TCR

The cutting edge

Engineering the Future – since 1758.

MAN Diesel & Turbo

TCR
The cutting edge

MAN Diesel & Turbo has more than 60 years unprecedented experience of producing turbochargers with plain bearings and uncooled hot gas casings.

What would a state-of-the-art diesel engine be without a turbocharger? With speed rates of over 70,000 rpm and circumference speeds faster than the speed of sound, the turbocharger is one of the most important engine components. As it “inhales” air into the engine, which is indispensable for combustion, it is often referred to as the engine’s lung.

A modern turbocharger is able to increase the engine output by more than 300%. Following MAN Diesel & Turbo’s successful and trend-setting design philosophy, TCR turbochargers feature plain bearings and uncooled casings. These new turbochargers were designed to meet with the special demands that are made upon HFO, MDO and gas engines. They cover the complete range of possible applications, such as propulsion and stationary engines, gensets and traction engines, all of which are subject to the strictest requirements with regard to size and weight.

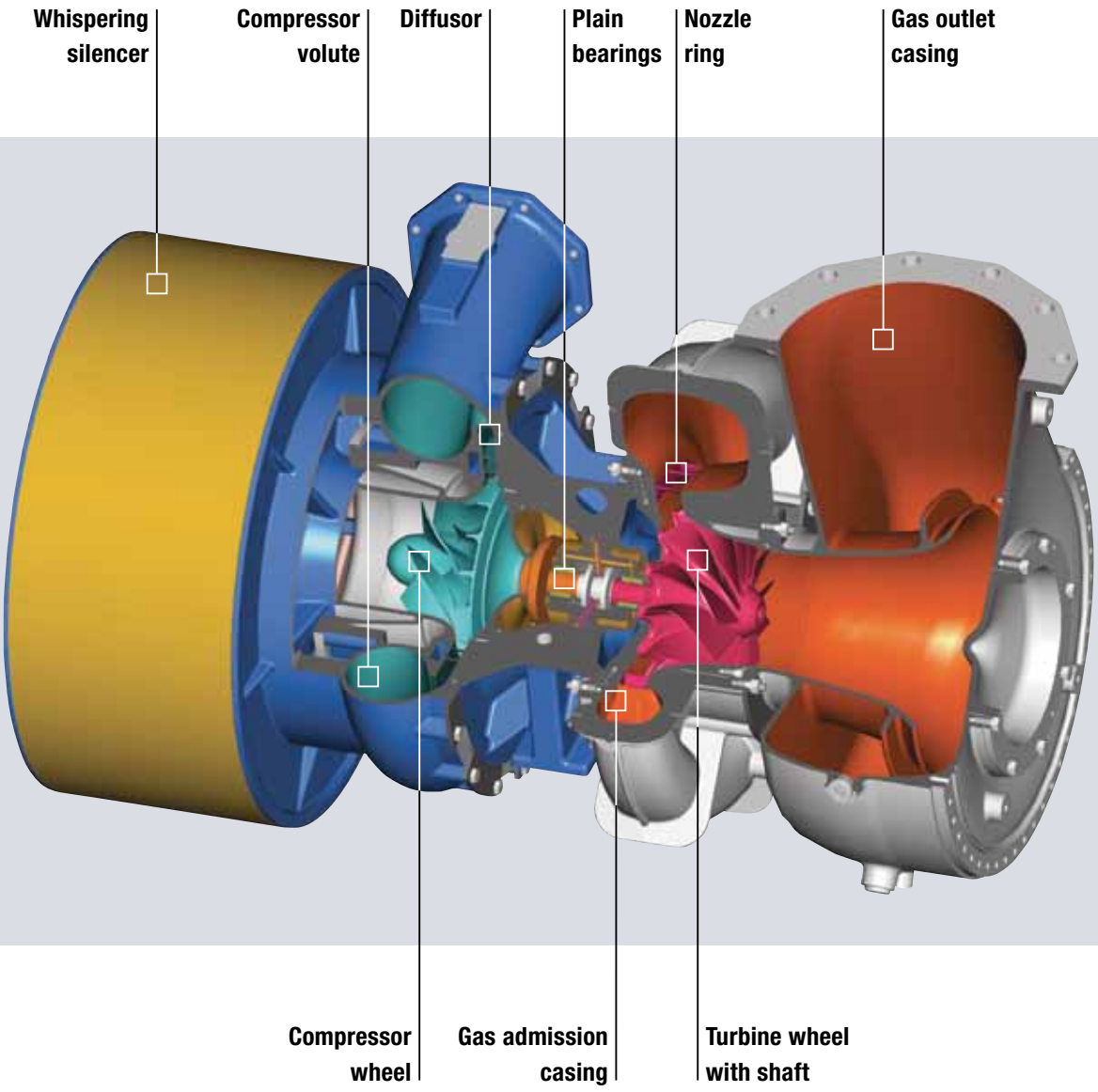
As compared to the previous generation, these new turbochargers offer the advantage of greater compactness and lighter weight without making any concessions with regard to efficiency and performance. Hightech materials ensure an extended service life and easier maintenance.

The new TCR turbocharger sets new standards for radial-flow turbochargers. Its big brother, the TCA type, has already proved a success as an axial-flow turbocharger.

Enjoy the Benefits

Features	Benefits
Turbine	
New CFD-optimised profiled rotor blades, nozzle ring, inlet and outlet casing	Increased efficiency
Constant and pulse pressure turbocharging	
Optional variable turbine geometry	Excellent adaption to variable engine conditions
Bearings	
High performance plain bearings	Minimised mechanical losses, extended service life
Optimised shaft diameter	Increased efficiency
Compact plain bearing concept	Ideal rotor dynamic behaviour
Compressor	
New CFD-optimised compressor wheel, diffuser ring and compressor volute	Increased efficiency
Extended pressure ratio and specific volume flow	Meeting future engine requirements and environmental regulations
Optional internal flow recirculation (IRC)	Extended surge margin
Optional jet assist	Excellent rotor acceleration
Easy Maintenance	
Extended inspection intervals	Less service stops required
Easy access to compressor wheel	Reduced service time
Reduced number of components	Low maintenance costs
New compressor wheel fixation	Reduced service time
Increased life time of parts	Low maintenance costs
Smart Design for Convenient Installation	
Uncooled casings	Less connections and no corrosion
Lubrication by the engine lube oil system	Simple installation, less sources of errors
Integrated oil inlet and oil drain	“Pipeless” design
Piston ring sealing	No sealing air required
Others	
Suitable for HFO, MDO, dual fuel and gas engines	
Compliance with present and future engine standards and environmental regulations	
Containment proven	Safe operation
Low moment of inertia	Excellent transient behaviour
New developed silencer	Low noise

Vital components that increase engine power by more than 300%



Turbine

Turbine wheel

All the flown-through components of the TCR turbocharger have been flow and stress optimised by means of modern 3D-CFD and FEA calculations. Part or full load optimisation is possible by means of a variety of different rotor/nozzle ring flow area combinations.

- New CFD-optimised profiled rotor blades, nozzle rings, inlet and outlet casing for increased efficiency
- Constant and pulse pressure turbocharging
- Variable nozzle ring (optional)

Bearing

Semi-floating journal bearings with squeeze oil damper

The TCR bearing includes tried and tested aspects of the radial and axial bearing design of the NR series, such as the floating radial bearing bushes coupled with new detail solutions like the non-rotating radial bearings. The new “semi-floating” design permits most reliable operation and low wear.

The most evident modification is the axial bearing now being arranged between the radial bearings. This arrangement enabels an extremely space-saving bearing design. For easy servicing, all bearings are housed in a bearing body.

- Semi-floating bearings with squeeze oil damper
- Compact bearing concept with centre thrust bearing
- Oil pressure adjusted by the turbocharger manufacturer
- Piston ring sealing without sealing air

Compressor

By applying up-to-date 3D CFD and FEA calculations,a new compressor wheel geometry has been created with further improved efficiencies. Depending on the application, part-load and full-load optimisation is possible by means of flow area combinations.

TCR turbochargers can be optionally equipped with the IRC system (internal recirculation) which is able to provide a larger compressor characteristic map with increased surge margin ability.

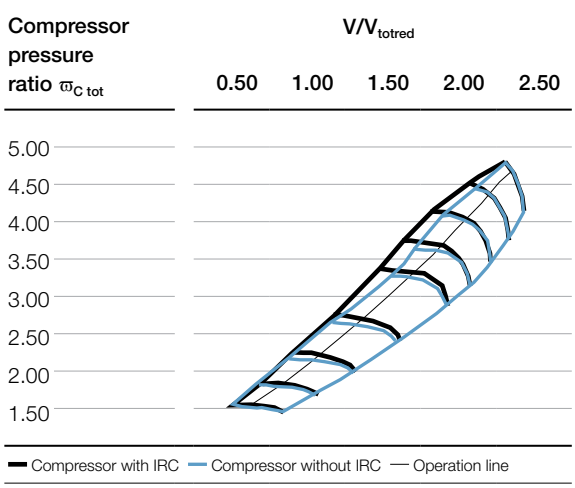
The compressor wheel is milled from a high resistant aluminium alloy that can withstand intake conditions within a wide temperature spectrum.

A new type of compressor wheel attachment, with a new designed retainer, simplifies maintenance and extends the service life of this component which is subject to great stresses.

- New CFD-optimised compressor wheel, diffuser ring and compressor volute for increased efficiency
- Extended pressure ratio and specific volume flow
- Internal flow recirculation (IRC) for extended surge margin (optional)
- New compressor wheel fixation for easy servicing
- Jet assist for quick rotor acceleration (optional)

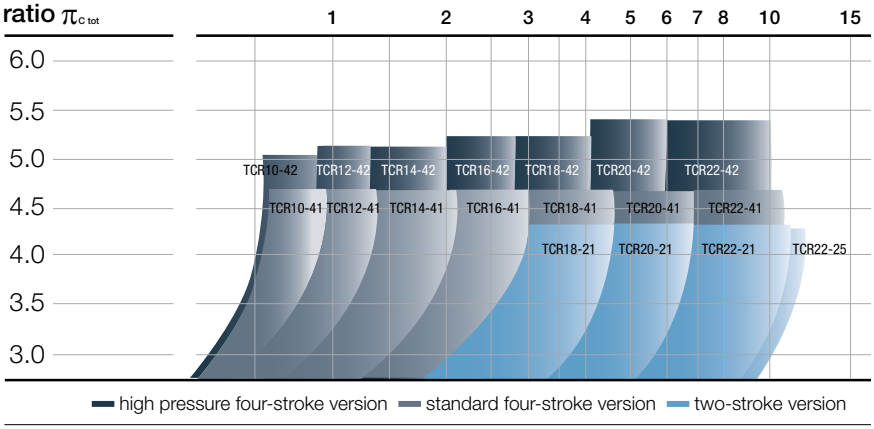
Insert piece with jet assist bores, diffusor

Compressor map with and without internal recirculation (IRC)



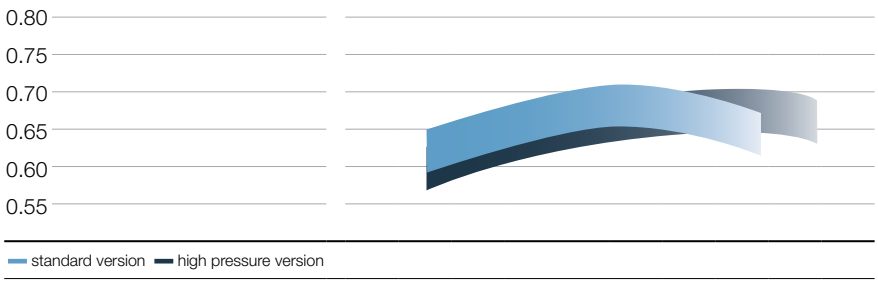
Compressor pressure ratio $\pi_{c\,tot}$

Compressor volume flow $V_{C\,tot}$ [m³/s]



Range of Turbocharger efficiency (η_{TC})

Compressor pressure ratio ϖ



Turbocharger programme

Type	Supercharged engine output [kW]		Max. permissible	Mass
	2-stroke	4-stroke	Speed	
	le*= 8 kg/kWh	le*= 7 kg/kWh	[rpm]	[kg]
TCR10	-	600	84,700	40
TCR12	-	800	70,850	100
TCR14	-	1,200	58,700	135
TCR16	-	1,800	48,800	205
TCR18	2,400	2,700	40,250	350
TCR20	3,500	3,900	33,450	600
TCR22	6,400	6,900	25,600	1,400

*Specific air consumption

Nozzle Ring

TCR nozzle rings are manufactured from an extremely resistant material which ensures a long service life. Optimum adaptation of the turbocharger to the respective engine is achieved by means of individually selected flow areas (matching).

A variable nozzle ring is optionally available. The variable nozzle ring permits optimum adaptation of the flow cross-section to the corresponding load conditions of the engine, thus reducing fuel consumption and pollutant emissions as well as improving dynamic load acceptance.

Whispering Silencer

Whispering silencer with patented radially inserted damping plates

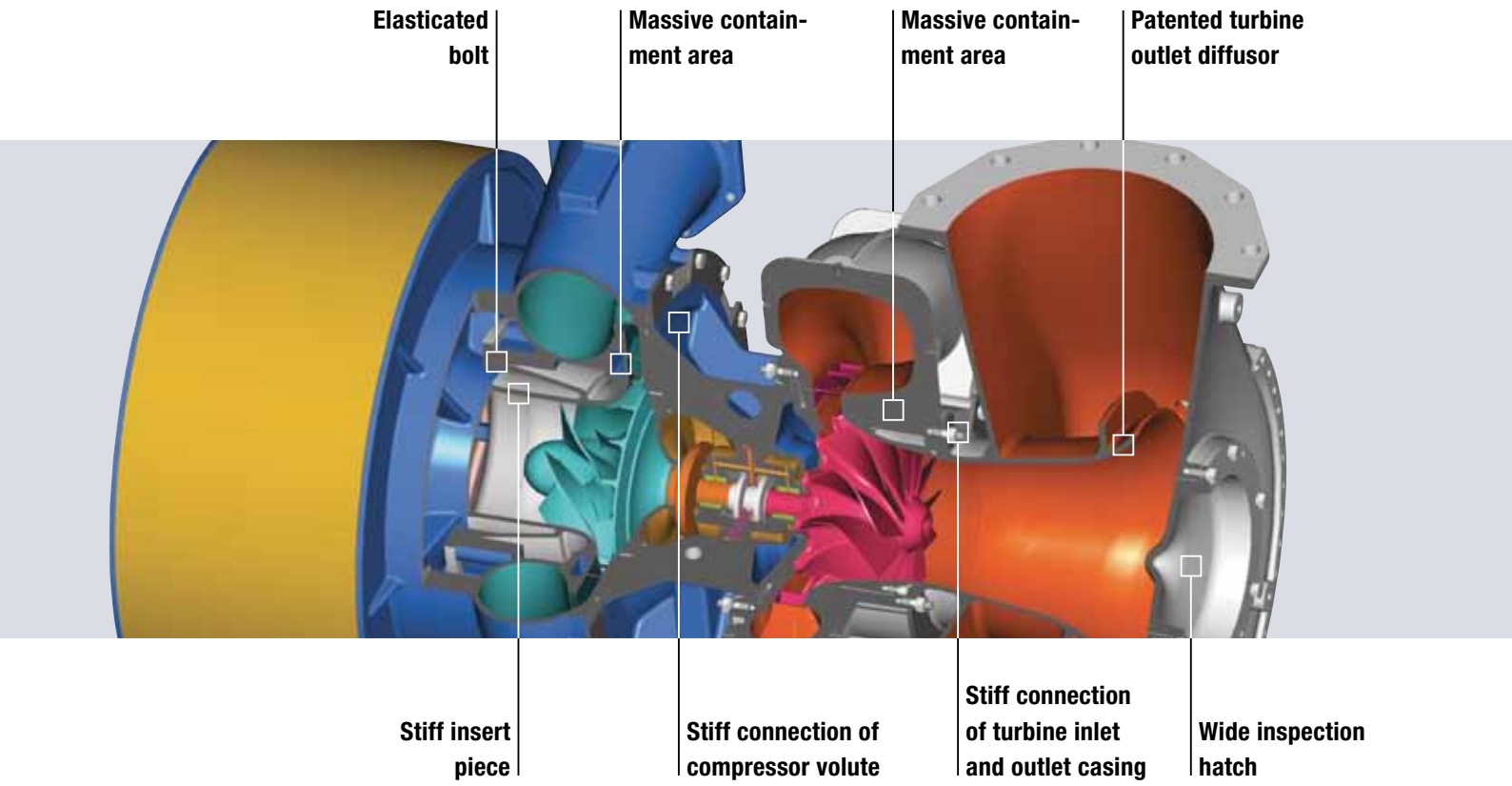
The entirely newly developed silencer cast from aluminium reduces sound imission to less than 105 dB(A). The radially arranged silencer segments have a flow-optimised design and contribute to the high efficiency of the turbocharger. The filter mat on the silencer circumference is easy to clean whenever necessary.

Casing

The uncooled casing of the TCR series has been designed in accordance with the “pipeless engine“ principle. All supply pipelines are integrated in the casing. The compressor and turbine casings have measuring connections for monitoring the pressure and temperature. A speed pick-up is also included in the scope of supply. The casings, which are manufactured from SiMo steel or ductile cast iron respectively are designed and have been tested to be containment proof.

Claw connections facilitate fast disassembly and allow the casing to be rotated into any required position. The casings are heat insulated and comply with the SOLAS requirements. The turbine outlet casing comes with a wide inspection hatch that provides good access to the turbine wheel for inspection and cleaning. Integrated turbine and compressor washing devices are optionally available. The DIN flange of the flow-optimised turbine outlet casing allows it to be easily fitted to the exhaust gas pipe. Alternatively, a simple and spacesaving 90° elbow can be supplied.

- Uncooled casings
- Lubrication by means of the engine lube oil system
- Integrated oil inlet and oil drain for pipeless engine
- Ports for pressure and temperature measurement on compressor and turbine side
- Containment proven
- Continuously rotatable
- Turbine outlet casing with DIN flange
- SOLAS conformity



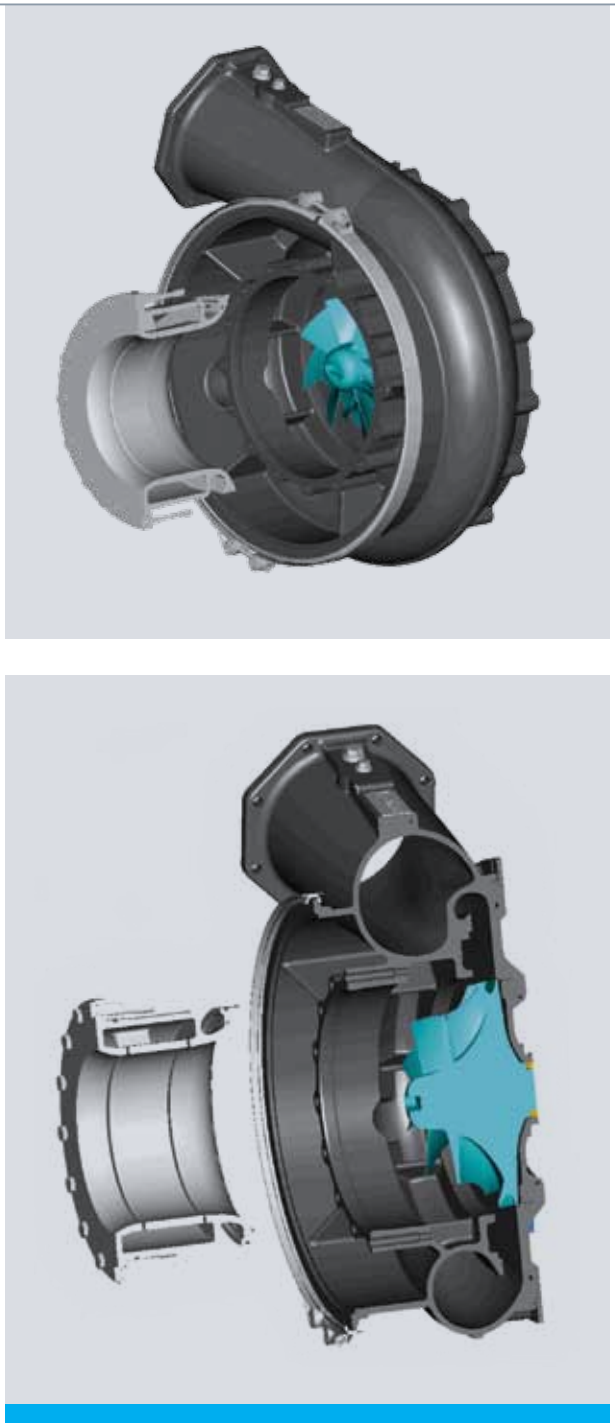
Maintenance

The best maintenance would be if no maintenance were necessary at all. In this respect the new TCR series features extended maintenance intervals of up to 30,000 operating hours.

When designing the turbocharger, great care was taken to ensure that servicing – even though seldom – can be carried out as easily as possible. For example, the compressor wheel can be taken out without dismantling the compressor casing. On the turbine side, the outlet casing comes with a wide inspection hatch that provides good access to the turbine wheel for inspection and cleaning.

MAN Diesel & Turbo has also reduced the number of screws and components to a minimum, developed a complete set of special tools and included a large number of pull-off screws and other helpful features to assist the service engineer during assembly.

- Extended maintenance intervals
- Easy access to compressor and turbine wheel
- Reduced number of components



Easy access to compressor wheel

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 coordination 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, diesel and gas engines
- Around the clock after sales service
- Largest turbocharger 'license net' 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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