TCS-PTG

Savings with Extra Power

MAN Diesel

Applications TCS-PTG

TES Thermal Efficiency Systems

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

MAN B&W 2-stroke marine diesels are well known for their low specific fuel consumption, overall efficiency, and long-term reliability.

The recent dramatic increase in fuel oil costs has revived interest in methods for maximising fuel economy in 2-stroke engine systems, while ensuring continued high system reliability. At the same time, MAN Diesels latest, market-leading, high efficiency TCA turbocharger range has made it possible to divert more exhaust gas to power turbine-based energy recovery systems.

With these factors in mind, the Turbocharger business unit of MAN Diesel has launched an updated product in its TES range of proven efficiency-enhancing solutions for 2-stroke engines.

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 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 system parallel to the turbochargers. It drives an electrical generator via a reduction gearbox and receives up to 13% of exhaust gas flow, diverted from the main engine exhaust gas receiver.

With this TCS-PTG “stand alone” solution in operation, auxiliary engine fuel 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 high efficiency turbochargers on the main engine, and depending on fuel oil prices, payback periods as short as 3 to 5 years can be achieved.

The TCS-PTG system is recommended for engines with rated outputs above 20 MW and in marine applications where the on-board electrical load is in excess of 10% of main engine power.

Enjoy the Benefits

Technical Data

TCS-PTG based on TCR	Max. output P_{el}*
TCS-PTG18	700 kW
TCS-PTG20	1 050 kW
TCS-PTG22	2 200 kW

TCS-PTG based on TCA	Max. output P_{el}*
TCS-PTG55	3 300 kW
TCS-PTG66	4 700 kW

Output revolution of
1 800 rpm
1 500 rpm

* The performace data vary to individual layout parameters. Available power based on typical 2-stroke-conditions with MAN Diesel high efficiency TCA turbochargers on the main engine ($\prod_{Turbine}$ = 3,3; T_{EG} = 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

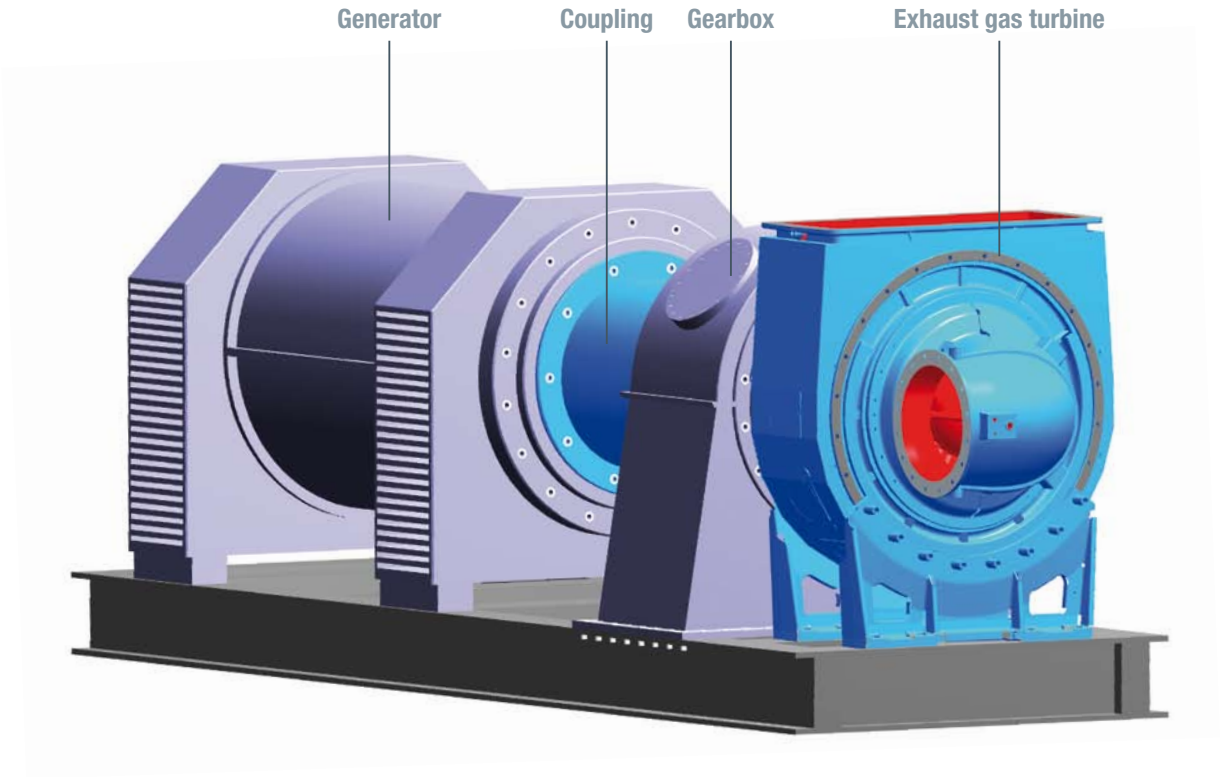
>> Gearbox to generator: high flexible coupling

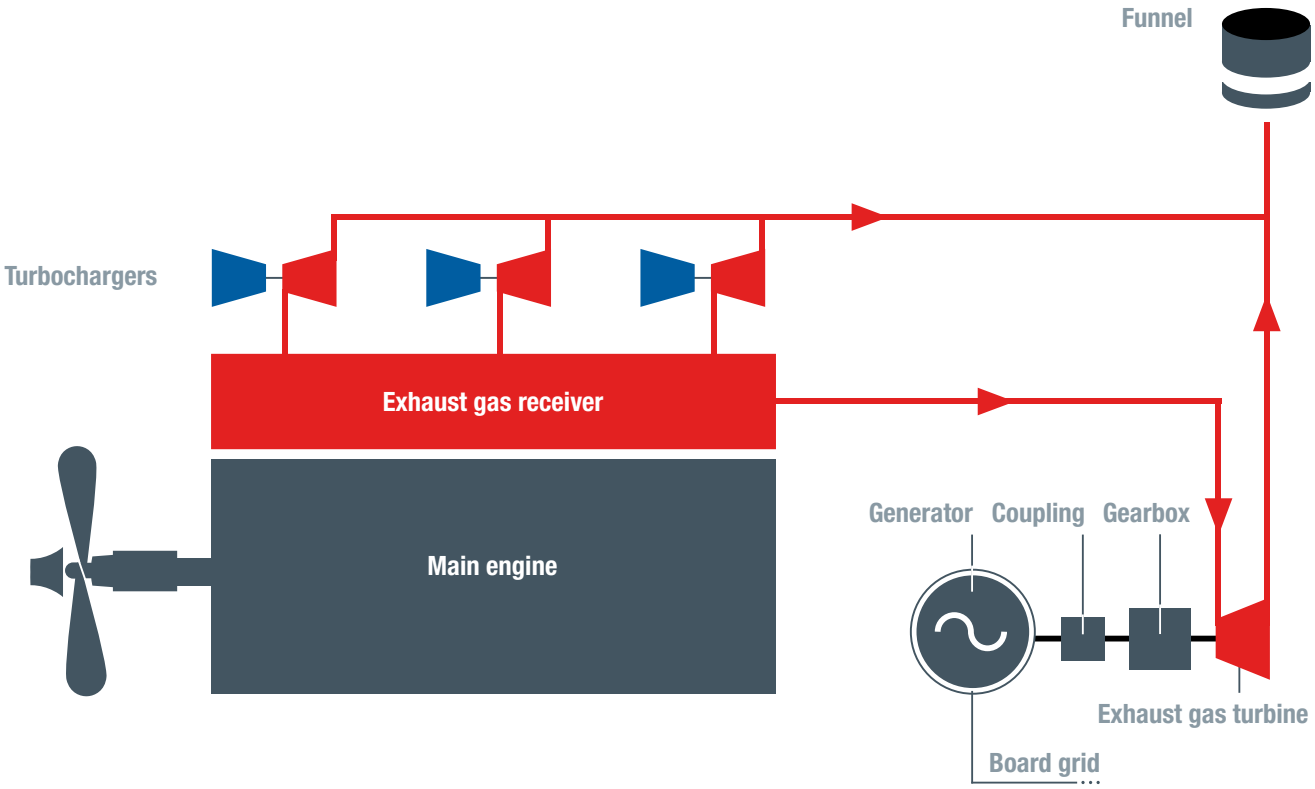
Generator

>> Asynchronous generator suited to marine and stationary applications

Valve system

>> Control of power turbine operating range
>> Fast acting emergency valves for emergency shutdown
>> Control and saftey equipment


Generator
Coupling
Gearbox
Exhaust gas turbine


Funnel
Turbochargers
Exhaust gas receiver
Main engine
Generator
Coupling
Gearbox
Exhaust gas turbine
Board grid

Estimation of fuel oil saving potential of TCS-PTG units

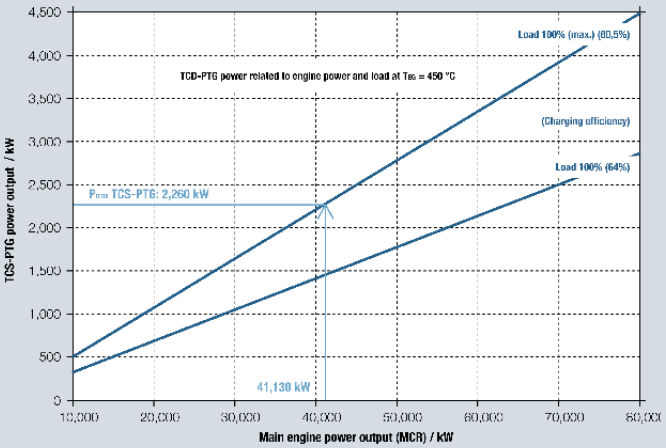
TCS-PTG-systems offer enormous saving potentials in 2-stroke engine applications. By generating additional power output, both fuel oil costs and CO_2 emissions can be reduced at the auxiliary engines. For stationary applications additional power can be generated which can be supplied direct to the grid. For estimating the saving potential of these systems, diagrams 1 to 4 (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.

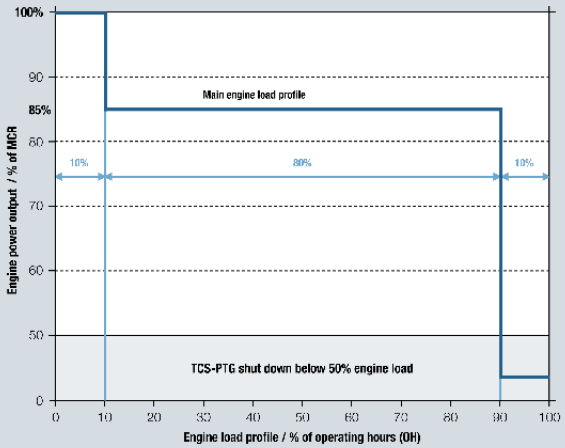
Procedure

1. With the specific main engine output at SMCR, exhaust gas pressure ratio and temperature known, the potential of an applicable TCS-PTG system can be estimated (diagram 1).
2. A specific load profile needs to be defined (example, diagram 2).
3. Calculation of average TCS-PTG power output:
   - a. Average TCS-PTG load:
     TCS-PTG load is dependent on main engine load (diagram 3). By combining the TCS-PTG load points from diagram 3 with the main engine load profile from diagram 2, the average TCS-PTG load is obtained as a percentage value.
   - b. Average TCS-PTG power output:
     With this value and the maximum achievable TCS-PTG power output at MCR, the average TCS-PTG power output can be calculated.
4. Using the average TCS-PTG power output and the estimated operating hours per year, annual achievable fuel oil savings for the auxiliary engines can be calculated (diagram 4).
5. Taking current fuel oil prices into account, the cost saving potential can be estimated.

1 *TCS-PTG power output in relation to size of main engine (SMCR)*



2 *Load profile example*



Example

9K90MC-C with TCA turbochargers on a container vessel

1. Main engine output of 41,130 kW @ 104 rpm at SMCR with TCA turbochargers leads to a maximum potential TCS-PTG power output of 2,260 kW (diagram 1).
2. Estimation of appropriate TCS-PTG loads in relation to main engine load points (diagram 2 and 3).
3. Calculation of average TCS-PTG power output:

a. Average TCS-PTG load:

Load Point	Readings out of Diagram 2	Readings out of Diagram 3
1.	10% of OH at 100% engine load	=> 100% TCS-PTG load
2.	80% of OH at 85% engine load	=> 79% TCS-PTG load
3.	10% of OH < 50% engine load	=> 0% TCS-PTG load

$$\frac{10\% \times 100\% + 80\% \times 79\% + 10\% \times 0\%}{100\%} = 73{,}2\%$$

Average TCS-PTG load = 73,2%.

b. Average TCS-PTG power output = 1,650 kW

4. Assuming 6,000 operating hours (OH) and an average TCS-PTG power output of 1,650 kW, approximately 2000 tons of fuel oil can be saved per year at the auxiliary engines (diagram 4).
5. Taking the current fuel oil prices into account, cost savings can be estimated.

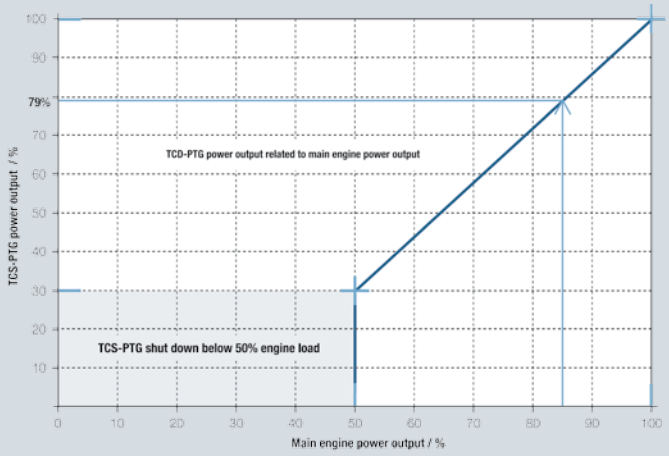
Conclusions

In stationary applications additional power output can be gained equivalent to nearly 100% of TCS-PTG rated load. For marine applications a TCS-PTG saves fuel oil. Thus costs, CO_2 emissions and maintenance of auxiliary engines can be reduced.

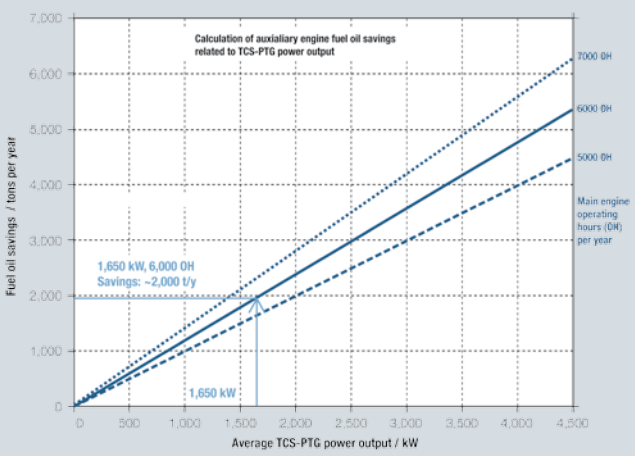
Note: Main engine fuel oil consumption might increase between 0,0-1,8%, depending on the application and turbocharging efficiency. Also exhaust gas temperature will rise.

Save your money and save your environment with MAN Diesel TCS-PTG systems. Economically and ecologically optimised vessels. Make your vessel an “ECO-Vessel”.

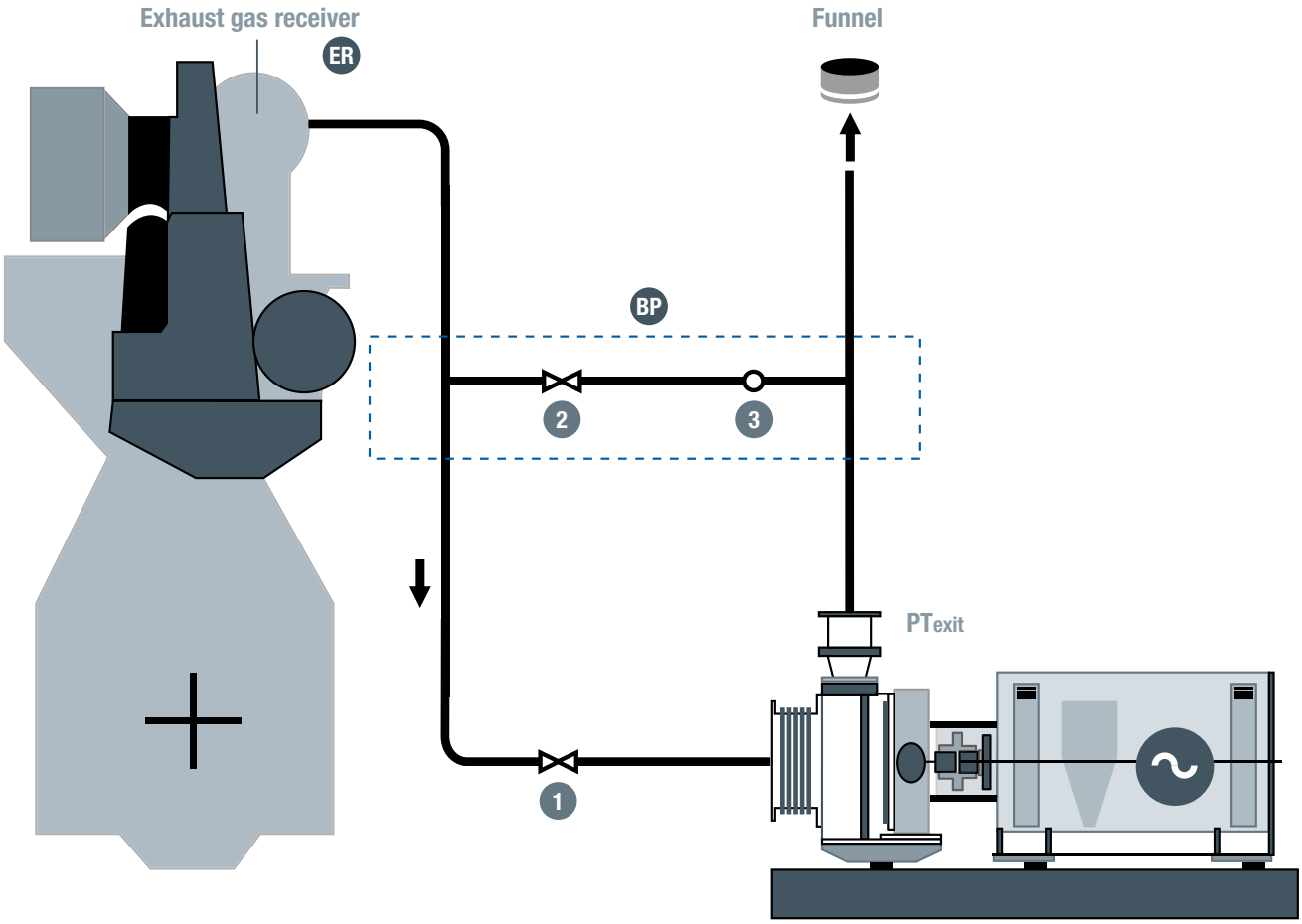
3 *TCS-PTG load in relation to main engine load*



4 *Fuel oil savings in relation to operating hours*



Schematic of the valve system



ER	**Exhaust gas receiver:**	Exhaust gas diverted before turbochargers
1	**Valves:**	Control valve power turbine
BP	**Bypass:**	To bypass dispensable exhaust gas
2	**Valves:**	Control valve bypass
3	**Orifice:**	Orifice simulates Δp of power turbine in shut down cases below 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. 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

Customer Support

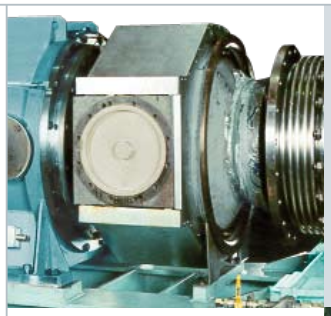
Around the Clock

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

Fast delivery of spare parts is of utmost importance to avoid down times. MAN Diesel has an efficient processing and stock dispatch system allowing most parts order to be delivered within 24/48 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.
- >> A one stop service for turbochargers, power turbines, diesel and gas engines.
- >> Around the clock after sales service.
- >> Largest turbocharger ‘license network’ with full exchangeability of spare parts.
- >> A high availability of spare parts through an intelligent central stocking system.
- >> Attractive price/performance ratio.

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