



China Classification Society
**Guidelines for Survey of
Intelligent Equipment**

China Classification Society
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1. Scope and description

1.1 This document is the *Guidelines* for survey of shipboard intelligent equipment and specifies the general technical requirements and inspection requirements for shipboard intelligent equipment. The *Guidelines* is applicable to the shipboard intelligent equipment requesting for our society's certification. Survey of equipment shall be carried out in accordance with these *Guidelines* unless these are corresponding special survey guidelines available.

1.2 Additional marks of product

For the system meeting the requirements of the *Guidelines*, the corresponding category of marks will be granted after the approval or single-piece and single-batch inspection and filled in the additional mark column of the product certificate. Symbols and descriptions are shown in Section 4.

1.3 Supplementary explanation of approval mode

CCS encourages the application of new technologies. Risk assessment and tests shall be performed for new technology beyond the scope specified in the existing rules and guidelines to prove that the system and equipment using the new technology can achieve the same level of safety as required by the CCS rules.

Intelligent equipment that conforms to Section 11, Chapter 3, Part 1 of the *Rules for Classification of Sea-Going Steel Ships* (hereinafter the *Rules for Steel Ships*) and its revision notification may request for approval in principle. AIP is the approval in principle for new products and technologies.

If there is express requirement for the approval of product in the *Licensing Requirements* appendix to the *Rules for Steel Ships*, the corresponding approval certificate should be obtained before installation and use on the ship. Approval and certification requirements are shown in Section 5.

2. Normative references

2.1 The following reference documents are indispensable for the application of the *Guidelines*. For dated references, only the referenced edition applies. For undated references, the latest edition applies.

Reference documents

Table 2.1

1.		CCS Rules for Classification of Sea-Going Steel Ships its revision notification
2.		CCS Rules for Intelligent Ships
3.		CCS Guidelines for Type Approval Test of Electric and Electronic Products
4.		CCS Guidelines for Safety and Reliability Assessment for Shipboard Software
5.		CCS Guidelines for Requirement and Security Assessment of Ship Cyber System.
6.		CCS Guidelines for Survey of Intelligent Integral Platform
7.		CCS Guidelines for Survey of Ships Intelligent Machinery
8.		
9.		CCS Guidelines for Survey of Intelligent Energy Efficiency Management of Ships
10.		CCS Guideline for Autonomous Cargo Transport Vessels
11.	IACS UR E22	On Board Use and Application of Computer Based Systems
12.	IEC 60812	System Reliability Analysis Techniques - Failure Mode Impact Analysis
13.	IEC 61162-450	Maritime navigation and radio communication equipment and systems - Digital interfaces - Part 450: Multiple talkers and multiple listeners - Ethernet interconnection
14.	IEC 61162-460	Maritime navigation and radio communication equipment and systems - Digital interfaces - Part 460: Multiple talkers and multiple listeners - Ethernet interconnection - Safety and security
15.	IEC 61508	Functional safety of electrical/electronic/programmable electronic safety-related systems
16.	IEC 62940	Maritime navigation and radio communication equipment and systems - Integrated communication system (ICS) - Operational and performance requirements, methods of testing and required test results
17.	ISO 8000-8	Data quality - Part 8: Information and data quality: Concepts and measuring
18.	ISO 9241-210	Ergonomics of human-system interaction — Part 210: Usability: Definitions and concepts
19.	ISO 16425	Ships and marine technology — Guidelines for the installation of ship communication networks for shipboard equipment and systems
20.	ISO 18028-2	Information technology – Security techniques – IT network security – Part 2: Network security architecture
21.	ISO 19847	Ships and marine technology – Shipboard data servers to share field data at sea
22.	ISO 19848	Ship and marine technology – Standard data for shipboard machinery and equipment
23.		BIMCO CIRM Industry Standard on Software Maintenance of Shipboard Equipment

3. Terms and abbreviations

3.1 Terms

Intelligent equipment means any kind of equipment, apparatus or machine with computational processing capacity. Fully functional intelligent equipment must have sensitive and accurate sensing function, correct thinking and judgment function, and effective execution function.

3.1.2 system

It consists of interactive programmable equipment and/or subsystems to accomplish one or more specific purposes.

3.1.3 Stakeholders

It means a person or organization that can influence, be influenced, or perceive itself as influenced by a decision or activity.

3.1.4 Owner

The owner enters into contract with the system integrator and/or the supplier that provides the hardware and software system according to the specifications. During the construction period, the owner may be the shipbuilder (builder or shipyard). After the ship is delivered, the owner may be the ship operating company.

3.1.5 System integrator

The system integrator is responsible for integrating the systems and products provided by the supplier into a complete system with specified requirements. The system integrator may also be responsible for the system integration of the ship. The shipyard shall assume the role of system integrator unless another organization is specifically contracted or assigned to assume such responsibility. If there are multiple teams completing system integration at any given time, one team must be responsible for overall system integration and coordination of integration activities. If different system integrators are responsible for specific phases of multiple-phase integration, one team must be responsible for identifying and coordinating all phases of the integration.

3.1.6 Supplier

The supplier is a contractor or subcontractor for system components or software under the coordination of the system integrator or shipyard. The supplier provides programmable equipment, subsystems, or systems to the system integrator. The supplier shall provide a functional description of the software to demonstrate that the software is compliant with the shipowner's requirements, applicable international and national standards, and applicable requirements of this section.

3.2 Abbreviations

3.2.1 CCS: China Classification Society.

4. Categories and layers of intelligent equipment

4.1 The division of categories and layers of intelligent equipment are as shown in Table 4.1.

Categories of intelligent equipment

Table 4.1

Class	Category	Description
c0	Stand-alone systems	Equipment or system that can independently complete preset functions without the need to interact with other equipment or systems
c1	Networked aid information exchange	Sending and obtaining aid information
c2	Networked collaborative perception	Perceptual fusion of real-time multivariate information
c3	Real-time remote connectivity	Relying on real-time remote connectivity to exchange aid information or for collaborative perception

4.2 The layering of intelligent equipment is shown in Table 4.2.

Layering of intelligent equipment

Table 4.2

Class	Layer	Typical scenarios
t0	Information summary presentation	<ul style="list-style-type: none"> - Integrated shipboard LAN system and two-way communication - Remote monitoring of areas and equipment within the ship - Automatic system matching management - One-way communication with shore base
t1	Decision support	<ul style="list-style-type: none"> - Integrated shipboard LAN system and two-way communication - Remote monitoring and control of areas and equipment within the ship - Automatic system matching management - One-way communication with shore base — Post-treatment of operating data
t2	Artificial monitoring	<ul style="list-style-type: none"> - Integrated, interconnected system LAN system on board - Intelligent coordination of ship-ship and ship-shore communications and navigation based on shore-based data centers — Whole life cycle management - Energy efficiency management with integrated equipment operation and matching of environmental conditions - Instantaneous decision support system
t3	Hybrid decision making	<ul style="list-style-type: none"> - Self-learning, judgment and decision making through data analysis - Semi-automatic, or fully automatic operation and automatic equipment maintenance management system - Automatic decision making based on environmental awareness and data analysis - Online information sharing and consulting decisions - Minimal crew configuration, reduced or eliminated human intervention
t4	Autonomous decision making	<ul style="list-style-type: none"> - Use of structurally advanced materials with inherent sensing capabilities - Interconnected IOT systems for analysis and decision making on operations and environment - Fully automatic without human intervention - "Communication" with other intelligent equipment

4.3 The layering of intelligent equipment is shown in Table 4.3.

Examples of categories and layers of intelligent equipment

Table 4.3

Examples of equipment or systems		Minimum equipment requirements	intelligent category
Autonomous operation (Ai)	A1: The ship is operated by crew and/or pilots when entering/leaving the port and berthing	c3t3	
	A2: The ship is operated by the remote control station when entering/leaving the port and berthing	c3t3	
	A3: The ship can operate autonomously from berth to berth, it is under remote monitoring, and it can be controlled by the remote control station if necessary.	c3t4	
Remote control (Ri)	R1: with crew on board	c3t1	
	R2: without crew on board	c3t1	
Intelligent navigation (Nx)	N: route design and optimization	c1t1	
	No: Autonomous navigation in open waters	c2t3	

	Nn: autonomous navigation in full range	c3t3
Intelligent hull (Hx)	Hh: Hull maintenance and service	c0t1
	Hm: Hull monitoring and aided decision-making	c1t1
Intelligent machinery (Mx)	M: Intelligent machinery	c1t1
	Mm: Maintenance of main unit and components as required	c1t2
	Ma: Maintenance of standby unit and components as required	c1t2
	Mp: Maintenance of propulsion shaft system as required	c1t2
Intelligent energy efficiency (Ex)	E: Intelligent energy efficiency	c1t1
	Es: Speed optimization	c1t1
	Et: Optimal load distribution based on trim angle	c1t1
Intelligent cargo (Cx)	C: Intelligent cargo	c1t1
	Cl: Automatic cargo loading and unloading	c1t2
Intelligent integration platform (I)	Ic1: Information summary presentation	c1t0
	Ic2: Aided decision making	c1t1
	Ic3: Control related	c2t2
Machinery monitoring and alarm system		c1t1
Power management system		c1t1
Power positioning system		c2t1
Intelligent DC bus controller assembly		c1t0
Electronic intelligent overhead crane anti-collision device		c0t1
Ship-borne equipment for intelligent management of fishing boat voyage		c1t0
Intelligent charger		c1t1
Intelligent valve group for safety of mud pump		c0t1
Intelligent terminal for voyage		c1t1

5. Approval and certification requirements

5.1 General requirements

Products applying for approval/inspection shall meet the certification requirements in the following table.

Certification requirements for intelligent equipment system **Table 5.1**

No.	Product name	Certificate category		Approval mode					Drawings review	Remarks
		C/E	W	PrA	DA	TA-B	TA-A	WA	PA	
1	Intelligent equipment	×	--	○	○	×	--	--	×	
1.1	Computer	--	○	--	--	×2/×3	--	--	○	
1.2	Display	--	○	--	--	×2/×3	--	--	○	
1.3	UPS	--	○	--	--	×2/×3	--	--	○	
1.4	PLC	--	○	--	--	×2/×3	--	--	○	
1.5	Routers and other network equipment	--	○	--	--	×2/×3	--	--	○	
1.6	Sensor	--	○	--	--	×2/×3	--	--	○	

1.7	Actuator	--	○	--	--	✕2/✕3	--	--	○	
1.8	Software	--	○	○	○	✕2/✕3	--	--	○	

Key:

- 1) C - marine product certificate; E - equivalent documents; W – manufacturer's certificate; ✕-applicable; ○- optional
- 2) PrA- Approval in Principle; DA - Design Approval; TA-B - Type Approval B; TA-A - Type Approval A; WA - Factory Approval; PA- Drawing Review.
- 3) ✕1: Inspection shall be carried out according to the approved drawings of complete products/systems (ships and products);
- 4) ✕2: Purchased parts that do not meet the certification requirements shall be surveyed in accordance with the requirements of the CCS Rules.
- 5) ✕ 3: Purchased parts that do not meet the certification requirements shall be subjected to integral type test with the whole product.

5.2 Supplementary explanation of approval mode

Intelligent equipment that conforms to Section 11, Chapter 3, Part 1 of the *Rules for Steel Ships* may request for approval in principle. AIP is the approval in principle for new products and technologies.

If there is express requirement for the approval of product in the *Licensing Requirements* appendix to the *Rules for Steel Ships*, the corresponding approval certificate should be obtained before installation and use on the ship.

Mode comparison

Table 5.2

	Applicable range	Assessment method:	Test
Type approval	For mature products, confirm that the manufacturer has the ability and conditions to continuously deliver products that meet the relevant requirements.	Product drawing review and site audit	Type test
Design approval	Applicable to the design approval of equipment and system type marine products.	Product drawing review	Prototype testing
Approval in principle	Available for technical approval services for new products or technologies of different technical maturity, such as concept design, principle prototype, engineering prototype, and final design.	Preliminary approval through based on review of the technical solution and technical principles of the product design.	Prototype verification test

5.3 Non-complete system certification

Usually, intelligent equipment should be a subject of the complete system certification, except for the following cases.

- (1) Only applying for approval of the software part;
- (2) The system is developed by more than one party, and they apply for approval separately;

For case (1), please follow the *CCS Guidelines for Safety and Reliability Assessment for Shipboard Software* (hereinafter referred to as the *CCS Software Guidelines*) as shown in Figure 7.2.3-2. The information such as hardware requirements should be denoted in the certificate (see Appendix for details).

For case 2, the objectives to be achieved, the scope and content of the accredited work should be clearly stated.

6. System requirements

6.1 For intelligent equipment without specific guidelines, their general requirements are as follows.

6.2 Intelligent equipment need to meet the basic requirements of the *CCS Rules for Steel Ships – Part 7 – Essential requirements for automation systems*.

6.3 Software shall comply with the requirements of the *CCS Software Guidelines*.

6.4 Network security shall meet the requirements of the *CCS Guidelines for Requirement and Security Assessment of Ship Cyber System* (hereinafter referred to as the *CCS Cyber Guidelines*).

6.5 The hardware shall be able to operate properly under the environmental conditions and other operating conditions specified in Section 1, Chapter 2, Part 7 of the *CCS Rules for Steel Ships*.

6.6 Survey of shipboard data server can be carried out in reference to ISO 19847. Shipboard equipment data format may be determined in accordance with ISO 19848. Data quality and measurements may be performed in accordance with ISO 8000-8.

6.7 Shipboard software maintenance can be carried out with reference to the *BIMCO CIRM Industry Standard on Software Maintenance of Shipboard Equipment*.

7. Test categories and requirements

7.1 Test categories

The categories are based on the *Rules for Steel Ships* and the *Guidelines for Type Approval Test of Electric and Electronic Products* (hereinafter referred to as *CCS Test Guidelines*) and broken down as follows:

Equipment summary

Table 7.1

No.	Name	Equipment type	Reserved mounting position	Special requirements
1	Server	Computer	Computer room	To control temperature and humidity
2	Core switch	Network device	Computer room	To control temperature and humidity
3	Convergence switch	Network device	Computer room	To control temperature and humidity
4	Router	Network device	Computer room, bridge house, central control room, machinery	
5	Intelligent gateway	Network device	Computer room, bridge house, central control room, machinery	
6	Fire partition wall	Network device	Computer room	To control temperature and humidity
7	Network management server	Computer	Computer room	To control temperature and humidity
8	Optical module	Attachment	Computer room, bridge house, control room	
9	Workstation	Computer	Computer room, bridge house, central control room, machinery	
10	Disk array	Storage device	Computer room	To control temperature and humidity

11	Electric cable	Cable		
12	Optical cable	Cable		
13	Vibrations sensor	Electrical equipment	Machinery	Intense vibration
14	Vibration data collector	Electrical equipment	Machinery	Intense vibration
15	Camera	Attachment	Computer room, bridge house, central control room, machinery	
16	3G/4G WIFI system	Network device	Computer room, bridge house, deck	
17	Secure encryption processing unit	Network device	Computer room, bridge house	
18	Oil analyzer	Electrical equipment	Machinery	

Test categories

Table 7.2

No.	Test	Category	Test requirements
Fc.1	Vibration IEC 60068-2-6 Fc	General vibration conditions	Frequency 2 (+3/0)~13.2Hz, amplitude $\pm 1.0\text{mm}$; frequency 13.2~100Hz, acceleration 0.7g
Fc.2		Intense vibration conditions	Frequency 2 (+3/0)~25Hz, amplitude $\pm 1.6\text{mm}$; frequency 25~100Hz, acceleration 4.0g
Fc.3		Special vibration conditions ①	Frequency 40 Hz~2000 Hz, acceleration 10.0g; temperature 600°C
B.1	High temperature IEC 60068-2-2 Bb (non-heat dissipating equipment) Be (heat dissipating equipment)	55°C	55°C $\pm 2^\circ\text{C}$ /16h
B.2		70°C ②	70°C $\pm 2^\circ\text{C}$ /16h
B.3		Special	For equipment enduring temperature higher than above specified value, the high temperature test should be conducted at the agreed test temperature and duration.
A.1	Low temperature IEC 60068-2-1 Ab (non-heat dissipating equipment) Ad (heat dissipating equipment)	+5°C	5°C $\pm 3^\circ\text{C}$ /2h
A.2		-25°C	-25°C $\pm 3^\circ\text{C}$ /2h
A.3		Special ③	The actual temperature of the premises where the equipment is located
Db.1	Alternating heat and humidity IEC 60068-2-30 Db	2 cycles	Temperature 55 $\pm 2^\circ\text{C}$, relative humidity 90~95%, 2 cycles (24h per cycle)
Db.2		6 cycles ④	Temperature 55 $\pm 2^\circ\text{C}$, relative humidity 90~95%, 6 cycles (24h per cycle)
Cab.1	Constant heat and humidity	4 days ⑤	Temperature 40 $\pm 2^\circ\text{C}$, relative humidity 90~95%, duration: 96h

	IEC60068-2-78 Cab		
Kb.1	Salt spray test IEC 60068-2-52 Kb	28 days	4 spraying cycles. Continuous spraying time 2h each cycle, 7 days storage period in humidity and heat. The pH value of sodium chloride (chemically pure or above) solution with a concentration of 5%±1% by mass is 6.5~7.2 at a temperature of 20°C±2°C. Storage period in humidity and heat, temperature 40°C±2°C, relative humidity 90-95%.
Ka.1	Salt spray test IEC 60068-2-11 Ka	Metal components	The pH value of sodium chloride (chemically pure or above) solution with a concentration of 5%±1% by mass is 6.5~7.2 at a temperature of 35°C±2°C. Temperature inside box: 35°C ± 2°C Duration is 24-96h according to different base metals and plating layers.

Note: ① Indicates very special vibration conditions, for example, on the fuel injection system or exhaust pipe of the diesel engine. For equipment with higher vibration conditions than those specified above, the vibration test should be conducted in accordance with the agreed vibration conditions, frequency range and duration.

② Applicable to equipment installed in Category C and Category E environments, and automation, control and instrumentation equipment affected by high temperatures, such as instrumentation equipment installed in consoles, enclosures, etc., and other heat dissipating power equipment.

③ Applicable only to equipment located in cold premises below +5°C and not in environment type E.

④ Applicable only to motors and transformers.

⑤ Applicable only to equipment installed in type A environment.

⑥ Electrical appliances and their accessories, instruments: Unless otherwise specified in the equipment standards, these devices on open decks should, in principle, undergo salt spray test Kb.

⑦ Motors and transformers: Unless otherwise specified in the equipment standards, motors and transformers on the open deck can undergo the salt spray test Ka of metal parts.

List of test requirements

Table 7.3

Type		A	B		C			D	E	When the location is not clear	Other special circumstances
Category		Controlled environment	Enclosed premises with general temperature, high humidity and vibration		Enclosed premises with high temperature, vibration and heat generated from other equipment			Environment with severe vibrations (e.g. installed on reciprocating machinery)	On open decks		
Type breakdown		A1	B1	B2	C1	C2	C3	D1	E1		
Typical scenarios		Computer room	Cab	Central control room (with air conditioning), living premises	Control room (without air conditioning)	Machine premises Enclosed oil purifier chamber	Machine premises below checkered steel plate, premises with risk of massive water immersion, inside the sewage well, etc.	Installed on reciprocating machines, such as internal combustion engines, air compressors, pumps	Open deck		
Environmental requirements		To control temperature and humidity, vibration, EMC	+5~+5 5 High humidity, vibration and EMC	+5~+55 High humidity, vibration, EMC	+5~+70 High humidity, high temperature, vibration, EMC	+5~+70 High humidity, high temperature, vibration, liquid splash, EMC	-25~+70 High humidity, high temperature, vibration, water immersion, salt spray, EMC	+5~+70 High humidity, high temperature, severe vibration, liquid splash, EMC	-25~+70 High humidity, high temperature, low temperature, vibration, water	-25~+70 High humidity, high temperature, low temperature, vibration, water immersion,	

									immersion, salt spray, high EMC	salt spray, high EMC	
All equipment, computers, and other electronic devices used for control, protection, safety, monitoring, alarming, and internal communication	Vibration	Fc.1	Fc.1	Fc.1	Fc.1	Fc.1	Fc.1	Fc.2	Fc.1	Fc.1 Fc.2	Fc.3
	High temperature	--	B.1 B.2 ①	B.1 B.2 ①	B.2	B.2	B.2	B.1 B.2 ①	B.2	B.2	B.3
	Low temperature	--	A.1	A.1	A.1	A.1	A.2	A.1	A.2	A.2	A.3
	Humidity and heat	Cab.1	Db.1	Db.1	Db.1	Db.1	Db.1	Db.1	Db.1	Db.1	
	Salt spray	--	--	--	--	--	Kb.1	--	Kb.1	Kb.1	
	EMC ②	EMC2	EMC1	EMC2	EMC2	EMC2	EMC2	EMC1 EMC2	EMC1	EMC1	
	Protection grade of shell	IP20	IP20	IP20	IP20	IP22 IP44 (in enclosed oil purifier chamber)	IP56 IP68 (in sewage wells)		IP56		
Electrical appliances and accessories, instruments	Vibration	Fc.1	Fc.1	Fc.1	Fc.1	Fc.1	Fc.1	Fc.2	Fc.1	Fc.1	Fc.3
	High temperature	--	B.1 B.2 ①	B.1 B.2 ①	B.2	B.2	B.2	B.1 B.2 ①	B.2	B.2	B.3
	Low temperature	--	A.1	A.1	A.1	A.1	A.2	A.1	A.2	--	A.3
	Humidity and heat	Cab.1	Db.1	Db.1	Db.1	Db.1	Db.1	Db.1	Db.1	Db.1	
	Salt spray	--	--	--	--	--	Kb.1	--	Kb.1	Kb.1	
	EMC ②	EMC2	EMC1	EMC2	EMC2	EMC2	EMC1	EMC2	EMC1	EMC1	
	Protection grade of shell	IP20	IP20	IP20	IP20	IP22 IP44 (in enclosed oil purifier chamber)	IP56 IP68 (in sewage wells)		IP56		

Generator, transformer	Vibration ③	Fc.1	Fc.1	Fc.1	Fc.1	Fc.1	Fc.1	Fc.2	Fc.1	Fc.1	
	High temperature	--	--	--	--	--	--	--	--	--	
	Low temperature	--	--	--	--	--	--	--	--	--	
	Humidity and heat	Cab.1	Db.1	Db.1	Db.1	Db.1	Db.1	Db.1	Db.1	Db.1	
	Salt spray	--	--	--	--	--	Ka.1	--	Ka.1	Ka.1	
	EMC ②	EMC2	EMC1	EMC2	EMC2	EMC2	EMC1	EMC2	EMC1	EMC1	
	Protection grade of shell	IP20	IP20	IP20	IP20	IP22 IP44 (in enclosed oil purifier chamber)	IP56 IP68 (in sewage wells)		IP56		

Note: ① Suitable for automation, control and instrumentation equipment subject to influence of high temperature, such as instrumentation installed in consoles, enclosures, and other heat dissipating power equipment

② EMC1 for open decks and cabs.

7.2 Test marking

Typical equipment and their applicable environment type, test requirement, test marking are shown in the following table.

Test type, requirements and markings

Table 7.4

No.	Name	Equipment type	Reserved mounting position	Applicable environment type	Test requirement	Test marking
1	Server	Computer	Computer room	A1	A1	Fc.1 Cab.1 EMC2
2	Core switch	Network device	Computer room	A1	A1	Fc.1 Cab.1 EMC2
3	Convergence switch	Network device	Computer room	A1	A1	Fc.1 Cab.1 EMC2
4	Router	Network device	Computer room, bridge house, central control room, machinery	A1 B1 B2 C1 C2	C2+EMC1	Fc.1 B.2 A.1 Db.1 EMC1
5	Intelligent gateway	Network device	Computer room, bridge house, central control room, machinery	A1 B1 B2 C1 C2	C2+EMC1	Fc.1 B.2 A.1 Db.1 EMC1
6	Fire partition wall	Network device	Computer room	A1	A1	Fc.1 Cab.1 EMC2
7	Network management server	Computer	Computer room	A1	A1	Fc.1 Cab.1 EMC2
8	Optical module	Attachment	Computer room, bridge house, control room	A1 B1 B2 C1	C1+EMC1	Fc.1 B.2 A.1 Db.1 EMC1
9	Workstation	Computer	Computer room, bridge house, central control room, machinery	A1 B1 B2 C1 C2	C2+EMC1	Fc.1 B.2 A.1 Db.1 EMC1
10	Disk array	Storage device	Computer room	A1	A1	Fc.1 Cab.1 EMC2
11	Electric cable	Cable				
12	Optical cable	Cable				
13	Vibrations sensor	Electrical equipment	Machinery	D1	D1	Fc.2 B.1/2 A.1 Db.1 EMC1/2 IP44
14	Vibration data collector	Electrical equipment	Machinery	D1	D1	Fc.2 B.1/2 A.1 Db.1 EMC1/2 IP44
15	Camera	Attachment	Computer room, bridge house, central control room, machinery	A1 B1 B2 C1 C2	C2+EMC1	Fc.1 B.2 A.1 Db.1 EMC1

16	3G/4G WIFI system	Network device	Computer room, bridge house, deck	A1 B1 E1	E1	Fc.1 B.2 A.2 Db.1 Kb.1 EMC1
17	Secure encryption processing unit	Network device	Computer room, bridge house	A1 B1	B1	Fc.1 B.1/2 A.1 Db.1 EMC1
18	Oil analyzer	Electrical equipment	Machinery	C1 C2 C3	C3	Fc.1 B.2 A.2 Db.1 Kb.1 EMC1

8. Essential requirements for survey

8.1 Drawing information and inspections and tests

In the absence of specific guidelines for intelligent equipment, the general requirements are shown in the following table, which lists the drawing information to be submitted and the inspections and tests to be performed by the stakeholders at each stage.

Summary of deliverable drawings, inspections and tests

Table 8.1

no	Requirement	Stakeholders				Classification society				
		Supplier	System integrator	Ship designer	Owner	Product approval	Ship drawing review	Single-piece and single-batch inspection	New construction survey	Post-construction survey
1	System manual	○	×			Ⓐ	Ⓒ	Ⓒ		
2	Hardware manual	○	×			Ⓐ		Ⓒ		
3	Wiring diagram	○	×	Ⓒ		Ⓐ	Ⓒ	Ⓒ		
4	Software manual	○	×			Ⓐ		Ⓒ		
5	User interface manual	○	×	Ⓒ		Ⓐ	Ⓒ	Ⓒ		
6	Risk assessment report	○	×			Ⓐ		Ⓒ		
7	Type test outline (excluding functional and fault tests)	○	×			Ⓐ				
8	Test outline for functional and fault tests	○	×			Ⓐ		Ⓒ		
9	Operation manual	○	×	Ⓒ	Ⓒ	Ⓘ	Ⓒ	Ⓒ	Ⓒ	Ⓒ
10	Quality plan	○	×			Ⓐ				
11	Evidence of software validation	○	×			Ⓘ				
12	Type test report (including functional and fault tests)	○	×			ⒶⓂ				
13	On-board system			×	Ⓒ		Ⓐ	Ⓒ	Ⓒ	

no	Requirement	Stakeholders				Classification society				
		Supplier	System integrator	Ship designer	Owner	Product approval	Ship drawing review	Single-piece and single-batch inspection	New construction survey	Post-construction survey
	single line diagram (including power supply)									
14	On-board system layout diagram			x	©		Ⓐ	©	©	
15	Software features description	○	x		©			Ⓘ		
16	List of software installed in the system and version numbers	○	x		©			Ⓘ	©	©
17	Software maintenance and usage manuals (including necessary procedures for software and hardware change management)	○	x		©			Ⓘ		©
18	List of interfaces between the system and other systems on the ship	○	x		©			Ⓘ	©	©
19	List of data transmission standards	○	x		©			Ⓘ		

no	Requirement	Stakeholders				Classification society				
		Supplier	System integrator	Ship designer	Owner	Product approval	Ship drawing review	Single-piece and single-batch inspection	New construction survey	Post-construction survey
20	Factory acceptance test outline	○	×					Ⓐ		
21	Factory acceptance test report	○	×					ⒶⓂ		
22	Outline of on-board tests (including wireless network tests)		×	○	Ⓒ				Ⓐ	Ⓒ
23	System installation technology		×	○	Ⓒ				Ⓐ	
24	Shipboard test report (reception test)		×	○	Ⓒ				ⒶⓂ	
25	Shipboard test report (comprehensive test)		○	×	Ⓒ				ⒶⓂ	ⒾⓂ
26	Updated software registry		×		○			Ⓒ	Ⓘ	Ⓘ
27	Software modification impact analysis records and test reports		×		○			Ⓒ	Ⓘ	Ⓘ

Key:

1) Ⓐ Submit to CCS for approval; Ⓘ Submit to CCS for inspection; Ⓜ Require witness by CCS surveyor.

2) Ⓒ Submit for approval/review; × Required to be submitted/conducted; ○ Submitted/conducted if necessary.

Note 1: The above numbered items presented the general requirements for the content of the documents to be submitted by the stakeholder, and the stakeholder may submit the applicable part of the above content depending on the actual situation.

Note 2: © For the purpose of submitting information for approval/review, as an example, item 9 "operation manual" shall be submitted by the system integrator or supplier for filing by CCS, and the information affixed with CCS filing seal shall be provided to the ship designer, owner, ship reviewer and other parties as supporting or background material.

Note 3: Ⓐ Ⓜ, the surveyor can adopt the form of either test report review or witness test, or both.

Note 4: ① Ⓜ, the surveyor can adopt the form of either test report filing or witness test, or both.

Note 5: Each item can be submitted by either the party marked by x or ○ while the submission by x is preferred. For example, item 1 "system manual" is to be submitted by either the system integrator or the supplier.

8.2 Drawing material description

8.2.1 The following drawing material shall be submitted to CCS for approval:

(1) The system manual (product technical conditions) shall specify the overall performance requirements of the product and the overall design requirements, and shall include at least the following as applicable:

- ① Provisions of the product environmental conditions: The adaptability requirements of the product to the operating conditions (including electromagnetic compatibility) specified in the *Rules for Steel Ships*;
- ② Detailed description of the product function: including system equipment, the scope of applicability, the control and monitoring functions that can be accomplished by the product and a detailed description of the method of implementation, a detailed description of the safety status of each function implemented, the characteristics of the system in various operating conditions (including, emergency conditions, fault conditions) and the operating guidelines for normal and abnormal conditions;
- ③ Detailed description of control transfers;
- ④ Detailed description of redundancy setting and transfer mechanism;
- ⑤ Detailed description of fault monitoring and fault identification functions (automatic and manual);
- ⑥ Detailed description of data security and user security level (function access restriction);
- ⑦ List of control and detection items: List of all input/output signals of the system (service description, instrumentation, type of system, signal, range and range of set limits)

(2) Hardware manual

At least the applicable part of the following should be included.

- ① A detailed list of technical specifications of hardware and external equipment;
- ② System block diagram: Describe the connections between all major system components (hardware and software units, modules) and the interfaces with other systems;
- ③ Detailed description of the main hardware configuration of the product;
- ④ Detailed information of input and output devices;
- ⑤ Detailed information of power supply equipment

(3) Wiring diagram

At least the applicable part of the following should be included.

- ① Power supply arrangement: Indicate the power supply arrangement of the system, and the connection between the distribution board, battery, converter or UPS;
- ② Circuit diagrams, details of input/output devices, and power supply for each circuit involving emergency operation, interlocking, and other important hardware circuits;

(4) Software manual

At least the applicable part of the following should be included.

- ① Description of the basic software installed in each hardware unit;
 - ② Description of the communication software installed in the network nodes;
 - ③ Description of the application software: information about the system modules that must operate to maintain functionality and their dependencies on other systems, the relationships between the software modules that must operate to maintain each function, and the data flow and control flow between software modules;
 - ④ Configuration of the software, including the order of priority scheme;
 - ⑤ Mechanism for switching between redundant systems
- (5) User interface manual

At least the applicable part of the following should be included.

- ① Functional assignment of each workstation and operator station and description of control transitions between stations
- ② Description of the assigned functions for each input device
- ③ The layout, size specifications and necessary photos of the input/output devices
- ④ Description of the user input interface and menu

(6) Risk assessment report: assess system risk by identifying and assessing the risks of each function of the system to determine the system risk throughout the life cycle. The risk assessment report is generally submitted by the system integrator or the supplier and should include data obtained from other suppliers. To amend the system category based on the risk assessment, consent from the CCS and the system supplier may be required. When the risks associated with the computer system are obvious, an exemption of the risk assessment is allowed, but the system integrator or supplier should submit supporting documentation to justify the exemption. The supporting documentation should include the known risks, the current computer system and the equivalence of the use environment of the initial computer system used to determine the risk and the suitability of the existing control measures for use in the current use environment.

(7) Type test outline (excluding functional and fault tests): in accordance with the requirements in the *CCS Guidelines for Type Approval Test of Electric and Electronic Products*, the type test outline should include at least visual inspection, insulation resistance measurement, energy fluctuations and fault test, marine environmental test, withstand voltage test, hull protection level test, electromagnetic compatibility test, etc.

(8) Outline for functional test and fault test: functional test and fault test procedures, including FMEA or similar analysis as may be required by CCS. Test procedures should be based on the requirements of the *Guidelines* in combination with the characteristics of specific products, and should describe the test configuration and simulation methods. Each test shall specify: initial state of equipment/system, test method, test result analysis and acceptance criteria. Each test shall cover normal mode and failure mode (including system self-check, system failure simulation test, redundant device conversion (if available)), as well as power supply and communication failure modes. Functional and fault tests can be verified by simulation.

(9) Quality plan

A quality plan should be developed based on the life cycle to document how the quality management system applies to a particular computer system, and include at least all of the following requirements:

- ① Procedures related to responsibilities, system documentation, configuration management, and personnel qualifications;
- ② Procedures for the software and associated hardware life cycle, including:
 - Institutional settings of hardware and software procured from suppliers;
 - Institutional settings for software code compilation and validation;
 - Institutional settings for validation prior to integration of systems on board
- ③ Quality system accreditation shall meet at least the following requirements:

- Intelligent equipment shall have validation procedures at the system level, subsystem level, and programmable device and module level to validate software code;
- Intelligent equipment shall have checkpoints, which may be a required submission, a test, a technical design review meeting, or an expert review meeting;
- Inform the owner of the procedures for software modification and installation on board

(10) Type test report: The surveyor may adopt the form of either audit test report or witness test, or both;

(11) Single line diagram of shipboard systems (including power supply)

(12) Layout diagram of shipboard systems

(13) Factory acceptance test outline:

① Before integration on board, inter-system integration test should be completed between systems, sub-systems and software modules. The purpose is to check the correct execution of software functions, the normal interaction and functional execution of the software and the hardware it controls, and the normal response of the software system in the event of a fault. Failures should be simulated as realistically as possible to demonstrate proper system failure detection and system response. It shall be possible to detect the analytic consequences of any failure as required.

② Functional test and failure simulation test requirements are developed by referencing to and tailoring the functional test and failure test outline.

③ The test outline can be prepared by the supplier or system integrator and jointly confirmed by the system integrator, owner and classification society. Typically, the test plan should include but not limited to the following: mobilization/commencement meeting (document description, plan, etc.), review of supplier documentation (including factory test report), review of hardware and software list (including version number); mechanical check (acceptance), wiring and terminal check, start-up test, routine system function inspection (including hardware redundancy and diagnostic check), visual inspection/operation, functional test and fault test, complex function and operation mode check, system interface test, FAT modification, FAT completion meeting.

(14) Factory acceptance test report: The surveyor may adopt the form of either audit test report or witness test, or both;

(15) Shipboard test outline (including wireless network test):

① The shipboard test outline (activity and time plan) is prepared by the system integrator and jointly confirmed by the system integrator, the owner and the classification society. It includes receiving test and comprehensive test. It should be conducted under the end-use environment of the computer system and the completion of the connection with other systems in the interconnection, and should include the verification of: a) the design functions; b) the safety response triggered by internal failure or external system equipment failure; c) the safety interconnection with other systems on the ship; d) confirmation of the normal implementation of the process of data acquisition, storage, transmission, display and application of intelligent equipment; e) test of the functions of intelligent navigation, intelligent cabin, intelligent energy efficiency management, etc. in accordance with the requirements of each integrated system; f) functional test and fault simulation test, the requirements of which shall be tailored according to the test outline of functional test and fault test.

② If the mooring/navigational test outline has included the requirements of the shipboard test outline, it is not necessary to prepare a separate shipboard test outline.

③ Acceptance test: The test plan should include but not limited to the following: mobilization/commencement meeting (document description, plan, etc.), review of supplier and system integrator documents (including factory test reports), review of hardware and software list (including version number); mechanical check (grounding system, power supply, network connection, etc.), initiation/diagnostic check (power on, initializing/commissioning the controller, diagnostic check) and download software.

④ Comprehensive test: Typically, the test plan should include, but not limited to, the following: start/commencement meeting (document description, plans, etc.), inspection of supplier's and system integrator's documents (including factory test reports), mechanical checks (communication chain between systems), diagnostic checks (check communication between systems, baud rate, etc.);

download software (if applicable). This test shall be performed by the owner after successful completion of the on-site acceptance test of each system. This is to test the performance of the connection of two or more independent systems. For example, this test should be performed when the system is integrated in the form of: an analysis system communicating with a DCS/PLC using non-conventional IO signals; an emergency shutdown ESD system; a connection to several manufacturers' DCSs, PLCs; a DCS integrated into a higher structured network; and other connections to the system that may also require this test.

(16) System installation process:

① The system installation process should be prepared by the system integrator and jointly confirmed by the system integrator, owner and classification society. It should include the use environment, installation requirements and installation process of relevant equipment. In particular, it should clarify: a) the environmental control requirements of computer, network equipment, sensors and actuators (such as temperature and humidity, salt spray, vibration); b) the installation, connection, electromagnetic compatibility and grounding requirements of computer and other IT equipment; c) the installation requirements of sensors (such as pipeline direction); d) the selection and connector production requirements of cables used by sensors and actuators; e) the cable laying process requirements.

(17) Shipboard test report (acceptance test): The surveyor can adopt the form of either audit test report or witness test, or both;

(18) Shipboard test report (comprehensive test): For new construction survey, the surveyor may adopt the form of either audit test report or witness test, or both;

8.2.2 The following drawings shall be submitted to CCS for future reference:

(1) Operation manual (including troubleshooting instructions).

At a minimum, the manual should include instructions for system startup, functional recovery, maintenance and periodic testing, data security and data backup, user rights restrictions, software reinstallation and system recovery, fault location and repair, system updates, and other matters requiring user attention.

(2) Evidence of software verification:

① Functional description of software modules and hardware description of related programmable equipment; The above documents should be submitted by the system integrator and the supplier.

② Evidence of software module validation (detection and correction of software errors) based on the selected software development standard. The standard selected for validation is likely to be different depending on the importance of correct operation of the software functions (e.g. IEC 61508 has different requirements depending on the safety integrity level, and other recognized standards use a similar approach). This document is to be submitted by system integrator and supplier;

③ Evidence of functional testing of programmable equipment at the software module, subsystem and system levels. This document shall be submitted by the supplier through the system integrator. Functional test addresses the functions of the specified software, not that of the operating system. Functional test shall also address function libraries, software user layers, and any parameter settings.

(3) Description of the software functions;

(4) List of software installed on the system and version numbers;

(5) Software maintenance and usage manuals (with necessary procedures for software and hardware change management);

(6) List of interfaces between the system and other systems of the ship;

(7) List of data transmission standards;

(8) Shipboard test report (comprehensive test): For post-construction survey, the surveyor may adopt the form of either review of test report or witness test, or combination of both;

(9) Updated software registry:

① List of system software and version numbers;

② Virus and malware scan results;

- ③ Including the relevant automation system alarm points and the rectification value of the security system parameters;
 - ④ When applicable, the calibration log of the equipment should be included.
- (10) Software modification impact analysis records and test reports

9. Additional requirements for the survey

9.1 Product approval

Product approval should be in accordance with the requirements of Chapter 3, Part 1 of the CCS *Rules for Steel Ships*. There are the following additional requirements.

- (1) Type test should be in accordance with the approved type test outline (excluding functional and fault tests) and functional and fault test outline.
- (2) The system integrator or supplier shall complete the approval of the integrated programmable equipment in the system. After the documents 1~11 mentioned in Table 8.1 are approved, type test completed and document 12 submitted, the approval of programmable equipment can be taken as a separate single piece inspection or as part of the principle / design / type approval completed. The approval document shall describe the compatibility of the programmable equipment in the ship application, the need for on-board testing during ship integration and specify the system components as approved programmable equipment.
- (3) CCS may approve subsystems and programmable equipment for limited applications under restricted use if their integration status in the ship's system cannot be determined. CCS may also require other necessary drawings, detailed information, test reports, and inspections related to the supplier's stated criteria be submitted in order to complete the approval. Conditional approval may be granted for subsystems and programmable equipment upon completion of the required inspections and tests. See Article 1.3 for details.
- (4) The certificate shall describe the stratified classification of the equipment and indicate the test marking for the entire equipment. See the appendix for details.

9.2 Ship drawing review

Ship drawing review audit shall be performed in accordance with the requirements of Section 5, Chapter 2, Part 1 of the *Rules for Steel Ships*, with the following additional requirements.

- (1) The ship designer or owner shall submit documents 13 and 14 of Table 8.1 and pass the review.

9.3 Single-piece and single-batch inspection

- (1) Typically, at this point the product/system has been approved in accordance with the aforementioned product type approval requirements and the drawing examination has been completed in accordance with the aforementioned ship examination requirements. At this point, the drawing review of the product is carried out in accordance with the requirements for single-piece and single-batch inspection set out in Section 2, Chapter 3, Part 1 of CCS *Rules for Steel Ships*.
- (2) If the product/system is not approved to apply for single-piece single-batch inspection, it shall be carried out in accordance with Article 3.2.2.4, Section 2, Chapter 3, Part 1 of CCS *Rules for Steel Ships*.
- (3) Documents 15~20 in Table 8.1 shall be submitted and pass the review.
- (4) The factory acceptance test has the following additional requirements:

The test shall be carried out according to the factory acceptance test outline, and the specific test steps are as follows:

- ① Test preparation; Rack/remote IO (forced IO by connecting the emulation device at the field end), bus interface, subsystem connection;
- ② Test implementation: It is divided into system characteristics, project-related supply and application content inspection. Mainly as follows: system performance inspection and test (start-up test, including

routine function test of hardware redundancy and diagnosis), inspection of related contents of the provided items (document inspection, inspection of hardware and software list (including version number), mechanical inspection (acceptance), wiring and terminal inspection); withstand voltage insulation test (if applicable); reference documents.

③ Application check steps: HMI display check, comprehensive function and interlock check, additional function, communication test with each subsystem, and system function check (in addition to related application function test, system characteristics also include system fault recovery, redundancy, alarm processing and confirmation, guaranteed system performance such as refresh rate, etc.).

(5) The certificate shall describe the stratified classification of the equipment and indicate the test markings for the entire equipment.

9.4 New construction survey

(1) Document review

① The documents 22 and 23 of Table 8.1 shall be submitted and pass the review.

② Activities are carried out after the build surveyor's examination and approval.

③ For the outline and process with approved comments, the surveyor shall verify the shipyard's response to the comments made and implement them in the corresponding inspection.

④ The review shall focus on confirming whether the relevant requirements in Part 7 of *CCS Rules for Steel Ships* are satisfied. The installation process of relevant sensors shall meet the corresponding technical requirements of the manufacturer during approval.

(2) Shipboard test

① Acceptance test and comprehensive test shall be conducted in accordance with the shipboard test outline.

② Acceptance test and comprehensive test requirements are provided in Article 8.2.1 (14).

④ If the supplier has carried out the test activity of Item ② of this article, acceptance test and comprehensive test, this step can also be done by reviewing the supplier's report. If the review is passed, the report can be used as an equivalent alternative to items 24 & 25 in Table 8.1. The report should be signed and annotated for the purpose of this clause.

9.5 Post-construction survey

(1) The following items shall be checked during annual survey, intermediate survey and special survey:

① Check the previous operation records of the intelligent equipment to confirm that the intelligent equipment is working properly;

② Confirm that the system data can be exchanged normally between the ship and shore, and confirm the data interaction history;

③ Spot check the system backup records and confirm that the system has implemented effective backup;

④ Check the intelligent navigation, intelligent cabin, intelligent energy efficiency management, etc. according to the requirements of each integrated system (if needed, conduct comprehensive tests according to the shipboard test outline).

⑤ If any supplier has carried out the testing work of items ①~④ of this article, this step can also be done by reviewing the report of the supplier. If time or testing conditions are problematic and do not permit witness on site, the test report completed within the last year can be reviewed, and if passed, it can be used as an equivalent substitute for items ①~④, and the report should be signed and annotated for the purpose of this clause.

⑥ Check whether the following documents reviewed by CCS are available on board: operation manual, list and version number of software installed in the system; software maintenance and usage manual (including necessary procedures for software and hardware change management); list of interfaces between the system and other systems of the ship; outline of tests on board (i.e. items 9, 16, 17, 18, 22 in Table 8.1).

⑦ Documents 26, 27 of Table 8.1 shall be submitted (if applicable) and pass the review.

(2) The modification or reconstruction of ships shall be carried out in accordance with the relevant requirements of Chapter 5, Part 1 of the *Rules for Classification of Sea-Going Steel Ships*.

Attachment 1: Supplementary explanation of the test

The examples in this attachment are for reference only. The test items and acceptance criteria shall be formulated by the stakeholders through mutual consultation.

The purpose of the type approval test is to demonstrate the capability of the equipment to perform the intended function under the specified test conditions.

The classification of environmental conditions is described in Article 1.3.2 of the *CCS Guidelines for Type Approval Test of Electric and Electronic Products* (hereinafter referred to as the *CCS Test Guidelines*).

According to the use of the equipment and its installation location, the type approval test of electrical and electronic equipment should be in accordance with the provisions of Table 1.3.3.a of the *CCS Test Guidelines*. The type approval test items of different types of electrical and electronic equipment are shown in Table 1.3.3.b of the *CCS Test Guidelines*.

Examples of test items of type test (excluding functional test and fault test) are as follows:

Example of test items of type test (excluding functional test and fault test)

No.	Test item	Test requirements	Remarks
1	Visual inspection	Article 2.1 of <i>CCS Test Guidelines</i>	
2	Insulation resistance measurement	Article 2.3 of <i>CCS Test Guidelines</i>	
3	Energy fluctuation and fault test	Articles 2.4 and 2.5 of <i>CCS Test Guidelines</i>	
4	Marine environmental test	Articles 2.6~2.13 of <i>CCS Test Guidelines</i>	
5	Withstand voltage test	Article 2.14 of <i>CCS Test Guidelines</i>	
6	Hull protection grade test	Article 2.15 of <i>CCS Test Guidelines</i>	
7	Delayed ignition test	Article 2.16 of <i>CCS Test Guidelines</i>	Where applicable
8	EMC test	Chapter 3 of <i>CCS Test Guidelines</i>	

The following is supplemented to the functional and fault tests:

Functional test and fault test process, including FMEA or similar analysis that CCS may require; The test procedures shall describe the test configuration and simulation methods in accordance with the provisions of Chapters 5 to 10 of the *Guidelines* and with the characteristics of the specific product. Each test shall specify: initial state of equipment/system, test method, test result analysis and acceptance criteria. Each test shall cover normal mode and failure mode (including system self-check, system failure simulation test, redundant device conversion (if available)), as well as power supply and communication failure modes. Functional and fault tests can be verified by simulation.

See the following table for functional test and fault test examples.

The following are additional requirements to the shipboard test outline (including wireless network testing):

① The shipboard test outline (activity and time plan) is prepared by the system integrator and jointly confirmed by the system integrator, the owner and the classification society. It includes receiving test and comprehensive test. It should be conducted under the end-use environment of the computer system and the completion of the connection with other systems in the interconnection, and should include the verification of: a) the design functions; b) the safety response triggered by internal failure or external system equipment failure; c) the safety interconnection with other systems on the ship; d) confirmation of the normal implementation of the process of data acquisition, storage, transmission, display and application of integrated platform; e) test of the functions of intelligent navigation, intelligent cabin, intelligent energy efficiency management, etc. in accordance with the requirements of each integrated system; f) functional test and fault simulation test, the requirements of which shall be tailored according to the test outline of functional test and fault test.

- ② If the mooring/navigational test outline has included the requirements of the shipboard test outline, it is not necessary to prepare a separate shipboard test outline.
- ③ Acceptance test: The test plan should include but not limited to the following: mobilization/commencement meeting (document description, plan, etc.), review of supplier and system integrator documents (including factory test reports), review of hardware and software list (including version number); mechanical check (grounding system, power supply, network connection, etc.); initiation/diagnostic check (power on, initializing/commissioning the controller, diagnostic check) and download software.
- ④ Comprehensive test: Typically, the test plan should include, but not limited to, the following: start/commencement meeting (document description, plans, etc.), inspection of supplier's and system integrator's documents (including factory test reports), mechanical checks (communication chain between systems), diagnostic checks (check communication between systems, baud rate, etc.); download software (if applicable). This test shall be performed by the owner after successful completion of the on-site acceptance test of each system. This is to test the performance of the connection of two or more independent systems. For example, this test should be performed when the system is integrated in the form of: an analysis system communicating with a DCS/PLC using non-conventional IO signals; an emergency shutdown ESD system; a connection to several manufacturers' DCSs, PLCs; a DCS integrated into a higher structured network; and other connections to the system that may also require this test.

Examples of receiving tests and comprehensive test are shown in the table below.

Example of functional test and fault test

No.	Test item	Initial state of equipment/system	Test method	Analysis of test results and its acceptance criteria	Test result requirements	Remarks
1	Document inspection		Check whether all documents have been submitted and are controlled versions.			
2	General inspection of software and hardware		Verify the consistency of the hardware structure, quantity, dimensions, paintwork, etc. with the relevant documentation. In addition, the contents of software authorization, spare parts, and consumables should also be checked.			
2.1	Hardware inspection					
2.2	Software authorization, version (including firmware) check					
2.3	Spare parts, consumables and tools check					
3	Electro-mechanical installation check		Check the hardware structure and design against the approved documents			
3.1	Cable introduction methods, brackets and accessories (cable fixing clips, fixing heads, etc.)					
3.2	Annotation, labeling					
3.3	Installation of components and modules					
3.4	Screw fastening connections, terminal connections					
3.5	Grounding, equipotential connection					
3.6	Electric shock protection, warning sign					

No.	Test item	Initial state of equipment/system	Test method	Analysis of test results and its acceptance criteria	Test result requirements	Remarks
3.7	Maintainability of fan and mechanism structure of cabinet					
3.8	Spare capacity					
4	Wiring and terminal check		Verify that wiring meets the guidelines provided in the engineering project specification book, and that the approved hardware documentation and workmanship meets industry standards.			
4.1	Wiring and cabling, internal circuit routing					
4.2	Fuse and disconnect switch					
4.3	Labeling, annotations					
4.4	Classification of cables, colors, cross-sections, voltages, explosion-proof ratings, etc.					
4.5	Cable bending inspection					
4.6	Manual cable bending, tensioning test					
4.7	Cable duct load bearing					
4.8	I/O to terminal wiring and connection labeling					
4.9	Orientation of system cable plug					
4.10	System voltage insulation test					
5	Start-up test and basic system functions		Verify that the system can start up properly, recover from a power failure and that it can be loaded online. In addition, check whether the system is running within any			

No.	Test item	Initial state of equipment/system	Test method	Analysis of test results and its acceptance criteria	Test result requirements	Remarks
			given constrains.			
5.1	Restart		Use of a new memory card and removal of the controller's battery backup			
5.2	Online changes					
5.3	Controller cycle time					
5.4	Show call time					
5.5	Time of value update					
5.6	System load (memory capacity, storage capacity, etc.)					
5.7	Login policy and level					5.3.1(9)
5.8	Alarm handling policy and its acknowledgement					
6	System alarm test		Check the alarm reports in the system, including system-related faults, control cabinet alarms, and system-generated alarms.			
6.1	Power failure, UPS monitoring					
6.2	Circuit breaker, fuse monitoring					
6.3	Cooling fan					
6.4	Communication and network monitoring					
6.5	Short circuit, disconnection, over-range, ground fault					
6.6	Watchdog					
7	Hardware redundancy and diagnostic checks		Ensure that redundant components can be operated and			5.3.1(2)~(5)、(10)

No.	Test item	Initial state of equipment/system	Test method	Analysis of test results and its acceptance criteria	Test result requirements	Remarks
			monitored properly			
7.1	Redundant operation and monitoring of controllers					
7.2	Redundant operation and monitoring of communication and network					
7.3	Redundant operation and monitoring of power supply					
7.4	Redundant operation and monitoring of operator station					
7.5	Redundant operation and monitoring of I/O devices					
7.6	Redundant operation and monitoring of all other devices not mentioned above					
8	Monitoring/operation		Verify the consistency between standard functions and graphic display schemes and specifications.			8
8.1	Background color and color change					
8.2	Symbol					
8.3	Static text and dynamic changes					
8.4	Screen organization (folding, transitions, sub-screens)					
9	Functional test based on function block diagrams, functional planning, etc.		Verify the consistency of system functions with the requirements of given documents.			8、9
9.1	Identification and labeling of circuits/functions					
9.2	Test the display of relevant I/O to the screen					

No.	Test item	Initial state of equipment/system	Test method	Analysis of test results and its acceptance criteria	Test result requirements	Remarks
9.3	Detailed functional check after putting in all relevant interlocks, alarms, messages, displays, trends, graphic screens and signal updates on device screens					
9.4	Bit number operation and trend acquisition functions (internal and external)					
9.5	Priority handling of alarms					
10	Complex functions and operating modes		Check the consistency of system functions with the requirements of given documents.			
10.1	Detailed functional check after putting in all relevant interlocks, alarms, messages, displays, trends, and signal updates on graphic screens and equipment screens					8、9
10.2	Whether the system integrates data from the three intelligent systems of intelligent navigation, intelligent cabin and intelligent energy efficiency, and whether the system is open to enable monitoring and intelligent management of the ship and data interaction with shore base.		Check the compliance of system functions with Chapter 5 of the guide			5.1
10.3	System requirements					
10.3.1	The two types of systems, Ic1 information summary display and Ic2 aided decision making of the intelligent integration platform should meet the requirements of our society's Class II computer system, and Ic3 control-related systems should meet the requirements of our society's Class III computer system. If the stakeholder revises		按照《船用软件安全及可靠性评估指南》对系统进行评估 Evaluate the system in accordance with the <i>Guidelines for Safety and Reliability Assessment for Shipboard Software</i> .			5.3.1(1)、5.4、6、10.1、10.2

No.	Test item	Initial state of equipment/system	Test method	Analysis of test results and its acceptance criteria	Test result requirements	Remarks
	the system category based on risk, the consent of CCS shall be obtained.					
10.3.2	<p>The database of the integration platform should have an effective integration process, i.e., the necessary data should be screened according to the data quality of each system and the functional requirements of the integration platform.</p> <p>The system supports multi-terminal (PC, mobile devices, etc.) access.</p> <p>The system should be provided with an interface for data transmission if necessary, so that all stakeholders can share the data.</p>					5.3.1(6)~(8)、5.3.2、7
10.4	The system shall meet the network security requirements.		Network security shall meet the requirements of <i>CCS Guidelines for Requirement and Security Assessment of Ship Cyber System</i> .			10.3
11	Sub-function integration test		Verify the interoperability of all related systems.			8、9
11.1	Detailed functional check after putting in all relevant interlocks, alarms, messages, displays, trends, and signal updates on graphic screens and equipment screens					

Example of acceptance test

No.	Test item	Initial state of equipment/system	Test method	Analysis of test results and its acceptance criteria	Test result requirements	Remarks
1	Control system documents check					
2	Hardware specification quantity check					
3	Number of software specifications check (correct software/firmware version, etc.)					
4	Electro-mechanical installation check					
4.1	Grounding system connected correctly					
4.2	Power supply system connected correctly					
4.3	Network system properly connected					
5	Start-up/diagnostic check					
5.1	Power-up of related hardware					
5.2	Debugging/initialization of related hardware and diagnostic checks					
6	Downloading software					

Comprehensive test example

No.	Test item	Initial state of equipment/system	Test method	Analysis of test results and its acceptance criteria	Test result requirements	Remarks
1	Control system documents check					
2	Electro-mechanical installation check					
3	Correct installation connection between systems (serial port, Ethernet, optical fiber, etc.)					
3.1	Correct setting of communication baud rate (dip switches on hardware, software settings, etc.)					
3.2	Verification of proper communication between system I/O signals between different systems					
4	The subsystem screen in the system is set up in accordance with the specifications					
4.1	Functions should be in line with the applicable content of the functional test and fault test in the type approval					

Attachment 2: Examples of Additional Information Description

The examples in this attachment are for reference only

Example 1:

Name of Software		Version of Software
Intelligent XXXX System Software		V 1.1.X
System module	module 1	V 1.1.X
	module 2	V 1.1.X
	

Software Operating Environment Requirement:

Hardware Configuration	CPU: i5 and above Memory: 8GB and above Hard disk: 1T and above Network card: 100 megabytes and above
Operating System	Windows server 2016 or Windows 7 Operating System and install the following software: .NET Framework 4.5 and above Microsoft office 2007 and above Google Chrome or IE9 and above
Database Requirements	Database MySQL 5.7 and above

Note: The requirements above are minimum requirements.

Software Control:

This certificate covers software only.

Hardware used for this product should be compliant with the rules of CCS.

All changes in software are to be recorded by the manufactory.

Significant software changes should be notified to the China Classification Society and relevant documents should be submitted for assessment. If the assessment confirms that the change will affect the function required in the rules, relevant type test should be carried out again, and type approval will be modified.

Example 2:

System composition:

Description about hardware:

No.	Name	Model and description	Suitable for environment type
1	Server	Advantech HPC-xxxx 2 sets, 16-core CPU*264G memory 2T*3 SAS hard disk, IP20	A1
2	Core switch		A1
3	Convergence switch		A1

4	Router		A1 B1 B2 C1 C2
5	Intelligent gateway		A1 B1 B2 C1 C2
6	Fire partition wall		A1
7	Network management server		A1
8	Optical module		A1 B1 B2 C1
9	Workstation		A1 B1 B2 C1 C2
10	Disk array		A1
11	Electric cable		
12	Optical cable		
13	Vibrations sensor		D1
14	Vibration data collector		D1
15	Camera		A1 B1 B2 C1 C2
16	3G/4G WIFI system		A1 B1 E1
17	Secure encryption processing unit		A1 B1
18	Oil analyzer		C1 C2 C3

Suitable for environment type: (See the provisions in Article 7 of the *CCS Guidelines for Survey of Intelligent Equipment*)

Name and Version of Software:

Name of Software		Version of Software
Intelligent XXXX System Software		V 1.1.X
System module	module 1	V 1.1.X
	module 2	V 1.1.X
	

Servers and workstations associated with this equipment shall be used together with UPS which can provide power supply for at least 30 minutes in case of main power interruption.

Software control:

The company shall record all changes to the software.

Significant software changes should be notified to the China Classification Society and relevant documents should be submitted for assessment. If the assessment confirms that the change will affect the function required in the rules, relevant type test should be carried out again, and type approval will be modified.