Guideline No.: H-01(201610)

H-01

HYDRAULIC POWER DEVICES

Issued date: October 28, 2016

Foreword:

CCS Product Inspection and Testing Guideline (hereinafter referred to as this Guideline) contains the technical requirements, inspection and testing criteria related to classification and statutory survey of marine products to be applied for CCS approval/inspection.

This Guideline frees the users to adopt other test methods and requirements which are equivalent to or are stricter than this Guideline.

This Guideline is published and updated by CCS, and is released at http://www.ccs.org.cn. Your comments or suggestions are welcomed and may be sent to our email addressed mp@ccs.org.cn.

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Main changes:

The “5 material and components” is amended to coordinate with the rules.

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HYDRAULI POWER DEVICES

1 Application

1.1 This guideline applies to marine hydraulic devices intended for installation onboard sea-going ships classed with CCS.

1.2 The hydraulic power devices referred to in This Guideline include:

(1) hydraulic power devices;

(2) hydraulic automatic control devices;

(3) hydraulic remote control devices.

1.3 This Guideline does not cover:

(1) hydraulic actuating units/parts of hydraulic power devices, such as hydraulic cylinders, hydraulic motors and remote control valves;

(2) start-up and control devices (including frequency controllers) of pump-driving power units (such as electric motors);

(3) associated electrical operating and control devices (such as electrical control devices of servo valves and proportional valves);

(4) monitoring, indication and alarm systems/devices.

The above parts and devices associated with hydraulic power devices are to be certified in compliance with the requirements of Chapter 3, PART ONE of CCS Rules for Classification of Sea-going Steel Ships.

1.4 This Guideline refers only to the relevant requirements clearly specified for hydraulic power units and control devices in the International Convention for the Safety of Life at Sea, 1974 (hereinafter referred to as “SOLAS”) and CCS Rules for Classification of Sea-going Steel Ships, not covering requirements which are not clearly specified therein for “hydraulic” means.

1.5 Although the relevant requirements for hydraulic power units and control devices of certain specific equipment and systems are not specified clearly or perfectly in SOLAS and CCS Rules for Classification of Sea-going Steel Ships, the configuration, function, capacity, protection, inspection and test of such equipment and systems, if fitted with hydraulic power units and control devices, are to comply with the equivalent technical requirements for non-hydraulic power units and control devices of corresponding equipment and systems in addition to the general requirements for hydraulic power devices in This Guideline, due to the rapid development of science and technology and the continuous development and improvement of hydraulic control techniques.

1.6 In respect to specific requirements for steering gear hydraulic power systems, reference is to be made to certain general requirements of This Guideline and in addition, to the relevant requirements in Section 1, Chapter 13, PART THREE of CCS Rules for Classification of Sea-going Steel Ships and in Chapter 1, PART SEVEN of the Guidelines.

1.7 In respect to requirements for windlass hydraulic power systems, reference is to be made to certain general requirements of this Chapter and in addition, to the relevant requirements in Section 2, Chapter 13, PART THREE of CCS Rules for Classification of Sea-going Steel Ships and in Chapter 2, PART SEVEN of the Guidelines.

2 Basis for approval and inspection

2.1 The approval and inspection in This Guideline are to be based on the following documents:
(1) CCS Rules for Classification of Sea-going Steel Ships;
(2) CCS Rules for Materials and Welding;
(3) CCS Rules for Lifting Appliances of Ships and Offshore Installations;
(4) SOLAS.
2.2 The paragraphs in the above mentioned basis for approval and inspection quoted are part of This Guideline. For quoted documents marked with the date, their subsequent amendments (except corrigenda) or revisions will be inapplicable, hence, it is to meet the requirements of the latest edition of these documents during the product design, manufacture and inspection. However, for those quoted documents without any date marked, the latest edition applies to This Guideline.

3 Terms and definitions

3.1 The terms and definitions given in SOLAS and CCS Rules for Classification of Sea-going Steel Ships are applicable to This Guideline.
3.2 The following definitions are added in This Guideline:
(1) Nominal pressure in respect to hydraulic power devices is usually taken as being equal to design pressure:

① for a system, nominal pressure usually is not less than the maximum permissible working pressure at the outlet of each pump unit of the system, i.e. not less than the maximum set value of the safety valve/relief valve at pump outlet;

② for hydraulic components, nominal pressure is their maximum permissible working pressure (such as the rated pressure);

③ for a multi-power/output control system, nominal pressure is also known as the maximum permissible working pressure of each power/output control subsystem, usually not greater than the set pressure of the safety valve installed therein.

(2) Working pressure usually is a combination of maximum pressure difference required for rated output power of the hydraulic actuator and pressure loss of the hydraulic system through its piping:

① for single power/output control systems, working pressure usually is the working pressure of pump outlet of each pump unit, not greater than the set pressure of the relief valve at pump outlet;

② for multi-power/output control systems, working pressure is also known as the maximum working pressure of each power/output control subsystem, usually not greater than the set pressure of the relief valve and pressure-reducing valve installed therein.

(3) Rated flow is the maximum flow possible for a piping or component:

① for non-constant power systems, rated flow usually is a combination of maximum flow required for rated output power of the hydraulic actuator and loss of capacity efficiency of the hydraulic system; for single power/output control systems, it usually is the maximum set flow of each pump unit;

② for constant power systems, rated flow usually is a combination of maximum flow

required for the hydraulic actuator and loss of capacity efficiency of the hydraulic system; for single power/output control systems, it usually is the maximum set flow of each constant power pump unit;

③ for multi-power/output control systems, rated flow is also known as the maximum flow of each power/output control subsystem.

(4) Single power/output control system is a system in which the pump unit (including the standby pump unit) supplies hydraulic power for only one hydraulic actuator.

(5) Multi-power/output control system is a system in which at least one pump unit (including the standby pump unit) supplies hydraulic power for several hydraulic actuators.

(6) Hydraulic power unit is a device which directly supplies hydraulic power for hydraulic actuators (such as hydraulic cylinders, hydraulic motors) of machineries (such as hydraulic steering gears, windlasses, winches and cranes), usually including hydraulic pumps, power units (such as electrical motors, diesel engines) which drive such pumps, and related piping, fittings, control valves and oil tanks, etc.

(7) Hydraulic automatic control device is a device using a controller (such as solenoid valve, hydraulic servo valve, proportional valve) to control hydraulic power so that the controlled object (such as machine, equipment) runs automatically to the preset order in a certain working condition or at a certain parameter (i.e. controlled value), without direct manual attendance. Such control devices usually include controllers, hydraulic piping systems, fittings, hydraulic pumps supplying controlled hydraulic power, power units driving such hydraulic pumps (e.g. electrical motors) and hydraulic actuators.

(8) Hydraulic remote control device is a device using hydraulic power to remotely control the object (such as machine, equipment) so that it runs automatically according to the operator's order in a certain working condition or at a certain parameter (i.e. controlled value), with direct manual operation of means of transmitting hydraulic power. Such remote devices usually include means of transmitting hydraulic power (such as control valves, control pumps), means of receiving hydraulic power (such as servo hydraulic cylinders, remotely controlled valves), piping systems, fittings, hydraulic pumps supplying hydraulic power for remote control, power units driving such pumps (e.g. electrical motors) and hydraulic actuators.

4 Plans and documents

4.1 Unless expressly provided otherwise by CCS, the following plans and technical documents are to be usually submitted to CCS when the applicant applies for inspection or approval of marine hydraulic power devices for the first time.

4.1.1 The following plans and documents are to be submitted to CCS for examination:

(1) List of main specifications and performance parameters (which may be included in general arrangement or hydraulic system drawing) usually covering:

① nominal pressure of each system (MPa);

② working pressure of each system (MPa);

③ set value of safety valves, relief valves, pressure-reducing valves and back pressure valves (MPa);

④ rated flow of each system (l/min);

⑤ specification, type, nominal pressure, capacity and nominal speed of hydraulic pumps;
⑥ specification, type, power, rated speed and electrical power supply of driving devices (electrical motors);
⑦ specification, type, nominal flow or diameter, nominal pressure and control power of associated solenoid/proportional/servo valves; if these valves are controlled by direct current, the voltage fluctuation data of the applicable power source which controls these valves are to be provided;
⑧ effective capacity of each oil tank (power unit oil tank, storage tanks), taken usually as 80% of total theoretical capacity of the oil tank;
⑨ arrangement of monitoring alarm points;
⑩ recommended type and applicable temperature range of hydraulic oil (compliance with the requirements for minimum and maximum ambient temperatures is necessary);
⑪ intended purpose of the product, etc.

(2) General arrangement of products, usually stating the following clearly:
① scope of supply of products for inspection (delivery);
② match relations between components of each system;
③ required installation height of hydraulic oil tank (if the hydraulic pump is not integrated with oil tank);
④ main technical parameters of products;
⑤ external dimensions.

(3) General assembly of hydraulic power/control units, usually stating the following clearly:
① relevant technical requirements for manufacturing, installation and inspection;
② main dimension (capacity), shell material;
③ fitting of oil level indicator;
④ oil suction position of hydraulic pump;
⑤ fitting of monitoring alarm sensors, such as those for oil temperature, oil level, low pressure, filter block;
⑥ setting of alarm points;
⑦ fitting of cooler (if applicable);
⑧ fitting of heater (if applicable).

(4) Drawings of following parts (if self-made):
① assembly of isolating valves and related documents;
② assembly of safety valves and related documents;
③ non-standard seals, etc.

(5) (Schematic) Diagram of hydraulic system, usually stating the following clearly:
① arrangement of complete sets of hydraulic power/control systems and their relationships (including internal oil circuit control);
② specification, type and main parameters (nominal pressure, nominal flow/diameter, rated speed, capacity, filter precision, etc.) of main components, usually including hydraulic hoses, hydraulic pumps, electrical motors, safety valves, relief valves, pressure-reducing valves, back pressure valves, solenoid valves, proportional valve/servo valves, filters, accumulators, pressure gauges and their switches, stop valves, pressure/flow/temperature measuring means, and coolers;
③ specification, type, diameter, wall thickness and material of piping systems;

④ table of (solenoid) control valve actions in working cycles of each system;
⑤ setting of safety valves, relief valves, pressure-reducing valves and back pressure valves (MPa);
⑥ main technical parameters of actuating unit (if applicable);
⑦ setting of monitoring alarm sensors, such as those for pressure, oil temperature, oil level, filter block;
⑧ recommended oil.

(6) Assembly drawing of oil manifold block, usually stating the following clearly:
① schematic hydraulic diagram;
② serial number or code name of external interfaces;
③ material type of manifold block;
④ relevant technical requirements for manufacturing and inspection.

(7) Type test programme, usually stating the following clearly:
① test items and acceptance criteria;
② test method;
③ requirements for test instrumentation;
④ requirements for ambient conditions of the test;
⑤ requirements for oil used in the test;
⑥ requirements for load-applying equipment used for the test.

4.1.2 The following plans and documents are to be submitted to CCS for information:

(1) Applicable technical standards.

(2) Hydraulic system calculations, usually covering check of the following:
① rated flow of the system;
② calculation or description for selection of nominal pressure of the system;
③ calculation for driving power of pumps and selection of electrical motors;
④ piping specification and rules-required wall thickness;
⑤ related calculation of isolating valves/safety valves (if self-made);
⑥ calculation or description for selection of oil pump coupling.

(3) Product instructions, usually including the following:
① rules and standards with which product design is in compliance, application of product;
② scope of supply of products and their main technical parameters (including recommended hydraulic oil);
③ working principles (with related schematic diagram);
④ requirements for installation and maintenance;
⑤ necessary safety caution;
⑥ emergency troubleshooting.

(4) Table of physical and chemical properties of material of main components and parts (if hydraulic manifold blocks and steel pipes etc. are of non-standard or non-Chinese-standard materials).

4.1.3 A manufacturer seeking the approval by CCS is to submit an application to CCS with the main process of manufacturing for the first（For example: Flange; Welding process of steel tube[If application] ;Heat treatment process Etc）; and the main acceptance standard of Welding and NDT[If application] for product approval, Please submit the document to CCS local branch

5 Materials and components

Materials and components are to comply with relevant requirements of CCS Rules

5.1 Components of hydraulic power devices:

Components of Hydraulic power devices **Table 5.1**

<table>
<tr><td rowspan="6">Hydraulic devices</td><td rowspan="3">Power unit</td><td colspan="3">Hydraulic pump</td></tr>
<tr><td rowspan="2">Pump driver</td><td>Electrical motor</td><td>Starter box (including frequency controller)</td></tr>
<tr><td colspan="2">Diesel engine</td></tr>
<tr><td colspan="3">Coupling</td></tr>
<tr><td>Fittings of piping</td><td colspan="3">Control valve (solenoid valve, proportional control valve, servo valve, etc.),safety valve, relief valve, back pressure valve, balance valve, oil filter, oil cooler, (main/standby) oil tank, steel pipe, high pressure hose, mechanical pipe joint, accumulator, heater, etc.</td></tr>
<tr><td rowspan="2">Monitoring and indicator components</td><td>Indicator</td><td colspan="2">Pressure gauge, level gauge, thermometer, lamp, etc.</td></tr>
<tr><td>Monitoring</td><td colspan="2">Pressure sensor/relay, temperature sensor, fluid level relay, travel switch, etc.</td></tr>
</table>

6 Evaluation of welding procedures

Welding structures related to equipment and system safety in Hydraulic power devices are to be in accordance with CCS Rules for Materials and Welding.

7 Design and technical requirements

7.1 Technical requirements

7.1.1 General technical requirements for marine Hydraulic power devices are given in Table 1.7.1.1.

General Technical Requirements for Marine Hydraulic power devices **Table 7.1.1**

No.	Specific requirements	Basis of inspection	Remarks
1	General		
1.1	Submission of plans and documents	3.3.2.1, PART ONE of CCS Rules for Classification of Sea-Going Steel Ships	Also to comply with the requirements of 4 of This Guide
		1.1.3.2, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
		1.1.3.3, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	

No.	Specific requirements	Basis of inspection	Remarks
1.2	Ambient conditions	1.2.1.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	1. For column "main and auxiliary machinery", fitting of pump oil suction and level sensor is to comply with the requirements. 2. All components installed on hydraulic actuating unit (such as hydraulic cylinder) or connected with hydraulic actuating unit are to be secured to prevent loosening caused by impact and vibration
		1.2.1.2, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	For column "air", selection of hydraulic oil and control of system temperature rise are to comply with the requirements.
1.3	Corrosion protection	1.3.5.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	The manufacturer is to ensure the following: 1. All internal surfaces of oil tank are cleaned thoroughly, free from humidity, dirt, chips, fluxes, scales, slag, fibrous substances and any other contaminants; 2. All internal coatings in oil tank are to be compatible with the hydraulic oil used for the system and with the atmospheric environment, and applied according to supplier's recommendation. If such coating is not used, internal steel surfaces are to be coated with rust inhibitors compatible with the hydraulic oil; 3. For important Hydraulic power devices on deck (such as launching arrangements of survival craft), it is recommended that seawater (salt mist) resistant material be used for oil tank
1.4	General safety	1.3.6.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	1. Hydraulic pumps and motors are to be installed in places protected against foreseeable, or they are to be suitably protected. 2. All drive shafts and couplings are to be suitably protected, in particular rotating parts of pumps are to be additionally fitted with protective cover
		1.3.6.2, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	Requirements for specific equipment: 1. For gas-loaded accumulators, the manufacturer is to ensure: 1) The following are to be marked on accumulators or their nameplate: — "Warning – Pressure vessel, oil is to be discharged before dismantling" — Rated air charging pressure — "Only … is to be used as charging medium (such as nitrogen) 2) Warning label is to be attached on hydraulic systems fitted with gas-loaded accumulators, indicating "Warning – system with accumulator, pressure to be reduced before repair"; the same is to be indicated on the diagram of hydraulic system
		1.3.6.3, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	Hydraulic systems are to be so designed that protective device is arranged or fitted to prevent personnel from being hurt by surface temperature exceeding touch limit

Continued Table 7.1.1

1.5	Associated electrical components, apparatus and installations	PART FOUR of CCS Rules for Classification of Sea-Going Steel Ships	For apparatuses controlled by direct current, e.g. solenoid valves, proportional valves and servo valves, particular attention is to be given to their capability of withstanding power and voltage variations in compliance with the requirements in 1.2.2.2, PART FOUR of CCS Rules for Classification of Sea-Going Steel Ships. None of these apparatuses which do not meet the criterion of 25% voltage drop is allowed in systems supplied directly by accumulators. Unless the requirements in 1.2.2.3, PART FOUR of CCS Rules for Classification of Sea-Going Steel Ships are complied with, none of these apparatuses which do not meet the criterion of 10% voltage drop is allowed. In practical application, consideration is to be given to testing voltage of electromagnetic coil terminals in operating condition of electromagnets/relays, and the sum of total voltage drops of cables is to comply 2.12.4.2, PART FOUR of CCS Rules for Classification of Sea-Going Steel Ships
2	Materials		
2.1	General	1.2.8.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	Mainly for pressure components and parts (such as steel pipes, accumulators, valves, oil manifold blocks)
		4.7.1.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	The manufacturer is to ensure the following: 1. Materials of seals and sealing devices are to be compatible with oil used, materials of adjacent parts and their working conditions and ambient conditions; 2. Components and parts are to be designed to facilitate servicing and replacing of seals and sealing devices
		4.7.1.3, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	Essential components and parts in hydraulic power transmission systems usually include pumps, piping, valves and accumulators
2.2	Hydraulic oil	4.7.1.2, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	1. In selection of hydraulic oil, the manufacturer is to ensure compliance with service limits of hydraulic oil for hydraulic components and apparatuses in use; 2. The manufacturer is to specify the type, viscosity and temperature of recommended “hydraulic oil” medium clearly in operating instructions, complying with ambient conditions required for intended purpose of Hydraulic power devices; 3. Special consideration is to be given to high-water-based medium as hydraulic oil
2.3	Use of materials containing asbestos	SOLAS Reg. II-1/3-5 1.2.8.2, PART THREE of CCS Rules for Classification of Sea-going Steel Ships	Materials containing asbestos are prohibited
3	Hydraulic systems		
3.1	Hydraulic systems are not to be used for lubrication purposes	4.7.2.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
3.2	Strength of pipes and fittings	4.7.2.2, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	The manufacturer is to ensure the following: 1. All components in the system are to be selected and specified to guarantee their safe use. Components are to be selected and specified to ensure reliable operation for their intended purposes within rated limits. Special attention is to be paid for the reliability of components which might cause danger when failed or inadvertently operated; 2. Strength check is to be carried out according to piping design pressure; 3. Transmission couplings and seats are to be capable of repeatedly withstanding the maximum torque in all conditions; 4. The rated pressure of pipe connection is not to be less than maximum working pressure at its position in the system

Continued Table 7.1.1

3.3	Fitting of filters	4.7.2.3, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	The manufacturer is to ensure the following: 1. The fitting of filters is to limit particle contamination of the system to a level suitable for the components selected and required for intended usage; 2. All filter assemblies are to be fitted with indication for maintenance. The indication is to be easily seen by operators or maintenance personnel; 3. Bypass valve is to be provided for filter assemblies which would be damaged due to their cartridge being not capable of withstanding total pressure difference of the system; 4. The filters are to be fitted for easy access and enough space is to be provided for replacing cartridge; 5. Unless agreed between customer and supplier, the pump oil suction line is not to be fitted with (fine) filter. However, oil suction screen or coarse filter is allowed; 6. For fitting of coarse filters, the pump inlet is to be in the condition defined by the manufacturer. Special attention is to be paid to this for cold start
3.4	Fitting of relief valves	4.7.2.3, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	1. Design is required to prevent the pressure of all parts in the system from exceeding maximum working pressure of the system or any part of it as well as rated pressure of any specific component. Otherwise, protective measures are to be taken; 2. Relief valves or safety valves satisfying rated flow are to be installed in all (manifold/sub)systems or pipelines requiring restriction of excessive pressure; 3. Systems are to be designed, manufactured and adjusted to minimize impact pressure and charge pressure without causing danger; 4. Personnel are not to be subjected to danger at pressure loss or critical pressure drops
3.5	Fitting of escape valves	4.7.2.4, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	

Continued Table 7.1.1

3.6	Fitting of accumulators	4.7.2.5, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	1. Requirements for hydraulic systems with gas-loaded accumulators: 1) Oil pressure of gas-loaded accumulator is to be relieved automatically or the accumulator is to be isolated reliably when stopping the hydraulic system; 2) If pressure is needed after stopping the system, above requirement is not necessary; 3) All associated pressure compoments are to be used in rated range of pressure, temperature and ambient conditions, and protective device may be needed to prevent overpressure at the air side in special cases; 4) If design of the accumulator requires isolation of oil pressure when stopping the system, complete information of safe maintenance is required on the accumulator or in an obvious place near it; 5) Main routine maintenance is examination or adjustment of charge pressure. Only devices and procedures recommended by the supplier are to be used for charge of accumulator. The dial of pressure gauges used for routine pressure monitoring is to have color code or other equivalent means to clearly indicate minimum and maximum allowable working pressure ranges of the system. The gas charged is to be nitrogen or another applicable gas. 2. No fuse plug, but only a safety valve is to be provided for an accumulator supplying emergency power source. Special consideration is to be given to reliability of the safety valve and selection of its orifice (safety valves may be selected according to ISO 4126 standard); 3. If the system has effective control to charging pressure of the hydraulic accumulator, relief valve need not be fitted at inlet of accumulator, only safety valve protecting the accumulator is required at fluid side (such as on the accumulator itself or at its hydraulic oil inlet). Unless proper precautions are taken, no stop valve is allowed between safety valve and accumulator. Special consideration is to be given for selecting orifice of the safety valve with the adjusted pressure being the lesser of the following: 1) not greater than design pressure of the accumulator; 2) maximum permissible pressure of service piping system of the accumulator. 4. The opening pressure of safety valve at air side (if any) is to be more than 10% of the set pressure of safety valve at liquid side, and the relief of safety valve at air side is to limit the inside pressure of the accumulator to not more than 120% of set pressure of safety valve at fluid side in any case; 5. Accumulators in which air and liquid are not isolated effectively are not to be used
3.7	Use of flexible hoses	4.7.2.6, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	1. Use of flexible hoses between fixed pipelines or between fixed pipelines and fixed equipment parts is forbidden, unless specially approved by CCS; 2. Production date of flexible hoses and flexible hose assemblies (such as season and year) is to be marked; 3. The longest storage time of flexible hoses recommended by the manufacturer is to be indicated; 4. Service life recommended by the supplier of the system is to be indicated and if possible, ambient conditions are to be considered, such as indoor or outdoor use, or any other heat source; 5. The bending radius of the flexible hose is not to be less than the maximum value recommended; 6. If failure of the flexible hose assembly will cause danger of hitting, it is to be fixed or sheltered; 7. If failure of the flexible hose assembly will cause danger of oil injection or burning, it is to be sheltered

Continued Table 7.1.1

3.8	Conditions for fitting of emergency hand pumps	4.7.2.7, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	If a solenoid valve is to be operated for the sake of safety or other reasons when its electrical control fails, it is to be provided with a manual emergency control button or similar means. Such means is to be designed and selected to prevent inadvertent operation. Unless specified otherwise, manual control is to be automatically reset when such control is relieved
3.9	Fitting of standby power pumps	4.7.2.8, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
3.10	Independent arrangement of the system	4.7.3.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
3.11	Fitting of general alarm devices	SOLAS Reg. II-1/53.4.3	Including oil temperature monitoring and alarm requirements

7.1.2 General technical requirements for marine hydraulic power units

(1) Marine hydraulic power units are to comply with the requirements of Table 1.7.1.1 of this Chapter and in addition, the general technical requirements of Table 7.1.2.

General Technical Requirements for Marine Hydraulic Power Units Table 7.1.2

No.	Specific requirements	Basis of inspection	Remarks
1	General		
1.1	Submission of plans and documents	2.1.2.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships 2.1.2.4, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	To comply with the requirements of 1.4 of This Guide
1.2	System design pressure	2.1.3.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	1. Unless specially required for parts such as actuators, pressure of the safety valve at pump outlet usually is simply the maximum working pressure of entire corresponding system of the pump unit; 2. For hydraulic devices with multi-purposes, separate safety valves/relief valves/pressure-reducing valves are to be installed for different intended purposes where additional protection is needed for the system and actuators. Different design pressures may be given for different parts of the system, and different settings of safety valves/relief valves are to determined. Hydraulic test and tightness test of such parts will be changed accordingly
1.3	Hydraulic system design temperature	2.1.4.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	1. Usually from maximum ambient temperature to the temperature when the inside temperature of circulating oil tank (of open-type systems) reaches 60℃ ~ 65℃ (i.e. maximum ambient temperature + system temperature rise). The system temperature rise is usually controlled within 20 K. Unless special consideration is given to selection of hydraulic oil and hydraulic components, oil cooler is to be installed; 2. The working temperature range of the system and any component is not to exceed the limits required for safe use; 3. When a heater is used, its dissipation power per unit area is not to exceed the range recommended by the hydraulic oil manufacturer. Automatic temperature control is to be adopted to keep the expected hydraulic oil temperature
1.4	Classes of pipes	2.1.5.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	There are flammable and non-flammable hydraulic oils, so the manufacturer is to specify the type and combustion properties of the hydraulic oil recommended for the system

Continued Table 7.1.2

1.5	Basic requirements for materials	2.1.6, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships 4.1.2, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	Consideration is mainly to be given to compatibility of special hydraulic media (such as seawater, pure water, high-water-based medium) with materials. The low temperature property of hydraulic oil is to meet ambient conditions for the system's intended purposes. For example, in the case of hydraulic equipment on deck, the effects on equipment performance because of viscosity variation of hydraulic oil at minimum ambient temperature are to be considered. Salt air corrosion protection within oil tank is also to be considered
2	Structure and design		
2.1	Carbon, low alloy steel pipes and valves	2.2.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	1. For cold-drawn steel pipes, usually the pipes delivered in annealed condition are to be purchased to ensure necessary elongation and compliance with the requirements in Chapter 4, PART TWO of CCS Rules for Materials and Welding; 2. The elongation of hydraulic manifold block material is not to be less than 12%
2.2	Check of wall thickness of steel pipes and permissible stress	2.2.2, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
2.3	Copper, copper alloy pipes and valves	2.3.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
2.4	Check of wall thickness of copper and copper alloy pipes and permissible stress	2.3.2, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
2.5	Grey cast iron pipes, valves and fittings	2.4.1.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	1. Brittle material with impact toughness α_k less than 50 Nm/cm^2 and elongation δ less than 5% is not to be used for marine hydraulic valve casing, unless specified otherwise by CCS; 2. For Class I and Class II duplicated piping systems which could operate as each other's standby or those provided with independent emergency means, consideration may be given to using grey cast iron as casing material of hydraulic valve between power pump and oil cylinder isolating valve (not including isolating valve)
2.6	Nodular graphite cast pipes, valves and fittings	2.4.2.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
2.7	Flexible hoses	2.4.4, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	Flexible hose is not to be used between fixed pipelines or between fixed pipelines and fixed equipment parts, unless specially approved by CCS
2.8	Connection of pipe lengths	2.5.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	Leakage is to be prevented for pipe connection. No pipe threading or stuffed structure is to be used
2.9	Flange connections	2.5.2, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
2.10	Mechanical joints	2.5.3, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
2.11	Heat treatment	2.5.4, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	

Continued Table 7.1.2

2.12	Non-destructive testing	2.5.5, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
3	Arrangement of hydraulic system		
3.1	Securing of pipes	2.8.1.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
3.2	Corrosion protection of pipes	2.8.3.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
3.3	Fitting of drain valves and cocks	2.8.5.2, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
3.4	Principle of fitting of safety valves	2.8.5.3, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
3.5	Considerations after installation of pressure-reducing valves	2.8.5.4, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
3.6	Restricted use of slip type expansion joints	2.8.7.3, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
3.7	Valves with remote control	2.8.8.4, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
4	Test by manufacturer		
4.1	Pressure tests of piping	2.7.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
4.2	Hydraulic tests of valves and fittings	2.7.2, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
5	Tests after installation on board		
5.1	Leakage test of hydraulic systems	2.7.3.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	Inspection is to be carried out in normal working condition of the equipment
5.2	Tightness test of hydraulic systems	2.7.3.2, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
5.3	Conditions for exemption of welded pipes from hydraulic tests	2.7.3.3 and 2.7.3.4, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	

Continued Table 7.1.2

6	Functioning of hydraulic system of ships with ice notations	14.1.1.2, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	Consideration is to be given in particular to effects of low temperature influence to system

7.1.3 General technical requirements for marine hydraulic automatic control devices and hydraulic remote control devices

(1) In addition to the requirements of Table 7.1.1 and Table 7.1.2 of This Guide, marine hydraulic control devices covered mainly by PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships are also to comply with the general technical requirements for marine hydraulic automatic control devices and hydraulic remote control devices of Table 7.1.3.

General Technical Requirements for Marine Hydraulic Automatic Control Devices and Hydraulic Remote Control Devices Table 7.1.3

No.	Specific requirements		Basis of inspection	Remarks
1	General			
1.1	Submission of plans and documents		1.1.3, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	To comply with the requirements of 1.4 of This Guide
1.2	Ambient conditions	Ambient air temperature	2.1.1.1, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
		Relative humidity	2.1.1.2, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
		Vibration	2.1.1.3, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
		Inclination and rolling	2.1.1.4, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
		Salt-air, oil-laden atmosphere, etc.	2.1.1.5, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
1.3	Applicability of associated electrical installations and parts to power source		2.1.2.1, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
1.4	Electromagnetic compatibility of system		2.1.2.2, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	

Continued Table 7.1.3

1.5	Range of pressure variations of power source	2.1.2.3, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	1. ±20％ pressure variations are in respect to controlled part (actuator). The pressure variation is a combination of output control pressure variation of hydraulic control devices and pressure loss through its piping, so the manufacturer of hydraulic control devices is to provide the deviation range to keep the control pressure in allowed ambient conditions, the values in the range being less than ±20 ％ of the control pressure variations; 2. If an accumulator is used to control pressure, the minimum pressure for recharge is to comply with the above requirements
1.6	Application of fail-safe principle and reliability of system installations	2.1.3, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
1.7	Independence principle of system/equipment design	2.1.4, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
1.8	Examination and lock-in of settings	2.1.5, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
1.9	Power supply	2.1.6, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
1.10	Fault indication, identification and alarm	2.1.7.1, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
2	Design of control systems		
2.1	Categories of control systems	2.2.1.1, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
2.2	Properties and accuracy of control devices	2.2.1.2, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
2.3	Safety independence	2.2.1.3, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
2.4	Measures to be taken after failure of control system	2.2.1.4, 3.7.2.1(5), 4.2.2.1(2)⑤ and 4.3.2.1(4), PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
2.5	Independence of control of essential equipment	2.2.1.5, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
2.6	Conditions for local relaxation of independence	2.2.1.6, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
3	Hydraulic power source and piping		

Continued Table 7.1.3

3.1	When the pressure of pump is less than the set value	2.2.2.1(1), PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
3.2	When system pressure is less than the set value	2.2.2.1(2), PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
3.3	Construction and arrangement of pipeline	3.9.1.2(1), PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
4	Safety systems		
4.1	In case of faults of equipment	2.3.1.1, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
4.2	Handling safety system faults	2.3.1.2, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
4.3	Safety system response after alarming	2.3.1.3, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
4.4	Requirements for maintaining the operation of safety systems	2.3.1.4, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
4.5	Override setting	2.3.2.1, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
4.6	Alarming in case of overriding	2.3.2.2, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
4.7	Preclusion of inadvertent operation of overriding push button	2.3.2.3, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	
5	Inspection and test		
5.1	Test of system after installation on board	1.1.5, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships	

7.1.4 Special technical requirements for categories of marine Hydraulic power devices

(1) Marine Hydraulic power devices are to comply with the requirements of Table 7.1.1, Table 7.1.2 and Table 7.1.3 (if applicable) and in addition, the special technical requirements for their categories in Table 7.1.4.

Special Technical Requirements for Categories of Marine Hydraulic power devices

Table 7.1.4

No.	Specific requirements	Basis of inspection	Remarks
1	Hydraulic system of hatch covers		
1.1	Hydraulic securing of hatch covers of bulk carriers	8.11.5.1, PART TWO of CCS Rules for Classification of Sea-Going Steel Ships	
2	Hydraulic control system of doors of ro-ro ships		
2.1	Hydraulic locking of doors	9.4.7.1(3), PART TWO of CCS Rules for Classification of Sea-Going Steel Ships 9.5.6.3, PART TWO of CCS Rules for Classification of Sea-Going Steel Ships	
2.2	Relationship between securing system and other systems	9.4.7.1(3), PART TWO of CCS Rules for Classification of Sea-Going Steel Ships 9.5.6.3, PART TWO of CCS Rules for Classification of Sea-Going Steel Ships	
3	Hydraulic devices of dredgers	14.9.3, PART TWO of CCS Rules for Classification of Sea-Going Steel Ships	
3.1	Power of hydraulic system connected to two half hulls	14.9.3.1, PART TWO of CCS Rules for Classification of Sea-Going Steel Ships	
3.2	Dynamic load acting on hydraulic device	14.9.3.7, PART TWO of CCS Rules for Classification of Sea-Going Steel Ships	
4	Hydraulic transmission arrangements of shafting	11.3.5, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
4.1	Emergency means for failures	11.3.5.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
4.2	Independence of lubrication oil system of hydraulic transmission arrangements	11.3.5.2, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
4.3	Parts of lubrication oil system of hydraulic transmission arrangements	11.3.5.2, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
4.4	Fitting of standby pumps	11.3.5.3, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	

Continued Table 7.1.4

4.5	Monitoring, indication and alarm of lubricating oil system of hydraulic transmission arrangements	11.3.5.4, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
4.6	Hydraulic couplings	11.3.5.5, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
4.7	Oil charging and discharging of hydraulic transmission arrangements	11.3.5.6, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
4.8	Control positions of hydraulic transmission arrangements	11.3.5.7, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
4.9	Fitting of interlocking device	11.3.5.8, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
4.10	Condition indication of controlled object of hydraulic transmission arrangements	11.3.5.9, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
5	Hydraulic transmission system for controllable pitch propeller	11.3.6, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
5.1	Conditions for fitting of standby pumps or manual emergency pumps and their capacities	11.3.6.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships 3.2.5.5, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
5.2	Interlocking of control system	11.3.6.3, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
5.3	Fitting of standby manual control system	11.3.6.3, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
5.4	Accuracy of control	11.3.6.4, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
5.5	Propeller locking ability	11.3.6.5, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
5.6	Pitch adjusting range	11.3.6.7, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
5.7	Time required for control of propeller blade	11.3.6.6, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	

Continued Table 7.1.4

5.8	System alarm	Excessively low pressure of system	11.3.6.9(1), PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	Requirements in item 10 of Table 3.10.1.1, item 9 of Table 4.2.6.1 and item 4 of Table 4.3.4.1, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships
		Low oil level of main hydraulic oil tank	11.3.6.9(2), PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	1. Requirements in item 10 of Table 3.10.1.1, item 9 of Table 4.2.6.1 and item 4 of Table 4.3.4.1, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships; 2. The influence of roll of the ship is to be considered for fitting of low hydraulic oil level sensors
		Blocked oil filter	11.3.6.9(3), PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	Usually it is in accordance with the set value provided by the filter manufacturer for pressure difference sensors. Otherwise, alarm value is to be set for the pressure not exceeding 0.35 MPa at both ends of the filter
		Excessively high oil temperature	11.3.6.9(5), PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	1. Requirements in item 10 of Table 3.10.1.1, item 9 of Table 4.2.6.1 and item 4 of Table 4.3.4.1, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships; 2. The system temperature rise is usually controlled within 20K. Unless special consideration is given to selection of hydraulic oil and hydraulic components, otherwise oil cooler is to be installed. Usually set value is 60℃ ~ 65℃, not higher than 70℃
		Failure of pitch adjusting function	11.3.6.9(6), PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	Requirements in item 10 of Table 3.10.1.1, item 9 of Table 4.2.6.1 and item 4 of Table 4.3.4.1, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships
		Failure of power supply to control system	11.3.6.9(7), PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	1. Requirements in item 10 of Table 3.10.1.1, item 9 of Table 4.2.6.1 and item 4 of Table 4.3.4.1, PART SEVEN of CCS Rules for Classification of Sea-Going Steel Ships
5.9	Handling of control system failures		11.3.6.11, PART THREE of the Rule; SOLAS Reg. II-1/26.3.10	
5.10	Means of emergency control		11.3.6.12, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
5.11	Hydraulic test and tightness test		11.3.6.13, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
6	Hydraulic Z propulsion arrangement		11.3.7, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
6.1	Control locations		11.3.7.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
6.2	Rudder indicator		11.3.7.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
6.3	Provision of spare power equipment and emergency control measures		11.3.7.3, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
6.4	Position of alarm indication		11.3.7.7, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	

Continued Table 7.1.4

6.5	System alarm	Low level of hydraulic oil	11.3.7.7(3), PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
6.6		Low pressure of hydraulic oil	11.3.7.7(4), PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
6.7		High temperature of hydraulic oil	11.3.7.7(5), PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
6.8		Oil filter blocks	11.3.7.7(6), PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
6.9	Requirements for hydraulic test and tightness test		11.3.7.9, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
6.10	Special requirements for hydraulic systems		11.3.7.10, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	Hydraulic systems are also to comply with the relevant requirements of the Guidelines, corresponding to 13.1.7, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships
7	Hydraulic transverse propulsion arrangement		11.3.8, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
7.1	Materials and tests		11.3.8.2, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
7.2	Driving motor		11.3.8.4, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
7.3	Position of alarm indicator		11.3.8.8, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
7.4	System alarm	Low level of hydraulic oil	11.3.8.8(6), PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
		Low pressure of hydraulic oil	11.3.8.8(7), PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
7.5	Automated equipment		11.3.8.11, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
8	Hydraulic system of steering gear		13.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
8.1	Power system of hydraulic steering gear		13.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	To comply with the relevant requirements hydraulic steering gearof the Guidelines

Continued Table 7.1.4

8.2	Arrangement of main steering gear control system		13.1.8.1(1), 13.1.8.1(2), 13.1.8.2 and 13.1.8.5(5), PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	1. Local manual emergency control is to be provided for controlled valves and pumps in steering gear room according to the requirements in 13.1.8.1(1) and 13.1.8.2(1), PART THREE of CCS Rules for Classification of Sea-Going Steel Ships; 2. For hydraulic equipment with steering wheel, idle running of the hand wheel is not to exceed half circle
8.3	Arrangement of auxiliary steering gear control system		13.1.8.1(3), 13.1.8.2 and 13.1.8.5(5), PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
8.4	Design pressure		2.1.3.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
8.5	Design temperature of hydraulic servo unit		2.1.4.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	It is usually to be -10℃ ~ 65℃ and ambient temperature plus system temperature rise. The system temperature rise is usually controlled within 20K. Unless special consideration is given to selection of hydraulic oil and hydraulic components, oil cooler is to be installed
8.6	Power failure of steering gear control system		13.1.9.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	Hydraulic remote control systems are to be additionally fitted with pressure loss alarm
9	Hydraulic system of windlass		13.2, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	To comply with the relevant requirements windlasses of the Guidelines
9.1	Connection with hydraulic pipelines of other deck machinery		13.2.5.1, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
9.2	Overload protection of prime mover		13.2.5.7, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
9.3	General requirements for hydraulic systems		13.2.5.8, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
9.4	Inspections by the manufacturer	Tests valves, etc. in piping system	13.2.6.1(1), PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
		Diesel engine of power unit	13.2.6.1(2), PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
		Electric motor of power unit	13.2.6.1(3), PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
		Final inspection and functional test	13.2.6.1(4), PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	To confirm compliance with the technical design requirements for windlasses
9.5	Test of hydraulic system after installation on board		13.2.6.2, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	

Continued Table 7.1.4

10	Pusher tug-barge combinations		
10.1	Local control	7.5.1.4, PART EIGHT of CCS Rules for Classification of Sea-Going Steel Ships	
10.2	Independent control	7.5.1.5, PART EIGHT of CCS Rules for Classification of Sea-Going Steel Ships	
10.3	Provision of power units	7.5.1.6, PART EIGHT of CCS Rules for Classification of Sea-Going Steel Ships	
10.4	Emergency disconnection in case of loss of power	7.5.1.7, PART EIGHT of CCS Rules for Classification of Sea-Going Steel Ships	
10.5	Limiting of actuator stroke	7.5.1.9, PART EIGHT of CCS Rules for Classification of Sea-Going Steel Ships	
10.6	Hydraulic connectors	7.5.1.10, PART EIGHT of CCS Rules for Classification of Sea-Going Steel Ships	Relevant technical requirements both in CCS Rules for Classification of Sea-Going Steel Ships and hydraulic steering gear of the Guidelines are to be complied with. The return oil of safety valve used to protect actuator is not to return to the low pressure space of the actuator
11	Lifting appliances		To comply with relevant requirements CRANES i of the Guidelines
11.1	Submission of plans and documents	1.3.6 of CCS Rules for Lifting Appliances of Ships and Offshore Installations	
11.2	Conditions for relaxation of test requirements for hydraulic cranes	7.4.2.5 of CCS Rules for Lifting Appliances of Ships and Offshore Installations	
12	Launching arrangements of survival craft		To comply with the requirements both LAUNCHING AND EMBARKATION APPLIANCES of the Guidelines and MSC.81(70)
12.1	No special requirements		
13	Remote control systems		
13.1	Emergency control of remote control valve of oil fuel system	4.2.6.2 and 4.2.6.3, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
13.2	Emergency control of remote control valve of lubricating oil system	4.6.4.3, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	
13.3	Emergency control of remote control valves of cargo oil tanks	5.2.4.1 and 5.2.4.2, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships	

Continued Table 7.1.4

14	Hydraulic control devices of watertight doors			2.9.8 and 2.9.9, PART FOUR of CCS Rules for Classification of Sea-Going Steel Ships
14.1	Watertight doors of passenger ships	Arrangement of hydraulic piping of controls	SOLAS Reg. II-1/15.6.3	
		Conditions for fitting of hydraulic equipment	SOLAS Reg. II-1/15.7.1.3	
		Control locations	SOLAS Reg. II-1/15.7.1.5	
		Audible alarm for closing doors	SOLAS Reg. II-1/15.7.1.6	
		Time required for door closing	SOLAS Reg. II-1/15.7.1.7	
		Provision of hydraulic power source and its capacity	SOLAS Reg. II-1/15.7.3	
		Provision of accumulator and its capacity	SOLAS Reg. II-1/.15.7.3	
		Hydraulic oil	SOLAS Reg. II-1/15.7.3	
		Failure isolation	SOLAS Reg. II-1/15.7.3	
		Alarm of low hydraulic fluid level	SOLAS Reg. II-1/15.7.3	
		Alarm of low pressure of accumulator	SOLAS Reg. II-1/15.7.3	
		Separation of power system from other systems	SOLAS Reg. II-1/15.7.3	
		Relationship between hydraulic power-operated systems and manual operation	SOLAS Reg. II-1/15.7.3	
		Fitting of control handles	SOLAS Reg. II-1/15.7.4	
		Associated electrical components	SOLAS Reg. II-1/15.7.6	
		Handling of single electrical fault	SOLAS Reg. II-1/15.7.8	
		Master mode	SOLAS Reg. II-1/15.8.1	
14.2	Watertight doors of cargo ships		SOLAS Reg. II-1/25-9.2	
15	Integrated cargo and ballast systems on tankers		2.6.7.3 and 2.6.7.4, PART FOUR of CCS Rules for Classification of Sea-Going Steel Ships	

7.2 Additional technical requirements

7.2.1 Design, manufacturing and inspection of hydraulic devices are to comply with the requirements of ISO 4413:1998 Hydraulic fluid power – General rules relating to systems. The manufacturer is to ensure the following:

(1) Design considerations

① When designing hydraulic systems, all aspects of possible methods of failure (including control supply failure) are to be considered.

② In each case, components are to be selected, applied, fitted and adjusted as follows:

a. in the event of a failure, safety of personnel is to be the prime consideration;

b. where the hydraulic motor is required to lock the load, the balance valve is to be installed directly and reliably on the body of the hydraulic motor, and no any other valve (such as pilot operated safety valve) is to be installed on pressure space, unless there are other reliable means approved by CCS;

c. where the hydraulic cylinder is required to lock the load, the balance valve and/or explosion-proof valve is to be installed on the oil port flange of the oil cylinder (explosion-proof valve may be installed inside the cylinder) to prevent pipe explosion etc., and no any other valve (such as pilot operated safety valve) is to be installed on pressure space, unless there are other reliable means approved by CCS;

d. the setting of protection pressure of the balance valve is to be identified.

③ The prevention of damage to the system and the environment is to be considered.

④ Leakage (internal or external) is not to cause a hazard.

⑤ Attention is to be paid to the direction in which components are fitted, which is to comply with the requirements recommended by the manufacturer. For example, the core of solenoid valves is to be axially horizontal.

⑥ The selection of control pressure of electrohydraulic valves is to comply with the requirements for their use.

(2) Fitting of hydraulic components and units

① The pressure at the pump inlet port is not to be less than the minimum specified by the pump supplier for the operating conditions and the system fluid used. Where the design is such that the pressure oil is to be supplied by an independent auxiliary pump unit, the start sequence of the auxiliary pump unit and main pump unit is to be considered.

② Means are to be provided to ensure that valves cannot be incorrectly mounted.

③ Hydraulic components are to be fitted with original bolts provided by the manufacturer for delivered components, or bolts with equivalent strength grade and specification.

(3) Adjustments

① Valves that permit adjustments of one or more controlled parameters are to have the following characteristics:

a. provision for securing the valve adjustment;

b. provisions for locking the adjustment to prevent unauthorized change, as agreed between purchaser and supplier;

c. provisions for monitoring the parameter being adjusted;

d. all adjustable valves and devices with adjusted parameters are to be reliably locked by mechanical means to prevent loosening caused by vibration.

(4) Design requirements for fluid tanks

① Provisions are to be made to prevent spilled fluid returning directly to the tank.

② Suction pipes are to be so located that adequate fluid supply is maintained at the minimum operating level and that air ingestion and the formation of vortices in the fluid are eliminated.

③ Fluid level indicators are to be permanent marked with system “high” and “low” levels.

④ Fluid level indicators are to be fitted at each filling point so that they are clearly visible when filling.

⑤ Means are to be provided to prevent the system fluid draining from pump casing back into the tank when the system is switched off.

(5) Design of layout of piping

① Piping is to be designed to discourage its use as a step or ladder. External loads are not to be imposed upon piping.

② Piping is not to be used to support components where they would impose undue loads on the piping. Undue loads may arise from component mass, shock, vibration and surge pressure.

③ Any connection to piping is to be accessible for tightening without disturbing adjacent piping or equipment, particularly where piping terminates in a cluster of fittings.

④ Piping is to be identified or located in such a manner that it is not possible to make an incorrect connection that might cause a hazard or malfunction.

⑤ Piping, both rigid and flexible, is to be mounted to minimize installation stresses and be located to protect against foreseeable damage and not restrict access for adjustment, repairs and replacement of components or work in progress.

(6) Prevention of unexpected start-up

① The system is to be designed to facilitate positive isolation from energy sources and also to facilitate dissipation of the pressurized fluid in the system in order to prevent unexpected start-up. In hydraulic systems this can be done by:

— mechanical locking of isolation valves to the shut-off position, and dissipation of pressure from hydraulic systems;

— isolation of the electrical supply.

(7) Control or power supply failure

① Hydraulic components controlled electrically, pneumatically and/or hydraulically are to be selected and applied so that the failure of the control power supply does not cause a hazard.

② Whatever the type of control supply or power used (e.g. electrical, hydraulic, etc.), the following actions or occurrences (unexpected or intentional) are not to cause a hazard:

— switching the supply on or off;

— supply reduction;

— supply cut-off or re-establishment.

③ When control power supply is restored (unexpectedly or intentionally), hazardous situations are not to occur.

(8) Adjustable control components and mechanisms

① Adjustable control mechanisms are to maintain their settings within specified limits until reset.

② Pressure and flow control valves are to be selected so that changes in working pressure, working temperature and load do not cause malfunction or a hazard.

③ Pressure and flow control devices or their enclosures are to be fitted with tamper-resistant devices where an unauthorized alteration to pressure or flow can cause a hazard or malfunction.

④ Means are to be supplied for locking the setting of adjustable components or for locking their enclosures, if changes or adjustment can cause a hazard or malfunction.

⑤ Safe manual controls are to be provided for each actuator for convenience of setting up.

⑥ Any actuator required to maintain its position or to adopt a specific position for safety in the event of a control system failure is to be controlled by a valve that is either spring biased or detent located to a safe position.

⑦ Where actuators are controlled by servo or proportional valves and malfunction of the control system may result in the actuators causing a hazard, then means are to be provided to maintain or recover control of these actuators.

⑧ Restarting a system after an emergency stop or emergency return is not to cause a hazard or damage.

7.3 Calculation and check of system parameters

7.3.1 Check of system rated flow Q_0:

Output flow Q_p of power system oil pump:

$$Q_p \geqslant qn\,\eta_v \times 10^{-3} \geqslant \text{system rated flow } Q_0 \qquad l/\text{min}$$

where: q —— theoretical capacity of the oil pump, in m*l*/r;

n —— rated speed of driving oil pump, in r/min;

η_v—— capacity efficiency at oil pump rated speed and specific pressure output.

7.3.2 Calculation of system nominal pressure P_0

$$P_0 = \triangle P_i + \triangle P_{in} + \triangle P_{out}$$

where: P_0—— system nominal pressure (pressure value at oil pump outlet), in MPa;

$\triangle P_i$—— pressure difference between oil inlet and oil outlet of hydraulic actuating unit, in MPa;

$\triangle P_{in}$—— pressure loss through piping between pump outlet and cylinder oil inlet at the maximum system design flow, in MPa;

$\triangle P_{out}$—— pressure loss through piping between cylinder oil outlet and oil tank or pump oil inlet at the maximum system design flow, in MPa.

Caution: For hydraulic oils of different types and different reference test temperatures and flows, flow path loss of the system is different due to factors such as change of viscosity of hydraulic oil, and the manufacturer is to make clear the condition in which a value is taken. The first product is usually to be tested to verify the correctness of pressure loss of the system through its piping, with the same configuration and at the maximum flow.

7.3.3 Calculation of driving power of pumps and calculation for selection of electrical motors

$$N \geqslant P\,Q_p/(60\eta_b\,n_b)\ \text{kW}$$

$$N_s \geqslant P_s\,Q_p/(60\eta_b\,n_b)\ \text{kW}$$

where: N —— driving power needed in normal working condition (power of electric motor), in kW;

N_s—— driving power needed when the relief valve or safety valve is opened (power of electric motor), in kW;

P —— working pressure of the system, in MPa;

P_s—— set pressure of the relief valve or safety valve, in MPa;

Q_p—— the actual maximum flow of the oil pump calculated according to 1.7.3.1 of this Chapter, in *l*/min;

n_b—— overload coefficient of the electric motor, usually taken as 1 in normal working condition and not more than 1.3 when the relief valve or safety valve is opened (for short time), unless evidence is provided to show that the overload ability of the selected motor meets design purposes of the system;

η_b—— total efficiency of the oil pump, to be selected according to data (such as pressure – flow – efficiency curve) provided by the manufacturer, usually with total efficiency of plunger pumps being 0.80 ~ 0.85, that of vane pumps being 0.60 ~ 0.75, and that of gear pumps being 0.60 ~ 0.70.

7.3.4 Check of pipe specification and wall thickness

The requirements in 2.2.2 and 2.3.2 of PART THREE of CCS Rules for Classification of Sea-going Steel Ships are to be complied with.

8 Strength requirements

8.1 Permissible stress

To determine the dimensions of parts, the permissible stress is not to exceed the following values:

$$\sigma_m \leqslant [\sigma]$$
$$\sigma_1 \leqslant 1.5[\sigma]$$
$$\sigma_n \leqslant 1.5[\sigma]$$
$$\sigma_1 + \sigma_n \leqslant 1.5[\sigma]$$
$$\sigma_m + \sigma_n \leqslant 1.5[\sigma]$$
$$[\tau_j] = (0.6 \sim 0.8)\ [\sigma]$$
$$[\tau_n] = (0.5 \sim 0.6)\ [\sigma]$$
$$[\sigma_{jy}] = (1.7 \sim 2)\ [\sigma]$$

where: σ_m —— equivalent primary general membrane stress, in N/mm^2;

σ_1 —— equivalent primary local membrane stress, in N/mm^2;

σ_n —— equivalent primary bending stress, in N/mm^2;

$[\tau_j]$ —— permissible shear stress of steel, in N/mm^2;

$[\tau_n]$ —— permissible torsional shear stress of steel, in N/mm^2;

$[\sigma_{jy}]$ —— permissible compression stress, in N/mm^2;

$[\sigma]$ = the lesser of R_m/A or R_{eH}/B, in N/mm^2;

R_m —— tensile strength of material at ambient temperature, in N/mm^2;

R_{eH} —— yield point or proof stress of material at ambient temperature, in N/mm^2.

The values of A and B are to be selected respectively according to requirements for related equipment in CCS Rules for Classification of Sea-going Steel Ships. If there is no requirement to the specific equipment, such values may be selected according to 2.2.2.4, 2.3.2.2 and 6.2.5.1 of PART THREE of CCS Rules for Classification of Sea-going Steel Ships.

8.2 Strength check of valves and flange bolts (the depth the thread screws in is not to be less than the diameter of the bolt)

Composite stress of the thread:

$$\sigma_L = 1.66\,(K_0 + K_c)\,F_L/d_L^2 \leqslant [\sigma] \quad \text{MPa}$$

where: K_0 —— preloaded thread coefficient, with static load K_0 = 1.2 ~ 2, dynamic load K_0 = 2 ~ 4;

K_c—— coefficient of rigidity, with K_c = 0.2 for connecting rod bolts and K_c = 0.2 ~ 0.3 for steel plate (or with metal gasket) connection;

F_L —— maximum tensile force acting on a single bolt, in N;

d_L —— inner diameter of thread, in mm.

9 Selection of typical samples

9.1 One sample is to be selected randomly for type test when the manufacturer applies for approval of products with single specification or it is the first application for products in batches.
9.2 One sample which is the most representative or one with maximum specifications (pressure and flow) is to be selected for type test when the manufacturer applies for approval of product series with the same type/drawing number but different specifications. Categories may be based on principles of hydraulic power and control systems. For each type of hydraulic systems of which the parts are basically the same and only the nominal pressure or required flow is different, consideration is to be given to the maximum nominal pressure and flow in selection of samples.
9.3 Approved products are to be subject to inspection and test either one by one or in batches for sampling, as appropriate.

10 Type test

10.1 According to the requirements in Chapter 3, PART ONE of CCS Rules for Classification of Sea-going Steel Ships, hydraulic power devices are to be inspected and certified by CCS. However, the design approval or type approval may be selected by the applicant or manufacturer on his own.
10.2 The type test programme provided by the applicant or manufacturer is usually at least to cover the following:
(1) Test items for which CCS surveyor is to be present:
① general inspection and test requirements for hydraulic power devices in CCS Rules for Classification of Sea-going Steel Ships;
② test and verification requirements for design performance of specific equipment in SOLAS or CCS rules, corresponding to intended purposes of hydraulic power devices.Unless agreed by CCS, the items for test after installation on board and sea trial, as required by SOLAS or CCS rules, must be replaced by equivalent tests at the manufacturer.
(2) Inspection items to be completed by the manufacturer: Test items and requirements specified in the design standard(s) selected and shown in public by the manufacture.
10.3 For pumps driven by diesel engines, the conditions at both minimum and maximum running speeds are to be checked.
10.4 If the general arrangement (system drawing) includes operation controls and/or actuating units, mechanical and electrical equipment are to be adjusted together in type test.
10.5 The type test of the first set of marine hydraulic power devices usually is to include the following items:
(1) hydraulic test prior to assembly of components and parts (to be carried out in accordance with the standards accepted by CCS, but the test pressure is not to be less than 1.5 times design pressure);
(2) tightness test (1.25 times design pressure of the system, but not exceeding design pressure plus 7 MPa);

(3) measurement of output of rated flow (for different output pressures);
(4) measurement of electric motor power (at rated condition of the system, possibly at combined power output for the multi-system type);
(5) measurement of resistance loss through piping (for specific hydraulic oil, oil temperature and flow);
(6) examination and setting of safety valves, relief valves, back pressure valves, pressure reducing valves, etc.;
(7) examination of adjustment of other adjusting valves (such as speed control valves, proportional valves, servo valves, etc.);
(8) examination of built-in monitoring, indication and alarm sensor apparatuses of hydraulic power devicesand their settings;
(9) test of temperature rise;
(10) tests of changeover, interlock and simultaneous running of units are to meet the intended purposes;
(11) performance test in connection with associated control equipment and actuating units (verification by analog test is acceptable in special cases) is to meet the intended purposes;
(12) verification of troubleshooting and emergency control functions and abilities.

11 Unit/Batch inspection

11.1 Quality assurance
(1) The manufacturer is to ensure the hydraulic power devices are so designed, manufactured, inspected and tested as to meet the performance characteristics of sample approved by CCS or type test sample.
(2) The manufacturer is to ensure to carry out quality control for product design, manufacture, inspection and identification in accordance with the relevant requirements of this Chapter. The hydraulic power devices which do not meet the requirements of this Chapter are not allowed to sale with the mark related to inspection requirements of CCS,
11.2 Inspection
(1) The manufacturer is to provide all necessary suitable conditions to the CCS site surveyor in order to verify that the provided documents are in compliance with the requirements of this Chapter, at least including:

① quality documents of the main components and parts;
② manufacturer's inspection and test report (inspection and test items are to meet the requirements in 1.11.3 ~ 1.11.4);
③ document of compliance or certificate of product.

11.3 According to the requirements in Chapter 3, PART ONE of CCS Rules for Classification of Sea-going Steel Ships, marine hydraulic power devices are to be subject to unit/batch inspection and certified by CCS. The unit/batch inspection after CCS approval usually is to include the following items:
(1) General inspection and test requirements for hydraulic power devices in CCS Rules for Classification of Sea-going Steel Ships:

① hydraulic test prior to installation of components and parts onboard the ship (to be

carried out in accordance with the standards accepted by CCS, but the test pressure is not to be less than 1.5 times design pressure);

② examination of safety valves, relief valves, back pressure valves, pressure reducing valves, etc.;

③ examination of adjustment of other adjusting valves (such as speed control valves, proportional valves, servo valves, etc.);

④ examination of built-in monitoring, indication and alarm sensor apparatuses of hydraulic power devicesand their settings;

⑤ emergency control function test.

(2) Test and verification requirements for design performance of specific equipment in SOLAS or CCS rules, corresponding to intended purposes of hydraulic power devices (verification by analog test is acceptable).

Specific test items may be agreed with local CCS inspection organizations after product approval.

11.4 The manufacturer is also to ensure completion of the following inspection items:

(1) routine inspection and test items specified in the design standard(s) selected and shown in public by the manufacture;

(2) special test items added in the technical contract for delivery, if applicable.

11.5 The manufacturer is to carry out inspection and test for the hydraulic power devices intended to apply for survey in accordance with the above-mentioned items, if it is qualified, then to apply CCS for survey. Where the manufacturer or product has been approved by CCS, the sampling proportion and sampling inspection and test items made by CCS site surveyor are to be in accordance with the inspection programme issued together with the certificate of type approval by CCS.

11.6 Necessary mechanical and electrical commissioning test, load test and operational test are to be carried out after hydraulic power devices is fitted on equipment or installed onboard (if it has not been assembled in manufacturer) in order to be in compliance with the relevant requirements of the CCS rules and the intended purposes.