

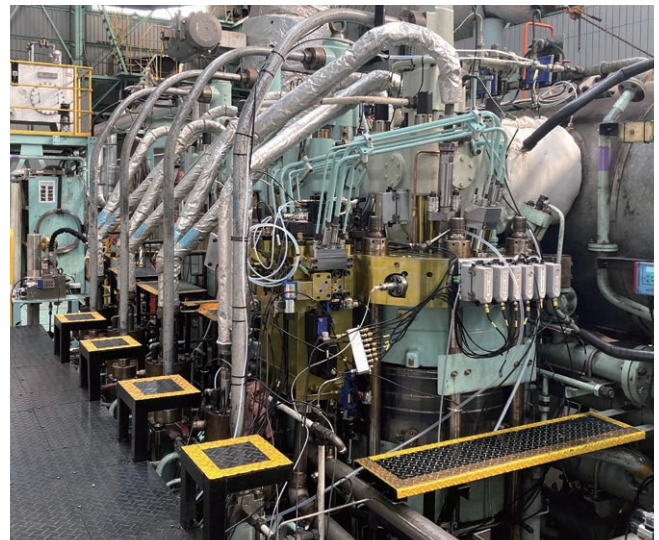
World's first successful hydrogen combustion operation of a large marine engine

MITSUI E&S Co., Ltd. and licensor MAN Energy Solutions SE (MAN ES) have achieved a world first with the successful hydrogen combustion operation of a large marine 2-stroke test engine with a bore size of 50cm located on the premises of the MITSUI Tamano Factory, aiming for the early launch of hydrogen-related businesses in the maritime industry.

This initiative is part of the Ministry of Land, Infrastructure, Transport and Tourism subsidy project "Maritime Industry Aggregation and Coordination Promotion Technology Development Support Project^(*)," which was adopted jointly with Daihatsu Diesel Co., Ltd. in fiscal 2021.

One of the four cylinders of the test engine 4S50ME-T (output 7MW, rated speed 117rpm, MEP 2.10MPa) was converted to hydrogen operation, based on the LNG-fired ME-GI engine design, and high-pressure hydrogen gas was supplied from the hydrogen gas supply facility (liquid hydrogen tank, hydrogen gas compressor, etc.) completed^(**) in October last year. The coupling operation was successfully conducted with this test engine at 100% load without any problems such as hydrogen leakage.

Hydrogen fuel ignites easily but requires accurate combustion control, but the company succeeded in covering the equivalent of 95% of the heat value with hy-



Hydrogen combustion test on MAN B&W 4S50ME-T

drogen fuel in this 100% engine load operation, and the cylinder pressure curve was equivalent to that of the other three cylinders operated with conventional fuel. The company also confirmed that the hydrogen gas supply facility is capable of the stable supply of high-pressure hydrogen required for the engine.

This is the world's first success in hydrogen combustion operation of a large marine 2-stroke engine with a bore size of 50cm, and the company is now preparing to provide marine propulsion systems that can greatly contribute to the GHG reduction of the maritime industry.

The Group will acquire technologies and expertise related to the storage, supply and utilization of hydrogen, which is a next-generation fuel, through the development of hydrogen fuel propulsion system technologies and hydrogen supply infrastructure-related technologies, and will contribute to the realization of a decarbonized society.

Note:

*1: June 16, 2022 "Construction of Hydrogen Supply Facility for Development of Hydrogen-Related Products"

*2: October 23, 2023 "Completion of Construction of Hydrogen Supply Facility for Development of Hydrogen-Related Products" Hydrogen combustion test on MAN B&W 4S50ME-T

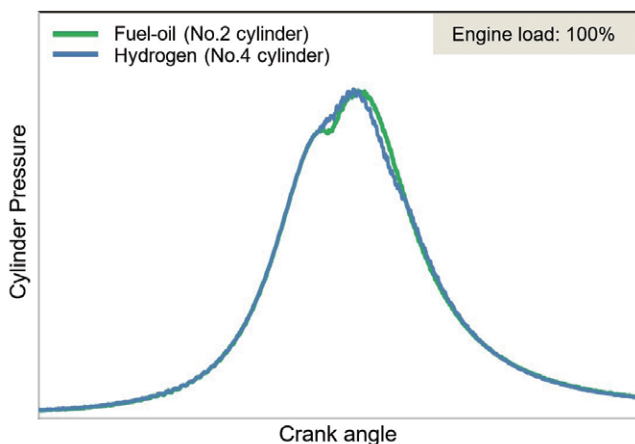


Figure shows cylinder pressure curve on hydrogen and conventional fuel



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JMU completes newly-developed Dunkirkmax-type bulk carrier SPRING HARMONY

Japan Marine United Corporation (JMU) delivered the SPRING HARMONY, a 181,000DWT bulk carrier, at its Ariake Shipyard on March 13, 2024. This is the 4th vessel of a newly-developed Dunkirkmax-type bulk carrier, called N181BC, which has proved successful in both economically and environmentally friendly areas.

The N181BC type has achieved the Energy Efficiency Design Index (EEDI) Phase 3 requirement (30% reduction from the reference line) by application of the latest energy saving technologies, and will contribute to environment protection through its eco-friendly performance. The design has increased deadweight and cargo hold capacity suitable for loading bulk coal and iron ore in its nine cargo holds, achieved by JMU's expertise

and vast experience. The SSSR (Super Stream Duct[®]) and SURF-BULB[®] installed on fore and aft of the propeller, respectively, greatly improve the propulsion performance. The ALV-Fin[®] (Advanced Low Viscous Resistance Fin) installed fore of the propeller controls stern water flow to gain better propulsive efficiency. Furthermore, a unique bow shape, the LEADGE-Bow[®], can reduce the added resistance due to waves, and the well-refined shape of the superstructure can attain low wind resistance.



Principal particulars

L (o.a.) x B (mld.) x D (mld.) x d (mld.):	292.0m x 45.00m x 24.55m x 18.20m
DWT/GT:	182,498t/93,367
Main engine:	MAN B&W 7S60ME-C10.6-HPSCR diesel x 1 unit
Speed:	14.4kt
Complement:	25
Classification:	ClassNK

Mitsubishi Shipbuilding acquires AiP from ClassNK for AFSS

— Approved in Tandem with AGAS —

Mitsubishi Shipbuilding Co, Ltd., a part of Mitsubishi Heavy Industries (MHI) Group, has acquired Approval in Principle (AiP) from the Japanese classification society ClassNK for an ammonia fuel supply system (AFSS) for the new X-DF-A design, a large, low-speed 2-stroke ammonia-fueled engine under development by WinGD, a Swiss designer and licensor of large marine engines. The AiP presentation ceremony took place on April 11, 2024 at the Sea Japan 2024 International Maritime Exhibition and Conference at Tokyo Big Sight.

In June 2023, Mitsubishi Shipbuilding and WinGD concluded a memorandum of understanding (MOU) to undertake joint technical studies on an AFSS, aiming to contribute to the achievement of a new target set by the International Maritime Organization (IMO) of net zero greenhouse gas (GHG) emissions in the global maritime industry by or



At AiP Presentation Ceremony

From right are Mr. Dominik Schneider, CEO, WinGD; Mr. Shin Ueda, President & CEO, Mitsubishi Shipbuilding; and Mr. Masaki Matsunaga, Executive Vice President / Director of Plan Approval and Technical Solution Division, ClassNK.

around 2050. The joint studies resulted in finalization in February 2024 of the basic design for an AFSS for the X-DF-A engine under development by WinGD. The AiP was acquired together with approval of a new ammonia gas abatement system (AGAS), and now technical studies will go forward with WinGD toward

commercialization.

Ammonia emits no CO₂ at combustion, so has the potential to contribute significantly to reducing GHG emissions in the maritime industry, and may be utilized in the future as a source of stable, clean energy. Going forward, Mitsubishi Shipbuilding will continue to develop marine ammonia handling systems, including fuel supply systems for ammonia combustion systems for the X-DF-A and other engines, as well as various ammonia gas abatement systems. In addition, by proposing the design and engineering of ammonia-fueled ships and onboard plants consisting of multiple ammonia-fueled combustion systems such as main engines, power generation engines, and boilers, Mitsubishi Shipbuilding will promote decarbonization of the maritime industry in a carbon-neutral society, and also contribute to reduction of environmental impacts on a global scale.

Mitsui E&S Shipbuilding obtains ClassNK's AiP of LFSS for marine engines

Mitsui E&S Shipbuilding Co., Ltd. (Mitsui E&S Shipbuilding) obtained Approval in Principle (AiP) of a Low-flashpoint Fuel (MeOH) Supply System (LFSS) for use in large low-speed marine main engines from Nippon Kaiji Kyokai (ClassNK), on April 11, 2024.

This LFSS has been developed exclusively for large marine main engines, with the main components featuring simple and compact designs with small size and low weight. The main components consist of pumps, heat exchangers, and a controller, with manufacture outsourced to Japanese companies. Therefore, Mitsui E&S Shipbuilding will be responsible for the operation manuals in English as well as supporting the various inquiries of users.

Engineers of Mitsui E&S Ship-



Mr. Masaki Matsunaga, Executive Vice President / Director of Plan Approval and Technical Solution Division of ClassNK (at left) and Mr. Yasunori Kohatake, President Representative Director of Mitsui E&S Shipbuilding Co., Ltd. (at right)

building will also be ready to attend commissioning tests and trial operations. Adoption of the Mitsui E&S Shipbuilding LFSS assembled in Ja-

pan will eliminate the need to invite engineers of overseas manufacturers to Japan and to dispatch engineers for the factory acceptance test (FAT) held abroad, which will reduce the administration and costs for Japanese shipbuilders as well as overseas shipowners who want to construct new ships in Japan.

Strengthened regulations for environmental protection will require conversion of the fuel for marine engines from the conventional heavy oil to new fuels including methanol. This switchover to new fuels will require much time and effort to be expended by the users.

Mitsui E&S Shipbuilding intends to support users of the new fuels by introducing the new LFSS and to supply expertise as part of the effort to achieve Carbon Neutral 2050.

Shin Kurushima Sanoyas completes Panamax bulk carrier LOWLANDS IYO

Shin Kurushima Sanoyas Shipbuilding Co., Ltd. completed construction of the Panamax bulk carrier, LOWLANDS IYO, at Shin Kurushima Sanoyas Mizushima Shipyard on March 13, 2024. This is the 19th vessel of a series of the Sanoyas newly-developed 82,000DWT-type Panamax bulk carriers. The vessel not only applies latest rules such as CSR B&T, NO_x Tier III regulations and SO_x emission regulations, but also has the equivalent level of deadweight with shallower draft than the builder's previous design.

The vessel exceeds 30% reduction of CO₂ emissions (Phase 3) required by the IMO's EEDI regulation in advance that will be applied to ships for which the building contract is placed on or after 2025.

For improvement of propulsion efficiency, the vessel is equipped with a low-speed, long-stroke electronically controlled main engine combined with a high-efficiency propeller and rudder

appendages. Furthermore, patented energy saving devices such as the Sanoyas developed STF (Sanoyas-Tandem-Fin) and ACE DUCT (Sanoyas Advanced flow Controlling and Energy saving DUCT) are applied. These energy saving devices have been improved over the previous design to achieve over 8% reduction of energy consumption so that EEDI Phase 3 is definitely satisfied.

Various eco-friendly features include the main engine with SCR compliant with the NO_x emission Tier III limit for the prevention of air pollution, and dedicated low sulphur gas oil tank to cruise in ECAs (Emission Control Areas). In addition, countermeasures such as Ballast Water Treatment System and independent hold-

ing tanks for rainwater on the upper deck for the protection of marine environment, are also incorporated.

Principal particulars

Hull No.:	1395
L (o.a.) x B (mld.) x D (mld.) x d (mld.):	229.00m x 32.24m x 20.15m x 14.594m
DWT/GT:	82,019t/43,455
Cargo hold capacity:	97,034m ³ (grain)
Classification:	ClassNK
Complement:	24
Speed, service:	Approx. 14.1kt
Delivery:	March 13, 2024



SKDY completes LNG-fueled vehicle carrier, CERULEAN ACE

Shin Kurushima Dockyard Co., Ltd. (SKDY) completed construction of the LNG-fueled vehicle carrier, CERULEAN ACE, at its Onishi Shipyard for delivery to Susan Navigation S.A. on March 13, 2024. The carrier can transport over 7,000 automobiles of the medium type and is now operated by Mitsui O.S.K. Lines, Ltd. (MOL) on routes worldwide.

The CERULEAN ACE is the third LNG-fueled vehicle carrier built by the Shin Kurushima Dockyard (SKDY) group, equipped with a high-pressure dual-fuel main engine and the first LNG fuel tank fabricated by the shipyard. The ship's main engine using LNG can decrease emissions of CO₂ by 25 to 30%, SO_x by approximately 98%, and NO_x by approximately 85%. Moreover, an Aerodynamic design has been adopted for the top section of the prow to reduce wind-pressure resistance by approximately 20%.

The car carrier is the post Panamax type that measures 199.95m in overall length and 38m in width and is capable of loading over 7,000 cars. The cargo holds consist of 12 car decks (No.1 to No. 12 decks), on which automobiles, small trucks, and heavy vehicles

can be loaded. For vehicle loading, the carrier employs stern and center rampways on the starboard side, and the car-deck-lift cars are provided.

The SKDY group has also been tackling insourcing of LNG tanks at Shin Kurushima Sanoyas Shipbuilding Co., Ltd. that has extensive experience in fabrication of gas tanks including LPG tanks, and a heat-resistant building for LNG-tank fabrication has been built at the Mizushima Works of Shin Kurushima Sanoyas.

Following the CERULEAN ACE, three more LNG-fueled vehicle carriers are now scheduled to be built at the SKDY group, all of which will use SKDY-fabricated LNG tanks. Furthermore, the SKDY group intends to supply its own LNG tank combined with a fuel gas supply system.

Principal particulars

Owner: Susan Navigation S.A.
Ship type: Pure car carrier
Hull No.: 6201



L (o.a.) x L (b.p.) x B x D x d (s) :
199.96m x 196.00m x 38.00m x
36.86m x 9.95m
DWT/GT: 19,889t/73,132
Cargoes: Cars, small trucks, and
heavy vehicles
Numbers of units
Abt. 7,150 units (RT43L type)
Abt. 6,000 units (Standard type)
Speed, service: 18.00kt (C.S.O, 15%
S.M.)
Main engine: Mitsui-MAN B&W
6S60ME-C10.5-GI-EGRBP
MCO: 10,450kW x 96.5min⁻¹
CSO: 8,883kW x Approx. 91.5min⁻¹
(85% M.C.O.)
Classification: ClassNK
Registry: Panama
Completion: March 13, 2024

Tsuneishi Shipbuilding delivers first LNG-fuelled limestone carrier

Tsuneishi Shipbuilding Co., Ltd. delivered its first LNG-fuelled limestone carrier, SHIMOKITA MARU, to the owner, NS United Kaiun Kaisha, Ltd., on March 19, to replace the old SHIMOKITA MARU of the same type. The new vessel is powered by a hybrid propulsion system consisting of an LNG-fuelled engine and batteries manufactured by Kawasaki

Heavy Industries, Ltd. intended to achieve zero emissions on entering and leaving port.

The hybrid propulsion system does not affect the loading operations, similar to conventional vessels, due to the ingenious design of the cargo holds. Measures to control limestone dust, vibrations, and unit lavatory adoption in all cabins will improve safety and

the onboard living environment. LNG fuel reduces CO₂ emissions by approximately 24% compared with conventional heavy oil fuel, and the exhaust gas does not contain SO_x. The LNG tanks use 7%

nickel steel plate developed by Nippon Steel Corporation, the first marine tank with the same performance as conventional 9% nickel steel plate.

Tsuneishi Shipbuilding will continue to research and develop various next-generation fuel vessels based on the present technology, and is committed to supply new types of vessels with both environmental performance and economic efficiency to preserve the global environment.

Principal particulars

L (o.a.) x B (mld.) x d (mld.): 93.8m x
18.2m x 9.9m
DWT: Approx. 5,646t
Propulsion system: Hybrid propulsion
system with LNG-fuelled engine
(8L30KG) and batteries
Main route: Shiriyazaki to Muroran
in Japan



Sasaki and MOL jointly receives BV's AiP for ammonia bunkering vessel

Sasaki Shipbuilding Co., Ltd. (Sasaki) and Mitsui O.S.K. Lines (MOL) received an Approval in Principle (AiP) for an ammonia (NH₃) bunkering vessel from Bureau Veritas (BV) in January 2024. The vessel was designed by Sasaki at the request of MOL, which has been studying the concept design of the ammonia bunkering vessel with BV since 2022.

For the purposes of the AiP, BV reviewed Sasaki's design for the 12,000m³ ammonia bunkering vessel with consideration to its NR 620 (Rules for bunkering ships) and NR



From left to right on the photo are Mr. Makoto Yamaguchi, Mr. Matthieu de Tugny, Mr. Jiro Sasaki, and Mr. Alex Gregg-Smith.

467 (Rules for the classification of steel ships). The vessel is also eligible for

the BV CLEANSHIP and GREENPASSPORT additional class notations.

The AiP was handed over by Matthieu de Tugny, Executive Vice-President, BV Marine & Offshore, and Alex Gregg-Smith, Senior Vice President & Chief Executive, BV Marine & Offshore North Asia and China, to Mr. Jiro Sasaki, Chief Operating Officer, Sasaki, and Mr. Makoto Yamaguchi, Executive Fellow (Chief Technical Officer at that time), MOL, during a ceremony at the Head Office of MOL in Tokyo.

NAMURA completes Dunkirkmax-type bulk carrier HENG MAY and BO MAY

Namura Shipbuilding Co., Ltd. delivered the two vessels, HENG MAY and BO MAY, at its Imari Shipyard & Works on March 1, 2024 and March 29, 2024, respectively. The vessels are the fifth and sixth of a newly-developed 182,000DWT-type bulk carrier with excellent features.

The principal dimensions have been optimized to satisfy the restrictions of the Port of Dunkirk in France. Improvement of propulsion performance and fuel saving in conformity with EEDI Phase 3 is achieved by the adoption of three energy saving devices, the Namura flow Control Fin (NCF), the Rudder-Fin and the additional fins behind the NCF developed by Namura, and an electronically controlled main engine, the latest model of high efficiency propeller, and low friction type anti-fouling paint.

For environmental protection, the vessels are equipped with a main engine and generator engines compliant with Annex VI of the MARPOL 73/78 regulations to reduce NO_x emissions, and an air seal type stern tube sealing device to reduce the risk of oil leakage. In addition, the vessels also comply with the SOLAS Chapter II-1 Regulation 3-12, Code on noise levels onboard ships to improve the environment of the living quarters.

The ballast water treatment system to control the quality of ballast water is equipped to protect the marine environment to comply with the International Convention for the Control and Management of Ships' Ballast Water and Sediments. The vessels have class notation IHM (Inventory of Hazardous Materials) for compliance with the ship recycling conven-

tion according to the Guidelines for the Inventory of Hazardous Materials.

The vessels have several storage tanks for appropriate management and discharge of drainage, sewage, rain water, and water used for cleaning cargo holds to satisfy port restrictions on such discharges.

Principal particulars

L (o.a.) x B (mld.) x d (mld.):	291.92m x 45.0m x 18.2m
DWT:	182,268t (HENG MAY)/ 182,317t (BO MAY)
GT:	93,555
Main engine:	MAN B&W 7G60ME-C10.5-EGRBP diesel x 1 unit
Complement:	24
Classification:	ABS
Registry:	Liberia
Completion:	March 1, 2024 (HENG MAY)/March 29, 2024 (BO MAY)



HENG MAY



BO MAY

MAERSK FORTALEZA

Builder: Imabari Shipbuilding Co., Ltd.
 Ship type: Container carrier
 L (o.a.) x B x D: 254.94m x 40.00m x 21.70m
 DWT/GT: 76,521t/57,872
 Main engine: 6G80ME-C10.6 diesel x 1 unit
 Speed, service: 21.50kt
 Classification: ClassNK
 Completion: April 3, 2024



WAN HAI 372

Owner: Wan Hai Lines (Singapore) Pte. Ltd.
 Builder: Japan Marine United Corporation
 Hull No.: 5509
 Ship type: 3,055TEU container ship
 L (o.a.) x B x D x d: 203.5m x 34.8m x 16.60m x 11.5m
 DWT/GT: 37,160t/30,676
 Main engine: MAN B&W 7S70ME-C10.5 diesel x 1 unit
 Speed, service: 21.6kt
 Complement: 25
 Classification: DNV
 Registry: Singapore
 Completion: April 23, 2024



CATHERINE

Builder: The Hakodate Dock Co., Ltd.
 Hull No.: 921
 Ship type: 40,000DWT-type bulk carrier
 L (o.a.) x B (mld.) x D (mld.) x d (mld.): 182.94m x 31.6m x 14.80m x 10.37m
 DWT/GT: 40,544t/24,427
 Main engine: J-ENG 6UEC42LSH-Eco-D3-EGR diesel x 1 unit
 Speed, service: abt. 13.6kt
 Classification: ClassNK
 Registry: Marshall Islands
 Completion: April 23, 2024



CASABLANCA TIGER

Owner: Hawk Marine Corporation S.A.
 Builder: Oshima Shipbuilding Co., Ltd.
 Hull No.: 11073
 Ship type: Bulk carrier
 L (o.a.) x B x D x d (ext.): 189.99m x 32.26m x 18.54m x 13.062m
 DWT/GT: 58,506t/32,680
 Main engine: Mitsui-MAN B&W 6S50ME-C9.7-EGRBP diesel x 1 unit
 Speed, service: 14.30kt
 Classification: ClassNK
 Registry: Liberia
 Completion: February 28, 2024



OCEAN BLISS

Builder: Saiki Heavy Industries Co., Ltd./Onomichi Dockyard Co., Ltd.
 Hull No.: 597
 Ship type: Bulk carrier
 L (b.p.) x B x D : abt. 174.00m x 32.00m x 14.80m
 DWT/GT: abt. 40,000t/abt. 25,200
 Main engine: MAN B&W 6G45ME-C9.7 diesel x 1 unit
 Speed, service: abt. 14.9kt
 Classification: ClassNK
 Registry: Singapore
 Completion: February 9, 2024



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