

TCS-PTG

Savings with extra power

Engineering the Future – since 1758.

MAN Diesel & Turbo





TES Thermal Efficiency Systems

A proven method of increasing efficiency
in 2-stroke diesel power systems

The Turbocharger business unit of MAN Diesel & Turbo has launched an updated product in its TES range of proven efficiency-enhancing solutions for 2-stroke engines in marine and stationary applications.

With the TCS-PTG (Turbo Compound System with Power Turbine and Generator) up to 5% of additional power can be extracted from the main engine exhaust gases. Depending on the size of the MAN Diesel & Turbo engine involved, a maximum of 4,700 kW can be produced.

The additional power output from the TCS-PTG system is in the form of 50 or 60 Hz electrical energy for the onboard power grid. The power turbine is inserted into the exhaust gas system parallel to the turbochargers. It drives an electrical generator via a reduction gearbox and receives up to 13% of the exhaust gas flow, diverted from the main engine exhaust gas receiver.

With this TCS-PTG “stand alone” solution in operation, auxiliary engine fuel, emissions and maintenance costs can be saved and generator set maintenance more flexibly planned – and carried out with the ship underway!

Used in combination with MAN Diesel & Turbo high efficiency turbochargers on the main engine, and depending on fuel oil prices, payback periods as short as 2 to 3 years can be achieved.

Enjoy the Benefits



Technical data

TCS-PTG based on TCR

	Max. output Pel*
TCS-PTG18	850 kW
TCS-PTG20	1,250 kW
TCS-PTG22	2,200 kW

TCS-PTG based on TCA

	Max. output Pel*
TCS-PTG55	3,300 kW
TCS-PTG66	4,700 kW

*The performance data vary to individual layout parameters. Available power based on typical 2-stroke-conditions with MAN Diesel & Turbo high efficiency TCA turbochargers on the main engine (ITurbine = 3.3; TEG = 450 °C).

Components

Exhaust gas turbine

- Newly developed high efficiency turbine
- New turbine nozzle ring with extended life time
- Bearing arrangement with long life time
- Axial: based on most modern TCA series
- Radial: based on most modern TCR series

Gearbox

- High efficiency high speed gearbox reducing turbine speed to generator speed

Couplings

- Gearbox to generator: high flexible coupling

Generator

- Synchronous generator suited to marine applications
- Asynchronous generator suited to stationary applications

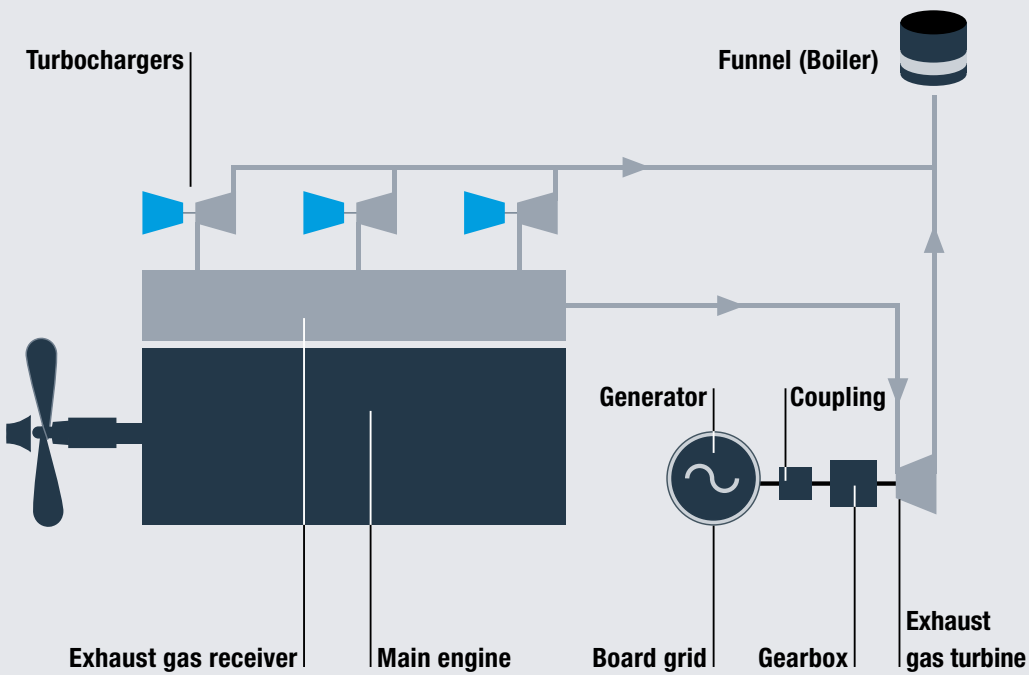
Exhaust gas system

- Control valves for power turbine operating range
- Fast acting emergency valves for emergency shutdown
- Control and safety equipment

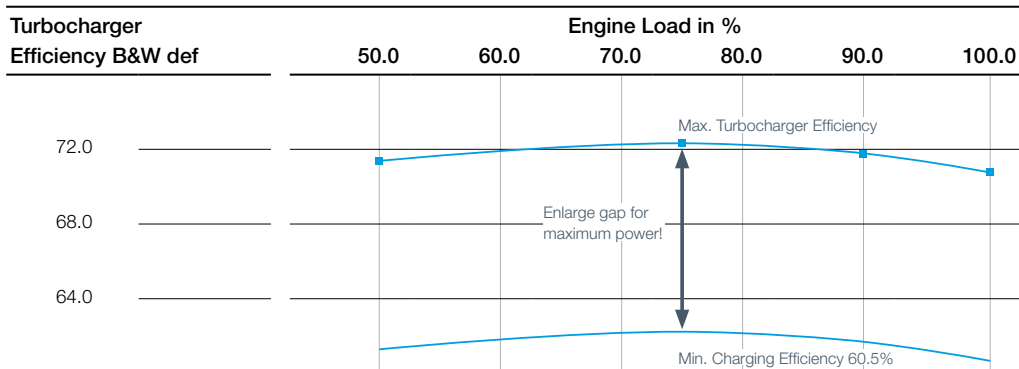
Optional: Variable Turbine Area (VTA) for exhaust gas turbine

- Increasing efficiency and flexibility of operation

Extraction of exhaust gas to power turbine before turbochargers.



Maximum power output with MAN Diesel & Turbo TCA high efficient turbochargers on the main engine and TCA/TCR based power turbine



Estimation of Fuel Oil Saving Potential of TCS-PTG Units

TCS-PTG-systems offer enormous saving potentials in 2-stroke engine applications. By generating additional power output, both fuel oil costs and CO₂ emissions can be reduced at the auxiliary engines. For stationary applications additional power can be generated which can be supplied directly to the grid. For estimating the saving potential of these systems, diagrams 1 to 3 based on ISO ambient reference conditions) help to quantify the advantages for an individual application case.

Diagrams and estimates are based on the use of high efficiency TCA turbochargers on the main engine. The layout of such a turbo compound system must be custom designed to take account of variables like exhaust gas pressure, temperature and mass flow. In this way each individual system may vary in terms of performance.

Example – 12K98ME7 with 3x TCA88 turbochargers on a container vessel

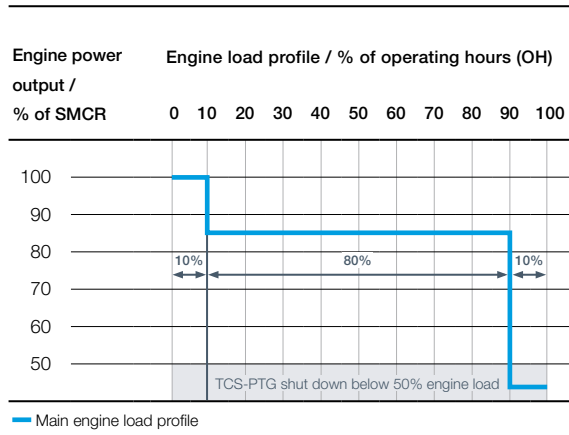
1 With main engine output at SMCR, exhaust gas pressure ratio and temperature known, the potential of an applicable TCS-PTG system can be estimated. For this example a 12K98ME7 with 74,760 kW at 97 rpm at SMCR is chosen. Best application for this engine is a TCS-PTG55 with a power output of 3,150 kW electrical.

2 Estimation of an appropriate load profile is done with help of diagrams 1 & 2.

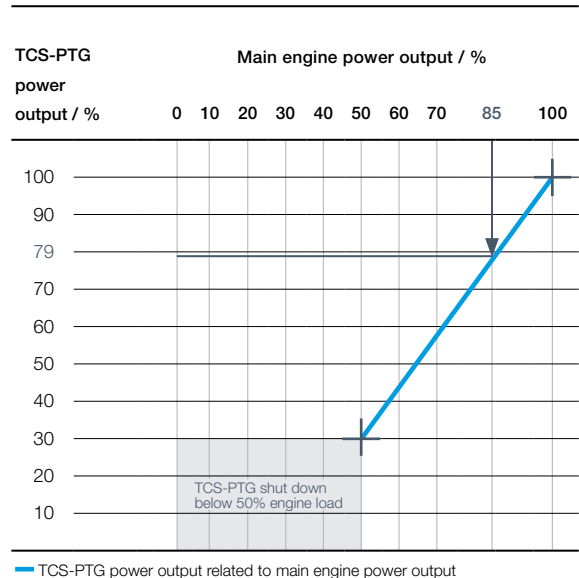
3 Calculation of average TCS-PTG power output:

a TCS-PTG load is dependent on main engine load (diagram 1). By combining the TCS-PTG load points from diagram 2 with main engine load profile from diagram 1 the average TCS-PTG load is obtained as a percentage value:

1 Load profile example



2 TCS-PTG load in relation to main engine load



Readings out of Diagram 1 & 2

10% of OH at 100% load	100% TCS-PTG power output
80% of OH at 85% load	79% TCS-PTG power output
10% of OH < 50% load	0% TCS-PTG power output

b Average TCS-PTG output is calculated as the following:

$$\frac{10\% \times 100\% + 80\% \times 79\% + 10\% \times 0\%}{100\%} = 73.2\%$$

Average TCS-PTG load is 73.2%

Average TCS-PTG power output is 2.3 MW

4 Assuming 6,000 OH and above TCS-PTG average power output, approximately 2,800 tons of fuel oil can be saved per year at the auxiliary engines (diagram 3).

5 Taking the current fuel prices in to account, annual cost savings can be estimated.

Conclusions

In stationary applications additional power output can be gained equivalent to nearly 100% of TCS-PTG related load.

For marine applications a TCS-PTG offers following advantages:

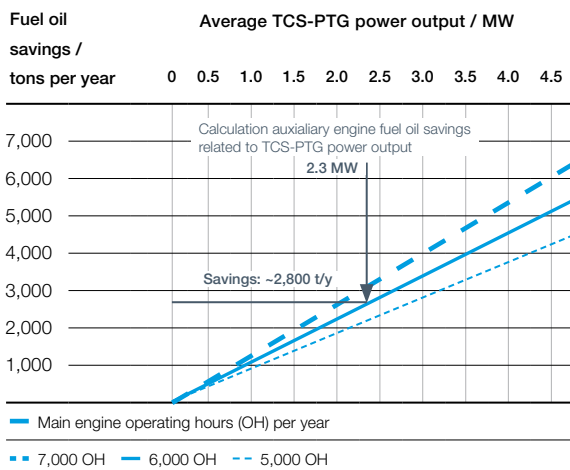
- High fuel oil saving potential on auxiliary engines
- Reducing running hours and thus maintenance of auxiliary engines
- Reduction of emissions

Save your money and save your environment with MAN Diesel & Turbo TCS-PTG systems. Economically and ecologically optimized vessels.

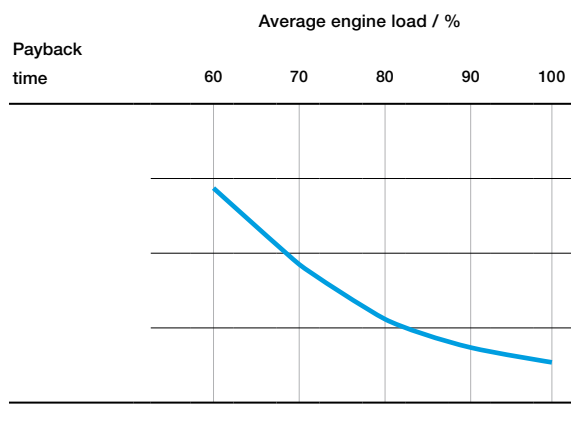
Make your vessel an "ECO-Vessel".

Please note: Main engines fuel consumption might increase between 0.0-1.8%, depending on the application and turbocharger efficiency. Also exhaust gas temperature will rise.

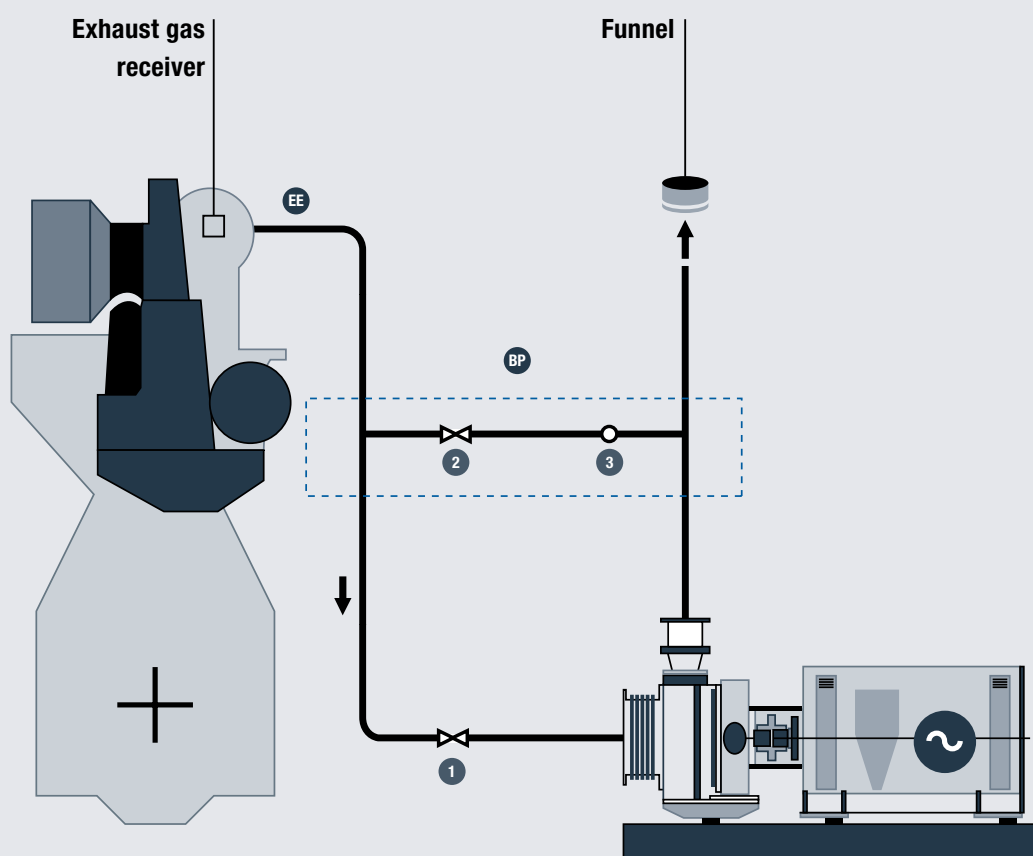
3 Fuel oil savings in relation to operating hours



Payback time vs. average engine load



Schematic of the Valve System



EE	Exhaust gas extraction	Exhaust gas diverted before turbochargers
1	Valves	Control and emergency valve power turbine
BP	Bypass	Bypass dispensable exhaust gas
2	Valves	Control and emergency valve bypass
3	Orifice	Orifice simulates Δp of power turbine in shut down cases above 50% engine load

Scope of Supply

One complete TCS-PTG unit includes following items:

- 1 Exhaust gas driven power turbine including:**
 - Speed pick-up
 - Speed indicating instrument
 - Turbine cleaning device
 - Operating manuals
 - Set of tools

- 2 Gearbox**

- 3 Coupling PTG-generator**

- 4 Synchronous or asynchronous generator**

- 5 Mounting of turbine, gearbox and generator on base frame**

- 6 Control and safety equipment consisting of:**
 - Control valves
 - Emergency valves
 - TCS-PTG-control cabinet incl. TCS-PTG-software

- 7 Thermodynamic layout**



World Class Service

Around the clock



PrimeServ – Peace of mind for life

Customer support for turbochargers is vital – MAN Diesel & Turbo provides a worldwide service network for repairs and maintenance.

A fast delivery of spare parts is of utmost importance to avoid down times. MAN Diesel & Turbo has an efficient processing and stock despatch system allowing parts to be delivered within 24 hours.

Continuous training of engineers, combined with regular service bulletins and video clips ensures the worldwide service network is always up to date.

A customer feedback programme also contributes to maintaining a high standard of service.

Close co-ordination with all licensees ensures that 'products built under licence' are fully covered by our global network.

Enjoy the benefits

- Knowledgeable partners in more than 150 service stations worldwide
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- Attractive price/performance ratio



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