RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

Part D Machinery Installations

Rules for the Survey and Construction of Steel Ships
Part D 2021 AMENDMENT NO.2
Guidance for the Survey and Construction of Steel Ships
Part D 2021 AMENDMENT NO.2

Rule No.61 / Notice No.58 27 December 2021
Resolved by Technical Committee on 28 July 2021

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NIPPON KAIJI KYOKAI

An asterisk (*) after the title of a requirement indicates that there is also relevant information in the corresponding Guidance.

RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

RULES

Part D Machinery Installations

2021 AMENDMENT NO.2

Rule No.61 27 December 2021

Resolved by Technical Committee on 28 July 2021

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Rule No.61 27 December 2021
AMENDMENT TO THE RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

"Rules for the survey and construction of steel ships" has been partly amended as follows:

Part D MACHINERY INSTALLATIONS

Amendment 2-1

Chapter 13 PIPING SYSTEMS

13.2 Piping

13.2.5 Bulkhead Valves*

Sub-paragraph -2 has been amended as follows.

2 Pipes passing through collision bulkheads are to be in accordance with the following **(1)** or **(2)**:

(1) ~~Pipes passing through collision bulkheads are to be fitted with the~~ A suitable screw-down valves or butterfly valves suitably supported by a seat or flanges that are operable from above the freeboard deck are to be fitted with and valve chests are to be secured to a bulkhead located inside the forepeak. However, these valves may be fitted on the aft side of the collision bulkhead in question provided that the valves are readily accessible under all service conditions, and that the space in which they are located is not a cargo space. Remote control devices for these valves may be omitted.

(2) Notwithstanding **(1)** above, in case where deemed appropriate by the Society, a remotely controlled valve capable of being operated from above the freeboard deck is to be fitted. The valve is to be normally closed. If the remote control system failure during operation of the valve, the valve is to be close automatically or be capable of being closed manually from a position above the freeboard deck. The valve may be located at the collision bulkhead on either the forward or aft side, provided the space on the aft side is not a cargo space.

EFFECTIVE DATE AND APPLICATION (Amendment 2-1)

1. The effective date of the amendments is 27 December 2021.

Amendment 2-2

Chapter 1 GENERAL

1.3 General Requirements for Machinery Installations

1.3.5 Ventilating Systems for Machinery Spaces*

Sub-paragraph -2 has been amended as follows.

2 In cases where ventilation louvers with means for closure are fitted to emergency generator rooms ~~or~~ and closing appliances are fitted to ventilators serving emergency generator rooms, such louvers or closing appliances are to comply with the requirements specified in the following **(1)** to **(4)**:

(1) Louvers and closing appliances may either be hand-operated or power-operated (hydraulic, pneumatic or electric) and are to be operable under fire conditions.

(2) Hand-operated louvers and closing appliances are to ~~comply with the following **(a)** and **(b):**~~
   ~~(a) Louvers and closing appliances are to~~ be kept open during normal operation of the vessel~~; and~~.
   ~~(b)~~ In addition, ~~C~~corresponding instruction plates are to be provided at the location where hand-operation is provided.

(3) Power-operated louvers and closing appliances are to ~~comply with the following **(a)** to **(c):**~~
   ~~(a) Louvers and closing appliances are to~~ be of a fail-to-open type~~;~~.
   ~~(b)~~ However, ~~C~~closed power-operated louvers and closing appliances are acceptable during normal operation of the vessel~~; and~~.
   ~~(c)~~ Power-operated louvers and closing appliances are to open automatically whenever the emergency generator is starting or in operation.

(4) Ventilation openings~~, louvers and closing appliances~~ with means for closure are to ~~comply with the following **(a)** to **(c):**~~
   ~~(a) It is to~~ be possible to close ~~ventilation openings~~ by a manual operation from a clearly marked safe position outside the space where the closing operation can be easily confirmed~~;~~.
   ~~(b)~~ In addition, ~~T~~the louver status (open or closed) is to be indicated at ~~the~~ this position ~~of the manual operation specified in **(a)** above; ~~,and
   ~~(c) Closing~~ the closing of ~~the~~ louvers and closing appliances is not to be possible from any ~~other~~ remote position other than ~~the~~this position ~~of manual operation specified in **(a)** above~~.

EFFECTIVE DATE AND APPLICATION (Amendment 2-2)

1. The effective date of the amendments is 1 January 2022.

2. Notwithstanding the amendments to the Rules, the current requirements may apply to ships for which the date of contract for construction* is before the effective date.

* "contract for construction" is defined in the latest version of IACS Procedural Requirement (PR) No.29.

IACS PR No.29 (Rev.0, July 2009)

1. The date of "contract for construction" of a vessel is the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. This date and the construction numbers (i.e. hull numbers) of all the vessels included in the contract are to be declared to the classification society by the party applying for the assignment of class to a newbuilding.

2. The date of "contract for construction" of a series of vessels, including specified optional vessels for which the option is ultimately exercised, is the date on which the contract to build the series is signed between the prospective owner and the shipbuilder.

For the purpose of this Procedural Requirement, vessels built under a single contract for construction are considered a "series of vessels" if they are built to the same approved plans for classification purposes. However, vessels within a series may have design alterations from the original design provided:

(1) such alterations do not affect matters related to classification, or

(2) If the alterations are subject to classification requirements, these alterations are to comply with the classification requirements in effect on the date on which the alterations are contracted between the prospective owner and the shipbuilder or, in the absence of the alteration contract, comply with the classification requirements in effect on the date on which the alterations are submitted to the Society for approval.

The optional vessels will be considered part of the same series of vessels if the option is exercised not later than 1 year after the contract to build the series was signed.

3. If a contract for construction is later amended to include additional vessels or additional options, the date of "contract for construction" for such vessels is the date on which the amendment to the contract, is signed between the prospective owner and the shipbuilder. The amendment to the contract is to be considered as a "new contract" to which **1.** and **2.** above apply.

4. If a contract for construction is amended to change the ship type, the date of "contract for construction" of this modified vessel, or vessels, is the date on which revised contract or new contract is signed between the Owner, or Owners, and the shipbuilder.

Note:
This Procedural Requirement applies from 1 July 2009.

Amendment 2-3

Chapter 2 RECIPROCATING INTERNAL COMBUSTION ENGINES

2.1 General

2.1.1 General*

Sub-paragraph -4 has been deleted.

~~**4** Electronically-controlled engines which are used as the main propulsion machinery are to be in accordance with the requirements specified otherwise by the Society in addition to those in this Chapter.~~

~~**5**~~**4** (Omitted)

~~**6**~~**5** (Omitted)

~~**7**~~**6** (Omitted)

2.1.2 Terminology*

Sub-paragraph -3 has been renumbered to Sub-paragraph -4, and Sub-paragraph -3 has been added as follows.

3 For electronically-controlled engines, the terminology is as specified in the following **(1)** to **(10)**:

(1) "Electronically-controlled engines" are engines whose fuel injection and/or Exhaust valve operation etc. are electronically controlled.

(2) "Accumulators" are small pressure vessels fitted to cylinders which provide hydraulic oil to those actuators attached to fuel injection devices or exhaust valve driving gears.

(3) "Common accumulators" are pressure vessels common to all cylinders for providing hydraulic oil or pressurized fuel oil.

(4) "Control valves" are components to control the delivery of hydraulic oil to drive actuators. The name control valve is generic for on-off-controlled solenoid valves, proportional-controlled valves or variable-controlled valves, etc.

(5) "Fuel oil pressure pumps" are pumps which provide pressurized fuel oil for common accumulators.

(6) "Hydraulic oil pressure pumps" are pumps to provide hydraulic oil for equipment, e.g. fuel injection devices, exhaust valve driving gears or control valves, through common accumulators.

(7) "Functional blocks" are blocks used to classify by function all items making up whole systems into the groups of systems, sub-systems, components, assemblies and parts.

(8) "Reliability block diagrams" are logical figures showing the relationship between functional blocks on an analytic level.

(9) "Normal operation" of main propulsion machinery means those operations at normal out-put conditions, using governors and all safety devices.

(10) "High-pressure" piping means piping in the down-stream of fuel oil pressure pumps or hydraulic oil pressure pumps.

~~**3**~~**4** (Omitted)

2.2 Materials, Construction and Strength

2.2.2 Construction, Installation and General*

Sub-paragraph -8 has been added as follows.

8 Essential components are to be so arranged that normal operation of main propulsion machinery is capable of being sustained or restored even though one of these components becomes inoperable, except in cases where special consideration and approval is given by the Society to the reliability of single arrangements. Single components provided for cylinders, which do not require a spare, may be acceptable in cases where any failed parts can be isolated.

2.5 Associated Installations

Paragraphs 2.5.7 to 2.5.11 have been added as follows.

2.5.7 Control Valves for Electronically-controlled Engines which are used as the Main Propulsion Machinery

1 Control valves are to be capable of retaining their expected ability to function properly for a period of time set by manufacturers.

2 Control valves are to be independently provided for each function (e.g. fuel injection, exhaust valve driving).

3 Means are to be provided to prevent fuel oil from continuously flowing into cylinders due to control valve failure.

2.5.8 Accumulators and Common Accumulators for Electronically-controlled Engines which are used as the Main Propulsion Machinery

1 Accumulators and common accumulators are to comply with the requirements in **Chapter 10**. However, notwithstanding this requirement, materials and non-destructive tests as well as surface inspections and dimension inspections are to be in accordance with **Table D2.1** and hydrostatic tests are to be in accordance with **Table D2.7**.

2 Accumulators are to be capable of retaining their expected ability to function properly for a period of time set by manufacturers.

3 In principle, at least two common accumulators are to be provided. However, in cases where results of fatigue analysis upon fluctuating stress are submitted and approved by the Society, a single arrangement may be acceptable.

2.5.9 Fuel Oil Piping Systems and Hydraulic Oil Piping Systems for Electronically-controlled Engines which are used as the Main Propulsion Machinery

1 At least two fuel oil pressure pumps and hydraulic oil pressure pumps are to be provided for their respective lines and are to be capable of supplying a sufficient amount of oil at the maximum continuous output of main propulsion machinery. In such cases, even though a single one of these pumps may become inoperable, the remaining pumps are to be capable of supplying a sufficient amount of fuel under normal service conditions. In cases where one or more of these pumps are provided as a stand-by pump, the pumps are to always be connected and ready for use.

2 Piping arrangements from fuel oil pressure pumps to the fuel injection devices and from hydraulic oil pressure pumps to exhaust valve driving gears are to be protected with jacketed piping systems or oil tight enclosures, to prevent any spread of oil from igniting.

3 Two common piping arrangements from fuel oil pressure pumps or a hydraulic oil pressure pumps to common accumulators, from one common accumulator to another common accumulator

and from common accumulators to those positions where distribution to cylinders are to be respectively provided. In cases where results of fatigue analysis upon fluctuating stress are submitted and approved by the Society, a single arrangement may be acceptable.

4 Valves or cocks provided on piping connected to equipment, e.g. accumulators or pumps, are to be located as close to such equipment as practicable.

5 In high-pressure piping, high-pressure alarms are to be provided. Relief valves are also to be provided at proper positions, so as to lead any released oil to lower-pressure sides.

6 In cases where pressure gauges using bourdon-tubes are provided in high-pressure piping, such gauges are to be ones that comply with recognized industrial standards, e.g. *JIS*, and be vibration-proof and heat-resistant types.

2.5.10 Electronic Control Systems for Electronically-controlled Engines which are used as the Main Propulsion Machinery

1 Systems are to be so arranged that the function of an entire system is capable of being sustained or restored in cases where there is a single failure in any equipment part or circuit.

2 Controllers for systems are to comply with the following:

(1) At least two main controllers which are integrated to control every function, e.g. fuel injection, exhaust valve drive, cylinder lubrication and supercharge, are to be provided.

(2) Notwithstanding the requirement in **(1)** above, a single main controller may be acceptable, in cases where normal operation of main propulsion machinery is available by using control systems independent from main controllers.

3 At least two sensors essential for the operation of main propulsion machinery, e.g. for the following uses, are to be independently provided. In cases where normal operation of main propulsion machinery is available without any feedback from such sensors, single arrangements may be acceptable.

(1) Number of revolutions

(2) Crank angles

(3) Fuel pressure in common accumulators

4 Power for control systems is to be supplied from two independent sources, one of which is to be supplied from a battery, and through two independent circuits.

5 Power for driving solenoid valves is to be supplied from two independent sources, and through two independent circuits.

6 Electronic-control systems of main propulsion machinery which comply with the requirements given in **-1** through **-5** above are regarded as the same as those which comply with the following requirements.

(1) **18.2.4-5(1)**

(2) **18.3.2-3(3)**

2.5.11 Failure Mode Effect Analysis for Electronically-controlled Engines which are used as the Main Propulsion Machinery

Failure Mode Effect Analysis (FMEA) is to be carried out, for electronic control systems, in order to confirm that any one equipment or circuits in such systems which lose function may not cause any malfunction or deterioration in other equipment or circuits, in accordance with the following:

(1) Systems are to be divided into functional blocks and drawn out in reliability block diagrams in which such functional blocks are systematically organized.

(2) Analytic levels are to be sufficient up to the extent of those functional blocks regarding sub-systems and components.

(3) FMEA results are to be created in table form as shown in **Table D2.6** or be of equivalent forms thereto.

(4) If FMEA results show that corrective action is demanded, then FMEA is to be carried out again after the corrective action to confirm the effectiveness of the corrective action.
(5) For failure modes, every possible failure from minor to catastrophic is to be considered.

Table D2.6 has been renumbered to Table D2.7, and Table D2.6 has been added as follows.

Table D2.6 Failure Mode Effect Analysis Table for Electronically-controlled Engines which are used as the Main Propulsion Machinery

Systems					Elements								
ID Number	Component	Subsystem	Operating mode	Failure mode	Failure cause	Failure detection Means	Alarm / Notification Means	Effect of failure			Failure severity	Corrective action	Remarks
								On component	On subsystem	On system			

Examples of Operating Mode: ack-up operations, fuel cost priority operations, NOx reduction operations, etc.
Examples of Failure Mode: piston pin stuck, connecting rod broken, lubricating oil leaked out, etc. (Failed parts are to be shown.)
Failure Severity:
(a) Catastrophic: loss of complete function, explosion, loss of life (Design change is to be compulsory.)
(b) Major: loss or deterioration of part of the ability to function properly (Possible design change is to be investigated.)
(c) Minor: negligible affect on ability to function properly (Design change may not be required.)

2.6 Tests

2.6.1 Shop Tests*

Sub-paragraph -1 has been amended as follows.

1 For components or accessories specified in **Table D2.~~6~~7**, hydrostatic tests are to be carried out on the water or oil side of the component at the pressures shown in the Table. In cases deemed necessary by the Society, tests may also be required for any components not specified in **Table D2.~~6~~7**.

Table D2.~~6~~7 Hydrostatic Test Pressure
(Table is omitted.)

Chapter 18 AUTOMATIC AND REMOTE CONTROL

18.1 General

18.1.1 Scope*

Sub-paragraph -3 has been amended as follows.

3 Computer based systems, including the hardware and software which constitute such systems, are to be in accordance with ~~requirements specified otherwise by the Society~~ **Annex 18.1.1** in addition to those specified in **-1** and **-2** above and throughout the rest of this chapter for design, construction, commissioning, maintenance, etc.

18.1.3 Drawings and Data*

Sub-paragraphs (1) and (2) have been amended as follows.

Drawings and data to be submitted are generally, as follows. In cases where the Society deems it to be necessary, the submission of drawings and data other than those specified below may be requested.

(1) Drawings and data for approval

((a) to (e) are omitted.)

(f) Drawings and data ~~deemed necessary by the Society~~ listed in **1.2(1), Annex 18.1.1** for computer based systems specified in **18.1.1-3.** With respect to computer based systems which have been already approved by the Society in accordance with **Chapter 8, Part 7 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**, only drawings and data on parts that differ from ship to ship need to be submitted.

(2) Drawings and data for reference

Drawings and data ~~deemed necessary by the Society~~ listed in **1.2(2), Annex 18.1.1** for computer based systems specified in **18.1.1-3.** With respect to computer based systems which have been already approved by the Society in accordance with **Chapter 8, Part 7 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**, only drawings and data on parts that differ from ship to ship need to be submitted; this, however, excludes those specified in **1.2(2)(a)** of the Annex.

Chapter 24 SPARE PARTS, TOOLS AND INSTRUMENTS

Table D24.1 has been amended as follows.

Table D24.1 Spare Parts for Reciprocating Internal Combustion Engines Used as Main Propulsion Machinery

Item	Spare parts	Number required
Main bearings	(Omitted)	(Omitted)
Cylinder liner		
Cylinder cover		
Cylinder valves		
Connecting rod bearings		
Pistons		
Piston rings		
Pistons cooling devices		
Chain for camshaft drives		
Cylinder lubricator		
Fuel injection pumps		
Fuel injection piping		
Scavenge blowers (including turbo chargers)		
Scavenging system		
Reduction and or reversing gear		
Gaskets and packings		
Parts for electronically-controlled engines	Control valves	1 of each type
	Accumulator diaphragms	2 of each type
	Sensors provided for each cylinder *Note: Spare parts may be omitted in cases where normal operation of main propulsion machinery is available without these sensors.	1 of each type*

Note:
The spare parts for scavenge blowers (including turbo chargers) may be omitted where it has been demonstrated, at the builder's test bench, for one engine of the type concerned, that the engine can be manoeuvred satisfactorily with one blower out of action. However, in this case the requisite blanking and blocking arrangements for running with one blower out of action are to be available on board.

Annex 18.1.1 has been added as follows.

Annex 18.1.1 COMPUTER BASED SYSTEMS

Chapter 1 INTRODUCTION

1.1 General

1.1.1 Scope

The requirements in this annex apply to computer based systems, including the hardware and software which constitute such systems, in accordance with **18.1.1-3, Part D of the Rules**.

1.1.2 References

For the purpose of application of this annex, the following identified standards may be used for the development of hardware/software of computer based systems. Other industry standards, however, may also be considered.

(1) *IEC* 61508 "Functional safety of electrical/electronic/programmable electronic safety-related systems"
(2) *ISO/IEC* 12207 "Systems and software engineering - Software life cycle processes"
(3) *ISO* 9001:2008 "Quality Management Systems – Requirements"
(4) *ISO/IEC* 90003 "Software engineering - Guidelines for the application of *ISO* 9001:2008 to computer software"
(5) *IEC* 60092-504 "Electrical installations in ships - Part 504: Special features - Control and instrumentation"
(6) *ISO/IEC* 25000 "Systems and software engineering - Systems and software Quality Requirements and Evaluation (SQuaRE) - Guide to SQuaRE"
(7) *ISO/IEC* 25041 "Systems and software engineering - Systems and software Quality Requirements and Evaluation (SQuaRE) - Evaluation guide for developers, acquirers and independent evaluators"
(8) *IEC* 61511 "Functional safety - Safety instrumented systems for the process industry sector"
(9) *ISO/IEC* 15288 "Systems and software engineering - system life cycle process"

1.2 Submission of Drawings and Data

The following drawings and data are, in principle, to be submitted. In cases where deemed necessary by the Society, other drawings and data may be required. However, no submission is required for category I systems unless it is specifically requested by the Society.

(1) Drawings and data for approval:
  (a) Documents related to quality management;
    i) Documents showing satisfaction of a quality system (**3.1.1-2**)
    ii) Quality plan (**3.1.1-3**)
    iii) Documents related to security policies (**3.4.1-1**)
  (b) Test programs and procedures for intra-system integration testing (**3.1.3**);
  (c) Test program for simulation tests for final integration (**3.1.5-1**);
  (d) Test program for on board tests (includes tests related to wireless data links) (**3.1.5-2** and **5.2.2(3)**); and
  (e) Test reports of environmental tests specified in **18.7.1(1), Part D of the Rules** or a certificate issued in accordance with **Chapter 1, Part 7 of the Guidance for the**

Approval and Type Approval of Materials and Equipment for Marine Use (**3.1.4** and **Chapter 4**).

(2) Drawings and data for reference:

(a) List of computer based systems installed on board;

(b) Risk assessment report or justification for the omission of risk assessment (**3.1.2**);

(c) Documents related to software code creation and testing, etc.:

i) Software module functional descriptions and associated hardware descriptions for programmable devices

ii) Evidence of verification (detection and correction of software errors) for software modules in accordance with the selected software development standard

iii) Evidence of functional tests for programmable devices at the software module, subsystem, and system levels (The functional testing is to be designed to test the provisions of features used by the software but provided by the operating system, function libraries, customized layer of software and any set of parameters.)

iv) Functional description of software

v) List and versions of software installed in system

(d) other drawings and data concerning systems such as the following:

i) User manual including instructions for use during software maintenance

ii) List of interfaces between system and other vessel systems

iii) List of standards used for data links

1.3 Omission of Surveyor Attendance during Testing

For category I systems, the presence of the Surveyor at the tests specified in this Annex may be omitted.

Chapter 2 DEFINITIONS

2.1 Stakeholders

2.1.1 Owner

The owner is responsible for contracting the system integrator and/or suppliers regarding the provision of a hardware system, including software, according to the owner's specification. The owner may be the "ship builder integrator" (builder or shipyard) during initial construction. After vessel delivery, the owner may delegate some responsibilities to the vessel operating company.

2.1.2 System Integrator

At ship construction, the role of the system integrator is to be taken by the shipyard unless an alternative organization is specifically contracted or assigned this responsibility.

The system integrator is responsible for the integration of systems and products provided by suppliers into the system subject to the requirements specified herein and for providing the integrated system. The system integrator may also be responsible for integration of the systems in the vessel.

If there are multiple parties performing system integration at any one time, then a single party is to be responsible for overall system integration and coordinating the integration activities. If there are multiple stages of integration, then different system integrators may be responsible for the specific stages of integration; in such cases, however, a single party is to be responsible for defining and coordinating all of the stages of integration.

2.1.3 Supplier

The supplier is any contracted or subcontracted provider of system components or software under the coordination of the system integrator or shipyard. The supplier is responsible for providing software, programmable devices, sub-systems or systems to the system integrator. The supplier is to provide a description of the software functionality which meets the owner's specification, applicable international and national standards, and the requirements specified herein.

2.2 Objects

2.2.1 Object Definitions

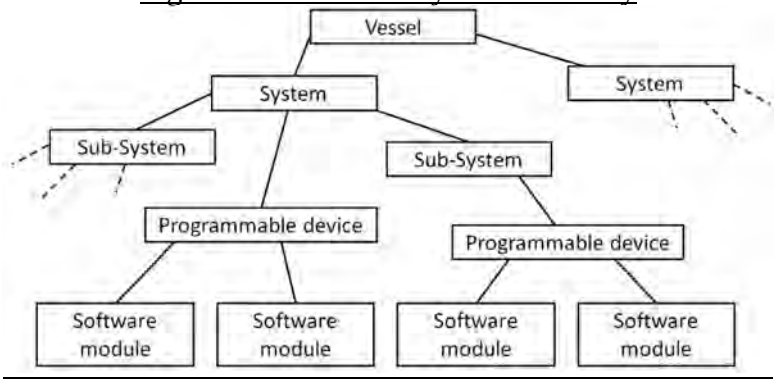
1 **Fig. 2.1** shows the hierarchy and relationships of a typical computer based system.

2 "Vessel" is the ship or offshore unit where the system is to be installed.

3 "System", "sub-system" and "programmable device" are as specified in **18.1.2, Part D of the Rules**.

4 "Software module" is a standalone piece of code which provides specific and closely coupled functionality.

Fig. 2.1 Illustrative system hierarchy



2.2.2 System Categories

Systems are typically assigned category I, II or III as shown in **Table 2.1** based upon their effect upon system functionality. The exact category, however, is dependent upon the risk assessment for all operational scenarios.

Table 2.1 System categories

Category	Effects	Typical system functionality
I	Those systems, failure of which will not lead to dangerous situations for human safety, safety of the vessel and/or threat to the environment.	- Monitoring function for informational or administrative tasks
II	Those systems, failure of which could eventually lead to dangerous situations for human safety, safety of the vessel and/or threat to the environment.	- Alarm and monitoring functions - Control functions which are necessary to maintain the vessel in its normal operational and habitable conditions
III	Those systems, failure of which could immediately lead to dangerous situations for human safety, safety of the vessel and/or threat to the environment.	- Control functions for maintaining the vessel's propulsion and steering - Vessel safety functions

Notes:

1 The following systems typically belong to Category III:

(1) vessel propulsion systems, which is defined as the means to generate and control mechanical thrust in order to move the vessel (devices used only during maneuvring, such as bow tunnel thrusters, do not fall under the scope of this requirement);

(2) steering system control systems;

(3) electric power systems (including power management system);

(4) vessel safety systems covering fire detection and fighting, flooding detection and fighting, internal communication systems involved in evacuation phases, vessel systems involved in operation of life saving appliances equipment;

(5) dynamic positioning systems of equipment classes 2 and 3 according to *IMO MSC/Circ.*645, as amended;

(6) drilling systems; and

(7) other systems deemed necessary by the Society.

2 The following systems typically belong to Category II:

(1) liquid cargo transfer control systems,

(2) bilge level detection and associated pump control systems,

(3) fuel oil treatment systems,

(4) ballast transfer valve remote control systems,

(5) stabilization and ride control systems,

(6) alarm and monitoring systems for propulsion systems, and

(7) other systems deemed necessary by the Society.

2.3 Other Terminology

2.3.1 Simulation Tests

"Simulation test" is a control system testing where the equipment under control is partly or fully replaced with simulation tools, or where parts of the communication network and lines are replaced with simulation tools.

Chapter 3 REQUIREMENTS FOR SOFTWARE AND SUPPORTING HARDWARE

3.1 Life Cycle Approach

A global top-to-bottom approach is to be undertaken regarding software and its integration into a system, spanning the software lifecycle. This approach is to be accomplished according to software development standards as listed herein or other standards recognized by the Society.

3.1.1 Quality System

1 System integrators and suppliers are to operate a quality system regarding software development and testing and associated hardware such as *ISO* 9001 taking into account *ISO* 90003.

2 Satisfaction of the requirement specified in **-1** above is to be demonstrated through either of the following **(1)** or **(2)**:

(1) The quality system being certified as compliant to the recognized standard by an organization with accreditation under a national accreditation scheme, or

(2) The quality system being confirmed compliance with a recognized standard by the Society through a specific assessment.

3 The quality system specified in **-1** above is to include a quality plan documenting the items listed in the following **(1)** to **(4)**:

(1) Relevant procedures regarding responsibilities, system documentation, configuration management and competent staff.

(2) Relevant procedures regarding software lifecycle and associated hardware. These procedures are to include the following **(a)** to **(c)**:
   (a) the organization set in place for acquisition of related hardware and software from suppliers,
   (b) the organization set in place for software code writing and verification, and
   (c) the organization set in place for system validation before integration in the vessel.

(3) For category II and III systems, the information specified in the following **(a)** to **(c)**:
   (a) Specific procedures for verification of software code at the level of systems, sub-systems and programmable devices and modules,
   (b) Drawings and data submitted for the Society and tests witnessed by the Surveyor, and
   (c) Specific procedures for software modification and installation on board the vessel defining interactions with owners.

(4) Relevant procedures regarding application of the quality management system for the specific computer based system.

3.1.2 Design Phase

Risk assessments of systems are to be according to the following **(1)** to **(4)**:

(1) This step is to be undertaken to determine the risks to the system throughout its lifecycle by identifying and evaluating the hazards associated with each function of the system. A risk assessment report is to be submitted to the Society in cases where deemed necessary by the Society.
   This document is normally to be submitted by the system integrator or the supplier, and is to include any data coming from other suppliers.

(2) *IEC/ISO* 31010 “Risk management - Risk assessment techniques” may be applied in order to determine the method of risk assessment. The method of risk assessment is to be agreed to by the Society.

(3) Based upon the risk assessment, a revised system category may need to be agreed upon by the Society and the system supplier.

(4) In cases where the risks associated with a computer based system are well understood, it is permissible for the risk assessment to be omitted; in such cases, however, the supplier or the system integrator is to provide a justification for the omission. The justification is to give consideration to the following **(a)** to **(c)**:

(a) How the risks are known.

(b) The equivalence of the context of use of the current computer based system and the computer based system initially used to determine the risks.

(c) The adequacy of existing control measures in the current context of use.

3.1.3 Integration Testing before Installation On Board

1 Intra-system integration testing is to be done between system and sub-system software modules before being integrated on board. The objective is to check the following **(1)** to **(3)**:

(1) the software functions are properly executed,

(2) the software and the hardware it controls interact and function properly together, and

(3) the software systems react properly in the case of failures.

2 Faults are to be simulated as realistically as possible to demonstrate appropriate system fault detection and system response. The results of any required failure analysis are to be observed.

3 Functional and failure testing may be demonstrated by simulation tests.

4 Category II and III systems are to comply with the following **(1)** to **(3)** in addition to the requirements in **-1** to **-3** above:

(1) Test programs and procedures for functional tests and failure tests are to be submitted to the Society. A FMEA may be requested by the Society in order to support containment of failure tests programs.

(2) Factory acceptance test including functional and failure tests is to be witnessed by the Society.

5 In applying **-1** to **-4** above, the tests are to be carried out when the computer based system acquires approval of use in accordance with **Chapter 1, Part 7 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use** or for each product.

3.1.4 Approval of Programmable Devices for Category II and III Systems

1 Approval is to be granted on a case-by-case basis, except in cases where the programmable device has received approval of use in accordance with the requirements specified in **Chapter 1, Part 7 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**.

2 The application for the approval of a programmable device integrated inside a system is to be made by the system integrator or supplier.

3 With respect to **-1** above, documentation for approval is recommended to address the information specified in the following **(1)** to **(3)**:

(1) the compatibility of the programmable device in the vessel's application

(2) the necessity to have on board tests during vessel integration, and

(3) the components of the systems using the approved programmable device.

3.1.5 Final Integration and On Board Testing

1 For computer based systems integrated with other computer based systems, simulation tests are to be undertaken before installation in cases where it is found necessary to check safe interaction with the other computer based systems and functions which are unable to be previously tested.

2 On board tests are to check whether a computer based system in its final environment and which is integrated with all other systems with which it interacts is as follows:

(1) performing the functions for which it was designed,

(2) reacting safely in the case of failures originating internally or by devices external to the system, and

(3) interacting safely with other systems implemented into on board systems.

3 In applying the requirements specified in **-1** and **-2** above, for category II and III systems, the following requirements are to be applied:
(1) Test specifications are to be submitted to the Society for approval.
(2) The tests are to be witnessed by a surveyor assigned by the Society.

3.2 Limited Approval

3.2.1 General

1 Sub-systems and programmable devices may be approved by the Society for limited applications with service restrictions in cases where the vessel systems in which they will be integrated into is not known. In such cases, sub-systems and programmable devices may be granted limited approval mentioning the required checks and tests performed.
2 In cases specified in **-1** above, requirements about quality systems specified in **3.1.1** may need to be satisfied as deemed necessary by the Society. Additional drawings, details, tests reports and surveys related to the standard declared by the supplier may be required by the Society upon request.

3.3 Modifications during Operation

3.3.1 Responsibilities

1 Organizations in charge of software modifications are to be clearly identified by owner to the Society.
2 A system integrator is to be designated by the owner as appropriate and is to satisfy the requirements specified in **3.1**.
3 Limited life cycle steps may be considered for modifications already considered and accepted in the scope of initial approval.
4 The level of documentation necessary to be provided for modifications is to be determined by the Society on a case-by-case basis.
5 At the vessel level, it is the responsibility of the owner to manage traceability of modifications. For category II and III systems, the software registry which contains the following **(1)** and **(2)** is to be updated. The achievement of this responsibility may be supported by system integrators updating the software registry:
(1) the lists and versions of software installed in systems, and
(2) the results of the security scans as described in **3.4.1-3**.

3.3.2 Change Management

1 The owner is to ensure that necessary procedures for software and hardware change management exist on board, and that any software modifications or upgrades are performed according to the procedures.
2 All changes to computer based systems in the operational phase are to be recorded and be traceable.

3.4 System Security

3.4.1 General

1 Owners, system integrators and suppliers are to adopt security policies and include these in their quality systems and procedures.
2 Physical and logical security measures are to be in place to prevent unauthorized or unintentional modification of software, whether undertaken at the physical system or remotely.

3 Prior to installation, all artefacts (intermediate work products produced during the development of software), software code, executables and the physical medium used for installation on the vessel are to be scanned for viruses and malicious software. Results of the scan are to be documented and kept with the software registry.

Chapter 4 REQUIREMENTS FOR HARDWARE REGARDING ENVIRONMENT

4.1 General

Environmental tests for hardware, which includes systems and/or sub-systems, are to comply with the requirements specified in **18.7.1(1), Part D of the Rules**. However, this requirement is not mandatory for category I systems.

Chapter 5 REQUIREMENTS FOR DATA LINKS

5.1 Requirements for Data Links

5.1.1 General Requirements

1 The requirements of this chapter apply to category II and III systems, unless otherwise specified.

2 Loss of a data link is to be specifically addressed in risk assessment analysis.

3 A single failure in data link hardware is to be automatically treated in order to restore proper working of system. For category III systems, a single failure in data link hardware is not to influence the proper working of the system.

4 Characteristics of data links are to prevent overloading in any operational condition of system.

5 Data links are to be self-checking, detecting failures on the link itself and data communication failures on nodes connected to the link. Detected failures are to initiate an audible and visual alarm.

5.2 Specific Requirements for Wireless Data Links

5.2.1 Requirements for Category III Systems

Category III systems are not to use wireless data links unless specifically considered by the Society on the basis of an engineering analysis carried out in accordance with an international or national standard acceptable to the Society.

5.2.2 Requirements for Category II Systems

Category II systems may use wireless data links in accordance with the following **(1)** to **(3)** requirements:

(1) Recognised international wireless communication system protocols incorporating the following **(a)** to **(d)** are to be employed:

(a) Message integrity

Fault prevention, detection, diagnosis, and correction so that the received message is not corrupted or altered when compared to the transmitted message.

(b) Configuration and device authentication

Only connection of devices included in the system design are to be permitted.

(c) Massage encryption

Protection of the confidentiality and or criticality of the data content.

(d) Security management

Protection of network assets, prevention of unauthorized access to network assets.

(2) The internal wireless system within the vessel is to comply with the radio frequency and power level requirements of the International Telecommunication Union and flag state requirements.

(3) For wireless data communication equipment, tests during harbour and sea trials are to be conducted to demonstrate the following **(a)** and **(b)**:

(a) Radio-frequency transmission does not cause failure of any equipment during expected operations.

(b) Radio-frequency transmission does not cause itself to fail as a result of electromagnetic interference during expected operating conditions during expected operations.

EFFECTIVE DATE AND APPLICATION (Amendment 2-3)

1. The effective date of the amendments is 1 January 2022.

Amendment 2-4

Chapter 9 BOILERS, ETC. AND INCINERATORS

9.1 General

Paragraph 9.1.1 has been amended as follows.

9.1.1 Scope

1 The requirements in this Chapter apply to ~~boilers excluding those given in the following **(1)** and **(2)**, thermal oil heaters and incinerators:~~ the following.

(1) Boilers (excluding the following **(a)** and **(b)**)

(~~1~~a) Steam boilers with a design pressure not exceeding 0.1 *MPa* and heating surface not exceeding 1 m^2

(~~2~~b) Hot water boilers with a design pressure not exceeding 0.1 *MPa* and heating surface not exceeding 8 m^2

(2) Thermal oil heaters

(3) Incinerators

2 The requirements in **9.11** may be applied to the boilers referred to in the preceding **-1(1)** with a design pressure not exceeding 0.35 *MPa* (hereinafter referred to as “small boilers”).

Paragraph 9.1.2 has been amended as follows.

9.1.2 Terminology

Terms used in this Part are defined as follows:

(1) “Boilers” are plants which generate steam or hot water by means of flame, combustion gases or other hot gases and include superheaters, reheaters, economizers and exhaust gas economizers, etc.

(2) “Main boiler” means boilers which supply steam to steam turbines used for the main propulsion of ships.

(~~2~~3) “Essential auxiliary boilers” are boilers which supply steam necessary for the operation of auxiliary machinery essential for main propulsion, auxiliary machinery for manoeuvring and safety as well as for generators.

(~~3~~4) “Exhaust gas boilers” are boilers which generates steam or hot water using only exhaust gases from reciprocating internal combustion engines, have independent steam spaces or hot wells and have outlets for steam or hot water.

(~~4~~5) “Exhaust gas economizers” are those equipment which generates steam or hot water using only exhaust gases from reciprocating internal combustion engines and do not have independent steam spaces or hot wells.

(~~5~~6) “Heating surfaces of boilers” are those areas calculated on combustion gas side surfaces where one side is exposed to combustion gas and the other side to water. Unless specified otherwise, the heating surfaces of superheaters, reheaters, economizers or exhaust gas economizers are excluded.

(~~6~~7) “Approved working pressures of boilers” and “nominal pressure of boilers with built-in superheaters” are as defined in **2.1.21** and **2.1.22, Part A**.

(~~7~~8) “Design pressures” are those pressure used in the calculations made to determine the scantlings of each component and are the maximum permissible working pressure of a component. Design pressures of boiler drums are not to be less than the approved working pressure of their respective boilers.

(9) “Fittings” are items directly attached (i.e. welded) to boilers (e.g. nozzles) as well as items not

directly attached but connected to the boilers (e.g. valve boxes (including safety valves) and water level gauges) that receive pressure.

(10) "End plates" means the plates that cover both ends of the shell.

(11) "Tube plates" means end plates to which smoke tubes are attached in the case of smoke tube boilers, or end plates to which water tubes are attached in the case of water tube boilers.

9.1.3 Drawings and Data to be Submitted*

Sub-paragraph (2) has been amended as follows.

Drawings and data to be submitted are generally as follows:

(1) Drawings (with materials and scantlings)
((a) to (k) are omitted.)

(2) Data
(a) Particulars of the boiler (design pressure, design temperature, maximum evaporation, heating surface, etc.)
((b) to (d) are omitted.)

9.3 Design Requirements

9.3.4 Boilers of Unusual Shape*

Sub-paragraph -1 has been amended as follows.

1 In cases where it is not practicable or reasonable to calculate the strength or to reinforce of the pressure receiving part of the boiler according to the requirements in **9.5** to **9.7** because the part is of an unusual shape, ~~another detailed method of~~ calculation ~~is~~ results by another detailed method or analysis results as deemed appropriate by the Society are to be used after receiving the approval of the Society. Based on the results of ~~this~~such calculation or analysis, the part may be considered to be in compliance with the requirements in **9.5** to **9.7**.

Paragraph 9.3.7 has been amended as follows.

9.3.7 Consideration for Soot Fire*

Consideration is to be given to prevent exhaust gas boilers and exhaust gas economizers, from being damaged by a soot fire.

9.5 Calculations of Required Dimensions of Each Member

9.5.5 Required Thickness of Flat End Plates and Cover Plates, etc., without Stays or Other Supports

Sub-paragraphs -1 and -2 have been amended as follows.

1 In cases where the flat end plates and cover plates without stays or other supports are welded to the shell plates, the required thickness is to be calculated by the following formulae:

(1) Circular plates

$$T_r = C_1 d \sqrt{\frac{P}{f}} + 1$$

(2) Non-circular plates

$$T_r = C_1 C_2 d \sqrt{\frac{P}{f}} + 1$$

where

C_1 : Constant shown in **Fig. D9.~~9~~11**

$C_2 = \sqrt{3.4 - 2.4\frac{d}{D'}}$, but need not be over 1.6.

d : Diameter shown in **Fig. D9.~~9~~11** (for circular plates), or the minimum length (for non-circular plates) (*mm*)

D' : Long span of non-circular end plates or covers measured perpendicular to the short span (*mm*)

2 In cases where the flat cover plates without stays are bolted to the shell plate, the required thickness is to be calculated by the following formulae:

(1) In cases where full face gaskets are used;

For circular plates

$$T_r = d \sqrt{\frac{C_3 P}{f}} + 1$$

For non-circular plates

$$T_r = d \sqrt{\frac{C_3 C_4 P}{f}} + 1$$

(2) In cases where moment due to gasket reaction is to be taken into account;

For circular plates

$$T_r = d \sqrt{\frac{C_3 P}{f} + \frac{1.78 W h_g}{f d^3}} + 1$$

For non-circular plates

$$T_r = d \sqrt{\frac{C_3 C_4 P}{f} + \frac{6 W h_g}{f L d^2}} + 1$$

where

C_3 : Constant determined by bolting methods as shown in **Fig. D9.1~~0~~1**

C_4 : $3.4 - 2.4\frac{d}{D'}$, but need not be over 2.5.

d : Diameter shown in **Fig. D9.1~~0~~2** (for circular plates), or minimum length (for non-circular plates) (*mm*)

D' : Long span of non-circular end plates or covers measured perpendicular to the short span (*mm*)

W : Mean load (*N*) of bolt loads necessary for the watertightness and allowable load of the bolt actually used

L : Total length of the circle passing through bolt centers (*mm*)

h_g : Arm length of moment due to the gasket reaction shown in **Fig. D9.1~~0~~2** (*mm*)

9.5.6 Required Thickness of Flat Plates with Stays or Other Supports*

Sub-paragraph -1 has been amended as follows.

1 The required thickness of flat plates, except tube nests supported by stays or stay tubes, is to be calculated by the following formula. In cases where gusset plates are used as supports instead of stays or stay tubes, they are to comply with standards deemed appropriate by the Society.

$$T_r = C_5 S \sqrt{\frac{P}{f}} + 1$$

where

C_5 : Constant determined by the fixing methods of the stays or stay tubes as given in **Table D9.3**. In cases where various fixing methods are used, the value C_5 is to be the mean of the constants for the respective methods.

S : In cases where the stays or stay tubes are arranged regularly, "*S*" is to be calculated by the following formula:

$$S = \sqrt{a^2 + b^2}(mm)$$

a : Horizontal pitch of stays or stay tubes (*mm*)

b : Vertical pitch of stays or stay tubes (*mm*).

In cases where stays or stay tubes are arranged irregularly, "*S*" is the diameter (*mm*) of the maximum circle drawn to pass through at least three supported points, but not including any supported point in the circle. However, in cases where the maximum circle drawn passes through only two supported points and there are no supported points located within the circle, the diameter (*mm*) of the maximum circle may be used as "*S*".

Paragraph 9.5.11 has been amended as follows.

9.5.11 Required Thickness of Furnace Foundation Ring Plates of Vertical Boilers

The required thickness of a furnace foundation ring plate (refer to **Fig. D9.~~9~~11(d)**(4)E) connecting the furnace bottom of a vertical boiler to the shell is to be calculated by the following formula:

$$T_r = 1.28\sqrt{DP}$$

where

D : Inside diameter of the shell (*mm*)

9.5.12 Required Diameter of Stays*

Sub-paragraph -2 has been amended as follows.

1 The required diameter of a stay is to be calculated by the following formula:

$$d = C\sqrt{PA} + 3$$

where

d : Required diameter of the stay (*mm*)

A : Net area supported by one stay (mm^2)

C : 0.13

2 In applying the formula in **-1** to diagonal stays, *C* in the formula is to be replaced by C_1 given by the following formula:

$$C_1 = 0.13\sqrt{\frac{L}{H}}$$

where

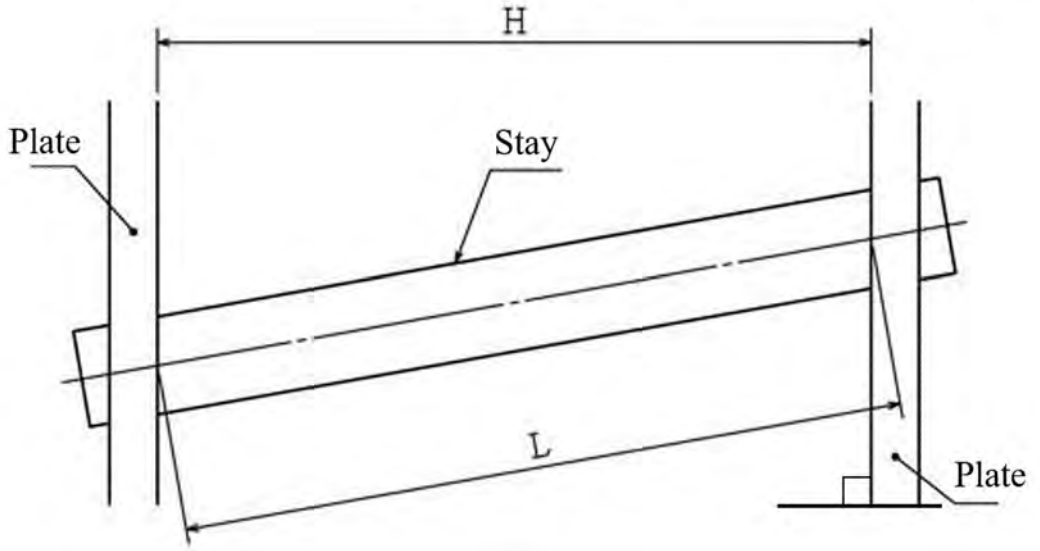
L : Length of the diagonal stay (*mm*) (refer to **Fig. D9.7)**

H : Equivalent length of the stays perpendicular to the support surface (*mm*) (refer to **Fig. D9.7)**

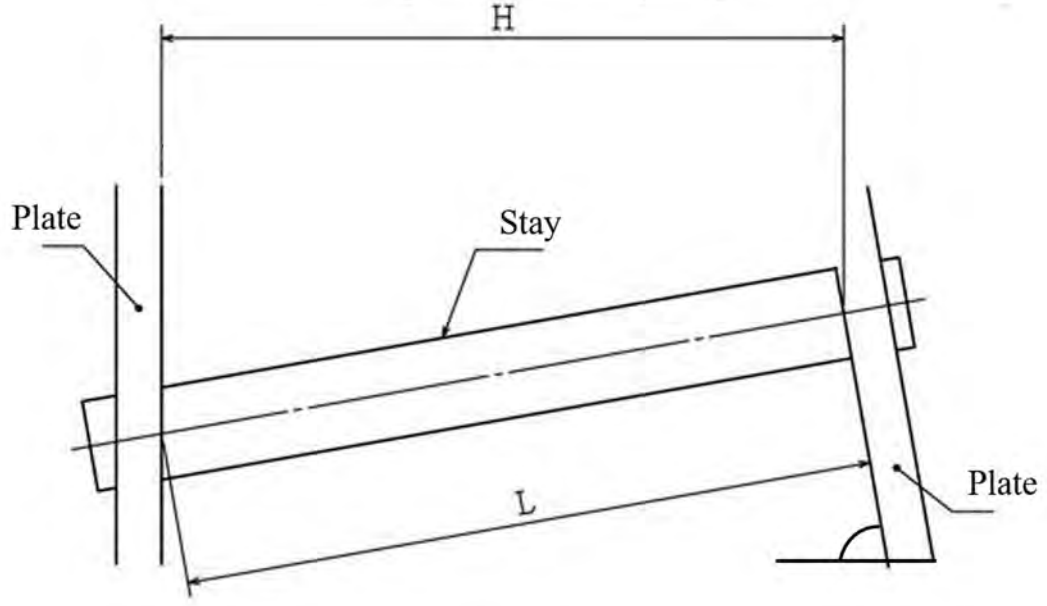
Fig. D9.7 and Fig. D9.8 have been renumbered to Fig. D9.8 and Fig. D9.9, and Fig. D9.7 has been added as follows.

Fig. D9.7 Corresponding Parts of L and H

(In cases where the ends of the plates are at right angles to the installation part)



(In cases where the ends of the plates are not at right angles to the installation part)



9.6 Manholes, Other Openings for Nozzles, etc. and their Reinforcements

9.6.1 Manholes, Cleaning Holes and Inspection Holes*

Sub-paragraph -4 has been added as follows.

1 Boilers are to be provided with manholes or cleaning holes of sufficient size at suitable positions, so that they permit easy access for the inspection and the maintenance. However, in cases where it is impractical to provide manholes or cleaning holes due to construction or dimension concerns, two or more inspection holes provided at positions suitable for internal inspection will be accepted as a substitute for them.
2 The construction of all manholes or cleaning holes is to comply with the following requirements in **(1)** to **(3)**:
(1) The minor axis of any oval manhole provided on the shell plate is to be parallel to the longitudinal direction of the drum.
(2) Internal type manhole covers are to be provided with a spigot which has a clearance of not more than 1.5 *mm* all-round.
(3) Covers are to have sufficient strength and be constructed so that the repetition of covering and uncovering does not to impair safety. In cases where covers are bolted shut, they are to be of such construction so that the breakage of a bolt will not cause any danger.
3 The inspection holes of headers are to be machine-finished so that all inspection hole covers can be effectively fitted.
4 In cases where flange openings on boiler drums are used as inspection holes, the pipes to be connected are to be ones that can be easily removed.

Paragraph 9.6.2 has been amended as follows.

9.6.2 Reinforcement of Openings

In cases where manholes, other openings for nozzles, etc. are provided in the shell, the openings are to be reinforced. However, this reinforcement may be omitted for any of the following single openings:
(1) Openings having a maximum diameter (in threaded openings, the diameter of the root) of not more than 60 *mm* or more than 1/4 of the inside diameter of the shell.
(2) Openings provided on the shell plate having a maximum diameter not exceeding the value given in **Fig. D9.~~7~~8**. In this case, unreinforced openings are not to exceed 200 *mm* in diameter.
(3) Openings provided on the end plate where no reinforcement is required due to the increased thickness of the end plates in compliance with the requirements in **9.5.3-2(3)**.
(4) Openings provided on the end plate or cover plate where the thickness of the end plate or cover plate is increased in accordance with the requirements in **9.6.3-3(2)**.

Fig. D9.~~7~~8 Maximum Diameter of Openings provided on the Shell for which Reinforcement may be Omitted
(Omitted.)

9.6.3 Reinforcing Procedures of Openings

Sub-paragraphs -3 and -4 have been amended as follows.

1 (Omitted)
2 (Omitted)
3 In cases where flat end plates or cover plates specified in **9.5.5** have openings, they are to

comply with the following:

(1) In cases where flat end plates or cover plates have openings with a diameter not exceeding one-half of the diameter for the circular plates or the minimum length (*d* shown in **Fig. D9.~~9~~11** and **Fig. D9.1~~0~~2**) for non-circular plates, the end plates or cover plates are to have a total cross sectional area of reinforcement not less than that calculated by the following formula:

$A_0 = 0.5 d_0 T_0$

(2) In cases where flat end plates or cover plates have openings with a diameter exceeding one-half of the diameter for the circular plates or the minimum length (*d* shown in **Fig. D9.~~9~~11**and **Fig. D9.1~~0~~2**) for non-circular plates, the thickness of end plates or cover plates is to be 1.5 *times* the required thickness specified in **9.5.5** except for the corrosion allowance.

4 Reinforcement is to be provided within its effective limit. The effective limit of reinforcement is the range on a vertical plane to the wall containing the centre of the opening that is enclosed by two lines along the wall and also by two lines parallel to the axis of the opening. The lengths of the four lines are as follows: (*See* **Fig. D9.~~8~~9**)

(1) (Omitted)

(2) (Omitted)

5 (Omitted)

6 (Omitted)

7 (Omitted)

Fig. D9.~~8~~9 Effective Limit of Reinforcement
(Omitted)

9.7 Tubes

9.7.1 Fitting of Tubes

Sub-paragraph -3 has been amended as follows.

1 Tubes are to be attached to the tube plate by expanding or another suitable method and the tubes are to project through the neck or belt of the parallel seating by not less than 6 *mm*, except for those attached by welding. In cases where the tube end is fitted by welding, consideration is to be given for preventing the deformation (thermal ratchet effect) of tubes due to tube-to-tube differentials in thermal expansion.

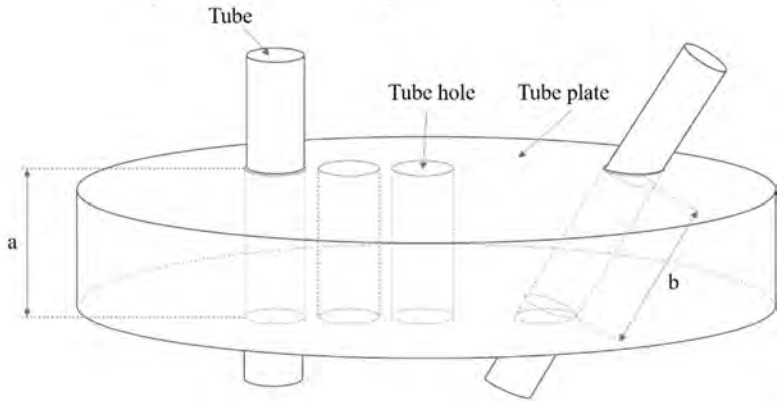
2 In cases where water tubes are secured against being pulled out by means of bellmouthing only, the included angle of belling is to be not less than 30 *degrees*.

3 Tube holes are to be formed so that the tubes can be effectively tightened inside them. Where the tubes are practically normal to the tube plates, the parallel seating of the holes is not to be less than 10 *mm* in depth(a). Where the tubes are not normal to the tube plate, the depth of the holes perpendicular(b) to the tube plate is not to be less than 10 *mm* for tubes not exceeding 60 *mm* in outside diameter, and not to be less than 13 *mm* for tubes exceeding 60 *mm* in outside diameter. (refer to **Fig. D9.10**)

4 In horizontal smoke tube type vertical boilers, each alternate smoke tube in the outer vertical rows of tubes is to be a stay tube.

Fig. D9.9 and Fig. D9.10 have been renumbered to Fig. D9.11 and Fig. D9.12, and Fig. D9.10 has been added as follows.

Fig. D9.10 Depth of Seating Tubes



9.8 Joints and Connection of Each Member

Paragraph 9.8.2 has been amended as follows.

9.8.2 Shapes of Joints and Connections

The shapes of welded joints and connections are to be as shown in **Fig. D9.~~9~~11**, or be of an equivalent shape that has been approved by the Society.

Paragraph 9.8.3 has been amended as follows.

9.8.3 Construction of Bolted Cover Plates

The construction of unstayed flat cover plates bolted to shells is to be as shown in **Fig. D9.1~~0~~2** or be of an equivalent construction that has been approved by the Society.

Fig. D9.9 has been amended as follows.

Fig. D9.~~9~~11 Examples of Welded Joints Approved for Each Case

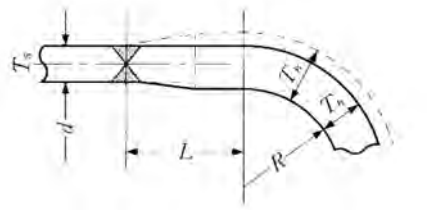
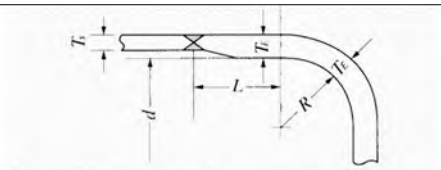
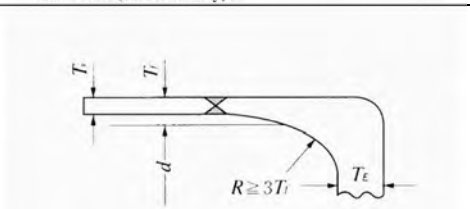
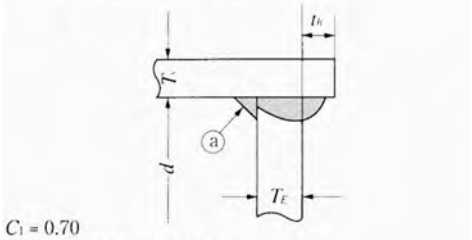
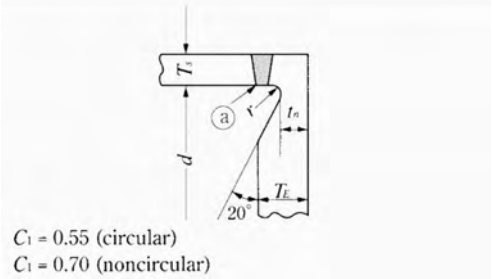
Welding part	Symbol	Welding mode and value of constant C_1	Remarks
(1) Welding joint between formed end plate and shell	*A*		L $\geq 3T_h$, but need not be more than 38 *mm* Where $T_h = 1.25T_s$, the above-mentioned value may be reduced.
(2) Welding joint between flat end plate or cover plate and shell	*A*	 In case L is not restricted, $C_1 = 0.50$ (circular or non-circular) $R \geq 3T_E$ In case $L \geq (1.1 - 0.8 \times \frac{T_S^2}{T_E^2}) \sqrt{dT_E}$ $C_1 = 0.39$ (circular only).	
	B	 $C_1 = 0.50$ (circular or noncircular)	$T_f \geq 2T_s$
	C	 $C_1 = 0.70$ (circular or noncircular)	(1) $T_s \geq 1.25T_{ro}$ (2) $t_h \geq T_s$ (3) Where the welding of part ⓐ, is considered difficult, the backing strip is to be used or the welding process, which ensures a good penetration to the root, is to be employed.
	D	 $C_1 = 0.55$ (circular) $C_1 = 0.70$ (noncircular)	(1) $r \geq 0.2T_E$, but not less than 5 *mm* (2) $t_n \geq 1.25T_{ro}$ (3) In welding the part ⓐ, such a welding process as to have a good penetration to the root, is to be employed. (4) End plates or cover plates are to be made of forged steel

Fig. D9.~~9~~11 Examples of Welded Joints Approved for Each Case (continued)

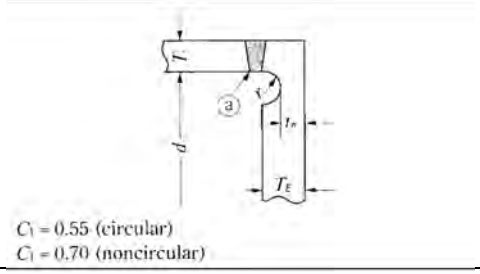
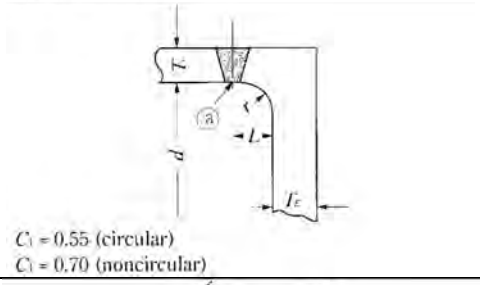
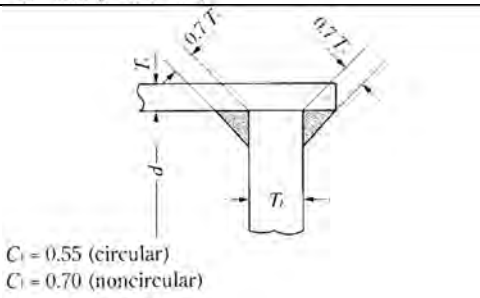
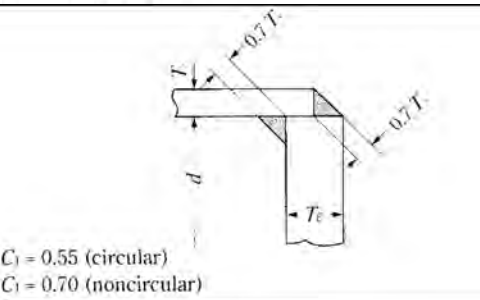
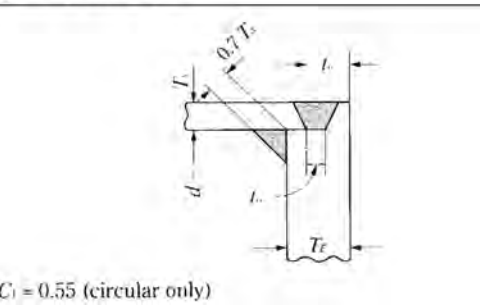
Welding part	Symbol	Welding mode and value of constant C_1	Remarks
(2) Welding joint between flat end plate or cover plate and shell	*E*	 $C_1 = 0.55$ (circular) $C_1 = 0.70$ (noncircular)	(1) $r \geq 0.2T_E$, but not less than 5 *mm* (2) $t_n \geq 1.25T_{ro}$ (3) In welding the part ⓐ, such a welding process as to have a good penetration to the root, is to be employed. (4) End plates or cover plates are to be made of forged steel.
	F	 $C_1 = 0.55$ (circular) $C_1 = 0.70$ (noncircular)	(1) $r \geq 0.3T_E$ (2) $L \geq T_E$ (3) For the part ⓐ, the same is required as above. (4) End plates or cover plates are to be made of forged steel.
	G	 $C_1 = 0.55$ (circular) $C_1 = 0.70$ (noncircular)	$T_s \geq 1.25T_{ro}$
	H	 $C_1 = 0.55$ (circular) $C_1 = 0.70$ (noncircular)	$T_s \geq 1.25T_{ro}$
	I	 $C_1 = 0.55$ (circular only)	(1) $T_s \geq 1.25T_{ro}$ (2) $t_a \geq T_s$, but need not be over 6.5 *mm*. (3) t_e is not be less than $2T_{ro}$ or $1.25T_s$, whichever is the greater.

Fig. D9.~~9~~11 Examples of Welded Joints Approved for Each Case (continued)

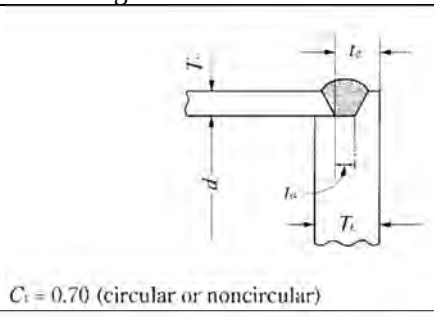
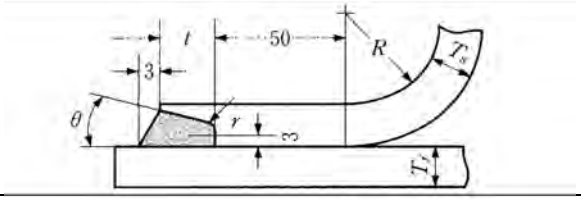
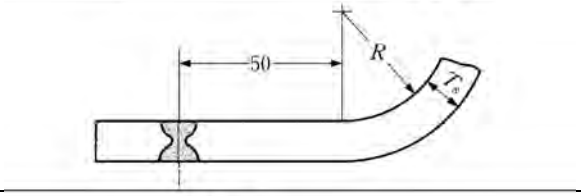
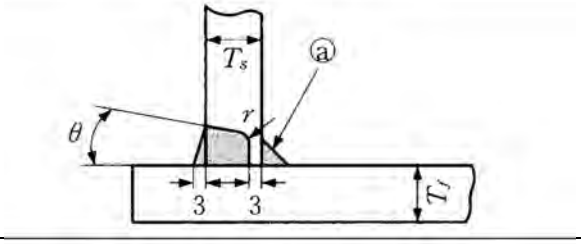
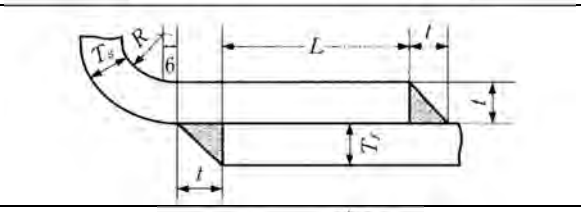
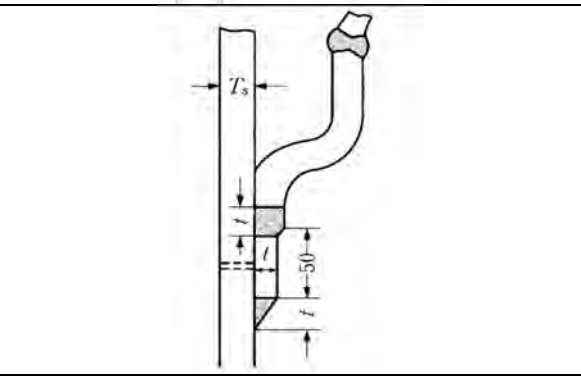
Welding part	Symbol	Welding mode and value of constant C_1	Remarks
(2) Welding joint between flat end plate or cover plate and shell	*J*	 $C_1 = 0.70$ (circular or noncircular)	(1) Tube headers only. (2) $T_s \geq 1.25T_{ro}$ (circular only) (3) $t_a \geq T_s$, but need not be over 6.5 *mm* (4) t_e is not be less than $2T_{ro}$ or $1.25T_s$, whichever is the greater.
(3) Welding joint between furnace and shell plate or end plate	*A*		(1) To be applied to welding joint on the front side of boiler. (2) $t \geq T_s - 3$ (3) θ ranges between 10°and 20° inclusive. (4) $10 \geq r \geq 5$
	B		
	C		(1) To be applied to welding joint on the front side of boiler. (2) The part ⓐ is to be of light fillet weld（throat thickness 4～6 *mm*）。 (3) θ ranges between 10°and 20° inclusive. (4) $10 \geq r \geq 5$
	D		(1) To be applied to welding joint on the front side of boiler. (2) $t \geq T_f$ (3) $L \geq 2T_s$
(4) Welding joint between ogee ring and shell plate	*A*		$t \geq T_s$

Fig. D9.~~9~~11 Examples of Welded Joints Approved for Each Case (continued)

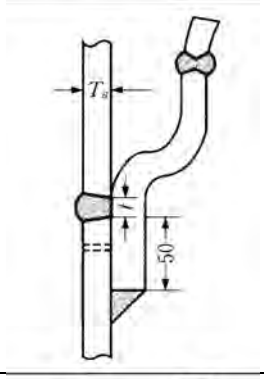
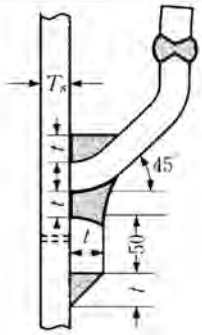
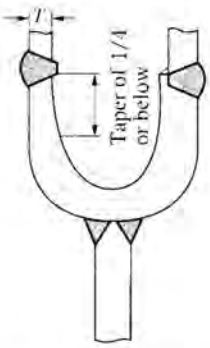
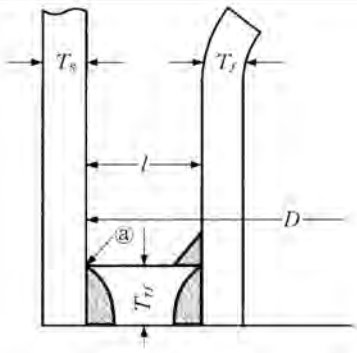
Welding part	Symbol	Welding mode and value of constant C_1	Remarks
(4) Welding joint between ogee ring and shell plate	*B*		$t \geq T_s$
	C		$t \geq T_s$
	D		$t \geq T_s$
	E		(1) If $D \leq 750$, $l \geq 50$. If $D > 750$, $l \geq 60$. (2) In welding the part ⓐ, such a welding process as to have a good penetration to the root, is to be employed.

Fig. D9.~~9~~11 Examples of Welded Joints Approved for Each Case (continued)

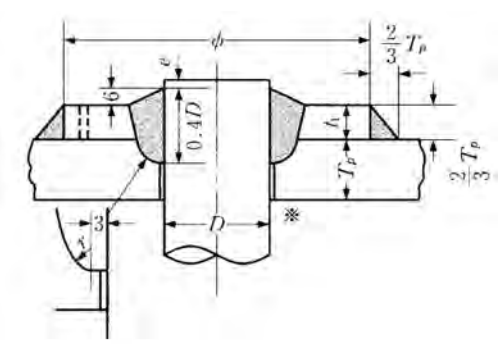
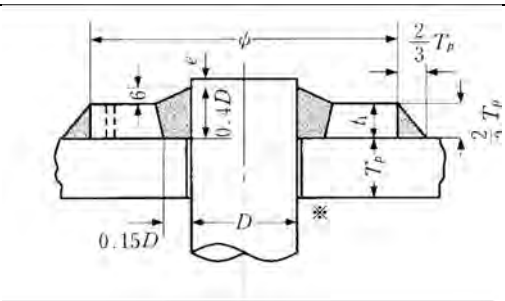
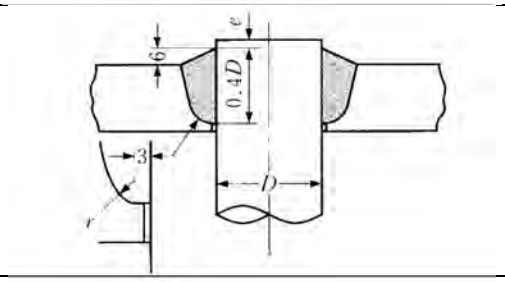
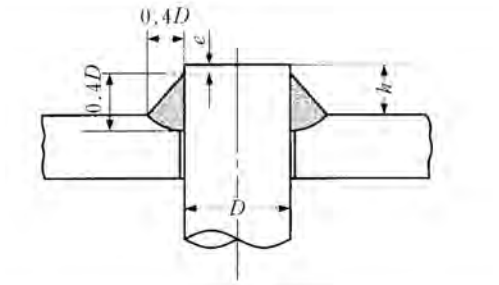
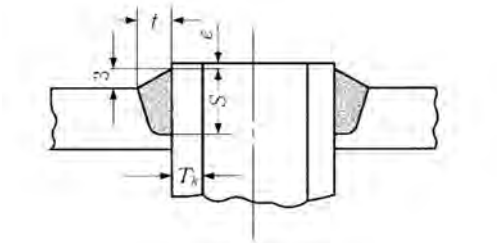
Welding part	Symbol	Welding mode and value of constant C_1	Remarks
(5) Welding joint between stay and tube plate or end plate	*A*		(1) $\emptyset \geq \frac{2}{3}P$($P$ means the pitch of stays, hereinafter the same being referred) (2) $t_1 \geq \frac{2}{3}T_p$ (3) The part marked by ※ is to be applied with light fillet welding (root thickness, 4～6 *mm*) or caulking from the side of plate for filling the gap. (4) On the fire side, to be $e \leq 1.5$
	B		(1) $\frac{2}{3}P > \emptyset \geq 3.5D$ (2) $t_1 \geq \frac{2}{3}T_p$ (3) The part marked by ※ is to be same as above. (4) On the fire side, to be $e \leq 1.5$
	C		On the side exposed to flame, $e \leq 1.5$
	D		On the side exposed to flame, $h \leq 10$ and $e \leq 1.5$
(6) Welding joint between stay tube or tube and tube plate or end plate	*A*		(1) $t \geq T_k$ (2) $S \geq 2t$ (3) On the side exposed to flame, $e \leq 1.5$

Fig. D9.~~9~~11 Examples of Welded Joints Approved for Each Case (continued)

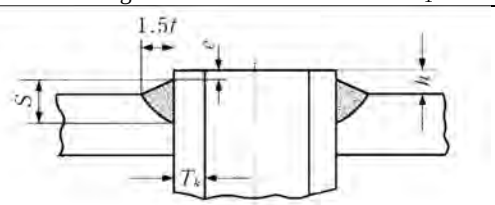
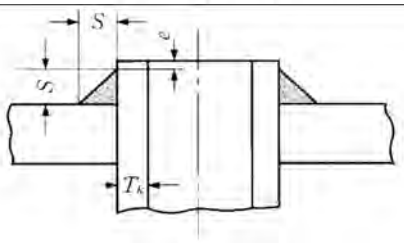
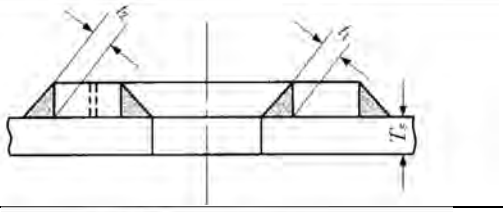
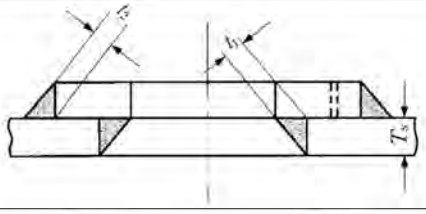
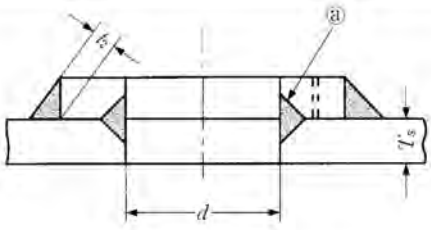
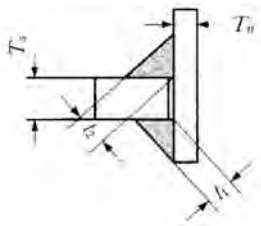
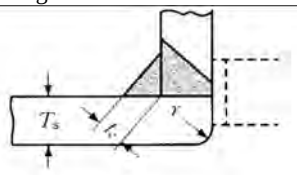
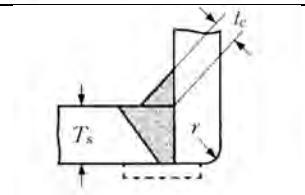
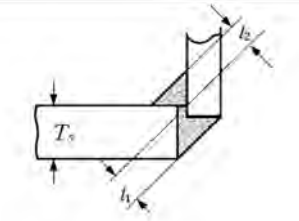
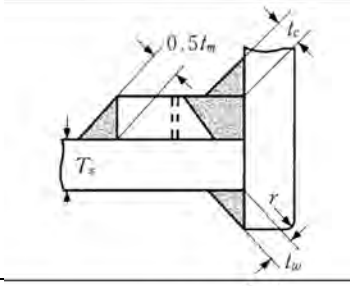
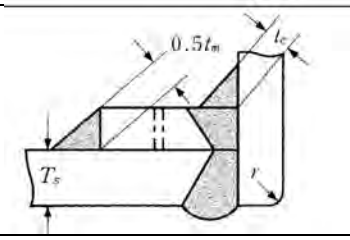
Welding part	Symbol	Welding mode and value of constant C_1	Remarks
(6) Welding joint between stay tube or tube and tube plate or end plate	*B*		(1) $t \geq T_k$ (2) $S \geq 1.5t$ or $t + 3$ On the side exposed to flame, $h \leq 10$ and $e \leq 1.5$
	C		(1) $S \geq T_k + 3$ (2) ~~To be welded after having tube expansion.~~ To conduct tube expansion either before or after welding. (3) On the side exposed to flame, $e \leq 1.5$
(7) Welding joint between seat or reinforcement ring and shell plate or end plate	*A*		(1) $t_1 + t_2 \geq 1.25t_m$ (2) $t_1,\ t_2 \geq \frac{1}{3}t_m$ but the minimum is 6.5 *mm*
	B		
	C		(1) To be applicable only for the case of $d < 60$. (2) $t_2 \geq 0.7t_m$ (3) The part ⓐ is to be welded for stopping leakage.
(8) Welding joint between nozzle and shell plate or end plate	*A*		(1) $t_c \geq 6.5$ or $0.7t_m$, whichever is the smaller (2) $t_1 + t_2 \geq 1.25t_m$ (3) $t_1,\ t_2 \geq \frac{1}{3}t_m$, ~~but the minimum is 6.5 mm~~; 6.5 *mm* or $0.7t_m$ whichever is the smaller.

Fig. D9.~~9~~11 Examples of Welded Joints Approved for Each Case (continued)

Welding port	Symbol	Welding mode and value of constant C_1	Remarks
(8) Welding joint between nozzle and shell plate or end plate	*B*		(1) $t_c \geq 6.5$ or $0.7t_m$, whichever is the smaller (2) $t_1 + t_2 \geq 1.25t_m$ (3) t_1, t_2 ~~$\geq \frac{1}{2}t_m$, but the minimum is 6.5 mm~~: 6.5 *mm* or $0.7t_m$ whichever is the smaller.
	C		
	D		
	E		(1) $t_c \geq 6.5$ or $0.7t_m$, whichever is the smaller (2) $t_1 + t_2 \geq 1.25t_m$ (3) t_1, t_2 ~~$\geq \frac{1}{2}t_m$, but the minimum is 6.5 mm~~: 6.5 *mm* or $0.7t_m$ whichever is the smaller. (4) $t_w \geq 0.7t_m$
	F		

Notes:

1. Constant C_1 is the value used for the formula in **9.5.5**.
2. The dimensions of welded parts are their minimum values.
3. The unit of all values in the figures is in *mm*.
4. The definitions of the symbols used in the figures are as Follows (units: *mm*):

T_s : Actual thickness of the shell plate
T_h : Actual thickness of the formed end plate
T_E : Actual thickness of the flat end plate or cover plate
T_{ro} : Required thickness of the seamless shell
T_p : Actual thickness of the tube plate or flat end plate (formed end plate)
T_{rf} : Required thickness of the furnace foundation ring plate
T_k : Actual thickness of the stay tube or tube
T_n : Actual thickness of the nozzle
t_m : Smaller value of the thickness of plates to be welded, but the maximum value is 20 *mm*.

Fig. D9.1~~0~~2 Examples of Bolting Covers and End Plates
(Omitted)

9.10 Tests

9.10.1 Shop Tests*

Sub-paragraph -2 has been amended as follows.

2 Boilers are to be subjected to hydrostatic tests at a pressure of 1.5 *times* the design pressure for boilers and at a pressure of 2 *times* the design pressure for boiler fittings that are not directly welded to boilers.

9.11 Construction etc. of Small Size Boilers

Paragraph 9.11.1 has been amended as follows.

9.11.1 General

Notwithstanding the requirements in **9.2** to **9.10**, the requirements in **9.11** may be applied to boilers with a design pressure that does not exceed 0.35 *MPa* ~~(hereinafter referred to as the "small boilers")~~.

Chapter 10 PRESSURE VESSELS

10.9 Tests

10.9.1 Shop Tests*

Sub-paragraph -2(2) has been amended as follows.

2 Pressure vessels and their fittings are to be subjected to hydrostatic tests according to the following requirements after being manufactured:

(1) (Omitted)

(2) Fittings of pressure vessels
The fittings ~~of~~ that are not directly welded to pressure vessels of Group I and Group II are to be subjected to hydrostatic tests at a pressure equal to 2 *times* their design pressure.

(3) (Omitted)

EFFECTIVE DATE AND APPLICATION (Amendment 2-4)

1. The effective date of the amendments is 1 January 2022.

2. Notwithstanding the amendments to the Rules, the current requirements apply to ships for which the date of contract for construction is before the effective date.

3. Notwithstanding the provision of preceding **2.**, the amendments to the Rules may apply to ships for which the date of contract for construction is before the effective date upon request of the owner.

Amendment 2-5

Chapter 12 PIPES, VALVES, PIPE FITTINGS AND AUXILIARIES

12.1 General

Paragraph 12.1.6 has been amended as follows.

12.1.6 Use of Special Materials*

~~1~~ Notwithstanding the provisions in **12.1.5** above, special materials such as rubber hoses, plastic pipes~~,~~ (including vinyl pipes) complying with **Annex 12.1.6**, aluminum alloys, etc. may be used~~, after taking into account safety against fire and flooding as well as their service conditions,~~ in cases where approved by the Society in accordance with requirements specified otherwise after taking into account their safety against fire and flooding as well as their service conditions.

Annex 12.2.6 has been added as follows.

Annex 12.1.6 PLASTIC PIPES

1.1 Scope

1 This annex is to apply to the materials, construction, strength, application, assembly and tests of piping systems on ships, including pipe joints and fittings, made predominately of materials other than metal.

2 The annex is not applicable to use of mechanical joints and flexible couplings in metallic piping systems which are accepted for use in accordance with **12.3.3-1** or **12.3.4-2, Part D of the Rules**.

3 The specification of the pipes is to be in accordance with a recognised national or international standard acceptable to the Society and the following requirements. However, the requirements in **1.4** (except **1.4.1-2(2)**) and **1.5** (except **1.5.2**) need not apply to the pipes specified in **1.3-2**.

1.2 Terminology

Terms used in this annex are defined as follows:

(1) "Plastic" means both thermoplastic and thermosetting plastic materials with or without reinforcement, such as *PVC* and fibre reinforced plastics - FRP. Plastic includes synthetic rubber and materials of similar thermo /mechanical properties.

(2) "Pipe/piping Systems" means those made of plastic(s) and include pipes, fittings, system joints, methods of joining and any internal or external liners, coverings and coatings required to comply with this annex.

(3) "Joint" means the location at which two pieces of pipe or a pipe and a fitting are connected together. The joint may be made by adhesive bonding, laminating, welding, flanges etc.

(4) "Fittings" means bends, elbows, fabricated branch pieces, etc. of plastic materials.

(5) "Nominal pressure" means the maximum permissible working pressure which is to be determined in accordance with **1.4.1-2**.

(6) "Design pressure" means the maximum working pressure which is expected under operation conditions or the highest set pressure of any safety valve or pressure relief device on the system, if fitted.

(7) "Fire endurance" means the capability of piping to maintain its strength and integrity (i.e. capable of performing its intended function) for some predetermined period of time while exposed to fire.

(8) "*FTP* Code" means as defined in **3.2.23, Part R of the Rules**.

1.3 Materials

1 Plastic pipes are to be those approved by the Society in accordance with **12.1.6, Part D of the Rules** and adequate for their service conditions.

2 Notwithstanding the requirement in **-1** above, pipes which comply with recognised standards such as *JIS* or *JWWA*, comply with **1.4.1-2(2)** and **1.5.2** and are adequate for their service conditions may be used for the following **(1)** and **(2)**:

(1) Drinking water pipes, domestic water pipes (including hot water pipes) and sanitary pipes located within accommodation spaces and engine rooms as well as deck scuppers located

within spaces.

(2) Pipes used for the "Auxiliary machinery for specific use" and "Other auxiliary machinery" (except for selective catalytic reduction (SCR) systems, exhaust gas recirculation (EGR) systems, exhaust gas cleaning systems (EGCS), etc.) specified in **1.1.1-6, Part D of the Rules**.

1.4 Design Requirements

1.4.1 Strength

1 The strength of fittings and joints is to be not less than that of the pipes.

2 The nominal pressure is to be determined from the following **(1)** to **(3)**:

(1) Internal Pressure

In the case of internal pressure, the smaller of the following is to be taken:

$P_{nint} \leq \frac{P_{sth}}{4}$ or $P_{nint} \leq \frac{P_{lth}}{2.5}$

where

P_{sth} : Short-term hydrostatic test failure pressure

P_{lth} : Long-term hydrostatic test failure pessure (>100,000h)

(2) External Pressure (for any installation which may be subject to vacuum conditions inside the pipe or a head of liquid acting on the outside of the pipe or for any pipes that would allow progressive flooding to other compartments through damaged piping or through open ended pipes in the compartments)

External pressure is to comply with the following formula. Maximum working external pressure is the sum of the vacuum inside pipes and heads of liquid acting on the outside of pipes.

$P_{next} \leq \frac{P_{col}}{3}$

where

P_{col} : Pipe collapse pressure (However, in no instance is the pipe collapse pressure to be less than 0.3 MPa)

(3) Wall Thickness

Notwithstanding the requirements of **(1)** or **(2)** above as applicable, the pipe or pipe layer minimum wall thickness is to follow recognised standards. In the absence of standards for pipes not subject to external pressure, the requirements of **(2)** above are to be met.

(4) Temperature

Nominal pressure is to be specified in accordance with the manufacturer's recommendations with due regard being given to the maximum possible working temperature.

3 Design temperature

(1) In this annex, design temperatures are to be the highest and lowest working temperatures of any liquid inside such pipes and atmospheric temperatures of the area where such pipes are arranged at the designed conditions. The design temperatures of ballast pipes are not to be less than 50 ºC for high temperature sides and are not to be more than 0 ºC for low temperature sides.

(2) The permissible working temperature depending on the working pressure is to be in accordance with manufacturer's recommendations, but in each case it is to be at least 20 ºC lower than the minimum heat distortion/deflection temperature of the pipe material, determined according to *ISO* 75-2:2013 method A, or equivalent e.g. *ASTM D648-18*. The minimum heat distortion/deflection temperature is to be not less than 80 ºC.

4 The sum of the longitudinal stresses due to pressure, weight and other loads is not to exceed the allowable stress in the longitudinal direction.

5 In the case of fibre reinforced plastic pipes, the sum of the longitudinal stresses is not to exceed half of the nominal circumferential stress derived from the nominal internal pressure condition according to **-2(1)** above.

6 Plastic pipes and joints are to have a minimum resistance to impact in accordance with recognised national or international standards, e.g. *ISO* 9854, *ISO* 9653, *ISO* 15493, *ASTM D2444* or their equivalent.

1.5 Requirements for Pipe/Piping Systems Depending On Service and/or Locations

1.5.1 Fire Endurance

1 Pipes and their associated fittings whose integrity is essential to the safety of ships are required to meet the minimum fire endurance requirements of *Appendix* 1 or 2, as applicable, of *IMO Res. A.*753(18) (including any amendments due to *IMO Res. MSC.*313(88) and *IMO Res. MSC.*399(95)).

2 Permitted use of piping depending on fire endurance, location and piping system is given in **Table 1**.

1.5.2 Flame Spread

1 All pipes, except those fitted on open decks and within tanks, cofferdams, pipe tunnels and ducts, if separated from accommodation, permanent manned areas and escape ways by means of an "*A*" class bulkhead, are to have low surface flame spread characteristics as determined by the test procedures given in *Appendix* 3 of *IMO Res. A.*753(18) (including any amendments due to *IMO Res. MSC.*313(88) and *IMO Res. MSC.*399(95)). Piping with both the total heat release (Q_t) of not more than 0.2 *MJ* and the peak heat release rate (Q_p) of not more than 1.0*kW* (both values determined in accordance with the requirements of "Test for Surface Flammability" specified in the *FTP* Code, *ANNEX* 1, *Part* 5) are considered to comply with the above requirements and may be exempted from testing in accordance to standard *ISO* 1716:2010 related to calorific value.

2 Surface flame spread characteristics are to be determined using the procedure given in the *FTP* Code, *ANNEX* 1, *Part* 5 with regard to the modifications due to the curvilinear pipe surfaces as also listed in *Appendix* 3 of *IMO Res. A.*753(18), as amended by *IMO Res. MSC.*313(88) and *IMO Res. MSC.* 399(95).

3 Surface flame spread characteristics may also be determined using the test procedures given in *ASTM D635-18*, or in other national equivalent standards. Under the procedure of *ASTM D635-18*, a maximum burning rate of 60 *mm/min* applies. In case of adoption of other national equivalent standards, the relevant acceptance criteria are to be defined.

1.5.3 Fire Protection Coatings

In cases where the fire protective coating of pipes and fittings is necessary for achieving required fire endurance levels, such coating is to meet the requirements in the following **(1)** to **(4)**:

(1) Pipes are generally to be delivered from the manufacturer with the protective coating already applied.

(2) The fire protection properties of such coatings are not to be diminished when exposed to salt water, oil or bilge slops. It is to be demonstrated that such coatings are resistant to those products that are likely to come into contact with the piping.

(3) When considering fire protection coatings, characteristics such as thermal expansion, resistance against vibrations, and elasticity are to be taken into account.

(4) Fire protection coatings are to have sufficient resistance to impact and be able to retain their integrity.

1.5.4 Electrical Conductivity

1 In cases where the piping systems for fluids with conductivity of less than 1,000 *pS/m* (*pico siemens per metre*), such as refined products and distillates, conductive pipes are to be used.

2 Regardless of the fluid being conveyed, plastic piping is to be electrically conductive if such piping passes through the hazardous areas specified in **4.3**, **Part H of the Rules**.

3 Pipes and fittings having conductive layers are to be protected against any possibility of spark damage to pipe walls.

4 In cases where electrical conductivity is to be ensured, the resistance of pipes and fittings is not to exceed 0.1 $M\Omega/m$.

1.5.5 Durability against Chemicals

Pipes are to be resistant to any chemical substances they might possibly come it to contact with during service.

1.5.6 Smoke Generation and Toxicity

Piping materials within the accommodation, service, and control spaces are to fulfill the requirements of *Appendix* 3 of *IMO Res*. *A*.753(18) (including any amendments due to *IMO Res*. *MSC*.313(88) and *IMO Res*. *MSC*.399(95)), on smoke and toxicity tests. Procedure modifications are necessary due to the curvilinear pipe surfaces listed in **Chapter 6, Part R of the Rules**.

Table 1 Fire Endurance Requirements Matrix

N	Piping Systems	Location										
		A	B	C	D	E	F	G	H	I	J	K
CARGO (FLAMMABLE CARGO f.p.[11] ≤ 60 ℃)												
1	Cargo lines	—	—	L1	—	—	○	—	○[10]	○	—	L1[2]
2	Crude oil washing lines	—	—	L1	—	—	○	—	○[10]	○	—	L1[2]
3	Vent lines	—	—	—	—	—	○	—	○[10]	○	—	×
INERT GAS												
4	Water seal effluent lines	—	—	○[1]	—	—	○[1]	○[1]	○[1]	○[1]	—	○
5	Scrubber effluent lines	○[1]	○[1]	—	—	—	—	—	○[1]	○[1]	—	○
6	Main lines	○	○	L1	—	—	—	—	—	○	—	L1[6]
7	Distribution lines	—	—	L1	—	—	○	—	—	○	—	L1[2]
FLAMMABLE LIQUIDS (f.p.[11] > 60 ℃)												
8	Cargo lines	×	×	L1	×	×	—[3]	○	○[10]	○	—	L1
9	Fuel oil	×	×	L1	×	×	—[3]	○	○	○	L1	L1
10	Lubricating	×	×	L1	×	×	—	—	—	○	L1	L1
11	Hydraulic oil	×	×	L1	×	×	○	○	○	○	L1	L1
SEAWATER[1]												
12	Bilge mains & branches	L1[7]	L1[7]	L1	×	×	—	○	○	○	—	L1
13	Fire mains & water sprays	L1	L1	L1	×	—	—	—	○	○	×	L1
14	Foam systems	L1W	L1W	L1W	—	—	—	—	—	○	L1W	L1W
15	Sprinkler systems	L1W	L1W	L3	×	—	—	—	○	○	L3	L3
16	Ballast	L3	L3	L3	L3	×	○[10]	○	○	○	L2W	L2W
17	Cooling water, essential services[12]	L3	L3	—	—	—	—	—	○	○	—	L2W
18	Tank cleaning services fixed machines	—	—	L3	—	—	○	—	○	○	—	L3[2]
19	Non-essential systems[13]	○	○	○	○	○	—	○	○	○	○	○
FRESHWATER												
20	Cooling water essential services[12]	L3	L3	—	—	—	—	○	○	○	L3	L3
21	Condensate returns	L3	L3	L3	○	○	—	—	—	○	○	○
22	Non-essential systems[13]	○	○	○	○	○	—	○	○	○	○	○
SANITARY/DRAINS/SCUPPERS												
23	Deck drains (internal)	L1W[4]	L1W[4]	—	L1W[4]	○	—	○	○	○	○	○
24	Sanitary drains (internal)	○	○	—	○	○	—	○	○	○	○	○
25	Scuppers and discharges (overboard)	○[1,8]	○[1,8]	○[1,8]	○[1,8]	○[1,8]	○	○	○	○	○[1,8]	○
SOUNDING/AIR												
26	Water tanks/dry spaces	○	○	○	○	○	○[10]	○	○	○	○	○
27	Oil tanks (f.p.[11] > 60 ℃)	×	×	×	×	×	×[3]	○	○[10]	○	×	×
MISCELLANEOUS												
28	Control air	L1[5]	L1[5]	L1[5]	L1[5]	L1[5]	—	○	○	○	L1[5]	L1[5]
29	Service air (non-essential)[13]	○	○	○	○	○	—	○	○	○	○	○
30	Brine	○	○	—	○	○	—	—	—	○	○	○
31	Auxiliary low pressure steam (≤ 0.7*MPa*)	L2W	L2W	○[9]	○[9]	○[9]	○	○	○	○	○[9]	○[9]
32	Central vacuum cleaners	—	—	—	○	—	—	—	—	○	○	○
33	Exhaust gas cleaning system / Exhaust gas recirculation system effluent line	L3[1]	L3[1]	—	—	—	—	—	—	—	L3[1, 14] —	—
34	Reductant agent transfer / supply system (SCR installations)	L1[15]	L1[15]	—	—	—	—	—	—	○	L3[14] —	○

Notes:

(1) LOCATION

A : "Machinery spaces of category *A*": Machinery spaces of category *A* as defined in **2.1.32, Part A of the Rules**

B : "Other machinery spaces and pump rooms": Spaces, other than category *A* machinery spaces and cargo pump rooms, containing: propulsion machinery; boilers; fuel oil units; steam and internal combustion engines; generators and major electrical machinery; oil filling stations; refrigerating, stabilising, ventilation and air-conditioning machinery as well as similar spaces and trunks to such spaces.

C : "Cargo pump rooms": Spaces containing cargo pumps and entrances and trunks to such spaces.

D : "Ro-ro cargo holds": Ro-ro cargo holds are ro-ro cargo spaces and special category spaces as defined in **3.2.41, Part R of the Rules** and **2.1.38, Rules for High Speed Craft**

E : "Other dry cargo holds": All spaces other than ro-ro cargo holds used for non-liquid cargo and trunks to such spaces.

F : "Cargo tanks": All spaces used for liquid cargo and trunks to such spaces.

G : "Fuel oil tanks": All spaces used for fuel oil (excluding cargo tanks) and trunks to such spaces.

H : "Ballast water tanks": All spaces used for ballast water and trunks to such spaces.

I : "Cofferdams, voids, etc.": Cofferdams and voids are those empty spaces between two bulkheads separating two adjacent compartments.

J : "Accommodation, service": Accommodation spaces, service spaces and control stations as defined in **2.1.36, 2.1.37, Part A of the Rules** and **9.2.3-2(1), Part R of the Rules**

K : "Open decks": Open deck spaces as defined in **9.2.4-2(10), Part R of the Rules** (excluding lifeboat and liferaft embarkation and lowering stations)

(2) ABBREVIATIONS

L1 : Pipes without leakage during pressure tests as a result of fire endurance tests (for more than one hour) and pressure tests (for more than 15 *minutes*) in dry conditions in accordance with *IMO Res. A*.753(18) *Appendix* 1 (including any amendments due to *IMO Res. MSC*.313(88) and *IMO Res. MSC*.399(95))

L1W : For piping systems which do not carry flammable fluid or any gas, pipes with negligible leakage (i.e. not exceeding 5 % flow loss) during pressure tests as a result of fire endurance tests (for more than one hour) and pressure tests (for more than 15 *minutes*) in dry conditions in accordance with *IMO Res. A*.753(18) *Appendix* 1 (including any amendments due to *IMO Res. MSC*.313(88) and *IMO Res. MSC*.399(95))

L2 : Pipes without leakage during pressure tests as a result of fire endurance tests (for more than 30 *minutes*) and pressure tests (for more than 15 *minutes*) in dry conditions in accordance with *IMO Res. A*.753(18) *Appendix* 1 (including any amendments due to *IMO Res. MSC*.313(88) and *IMO Res. MSC*.399(95))

L2W : Pipes with negligible leakage (i.e. not exceeding 5 % flow loss) during pressure tests as a result of fire endurance tests (for more than 30 *minutes*) and pressure tests (for more than 15 *minutes*) in dry conditions in accordance with *IMO Res. A*.753(18) *Appendix* 1 (including any amendments due to *IMO Res. MSC*.313(88) and *IMO Res. MSC*.399(95))

L3 : Pipes without significant leakage (i.e. not exceeding 0.2 *l*/*min*) during pressure tests as a result of fire endurance tests (for more than 30 *minutes*) and pressure tests (for more than 15 *minutes*) in wet conditions in accordance with *IMO Res. A*.753(18) *Appendix* 1 (including any amendments due to *IMO Res. MSC*.313(88) and *IMO Res. MSC*.399(95))

○ : No fire endurance test required

– : Not applicable

× : Metallic materials having a melting point greater than 925 ºC

(3) FOOTNOTES

1 : In cases where non-metallic piping is used, remotely controlled valves are to be provided at ship's side (such valves are to be controlled from outside spaces).

2 : Remote closing valves are to be provided at cargo tanks.

3 : When cargo tanks contain flammable liquids with a f.p. (to be determined by an approved closed cup method) > 60 ºC, "○" may replace "–" or "×".

4 : In the case of drains serving only the space concerned, "○" may replace "L1W".

5 : When controlling functions are not required by statutory requirements or guidelines, "○" may replace "L1".

6 : In the case of pipes between machinery spaces and deck water seals, "○" may replace "L1".

7 : In the case of passenger vessels, "×" is to replace "L1".

8 : Scuppers serving open decks in positions I and II, as defined in **20.1.2, Part C of the Rules**, should be "×" throughout unless fitted at the upper end with the means of closing capable of being operated from a position above the freeboard deck in order to prevent downflooding.

9 : In the case of essential services, such as fuel oil tank heating and the ship's whistle, "×" is to replace "○".

10 : In the case of tankers where compliance with **3.2.4(1)(a)vi), Part 3 of the Rules for Marine Pollution Prevention Systems** is required, "–" is to replace "○".

11 : To be determined by an approved closed cup method.

12 : Pipe lines used for the "auxiliary machinery essential for main propulsion", "auxiliary machinery for the manoeuvring and safety" and "auxiliary machinery for cargo handling" specified in **1.1.1-6, Part D of the Rules**.

13 : Pipes specified in **1.3-2(1)** and **(2)**

14 : L3 in service spaces, NA in accommodation and control spaces.

15 :Type approved plastic piping without fire endurance test (○) is acceptable downstream of the tank valve, provided this valve is metal seated and arranged as fail-to-closed or with quick closing from a safe position outside the space in the event of fire.

1.6 Installation

1.6.1 Supports

1 Selection and spacing of pipe supports in shipboard systems are to be determined as a function of allowable stresses and maximum deflection criteria. Support spacing is not to be greater than that recommended the pipe manufacturer. The selection and spacing of pipe supports are to take into account pipe dimensions, length of the piping, mechanical and physical properties of pipe materials, mass of pipes and contained fluids, external pressures, operating temperatures, thermal expansion effects, loads due to external forces, thrust forces, water hammers, vibrations, fatigue and maximum accelerations to which such systems may be subjected. Combination of loads is to be considered.

2 Each support is to evenly distribute the load of the pipe and its contents over the full width of the support. Measures are to be taken to minimise any wearing down of such pipes in the places where they come in contact with their supports.

3 Heavy components in piping systems, such as valves and expansion joints, are to be independently supported.

1.6.2 Expansion

1 Suitable provisions are to be made in pipelines to allow for relative movement between pipes made of plastic and steel structures, paying due regard to:

(1) The difference in the coefficients of thermal expansion.

(2) Deformations of the ship's hull and its structure.

2 When calculating the thermal expansions, system working temperatures as well as those temperatures at which assembly is performed are to be taken into account.

1.6.3 External Loads

1 When installing piping, allowances are to be made for temporary point loads in cases where applicable. Such allowances are to include at least the force exerted by a load (person) of 100 *kg* at mid-span on any pipe of more than 100 *mm* nominal outside diameter.

2 Besides for providing adequate robustness for all piping including open-ended piping a minimum wall thickness, complying with **1.4.1-2**, may be increased taking into account the conditions encountered during service on board ships.

3 Pipes are to be protected from mechanical damage in cases where necessary.

1.6.4 Strength of Connections

1 The strength of connections is to be not less than that of the piping system in which they are installed.

2 Pipes may be assembled using adhesive-bonded, welded, flanged or other joints.

3 Adhesives, when used for joint assembly, are to be suitable for providing permanent seals between pipes and fittings throughout the temperature and pressure ranges of their intended

application.

4 All tightening of joints is to be performed in accordance with manufacturer instructions.

1.6.5 Installation of Conductive Pipes

1 In cases where pipes are required to be electrically conductive (as specified in **1.5.4**), sufficient consideration is to be given to electrical continuity.

2 Any resistance to earth from any points in such piping systems is not to exceed 1 $M\Omega$.

3 Earthing wires are to be accessible for inspection.

1.6.6 Application of Fire Protection Coatings

1 Fire protection coatings are to be applied on joints, in cases where such coatings are necessary for meeting the required fire endurance in accordance with **1.5.3**, after performing hydrostatic pressure tests of such piping systems.

2 Such fire protection coatings are to be applied in accordance with manufacturer recommendations, using procedures approved for each particular case.

3 Pipes are to be electrically conductive, even after being coated with fire protective coatings, in cases where it is necessary to coat conductive pipes.

1.6.7 Penetration of Divisions

1 Where plastic pipes pass through "*A*" or "*B*" class divisions, arrangements are to be made to ensure that their fire endurance is not impaired in accordance with **9.3, Part R of the Rules**.

2 When plastic pipes pass through oiltight and watertight bulkheads or decks, the watertight or oiltight integrity of the bulkhead or deck is to be maintained, and such penetrations are to be of steel. Steel penetration may also be required for other steel divisions in cases where deemed necessary. For pipes not able to satisfy the requirements in **1.4.1-2(2)**, a metallic shut-off valve operable from above the freeboard deck is to be fitted at the bulkhead or deck.

3 If bulkheads or decks are also fire divisions and destruction by fire of any plastic pipes may cause the inflow of liquid from tanks, metallic shut-off valves operable from above freeboard decks should be fitted at such bulkheads or decks.

1.6.8 Control During Installation

1 Pipes are to be properly protected from any damage caused by sparks from things such as welding and cutting as well as from any mechanical impact with heavy objects during assembling.

2 Installation is to be in accordance with manufacturer guidelines.

3 Sufficient consideration is to be given to fire protection and safety of life in cases where adhesives are being used as well as in cases of cutting or grinding pipes.

4 Methods for connecting pipes are to be approved by the Society before such work is started.

5 The tests and explanations specified in this annex are to be completed before shipboard piping installation commences.

6 All personnel involved in either connecting or bonding plastic pipes by welding, lamination or similar methods are to be properly qualified. Records for each person, including the bonding procedure with dates as well as the results of any qualification testing are to be shown to the Surveyor if necessary.

1.6.9 Bonding Procedure Quality Testing

1 Procedures for making bonds are to include:

(1) materials used,

(2) tools and fixtures,

(3) joint preparation requirements,

(4) cure temperatures,

(5) dimensional requirements and tolerances, and

(6) test acceptance criteria upon completion of assembly.

2 Test assemblies are to be fabricated in accordance with procedures in order to be qualified and such assemblies are to consist of at least one pipe-to-pipe joint and one pipe-to-fitting joint.

3 In cases where such test assemblies have been cured, they are to be subjected to hydrostatic test pressures at safety factors 2.5 *times* the design pressures of such test assemblies for not less than one *hour*. No leakages or separation of joints are allowed. Such tests are to be conducted so that joints are loaded in both longitudinal and circumferential directions.

4 Selection of pipes used for test assemblies is to be in accordance with the following:

(1) In cases where the largest size to be joined has a nominal outside diameter that is 200 *mm* or smaller, test assemblies are to be the largest piping size to be joined.

(2) In cases where the largest size to be joined has a nominal outside diameter that is greater than 200 *mm*, the size of the test assembly is to be either 200 *mm* or 25 % of the largest piping size to be joined, whichever is greater.

5 When conducting performance qualifications, each bonder and each bonding operator are to make up test assemblies, the size and number of which are to be as required in **-4**.

6 Any change in the bonding procedure which will affect the physical and mechanical properties of the joint is to be approved by the Society.

1.6.10 Miscellaneous

1 Sufficient consideration is to be given to any wearing down caused by materials such as sand and sludge.

2 In cases where *GRP* pipes are used as drain pipes from scrubbers and blower casings of inert gas systems, the requirements specified in **35.2.2-1(3), Part R of the Rules** are also to be applied.

3 In cases where plastic pipes are to be installed in external areas, such pipes are to either be specifically approved for external use or be protected against ultraviolet radiation.

4 After installation on board, plastic pipes are to be easily distinguishable from pipes made of other materials.

1.7 Tests

1.7.1 Shop Tests

1 Plastic pipes, except for those piping systems specified in **1.3-2**, are to be subjected to the following tests and measurements of dimension after they have been manufactured. The number of test specimens, testing procedures, results, procedures of measurement of dimension and tolerance are to comply with the internal standards of manufacturers that have been approved by the Society.

(1) Tensile tests

(2) Hydrostatic tests (Hydrostatic pressures are not to be less than 1.5 *times* nominal pressure. Alternatively, for pipes and fittings not employing hand lay-up techniques, the hydrostatic pressure test may be carried out in accordance with the hydrostatic testing requirements stipulated in the recognised national or international standard to which the pipe or fittings are manufactured, provided that there is an effective quality system in place.)

(3) Outside diameter and wall thickness measurements

(4) Ascertainment of uniform quality and the presence of no harmful defects

(5) Electric conductivity test (only for those pipes which require electric conductivity in accordance with **1.5.4** above)

2 For tests and measurements specified in **-1** above, in cases where the manufacture has been assessed in accordance with the **Rules for Approval of Manufacturers and Service Suppliers**, the requirements that items be tested in the presence of the Surveyor may be reduced. In such cases, the Society's Surveyor may require submission of all relevant test results instead.

3 The plastic pipes specified in **1.3-2** are to be subjected to the tests specified in **-1(2)** and **1.5.2** above for every batch of pipes. Those tests are to be conducted in the presence of the Surveyor. In cases where the manufacturer has been assessed in accordance with the **Rules for Approval of Manufacturers and Service Suppliers** or the manufacturer has a quality system that meets *ISO* 9001:2015 standards or their equivalent, the tests are to be conducted by the manufacturer at the frequency specified in the quality system. In such cases, the Society may require submission of all relevant test results instead. The quality system is to consist of elements necessary to ensure that pipes and fittings are produced with consistent and uniform mechanical and physical properties.

4 Plastic pipes which have been connected by adhesive bonding, laminating, welding, etc. are to be subjected to hydrostatic tests after completion of all fabrication processes at pressures of 1.5 *times* design pressure. (See **1.1.4, Part D of the Rules**) These tests may be carried out after installation on board.

5 Notwithstanding the requirements specified in **-1** above, the Society may request hydrostatic tests for all plastic pipes at a hydrostatic pressure not less than 1.5 *times* the nominal pressure taking into consideration the pipe service conditions.

1.7.2 On board Tests and Inspection

After installed on board, in addition to those tests and inspections specified in **2.1.4-1(8), Part B of the Rules**, the following tests and inspections are to be carried out.

(1) Hydrostatic tests at pressures 1.5 *times* design pressure or 0.4 *MPa*, whichever is greater, used for “auxiliary machinery essential for main propulsion”, “auxiliary machinery for the manoeuvring and the safety” and “auxiliary machinery for cargo handling” specified in **1.1.6-1, Part D of the Rules** and for selective catalytic reduction (SCR) systems, exhaust gas recirculation (EGR) systems and exhaust gas cleaning systems (EGCS), etc.

(2) Leakage tests at service conditions, used for other than auxiliary machinery specified in **(1)** above.

(3) Sufficient earthing to hulls for those pipes required to be electrically conductive in accordance with **1.5.4** above.

(4) Safe support of pipes and no harmful defects on their external surface.

EFFECTIVE DATE AND APPLICATION (Amendment 2-5)

1. The effective date of the amendments is 1 July 2022.

2. Notwithstanding the amendments to the Rules, the current requirements apply to plastic piping systems other than those which fall under the following:

(1) plastic piping systems for which the application for approval of use is submitted to the Society on or after the effective date;

(2) plastic piping systems for which the date of renewal of approval of use is on or after the effective date; or

(3) plastic piping systems used on ships for which the date of contract for construction* is on or after the effective date.

* "contract for construction" is defined in the latest version of IACS Procedural Requirement (PR) No.29.

IACS PR No.29 (Rev.0, July 2009)

1. The date of "contract for construction" of a vessel is the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. This date and the construction numbers (i.e. hull numbers) of all the vessels included in the contract are to be declared to the classification society by the party applying for the assignment of class to a newbuilding.

2. The date of "contract for construction" of a series of vessels, including specified optional vessels for which the option is ultimately exercised, is the date on which the contract to build the series is signed between the prospective owner and the shipbuilder.

For the purpose of this Procedural Requirement, vessels built under a single contract for construction are considered a "series of vessels" if they are built to the same approved plans for classification purposes. However, vessels within a series may have design alterations from the original design provided:

(1) such alterations do not affect matters related to classification, or

(2) If the alterations are subject to classification requirements, these alterations are to comply with the classification requirements in effect on the date on which the alterations are contracted between the prospective owner and the shipbuilder or, in the absence of the alteration contract, comply with the classification requirements in effect on the date on which the alterations are submitted to the Society for approval.

The optional vessels will be considered part of the same series of vessels if the option is exercised not later than 1 year after the contract to build the series was signed.

3. If a contract for construction is later amended to include additional vessels or additional options, the date of "contract for construction" for such vessels is the date on which the amendment to the contract, is signed between the prospective owner and the shipbuilder. The amendment to the contract is to be considered as a "new contract" to which **1.** and **2.** above apply.

4. If a contract for construction is amended to change the ship type, the date of "contract for construction" of this modified vessel, or vessels, is the date on which revised contract or new contract is signed between the Owner, or Owners, and the shipbuilder.

Note:
This Procedural Requirement applies from 1 July 2009.

GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

GUIDANCE

Part D Machinery Installations

2021 AMENDMENT NO.2

Notice No.58 27 December 2021

Resolved by Technical Committee on 28 July 2021

Notice No.58 27 December 2021
AMENDMENT TO THE GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

"Guidance for the survey and construction of steel ships" has been partly amended as follows:

Part D MACHINERY INSTALLATIONS

Amendment 2-1

D13 PIPING SYSTEMS

D13.2 Piping

D13.2.5 Bulkhead Valves

Sub-paragraph -5 has been added as follows.

1 With respect to the provisions of **13.5.10, Part D of the Rules**, bulkhead valves capable of being brought into operation from a readily accessible enclosed space, the location of which is accessible from the navigation bridge or continuously manned propulsion machinery control rooms without traversing exposed decks, may be accepted as an alternative to valves operable from above the freeboard deck required by the provisions of **13.2.5-2, Part D of the Rules**.
2 Pipes penetrating stern tanks are to be fitted with stop valves at the fore side of the bulkhead.
3 The requirements for pipes piercing collision bulkheads specified in **13.2.5-1 and -2, Part D of the Rules** apply only to those extending below the freeboard deck. However, in accordance with the provisions of **13.1.5(2), Part C of the Rules**, those pipes piercing the extension part of the collision bulkhead (the weathertight part above the freeboard deck) and opening into enclosed spaces behind such bulkheads, are to be fitted with non-return valves on the aft side of the bulkhead.
4 The number of pipes piercing the collision bulkhead specified in **13.2.5-2, Part D of the Rules**, is to be in principle just one. Where the forepeak is divided to hold two different kinds of liquids, the Society may allow the collision bulkhead to be pierced below the freeboard deck by two pipes. However, the Society is satisfied that there is no practical alternative to the fitting of such a second pipe and, that having regard to the additional subdivision provided in the forepeak, the safety of the ship is maintained. In addition, valves complied with the requirements in **13.2.5-2, Part D of the Rules**, are to be fitted.
5 The wording "where deemed appropriate by the Society" in **13.2.5-2(2), Part D of the Rules** means cases where the Administration has decided on the voluntary early implementation of the amendments in resolution in accordance with *MSC*.8/*Circ*.1.

EFFECTIVE DATE AND APPLICATION (Amendment 2-1)

1. The effective date of the amendments is 27 December 2021.

Amendment 2-2

D1 GENERAL

D1.1 General

Paragraph D1.1.3 has been deleted.

~~**D1.1.3 Machinery Installations with Novel Design Features**~~

~~For installations in ships having main and essential auxiliary boilers that burn coal as fuel, the requirements specified in the **Annex D1.1.3 "Guidance for the Survey and Construction of Coal Burning Installations in Ships**" are to apply; however, these requirements (excluding in **1.1.3**, **1.1.5** and **1.1.6**) may be regarded as reference for considering plans.~~

Annex D1.1.3 has been deleted.

~~**Annex D1.1.3 GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF COAL BURNING INSTALLATIONS IN SHIPS**~~

~~**(Omitted)**~~

EFFECTIVE DATE AND APPLICATION (Amendment 2-2)

1. The effective date of the amendments is 1 January 2022

2. Notwithstanding the amendments to the Guidance, the current requirements apply to ships for which the date of contract for construction is before the effective date.

Amendment 2-3

D1 GENERAL

D1.3 General Requirements for Machinery Installations

Paragraph D1.3.5 has been deleted.

~~**D1.3.5 Ventilating Systems for Machinery Spaces**~~

~~The wording "louvers" specified in **1.3.5-2, Part D of the Rules** means the following:~~

~~(1) Those which are hand-operated;~~

~~(2) Those which are power-operated;~~

~~(3) Those which are of fixed type with a hand-operated closing door; and~~

~~(4) Those which are of fixed type with an automatic closing door.~~

EFFECTIVE DATE AND APPLICATION (Amendment 2-3)

1. The effective date of the amendments is 1 January 2022.

2. Notwithstanding the amendments to the Guidance, the current requirements may apply to ships for which the date of contract for construction* is before the effective date.

* "contract for construction" is defined in the latest version of IACS Procedural Requirement (PR) No.29.

IACS PR No.29 (Rev.0, July 2009)

1. The date of "contract for construction" of a vessel is the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. This date and the construction numbers (i.e. hull numbers) of all the vessels included in the contract are to be declared to the classification society by the party applying for the assignment of class to a newbuilding.

2. The date of "contract for construction" of a series of vessels, including specified optional vessels for which the option is ultimately exercised, is the date on which the contract to build the series is signed between the prospective owner and the shipbuilder.

For the purpose of this Procedural Requirement, vessels built under a single contract for construction are considered a "series of vessels" if they are built to the same approved plans for classification purposes. However, vessels within a series may have design alterations from the original design provided:

(1) such alterations do not affect matters related to classification, or

(2) If the alterations are subject to classification requirements, these alterations are to comply with the classification requirements in effect on the date on which the alterations are contracted between the prospective owner and the shipbuilder or, in the absence of the alteration contract, comply with the classification requirements in effect on the date on which the alterations are submitted to the Society for approval.

The optional vessels will be considered part of the same series of vessels if the option is exercised not later than 1 year after the contract to build the series was signed.

3. If a contract for construction is later amended to include additional vessels or additional options, the date of "contract for construction" for such vessels is the date on which the amendment to the contract, is signed between the prospective owner and the shipbuilder. The amendment to the contract is to be considered as a "new contract" to which **1.** and **2.** above apply.

4. If a contract for construction is amended to change the ship type, the date of "contract for construction" of this modified vessel, or vessels, is the date on which revised contract or new contract is signed between the Owner, or Owners, and the shipbuilder.

Note:
This Procedural Requirement applies from 1 July 2009.

Amendment 2-4

D2 RECIPROCATING INTERNAL CONBUSTION ENGINES

D2.1 General

D2.1.1 General

Sub-paragraph -2 has been deleted, and Sub-paragraph -3 has been renumbered to Sub-paragraph -2.

~~**2 The wording "the requirements specified otherwise by the Society" in 2.1.1-4, Part D of the Rules means "GUIDANCE FOR THE ADDITIONAL REQUIREMENTS ON ELECTRONICALLY-CONTROLLED ENGINES" in Annex D2.1.1.**~~

Sub-paragraph -3 has been amended as follows.

~~**3**~~**2** The wording "the requirements specified otherwise by the Society" in **2.1.1-~~7~~6, Part D of the Rules** means **Annex 3** "**GUIDANCE FOR HIGH PRESSURE DUAL FUEL ENGINES**" or **Annex 4** "**GUIDANCE FOR LOW PRESSURE DUAL FUEL ENGINES**" of **Part N** for gas-fuelled engines to which **Chapter 16, Part N of the Rules** apply, and **Annex 3** "**GUIDANCE FOR HIGH PRESSURE GAS-FUELLED ENGINES**" or **Annex 4** "**GUIDANCE FOR LOW PRESSURE GAS-FUELLED ENGINES**" of **Part GF** for gas-fuelled engines to which **Chapter 16, Part N of the Rules** does not apply (**Part GF of the Rules** apply instead).

Paragraph D2.1.2 has been amended as follows.

D2.1.2 Terminology

The wording "the requirements specified otherwise by the Society" in **2.1.2-~~3~~4, Part D of the Rules** means **1.4 of Annex 4, Part GF** or **1.4 of Annex 4, Part N**.

D10 PRESSURE VESSELS

D10.9 Tests

D10.9.1 Shop Tests

Sub-paragraph -2 has been amended as follows.

2 Notwithstanding the requirements in **10.9.1, Part D of the Rules**, hydrostatic tests of heat exchangers fitted to engines having cylinder bores of 300 *mm* or less may be omitted. (see **Table D2.~~6~~7 of the Rules**)

D18 AUTOMATIC AND REMOTE CONTROL

D18.1 General

Paragraph D18.1.1 has been amended as follows.

D18.1.1 Scope

~~1~~ In cases where dynamic positioning systems (DPS), which are regarded as part of the automatic and remote control systems of main propulsion machinery, are installed, the requirements of **Chapter 18, Part D of the Rules** are to apply.

~~**2** The "requirements specified otherwise by the Society" referred to in **18.1.1-3, Part D of the Rules** means **Annex D18.1.1 "COMPUTER-BASED SYSTEMS"**~~

Paragraph D18.1.3 has been deleted.

~~**D18.1.3 Drawings and Data**~~

~~**1** The "drawings and data deemed necessary by the Society" stipulated in **18.1.3(1)(f), Part D of the Rules** refer to the items specified in **1.2(1) of Annex D18.1.1 "COMPUTER-BASED SYSTEMS"** as a standard. With respect to computer-based systems which have been already approved by the Society in accordance with **Chapter 8, Part 7 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**, only drawings and data on parts that differ from ship to ship need to be submitted.~~

~~**2** The "drawings and data deemed necessary by the Society" stipulated in **18.1.3(2), Part D of the Rules** refer to the items specified in **1.2(2) of Annex D18.1.1 "COMPUTER-BASED SYSTEMS"** as a standard. With respect to computer-based systems which have been already approved by the Society in accordance with **Chapter 8, Part 7 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**, only drawings and data on parts that differ from ship to ship need to be submitted; this, however, excludes those specified in **1.2(2)(a)** of the Annex.~~

Annex D2.1.1 has been deleted.

~~**Annex D2.1.1 GUIDANCE FOR THE ADDITIONAL REQUIREMENTS ON ELECTRONICALLY-CONTROLLED ENGINES**~~

~~**(Omitted)**~~

Annex D18.1.1 has been deleted.

~~**Annex D18.1.1 COMPUTER BASED SYSTEMS**~~

~~**(Omitted)**~~

EFFECTIVE DATE AND APPLICATION (Amendment 2-4)

1. The effective date of the amendments is 1 January 2022.

Amendment 2-5

D9 BOILERS, ETC. AND INCINERATORS

D9.2 Materials and Welding

Paragraph D9.2.1 has been amended as follows.

D9.2.1 Materials

1 The pressure parts of boilers in **9.2.1-1, Part D of the Rules** which are required to use materials complying with the requirements given in **Part K of the Rules**, include all those shown in **Fig. D9.2.1-1** such as: nozzles welded to the boiler drum, manhole rings, stiffeners (except for those used for screwing fittings), flanges attached to nozzles (except for those used for connecting piping), manhole covers, cleaning hole covers, inspection hole covers, etc. .

2 The boiler fittings "whose dimensions and conditions of service have been approved by the Society" referred to in **9.2.1-2, Part D of the Rules** means the fittings specified in **D1.1.4**. In addition, the wording "standards recognized by the Society" referred to in **9.2.1-2, Part D of the Rules** means national or international standards such as *JIS*.

Section D9.3 has been added as follows.

D9.3 Design Requirements

D9.3.4 Boilers of Unusual Shape

The "analysis results as deemed appropriate by the Society" specified in **9.3.4, Part D of the Rules** means structural strength analysis by a strength assessment such as FEM.

D9.3.7 Consideration for Soot Fire

The "consideration" specified in **9.3.7, Part D of the Rules** means (but is not limited to) arrangements for soot cleaning such as the soot blowers with cleaning holes.

D9.5 Calculations of Required Dimensions of Each Member

D9.5.6 Required Thickness of Flat Plates with Stays or Other Supports

Sub-paragraph -2 has been renumbered to -3, and -2 has been added as follows.

1 (Omitted)

2 The standards "deemed appropriate the Society" specified in **9.5.6-1, Part D of the Rules** means national or international standards such as *JIS*.

~~**2**~~**3** (Omitted)

Section D9.11 has been added as follows.

D9.11 Construction etc. of Small Size Boilers

D9.11.2 Materials, Construction, Strength and Accessories of Small Boilers

The wording "recognized standard" referred to in **9.11.2-1, Part D of the Rules** means the

requirements of national or international standards such as *JIS*.

EFFECTIVE DATE AND APPLICATION (Amendment 2-5)

1. The effective date of the amendments is 1 January 2022.

2. Notwithstanding the amendments to the Guidance, the current requirements apply to ships for which the date of contract for construction is before the effective date.

3. Notwithstanding the provision of preceding **2.**, the amendments to the Guidance may apply to ships for which the date of contract for construction is before the effective date upon request of the owner.

Amendment 2-6

D12 PIPES, VALVES, PIPE FITTINGS AND AUXILIARIES

D12.1 General

Paragraph D12.1.6 has been amended as follows.

D12.1.6 Use of Special Materials

1 The wording "requirements specified otherwise" in **12.16, Part D of the Rules** means as follows.

(1) In cases where rubber hoses, Teflon hoses or nylon hoses are used for the following pipes~~:~~, ~~those~~ materials approved ~~under the requirements of the~~ in accordance with ~~"~~**Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**~~"~~ are to be used~~:~~.

(~~1~~a) Pipes of Group I or Group II

(~~2~~b) Pipes likely to cause fire or flooding in cases where they rupture

~~**2**~~(2) ~~In cases where~~ Only plastic pipes (including vinyl pipes) approved by the Society in accordance with **Chapter 6, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use** are to be used~~, the requirements specified in the **Annex D12.1.6-2 "GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF PLASTIC PIPES**" are to be complied with~~.

~~**3**~~(3) In cases where aluminum alloy pipes are used; the following requirements are to be complied with:

(~~1~~a) As a rule, aluminum alloy pipes are to be in accordance with the requirements of the code deemed appropriate by the Society, and are to be of seamless drawn pipes or seamless extruded pipes.

(~~2~~b) Aluminum alloy pipes are not to be used for any of the following applications:

~~(~~a~~~~i) As a rule, pipes with a design temperature exceeding 150 °C.

~~(~~b~~~~ii) Any pipes which penetrates either an "*A*-Class division" or a "*B*-Class division."

~~(~~c~~~~iii) Piping in which the use of copper alloy pipes is prohibited by **Table D12.2, Part D of the Rules**.

(~~3~~c) The required thickness of aluminum alloy pipes subject to internal pressure are to be in accordance with the following requirements:

Pipe thickness is to be determined using the formula in **12.2.1-1, Part D of the Rules**. In this case, allowable stress (*f*) is to be the smallest of the following values. However, in cases where the design temperature is not in the creep region of the material, no consideration needs to be given to the value of f_3.

$$f_1 = \frac{R_{20}}{4.0},\ f_2 = \frac{E_t}{1.5},\ f_3 = \frac{S_R}{1.6}$$

where

R_{20}: ~~Rule-required~~Specified minimum tensile strength (N/mm^2) of the material at room temperature (less than 50 °C)

E_t: 0.2 % proof stress (N/mm^2) of the material at design temperature

S_R: Mean value of creep breaking stress (N/mm^2) of the material after 100,000 *hours* at design temperature

~~**4**~~**2** (Omitted)

Annex D12.1.6-2 has been deleted.

~~**Annex D12.1.6-2 GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF PLASTIC PIPES**~~

(Omitted)

EFFECTIVE DATE AND APPLICATION (Amendment 2-6)

1. The effective date of the amendments is 1 July 2022.

2. Notwithstanding the amendments to the Guidance, the current requirements apply to plastic piping systems other than those which fall under the following:

(1) plastic piping systems for which the application for approval of use is submitted to the Society on or after the effective date;

(2) plastic piping systems for which the date of renewal of approval of use is on or after the effective date; or

(3) plastic piping systems used on ships for which the date of contract for construction* is on or after the effective date.

* "contract for construction" is defined in the latest version of IACS Procedural Requirement (PR) No.29.

IACS PR No.29 (Rev.0, July 2009)

1. The date of "contract for construction" of a vessel is the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. This date and the construction numbers (i.e. hull numbers) of all the vessels included in the contract are to be declared to the classification society by the party applying for the assignment of class to a newbuilding.

2. The date of "contract for construction" of a series of vessels, including specified optional vessels for which the option is ultimately exercised, is the date on which the contract to build the series is signed between the prospective owner and the shipbuilder.

For the purpose of this Procedural Requirement, vessels built under a single contract for construction are considered a "series of vessels" if they are built to the same approved plans for classification purposes. However, vessels within a series may have design alterations from the original design provided:

(1) such alterations do not affect matters related to classification, or

(2) If the alterations are subject to classification requirements, these alterations are to comply with the classification requirements in effect on the date on which the alterations are contracted between the prospective owner and the shipbuilder or, in the absence of the alteration contract, comply with the classification requirements in effect on the date on which the alterations are submitted to the Society for approval.

The optional vessels will be considered part of the same series of vessels if the option is exercised not later than 1 year after the contract to build the series was signed.

3. If a contract for construction is later amended to include additional vessels or additional options, the date of "contract for construction" for such vessels is the date on which the amendment to the contract, is signed between the prospective owner and the shipbuilder. The amendment to the contract is to be considered as a "new contract" to which **1.** and **2.** above apply.

4. If a contract for construction is amended to change the ship type, the date of "contract for construction" of this modified vessel, or vessels, is the date on which revised contract or new contract is signed between the Owner, or Owners, and the shipbuilder.

Note:
This Procedural Requirement applies from 1 July 2009.