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Technical Dimension Analysis of Standardization in China's Cruise Industry: Focus on Design and Construction Standardization

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Abstract: ***Driven by the global cruise industry's full recovery momentum and China's national strategy to expand domestic demand, the eastern coastal region, as the core carrier of China's cruise economy, has formed a distinct three-tier spatial pattern: Shanghai as the national hub, Bohai Rim and Guangdong-Hainan as regional growth poles, and Jiangsu-Zhejiang-Fujian as emerging pilot zones. Targeting outstanding problems including widespread path homogeneity, low port utilization (only 32% on average), cross-provincial administrative barriers, and unclear industrial division of labor, this paper systematically proposes a tiered differentiated positioning system, a cross-province interconnected cruise network and a coordinated industrial collaboration mechanism, to support eastern coastal provinces to leverage their respective comparative advantages, avoid homogeneous competition, and jointly build a world-class globally competitive cruise economic belt with Chinese characteristics.***

Keywords: China's cruise industry, Design and construction standardization, Structural engineering, Cruise safety system, Vibration and noise reduction, Modular construction, Domestic cruise manufacturing, Independent standard system.

1. Introduction

The global cruise industry achieved a comprehensive post-pandemic recovery in 2023, with official statistics from Cruise Lines International Association showing total global cruise passenger volume reaching 31.5 million that year, recovering to 92% of the pre-pandemic 2019 level, and the figure further climbed to 37.7 million in 2025, setting a new all-time historical high. Against this backdrop of global industrial restructuring, China's cruise economy has been elevated to a key strategic position in the national maritime power construction and domestic demand expansion strategy, growing into a comprehensive industrial ecosystem that integrates high-end shipbuilding, modern tourism services, cultural creation and international trade. As China's shipbuilding industry maintained its global leading position for 16 consecutive years, with its 2026 first-quarter new order market share reaching 69.8% of the global total, the independent construction of large cruise vessels has become the final key technical breakthrough for China to achieve full coverage of all top-tier high-value ship types.

However, large cruise vessels are universally recognized as the only high-value ship type that China had not fully conquered before 2023, and their design and construction process faces far higher technical barriers than any other marine engineering product. Three European shipyards, Italy's Fincantieri, Germany's Meyer Werft and France's Chantiers de l'Atlantique, have long occupied approximately 90% of the global large cruise construction order market, and have never publicly released dedicated cruise design and construction standards, instead continuously raising technical access thresholds to maintain their monopoly position. For a long time after China launched the domestic large cruise project in 2019, there were no mature national independent standards to guide the entire construction process, and the industry faced severe risks of project schedule delay, cost overrun and quality out of control.

This background made the construction of a fully independent cruise design and construction standard system an urgent core task for China's cruise industry. As clearly stated in the National Standardization Development Outline issued by the Central Committee of the Communist Party of China and the State Council in 2021, standards serve as the technical support for economic activities and an important component of the national basic institutional system, and standardization plays a foundational and leading role in promoting the modernization of national governance systems and governance capabilities. The Outline explicitly requires the implementation of the high-end equipment manufacturing standardization foundation strengthening project and the new industry standardization leading project, carrying out standardization research for emerging industries around key links, key fields and key product technological breakthroughs and standard formulation and application, to form standard clusters that drive industrial optimization and upgrading. Guided by this top-level national strategic framework, China's cruise construction team led by Shanghai Waigaoqiao Shipbuilding, which belongs to China State Shipbuilding Corporation, fully relied on the construction practice of the first domestically built large cruise ship, systematically carried out full-process standardization research, and finally built a complete three-dimensional standard system covering all links from design to construction to final delivery.

This paper systematically sorts out the technical dimensions of this standard system, focusing on the four core technical modules of structural engineering standardization, safety system standardization, vibration and noise reduction technical standardization, and construction process standardization, all based on verified public data and officially released industry specifications, to clarify the development logic, practical achievements and optimization direction of China's independent cruise design and construction standard system.

As the undisputed "crown jewel of the shipbuilding industry",

large cruise vessels are acknowledged as one of the most complex megaprojects of modern engineering, integrating over 25 million individual components across more than 300 professional disciplines. The technical standardization of this sector is not merely an administrative procedural requirement, but the foundational guarantee for breaking the long-term technological monopoly of European shipyards, realizing mass serial production of domestic large cruise ships, and building a fully independent and controllable domestic cruise industrial ecosystem. Based on the latest verified authoritative public data, released national industry standards, official policy documents and first-hand operation records of domestic cruise construction projects, this paper systematically analyzes the full technical logic of China's cruise design and construction standardization system, focusing on four core technical domains: structural engineering standardization, safety system standardization, vibration and noise reduction technical standardization, and construction process standardization. The study finds that China's cruise design and construction standardization system has formed a unique development path that adheres to the guiding framework of the National Standardization Development Outline issued by the Central Committee of the Communist Party of China and the State Council, follows the "introduction, digestion, absorption, re-innovation" working mode, and builds a three-dimensional integrated enterprise standard system covering technology, operation and management. The successfully implemented standardized construction mode has effectively supported the milestone delivery of Adora Magic City in November 2023, with the follow-up second vessel Adora Flower City achieving a 20% improvement in construction efficiency and a 5% increase in localization rate compared to the first ship. Targeted optimization suggestions are proposed to further promote the continuous improvement of the standard system, accelerate the mutual recognition with international classification society standards, and support China's cruise manufacturing industry to break through the 50% localization rate target by 2030. This research provides evidence-based technical support for China's cruise industry to consolidate core technological advantages and accelerate the construction of a world-class cruise design and construction base.

2. Macro Framework of China's Cruise Design and Construction Standardization System

The construction of China's cruise design and construction standardization system was formally launched against the background of the milestone launch of the first domestic large cruise ship project in October 2019. Facing the absence of public international dedicated cruise standards and the technical blockade from European cruise building enterprises, the construction team established a clear standardization strategic positioning at the initial stage of the project: taking the major domestic large cruise engineering project as the core carrier, guided by the top-level design of the National Standardization Development Outline, closely aligned with the actual demands of cruise design and construction, following the working principle of "introduction, digestion, absorption and re-innovation", and building a three-dimensional integrated enterprise standard system covering technology, operation and management.

This standardization framework follows three core foundational principles in the entire implementation process. The first principle is the deep integration of standardization and design and construction demands. The standard formulation work is never separated from actual project requirements, and every new standard is derived from the practical problems encountered on the construction site, ensuring that every technical specification has clear operability and targeted problem-solving effect. The second principle is the interactive development of standardization and technological innovation. All major technological breakthroughs achieved in the cruise construction process are immediately summarized and transformed into formal technical standards, ensuring that advanced technological achievements can be quickly replicated and promoted in subsequent projects, rather than being scattered as isolated on-site experience. The third principle is the synchronized implementation of standard formulation and standard application. The new standards formulated are directly applied to the ongoing construction process of the first domestic cruise ship after passing the expert review, and dynamically revised and optimized in practical operation, avoiding the common disconnection between standard formulation and on-site application that exists in many traditional industries.

Under the guidance of this three-pronged framework, the standardization construction of China's cruise design and construction has achieved comprehensive breakthroughs across all major technical domains. The system effectively eliminates potential management blind zones in the ultra-large complex cruise engineering, completely avoids the risks of schedule delay, cost out of control and quality defect that are commonly seen in large cruise construction projects, and provides solid technical guarantee for the smooth delivery of the first domestically built large cruise ship Adora Magic City in November 2023 after eight years of scientific and technological research and five years of on-site construction. The system also successfully drives the transformation of China's cruise engineering from the previous "transit economy" dominated by imported components and technologies to a full "industrial chain economy" with independent localized supporting capabilities and general contracting capabilities, and provides a replicable new model for the Chinese shipbuilding industry's standardization construction of super-large high-end equipment.

3. Core Technical Dimension Analysis of Standardization

3.1 Structural Engineering Standardization

Structural engineering is the most fundamental core link in cruise design and construction, and its standardization directly determines the hull strength, overall weight control level and long-term operation safety of the cruise vessel. Unlike traditional cargo ships or ordinary passenger ships, large cruise vessels have extremely high requirements for weight accuracy control. Even a tiny 1% deviation in total weight will lead to the failure of the entire vessel's stability parameters, and the maximum allowable weight error of the entire 135,500 gross tonnage Adora Magic City is only 0.5 tons,

which is far more stringent than the standard requirements for any other conventional ship type. To achieve this extremely high precision requirement, China's cruise construction team has built a complete independent standard system for weight and center of gravity control based on digital twin technology, covering every link from conceptual design to final total assembly construction. This standard system clearly defines the weight detection frequency, data reporting specification and deviation correction mechanism for every single piece of equipment, every section of pipeline and every cabin decorative component on board, realizing full-cycle digital tracking of all 25 million components, and finally successfully controlling the total weight deviation of the first domestically built cruise ship within the allowable error range.

The standardization of thin plate deformation control technology is another landmark achievement in the structural engineering domain. The superstructure of large cruise vessels uses a large number of ultra-thin steel plates with a thickness of only 3 to 6 millimeters, and the welding deformation control of these thin plates is recognized globally as one of the most difficult technical problems in cruise construction. Before the formation of independent standards, any slight welding deviation would cause irreversible deformation of the thin plate, leading to rework and serious schedule delays. To solve this problem, China's cruise construction team independently built the first 5G-enabled intelligent cruise thin plate production line in the world, and formulated a complete set of special standards for thin plate cutting, welding, detection and correction, clearly stipulating the welding current parameters, plate clamping specifications, and post-weld cooling time of every working procedure. After full application of this standard system, the welding qualification rate of cruise thin plates has been increased to 99.7%, completely solving the long-standing global problem of thin plate deformation in large cruise construction.

China's cruise structural standardization system also fully absorbs the international mature norms and incorporates the independently developed new specifications, fully aligning with China's released national standards such as GB/T 7452 Mechanical Vibration — Measurement, Reporting and Evaluation of Habitability Vibration for Passenger Ships and Merchant Ships, clearly defining the vibration limit requirements for different areas of the cruise hull, forming a unique structural technical standard system that combines international general requirements with Chinese independent technological achievements. The system is further extended to the standardization of Panama bitt base mooring equipment, which has been formally issued as the national standard GB/T 47734-2026 Ships and Marine Technology — Mooring and Towing Equipment — Panama Bitt Base, unifying the dimensional tolerance, load-bearing capacity and material specification requirements of this key shipboard component, and realizing full compatibility between Chinese-built cruise vessels and port infrastructure around the world.

3.2 Safety System Standardization

Safety system is the lifeline of cruise operation, and its standardization construction directly relates to the life safety of more than 5,000 passengers and crew members on board, which is one of the most important technical dimensions in the entire cruise standard system. The core breakthrough in the field of safety system standardization in China's cruise industry is the independent construction of a complete set of technical specifications for the "safe return to port" system, one of the three globally recognized core technologies of large cruise vessels. This set of standards clearly defines the independent operation specifications of the redundant power system, fire protection system, communication system and navigation system after any single major failure, ensuring that the cruise vessel can safely return to the nearest port even under the worst accident scenario, completely breaking the long-term technical monopoly of European shipyards on this core safety technology.

In the field of fire safety standardization, China's cruise construction standards integrate a large number of advanced technical specifications beyond the minimum requirements of International Maritime Organization conventions, covering all core links from overall layout design, active and passive fire protection system configuration, to evacuation simulation verification. The standard explicitly requires the use of full-process digital evacuation simulation technology in the design stage to verify the evacuation efficiency of all passengers and crew members in different accident scenarios, ensuring that all personnel can complete safe evacuation within the time specified by the strictest safety standards. All the lightweight decorative materials used in cruise cabins must pass the highest-level flame-retardant test specified in the Chinese national mandatory standard, and all material procurement, testing and installation processes are fully incorporated into the standardized management system, eliminating hidden safety risks at the source.

The safety system standardization also covers the full normalized operation specifications for cruise port entry and exit, emergency disposal for mass rescue operations, and on-board medical emergency response, fully aligned with the optimized regulatory requirements released by the General Administration of Customs of China, the Maritime Safety Administration and other relevant national departments. The formed safety operation standard system has effectively supported the smooth implementation of the International Cruise in the People's Republic of China Port Call and Supply Regulations issued by the State Council, and provides clear technical specifications for 10 targeted support measures issued by the General Administration of Customs, covering cruise material supply, equipment maintenance and passenger entry-exit clearance, completely closing the institutional loopholes in the cruise safety supervision process.

3.3 Vibration and Noise Reduction Technical Standardization

As a floating five-star resort on the sea, the comfort level of cruise vessels directly determines passenger experience, and vibration and noise reduction technology is one of the most core indicators reflecting comfort performance, which has extremely strict standardized technical requirements. The latest Chinese national mandatory standard GB 5980 Noise Level Regulations for Inland River Vessels and guiding standard GB/T 7452 Mechanical Vibration — Measurement, Reporting and Evaluation of Habitability Vibration for

Passenger Ships and Merchant Ships lay the basic normative foundation for the vibration and noise reduction design of cruise vessels. On this basis, China's cruise construction team has further formulated a stricter set of independent enterprise standards, requiring that the indoor noise level of cruise passenger cabins must be controlled below 49 decibels, which is even lower than the volume of normal daily human conversation.

To achieve this extremely high standard, the cruise construction team has developed a full set of standardized vibration and noise control technical specifications covering the entire vessel. The standards clearly stipulate that a total of 1400 acoustic monitoring points are arranged across all areas of the entire cruise to build a full-coverage acoustic perception map, which can real-time capture and locate any abnormal vibration and noise signal. The specification clearly defines the configuration requirements of high-precision vibration damping bases for all power equipment on board, the laying standards of damping sound insulation materials for all bulkheads and pipelines, and the detailed installation process requirements of special double-layer wall panels with air insulation layers and single-layer wall panels with open sound-absorbing backing. The standardized modular installation process of cabin wall panels strictly controls the joint installation accuracy of all decorative components, effectively eliminating the sound diffraction effect caused by excessive gaps between components, achieving the leading technical level that passengers singing karaoke inside the cabin cannot be heard by people walking in the corridor outside unless they press their ears directly against the cabin door.

In the aspect of hull anti-rolling and vibration reduction, the independent standard clearly defines the technical parameters of the extra-large stabilizer fins equipped on the cruise, which can reduce the hull rolling amplitude by 88%, ensuring that passengers can sleep stably even under severe sea conditions. This complete set of vibration and noise reduction technical standards has not only been successfully applied to Adora Magic City and Adora Flower City, but also formed a positive technical radiation effect on China's high-end residential building, high-speed train and other related industries, echoing the advanced design concept of modernist architectural master Le Corbusier who highly praised the standardization level of ocean liners a century ago, providing new technical references for the standardization construction of other high-end civilian products.

3.4 Construction Process Standardization

The standardization of construction process is the key link for transforming advanced design specifications into actual high-quality products, and its core achievement is the full implementation of modular cabin construction standards. The more than 2000 standard cabin modules on the cruise are all produced in dedicated specialized factories next to the shipyard according to unified technical specifications, and the finished modules are transported to the dock side and directly installed into the hull as standard components, just like pushing drawers into a cabinet. This standardized modular production mode not only greatly shortens the on-site construction cycle, but also effectively improves the installation quality, completely eliminating the quality instability defects caused by on-site dispersed operations. The independent formulated modular construction standard clearly defines the size tolerance, installation precision, performance testing specification of every cabin module, ensuring that all 2000+ cabins on board can reach the consistent high comfort standard.

China's cruise construction team independently developed the new generation shipbuilding management platform SWS TIME and cruise digital design platform, and implanted more than 2700 different rule specifications into the digital design system, realizing the automatic identification and prompt of non-standard design content in the design stage, and avoiding quality defects caused by non-compliant design at the source. The construction process standard system also covers the 5G intelligent thin plate production line operation specifications, cross-professional construction coordination standards, final assembly and debugging process specifications, forming a full-process traceable standardized management system. Through the implementation of this set of process standards, the construction efficiency of the second domestic large cruise ship Adora Flower City has increased by 20% compared with the first vessel, the localization rate of bulk materials has been increased to about 35%, 5% higher than the first ship, effectively supporting the realization of the phased target that the localization rate of the third domestic cruise ship will exceed 50% by 2030, and will break through 80% by 2035.

The standardization of construction process also drives the formation of the "1 main assembly enterprise + 100 general contractors + 1500 suppliers" cruise ecosystem collaborative standard, realizing the unified technical specification docking between all supporting enterprises in the industrial chain, which effectively eliminates the technical barriers between different suppliers, and greatly improves the overall collaborative efficiency of the entire cruise industrial chain in the Yangtze River Delta region.

4. Conclusion and Outlook

The independent cruise design and construction standardization system built by China after years of technical research is not only the core supporting condition for China to break the long-term European monopoly in large cruise manufacturing, but also a landmark achievement of China's high-end equipment manufacturing standardization construction under the guidance of the National Standardization Development Outline. This system fully covers the four core technical dimensions of structural engineering, safety system, vibration and noise reduction and construction process, effectively guarantees the smooth delivery and successful commercial operation of the first two domestically built large cruise ships, and lays a solid technical foundation for the subsequent mass serial production of domestic large cruise vessels.

At the current stage, China's cruise design and construction standardization construction still faces important development opportunities. With the continuous expansion of subsequent cruise construction projects, the system will be further continuously optimized, and will gradually realize full mutual recognition with the specifications of major

international classification societies, continuously improving its international influence. It is foreseeable that by 2030, with the support of this mature independent standard system, the localization rate of core equipment for China's domestically built large cruise ships will successfully break through the 50% target, driving the overall coordinated upgrading of the entire domestic cruise industrial chain, and strongly supporting Shanghai to build a world-class cruise design and construction base, helping China realize the historic leap from a large cruise consumption country to a world-class cruise industrial power.

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