

CCS SHIP TYPE SERVICE MANUAL OF CHEMICAL TANKER

CCS
CHINA CLASSIFICATION SOCIETY
中国船级社

Overview

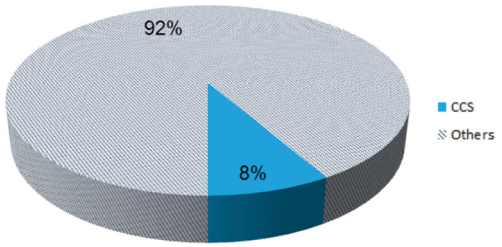
By sticking to the policy of "building first-class international classification society with own characteristics and with technology as the foundation and credibility as the cornerstone", CCS improves continuously its image and value of chemical tankers through advanced technology and quality service and is widely and highly recognized by the industry.

CCS classed chemical tankers cover the deadweight tonnage from thousand tons to 38 thousand tons, as well as the boundary material of cargo tanks cover carbon manganese steel, duplex stainless steel and austenitic stainless steel. CCS also provides the clients with series of technical services such as emission control solution, ship intelligenization, vibration noise evaluation and ship emergency efficiency

By committing to the mission of "safety, environmental protection and creating value for clients and society" and based on over 120 offices established across the globe, CCS provides the ship owner with 7X24 hours of survey and technical support services. Relying on its highly efficient service system structure, CCS continuously provides comprehensive support for conducting survey activities, safeguarding ship safety and emergency response to accidents. CCS has continuously achieved outstanding performance in three main MoUs and witnessed healthy and steady increase of its fleet size.

Performance (classed fleet)

At present, CCS has more than 300 chemical tankers, covering 8% of total chemical tankers engaged in international voyages.





38,000DWT duplex stainless steel chemical tanker of Sinochem International

Ship type classification and characteristics

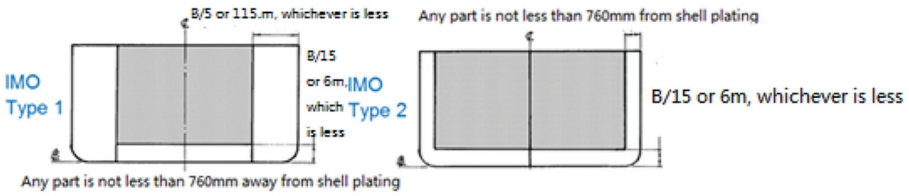
◆ Ship type classification

◎ Chemical tanker: according to IMO IBC CODE, chemical tankers are classified as follows according to danger level of cargo being carried:

• IMO type 1 is a chemical tanker intended to transport Chapter 17 products with very severe environmental and safety hazards which require maximum preventive measures to preclude an escape of such cargo. The location of cargo tank is shown in left figure below;

• IMO type 2 is a chemical tanker intended to transport Chapter 17 products with appreciably severe environmental and safety hazards which require significant preventive measures to preclude an escape of such cargo. The location of cargo tank is shown in right figure below;

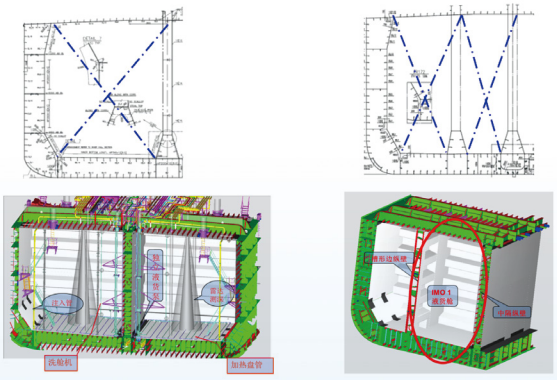
• IMO type 3 is a chemical tanker intended to transport Chapter 17 products with sufficiently severe environmental and safety hazards which require a moderate degree of containment to increase survival capability in a damaged condition.



According to boundary material of cargo tank, chemical tankers are divided into chemical tanker of duplex stainless steel, chemical tanker of austenitic stainless steel and chemical tanker of marine structural steel with special coating type.

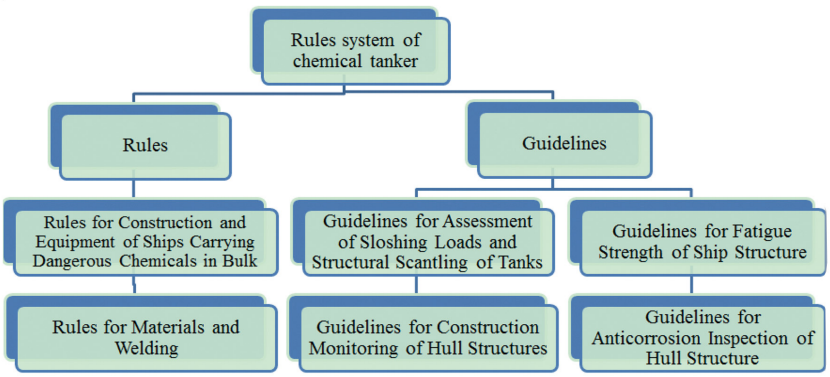
◎ Characteristics of chemical tanker:

• Cargo oil tank is enveloped by double bottom, double hull, deck and cofferdam (if any);
• Cargo tank inwall and piping adopt stainless steel or anticorrosive coating;
• Cargo tank is provided with divisions as well as dedicated cargo pumps and piping.



Rules system

CCS has established a set of complete rules system of chemical tankers, and ship type has covered checmial tanker of IMO Type 1, Type 2 and Type 3 with duplex stainless steel, austenitic stainless steel and marine structural steel of special coating type.



Characters of classification and class notations

CCS typical characters of classification and class notations are as follows:

★ CSA Chemical/Oil Tanker, Double Hull, F.P.≤60℃,CSR, Type 2 for all Cargo Tanks, Type 1 for Cargo Tanks Nos.5(CP&CS); Max. Cargo Temperature 80℃; Max. Pressure 0.025MPa & Max. Cargo Density 1.3t/m^3 for all Cargo Tanks; Max. Pressure 0.065MPa & Max. Cargo Density 1.025t/m^3 for Cargo Tanks Nos.6(P&S); Stainless Steel; PSPC(B); CM; Emergency Towing Arrangements; Loading Computer(S,I,D);ESP; In-Water Survey

★ CSM AUT-0; BWMS;BWMP; OMBO; IGS; SCM; G-EP(GPR)

Class notation	Description	Remarks
Chemical Tanker	Ship similar to oil tanker, with cargo containment and carrying liquid cargo listed in Rules for Construction and Equipment of Ships Carrying Dangerous Liquid Chemicals in Bulk. Ships constructed on or after 1 July 1986 and complying with IBC Code are to be assigned the following notations respectively, depending on the category of chemicals carried: ① Type 1: carrying chemicals with very severe environmental and safety hazards, and cargo tank type includes integral tank and independent tank; ② Type 2: carrying chemicals with appreciably severe environmental and safety hazards, and cargo tank type includes integral tank and independent tank; ③ Type 3: carrying chemicals with sufficiently severe environmental and safety hazards, and cargo tank type includes integral tank and independent tank.	Ships constructed before 1 July 1986 and complying with IBC Code are to be assigned the notations of Type I/Type II/Type III respectively instead of Type 1/ Type 2/Type 3.

Class notation	Description	Remarks
Max.Pressure × × × Mpa Max.Cargo Density × × × t/m^3 Max. Cargo Temperature × × ×℃	For ships carrying chemicals in bulk, the scantlings of structural members of cargo tanks are determined according to: • Maximum design pressure • Maximum temperature • Maximum cargo density	
Stainless Steel	Cargo tankers boundary of chemical tanker are made of stainless steel material.	
COMPASS	For ships subject to ship design check according to COMPASS-Structure software, one or more suffix of R, D and F has following meaning: R: ships subject to rules check according to COMPASS-Structure; D: ships subject to direct calculation of ship structure according to COMPASS-Structure; F: ships subject to ship structure fatigue strength evaluation according to COMPASS-Structure.	This class notation is necessary to CSR ships.
Emergency Towing Arrangements	This notation is to be assigned to tankers provided with emergency towing arrangements.	This class notation is necessary to tankers of 20,000 deadweight tonnage and above.
Loading Computer	For ships granted with provision of approved loading computer, one or more suffix of OA, S, I and D has following meaning: OA: The loading computer has capacity of calculating optimal trim optimizing curve under various loading conditions as well as automatically optimizing and generating optimal energy-saving loading scheme: S: The loading computer can be used to calculate and check hull strength under various loading conditions; I: The loading computer can be used to calculate and check intact stability; D: The loading computer can be used to calculate and check damage stability.	OA, S, I and D can be of individual or random combination.
PSPC	Ships of which specific spaces comply with IMO Performance Standard for Protective Coatings may be assigned this notation, with one or more of suffixes B,C, D and V being added thereafter. Meanings of the suffixes are as follows: B: protective coatings applied in dedicated seawater ballast tanks of all types of ships; C: protective coatings applied in cargo oil tank spaces of crude oil tankers; D: protective coatings applied in double-side skin spaces; V: protective coatings applied in void spaces of bulk carriers and oil tankers.	B, C, D and V can operate both separately and together
CM	Ships for which the Construction Monitor of structural precision at critical locations of hull (including alignment, fitting-up, edge treatment and technological standards) is in accordance with an approved plan.	

Class notation	Description	Remarks
In-Water Survey	For ships suitable for in-water surveys, this notation may be assigned.	
ESP	For chemical tankers subject to Enhanced Survey Programme, this notation is to be added after type notation.	
AUT-0	Main propulsion machinery remotely controlled from BCS, machinery space including center control station periodically unattended.	
IGS	This notation may be added for ships fitted with Inert Gas System.	
COW	This notation may be added for ships fitted with Crude Oil Washing system.	
SCM	This notation may be assigned to oil-lubricated or water-lubricated propeller shafts fitted with approved shaft seals.	

Class notations recommended for chemical tankers are as follows:

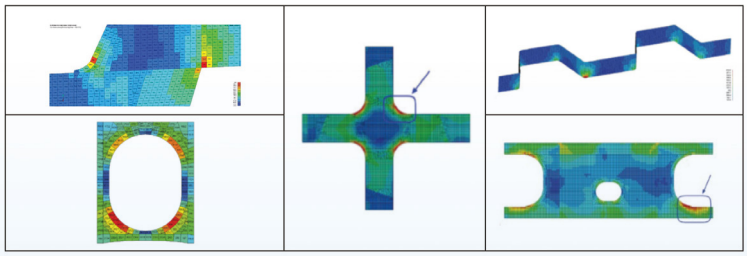
Class notation	Description
EOM	Capable of monitoring ship's operation in real time and supporting decision on operational energy efficiency management and optimization by collecting operational parameters of ship's energy-consuming equipment and navigational equipment and synchronizing with shore-based equipment.
i-ship	Intelligent ship is the development trend of the shipping industry. Intelligent ships are to be assigned with this notation with one or more of suffixes N, H, M, E, C and I being added thereafter: Ai– functional notation for autonomous operation; Ri– functional notation for remote control; Nx – functional notation for intelligent navigation; Hx – functional notation for intelligent hull; Mx – functional notation for intelligent machinery; Ex – functional notation for intelligent energy efficiency management; Cx – functional notation for intelligent cargo management; I – functional notation for intelligent integration platform; i – numbers such as 1, 2, 3, indicating the scope and degree of remote control and autonomous operation; x – additional notation for optional function.
DFDR	Natural gas fuel ready system. During design and construction stage of the ship, full consideration has been given to the conversion preparation for natural gas fuel system in the future. Structures, systems and installations related to the natural gas fuel system are ready in the design stage and are reinforced and installed complying with the relevant requirements of CCS.
ERS	Upon prior ERS agreement between the owner and CCS and an electronic database for stability and structural strength of a ship, CCS will in case of emergency of the ship, e.g. collision at sea, grounding, oil spillage, etc. and at request of the owner, initiate an emergency response procedure to provide calculation and analysis for damage stability, structural strength and spillage, giving technical support to the ship in getting out of danger and recommendations to the owner/master in making final decision.

Class notation	Description
G-EP (X)	Environmental protection notation for green eco-ships.Where it is necessary to indicate further the level of environmental protection, "X" is used to represent the sub-elements as follows: OILx-- control of discharge of oil pollutants, where x is 1 or 2; EAL-- environmental acceptable lubricants; IBTS-- integrated bilge water treatment system; NLSx-- control of discharge of noxious liquid substances, where x is 1 or 2; SC-- control of discharge of sewage; GWC-- control of discharge of grey water; RC-- control of discharge of garbage; NECx-- control of NOx emission, where x is 1 or 2; SEC-- control of SOx emission; VCS/VCS-T-- VOC emission control; RSCx-- control of refrigeration system; INC-- emission control of incineration operation on board; BC20, BC70-- emission control of black carbon; AFS/AFS +-- anti-fouling systems; GPR/GPR+-- green passport; GPR(EU)/GPR(EU)+ -- green passport (EU)
G-ECO (X)	Ecological protection notation for green eco-ships. Where it is necessary to indicate further the level of ecological protection, "X" is used to represent the sub-elements as follows: CDx-- CO_2 emission design index, where "x" represents the percentage ratio of the ship's Attained EEDI value lower than the reference line value for that ship; COM-- CO_2 emission operation management; BWM(T)-- ballast water treatment; BWM(Es)-- ballast water sequential method; BWM(Ef)-- ballast water flow-through method; BWM(Ed)-- ballast water dilution method; BWM(O)-- other management method of ballast water; BIO-- biofouling management; VIBx-- comfort onboard (vibration), where x is 1 or 2 or 3, and 3 means the highest grade; NOIx-- comfort onboard (compartment noise), where x is 1 or 2 or 3, and 3 means the highest grade; CLx-- comfort onboard (indoor climate), where x is 1 or 2 or 3, and 3 means the highest grade; UW-- underwater noise; RN-- ambient noise.

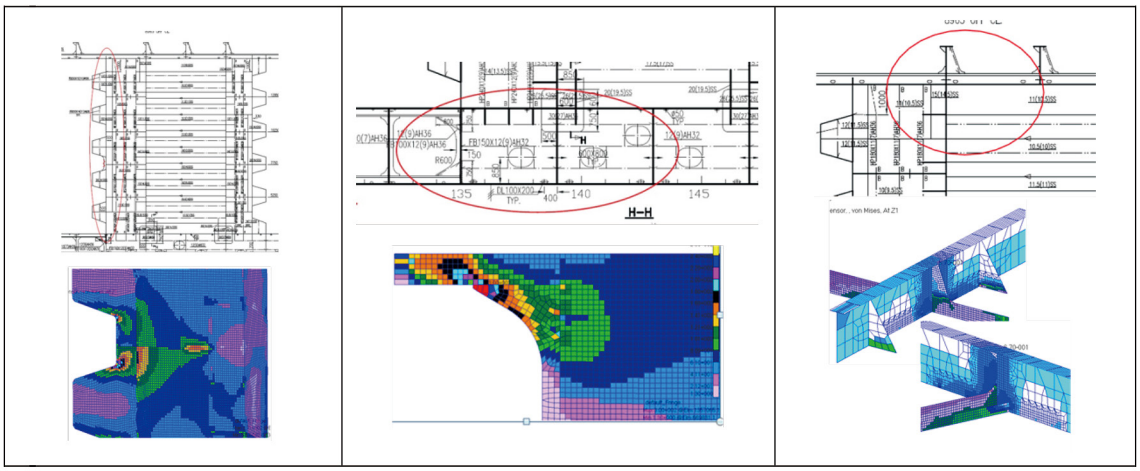
Key technology

◆ Critical Structural areas

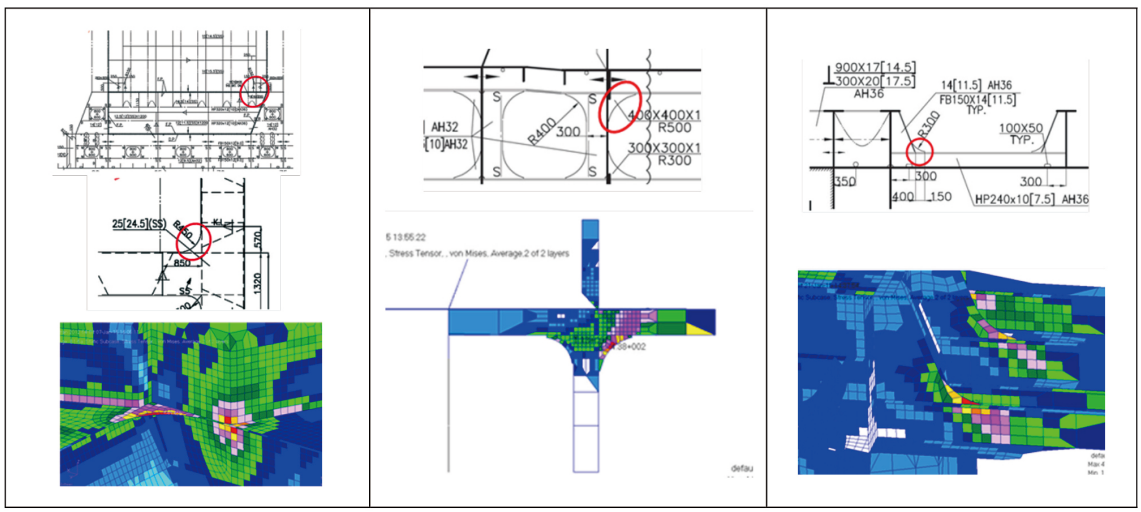
(1) Bracket toe of deck transverse, PMA manhole, lower stool top plate and upper stool bottom plate at the connection of corrugated longitudinal bulkhead and transverse bulkhead, lower end of vertical corrugated bulkhead, connection of local bottom girder and longitudinal.



（2）Horizontal corrugated longitudinal bulkhead in the cargo tank of IMO Type 1 chemical tanker: end connection of local longitudinal bulkhead and transverse bulkhead, inner bottom longitudinal near the connection of local longitudinal bulkhead and transverse bulkhead, bracket toe at the end of local deck girder.

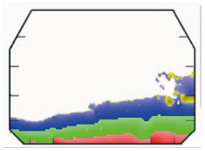


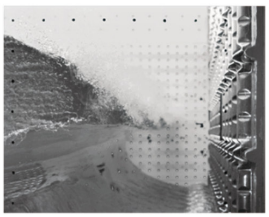
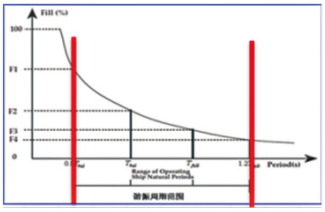
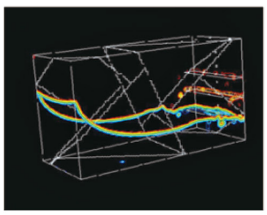
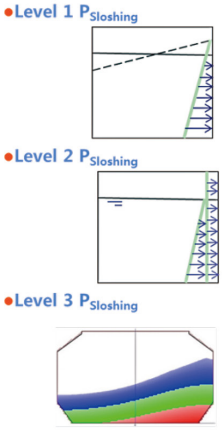
（3）Vertical corrugated longitudinal bulkhead in the cargo tank of IMO Type 1 chemical tanker: lower end near the connection of local longitudinal bulkhead and transverse bulkhead, inner bottom longitudinal near the connection of local longitudinal bulkhead and transverse bulkhead, bracket toe at the end of local deck girder.



Sloshing load and strength assessment

Due to the diverse type and different quantity of chemical products orders, cargo tanks are often partially loaded, bring severe sloshing load to the tank boundary structures as the ship moves, so cargo tank safety must be ensured through sloshing strength evaluation. The loading limitation approved after sloshing evaluation is to be included in the Loading Manual as the guidelines for operation.



Structural arrangement and node optimization

CCS can provide structural arrangement and node optimization schemes for main ship types by structural design research and damage case analysis of large amount of real ships. CCS has successfully provided technical service of structural arrangement and node optimization to a series of VLCC, VLOC and large container ship projects, helping shipyard and shipowner save cost and enhance competitiveness.

Optimization of longitudinal spacing

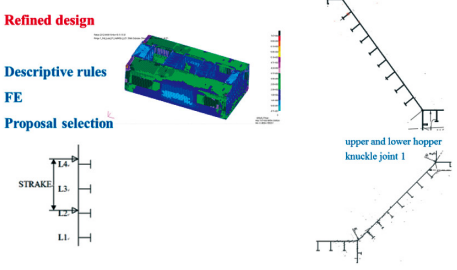
➢ Arrangement requirements for PMA is that longitudinal spacing is to be within 800~942 mm.

➢Differences in weight of longitudinal member with different longitudinal spacing

Plan	Longitudinal spacing(mm)	Weight of longitudinal member
A	850	100%
B	900	101.69%
C	950	101.83%

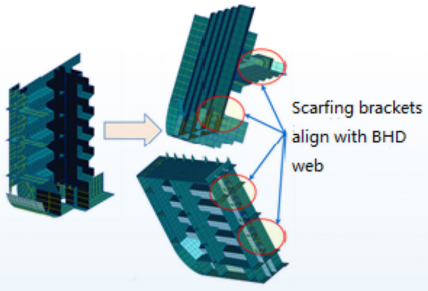
Analysis:

Theoretically speaking, there are no final conclusions: optimization of relatively small longitudinal spacing is based on engineering experience. In fact, longitudinal spacing is to match frame spacing and longitudinal strength margin of the ship.



Detailed requirements for corrugated bulkhead

A4.9.6.3 Where lower stools are provided, scarfing brackets aligned with the web of vertical corrugated bulkhead are to be provided within the lower stools as far as possible. Where lower stools are not provided, the double bottom floor is generally to be aligned with the flange of vertical corrugated transverse bulkhead and the double bottom girder is generally to be aligned with the flange of vertical corrugated longitudinal bulkhead. And scarfing brackets aligned with the vertical corrugated web are to be provided below the inner bottom and hopper tank sloping plating as far as possible. Where the transverse bulkheads are horizontally corrugated, primary members aligned with the flange of corrugated bulkhead are generally to be provided in way of the intersection of corrugated bulkheads and inner shell and longitudinal bulkheads and scarfing brackets aligned with the web of corrugated bulkheads are to be provided as far as possible.



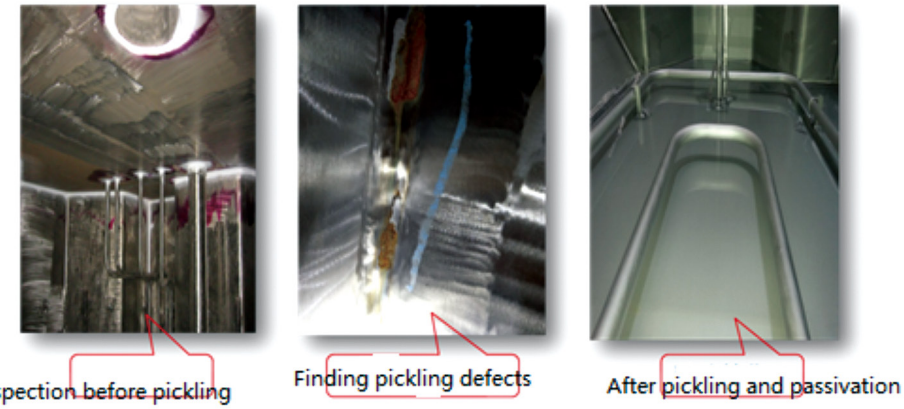
◆ Application of stainless steel material

With the development of welding, processing and construction management, the proportion of stainless steel cargo tanks increases sharply, which represents mainstream development in the fields of chemical tankers. Stainless steel has following advantages which can significantly shorten inspection and tanker washing, reduce ship berthing period and decrease berthing cost:

① With better corrosion resistance, stainless steel cargo tank is fit for all kinds of cargo;

② With higher yield strength, duplex stainless steel can lead to lighter ship weight;

For stainless steel, pickling and passivation is to be carried out to improve the corrosion-resistant performance. Comparison before and after passivation is shown as follows:



◆ Requirements for coating

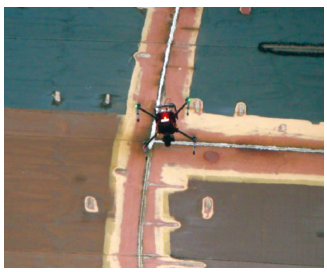
Ballast tanks are to meet the requirements of resolution MSC.215(82) 'Performance Standard for Protective Coating for Dedicated Seawater Ballast Tanks in All types of Ships and Double-side Skin Spaces of Bulk Carriers'. The inner side of ballast tank is of stainless steel material in stainless steel chemial tanker, so it is recommended to protect stainless steel side firstly during the grit washing. After carbon steel layer is washed by steel grit, stainless steel side will be grit-washed by non-metalic abrasive, and coating will not be carried out until satisfactory cleaning and roughness examination is done.



◆ Survey by means of unmanned aerial vehicle (UAV)

During ship surveys, UAVs may be used by CCS to take close-up photos, scanning hull structures automatically or by manual control. In this way, defect screening can be achieved through image recognition technology. UAV can be used as an alternative or supplementary way for survey of those hull structures that are not easy to be accessed or in areas of poor visibility, thus helping to improve survey quality and efficiency, increase survey safety and reduce cost.





Hotspot technology

◆ SOx & NOx emission control

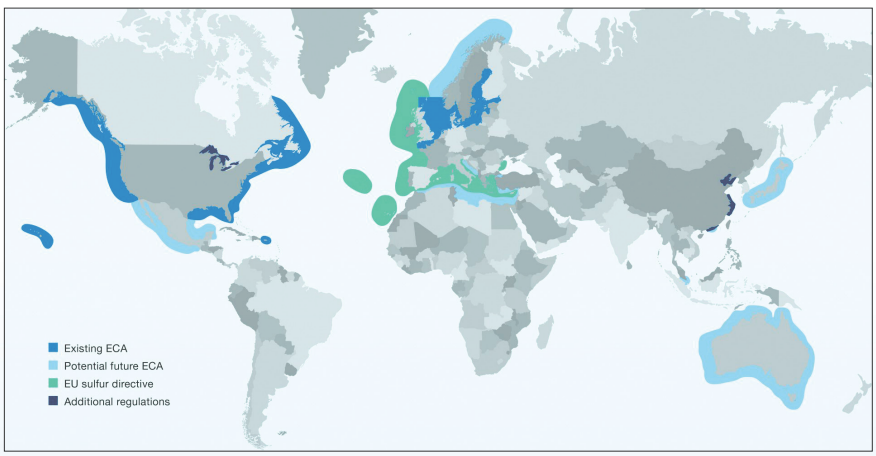
In recent years, with more and more strict requirements for ship air pollution emission control by international conventions and relevant countries and regions, CCS is always committed to the study of various technology and method of effectively reducing ship SOx/NOx emission. According to ship type characteristics and route, CCS can provide the shipowner with single or combined emission control solution and carry out corresponding economy analysis.

◎ **At present, aiming at requirements for SOx emission, followings can be adopted:**

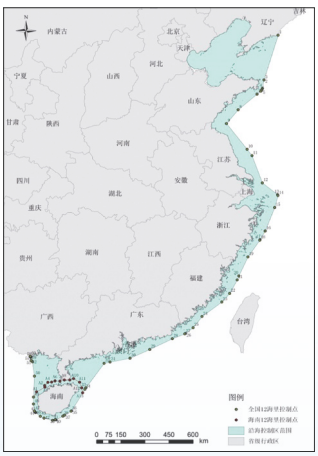
- Low-sulphur fuel oil;
- Dual-fuel power system;
- Exhaust gas cleaning (EGC) system.

◎ **Aiming at requirements for NOx Tier III, following can be adopted:**

- Low-pressure dual-fuel power system;
- Exhaust post-processing SCR system;
- Exhaust recycling EGR system.



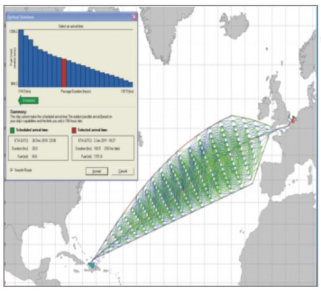
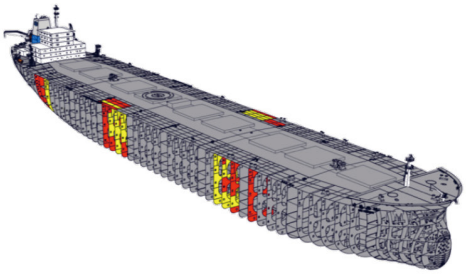
a) Global ECAs



b) China ECAs

◆ Intelligenization

CCS can provide shipowners with intelligent technology application service in 8 aspects, i.e. intelligent liquid cargo management, route optimization, full life cycle mangement of structure, condition montoring and assisted decision-making of engine room equipment, montoring and assisted decision-making of energy efficiency parameters, speed optimization, best trimming stowage, and intelligent integrated platform.


◆ Vibration and noise evaluation

Excessive ship vibration and noise will adversely affect the comfort of crew or passengers, cause local structural fatigue damage, cause mechanical equipment failure, and reduce the reliability of ship operation. CCS has a complete system of rules and standards for shipboard vibration and noise control, and provides optional comfort class notation.

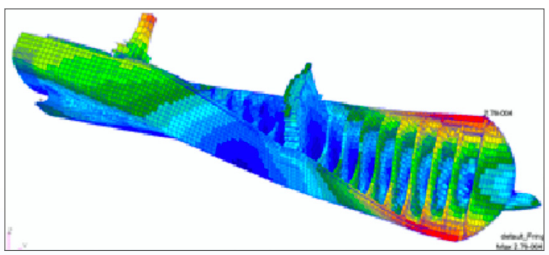
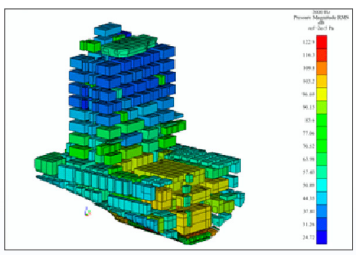
CCS can provide the following technical services:

(1) Hull vibration and compartment noise assessment;

(2) Real ship measurement of hull vibration and compartment noise;

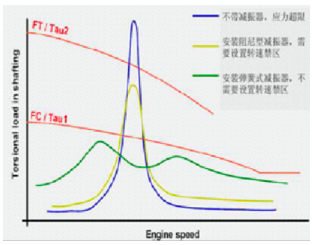
(3) Solutions for harmful vibration and noise on board;

(4) Cooperative development of ships with vibration and noise comfort.


◆ Shafting vibration and alignment

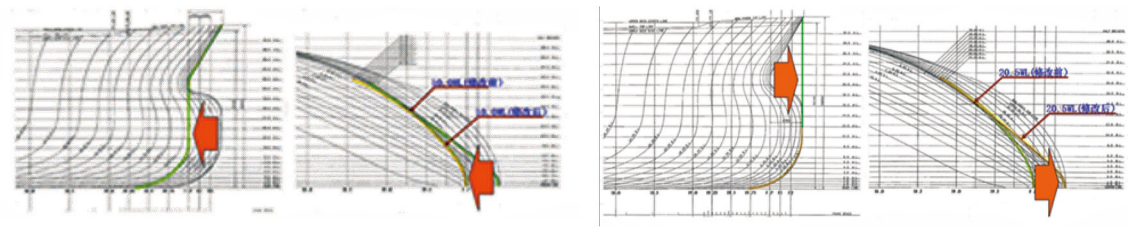
Through the analysis and evaluation of shafting vibration and alignment characteristics, CCS can provide technical support for shafting design, component arrangement and alignment construction technique plan, effectively avoiding excessive vibration that may occur in the ship's propulsion system and the resulting fatigue damage of shafting components, and bearing overheating caused by shafting alignment technique and design etc. This service can provide customers with shafting vibration and alignment (design plan, condition) assessment, shafting vibration and alignment design (design plan, equipment selection) and other services, and assist shipyards/ship owners to implement cause analysis of shafting vibration failure and provide solutions.

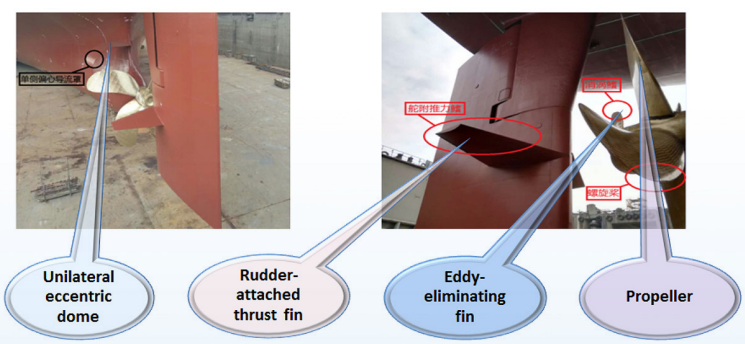





◆ Application of Energy Efficiency Technology on Ships

Due to the double pressure of environmental protection and operational cost, the shipbuilding and shipping industries have focused attention on ship's energy saving and emission reduction. According to ship type, logistics and route characteristics, and based on reliable experience, scientific experiments and numerical calculations, CCS can provide ship resistance reduction (including lines optimization, air lubrication, low-resistance coating application), energy-saving devices, light weight control, high-efficiency propulsion system, electrical and machinery equipment and system optimization, optimal trim, new energy utilization (including wind energy), energy efficiency online intelligent management and other energy efficiency technical solutions and technical services.

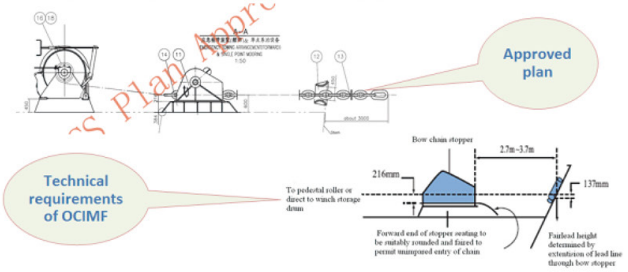




◆ Survey for compliance with OCIMF requirements

Industry organizations such as CDI and OCIMF devote themselves to improving safety of chemical tankers as well as oil tankers and protecting environment, always focus on ship's hardware and equipment configuration, and have respective complicated inspection requirements. CCS can provide chemical tankers with technical value-added services of audit survey required by these organizations with owner's authorization.

Emergency towing and single-point mooring equipment



According to the provisions of paragraph 4.7.7 of Guidelines for Implementation of the Requirements for Construction and Equipment of Tankers by Oil Industry Organization, single-point mooring equipment is to be arranged in a straight line as far as possible, and the front end of bow chain stopper foundation is to permit unimpaired entry of chain.

Provision of oil blocking flat bar on upper deck

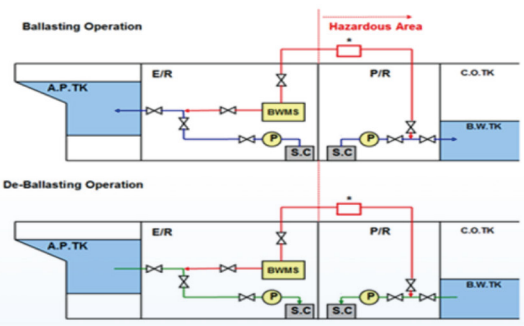


According to the requirements of SOLAS Reg. II-2/4.5.1.6, a permanent continuous coaming of a height at least 300 mm, extending from side to side, is to be provided on upper deck to keep deck spills away from the accommodation and service areas. The OCIMF also has relevant provisions. For example, Exxon Mobil requires that for oil tankers and dangerous chemical tankers over 100000 DWT, the continuous coaming at the edge of bow deck is to be at least 250 mm in height, transit gradually to aft end of cargo tank and connect with transverse coaming at aft end of which the height is 400 mm.

◆ BWM Convention

The BWM Convention entered into force on 8th Sept. 2017. See the table below for the date of mandatory implementation for D2 standard. CCS can provide recommendations on the type selection, installation and survey timing of BWMS as well as strategies based on ship type, ballast demand and navigation route. For BWMS installed on cargo tankers, two points are to be noted: ① isolation arrangement is to be located on the open deck within the hazardous area; ② ballast water from hazardous area is not to be discharged into the safe area.

Date of construction	Ballast water capacity (m^3)	Date of mandatory implementation for D2 standard (installing BWMS)
8 Sept. 2017 or after	all	At ship delivery
Prior to 8 Sept. 2017	all	For existing ships that have completed IOPP renewal survey on or after 8 Sept. 2014 but before 8 Sept. 2017, at the first IOPP renewal survey on or after 8 Sept. 2017
		For existing ships that have completed IOPP renewal survey on or after 8 Sept. 2017 but before 8 Sept. 2019, at the first IOPP renewal survey on or after 8 Sept. 2019
		For existing ships that will have IOPP renewal survey on or after 2019, at the first IOPP renewal survey on or after 2019
		For existing ships to which IOPP survey is not applicable, at a date determined by the Administration but not later than 8 Sept. 2024



CCS ship type service:

◆ Joint development of ship type

Joint development of ship type is accomplished in cooperation with the shipyard or designer. By making use of CCS advantage in marine knowledge and technology, including comprehensive information such as route, port and channels and by means of advanced technical rules, economic analysis, and structural and performance calculation analysis, effective technical solutions are provided in order to jointly develope top quality ship types.

◆ Optimization and upgrading of ship type

Reliable structural optimization and upgrading solutions are provided by means of scientifically reasonable quantitative and qualitative research and analysis based on current characteristics of ship type, so as to provide strong support for ship type upgrading, making the ship safer, more environmentally friendly, more economical and more efficient.

◆ Approval of ship type

With compliance evaluation been carried out on ship types submitted by shipyards and designers in accordance with the agreed rules and conventions, ship type approval certificate will be issued to lay the foundation for plan approval and ship type promotion in the future.

◆ Recommendation of ship type

Excellent and reliable ship type is recommended to industry in accordance with the basic needs of the client and based on CCS ship type performance accumulation and advantage in technical experience, covering principle particulars, structural arrangement, and model selection of main engine, energy efficiency indicator and emission scheme, etc.

◆ Technical training of clients

Based on the needs of the clients, CCS can provide comprehensive and customized technical training service related to rules, software and technical solutions.

This is made of recycled paper.

CCS
CHINA CLASSIFICATION SOCIETY
中国船级社

Contact information:

Technical support: Yang Yan
Tel: 021-61089274
E-mail: yangyan@ccs.org.cn

APR, 2023