

# TCA Turbocharger

The benchmark



Engineering the Future – since 1758.

**MAN Diesel & Turbo**





## MAN Diesel & Turbo

### Aspiring to turbocharger perfection

MAN Diesel & Turbo is the world's leading designer and manufacturer of large exhaust gas turbochargers for low and medium speed diesel and gas engines.

As an integral part of a leading developer and builder of two-and four-stroke, low and medium speed engines, the MAN Diesel & Turbo Business Unit Turbocharger has a deep understanding of all the core technologies of large engines and their interaction with the turbocharger.

The result is world and market leading turbocharger technology.

More than ever before, the development focus at the MAN Diesel & Turbo Business Unit Turbocharger is the environmental performance of low and medium speed diesel and gas engines. The contribution of high efficiency exhaust gas turbochargers to this goal has been – and will continue to be – considerable.

MAN Diesel and Turbo's absolute commitment to reducing emissions while increasing fuel efficiency and power density starts with our active partnership in the emissions law making process and ends with the delivery of turbochargers that achieve an ideal synthesis of product characteristics.

# TCA – The Benchmark



MAN Diesel & Turbo has more than 75 years unprecedented experience of producing turbochargers with plain bearings and uncooled hot gas casings.

Modern turbochargers are crucial to generate high power and increased fuel efficiency for a wide range of engines, including ship propulsion systems, diesel and gas power plants and rail traction applications.

The new series of TCA turbochargers is available in 2-stroke and 4-stroke versions for diesel, dual fuel and gas engines. They have been developed to provide a robust and reliable platform for engine applications ranging from approx. 3MW up to 30MW output per turbocharger. Integral design combined with advanced materials has improved turbocharger efficiency, simplified installation on the engine, and has extended times between overhauls. Using fewer parts than any other generation has reduced maintenance and service times, which ensures lower life cycle costs.

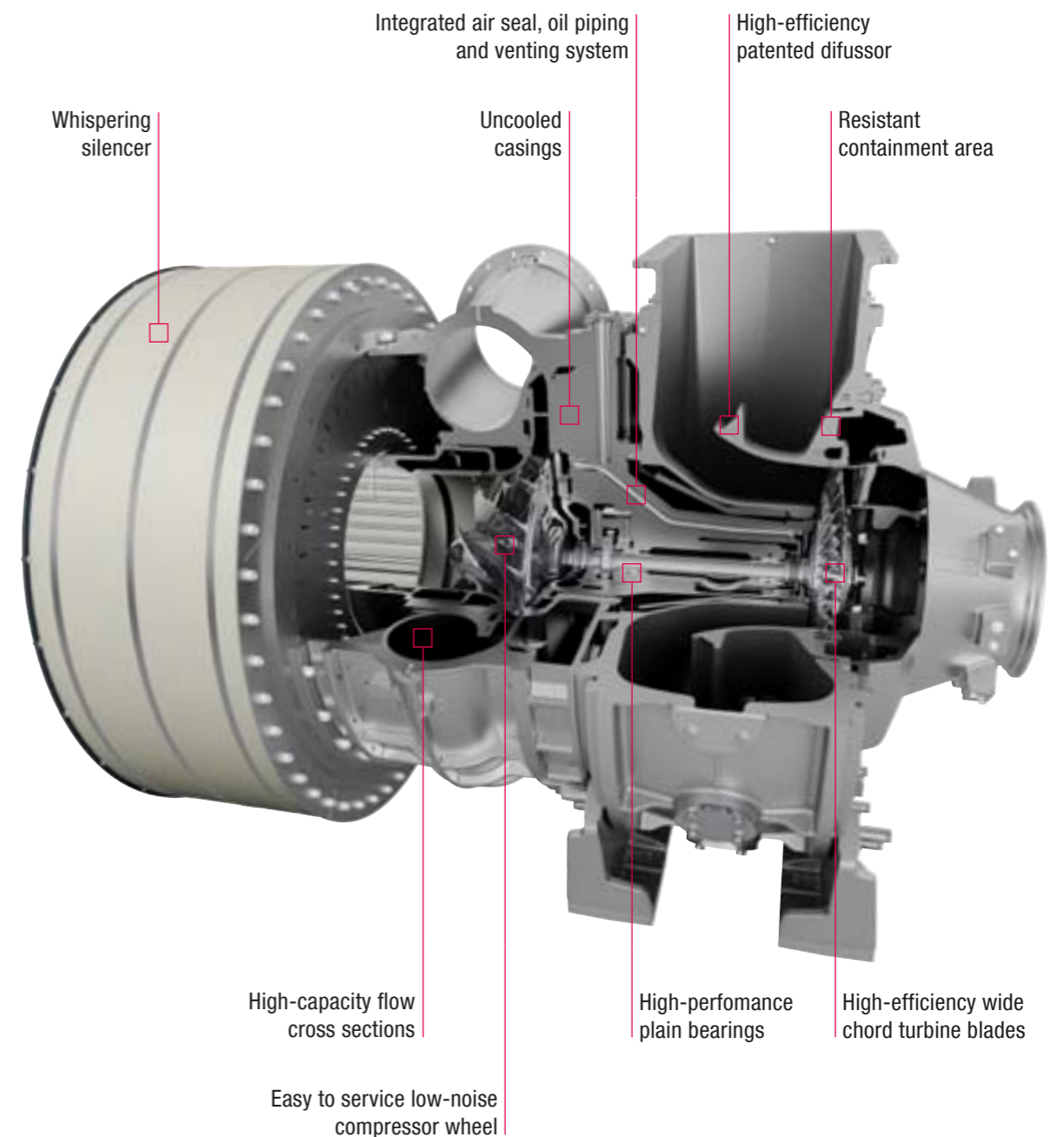
The TCA range contributes to fuel oil savings and meets all environmental emission standards.

# Enjoy the Benefits



| Features   | Benefits   |
|--|--|
| <b>Turbine</b>   |  |
| Newly developed wide-chord turbine blades without damping wire | Increased efficiency   |
| New turbine nozzle ring  | Extended life-time   |
| Optional variable turbine area (VTA)                           | Reduced SFOC at part load  |
| New optimised turbine outlet diffuser                          | Increased efficiency   |
| New optimised turbine inlet casing                             | Increased efficiency   |
| <b>Bearings</b>  |  |
| Reduced shaft diameter   | Minimised mechanical losses  |
| High performance thrust bearings                               | Minimised mechanical losses  |
| Floating journal bearing bushes                                | Optimised damping behaviour  |
| <b>Compressor</b>  |  |
| Newly developed compressor wheel                               | Reduced noise emission. Increased efficiency and optimisation of the engines operating line (in the map) |
| Optional internal re-circulation                               | Increased surge margin   |
| Newly developed compressor volute                              | Increased efficiency   |
| New compressor diffuser vanes                                  | Increased efficiency   |
| Optional Jet Assist  | Fast rotor acceleration  |
| <b>Easy Maintenance</b>  |  |
| Thrust bearing inspection without shaft removal                | Reduced service time   |
| Compressor wheel change  | Basic tooling without dismantling compressor casing  |
| Easy replacement of turbine blades                             | Reduced service time   |
| Extended Parts Life-Time                                       | Low maintenance costs  |
| <b>Design Features</b>   |  |
| Air cooled casings   | No corrosion   |
| Post lubrication tank  | Safe operation   |
| Lubrication by engine lube oil system                          | Simple and reliable  |
| Integrated oil piping and oil venting system                   | Compact design   |
| Integrated sealing air supply                                  | Compact design   |
| Reduced number of parts  | Low maintenance costs  |
| Integrated burst protection                                    | Safe operation   |

Vital components that increase engine power by more than 300%



# Turbine

# Bearings



All components of the TCA turbocharger have been optimised with regard to flow control and stress reduction by means of modern 3D CFD and FEM calculations.

The result is a turbine with very stiff and high-wear resistant wide-chord blades, which are supported in the turbine disc by means of a 'fir tree foot'.

A damping wire is therefore no longer necessary, which makes maintenance work easier and improves efficiency.



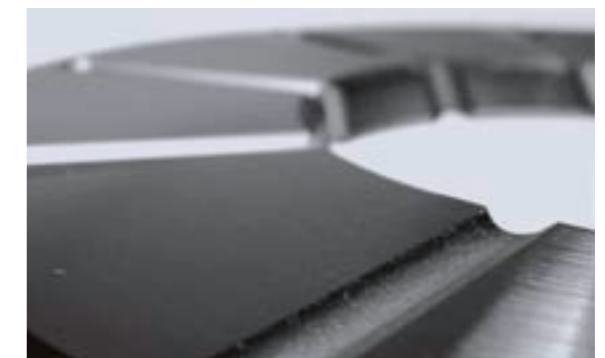
The rotor is running on two internal radial bearings with floating bushes and a separate thrust bearing. The advanced design provides higher safety margins.

Bearing points with small diameters could be realised by optimising both the rotor dynamics and the shaft/hub connection of the compressor wheel and turbine shaft.

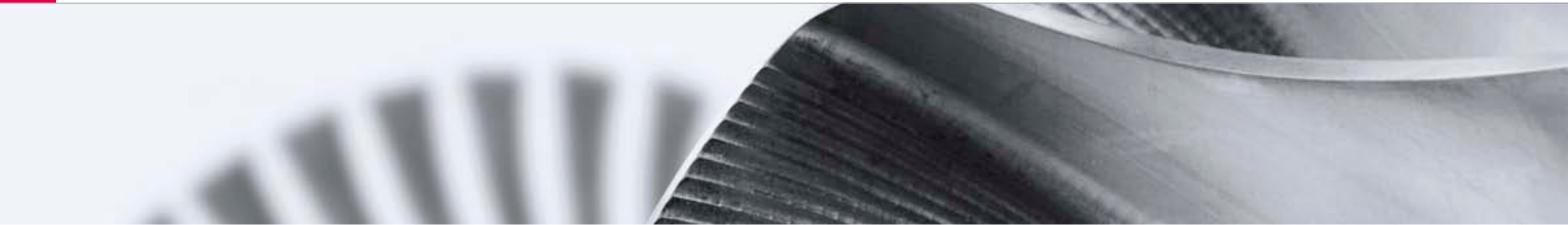
The result is low circumferential speeds of the bearing bushes and minimisation of the friction losses which contributes to a higher total efficiency.

Special features of the floating bearing bushes are very quiet running and minimal bearing wear. The expected service life of the bearing body is up to 50,000 hours.

Easy handling and short maintenance times were essential requirements for the support design. For example neither the compressor casing nor the turbine rotor has to be disassembled for removal of the thrust bearing. I.e. a bearing inspection can be carried out in normal harbor lay days.



# Compressor

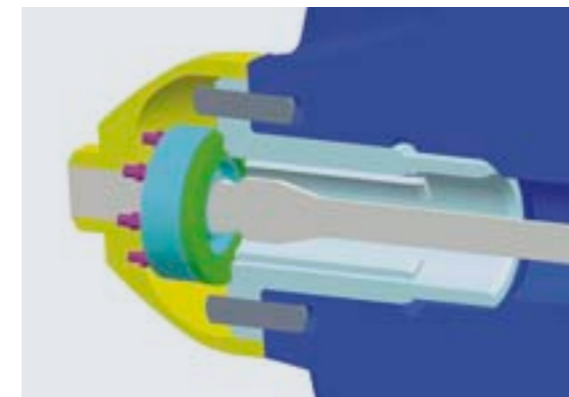


The compressor wheel operates at a circumferential speed well over 500 m/s which results in very high centrifugal forces. The standard design of resistant aluminium alloy in combination with a specially adapted machining process ensures a long service life for this stressed component.

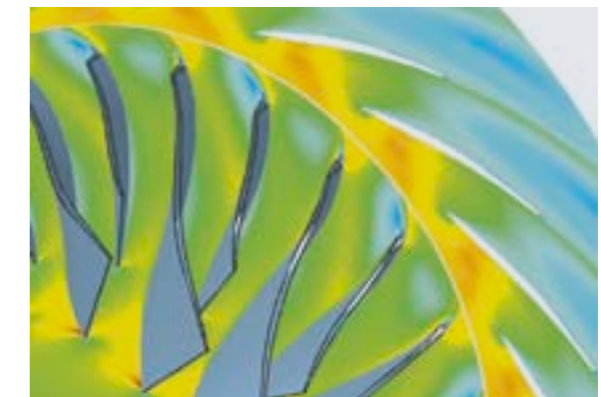
A compressor wheel suitable for use in very high pressure conditions has been developed specifically for the TCA series, utilising advanced 3D CFD and FEM calculations. The benefit is optimised geometry,

which ensures a high efficiency at a safe surge margin within the whole operating range. In addition, noise is considerably reduced.

The force and form locking compressor wheel attachment on the turbine shaft permits assembly and disassembly of the compressor wheel, without having to use an unwieldy hydraulic tool. This new shaft/hub connection protected by a MAN Diesel & Turbo patent reduces replacement time substantially and makes maintenance easy.

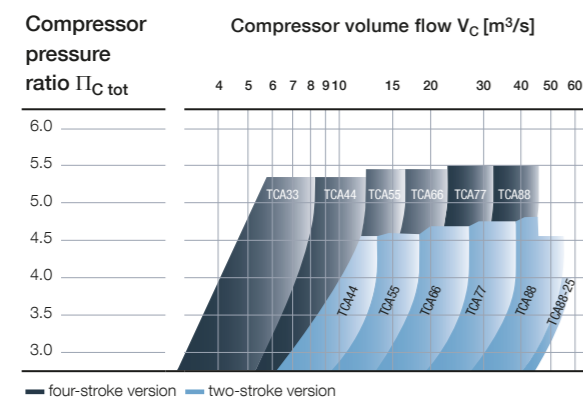


Patented shaft/hub connection

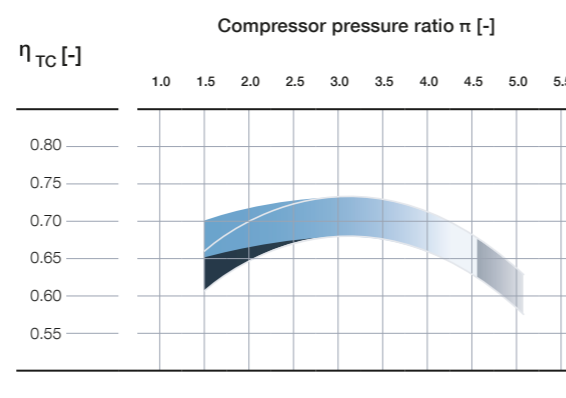


Pressure and mach number distribution

## Turbocharger application range



## Range of turbocharger efficiency



## Turbocharger programme

| Type  | Max. supercharged engine output [kW] |                              | Max. permissible speed (rpm) | Mass (kg) |
|-------|--------------------------------------|------------------------------|------------------------------|-----------|
|       | 2-stroke<br>le* = 8.0 kg/kWh         | 4-stroke<br>le* = 6.5 kg/kWh |                              |           |
| TCA33 | -                                    | 5,400                        | 27,800                       | 1,140     |
| TCA44 | 7,000                                | 7,900                        | 22,700                       | 1,970     |
| TCA55 | 9,600                                | 10,400                       | 20,000                       | 3,290     |
| TCA66 | 14,000                               | 14,800                       | 16,900                       | 5,510     |
| TCA77 | 20,000                               | 21,000                       | 14,200                       | 9,250     |
| TCA88 | 30,000                               | 30,000                       | 12,000                       | 15,790    |

\* Specific air consumption

# Nozzle Ring



TCA nozzle rings are manufactured from highly resistant materials which ensures a long service life. Optimum matching of the turbocharger to the corresponding engine is obtained by individually adapting nozzle rings.

As an option a variable turbine area (VTA) permits optimum adaptation of the 'flow cross section' to the corresponding load condition of the engine and therefore reduces both fuel consumption and pollutant emissions, especially at part load operation (Fig. 1).

Patented variable nozzle ring

### Benefits of VTA

- Up to 5 g/kWh lower fuel consumption
- Lower soot and smoke emission
- Lower CO<sub>2</sub> emissions
- Lower particle emissions
- Suitable for TCA and TCR turbochargers
- Retrofit packages
- Short payback time
- VTA cuts fuel consumption and reduces emissions



# Casings

The uncooled casings of the TCA series are designed in accordance with the 'pipeless engine' principle. All supply pipes are fully integrated within the casing. Only one oil supply and discharge pipe and a venting pipe have to be connected externally.

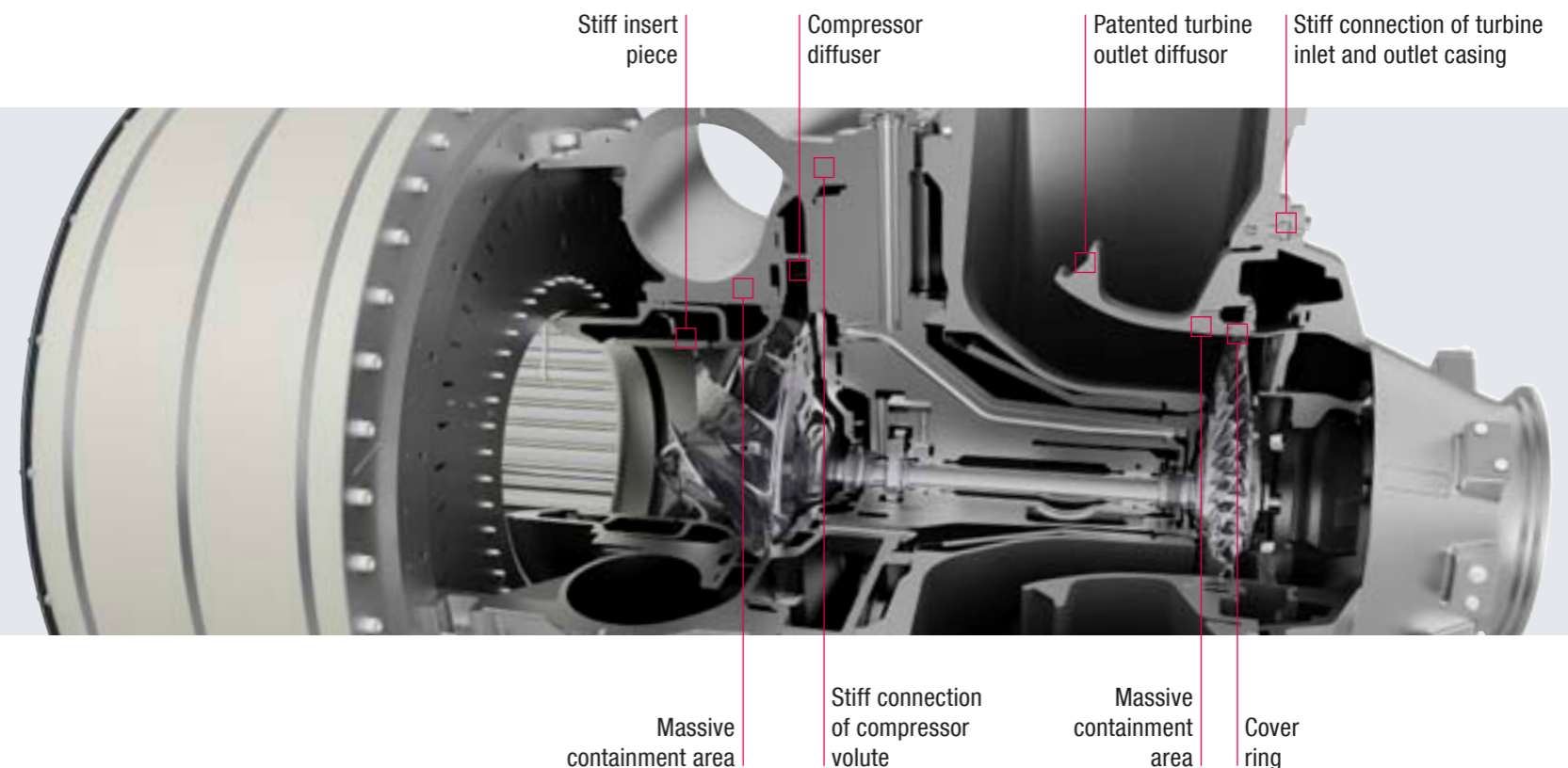
Due to a robust structure and the material thickness of the casing walls, the TCA turbocharger will not require any additional burst protection; and the rigid connection of the turbine outlet, bearing and compressor casing by means of tie rods offers additional safety.

Newly developed one and two socket compressor spirals permit optimum attachment of the turbocharger to the engine. The stiff insert piece is part of the patented burst protection in the compressor.

An essential item of the development work was the design of the (patented) turbine outlet diffuser, which effectively converts kinetic energy remaining downstream of the turbine wheel into pressure. Simultaneously the outlet diffuser acts as an integrated burst protection within the turbine.

A further vital point is the reduction of noise emission. This is due to the compact design (the noise emitting surface area is greatly minimised), combined with newly developed insulation of the turbine outlet and compressor casing.

In order to permit optimum mounting to the engine all casings can be installed and turned in steps of 15°.



## World-Class Service

Marine propulsion, gensets and stationary plants



### The PrimeServ offering

The MAN Diesel & Turbo Group offers worldwide, round-the-clock service, 365 days a year. In addition to MAN Diesel & Turbo's service headquarters in Augsburg, Copenhagen, Frederikshavn, Saint-Nazaire, Hamburg and Stockport, service centers on all continents provide comprehensive and continuous support.

MAN Diesel & Turbo engines are renowned for their quality and durability. We are a global organization with a strong local presence, delivering exceptional field service management, tailor-made solutions, and first-class technical support.

PrimeServ provides advice and assistance to customers throughout the product lifecycle, from delivery to resale. With our far-reaching network of Service centers, we respond rapidly to customer needs. What's more, we offer outstanding service and unrivalled technical expertise. Plus, we only use genuine spare parts – safeguarding the longevity of your engine.

### PrimeServ's aim is to provide:

- Prompt delivery of high demand OEM spare parts within 24 hours
- Fast, reliable and competent customer support
- Individually tailored O&M contracts
- Ongoing training and qualification of operators and maintainers
- Global service, open 24 hours-a-day, 365 days-a-year
- Diagnosis and troubleshooting with our high performance Online Service





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