HPT: High Pressure Tuning for MAN Diesel & Turbo two-stroke engines

In 2011, ABB Turbocharging introduced a new way of reducing fuel consumption on low-speed diesels. Fast forward 18 months and High Pressure Tuning is indispensable for getting the best out of MAN two-strokes.

Text:Klaus Fußstetter, Photography: ABB Turbo Systems Ltd, Michael Reinhard
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Owners and operators in a global merchant fleet comprising more than 50,000 ships are constantly looking for ways to improve the profitability of global transportation.

Among their wide range of focuses, reducing fuel costs is an evergreen. It provides a major incentive for improving their economic situation, since a vast majority of total operating costs are attributable to their fuel bills when their ships are at sea. The continuous rise in bunker prices, coupled with the implementation of new emissions control regulations has turned industry attention to fuel efficiency and slow steaming – i.e. operating vessels at reduced speed.

In 2009, ABB Turbocharging launched a new highly efficient high pressure turbocharger generation – the A100-L. It opened up operating modes that were not hitherto fully utilized by engine designers. As the next step, and with the new market requirements of the current market in mind, ABB Turbocharging turned its attention to innovations which support the marine industry's efforts by employing the latest turbocharger technologies.

Late in 2011, the innovative concept of High Pressure Tuning – or HPT – was presented to leading engine designer and licensor MAN Diesel & Turbo for the first time.

Enhancing efficiency

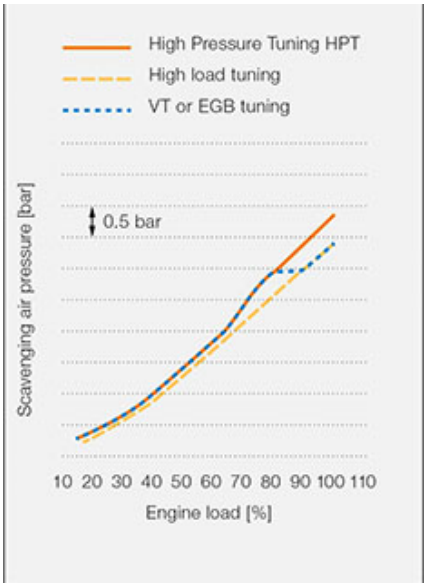

Fig. 1: Scavenging air pressure tuning curve

HPT is a way of improving the fuel consumption of modern electronically controlled two-stroke engines at low and part load. By increasing scavenging air pressure (Fig. 1) it results in higher peak firing pressures in the engine's cylinders. The laws of physics say that the efficiency of a diesel engine cycle can be enhanced with higher cylinder peak pressures.

A variable exhaust valve controls the engine's compression ratio at high engine loads in order to avoid excessive firing pressures in the cylinder. To achieve this, under hydraulic control the exhaust gas valve is closed later compared to standard operation (Fig. 2). The engine control system ensures that all engine parameters are well adjusted, according to design requirements. The start of injection remains unchanged in order to achieve the most efficient combustion process for the fuel injected.

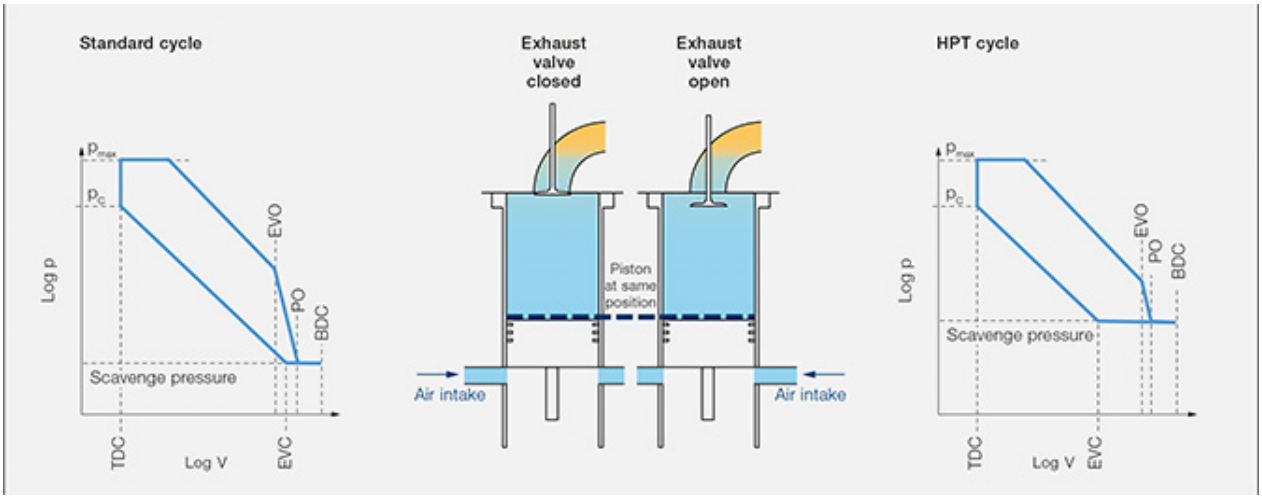

Fig. 2: Standard versus HPT cycle

By this so called "two-stroke Miller effect", emissions of oxides of nitrogen (NOx) are reduced at higher engine loads, which makes a further reduction in fuel oil consumption possible at part loads, while keeping the NOx emissions within the limits of the IMO E3 cycle. Lowering the fuel consumption of an engine means, at the same time, a reduction in emissions of the greenhouse gas carbon dioxide (CO2).

HPT tuned engines can be turbo-charged without any additional devices, such as exhaust gas bypass valves (wastegates) or turbochargers with other variable devices (Fig. 3).

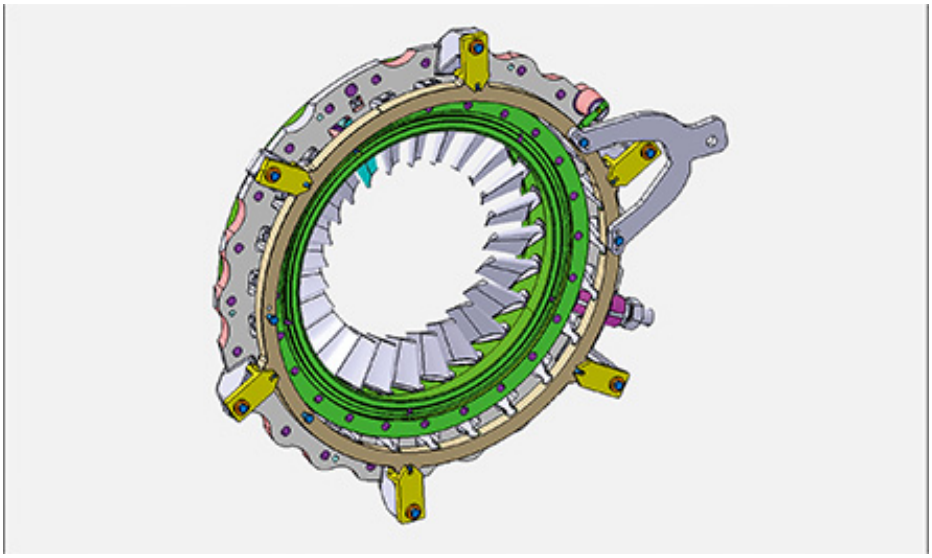

Fig. 3: Moving parts – VTG

HPT for MAN

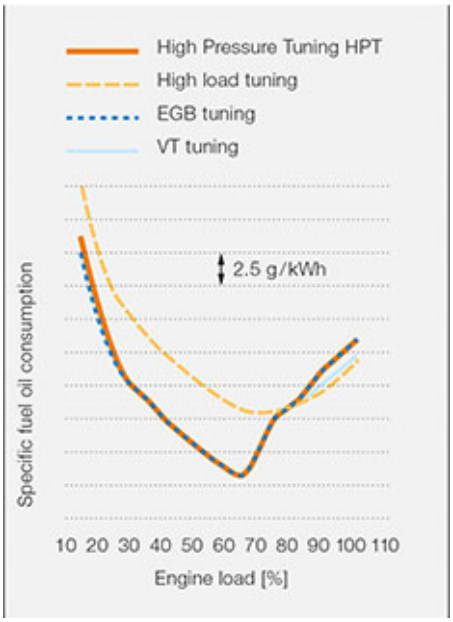

Fig. 4: Specific fuel oil consumption tuning curve

HPT offers engine builders, ship owners and operators financial benefits, thanks to the reduction of extra hardware and installation costs, and hence lower initial investment and first costs. The elimination of moving parts and additional components also removes their related service costs. Engines tuned with HPT are fuel efficient, from the lowest loads right up to higher part load operation, with a fuel saving of 5 g per kWh (Fig. 4), compared to an engine with standard tuning. The potential fuel saving on a large container vessel tuned with HPT could amount to several hundred thousand dollars in just one year.

Based on successful engine testing, MAN Diesel & Turbo and ABB decided to make High Pressure Tuning (HPT) available to their customers. Consequently, HPT is now offered on ME and ME-C engines from the current MAN engine portfolio with bore sizes from 50 cm right up to the largest 98 cm models.

Late in 2012, ABB Turbocharging introduced the new A200-L generation, which in combination with HPT enables the marine business to further increase the profitability of global seaborne transport. The number of project inquiries for HPT engines with A100-L and A200-L turbochargers proves that ABB has precisely fulfilled the market's requirements.

About the author

Klaus Fußstetter graduated as a mechanical engineer from the Technical University Munich (TUM) and joined ABB Switzerland in 1993 as a simulation specialist for turbocharging systems. As senior manager for project and application engineering, he is responsible for ABB's important customer, MAN Diesel & Turbo.

Source: ABB charge!
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