RULES
FOR THE CLASSIFICATION AND CONSTRUCTION OF STATIONARY FLOATING OBJECTS

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GDAŃSK

The Rules for the Classification and Construction of Stationary Floating Objects have been approved by the PRS SA Board on 28 September 2020 r. based on the Technical Committee Resolution No. 1/20 of 8 September 2020 and enter into force on 1 October 2020.

The Rules are extended and supplemented by the below publications:

Publication 23/P – Pipelines Prefabrication
Publication 51/P – Procedural Requirements for Service Suppliers.

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0 RULES STRUCTURE AND SCOPE

0.1 Regulations relating to the scope of PRS supervision activity, PRS liability, the survey procedures, methods and forms, the procedure for technical documentation approval, as well as the kind of the issued documents are given in, separately published by PRS, *Supervision Activity Regulations.*

0.2 *Rules for the Classification and Construction of Stationary Floating Objects,* further referred to as *the Rules*, consist of the following Parts:

Part 1 – Classification Regulations,

Part 2 – Object Functional Properties and Structure,

Part 3 – Stability, Subdivision, Downflooding Height,

Part 4 – Fastening, Towing, Drydocking and Beaching,

Part 5 – Fire Protection and Life-saving Means,

Part 6 – Machinery and Systems,

Part 7 – Environmental and Human Impact of the Object

0.3 Additional rule requirements are contained in separately issued (Rule) Publications P, referred to in particular Parts of these Rules.

0.4 Additional recommendations and guidance on the issues included in the *Rules* are included in separately issued *Publications "I"* (informative), cited in different parts of the *Rules*.

PART I
CLASSIFICATION REGULATIONS

1 GENERAL

1.1 Application

1.1.1 These *Rules* apply to stationary floating objects defined in 1.2.1, called further SOP or the objects placed in waters supervised by the Polish Maritime Administration or the Inland Waters Administration.

1.1.2 The Rules are applicable to objects under construction, conversion and in service. They contain technical safety requirements, which should be complied with by SOP, and define the principles and scope of the PRS technical supervision over design, construction and operation of such objects.

1.1.3 Floating objects which have machinery or engineering arrangements allowing them to move freely and/or to manoeuvre, are treated as ships and are not covered by these Rules. They shall comply with other requirements of respective PRS *Rules*.

1.1.4 Surface objects permanently fixed to the ground by a foundation are treated as buildings in the meaning of *building law* rules. These *Rules* are not applicable to such objects.

1.1.5 In the case of innovative structural solutions, materials or technologies applied to SOP manufacture, PRS shall apply the requirements of these Rules in the reasonable scope or shall define other set of requirements.

1.1.6 SOP may be assigned PRS class after it complies with the requirements of these *Rules*.

1.2 Terms and definitions

1.2.1 General terminology

Stationary floating object (SOP – Stacjonarny obiekt pływający) – a utility object placed and operating in water environment, which is not a ship nor building object, and which:
- is supported on the water by means of buoyancy elements,
- is immobilized by mooring, anchoring or other system, ensuring permanent position in relation to the shore,
- is able to freely move horizontally with fluctuating water level,
- is connected with the shore so that communication by foot or with light carts is possible.

SOP may perform residential, gastronomical, hotel, office, floating berth function or other service, recreational or specialized (research, rescue, monitoring, defense and safety) functions.

Objects fulfilling storage, production or industrial functions and floating platforms and artificial islands do not fall under this definition and are not subject to the requirements of these *Rules*.

$L_C \times B_C$ – the parameter defining the object size in meters, where L_C means maximum length and B_C maximum breadth of SOP measured horizontally between its extreme structural elements. The extreme elements are considered elements both in underwater and surface part of SOP.

Utility spaces – enclosed accessible spaces, structurally isolated in the buoyancy part of SOP, as well as enclosed spaces in the SOP erection, isolated by structurally permanent roofing, deck and walls.

Accommodation spaces – spaces for persons residing or working/present onboard SOP, including accommodation cabins, corridors and lobbies.

Machinery spaces – spaces, where diesel engines or other oil fuel supplied machinery (such as thermal oil boilers) are located.

Galleys – spaces, where cooking appliances (cookers, ovens, stove plates, etc.) are located or similar spaces used for preparation of meals.

Escape route – a combination of openings (doors, manholes, windows, etc.) and public communication ways (corridors, stairs, gangways, etc.) ensuring safe leave of any place onboard SOP intended for people's stay and descent to the wharf.

Shore infrastructure – any objects, machinery, utility networks and systems used for SOP service, located onshore and not being a permanent part of the SOP structure or mechanical systems.

Survey – a set of activities relating to SOP, its structure, machinery, appliances, equipment, etc. performed through the review of technical documentation, as well as conducting appropriate examinations, measurements and tests.

SOP Operator – the SOP owner or organization , or a person who formally took from the SOP owner the responsibility for the SOP operation and resulting duties related to SOP safe operation and its proper maintenance.

SOP user – each person onboard SOP.

WT (Technical Specifications) Regulation – the Regulation of the Minister of Infrastructure of 12 April 2002 on the Technical Specifications for Buildings and Their Location (Journal of Laws 2002, No. 75 item 690, as further amended).

ES-TRIN Standard – the ES-TRIN Standard, rev. 2017/1, introduced by the Directive **(**EU) 2016/1629 of the European Parliament and of the Council of 14 September 2016 laying down technical requirements for inland waterway vessels, being an Annex to the Announcement of the Minister of Maritime Economy and Inland Navigation of 25 April 2019 (Official Gazette of the Ministry of Maritime Economy and Inland Navigation, item 21).

1.2.2 Terminology for supporting and buoyancy parts

1.2.2.1 Basic dimensions

Buoyancy length (L_w), [m] – the distance from the bow transom to stern transom measured along the plane of maximum draught, when SOP has only one buoyancy element. When SOP has several buoyancy elements, L_w is a distance between the most extreme transoms of buoyancy elements.

SOP hull length (L_k), [m] – the maximum length of the SOP hull without protruding parts (e.g. fenders).

Maximum length of the supporting part (L_s), [m] – it is to be assumed not less than L_w.

Breadth of SOP buoyancy part (B), [m] – the maximum breadth of the buoyancy part, measured between the outer edges of frames.

Moulded depth of buoyancy part (H), [m] – the vertical distance measured amidships from the base plane to the lower line of the buoyancy deck at side.

Moulded draught (T), [m] – the vertical distance measured amidships from the base plane to the waterline.

Freeboard (F), [m] – vertical distance from the waterline to the lowest point of the upper line of the buoyancy deck.

1.2.2.2 Decks

Upper deck – the highest deck extending along the whole length of SOP. The upper deck may be stepped.

Open deck – the upper deck or superstructure deck not protected by any deck erection.

Strength deck – a deck or a system of decks which is the highest continuous structural hull supporting member.

Closed deck – a deck protected by an erection.

Buoyancy deck – a deck or a plane which is a watertight enclosure of a buoyancy element from the top.

1.2.2.3 Other terms

Buoyancy element – a close, watertight part of SOP structure where buoyancy forces are expected to act.

Supporting element – a strength part of SOP where general loads are transferred.

Hull – a structure being at once a buoyancy and supporting element, which has watertight bottom, sides and deck.

Buoyancy segment – a single SOP provided with own buoyancy parts and supporting parts, being a part of a bigger SOP, having articulated connection with other objects, so that the moment due to vertical forces in connections has zero value.

Multi-hull structure – a SOP structure consisting of several (a minimum of two) elements of rigidly connected objects (being independent stationary floating objects), taking any top view configuration.

Design thickness – the thickness of a hull structural component intended to be used in the process of hull construction.

Net thickness – the design thickness reduced by the corrosion addition

Note: Unless otherwise stated in any part of the text of the *Rules*, the term "thickness" shall be understood as the design thickness.

Margin line – the line drawn at SOP side at least 10 cm below the buoyancy deck and not less than 10 cm below the lowest non-watertight point.

Forward perpendicular – a vertical line in the object symmetry plane passing the point of intersection of waterline with the forward transom, at maximum draught of the object.

After perpendicular – a vertical line in the object symmetry plane, which crosses the aft end of the length L_w.

Base plane – horizontal plane which crosses amidships the top of bottom plating.

Midship section – hull cross-section at the middle of the distance between the forward perpendicular and the after perpendicular.

Transom – watertight, extreme outer partition of the object buoyancy part; forward transom and after transom is distinguished depending on its situation against x-axis of the object.

Stiffeners – a general name of members supporting directly the plating plates, e.g. bottom frames – bottom stiffeners, side frames – side stiffeners, deck beams – deck stiffeners.

Stiffener span – a segment between the neighboring girders supporting this stiffener (or between a girder and a bulkhead/division).

Girders (primary supporting members) – a general name for structural members supporting the stiffener systems or other girders.

Waterline – the waterline to which an object is drawn into fresh water with full load, stores and possible fixed ballast.

Damage waterline (equilibrium waterline) – the waterline to which an object is drawn into fresh water after flooding one compartment or a group of compartments.

1.2.3 Terminology of environment pollution protection

Oily bilge water – oil contaminated water due to any leakage or maintenance operations in the machinery spaces. Any liquid penetrating into the bilge system including bilge wells, bilge water piping and bilge water tanks as well as liquid dripping from tops of the tanks are also considered as bilge water.

Oily water holding tank – tank in which oily bilge water is retained before its discharge to reception facilities, transfer or purification.

Sewage (black water) – means:
- liquid and other waste from lavatories and urinals,
- drainage from medical premises (dispensary, sick bay, etc.) via wash basins, bathtubs, wash tubes and scuppers located in such premises,
- other drainage water mixed with the above mentioned sewage.

Grey water – drainage from dishwater, shower, laundry, bath and washbasin drains. It does not include drainage from toilets, urinals, hospitals.

Garbage – all kinds of food wastes, domestic wastes and operational wastes, commercial activity wastes, all plastics, cooking oil, generated during the normal operation of the SOP and liable to be disposed off continuously or periodically.

2 SCOPE OF SURVEY

2.1 PRS supervision over SOP covers its main components (the buoyancy part, supporting part, deck, erection), fastening arrangements, accommodation ladders, electrical -, gas –, heat supply, ventilation, air-conditioning, water and sewage and other machinery and systems referred to in these *Rules*. The supervision coves also the object stability, subdivision, fire protection and environmental protection.

2.2 PRS supervision covers the construction and commissioning stages, including designing, constructing, equipping and testing. The supervision cover also conversions changing the object functions or its stability and/or buoyancy parameters (dimensions, mass, gravity centre position) or other features affecting its safety or environmental impact.

2.3 At the stage of the object construction/conversion and commissioning, the supervision is realized through:
- approval of the required technical documentation and test programme for conformity with these *Rules*,
- supervision of major stages of construction/conversion, equipment and tests of SOP,
- initial survey of completed SOP in its final location (mooring place).

At the stage of construction/conversion, the number and scope of surveys are determined by PRS on an individual basis and depend on the object complexity, whether it is a single, prototype or serial unit, on its construction and equipping conditions (at manufacture, at location place) and on whether its particular parts (buoyancy, supporting, deck, erection) or the whole object are covered with the *Product Type Approval Certificate* issued by PRS.

2.4 The supervision during the in-service stage covers:
- objects of purpose RESIDENTIAL,
- objects which can carry more than 50 persons at one time,
- objects which have metallic buoyancy part susceptible to corrosion.

The supervision consists in periodical checking whether the object complies with the requirements of the *Rules* its construction was based on, whether it is properly maintained and operated as it has been assumed, in particular as regards its location, floatability, stability and fire protection.

2.5 *The SOP Operator* is obliged to inform PRS on any damages and failures of the object and its fastening in the mooring place and on any conversions which can affect the object safety or its environment. In such cases, PRS shall decide on the necessity of carrying out an occasional survey and on its scope.

3 SOP CLASS

3.1 General

3.1.1 PRS may assign class to a new-built or existing stationary floating object and renew, suspend, withdraw or reinstate class to an existing SOP classed by PRS.

3.1.2 Submission of a written application by the SOP operator, submission of the required technical documentation and positive result of the object survey are the conditions for class assignment to a stationary floating object.

3.1.3 The assignment, renewal or reinstatement of class confirms that SOP complies with the requirements of the *Rules* valid in the time of class assignment, i.e. the object construction.

3.1.4 The assignment, renewal or reinstatement of the SOP class is effected by the issue of *SOP Class Certificate*. The class of the objects, referred to in 2.4, is assigned or renewed for a period of 7 years and remains valid, provided the object is subjected to required surveys and is operated according to its designation. The class of other objects is assigned without time limit.

3.1.5 PRS may renew class for a shorter period or shorten the class validity, due to technical condition of the object, after Class Renewal Survey, adding appropriate validity restricting mark in the *SOP Class Certificate*. In reasonable cases, PRS may prolong the class validity period.

3.1.6 SOP fastening in its mooring place and connecting to shore infrastructure is not covered with the *SOP Class Certificate*. At the request of the SOP Operator, PRS may issue a separate document – *Certificate of SOP Fastening and Connecting Control* confirming proper fastening and connecting of the object and its compliance with an approved documentation. Such document ceases to be valid each time when the object is disconnected and fastened and connected again, e.g. due to change of location, after dismantling before winter season, for repair, inspection, overhaul, after changing the fastening and/or connection method, etc.

3.2 Symbol of class

3.2.1 Main symbol of class

The stationary floating object constructed under survey of PRS is assigned main symbol of class which emphasizes its purpose and seasonal nature. The main symbol of class is presented below:

OBJECT ....

(purpose) (seasonal nature)

Examples:

SEASONAL GASTRONOMICAL OBJECT

YEAR-ROUND WORKING OBJECT

3.2.1.1 The object purpose

It defines the utility function of the object, i.e. fulfilled function and accessibility.

Purpose	Description
RESIDENTIAL	A public use object, a place for residence or overnight, where over 12 persons may stay. They include: hotels, hostels, guest houses, workers' dormitories, multi-family houses, etc.
GASTRONOMICAL	A public use object, used for preparation and consumption of meals, equipped with cooking and/or heating appliances. They include: bars, restaurants, pizzeries, cafes, etc.
COMMERCIAL	A public use object, intended for providing services, sales or recreational purposes. They include: shops, beauty salons, hairdressers, SPAs, gyms, diving centers, pools, swimming baths, social and sanitary facilities of marinas, summer houses for rental (up to 12 persons), etc.
WORKING	The object usually accessible to the personnel servicing it or working in. They include: offices, studios, watch rooms, duty stations, fish farming related objects, monitoring, measurement, testing stations, laboratories, etc.
PRIVATE	Object intended solely for private, non-commercial use, usually as a place of residence, where up to 12 persons may be present at one time.
OTHER	Object of function other than above.

Note: for objects with purpose OTHER, the requirements of these Rules may be applied selectively or be extended, considering fulfilled function and necessity of ensuring safety the object, persons present therein and of natural environment.

3.2.1.2 The object seasonal nature

It defines possibility of seasonal or year-round operation of the object.

Object operation	Description
SEASONAL	The object spaces and installations are adapted for operation beyond winter season, i.e. from April until October incl.
YEAR-ROUND	The object spaces and installations are adapted for year-round operation.

Note: The possibility of leaving the object on the water throughout the year depends on expected icing conditions. The object manager is the person who makes the decision on leaving SOP for the winter period on the water reservoir considered.

3.2.2 Symbols supplementing the main symbol of class

The main symbol of class is supplemented with additional symbols indicating other features of the object.

3.2.2.1 The object location

It defines the possibility of locating and operating of the object on the given water reservoir present on the territory of the Republic of Poland. The object features allowing its safe operation on the given water reservoir with the highest waves met there, decide on assignment to the given location.

Symbol of the object loaction	Description of location
01	Regions of inland flowing and standing waters included into area 4 and regions of inland ports and harbours.
02	Combining category 01 area and the areas of inland flowing and standing waters included into area 3, as well as areas of internal sea waters included into area 3 where waves of height up to 0.6 m may be met (ports and harbours).
03	Combining category 02 area and the areas of inland flowing and standing waters included into area 2, as well as regions of internal sea waters included in total into area 3 and area 2, where waves of height up to 1.2 m may be met.
04	In special cases, where SOP may not be fully qualified into any of the above categories, it is assigned category 04. In such case, the SOP Certificate of Class shall precisely describe water reservoir (name, parameters, features) and conditions under which the considered object may be located and operated.

For the purpose of these *Rules*, the operation regions are defined as below:
- *region 1* – waters with wave height up to 2 m. This region includes the following Polish water reservoirs: the part of Zatoka Pomorska (the Pomeranian Bay) – southward from the line linking Nord Perd on Rugen Island and the lighthouse Niechorze and the part of Zatoka Gdańska (the Bay of Gdańsk) – southward from the line linking the lighthouse Hel and the sea buoy of Baltijsk harbour, where the SOP objects are not possible to be seated due to waving nature.
- *region 2* – waters with wave height up to 1.2 m. This region includes the following Polish water reservoirs: Zalew Szczeciński (the Bay of Szczecin), Zalew Kamieński (the Bay of Kamień), Zalew Wiślany (the Vistula Lagoon), Zatoka Pucka (the Bay of Puck), Zbiornik Włocławski (the Włocławek Reservoir) and the lakes Śniardwy, Niegocin and Mamry.
- *region 3* – waters with wave height up to 0.6 m. This region includes the Polish rivers, lakes and channels considered inland waterways by separate regulations and sea ports, except the areas listed in regions 1 and 2.
- *region 4* – inland waters, which are not considered inland waterways by separate regulations, with negligible wave height.

For the purpose of these *Rules*, the below water reservoirs are considered internal sea waters:
- a part of Nowowarpieńskie (Neuwarper) Lake and a part of the Zalew Szczeciński (the Bay of Szczecin) together with Świna and Dziwna rivers and Zalew Kamieński (the Bay of Kamień), eastward of the state border between the Republic of Poland and the Federal Republic of Germany, as well as Odra river between Zalew Szczeciński (the Bay of Szczecin) and Szczecin harbour waters;
- a part of Zatoka Gdańska (the Bay of Gdańsk) up to the baseline of territorial sea;
- a part of Zalew Wiślany (the Vistula Lagoon) south-westward from the state border between the Republic of Poland and Russian Federation on this Lagoon;

– the port waters up to the line connecting the furthest out into the sea permanent port facilities, being an integral part of the port system;
– waters between the sea shore line, defined on the basis of the Water Law Act of 20 July 2017, and the baseline of territorial sea.

3.2.2.2 The type of object

The type of object defines its permissible payload, depending on its size.

Object type symbol	Type description
A	Objects without utility spaces, $L_C \times B_C \leq 100$ m², designated for temporary and one-off stay of the documentation defined number of persons and/or of defined payload.
B	Objects without utility spaces, $L_C \times B_C > 100$ m², designated for temporary and one-off stay of the documentation defined number of persons and/or of defined payload.
C	Objects without utility spaces, not intended for people's stay, of payload and $L_C \, x \, B_C$ parameter defined in respective documentation.
D	Objects having an erection or a buoyancy part occupied with utility spaces, with $L_C \times B_C \leq 40$ m², adapted for temporary or permanent stay of no more than 6 persons at one time.
E	Objects having an erection or a buoyancy part occupied with utility spaces, with $L_C \times B_C \leq 100$ m², adapted for temporary or permanent stay of no more than 12 persons at one time, not qualified into category D.
F	Other objects, having an erection with rooms or a buoyancy part occupied with utility spaces, not qualified into categories D nor E.

3.2.3 Other entries and information

3.2.3.1 PRS may assign more than one main symbol of class to the object if it is justified by the object properties and designation.

3.2.3.2 If SOP has been built without PRS survey and the SOP Operator applies for class assignment, the class may be assigned after inspecting the object by PRS and satisfying that it complies with basic safety requirements. For such object, the main symbol of class is put in parentheses.

3.3 Class assignment, maintenance and renewal

3.3.1 The class is assigned after completion of an initial survey of SOP with positive result. The initial survey is performed on a complete, finally located SOP.

3.3.2 The SOP class is maintained under the below conditions:
– the object is kept in a satisfactory technical condition,
– it is operated in accordance with *SOP Certificate of Class* conditions and the manufacturer's guidelines,
– the recommendations issued by PRS after survey are executed at specified dates
– the required occasional surveys are performed.

3.3.3 SOP covered with in-service survey (see 2.4) are subject to the Class Renewal Survey.

3.3.4 Class Renewal Survey aim is to ascertain that SOP – its component parts (buoyancy, supporting parts, deck, erection), equipment and installations which influence the object safety are maintained in a proper condition, comply with the requirements of the *Rules* and that SOP is fit for its intended purpose for the subsequent 7-year or shortened period, subject to proper maintenance and operation.

3.3.5 The Class Renewal Survey shall be held at 7-yearly intervals. In exceptional cases, however, upon PRS Head Office agreement following the Owner's request, a maximum 3-month extension of class beyond the 7th year may be granted.

3.4 The scope of Class Renewal Survey

- visual examination of the buoyancy part in dry-dock conditions and thickness measurements of plating in this part (it applies to the SOPs, who have metallic buoyancy part susceptible to corrosion), to the scope defined by PRS Surveyor, depending on technical condition,
- internal examinations of accessible parts of the buoyancy part,
- visual examinations, as far as practicable, of the SOP buoyancy part connection with its deck and/or erection,
- visual examinations of deck for its wear and damages,
- visual examinations of SOP erection for its tightness, damages and attachment of its elements (it applies in particular to tanks, roofings, sheds, single walls, screens, bulwarks, architectural elements, etc.),
- checking operation of closing appliances of all openings, through which water can enter the SOP interior,
- visual examinations of all machinery mounted on the deck and outside the erection, for its fastening,
- visual examinations of external rails, guardrails, stairs and gangways/accommodation ladders, for their operational safety,
- visual examinations of arrangements for SOP mooring (elements to which mooring lines, anchoring ropes/chains, fastening arms, clamps/guides associated with mooring posts, etc. are attached),
- visual examinations of the SOP towing and/or docking (lifting) arrangements,
- checking condition and number of life-saving appliances and embarkation ladders,
- visual examinations and operational tests of fire-extinguishing system and fire detection alarm system,
- checking of the arrangement of portable fire-fighting equipment and its technical inspection validity,
- visual examinations and operational tests of liquid fuel supplied heating system and checking exhaust ducts,
- checking liquid gas system for domestic purposes – automatic closing of gas supply in the case of flame decay, control of gas bottles room (for its ventilation, heating, lighting, warning notices), checking bottles securing, validity inspection of the installation attestation after tightness and pressure test (required attestation renewal every 3 years and after each modification or repair),
- visual examinations and operational tests of the anti-heeling system,
- visual examinations and operational tests of the bilge system including arrangements for bilge oily water discharge to reception facilities,
- visual examinations of the sanitary sewage system, including arrangements for sewage discharge to reception facilities,
- operational tests of generating set/accumulator battery,
- operational tests of lighting essential for the SOP and present persons safety,
- visual examinations of the connections and protective devices of fixed heating appliances and cooking stoves,
- visual examinations of earthing and lightning protection system,
- resistance measurement of insulation of permanently installed electric network and electric appliances.

Instead of visual examinations of the buoyancy part in docking condition, the diver's survey or ROW survey may be carried out. Such surveys shall be performed in the presence of PRS Surveyor, and the executing company shall be PRS approved in accordance with *Publication 51/P – Procedural Requirements for Service Suppliers.*

4 CLASS SUSPENSION AND WITHDRAWAL

4.1 Class of SOP is suspended automatically for the following reasons:
- damage to buoyancy part of SOP,
- damage to the arrangements for SOP fastening,
- transgressing the service conditions specified in the *SOP Certificate of Class*,
- exceeding the deadline for the Class Renewal Survey,
- exceeding the deadline for executing PRS issued recommendations.

The class of SOP may also be suspended if the Operator has not paid PRS for its services connected with the object survey at the agreed date. Such cases are subject to individual consideration by PRS.

4.2 Class of SOP is withdrawn for the following reasons:
- introduction of alterations to structure, machinery, installations and equipment covered by the requirements of the *Rules*, without the prior agreement with PRS,
- suspension of class for a period exceeding 6 months,
- the SOP has sunk or been scrapped,
- at the SOP Operator's written request.

5 TECHNICAL DOCUMENTATION OF SOP

5.1 Classification documentation of SOP under construction

5.1.1 Prior to the commencement of SOP construction, technical documentation, within the required scope, taking into account the SOP type, its machinery, installations and equipment shall be submitted to the PRS Head Office for consideration and approval or for reference.

5.1.2 The technical documentation shall contain any information necessary to confirm that the designed object complies with the requirements of these *Rules*.

5.1.3 The items of technical documentation specified below may be properly combined in drawings, provided that all the required information is indicated.

General documentation:
- SOP specification including: the object purpose/function, its expected location, main dimensions, number of persons it is designed for, other basic data, requested main symbol of class, description of machinery and installations, which do not require presentation in the drawings;
- SOP General Arrangement Plan indicating arrangement of all spaces together with their equipment and arrangement of permanently installed machinery and equipment;
- design tonnage and displacement calculations and position of buoyancy centre;
- stability and floatability and general strength analysis to the scope complying with the requirements of these *Rules*, supplemented with the distribution of light mass of SOP along the object length;
- hull/buoyancy element body lines;
- Tanks Plan.

The SOP structure:
- midship section with characteristic hull cross-sections/buoyancy elements;

- longitudinal section with specified frame spacing, position of watertight bulkheads, pillars, erections, hull and buoyancy elements;
- design drawings of decks and double bottom (where applied), taking into account distribution and dimensions of openings;
- shell expansion containing detailed information on welds, frame spacing, distribution of primary supporting members, stiffeners, sea water intake openings, bulkheads, decks, distribution and dimension of openings, hull and buoyancy elements;
- design drawings of bow and stern transom;
- design drawings of longitudinal and transverse bulkheads and tank bulkheads specifying height of air pipes;
- design drawings of supporting element (except hulls);
- design drawings in the region of installation of generating units, lifts and cranes (where applied) and structures under them, tanks, pillars, strengthenings (mass, type and unit output, type and SWL of lift/crane to be given and manufacturer's instructions on foundation to be considered);
- drawings of SOP strengthenings and structure under towing, mooring bollards/other elements for SOP attachment and under anchor winches (if applied) and strength calculations of the strengthenings and structures in way of their attachment;
- drawings and strength calculations of supporting element connection with buoyancy elements, if they are separate structures;
- drawings and strength calculations of mutual connections of SOP segments, for multi-segment structures;
- design drawings of a supporting element (if it is not a hull);
- welding tables for hull, supporting and buoyancy elements, unless all weld sizes and welding data are specified in the design drawings;
- information on loads of hull/supporting elements, including response from erection or buoyancy element;
- calculations of hull structure, buoyancy and supporting elements for general and local strength;
- other drawings, data and calculations specific for the given SOP configuration;
- design drawings of SOP erection with specified response from the erection load on the hull;
- plan of openings in SOP deck and erection, specifying heights of coamings and structures of closing appliances;
- drawing of devices used for SOP fastening, towing and/or docking (lifting);
- plan of corrosion protection of the SOP buoyancy and supporting parts;
- plan of spaces insulation;
- selection of the number and size of gangways/accommodation ladders connecting SOP with the shore and their structure documentation;
- plan of escape routes, distribution of fire-fighting equipment, life-saving means and re-boarding ladders;
- plan and structure of railings.

Piping and ducts systems:

- anti-heeling system;
- bilge system;
- gas system for domestic purposes (specifying bottles arrangement);
- ventilation and air-conditioning system;
- water/oil heating systems;
- fuel systems;
- exhaust gas system;
- water main and sanitary sewage systems;

– fire-extinguishing system;
– overflow and air piping systems for tanks (unless given on other drawings).

Electrical systems:
– power balance and selection of supply sources;
– drawing of location and securing of the generating unit, accumulator batteries;
– principle diagram of electrical system, together with circuits data, applied protecting devices and cable cross-sections;
– lightning system;
– fire detection and alarm systems.

5.2 Classification documentation of SOP under conversion

5.2.1 Prior to SOP conversion, the documentation of the SOP parts, machinery and equipment to be subject to conversion and an updated stability and subdivision analysis if the lightweight of SOP (its displacement minus deadweight) has changed by more than 2% or the height of lightweight SOP centre of mass increased by more than 4 cm or 2%, whichever is less, shall be submitted to the PRS Head Office for consideration and approval.

5.3 Operational documentation of SOP

5.3.1 During surveys for the assignment, confirmation and renewal of class, the *SOP Operation and Maintenance Manual* availability on the object or possession by the SOP Operator is checked. The manual shall include, respectively to function, operation method and location of the object, at least the below items:
– the general arrangement plan, specifying escape routes, re-boarding ladders, arrangement of portable fire extinguishers and places of activation of fire-extinguishing systems, as well as the arrangement of life-saving means;
– the principles of safe operation of the object, including permissible load/draught, heels, permissible loads of gangways/accommodation ladders, permissible weather and hydrological conditions;
– procedure for the case of damage to the object fastening and methods of its temporary/ emergency securing;
– the object protection against heavy weather and hydrological conditions;
– method of the object maintenance and possible repairs;
– the principles of safe towing and beaching/docking/putting on a slipway of the object;
– safeguarding of the object for seasonal/periodical lay-out;
– the principles of treatment of waste generated onboard (oily bilge water, sanitary sewage, garbage);
– the principles of treatment in case of oily bilge water or oil products escape overboard;
– other essential issues related to the safety of the object, persons onboard and its environment, including the way of object re-boarding.

5.4 Documentation of SOP fastening and connecting in the planned location

The below documentation does not constitute a condition for assignment of class to a SOP and is required only when PRS is to issue the *SOP Fastening and Connection Control Certificate*:
– arrangement plan of anchors, mooring posts, mooring bollards or other external elements, the SOP will be fastened to and a list of ropes or other elements used for SOP fastening;
– selection of the number and size of anchors, diameters of ropes, etc.;
– drawing of SOP fastening to the shore infrastructure (electrical, water and sewage systems).

PART II
USABILITY PROPERTIES AND STRUCTURE OF THE OBJECT

1 GENERAL

1.1 General requirements

1.1.1 The utility rooms shall be so designed and equipped that they meet the needs related to safety, health and comfort of the persons onboard. The spaces shall be easily and safely accessible and sufficiently isolated from heat and cold.

1.1.2 The utility rooms in the hull are divided into:
- spaces intended for people's permanent or temporary stay, in accordance with the WT Regulation;
- spaces not intended for people's stay, where the SOP crew may be safely present for a short period of time (e.g. for inspection, starting machinery located there, storage service, etc.).

1.1.3 It is generally recommended that spaces where people are normally present should not be designed in buoyancy part, below the waterline.

1.1.4 Spaces which are not designated for people's stay shall have height allowing people's movement in an upright or an inclined position, be provided with lighting, stairs or ladder, natural ventilation and, depending on function, other equipment (e.g. insulation, heating). If the spaces are exposed to external flooding, they shall have watertight closures, or possibly weathertight in the case deck manholes are applied having coamings of height defined by the PRS Rules for the given operating region.

1.1.5 The design requirements for closures of deck and erection openings have been defined in subchapter 2.7.12 and in Chapter 3 of this *Part*.

1.1.6 SOP may be equipped with lifts and lifting appliances.

1.1.7 The lifts and lifting appliances shall be designed in accordance with conditions specified in:
- *Directive 2014/33/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to lifts and safety components for lifts;*
- **the Regulation of the Minister for Entrepreneurship and Technology of 30 October 2018** *on the technical inspection conditions for the operation, repair and upgrading of handling equipment* (Official Journal 2018 item 2176);
- *the Regulation of the Council of Ministers of 07 December 2012 on the types of technical devices subject to technical supervision* (Journal of Laws 2012 item 1468), issued on the basis of art.5 item 2 of the act on technical supervision.

1.1.8 Any design and equipment solutions not covered by these Rules are subject to separate consideration by PRS.

1.2 Architecture of the object

1.2.1 The *Rules* do not govern issues related to the object architecture, they only indicate the necessity of using such architectonic solutions that:
- the shape and external colors of the object do not contribute to reduced visibility (noticeability), what is particularly important for SOPs of small dimensions, located in water reservoirs being water routes. At once, the external colors and shape of the object shall help to match with environment to ensure that landscape features are maintained and/or local environmental requirements observed. It is of particular importance for locating SOPs in the areas covered with conservation protection;
- external architectonic-decorative details (masts, rigging, bowsprit, etc.) do not contribute to violating safety rules and do not interfere with the space of neighbouring users (objects);

– external architectonic solutions of large planes exposed to wind (such as sides, roofings, screens, decorative sails, etc.) do not contribute to the object release from mooring, to its excessive heels and do not cause other safety hazards;
– the applied arrangements and decorative elements do not contribute to creation or increase of hazard for the object users (such as slippery floor, protruding wall decorative elements, large reflective surfaces, blinding lights, etc.).

1.3 Functional and utility layout and required space parameters

1.3.1 When designing location and arrangement of spaces, including tanks and stores which can be an essential load of the object:
– the variable loads shall be preferably symmetrically distributed in relation to main axes, aimed at limiting the object heels negatively affecting the comfort of users;
– the stores, tanks and heavy fixed equipment (machinery) should be located, as far as possible, in the lower and middle parts of the object so that their centres of gravity were below the minimum draught waterline.

1.3.2 For the objects with the purpose RESIDENTIAL, GASTRONOMICAL and COMMERCIAL, technical parameters of spaces (location, distribution, dimensions, etc.) where people may be present permanently shall be the same as for buildings, i.e. in accordance with WT Regulation – Part III, Chapter 5. Departures from these conditions, to meet SOP specifics, shall be justified.

1.3.3 For the objects with the purpose WORKING, PRIVATE and OTHER, parameters and other conditions for spaces where people may be present shall be in accordance with the WT Regulation or in accordance with the requirements of ES-TRIN Standard, including:
– article 14.03 Dimensions of work stations,
– article 14.05 Access to work stations – paragraphs 1a, 1c, 2,
– article 14.08 Interior rooms,
– article 15.01 Accommodation. General – paragraphs 2 and 3,
– article 15.02 Special design requirements for accommodation – paragraphs 1, 2, 4, 5, 6, 9, 10, 12, 13.

1.3.4 For objects of purpose RESIDANTIAL, GASTRONOMICAL and COMMERCIAL, the arrangement of spaces shall be such to separate to the maximum extent the public spaces from other spaces (galleys/pantries, boiler rooms, storerooms, social spaces of employees, service rooms, etc.).

1.4 Communication lines and shore connection

1.4.1 Requirements for the width of routes and entries

1.4.1.1 The minimum widths of communication lines (corridors, connecting spaces, stairs, ramps, passageways and accesses on deck) shall be in accordance with the WT Regulation requirements specified in §62, §68 to 71, §236 to 257 or in the ES-TRIN Standard – art. 19.06 items 3, 4, 5, 9, 10, 13.

1.4.1.2 The entries to the object and its spaces shall have parameters and characteristics in accordance with the WT regulation requirements – Chapter 3 of Part III or with ES-TRIN Standard.

Doors and sills/coamings shall also comply with the requirements given in paragraphs 3.6.4 to 3.6.10.

1.4.1.3 Stairs shall be designed in accordance with PN EN 13056 Standard.

1.4.1.4 The requirements for escape routes are given in subchapter 1.2 of *Part 5* of these *Rules*.

1.4.2 Accommodation ladders, gangways and other means for communication with shore

1.4.2.1 Accommodation ladders and gangways shall be designed in accordance with PN EN 14206 Standard and the requirements of ES-TRIN Standard.

1.4.2.2 Objects of purpose RESIDENTIAL, GASTRONOMICAL and COMMERCIAL shall be have accommodation ladders or gangways of such number, parameters and distribution that an efficient and safe evacuation of all persons present onboard SOP is ensured within 5 minutes. Onboard the objects where more than 50 persons may be present, at least 2 independent escape routes to the shore shall be ensured.

1.4.2.3 Separate accommodation ladders or gangways shall be possibly provided for technical service and for the transport of provisions and wastes removal.

1.4.2.4 For all the objects located on water reservoirs with significant water level fluctuations, accommodation ladders and gangways shall be applied which make possible safe communication when the water level changes and at its extreme levels.

1.4.3 SOP accessibility for persons with reduced mobility

1.4.3.1 The objects of purpose RESIDENTIAL, GASTRONOMICAL and COMMERCIAL without personal lifts shall be provided with technical arrangements ensuring access of persons with reduced mobility to tiers with utility spaces.

1.4.3.2 Onboard objects of purpose RESIDENTIAL, GASTRONOMICAL and COMMERCIAL, solutions or arrangements shall be applied which make possible access of the persons with reduced mobility from the shore to the object and opposite. Such access may be unaided or with SOP crew assistance.

1.4.3.3 Technical solutions shall be introduced that persons with reduced mobility are ensured an efficient and safe access to, and disembarkation from, the object, the possibility of movement along defined areas of the object, the use of bathrooms and water closets and other utility spaces and arrangements (such as places in restaurants), and the object shall be equipped with appropriate alarm and calling systems (bells, alarms, an emergency internal communication system) in places of potential difficulties (WC, stairs, accommodation ladders, etc.). Ensuring specified facilities to persons with reduced mobility may not restrict the use for other users or the object service personnel.

1.5 Fastening furniture and equipment

1.5.1 Furniture and equipment in spaces where people may be present and in communication spaces, which may pose danger to people's life and health when moved or collapsed, shall be fixed so as to prevent their movement or collapse.

1.5.2 Power supplied machinery and large-size equipment (it does not apply to small RTV or household appliances), which may pose danger to people's life and health and cause fire hazard when moved or collapsed, shall be fixed so as to prevent their movement or collapse. The fixing method may not lead to the equipment damage or reducing its functionality.

2 STRUCTURE OF SUPPORTING AND BUOYANCY PARTS

2.1 General

2.1.1 The requirements of this Chapter apply to those elements of SOP which ensure the object floatability and take loads from gravity, displacement forces, waves and from the utility part, i.e. the erection. Hulls, buoyancy and supporting elements may fulfil such functions.

2.1.2 The specified requirements apply to the objects:
- made of structural steel, stainless steel and corrosion resistant weldable aluminium alloys,
- having length of hull, buoyancy or supporting element not greater than 40 m.

Application of other materials and objects of length greater than 40 m will be subject to separate consideration by PRS.

2.2 Co-ordinate system

For SOP object, the following co-ordinate system has been adopted in this *Part* of the *Rules*.

- The co-ordinate system begins at the intersection of the hull centre plane, the after end of length L_w and the base plane,
- the longitudinals axis x, sense towards bow transom,
- the transverse axis y, sense towards port side,
- the vertical axis z, sense upwards.

2.3 Materials and welding. Corrosion additions

2.3.1 Materials

2.3.1.1 Weldable structural conventional carbon steels of yield strength not less than 235 MPa shall be used for hull construction.

2.3.1.2 Hulls, buoyancy and supporting elements of length above 15 m shall be made from structural conventional steel with steelmill certificate.

2.3.1.3 Where aluminium alloys are used for the construction of hull, supporting or buoyancy elements, corrosion resistant alloys in welded condition, mainly the 5xxx and 6xxx aluminium alloys, shall be used.

2.3.1.4 Non-weldable connections of structural elements will be considered separately.

2.3.2 Welded joints

2.3.2.1 General

2.3.2.1.1 Welded joints shall be performed in accordance with the below requirements.

2.3.2.1.2 In the local hull structure strengthenings, higher thickness plates are recommended to be used avoiding doubling plates. If doubling plates are indispensable, their edges shall be joined with a continuous weld, and in the case or larger surfaces – also with slot welds.

The distance between the continuous weld and slot welds as well as between the slot welds shall not be greater than 40-times as much as the doubling plate thickness.

In places where plates may separate from the plating, the use of doubling plates is not allowed.

2.3.2.1.3 Concentration of welds, too little distance between parallel butt welds and fillet welds, as well as intersection of welds at too acute angle shall be avoided.

The distance between parallel welds shall be at least:
- $10t$ ((where t – design thickness of a thinner plate) between butt welds, but not less than 100 mm;
- $5t$ between butt weld and fillet weld, however, not less than 50 mm;
- $4t$ between butt weld and fillet weld (within the distance not exceeding 2 m), however, not less than 30 mm.

Butt welds shall not intersect at an angle lesser than 60°.

2.3.2.1.4 Distance between the lines of contact between the side shell plating and deck plating as well as bulkheads and web frames parallel with these contact lines shall not be less than 100 mm. For field joints, this distance shall not be less than 200 mm.

2.3.2.1.5 In the locations where a stiffener intersects with the butt weld, scallops in the stiffener are recommended.

The length of scallops shall not be less than 50 mm and not more than 150 mm, whereas their depth shall not be greater than 0.25 of the stiffener height and not greater than 75 mm. The rounding radius of a scallop shall be equal to its height. The scallops shall be all-round welded:
- in areas subjected to increased vibration, if any,
- in areas subjected to large concentrated forces, e.g. under and over pillars, in way of bolted connections, etc.,
- within the bilge of the radius less than 300 mm
- within brackets and stiffener ends

If a scallop is waived, the butt weld shall be equalized with the plate surface in way of contact with the stiffener, and where the butt weld intersects with the stiffener, it shall not be welded to plates throughout the distance of 60 mm, i.e. 30 mm into both directions from the butt weld. In the case of automatic welding, the weld need not be interrupted.

2.3.2.1.6 Butt weld shall be applied to connect plates. PRS may permit application of lap welds or welds with connection lug if a butt weld is impracticable to be made in the particular conditions.

2.3.2.2 Butt welds

2.3.2.2.1 Butt welds shall be so made to achieve through penetration. Where double side welded joints are applied, the weld root shall be removed before the weld is made on the other side. Where a sealing run is impracticable, the penetration run shall be correct and free from imperfections, e.g. performed with backing which facilitates the correct forming of the weld root.

2.3.2.2.2 Where two butt-welded plates are different, the thickness of the thicker plate shall be reduced by beveling not exceeding 1:3 i.e. the tangent of the slop angle of beveled edge shall be not greater than 1/3.

2.3.2.3 Fillet welds

2.3.2.3.1 For tight joints, double continuous welds shall be applied, whereas for other joints – continuous or intermittent welds shall be applied, as specified in Table 2.3.2.3.3.

2.3.2.3.2 The distance between portions of intermittent fillet welds shall be measured on one side of the welded component, as shown in drawings 2.3.2.3.2-1 and 2.3.2.3.2-2.

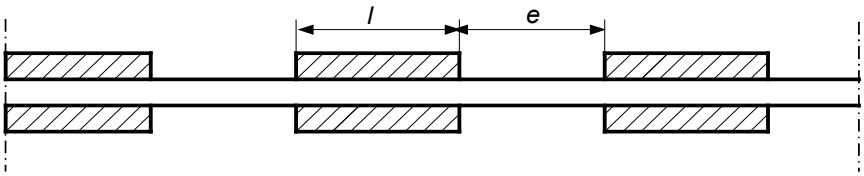


Fig. 2.3.2.3.2-1 Chain welds

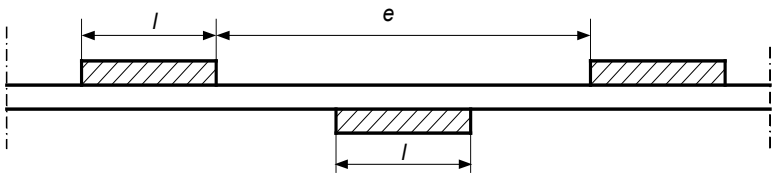


Fig. 2.3.2.3.2-2 Staggered welds

Distance *e* shall be so selected that it is not greater than that obtained using the following formulae:

– for chain welds (see Fig. 2.3.2.3.2-1)

$$e = 15\,t \quad \text{[mm]} \qquad (2.3.2.3.2\text{-}1)$$

– for staggered welds (see Fig. 2.3.2.3.2-2)

$$e = l + 10t \quad \text{[mm]} \qquad (2.3.2.3.2\text{-}2)$$

where:

l – weld length, [mm];

t – design thickness of thinner component, [mm].

The length l shall not be less than 75 mm.

2.3.2.3.3 The thickness of weld *a* (see Fig. 2.3.2.3.3) shall be not less than calculated from the formula:

$$a = kt \quad \text{[mm]} \qquad (2.3.2.3.3)$$

where:

k – coefficient acc. to Table 2.3.2.3.3,

t – thickness of thinner element, [mm], shall be not less than 2.5 mm, regardless of the weld type and welding procedure.

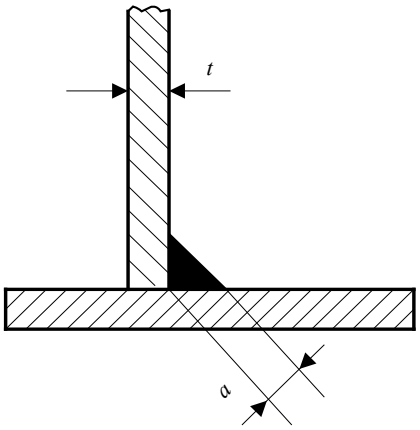


Fig. 2.3.2.3.3 Thickness of weld *a*

Where there is a significant difference in thickness of the joined components, PRS' approval is required in each particular case.

Table 2.3.2.3.3
Values of coefficient *k* and required type of fillet weld

Item	Joined elements	Weld type	Coefficient *k* (in formula 2.3.2.3.3)
1	Single bottom		
1.1	Floors:		
	– to flat keel	c	0.5
	– to bottom shell	s	0.5
	– to bilge plating	c	0.4
	– to face plates	p	0.5
1.2	Tight floors		
	– to shell	c	0.5
1.3	Bottom girders:		
	– to floors	c	0.6
	– to bulkhead plating	c	0.6
	– to flat keel	s	0.6
	– to bottom shell	s	0.6
	– to face plates	s	0.5

Item	Joined elements	Weld type	Coefficient *k* (in formula 2.3.2.3.3)
2	Double bottom		
2.1	Floors:		
	– to outer bottom shell	s	0.5
	– to flat keel	c	0.5
	– to bilge plating	c[2]	0.5
	– to inner bottom shell	s	0.5
	– to stiffeners	s	0.4
2.2	Bottom girders:		
	– to flat keel	c	0.6
	– to inner bottom plating	s	0.5
	– to outer bottom shell	s	0.6
	– to floors	c[2]	0.6
3.	Side stringers:		
	– to plating	s	0.5
	– to flange	p	0.5
4	Frames		
4.1	Transverse frames:		
	– to shell	p	0.5
	– to shell in tanks	s	0.5
4.2	Bottom longitudinals to plating	s	0.5
4.3	Longitudinals side frames to plating	s[3]	0.5
4.4	Web frames to plating and their face plates	s	0.5
5	Sea chests:		
	– to plating and upper plate, on water side	c	0.6
	– ditto on the opposite side	c	0.4
6	Decks		
6.1	Stringer plate:		
	– to sheerstrake, upper side	c	0.5
	– to sheerstrake, lower side	c	0.4
	– to shell	c	0.4
7	Deck beams		
7.1	Beams:		
	– to decks	p	0.5
	– to tank decks	s	0.5
7.2	Deck longitudinals to deck	s[3]	0.5
7.3	Deck transverse (if the deck is framed longitudinally):		
	– to decks	s	0.5
	– to face plates	s	0.5
8	Deck girders:		
	– at pillars and bulkheads to deck	c	0.4
	– to decks	s	0.5
	– to face plates	s[3]	0.5
9	Pillars to decks, face plates and intermediate plates	c	0.5
10	Watertight bulkheads, tank bulkheads and cofferdam bulkheads		
10.1	Plating:		
	– to shell and other bulkheads	c	0.5
	– to bulkhead stiffeners	s[3]	0.5
	– to horizontal and vertical girders at bulkheads	s	0.5
11	Wash bulkheads:		
	– to plating	s[3]	0.5
	– to stiffeners	s[3]	0.5

1 Chain welds may be applied instead of staggered welds.
2 In double bottom of more than 750 mm in height, chain welds may be applied.

3 In objects intended for operating area 3, staggered welds may be applied.

Symbols:
c – double continuous welds;
s – chain welds;
p – staggered welds;
k – throat thickness coefficient (see formula 2.3.2.3.3).

2.3.2.3.4 If double continuous welds are intended to be applied, instead of intermittent welds in accordance with Table 2.3.2.3.3, then their thickness shall be determined using the following formula:

$$a_{red} = a\left(0{,}4 + 0{,}6\frac{l}{l+e}\right) \text{ [mm]} \qquad (2.3.2.3.4)$$

where:

a – intermittent weld thickness, [mm];
l – weld length, [mm] (see Figs. 2.3.2.3.2-1 and 2.3.2.3.2-2);
e – distance between weld portions, [mm] (see Figs. 2.3.2.3.2-1 and 2.3.2.3.2-2).

2.3.2.3.5 In objects operated in area 3, instead of chain welds, single continuous welds with the same weld thickness *a* may be applied, whereas instead of staggered welds, single intermittent welds with the value *l*+*e* reduced by 50% and the same value *l* (*l, e* see Fig. 2.3.2.3.2-2) may be applied.

Single welds shall not be applied:
– in areas subjected to increased vibration
– in areas subjected to large concentrated separating forces and bending moments (e.g. in way of pillars, bolted connections, places where considerable concentrated forces may be present),
– in those joints where the angle between the added component and the plate is less than 80°;

2.3.2.3.6 Where elements containing scallops are to be welded, the weld dimensions shall be determined as for chain welds. The welds shall be continuous at the perimeter.

2.3.2.3.7 Where welds are made with an automatic welding machine, the weld thickness obtained using formula 2.3.2.3.3 or 2.3.2.3.4 may be reduced by 25%, however the throat of a fillet weld shall never be less than 2.5 mm.

2.3.2.3.8 Intermittent or single welds joining structural members with the plating shall be substituted at their ends by double continuous welds which:
– reach at least the bracket end, if applied to join the members;
– have a length equal to double height of the member, if brackets have not been applied; this also refers to the joints between webs and face plates at the members' ends.

2.3.2.3.9 In longitudinally framed objects such members as: frames, beams, bulkhead stiffeners, etc., shall have their ends welded to the stiffened plating throughout the length equal to triple height of the member with a double continuous weld of the thickness equal to $k = 0.7$ (see formula 2.3.2.3.3).

2.3.2.3.10 If longitudinal and transverse stiffeners of hull, buoyancy or supporting element, such as frames, beams, bulkhead stiffeners intersect with the web frames, then those members shall be welded together.

2.3.2.4 Lap welds

In lap joints permitted for application in accordance with paragraph 2.3.2.1.6, the overlap width shall not be less than quadruple thickness of the thinner component, however not more than 40 mm. The joints shall be made with double continuous welds of the thickness obtained from formula 2.3.2.3.3 for $k = 0.7$.

2.3.2.5 Slot welds

2.3.2.5.1 Where application of a fillet weld is impossible, pin slot weld (Fig. 2.3.2.5.1-1) or slot weld with backing (Fig. 2.3.2.5.1-2) may be applied. Pin slot welds may be applied only in those joints where, as a result of great thickness of plating and its possible deformation, it is difficult to bring the plate to contact with the backing (face plate) on the stiffener.

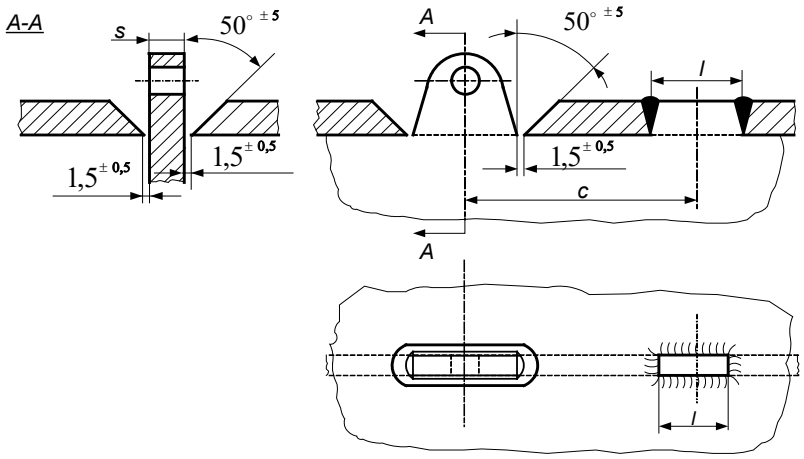


Fig. 2.3.2.5.1-1 Pin slot weld

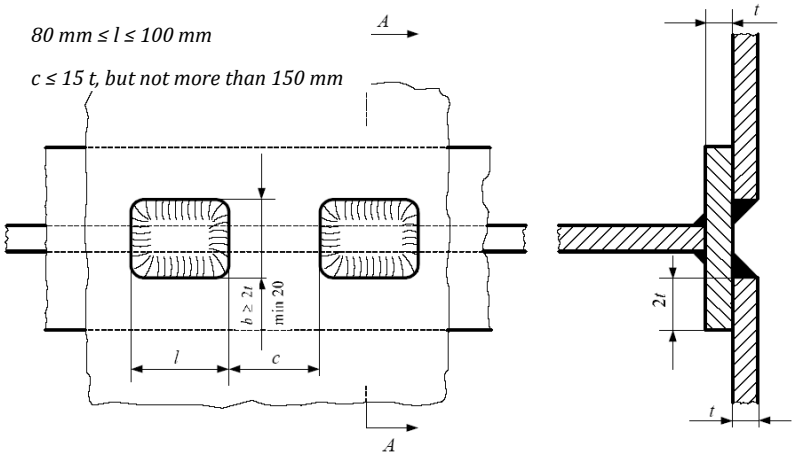


Fig. 2.3.2.5.1-2 Slot weld with backing

2.3.2.5.2 The slots for welds shall be situated with their longitudinal axes parallel with the stress direction and shall have rounded edges.

The length of the holes shall not be less than 80 mm and not be more than 100 mm, their spacing along the longitudinal axis shall not be more than 15 times as much as thickness of the plate welded with backing or web (rib), but not more than 150 mm.

The width of the hole for weld with backing shall be at least double thickness of the plate welded with backing, however not less than 20 mm. The edges of the backing flat bar shall stand out of the weld hole edges on each side by double thickness of the joined plate, however they need not stand out by more than 20 mm on each side. The backing thickness shall be at least equal to thickness of the joined plate.

Weld thickness within the hole shall be determined as for the lap weld (see 2.3.2.4).

2.3.2.5.3 The space remaining after making a slot weld shall be filled with pitch or similar material carefully. The hole shall not be fully filled with weld.

2.3.2.5.4 Pin slot welds shall be applied where application of a slot weld is impracticable. Single pin slot welds may particularly be applied to bring the plate to contact with the backing. The slot width shall be so determined to suit the pin thickness (see Fig. 2.3.2.5.1-1), and the edges shall be beveled at the angle of 50°. The groove so created shall be fully filled with the weld.

2.3.2.6 Inspection of welded joints

Welded joints are subject to inspection in accordance with the requirements specified in the valid standards to the scope agreed with PRS.

2.3.2.7 Corrosion additions

2.3.2.7.1 Corrosion additions are applicable to those objects whose hulls, buoyancy and supporting elements are designed on the basis of these requirements and regard to the assumed 25-year period of service. For assumed longer period of service, greater additions shall be applied, upon agreement with PRS.

2.3.2.7.2 When the object is correctly operated and its surfaces contacting air, fresh and outboard water properly maintained, the value of corrosion additions for steel shell plating as well as walls, stiffeners and girders is 1.0 mm. For structure parts exposed to contact with fuel and sewage, the addition amounts to 1.5 mm. The additions shall be added to the net thickness.

2.3.2.7.3 Corrosion additions shall also be taken into account while determining throat thickness of fillet welds. The values of such additions shall be taken as halves of the values specified for plates and stiffeners, but for one side of the weld. Where the weld may corrode from both sides, the addition shall be applied to each side of weld, respectively to corroding agent. To calculate the net thickness of welds, the net thickness of plates may be taken.

2.3.2.7.4 PRS may accept lower values of corrosion additions than those specified above if the Operator submits reliable data on corrosion of the existing similar objects in the service similar to that intended for the object to be classified.

2.3.2.7.5 Where stainless steels and aluminium alloys are applied at PRS approval, the corrosion additions need not be applied if the minimum thicknesses of plates amount to 3 mm for stainless steels and 4 mm for aluminium alloys. Lower thicknesses may be applied upon PRS approval on the basis of precise direct calculations of the structure and after the corrosion and strength properties analysis of materials in the defined water environment, where the object will be operated.

2.4 Structure strength of SOP hull, buoyancy and supporting elements

2.4.1 General

2.4.1.1 Scope of strength analyses

2.4.1.1.1 Hulls of objects designed in line with this Chapter shall fulfil the general strength criteria specified in sub-chapter 2.5.4, the criteria for combined stress – in the hull longitudinal members – caused by general bending and local loads, as specified in sub-chapter 2.5.6, as well as the local strength criteria specified in sub-chapter 2.5.5. Independent criteria for the structures with members of the design thickness (see 2.5.4.3.5.1 and 2.5.4.4.1) and for the structures with members of the net thickness, i.e. the reduced corrosion additions (see 2.5.4.4.2 as well as 2.5.5 and 2.5.6) apply.

2.4.1.1.2 Criteria of structural members' buckling strength, as specified in 2.5.8, apply to the net thicknesses of structural members, i.e. the design thicknesses reduced by the corrosion additions, as specified in 2.3.2.7.

2.4.1.1.3 If during the service of the hull of a designed object, the values of corrosion diminution exceed those specified in 2.3.2.7, and the corroded structure no longer fulfils the requirements specified in 2.5.4 to 2.5.7, then it may prove necessary to apply restrictions in the form of e.g. reduction of deadweight, the change of the allowable operating area, deleting some loading conditions from the object SOP Stability Booklet, etc. However, the above is subject to the condition that the actual plating thickness will not be less than the thickness specified in 2.4.1.2.

2.4.1.1.4 The general strength requirements apply to hull and supporting element. They can also apply to buoyancy elements if they are relatively long as compared with breadth and height and the stresses due to own longitudinal bending have significant values.

2.4.1.1.5 The local requirements related to plating and stiffeners' system apply to hull and buoyancy elements. They may be applicable to the buoyancy elements only when they are subjected to outboard water pressures, pressures of liquids in tanks and surface functional loads.

2.4.1.2 Minimum plating thickness

2.4.1.2.1 The actual (net) thickness of the bottom, bilge and side plates, measured at any operation stage of steel hull object, shall be not less than the greatest of the values determined from formulae 2.4.1.2.1-1 to 2.4.1.2.1-3:

$$t_{min} = fbc(1.5 + 0.06L_w) \text{ [mm], however, not less than 3 mm} \quad (2.4.1.2.1\text{-}1)$$

$$t_{\min} = 0.006a\sqrt{T} \text{ [mm]} \quad (2.4.1.2.1\text{-}2)$$

$$t_{\min} = f \cdot 0.55\sqrt{L_W} \text{ [mm]} \quad (2.4.1.2.1\text{-}3)$$

where:

b = 1.0 – for the bottom plates and side plates;
b = 1.25 – for the bilge plates;
c – factor for the type of structure:
c = 0.95 – for SOP with double bottom and wing voids;
c = 1.0 – for other types of structure;
f – frame spacing factor:
f = 1.0 – for $a \leq 500$ mm;
f = 1.0 + 0.0013 (a – 500) – for $a > 500$ mm;

when calculating t_{min} of the side plates, f = 1.0 may be taken, irrespective of a value;

a – shell (longitudinal and transverse) frame spacing, [mm].

Where longitudinal framing system has been applied, the a value taken for calculations may not be less than 400 mm.

L_W –buoyancy length of the object, [m].

The value of t_{min} for the bilge plates shall be not less than that required for the bottom plates and side plates.

The actual net thickness of the bottom, bilge and side plating shall be not less than minimum required net thickness based on the direct calculation – see 2.5. The loads of the sea pressure, structure weight and payload shall be taken into account in this calculation.

The above requirements may be waived if it is evident from direct calculations of general, zone and local strength (according to Chapter 2.5) that the strength criteria specified there are complied with at lesser plating thickness than thickness determined in accordance with formulae 2.4.1.2.1-1, 2.4.1.2.1-2 and 2.4.1.2.1-3. The plating thickness may, however, be not less than 3 mm.

The plating not fulfilling the above requirements shall be replaced.

2.4.1.2.2 The thickness of plates, calculated according to 2.4.1.2.1-1, 2.4.1.2.1-2 and 2.4.1.2.1-3, may be considered acceptable, provided that the following conditions are satisfied:
- the hull is constructed of hull steel;
- the plates thickness reduction due to corrosion is uniform;
- the internal structural elements (frames and other stiffeners of the plating, floors, primary supporting members, bulkheads and partitions) are in good condition, i.e. do not show excessive corrosion or permanent deformations;
- the hull shows no indication of damage due to general bending (e.g. permanent deformations, cracks, etc.).

2.4.1.2.3 Plates not complying with the criteria specified in 2.4.1.2.1 shall be repaired or replaced, without delay. However, the values of the plates thickness lesser, by not more than 10%, than the values calculated in accordance with 2.4.1.2.1, may be permitted locally.

2.4.1.2.4 Where a material other than steel is used for the construction of hull, the minimum plating thickness shall be such as to ensure that the hull general, zone and local strength will equal at least the strength of a steel hull having the minimum plating thickness determined in accordance with 2.4.1.2.1.

2.4.1.2.5 For stainless steel, the minimum thickness is 3 mm.

2.4.1.2.6 For aluminium alloys corrosion resistant after welding, the minimum thickness is 4 mm.

2.4.1.2.7 For possible PRS approval of thickness lower than the minimum values specified in 2.4.1.2.5 and 2.4.1.2.6, additional calculations of structure, to the scope agreed with PRS, and corrosion resistance analysis of the applied material for the given SOP operation area, are required.

2.5 Strength calculations of the SOP hull, buoyancy and supporting elements structure

2.5.1 General

The design loads determined as required in sub-chapter 2.5 shall be applied to assess the general strength of hull or supporting element (see 2.5.4), local strength (2.5.5) as well as buckling strength of structural members (2.5.7).

Bending moments and shear forces in the general bending conditions shall be calculated as required in sub-chapter 2.5.2.

The values of pressure and loads imposed by the equipment on the hull structure as well as the values of pressure imposed by the outside water shall be determined as required in 2.5.3.

2.5.2 Bending moments and shear forces due to general bending of hull and supporting and buoyancy elements

2.5.2.1 The design values of the wave bending moments and shear forces shall be determined as required in paragraph 2.5.2.9, taking account of the still water as well as longitudinal wave conditions, as well as SOP transport conditions with the use of a crane, docking, putting on a slip and beaching, for hull, supporting and buoyancy element.

2.5.2.2 Still water bending moments and shear forces $Ms(x)$ and $Qs(x)$ for the frame x shall be determined for the most adverse loading conditions.

The applied calculation methods and software shall ensure adequate accuracy of the calculations. The values of the curve of weight and curve of buoyancy shall be given, in general, for 21 compartments along the object. For hulls and buoyancy elements of simple shape, lower number of compartments may be applied, upon agreement with PRS.

2.5.2.3 In the calculations of still water bending moments and shear forces, the following loading conditions shall be taken into account:
- object without persons, carrying 100% of stores;
- object without persons, carrying 10% of stores;
- object with the maximum allowable number of persons, carrying 100% of stores;
- object with the maximum allowable number of persons, carrying 10% of stores

Longitudinal orientation of people onboard the object is the most increasing its bending moments; with hull in sagging (its middle part is lower than extreme parts), people are concentrated in the middle part, with hull in hogging – on the extreme parts of the object.

2.5.2.4 Where an erection has been installed on a hull which is at once a supporting and buoyancy element, then loads acting directly on deck and response from forces acting on the erection where the erection strength components are attached to deck shall be taken as static load acting downwards on the deck.

2.5.2.5 Where several buoyancy elements are connected with one supporting element, the longitudinal strength of each separate buoyancy element shall be checked. With the purpose to determine still water bending moment, the distribution of weight along the element length, response at places of the buoyancy element attachment to supporting element and buoyancy distribution along the buoyancy element shall be taken as the load of a single buoyancy element. Response from buoyancy elements, distribution of the dead weight of the supporting element and its direct load (utility, stores, etc.) and response from erection loads shall be taken into account in calculations of the supporting element.

2.5.2.6 For all types of objects designed to have one-compartment subdivision, additional calculation of the still water bending moments and shear forces shall be performed for each loading or service condition determined in accordance with the requirements specified in paragraph 2.5.2.3 at the assumption of emergency flooding one watertight compartment up to the equilibrium waterline. The allowable structure response characteristics are specified in paragraphs 2.5.4.3.5.4 and 2.5.4.4.3.

2.5.2.7 The design values of the wave bending moment M_w and the wave shear force Q_w shall be calculated from the formulae:

$$M_w = k_1 k_2 A_1 h \delta B L_w^2 \quad \text{[kNm]} \qquad (2.5.2.7\text{-}1)$$

$$Q_w = k_1 k_2 A_2 h \delta B L_w \quad \text{[kN]} \qquad (2.5.2.7\text{-}2)$$

where:

k_1 – dimensionless coefficient, depending on the operating area, of values specified in Table 2.5.2.7-1;

k_2 – dimensionless coefficient, depending on the moulded draught T of the object, having values given in Table 2.5.2.7-2 (for intermediate values of T, linear interpolation shall be applied);

A_1, A_2 – dimensionless coefficients of values depending on the operating area and length L_w of the object, specified in Table 2.5.2.7-3; for intermediate values of L_w , the values of A_1 and A_2 shall be determined using linear interpolation;

δ – block coefficient $\delta = \frac{V}{L_w B T}$;

L_w, B, T – length, breadth and moulded draught of the object, [m] (see 2.2.1);

V – volume of underwater part of hull at draught T, [m^3];

h – wave height, depending on the operating area, given in Table 2.5.2.7-1, [m].

Table 2.5.2.7-1
Values of coefficient k_1

Operating area	Wave height h [m]	k_1
2	1.2	0.78
3	0.6	0.60

Table 2.5.2.7-2
Values of coefficient k_2

T [m]	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.25	1.5	1.75	2.0	2.25	2.5	≥3.0
k_2	0.74	0.67	0.61	0.55	0.50	0.45	0.41	0.37	0.29	0.22	0.17	0.14	0.11	0.082	0.05

Table 2.5.2.7-3
Values of coefficients A_1 and A_2 as function of L_w

Operating area				
2	L_w, [m]	≤ 15	30	40
	A_1	0.31	0.25	0.21
	A_2	1.00	1.00	0.83
3	L_w, [m]	≤ 10	25	40
	A_1	0.31	0.25	0.19
	A_2	1.00	1.00	0.74

2.5.2.8 The design values of the wave bending moment M_w(x) and wave shear force Q_w(x) from longitudinal wave shall be calculated using the following formulae:

$$M_w(x) = M_w k_M(x) \text{ [kNm]} \quad (2.5.2.8\text{-}1)$$

$$Q_w(x) = Q_w k_Q(x) \text{ [kN]} \quad (2.5.2.8\text{-}2)$$

where:
x – coordinate along the object hull (x = 0 at the after perpendicular);
M_w – wave bending moment, obtained from formula 2.5.2.7-1;
Q_w – wave shear force, obtained from formula 2.5.2.7-1;
$k_M(x)$ – dimensionless coefficient taking values shown in Fig. 2.5.2.8-1;
$k_Q(x)$ – dimensionless coefficient taking values shown in Fig. 2.5.2.8-2.

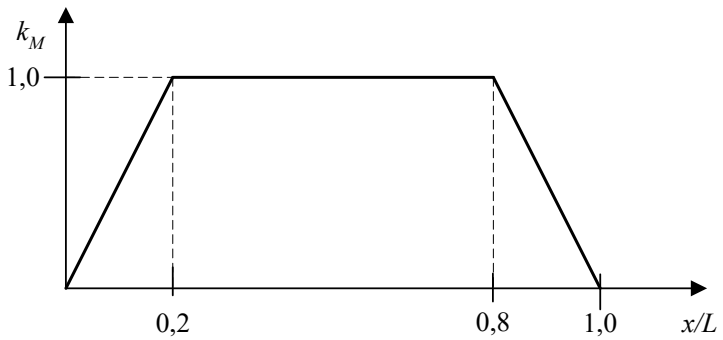


Fig. 2.5.2.8-1 Values of coefficient k_M

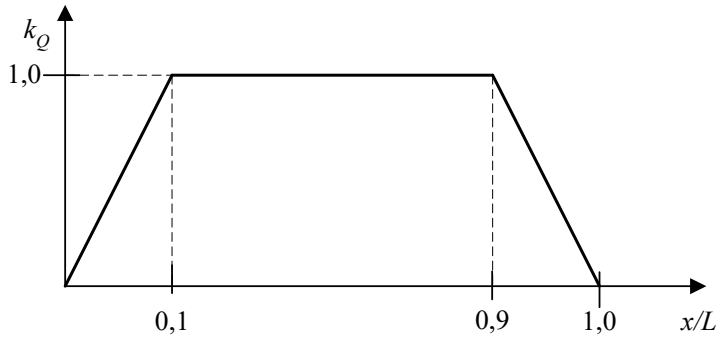


Fig. 2.5.2.8-2 Values of coefficient k_Q

2.5.2.9 The design values of bending moments and shear forces in particular transverse sections of hull shall be determined by adding up their maximum still water values obtained in accordance with paragraphs 2.5.2.2 ÷ 2.5.2.6 and their design wave moments obtained in accordance with paragraphs 2.5.2.7 and 2.5.2.8. The values of $M_w(x)$ and $Q_w(x)$ (see 2.5.2.8) shall be taken for the same sign as the values of $M_s(x)$ and $Q_s(x)$ (bending moment and shear force) in still water.

2.5.2.10 Where several buoyancy elements are connected with one supporting element, the case of wave loads from transverse wave in relation to longitudinal axis of the buoyancy element shall also be considered as wave moment for the buoyancy element, when the buoyancy is changed in the case the buoyancy element in its entire length falls on a wave crest or trough and it is supported on the supporting element only in attachment points.

2.5.2.11 When the supporting element is loaded with responses from buoyancy elements only in several points along its length or the buoyancy elements have different dimensions (L, B, T, H) or shapes and this load cannot be replaced, due to large calculation error, with continuous load, the maximum wave moment M_w and maximum shear force Q_w of the supporting element shall be determined directly, for buoyancy elements placed on a wave, with longitudinal wave various orientation to the object. The wave height may not be higher than the maximum one for the given operating area, and its length shall be within 10 to 20 its heights. For calculation of the supporting element structure, 150% of so calculated maximum moment and shear force shall be taken as a load.

2.5.2.12 When the object supporting element is torsion susceptible, its structure shall be checked for load by torsional moments. The values of static torsional moments shall be calculated considering asymmetrical arrangement of persons (their halfs located in extreme parts of the object diagonally), asymmetrical arrangement of stores, asymmetrical filling of tanks. The torsional wave moment shall be determined with asymmetrical arrangement of buoyancy part against waves. Calculations of the torsional wave moment shall take sinusoidal waves, with length and orientation in relation to buoyancy elements maximizing the value of torsional moment. The wave height to be considered may not be higher than maximum value for the given operating area and not higher than 1/10 of adopted wave length. The sum of the above moments means the load of the structure. Wave length 10 to 20 times its height shall be adopted.

2.5.2.13 For non-typical structure or configuration of buoyancy and supporting elements of the object, the scope of PRS requirements for general loads (longitudinal moments, shear forces and torsional moments) may be changed and adjusted to the given SOP design.

2.5.2.14 In some cases, PRS may require checking structure for general bending from horizontal forces (e.g. due to wind pressure on the object and units moored thereto).

2.5.2.15 Calculations of bending moments and shear forces acting at the stage of transfering SOP or its components by a crane, during docking, putting on a slipway and beaching, shall be carried out similar to still water calculations, however, instead of buoyancy force, the value of response in the hull/supporting element support points at crane slings, dock or slipway supports and onshore supports of SOP, shall be considered.

2.5.3 Local loads on structure

2.5.3.1 The stress in the longitudinal members of the hull or shell plating which are exposed to general bending determined within the analysis of the structure local strength, as required in 2.5.5 for the loads defined in this sub-chapter 2.5.3, shall be combined with the general bending stress, as required in sub-chapter 2.5.6.

The stress in the transverse members are subject to assessment as required in paragraphs 2.5.5.2.7 and 2.5.5.3.5, whereas the stress in the shell plating not exposed to the general bending – as required in paragraph .... .

The structure local strength shall be checked for those combinations of inner and outside loads (2.5.3.2÷2.5.3.7) which impose the maximum values of stress in the shell plating and stiffeners.

2.5.3.2 The loads to be used for local strength analysis shall be determined in the loading conditions specified in 2.5.2.3.

The loads occurring in the following conditions shall also be taken into account (if apply):
- emergency downflooding of a watertight compartment, for objects which should have subdivision,
- hull tightness tests.

2.5.3.3 The local loads of structure occur in the form of the design pressures (outside water pressure, ballast pressure, pressure of stores inside the hull) or concentrated forces (loads imposed by the SOP equipment, response from erection loads, etc.).

2.5.3.4 The design pressure from the water ballast, liquid stores shall be determined from the below formula:

$$p = \rho g h_c \text{ [kPa]} \qquad (2.5.3.4)$$

where:
ρ – mass density of liquid (for water to be taken ρ = 1.0 t/m^3);
g = 9.81 – acceleration of gravity, [m/s^2]
h_c – vertical distance from the air pipe top, in m, whose position shall not be taken lower than 1 m from the uppermost point of tank top.

2.5.3.5 For the emergency flooding of a watertight compartment, loads shall be taken in the form of hydrostatic pressure whose value shall be calculated using the method adequate to location of the object equilibrium waterline in damaged condition.

2.5.3.6 The design (minimum) loads of decks (for plating and stiffeners) shall be taken:
- 4.5 kPa, for upper, weather decks and those occupied by persons;
- 3.0 kPa, for decks in accommodation spaces and galleys.

Where primary supporting members are loaded, for restricted number of persons onboard, the product of combined weight of persons (taking 85 kg as a mass of one person) and the area supported by a single beam, however not exceeding the value for plating and stiffeners, may be taken as a load.

2.5.3.7 Scantlings of the plating and plating stiffeners shall be determined taking into account the following two values of pressure imposed by outside water on the hull plating:

– the maximum value of hydrostatic pressure corresponding to the object/buoyancy element draught $T + 0{,}5h$;
– the minimum value of hydrostatic pressure corresponding to the draught $T - 0.5\ h$.

where:
T – object/buoyancy element draught at the loading condition under consideration,
h – wave height depending on the SOP operating area.

In general, the draught $T + 0{,}5h$ shall be taken for scantling of these structure fragments which are not subjected to the loads imposed from the hull inside, whereas the draught $T - 0{,}5h$ – for scantling of the bottom and side areas which are subjected to the loads imposed from the hull inside, e.g. pressure of liquid in tanks.

2.5.3.8 If stresses are necessary to be determined in the complex system of girders or stiffeners by direct calculations, the load shall be determined using the models described in 2.5.5.3 in accordance with the following algorithm:
– it shall be assumed that the hull or supporting element is statically positioned on front waves (the wave direction is parallel to the hull symmetry plane), and the position of the object against still water is constant;
– the pressures imposed from the structure inside have been determined in accordance with 2.5.3.3 ÷ 2.5.3.6, and the outside pressures are hydrostatic pressures, corresponding to the wave in the particular frame sections of hull.

Wave height h and wave length λ take the following values depending on the operating area:
– area 2: h = 1.2 m, λ = 12 m to 24 m,
– area 3: h = 0.6 m, λ = 6 m do 12 m.

2.5.3.9 The hull/supporting element structure shall also be checked for the loads from forces acting on installed anchoring, mooring, towing equipment, lifting appliances, SOP lifting crane (where SOP lifting is expected) and on supports during docking, putting on a slipway and beaching operations.

2.5.3.10 The design load application point is the point where design pressure shall be determined.

Position of the load application point shall be determined as below:
– for horizontally stiffened plates: in geometrical centre of non-stiffened area;
– for vertically stiffened plates: on the lower edge of plate, if the edge is unsupported (e.g. at change of plating thickness) and at the distance of half the stiffener spacing above the lower edge of plate, if the edge is supported;
– for stiffeners: in the middle of span; for non-linear pressure distribution along the stiffener span, the design pressure shall be determined in the middle of stiffener span and as an arithmetic average of pressures at stiffener ends, taking the greater value;
– for girders: at geometrical centre of the area supported by the girder.

2.5.4 General strength

2.5.4.1 Scope of Calculations

The stresses imposed by the general bending of hull/supporting element shall be calculated for the extreme values of the design bending moments and shear forces determined in accordance with 2.5.2 causing sagging or hogging type of hull deflection.

Calculations shall be performed for those frame sections of hull, where extreme values of combined stresses for the general bending of hull and local bending of plating, stiffeners or girders as well as in those sections where the extreme values of shear forces occur.

2.5.4.2 Members Stressed by General Bending

2.5.4.2.1 When calculating normal stress – caused by the bending moment in general bending conditions – in the hull cross-sections, it may be assumed that they are carried by all the longitudinal members of hull in the particular section, extending over the length not less than double moulded depth of SOP.

Reduced effectiveness of compressed members shall be taken into account in accordance with the provisions of 2.5.4.3.1. Hull openings and intermittent longitudinal members shall also be taken into account in accordance with the provisions of 2.5.4.2.2 and 2.5.4.2.3, respectively.

2.5.4.2.2 Openings in the hull section under consideration shall be taken into account.

In those hull sections which are located near openings, cross-sectional areas of the members shall not be taken into account in the area determined as shown in Fig. 2.5.4.2.2.

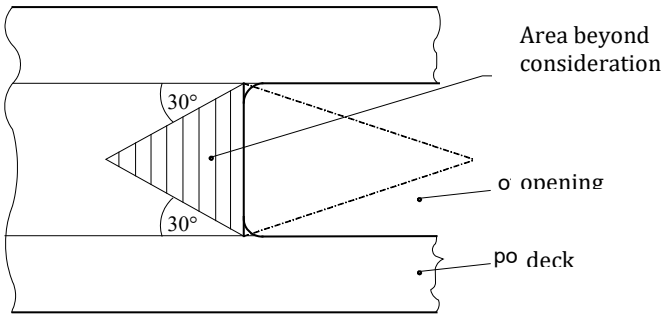


Fig. 2.5.4.2.2 Principle of consideration of deck openings

2.5.4.2.3 In way of their ends, longitudinal members of hull structure (e.g. sides and superstructure decks, etc.) shall be taken into account as shown in Fig. 2.5.4.2.3.

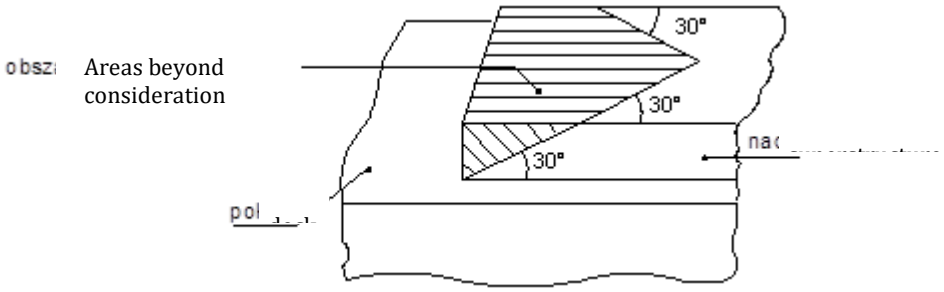


Fig. 2.5.4.2.3 Principle of consideration of longitudinal structure members in way of their ends

2.5.4.3 Calculation method

In the general bending conditions, the values of normal stress σ in the transverse hull/supporting element section containing compressed whippy plating, shall be calculated using an iterative method, taking into account the reduced values of the cross-sectional areas of the plating of the bottom, decks, sides and longitudinal bulkheads calculated by the method accepted by PRS.

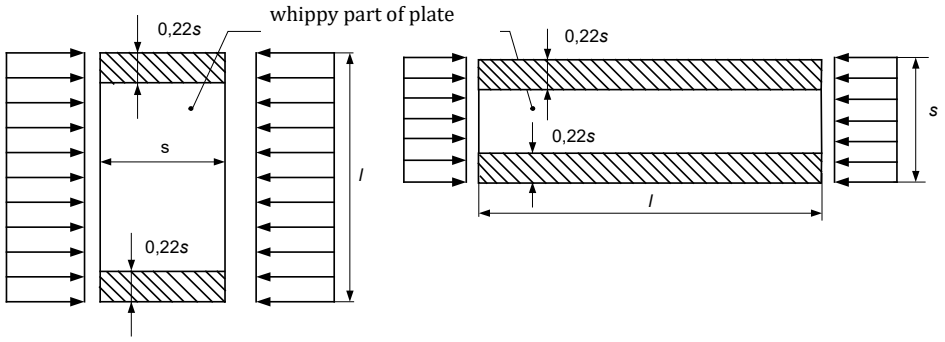
The calculations' results may be considered sufficiently accurate if the maximum values of the normal stresses determined in the subsequent iterative steps differ no more than by 3%.

2.5.4.3.1 Reducing transverse section of plates

The following elements of hull cross-section are not subject to reduction:

- elements, in which normal stress is tensile
- stiffeners and longitudinal members

- curved bilge plating
- rounded strakes
- portions of compressed plating of the bottom, decks, sides, bulkheads and longitudinal bulkheads located at longitudinal edges of plates (determined by stiffeners or longitudinal members, edges of the connection between deck and side, etc.) of the width equal to 22% of the shorter side of the plate (Fig. 2.5.4.3.1).



a) transverse framing system $(s / l \le \sqrt{2})$ b) longitudinal framing system $(l / s > \sqrt{2})$

Fig. 2.5.4.3.1 Plate portions which are not subject to reduction

2.5.4.3.2 Calculations of general stresses due to hull bending taking into account reduction of whippy part cross-sections may be performed also by other methods upon their approval by PRS.

2.5.4.3.3 Calculations where whippy elements are omitted in hull cross-sections are permitted.

2.5.4.3.4 Normal stresses in hull/supporting element cross-sections on the considered hull frame section shall be calculated from the below formula:

$$\sigma = 10^3 \frac{M_s(x)+M_w(x)}{I_{xx}} \cdot e \text{ [MPa]} \qquad (2.5.4.3.4)$$

where:

$M_s(x)$ – hull bending moment in still water for section (x), [kNm];
$M_w(x)$ – hull bending wave moment for section (x), [kNm];
I_{xx} – moment of inertia of frame cross-section (x) taking into account reduction of compressed, whipped fragments of plating, [cm^4];
e – distance of the stress calculated element to neutral axis of the cross-section, [cm].

2.5.4.3.5 Shear stresses in hull/supporting element

2.5.4.3.5.1 Maximum values of shear stress τ in the side shell plating, in the analysed frame section of the hull, shall be calculated using the following formula:

$$\tau = 100 \frac{(Q_s+Q_w)S_n}{I_n t} \text{ [MPa]} \qquad (2.5.4.3.5.1)$$

where:

Q_s – still water shear force, [kN], determined in accordance with 2.5.2;
Q_w – design wave shear force, [kN], determined in accordance with 2.5.2.7;
S_n – first moment of area of the longitudinal structure members situated above or below the horizontal neutral axis, taken about this axis, [cm^3];
I_n – moment of inertia of the hull cross-section taken about the horizontal neutral axis, [cm^4];
t – combined thickness of both sides' plating in way of the neutral axis, [mm].

The values of Q_s and Q_w shall be determined in accordance with 2.5.2.9.

The values of S_n and I_n may be calculated for the hull cross-section without the reduction of whippy portions of the hull section. The values of S_n , I_n and t shall be determined for the design thicknesses of the hull structure members.

2.5.4.3.5.2 For the SOP hull with longitudinal bulkheads or double-side skin construction, the shear stress in plating shall be calculated in accordance with the theory of thin-walled beam bending. The values of Q_s and Q_w shall be determined in accordance with 2.5.4.3.5.1.

2.5.4.3.5.3 The allowable value of stress τ is $0.35R_e$. R_e – yield stress of the plating material.

2.5.4.3.5.4 In the damage condition as defined in 2.5.2.6, the allowable value of stress τ obtained in accordance with 2.5.4.3.5.1 and 2.5.4.3.5.2 is 0.40 R_e. R_e – yield stress of the plating material.

2.5.4.4 Criteria for general bending normal stress

2.5.4.4.1 Allowable values of normal stress σ due to general bending of hull/supporting element calculated for the design thicknesses of hull structure members as required in 2.5.4.2, are as follows:

– 0.60 R_e in the longitudinal members which are additionally subjected to local bending by transverse load;
– 0.70 R_e in the longitudinal members which are not subjected to local bending by transverse load.

2.5.4.4.2 Hull structure of net scantlings (i.e. the design scantlings reduced by the corrosion additions determined as required in sub-chapter 2.3.2.7), as well as the hull structure of the actual scantlings (i.e. measured at the survey of a SOP object in service) shall fulfil the following condition:

$$M_{gr} \geq cM \qquad (2.5.4.4.2)$$

where:

M_{gr} – bending moment causing the maximum value of stress $|\sigma| = R_e$ in the hull cross-section elements which are not subject to reduction (see 2.5.4.3.1). Calculations of value σ in the hull cross-section elements shall be performed taking into account the reduction of whippy portions in accordance with 2.5.4.3, 2.5.4.3.1;

$M = M_s + M_w$ – design value of the hull bending moment, determined in accordance with 2.5.2.9, [kNm];

c – coefficient, to be taken as follows:
1.1 if the rigid elements, where $|\sigma| = R_e$ are not subjected to transverse load due to displacement or payload;
1,25 if the above mentioned elements are subjected to transverse load.

2.5.4.4.3 In the damage conditions as defined in paragraph 2.5.2.6, a criterion in the form (2.5.4.4.2) shall be fulfilled using the following values of c:

c = 1.0 if the rigid elements, where $|\sigma| = R_e$ are not subjected to transverse load due to displacement or payload;

c = 1.15 if the above mentioned elements are subjected to transverse load.

2.5.5 Local strength

2.5.5.1 General requirements

2.5.5.1.1 Checking of the hull/supporting and buoyancy element structure local strength criteria as required in this chapter shall be performed for net scantlings of the structure members, i.e. after deduction of corrosion additions from the thickness design values, as specified in 2.3.2.7.

2.5.5.1.2 Design loads for checking the local strength criteria are specified in 2.5.3.

2.5.5.2 Strength of stiffeners

2.5.5.2.1 Stiffener span together with the effective width of plating shall be considered as a portion of a multi-span beam or a portion of a flat framework. The beam or frame is supported on girders, bulkheads, etc. which in general may be regarded as hinged immovable supports.

2.5.5.2.2 If in the structure there are stiffeners of similar heights situated transversely against each other, a calculation model analogous to the one defined in sub-chapter 2.5.5.3 for girders shall be applied.

2.5.5.2.3 The effective width of plating shall be taken as the lesser value out of b_1 and b_2:

$$b_1 = 0.44s \quad \text{[m]} \tag{2.5.5.2.3-1}$$

$$b_2 = 0.056\sqrt{\frac{235}{R_e}}t \quad \text{[m]} \tag{2.5.5.2.3-2}$$

where:

s – spacing of stiffeners, [m];
t – plating thickness, [mm];
R_e – plating material yield stress, [MPa].

2.5.5.2.4 Stiffeners' span l shall be determined as shown in Fig. 2.5.5.2.4. The span l of curvilinear stiffeners is measured as the length of chord connecting the points of their ends' support.

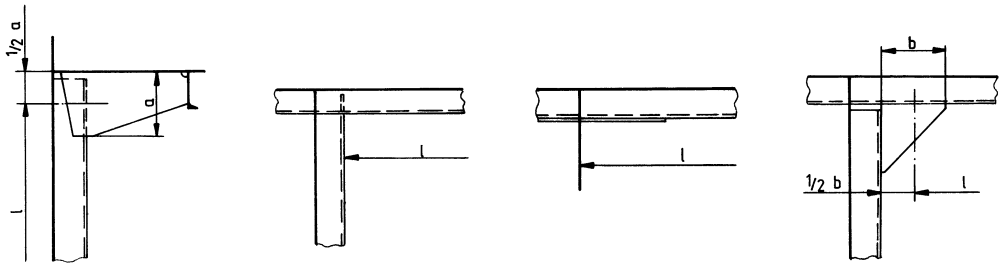


Fig. 2.5.5.2.4 Stiffener span determination pattern

2.5.5.2.5 Construction and scantlings of brackets connecting the stiffeners with girders or stiffeners between each other shall fulfil the requirements specified in 2.7.3.

2.5.5.2.6 The maximum value of the bending moment in a stiffener span shall be calculated using the following formula:

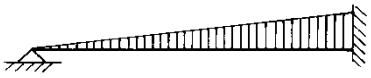
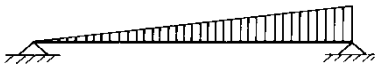
$$M = \frac{psl^2}{m} \quad \text{[kNm]} \tag{2.5.5.2.6}$$

where:

p – design pressure at midspan of l, [kPa];
s – spacing of stiffeners, [m];
l – span determined as specified in 2.5.5.2.4, [m];
m – bending moment coefficient.

For longitudinal stiffeners of hull shell plating, decks and longitudinal bulkheads, m = 12 shall be taken. For other boundary conditions than fixing and loads variable along the stiffener, the data given in Table 2.5.5.2.6 may be used. In other cases direct calculations shall be performed using models defined in 2.5.5.2.2.

Table 2.5.5.2.6
Coefficients *m*

Load and boundary conditions	Bending moments' coefficients		
Location	1	2	3
1 support — 2 extreme between supports — 3 support	m_1	m_2	m_3
	12.0	24.0	12.0
	–	14.2	8.0
	–	8.0	–
	15	23.3	10
	–	16.8	7.5
	–	7.8	–

2.5.5.2.7 The maximum value of normal stresses in stiffeners shall fulfil the following condition:

$$\sigma = 1000\frac{M}{W} \leq \sigma_{dop} \quad \text{[MPa]} \qquad (2.5.5.2.7)$$

where:

M – bending moment obtained in accordance with 2.5.5.2.6, [kNm];
W – section modulus of a stiffener together with the effective strake of plating, [cm^3];
σ_{dop} =0.85 R_e – allowable stress;
R_e – yield stress, [MPa].

For longitudinal stiffeners, the requirements specified in 2.5.6 shall also be fulfilled.

2.5.5.3 Strength of girders

In general, strength of girders shall be checked by direct calculations using the models of flat frameworks, three-dimensional frameworks or grillages.

Finite element method calculations of the structure using membrane or shell elements are subject to PRS acceptance in each particular case.

Loads for structure model shall be taken as required in sub-chapter 2.5.3.

2.5.5.3.1 Where the boundary conditions at the girder ends are known, a single-span beam model may be used in calculations. The design length l of beam shall be determined as shown in Fig. 2.5.5.3.1.

The span l of curvilinear girders shall be measured as the length of chord connecting the points of their ends' support.

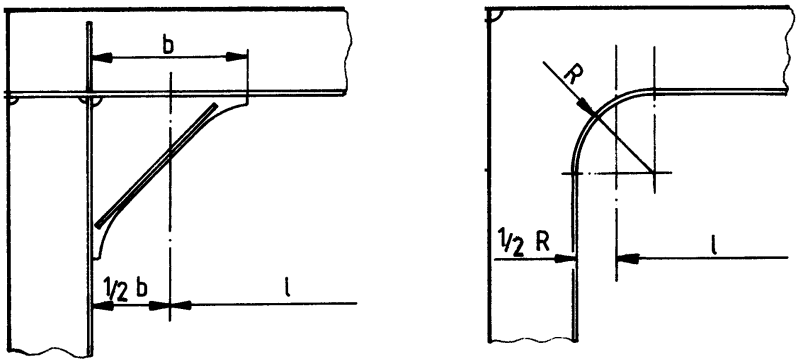


Fig. 2.5.5.3.1 Girder span determination pattern

2.5.5.3.2 The effective width of plating b_e for girders situated transversely to the plating stiffeners shall be calculated using the following formula:

$$b_e = 0{,}44s + (d - 0{,}44s)\frac{\sigma_E}{R_e} \quad \text{[m]} \qquad (2.5.5.3.2)$$

where:

s – spacing of stiffeners, [m];
σ_E – ideal critical stress calculated using formula 2.5.7.5.2 [MPa]; $\sigma_E \leq R_e$ shall be taken in the formula;
d – the lesser value out of the spacing of girders and $\frac{1}{6}l$ (l – girder span), [m].

2.5.5.3.3 For girders situated in parallel with the stiffeners, sectional areas of the stiffeners on both sides of the girder in the distance not greater than d_1 may be included in the effective sectional area of plating. The distance d_1 shall be determined using the following formula:

$$d_1 = Min\left(\frac{1}{2}d, \frac{1}{12}l\right) \quad \text{[m]} \qquad (2.5.5.3.3\text{-}1)$$

where:

Min – means the lesser value;
d – spacing of girders, [m];
l – girder span determined in accordance with 2.5.5.3.1, [m].

The effective width of plating shall be calculated using the following formula:

$$b_e = 0.44d_1 + 0.56d_1\frac{\sigma_E}{R_e} \quad \text{[m]} \qquad (2.5.5.3.3\text{-}2)$$

where:

d_1 – to be calculated using formula 2.5.5.3.3-1, [m];
σ_E – ideal critical stress in plates, to be calculated using formula 2.5.7.5.2 (for a plate compressed along the longer side, $K = 4$ shall be taken), [MPa]; in formula 2.5.5.3.3-2 $\sigma_E \leq R_e$ shall be taken.

2.5.5.3.4 Shear stress in girder webs shall be calculated for the effective sectional area of web in accordance with the following formula:

$$A_s = 0{,}01h_s t_s \qquad \text{[cm}^2\text{]} \qquad (2.5.5.3.4)$$

where:

t_s – web thickness, [mm];
h_s – web net height, [mm].

Web net thickness h_s shall be determined deducting cuts and holes in the section under consideration. If the edge of a web hole is closer than $h/3$ from the section under consideration, then the lesser value, out of the following two: h_3 and $(h_1 + h_2)$ shown in Fig. 2.5.5.3.4, shall be taken as h_s.

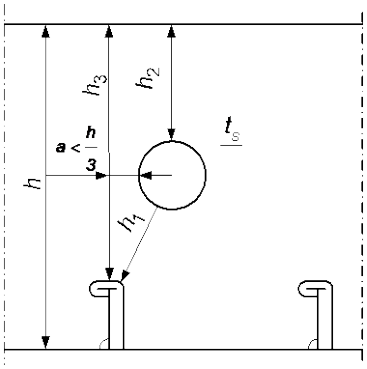


Fig. 2.5.5.3.4 Determining of web net height

2.5.5.3.5 Allowable stress values in girders due to local bending are as follows:

- $\tau_{dop} = 0.4R_e$,
- $\sigma_{dop} = 0.75R_e$,
- $\sigma_{zr,dop} = \sqrt{\sigma^2 + 3\tau^2} = 0.95R_e$,
- R_e – yield stress of girder material.

Longitudinal girders participating in general bending shall also fulfil the conditions specified in 2.5.6.3.

2.5.5.4 Strength of plating of bottom, sides, decks, bulkheads and tank walls

2.5.5.4.1 Required net thickness of plating with longitudinal stiffeners participating in longitudinal strength and of plating with longitudinal or transverse stiffeners not participating in longitudinal strength shall be calculated in accordance with the following formula:

$$t = 22.4\, s\sqrt{\frac{p}{R_e}} \quad \text{[mm]} \qquad (2.5.5.4.1\text{-}1)$$

where:

s – spacing of stiffeners, [m];
p – water or payload pressure, [kPa], determined in accordance with 2.5.3;
R_e – yield stress, [MPa].

If t, [mm], calculated using formula 2.5.5.4.1-1 for plating participating in longitudinal strength fulfils the following condition:

$$t < 10s \qquad (2.5.5.4.1\text{-}2)$$

where:

s – spacing of stiffeners, [m],

then the required plating net thickness for transverse and longitudinal framing system shall be determined by an analysis of normal stress values in plates, taking into account membrane stress, which shall not be greater than the allowable values specified in 2.5.6.4.2.

2.5.5.4.2 Where whippy portions of compressed plating are not considered in calculations of longitudinal strength, the net thickness – for plates supported both by longitudinal and transverse framing system – may be determined as not less than the value calculated according to the following formulae:

- for plating of bottom, bilge, sides and transom:

$$t = 0.8\, a(0{,}1\, L + 6.5) \text{ [mm]} \qquad (2.5.5.4.2\text{-}1)$$

- for plating of strength deck and open deck:

$$t = 0.8\, a(0.1\, L + 4) \text{ [mm]} \qquad (2.5.5.4.2\text{-}2)$$

where:
a – spacing of stiffeners, [m];
L – the length of hull L_k / supporting element L_s, [m].

For so calculated net thickness t_n , the maximum stresses in plating, for support at longer side of plate, may be calculated from the formula:

$$\sigma = 500\left(\frac{a}{t_n}\right)^2 p \quad \text{[MPa]} \qquad (2.5.5.4.2\text{-}3)$$

where:
a – width of shorter side of plate, [m];
t_n – net thickness of plate (design thickness minus corrosion addition), [mm];
p – pressure/load, [kPa].

Transversely stiffened plating plates shall comply with the criterium for combined normal stresses due to general bending and local bending, specified in 2.5.6.4.

2.5.5.4.3 Strength of bulkhead plating shall be checked to the below requirements:
– where a side or longitudinal bulkhead is stiffened longitudinally, the value of p in the middle of the plate shall be taken for the calculations required in 2.5.5.4.1;
– plating of transverse bulkheads stiffened horizontally shall be calculated as required in 2.5.5.4.1;
– Plating of transverse bulkheads stiffened vertically shall be checked in accordance with 2.5.5.4.1, by separate calculations for the value of p at the level of both ends of the longer side of plate or in the location of the plating thickness change. The end of the longer side of plate is located at the level of the bottom, deck, horizontal girder of bulkhead, etc.

2.5.6 Combined normal stress in longitudinal hull members

2.5.6.1 General requirements

In 2.5.6.2 to 2.5.6.4, criteria are specified for the combined normal stress caused by hull general bending in the vertical plane and by local bending of stiffeners and girders situated longitudinally as well as plating in the transversely framed system.

Adding up the stresses shall be done directly for the components corresponding to the extreme values of the hull bending moment, determined in accordance with 2.5.2.9 and local load acting on the hull, determined in accordance with 2.5.3.

The stresses shall be calculated for the net scantlings, i.e. after deduction of corrosion additions from the design scantlings determined in accordance with 2.3.2.7.

2.5.6.2 Stiffeners

2.5.6.2.1 Stress values σ_s calculated for the plating as required in 2.5.4.1 ÷ 2.5.4.3.1 as well as the values of stress caused by local bending σ calculated as required in 2.5.5.2 shall be added up.

In typical cases, distribution of local bending moments of stiffener shall be assumed as for the beam of fixed ends and with continuous load. For constant cross-section of the stiffener, the bending moment on supports is dimensioning one and is twice more than in the middle of the stiffener length. Moreover, stresses in the stiffener face plate are usually other than in the plating effective strake.

When the deck is compressed, the deck compressive stresses from general bending shall be combined with local bending stresses in the stiffener face plate on the support and in the other point compressive stresses of deck plating to be combined with the stresses in stiffener, in the plating effective strake in the mid of stiffener span. For plating subjected to tension, tensile stresses due to general bending shall be combined on the support with local bending stresses in effective strake, with stresses in face plate in the middle of stiffener span (two times lower than on the support).

For the bottom, sides and longitudinals bulkheads, the same principle applies.

If a stiffener is situated within the effective longitudinal girder strake, then the component of stress resulting from the girder bending shall also be taken into account.

2.5.6.2.2 The allowable value of combined stresses determined at the ends and in the midspan is:

$$\sigma_{dop} = 0.95R_e \text{ [MPa]}$$

where R_e – the yield stress of stiffener or plating material.

2.5.6.3 Girders

2.5.6.3.1 Stress values σ_s calculated for the plating as required in 2.5.4.1 ÷ 2.5.4.3.1, as well as the values of stress caused by local bending σ calculated as required in 2.5.5.3 shall be added up, taking into account remarks of 2.5.5.3. Stresses in the effective strake of girder and stresses in the girder face plate shall be added up separately.

2.5.6.3.2 The allowable value of combined stresses determined at the ends and in the midspan is:

$$\sigma_{dop} = 0.90R_e \text{ [MPa]}$$

where R_e – yield stress of the girder material.

Reduced stress $\sqrt{\sigma^2 + 3\tau^2}$, calculated for the values of combined stresses σ and stresses τ calculated as required in 2.5.5.3 shall not exceed $1.0R_e$.

R_e – yield stress of the girder material.

2.5.6.4 Plating

2.5.6.4.1 Combined stresses σ shall be calculated by a method agreed with PRS.

2.5.6.4.2 The allowable value of stresses σ is:
– at the plate edges supported by a stiffener: 1.0 R_e
– in the middle of the plate: $0{,}85R_e$.

where R_e – yield stress of plating material.

2.5.7 Buckling control of structure elements

2.5.7.1 Structure elements subject to buckling control

The following structure elements shall fulfil the stability criteria, specified in this Chapter, for the critical stress determined in accordance with 2.5.7.2.4 or 2.5.7.5.3:
– longitudinal stiffeners of: deck, bottom and longitudinal bulkheads – in the scope of flexural buckling (acc. to 2.5.7.2.2);
– local buckling of web and flange as well as, in justified cases, the critical value of the cross-sectional moment of inertia of stiffeners and girders due to buckling of supported elements;
– deck pillars and other elements subjected to compressive axial forces (in accordance with 2.5.7.4);
– side shell plating and longitudinal and transverse bulkheads' plating (in accordance with 2.5.7.5 do 2.5.7.5.4).

2.5.7.2 Buckling strength of stiffeners

2.5.7.2.1 The values of the ideal critical stress calculated in accordance with 2.5.7.2.2, shall be transformed to the critical values – in accordance with 2.5.7.5.3 of this *Part 2*.

The critical stress values shall be greater than the design compressive stress, due to the hull general bending and girders' bending, by at least 10% (see 2.5.6.2.1).

The requirements specified in 2.5.7.2.3, regarding the buckling strength of stiffeners' flanges, shall also be fulfilled. In well-grounded cases, PRS may require checking inertia moments of stiffeners supporting plating plates compressed in their planes perpendicularly to stiffeners, under condition of ensuring such plating buckling where the half wave of buckled plating is equal to stiffener spacing.

2.5.7.2.2 Ideal critical stress σ_E at the flexural buckling of compressed stiffeners may be calculated using the following formula:

$$\sigma_E = 0.001E\frac{I_\alpha}{Al^2} \quad \text{[MPa]} \qquad (2.5.7.2.2)$$

where:

E – Young's modulus, [MPa];
l – span of stiffener, [m];
I_α – cross-sectional moment of inertia of the stiffener, without the corrosion addition, relative to the axis perpendicular to the expected buckling direction, i.e. perpendicularly to the plating, [cm^4];
A – stiffener cross-sectional area, [cm^2].

In the calculations of the values of I_α and A, the effective sectional area of plating with 44% of stiffeners spacing in width and of the net thickness may be taken into account.

The value of σ_E obtained using formula 2.5.7.2.2 concerns the case of axial compression and free support of both stiffener ends.

Where a stiffener is fixed at one end, the calculated value of σ_E may be doubled, whereas for a stiffener fixed at both ends the calculated value of σ_E may be quadrupled.

It may be considered that the conditions of fixing of the ends of a supporting element (stiffener) occur if ends of the supporting element are joined with the girders of considerable bending rigidity in two perpendicular directions.

2.5.7.2.3 Buckling strength of the flange of a longitudinal stiffener made of an angle or steel T-section (R_e=235 MPa) may be considered sufficient provided the following condition is fulfilled:

$$t_m \geq \frac{1}{15}b_m \qquad (2.5.7.2.3)$$

where:

b_m – flange width for an angle or flange half-width for a T-section, [mm];
t_m – flange thickness, [mm].

2.5.7.2.4 Critical stress in stiffeners under the conditions of flexural local buckling shall be determined using the following formula:

$$\sigma_c = \sigma_E \quad \text{[MPa]}, \quad \text{if} \quad \sigma_E \leq \frac{R_e}{2} \qquad (2.5.7.2.4\text{-}1)$$

$$\sigma_c = R_e\left(1 - \frac{R_e}{4\sigma_E}\right) \quad \text{[MPa]}, \quad \text{if} \quad \sigma_E > \frac{R_e}{2} \qquad (2.5.7.2.4\text{-}2)$$

where:

σ_E – ideal critical stress, [MPa], determined in accordance with 2.5.7.2.2 of this *Part 2*;
R_e – yield stress, [MPa].

2.5.7.3 Buckling strength of girders

2.5.7.3.1 Buckling strength of girders subjected to axial loads (pillars and cross-ties) shall be checked as required in 2.5.7.4.

2.5.7.3.2 Checking of buckling strength of the girders subjected to axial loads due to the hull general bending need not, in general, be performed.

The face plates of girders, however, shall fulfil the requirements specified in 2.5.7.2.3 (as flanges of stiffeners).

The girder webs shall fulfil the requirements specified in 2.5.7.2.2 ÷ 2.5.7.2 concerning the buckling strength of plates.

2.5.7.4 Buckling strength of pillars, struts and supporting stiffeners

Critical buckling stress σ_c of pillars, cross-ties and panting beams, determined in accordance with 2.5.7.2.2 and 2.5.7.2.4, shall not be less than:

$$\sigma_c = \frac{10P}{Ak_1} \quad \text{[MPa]} \qquad (2.5.7.4\text{-}1)$$

where:

P – axial load, determined by zone strength analysis of the structure (of complex girder system) as required in 2.5.5.3, [kN];

$$k_1 = \frac{0.7}{1+\frac{l}{i}} \qquad (2.5.7.4.\text{-}2)$$

where:

l – span of a pillar , cross-tie or panting beam, [m],

$i = \sqrt{\frac{I_\alpha}{A}}$ – radius of gyration of cross-section of the supporting member, [cm];

I_α, A – acc. to 2.5.7.2.2 – as for stiffeners.

2.5.7.5 Scope of buckling control for plates

Buckling strength criteria for plates specified in 2.5.7.5.4 which regard the critical stress values determined in accordance with 2.5.7.5.2 and 2.5.7.5.3 apply to the plating of side shell, longitudinal bulkheads, transverse bulkheads and to girder webs.

For deck and bottom plating, elastic buckling of plates may be accepted.

2.5.7.5.1 Buckling control method for plates

2.5.7.5.1.1 PRS may require that criteria of buckling strength of plates subjected to combined in-plane load shall be fulfilled.

Within the zones of the extreme values of hull bending moment (general bending) or in the girder, it is sufficient to fulfil the criterion for uni-axial compression – see 2.5.7.5.3.1 and 2.5.7.5.4.

Within the zones of the extreme values of shear forces, it is sufficient to fulfil the criterion for pure shearing.

2.5.7.5.1.2 To assess the buckling strength of plates, the values of ideal critical stress shall be calculated first, in accordance with 2.5.7.5.2, and then value of critical stress shall be calculated in accordance with 2.5.7.5.4.

2.5.7.5.1.3 Where a circular or oval opening has been cut out in the centre of plate, the value of ideal critical stress shall be calculated by methods accepted by PRS.

2.5.7.5.2 Ideal elastic buckling stress of plates

2.5.7.5.2.1 Ideal critical stress σ_E at uni-axial compression of the plate fields within the adjacent supporting contour shall be determined using the following formula:

$$\sigma_E = 0.9mE\left[\frac{t_n}{1000s}\right]^2 \quad \text{[MPa]} \qquad (2.5.7.5.2.1\text{-}1)$$

For plate fields stiffened longitudinally (parallel to the compressive stress):

$$m = \frac{8.4}{k_2+1.1} \qquad (2.5.7.5.2.1\text{-}2)$$

For plate fields stiffened transversely (perpendicularly to compressive stress):

$$m = c\left[1+\left(\frac{s}{l}\right)^2\right]^2 \frac{2.1}{k_2+1.1} \qquad (2.5.7.5.2.1\text{-}3)$$

where:

E – Young's modulus, [MPa];
t_n – plating net thickness, [mm];
s – length of the plate field shorter side, [m];
l – length of the plate field longer side, [m];
c = 1.30 – where plating is stiffened with bottom floors or deep girders,
c = 1.21 – where stiffeners are angles or T-sections,
c = 1.10 – where stiffeners are bulb flats,
c = 1.05 – where stiffeners are flat bars;
k_2 – ratio of the smallest to the largest compressive stress σ (see Fig. 2.5.7.5.2.1).

The assumed value of k_2 shall meet the condition that $0 \le k_2 \le 1$.

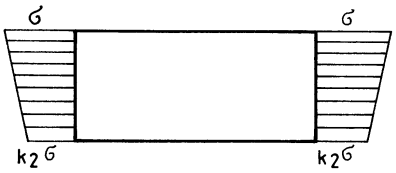


Fig. 2.5.7.5.2.1 Definition of coefficient k_2

2.5.7.5.2.2 The value of ideal critical shear stress and for combined in-plane load shall be determined, where necessary, by methods accepted by PRS.

2.5.7.5.3 Critical stress of plates

2.5.7.5.3.1 Critical stress at uni-axial compression of plates shall be determined using the following formula:

$$\sigma_c = \sigma_E \quad \text{[MPa]}, \quad \text{if} \quad \sigma_E \le \frac{R_e}{2} \qquad (2.5.7.5.3.1\text{-}1)$$

$$\sigma_c = R_e\left(1-\frac{R_e}{4\sigma_E}\right) \quad \text{[MPa]}, \quad \text{if} \quad \sigma_E > \frac{R_e}{2} \qquad (2.5.7.5.3.1\text{-}2)$$

where:

σ_E – ideal critical stress at compression, [MPa], determined in accordance with 2.5.7.5.2.1.

2.5.7.5.4 Criterion for buckling strength of plates

For plates subject to the check for buckling strength at uni-axial compression, the following condition shall be fulfilled:

$$\sigma_c \ge \sigma_r \qquad (2.5.7.5.4)$$

where:

σ_c – critical stress calculated in accordance with 3.6.8.1, [MPa];
σ_r – compressive stress determined for the design loads, [MPa].

For plate panels subject to the check for buckling strength at pure shearing and for combined in-plane load, the condition that critical stress shall be higher than design stress shall be fulfilled.

2.6 Arrangements for multi-hull structures

2.6.1 General

2.6.1.1 Each hull, supporting and buoyancy element being a part of multi-hull SOP structure shall comply with the requirements of these Rules as a single-hull structure, within the scope of local and longitudinal strength.

2.6.2 Multi-hull structure in linear configuration

2.6.2.1 The SOP configurations with hulls positioned along one straight line shall be considered regarding their longitudinals strength as a single hull of lengths L_s, L_w and L_k defined for the whole line of hulls. The breadth B shall be assumed as an average calculated from the product of total waterline area and length L_w.

2.6.2.2 The distribution of bending moments and shear forces shall be determined in accordance with the requirements for a single hull, both in still water and on waves. The stresses in hulls and their connections shall also be determined in accordance with single hull requirements. The same level of allowable stresses applies.

2.6.3 Requirements for multi-hull SOP with non-linear configuration

2.6.3.1 The requirements specified in this paragraph apply to multi-hull SOPs whose objects are arranged against each other to form letters H, T, C, U, etc. in a top view. Generally, no restrictions are provided in this scope, however, PRS may introduce additional requirements for each configuration.

2.6.3.2 The structure shall be checked for general loads in still water and on waves of parameters given in 2.5.3.8. The values of bending moments due to vertical and horizontal forces, vertical and horizontal shear forces and torsional moments, shall be determined.

2.6.3.3 The still water distribution along the object of vertical shear forces, bending moments due to the shear forces and torsional moments, shall be determined. The calculations shall be performed as for the single-hull object, by applying loads from the whole structure weight, payloads and buoyancy force to the grillage made of beams of particular hull components.

2.6.3.4 The wave-induced loads are the vertical and horizontal shear forces, bending moments due to the shear forces and torsional moments. The wave size shall be assumed in accordance with 2.5.3.8. Numerous cases of the wave length and position (wave troughs and crests) against SOP shall be considered. For wave sizes which are maximum values for the SOP operating area, wave lengths (length range 10 to 20 times the wave height) and positions of crests and troughs shall be selected for the multi-hull arrangement of SOP, to achieve locally maximum loads of hulls and their connections. The selected for calculations wave positions related to hulls shall ensure balance of vertical buoyancy forces and gravity forces of SOP.

2.6.3.5 The still water loads shall be added to wave loads to receive longitudinal distribution of total vertical and horizontal shear forces, vertical and horizontal bending moments and torsional moments.

2.6.3.6 Based on the above loads and according to the requirements for single-hull SOP, the stresses for different hull cross-sections of net thickness considering reduction of whippy structural members shall be defined, including extreme load values and minimum section moduli for hull bending, minimum plate thickness for shear and torsion, etc.

2.6.3.7 The general strength stresses shall be combined with local strength stresses for particular cross-section points, where maximum total stress may be expected. The stress level shall not exceed allowable stresses for single-hull structures, defined in 2.5.6.

2.7 General particulars of structure for hull, buoyancy and supporting elements

2.7.1 Rounding of scantlings

Section modulus and moments of inertia shall be rounded up. Rounding down is acceptable where it is not more than 3% of the required value of a modulus or moment.

When rounding plate thickness, millimetre fractions lesser than 0.25 may be neglected, whereas the fractions equal 0.25 and above shall be rounded up. Plates thinner than 3 mm for steel and 4 mm for aluminium shall not be applied, unless otherwise provided in the *Rules*.

2.7.2 General provisions

2.7.2.1 All parts of the hull, supporting and buoyancy elements shall be accessible for inspection and maintenance. In doubtful cases the procedure and type of inspection is each time subject to PRS acceptance.

2.7.2.2 Hull stiffeners and girders shall be so arranged that frames are created in the frame planes and in the longitudinal planes. This means that, e.g. the longitudinal stiffeners of the bottom and deck and vertical stiffeners of transverse bulkheads shall be coplanar. A similar principle applies to girders situated in the frame planes.

2.7.2.3 Smooth change of thickness of the structure members shall be provided. In general, thicknesses of the adjacent plate panels situated in one plane shall not differ by more than 30% of the thicker panel thickness – except for local strengthening of the plating.

2.7.2.4 The change of web height of stiffeners or girders shall be achieved throughout the length not less than five times as much as the height difference of the joined webs. Scantlings of the above mentioned girders' flanges shall change smoothly.

2.7.2.5 Changes in the hull structure fore-and-aft shall be as smooth as possible. In one frame section, no more than 1/3 of all stiffeners or longitudinal girders shall end.

The places where consecutive portions of longitudinal girders are cut shall not be at the shorter distance than 2 frame spacings.

The change from the longitudinally to transversely framed system of hull shall be gradual.

2.7.2.6 Longitudinal stiffeners of hull shall not be cut in the places of local stress concentration, e.g. near the shell openings.

2.7.2.7 In way of ends of decks or inner bottom or longitudinal bulkheads, the stress concentration shall be reduced by the use of smoothly shaped brackets coplanar with those structures' plating.

Examples of recommended designs are shown in Fig. 2.7.2.7.

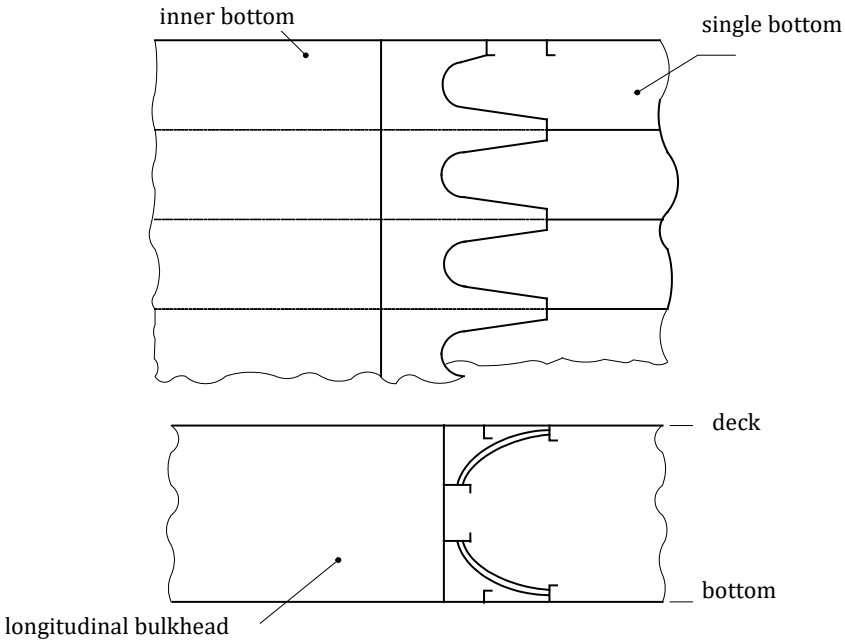


Fig. 2.7.2.7 Recommended design patterns for reduction of stress concentration

2.7.3 Construction of stiffeners and girders

2.7.3.1 Ends of stiffeners of the plating of the hull, decks and bulkheads, except those specified in 2.7.3.2, shall be connected, with use of brackets, to the girders or plating panels situated transversely to the stiffeners.

2.7.3.2 Where fulfilment of the requirements specified in 2.7.3.1 is impossible or impracticable, the ends of stiffeners shall be beveled. Such a solution is acceptable for the following stiffening elements:

– stiffeners of girder webs;
– stiffeners of bulkhead plating if the plating is strong enough to equilibrate, in the form of shear stresses perpendicular to the plating, the shear forces imposed on the bulkhead (response at ends of stiffeners). Stiffeners and girders whose webs are coplanar shall be joined with use of a bracket. That bracket shall be coplanar with the webs of the joined beams. Only in connections between stiffeners as well as stiffeners and girders overlap brackets are permitted.

In regions of small dynamical loads and of insignificant vibrations, stiffeners with beveled ends may be applied, provided that the thickness of plating supported by the stiffeners (at considered ends) is not less than the thickness defined from the formula 2.7.3.2-1:

$$t = 1{,}25\sqrt{\frac{(l-0{,}5a)ap}{R_e/235}} + t_k \text{ [mm]} \qquad (2.7.3.2\text{-}1)$$

where:
l – stiffener span, [m],
a – spacing of stiffeners, [m],
p – pressure acting on the plating supported by the considered stiffener, [kPa],
R_e – yield stress of the plating material, [MPa]
t_k – corrosion addition, [mm].

Section modulus of the beveled stiffener shall be calculated in accordance with formula 2.7.3.2-1, taking m = 7.5 and $s = 0.6R_e$ for calculations:

$$W = w_k \frac{1000apl^2}{m\sigma} \text{ [cm}^3\text{]} \qquad (2.7.3.2\text{-}2)$$

where:

w_k – corrosion addition coefficient:

–for angles, T-sections, I-sections and channel sections: $w_k = 1 + 0.1t_k$;

–for bulb sections: $w_k = 1 + 0.06t_k$;

R_e – yield stress of stiffener material, [MPa].

Other symbols *a, l, p*, t_k – see formula 2.7.3.2-1.

Girder webs and flanges shall be connected by welding.

2.7.3.3 Connections of stiffener ends to girders or brackets shall be made as shown in Fig. 2.7.3.3.

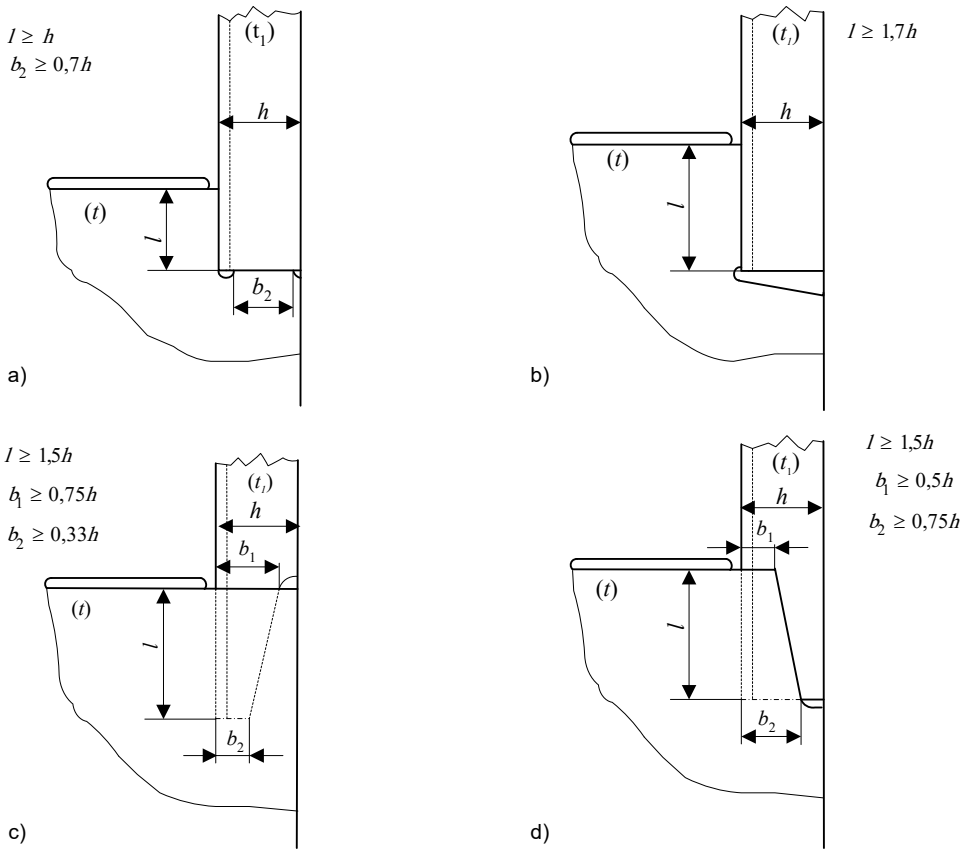


Fig. 2.7.3.3 Required design patterns for connection of stiffener ends to girders or brackets

Where section thickness t_1 of web is greater than plate thickness *t*, then the weld length *l* shall be increased in proportion to ratio t_1/t. The required weld thickness shall be determined in accordance with formula 2.3.2.3.3 by applying weld height coefficient k = 0.6.

2.7.3.4 The length of sides of a bracket connecting stiffeners, measured at the stiffener flanges, shall not be less than double height of the lower stiffener web, unless required otherwise in other Chapters. For connections of girders, the above defined bracket side length shall not be less than the web height of the lower girder connected.

2.7.3.5 Where the ratio of the free edge length to its thickness is greater than 50, a bracket shall be flanged or welded face plate shall be fitted.

The ratio of the flange width (or face plate width on one side of the bracket plane) to the flange thickness (or face plate thickness) shall range from 8 to 12.

2.7.3.6 A girder crossing a bulkhead shall be connected to the bulkhead structure member with brackets situated on both sides of the bulkhead.

2.7.3.7 Stiffeners may be cut in the places where they cross girders, divisions or bulkheads. In those cases brackets shall be applied on both sides of the transverse wall (girder web or plating of a division or bulkhead). The brackets shall be coplanar with the webs of stiffeners.

The brackets shall be connected to the stiffener of the transverse wall. Recommended design patterns are shown in Fig. 2.7.3.7.

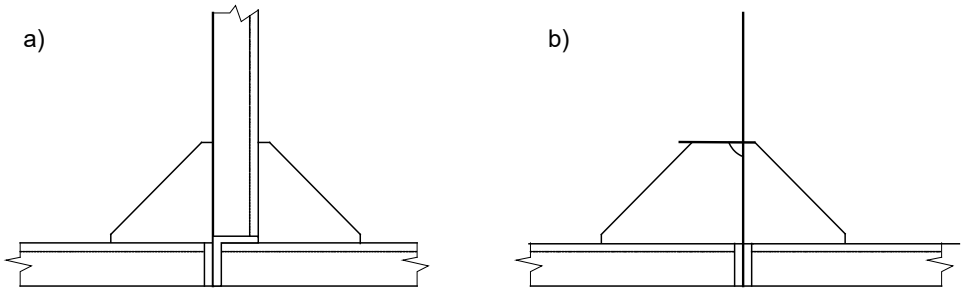


Fig. 2.7.3.7. Recommended design patterns for connections of stiffeners to girders, divisions or bulkheads

2.7.3.8 Stiffeners crossing transverse walls (girder web or plating of a division or bulkhead) shall be welded to the edges of the wall openings.

2.7.3.9 Bent flanges and bracket face plates shall not be welded to the plating of the sides, bottom, decks as well as to the face plates of longitudinals, deck beams and web frames.

2.7.3.10 Bracket corners shall be cut as shown in Fig. 2.7.3.10. In corners of an obtuse angle, circular cuts shall be made with the radius greater than 20 mm (Fig. 2.7.3.10).

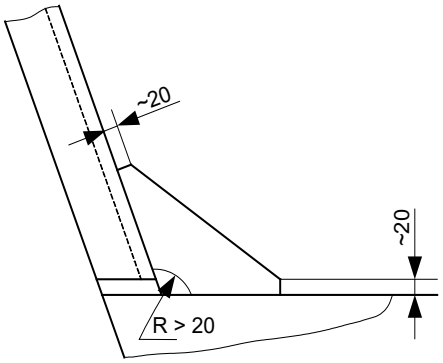


Fig. 2.7.3.10. Bracket design pattern

2.7.3.11 In the areas where the planes of the three mutually perpendicular plates intersect (e.g. the area of connection of transverse bulkhead, longitudinal bulkhead and platform), brackets shall be applied to reduce stress concentration. The brackets shall be situated coplanar with that plate whose outer edge is in the above mentioned area.

2.7.3.12 Webs of the steel girders with the ratio of height to thickness greater than 80 shall be stiffened vertically or horizontally to fulfil the buckling strength criteria specified in sub-chapter 2.5.7.3.

2.7.3.13 Stiffeners of girders mentioned in paragraph 2.7.3.12 may be made of flat bars. The flat bar's ratio of height to thickness shall not exceed 10. Stiffener thickness shall not be less than 80% of the stiffened web thickness.

2.7.4 Openings in structural elements

2.7.4.1 Rectangular openings in the longitudinal members of hull shall have their corners rounded with the radius not less than 10% of the opening width. The opening edges shall be smooth.

Application of not-rounded corners is subject to PRS acceptance in each particular case.

2.7.4.2 It is recommended that openings in the longitudinal members of hull have their longer sides situated fore-and-aft of SOP.

2.7.4.3 Where several openings in the plating or girder web are necessary to be made in close proximity, they shall be preferably arranged fore-and-aft in line.

2.7.4.4 Stiffener ends in way of shell openings shall be welded to the dedicated transverse stiffeners. The design pattern is shown in Fig. 2.7.4.4.

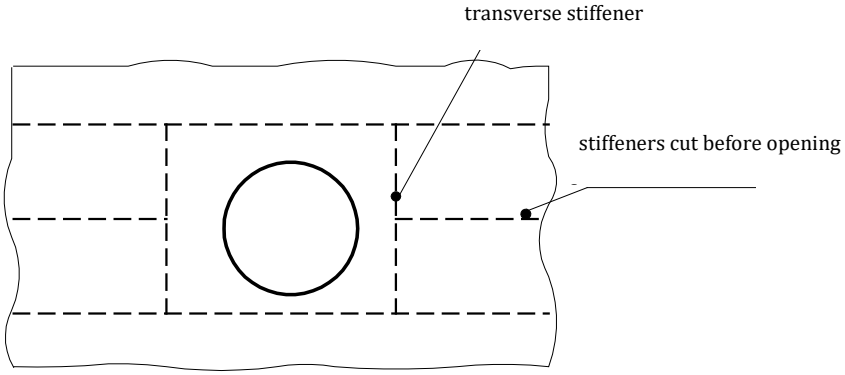


Fig. 2.7.4.4. Stiffening of plating in way of opening

2.7.4.5 Openings in webs of stiffeners or girders are not permitted in the distance less than 50% of the web height from:
- bracket end;
- transverse wall (web of a transverse member, bulkhead, etc.), unless the bracket has been applied.

2.7.4.6 The height of cut-outs in a girder web, for stiffeners, shall not exceed 40% of the member depth. The total height of lightening and transfer holes and cut-outs in girder webs shall not exceed 50% of a web depth and their length shall not exceed 75%. The distance between the edges of cut-outs for plating stiffeners and the edges of other openings shall not be less than the stiffener depth.

2.7.4.7 In girder webs and stiffeners supporting the SOP bottom plating as well as top and bottom walls (horizontal or virtually horizontal) of integral tanks, drain holes or vent holes shall be made for effective drainage on the bottom or air flow in the top part of the tank. The holes shall fulfil the minimum requirements for scallops specified in 2.3.2.1.5.

2.7.5 Bottom girders

2.7.5.1 For transverse framing system, use of floors on each frame is recommended.

2.7.5.2 Upper edges of floors shall be stiffened by means of a face plate or flange. Recommended width of the face plate or flange is $10t$ (t – web thickness); the thickness t_m of the face plate shall be not less than t + 1 mm.

The below condition shall be fulfilled:

$$t_m \geq \frac{1}{15} b_m \qquad (2.7.5.2)$$

where:

b_m – the flange width or a half of the face plate width for T-section.

2.7.5.3 It is recommended that in SOP objects with ratio $L/H > 25$, the bottom centre girder shall be continuous. The depth shall not be less than the bottom floor height.

2.7.5.4 It is recommended that in objects with the hull breadth from 6 to 10 m, one longitudinal should be applied on each side of the centre girder, whereas in objects with a breadth over 10 m – at least two longitudinals should be applied.

2.7.5.5 Any possible changes in the arrangement of longitudinals shall be gradual, throughout the length of at least two frame spacings.

2.7.5.6 Where double bottom is applied, the requirements agreed with PRS apply.

2.7.5.7 Open floors and solid floors shall comply with PRS agreed requirements.

2.7.6 Side stringers

2.7.6.1 Where the frame span exceeds 2.7 m, side stringers shall be applied..

2.7.6.2 Side stringer shall be connected to transverse bulkheads with brackets. The brackets' sides shall have the length equal to the stringer height.

2.7.7 Fenders

2.7.7.1 Where steel fenders, e.g. made of half-round bars or pipes, are applied, they shall be fixed to the plating with watertight double continuous weld.

2.7.7.2 Where wooden fenders are applied, they shall not be through-bolted to the shell plating.

2.7.8 Plating strengthening

Local thickening of plating panels by 50% shall be applied in way of deck 'steps' at the sides.

Local plating strengthenings shall be considered in the hull structure due to use of specific equipment in spaces and decks accessible for people and strengthenings shall be provided considering loads present during operation of lifting appliances in region of foundation of such equipment (if applied).

Hull strengthenings shall be provided in region where response from erection loads exists.

Strengthenings in region of foundation of aggregates shall be agreed with PRS.

2.7.9 Decks

2.7.9.1 Deck structure shall be adapted to response from erection loads.

2.7.9.2 Transverse deck girders shall be applied in the web frame planes.

2.7.9.3 Deck girder web depth shall not be less than 1.6 the height of deck beams.

2.7.9.4 Deck girder web thickness shall not be less than the thickness of deck beams.

2.7.9.5 Deck girder face plate width shall not be greater than the web height, and its thickness – not less than the web thickness increased by 1 mm, however, not greater than double web thickness.

2.7.9.6 Deck girder shall be stiffened with tripping brackets if the difference between its web height and deck beam web height exceeds 60 mm. Thickness of brackets shall be equal to the web thickness. The distance between brackets shall be equal to double spacing of deck beams – if the face plate or flange is asymmetrical, and four spacings – if the face plate or flange is symmetrical.

2.7.10 Pillars

2.7.10.1 Where deck erections, heavy deck machinery etc., are not seated on the strong deck members, they shall be supported by pillars positioned on bottom floors.

2.7.10.2 Pillars shall run in one perpendicular at the particular tie, if practicable. Hull structure under and above the pillars shall be so stiffened that the pillars can bear the load by their whole cross-sectional area. In way of their connection to girders, deck beams and floors, the pillars shall be strengthened with vertical brackets.

2.7.11 Deep tanks

2.7.11.1 Domestic water tanks shall be separated by cofferdams from fuel, sewage, etc. tanks. Cofferdam width shall not be less than 400 mm.

2.7.11.2 In the lower portion of girders inside tanks, limber holes shall be provided.

2.7.12 Deck and shell openings

2.7.12.1 Shell openings

2.7.12.1.1 Shell openings shall have rounded corners; the fillet radius shall not be less than 50 mm.

2.7.12.1.2 Openings with more than 300 mm in diameter, made in plating, require full compensation of the loss by increasing the plating thickness in way of such an opening.

2.7.12.1.3 In way of valves' and pipelines' fixing, strengthening flanges shall be installed on the shell plating. Shell penetration by bolts or direct welding of bolts to the shell plating are not permitted.

2.7.12.1.4 Where scuttles or other openings reducing the sectional area by more than 20% are made in the sheer strake, equivalent strengthening shall be provided.

2.7.12.2 Openings in the strength deck and their closures

2.7.12.2.1 Openings in the strength deck shall have rounded corners; the fillet radius shall not be less than 5% of the opening width or 50 mm, whichever is greater.

2.7.12.2.2 Thickness of plating panels embracing corners of large openings with more than 0.5B in width shall be subject to separate consideration by PRS.

2.7.12.2.3 Deck hatchways and their closures

2.7.12.2.3.1 Thickness of hatch coamings (if any) shall be not less than deck thickness there. Upper edge of the hatch coaming shall be stiffened by a profile, while high coamings – by vertical struts, to prevent buckling of the coaming plate.

Hatches without coamings may be applied on all decks. Covers of such hatches shall have closing arrangements ensuring watertightness and operating comfort. Construction of the hatch cover shall ensure the same local strength as the deck in way of the hatch.

2.7.12.2.3.2 The hatch covers shall be easily accessible and safe in operation. They can be closed by any way, provided the covers are protected against accidental self-turning or self-movement. They shall be disabled in open position by arrangements preventing their movement or closing by wind or heel of the object.

2.7.12.2.3.3 All companion hatches, skylights and ventilating trunks may be closed with covers attached to their coamings by means of hinges.

2.7.12.2.3.4 Covers of companion hatches, shall be fitted with securing devices capable of being operated from outside of the cover. Covers of ventilation trunks shall ensure their opening from outer side, while covers of skylights – from inner side. Where the hatches and skylights are also used as emergency exits, the securing devices shall be capable of being operated from both sides of the cover. When secured, the covers shall be splash-tight. The tightness shall be provided by gaskets made of rubber or other suitable material.

2.7.12.2.3.5 The dimensions of manholes of rectangular shape shall be at least 0.45 x 0.50 m or – if the manholes are round – their diameter shall be at least 0.45 m.

2.7.12.2.3.6 The thickness of steel covers of manholes shall be not less than that of the plating surrounding the manhole with the same stiffener spacing. The hatch cover shall be stiffened and strengthened respectively to its size and expected load. The covers made from other material are subject to special consideration of PRS in each particular case. Hatch covers designed to be walked on shall be capable of withstanding the load of at least 4.5 kN/m^2, however not less than 0.9 kN. Hatch covers which are not designed to be walked on shall be clearly marked as such. Hatch covers designed to receive large deck cargo shall have the permissible load in kN/m^2 marked on them.

2.7.12.2.3.7 The weight of rotational covers shall not exceed 20 kg, to enable their manual opening and closing by one person. Sliding covers shall have such structure, weight and guides to enable their operating by one person with pressure not exceeding 200 kN. Where hatch covers with weight, structure or location which make impracticable their operation from both sides need to be applied, they shall be equipped with devices and mechanisms supporting or enabling their operation.

2.7.12.3 Openings in hull watertight bulkheads and their closures

2.7.12.3.1 The number of doors in watertight bulkheads below the buoyancy deck shall be limited to the minimum consistent with the design of the object and the safety of the object operation.

2.7.12.3.2 In watertight bulkheads, doors operated from both sides of a bulkhead shall be used. The strength of the doors shall be equal to that of the bulkhead.

2.7.12.3.3 Doors closed by their own weight or by falling mass are not permitted.

2.7.12.3.4 Any bulkhead penetrations, e.g. for pipings and cable routes, shall be watertight.

2.7.12.4 Openings in shell plating and their closures

2.7.12.4.1 No sidescuttles are recommended at hull places immersed permanently or periodically. Where the sidescuttles are installed in the plating below the design waterline, effect of increased external pressure and possible loss of tightness after mechanical damage outside and inside shall be considered. The sidescuttles shall be generally of a non-opening type. If opening type sidescuttles are installed, they may be opened only with use of a key.

2.7.12.4.2 If sidescuttles immersed permanently or periodically are used onboard, they shall be intended for such use and have appropriate certificate issued by PRS, i.e. *the Acceptance Certificate 3.2*, and when the sidescuttle should also have fire resistance properties – *the Type Approval Certificate* or *MED Certificate*. Doors to spaces where such types of sidescuttles are fitted shall be watertight and shall open outside the space.

2.7.12.4.3 Sidescuttles shall be watertight, have high glazing resistance to mechanical damage and ensure minimizing of heat losses in the winter (sidescuttles of coefficient $U \leq 1.7$ shall be applied). Destructive effect of freezing water and ice forming in the winter on the sidescuttles shall be prevented.

2.7.12.4.4 The sidescuttles shall be permanently equipped at the internal side with watertight covers with manual closing by two bolted mechanisms. The glass thickness and kind shall be in accordance with technical conditions adopted by the sidescuttles' manufacturer. It is recommended to use double glazing – two separate glass panels of hardened laminate glass or at least two separate window frames (external and internal) with hardened laminated glass panels. Installation of permanently or periodically immersed sidescuttles shall be performed strictly according to manufacturer's instructions, and the installed product shall have long-term manufacturer's guarantee.

2.7.13 Tightness tests

2.7.13.1 Watertight components of hull such as plating, bulkheads, tanks, deck shall be subjected to tightness test in accordance with the requirements specified in this Chapter.

2.7.13.2 Hydraulic tests shall not be performed at an ambient temperature below 2 °C.

2.7.13.3 Tests shall be performed after watertight welded components have been fixed to the structure, however before cementing and painting.

2.7.13.4 If any work which may impair the structure watertightness has been performed after the tightness test, the test shall be repeated.

2.7.13.5 In special cases, PRS may accept compressed air tests or paraffin and chalk tests instead of hydraulic tests.

2.7.13.6 Central bottom girder need not be watertight, unless it bounds a watertight compartment.

2.7.13.7 Tightness tests shall be performed in accordance with the requirements agreed with PRS.

2.7.14 Principles of joining buoyancy segments

2.7.14.1 The required method of articulated connection of buoyancy segments in one multi-segment object shall fulfil the following requirements:

- articulated connections shall have horizontal axes of colinear pins (if several pins are within one connection) perpendicular to longitudinal symmetry plane of segments;
- the connections shall ensure such pitching angle of the objects that segments cannot hit each other, under any permitted load and at maximum waves assumed for the given operating area, at longitudinal wave (it depends on the ratio of articulation spacing to wave length and on the articulation distance to the lower part of segment);
- articulations shall be placed as close as possible to the level of utility deck (landing);
- articulations shall have strength connections with supporting elements of each segment and with horizontal plates, trusses, frames or other members transferring horizontal forces normal to longitudinal axis of segment;
- the structure of articulations shall enable transfering forces acting along the axis of articulation pins or additional structural components transfering the forces and protecting pins from the forces action shall be applied;
- it is recommended to retract pairs of extreme articulations towards the outer edges of segments to maximum possible distance, to minimize forces in connections due to horizontal loads;
- gaps between segments in lines of articulations attachment on public decks, shall be covered with swinging plates.

2.7.14.2 The forces acting on the articulations shall be calculated by using a model of several beams (reflecting segments) simply connected, loaded with static buoyancy forces and wave-induced forces, dead weight and load on segment decks. The buoyancy forces distribution shall be assumed in accordance with draught of segments under load.

2.7.14.3 The forces due to loads on decks of individual segments shall be taken in various options, which should reflect real situations and at once which generate maximum bending moments of segments, maximum shear forces and maximum response in articulations. Respectively to designed configuration of the segment assembly, PRS may define sets of loads to be taken for calculations. It applies also to loads unsymmetrical in relation to the longitudinal axis of segment (torsional loads) which generate vertical response in connections.

PRS may also show loads which shall be treated as existing simultaneously.

The calculations shall lead to determination of bending moments due to vertical and horizontal forces, vertical and horizontal shear forces and responses in articulations (components along *x, y, z* axes).

2.7.14.4 Permissible stresses for metal elements of articulations equal to:
- 0.7 R_e – combined normal stresses;
- 0.4 R_e – combined shear stresses;
- 0.8 R_e – equivalent stresses.

where *Re* – yield stress of material.

The stresses concern weldable structural steels, weldable stainless steels and water corrosion resistant weldable aluminium alloys (grades 5000, 6000), while the yield stress of material R_e shall not exceed 0.7 of the tensile stress R_m.

For compressed elements exposed to buckling, safety factors not less than 1.2 (taking into account the yield stress effect) shall be ensured.

2.7.14.5 Articulations and elements binding them with the object supporting elements shall be accessible for inspection and maintenance.

2.7.14.6 In the case the designer proposes such segment connection that bending moments may occur due to vertical forces in the segments connection (horizontal vector of the moment normal to longitudinal axis of segment), then such segments shall be considered as one segment having the length of the supporting element equal to the spacing of nearest articulations.

2.7.14.7 The possibility of using connections other than articulations to connect buoyancy segments is subject to separate consideration by PRS.

2.7.15 Guard rails and bulwarks

2.7.15.1 All exposed parts of continuous decks and superstructure decks shall be protected at edges by appropriately high bulwarks or fixed guard rails complying with the requirements for external rails defined in § 298 of the WT Regulation. This does not apply to the edge of the deck intended for use of floating units moored to SOP and for bathing.

2.7.15.2 Possibility of protecting openings and arrangements used for SOP embarkation and disembarkation shall be ensured and their clear width shall be at least 1000 mm. Openings used for SOP embarkation and disembarkation of persons with reduced mobility shall have clear width of at least 1500 mm.

3 ERECTION STRUCTURE

3.1 General

3.1.1 Elements of erection structure exposed to water or moisture shall be constructed of materials, and using technology, ensuring long-term resistance to harmful effect of those factors (e.g. of laminates) or of materials having suitable resistance (such as metal, wood), and properly protected by an impregnate and protective coatings.

3.1.2 Design of structure elements, their coverings and the method of the object furnishing shall be such to enable their further maintenance, repair or replacement without excessive expenses and technical difficulties.

3.1.3 Design of the erection shape shall, as far as practicable, ensure that its planes, including those of buoyancy part and elements of external design do not contribute excessively, when resisting to wind pressure, to increase of forces which cause object heels and turns.

3.1.4 Erections together with deck surfaces shall enable direct and natural outflow of rain waters outboard.

3.1.5 Erection and deck fixtures of the objects operated in the winter shall be so designed and constructed that snow and ice can be safely removed from decks and passages.

3.1.6 The erection structure shall be supported on the supporting structure transfering safely loads from the erection and buoyancy (side) deck to buoyancy part of the object. Seating of the erection directly on deck is permitted by design only for objects of category D and E having suitably strengthened deck, which can transfer combined effect of the erection loads (i.e. of its weight, payload, snow and wind load, etc.) to the buoyancy part.

Where erection or its part is a supporting element, the strength calculations of the supporting element shall consider response from buoyancy elements loaded by buoyancy forces in waving conditions. Sinusoidal wave shall be assumed to have height equal to maximum wave for the given operating area (within the range 10 to 30 wave heights) and its length so chosen to maximize the bending moment of the supporting element. Several positions of the wave in relation to the object shall be considered. The positions shall be so selected to consider the maximum sagging and hogging (wave along the object) and torsion (skew wave).

3.1.7 Calculations of the erection structure shall consider flexibility of hull/supporting element, variability of buoyancy/waving forces and existing simultaneously roll of 20° and pitch equal to $20°(\frac{B}{L_w})^2$ (however, not less than 3°).

3.2 Structure of internal and external walls

3.2.1 Where multi-layer external covers are used, arrangements preventing water steam condensation inside such covers shall be applied.

3.2.2 Application of an efficient insulation of floors of lower spaces shall be considered, to prevent passage of moisture from the buoyancy part.

3.3 Technologies and systems of connecting elements

3.3.1 Selected technology of erection construction, the methods of its assembly and connection to supporting structure of SOP shall be described in technical documentation.

3.3.2 Any joints of erection and of its components shall be designed based on calculations of their required strength to acting forces, allowable deformations and dimensions and so that to ensure their durability, required tightness and appropriate accessibility for maintenance and repairs. Design of joints shall consider their effect on the safety of persons present on the object and performance aesthetics.

3.3.3 Butt joints are recommended where welded connections are applied in places transfering static and dynamical loads.

3.3.4 Geometrical notches shall be eliminated, as far as practicable and connections introducing additional forces and moments increasing stresses and deformations, shall be avoided during design.

3.3.5 Connection of individual elements of erection with each other and of the whole erection to the SOP supporting structure shall be designed in accordance with standards commonly applied in EU.

3.4 Insulation of outer walls

3.4.1 Design of external walls (screens) of year-round objects shall consider such structure and properties of the walls as to protect the object against heat loss and water systems against freezing.

3.4.2 For SOPs operated when daily average external temperature is below 16°C, i.e. between 1 October and 30 April, the thermal parameters of spaces shall correspond to required parameters for residential buildings and the method of applying thermal insulation layers shall take into account principles of building physics and material properties. The use of the requirements of Annex 2 to WT Regulation is recommended. Considering the above, the heat transfer coefficient for external divisions of year-round SOPs shall have value $U \leq U_{maks}$ adopted for residential buildings.

3.4.3 The object shall be so designed and constructed to restrict the possibility of its overheating in summertime.

3.4.4 For spaces where potable water tanks and gas tanks are located, spaces with devices susceptible to overheating, spaces where food is stored and processed, and similar spaces, protection from overheating in the summertime shall be applied.

3.5 Materials and products permitted for use

3.5.1 For the construction of utility part of SOP (erection), the use of the below kinds of materials is permitted. The materials not mentioned in Table 3.5.1 will be considered by PRS as permitted for use after submitting by the designer technical approval or declaration of their usability properties fulfilling the requirements for applicability in the SOP type objects (bending, compression and tensile strength, fragility, watertightness, water absorption, UV radiation resistance, etc.) and after developing method of proper assembly and connection with other materials in the place of use, complying with the requirements of 2.3.1. The use in object interiors of materials and products non-complying with sanitary requirements (harmful and dangerous for health) and easily flammable and emitting toxic and harmful substances under increased temperature is forbidden.

Table 3.5.1
Materials and products permitted for use [7)]

Element [2)]	Type of material											
	Soft-wood	Impregnated hardwood[1)]	Water resistant hardwood plywood	Steel	Aluminium alloys	Laminate	WPC composite[3)]	g-k panels, ceramic materials	Hardened glass	Acrylic glass (Plexiglass)	Polycarbonate	Foil, styrofoam, mineral wool
Supporting elements (beams, pillars, supports, ribs, load-bearing walls	YES	YES	YES	YES	YES	YES	NR	NO	NO	NO	NO	NA
Ceilings, decks	YES	YES	YES	YES	YES	YES	YES	NO	NO	NO	NO	NA
External coverings of outer walls	YES	YES	YES	YES	YES	YES	YES	NO	NO	NO	YES	NA
Inner wall structures and coverings	YES	YES	YES	YES	YES	YES	YES	YES [6)]	NO	NO	YES	NA
Windows, display windows, portholes, lights-fames, frames, muntins[4)]	YES	YES	NO	YES	YES	NO	NO	NO	NO	NO	NO	NA
Floorings and ceilings	YES	YES	YES	YES	YES	YES	YES	YES [6)]	NO	NO	NO	NA
External doors and manholes - frames wings[4)]	YES	YES	NR	YES	YES	NR	NR	NA	NO	NO	NO	NA
Internal doors – frames, wings[4)]	YES	YES	YES	YES	YES	NR	NR	NA	NO	NO	NO	NA
Glazing of windows, light frames and doors [5)]	NA	NA	NA	NA	NA	NA	NA	NA	YES	YES	C	NA
Insulation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	YES

Symbols:
NR – not recommended
NA – not applicable
C – conditionally

1) as natural wood and glued laminar wood products.
2) other elements of the object, such as elevator trunks, stairs, handrails, architectural elements shall be selected by the designer considering the properties of applied materials and products ensuring structural strength, service life, safety of the use and functionality appropriate to their application.
3) WPC (*Wood Plastic Composites*). Product consisting of wood particles and/or cellulose fibers joined by phenolic resins, whereas for SOP needs thermoplastics (resins) content of 30-90% in the composite is permitted (the composition affects WPC properties required for use in the given SOP element).
4) window frames and doors mounted on upper decks and inside the object may be constructed of the PCW or PCW reinforced with steel profiles.
5) in windows and door wings with low susceptibility to mechanical damage, glazing made of window glass or reinforced glass panel at least 3 mm thick (thickness selected to the case), may be used.
6) the g-k panels as coverings of walls and ceilings, ceramic materials as coverings of walls and flooring.
7) the use of other materials and products is subject to separate consideration by PRS.

3.5.2 After choosing structural or finishing material appropriate for the given application, the designer shall determine:
- required dimensions of the element (in particular its thickness), in respect of required strength, stiffness and weight;
- demanded dimensions and texture, considering technological and architectural aspects;
- the arrangement and method of connecting individual elements forming the surface (e.g. of an outer wall), considering technological and architectural aspects;
- the method of protecting by impregnates or paint coatings (the kind of impregnate, varnish or paint, their application technique and demanded number of layers and their thickness shall be specified);
- for structure elements and external coverings, the methods of permanent and efficient provision of watertightness in connection points.

3.5.3 Material properties shall ensure the element durability (between maintenance activities) considering effect of such factors as: fresh or sea water, high humidity, considerable variability and extreme values of air temperature, sun radiation and the element high strength and mechanical resistance to impacts and scratches. Depending on the place of installation and on the amount of built-in material, submission of sanitary certificate (confirming lack of harmful effect on health) and of the certificate confirming required fire resistance of the product and of description of possible hazard of emitting toxic and noxious substances during fire, may be required.

3.5.4 Only the materials and products which are granted the declaration of performance and declaration of conformity and are permitted for use in the EU countries may be applied. The materials and products of unknown origin or those whose quality or enclosed documentation rises doubts as to manufacturer's reliability and material properties, may not be applied.

3.5.5 Depending on the kind of material planned for use and its place of installation, PRS may require carrying out test of its properties, in accordance with individual testing programme.

3.5.6 The used materials and products shall also comply with the requirements given in Chapter 1 of *Part 5* of *these Rules*.

3.6 Windows, doors and service penetrations in bulkheads

3.6.1 Parameters, properties and locations of windows and balcony doors situated beyond the wave impact zone shall be designed based on technical conditions for windows mounted in buildings, and the method of assembly of window frames shall be taken to fit the erection structure and the material to be used for its construction. Appropriate protection of windows shall be considered, respectively to the risk of hitting by elements of masts of sailing yachts moored to SOP. Any possible technical arrangements permitted for use in building industry, protecting from falling people out of the window shall be used (windowsills min. 85 cm above the floor, reinforced glass of

display windows, guard rails, balcony railings, port-fenetre windows, etc.). Windows of type fix (non-opening), tilting, turn or tilt-and-turn windows are permitted. Windows with sliding or turning frames are not recommended. Turn or sliding balcony doors are allowed.

3.6.2 External doors self-closing or self-opening under air movement (draught, wind) or heels of the object shall not be used. Doors shall be blocked in their extreme positions (closed, fully-open) by appropriate locks or blockades.

3.6.3 External doors, leading from an open deck to superstructures, deckhouses and companionways, which may be affected by waves shall be weathertight.

3.6.4 Clear width of external doors leading to public spaces shall be not less than 80 cm and shall ensure access for persons of reduced mobility, if such persons are expected to use the spaces. The clear width of other external doors shall amount to not less than 70 cm. For objects of purpose PRIVATE, no minimum dimensions of doors are specified.

3.6.5 The door opening direction shall be in accordance with the requirements of fire protection regulations for buildings (acc. to WT Regulation) or for passenger ships (acc. to ES-TRIN Standard).

3.6.6 Doors located in escape ways shall additionally comply with the requirements specified in Chapter 1, *Part 5* of these *Rules*.

3.6.7 Service penetrations in sides, decks and other structural divisions shall be so designed that their replacement, repair or maintenance does not affect the division structure. Service penetrations shall be avoided in the object plating which is, or may fall, below the waterline.

3.6.8 Any penetrations of pipings and cables in the internal and external divisions shall be so constructed that they do not affect watertightness and fire-resistance of the division.

3.6.9 Service penetrations in external divisions of spaces where gases may accumulate (battery rooms, boiler rooms, gas tank rooms, etc.) shall have arrangements protecting against gas penetration to adjacent spaces.

4 STRENGTHENINGS OF THE OBJECT STRUCTURE IN WAY OF INSTALLING MOORING, ANCHORING, TOWING EQUIPMEMT AND THE ARRANGEMENTS FOR THE SOP BEACHING AND FOR TRANSPORT AND DRY DOCKING

4.1 The anchoring, mooring and towing equipment and that for lifting with a crane shall be located on the hull/supporting element or have strength connections with hull/supporting element through foundation, reinforcements, brackets, etc.

4.2 The values of forces acting on the above equipment and allowable stress limits shall be taken in accordance with *Part 4* of these *Rules*. Allowable stress level concerns the equipment foundations and also stresses generated in the supporting element and intermediate structure between the equipment and the supporting element. The designer shall perform appropriate calculations and submit them to PRS for consideration.

For loads existing during lifting by a crane, the dynamic factor equal to 1.15 shall be considered and the level of equivalent stresses shall not be greater than $0.5R_e$ of material in the element transfering forces between slings and the hull/supporting element. In the case of use of a set of traverses uniformly distributing loads irrespective of different sling lengths, allowable stress level may be increased to $0.8R_e$.

4.3 Fragments or parts of the object structure intended for land transportation shall be equipped with elements (e.g. eyes) appropriate for attachment to the transport means and for the method of loading and unloading. The elements shall be located in strong nodes of structure or local reinforcements transfering loads to hull or supporting element shall be applied.

4.4 Considering local loads existing during docking, putting on a slip and onshore stay, appropriate reinforcements of the lowest (usually buoyancy) parts of the object shall be provided. In the above cases, the object supports shall be placed under stiff elements of structure resistant to vertical forces or appropriate reinforcements shall be provided.

If the number of supports is small or they are unevenly distributed along the supporting element, PRS may require submission of general (longitudinal) strength calculations of the supporting element for loads existing during docking.

4.5 Where launching or other transportation operations of the object are to be carried out with the use of a crane, the object shall be equipped with appropriate elements (fasteners) for hooking the object to the crane slings or wrapping the hull around with belts transfering forces from sling ropes to the supporting element. The fasteners capacity, their arrangement and design connection with supporting element shall ensure their simultaneous use for safe and efficient lifting of the object and its carrying by the crane. Appropriate reinforcements of the structure shall also be provided in points of belt attachment or supporting onshore or on land transport means.

5 CORROSION PROTECTION OF THE OBJECT STRUCTURE

5.1 The method of corrosion protection of the object shall be adequate to the factors affecting corrosion of particular fragments of structure, the structure material and to the values of adopted corrosion additions.

5.2 The corrosion protection of the above - and underwater part shall be of coating type, designed based on general principles taking into account operating conditions and protection efficiency within assumed operation period. The coating plan shall be agreed with PRS.

5.3 Where wooden structures are used, protection by impregnation shall be considered, while for metal structures – the use of cathodic protection. The methods of corrosion protection of the object structure other than coating protection shall be separately considered by PRS.

5.4 The designer is responsible for application of proper corrosion protection. PRS will only check whether appropriate and efficient method of protection has been used on the basis of documentation supplied by the designer and during survey of the object upon completion of anti-corrosion works.

PART III
STABILITY, SUBDIVISION, FLOODING HEIGHT

1 STABILITY

1.1 Calculations of stability and subdivision

1.1.1 Intact stability

1.1.1.1 Intact Stability of SOP shall be demonstrated at the below standard loading conditions:
- full loading: 100% persons, 98% stores,
- partial loading: 100% persons, 50% stores,
- minimum loading: 100% persons, 10% stores;
- light object: no persons, 10% stores.

For all standard loading conditions it shall be assumed that tanks for equalizing heels are empty or full, respectively to their normal use.

For SOPs intended for year-round use or remaining all year round in the water reservoir, the stability calculations shall also consider snow load.

The SOP stability shall be calculated for the heel in relation to the object axis for which the main moment of inertia of waterline area reaches minimum value.

For objects which are secured to piles, only stability calculations for towing operation with necessary crew and equipment are required.

Stability of objects built of segments with flexible connections is subject to separate consideration by PRS.

1.1.1.2 The sufficient intact stability of SOP is proved by calculation with the below intact stability assumptions and for standard loading conditions as mentioned in 1.1.1 above:

a) maximum righting lever h_{max} is reached at the angle of heel $\phi_{max} \geq (\phi_{mom} + 3°)$ and it shall not be less than 0.20 m. If $\phi_f < \phi_{max}$, the righting lever at flooding angle ϕ_f may not be less than 0.20 m;
b) flooding angle ϕ_f may not be less than $(\phi_{mom} + 3°)$;
c) area A under the righting lever curve (see Fig. 3.1.2) shall – depending on the angles ϕ_f and ϕ_{max} – have the below values:

Table 1.1.1.2
Definition of area *A*

Item	If		A [m·rad]
1	$\phi_{max} \leq 15°$ or $\phi_f \leq 15°$		0,05 m·rad up to the smaller of angles ϕ_{max} or ϕ_f
2	$15° < \phi_{max} < 30°$	$\phi_{max} \leq \phi_f$	$0.035+0.001 \cdot (30- \phi_{max})$ m·rad up to the angle ϕ_{max}
3	$15° < \phi_f < 30°$	$\phi_{max} > \phi_f$	$0.035+0.001 \cdot (30- \phi_f)$ m·rad up to the angle ϕ_f
4	$\phi_{max} \geq 30°$ and $\phi_f \geq 30°$		0.035 m·rad up to the angle $\phi = 30°$

where:

h_{max} – maximum righting lever;
ϕ – angle of heel;
ϕ_f – angle of flooding, i.e. angle of heel at which openings in the hull, superstructure or deckhouse not provided with weathertight closures are submerged;
ϕ_{mom} – maximum angle of heel according to conditions given in e);
ϕ_{max} – angle of heel at which the maximum righting lever occurs;
A – area under the righting lever curve.

d) initial metacentric height, GM_0, corrected for free surfaces in liquid tanks, may not be less than 0.15 m;

e) angle of heel ϕ_{mom} resulting from simultaneous action of the heeling moment due to crowding of all persons and wind pressure in accordance with pkt. 1.1.1.3 and 1.1.1.4 may not exceed 5°.
f) freeboard resulting from simultaneous action of the heeling moment due to crowding of all persons and wind pressure may not be less than 200 mm; in case of object operating in region 4, the freeboard may not be less than 100 mm;
g) in the case of SOPs with non-watertight windows or other openings in hull situated below the buoyancy deck, the residual safety clearance of such openings shall not be less than 100 mm at the heel resulting from the simultaneous action of the heeling moments referred to in (f).

1.1.1.3 Heeling moment M_p due to crowding persons towards one side is calculated in accordance with the below formula:

$$M_p = g \cdot P \cdot y = g \cdot \Sigma P_i \cdot y_i \ \text{[kNm]} \qquad (1.1.1.3)$$

where:

P – total mass of persons present on SOP [t], calculated assuming average weight of one person of 0.075 t,
y – lateral distance of the centre of combined mass of persons P to the centre plane, [m],
g – acceleration of gravity (g = 9.81 m/s^2),
P_i – mass of persons crowded on area A_i, [t]

$P_i = n_i \cdot 0.075 \cdot A_i$

where:

A_i – the area occupied by the persons [m^2],
n_i – number of persons per a square meter,
n_i – 3.75 for areas of free deck with mobile equipment; for deck areas with fixed equipment, such as benches, n_i is calculated with the assumption that one person occupies the seat of 0.50 m in width and 0.75 m in depth,

y_i – lateral distance of geometrical centre of area A_i to the centre plane [m].

The calculation is performed for crowding of persons both on portside and starboard. Distribution of persons in the least favourable case as regards stability is taken for calculations. At calculating moment due to crowding of persons, cabins are regarded empty. For calculations at various loading conditions it is assumed that the gravity centre of a person is positioned 1 m above the lowest point of the considered deck and that the mass of the person is 0.075 t.

1.1.1.4 The heeling moment due to wind pressure M_w is calculated as below:

$$M_w = p_w \cdot A_w \cdot (l_w + T/2) \ \text{[kNm]} \qquad (1.1.1.4)$$

where:

p_w – wind heeling pressure of 0.25 kN/m^2,
A_w – lateral plane of the SOP hull above the draught level at the given loading conditions in m^2,
l_w – distance of the centre of gravity of the lateral plane A_w to the plane of draught according to the considered loading condition in m,
T – SOP draught at the given loading condition in m.

1.1.2 Damage stability

1.1.2.1 To ensure that the SOP object for which damage stability criteria are required to be fulfilled will remain buoyant in damaged condition, the hull interior shall be subdivided by transverse and/or longitudinal watertight bulkheads. In SOPs with a hull length L_k < 15 m carrying not more than 50 passengers, this may also be ensured by changing permeability of the space by e.g. filling such space or its part with a non-absorbable buoyancy material or by using additional floats permanently fixed to the hull. The buoyancy material used shall be approved by PRS and permanently fixed to the hull.

For other SOPs, application of buoyancy material is subject to PRS consent in each particular case.

1.1.2.2 Damage stability calculations shall be performed for the required loading conditions taking account of three intermediate stages of downflooding (25%, 50% and 75% of the final downflooding condition) and also for the final downflooding condition. Damage stability calculations for the final downflooding condition shall be based on the method of "constant buoyancy".

1.1.2.3 In well-grounded cases, such as object mooring in shallow waters, PRS may, at designer's request, waive from the requirement of performing damage stability calculations.

1.1.2.4 Detailed requirements for various sizes of SOP:
- objects of length L_k < 25 m carrying not more than 50 persons, shall comply with the damage stability requirements specified in subchapter 3.1 for damages defined in Table 1.1.2.4 or shall have such subdivision that after symmetrical downflooding of compartment the following requirements are complied with:
  - the object draught shall not exceed margin line,
  - metacentric height *GM* shall not be less than 0.10 m,
  - in an intermediate condition, the metacentric height *GM* shall by positive.
- objects of length L_k < 45 m carrying not more than 250 persons shall have such subdivision that after downflooding of one compartment, the damage stability requirements specified in subchapter 3.1 for the below damages are complied with:

Table 1.1.2.4
Definition of damages

Damage	Extent of damage for one compartment, [m]
Longitudinal of sides	0.10 L_W, however, not less than 4.0 m
Transverse of sides	*B/5*
Vertical of sides	From SOP bottom upwards without limits
Longitudinal of bottom	0.10 L_W, however, not less than 4.0 m
Transverse of bottom	*B/5*

When damages of lower extent than specified above result in more severe effects as regards heels or loss of metacentric height, they shall be also considered in calculations

2 FLOODING HEIGHT

2.1 Flooding openings

2.1.1 Each opening in the SOP hull or deck (including recess edge), through which water can enter the object, its bilges or recess, is a flooding opening.

2.1.2 The angle of heel at which flooding openings (except those excluded in 2.1.4) immerse with SOP in still water and in appropriate loading condition and at designed trim is the angle of flooding. If the openings are not arranged symmetrically to SOP symmetry axis, the case related to the smallest angle of heel shall be taken.

2.1.3 The flooding height is defined as the lowest height above waterplane to any flooding opening, except those excluded in 2.1.4, with SOP in upright still water condition in full loading condition, measured up to the critical point of flooding, which may be within pipes or ducts of the hull interior.

2.1.4 The requirement given in 2.2.1 applies to any flooding openings, except:
a) watertight recesses of total volume less than $(L_k BF)/40$ or quick-draining recesses,
b) drains from:
   – quick-draining recesses, or
   – watertight recesses, which when filled will not cause flooding or capsizing of SOP in upright position,
c) the non-opening type machinery, being in accordance with PN-EN ISO 12216 Standard;
d) the opening type machinery which is mounted in the compartment of limited volume, such that even when flooded, SOP complies with all requirements;
e) exhausts of generator engine or other openings connected only with watertight systems;
f) outboard outlets equipped with non-return valves.

2.2 Required heights of flooding

2.2.1 Required heights of flooding *Y* for SOP depending on the object length are shown in Fig. 2.2.1.

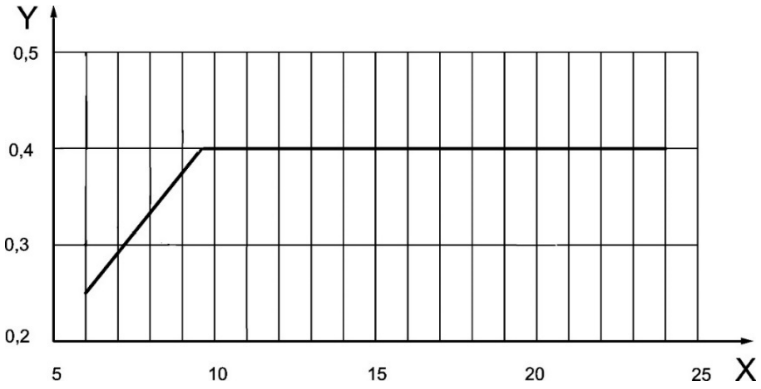


Fig. 2.2.1 Required height of flooding *Y*

Symbols:
X - hull length, [m];
Y - required height of flooding, [m].

3 HEEL, TRIM AND DRAUGHT CRITERIUM

3.1 Damage stability criteria

3.1.1 For all intermediate stages of downflooding, defined in 1.1.2.2, the following criteria shall be fulfilled:
– heeling angle at the equilibrium position of any intermediate stage in question shall not exceed 15°;
– beyond the heel in the equilibrium position of the intermediate stage in question, the positive part of the righting lever curve shall display a righting level value of $GZ \geq 0.02$ m before the first unprotected opening becomes immersed or the heeling angle of 25° is reached (whichever is lesser),
– non-watertight openings shall not be immersed before the heel in the equilibrium position of the intermediate stage in question has been reached,

3.1.2 During the final stage of flooding, the following criteria shall be fulfilled taking into account the heeling moment due to crowding of all persons towards one side:
– heeling angle φ_p shall not exceed 10°;
– beyond the equilibrium position, the positive part of the righting lever curve shall display a righting lever value of $GZ \geq 0.02$ m with an area $A \geq 0.0025$ mrad. These minimum values for stability shall be reached until the immersion of the first unprotected opening or before reaching a heeling angle of 25° (whichever is lesser).

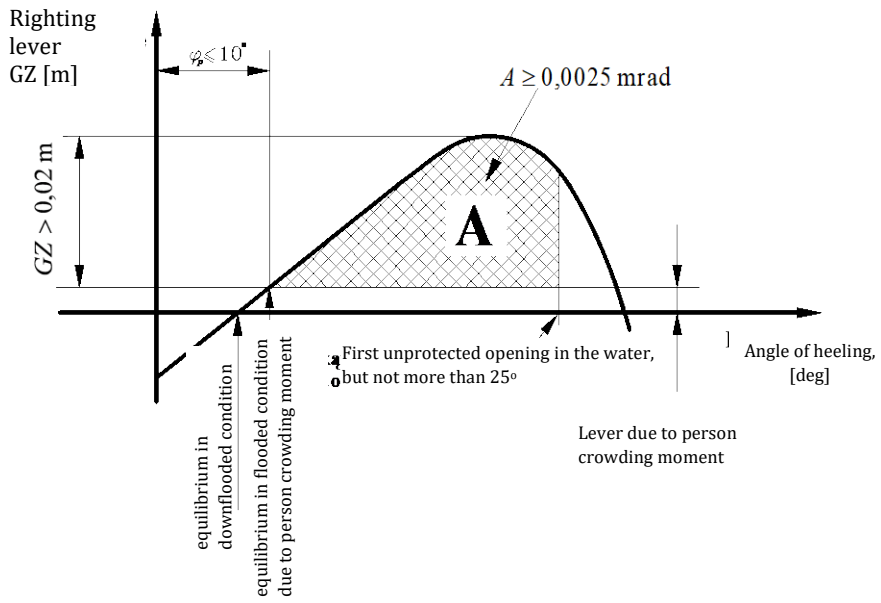


Fig. 3.1.2 Righting lever curve

- non-watertight openings shall not be immersed before the equilibrium position has been reached; if such openings are immersed before this point, the rooms affording access are deemed to be flooded for damaged stability calculations;
- where shut-off devices are applied, these shall be watertight and capable of being closed and also marked respectively
- if cross-flood openings to reduce asymmetrical flooding are provided, they shall fulfil the following conditions
  - they shall not be equipped with shut-off devices and they shall be self-acting;
  - total time allowed for compensation shall not exceed 15 minutes

3.1.3 At the final stage of downflooding, the lowermost point of an opening which does not ensure watertightness (e.g. doors, windows, hatches) shall be situated at least 0.1 m above the damage waterline and the buoyancy deck shall not be immersed.

3.2 Methods of measurement and alarm

3.2.1 Means to inform on excessive heel and draught of the object shall be provided.

3.2.2 Heeling may be indicated by:
- inclinometers,
- clinometers,
- level sensors coupled with alarm system.

3.2.3 Draught may be indicated by:
- immersion sensors based on the principle of pressure measurement,
- draught scales marked on the object hull.

3.2.4 Each SOP which can carry more than 12 persons shall be equipped with alarm system indicating excessive heel or excessive draught caused by object overloading, uneven loading, external factors or damage. On other SOPs, the use of such system is recommended.

PART IV
FASTENING, TOWING, PUTTING ON A SLIP AND TRANSPORTATION

1 FASTENING OF SOP

1.1 General principles of SOP fastening

1.1.1 Each SOP shall be equipped with a device which enables its steady position in relation to the wharf, platform or other place of its mooring.

1.1.2 SOP may be fastened by means of mooring ropes to bollards, mooring piles, anchors, other units/objects, etc. or by means of other securing systems. Fastening method shall enable vertical movement of the object in result of water level changes in the water reservoir.

1.2 Fastening by mooring ropes

1.2.1 Each SOP permanently fastened by means of mooring ropes shall be equipped with mooring equipment having sufficient allowable workload, enabling stable position of the object and safe carrying out any mooring operation needed for normal operation.

Such operation include warping SOP side or stern to coastal and floating berths, side to side mooring to another unit (with possible drawing of units against each other), small movements of the object within water reservoir.

1.2.2 The mooring arrangement plan shall define: the purpose and type of each appliance and their allowable working load. The plan shall also show the manner of applying mooring lines load including limiting fleet angles. The plan shall include the arrangement of mooring lines showing the number of lines (n) and the minimum breaking strength of each mooring line.

Selection of the equipment shall be executed in accordance with PRS approved standards, e.g. ISO 13795.

1.2.3 The mooring ropes shall be chosen according to Table 1.2.3, depending on the equipment number W, calculated in accordance with the below formula:

$$W = L_k(0{,}3B + 0{,}6H) + 0{,}3N + 5{,}5D_p^{2/3} \qquad (1.2.3\text{-}1)$$

where:
L_k – SOP hull length, [m];
B – SOP hull breadth, [m];
H – SOP hull moulded draught, [m];
D_p – lightweight of an empty object, fully equipped, [t];
N – lateral area of deckhouse or superstructure if their width or length exceeds $0.5B$, [m^2].

Table 1.2.3
Selection of diameters of synthetic mooring ropes

W [m^2]	Rope diameter	
	polyamide	polypropylene
	mm	mm
Up to 6	10	12
8	10	12
10	12	14
15	12	12
20	12	14
25	14	16
30	14	16
40	14	16
50	14	16

W [m²]	Rope diameter	
	polyamide	polypropylene
	mm	mm
60	16	20
70	16	20
80	16	20
90	16	20
100	18	24
110	18	24
120	18	24
130	18	24
140	20	24
150	20	26

When synthetic fibre ropes are used, the total breaking strength of the rope F_s shall be not less than defined from the below formula:

$$F_s = c_s F \qquad (1.2.3\text{-}2)$$

where:
F_s – total breaking strength
c_s – coefficient equal to:
- 1.3 for propylene ropes,
- 1.2 for ropes made of other sythetic fibres

F – minimum breaking strength acc. to Table 1.2.5.

1.2.4 Each SOP shall be equipped with mooring ropes of sufficient length and diameter as specified in Table 1.2.3. The number and length of mooring ropes shall enable safe fastening of SOP.

1.2.5 The design load of mooring rope taken for calculations of equipment and hull reinforcements shall amount to 1.25 of the breaking strength of mooring rope, chosen in accordance with Table 1.2.5. The design load of mooring ropes shall be applied in accordance with directions shown on the mooring and towing arrangement plan. Possible changes of the direction (vertical and horizontal) of the mooring force shall, however, be considered.

Breaking strength of polyamide and polypropylene twisted triangular ropes are shown in Table 1.2.5.

Table 1.2.5
Minimum breaking strength of synthetic ropes

	Minimum breaking strength of rope [kN]	
Rope diameter [mm]	Polyamide PN-EN ISO 1140	Polypropylene PN-EN ISO 1346
6	8	6
8	14	11
10	21	16
12	30	23
14	40	31
16	52	40
18	64	49
20	79	61
22	94	73
24	112	86
26	129	101
28	149	116

1.2.6 Mooring ropes may be made of steel or of natural or synthetic fibres. Irrespective of the value of breaking strength taken from Table 1.2.3, the diameter of mooring ropes from natural fibres shall be equal to at least 20 mm.

1.2.7 A rope of natural fibres shall be made from manila or sisal. Onboard the units with equipment number not exceeding 90, hemp ropes may be used.

Synthetic fibre ropes shall be made of homogeneous approved synthetic materials (nylon, polypropylene, kapron and other).

1.2.8 Steel mooring ropes shall have elastic structure, and the steel rope shall contain not less than:
- 72 steel wires in 6 strands with 7 cores made of fibre – when the real breaking strength does not exceed 216 kN;
- 144 steel wires in 6 strands with 7 cores made of fibre – when the real breaking strength exceeds 216 kN, but is not greater than 490 kN;
- 222 steel wires in 6 strands with one core made of fibre – when the real breaking strength exceeds 490 kN. Instead of steel ropes with 222 steel wires in 6 strands with one core, ropes of the same structure with 216 steel wires may be used.

1.2.9 The number and arrangement of mooring bollards, open fairleads and closed fairleads, rollers-guides and other mooring equipment shall be determined based on structural properties, purpose and general arrangement of the object.

1.2.10 The bollards onboard SOP shall be made of steel or cast iron, welded or cast. The outside diameter of the bollard columns shall not be less than 10 diameters of the steel wire rope, not less than 5.5 times the diameter of the synthetic fibre rope and not less than 1 circumference of the natural fibre rope according to the designation of the bollard. The distance between the axes of bollard columns shall not be less than 2.5 diameters of steel wire rope or 3 circumferences of natural fibre rope.

1.2.11 Special mooring machinery (capstans, winches, etc.), as well as other deck machinery fitted with mooring brakes may be used for warping the mooring ropes. The rated pull of this machinery shall be not less than 0.22 nor more than 0.33 times the minimum breaking strength of the mooring rope.

1.2.12 If anchors are used for fastening SOP, their number, weight and arrangement in the water reservoir shall be in accordance with the number, kind and distribution of the mooring equipment onboard SOP. These *Rules* do not cover the issues of anchor selection.

1.3 Other fastening systems

1.3.1 Other systems of SOP fastenings which depend of the berth infrastructure, are subject to individual consideration.

1.3.2 PRS will consider connecting elements, including welded, bolted and other equivalent joints, connecting deck equipment with supporting structure, being parts of the equipment and also applicable recognized industrial standards.

1.3.3 Fastening equipment shall be so located on longitudinals, deck beams and/or girders, which form the deck and/or hull structure, to facilitate efficient distribution of loads on the hull structure.

1.4 Occasional, emergency fastening of SOP

1.4.1 The manager of water reservoir where SOP is located, may require providing onboard a system of emergency fastening/immobilizing by means of dropped anchors, taking into account hydro-meteorological conditions existing on the given reservoir, secure fastening of SOP (possibility of SOP breaking its leash) and the hazard the object could pose to neighboring objects, such as bridges, power engineering lines, locks, etc. Selection of such anchors, associated ropes/chains and equipment is subject to individual consideration by PRS.

2 TOWING AND BEACHING OF SOP

2.1 Towing equipment of the object

2.1.1 Each SOP shall be equipped with equipment necessary for its towing, consisting of ropes, bollards and towing fairleads (if applicable), considering the type of SOP. Towing ropes may be stored beyond the SOP, at the disposal of the SOP Operator or tug master.

2.1.2 The required towing equipment includes:
- towing ropes, in the number sufficient for the size of SOP and its operations,
- towing bollards, cleats,
- towing beams and other arrangements for guiding the towing rope (rollers, leading sheaves, etc.), as well as bollards and other elements reducing the line swinging overboard;

All components of the towing arrangements, as well their fastenings shall be so selected that when subjected to the load equal to the towing rope breaking load, the stresses in their components will not exceed 0.95 times the yield stress of their material.

2.1.3 Towing equipment shall be arranged in such a way that its use will not constitute a hazard to the safety of the crew, the SOP or the cargo. The towing arrangements shall be located on deck reinforcements or on additional reinforcements ensuring efficient distribution of load onto the SOP structure. Where necessary, additional stiffeners and/or brackets shall be added to enable direct transmission of loads from the bollard or foundations of other items of towing equipment to strengthening system under deck plating. The size of stiffeners and brackets shall be chosen considering towing rope breaking force, so that stresses in the structure do not exceed permissible values.

2.1.4 Towing equipment parts transfering forces and their fastenings to supporting structure of SOP, except ropes, shall be checked by calculations for transmitting full towing rope breaking load. Equivalent stresses acting in these parts shall not exceed 0.95 times the yield stress of their material.

2.1.5 Towing ropes may be made of steel, natural or synthetic fibres. Towing ropes are selected on the basis of Table 2.1.5, after determining the equipment number *W*, according to formula 1.2.3-1.

2.1.6 The requirements specified in 1.2.9 to 1.2.10 for mooring bollards apply also to towing bollards.

Table 2.1.5
Selection of diameters and lengths of synthetic towing ropes

W [m²]		Rope diameter	
	Rope length	polyamide	polypropylene
	m	mm	mm
up to 6	30	10	12
8	35	10	12
10	35	12	14
15	40	12	14
20	40	14	16
25	40	14	18
30	40	16	18
40	45	16	18
50	45	16	18
60	50	16	20
70	55	16	20
80	60	18	20
90	65	18	22
100	65	18	22
110	70	20	24
120	70	20	24
130	75	22	26
140	75	22	26
150	80	22	28

2.2 Equipment and technical arrangements for SOP beaching and land transportation

2.2.1 Some SOPs, due to their dimensions, may require docking for the execution of periodical surveys, maintenance, occasional repairs and overhauls. *The SOP operation and maintenance manual* shall include descriptions of applied strengthenings of the object structure and onboard equipment and fittings used for docking, description of activities to protect the object during docking period and methods of object fastening in a dock. If docking will not be necessary or no technical arrangements for docking are provided, appropriate information shall be entered in the Manual.

2.2.2 SOP which requires periodical or occasional displacement to the shore for proper protection and storage during winter, carrying out surveys, maintenance, repairs or overhauls, shall be properly fitted for that purpose. *The SOP operation and maintenance manual* shall define methods (technology) of removing the objects from water reservoir, their loading to, transportation by, and unloading from, road transport means, and technical arrangements (strengthenings, grips, etc) appropriate for these operations.

2.2.3 Technical arrangements applied for the purpose described in 2.2.2 shall be at once applicable at safe and proper transportation of the object onshore (carts, haul trailers, car trailers and platforms, etc.), and at stable fastening of the object onshore for the time of its winter storage or overhauls. *The SOP operation and maintenance manual* shall define which external elements of SOP shall be dismantled for land transportation.

PART V
FIRE PROTECTION AND LIFE-SAVING MEANS

1 STRUCTURAL FIRE PROTECTION, FIRE DETECTION AND EXTINGUISHING

Note: Unless explicitly stated otherwise, the requirements of 1.1 to 1.5 apply to objects with purpose RESIDENTIAL and GASTRONOMICAL, the requirements of 1.6 apply to objects with purpose COMMERCIAL, WORKING and OTHER, the requirements of 1.7 and 1.9 apply to all objects, and those of subchapter 1.8 to untypical objects.

1.1 Structure and equipment of spaces

1.1.1 Structures of external walls of erection, staircases and corridors within accommodation spaces shall be made of steel or of non-combustible materials (Class A1 or A2). Internal walls and ceilings of accommodation spaces shall be constructed of flame-retardant materials (Classes B, C or D).

1.1.2 Stairs in accommodation spaces and gangways/accommodation ladders shall have framework made of steel or steel equivalent material.

1.1.3 Internal stairs of accommodation spaces shall be enclosed at all levels by walls forming a staircase, with self-closing doors.

1.1.4 Walls of machinery spaces, galleys and flammable material stores adjacent to accommodation spaces shall be made of steel or non-combustible materials.

1.1.5 Insulation materials used in the spaces shall be non-combustible.

1.1.6 Exposed external surfaces of walls, floors and ceilings of corridors and staircases within accommodation spaces are to be constructed of low flame spread (LFS) materials. In the event of fire, they are not to give off dangerous amounts of toxic gases or smoke.

1.1.7 The equipment of spaces (furniture, floor coverings, textiles, decorative elements, etc.) shall be, as far as practicable, made of flame-retardant materials or their surfaces shall have LFS properties.

1.1.8 Paints, varnishes and other surface treatment products, used inside accommodation spaces are not to give off dangerous amounts of toxic gases or smoke.

1.2 Means of escape

1.2.1 From each accommodation area, at least two widely separated escape routes leading to gangway/accommodation ladder connecting the object with the shore, are to be provided.

1.2.2 Each object carrying more than 50 persons shall be provided with at least two gangways/ accommodation ladders for evacuation to the shore.

1.2.3 The gangway/accommodation ladder connecting object with the berth shall have clear width of at least 1.2 m, while the gangway/accommodation ladder for use by persons with reduced mobility (on wheelchairs) shall have clear width of at least 1.5 m.

1.2.4 Spaces or groups of spaces for more than 50 persons or having more than 12 sleeping berths, shall have at least two exits leading to an open deck. One of them may be an emergency exit.

1.2.5 Emergency exits may be provided by windows which enable evacuation in emergency, having opening of the area at least 0.36 m^2, with the smaller dimension not less than 0.5 m.

1.2.6 Corridors and stairs serving as escape routes shall be properly arranged and shall have clear width of at least 0.8 m and clear height of at least 2 m.

1.2.7 Doors from public spaces shall open outwards or may be of sliding type. Doors from cabins, to a corridor may open inwards.

1.2.8 Escape routes in all spaces where persons are normally present or which are accessible for them, and exits and emergency exits from the spaces, shall be marked with symbols used for evacuation routes.

1.2.9 The evacuation routes shall have sufficient lighting, to ensure safe evacuation at night.

1.2.10 The evacuation plan specifying escape directions leading to exits from spaces and to gangways/accommodation ladders connecting the object with the berth, shall be posted in public spaces.

1.3 Ventilation of accommodation spaces

1.3.1 Ventilation system in accommodation spaces shall be so designed as to ensure that it does not cause the spread of fire and smoke in the event of fire.

1.3.2 In the case of objects with purpose RESIDENTIAL, which can carry more than 50 persons, the air intake openings and draught ventilation outlets serving accommodation spaces, located on the open deck, shall be provided with closures operated from outside of the spaces.

1.3.3 Fans shutdown buttons shall be located in a safe place, outside the accommodation spaces.

1.4 Fire detection and alarm system

1.4.1 SOP with purpose RESIDENTIAL which can carry more than 50 persons, shall be equipped with fire detection and alarm system.

1.4.2 SOP with purpose GASTRONOMICAL intended to serve more than 300 persons, with closed spaces for Clients, shall be equipped with fire detection and alarm system.

1.4.3 Fire sensors shall be distributed in accommodation spaces, corridors and lobbies, as well as in galley, storerooms and other similar spaces posing fire hazard.

1.4.4 Outbreak of fire shall be automatically signalized by a receiving device placed in permanently manned space, e.g. in reception or concierge desks. The receiving device shall signalize damages in the system.

1.4.5 The manual call points shall be distributed in corridors and lobbies.

1.5 Water fire main system

1.5.1 SOP with purpose RESIDENTIAL which can carry more than 50 persons shall be equipped with piping system with external hydrants, complying with the requirements of the Polish Standards, consisting of shut-off valve and semi-rigid fire hose provided with water nozzle.

1.5.2 The nominal diameter of typical hydrants used onboard objects shall equal to 25 mm. The minimum capacity of water intake measured at the nozzle outlet shall amount to at least 1.0 dm^3/s and the pressure shall be not less than 0.2 MPa.

1.5.3 Hydrants shall be located on each tier of the object, in corridors and lobbies, in easily accessible places, where hose spreading is possible. The hydrants shall be so distributed that their range covers the whole area of protected object, taking into account lengths of fire hose sections and effective fire jet range, which shall be at least 10 m.

1.5.4 Fire hoses with nozzles shall be permanently connected to the hydrant valve and shall be placed in a cabinet, allowing their easy spreading and immediate use.

1.5.5 The water fire main system shall be supplied with water of sufficient capacity from the water pipeline located onshore, by means of a permanent flexible shore connection.

1.5.6 Capacity of the system shall ensure delivery of simultaneous water jet from two adjacent hydrants.

1.5.7 Where shore water piping is not accessible, the water fire main system may be supplied by fire pump installed onboard the object, ensuring sufficient capacity and pressure in the system.

1.5.8 The fire pump shall be permanently connected to the system pipelines and shall have independent drive (internal combustion or electric) ensuring the pump operation in the case of fire onboard by taking outboard water. The pump shall be started manually from the place which will not be cut by fire onboard.

1.5.9 Supplying of internal hydrants shall be ensured for at least one hour.

1.5.10 Hydrants shall be painted red and be marked with appropriate symbol used in fire protection onshore.

1.5.11 For SOP with purpose RESIDENTIAL which can carry up to 50 persons and with purpose GASTRONOMICAL serving more than 50 persons, the possibility of delivering water to extinguish fire through a spread line of fire hoses from hydrants located onshore or through the fire hose connected to portable fire pump, located onboard (motor pump), shall be provided.

1.5.12 Such portable fire pump shall be of self-priming type and equipped with a rigid suction hose of appropriate length for intake of outboard water, ending with a filter, and with fire delivery hose with nozzle. The pump shall be located onboard in a locker easily accessible from open deck.

1.5.13 If the pump is driven by an internal combustion engine, it should be the diesel engine supplied by fuel oil having flash point above 60°C.

1.6 Individual requirements

Within the scope of structure and equipment of spaces and escape routes, objects with purpose COMMERCIAL, WORKING, PRIVATE or OTHER are subject each time to individual consideration, taking into account the nature of the object use, the number of persons the object can carry and potential fire hazard.

1.7 Portable extinguishers

1.7.1 All SOPs shall be equipped with portable fire-extinguishers complying with the requirements of European Standards PN-EN 3-7 and PN-EN 3-8.

1.7.2 Onboard the objects, in way of accommodation, gastronomical, commercial or working spaces (in corridors, lobbies, public spaces), in the vicinity of each entry from deck or in another easily accessible place, at least one 6 kg dry powder extinguisher shall be provided, for extinguishing fires of groups A, B and C.

1.7.3 In galley spaces, at least one 6 kg dry powder extinguisher, to extinguish fires of groups A, B and C and one extinguisher suitable for extinguishing fire of edible oil (group F fire), shall be provided.

1.7.4 In service spaces containing electrical appliances (switchboards, server rooms, etc.), at least one 5 kg carbon-dioxide fire extinguisher shall be located.

1.8 Additional requirements for untypical objects

Objects considered as high (having more than 4 tiers) or of utility area being fire zone greater than 1000 m^2 , shall comply with applicable fire safety requirements , specified in WT Regulation.

1.9 Relieving requirements

Taking into account the possibility of quick access and easy extinguishing fire of the object from berth by land fire brigade, the above requirements may be relieved upon agreement with field department of the State Fire Service.

2 LIFE-SAVING MEANS

2.1 Portable life-saving means

2.1.1 Lifebuoys

2.1.1.1 Each SOP moored on inland waterways shall be equipped with at least two lifebuoys, placed on main deck on the waterside. They shall be easily accessible and fastened so that they can be quickly used in emergency.

2.1.1.2 For SOPs with purpose RESIDENTIAL, GASTRONOMICAL, COMMERCIAL, the minimum number of lifebuoys shall be defined based on the below table. Comparing ranges from columns 1 and 2, higher value from column 3 shall be taken.

Table 2.1.1.2
Required number of lifebuoys

SOP length [m]	Maximum number of persons	Minimum number of lifebuoys *)
up to 15	up to 36	2
15 ÷ 24	do 200	3
24 ÷35	201 ÷300	4
35 ÷ 50	301 ÷ 600	6
above 50	above 600	8

*) considering the departure from 2.1.1.1.

2.1.1.3 If SOP has more than one deck, two additional lifebuoys shall be placed on each exposed deck where people may be present. This requirement does not apply to objects with purpose PRIVATE, OTHER and A, C, D and E. Distribution and attachment of the lifebuoys shall be as described in 2.1.1.1. These lifebuoys are not included in the number of required lifebuoys, based on Table 2.1.1.2.

2.1.1.4 The lifebuoy is considered as fulfilling the safety requirements if it has valid attestation.

2.1.1.5 After repair, lifebuoy is subject to technical supervision to be performed by an authorized body.

2.1.1.6 At least a half of required lifebuoys shall be provided with buoyant lifeline of diameter 8÷11 mm and length 30 m. One end of the lifeline shall be permanently fastened to the lifebuoy. Lifeline storage and coiling shall ensure its immediate use and prevent it from being tangled.

2.1.2 Life jackets/lifebelts

2.1.2.1 SOPs are relieved from obligation of providing lifejackets/lifebelts onboard.

2.1.2.2 If SOP is towed to another place of mooring, the towing body is responsible for supplying lifejackets/lifebelts to persons present onboard SOP during towing.

2.1.3 Throw lines

2.1.3.1 Each SOP localized on running waters shall be equipped with at least two throw lines of any structure, made from buoyant line having minimum diameter of 6 mm. The length of throw line shall equal to 25 - 30 m.

2.1.3.2 The throw line shall be stored in the vicinity of lifebuoy position on main deck, ready for immediate use.

2.1.4 Rescue rods

2.1.4.1 It is recommended that SOP with purpose RESIDENTIAL, GASTRONOMICAL and COMMERCIAL should be equipped with at least one 4 m rescue rod made of wood, aluminium pipe or other material. The rod end shall have a grip for a person in water to hold on or, where necessary, for hooking by rescuer of an unresponsive drowning person.

2.1.4.2 The rescue rod shall be stored in the vicinity of one of lifebuoys in an easily accessible place, ready for immediate use.

2.2 Means for SOP re-boarding

2.2.1 Each SOP shall be provided with appropriate means for SOP re-boarding. Applied arrangements may include ladders, steps, braces, grips, etc.

2.2.2 The side or erection structure or SOP fittings shall be of such design as to enable person in water holding it by hand and waiting for rescue in the water without swimming. Elements affording such possibility shall be distributed along the whole perimeter of SOP, spaced not more than 12 m, except the section adjacent to berth or pier, provided SOP is so fastened there that falling into water is not possible. Means referred to in 2.2.1 may be considered as such elements.

2.2.3 Means for SOP re-boarding shall comply with the below requirements:
- they shall be permanently fastened to SOP;
- they shall be capable of using by the person in water without assistance of other persons;
- their lowest point of foot support shall be at least 300 mm below the water level for SOPs in lightweight condition, in accordance with ISO 15085 Standard.

2.2.4 The re-boarding method shall be described in the *SOP operation and maintenance manual*.

2.3 First aid kits

2.3.1 Each SOP shall have onboard portable first aid kit. It shall be stored in an easily accessible place, protected from small kids and marked by an appropriate symbol.

2.3.2 If SOP purpose is COMMERCIAL, the type of the first aid kit and its equipment shall be agreed with relevant occupational medicine physician, taking into account the number of persons the SOP can carry and potential hazards.

2.3.3 Irrespective of the type of first aid kit used onboard SOP, it is recommended that the kit should contain:
- Basic Instructions for life support,
- Basic Instructions for bodily injury and poisoning,
- an epithesis (a splint) and materials for stiffening broken limbs,
- a mouthpiece or mask for mouth-to-mouth resuscitation,
- thermal emergency blanket.

PART VI
MACHINERY AND INSTALLATIONS

1 GAS SUPPLY SYSTEMS AND APPLIANCES

1.1 General requirements

1.1.1 SOP provided with spaces for people's stay may be equipped with gas system supplied from LPG or LNG tanks.

1.1.2 The onboard gas system consists of: LNG gas bunkering connection, liquefied gas tanks, piping system with fittings, shapes and other equipment, control and measuring devices, reduction devices, protection devices, warning and alarm devices, gas appliances together with exhaust or air- flue systems if they are parts of the equipment.

1.1.3 Gas systems shall not be used if SOPs height between extreme decks is more than 12 m.

1.1.4 Gas system may be utilized only for household purposes (e.g. for cookers) and for heating spaces and domestic water.

1.1.5 Gas systems supplied with gas of density higher than air density (propane, propane-butane) may not be used in SOP spaces, where floor level is (or may be) lower than water level of adjacent water reservoir or in spaces located below the deck where gas might accumulate after the system unsealing.

1.1.6 Gas tanks installed onboard SOP shall be protected from excessive heating by sun radiation or by appliances emitting thermal energy.

1.1.7 Fixed gas tanks and replaceable gas containers shall be reliably fastened to the object structure to prevent their displacement or falling and damage of connecting fittings. Additionally, the replaceable containers shall be fitted so that to enable their easy, safe and multiple replacement.

1.2 Liquefied gas (LPG) tanks (propane-butane or technical propane)

1.2.1 Cylinders of volume up to 11 kg may be installed inside SOP spaces, provided the below requirements are fulfilled:

- no more than two cylinders may be installed in one room,
- temperature below 35°C shall be maintained in the space where gas cylinder is installed,
- the cylinder shall be installed in vertical position only,
- the cylinder shall be protected from mechanical damage,
- the distance between the cylinder and the heat radiating device, except the units of gas appliances and cylinders, shall be at least 1.5 m,
- the cylinder shall not be placed at a distance less than 1 m from appliances which can be a source of sparking,
- gas appliances shall be connected to pressure reducing device by means of flexible pipe of length not exceeding 3 m and pressure resistance of at least 300 kPa, resistant to liquid gas components, mechanical damage and temperature up to 60°C,
- the gas appliance of thermal output exceeding 10 kW shall be connected with flexible pipe referred to in 1.2.1.7, by means of steel pipe at least 0.5 m in length.

1.2.2 Cylinders of capacity 11kg to 35 kg or cylinder batteries may be installed only on outer deck in a free-standing or erection built-in cabinet, outside the space where people may by temporarily or permanently present and so that people's movement on deck is not obstructed. The cabinet may be built-in if it is gastight from the side of the erection, its fire resistance is at least R30 and it opens only outwards.

1.2.3 Use of LPG cylinders having volume above 35 kg is not permitted.

1.2.4 Simultaneous connecting greater number of cylinders than it is necessary for system operation is not allowed. Several cylinders may be connected only in the case of using the change-over or shut-off valve. No more than 6 cylinders may be connected to one system.

1.2.5 A shut-off valve for gas inlet from the cylinder to SOP gas system shall be applied. The valve shall be located as close to the cylinder/set of cylinders as possible in an easily accessible place, protected against mechanical damage.

Where 11 kg cylinder or a set of cylinders is used, the shut-off valve, together with reduction device, shall be located outside the erection (in the cylinder cabinet), appropriately marked and protected against mechanical damage and unauthorized access.

1.2.6 On the outer side of the cabinet, the placard „liquefied gas system" and the symbols of „fire and smoking prohibited" shall be placed.

1.2.7 No spare and empty cylinders may be stored onboard.

1.3 LNG cylinders

1.3.1 The LNG cylinders may be installed onboard SOP only outside its spaces, maintaining appropriate requirements and technical conditions applicable for such type fuel tanks, mounted on land wheel transport means.

1.3.2 For LNG supplied systems, the requirements specified in current PN-EN 1160 Standard shall apply.

1.4 Requirements for gas fuel supplied appliances

1.4.1 Gas cooking and heating appliances, gas systems shall be permanently fastened to the object structures, to prevent them from falling down or displacement. Fastening method shall be in accordance with manufacturer's instructions.

1.4.2 For onboard gas boilers and other gas appliances, exhaust gas ducts, air and flue ducts and for spaces where gas appliances are installed, technical conditions shall comply with requirements of Polish Standards and shall ensure that:

- gas appliances not supervised permanently, such as gas boilers or space heaters, shall be equipped with automatic devices protecting from the effects of pressure drop or break in gas supply. This requirement does not apply to appliances supplied from single liquid gas cylinders of capacity up to 11 kg,
- the volume of spaces where gas appliances are installed may not be less than:
  - 8 m^3 for appliances consuming air from those spaces for combustion,
  - 6.5 m^3 for appliances having closed combustion chamber,
- gas heating boilers may not be installed in spaces of height less than 220 cm,
- connections of appliances with gas supply system may be executed as a permanent (rigid) connection or by flexible metal lines. In both cases, the gas appliance shall be fixed to the SOP structure, to preclude its movements when the object moves,
- gas boilers of thermal power exceeding 60 kW may not be installed onboard SOP,
- more than two gas boilers may not be installed onboard SOP (it does not apply to instantaneous water heaters),
- the gas appliances with open combustion chamber may not be installed in accommodation spaces,

– the gas appliances with closed combustion chamber may be installed in accommodation spaces, irrespective of used ventilation system, provided that coaxial exhaust and air pipes will be used,
– in spaces where installed gas appliances use air from the space for combustion, fresh air intake shall be ensured through ventilation openings having free cross-section area of at least 220 cm^2.

1.5 Gas system lines

1.5.1 The gas system lines construction shall ensure compliance with tightness and strength requirements specified in 1.5.4.

1.5.2 The gas system lines shall be led on the surface of walls or under ceilings, or in special recesses and troughs made in the walls.

1.5.3 The lines shall not be built-over or permanently shielded, except the below cases:
– for penetrations in walls and ceilings, the gas pipes shall be run in shielding pipes permanently fixed to the structure, with internal diameter at least double to the external diameter of the gas pipe;
– in spaces of higher aesthetics, pipes may be hidden behind light, easily dismountable covers;
– in places exposed to mechanical damage, gas pipings shall be run under cover, properly selected for efficient protection and easily dismountable.

In the above cases of using covers fully hiding gas pipings located in the space, openwork or partial openwork covers, or such having at least two ventilation openings or slots (> 5 cm^2) in each space shall be used. The route of covered gas pipings shall be clearly and explicitly marked or indicated.

1.5.4 Prior to commissioning the system and re-commissioning after any serious change or repair, the system shall be subjected to the following tests:
– pressure test, with the use of air, inert gas or fluid, with pressure of 20 bars above atmospheric pressure, for medium pressure delivery pipes between closing device of first pressure reductor and shut-off valves, installed before the last pressure reductor,
– tightness test, with the use of air or inert gas with test pressure of 3.5 bar above the atmospheric pressure, for the medium pressure delivery pipes between the closing device of the first pressure reductor and shut-off valves, installed before the last pressure reductor,
– tightness test, with the use of air or inert gas with test pressure of 1 bar above the atmospheric pressure, for the working pressure delivery pipes between the closing device of the single or last pressure reductor and shut-off valves, installed before the gas consumers,
– tightness test, with test pressure of 0.15 bar above the atmospheric pressure, for delivery pipes between the closing device of the single or last pressure reductor and the gas consumer setting,
– the pipes are considered gastight if after the time sufficient for equalizing temperatures no test pressure drop is observed within 10 minutes.

1.5.5 Steel gas pipes, after being subjected to tightness test, shall be protected against corrosion.

1.5.6 Pipes of internal gas system shall be made of steel pipes, seamless or with a seam, and connected with use of welded or threaded joints.

1.5.7 On the external side of SOP hull, no gas pipes made of:
– steel pipes distributing gas fuel containing water steam or other components subject to condensation during operation,
– copper pipes,
may be carried.

1.5.8 The gas system pipes shall be led in accordance with the below requirements:
- the gas system pipes may not be led through spaces where operation or service may result in breaching technical condition of the system or may affect operational parameters of gas,
- the gas system pipes may be led through accommodation spaces, provided copper pipes being in accordance with the Polish Standard for gas copper pipes, joined by brazing, or seamless steel pipes or seamed pipes, complying with the Polish Standard for pipes joined by welding are used;
- the gas system pipes shall be so located to ensure their operational safety. The distance between gas system pipes and other pipes shall enable carrying out maintenance works;
- horizontal sections of gas pipelines shall be located at least 0.1 m above other system pipes, but if the gas density is higher than air density they shall be located below electrical cables and sparking appliances;
- spacing between the gas system pipes and other system pipes they cross shall be at least 0.02 m.

1.6 Onshore systems terminals

1.6.1 Permanent connection of SOP to gas shore systems (networks and tanks) is not allowed.

1.6.2 The liquid gas (propane-butane) (LPG) system supply from replaceable gas cylinders exposed to the effect of air temperature lower than 0°C, is not recommended.

1.6.3 The year-around supply of the system with liquefied gas (technical propane) stored onboard SOP in replaceable gas cylinders or cylinder batteries is permitted. SOP may also be provided with a connection for bunkering onboard LNG gas tanks from mobile bunker stations.

1.6.4 The bunkering shore connection, together with the gas tank filling pipes, shall be constructed in accordance with separate rules and technical conditions for land transport means supplied with LNG fuel.

1.6.5 The bunkering shore connection (filler neck) intended for onboard gas tank, together with the filling pipes, shall be protected against accidental mechanical damage and access of unauthorized persons. The tank, external systems and the connection (filler neck) shall be marked with appropriate symbols and warning plates.

2 HEATING, VENTILATION AND AIR CONDITIONING

2.1 Heat sources

2.1.1 SOP, which requires heating with regard to its purpose, shall be equipped with heating system and heating appliances, which are not stoves, kitchen range nor fireplaces. Thermal energy may be supplied to SOP from external sources or from onboard appliances.

2.1.2 It is not recommended to use technical arrangements making possible heat supply to SOP from external sources by fluids, steam or air pressurized to more than 0.1 MPa and of temperature above 70°C.

2.1.3 Thermal energy may not be generated onboard SOP by means of boilers fired by solid fuel (coal, wood, coal- and wood-based fuels). Departure from this requirement is possible only after receiving appropriate approvals from local administration bodies and from administrator of this area and upon applying technical arrangements for discharge of ashes, fumes and flues being result of heat generating, complying with environment protection regulations.

2.1.4 Thermal energy may be generated onboard SOP by means of boilers fired by fuel oil stored in onboard tanks, provided that the object complies with environmental requirements for emission of exhaust gas and pollution by petroleum products.

2.1.5 The use of LNG or LPG supplied heating systems onboard SOP is permitted.

2.1.6 Design of appliances for onboard generating thermal energy used for heating of the object, fuel tanks for heating purposes and connections to external fuel sources shall be based on the WT Regulation.

2.2 Heating systems

2.2.1 SOPs intended for people's stay and another SOPs, according to their purpose, shall be equipped with the system for heating spaces within the period of lower temperatures, which enables maintenance of internal temperature appropriate to the object purpose.

2.2.2 The heating systems shall be designed taking into account their working conditions onboard floating object. Designs of tanks for heating fuel and terminals for object supply with fuel from external sources shall be prepared considering technical conditions for such systems, as determined by the fuel supplier.

2.2.3 The water heating system is a system of connected pipes with fittings, circulation pumps, heaters and other appliances, located after valves separating from the heat source. The water heating system shall be protected from excessive pressure and temperature rise, in accordance with the requirements of Polish Standards for the protection of the water heating systems.

2.2.4 The water heating system of a closed type or the one equipped with automatic control fittings shall have devices for local venting, in accordance with the requirements of Polish Standards for venting the water heating systems.

Heat losses in delivery and return pipes of the water central heating system shall be reasonably low.

2.2.5 The air heating system is a system of connected air ducts and pipes, together with intake and uptake ventilators and the elements of air stream control, located between the air heating source and heated spaces. The mechanical ventilation system may also fulfil the function of the air heating system. Heat losses in the air heating ducts shall be reasonably low.

2.2.6 The electric heating system is a system of electric supply between the place of energy intake and the places of electric energy processing to thermal energy, together with processing appliances (heaters, radiators, thermal curtains, etc.) and control fittings for network settings and control and measuring equipment and safety devices.

2.2.7 Water and air heating system are recommended to be thermally insulated, based on the requirements given in Attachment 2 to WT Regulation.

2.2.8 The heating systems shall be provided with appropriate control and measuring equipment ensuring their safe operation and with the equipment for control of heating medium parameters.

2.2.9 In spaces where people may be present, the use of steam heating and water heating systems with heating medium temperature above 90°C is forbidden.

2.2.10 The location and housing of heating system pipelines shall enable system replacement without interfering in the object structure.

2.2.11 The water heating systems elements exposed to intensive external air in the winter, shall be protected from freezing and have, where it is required, thermal insulation protecting from excessive losses of heat.

2.2.12 The object heating systems may be designed based on appropriate provisions of the WT regulation.

2.3 Exhaust ducts

2.3.1 SOPs, where solid fuel furnaces or combustion chambers with burners fired by solid or gaseous fuel are installed, shall have exhaust ducts for discharging fumes and flues.

2.3.2 Ventilation, exhaust and fume ducts onboard SOP shall be designed based on the rules of Part IV, Chapter 5 of the WT Regulation, as far as it is practicable due to the SOP nature.

Moreover, in the case of designing exhaust ducts for gas appliances, the rules specified in §174 and §175 of Chapter 7 of the WT Regulation, shall be considered.

2.4 Ventilation and air conditioning

2.4.1 SOP spaces shall have ensured ventilation or air conditioning, appropriate to their purpose.

2.4.2 Notwithstanding compliance with the provisions of 2.4.3, the ventilation systems shall be constructed as specified below:
- ventilation ducts shall be constructed of non-combustible or flame-retardant material, reliably connected with each other and fastened to SOP structure;
- ventilation systems of galley and machinery spaces shall be separated from such systems of other spaces;
- galleys shall be equipped with ventilation systems and pantries with an exhaust duct;
- the exhaust ducts shall be provided with inspection hatches for inspection and cleaning.

2.4.3 Systems, including appliances for ventilation and air conditioning of SOP spaces, shall be designed based on applicable rules of Part IV, Chapter 6 of the WT Regulation, applicable to buildings.

2.4.4 Ventilation systems of spaces onboard objects with purpose GASTRONOMICAL and RESIDENTIAL shall also comply with the requirements of subchapter 1.3 of Chapter 5 of these *Rules*.

2.5 Requirements for liquid fuel system for supply of heating boilers

2.5.1 The system may utilize only the liquid fuel of flash point above 55°C.

2.5.2 The systems shall be constructed of steel seamless pipes.

2.5.3 After being installed onboard SOP, the system shall be subjected, in the presence of PRS Surveyor, to hydraulic test with test pressure not less than 1.5 times the rated pressure and not less than 0.4 MPa.

2.5.4 Independent fuel tanks shall not be placed above stairs, generating sets, exhaust ducts, electrical appliances. If it is necessary to locate fuel tanks in the above places, tanks which are not integral with the object structure shall be provided with trays below the entire bottom surface and the tanks which are integral with SOP hull shall be provided with trays on tank perimeter. Trays shall have coamings of appropriate height.

2.5.5 Piping sections may be joined with each other with the use of:
- permanent welded joints,
- flanged connections,
- threaded joints where sealing is not provided on the thread but on taper or gasket (e.g. by means of joints with parallel pipe (BSPP) threads),
- screwed and compression mechanical connectors.

Each of the above connections/joints shall comply with approved standards or have verified structure for the intended purpose and have PRS approval.

Pipelines shall have no soldered joints.

2.5.6 Fire-resistant flexible joints approved by PRS may be used for connecting to internal combustion engines ZP and boiler burners. Hose material in flexible pipes shall be selected taking into account fuel which will carry, fuel pressure, temperature and external conditions. Hose length shall not be more than it is necessary to ensure joint flexibility and normal operation of internal combustion engine or boiler burner.

2.5.7 Welding and non-destructive examination of welds shall meet the requirements contained in *Publication 23/P – Pipelines Prefabrication*.

2.5.8 Gaskets used in flanged joints shall be resistant to the effect of carried fuel and environment and be appropriate for the design pressure and temperature, and shall have dimensions and shape complying with approved standards.

2.5.9 Directly at tank outlets the pipework for the distribution of fuels shall be fitted with a quick-closing valve that can be operated from the deck, or from other safe place outside the space where the tank is located, even when the rooms in question are closed. If the operating device is concealed, the lid or cover shall not be lockable.

The operating device shall be marked in red. If the device is concealed it shall be marked with a symbol for the quick-closing valve with a side length of at least 10 cm.

This requirement does not apply to fuel tanks mounted directly on the engine.

2.5.10 Drip trays shall be fitted at the tank which is not integral with SOP hull structure, at pumps, filters, around generating sets, boilers and other appliances where leak may be expected.

2.5.11 The tanks shall be provided, in their lower part, below the intake to suction pipe of the tank, with self-closing valves and drain pipes led to the drip tray.

2.5.12 Bunkering of oil fuel shall be effected by means of a permanent pipeline.

The orifice for the fuel tank filler necks shall be above the deck and shall be fitted with a connection piece in accordance with standard EN 12827:2001.

2.5.13 Drip tray shall be installed below the orifice for protection against fuel spill.

If fuel is taken on from bunkering stations with their own technical devices to prevent fuel spills on board during bunkering, the above mentioned requirement does not apply.

2.5.14 Filling pipes of the tanks shall be led through the tank wall in its upper part. Where such an arrangement is impracticable, the filling pipes shall be fitted with non-return valves installed directly on the tanks.

Filling pipes shall be connected to the tanks as close to the tank bottom as practicable.

2.6 Oil fuel tanks

2.6.1 Liquid fuels shall be stored in steel tanks or tanks made of equivalent material, which are either an integral part of the hull or independent tanks which are firmly attached to the hull. These requirements shall not apply to tanks having a capacity of no more than 12 liters that have been incorporated in auxiliaries during their manufacture.

2.6.2 Independent tanks may be used, provided that they fulfil the following conditions:
- capacity of these tanks does not exceed 1 000 liters,
- the tanks have been attached sufficiently firmly and earthed
- the tanks are made of steel of a sufficient wall thickness and are installed in a drip tray. The latter shall be so designed as to prevent leaking fuel outboard SOP.

The drip tray may be waived if double-skin tanks with a leak protection or leakage warning system are used and which are filled only via an automatic delivery valve. These requirements are considered to be fulfilled if the construction of a tank has been approved by PRS.

2.6.3 Oil fuel tanks which form an integral part of hull shall be separated from accommodation spaces and water tanks by means of cofferdams.

2.6.4 Oil fuel tanks which do not form an integral part of the hull structure shall fulfil the requirements for hull tanks, where applicable.

2.6.5 Oil fuel tanks situated on open decks, superstructures and in other places open to the atmosphere shall be protected from exposure to the sun rays.

2.6.6 Large oil fuel tanks shall be provided with openings having leak-proof closures that are intended to permit cleaning and inspection.

2.6.7 Hull integrated or independent fuel tank shall be provided with air pipeline, leading to a place on an open deck where emitted vapours will not cause fire hazard and shall be equipped with a flame passage preventing device of design agreed with PRS. The total cross-sectional area of air pipes of the tanks filled by gravity shall not be less than the total cross-sectional area of all pipes by which the liquid may be simultaneously delivered into the tank. The total cross-sectional area of air pipes of pump filled tanks shall be at least 1.25 times the cross-sectional area of the tank filling pipe.

2.6.8 Fuel tanks shall be provided with devices for measuring fuel amount. If sounding pipe with bayonet is applied it shall be led to an open deck and provided with leak-proof deck closure. Use of level gauges with a transparent insert on tanks is subject to separate consideration by PRS. Where electric fuel level indicator has been used, it shall be of type approved by PRS.

2.7 Liquid fuel fired heating boilers

Liquid fuel fired heating boilers shall have conformity declarations issued by their manufacturers, confirming compliance with requirements of applicable EU directives and regulations.

2.7.1 Vaporizing oil burner stoves

2.7.1.1 It shall be possible to light vaporizing oil burner stoves without the aid of another combustible liquid. They shall be fixed above a metal drip pan which encompasses all the fuel-carrying parts, whose sides are at least 20 mm high and which has a capacity of at least two liters.

2.7.1.2 Vaporizing oil burner stoves shall be fitted with a suitable regulator which, at all settings, ensures a virtually constant flow of fuel to the burner and which prevents any fuel leak should the flame go out. Regulators shall be considered suitable which function properly even when exposed to vibration and inclined up to 5° and which, in addition to a level-regulating float, have:
- a second float which closes off the fuel supply when the permitted level is exceeded, or
- an overflow pipe, but only if the drip pan has sufficient capacity to accommodate at least the contents of the fuel tank.

2.7.1.3 Where the fuel tank of a vaporizing oil burner stove is installed separately:
- the drop between the tank and the burner feed may not exceed the value that is laid down in the manufacturer's operating instructions;
- it shall be so installed as to be protected from unacceptable heating;
- it shall be possible to interrupt the fuel supply from outside the fuel tank space.

2.7.1.4 The flues of vaporizing oil burner stoves shall be fitted with a device to prevent draught inversion.

2.7.2 Atomising oil burner heating appliances

2.7.2.1 The appliances shall comply with the below requirements:
- adequate ventilation of the burner shall be ensured before the fuel is supplied;
- the fuel supply shall be regulated by a thermostat;
- the fuel shall be ignited by an electric device or by a pilot flame;
- a flame monitoring device shall cut off the fuel supply when the flame goes out;
- the main switch shall be placed at an easily accessible point outside the installation room.

2.7.3 Forced-air heating boliers

2.7.3.1 Forced-air heating boilers consisting of a combustion chamber around which the heating air is conducted under pressure to a distribution system or to a room shall meet the following requirements:
- if the fuel is atomized under pressure, the combustion air shall be supplied by a blower;
- the combustion chamber shall be well ventilated before the burner can be lit. Ventilation may be considered complete when the combustion air blower continues to operate after the flame has gone out;
- the fuel supply shall be automatically cut off if:
  - the fire goes out;
  - the supply of combustion air is not sufficient;
  - the heated air exceeds a previously set temperature, or
  - the power supply of the safety devices fails.

In the above cases the fuel supply shall not be re-established automatically after being cut off;
- it shall be possible to switch off the combustion air and heating air blowers from outside the room where the heating appliance is located;
- where heating air is drawn from outside, the intake vents shall be located as far as possible above the deck. They shall be installed in such a manner that rain and spray water cannot enter;
- heating air pipes shall be made of metal;
- it shall not be possible to close the heating air outlet apertures completely
- it shall not be possible for any leaking fuel to reach the heating air pipes;
- it shall not be possible for forced-air heating appliances to draw their heating air from machinery spaces.

3 WATER AND SEWAGE SYSTEMS

3.1 Cold and hot water systems

3.1.1 SOP with spaces intended for people's stay shall have ensured supply with potable water and, respectively to the object purpose, with water for other purposes, in amounts necessary for current needs.

3.1.2 For SOP whose operation is not connected with permanent or temporary people's stay, water supply shall be adequate to the object purpose.

3.1.3 SOP equipped with baths, showers or washbasins shall have individual or central hot water system.

3.1.4 Objects with purpose RESIDENTIAL, GASTRONOMICAL, COMMERCIAL, WORKING and PRIVATE shall have ensured the possibility of being connected to an external or other water supply system. Connections to an external potable water system or inlet openings to onboard potable water tanks shall be installed above deck and be properly marked that they are designed only for potable water.

3.1.5 Connections or inlet openings for non-potable water supply shall be appropriately marked and so located that they cannot be mistaken for potable water systems.

3.1.6 SOP having connection to shore water supply system shall be equipped with an easily accessible valve shutting off water supply to the onboard system, located possibly close to the connection.

3.1.7 Potable water systems shall be made of a corrosion-resistant material which poses no physiological danger.

3.1.8 Potable water systems shall be protected against excessive heating.

3.1.9 The systems shall be equipped at their lowest points with drain valves for complete emptying of the system. For objects with purpose RESIDENTIAL, GASTRONOMICAL, COMMERCIAL and PRIVATE provided with high capacity system, technical arrangements shall be applied to enable discharge of water released in emergency directly overboard. The entire system shall be so constructed that it is capable of being completely emptied.

3.1.10 Water supply systems onboard objects of category YEAR-ROUND, including connectors referred to in 3.1.13, shall be equipped with means preventing water freezing inside.

3.1.11 Potable water pipes shall not pass through tanks containing other liquids. Potable water systems may not be connected to other liquid supply systems.

3.1.12 A point for assembly of water meter unit and possibly of water filters shall be provided close to the connection for an external water supply system. It shall be assumed that the main water meter unit will generally be located on land, outside SOP.

3.1.13 If appropriate land infrastructure exists, it is recommended that SOP should be permanently connected to land-based water supply system by means of flexible joints so selected that they cannot be damaged in result of possible SOP movements due to its fastening method and changes of water level in the water reservoir. It is recommended that the joints should be suspended under the accommodation ladder leading to the berth, to be protected against damage.

3.1.14 The water supply system shall be so designed and constructed to ensure water supply to SOP as intended.

3.1.15 Design of the onboard cold and hot water systems shall be based on the rules for designing these systems in buildings, i.e. the provisions of the WT Regulation.

3.2 Water tanks

3.2.1 Where SOP connection to land-based water supply network is not possible, the water in the necessary amounts and of required quality may be stored in tanks being an integral part of SOP structure or in built-in tanks, installed permanently.

3.2.2 Potable water tanks shall be fitted with a suitable lockable opening to enable the inside to be cleaned and disinfected.

3.2.3 The tanks shall have water level indicator to enable control of the tank filling. They shall also have a valve shutting down water inflow after reaching maximum permissible filling level of the tank.

3.2.4 Tanks emptied/filled in by gravity or mechanically shall be fitted with air vents provided with appropriate filters.

3.2.5 Pressure vessels for the storage of drinking water shall be filled only with uncontaminated compressed air.

3.2.6 Potable water tanks may not have common wall with other tanks.

3.2.7 Potable water tanks installed onboard SOP shall be protected against excessive heating from sun radiation and appliances emitting thermal energy.

3.2.8 Pressure vessels for the storage of drinking water shall be equipped with appropriate safety valves.

3.3 Sewage system

3.3.1 The system shall be designed with such slope to ensure sewage drainage at heel and trim angles of SOP.

3.3.2 Release pipes (risers) of gravity sewage system shall have air vents similar to the same pipes in buildings, as defined in §124 of the WT Regulation.

3.3.3 The sewage system shall comply with the requirements of Polish Standards for such systems.

3.3.4 Onboard YEAR-ROUND SOP, the sewage systems shall be protected against freezing.

3.4 Equipment requirements

3.4.1 The SOPs of category A, B or C need not be equipped with sanitary appliances.

3.4.2 The SOPs of category D need not be equipped with permanently built-in sanitary equipment.

3.4.3 The SOPs of category E or F shall be equipped with sanitary facilities with design based on the requirements for buildings, as defined in Chapter 6 Part III of the WT Regulation. The requirements may by applied jointly to SOP and to its separate land-based facilities.

3.4.4 SOP which is an object of public use or which requires watch shall have at least one single-user sanitary facility, equipped with a toilet bowl and a washbasin with possible sewage discharge to the tank located onboard or having connection to land-based sewage system. The object with access to WC and washbasin onshore may be exempted from such a requirement.

3.4.5 If the SOP does not fulfil by itself and fully the requirement of having a sanitary facility, then the design shall include a reservation that, due to absence of appropriate arrangements, the SOP may operate only in association with appropriate land-based facilities equipped with rule required arrangements, made accessible to SOP user.

3.4.6 The requirement of object equipping with sanitary facilities means its equipment with at least water closets and washbasins. Where SOP is at once a workplace, it shall be equipped with sanitary appliances and hygienic and sanitary spaces, in accordance with the OHS regulations and the provisions of Chapter 6, Part III of the WT Regulation.

3.4.7 If gastronomical activity or other services which require fulfilling specific conditions are carried out onboard SOP, the SOP design shall consider appropriate sanitary regulations.

4 ANTI-HEELING SYSTEMS

4.1 General

4.1.1 The anti-heeling systems need not be applied onboard objects with purpose PRIVATE and OTHER. Objects of other categories shall be so designed that the use of anti-heeling systems is not necessary or restricted to a minimum.

4.1.2 Design of anti-heeling system shall include:
- carrying out calculations verifying strength of hull structure loaded by all and individual (in most unfavorable asymmetric distribution of loads) filled-in equalizing tanks;
- carrying out calculations verifying influence of equalizing tanks on the object buoyancy. The calculations shall be performed for the conditions of all tanks completely filled, totally empty and for extremely unfavorable asymmetric distribution of loads, when a part of tanks is filled and part of them empty;
- development of a system of either hand-operated or automatic, or semi-automatic safe operation of equalizing tanks, together with sounding and monitoring system.

4.1.3 The system parameters shall be so chosen that filling in and emptying equalizing tanks with water can be appropriate to the object needs and its operational requirements in extreme conditions (the designer shall define maximum filling and emptying time for particular tanks). The system shall also enable water pumping over between tanks.

4.1.4 The system shall be protected against taking mechanically polluted water from the water reservoir, what can result in the system damage. The openings in outer plating leading to bottom and side sea chests shall be equipped with protective gratings; instead mounting gratings, openings or slots may be cut in the SOP hull. Combined area of the openings or slots shall not be less than 2.5 times the combined cross-sectional area of installed outboard water intake fittings. Diameters of openings or breadths of mesh in gratings or in outer plating shall be equal to ca. 20 mm.

4.1.5 The system shall be possible of being emptied from water to be protected against damage due to freezing. Onboard SOP of category YEAR-ROUND, arrangements to prevent water freezing in tanks and pipings shall additionally be provided.

4.1.6 At least one pump shall be provided for filling and emptying tanks. It is recommended to determine the capacity of the pump with the assumption that when pumping out water from the largest tank, the velocity of the water flow is not less than 2 m/s, with the suction pipe diameter determined by the formula 4.1.7.

4.1.7 For particular tanks, internal diameters of equalizing pipelines d_w shall not be less than that determined by the formula:

$$d_w = 18\sqrt[3]{V} \text{ [mm]} \quad (4.1.7)$$

where:
V – volume of the equalizing tank [m^3].

The actual diameter may have the nearest standard size.

4.1.8 Arrangement of the suction branches shall ensure the discharge of water from every equalizing tank when the SOP is upright or inclined not more than 5°.

4.1.9 Pipes passing through other tanks shall be led inside tight tunnels forming an integral part of the tank or made of seamless steel pipes permanently connected. Where it is impracticable to make permanent joints, flange joints with gaskets may be permitted.

4.1.10 Leading equalizing pipelines through utility spaces shall be avoided.

4.2 Equipment requirements

4.2.1 All pumps, indicators and hand-operated valves shall be located in places accessible for service, protected against operating by unauthorized persons.

4.2.2 Onboard pumps intended for other purposes may be used as equalizing pumps, provided they are connected to the anti-heeling system so that they can be re-connected to appropriate systems. Bilge pump may be used as a stand-by one.

4.2.3 Pumps used for equalizing heels shall be of self-priming type.

4.2.4 The electrical requirements for the anti-heeling system are specified in 6.3.3.1 of this *Part 6.*

5 BILGE SYSTEMS

5.1 General

5.1.1 SOP objects of categories D, E and F with purpose RESIDENTIAL, GASTRONOMICAL, COMMERCIAL, WORKING, PRIVATE shall be equipped with an efficient bilge system for overboard discharging water which can collect in the lowest places of the buoyancy part. The requirement does not apply to multi-hull objects where dimensions of single buoyancy elements prevent installation of inspection manholes and pumps (e.g. they are constructed from fabricated plastic elements) and they at once have single compartment subdivision.

5.1.2 Bilge system shall enable removal of rainwater, waves or splashes and water from small leaks or cleaning works which can enter the object interior. The rules do not include SOP draining in result of heavy damage to hull plating.

5.1.3 The system design shall enable pumping out water from each compartment, at object heel up to 5°.

5.1.4 If watertight bulkheads and/or separate compartments below main deck are onboard, the possibility of pumping out water from each compartment shall be ensured.

5.1.5 For each flat bottom watertight compartment, where the bottom width exceeds 5 m, at least suction branch at each side shall be provided.

5.1.6 The suction branches shall be located as low as possible in the bilge and they shall be provided with easily accessible strum boxes. Strum boxes shall be so constructed that they can be cleared without dismantling any joint on the suction branch. It is recommended that diameter of perforations in the strum box should not exceed 10 mm and their combined area should be not less than double cross-sectional area of the pipeline.

5.1.7 Side penetrations of the bilge system outlets shall be located above the maximum heel waterline, unless the outlet is provided with side valve complying with ISO 9093 and means are provided protecting against outboard water entering the SOP interior.

5.1.8 If several pumps are connected with one side penetration, the system shall be so designed that operation of one pump does not result in back flooding of another pump and operation of all pumps does not reduce capacity of any single pump.

5.1.9 Where hoses are used in the system, their connections to the system shall be protected by corrosion resistant hose clamps or made with the use of permanent terminals.

5.1.10 The bilge system shall be so designed that its reverse operation shall not cause flooding SOP with outboard water. If branched pipeline is applied, the non-return valve shall be installed on each suction branch.

5.1.11 Bilges in which bilge water polluted with chemicals/oily products may be present, shall be accessible for cleaning.

5.1.12 The possibility of transfering oily bilge water to oily bilge water retention tank, referred to in 2.1.1 of Part 7 of these *Rules*, shall be ensured.

5.1.13 On every SOP, discharge overboard of bilge water polluted with chemicals or oily products is strictly forbidden.

5.2 Machinery requirements

5.2.1 Bilge pumps shall be installed permanently. They can include:
- hand-operated pumps: membrane, piston, wing or skipper's pumps operated from the deck or from an easily accessible place above waterline,
- mechanically driven self-priming pumps,
- submersible electrically-driven pumps, operated from main control station, including pumps started also automatically at the rise of bilge water level.

5.2.2 Required minimum number of pumps depending on parameter $L_c x B_c$ is shown in Table 5.2.3. It shall be noted that the final number of bilge pumps depends on the number and arrangement of watertight compartments and the object structure and it may be greater than the minimum amount.

5.2.3 Capacity of each pump shall be not less than specified in the below table and the possibility of sufficient draining of all compartments. Arrangement of pumps shall in emergency minimize the risk of loss of bilge water draining possibility.

Table 5.2.3
Requirements for bilge pumps

SOP category	Required minimum number of pumps in relation to parameter L_c x B_c*)			Min. capacity of each bilge pump l/min **)		
	L_c x B_c < 40	40 ≤ L_c x B_c ≤ 100	L_c x B_c > 100	L_c x B_c < 40	40 ≤ L_c x B_c ≤ 100	L_c x B_c > 100
A	0	2	ND	0	35	ND
B	ND	ND	2	ND	ND	50
C	ND	ND	ND	ND	ND	ND
D	2	ND	ND	15	ND	ND
E	ND	2	ND	ND	35	ND
F	2	2	4	15	35	50

ND – not applicable
*) The real number and capacity of pumps shall be determined by calculations and may not be less than specified in Table 5.2.3.
**) The capacity of hand-operated pumps shall be determined for 45 cycles per minute.

5.2.4 If several bilge pumps connected to a common pipeline are used, a non-return shut-off valve shall be fitted on the terminal of each pump.

5.2.5 The power-driven bilge pumps may be used also for other purposes, provided a three-way cock with L plug or another arrangement to prevent accidental ingress of outboard water into SOP interior has been applied.

5.2.6 The bilge pumps shall be fit for operation within temperature range from 0°C to +60°C, and withstand in dry condition without starting the temperature range from –40°C to +60°C.

5.2.7 If hoses are used in the system, the branch pieces of the bilge pumps and of other components shall have sufficient length to enable proper mounting of a hose by means of hose clamps.

5.2.8 The bilge pumps shall be mounted in accessible places to enable their maintenance and repairs.

5.2.9 The hand-operated pumps shall be so installed that their rated capacity can be utilized.

5.2.10 The electrical requirements for bilge system are given in 6.3.3.2 of this *Part 6.*

6 ELECTRICAL EQUIPMENT AND SYSTEMS

6.1 General

6.1.1 Cable network, cables and fittings

6.1.1.1 SOP, respectively to its purpose, shall be equipped with an internal electrical system.

6.1.1.2 The electrical equipment elements which are not subject to detailed requirements are considered as providing adequate safety level if they have been manufactured in accordance with valid European Standard or the requirements of authorized Class Society.

6.1.1.3 The allowable maximum current voltage shall be taken similar to the values defined in art. 10.06 of ES-TRIN Standard; the use of values greater than 400 V is not recommended.

6.1.1.4 At designing electrical installation, the rules of ES-TRIN Standard, Chapter 10, shall be applied.

6.1.2 Electrical appliances and protective earthing

6.1.2.1 Protective earthing shall be applied for the appliances the rated voltage of which is higher than the safe voltage, i.e. above 50V. Protective earthing shall be executed in accordance with the requirements of art. 10.05 of ES-TRIN Standard and paragraph 2.4 of *Part VII* of the *PRS Rules for the classification and Construction of Inland Waterways Vessels*.

6.1.2.2 The appliances shall withstand permanent heel up to 5° and the object internal temperatures between 0°C and +40°C, and external temperatures between –20°C and +40°C. The appliances shall operate properly within this range.

6.1.2.3 The electrical and electronic equipment and appliances shall be fully accessible and easily maintained.

6.1.2.4 The appliances, lighting and installations shall have appropriate degree of protection IP defined in accordance with PN-EN 60529:2003 Standard. Kind of minimum protection may be determined similar to the protection used onboard ships, defined in art. 10.03 of ES-TRIN Standard.

6.1.3 Anti-explosion protection

6.1.3.1 The electrical installation and appliances in spaces of explosion hazard shall fulfil the requirements of art. 10.04 of ES-TRIN Standard.

6.1.4 Lightning protection

6.1.4.1 The object shall be fitted with a lightning protection, the protection zone of which should comprise all arrangements that require protection against lightning. When an object is exposed to the risk of fire or explosion due to after-effects of lightnings, the earthing installation which would preclude secondary sparking is to be provided.

6.1.4.2 The lightning installation is to consist of a spike, lightning conductors and earthing. On metal masts, the lightning conductors need not be fitted if provision is made for a reliable electrical connection of the mast to the metal hull or to the earthing point.

6.1.4.3 Onboard objects with a metal hull, vertical structures such as masts, superstructures, etc. shall be used as spikes if they are expected to be electrically connected to the metal hull. Additional spikes may be used only when the structural elements do not form required protective zone.

6.1.4.4 If electrical equipment is installed on top of a metal mast, a lightning spike having a reliable connection with the mast is to be provided.

6.1.4.5 On each mast made of non-conducting material, a proper lightning installation is to be fitted.

6.1.4.6 Spikes are to be made of a rod of at least 12 mm in diameter. The rod may be of copper, copper alloys or steel suitably protected against corrosion; for aluminium masts, the spike may be made of an aluminium rod.

6.1.4.7 The spike is to be fitted to the mast in such a way as to project at least 300 mm above the top of the mast and any equipment fitted on its top.

6.1.4.8 The lightning conductor is to be made of a rod, flat bar or metal rope having a cross-section not less than 70 mm^2 for copper or its alloys and not less than 100 mm^2 for steel, the steel lightning conductors being suitably protected against corrosion.

6.1.4.9 Lightning conductors are to be run on the outer side of the mast and superstructures and as straight as possible with a minimum number of bends which should be smooth and have the largest possible radii.

6.1.4.10 Lightning conductors are not to pass through explosion-hazardous spaces.

6.1.4.11 In composite objects, the metal structures immersed in water under all conditions of sailing may be used as earthing.

6.1.4.12 Provision is to be made for earthing the object hull when the object is beyond water, e.g. for maintenance or repair.

6.1.4.13 Connections in the lightning installation are to be welded, clamped, riveted or bolted with clamps.

6.1.4.14 The contact area of connections is to be at least 1000 mm^2. Clamps and bolts are to be made of copper, copper alloys or steel suitably protected against corrosion.

6.1.4.15 Connections in the lightning installation should be accessible for inspection and protected against mechanical damage.

6.1.5 Telecommunication system

6.1.5.1 The SOP Rules do not specify detailed requirements for SOP equipment with low-current systems and appliances, nor define specific technical conditions for their installation and operation, except the below given.

6.1.5.2 For the objects with purpose RESIDENTIAL, GASTRONOMICAL, COMMERCIAL, the below provisions shall be considered:
- the possibility of use of the broadband Internet (public spaces, guest rooms, service rooms, crew spaces),
- facilities for reduced mobility persons – installation of paging equipment in places of potential presence of such persons where safe self-service may be difficult (e.g. gangways, slopes, toilets, etc.).

6.1.5.3 Carrying low-current systems close to gas systems without necessary protection and combining the low-current systems in common bundles with cables conducting current > 50 V is forbidden.

6.2 Power sources and distribution

6.2.1 Power balance

The object design shall specify planned energy consumers, their maximum power consumption, required installed load or maximum generated power of own energy sources and necessary power reserve.

6.2.2 Supply from land-based network

6.2.2.1 For SOPs with purpose: RESIDENTIAL, GASTRONOMICAL, COMMERCIAL, WORKING, PRIVATE, possibility of being connected to an external power grid shall be ensured. If an appropriate land-based infrastructure is absent, the use onboard SOP of individual energy sources, referred to in subchapter 6.2.3, is permitted.

6.2.2.2 Objects adapted for supplying electrical energy from onshore grid shall be equipped with a switch shutting down current supply to any onboard systems and appliances, installed in an accessible place, possibly close to external grid terminal. The switch shall be marked and protected so as to be capable of immediate use when necessary. It is recommended that an additional emergency main switch should be used, located onshore close to the object and shutting down energy supply from external power grid in emergency.

6.2.2.3 The power connection shall be constructed and fitted in an elastic way and shall be carried in flexible shielding pipes. Cables, their fastenings and connections may not be subject to tensile loads. Objects of category: YEAR-ROUND present in water reservoir and having underwater power connection shall be protected by rigid shields where destructive ice effect may be expected. Used cables shall maintain their flexibility down to -20^0C and resistance to environmental hazards.

6.2.2.4 The power supply terminal shall be permanently fixed to SOP system by a fixed joint or plug-in socket.

6.2.2.5 Terminal cables shall be carried in places which are hardly accessible to unauthorized persons and where they are not exposed to direct contact with objects floating in SOP neighborhood. If leading cable along such route is not practicable (completely or partly), they shall be separated or protected against damage, so as to eliminate any danger of electric shock to people and animals. It is recommended that the terminal cables shall be suspended under the accommodation ladder leading to the berth, to protect them from damage.

6.2.2.6 The supply of the object from the shore through terminals adapted for safe transmission of current up to 400 V is permitted. Cable parameters and properties and the method of constructing the terminal shall be in accordance with technical conditions adopted by a local supplier of power energy (the grid operator). If the operator's technical conditions do not sufficiently specify cable parameters, the connection cable and cables led on external side of the object shall be insulated as required for cables of at least 0.6 kV.

6.2.2.7 The main distribution (metering) switchboard shall indicate if the terminal is live. Indicating devices are required to compare polarity at direct current, while at three-phase current indicating sequence of the terminal phases with object network. The board shall be provided with a nameplate specifying current and rated voltage, and also current frequency for alternating current.

6.2.2.8 Connection to land-based grids or other external grids shall fulfil the requirements of art. 10.08 of ES-TRIN Standard.

6.2.3 Generating sets and systems onboard the object

6.2.3.1 Combustion power generators are not recommended as permanent source of power onboard SOP, due to emitted noise and harmful effect on environment. Such generators shall serve as emergency source of power supply.

6.2.3.2 Power generators and their internal combustion engines shall be issued with manufacturer's declarations of conformity, confirming compliance with the requirements of applicable EU directives and regulations. Fuel tanks of power generators shall comply with the requirements of subchapter 2.6 of this *Part 6.*

6.2.3.3 The systems of renewable energy sources may be installed onboard SOPs as power sources for loading batteries or supplying small consumers. Applied technical arrangements for generation of energy from the renewable energy sources shall be safe for the object, its users and object environment. It is recommended to analyze possibilities and profitability of energy generation using RES by dedicated system located onshore with transfer possibility to SOP with the use of cable connection. The use of some power generation systems for the needs of SOP may require acquiring separate decisions of local administrative bodies, due to environmental effect of these systems.

6.2.3.4 PRS does not define own conditions for the design and construction of power sources located onboard SOP. PRS shall only consider influence of used generating systems and appliances on general safety, including their assembly method and place.

6.2.3.5 Accumulator batteries shall be used in accordance with the requirements of art. 10.11 of ES-TRIN Standard.

6.2.4 System switchboards and protection

6.2.4.1 Switchboards, switches, protective devices, measuring and monitoring equipment shall be designed respecting the provisions of art. 10.12 of ES-TRIN Standard.

6.2.4.2 The object system and terminal shall be protected against short circuits and overloads.

6.2.4.3 All circuits shall have separate overload and short circuit protection. In the case of isolated supply systems, insulation condition control devices shall be applied, while for earthed systems except the trip-free circuit breaker, a residual current device of threshold 30 mA isolating the whole system shall be installed in the switchboard supply circuit.

6.3 Electric drives of equipment

6.3.1 Deck winches

6.3.1.1 Mooring winch motor shall ensure uninterrupted heaving-in of a mooring line at a rated pull for a period of not less than 30 minutes.

6.3.1.2 Mooring winch shall be provided with an automatic braking device holding the mooring line under tension of not less than 1.5 times the rated pull at the power loss or drive failure.

6.3.1.3 Mooring winch motor shall ensure operation at temperatures from –20°C to +40°C, at relative air humidity of 80 ± 3% at temperature +40 ± 2°C and at relative humidity 95 ± 3% at temperature +25 ± 2°C. Its degree of enclosure protection shall be relevant for the place of installation, i.e. min. IP56 on open deck and min. IP44 for other spaces.

6.3.2 Pumps and fans

6.3.2.1 Motors of fans and pumps other than bilge pumps shall comply with the same requirements as contained in 6.3.1.3 for driving motors of mooring winches.

6.3.3 Other equipment

6.3.3.1 Anti-heeling system

6.3.3.1.1 The pumps and valves of equalizing tanks shall be supplied from separate electrical circuit having own protective device.

6.3.3.1.2 The electrical system of control unit shall be a separate circuit with own protection.

6.3.3.1.3 Cables, cable connections and appliances located below side deck shall be watertight.

6.3.3.1.4 Control panel of the system shall be located in a place accessible for personnel of the object and be protected against access of unauthorized persons. The system diagram and service manual shall be placed at the control panel.

6.3.3.1.5 Where the control system is not of central and automatic type, all valves, switches, controls shall be designed to be placed, if possible, at one place, to facilitate mechanical operation of the whole system and to enable safe minimizing of operation time.

6.3.3.1.6 The devices shall withstand permanent heels up to 15°, the internal temperatures between 0°C and +40°C and external temperatures between –20°C and +40°C. The devices shall operate perfectly within these ranges.

6.3.3.1.7 The electrical and electronic equipment and appliances shall be fully accessible and easily maintained.

6.3.3.2 Bilge system

6.3.3.2.1 Electrical bilge pumps shall comply with the requirements of PN-EN ISO 8849 Standard and they shall be marked: „ISO 8849 MARINE".

Electrical connections shall be water resistant up to the enclosure protection degree IP67, in accordance with IEC 60529 and they shall be placed above maximum permissible water level, unless they are of submersible type. If the switch is exposed to water splashes, it shall be water resistant up to the protection degree IP56, in accordance with IEC 60529.

6.3.3.2.2 Motors of bilge non-submersible pumps shall be placed above the critical level of bilge water.

6.3.3.2.3 Automatically controlled bilge pumps shall be equipped with an easily accessible manually-operated power switch, starting the pump.

6.3.3.2.4 Automatic control shall be equipped with visual indicator of the pump supply and readiness for operation in automatic mode.

6.3.3.2.5 Checking or signaling the liquid level in bilge wells shall be possible. Each of closed rooms shall have, installed inside, a detector of high bilge water level alarm initiating sound signal onboard of the object.

6.4 Lighting

6.4.1 General

6.4.1.1 SOP spaces where people may be present and internal passageways shall be provided with lighting.

6.4.1.2 Only electrical systems and fittings are permitted for lighting. The use of gas and oil lamps is not allowed.

6.4.1.3 Used external lighting of the object may not obstruct visibility of any navigational lights.

6.4.1.4 Onboard the objects with purpose RESIDENTIAL, GASTRONOMICAL, COMMERCIAL, the lighting of escape routes and permanent twilight lighting of places essential for users' safety (such as accommodation ladders), shall be applied.

6.4.1.5 Objects with purpose RESIDENTIAL, GASTRONOMICAL, COMMERCIAL shall be equipped with permanent internal and external lighting designed based on technical standards admitted for use in the European Union.

6.4.2 Emergency supply and lighting

6.4.2.1 Public objects with purpose RESIDENTIAL, GASTRONOMICAL, COMMERCIAL are obliged to use an emergency lighting with separate source of supply. In well-grounded cases, PRS may consider departure from this requirement. Objects of other categories may be provided with emergency lighting if the designer or the object user considers it necessary due to untypical, specialized functions of the object.

6.4.2.2 Objects of all categories may be provided with an emergency, reserve power supply source, if it is necessary due to periodical or continuous maintaining operation of essential systems and appliances installed onboard.

6.4.2.3 During designing emergency systems, the requirements defined in items 3-8, 10 and 11, art. 19.10 of ES-TRIN Standard shall be applied.

6.4.3 Navigation lights

6.4.3.1 SOPs of all categories shall be adapted for installation onboard and operation of the navigational lighting and marking required by separate rules, used during object towing.

6.4.3.2 SOPs of all categories located close to water routes, ports and harbors shall be equipped with permanent position lights, in accordance with the requirements of separate rules or decisions of the water reservoir administrative bodies.

6.4.3.3 Designing navigational lighting and marking onboard SOP shall be effected based on *the Rules for the Classification and Construction of Inland Waterways Vessels, Part VII*, Chapter 6.3.

6.5 Automation

6.5.1 Equipment operation control and monitoring systems

The SOP Rules do not introduce own standards for design of control and monitoring systems for the operation of appliances being SOP equipment.

PART VII
OBJECT IMPACT ON THE ENVIRONMENT AND PEOPLE

1 NOISE AND VIBRATIONS PROTECTION

1.1 SOP shall be so designed that noise generated during operation falls within range permitted by valid legal regulations. Transfer of vibrations from operating machinery onto SOP structure shall be reduced as far as possible.

1.2 In order to ensure proper protection against noise and vibrations, SOP shall comply with the requirements of Part IX of the WT Regulation which, due to SOP specifics, are reasonable and practicable for use onboard objects moored in a water reservoir.

2 PREVENTION OF ENVIRONMENT POLLUTION

2.1 Prevention of pollution by oil

2.1.1 Each SOP where petroleum fuel supplied machinery is located shall be fitted with fixed or detachable holding tank for oily bilge water which can collect in machinery spaces. Oily bilge water is permitted in bilges of machinery spaces of adequate bottom structure.

2.1.2 The holding tank for oily bilge water shall be provided with an air vent pipe and arrangements for the measurement of the amount of the oily bilge water. Moreover, it shall be possible to discharge the tank contents to land-based reception facilities through standard shore connection. One of bilge pumps required in 5.2.2 of *Part 6* of these *Rules* may be used for this purpose.

2.1.3 Standard shore connection for oily bilge water shall be located in the readily available position on open deck and be constructed in accordance with the requirements of PN-EN 1305 Standard. The shore connection shall be provided with a placard „Oily bilge water”. .

2.1.4 Pumps and hoses of the bilge water recipient may be used for discharge of oily bilge water collected in tanks and bilges. In such a case, a suction pipe extended to the tank bottom and equipped with connection for tank emptying by the pump of recipient, shall be installed in the tank.

2.2 Sewage pollution prevention

2.2.1 Each SOP provided with built-in sanitary facilities shall be equipped with a sewage holding tank ensuring the possibility of temporary collecting grey and black sewage.

2.2.2 The sewage holding tank shall have:
- technical arrangements and system preventing the tank from being overfilled;
- technical arrangements ensuring its tightness and access for periodical cleaning and disinfection;
- an air vent pipe;
- technical arrangements for tank emptying by external reception facilities.

2.2.3 In the case of SOP of category YEAR-ROUND, such sewage holding tank location or other arrangements shall be provided, which preclude freezing of the tank contents.

2.2.4 The sewage discharge pipeline (if any) shall be led to an open deck and ended with a flange complying with the requirements of PN-EN ISO 15749-4 Standard and fitted with a placard „Sanitary sewage”.

2.2.5 If appropriate land-based infrastructure exists, it is recommended to connect permanently SOP to land-based sewage system by a flexible connection for sewage discharge. The connection shall be so selected that it cannot be subject to damage due to possible SOP movements resulting from the method of the object fastening and from water level changes. It is recommended that the connection should be suspended under the SOP-berth accommodation ladder, to protect it from damage. For YEAR-ROUND SOPs, the connection shall be protected from freezing.

2.3 Wastes pollution protection

2.3.1 Each SOP intended for people's stay and other SOPs where wastes are generated during operation, shall have places for temporary collecting wastes providing the possibility of segregation, situated onboard SOP or close to it.

2.3.2 Onboard SOP with purpose RESIDENTIAL, GASTRONOMICAL, COMMERCIAL, WORKING and PRIVATE, places shall be designated and appropriately adapted for containers intended for temporary collection of wastes, taking into account wastes segregation. SOPs of category D need not be equipped with the above arrangements if the design documentation specifies that the SOP operation is conditioned upon its location and use only in connection with the onshore infrastructure ensuring places for collecting segregated wastes.

2.3.3 Onboard SOP with purpose RESIDENTIAL, GASTRONOMICAL, COMMERCIAL, all accommodation spaces, service spaces, galleys and other spaces where wastes may be generated, shall be equipped with individual wastes containers, considering the possibility of segregation.

2.3.4 Depending on the kind of SOP operation and provided services, places shall be provided for collecting wastes and methods for temporary separate holding of other untypical wastes, generated during the operation, in particular the biodegradable and dangerous wastes.

2.3.5 Containers for temporary collecting solid wastes shall be fixed so as to prevent them from collapsing, displacement or falling overboard due to object heeling. The wheeled containers shall be additionally equipped with efficient wheel blockades and systems for temporary fastening to fixed elements of structure.

2.3.6 Waste collection containers of volume above 40 l shall be located in such places where the way between them and places of their emptying is free of architectural barriers preventing containers moving on own wheels or on carts.

2.4 Air pollution prevention

2.4.1 Application of refrigerants containing chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) in refrigerating installations is prohibited.

2.4.2 Application of halons in fire extinguishing systems onboard objects is prohibited.