The MAN 23/30H GenSet Marches On

Introduction of new model marks half-century of success

First introduced 50 years ago, the MAN 23/30H GenSet has since proved to be a reliable performer and enjoys a good reputation to this day.

The first 23/30H came on the market in 1965 but the original engine bears little resemblance to the modern variants where all fundamental characteristics, such as output, design concept, fuel consumption and emissions, component materials, engine components, etc., have greatly evolved after five decades of continuous development. Indeed, the only original component that has survived is the crankcase ventilation system, known as the ‘briefing pot’ in daily speak.

The L23/30H engine has a long history of operational stability and has significantly increased its number of sales in recent years. The engine is popular with shipowners for a number of reasons, not least for its broad market penetration that has ensured global recognition on account of its reliability and ‘forgiving’ service demands.

MAN Diesel & Turbo licensees also appreciate the 23/30H and over the many decades of its existence have localised the manufacture of many of the engine’s components. Indeed, some licensees have a permanent production line price-optimisation program that aims to reduce prices by 2-3% annually.

Applications for the engine include tankers, bulk carriers and product tanker as auxiliary engines although there have been some sales as prime movers for fishing trawlers, while a small number are employed in Greenland as power plants. The engine is mostly HFO-driven with gas and marine oil also used in special environmental areas.

23/30 characteristics

The 23/30H GenSet exists as Mk. 1, Mk. 2 and ‘Monocoque’ versions. Mk. 1 is currently undergoing a drive to extend its TBOs and is still popular, while Mk. 2 was introduced more recently to the market and with considerable success.

Successful Japanese Demonstration of ME-LGI Concept

Mitsui tests first commercial model on HFO and methanol

Mitsui Engineering & Shipbuilding Co., Ltd. (MES) – the MAN Diesel & Turbo licensee – recently demonstrated the liquid-gas-injection concept successfully in Japan.

The successful demonstration took place on 17 June, 2015 using the very first ME-LGI engine to ever be commercially produced. The engine is bound for a vessel currently under construction by Minaminippon Shipbuilding Co., Ltd. for Mitsui O.S.K. Lines, Ltd.

Ole Grøne, Senior Vice President – Two-Stroke Promotion & Sales – MAN Diesel & Turbo, described the event as a significant milestone in the development of diesel technology and said: “The immediate market acceptance of our ME-GI (Gas Injection) engine confirmed the growing demand for low-sulphur, non-HFO options in the face of increasingly stricter sulphur limits in fuel. In turn, extending our dual-fuel engine programme with an ME-LGI unit that can run on liquid fuels was therefore a natural step.”

He continued: “The interest in our ME-LGI engine confirms this dual-fuel, low-speed trend and will... Continued on page 2
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The very latest version is the 23/30H Monocoque, with the very first model due for construction during 2015.

Globally, 12,000 or so 23/30H units have been produced over its lifetime, and many of the original Mk 1 models are still in use. Overall, 7/5 of sales occur in Asia, especially China.

The 23/30H engine is optimised for part-load operation, typically at 40-65%. Stena Line was the first customer to optimise turbochargers and engine timing for its Mk. 2 engines, in the process delivering a 3 g/kWh improvement in fuel consumption due to the employment of alternative turbocharger matching and a turbocharger waste gate, combined with new valve timing.

The 23/30H also stands out from its competitors in that its mep is >20 bar. Generally, any engine with an mep >20 bar experiences greater operative stress, which – in the long run – means more spare parts and greater running costs over an engine’s lifetime.

The Mk. 2 version of the engine arrived at the end of the last decade with a key difference to its Mk. 1 counterpart being an increased output of 10%, better SFOC and rating within the existing class rules, up to 19.8 and with no special levelling requirements – a more conventional, 4-point support variant is also available.

The Monocoque idea is not an innovation as standard today. Originally developed to increase the life of the engine’s lifetime, the Monocoque concept was introduced to the market. Successfully optimised for reduced vibration and a turbocharger waste gate, the basic Monocoque idea is not an innovation as such, rather a natural result of the continuous development that has maintained the 23/30H’s market competitiveness over its lifetime.

The L23/30H Mk. 2 Monocoque GenSet features a number of improvements compared to its predecessors. The defining difference is that the alternator now has a top bracing that makes it a load-bearing component and comes as a standard specification such that all generators fit the baseline. The benefits stemming from this design change are multiple and include:

- easier installation
- reduced vibration levels
- reduced weight
- easy fitting/adjustment of alternator
- GenSet mounting points Conical from 8 to 3 and which adjust to their foundation with no special levelling required – a more conventional, 4-point support variant is also available.

The Monocoque is also significantly cheaper than its predecessors, owing to:

- the use of fewer materials
- fewer components
- reduced number/cost of conical mounting points
- simplified manufacturing and handling
- simplified assembly of the alternator

23/30 Mk. 1 TBO case studies
MAN Diesel & Turbo recently started a campaign to extend TBOs for Mk. 1 engines, a theme that is still very relevant as many Mk-1 units are still in operation. In general, customers are interested in long TBOs and how many spare parts they’ll have to buy in an engine’s lifetime, which is equivalent to the ship’s lifetime. The extended TBO campaign stems from direct customer requests, as indeed have all 23/30H design changes through the years, and is a key reason for the engine maintaining its good reputation.

In connection with this, A.P. Møller-Maersk has an on-going project to extend TBOs across its fleet. The first case study involves the ‘Maersk Rosyth’, a 43,000 tonne chemical tanker built by Guangzhou Shipyard Intl. in China. The vessel features three MAN GenSets, #3 being an MAN 7L23/30H-720/PM auxiliary engine built by STX in 2001 and which – at the commencement of the project – had a scrap life of 43,730 running hours.

The overhaul inspection of the Maersk Rosyth’s auxiliary engines confirmed that the L23/30H-720/PM is capable of operating on HFO with 20,000 hours between main overhaul.

- Regular maintenance cleaning of the turbocharger, lube oil and fuel oil is carried out as recommended.
- The main overhaul is carried out as recommended with the correct spare parts, and that engine performance is brought back to “shop-test level”.

The second case study involved the Karen Maersk, an A.P. Møller-Maersk tanker also built by Guangzhou Shipyard Intl. in China with 2 × 6L23/30H GenSets. Constructed in China by ZJME in 2009, two of the ship’s auxiliary engines had respective running hours of 12,040 and 11,585 hours before arriving at MAN PrimeServ Holeyby for inspection.

The overhaul inspection showed that the L23/30H-900/PM engine is capable of operating at more than 12,000 hours between main overhaul. Prime indicators of this are the intact chromium layer on the piston rings and the low wear rate displayed by the cylinder liners and valves. In fact, PrimeServ recommended that the engines’ current overhaul interval be extended to 16,000hrs on HFO.

To achieve this, Holeyby recommended that newest cylinder setup be used with:

- Piston rings changed to nodular cast iron KV1 instead of LP1, which is a cast iron material (KV1 is standard today).
- Additional drain bores in the pistons for a better scraping effect (also standard today).

If KV1 rings and extra drain bores are introduced, and fuel-and lube oil cleaning maintained as recommended, the Karen Maersk’s L23/30H-900/PM main overhaul interval can potentially be increased to 20,000 hours.
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...offer even more alternatives to HFO, which – apart from methanol – will include LPG, dimethyl ether (DME), and (bio-) ethanol, as well as several other, low-sulphur, low-flashpoint fuels.”

Grene concluded: “We welcome our partners’ interest in our technology and acknowledge their taking the lead in proving the ME-LGI concept. We are confident that their faith will be rewarded in the immediate future.”

Demonstration
Mitsui’s ME-LGI demonstration involved four separate stages:
1. Change to methanol running.
2. Methanol running 50-75%.
3. Load variation.

The event took place at the company’s dual-fuel portfolio and enables the exploitation of more low-flashpoint fuels such as methanol and LPG.

“Consequently, the new engine is designed to be very easily retrofitted to different fuels,” said Dr Daniel Struckmeier – Head of Emission and Technology and Technical Cooperation. “This includes the use of fuel-oil running, when required for long-term efficiency and to avoid port fees, as well as the use of low-flashpoint fuels such as methanol and LPG.”

At an awards ceremony held on April 15th, 2015 at the PrimeServ Academy in Shanghai, MAN Diesel & Turbo SE was awarded approval in principle for its Scrubbers for the entire medium-speed engine portfolio fulfilling IMO Tier III regulations by the China Classification Society (CCS).

Testing took place on an MAN 8L21/31 auxiliary engine with an integrated Scrubbers (Selective Catalytic Reduction) system but the certificate actually applies to the entire medium-speed engine portfolio. The MAN-built engine is bound for a DFDS Seaways Ro-Ro vessel, the "Petunia Seaways". The ceremony was attended by major shipowner companies and licensees.

Goetz Kassing, Chairman and Head of MAN Diesel & Turbo China, received the certificate on behalf of MAN Diesel & Turbo from Sun Feng, Vice President of CCS. Founded in 1956, CCS is the only professional organization in China to provide classification services.

“This certificate represents an important milestone in our collaboration with CCS and is of utmost importance in providing a complete IMO Tier III package solution to our customers,” said Dr Daniel Struckmeier – Head of Emission 2016 – Senior Project Manager, MAN Diesel & Turbo. “This milestone is one of three agreed major steps in a long-term relationship with CCS. The first step has been accomplished after issuance of the first IMO Tier III EAPP certificate for the 21/31 engine group in February this year. Today’s award finalised the second step, which includes the certification of the MAN Diesel & Turbo Scrubbers for Technical Cooperation during Marintec China. Both parties have since strengthened their cooperation in the fields of ship technology, ship-type research & development and market cooperation.

“We are proud to present the first Tier III Certificate to MAN. Based on the good cooperation, we can provide a better service for the marine and shipbuilding industry,” said Sun Feng after the ceremony.

“China is MAN Diesel & Turbo’s most important market,” said Goetz Kassing, Chairman and Head of MAN Diesel & Turbo, Region China. “As China has taken the next steps to higher levels of efficient and clean energy production for a sustainable and better environment, it is our priority to align our engines with the new policies to stay ahead of the competition.”

The ME-LGI concept is an entirely new concept that can be applied to all MAN Diesel & Turbo low-speed engines, either ordered as an original unit or through retrofitting. With two injection concepts, the ME-GI and the ME-LGI concept greatly expand the company’s dual-fuel portfolio and enables the exploitation of more low-flashpoint fuels such as methanol and LPG.

The engine’s “ME” prefix indicates that the new engine benefits from well-proven electronic controls that also encompass the fuel being injected by a so-called Fuel Booster Injection Valve. This innovative fuel booster, specially developed for the ME-LGI engine, ensures that a low-pressure, fuel gas supply system can be employed, significantly reducing first-time costs and increasing reliability. The Fuel Booster Injection Valve will be introduced also on regular ME HFO engines, eventually.

MAN developed the ME-LGI engine in response to interest from the shipping world in operating on alternatives to heavy fuel oil. Methanol and LPG carriers have already operated at sea for many years, and many more LPG tankers are currently being built as the global LPG infrastructure grows. With a viable, convenient and economic fuel already on-board, exploiting a fraction of the cargo to power a vessel makes sense with another important factor being the benefit to the environment. MAN Diesel & Turbo has previously stated that it is already working towards a Tier-III-compatible ME-LGI version.
Upgrade Packages Ordered for Odfjell Tankers

Fuel-saving upgrade package with Kappel technology designed to optimise propulsion efficiency and lower the fuel consumption of 11 vessels

The vessels are of the Kværner Class and are due to dock during 2015-17, at which time the upgrade work will be implemented. The first vessel, M/T Bow Clipper, will dock and be upgraded in August 2015.

Each vessel has an MAN B&W two-stroke engine powering a four-bladed, controllable pitch propeller and a PTO-driven shaft alternator. The vessels’ new service speed and a pre-fabricated rudder bulb kit – will all contribute to power savings and reduced exhaust-gas emissions.

The Kappel blades, fairing cone and rudder bulb are designed and customised for the tanker’s hull and rudder designs. The calculated power saving has been verified by tank-test analyses at MARINTEK (Norwegian Marine Technology Research Institute) as reported in preliminary results.

“It’s a very exciting project and we are proud to be part of it. With our new design possibilities, we are furthermore looking forward to offering this fuel-saving concept to other fleets with similar operational patterns,” said Kjartan Ross, Business Development Manager of MAN Diesel & Turbo’s Propeller & Aft Ship organisation. He continued: “With the long lifetime expectancy of Odfjell’s high value, quality vessels, this upgrade investment is straightforward and very attractive.”

Front runner

As technological front-runners, Odfjell embarked on the ambitious Kværner Class newbuilding programme of 37,500 dwt ships with fully-segregated stainless-steel tanks and piping systems in 1991.

The first such vessel was delivered in 1994 and the new series was packed with new technology: controllable pitch propellers, shaft alternators on main engines, bow thrusters, fixed tank-cleaning machines and radar positioned in each tank to gauge usage.

Odfjell was also a pioneer within the area of fully computer-controlled engines. The last ship in the series, M/T Bow Firda, was delivered in 2003 and has a main engine – an MAN B&W 7S50ME-C type – with electronically controlled timing and no camshaft – a world first.

The following Kværner Class vessels are currently scheduled for upgrade:

- Bow Flower
- Bow Clipper
- Bow Fortune
- Bow Cecil
- Bow Flora
- Bow Cardinal
- Bow Faith
- Bow Cedar
- Bow Fogus
- Bow Chain
- Bow Fida.

About Odfjell

Odfjell SE is a leading company in the global market for transportation and storage of bulk liquid chemicals, acids, edible oils and other special products. Originally set up in 1914, the company pioneered the development of the chemical tanker trades in the middle/late 1950s and the tank storage business in the late 1960s. Odfjell owns and operates chemical tankers and LPG/Ethylene carriers in global and regional trades as well as a joint venture network of tank terminals. Today’s tanker fleet amounts to 80 vessels.

Anglo-Eastern Signs Premium Turbocharger Maintenance Contract

MAN PrimeServ Turbocharger, of MAN Diesel & Turbo’s service division, recently signed a Premium Turbocharger Maintenance Contract with Anglo-Eastern Ship Management.

The contract covers approximately 330 turbochargers installed aboard various vessels from the Anglo-Eastern fleet operating worldwide. The turbocharger types covered by the contract are essentially a mixture of NA/TCA axial types for main engines, and NR/TCR radial types for auxiliary engines.

PrimeServ reports that a key influence in the negotiations was the good fit between the global nature of Anglo-Eastern’s trading routes and PrimeServ’s global network of service centres. Under the terms of the agreement, PrimeServ will provide all relevant services as a complete maintenance package.

The new agreement represents the first time Anglo-Eastern has employed PrimeServ to handle its turbocharger service programme. Accordingly, MAN PrimeServ Turbocharger – in coordination with the MAN PrimeServ network – will coordinate and plan all upcoming scheduled maintenance intervals for Anglo-Eastern’s turbochargers, including the timely delivery of necessary spare parts.

Premium Maintenance Contracts

With a Premium Maintenance Contract, MAN Diesel & Turbo handles all scheduled maintenance planning for the customer six to seven months prior to an upcoming turbocharger service. The customer then simply confirms the upcoming service by email. Such contracts entail several, other benefits:

- timely spare-parts planning that enables the customer to order the necessary parts on-time
- MAN PrimeServ Turbocharger monitors and administrates upcoming maintenance intervals
- fixed prices for turbocharger services and spare parts
- turbocharger operational data constantly updated including the complete maintenance history
- open access to maintenance documentation, electronic spare parts catalogues and service reports through PrimeServ’s customer intranet.

About Anglo-Eastern

Established in 1974, Anglo-Eastern offers technical services to third parties around the globe serving all types and sizes of ships and is experienced in ship management, crew management, the education and training of seafarers, new building consultancy, dry-docking, IT solutions and insurance services. It offers its services around the globe, supported by 22 offices in 14 countries with a head office in Hong Kong. Anglo-Eastern has currently over 470 ships in full technical management with over 21,000 seafarers in the pool.
Icelandic Trawlers Specified with MAN’s SCR System

Technical specifications meet IMO Tier III and promote ecologically friendly fishing

In connection with the recent announcement of the construction of three wetfish trawlers for HB Grandi, the Icelandic fishing concern, MAN Diesel & Turbo has announced that the newbuildings’ MAN main engines will also feature its SCR (Selective Catalytic Reduction) system.

The company states that the system will enable the trawlers’ IMO Tier II-compliant engines to fulfil the strict IMO Tier III NOx emission requirements.

Vilhjalmur Vilhjalmsson, CEO of HB Grandi said: “When we decided to renew our fresh-fish fleet, we immediately focused on the task of curtailing the ships’ power requirements, both in terms of the propulsion plant as well as electricity production, so as to make the exhaust gas as clean as possible.”

Vilhjalmsson added that HB Grandi deliberately pursues a green company profile and that its focus on clean and responsible fishing ultimately led to MAN technology being chosen for the trawlers. As such, HB Grandi’s profile suited the minimal environmental footprint from operations, including the cleaner exhaust gases and NOx reduction that the MAN package offers. A further advantage of choosing MAN was the relatively straightforward integration of engine, propeller, propulsion controls and SCR systems that equipment from the same manufacturer entails.

MAN Diesel & Turbo reports that special attention was given to selecting the optimal position for the SCR system aboard the trawler. This challenge was met and solved in great part through good cooperation with Nautic, the Icelandic specialist designer and ship consultant, at an early stage of the project. Nautic – based in Reykjavik – is designing the new vessels, which will replace three wetfish trawlers currently in service. The vessels, with their distinctive bows, will be built in Turkey by Celiktrans Deniz Ltd. Sti. with delivery scheduled for May 2016, late-2016 and spring 2017, respectively.

Propulsion package characteristics

The newbuilding HB Grandi wetfish trawlers will enjoy the benefit of several features to optimise operation. These include employing a floating-frequency concept that increases their flexibility and economical part-load pattern with an up to 17% lower engine/propeller speed and a commensurately lower fuel consumption.

MAN Diesel & Turbo’s Alphatronic 3000 generation propulsion control system will also be installed aboard the trawlers and, among other characteristics, features tailored ‘dual-propeller load curves’ for optimising towing/trawling and free-sailing conditions.

Selective Catalytic Reduction

SCR is the most tested and approved system for achieving NOx reduction rates up to 90%. SCR involves the injection of ammonia or urea into the diesel engine’s exhaust stream. The urea decomposes into ammonia and carbon dioxide, with the ammonia subsequently reacting with NOx and oxygen in the presence of a catalyst, transforming into the ecologically-benign constituents of water and nitrogen.

In order to optimise the SCR process at part load, the engine is specified with a turbocharger bypass as part of the exhaust gas temperature system that ensures sufficiently high temperatures.

SCR plant description

MAN Diesel & Turbo’s SCR system is available in fourteen different sizes, in this way covering its entire portfolio of medium-speed engines. The system has been de- signed as a modular kit of components for reasons of simplicity and to minimise costs.

A special feature of the system is its communication with the engine control system that optimises the temperature for the SCR system at individual loadpoints. A further special feature of the system is its continuous NOx-emission control that saves urea and avoids ammonia slip. MAN Diesel & Turbo also offers customised SCR systems on demand.

The main components of the MAN Diesel & Turbo SCR system are:

- an SCR reactor
- catalyst elements
- a soot-blowing system
- a dosing unit
- a mixing device
- a urea-injection lance
- a control unit
- a compressed-air reservoir module.

Graphic representations of the Nautic wetfish trawler design for HB Grandi. Each vessel will be powered by an MAN six-cylinder L27/38 unit, accompanied by a four-bladed, 3.8-metre, ducted MAN Alpha VBS 860 propeller (both images courtesy HB Grandi/Nautic).

Annotated diagram showing the key components of the MAN Diesel & Turbo SCR system.
Examining the Exploitation of Methanol as a Fuel Type

MAN Diesel & Turbo’s dual-fuel ME-LGI concept explores liquid possibilities

Methanol as a ship fuel is interesting for ship operators because it does not contain sulphur and is liquid in ambient air conditions, which makes it easy to store on board ships.

For ships operating in International Maritime Organization (IMO) emission control areas (ECA), methanol could be a feasible solution to meet sulphur requirements.

When using methanol, the emission reductions are similar to the advantages obtained by using liquid natural gas (LNG), however installation costs on board are only a fraction of the costs for LNG. Furthermore, methanol can be produced from biomass.

Other issues also increase the interest in methanol and other new fuel types. To limit CO₂ emissions, the IMO decided already in 2013 to adopt the Energy Efficiency Design Index (EEDI) as a mandatory instrument for ships built after January 2013. This has influenced the engine market and technical solutions quicker than anticipated. Therefore, to lower the EEDI, alternative low carbon fuels, such as natural gas (NG), liquefied petroleum gas (LPG) and methanol will be serious rivals to fuel-oil in the future.

By nature, NG, LPG and methanol generate fewer CO₂ emissions during combustion than fuel oils. Furthermore, methanol is interesting because bio-methanol can be made from a vast variety of biomass and mixed with methanol made from fossil fuels.

MAN developed the ME-LGI (Liquid Gas Injection) engine in response to interest from the shipping world in operating on alternative fuel types to heavy fuel oil. Methanol and LPG carriers have already operated at sea for many years and many more LPG tankers are currently being built as the global LPG infrastructure grows.

With a viable, convenient and economic fuel already on board, exploiting a fraction of the cargo to power the vessel makes sense with another important factor being the benefit to the environment. MAN Diesel & Turbo is working towards a Tier III compatible ME-LGI version, which can already be ordered today.

Further market feedback also tells MAN Diesel & Turbo that there is an interest in methanol from ships operating in remote areas where it is difficult to establish LNG delivery and terminals. Large-scale LNG is economically feasible, but small-scale LNG becomes expensive due to the rather large investment costs. Methanol can be stored in normal non-pressure tanks, and is easy to transport. Train, truck and ship deliveries are already in place in many areas, so methanol infrastructure can easily be established and become feasible – even for a single ship in a remote area.

At the moment, the cost of methanol is higher than the cost of heavy fuel oil (HFO), but it only makes sense to use methanol in sulphur emission control area (SECA) zones, for river traffic, in remote areas with strict emission control (for example on lakes or in arctic zones) and in inland waters.

In 2015, an approx. 30% reduction of fuel costs will be achievable when compared to marine gas oil (MGO) containing 0.1% sulphur. Therefore, it also makes sense to consider retrofit solutions for existing ships.

When all this is said, it is important to notice that methanol is toxic, corrosive and takes up twice as much space as marine diesel oil (MDO). Because of this, special considerations have to be taken – both in terms of the engine design, during maintenance and in case of leakages.

Methanol as a Fuel

In 2012, MAN Diesel & Turbo decided to expand its engine portfolio by looking at low-flashpoint fuels and, as a result, the ME-LGI engine series was introduced.

The MAN B&W ME-LGI engine is the dual-fuel solution for low-flashpoint liquid fuels in contrast to the ME-GI (Gas Injection) engine where the fuel is injected in the gaseous state. Methanol is characterised by a low cetane number and its self-ignition quality is therefore poor. The ME-LGI engine can be delivered in different versions, depending on the low flashpoint liquid (LFL) fuel type used. Fuels for the ME-LGI engine are categorised by their vapour pressure at 60°C and injection is accomplished by a Fuel Booster Injection Valve (FBIV), using 300 bar hydraulic power to raise the fuel pressure to injection pressure, illustrated in Fig. 1.

Methanol has a flash point of 11°C, which is not Safety of Life at Sea (SOLAS)-compliant. However, since MAN Diesel & Turbo uses a double-wall design with all its methanol components, and since all leakages are monitored and collected in the double barrier, there are no problems related to this. Indeed, it is far easier to handle methanol than LNG.

To be able to use methanol fuel on the ME-LGI, the cylinder covers are equipped with fuel booster injection valves designed specifically for methanol operation. For a 50-bore engine, this means that each cylinder cover is equipped with two additional methanol booster injectors. A liquid gas injection (LGI) block is also fitted on the cylinder cover.

This block contains a control valve for methanol fuel injection, a sealing booster activation valve, a forced-suction activation valve, an LGI purge valve and methanol fuel inlet/outlet valves. All pipes for hydraulic oil and fuel are double-walled. Furthermore, the double-walled pipes for methanol fuel are vented with ventilation air, see Fig. 2.

The methanol booster injector valve must be cooled, and running surfaces must be lubricated. For this purpose, a combined sealing and cooling oil system delivering a 50-bar system oil pressure has been integrated into the engine, and the system both lubricates all running surfaces and ensures that the temperature in the booster
The valve is lower than the maximum permitted 60°C. The actual design is shown in Fig. 3.

The sealing oil pressure is generated internally in the booster valve in order to avoid contamination of the hydraulic oil operating the valve. The sealing oil has other advantages. It avoids methanol from going into the umbrella system and further down into the drain oil system. The cooling oil and sealing oil system are fully integrated in the engine design, including equipment for continuous monitoring of methanol contamination in the oil system. If methanol is detected in the system, the engine switches to fuel-oil mode, and methanol is purged from the engine. At the same time, the cooling oil pump supply side switches to clean system oil, and the oil circuit is flushed with clean oil. The clean oil is then collected, together with the contaminated oil in the cooling oil tank, and the system is only able to continue operation when no methanol is detected in the tank.

To ensure the correct temperature of the FBIV, the oil is cooled in a heat exchanger, which is connected to, e.g., the low temperature cooling system. When the fuel is injected, the combustion condition is monitored with pressure mean indicator (PMI) sensors located in each of the cylinder covers. The injection pressure is approx. 500 bar. Three combustion conditions are monitored: the compression pressures, combustion pressures and expansion pressures.

The 8-bar-pressurised methanol is delivered to the engine via double-walled pipes, ventilated with dry air taken from the starting air system. To suck in air, a ventilation system is fitted at the outlet. All methanol fuel equipment is made in a double-walled design, and any methanol leakage develops into methanol vapour. This is monitored by HC sensors located close to the outlet of the double-walled piping system. In case of an excessive methanol vapour content in the ventilation, the safety system shuts down methanol operation and returns to operation on fuel-oil alone. This switch is performed smoothly and without any power loss.

A methanol control and safety system is integrated into the engine and the main operating panel (MOP) is equipped with a user-friendly interface for methanol operation. On this panel, the LGI system monitors and indicates the relevant pressure, temperatures and position of the different valves.

This article is a heavily abridged version of the original technical paper – “Using Methanol Fuel in the MAN B&W ME-LGI Series”, – written by René Sejer Laursen of MAN Diesel & Turbo’s Two-Stroke business unit in Copenhagen. The paper is freely available from the company upon request.

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**Fig. 3:** The methanol booster injector with cooling oil (blue) and sealing oil (red) supply fully integrated.

**Fig. 4:** ME-LGI system overview
World’s First G45 Engine Passes Type Approval Test in Korea

Fully electronic control system heightens green profile of ultra-long-stroke G-type engine; first engine in series of eight for Odfjell vessels

Recently, STX Heavy Industries successfully built the world’s first 45-centimetre-bore, ultra-long-stroke, low-speed engine.

The MAN B&W SG45ME-C9.5 engine passed its TAT (Type Approval Test) and features a fully electronically-controlled system that optimises vessels’ green profile. MAN Diesel & Turbo considers the G45 engine as an excellent choice for smaller, oceangoing ships.

Development of the new engine focused on reducing exhaust-gas emissions to a minimum, while the introduction of a fully electronically-controlled system aims at optimising fuel economy. The new engine is the first in a series of eight individual main-engines bound for vessels currently under construction by Chinese shipyard NanTong Sinopacific Offshore & Engineering Co. Ltd. and ordered by Odfjell, a leading company in the global market for the transportation of bulk liquid chemicals.

The TAT was performed at STX’s Changwon plant with the attendance of several classification societies and shipowners.

G45 application example

MAN Diesel & Turbo offers the example of a G45 engine installed aboard an 800-teu container ship as an illustration of a typical application for the new engine type.

Given a design draught of 8 metres for the vessel, a 5.7-m, four-bladed propeller could be employed. With this propeller and a service speed of 17 knots, an SMCR engine speed of about 105 rpm would be optimal and the SMCR power would approximately be 6,070 kW (with a 15% sea margin and 10% engine margin). At a normal continuous rating of 5,465 kW, a typical, modern, low-speed engine would have a specific fuel-oil consumption of 166 g/kWh, resulting in a so-called energy efficiency design index (EEDI), will be reduced. In the future, this drive will probably result in operation at lower than normal service ship speeds compared to earlier, resulting in reduced propulsion power utilisation.

Rationale behind G-type introduction

The optimum propeller speed of oceangoing ships such as bulkers and container vessels is changing and steadily becoming lower. This is because the larger the propeller diameter that can be used for the ship, the correspondingly lower the actual propeller power and pertaining speed requirement will be, and the lower the propulsion power demand there is on ton bulk transported.

These factors have an influence on which main engine type should be selected and installed as the prime mover, and also on the size of the vessel to be built. Recent development steps have made it possible to offer solutions that enable significantly lower transport costs.

As the two-stroke main engine is directly coupled to the propeller, the introduction of the latest MAN B&W, ultra-long-stroke G-engine types meets this trend of installing large propellers, which may reduce the ship’s fuel consumption. Accordingly, today bulk carriers and container ships, among other vessel types, are often ordered with a G-engine type as prime mover.

<table>
<thead>
<tr>
<th>MAN B&amp;W SG45ME-C9.5</th>
<th>Stroke (mm)</th>
<th>2,250</th>
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<tbody>
<tr>
<td>Power output L1 (kW)</td>
<td>6,950</td>
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</tr>
<tr>
<td>MEP L1 (B)</td>
<td>21,0</td>
<td></td>
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</tbody>
</table>

Source: MAN Diesel & Turbo
MAN Diesel & Turbo has won the order for 3 × MAN 6L21/31 gensets to power a wellboat newbuilding for Patagonia Wellboat, the well-known Chilean fish-farming operator.

The order is the latest in a long history of wellboat references for MAN Diesel & Turbo in Chile’s important, domestic fish-farming industry.

The new wellboat will be built at Asenav – Chile’s largest, private shipbuilder – in Valdivia, Chile. It will be the first vessel in a new generation of wellboats designed and developed by Asenav in cooperation with Patagonia Wellboat.

Engine delivery is scheduled for Q4 2015 with vessel delivery expected May 2016. The new order includes an option for an extra, identical wellboat.

A significant reference

The order for the gensets is the latest in a long line of Chilean fishing and fish-farm orders for medium-speed MAN engines, where especially the 23/30 model has been popular.

The MAN 21/31 engine has already established a solid foothold in other, major South American fishing markets such as the recent three trawlers ordered by Norwegian-based fishing concern, Copeinca (Corporacion Pesquera Inca S.A.), built at Peru’s SIMA Callao shipyard (Servicios Industriales de la Marina S.A.) and equipped with 6L21/31 main propulsion engines.

The MAN 21/31 engine

The L21/31 engine has a 1,290-1,400 kW output range and, besides applications such as large fishing vessels, is also commonly employed by small to medium-sized tankers, cargo vessels, ferries, Ro-Ro vessels, coasters, tugs, workboats and supply vessels.

Geographical context

The Republic of Chile has a very well-developed fish-farming industry that frequently uses wellboats to transport the harvest from deep-water cages to holding areas near onshore processing facilities. For MAN Diesel & Turbo, this offered an opportunity to re-establish links with the local shipbuilding industry.

Flanked by the Pacific Ocean to the west and the Andes to the east, Chile’s coastline is almost 6,500 kilometres long and reaches all the way south to the Antarctic Ocean. Carved up by fjords and dotted with islands in sparsely-populated areas, southern Chile is an ideal location for intensive fish production. Forecasts indicate that farmed produce here will provide 40% of the total output by global fisheries in 2015.

Wellboat design and functions

Patagonia Wellboats is a pioneer in transporting live fish and has a fleet of wellboats for the transportation of salmon and trout, the latest generation of which have all been built by Asenav.

The wellboat concept originates from a desire for a better product. Traditionally, the aquatic culture approach has involved catching fish, processing them in situ and preserving them with ice until the market can be reached.

Wellboats are a unique kind of fishing-vessel-cum-housing-facility where fish are collected from where they are bred and transported live to processing facilities near the market. Huge pipelines transfer the fish from their breeding enclosures at sea to the wellboat’s storage tanks – whose water closely replicates that of the fish farm with no disadvantage to the fish.

Indeed, wellboats carefully control all conditions in their storage tanks such as water temperature, CO₂ levels and water quality to help the fish settle and stay calm, minimising the stress factors that inevitably affect fish quality. There are also cameras in each tank to monitor movement.

Though storage capacity differs, a wellboat typically holds about 1,400 cubic metres of water and houses up to 160 tonnes of fish.

About ASENAV and Patagonia Wellboat

Asenav was established in 1973. Its shipyard in Valdivia builds tugs, wellboats, motor yachts, fishing vessels, offshore ships, small cruisers, and RoPax and naval vessels for the Chilean Government, as well as customers within and without South America. Some of the high technology and designs developed by the company are licensed to foreign concerns, and Asenav continues to develop its own range in accordance with customer requirements.

Patagonia Wellboat was founded in 1991 in Puerto Montt, Chile and offers shuttle services for smolts using large-capacity vessels especially equipped for the loading, transportation and unloading of juvenile fish.
MAN Diesel & Turbo’s two-stage turbocharging development project, ECOCHARGE, recently passed a significant milestone on its way to a successful market introduction.

The company reports that individual MAN TCR20 and MAN TCX17 units – combined as a single, two-stage turbocharging system – has had a first run on an MAN 12V35/44 gas engine on a test bed at its Augsburg, Germany works. The company reports that the ECOCHARGE system has been developed for both gas- as well as HFO-burning engines.

Now that the TCX series has proven its strengths and functionality on the burner rig, the new ECOCHARGE system will run over the coming months on the engine to prove its strengths and functionality. The test is the first real opportunity to prove the thermodynamic calculations on an engine, which is key to a successful field test.

MAN Diesel & Turbo sees great potential in two-stage turbocharged engines, which can be seen in the spate of recent orders for such solutions. Two-stage turbocharging differs significantly from single-stage turbocharging in that it also copes with the demands of a high-pressure stage. The MAN TCX turbocharger has been especially developed for two-stage turbocharger applications.

The combination of an MAN TCR20 – for the low-pressure stage – and an MAN TCX17 – for the high-pressure stage – offers significant potential for today’s demand for more economical and environmentally-friendly engine operation. This is because two-stage turbocharging supplies engines with improved scavenging air pressures ranging from 5 to >10 bar, as well as significantly improved turbocharging efficiencies.

Benefits
MAN ECOCHARGE offers major benefits for engine builders. The increase in turbocharging efficiencies, in comparison to single-stage turbochargers, is mainly related to the intercooler – positioned between the low-pressure-stage and high-pressure-stage turbochargers – that significantly reduces the energy required to compress the intake air to high pressure. The resulting, higher efficiencies have an instantaneous impact on the engine by advantageously increasing the air pressure over the cylinder during the scavenging process. Additionally, greater turbocharging efficiency fosters the reduction of NOx emissions through the Miller cycle while the improved scavenging efficiencies provided by the ECOCHARGE system make the engine more fuel efficient.

Engine builders can profit from two-stage turbocharging with regard to power output and engine size. The higher power-density generated by the ECOCHARGE technology presents the opportunity to choose between significantly boosting an engine’s power output or reducing engine size, all the while maintaining an excellent engine performance.

The ECOCHARGE system’s increased efficiencies and higher cylinder rating facilitate the use of a smaller engine – and with the same power output as that of a larger unit – using traditional, single-stage turbocharging.

The TCX prototype pictured mounted on the ECOCHARGE two-stage turbocharging system

Frontal view of the ECOCHARGE two-stage turbocharging system featuring 2 × TCR20 and 2 × TCX17 turbochargers

The higher turbocharging efficiencies of two-stage turbocharging are related to the reduced level of work required post-intercooling, as shown in the diagram here.
Dual-Fuel L35/44DF Engine Moves towards Market Entry

Classification societies award type approval

At an official event in Augsburg representatives from all major classification societies awarded type approval to MAN Diesel & Turbo’s L35/44DF engine.

The engine gave a perfect performance and is now certified for GenSet and Controllable Pitch Propeller (CPP) operation all over the world. Lasting from March 30 to April 2, this has been the longest type approval test (TAT) MAN has run so far. Within the shipping industry, all new engines require type approval before installation on board a ship. Class certificates are valid for 5-7 years.

The first L35/44DF’s FAT (Factory Acceptance Test) will take place at MAN Diesel & Turbo’s Frederikshavn, Denmark facility in May, for which the Type Approval Test in Augsburg is a prerequisite.

Members of the partaking 10 classification societies were impressed by the engine’s performance. “The 35/44DF showed a spotless overall performance with no unplanned quick changeovers from gas to diesel during operation or any of the type approval tests”, sums up Dr. Günter Heider, Senior Manager at MAN Diesel & Turbo and Head of Test & Validation Four-Stroke Diesel & Gas Engines.

“Among the features that were specifically appreciated and praised by the association members were the quick change overs from gas to diesel mode at 100% load, the restriction-free gas load performance at an overload of 110% and the engine’s logic and clear modular design.”

Type approval tests
The entire TAT process involves a series of thorough running tests along with the detailed study of all documentation, sketches and calculations relevant to proceedings.

There are three main test blocks:
1) Extreme Conditions Test
This tests the engine with minimal oil pressure and max temperature at 110% performance, a cyclic loading operation over the course of 40 hours and 1-hour full-torque test at 87% of the nominal speed with a shutdown by engine overspeed, all to stress the engine and its components as much as possible. The engine is opened up afterwards and its parts checked by the classification societies.

2) Emergency Operation
Here, the engine needs to perform in non-supercharged conditions (suction engine). This test block usually takes 1-2 days with just one or two classification societies present as observers.

3) Type Approval Test
This demonstrates an engine’s ability to perform under different, defined engine loads and covers the engine’s ability to switch smoothly from diesel to gas operation and back. The engine’s Alarm & Safety System is also tested to prove compliance with MAN’S safety concept for marine DF engines. In addition an Integration Test has to be performed to show the engine’s reliability in the event of the control system partly or completely failing.

### Specification

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<tr>
<th>Specification</th>
<th>Dimension</th>
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Application: Marine
Source: MAN Diesel & Turbo
A Routine Inspection aboard the Majestic Mærsk

It's early Monday morning in Bremerhaven when DieselFacts meets up with MAN Diesel & Turbo Superintendent Jörgen Gunnarsson who is about to begin his routine inspection of the two main engines aboard the Triple E ship Majestic Mærsk.

On the gangway (1)
The sun is rising up as Jörgen Gunnarsson steps onto the gangway to start his routine inspection of the Majestic Mærsk.

In the engine control room (2)
Gunnarsson puts on his boiler suit and grabs a cup of coffee in the Engine Control Room (ECR) before checking the latest data from the two MAN Diesel & Turbo low-speed engines that propel the big ship. “The data will inform us on the history of all pressures, temperatures, settings and so on. In fact, I can see everything that has been recorded since the vessel’s delivery,” Gunnarsson explains. “You could call it ‘the black box’ of the ship, but conversations are not recorded as they are in airplane cockpits,” adds the Superintendent.

Tests in the Engine Room (3)
Modern engines like the ones on Majestic Mærsk are able to “survey themselves” and provide plenty of data for engineers. But Gunnarsson also makes his own measurements to ensure the long-term health of the engines. In the picture, the superintendent is checking piston rings.

“When I inspect an engine, I am looking for abnormalities. My report can look a bit negative and as if the engine is running badly, but that’s not true,” says Gunnarsson.

Explaining his findings (4)
Using a headlight, Superintendent Gunnarsson takes a closer look at the piston rings. He uses a mirror with a telescopic extension, which enables him to see the other side of the pistons. In a notebook, he takes notes before explaining some of his findings to a cadet onboard (picture). With a small camera, Gunnarsson also takes pictures for other engineers to analyse later.

Gunnarsson explains: “Things that look normal don’t need any comments or actions, while things that look abnormal often need to be kept under observation, sometimes with a view to replacement or repair. That’s the reason my inspection sounds worse than it is.”

Reporting to the office (5)
To accommodate DieselFacts’ wish to get an overview of the ship, Gunnarsson goes to the bridge. While there, he phones the MAN Diesel & Turbo office to report his findings (at this point he has already entered his findings into the company database).

The Captain’s view (6)
The contrast is rather striking between Gunnarsson’s focus on engine details and the captain’s total overview from the bridge, but the hotline between these “two worlds” is regularly used. Besides being in continuous phone contact, the captain also visits the ECR at least once a day.

The business that never sleeps (7)
While the Majestic Mærsk is docked at Bremerhaven Port, its workers are busy offloading containers from the huge ship.

The Triple E ships, the largest type of Maersk ship, are powered by two MAN B&W 8S80ME-C9 engines, each with 8 cylinders (800-mm bore, 3,450-mm stroke) and an output of 29,680 kW.