The VTR..4 series of turbochargers is designed for two-stroke low-speed and four-stroke medium-speed, heavy-duty diesel and gas engines with ratings ranging from 700 kW to about 18,500 KW per turbocharger.

The design of the VTR with its easily maintained external bearings has proved its worth many thousands of times over in its main fields of application – on marine propulsion engines, especially at part load, and in stationary power plants, on units burning heavy oil and in continuous operation.

The high pressure-charging capability of VTR..4 turbochargers is the result of intensive research by ABB in the fields of thermodynamics and aerodynamics. Uncooled gas casings are available as an alternative to water-cooled gas casings. The well-proven design and extremely robust construction of the VTR..4 have major benefits for engine-builders and end-users alike.

The rotor runs in spring-mounted, rolling-contact bearings, which can be easily accessed from either end of the rotor. Each bearing has its own lubricating and oil cooling system.

Major benefits for the engine manufacturer

- ABB has unmatched experience in every aspect of supercharging thanks to its long and close collaboration with the worldwide diesel engine industry.
- An ongoing development and test program ensures that ABB turbochargers are always at the forefront of technology.
- A comprehensive and confidential consultancy service is available, right from the earliest stages of new projects.
- The modular design of the VTR turbocharger, with various casing configurations, turbine blades/nozzle rings and compressor wheels/diffusers, ensures optimum matching with all engine types and designs.
- The integrated lubrication system eliminates the need for a separate lubrication system with its piping filters, oil tanks and safety features.
- With their external, antifriction bearings, VTR turbochargers can make a major contribution to improved power output and efficiency.

Major benefits for the engine user

- VTR turbochargers are highly reliable and are designed for the engine’s lifetime.
- Precise manufacturing tolerances enable spare parts to be installed without any need for re-machining.
- External bearings are easy to maintain. The rotor shaft can be removed without having to dismantle the gas manifolds or pulling off the compressor wheels.
- The low friction losses of the external antifriction bearings afford optimum engine performance during part-load operation.
- Connectors on the compressor side allow water cleaning during operation.
- An experienced technical team is available for assistance in every aspect of operation.
- A worldwide network of service stations offers 24-hour service support.
## Design features

### Bearings and lubrication

**External bearings**
External bearings have important benefits for most applications in which medium-size and large turbochargers are used. For example, they are easily accessible, which simplifies and speeds up servicing. And because the bearings can be removed without having to dismantle the compressor wheel, there is no need to manoeuvre large, heavy shafts when servicing them. The rotor shafts can also be removed without having to dismantle the air and gas pipes.

The use of external bearings results in lower bearing forces and permits the use of self-lubricating antifriction bearings. Sleeve bearings with external lubrication (engine lubrication) are available as an alternative for the larger turbocharger types (see Table 1).

Any imbalance of the rotor shaft caused by contamination or foreign particles is absorbed by damping spring assemblies in the bearings. The lower forces associated with external bearings are a distinct advantage here.

**Bearings and lubrication system**
Oil centrifuges in the closed lubrication system of the antifriction bearing separate out any dirt particles and ensure constant lubrication with pure lubricating oil, even in an inclined position. The turbine oil used has a positive effect on service life.

The oil pumps that are used can be seen in Table 2. Sleeve bearings with external lubrication can be supplied on request, however at considerable extra cost, particularly for the large turbochargers, since separate oil filtering systems and a standby tank for emergency lubrication must be provided.

**Bearing support for VTR 714**
LA70/TA07 has been introduced to handle higher performance and vibrations.

### Tables

#### Table 1

<table>
<thead>
<tr>
<th>Bearing design</th>
<th>Standard design self-lubricating antifriction bearings</th>
<th>On request: sleeve bearings with external lubrication</th>
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<tr>
<td>All types</td>
<td>VTR 454, 564, 714</td>
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#### Table 2

<table>
<thead>
<tr>
<th>Oil supply for roller bearing</th>
<th>Centrifugal oil pump</th>
<th>Standard gear oil pump</th>
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<tr>
<td>VTR 214, 254, 304, 354</td>
<td>VTR 454, 564, 714</td>
<td></td>
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</table>
Design features
Casings and cooling

Gas and air casings
The gas inlet, gas outlet and compressor casings are split vertically and bolted together. The three casings and the supports can be turned with respect to one another in increments of 15 or 30 degrees, giving the engine designer maximum freedom for mounting the turbocharger on the engine.

Gas inlet casing
A large range of casings is available, with gas inlets in different numbers and different arrangements for greater flexibility when matching the turbocharger to the various charging systems, engine types (vee or in-line), and cylinder numbers. Uncooled casings, for use with heat recovery systems, are available as an alternative to the water-cooled casings of the VTR..4.

Concept of the uncooled VTR turbocharger
The gas inlet ducts of uncooled VTR..4 turbochargers do not come into contact with cooling water at any point. This makes the greatest possible amount of heat available for further use.

In the interests of operational reliability, the bearing housing at the turbine end is cooled with a small amount of water to keep the temperature of the lubricating oil low.

Cooling of the jacket of the gas outlet casing ensures that the temperature at every point on its surface remains within the limits stipulated by the classification societies for the prevention of fire and protection against accidental contact.

Air intake
The air to be compressed is drawn in through
- air suction branches or
- a filter-silencer.

The silencer has an integrated filter which separates coarse dirt particles from the intake air, thereby significantly reducing compressor contamination. The filter can be cleaned during operation without having to dismantle the silencer.

Shaped, felt-covered plates reduce compressor noise in line with international regulations.
**Turbine and compressor**

VTR turbochargers are fitted with single-stage axial turbines and radial compressors. The different turbine blade heights and large number of guide vane (nozzle ring) variants, as well as different compressor wheel widths and a range of diffusers, afford optimum matching of engines and turbocharger operating characteristics.

**Removal of the rotor shaft**

With VTR turbochargers there is no need to disconnect any air, gas or water pipes when removing the rotor shaft, nozzle rings or diffusers. The rotor shaft can be withdrawn in four easy steps. After taking off the filter-silencer or the suction branch at the air intake, the bearings are removed. The air inlet casing and the heat insulating partition wall are then disconnected from the gas casing, after which the rotor assembly can be withdrawn.
Before a turbocharger can be precisely specified, factors such as the turbine blades, guide vanes and compressor wheel variants have to be considered. This is an area where only close collaboration with trained and experienced turbocharger specialists at ABB Turbo Systems Ltd will ensure the optimum supercharging solution.

The capacity ranges of the various VTR turbochargers shown here can be used as an initial selection guide to identify the optimum VTR size for a particular engine.
The principal space requirement and engine attachment configuration can be determined from the overall dimensions shown in the table. Detailed dimensional data should be taken from the drawings ABB Turbo Systems provides for each size of turbocharger.

Also indicated are the oil flows required for self-lubrication of the antifriction bearings on the compressor and turbine sides.

The oil must be changed after 500 to 1000 hours of operation, depending on its quality and the work cycle. Turbine oils are preferred to engine oils (particularly engine oils with additives for heavy fuel oil operation), because of their better resistance to ageing. If synthetic oils are used, the lifetime can be increased to 3000 hours (depending on the turbocharger size and application). Viscosity ranges vary according to operating conditions and precise details are given in the operating instructions.

The maximum required cooling water flows given in the data are based on a gas temperature of 600 °C at the turbine inlet and a cooling water temperature of 65 °C at the inlet, for both gas casings. The exhaust gas temperature associated with 2-stroke engines would normally call for water flows of about half these figures.

<table>
<thead>
<tr>
<th>VTR..4-11</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>Weight kg*</th>
<th>Water</th>
<th>Oil l/min</th>
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<td>613</td>
<td>670</td>
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<td>656</td>
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<td>18.00</td>
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</table>

*not including water (with water add approx. 5%)  
CS = bearing compressor side  
TS = bearing turbine side

<table>
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<tr>
<th>VTR..4-32</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>Weight kg*</th>
<th>Oil l/min</th>
<th>Oil l/min</th>
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*not including water (with water add approx. 5%)  
CS = bearing compressor side  
TS = bearing turbine side