cargo pipes over the deck with shore connections including stern pipes for cargo discharge and loading.	FI
Cargo piping arrangements	S010 - Piping diagram (PD)	Including cargo stripping system. For vacuum stripping systems, details shall include termination of air pipes and openings from drain tanks and other tanks.	AP
	C030 - Detailed drawing	Cargo pump (s)	AP
Cargo tank venting system	S010 - Piping diagram (PD)		AP
Cargo tank level measurement system	I200 - Control and monitoring system documentation		AP
	Z030 - Arrangement plan	Shall indicate type and location of level indicators.	FI
Specification of tank coating with certificate of acceptance for toxicity and tainting testing by recognised laboratory or health authority	Z261 - Test report		FI
Specifications of metallic and non-metallic materials in contact with the cargo	M010 - Material specification, metals	Yard's declaration of materials in contact with cargo.	FI

2.1.2
For general requirements for documentation, including definition of the info codes, see DNVGL-CG-0550 Sec.6.

2.1.3
For full definition of the documentation types, see DNVGL-CG-0550 Sec.5.

2.1.4
For general requirement for documentation of instrumentation and automation, including computer based control and monitoring, see Pt.4 Ch.9 Sec.1 Table 5.

2.2 Certification requirements

2.2.1
The following control and monitoring system shall be approved by the society: Documentation shall be submitted as required by Table 2

Table 2 Certification requirements

Object	*Certificate type*	*Issued by*	*Certification standard* [1)]	*Additional description*
Water quality instrument	PC	Society		
1) Unless otherwise specified the certification standard is the Society`s rules. PC = product certificate, MC = material certificate, TR = test report				

2.2.2
For full definition of the documentation types, see DNVGL-CG-0550 Sec.5.

2.2.3
For full definition of certificate types, see DNVGL-CG-0550 Sec.4.

2.3 Surveys and Testing

2.3.1 General

2.3.1.1
All systems and installations covered by this section shall be surveyed and tested to the satisfaction of the surveyor.

3 Requirement for carriage of potable water

3.1 Material

3.1.1 Cargo piping and cargo tank materials

3.1.1.1
Materials in contact with water, including coatings shall not give off harmful substances in contact with water nor cause tainting or discoloration.

3.1.1.2
For non-metallic materials and coatings documentation showing their suitability for use in contact with water intended for human consumption shall be submitted, e.g. test documentation according to BS 6920 or equivalent.

3.2 Tank Arrangement

3.2.1 Cargo tanks

3.2.1.1
Cargo tanks shall be separated from tanks containing fuel oil, lubricating oil or any other liquid, except ballast water, by mean of cofferdams.

3.2.1.2
Cargo tanks shall be provided with means to guard against liquid rising in the venting system to a height which will exceed the design head of cargo tanks. This shall be accomplished by high level alarms or overflow control systems or other equivalent means.

3.2.2 Ballast tanks

The vessel shall have sufficient segregated ballast capacity in order to enable safe operation under all conditions in normal operation of the vessel, i.e. sufficient for propeller submergence and draught forward in accordance with Pt.3 Ch.10.

3.3 Piping System

3.3.1 Cargo piping and tank vent

3.3.1.1
Cargo piping shall be separated from all other piping systems, i.e. no physical connection is allowed.

3.3.1.2
Tank vents shall be designed so as to prevent ingress of sea water.

3.3.1.3
The height of cargo tank vent outlets shall comply with load line requirements.

3.3.1.4
The venting system may consist of individual vents from each tank or vents from each individual tank may be connected to a common header.

3.3.1.5
Hydraulically operated valves shall not be located inside cargo tanks unless the hydraulic fluid used is harmless to the water quality in case a leakage should occur.

3.3.1.6
Submerged cargo pumps are not accepted if leakage of hydraulic fluid or lubricants may contaminate the cargo.

CHANGES – HISTORIC

July 2019 edition

Changes July 2019, entering into force 1 January 2020

Topic	*Reference*	*Description*
New requirements for towing, anchor handling and lifting in the International Code on Intact Stability (2008 IS Code), effective from 2020-01-01	Sec.1 Table 4	Documentation for Crane vessel, Lifting operational and planning manual has been added for approval, see Sec.2 [4.4.1].
	Sec.2 [4]	For notation **Crane vessel**, most of the stability requirements have been replaced with references to new requirements in the International Code on Intact Stability, 2008 (2008 IS Code).
	From Sec.11 [5.1.3] to Sec.11 [5.1.6] and Sec.11 [6.6.1	For notation **Tug** and **Escort tug**, the stability parts have generally been replaced with references to new requirements in the International Code on Intact Stability, 2008 (2008 IS Code).
Sounding systems for ballast tanks	Sec.5 [3.3	Requirements for remote sounding systems moved from Pt.4 Ch.6.
Overall strength of substructure in fore ship	Sec.10 [7]	Updates on the following: — Formulation of design vertical ice force at the stem and introducing new class factors for this purpose. — Position of load application considering the most unfavourable draughts. — Formulation of the extent of load distribution along the stem. — Direct calculation and acceptance criteria.
	Sec.10 [8.1]	Design vertical shear force and bending moment are updated to consider the new design vertical ice force formulation.

July 2018 edition

Changes July 2018, entering into force 1 January 2019

Topic	*Reference*	*Description*
Review of requirements for semi-submersible heavy lift vessels	Sec.5	The main improvements of this review are: — clarification of submerged operating — the wave load analyses are now linked to operational conditions — clarification of design loads for damages and submerged conditions and water ballast tanks — clarification of scope of FE and fatigue analyses.
General restructure and update of rule text focus	Sec.6	Updated entire section.
	Sec.6 [2]	New subsection with general requirements.

Topic	*Reference*	*Description*
Renamed ship type notation	Sec.6 [1.3.1]	Changed name of notation **Diving Support Vessel** to **DSV**.
New qualifier **OCS**	Sec.6 [1.3.1]	Qualifier for vessel with saturation diving system classed by another IACS member.
New qualifier **Ready**	Sec.6 [1.7]	General requirements.
	Sec.6 [6.2.2]	Requirements for capacity of gas storage.
	Sec.6 [7.1]	Requirements for main and emergency source of power.
Update of rule requirements for diving support vessels	Sec.6 [1.3.7]	**DSV(SAT)** or **DVS(OCS)** made mandatory class notations for saturation diving systems on board DNV GL classed vessels.
	Sec.6 [2.2.3]	System design principles for diving systems. Redundancy requirements from design philosophy.
	Sec.6 [4]	Added guidance on how to handle vessels with class notation **SPS** with respect to stability. Added requirements to assess physical locations of essential equipment after damage and how to recover the diving bell.
	Sec.6 [8.3]	Added requirement to split the extinguishing zones within the outer area. Added requirement for ingress protection rating within the control rooms protected by water based extinguishing systems.
	Sec.6 [3.1.2]	Clarification of loads to be applied in the deck deflection study and of the extent of model to be discussed with class.

January 2018 edition

Changes January 2018, entering into force 1 July 2018

Topic	*Reference*	*Description*
New ship type notation - **Tanker for potable water**	Sec.16	For vessels intended to carry potable water in bulk.

July 2017 edition

Changes July 2017, entering into force 1 January 2018

Topic	*Reference*	*Description*
Methods for establishing escort rating number for escort tugs	Sec.11 [1.3] and Sec.11 [1.4]	Introduction of additional qualifiers and definitions
	Sec.11 [6.8] to Sec.11 [6.10]	Introduction of additional qualifiers and definitions
Removed class requirements to tricing winch	Sec.11 [3.6.4] and Sec.11 [3.7.5]	Deletion of paragraph

Topic	Reference	Description
winch drum requirements	Sec.11 [3.7.2]	For smaller tugs this requirement was not practicable due to smaller necessary winches.
Loadline requirements	Sec.11 [5.2]	Rephrased and aligned to general loadline requirements for ships and introduced special requirements for side scuttles and windows. Introduced special requirements for ventilation of machinery space applicable to small tugs and tugs in domestic trade.
Requirements to Propulsion system	Sec.11 [6.4]	Clarification and adding requirement for escort tugs
Restructuring of Section 11	Sec.11 [1.3.2]	Moved to Sec.11 [6.2.3]
	Sec.11 [1.3.3]	Moved to Sec.11 [6.3.2]
	Sec.11 [1.3.4]	Moved to Sec.11 [6.2.4]
	Sec.11 [1.5]	Moved to Sec.11 [6.9] (including all sub-paragraphs)

January 2017 edition

Main changes January 2017, entering into force July 2017

• Sec.2 Crane vessels

— Sec.2 [4.4.4]: Correction has been made to the explanation of A_{RL} and A_{HL}.

• Sec.10 Icebreaker

— Sec.10 [5.1]: Table reference Pt.6 Ch.6 Sec.5 Table 8 has been added to be aligned with Pt.6 Ch.6 Sec.5.
— Sec.10 Table 1: Minor adjustments have been made to be aligned with IACS Polar class requirements, UR 12.

July 2016 edition

Main changes July 2016, entering into force as from date of publication

• Sec.1 General

— Sec.1 [2.1]: Class notation Pipe laying vessel is added to the table.

• Sec.5 Semi-submersible heavy transport vessel

— Sec.5 [2.1]: Changing acceptance criteria to AC-II, with reduced dynamic wave loads in temporarily submerged condition and in aft loading/aft-unloading condition (non-submerged condition). Permissible stresses will be based on AC-II.
— Sec.5 [2.2]: Changing acceptance criteria to AC-II, with reduced dynamic wave loads in temporarily submerged condition and in aft loading/aft-unloading condition (non-submerged condition). Permissible stresses will be based on AC-II.

— Sec.5 [2.3]: Changing acceptance criteria to AC-II, with reduced dynamic wave loads in temporarily submerged condition and in aft loading/aft-unloading condition (non-submerged condition). Permissible stresses will be based on AC-II.
— Sec.5 [2.4]: Changing acceptance criteria to AC-II, with reduced dynamic wave loads in temporarily submerged condition and in aft loading/aft-unloading condition (non-submerged condition). Permissible stresses will be based on AC-II.

• Sec.7 Seismographic research vessels

— Sec.7 [3.1.2]: Improvement of the minimum GM value used in racking analysis is needed to be in line with minimum value given in Pt.3 Ch.4. Some minor improvement and clarifications of the racking moment calculation is also needed.
— Sec.7 [3.1.3]: Correction typo.
— Sec.7 [3.1.5]: Missing requirement related to general FE load application included.
— Sec.7 [3.2.2]: Requirements for design load sets for beam analysis has been included.
— Sec.7 [3.2.3]: New paragraph: Design Load sets for beam analysis.

• Sec.10 Icebreaker

— Sec.10 [3.2]: Figure 1 has been amended with respect to hull area extensions for aft ship region in order to get it aligned with the rule text given in [3.2].
— Sec.10 [5.1]: Hull Area Factors (AF) for ships with class notation Icebreaker with thrusters/podded propulsion.

• Sec.12 Dredgers

— Sec.12 [2.6.3]: The January 2016 version was missing the requirements to brackets in double bottom. During the merging of the LGL rules these requirements were by mistake forgotten. The requirements are still valid.
— Sec.12 [2.6.6]: New paragraph: Brackets.

• Sec.14 Slop reception vessel

— Sec.14 [1.3.2]: Requirements for Slop Reception Vessels are included in the rules due to customer interest (copied from legacy DNV Rules).
— Sec.14 [2.1.3]: New requirement regarding compliance with MARPOL AnnexI.

• Sec.15 Refrigerated cargo vessels

A section Refrigerated Cargo Vessels is included in the Rules due to customer interest in Fruit Juice Carriers and other refrigerated fruit vessels.

January 2016 edition

This document supersedes the October 2015 edition.

Main changes January 2016, entering into force as from date of publication

• Sec.10 Icebreaker

— [5]: Old Table 1 is deleted since the ramming speed, V_{ram}, is not applied in any formula.
— Table 2: Hull area factors for podded/thruster propulsion was missing and is now included.

— [7.2]: The requirements for overall strength of substructure in the fore ship has been amended.

October 2015 edition

This is a new document.

The rules enter into force 1 January 2016.