MAN B&W Diesel

DIESELFACTS

• SERVICE • ENGINES • TURBOCHARGERS • PROPULSION SYSTEMS • MARINE • STATIONARY •

• 2005 • 3 •

10,000 MC engines and still going strong

Peter Sunn Pedersen, Executive Vice President, MAN B&W Diesel

On the occasion of the 10,000th MC engine, MAN B&W Diesel's Executive Vice President, Peter Sunn Pedersen, states:

"We are happy at MAN B&W Diesel to announce yet another milestone in the long history of our company, the contracting of the 10,000th MC engine.

This achievement has only been made possible by our customers and I would like to thank our business partners for their continued trust and support throughout the years since the MC engine was born nearly 25 years ago.

That may sound as a long time, but due to our traditional continuous development of the engine range, our customers can be confident to get a reliable, state-of-the-art prime mover complying with all current safety and environmental requirements.

Full speed ahead – the MC engine, still going strong. For a quarter of a century, world trade has trusted the MC engine to deliver.

The MC engine has proven to be the economical and reliable workhorse of the high seas with only a modest demand for maintenance – and should spare parts or technical service be needed, it is our company vision to be the leading supplier of that as well!"

Reduce fuel consumption and CO_2

Utilise waste heat and save costs with the Thermo Efficiency System (TES)

MAN B&W Diesel's large two-stroke engines can now be delivered as with the TES. The increased exhaust gas temperatures now make it possible to use waste heat in the exhaust gas to create 'free' energy.

The development of high-efficiency turbochargers (approximately 70% efficiency) has made it possible to introduce TES as an alternative to a standard engine.

With TES, it is now possible to lower the total fuel consumption of the ship and, thereby, to obtain a correspondingly lower CO_2 emission, which is a distinct advantage in today's environmentally conscious society.

The TES concept is shown in Fig. 1. The objective is to utilise part of the turbocharger's high efficiency to produce an additional power output (up to a maximum of 4.6% of the main engine output) through the installation of an exhaust gas turbine.

The exhaust gas turbine is supplied with an exhaust gas via a bypass around the turbochargers. This bypass gas amount is equal to about 12% of the total exhaust gas.

An expected minor increase of the specific fuel oil consumption can be avoided by increasing the maximum combustion pressure.

The resultant rise in exhaust gas temperature is +50°C. This temperature rise makes it possible to produce more steam by means of an exhaust gas boiler. As superheated steam, this will be led to a steam turbine for production of extra power.

The steam system can be delivered as both a single-pressure steam system (min. 7 bar abs) and as a dual-pressure steam system (approximately 4-5 and

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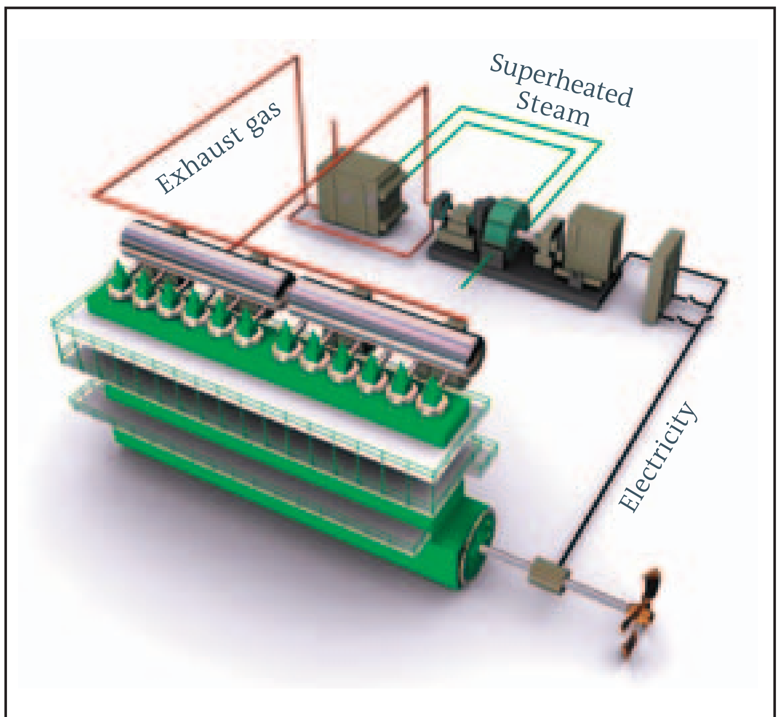

Fig. 1. The Thermo Efficiency System
The hot exhaust gas feeds both a boiler and an exhaust gas turbine (power turbine). The exhaust gas turbine is feed by a flow of exhaust gas that has by-passed the turbocharger. The boiler uses the normal, post-turbocharger, exhaust gas to create super-heated steam, which is then used to power a steam turbine and supply steam for heating services.

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Thermo Efficiency System

10-11 bar abs for the low and high steam pressures respectively).

The additional power production of the two systems is shown in Figs. 2 and 3.

The process for the dual-pressure steam system is requires an expensive feedwater preheater system, in which the engine's jacket water and scavenge air coolers are alternative heat sources. MAN B&W Diesel recommends the single-pressure system due to its simplicity and reduced costs.

The risk of soot deposits and fires in exhaust gas boilers impose certain limits on the heat utilisation of the boiler. However, a main engine with an optimum fuel injection system, as used for the ME engines, will reduce these risks as it is a smokeless engine.

The vessel's electricity is produced by a common generator, connected by two reduction gears for the exhaust gas turbine and the steam turbine.

Fig. 4 shows an example of the complete turbine generating set, as proposed by Peter Brotherhood, who, together with Aalborg Industries and Siemens, has started cooperation on development, production and delivery of complete TES packages.

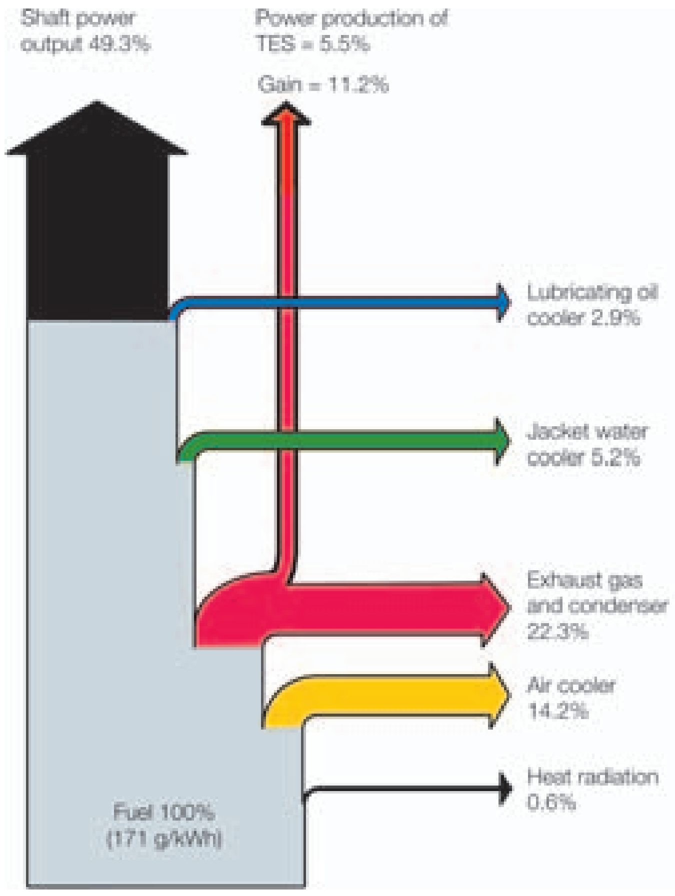


Fig. 2: Dual pressure heat balance diagram of the normally-rated MAN B&W Diesel 12K98ME/MC engine fitted with TES, operating at ISO ambient reference conditions and at 100% SMCR.

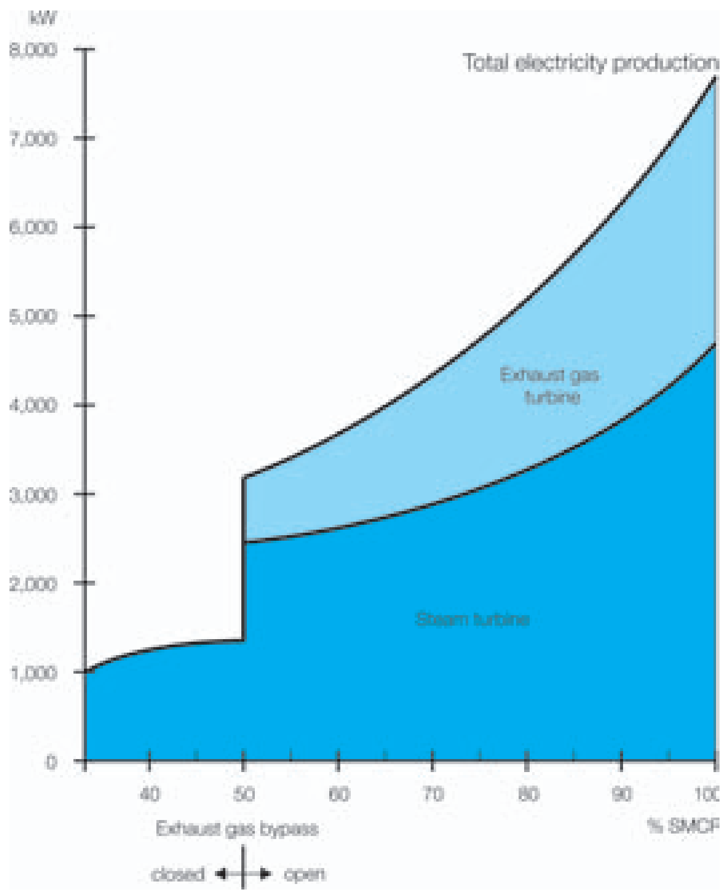


Fig. 3: Total expected electric power production for the dual pressureTES when applied to an MAN B&W Diesel 12K98ME/MC main engine – based on ISO ambient reference conditions.

What can TES achieve ?

Considerable cost savings can be obtained through the additional electricity supply. For single pressure TES, the additional power is in the range of 8-9%. The dual-pressure TES offers 9-10% (obtained when running the main engine at ISO ambient reference conditions (25°C air and 25°C cooling water) and 85% SMCR engine load).

For an MAN B&W Diesel 12K98ME engine (Mark 6), operating at SMCR (= 68,640 kW), in an 8,000 teu container vessel, a dual-pressure TES produces an electricity power production of approximately 5,700 kW. This corresponds to an annual fuel cost saving of approximately USD 1,000,000.

Conclusion

The investment costs for smaller two-stroke main engines – for instance a 6S90ME-C (Mark 7), SMCR = 29,340 kW for a VLCC – are, for TES, relatively higher than for a 12K98ME engine. This results in the payback time increasing from five to nine years in case of a 6S90MC-C.

Furthermore, it will not always be possible to use all obtainable electric power production because of lack of large electric power consumers on a VLCC, whereas the large container vessels with many refrigerated containers will, often, be able to fully consume the large amount of electric power produced, enabling the fuel for the corresponding diesel generators to be saved.

Therefore, when only considering the payback time, the installation of the TES is normally only relevant for the large merchant ships, such as the large container vessels. We must also not forget the owners' advantage with regard to the possibility of obtaining additional freight charters and higher freight rates, thanks to the 'green ship' image when using an environmentally-friendly ship with a low fuel consumption and a correspondingly low CO_2 emission.

Furthermore, the latest drastic increase in the price of fuel could also motivate shipowners to install the TES. Orders have already been taken for the TES. ■

MAN B&W Diesel have produced a technical paper on the subject of the Thermo Efficiency System. A copy can be obtained by contacting:
dieselfacts@dk.manbw.com

Fig. 4: The complete turbine generating set. The unit for an MAN B&W Diesel 12K98ME/MC engine measures only 10 m by 3.5 m.

More Bangs for your Bucks

Dieselfacts talks to an enthusiastic Paul Dunn about the 'Pit-Stop' containerised overhaul solutions

The response to MAN B&W Diesel's tailor-made Pit-Stop servicing solution for four-stroke diesel engines is catching the attention of many influencial figures within major companies in the shipping industry. Dieselfacts examines the impact of this containerised maintenance package on one of the main players in the global market.

General Technical Manager of World-Wide Shipping Managers Pte. Ltd. (Singapore), Mr Paul Dunn, talks to Dieselfacts about the impact and future of the Pit-Stop arrangement for his company.

World-Wide Shipping (WWS) company was founded in 1955 by Yue-Kong Pao. His first vessel was a 27 year-old coal-burning freighter and, 25 years later, the World-Wide house flag was flying on board nearly 200 vessels – the largest fleet ever assembled in private ownership. Today, WWS remains a major player in the tanker market, as well as having a significant dry bulk fleet.

WWS has continued to renew and modernise its fleet and became the first major tanker owner to be able to lead a return to the newbuilding yards after the turbulent years of the 1980s. WWS continues to maintain high standards in people and ships – the Group's policy since the beginning has always been to provide stable, large-scale, long-term transport capacity.

Paul Dunn: I started as a trainee marine engineer in 1970 and, within the same company, worked my way up to become a Chief Engineer by 1981. I then moved on to become a superintendent and manager of Newbuildings for WWS in Korea. For a short time, I ventured away from WWS but returned in 2001, to take up my present position as General Technical Manager.

Dieselfacts: What is your relationship with MAN B&W Diesel?

Paul Dunn: MAN B&W Diesel has been the engine of choice for WWS for many years. Today, most of our engines are provided by MAN B&W Diesel. This, naturally, results in an on-going dialogue.

Dieselfacts: When did you first become aware of the Pit-Stop service?

Paul Dunn: The Pit-Stop concept was brought to my attention just over two years ago.

Dieselfacts: What aspects of the service attracted you to the Pit-Stop service?

Paul Dunn: The immediate thought was that this could standardise the maintenance procedures while, at the same time, increase the overall standard of the work done on the engines. With 42 identical engines, the potential was obvious. One of the main challenges with any fleet is the logistics. This tailor-made, containerised solution streamlined many issues. Across the entire industry, there is a growing issue of finding enough staff with the right sets of skills required in order to correctly maintain the engines in their optimum condition. Therefore, the Pit-Stop agreement we entered in to, where each container would be accompanied by a Superintendent, meant that each time major maintenance was performed the skills and techniques of the staff would be updated along with the engine.

Dieselfacts: Could you describe your experience with the Pit-Stop programme?

Paul Dunn: Initially, we arranged for four Pit-Stop containers; three for our five cylinder engines and one for our six cylinder engines. Although the agreement was for a two-year period, we saw this arrangement as a much longer solution – lasting for a minimum of at least five to six years. In addition, knowing that the older five cylinder units would be disposed of at some time in the future, each of the four containers was designed for the six cylinder units. Like any new venture, there has been a learning curve for both parties concerned. The issue of a few incorrect spares parts has been more than offset by the positive follow up and the advantages of the service. The knowledge and experience of the MAN B&W Diesel staff on board our vessels resulted in resolution of some issues which the local staff were not aware of.

Dieselfacts: What did you see as the benefits for your company?

Paul Dunn: There are many advantages to a properly overhauled engine. In addition to obtaining optimal operating conditions for the engines – getting the most bang for the buck – ancillary equipment such as pumps and pipes are also brought under the spotlight; if the engine's mechanically correct and yet not obtaining expected outputs, then we might suspect that something else might be causing the problem – a leaking pump, blocked or reduced pipe diameter, for example. A leaking pump, in addition to being inefficient, could appear to be dirty and dangerous. This is important when the number of various inspections are increasing. So, good appearance also becomes one of relative competitive advantage. The issue of approved spare parts is now more important than ever before. With the Pit-Stop arrangement, we are sure to receive officially approved parts that we know and can document.

Mr Paul Dunn, General Technical Manager of World-Wide Shipping Managers Pte. Ltd. While visiting MAN B&W Diesel's headquarters in Copenhagen, Mr Dunn happily took time out from his schedule to talk to Dieselfacts about his experience with the tailor-made 'Pit-Stop' containerised overhaul solution.

Dieselfacts: Do you see this arrangement as a change in servicing philosophy.

Paul Dunn: Yes. As less and less staff becomes available with the appropriate level of skills and experience we expect, then this servicing support opportunity will be more and more important. Such arrangements also allow the company to make better and longer term plans. We expect that Time Between Overhauls (TBOs) will be increased significantly.

Dieselfacts: How do you see the future of Pit-Stop within your company.

Paul Dunn: It's early days, but assuming the concept does work. We foresee that, due to better running conditions, that the minor, planned, routine stoppages will not be needed. This means that planned maintenance can be done during the dry-docking periods.

Dieselfacts: What do you see as the future challenges and opportunities in the shipping world.

Paul Dunn: Obviously, staff training is one major concern. Another is the increasing number of regulations, especially relating to environmental concerns. In the future, such regulations are expected to be even stricter. The makes the issue of correct and efficient engine maintenance increasingly important. ■

Reducing lube oil costs with the Alpha Lubricator

Otto Winkel, Senior Vice President Diesel Service, gives his view on the lube oil situation

Dieselfacts: Some trade journals are predicting a steep rise in the price of lube oil. What is your view of the situation?

Otto Winkel: First of all, I would like to make it clear that we have highlighted the current situation, not to make short-term gains, but to try to help our customers as much as we can.

As a results of reports, shipowners have been contacting MAN B&W Diesel to see what we can do to help them. We can offer assistance on several levels. Firstly, we can help with advice on an optimising of existing plant to use the minimum lube oil possible. Secondly, we can offer solutions that present proven significant savings in lube oil in the range of 30% to 50% with our Alpha Lubricator system. However, due their popularity, there is a delivery time of about 10 weeks at present.

Dieselfacts: How do you see the future of lube oil supply affecting the running of vessels?

Otto Winkel: Any measures that a vessel operator can enact to reduce the consumption of lube oil will have a two-fold effect; firstly, an overall reduction in purchase costs and, secondly, decrease the dependence on future, possibly unsecured supply of lube oil – thereby reducing the chances of being hit by the very real chance of lack of supply through lube oil rationing.

Dieselfacts: Do you see differences in the global supply of lube oil?

Otto Winkel: In addition to existing capacity constraints in a growing transportation market, existing production facilities have recently been adversely affected by severe weather conditions in key geographical regions. Recently, in South East Asia, for example, several key port areas have been adversely affected by such issues, resulting in production halts and reduced capacity. These factors, together with untimely plant maintenance shutdowns in pivotal port locations, have led to a situation were lube oil supply is no-longer guaranteed. The days of lube oil over-supply and unsustainable competitive prices are over.

Dieselfacts: Can you point to cases where customers have benefited from MAN B&W Diesel?

"We can offer solutions that present proven significant savings in lube oil in the range of 30% to 50% with our Alpha Lubricator system"

Otto Winkel, Senior Vice President Diesel Service

Otto Winkel: Case after case continues to show that, when selected as a retrofit option, the Alpha Lubricator regularly presents costs savings of between 30-50%. As the case stories below highlight, there's money to be saved by the simple step of retrofitting the Alpha Lubricator to an existing plant.

Case history – Hapag Lloyd
In the case involving the 4,890 teu container vessel M/V Tokyo Express (Hapag Lloyd, Hamburg), the Alpha Lubricator system saved over 20 tons of lube oil over a 13 week period. The previous, Jensen lubricators, had been using 60 tons of lube oil. This figure has now been reduced to 40 tons with the Alpha Lubricator system.

It was also observed that, in addition to the lube oil savings, the condition of the cylinder liner, piston and piston rings was far better than before – no residues and an overall reduction in the 'wear and tear'.

Case history – Teo Shipping
Teo Shipping of Greece has realised similar results from retrofitting the Alpha Lubricator system. The M/V Tiger Wave was retrofitted in March 2003 and has since run approximately 15,000 hours. The cost savings for this vessel are above USD 200,000 per year.

Before retrofitting, it was common for the vessel to use 500 L of lube oil per day. The lube oil consumption after the retrofit was initially set at 390 L per day, which was reduced over a six month period to 300 L per day. During the last year, the engine, an MAN B&W Diesel 6S60MC driving a fixed pitched propeller, has been operating on 280 L per day.

Since the retrofitting, the engine has been through a routine overhaul procedure, during which no negative changes were reported on either the cylinder liners nor piston crowns. The same procedure was also performed on the M/V Gallant Wave a year later with similar results.

The operator was also keen to highlight that this retrofit procedure was helped by careful planning and communication, both before and during the operation.

Case history – Franship
The Franco-Belgian shipping group, Franship has retrofitted four vessels to date: M/V Algarve, M/V Luxemburg, M/V Pacific Lagoon and the M/V Picardie (now under new ownership). The vessels had the same main engine, an MAN B&W Diesel 7S80MC.

When Franship was asked to give an estimate for cost savings for cylinder oil for this year (the first complete year of operation after the retrofit), a company spokesman stated that savings were expected to be in the range of USD 80,000 to 100,000 per vessel.

Case history – BP
The BP tanker M/V British Progress entered dry-docking in July, 2002 – after 12,700 main engine running hours – During this time she was retrofitted with an Alpha Lubricator system. The cylinder condition was evaluated during this drydocking in order to determine the Alpha Lubricators influence on the cylinder condition.

All cylinder liners were measured and the liner surface was inspected. The average wear rates were found to be 0.07 mm – sufficient to maintain a good cylinder surface with an adequate porosity of the liner surface.

Cylinder oil consumption before and after installation of Alpha lubricator.

Before installation of the Alpha Lubricator:
= 1.1 g/bhph at 100% Maximum Continuous Rating (MCR).
After installation of the Alpha Lubricator:
= 0.8 g/bhph at 100% MCR.

Since the installation of the Alpha lubricator the vessel has saved 236,130 Kg of cylinder lube oil, without increased liner wear rate. Assuming that the price one (1) Kg of cylinder is US$ 0.60. the total saving since installation is US$ 141,678. ■

Anna Knutsen's remarkable record

Class inspection confirms engines' excellent condition after 20 years of service

'Anna Knutsen' vessel data: delivered in December 1986 from Moss Rosenberg Verft / Moss Fredrikstad Verft, Norway, as yard no. 443. Deadweight: 123,819 tons. Main engines: 2 x MAN B&W 4L70MCE (9,760 BHP @ 95 rpm). Two main engine driven alternators (PTO gears). Propellers: 2 x CPP, diameter 6.1 m. Side thrusters/ rudders: Two tunnel thrusters and two Becker Rudders. Two electrohydraulic steering gears.

'Anna Knutsen', owned and operated by Knutsen OAS Shipping in Haugesund, Norway, was one of the first shuttle tankers to have a twin MAN B&W Diesel MC engine configuration. This propulsion concept has provided the vessel with full mobility due to the reliability of the MC engines. A recent inspection confirmed the remarkable condition of the engines.

'Anna Knutsen' was fitted with two MAN B&W Diesel 4L70MCE main engines, which have both performed faultlessly from the beginning. The engines were built by MAN B&W Diesel-licensee Kawasaki Heavy Industries (Japan). 'Anna Knutsen' also has a sister vessel, 'Ragnhild Knutsen', which is producing similar service performance.

The fully redundant twin engine configuration was designed to be the main producer of propulsion power and shipboard electricity. By use of large clutches the controllable pitch propellers are disengaged in port, and one of the main engines is then producing electrical power for the cargo pumps, hence also acting as an auxiliary engine.

Today, shuttle tankers supply about half Norway's oil transportation needs, and most of the shuttle tankers are equipped with twin screw propulsion plants, similar to the one installed in 'Anna Knutsen'.

20-year inspection

These vessels are subject to very strict regulations from port authorities, classification societies and oil companies (charterers). 'Anna Knutsen' has been re-built to double-hull, and she was also the first vessel to be equipped with a VOC plant.

In October 2005, 'Anna Knutsen' had her 20-year class inspection during dry-docking in Brest, France. Due to her age she was also subject to a CAP (Condition Assessment Programme) hull survey by Det Norske Veritas (DNV). This is required by oil companies, to which the cargo is sold by charterer Statoil, for all vessels above 15 years of age.

MAN B&W Diesel staff attended the vessel in Sobrena drydock October 11-12, 2005. Peter Keite from the Technical Service department was welcomed by the vessel superintendent, Mr. Egil O. Endresen, Captain Harald Aalmo and Chief Engineer Arvid Magne Hansen.

Chief Engineer Hansen has worked onboard 'Anna Knutsen' the last nine years. Yet he has never experienced any operational problems with the main engines, even though running hours now have reached 134,594 and 135,027 for port and starboard engines, respectively. In addition to the excellent engine condition, Hansen and superintendent Endresen were pleased to report the absence of smoke from main engines at any load, neither during loading, transit or unloading.

During the inspection DNV did not initiate much work on the main engines, except that main bearings were classed. Starboard main engine inspection was completed by Peter Keite and DNV on October 12, without remarks.

Maintenance and repairs

Chief engineer Hansen and his colleagues follow very strict maintenance routines. Piston overhaul is made every 20,000 operating hours, and the last cylinder condition report for cyl. no. 4 mentions 0.013 mm wear per 1,000 hours. Average piston running time is 102,705 hours.

Specific cylinder oil consumption is calculated to 1.1 g/bhp, and oil type used is Mobilgard 570.

From left: Owner's superintendent, Egil O.Endresen, Chief Engineer Arvid Magne Hansen and Peter Keite from MAN B&W Diesel.

Exhaust valves are overhauled every 10,000 hours. Chief Engineer Hansen is planning to use the new DuraSpindle on the next renewal, and expects to reach TBOs of 20,000 hours with the W-seat.

Two years ago they started renewal of plungers and barrels. Only one cylinder remains and lifetime has now exceeded 125,000 hours.

The superintendent has always stressed his crew to increase and decrease engine load very gently, and they do not allow engine load to exceed 85%. This is surely one of many reasons why the engines remain in such good condition.

Further maintenance routines include cleaning of scavenge air receivers every three months, and cleaning of exhaust gas boilers every six months. Hansen reports practically no leaks from stuffing boxes and connecting rods.

A valuable future

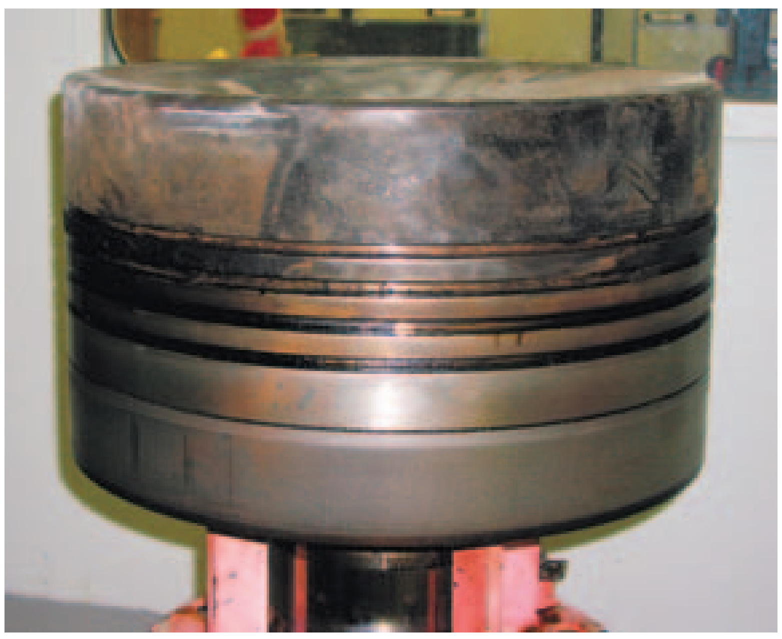
'Anna Knutsen' is operating in a very harsh environment in the North Sea. Connection to the loading buoy can be done in wave heights up to 4.5 m, and loading can proceed in wave heights up to 5.5 m. Further regulations and limitations with respect to wind, current, drifting and distance to platforms also apply.

Still, 'Anna Knutsen' has taken 933 oil cargoes since she started operation. With a cargo capacity of 800,000 barrels and an oil price of USD 60 per barrel, each cargo represents USD 48 mill. worth of money!

Although built in 1986, 'Anna Knutsen' continues to prove that she can still function like new, even in the most demanding conditions. ■

Visual inspection confirms the excellent overall condition of the running gear.

Upper bearing shell removed to allow further inspection.



One of the original pistons.

Developing the AHT nozzle design

Propulsion of Offshore Support Vessels (OSV)

The development of the offshore propulsion business at MAN B&W Diesel dates back to the early 1970's. Since then, the Company has focused on supplying complete propulsion systems, while at the same time also developing the associated know-how and technology.

The typical standard OSV, designed for maximum bollard pull, is a twin screw vessel with controllable pitch (CP) propellers operating within nozzles.

To ensure that a certain bollard pull is obtained, various approaches can be taken. Most are methods that directly lead to the required power to be installed and are based on 'rule of thumb' figures. However, precise optimisation of an OSV for bollard pull requires a more detailed analysis of parameters, e.g. engine power, propeller diameter, nozzle design and propeller hull interaction.

The propeller diameter should be as big as the hull can accommodate, and still secure a full immersion of the propeller in ballast draft. It is presumed that the propeller speed is optimised for the given power and propeller diameter.

In order to obtain a bollard pull of 90 tons, several combinations of engine power and propeller diameter exist. The MAN B&W Diesel standard propulsion programme for the L27/38 engine type can be used to illustrate a number of possibilities for obtaining a 90 tons bollard pull. Possible twin screw plant combinations with ducted propellers are listed in Table 1.

The example clearly reflects the influence of the power density, which comes from the larger propeller diameter on the bollard pull. A twin screw 6L27/38 propulsion plant with a power of 2x2040 kW delivers a bollard pull similar to a twin screw 9L27/38 plant with a power of 2x3060 kW. The cost comparison of the different propulsion configurations given in Fig. 1 further highlights the advantage of a low power density, which comes from a larger propeller diameter.

The power needed for maintaining a service speed of 12 knots (shown in Fig. 2) again favours the lower power density given by the 6L27/38 propulsion plant. From both an initial investment and operating cost point of view, the lowest power density configuration is indeed preferable.

Recently, new nozzle types have appeared on the market claiming a higher performance based on a CFD shape optimisation. At MAN B&W Diesel, a new nozzle type, called Alpha High Thrust (AHT), has been developed to increase the performance compared to earlier types.

The AHT nozzle is customised according to its application. For example, an Anchor Handling Tug Supply (AHTS) vessel could be optimised for maximum bollard pull, whereas a purse seiner could be optimised for service speed. The two nozzle designs will differ significantly, not only in its appearance, but also in performance when compared to a standard off-the-shelf nozzle design.

A prerequisite for obtaining a good and uniform inflow to the propeller is a proper flow alignment of the struts. Until recently, the traditional way of achieving this has been paint or tuft test during model experiments. However, the emergence of numerical tools as CFD including viscous effects, now makes it possible to optimise the orientation of the struts at an earlier stage.

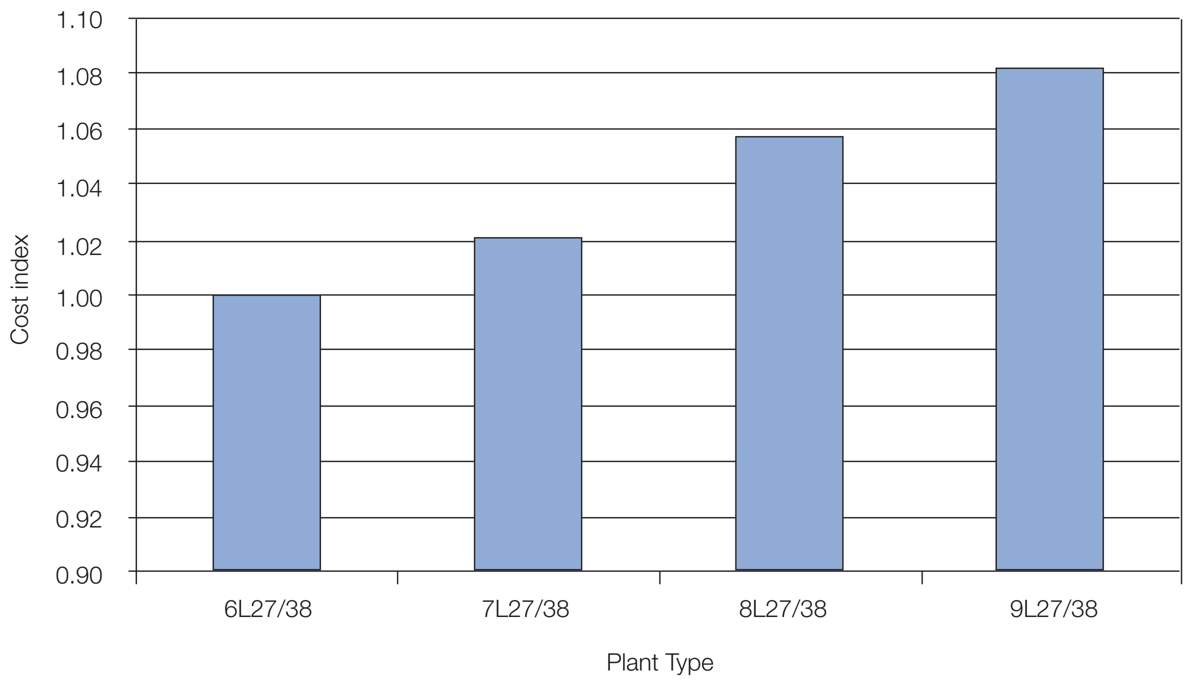


Fig. 1: An analysis of propulsion plant costs for a 90-ton bollard pull OSV clearly shows the advantage of a low power density. The six-cylinder unit has a cost index saving of about 8% over a nine-cylinder unit.

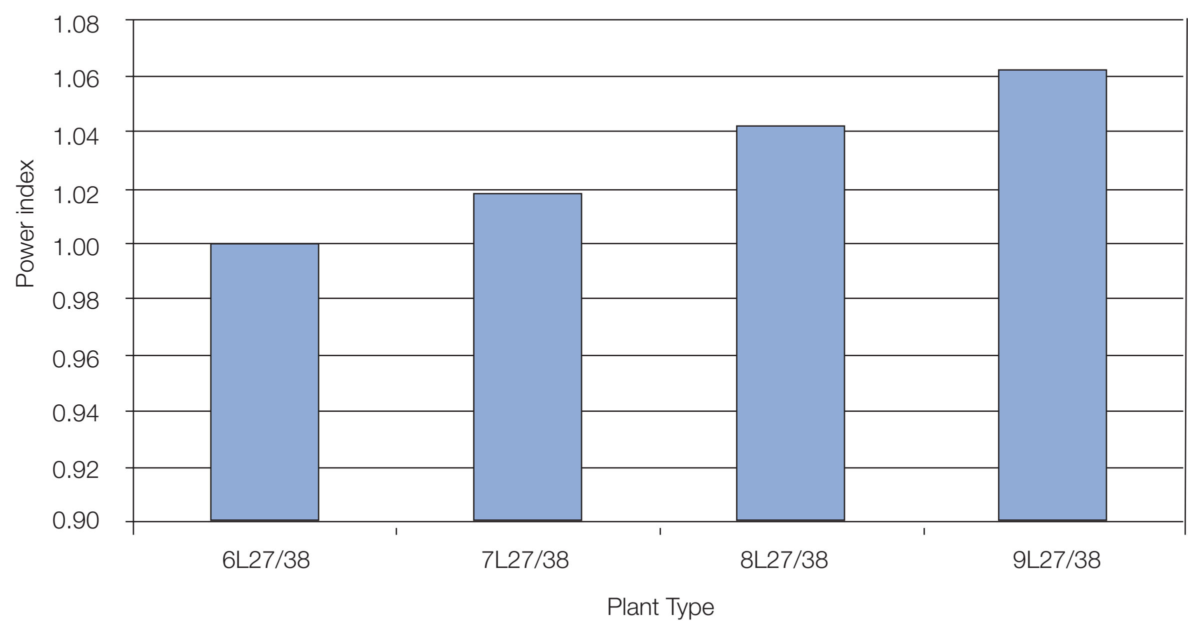


Fig. 2: Propulsion power index at 12 knots service speed for a 90-ton bollard pull OSV. The six-cylinder unit is superior to the nine-cylinder plant.

Other areas of optimisation are the rudder shape and the rudder positioning. Nozzle positioning and tilting are also very important areas that should be addressed. As many of these items are not only related to the propulsion system but also adjacent areas like hull and rudder design, it requires that a close cooperation is established between the involved parties.

Developing the AHT nozzle design

By systematically designing various nozzle geometries and subsequently performing CFD calculations on each individual parameter, an optimised solution has been established. Calculations have been performed for various conditions including bollard pull, astern and ahead.

An iterative process was used in the development of the AHT nozzle series for an OSV:

1. Calculations based on several design proposals were used to determine whether a bollard pull improvement had occurred compared to the 19A nozzle. The AHT design was refined, finally leading to an optimum solution for bollard pull.

An optimum geometry is characterised by a uniform pressure distribution at the nozzle inlet followed by an even conversion of the high velocity flow into thrust. A comparison between the 19A type nozzle (left top and bottom) and the AHT design (right top and bottom) in Fig. 3 shows improvement of both relative pressure and velocity distribution.

The higher velocity at the leading edge of the AHT nozzle design results in a lower pressure, generating more forward thrust. It is also shown that the diffusion angle results in a larger pressure at the trailing edge. This pressure difference contributes to a larger bollard pull. The calculations for this particular case were performed in model scale. The influence going from model scale to full scale showed a tendency towards a better full scale performance.

2. After reaching an optimum design using the 2D model, a more detailed 3D model con-

Possible twin-screw plant combinations

Engine Type	Engine Power (kW)	Gearbox Series	Gearbox Type	Propeller Speed (rpm)	Propeller Diameter (mm)	Bollard pull for a twin screw OSV (tons)
6L27/38	2040	AMG28EV	60VO28	134	3650	90.0
7L27/38	2380	AMG28EV	45VO30	177	3200	91.2
8L27/38	2720	AMG28EV	36VO30	224	2850	91.8
9L27/38	3060	AMG28EV	29VO30	274	2550	91.2

Table 1: The above twin-screw plant combinations for a 90-ton bollard pull show the flexibility in the application of the AHT propeller when combined with the MAN B&W Diesel 27/38 engine.

sisting of nozzle, propeller blades and hub is calculated in order to verify the bollard pull improvement from the 2D model calculation. If further refinement is needed, the ability to study flow details such as propeller tip circulation, flow separation and similar phenomena all associated with viscous effects is an advantage in using CFD.

Application

The design procedure described above has been applied for an ocean-going tug boat having a bollard pull requirement of 210 tons. The vessel is designed with a propeller diameter as big as the draft of the vessel allows, thus leading to a relatively small clearance between the hull and the nozzle.

Out of all the possible nozzle supports designs, the head box type was selected. In order to avoid vibration, a relatively wide head box is needed to keep a sufficiently high natural frequency. The negative influence of the head box on the performance of the nozzle is limited due to it's location in the hull boundary layer. This is also confirmed by a relatively small thrust deduction being in the order of 5-6%.

A thorough investigation of several propeller and nozzle combinations was carried out. This was supplemented by intensive CFD optimisation. A 19A type nozzle and a corresponding propeller design were used for benchmarking. Based on various CFD optimisation studies, a customised AHT nozzle and propeller blade design finally emerged.

This showed a nozzle thrust improvement in bollard pull condition of almost 8%. In order to make a comparison with subsequent model tank test results, all calculations were carried out in model scale.

An example of a 3D propeller/nozzle system for the AHT nozzle is shown in Figure 4. The cutting plane illustrates the velocity distribution.

This article has been compiled from a technical paper presented at OSV Singapore 2005 by staff from the Propulsion Research and Development Department of MAN B&W Diesel in Frederikshavn (Denmark). ■

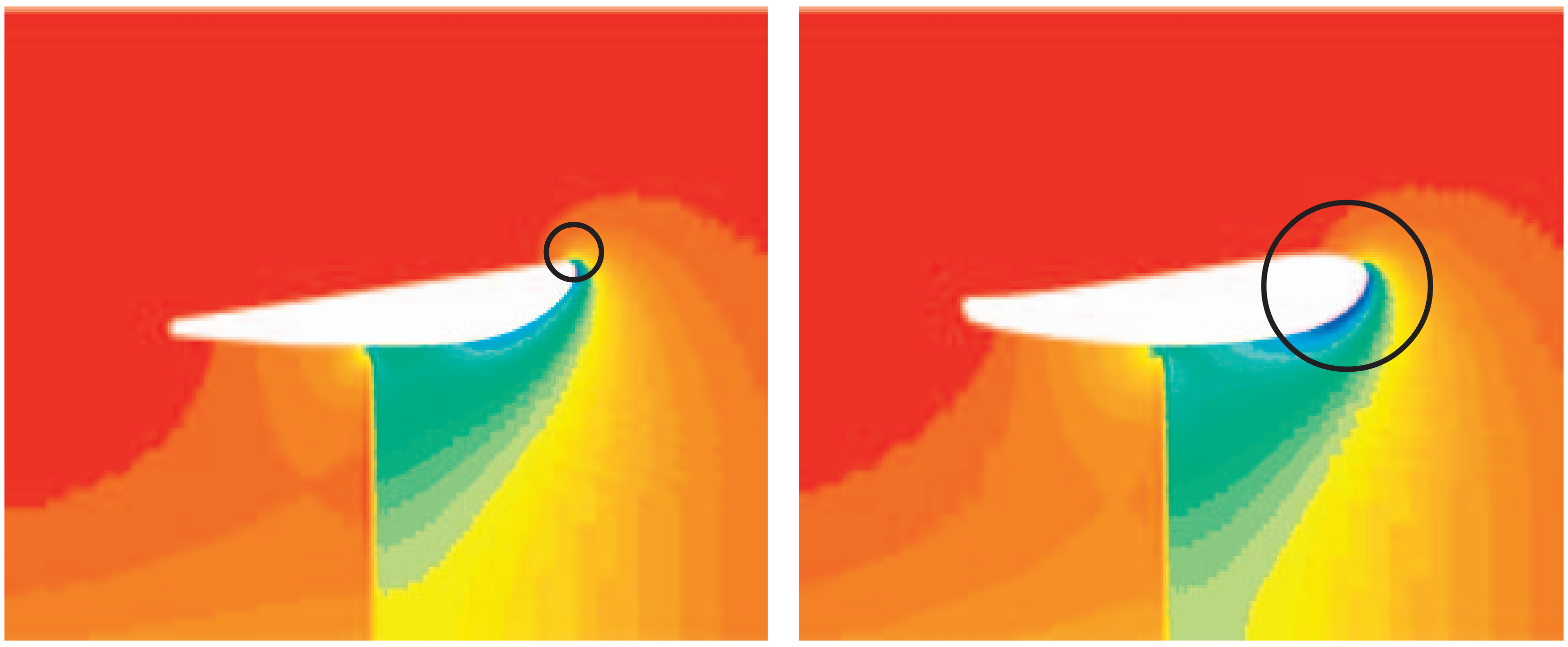


Fig. 3a: Computer models show the pressure distribution of the 19A (left) and new AHT (right) type nozzles.

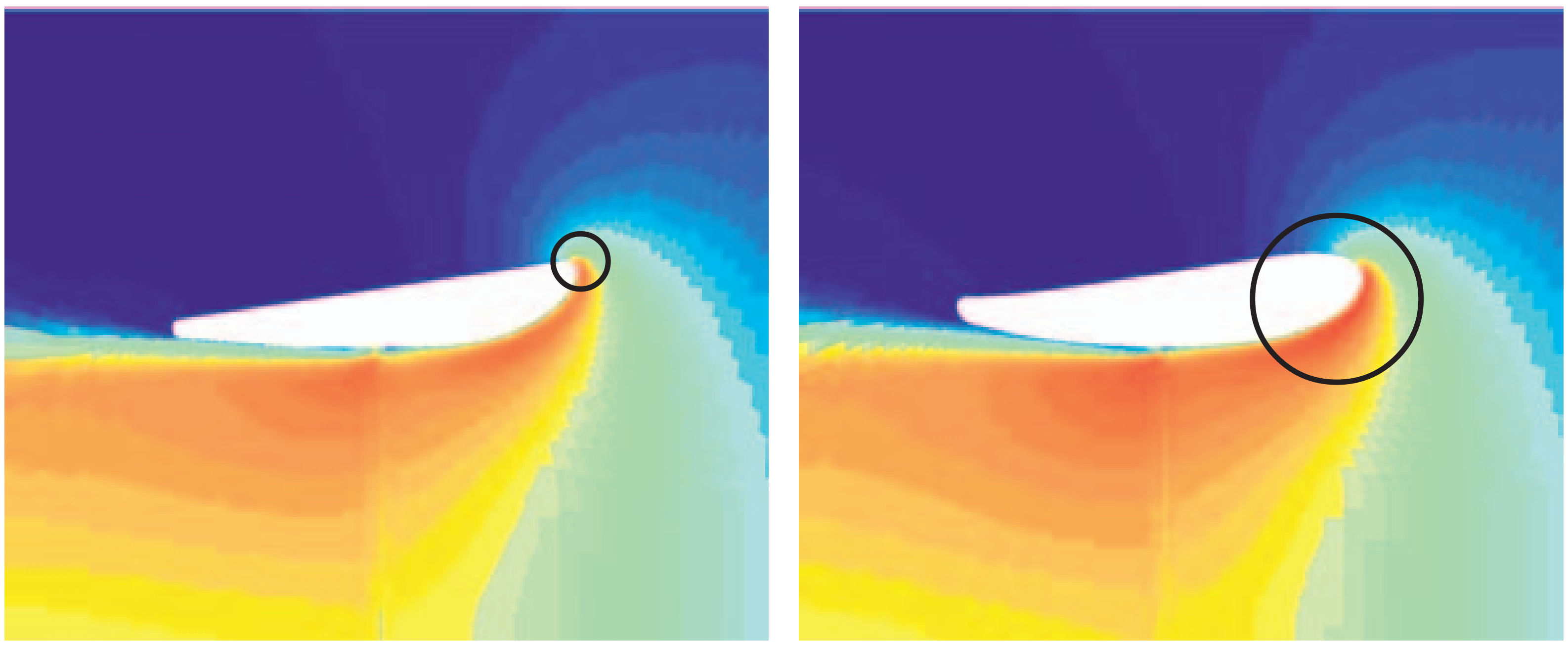


Fig. 3b: Computer models showing the velocity distribution of the 19A (left) and new AHT (right) type nozzles.

The AHT nozzle directly replaces existing nozzles, as seen above.

Fig. 4. The 3D slice-cut model of nozzle, propeller blades and hub for the AHT design. This model clearly shows how smoothly the higher pressure increases across the whole blade width.

Discovering the Royal Yacht Dannebrog

An exclusive tour on board the floating home of the Danish Royal Family

Denmark's most famous ship, the Royal Yacht Dannebrog, is moored for the Summer in the middle of the Copenhagen harbour when Dieselfacts visits the yacht.

Lieutenant-Commander Brian P. M. Enevoldsen, the Chief Engineer (or Technical Officer – which is his official title) gives Dieselfacts a detailed tour of the yacht.

Dannebrog was built in 1932 at the Danish Naval Dockyard, which was situated in Copenhagen. The yacht replaced the previous Royal Yacht, the paddle steamer Dannebrog, which was built at B&W's shipyard in Copenhagen in 1879.

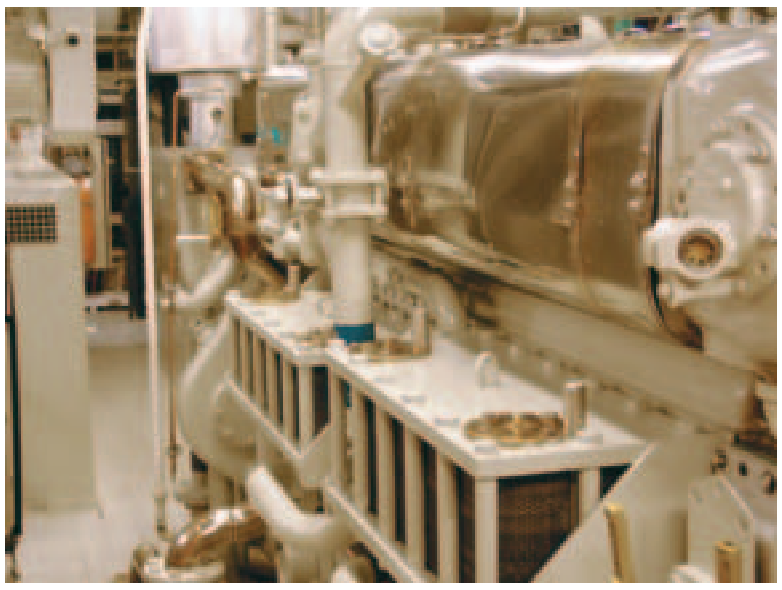
The present Dannebrog was modernised in 1980 by fitting two B&W Alpha Diesel propulsion systems (type 6T23L-KVO) – comprising two 6T23L main engines (flexible mountings were also installed for maximum passenger comfort), 29KVO10 reduction gear, VB560 propellers and the original pneumatic Automalpha remote control system. This has now been replaced by the modern Alphatronic electronic system, specially designed for Dannebrog.

'Dannebrog' is both the name of the Danish royal family's yacht and also the name of the flag of Denmark

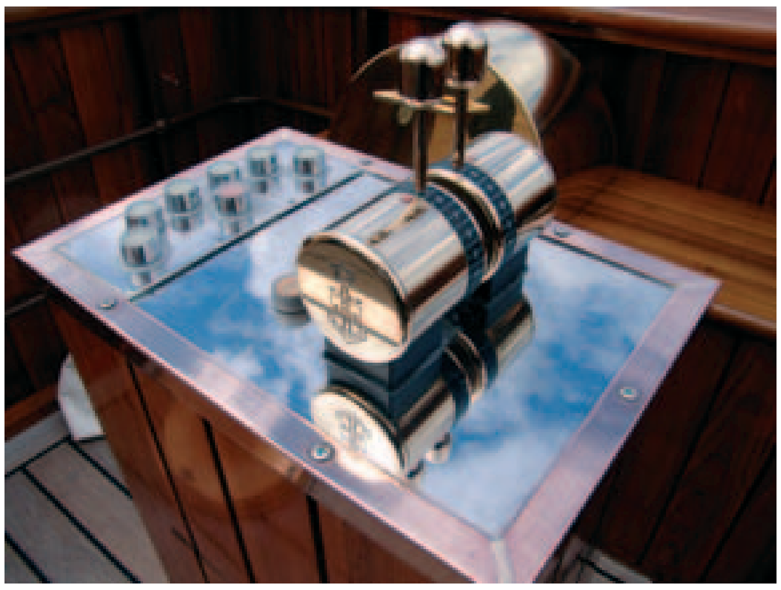
The special sound-proofing of the engine room enables the Royal Family to stay undisturbed in the rooms directly above the engine room.

There are three engineers onboard, including the Chief Engineer. The Yacht's technical division has two chief petty officers, an able seaman and six ordinary seamen.

The engine room is as spotless as the Yacht's staterooms. Every surface is polished and main-

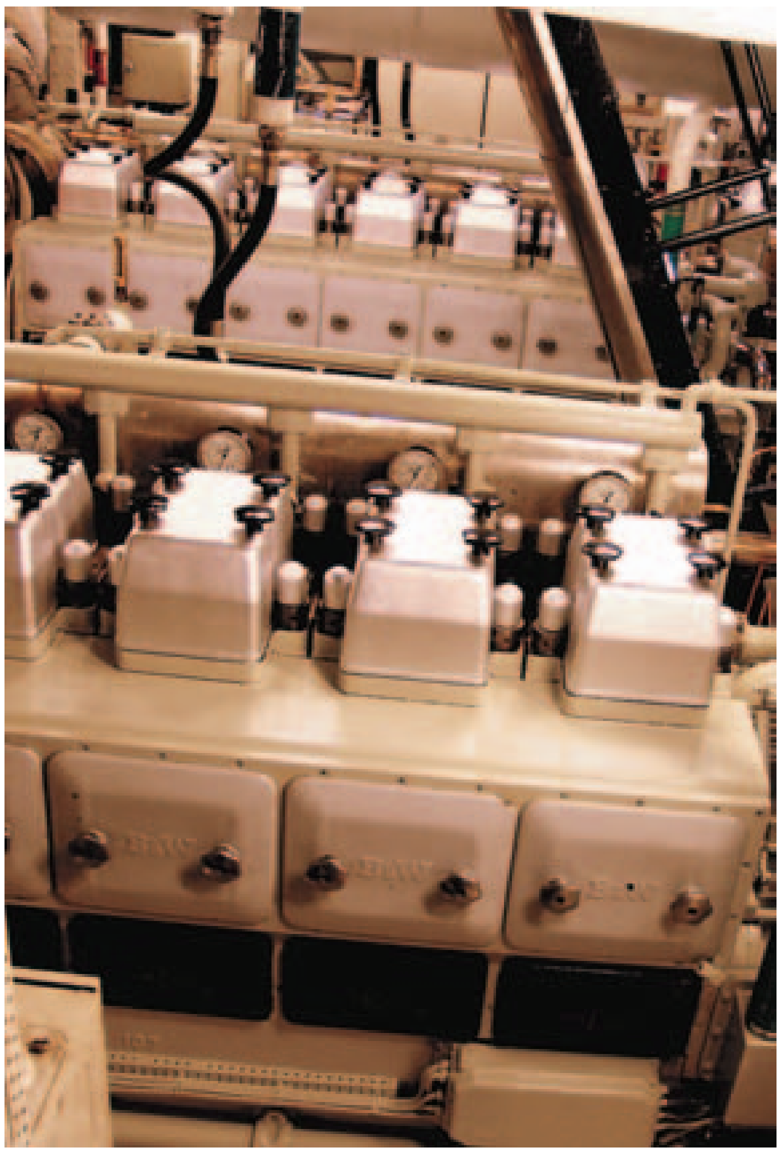


The attention to detail is seen by the polished surfaces of the engine covers



The hand crafted, tailor-made Alphatronic remote control system

The bridge main control panel



A perfect example of well maintained engines

tained in the approved fashion – to a degree which would deeply impress anyone.

Dannebrog is a navy ship which is at the reigning monarch's disposal. The crew of 53 people is made up of: nine officers (including the Captain), seven petty officers, two able seamen and 35 ordinary seamen.

In practice, the Dannebrog 'fleet' consists of 11 vessels; the Royal Yacht travels with two barges, two rubber dinghies and HRH The Prince Consort's speed boat. The other five vessels (two barges, two working stages and a painting stage) are moored in Copenhagen Harbour.

Alphatronic control system

While the Royal Yacht has preserved its original exterior, the inside is installed with modern equipment. A unique detail is seen on MAN B&W Diesel's recently installed Alphatronic system, the 'handlebars' have been specially manufactured in brass with the Dannebrog's coat of arms engraved. They were manufactured from MAN B&W Diesel design's by the Frederikshavn Naval Station.

Every Summer, HM The Queen Margrethe and HRH The Prince Consort Henrik tour around Denmark on the Dannebrog. They also go on many other official tours to promote Denmark. Last year Dannebrog went on a record-long official tour, which took the Yacht 17,876 nautical miles from Denmark to Greenland and on to Athens. The Yacht was also used by HRH The Crown Prince Frederik and HRH The Crown Princess Mary. In an average year, the Yacht covers about 8,500 nautical miles.

There are numerous unique details on board the Dannebrog. HM The Queen Margrethe has taken a personal interest in the interior with, for example, her own paintings in the dining salon.

Dannebrog has its own colour called 'Dannebrog yellow'. A lot of work is put into ensuring that the Yacht is painted the same shade every year.

Dannebrog only sails in the Summer. During the Winter months the Yacht is moored at the Frederikshavn Naval Station, where maintenance is performed in cooperation with specialists from MAN B&W Diesel.

MAN B&W Diesel is called in for modernising and major overhauls of Dannebrog's engines. The forth-coming winter sees a 20,000-hour overhaul lying ahead. However, MAN B&W Diesel's maintenance tasks are very small compared to the other maintenance on the Yacht.

Since the flag was first hoisted in 1932, the Yacht has travelled more than 300,000 nautical miles and visited most of the

Lieutenant-Commander Brian P. M. Enevoldsen

ports in Denmark, Greenland and the Faroe Islands.

The Yacht has also visited many European ports, especially in France and has toured the Mediterranean and the Caribbean Seas. ■

The Royal Yacht Dannebrog

Main engines:	Two B&W Diesel Alpha diesel engines, each with 870 hp
Control system:	Alphatronic
Yard:	Copenhagen Naval Dockyard
Length:	78.43 m
Width:	10.40 m
Draught:	3.62 m
Mast height:	23 m
Weight:	1,236 t
Speed:	13.5 knots

The Royal Yacht Dannebrog – berthed in Copenhagen harbour

Impressive results for first TCA turbocharger

Excellent condition of first TCA after 14,000 hours confirmed by inspection team

Two and a half years after commissioning the very first TCA turbocharger on board the 37,600 dwt chemical tanker M/T Jo Sequoia (Jo Tankers, Norway), the first TCA77 turbocharger has accrued over 14,000 operating hours. At the end of August, an MAN B&W Diesel staff of four, led by Augsburg-based Test Engineer, Dietmar Beer, subjected the TCA77 to a thorough inspection while the vessel was berthed in Singapore.

Dietmar Beer, leader of the inspection team.

Due to the long maintenance intervals for TCA turbochargers, regular intermediate inspections had been agreed upon with the Norwegian ship owners. These checks were enacted in order to obtain intermediate operating results prior to the scheduled maintenance work, which is generally only due after 25,000 operating hours.

Careful assessment

The MAN B&W Diesel team attended the vessel for a period of five days in order to perform extensive thermodynamic measurements. The team compared the newly obtained figures to those measured during the initial Seatrials and turbocharger matching.

When compared to the new condition, the team observed only a very slight efficiency loss. This was partly due to the exemplary maintenance work by the shipboard personnel, which performs dry cleaning of the turbine once per day and wet cleaning with water once per month. The excellent condition of the turbocharger blades can be seen in Fig. 1.

Modifications

The wet cleaning devices that had been supplied were modified during the 6,000-hour maintenance routine, after the pipes were plugged. The modified routine, i.e. blowing air through the ring pipe, which prevents water from remaining in the turbine after washing and, therefore, avoids corrosion, proved to be a great success.

As the resilient support of the lube oil tank, placed on the turbocharger, had shown some weak spots after 2,500 hours, an interim solution had been utilised. This temporary fix was now replaced by a new, more rigid design.

Design confidence

The fitting of the new design was carefully supervised by two people, Superintendent John S. Sibbald and Dietmar Beer. Mr Beer confidently predicted that "this will hold out", when commenting on the new rigid support of the emergency oil tank. Mr Beer was so confident that he now runs the risk of losing three bottles of beer to John S. Sibbald if the new design doesn't hold out!

Superintendent Sibbald was keen to remind the MAN B&W Diesel Service team that speed, along with 'doing it right first time', was an important factor with regard to minimising off-hire costs – each hour that the vessel was out of service costs more than a thousand dollars.

With this in mind, and actively assisted by the helpful crew of the M/T Jo Sequoia, the MAN B&W Diesel service team disassembled the turbocharger down to the bearings within only one day. Figure 2 shows the 'as-new' condition of the tubocharger's journal bearing and trust bearing as seen after 14,000 operational hours.

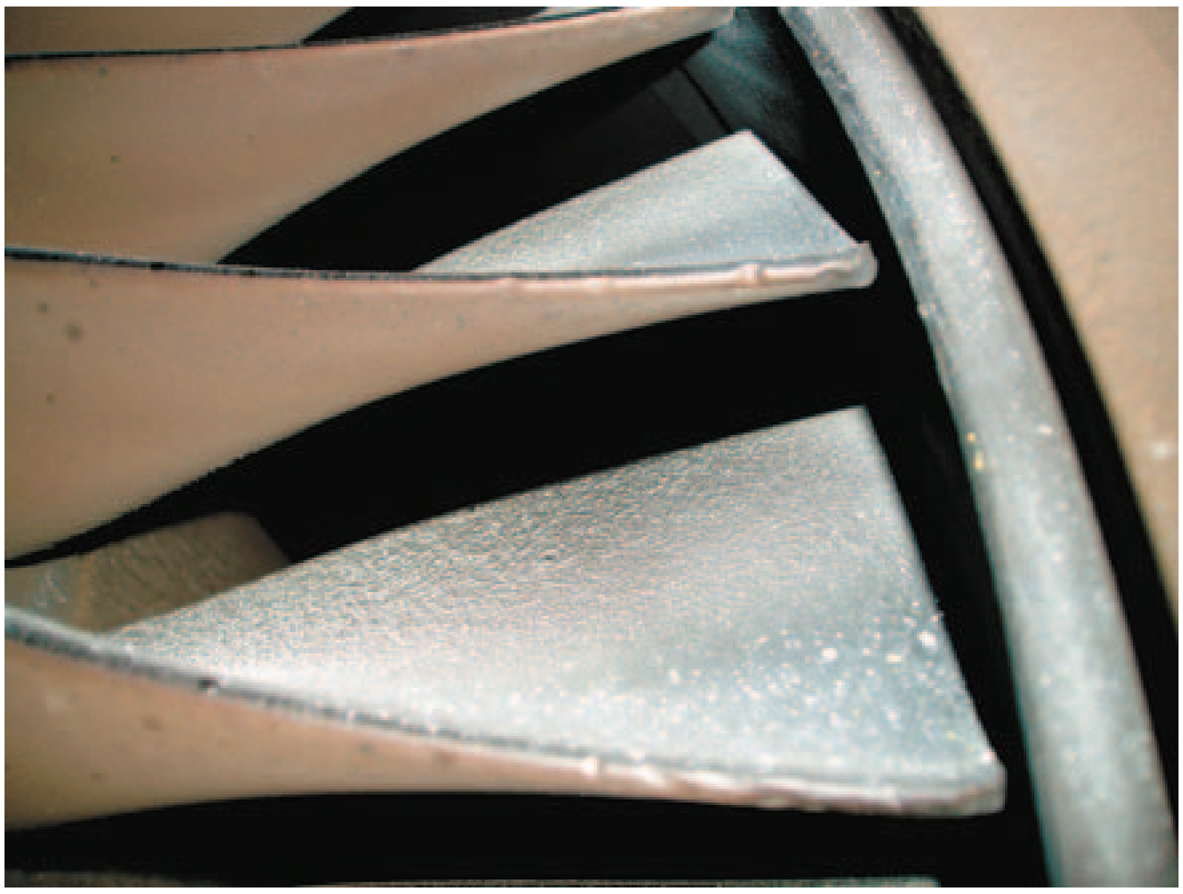


Fig. 1: The excellent condition of the blades is shown this the above, close-up photograph taken during the 14,000-hour overhaul.

Saving precious hours

The compressor wheel attachment, with the novel 'super bolt' system and the spline shaft teeth prove themselves once again – saving precious hours. The critical parts were quickly removed for detailed inspection. Expert examination by the MAN B&W Diesel team found no signs of fretting corrosion on the turbine rotor, in other words, they were in perfect condition.

The thrust ring and labyrinth ring were also faultless. The two radial bearings did not show any wear patterns and the thrust bearing, which was exchanged during the 6,000-hour inspection (due to a design modification), showed an 'as-new' appearance. This shows that the existing operating conditions of high oil pressure and low oil temperature are a perfect environment for the bearings.

A final 'crack test' of the turbine blades on board the M/T Jo Sequoia confirmed that everything continues to be in optimal condition. Encouraged by Superintendent Sibbald, the team quickly re-assembled the TCA77 turbocharger.

The next inspection is scheduled to take place two years hence, and Dietmar Beer is looking forward to receiving his three bottles of beer. ■

Inspection and assessment of the TCA turbocharger's condition.

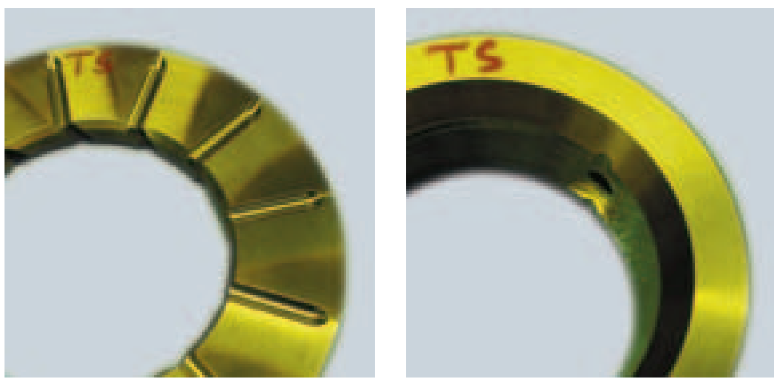


Fig. 2: Perfect condition of the turbocharger thrust bearing disc and journal bearing after 14,000 operational hours.

M/V Jo Sequoia (Jo Tankers, Norway).

Taskforce mission accomplished

Successful solution to variations in class shafting regulations

MAN B&W Diesel takes an active role in promoting cross-industry cooperation with bodies such the International Council on Combustion Engines (CIMAC). As an active member of CIMAC, MAN B&W Diesel is able, like other members of CIMAC, to highlight issues within the CIMAC framework with the aim to find solutions to common problems.

Case history

Until recently, the classification rules for vibration analysis and measurements for shafting varied by some 30% or more – the maximum ultimate tensile strength (UTS_{max}) for either the intermediate and propeller shafts could be 600 or 800, depending on which society was validating.

In early 2001, through the instigation of a research engineer within the Engineering Department of MAN B&W Diesel in Copenhagen, a proposal was made through the Danish CIMAC committee to harmonise these differences.

The proposal called for the Group to define a set of shaft scantling rules, based on the commonly accepted stress evaluation methods that would be used by all parties. This ruleset would then be presented to an International Association of Classification Societies (IACS) working party for adoption within their organisation.

CIMAC drew up a new, temporary and fast working Working Group within CIMAC – Working Group (WG) 14 (Shafting).

As shafting design is a yard responsibility, the original forecast was that the yard representatives and national yard organisations must be the major contributor to the work of the Group. In addition, a number of classification societies were also asked to be present, as were individuals from major diesel engine designers/builders – the engine designers/builders also taking shaft design responsibilities.

The creation of WG14 brought together 12 specialists from nine countries with one aim – to quickly resolve the main differences between the various classification rules for shafting design, in particular, the variation in limits for torsional related shaft stress and the variation in acceptance level for shaft material specification.

During the early stages of the Working Group activities, it was learnt that an ISO committee (ISO/TC 108/SC 2/WG2) was working on a similar project to CIMAC WG14. A formal liaison was set up and discussions between the two organisations lead, it was decided that the issue would be handled by the CIMAC WG14.

As the WG was tasked to reach quick proposals, most routine communication was conducted by e-mail, which was coordinated by the Group's Chairman and Secretary. This meant that a consensus was achieved with only two Working Group 14 meetings.

The first meeting was held at MAN B&W Diesel's Copenhagen site in May 2002. This 'kick off' meeting brought together all the main participants in one room, where each sought to clarify issues and define the scope of the WG. One of the main outcomes of the meeting was the acknowledgement for greater and more detailed information from the classification societies with regard to statistics.

Over the following few months, the requested information was received and distributed to the Group's membership. The second (final) meeting, held in October 2002, was convened for the purpose of finalising the Group's findings and recommendations, which were then forwarded to the IACS meeting in November 2002.

During the following year, WG14 requested a status report from IACS. The appointment by IACS of a liaison representative with WG14 brought positive results and formal IACS approval of the WG14 recommendation was obtained in early 2005, for adoption in 2006.

Result

Although the new set of rules will be formally adopted by 2006, these proposals have already received approval from classification society relating to a shafting design. This design would have been turned down if that society followed its present rules. ■

New laser repair solution for crossheads

MAN B&W Diesel Service Center Werk Hamburg high technology approach

The crossheads, forming part of type MC-engines, are not generally considered as wear parts and usually perform their duty within the individual running gears untiringly throughout their service life. If, however, such a component ever does suffer damage, good technical solutions are at a premium.

Apart from a technically sound repair solution, a short repair time is of special importance. The highly qualified staff at the Service Center Werk Hamburg are ready to face the challenges involved.

Today, the surface of crossheads can be returned to operational condition, even though the admissible thickness of the coating had reached their feasibility limit.

In consultation with specialists from MAN B&W Diesel in Copenhagen, a new repair solution, involving the application of an innovative laser welding method, was initiated.

The advantages inherent in this method are tailor-made deposit welding operations, exceptional adherence of the materials used, the use of high-alloy filling materials, as well as minimal component deformation.

The new method is now being developed at several technical universities, in close cooperation with MAN B&W Diesel R&D staff. The implementation of this special repair method has been proven within the last month. Returning a vessel to service in half the normal time. ■

MAN B&W Diesel Service Center Werk Hamburg is introducing new technologies to reduce off-hire time and improve quality.

Operating on Low Sulphur Fuel

Keeping vessels operating effectively in the light of IMO's MARPOL Annex VI

The IMO Annex VI of MARPOL 73/78, Regulations for the Prevention of Air Pollution from Ships, has been ratified and took effect from May 2005.

Thus, the SO_x limit applies to all vessels in the category of ships with an engine power output of more than 130 kW. The NO_x limit is only for vessels where the keel was laid after 1 January 2000.

In restricted areas like the Baltic Sea, the English Channel and the North Sea, the limit is 1.5% sulphur, which will be enforced as from 19 May 2006.

IMO has indicated that, in future, further limitations will be imposed on SO_x as well as on other components in the exhaust gas.

The EU has introduced separate regulations to cut sulphur dioxide (SO_2) emissions from ships.

In reaching a political agreement on the European Commission's marine fuel sulphur proposal, the Environment Council has agreed to reduce ships' yearly SO_2 emissions in the EU by over 500,000 tonnes from 2007, to the benefit of human health and the environment.

Marine fuel currently has a maximum sulphur content of 5% or 50,000 parts per million (ppm), compared with petrol for cars, which will have 10 ppm from 2007. As part of its 2002 ship emissions strategy, the Commission presented a proposal for a directive to reduce the sulphur content in marine fuels used in the EU. The main provisions were:

- A 1.5% sulphur limit on fuels used by all ships in the Baltic Sea, North Sea & the Channel. Today's political agreement incorporates this provision, and sets implementation dates starting on 19 May 2006
- The same 1.5% sulphur limit on fuels used by passenger vessels on regular services between EU ports from 1 July 2007. EU Ministers have rubber-stamped this and brought the deadline forward to 19 May 2006.

The average sulphur content of fuel oil used for marine diesel engines is 2.7%. This will undoubtedly change with the coming emission legislation, which will lower the emission limits of SO_x, NO_x, particulate, HC and CO.

So far, the authorities have reduced the SO_x content in the exhaust gas by introducing limits on the content of sulphur in the fuel oil used. This is a much more efficient and straightforward solution, obtained from the refining process, than the installation of separate complicated SO_x cleaning facilities on board each vessel.

However, this solution still requires that it is feasible for the refineries to lower the sulphur level at a reasonable cost and effort. So far, the question is whether there will be sufficient low-sulphur fuel oil available in the future, and whether marine diesel and gas oils will be used to any wider extent. This is a somewhat political question, which will not be discussed in this paper.

However, we will highlight the technical areas which MAN B&W Diesel expects will be affected when changing from higher sulphur fuel oils to lower sulphur fuel oils.

The engines

Most MAN B&W Diesel two-stroke engines of today are operating on fuels with sulphur levels higher than 1.5%. This gives us much experience with high-sulphur fuels. However, on the basis of operation on power stations and special marine vessels designated for operation on low-sulphur fuel, we have created the guidelines described in this paper.

It should also be mentioned that on testbed all two-stroke engines are operated on standard environmentally friendly fuel oil, which is typically a land-based diesel oil with a very low sulphur content and viscosity but, also in this condition, the two-stroke engine operates successfully as long as the necessary precautions are being taken.

The work continues to compare fuel samples and service experience and, today, there are definitely more reports of cases where a poor liner and piston ring condition is thought to be due to a low ignition quality.

The investigations indicate that a low-sulphur fuel has often been used when this happens, and the question is whether new oils from the spot market have characteristics which have so far been overlooked and, therefore, ought to be investigated further.

When focus is narrowly on the fuel oils, the drawback can be that some operators, when experiencing unacceptable conditions in the combustion chamber, may be prompted to blame the fuel without taking other possible causes into consideration, such as insufficient cleaning of the fuel oil, type of cylinder lube oil, and feed rate.

The test results, shown in Figs. 1 and 2, of the ignition and combustion properties measured on a FIA-100 Fuel Combustion Analyzer, illustrate the effects of a mixture of fuels. Whether or not this fuel would have a negative effect on the performance of a two-stroke engine is open to doubt, but the test unquestionably illustrates that the fuel consists of a mixture of very different fuels with very different flashpoints, resulting in an irregular heat release in the test set-up.

The high temperature analysis illustrated in Fig. 1. apparently shows the three distinct fractions used in blending the fuel, i.e.:

- heavy naphta (bp H" 190-270°C)
- heavy gasoil (bp H" 350-450°C)
- residue (bp > 580°C)

A series of tests with fuels with expected low ignition qualities have been performed on MAN B&W Diesel two-stroke engines and, so far, we do not have any evidence to show that the ignition quality has any influence on the engine performance.

Dual fuel ships

Lately, however, we have received reports from ships with dual fuel systems, where either the auxiliary engines were difficult to operate, or damage to the combustion chamber was found. In addition to the traditional CCAI or CCI values, which are not considered being reliable, it is being considered to introduce the ignition characteristics in the CIMAC fuel recommendation and the ISO 8217 fuel standard.

It is obvious that the slower the speed and the larger the dimensions of the engine, the less sensitive it will be to ignition delays, but as an increasing number of ships are designed with dual fuel systems, where the same fuel is to be used in the auxiliary and main engines, both engine types should be able to operate on the fuel available on the market.

The industry therefore needs to follow and consider low-sulphur fuel's introduction on the market!

In various chemical combinations, the sulphur in the fuel oil has a lubricating effect.

The use of DO and GO with a sulphur content close to zero and, at the same time, a low viscosity might cause fuel pump and fuel valve wear and, consequently, the risk of sticking. But this situation needs to be considered also from a hydrodynamic point of view, so if the viscosity and, thereby, the oil film is thick enough, also low-sulphur fuels can be used.

This risk limits the viscosity at the engine inlet to minimum of two cSt. In special cases with a very low viscosity gas oil and high ambient temperatures, this might call for cooling of the diesel oil before the proper viscosity can be obtained at the engine inlet.

Our experience with low-sulphur fuel operation and cylinder lubrication with low-BN cylinder lube oil is primarily obtained from stationary engines, operating at 100% load and 100% rpm in high ambient conditions. Whether the same necessity for low-BN cylinder lube oil applies for marine engines as well will, as such, depend on the operational profile, engine size and overall engine condition and, therefore, should be considered on a case-to-case basis.

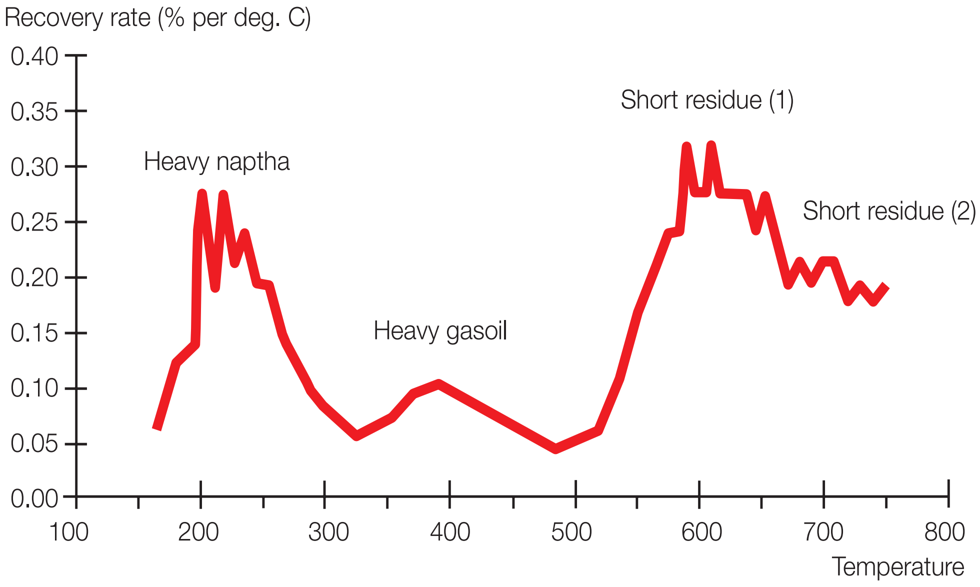


Fig. 1: Simulated distillation (SIMDIST) recovery rate

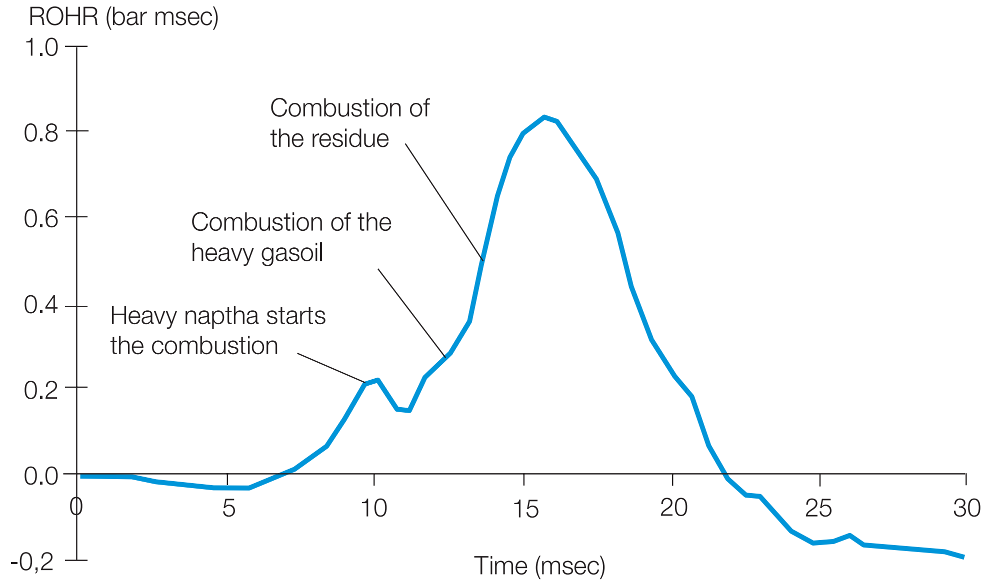


Fig. 2: Rate of heat release (ROHR) curve

Chemical mechanisms
It is therefore important to acknowledge the corrosion mechanisms prevailing on the cylinder liner, and know about the low-BN cylinder oil.

Acid corrosion, which is by far the most influencing cause of wear seen in cylinder liners, is basically the result of a condensation of the HFO sulphur compound. The corrosion is caused by the combination of water being present during the combustion process, and a thermodynamic condition where the temperature and pressure are below the dew point curve of the sulphur trioxide. Even though the water mist catcher of the scavenge air cooler removes water droplets, the scavenge air is saturated with water vapour when entering the cylinder.

It has not been clearly mapped, as such, how much sulphur trioxide is formed, and what is the necessary time frame before the acid corrodes the surface of the liner wall, and when new cylinder oil must be fed to the liner surface in order to neutralise the sulphur. (Fig. 2)

In order to neutralise the acid, the cylinder lube oil contains alkaline components – usually calcium salts. The Base Number (BN or TBN) is a measure of the cylinder lube oil's ability to neutralise acid. The higher the BN, the more acid can be neutralised.

The BN is therefore an important parameter in controlling the corrosion on the cylinder liner surface. Controlled corrosion – not avoiding corrosion – is important to ensure the proper tribology needed for creation of the lubricating oil film. If the neutralisation of the acid is too efficient, the cylinder liner surface has a risk of being polished, i.e. the lube oil film is damaged and the risk of scuffing increases.

In other words, operating the engine with an unmatched BN/fuel sulphur content could increase the risk of either scuffing or excessive corrosive wear. Fig. 4 shows the same cylinder liner using the same low-sulphur fuel; firstly, using BN70 and then BN40.

Based on experience, MAN B&W Diesel finds it essential for a good cylinder condition and overall engine performance that an 'open' graphite structure is kept on the cylinder surface, so that a hydrodynamic oil film is kept between the piston rings and cylinder walls at all times.

Therefore, running on low-sulphur fuel is considered more complex due to the relationship between liner corrosion and scuffing resistance, dry lubrication properties from the sulphur content (or lack of same), the interaction between the BN in the cylinder oil and the detergency level, possible surplus of alkaline additives, the piston ring pack, etc.

The total alkaline content of the cylinder oil has to match the sulphur content in the fuel oil in accordance with the equation: Dosage F x S%, where F = 0.21-0.25 g/bhph, based on a BN70 cylinder oil. The minimum feed rate for proper oil distribution and oil film thickness has so far been set to 0.5 g/bhph, which at the above-mentioned equation will be reached at 2% sulphur. This means that the theoretical limit, using an ordinary BN70 oil, is 2%.

As an example, an engine using 1% sulphur fuel at a dosage of 0.5 g/bhph would be overadditivated.

Therefore, a fuel with a sulphur content as low as 0.5% could call for a combination of a low cylinder oil dosage and a low-BN oil (BN40-50).

When this is said, it is essential that the actual cylinder and piston ring condition is inspected. With its unique distribution of oil film, the Alpha Lubricator, which is used for cylinder lubrication on MAN B&W engines, has shown that a lube oil feed rate down to 0.5 g/bhph can be reached. It has also been shown that thanks to the low cylinder lube oil feed rate, many engines can use low-sulphur fuel and still use BN70 cylinder oil.

It is therefore important to acknowledge that before changing from BN70 to BN40-50, it is important to evaluate the engine's actual condition after the first operating period on low-sulphur fuel. See Fig. 5.

The complexity of designing a low-BN cylinder oil consists in achieving the proper detergency level, which is seldom at the same high level as BN70 oils. Therefore, we recommend that the low-BN cylinder oil type is selected very carefully. All the major oil companies have low-BN cylinder oils available today.

For how long the engine can run on low-sulphur fuel and BN70 cylinder oil is individual, but it is not expected to result in any unsatisfactory conditions in the course of the first weeks, where the engine can be inspected for optimisation of the feed rate and lube oil BN level.

Conclusion
It is inevitable that the exhaust gas emission from marine engines will be further regulated, and we expect that many new engines, and especially existing engines, will eventually have to be operated on low-sulphur fuel. This will be the case even though exhaust gas scrubbers and/or emission trading have become possible by the time new regulations are introduced.

On MAN B&W Diesel two-stroke engines, no difference in the engine performance is considered between DO/GO and HFO operation, where the HFO used today has a sulphur content of 2.7% on average.

However, the operators have to take the necessary precautions, and the marine industry has to consider what general application the new low-sulphur fuels are being designed for, especially with regard to the fuel compatibility between fuels, and ignition qualities.

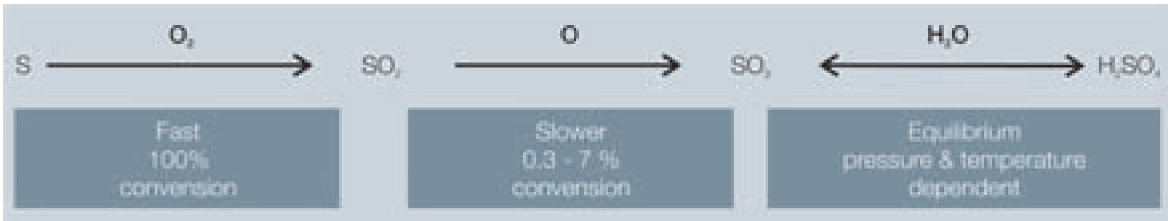


Fig. 3: Chemical conversion of sulphur (S) to sulphuricacid (H_2SO_4)

'Open' graphite structure with good tribological abilities

'Closed' graphite structure with reduced tribological abilities

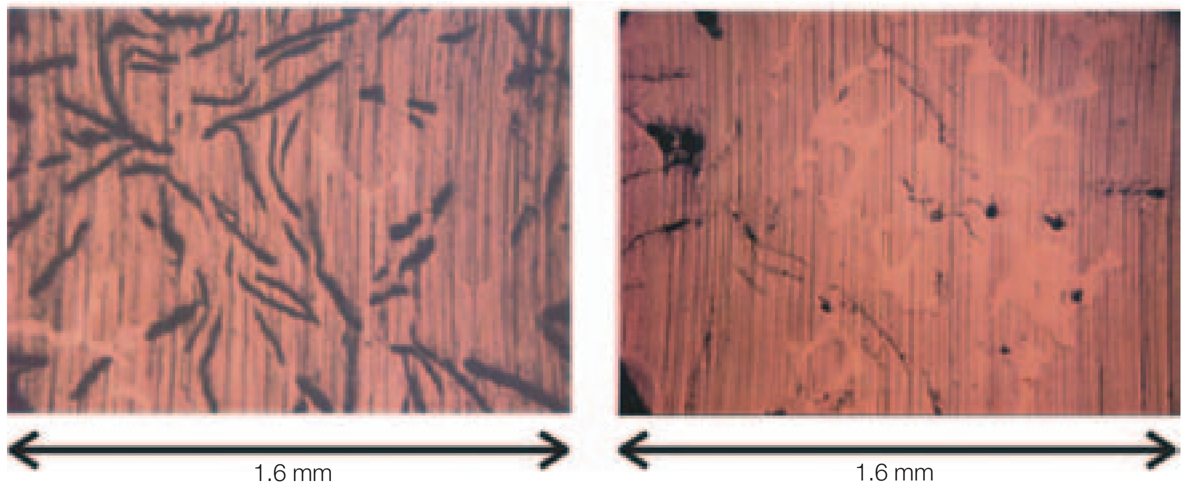


Fig. 4: A microscopic investigation shows the difference between cylinder liner surfaces that are good and bad for cylinder lubrication. The 'open' structure allows a sufficient oil film, which is required to maintain good running conditions. The 'close' structure fails to hold enough lubricating oil and, therefore, lead to early wear conditions.

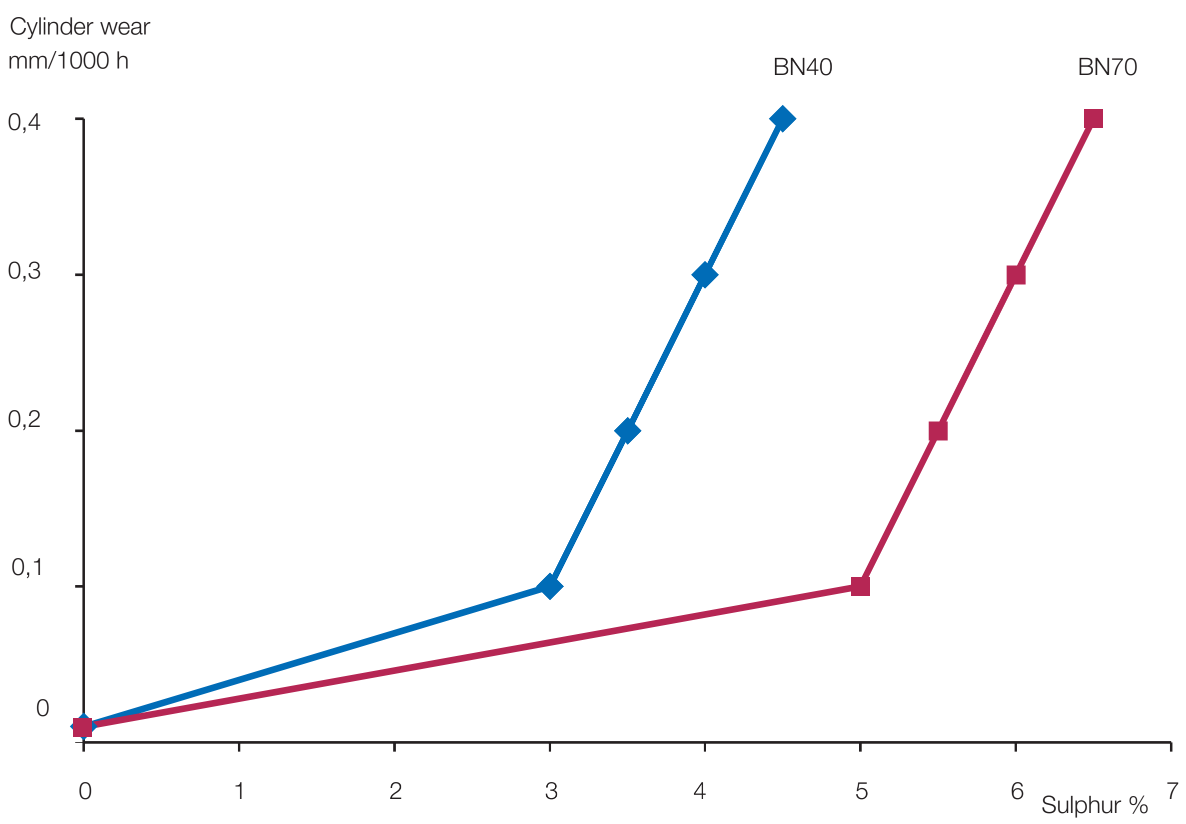


Fig. 5: Comparison of sulphur content and lube oil TBN with respect to cylinder wear (equal cylinder oil feed rates). The above shows that a reduced sulphur content requires a careful choice of lube oil. The BN40 clearly being more suitable than a BN70 lube oil.

Complete Propulsion Solutions for AHTS

Swire Pacific Offshore takes the long-term view

MAN B&W Diesel has been awarded the contract to supply complete twin-screw medium speed propulsion packages for six Anchor Handling Tug Supply Vessels (AHTS).

The newbuildings, which will be built by Labroy Shipyard, Batam, Indonesia (Labroy Shipbuilding and Engineering Pte. Ltd., Singapore) are to be operated by Swire Pacific Offshore Limited, Singapore.

The first newbuilding is expected to be launched in the beginning of 2007, and the following vessels are planned to follow at two month intervals.

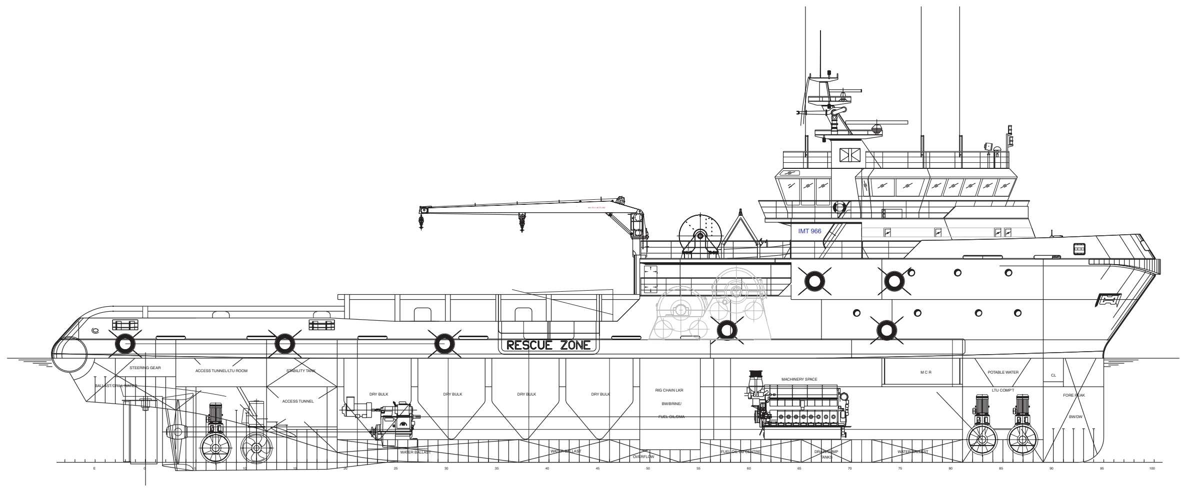
The 120-ton bollard pull AHTS vessels have been designed by the UK-based IMT Marine Consultants Ltd., with specific optimisation for the worldwide operation of Swire Pacific Offshore activities.

Senior Sales Manager of MAN B&W Diesel's International Offshore Group, Mr Steven Birdsall, explains: "Three decisive factors were behind Swire's choice of MAN B&W Diesel:

1) The ability to procure a total propulsion package from the same manufacture, which included the main engines, gearboxes, shafting, propellers, nozzles and the propulsion control and management system.

2) The capability of having the same series engine to cover all of their propulsion power requirements on varying-sized AHTS's (60 to 120 ton bollard pull) and thereby having the possibility of interchangeability of spare parts and trained engineers, whom could be transferred from vessel to vessel.

3) MAN B&W Diesel's willingness to 'tailor make' a perfect matching propulsion package, tuned to meet Swire's specific operational requirements for present and future projects."



The 120-ton bollard pull AHTS vessel

Propulsion Package

A total main engine output of 2 x 3,285 kW will supply the propeller thrust, for a bollard pull of more than 120 metric tons. The ship service speed is optimised for 13.5 knots. The MAN B&W Diesel twin-screw Alpha Propulsion System type 9L27/38-VBS, which has been specified for the newbuildings, include:

Main Engines

Two MAN B&W Diesel 9L27/38 engines, fitted with full engine power PTO and integrated journal bearing at the front-end, driving a fire-fighting pump arrangement.

Reduction Gearboxes

Two MAN B&W Alpha AMG55 gearboxes, type 57VO55EV, with a speed reduction ratio of 800:141. Additionally, each gearbox is equipped with a 1,800 r/min PTO shaft for a 1600 kVA shaft alternator.

Propellers

Two MAN B&W Alpha type VBS980 four-bladed controllable pitch propellers. The 3,800 mm ducted CPP systems are complete with tail, intermediate shafts and bearings, stern tube equipment, and MAN B&W Diesel fixed propeller nozzles type AHT.

Alphatronic Control System

In addition to the engine room control station, the Alphatronic 2000 Monitoring, Control and Safety System includes a main bridge control station and an aft bridge slave control station. The propulsion control is interfaced to a Joystick/Dyn Pos System, which manages the overall ship manoeuvring via gyro compass, rudders and thrusters. ■

Hi-tech Chinese training vessel

Chinese crews to be trained with MAN B&W Diesel's state-of-the-art equipment

MAN B&W Diesel Denmark, has been awarded the contract to supply a complete propulsion package, including computer controlled surveillance, for Dalian Maritime University's new 2250-ton ocean-going training ship.

As the largest maritime university in China, Dalian Maritime University (DMU) enjoys a high reputation internationally as a centre of excellence for maritime education and training. The DMU has approximately 15,000 students. Since 1953, DMU has trained over 40,000 personnel.

Sales Manager, Zhang Lei, from MAN B&W Diesel China explains: "The DMU training ship project was started some years ago, with the aim of training the next generation of seafarers. To integrate theory with practice, students will be trained on the ship for about 2 months after 2 year's theoretical education in the classroom and will be trained on the ship for another 4 months before they graduate."

The solution chosen for the propulsion plant is a package that includes an MAN B&W Diesel 6S35MC engine, controlled by an MAN B&W Diesel Alphatronic 2000 control system. This widely respected main engine design will be the principal source of power for the MAN B&W Diesel controllable pitch (CP) propeller and shaft generator.

Professor Dong from the DMU states, "As a world-renowned maritime university, this is the first time DMU has built a pure training vessel for training crew and scientists. It was important, therefore, that the equipment selected should represent the very latest technology, with a high degree of acceptance in the market."

The 6S35MC main engine in the DMU training vessel will be provided with a PTO power take off (tunnel gear) to drive a shaft generator. To further facilitate the operation of the ship, it will be equipped with a CP propeller that runs at a constant rate of revolutions.

For optimal cylinder lubrication, the engine is equipped with MAN B&W Diesel's electronically controlled Alpha Lubricators. This system supplies the optimal solution in terms of savings in lube oil costs and the environmental impact.

The Alphatronic 2000 control system will allowgives the engineers to learn about the management and control of the vessel's electronic equipment.

DMU has acquired the Computer Controlled Surveillance (CoCoS) Maintenance package.

The total solution package will be delivered in June 2006 from MAN B&W Diesel in Frederikshavn, Denmark.

The packaged solution from MAN B&W Diesel will allow DMU students to become familiar with the most popular equipment in the industry, making them well equipped to deal with scenarios they can expect to be confronted with in future. ■

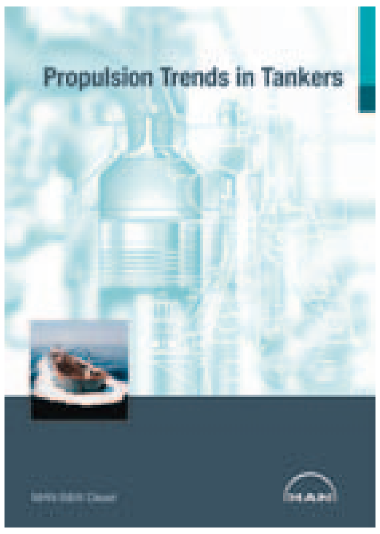
Artist illustration of the training ship

Propulsion package particulars

Main engine:	MAN B&W Diesel 6S35MC
CPP:	VBS 980-ODS
Remote Control:	Alphatronic 2000
PTO:	Tunnel Gearbox model BWIV-S35/GCR650-50
Maintenance system:	CoCoS EDS & CoCoS Maintenance
Loa:	116 m
Lbp:	105 m
Breadth:	18 m
Draught:	5.4 m
Deadweight:	2,250 t
Speed:	17.3 knots
Range:	10,000 miles at 16.7 knots
Crew / students:	32 /204
Class:	The vessel is classed by CCS with unrestricted service area.

Latest technical paper:

Propulsion Trends in Tankers



The updated paper now includes new areas such as the emerging market segment of Ice-classed tankers.

All sizes of tankers, from small 5,000 dwt vessels through to 350,000 dwt ULCC giants, have been evaluated with regard to their present day propulsion needs. Economic and technical conditions are constantly evolving. In recent years, ever-more stricter environmental controls have resulted in increased demands on the power plant to be more and more fuel efficient, yet there has also been a parallel demand from ship operators for higher ship speeds.

These diverse, and often conflicting, issues lead to new solutions and developments in the design of vessels and their power plants.

Due to technical develoments, increasing diameter of propeller blades, for example, determine which main engine solution is best suited for a particular application.

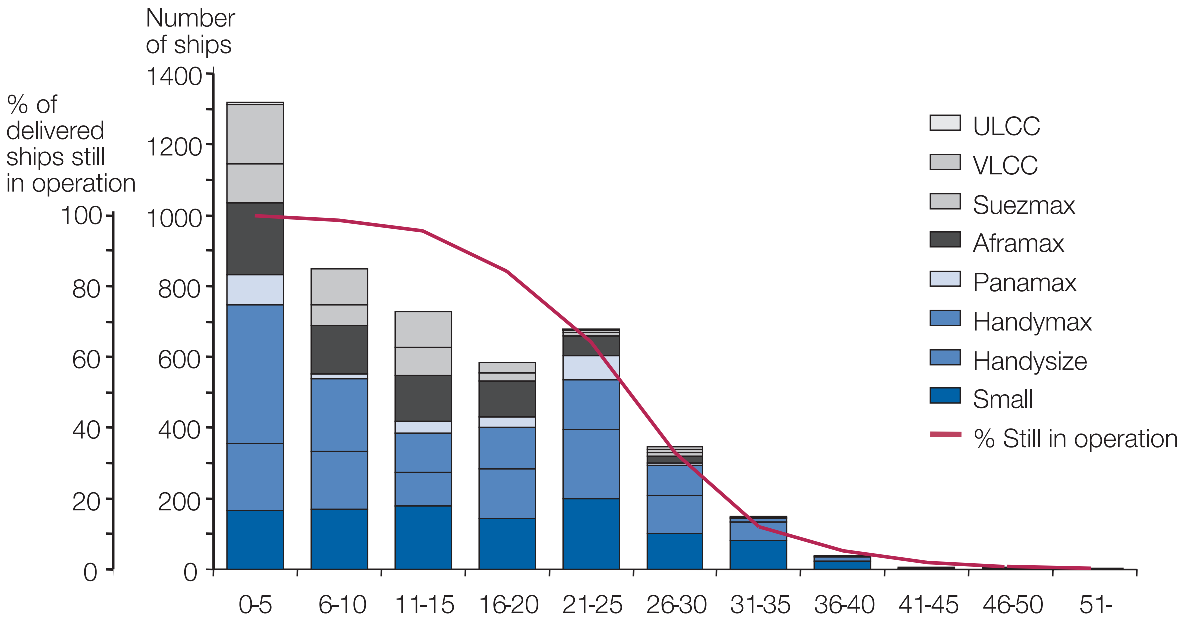
Other, more recent, issues are also addressed. The recent, dramatic rise in the price of oil present operators with challenges such as how to save on running costs and which is the most appropriate vessel for their choosen market segment.

The growing 'globalisation' of world trade, especially with the rise of China as a major importer/exporter of raw and finished goods, has given rise to changing patterns of world trade.

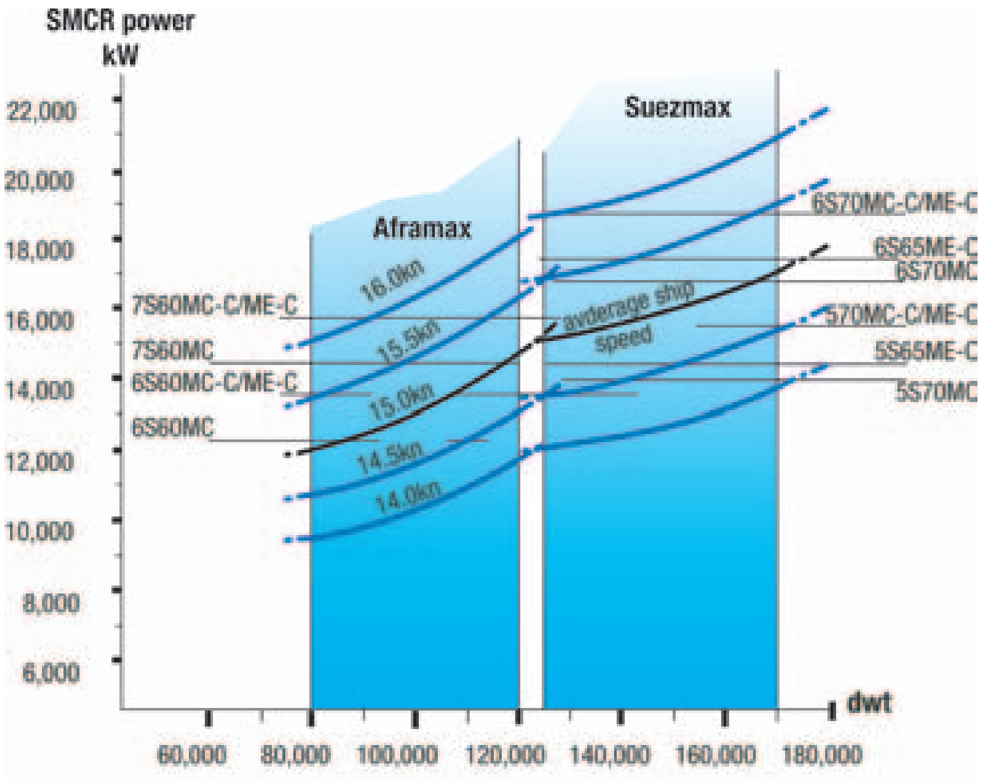
The paper analyses the issues and results produced by IMO's 'Marpol 73/78 Annex I, Regulation 13F' (all tankers above 5,000 dwt, delivered after 6 July, 1996, to have double hulls with a hull spacing greater than 2m) has also given rise to changes in vessel performance and dimensions. In addition, the Joint Tanker Project (JTP) proposals being worked on by the classification societies, result in possible changes to the design of hulls, scantling drafts and service speed.

A new section in the paper looks at ice class notation for all modern sizes of tankers. In addition to hull design, the vessel's minimum power requirements have to be met, according to various requirements as set down by the different classification societies.

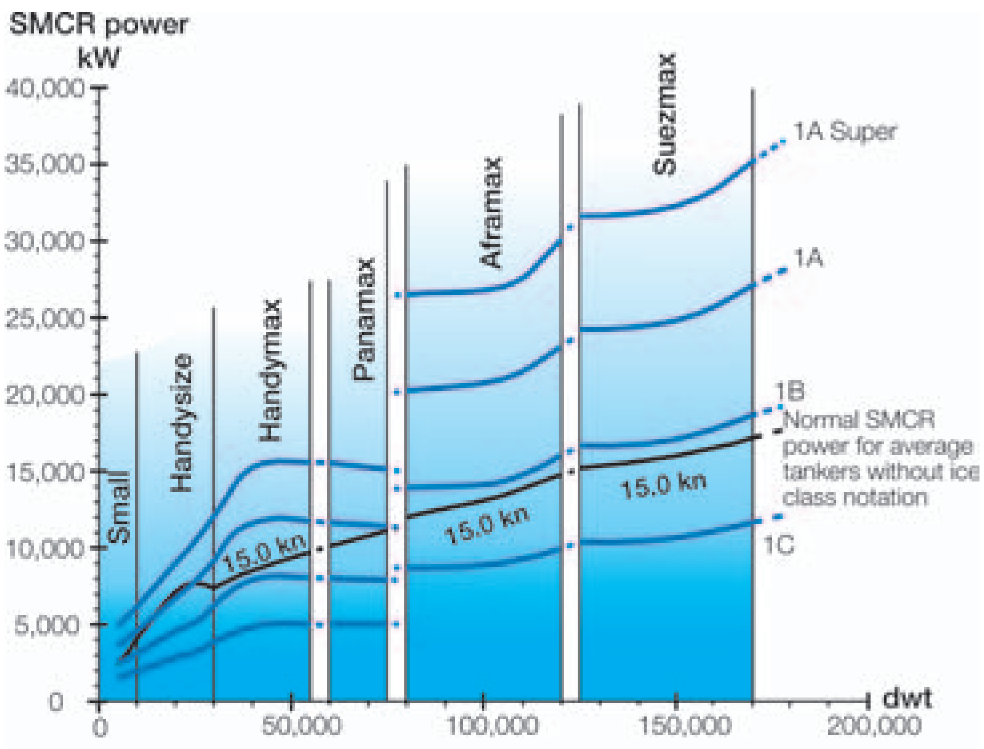
A hard copy of this paper and other in the series can be obtained by contacting:
dieselfacts@dk.manbw.com



Age of tanker fleet (in years) related to the number and type of vessels still in operation (January 2005).



Propulsion SMCR power demand of Aframax and Suezmax tankers.



Minimum required propulsion SMCR power demand (CP propeller) for average-size tankers with Finnish/Swedish notation.

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DIESELFACTS can be contacted at: dieselfacts@dk.manbw.com

ShipRepair & Conversion 2005 DUBAI

See you in Dubai at stand D30

MAN B&W Diesel will be represented at this year's event by senior technical staff drawn from the Service Center Dubai, Hamburg Service Werk, Denmark and UK service departments.

This year's event is the first to be held outside its traditional home of London, and will be held at the Dubai World Trade Centre, November 7-9. The MAN B&W Diesel event staff can be found at stand D30 in the Sheikh Rashid Hall.

Senior service centre staff will be available for consultation on a wide range of issues, including the planned expansion of Service Center Dubai.

As the specialist international event for the ship repair, maintenance, conversion and refit industries, MAN B&W Diesel is ideally placed to offer a broad range of solutions, based on the long-term best interests of the customer.

MAN B&W Diesel has always been at the leading edge of diesel engine technology, constantly developing a range of new technologies and best-practice repair, conversion and refit solutions for all sizes of vessels.

Information on these techniques, products and services will be available to all visitors attending the MAN B&W Diesel stand throughout the duration of the exhibition.

Additional information can be found on the event's web site: **www.shiprepairex.com**

World's largest ME engines in service

The highly efficient and environmentally conscious ME engine range has welcomed into service three of the World's most impressive engines on the ultra modern containerships: Savannah Express, Huston Express and Colombo Express.

The first to enter service, the M/V Savannah Express, has accured over 2,500 operational hours since her seatrial in early April. The engine was built by a long-standing MAN B&W Diesel licensee, Doosan Engine Co. Ltd. (Korea).

In addition to the ME main engine, this vessel has also has four MAN B&W Diesel 32/40 generating sets.

The M/V Colombo Express is the third vessel to operate, so far, with an MAN B&W Diesel 12K98ME-C main engine

All these vessels have performed tirelessly and smokelessly.

Engine Data

Engine:	MAN B&W Diesel 12K98ME-C (Mk7)
Bore:	980 mm
Stroke:	2,660 mm
RPM:	97
MEP:	19.2 bar
Output:	74,760 kW
SFOC:	171 g/kWh
Lube oil:	7.5-11 kg/cyl. 24h
Cyl. oil:	0.7 -1.1 g/kWh

M/V Savannah Express, the first vessel in operational service with an MAN B&W Diesel 12K98ME-C

New focus for Stockport

RK280 success presents new direction for UK production.

The increasing market penetration by the RK280 series, produced at MAN B&W Diesel's UK Stockport engine production facility, has been reinforced by a realignment of other models in this important market segment.

From the Summer of 2005, the Stockport facility will focus all its efforts on supplying market demand for the RK280. This has resulted in the entire production line been optimised for the production of the RK280, including purchasing and logistics.

The production team at Stockport is supported by dedicated Development, Assembly and Testing divisions on site.

The new Head of Development, Dr. Franz Koch, has transferred his base to Stockport, where he will also be able to call upon assistance from MAN B&W Diesel's experienced four-stroke staff based in Augsburg, Germany.

Production and spare part supply of the other engines in the range that were formally under the Stockport umbrella will be undertaken by other MAN B&W Diesel production sites in Germany, Denmark and France. This includes the RK215 and 270, VP185 and the older engine models such as Mirrlees Blackstone, Paxman and Ruston.

The excellent reputation and experience of the Service division will be enhanced through the greater specialisation at the Stockport facility. Wayne Jones recently joined the team in Stockport as head of the Service division. As the Director of Customer Support Services, he brings a wealth of experience to the team.

An expansion of the Service and Spare Parts Business will be aligned with the entire operation, in line with customer needs. ■

www.manbw.com

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