Royal Belgian Institute of Marine Engineers

The big one from

With containerships of over 10,000 TEU under development, the requirement power becomes crucial and one solution could be the K108ME-C from MAN

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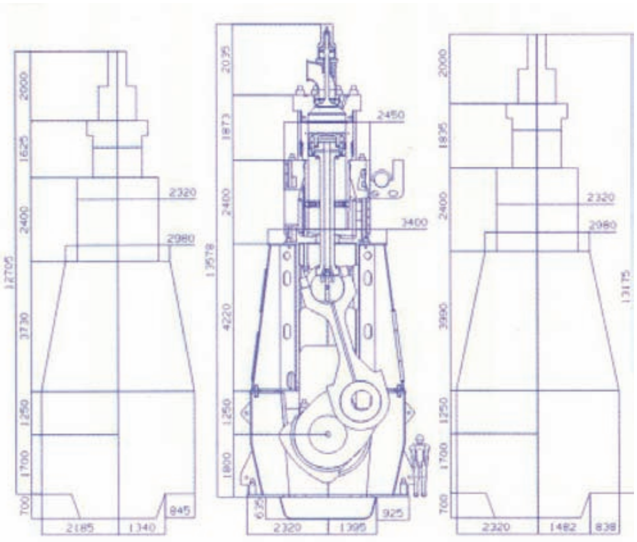
There are only three companies world-wide capable of designing, developing and manufacturing large bore. i.e. over 750mm. two-stroke diesel engines and the arrival of a significant new model is always noteworthy particularly when it is designed to power the next generation of large post-Panamax container ships. Not only is there a growing need to power these larger than 10,OOOTEU ships but there is also a requirement for high service speeds of around 25 knots and maximum reliability. Keeping engines of such gargantuan proportions running without breakdowns poses another problem of a different order and also raises questions concerning minimum safe manning levels until such time as maintenance-free engines become a reality.



The design of K108ME-C (centre) is compared with K98MC (right) and K98MC-C (left). It has been possible to maintain the width of the bedplate. However. the centre height of the crankshaft has been lifted by 100 mm to allow for the increased swing of the crankshaft, and because of the increase in the crankpin diameter.

Optimum boxship solution

MAN B&W believes that a single-screw propulsion system coupled to a slow speed main engine is the best solution for container ships to ensure the lowest possible transportation costs per box. It was against this background that the new engine was developed featuring a 1080mm bore, the largest ever produced to date. and a 2660mm stroke. Each cylinder produces an output of 6.950kW (9,450BHP) at an engine speed of 94 rpm and a MEP (mean effective pressure) of 18.2 bar. Weighing in at 2.670 tonnes for a 12 cylinder version. this gives a weight to power ratio of 23.6 kg/BHPh.
The K108 is being introduced with a modest rating and, in a 14-cylinder version, can deliver as much as 97,300 kW. Although the engine is offered as an electronically controlled engine as standard, the design also facilitates the use of a traditional camshaft should this be desired, Design-wise, the K108ME-C is basically a scaling up of the K98MC-C engine requiring only minor changes. The stroke of the 108 is therefore the same as that for the 98 as is also the 94rpm and the piston speed.

With the introduction of this engine, the shipping industry now has the means to power a 12,000TEU boxship (or 10,OOOTEU fully loaded), using a single 9.8 metre diameter 6-bladed propeller to achieve a 26 knot service speed.

Based on a fully developed Samsung design, this vessel will have an estimated length between perpendiculars of 380 metres, a breadth of 51.2 metres and a design draught of 14.6 metres.

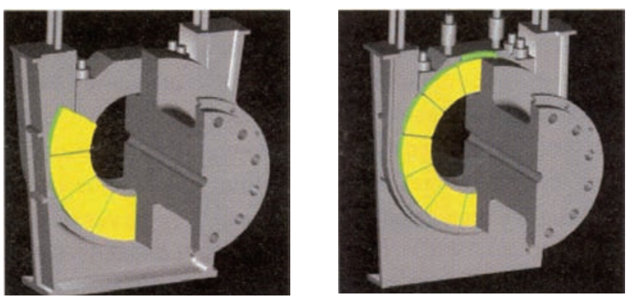
The power required for this size vessel operating at a sea margin of 15%, an engine margin of 10% and a propeller light running of 5% is estimated to be 79.915 kW at 94 rpm. Based on these assumptions, either a 14K98ME or a 12K108ME-C main engine will meet the requirements of achieving the suggested power and engine speed.

As the power prediction indicates, a relatively low rpm results from the choice of the large propeller, and this will be a natural consequence of its ability to absorb 80 MW and above. The K108 has therefore been given the same stroke length and mean effective pressure as the K98 and, by using the K108, two cylinders can normally be saved on such large engines. The final choice lies with the buyer.

Thrust bearing

One of the main design changes that had to be made was the thrust bearing. The Ki08 needs to accommodate a very high thrust force through the integrated thrust bearing and an interesting development, the so-called flex-cam, has been made to improve the load carrying capacity of the thrust bearing. The normal solution is a relatively stiff thrust cam on the crankshaft acting through tilting pads (segments) on the relatively flexible thrust block. The effect is an

A comparison between the traditional horseshoe design (left) and the so-called flex cam thrust bearing as used in the K108



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for more propulsion
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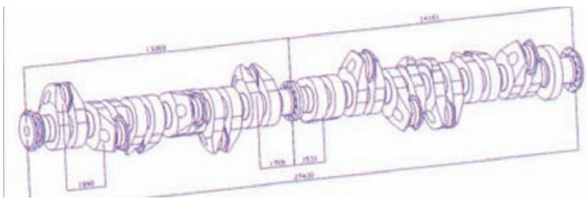
uneven loading of the tilting pads. The idea is to adjust the flexibility of the thrust cam to match the flexibility of the thrust block. Furthermore, the thrust bearing is a whole circle instead of the normal horse-shoe shape and this is achieved by integrating the main bearing cap with the thrust bearing which gives several benefits. One is the lower loading of the tilting pads which is reduced by 20%. while the oil film thick-ness is increased by five times. Furthermore, due to the fact that the aft section becomes more rigid. Deformation of the last main bearing is reduced by 30%.

How big can they get?

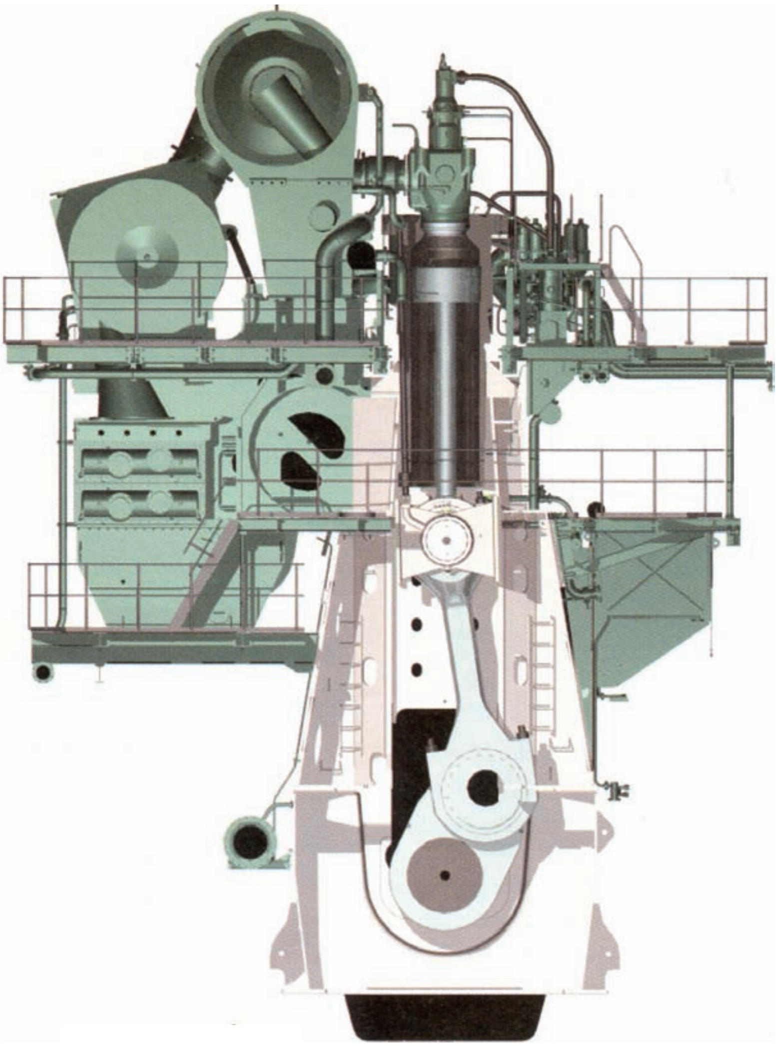
With the expected demand for increasing the power of the single installed engine, it is only natural to ask "what is the maximum power of an engine?" MAN B&W has carried out detailed studies of engines up to 18 cylinders, and there is no doubt that such engines can be produced and will be reliable. However, they will be physically very long and, from a maintenance point of view, not optimal due to the number of cylinders. Another possibility is to increase the bore size to 1200mm. From a theoretical point of view, it is possible to design much larger engines but. now and in the foreseeable future, the limit in the size of engines is dictated by practical considerations.

There is no problem with strength of the components and, thanks to the effective bore cooling principle, it is possible to cool the OROS combustion chamber which has ample margins. MAN B&W's evaluation is that, even for much larger engines than today's, pistons can be adequately cooled by the simple oil shaking and the cylinder liner can be made from the same material as for the existing engines, thus ensuring a good cylinder con-dition. Machining of the crankshaft is currently the limi-ting factor and only a handful of foun-dries world-wide(HSD and HHI in Korea, Sidenor in Spain and Kobe Steel in Japan) are capable of handling castings of this size. Other items like bed plate, frame box and cylinder frame can be more easily produced in large enough sizes as the engines for large container ships have a relatively short stroke.

At present however, MAN B&W believes the K108 engine is the largest that can be produced based on a minimum requirement of two factories able to manufacture the crankshafts. However, there are plans to extend the production capabilities at other locations. The limiting factors for the production of large crankshafts are weight and dimensions. The weight problem can be overcome by manufacturing the crankshaft in two or more sections which is the normal procedure today. Regarding dimensions, the critical aspects are the diameters of the main bearing and crankpin journals. These are made using a ring turning device, the steady rest for the main journals during machining, and the design of the tool holder.



The crankshaft design is shown above. It utilises the stepped shrink fit that is standard for all K9BMC·C engines. The crankshaft for a 12K10BME-C can be made in two sections, whereas. for a 14K10BME-C, it needs to be made in three sections.



Cross-section drawing of the K108ME-C

Conclusion

There is no doubt that the Kl08 will be a very reliable engine, as it exploits the well-proven technology of the K98 engines. Speaking to The Motor Ship, Thomas Knudsen, VP Research & Development at MAN B&W, is confident that the Kl08 is the ideal solution to power the next generation of even larger container ships such as the 14,OOOTEU design currently under development by Samsung which would require 97,OOOkW, the output from the 14 cylinder version Looking further ahead, the Malacca·max up to 20,OOOTEU would require a main engine with an output of 130,OOOkW. This would mean an 18 or 19 cylinder version of the K108 leading to speculation that a 1200mm bore might be called for.

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