17-410

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 2017 AMENDMENT NO.1
Guidance for the Survey and Construction of Steel Ships
Part D 2017 AMENDMENT NO.1

Rule No.29 / Notice No.27 1st June 2017
Resolved by Technical Committee on 30th January 2017
Approved by Board of Directors on 20th February 2017

ClassNK
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

2017 AMENDMENT NO.1

Rule No.29 1st June 2017

Resolved by Technical Committee on 30th January 2017

Approved by Board of Directors on 20th February 2017

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

Rule No.29 1st June 2017
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 1-1

Chapter 2 DIESEL ENGINES

2.6 Tests

2.6.1 Shop Tests*

Table D2.6 has been amended as follows.

Table D2.6 Hydrostatic Test Pressure

Part		Cylinder bore *D* (*mm*)		Test Pressure[(1)](*MPa*)
		D ≤ 300	300<*D*	
Cylinder block (gray cast iron or spheroidal graphite cast iron) [(2)] [(3)]		○	○	1.5*P*
Engine block (gray cast iron or spheroidal graphite cast iron) [(3)] [(4)]		○	○	1.5*P*
Cylinder liner [(3)]			○	1.5*P*
Cylinder head (gray cast iron, spheroidal graphite cast iron, cast steel or forged steel)			○	1.5*P*
High pressure fuel line	Fuel injection pump body	*TR*[(6)]	○	1.5*P* or *P* +30, whichever is smaller
	fuel injection valves [(5)]			
	fuel injection pipes including common fuel rail [(5)]	*TR*[(6)]	○	
High pressure common servo oil system		*TR*[(6)]	○	1.5*P*
Turbocharger, cooling space [(7)]		○	○	0.4 or 1.5*P*, whichever is greater
Heat exchanger, both sides			○	1.5*P*
Exhaust gas valve cage [(2)]		○	○	1.5*P*
Accumulator of common rail fuel or servo oil system [(8)]		○	○	1.5*P*
Piping, pumps, actuators, etc. for hydraulic drive of valves [(9)]		○	○	1.5*P*
Engine driven pumps (oil, water, fuel, bilge) [(9)]		○	○	1.5*P*
Piping system other than those listed in this Table		○	○	Apply the requirements in **12.6**

Notes:
(1) *P* is the maximum working pressure (*MPa*).
(2) Only for crosshead diesel engines.
(3) Hydrostatic tests are also required for those parts filled with cooling water that have the ability to contain water which is in contact with the cylinder or cylinder liner.
(4) Only when engine power exceeds 400 *kW/cyl*.
(5) Only when not autofretted.
(6) For items marked by *TR*, submission of a test report signed by the manufacturer which compiles test results in an acceptance protocol issued by the manufacturer may be accepted. Tests or inspections may be carried out on samples from

the current production.

(7) In cases where the manufacturer has a quality system deemed appropriate by the Society, hydrostatic tests for categories *A* and *B* turbochargers may be substituted for by manufacturer tests. In such cases, the submission or presentation of test records may be required by the Society.

(8) Only when capacity exceeds 0.5*l*.

(9) Only when engine power exceeds 800 *kW*/*cyl*.

EFFECTIVE DATE AND APPLICATION (Amendment 1-1)

1. The effective date of the amendments is 1 July 2017.

2. Notwithstanding the amendments to the Rules, the current requirements apply to diesel engines for which the date of application for approval is before the effective date.

Amendment 1-2

Chapter 18 AUTOMATIC AND REMOTE CONTROL

18.1 General

18.1.1 Scope*

Sub-paragraph -3 has been added as follows.

1 The requirements in this Chapter apply to automatic or remote control systems which are used to control the following machinery and equipment:

(1) Main propulsion machinery (in this Chapter, propulsion generating sets in electric propulsion ships are excluded),
(2) Controllable pitch propeller
(3) Steam generating sets
(4) Electric generating sets (in this Chapter, propulsion generating sets in electric propulsion ships are included)
(5) Auxiliary machinery associated with the machinery and equipment listed in **(1)** to **(4)**
(6) Fuel oil systems
(7) Bilge systems
(8) Deck machinery

2 In case where considered necessary by the Society, the requirements in this Chapter are correspondingly applied to those automatic or remote control systems which are used for controlling machinery and equipment not listed in **-1(1)** to **(8).**

3 In cases where machinery and equipment which are deemed necessary by the Society use computer based systems for the proper achievement of their functions, the design, construction, commissioning and maintenance of such computer based systems are to be in accordance with requirements specified otherwise by the Society in addition to those specified in **-1** and **-2** above and throughout the rest of this chapter.

18.1.3 Drawings and Data*

Sub-paragraph (6) has been amended as follows.

Drawings and data to be submitted are generally, as follows:

(6) Drawings and data for those computers and computerized systems specified in ~~**18.2.7**~~**18.1.1-3**~~.~~

18.2 System Design

Paragraph 18.2.7 has been deleted.

~~**18.2.7 Computers and Computerized Systems***~~

~~**1** Computerized control systems, alarm systems and safety systems are divided into three categories as shown in **Table D18.1** based upon the impact a single failure has on human and vessel safety as well as the environment. These systems are to comply with the requirements in this Chapter and the following **2** through **5**. However, where this requirement is impracticable, the systems are to comply with requirements deemed appropriate by the Society.~~

Table D18.1 Computerized System Categories

Category	Effects in case of failure	System functionality
I	Those systems which will not lead to dangerous situations for human safety, safety of the vessel and threat to the environment.	- Systems related to informational or administrative tasks
II	Those systems which could eventually lead to dangerous situations for human safety, safety of the vessel and threat to the environment.	- Alarm systems - Control systems which are necessary to maintain the ship in normal operational and habitable conditions
III	Those systems which could immediately lead to dangerous situations for human safety, safety of the vessel and threat to the environment.	- Control systems for maintaining the vessel's propulsion and steering - Safety systems

2 Computers used for the control systems, alarm systems and safety systems for machinery and equipment, considered necessary by the Society, are to comply with the following:

(1) Reliability and maintainability

The reliability and maintainability of the computerized systems are not to be inferior to those of systems not relying upon computers.

(2) Requirements for Computers

(a) The composition of computers is to be so planned that the extent of any damage due to a failure in any part of a circuit or component is kept to a minimum as far as possible.

(b) Each component is to be protected against any fear of overvoltage (electronic noise) which may intrude from input or output terminals.

(c) Central processing units and important peripheral devices are to have self-monitoring functions.

(d) Important programs and data are to be ensured against loss in cases where an external electrical power supply may be temporarily interrupted.

(e) Computers are to be set up so they can be quickly re-started following planned procedures within a short period of time after electrical power has been restored after a power failure.

(f) Spare parts for all important elements which require special techniques for repair work, are to be kept in ample supply for easy replacement.

(g) Change-over to back-up means is to be able to be performed easily and soundly.

(3) Back-up means

(a) In cases where one computer simultaneously performs fuel control (governor control, electronic injection control, etc.) and remote control of main propulsion machinery in diesel or turbine ships, or output control (rotational speed control, load control, etc.) and remote control of main propulsion machinery in electric propulsion ships, one of the following systems is to be provided in case of a computer failure. However, where this requirement is impracticable, the systems are to comply with requirements deemed appropriate by the Society.

i) Stand-by computer

ii) Governor controlled back-up systems operated at the main control station

(b) Important safety systems utilizing computers are to be provided with back-up means which can be used in a short time in the event of failure of the computer in service.

(c) In cases where visual display units (VDU) are adopted as indicators for the alarm systems stipulated in this Chapter, at least two VDUs are to be installed or other arrangements, deemed appropriate by the Society, are to be considered.

(4) Components of computerized systems

The separation of computerized control systems and safety systems are to comply with the requirements in **18.2.4.1** and **18.2.6.1** respectively. However, in cases where these requirements are impracticable, those systems are to comply with requirements deemed appropriate by the Society.

3 The communication links for transferring data between separate terminals of those systems categorized as Categories II and III in **Table D18.1** are to comply with the following:

(1) In cases where the failure of a single component of the data communication link results in a loss of data communication, means are to be provided for the automatic restoration of the link.

(2) In cases where a data communication link covers two or more systems from among those control systems, alarms systems and safety systems specified in this Chapter, the link including cables is to be installed in duplicate; unless there are alternate means of performing the same functions without the use of the link.

(3) The data communication link is to be self-checking and visual and audible alarms are to be activated when failures in the link are detected.

(4) System self-checking capabilities are to be arranged to initiate a transition to the least hazardous state for the complete installation in cases where failures of data communication have occurred.

(5) The characteristics of the data communication links are to be able to ensure the prevention of overloading and that at all necessary information is transmitted in an appropriate amount of time.

4 The wireless data communication links for transferring data between separate terminals of those systems categorized as Category II in **Table D18.1** are to comply with the following **(1)** to **(3)** in addition to **3** above. However, in cases where systems categorized as Category III in **Table D18.1** are used, such systems are to comply with requirements deemed appropriate by the Society.

(1) In cases where functions that are required to operate continuously in order to provide essential services dependant on wireless data communication links are used, an alternative means of control which can be brought in action within an acceptable period of time is to be provided.

(2) Wireless data communications are to be employed recognized international wireless communication system protocols that incorporate the following:

(a) Fault prevention, detection, diagnosis, and correction in order to ensure message integrity (i.e., the received message is neither corrupted nor altered when compared to the transmitted message).

(b) Configuration and device authentication which only permit the connection of devices included in the system design.

(c) Massage encryption which is capable of protecting the contents of confidential and/or criticality data.

(d) Security management which is capable of protecting the network and preventing unauthorized access.

(3) Wireless systems are to comply with the radio frequency and power level standards deemed appropriate by the Society.

5 In cases where system specifications are modified, the following items are to be complied with:

(1) Systems categorized as Categories II and III in **Table D18.1** are to be protected against any program modifications by end users.

(2) For systems categorized as Category III in **Table D18.1**, any modifications of parameters by manufacturers are to be approved by the Society.

(3) Any modifications made after shipment are to be documented and traceable.

EFFECTIVE DATE AND APPLICATION (Amendment 1-2)

1. The effective date of the amendments is 1 July 2017.

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.

* "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

2017 AMENDMENT NO.1

Notice No.27 1st June 2017

Resolved by Technical Committee on 30th January 2017

Notice No.27 1st June 2017
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 1-1

D2 DIESEL ENGINES

D2.6 Tests

D2.6.1 Shop Tests

Sub-paragraph -1(5) has been amended as follows.

1 The purpose of the shop trials specified in **2.6.1-2**, **Part D of the Rules** is to verify design premises such as engine power, safety against fire, adherence to approved limits such as maximum pressure, and functionality as well as to establish reference values or base lines for later reference in the operational phase. The programme is to be in accordance with the following:

(5) The programme shown in **Table D2.6.1-1** is to be used ~~as the standard~~ for the shop trials of diesel engines. In this case, refer to the *JIS* specified below or those considered equivalent thereto for more details on each respective testing procedure. However, additional tests may be requested by the Society depending on the engine application, service experience, or other relevant reasons. In addition, alternatives to the detailed tests may be agreed between the manufacturer and the Society when the overall scope of tests is found to be equivalent.~~:~~

(a) For the main engines of diesel ships or electrical propulsion ships;
JIS F 4304 "Shipbuilding - Internal combustion engines for propelling use-shop test code"

(b) For diesel engines driving generators or essential auxiliary machinery;
JIS F 4306 "Shipbuilding - Water cooled four-cycle generator diesel engines"

EFFECTIVE DATE AND APPLICATION (Amendment 1-1)

1. The effective date of the amendments is 1 June 2017.

2. Notwithstanding the amendments to the Guidance, the current requirements apply to diesel engines for which the date of application for approval is before the effective date.

Amendment 1-2

D15 STEERING GEARS

D15.3 Controls

Paragraph D15.3.1 has been amended as follows.

D15.3.1 General

(-1 to -3 are omitted.)

4 The control systems specified in the requirements of **15.3.1-1(2), Part D of the Rules** are to be provided with the following ~~**(1) and (2)**~~ failure detection functions:

(1) At least the following failures that may cause reduced or erroneous system performance are to be automatically detected~~. In such cases,~~ and individual visible and audible alarms are to be given on the navigation bridge ~~in the event of all failures~~:

(a) Power supply failure

(b) Earth fault on AC and DC circuits

(~~b~~c) Loop failure in closed loop systems, both command and feedback loops (normally short circuit, broken connections and earth faults)

(~~c~~d) Data communication errors ~~In cases where programmable electric systems are used:~~

~~i) Data communication errors~~

~~ii) Computer hardware and software failures~~

(~~d~~e) Programmable system failures (Hardware and software failures) ~~Hydraulic locking considering order given by steering wheel or lever~~

(f) Hydraulic locking

(g) In the case of closed loop systems, deviation between rudder order and feedback

Individual visible and audible deviation alarms are to be initiated on the navigation bridge when the rudder's actual position does not reach its set point within acceptable time limits (e.g., follow-up control and autopilot). The deviation alarm may be caused by mechanical, hydraulic or electrical failures.

~~(2) In cases where, the above **(1)(b)** and **(c)** are not able to be detected due to the characteristics of the rudder, the monitoring of the following may be accepted as an alternative measure. In such cases, visible and audible alarms indicating rudder failure are to be given on the navigation bridge when detecting critical deviations between rudder order and response. All electric components of the control systems are to be duplicated.~~

~~(a) Actual rudder positions are to follow the set value.~~

~~(b) Actual rudder positions are to reach a set position within acceptable time limits.~~

~~(c) The end actual position is to corresponded to the set value within the design offset tolerances.~~

5 ~~Measures which result in the least critical of any new possible conditions by the most probable failures are to be provided f~~For the control systems specified in the requirements of **15.3.1-1(2), Part D of the Rules**~~.~~, the rudder is to be stopped in either of the following positions in cases where a failure (as defined but not limited to those in **D15.3.1-4**) likely to cause uncontrolled movement of the rudder occurs:

(1) the rudder angle when failure occurs, or

(2) the midship/neutral position.

(-6 to -10 are omitted.)

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 "machinery and equipment which are deemed necessary by the Society" referred to in **18.1.1-3, Part D of the Rules** means machinery and equipment used for the purposes specified in **(1)** to **(4)** given below and includes programmable controllers such as sequencers.

(1) Control systems for the machinery and equipment specified in **18.1.1-1, Part D of the Rules**.

(2) Alarm systems specified in **18.2.5, Part D of the Rules**.

(3) Safety systems for the machinery and equipment specified in **18.1.1-1, Part D of the Rules**.

(4) Control, alarm, and safety systems related to **Table 2.1 of Annex D18.1.1** "**COMPUTER BASED SYSTEMS**".

3 Notwithstanding the requirements in **-2** above, the "machinery and equipment which are deemed necessary by the Society" referred to in **18.1.1-3, Part D of the Rules** is not to include the machinery and equipment specified in the following **(1)** to **(4)**:

(1) navigating equipment specified in the **Rules for Safety Equipment**,

(2) radio installations specified in the **Rules for Radio Installations**,

(3) stability instruments, and

(4) loading computers.

4 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 amended as follows.

D18.1.3 Drawings and Data

The drawings and data stipulated in **18.1.3(6), Part D of the Rules** refer to items specified in **Annex D18.1.1** "**COMPUTER BASED SYSTEMS**" as a standard ~~the following items that are standard for systems categorized as Categories II and III in **Table D18.1**~~. With respect to those automatic devices and equipment which have been already approved by the Society, only data on parts that differ from ship to ship need to be submitted.

~~(1) Hardware description~~

- ~~(a) System block diagrams, showing the arrangement, input and output devices and interconnections~~
- ~~(b) Connection diagrams including data communication, electrical power circuit diagrams~~
- ~~(c) Back-up systems and back-up procedures~~
- ~~(d) Protections against power failure and procedures for restarting the system after recovery of power~~

~~(2) Software description~~

- ~~(a) Operating Systems and data communication software~~
- ~~(b) Intended functions~~
- ~~(c) Application software, control logic~~
- ~~(d) Detailed descriptions of control and monitoring equipment, and safety systems~~

~~(3) Quality control of software~~

(a) Quality standards
(b) A quality plan for software lifecycle
(c) Quality assurance procedures in production

(4) Documentation of software modification
Work procedures for modifying program contents and data including upgrades

(5) Failure analysis for systems
(a) Verification process and results (including counter measures) by failure analysis methods such as FTA, FMEA and FMECA
(b) Evidence that the failure of a system of Category I will not impact human safety, safety of the vessel, or the environment

(6) Engineering analysis
In accordance with requirements specified in **18.2.7-1, Part D of the Rule**s, an engineering analysis deemed appropriate by the Society in cases where alternative designs or arrangements are used.

(7) Test procedures for hardware
Procedures according to the requirements of **18.7.1, Part D of the Rules**

(8) Test procedures for software
Procedures to verify that systems interact correctly to perform the intended functions and do not perform unintended functions (the test is carried out in each module, subsystem and whole system, if necessary)

(9) Test procedures to verify the integration of systems at factory (including failure simulation)
(a) Operation test procedures for the completed system combining actual hardware and finalized software which were verified according to **(7)** and **(8)**
(b) Confirmation method for the adequacy of the results of failure analysis methods such as FTA, FMEA and FMECA

(10) On-board test procedures
(a) Operation test procedures on board of the systems after installation of the software
(b) Verification test procedures related to the electromagnetic effects of at least the following in cases where wireless data communication systems are to be installed.
i) The electromagnetic effects of the wireless data communication system on other equipment.
ii) The effects of electromagnetic interference expected during normal operation on the wireless data communication system.

(11) Detailed descriptions of system modifications and their verification test procedures (where the modification influences the functionality or safety of the systems)

(12) Description of the wireless data communication system
(a) Details of the manufacturer recommended installation and maintenance practices
(b) Network plans (including the arrangement of all system devices) as well as the identification of the type and location of all antennas
(c) Specifications of wireless communication system protocols and management functions (refer to **18.2.7-4.(2), Part D of the Rules**)
(d) Details of radio frequencies and power levels
(e) Evidence for approval of use from Society in accordance with **Chapter 1, Part 7 of "Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use."**

(13) Spare parts and replacement procedures

D18.2 System Design

Paragraph D18.2.7 has been deleted.

~~**D18.2.7 Computers and Computerized Systems**~~

~~**1** Examples of computerized systems relevant to **Table D18.1, Part D of the Rules** are shown in the **Table D18.2.7-1**. Where independent effective backup or other means of averting danger is provided, a Category III system may be downgraded to Category II.~~

~~**2** The computers "considered necessary by the Society" specified in **18.2.7, Part D of the Rules** means those used for the following systems in general. In this case, programmable controllers such as sequencers are included.~~

~~(1) Control systems for the machinery and equipment specified in **18.1.1-1(1)** through **(5), Part D of the Rules**.~~

~~(2) Alarm systems specified in **18.2.5, Part D of the Rules**.~~

~~(3) The safety systems for the machinery and equipment specified in **18.1.1-1, Part D of the Rules**~~

~~(4) Control systems, alarm systems and safety systems relevant to **Table D18.1, Part D of the Rules**~~

~~**3** The wording "requirements deemed appropriate by the Society" specified in **18.2.7-1, Part D of the Rules** means those cases where an alternative design or arrangement is used and the results of an engineering analysis conducted in accordance with relevant international or national standards acceptable to the Society are satisfactory and approved by the Society.~~

~~**4** "The extent of effect due to a failure of part of circuits or components is limited to a minimum" specified in **18.2.7-2(2)(a), Part D of the Rules** means, for example, that in a system always controlled by two or more computers, the system can be made to cope with the failure of one computer without hindering performance.~~

~~**5** The requirements "deemed appropriate by the Society" specified in **18.2.7-2(3)(a), Part D of the Rules** mean that the results of a failure analysis such as FMEA on the system are satisfactory and approved by the Society.~~

~~**6** "Back-up means" specified in **18.2.7-2(3)(b), Part D of the Rules** refer to either of the following pieces of equipment or systems.~~

~~(1) Safety systems that do no rely on computers~~

~~(2) Stand-by computers~~

~~**7** "Other arrangements deemed appropriate by the Society" specified in **18.2.7-2(3)(c), Part D of the Rules** means, for example, the combination of a VDU and an alarm printer.~~

~~**8** "Requirements deemed appropriate by the Society" specified in **18.2.7-2(4), Part D of the Rules** means the following.~~

~~(1) In cases where secondary control systems or stand-by computers are installed for those control systems specified in **-2(1)** above, the independence of such control systems may not be required for individual machinery or equipment. In such cases, local control equipment fitted to main propulsion machinery in accordance with the requirements given in **18.3.2-3(2), Part D of the Rules** may not be regarded as the secondary control systems.~~

~~(2) In cases where safety systems conform to the requirement given in **-6**, the independence of individual machinery and equipment in systems, and their independence from other systems may not be required.~~

~~(3) In cases where secondary systems or stand-by computers are installed in both control systems and safety systems, the independence of individual machinery and equipment in their systems including alarm systems, and their independence from the other systems may not be required.~~

~~**9** The wording "requirements deemed appropriate by the Society" specified in **18.2.7-4, Part D of the Rules** means that the results of the engineering analysis specified in **-3** are satisfactory and~~

~~approved by the Society.~~

~~**10** The wording "standards deemed appropriate by the Society" specified in **18.2.7-4(3), Part D of the Rules** means the requirements specified by the International Telecommunications Union (ITU) and the relevant flag state.~~

~~**11** "Parameters" specified in **18.2.7-5(2), Part D of the Rules** means those settings specified in the relevant chapters of the equipment specified in **18.1.1-1, Part D of the Rules**.~~

~~Table D18.2.7-1 Examples of Computerized Systems~~

~~Category~~	~~Examples~~
~~I~~	~~- Maintenance support systems~~ ~~- Information and diagnostic systems~~
~~II~~	~~- Alarm and monitoring systems~~ ~~- Main propulsion remote control systems~~ ~~- Governor control systems~~ ~~- Control systems for auxiliary machinery~~ ~~- Bilge systems~~ ~~- Other systems considered necessary by the Society~~
~~III~~	~~- Control systems for propulsion with steering~~ ~~- Electronic fuel injection systems for main diesel engines~~ ~~- Burner control systems (for those main boilers and essential auxiliary boilers defined in **9.1.2(2), Part D of the Rules**)~~ ~~- Power supply control systems~~ ~~- Other systems considered necessary by the Society~~

Annex D18.1.1 has been added as follows.

Annex D18.1.1 COMPUTER BASED SYSTEMS

Chapter 1 INTRODUCTION

1.1 General

1.1.1 Scope

The requirements in this annex relate to the design, construction, commissioning and maintenance of computer based systems which depend upon software to automatically or remotely control the machinery and equipment fitted with such systems, and apply to the software as well as any hardware supporting such software for said machinery and equipment 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 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) quality plan,
  (b) test programs and procedures for functional tests and failure tests in integration testing before installation on board,
  (c) test program for simulation tests for final integration,
  (d) test program for on board tests (includes tests related to wireless data links), and
  (e) test reports of environmental tests according to UR E10.

(2) Drawings and data for reference:
- (a) documents related to quality systems (includes security policies specified in **3.4.1-1**);
- (b) risk assessment report;
- (c) documents related to software code creation and testing such as the following:
  - i) software module functional description and associated hardware description,
  - ii) evidence of verification of software code, and
  - iii) evidence of functional tests for elements at the level of software module, sub-system and system;
- (d) other drawings and data such as the following:
  - i) functional description of software;
  - ii) list and versions of software installed in system;
  - iii) user manual;
  - iv) list of interfaces between system and other vessel systems;
  - v) list of standards used for data links; and
  - vi) documentation demonstrating the adequacy of failure test (in cases where deemed necessary by the Society).

Chapter 2 DEFINITIONS

2.1 Stakeholders

2.1.1 Owner

The owner is responsible for contracting the system integrator and 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

The role of the system integrator is to be taken by the shipyard unless an alternative organisation 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 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

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

2.2.1 Object Definitions

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

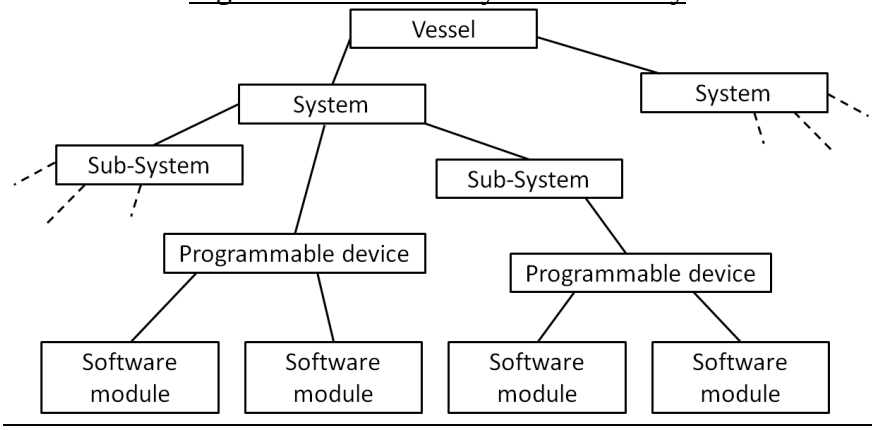
2 "System" is a combination of interacting programmable devices and/or sub-systems organized to achieve one or more specified purposes.

3 "Sub-system" is identifiable part of a system, which may perform a specific function or set of functions.

4 "Programmable device" is the physical component where software is installed.

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

Fig. 2.1 Illustrative system hierarchy



2.3 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;

(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.

2.4 Other Terminology

2.4.1 Simulation Tests

A simulation test is 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, and is to span 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 which takes 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 is certified as compliant to the recognized standard by an organisation with accreditation under a national accreditation scheme.

(2) Verification of compliance with standards recognized by the Society.

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 Class 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

1 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) Means to know the risks.

(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.

2 For category II and III systems, the following documentation related to software code creation and testing is to be provided to the Society:

(1) Software module functional descriptions and associated hardware descriptions for programmable devices. This is to be provided by supplier and system integrator.

(2) Evidence of verification (detection and correction of software errors) for software modules in accordance with the selected software development standard. This is to be supplied by the supplier and system integrator.

(3) Evidence of functional tests for programmable devices at the software module, subsystem, and system levels. This is to be supplied by the supplier via the system integrator. 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.

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 software functions are properly executed, the software and the hardware it controls interact and function properly together, and 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.

(3) The documentation specified in **(a)** to **(g)** below are to be provided the Society:

(a) functional description of software,

(b) list and versions of software installed in system,

(c) user manual including instructions for use during software maintenance,

(d) list of interfaces between system and other vessel systems,

(e) list of standards used for data links,

(f) additional documentation as requested by the Society which might include an FMEA or equivalent to demonstrate the adequacy of failure test case applied, and

(g) other documentation deemed necessary by the Society.

3.1.4 Approval of Programmable Devices for Category II and III Systems

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

2 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**.

3 With respect to **-2** 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 Simulation tests are to be undertaken before installation in cases where it is found necessary to check safe interaction with other computerized systems and functions which are unable to be previously tested. In such cases, the specifications of the simulation tests are to be submitted to the Society by the system integrator. The simulation tests are to be witnessed by the Surveyor.

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 implemented on board systems.

3 For category II and III systems, final integration and on board testing is to comply with the following requirements:

(1) Test specifications are to be submitted to the Society by the system integrator 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, requirements related to the quality systems specified in **3.1.1** may need to be satisfied as deemed necessary 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.

2 With respect to **-1**, sub-systems and programmable devices may be granted limited approval based upon the carrying out of required checks and tests.

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 and is to satisfy the requirements specified in **3.1**.

3 Software modifications are to be carried out for any modification already considered for each life cycle stage and in accordance with 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 all modifications. For category II and III systems, the achievement of this responsibility is to be supported by system integrators updating the software registry. This software registry is to contain the following **(1)** and **(2)**:

(1) the lists and versions of software installed in systems required by **3.1.3-4(3)(b)**, and

(2) the results of the security scans required by **3.4.1-3**.

3.3.2 Modification Management

1 The owner is to ensure that necessary procedures for software and hardware modification management are maintained, and that any software modifications or upgrades are performed according to such procedures.

2 All modifications 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 For category I, II, and III systems, 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, software code, executables and the physical medium used for installation on the vessel are to be scanned for viruses and malicious software.

4 Results of the scan specified in **-3** above are to be documented and added to 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 General Requirements

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

5.1.1 Loss of a Data Link

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

5.1.2 Automatic Recovery after a Single Failure

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

5.1.3 Measures against Overload

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

5.1.4 Checking and Detecting Failures

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) Fault prevention, detection, diagnosis, and correction in order to ensure message integrity (i.e., the received message is neither corrupted nor altered when compared to the transmitted message).
   (b) Configuration and device authentication which only permit the connection of devices included in the system design.
   (c) Massage encryption which is capable of protecting the contents of confidential and/or criticality data.
   (d) Security management which is capable of protecting the network and preventing unauthorized access.

(2) The internal wireless system within the vessel is to comply with the radio frequency and power level standards (e.g., 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.
   (b) Radio-frequency transmission does not cause itself to fail as a result of electromagnetic

interference during expected operating conditions.

EFFECTIVE DATE AND APPLICATION (Amendment 1-2)

1. The effective date of the amendments is 1 July 2017.

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.

* "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 1-3

Annex D1.1.3-1 GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF WATERJET PROPULSION SYSTEMS

1.1 General

Paragraph 1.1.4 has been amended as follows.

1.1.4 Terminology

The terms used in this Guidance are defined as follows:

(1) Waterjet propulsion systems are systems, including the following components **(a)** through **(~~e~~f)**, which receives water through inlet ducts and discharges it through nozzles at an increased velocity to produce propulsive thrust and control.
   (a) Shaftings (main shafts, bearings, shaft couplings, coupling bolts and sealing devices)
   (b) Water intake ducts
   (c) Waterjet pump units
   (d) Steering and reversing systems
   (e) Control systems
   (f) Rudders

(2) Waterjet pump units are made up of impellers, impeller casings, stators, stator casings, nozzles, bearings, bearing housing and sealing devices.

(3) Impellers are a rotating assemblies provided with blades to give energy to the water.

(4) Main shafts are shafts that impellers are connected to.

(5) Water intake ducts are portions that lead water drawn from water intakes to impeller inlets.

(6) Nozzles are portions that inject rectified water from impellers.

(7) Deflectors are devices serving as rudders by leading water injected from nozzles either to port or to starboard.

(8) Reversers are devices to thrust ships to go astern by reversing flow directions of water injected from nozzles.

(9) Stators are assemblies composed of rows of stationary vanes that reduce any swirl added to water by impellers.

(10) Steering and reversing systems are those systems consisting of deflectors, reversers and hydraulic power system driving defectors and/or reversers.

(11) Hydraulic power systems are systems composed of power units (hydraulic pumps and electric motors or engines for driving such pumps and its associated electrical equipment), and hydraulic piping systems and hydraulic actuators.

(12) Actuators are devices such as hydraulic cylinders for moving reversers and defectors.

(1~~2~~3) High speed engines are diesel engines complying with the following condition or gas turbines:

$$\left(S \cdot n^2\right) / \left(1.8 \times 10^6\right) \geq 90$$

$$\left(\pi \cdot d_j \cdot n\right) / \left(6 \times 10^4\right) \geq 6$$

S : Length of stroke (*mm*)

n : Number of revolutions of an engine at maximum continuous output (*rpm*)

d_j : Diameter of journal (*mm*)

1.5 Steering and Reversing Systems

Paragraph 1.5.1 has been amended as follows.

1.5.1 Capability of Steering and Reversing

1 Each ~~D~~deflector~~s are~~is, in principle, to be capable of changing direction of the ship's directional control system from one side to the other at declared steering angle limits at an average rotational speed of not less than 2.3°/*s* with the ship running ahead at speeds specified in **2.1.8**, **Part A of the Rules** while operating with all power units. In addition, ships are to have sufficient steering capability according to their ship type. The wording "declared steering angle limits" refers to the operational limits of deflectors in terms of maximum steering angle according to manufacturer guidelines for safe operation.

2 Reversers are to be such that they provide sufficient power for going astern to secure proper control of the ship under all normal circumstances, and when transferred from ahead to astern runs, they are to have astern power to provide effective braking for ships.

3 Propulsion systems are to be arranged so that after a single failure in its piping or in one of the power units, ship steering capability (but not individual propulsion system operation) can be maintained or speedily regained (e.g. by the possibility of positioning the failed deflector and reverser in a neutral position in an emergency, if needed).

4 The requirements of **-1** and **-3** are to apply regardless whether the propulsion systems are arranged with common or dedicated power units.

1.5.2 General Construction of Steering and Reversing Systems

Sub-paragraph -5 has been added as follows.

1 Design pressures of the scantlings of piping and other components of hydraulic power systems subject to internal hydraulic pressure are to be at least 125% of the maximum working pressure expected under the worst permissible operating condition, taking into account any pressure which may exist in the low pressure side of systems. Design pressures are not to be less than relief valve setting pressures.

2 Reversers are to have sufficient strength against any thrusts at maximum astern power output.

3 The construction and strength of hydraulic pumps and hydraulic systems are to comply with the requirements in **10.5**, **12.2.1**, **12.3**, **12.4.2** through **12.4.4** and **12.5.1**, **Part D of the Rules**.

4 The arrangements of piping, relief valves and measuring devices for hydraulic systems and the construction of liquid level indicators are to comply with the requirements in **13.2.1** and **13.8.4**, **Part D of the Rules**.

5 Propulsion systems are to be provided with an additional possibility of positioning and locking the failed deflector and reverser in a neutral position after a failure of its own power unit(s) and actuator(s).

1.6 Electric Installations

1.6.3 Electrical Installations for Steering and Reversing Systems

Sub-paragraph (1) has been amended as follows.

In cases where hydraulic pumps for hydraulic power systems are driven by electric motors, electrical installations for steering and reversing systems are to comply with the following requirements in **(1)** through **(7)**:

(1) Each propulsion system is to be served ~~separately~~ by at least two exclusive circuits fed directly from main switchboards. ~~In cases where three or more propulsion systems are provided, these exclusive circuits may be composed of at least two systems.~~ However, ~~O~~one of these circuits may be supplied through the emergency switchboard.

(2) Cables used in those exclusive circuits required in **(1)** are to be separated as far as practicable throughout their length.

(3) Audible and visual alarms are to be given on navigation bridges in the event of any power failure to electric motors for hydraulic pumps.

(4) Means for indicating that electric motors for hydraulic pumps are running are to be installed on navigation bridges and positions from which main engines are normally controlled.

(5) Short circuit protection and overload alarms are to be provided for such circuits and motors respectively. Overload alarms are to be both audible and visible and are to be situated in conspicuous positions in places from which main engines are normally controlled.

(6) Protection against excess current, including starting currents, if provided, is to be for not less than twice the full load current of those motors or circuits so protected, and to be arranged to permit the passage of any appropriate starting currents.

(7) In cases where a three-phase supply is used, alarms are to be provided that will indicate failure of any one of the supply phases. Such alarms are to be both audible and visible and are to be situated in conspicuous positions in places from which main engines are normally controlled.

1.12 Special Requirements for Propulsion Systems Installed in Ships with Restricted Area of Service and Small Ships

Paragraph 1.12.1 has been amended as follows.

1.12.1 Ships with Class Notation "*Coasting Service*", "*Smooth Water Service*" or Equivalent

1 For ships with the Class Notation "*Coasting Service*", "*Smooth Water Service*" or equivalent, the requirements specified in **1.11** are not necessary.

2 For ships with the Class Notation "*Coasting Service*", "*Smooth Water Service*" or equivalent, which are not engaged in international voyages, or whose gross tonnage is less than 500 *tons*, the following requirements are not necessary in addition to the requirement in **-1**.

(1) **1.5.1-3**
(2) **1.5.2-5**
(~~1~~3) **1.5.4-4**
(~~2~~4) **1.6.2**
(~~3~~5) **1.6.3(2)**, **(5)** (only those requirements concerned with overload alarms of motors) and **(7)**
(~~4~~6) **1.7.1-7**
(~~5~~7) **1.10.2**

3 For the ships specified in **-2**, the following requirements may be applied:

(1) Notwithstanding the requirements of **1.6.3(1)**, each propulsion system may be served separately by exclusive circuits fed directly from main switchboards. In cases where three or more propulsion systems are provided, these exclusive circuits may be composed of at least two systems. In addition, one of these circuits may be supplied through the emergency switchboard.

Annex D1.1.3-3 GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF AZIMUTH THRUSTERS

1.1 General

Paragraph 1.1.4 has been amended as follows.

1.1.4 Terminology

The terms used in this Guidance are defined as follows:

(1) Thrusters are propulsion units which control ship direction through ~~with~~ steering functions enabled by their own capability of azimuthing. Thrusters ~~are made up of~~ include the following components:
   (a) Propellers
   (b) Propeller shafts
   (c) Gears, clutches and gear shafts for transmission of propulsion torque (when integrated in thrusters)
   (d) Azimuth thruster casings
   (e) Azimuth steering gears
   (f) Control systems

(2) Azimuth thruster casings are watertight structures that include steering columns (or struts), propeller pods, propeller nozzles and nozzle supports.

(3) Azimuth steering gears are devices for applying steering torque to thrusters, and include power units ~~electric motors, hydraulic pumps~~, hydraulic systems, actuators, ~~hydraulic motors and~~ gear assemblies for azimuth steering gears and rudder.

(4) Power units, depending on the type of steering gear, are defined as follows:
   (a) an electric motor and its associated electrical equipment (in the case of electric steering gear); or
   (b) a hydraulic pump, electric motor and its associated electrical equipment (in the case of electrohydraulic steering gear).

(5) Actuators are devices such as hydraulic motors and electric motors for transmitting power to the gear assemblies for azimuth steering gears.

1.4 Construction and Strength

1.4.1 General

Sub-paragraph -3 has been added as follows.

1 The installation and construction of thrusters are to be such that ship stability is not adversely affected even when sea water enters azimuth thruster casings and floods compartments where they are installed.

2 Sealing devices are to be provided in cases where thrusters penetrate hull structures to prevent any sea water from entering ships.

3 Thrusters are to be provided with an additional possibility of positioning and locking the failed thruster in a neutral position after a failure of its own power unit(s) and actuator(s).

1.5 Azimuth Steering Gears

Paragraph 1.5.1 has been amended as follows.

1.5.1 Capability of Azimuth Steering Gears

1 The steering arrangement of each thruster~~s~~ ~~are~~is to be capable of changing direction of the ship's directional control system from one side to the other at declared steering angle limits at an average rotational speed of not less than 2.3°/*s* with the ship running ahead at speeds specified in **2.1.8**, **Part A of the Rules** while operating with all power units. The wording "declared steering angle limits" refers to the operational limits in terms of maximum steering angle according to manufacturer guidelines for safe operation.

2 In addition to the requirements specified in **-1**, the rate of turning for azimuth steering gears is to be not less than 1.0 *rpm* in static conditions of ships if astern power is obtained by turning thrusters.

3 Thrusters are to be arranged so that after a single failure in its piping or in one of the power units, ship steering capability (but not individual steering system operation) can be maintained or speedily regained (e.g. by the possibility of positioning the failed thruster in a neutral position in an emergency, if needed).

4 The requirements of **-1** and **-3** are to apply regardless whether the thrusters are arranged with common or dedicated power units.

1.6 Electric Installations

1.6.1 General

Sub-paragraph -1 has been amended as follows.

1 Each ~~T~~thruster~~s~~ ~~are~~is to be served ~~separately~~ by at least two exclusive circuits fed directly from main switchboards. ~~In cases where three or more thrusters are provided, such exclusive circuits may be composed of at least two systems.~~ However,~~Either~~ one of these circuits may be supplied through emergency switchboards.

2 Cables used in those exclusive circuits required in **-1** are to be separated, as far as practicable, throughout their length.

3 Audible and visual alarms are to be given on navigation bridges and at positions from which main engines are normally controlled in the event of any power failure to electric motors for propulsion and steering.

4 For items not specified in this section **1.6.1**, those requirements specified in **Part H of the Rules** are to apply.

1.13 Special Requirements for Thrusters Installed in Ships with Restricted Areas of Service and Small Ships

Paragraph 1.13.1 has been amended as follows.

1.13.1 Ships with Class Notation "*Coasting Service*", "*Smooth Water Service*" or the Equivalent

1 For ships with the Class Notation "*Coasting Service*", "*Smooth Water Service*" or the equivalent, the following requirements are not necessary and may be omitted.

(1) Those requirements for auxiliary fans specified in **1.10.1-3**

(2) **1.12.1**

2 For those ships with the Class Notation "*Coasting Service*", "*Smooth Water Service*" or the equivalent which are not engaged in international voyages or whose gross tonnage is less than 500 *tons*, in addition to those requirements specified in **-1,** the following requirements are not necessary and may be omitted.

(1) **1.4.1-3**
(2) **1.5.1-3**
(~~1~~3) **1.5.3(4)**
(~~2~~4) **1.6.1-2**
(~~3~~5) **1.6.2**
(~~4~~6) Those requirements for overload alarms of motors specified in **1.6.3(2)**
(~~5~~7) **1.6.3(4)**
(~~6~~8) **1.7.1-5**
(~~7~~9) **1.11.2**

3 For the ships specified in **-2**, the following requirements may be applied.

(1) Notwithstanding the requirements of **1.6.1-1**, each thruster may be served separately by exclusive circuits fed directly from main switchboards. In cases where three or more thrusters are provided, such exclusive circuits may be composed of at least two systems. In addition, one of these circuits may be supplied through emergency switchboard.

EFFECTIVE DATE AND APPLICATION (Amendment 1-3)

1. The effective date of the amendments is 1 July 2017.

2. Notwithstanding the amendments to the Guidance, the current requirements apply to waterjet propulsion systems or azimuth thrusters whose date of application for approval is before the effective date and that are installed on 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.