Operation Manual

TPL65VA33

<table>
<thead>
<tr>
<th>Type</th>
<th>TPL65VA33</th>
<th>HT564962</th>
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</thead>
<tbody>
<tr>
<td>$n_{\text{M max}}$</td>
<td>503</td>
<td>650</td>
</tr>
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<td>$n_{\text{B max}}$</td>
<td>486</td>
<td>620</td>
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<tr>
<td>$t_{\text{M max}}$</td>
<td>$1/s$</td>
<td>$\text{°C}$</td>
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<tr>
<td>$t_{\text{B max}}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>01210 kg</td>
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</tr>
</tbody>
</table>

Year 2016

Application according to the Operation Manual

made in Switzerland

ABB Turbo Systems Ltd
CH 5401 Baden

ABB Turbocharging
Operating condition and replacement intervals

The operational limits for the turbocharger nBmax, tBmax, nMmax, tMmax, inspection- and replacement intervals for the components concerned on the rating plate are valid for the operational mode and compressor inlet condition, which has been agreed upon between the engine builder and ABB.

Note: Replacement intervals of components depends on the load profile, turbine inlet temperature, suction air temperature and turbocharger speed. In case the operation conditions differs significantly from what is considered to be normal for the current application, it is recommended to contact ABB for a re-calculation of replacement intervals. Frequent load alterations, high temperatures and high speed lower the life of components. Unless otherwise agreed, the application limits nMmax, tMmax are valid for the test operation for a limited time.
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1 Preliminary remarks

1.1 Purpose of this manual

This operation manual belongs to the turbocharger with the identical HT number (01), see the cover sheet of the operation manual and the turbocharger rating plate.

Operation Manual

This Operation Manual enables you to familiarize yourself with the turbocharger supplied by ABB Turbo Systems and to use it as intended.

It provides important information in order that the turbocharger can be operated safely, correctly and efficiently.

This Operation Manual complements and expands existing national regulations concerning work safety and accident prevention.

Target group

This Operation Manual is intended for engineers and qualified mechanics who are responsible for operating the engine and the turbocharger installed on it.

Availability of operation manual

An operation manual must be available at all times at the place where the turbocharger is used.

Everyone who operates or works on the turbocharger must have first read and understood the operation manual.
1.2 Layout and function

01 Filter silencer
02 Radial plain bearing
03 Thrust bearing
04 Bearing bush
05 Radial plain bearing
06 Gas outlet casing
07 Gas inlet casing
08 Nozzle ring
09 Turbine wheel
10 Bearing casing
11 Diffuser
12 Compressor wheel
13 Air outlet casing
Mode of operation

The turbocharger is a turbomachine and consists of the following main components:

- Turbine
- Compressor

These are both mounted on a common shaft.

The exhaust gases from the diesel engine flow through the gas inlet casing (07) and nozzle ring (08) to the turbine wheel.

The turbine wheel (09) uses the energy contained in the exhaust gas to drive the compressor wheel (12). The compressor then draws in fresh air and forces precompressed air into the cylinders.

The exhaust gases escape to free air through an exhaust gas pipe which is connected to the gas outlet casing (06).

The air which is necessary for operation of the diesel engine and is compressed in the turbocharger is drawn through the suction branch or the filter silencer (01) into the compressor wheel (12). It then passes through the diffuser (11) and leaves the turbocharger through the air outlet casing (13).

The rotor runs in two radial plain bearings (02/05). One plain bearing is in the bearing bush (04), and the second one is in the axial thrust bearing (03) at the compressor end.

The plain bearings are connected to a central lubricating oil duct which is fed with oil from the engine's lubricating oil circuit. The oil outlet is always at the lowest point of the bearing casing (10).

Turbocharger version with compressor wheel cooling system

Depending on its range of use, the turbocharger is provided with a compressor wheel cooling system. Compressor wheel cooling means that, after the charge air cooler at the engine end, cooled compressor air is delivered to the turbocharger to cool the compressor wheel.

In view of the respective operating conditions, it is absolutely essential that the compressor wheel is cooled in order to guarantee its reliability and replacement intervals. In the case of the turbocharger version with compressor wheel cooling, the cooling air is supplied through the side connection (15) in the bearing casing.
Additional function TPL..V.

These turbocharger types have adjustable guide vanes at the turbine end instead of a nozzle ring.
1.3 Intended use of the turbocharger

This turbocharger supplied by ABB Turbo Systems has been developed for use on diesel engines to generate the volume of air and the charging pressure required to operate the engine.

The engine builder has provided ABB Turbo Systems with information regarding the intended use of the engine, from which the operating limits specific to the turbocharger shown on the rating plate (such as operating speeds, temperatures, exchange intervals / replacement intervals) have been derived.

If it is used in conjunction with a gas engine, the engine must not be installed in a potentially explosive environment, and precautionary measures must be taken to ensure that the machine room as a whole is classified as not potentially explosive.

Any other use will be regarded as a special application which must first be discussed with ABB Turbo Systems. The manufacturer accepts no liability for other applications. If it is used otherwise, ABB Turbo Systems reserves the right to reject all warranty claims.

This turbocharger was built according to state-of-the-art technology and is operationally safe according to recognised safety regulations.

Improper operation and maintenance of the turbocharger can result in danger to life and limb of the user or third parties. In addition, improper use may cause damage to the machine.

- The machine may be operated only by trained personnel.

Use of the turbocharger as intended also includes observance of the installation / fitting, disassembly / removal, operating, maintenance / servicing and repair conditions specified by the manufacturer. Disposal regulations set down by local authorities must be observed.

The turbocharger may be installed only when in technically perfect condition while observing the instructions given in the engine builder’s manual. It may be used only for the intended purpose and operated in compliance with the operation manual.

- Malfunctions which could affect safety must be eliminated immediately.

The manufacturer accepts no liability for any damage resulting from unauthorised alterations to the turbocharger.
1.4 Storage of new turbochargers and spare parts

Storage of new turbochargers and spare parts up to 6 months

New turbochargers and spare parts from ABB Turbo Systems can be stored in sealed packaging without additional mothballing measures for up to 6 months from the date of delivery (marked by the VCI label on the package).

Volatile Corrosion Inhibitor (VCI)

Only dry rooms in which the relative humidity is between 40…70 % and no condensation can form are suitable for storage.

Storage of new turbochargers and spare parts for more than 6 months (VCI)

Protection of health when handling VCIs

VCI products are not hazardous in the sense of the Hazardous Substances Ordinance. Nevertheless, the following points are to be observed when handling VCIs:

► Ensure good room ventilation.
► Do not eat, drink or keep food at the workplace while working with VCIs.
► Wear safety gloves.
► Clean hands and face after working with VCIs.
► For further information refer to www.branopac.com.

Wear safety gloves against chemical risks.

The following mothballing measures are required every 6 months:

► Open the package.
► Remove the VCI corrosion protection emitter from the package and replace it with a new, identical VCI corrosion protection emitter. New VCI corrosion protection emitters can be obtained at www.branopac.com.
► Dispose of the old VCI corrosion protection emitter in an environmentally compatible manner, professionally and in accordance with local regulations.
► Seal the package. The better the external seal is designed, the more permanent the protection.
Long-term storage of replacement turbochargers or spare parts

Per order, turbochargers or cartridge groups will be prepared by ABB Turbo Systems for prolonged storage. The package is equipped with a hygrometer (see illustration).

The following measures are required every 6 months:

- Check the hygrometer (02) in the sight-glass. There is an opening (01) in the wooden crate which allows this check to be carried out. When the display field has changed colour at the 70% level, the maximum permissible humidity has been exceeded. In this case the turbocharger or rotor must be inspected by an ABB Turbocharging Service Station and repacked.

- Inspect the package for damage. If the package is damaged, the turbocharger or cartridge group must be inspected by an ABB Turbocharging Service Station and repacked.

After every 3 years the following work steps must be performed by an ABB Turbocharging Service Station:

- Inspect the components
- Exchange the desiccant agent
- Repackage the components.

Replacement components ready for operation

If the 70% display field of the hygrometer (02) has not changed colour and the package is undamaged, the replacement turbocharger or replacement cartridge group can be placed into operation without any prior testing by an ABB Turbocharging Service Station.

Unpacking replacement turbochargers or spare parts

The corrosion protection effect ends after the material is unpacked from the VCI package.

To avoid the formation of condensation, the surroundings and the content of the package must have the same temperature during unpacking.
1.5 Essential information

Organisational measures

In addition to this manual, the general, statutory regulations applicable in the respective country for the prevention of accidents and the protection of the environment must be observed.

This also applies to the provision and wearing of personnel protection equipment.

NOTICE

The safety and risk consciousness of the personnel working on and with the turbocharger must be checked regularly with reference to this manual.

▶ The turbocharger must be shut down immediately by stopping the engine in the event of alterations affecting safety or of corresponding operating behaviour. The fault must be reported to the person or department responsible.

NOTICE

Additions and alterations to, and conversions of the turbocharger that could compromise safety require the prior approval of ABB Turbo Systems.
Original parts and safety

Original parts and accessories are specially designed for the turbocharger supplied by ABB Turbo Systems.

**Use original parts**

Operation of the turbocharger with non-original parts can impair the safety of the turbocharger and can cause serious damage to property and injury to personnel.

- Only use original parts from ABB Turbo Systems.

ABB Turbo Systems accepts no liability for any damage resulting from the use of non-original parts and corresponding accessories.

**Competence of personnel**

The turbocharger must only be operated and serviced by trained and authorised personnel. Basic mechanical training is a prerequisite.
Design variants
This document is valid for different design variants of turbochargers. There may be sections and descriptions of components that are not relevant for a specific turbocharger variant.

ABB Turbocharging Service Stations will be happy to provide information on questions regarding a design variant (see Contact information at www.abb.com/turbocharging).

Accuracy of illustrations
The illustrations in this document are general in nature and intended for ease of understanding. Differences in detail are therefore possible.

Registered trademarks
Registered trademarks of external companies are used in this document. The trademarks are marked with ®.
1.6 Symbols and definitions

The following symbols are used in the documents:

▷ Prerequisite

► Work step

■ Enumeration, first level

- Enumeration, second level

Definition of notes

**Note**

A note provides suggestions which facilitate the work on the product.

Definition of mandatory signs

Mandatory signs show the protective equipment to be worn for a task. The mandatory signs are described in chapter Safety and must be complied with.

Definition of caution / warning

The caution and warning signs are described in the chapter Safety.

**ABB Turbo Systems**

In this document, ABB Turbo Systems Ltd is abbreviated to ABB Turbo Systems.

**Official ABB Turbo Systems Service Stations**

In this document, official service stations are referred to as ABB Turbocharging Service Stations. They are inspected and certified regularly by ABB Turbo Systems. See also chapter Contact information [➙ 18].
1.7 Turbocharger rating plate

Operating limits

01 Turbocharger operating limits at engine overload (110%). Only when operating in the test rig unless otherwise agreed with the enginebuilder.

02 Turbocharger operating limits during operation

Recommended replacement intervals for turbocharger components

03 Replacement interval for plain bearings in 1000 h
04 Replacement interval for compressor in 1000 h
05 Replacement interval for turbine in 1000 h

Further information

06 Part number for customer
07 Designation of special design
08 Turbocharger weight in kg
09 Turbocharger type
10 Serial number
11 Year of turbocharger construction
1.7.1 **Explanation of the rating plate**

The recommended replacement intervals and the corresponding operational limits are jointly defined with the engine manufacturer. This information is specific to the system.

Operation above the indicated values \( n_{\text{Bmax}} \) and \( t_{\text{Bmax}} \) can considerably shorten the recommended replacement intervals. In such cases, we recommend that you contact the nearest official ABB Turbocharging service station.

\( n_{\text{Mmax}} \) and \( t_{\text{Mmax}} \) normally apply only when running at overload (110%) during trials on the engine test bed. These limits can also be permitted during operation for special applications. Operation above \( n_{\text{Mmax}} \) and \( t_{\text{Mmax}} \) is not permitted.

Non-observance of the recommended replacement intervals can increase the risk of unpredictable component failures.

1.7.2 **Positions of the rating plates**

A rating plate is attached to the turbocharger foot, one on the left and one on the right. In the case of turbochargers with insulation supplied by ABB Turbo Systems, at least one additional rating plate is attached to the insulation of the gas outlet casing.
1.8 Contact information

Contact information

Contact information for the official service stations of ABB Turbo Systems is available online.

► Scan the QR code to access our website.

ABB Turbo Systems AG
Bruggerstrasse 71a
CH-5401 Baden
Switzerland

www.abb.com/turbocharging
2 Safety

2.1 Introduction

Turbochargers manufactured by ABB Turbo Systems are state of the art and comply with the pertinent safety and health-protection requirements that applied when the turbocharger was manufactured. Consequently, the turbocharger is safe to operate. Nevertheless, during turbocharger operation and when working on the turbocharger, residual risks can exist which:

- originate from the turbocharger itself and its accessories
- originate from the operating and auxiliary materials used
- are the consequence of insufficient observance of the safety instructions
- are the consequence of unsatisfactory and improper execution of maintenance and inspection work

The operator is responsible for access to the turbocharger as well as the organisational measures which regulate the safe handling of the turbocharger by his personnel.

All instructions in this chapter must be observed to ensure safe and trouble-free turbocharger operation and during work on the turbocharger.

In the same vein, all other specially marked safety instructions in every chapter of this manual must be observed (see the section entitled Definition of safety instructions).
2.2 **CE conformity**

**Information**

ABB turbochargers fulfil Directive 2006/42/EC on machinery and are considered partly completed machinery in the sense of Article 2 g.
### 2.3 Definition of mandatory signs

<table>
<thead>
<tr>
<th>To be worn at all times</th>
<th>To be worn according to the specific work</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Protective clothing</strong></td>
<td><strong>Safety glasses</strong></td>
</tr>
<tr>
<td><strong>Safety footwear</strong></td>
<td><strong>Safety goggles</strong></td>
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<tr>
<td></td>
<td><strong>Safety gloves</strong> against</td>
</tr>
<tr>
<td></td>
<td>- mechanical hazards</td>
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<tr>
<td></td>
<td>- chemical hazards</td>
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<tr>
<td></td>
<td>- heat hazards</td>
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<tr>
<td></td>
<td><strong>Respiratory mask</strong> against</td>
</tr>
<tr>
<td></td>
<td>- dust</td>
</tr>
<tr>
<td></td>
<td>- gases</td>
</tr>
<tr>
<td><strong>Safety helmet</strong></td>
<td><strong>Ear protection</strong></td>
</tr>
</tbody>
</table>
2.4 Definition of Safety instructions

The following symbols and terms used in this manual concern safety or refer to possible hazards:

### Definition of warning

![WARNING]

Serious personal injuries and even accidents with fatal consequences may occur if work and operating instructions marked with this symbol and the word **WARNING** are either not followed or not followed precisely.

- **Warning signs must be observed at all times.**

### Definition of caution

![CAUTION]

Serious machine or property damage may occur if work and operating instructions marked with this symbol and the word **CAUTION** are either not followed or not followed precisely.

- **Caution signs must be observed at all times.**
2.5 Warning plates on the turbocharger

Warnings that have been attached to turbochargers by ABB Turbo Systems must not be removed. Illegible warnings must be replaced with new ones. Further information is available from ABB Turbocharging service stations.

<table>
<thead>
<tr>
<th>Part number</th>
<th>Size [mm]</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>81080</td>
<td>105 x 74</td>
<td>TPL / TPR</td>
</tr>
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When uninsulated turbochargers are delivered to the engine builder, the warning plates must be subsequently attached to the insulation. This is the responsibility of the engine builder.
2.6 Safe operation and maintenance

The instructions specified in this section are for the safety of personnel. Together with the instructions in the Hazards during operation and maintenance section, they allow the user to safely use the turbocharger.

Work safety and work area safety

Risk of falling

There is the risk that someone can fall when working on the turbocharger.

► Do not climb on the turbocharger or on parts attached to it or use these as climbing aids.
► When working at levels above the head, use climbing aids and work platforms suitable for this purpose.

► Observe all general regulations for the prevention of accidents.
► Do not work on the turbocharger if you are under physical or mental stress.
► Work only with suitable tools as well as equipment and working materials that are in perfect condition.
► Electric tools must be solidly earthed, and connecting cables may not be damaged.
► Keep the workplace clean, clear away loose objects and remove obstacles on the floor.
► Keep the floor, equipment and the turbocharger clean.
► Have oil binding materials ready at hand and keep oil catch pans ready or in position
► Eliminate leaks.
► Keep fire-protection materials and fire-extinguishing equipment ready.

Welding work

► If welding work is being carried out above the turbocharger, make sure to cover the filter silencer so that the filter mat is not damaged.
► Remove combustible objects and substances out of the range of flying sparks.
► Cover all connections on the turbocharger so that no foreign objects can get into the turbocharger.
Safety during start-up / commissioning and operation

▶ Before starting work, carry out visual inspection of working area.
▶ Remove any obstacles and objects lying around.
▶ Before start-up / commissioning, check all pipes from and to turbocharger for damage and leaks.
▶ Don't work in any way that could impair safety when working on turbocharger.
▶ After about every 12 hours of operation or at least once a day, inspect turbocharger for visible damage and defects.
▶ Immediately report any damage or changes in operational performance to person responsible.
▶ If damage is discovered, immediately shut down turbocharger and secure it against inadvertent or unauthorized use.
▶ When switching on auxiliary power sources (hydraulics, pneumatics, electricity, water), keep an eye open for any hazards resulting from supplying these power sources.

Safety during cleaning

It is possible that detergents or solvents will be used for cleaning. In this case, the safety instructions of the Hazard due to operating materials and supplies section in this chapter must always be observed.

▶ Protect the floor against unintentional penetration of detergents or solvents before starting cleaning operations.
▶ Wear appropriate protective clothing.
▶ Inspect the electric cables for abrasion and damaged areas before and after your cleaning work.
Safety during disassembly, assembly, maintenance and troubleshooting

► Always perform the specified adjustments, servicing as well as inspection work and observe inspection intervals.
► Inform operating personnel about all service and repair work before beginning.
► Before opening a cover or removing a protective device on a turbocharger, the engine must be switched off and the turbocharger must have come to a standstill.
► Ensure that the supply of oil is interrupted, especially with an external oil supply.
► Put the engine into operation only after all parts have been refitted properly.

Mechanical work on the turbocharger
Possible damage to or destruction of components on the turbocharger.
► Perform only those tasks that are described in this manual.
► Perform work only for which training has been carried out.

Safety when taking out of operation or mothballing

► Secure the rotor so it cannot turn. The rotor can turn on its own from the force of the stack draught.
► Clean the turbocharger before mothballing it.
► Wear appropriate protective clothing.
2.7 Hazards during operation and maintenance

Mechanical hazards during operation

During normal operation, no mechanical hazards emanate from the turbocharger if it has been installed properly.

**Risk of injury**

Contact with rotating parts can lead to serious injuries. The turbocharger must never be operated without a filter silencer or an air suction branch. When the engine is at a standstill, the rotor can turn on its own because of stack draught.

- Operate the turbocharger in accordance with instructions.
- During maintenance work, secure the rotor against unintentional rotation.

Mechanical hazards when working on the turbocharger

During maintenance work, various risks can occur through the improper handling of components, through the non-observance of work instructions, due to inadequate care or as a consequence of insufficient training.

**Mechanical hazards**

Serious personal injuries or accidents with fatal consequences can occur through mechanical influences as a result of risky, improper working methods.

- Heed the general rules for work safety and accident prevention.
- Ensure the safety of the work area.
- Perform only those tasks that are described in this manual.
- Perform work only for which training has been carried out.
Hazards during operation and maintenance

Hazards due to noise

The development of noise during operation is influenced by the installation and operating conditions. Noise with a sound pressure level exceeding 85 dB(A) is harmful.

**WARNING**

**Hazards due to noise**

Noise can cause impaired hearing, damage to health, mental disturbances, diminished attention and irritation.

- Always wear ear protection when the engine is running.
- When the sound pressure level is above 85 dB(A), always wear ear protection.

Wear ear protection.

Hazards due to hot surfaces and substances

During operation, turbocharger surfaces and attached parts as well as operating materials (lubricating oil) become hot. The surface temperature is dependent on the effectiveness of the insulation being used. The temperature can become high enough so that it falls into ranges where burns are possible.

**WARNING**

**Risk of burning**

Touching hot surfaces or contact with hot operating materials can lead to serious burns.

- Do not touch hot surfaces and heed the warning plate on the turbocharger.
- Wear heat-resistant safety gloves and protective clothing.
- Allow the turbocharger to cool down before carrying out any work.

Wear safety gloves against thermal risks.
Hazards during operation and maintenance

Hot surfaces on uninsulated turbochargers

Uninsulated turbochargers can cause serious personal injuries (burns). The turbocharger is supplied by ABB Turbo Systems without insulation depending on the order from the engine builder. In this case, the engine builder is responsible for insulating the turbocharger properly or for providing protection against hot surfaces being touched.

- The engine builder's instructions and specifications about protection against hot turbocharger surfaces must be observed in every case.

Hazards due to operating and auxiliary materials

Operating and auxiliary materials are substances used for operation or the execution of maintenance work. Oils, greases, coolants, cleaning agents and solvents, acids, etc. can be regarded as hazardous materials. Operating and auxiliary materials can be combustible and easily ignited.

Handling operating and auxiliary materials

Ingestion or inhalation of vapours of operating and auxiliary materials or contact with such can cause damage to health.

- Avoid inhalation and contact with the skin.
- Ensure good ventilation.
- Observe details in the safety data sheets of the operating and auxiliary materials.
- Observe local laws.

- Wear safety goggles.
- Wear safety gloves against chemical risks.
- Wear a respiratory mask to protect against gases.
Hemeralopía
treball per les

Strobilometria de

Especials

Observacions

Investigador

Fisura

Fisiologia

Aparat d'ana

Estrat de

Núvols

Catalan al

Aparat

Estrat de

Núvols

Catalan al

Aparat

Estrat de

Núvols

Catalan al

Aparat

Estrat de

Núvols

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Núvols

Catalan al

Aparat

Estrat de

Núvols

Catalan al

Aparat
Hazard during operation and maintenance

Hazzards when handling insulating materials

**Hazards due to insulating materials**
Dust and fibres from insulating materials can cause damage to health or irritations. Unsuitable, combustible insulating materials signify a fire hazard.

- Use only suitable, non-combustible insulating materials.
- Ensure that the work area is well ventilated.
- Avoid stirring up dust.
- Use tools and processes which keep dust to a minimum.
- Remove packing materials only in the work area.
- Take particular care when removing old insulating materials.
- Dispose of insulating materials properly and in an environmentally compatible way in accordance with applicable local regulations.

Wear safety goggles.

Wear a respiratory mask to protect against particles.

Wear safety gloves against chemical risks.

- Use only suitable, non-combustible insulating materials.
- Ensure that the work area is well ventilated.
- Wear suitable work clothing (safety glasses, respiratory mask).
- Avoid stirring up dust.
- Use tools and processes which keep dust to a minimum.
- Remove packing materials only in the work area.
- Take particular care when removing old insulating materials.
- Dispose of insulating materials properly and in an environmentally compatible way in accordance with applicable local regulations.
Hazards due to electrical components

**WARNING**

**Hazards due to electrical components**

Electrical components operate with voltages which can present hazards to humans.

- All work on or with electrical components may only be performed by trained specialists.
- Heed any country-specific regulations.
2.8 Periodic checking of the pressure vessel

The pressure vessels used by ABB Turbo Systems, such as those for wet or dry cleaning, are so-called "simple pressure vessels".

- The local, statutory regulations covering periodic checks of pressure vessels must be observed.
- The operator is responsible for the safe operation of the pressure vessel.

**WARNING**

Hazards from pressure vessels

The operator must keep the pressure vessel in a proper condition and monitor it. Necessary repair or maintenance work must be carried out without delay and the required safety precautions must be taken.

- Pressure equipment must not be operated if it has defects.
2.9 Lifting loads

**Suspension loads**

Loads not suspended in compliance with regulations may lead to personal injury or accidents with fatal consequences.

- Loads must always be fastened to technically perfect lifting gear with sufficient loading capacity.
- Make sure the load is suspended properly on the crane hook.
- Do not let anyone stand beneath a suspended load.

Wear safety gloves against mechanical risks.

Wear safety helmet.

In the case of two or more suspension points, the slinging angle must not exceed 45°. This avoids excessive loading due to inclined tensile loading.

- Fasten turbocharger assemblies / components as described in respective handling steps.
- Before attaching slings, allow turbocharger components to cool down (maximum 80°C).
- Use suitable protection at sharp edges.
- Completely screw in assembly / fitting devices without fail so that they cannot work loose during use.
- Use assembly / fitting devices only for applications described.
- Make sure removed turbocharger components stand safely and securely.
3 Commissioning

3.1 Oil supply

A carefully designed and installed oil supply, which functions in all possible operational conditions, is an important prerequisite for trouble-free turbocharger operation.

The turbocharger is normally lubricated with oil from the engine oil circuit.

With regard to the oil supply, please observe the engine builder's specifications for lubricating oil selection, oil change intervals, oil filtration, oil pressure and oil temperature.

Oil filtration

A lubricating oil filter system with a filter mesh size of ≤ 0.034 mm is adequate for this turbocharger.
Oil pressure

The oil pressure in front of the turbocharger must be maintained precisely to ensure trouble-free operation.

The permissible oil pressure ranges at measuring point M (blind connection) on the turbocharger are listed below.

<table>
<thead>
<tr>
<th>Status for operation</th>
<th>Oil pressure in front of the turbocharger [bar]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permissible, for normal operation</td>
<td>1.3 ... 2.5</td>
</tr>
<tr>
<td>Permissible, during engine warm-up</td>
<td>1.3 ... 5.0</td>
</tr>
<tr>
<td>Temporarily permissible ( &lt; 1 h ) -&gt; alarm</td>
<td>1.1 ... 1.3</td>
</tr>
<tr>
<td>Not permissible -&gt; emergency stop</td>
<td>0.0 ... 1.1</td>
</tr>
<tr>
<td>Permissible, during pre- and post-lubrication (engine stopped)</td>
<td>0.2 ... 2.5</td>
</tr>
</tbody>
</table>

**NOTICE**

Oil orifice

To make sure these oil pressures are obtained, a regulating orifice is fitted in the turbocharger oil inlet. The orifice is fitted by the engine builder and secured by a safety ring.
Oil temperature

Lubricating oil temperature at the inlet

Machine damage
If the oil temperature at the oil inlet exceeds the admissible range, this may lead to engine damage.
> Observe oil temperature at the oil inlet according to the following table.

<table>
<thead>
<tr>
<th>Status for operation</th>
<th>Oil temperature at the inlet $T_{\text{oil,inlet}}$ [°C]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permissible</td>
<td>30 … 90</td>
</tr>
<tr>
<td>Temporarily permissible (&lt; 1h) -&gt; alarm</td>
<td>&gt; 90</td>
</tr>
<tr>
<td>Not permissible -&gt; stop the engine</td>
<td>&gt; 95</td>
</tr>
<tr>
<td>Not permissible -&gt; Do not start the engine</td>
<td>&lt; 30</td>
</tr>
<tr>
<td>(before starting: preheat the oil)</td>
<td></td>
</tr>
</tbody>
</table>

Lubricating oil temperature at the outlet
The oil temperature at the outlet is mainly dependant on:

- Lubricating oil temperature and pressure at the oil inlet
- Engine load and turbocharger speed
- Exhaust gas temperature

The maximum admissible oil temperature at the outlet is listed in the following table. The specified oil outlet temperature is to be considered as alarm value for the turbocharger operation and must be monitored according to the current regulations.

<table>
<thead>
<tr>
<th>Status for operation</th>
<th>Oil temperature at the outlet $T_{\text{oil, outlet}}$ [°C]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permissible</td>
<td>≤ 140</td>
</tr>
<tr>
<td>Temporarily permissible -&gt; alarm</td>
<td>&gt; 140</td>
</tr>
<tr>
<td>Not permissible -&gt; stop the engine</td>
<td>&gt; 160</td>
</tr>
</tbody>
</table>

If the turbocharger was operated for a longer period of time outside of the admissible range, ABB Turbo Systems recommends to have the turbocharger inspected by an ABB Turbocharging Service Station.
### 3.2 Inspection work

Inspection work includes preventive visual controls plus monitoring and measuring work before and during commissioning. Inspections help detect changes to the turbocharger. Machine damage can be avoided.

#### 3.2.1 Inspection before commissioning

- **Monitoring equipment**
  - Check for correct functioning.

- **Air filter mat**
  - Inspect for damage.

- **Lubricating system**
  - Check oil filter for cleanliness before commissioning.

**CAUTION**

It is urgently recommended that the entire lubricating system be flushed thoroughly with warm oil using a bypass pipe before starting up the first time (commissioning) and after all service work on the lubricating system.

It is urgently recommended that a running-in filter is used when running in the engine and after all service work on the lubricating system.

- Check the oil pressure in the oil supply lines.

- **TPL..VA**
  - Check that variable turbine geometry module can be adjusted.

**TPL65: Version with compressor wheel cooling system**

- Check whether compressor wheel cooling system is fitted to bearing casing.

**Failure of compressor wheel cooling system**

The service life of the compressor wheel will be impaired if the breakdown of the compressor wheel cooling system lasts long.

- Ensure supply of cooling air.
3.2.2 Check after start-up (engine at idling speed)

Lubricating system

- Check oil pressure in oil supply lines.
- Check oil inlet temperature.

The permissible values are listed in the section Oil supply.

Gas, air and oil lines

- Check all gas, air and oil lines for leaks after starting the engine.

3.2.3 Check when running up engine

- Measure the speed, oil pressure and charging pressure at various engine performance levels.
- Measure the exhaust gas temperature in front of and behind the turbine.
- Measure the air temperature in front of and behind the compressor.
- Check the functioning of the variable turbine geometry module.

The measured values must be compared with the values in the acceptance test report while taking different operating conditions into account.

NOTICE

Lubricants and pastes used during assembly of the turbocharger liquefy or vaporise and might escape as an oily liquid in the first few hours after commissioning. If oily liquid continues to escape after this period, the operator is to search for the cause of a possible oil leak. The first step is to check the seal for the oil supply to the turbocharger. If this is not in proper condition, contact an official ABB Turbocharging service station.

3.2.4 Inspection after 100 service hours

Clean or replace lubricating oil filters after the first 100 service hours.
3.3 Commissioning after taking out of operation

If provided

- Remove cover plates (blind flanges) between compressor casing outlet and charge air duct, before gas inlet and after gas outlet.

- Inspect exhaust gas duct / line in front of and after turbine for any combustion deposits, foreign matter or residual water. Clean and remove.

- Inspect air supply line or filter silencer for any foreign matter. Clean and remove.

- Start up turbocharger oil circulation system at engine end.

- Prepare turbocharger for operation as instructed in section "Inspection work before start-up / commissioning" of chapter headed "Start-up / commissioning".

- Start up turbocharger.

TPL65: Version with compressor wheel cooling system

- Remove screw plug on cooling air connection and fit cooling air line.
4 Operation

4.1 Noise emissions

**Hazards due to noise**

Noise can cause impaired hearing, damage to health, mental disturbances, diminished attention and irritation.

- Always wear ear protection when the engine is running.
- When the sound pressure level is above 85 dB(A), always wear ear protection.

Wear ear protection.

The sound pressure level (A-weighted) of emissions is measured at a distance of 1 metre from the turbocharger.

The highest sound pressure level of emissions\(^1\) reaches a maximum of 105 dB(A) near the filter silencer and over the entire speed range.

The following prerequisites must be fulfilled on the turbocharger in order to observe this limit value:

- Fitted air-inlet system
- All standard, noise-reducing measures have been taken\(^2\).
- The bellows at the air outlet have been perfectly insulated acoustically by the engine builder. He is also responsible for insulating the charge air / scavenging air line and the charge air cooler.

\(^1\) Directive 2006/42/EC, 1.7.4.2 / u / Paragraphs 5 + 7: A-weighted emission sound pressure level

\(^2\) In the event of divergent insulation designs, the engine builder must ensure that equivalent acoustic insulating measures are taken.
Suggestion for noise insulation of the bellows

01 Compressor casing
02 Bellows
03 Charge air duct / scavenging air line
04 Insulation pads
05 Insulation mat (at least 15 mm)
06 Sheet metal cover
4.2 Servicing work

Service work to be carried out during operation involves visual checks, monitoring, measuring, inspection work and functional checks. It is then possible for changes to the turbocharger to be identified and rectified. In this way, it can be ensured that the turbocharger remains in full working order.

Service intervals

Service work on the turbocharger that is neglected or carried out too late can lead to excessive contamination and wear as well as operating failures.

- Carry out service work at specified time intervals.

Shortened service intervals

Despite observance of the service intervals, unusual loads, such as several start-stops a day, harsh environmental factors, poor fuel quality or heavy installation vibration can lead to premature machine damage.

- A shortened service interval must be arranged with ABB Turbo Systems.

Service inspection after 5 years

To prevent age- and stoppage-related machine damage, an inspection by an ABB Turbocharging Service Station is recommended at the latest 5 years after the last service.

4.2.1 Service work every 25 ... 50 hours

- Visual inspection for air, exhaust gas, water and oil leaks.
- Record operating data and enter it in the engine logbook.
- Clarify the cause of any variances.

Unknown changes during operation

The consequences can range from an impairment to a breakdown.

- Have unknown causes clarified by an ABB Turbocharging service station.
4.2.2 Entries in engine logbook

By monitoring the engine, conclusions can be drawn about the turbocharger performance.

The following operating data and measured values must be entered regularly in the engine manufacturer's engine logbook:

- Engine performance and speed
- Air intake temperature
- Exhaust gas temperature in front of and behind the turbine
- Pressure of charge air
- Pressure drop in charge air cooler
- Lubricating oil pressure and lubricating oil temperature

If provided

- Air temperature behind compressor and charge air cooler
- Turbocharger speed
- Pressure loss in air filter

4.2.3 Servicing work according to the engine manufacturer's instructions

Oil filter

- Clean or replace oil filter in supply line to turbocharger when engine is not running.
4.2.4 Service work every 15000 hours

Inspection and assessment of the rotor and bearing parts as well as replacement of the variable turbine geometry module with a CPEX variable turbine geometry module must be carried out by an ABB Turbocharging Service Station.

▷ It is recommended that the turbocharger is inspected once a year, but at least after every 15000 operating hours.
  ▶ Disassemble turbocharger
  ▶ Clearance measurement
  ▶ Clean the turbine and compressor wheels and inspect for damage
  ▶ Clean the turbine and compressor casings and inspect for any cracks and erosion or corrosion
  ▶ Clean bearing casing and blow air through oil ports
  ▶ Inspect and assess sealing air lines
  ▶ Inspect and assess rotor and bearing parts
  ▶ Have the variable turbine geometry module overhauled by ABB Turbo Systems. ABB Turbocharging Service Stations have variable turbine geometry modules replaced with overhauled ones as part of the CPEX (Customer Part Exchange) programme.

4.2.5 Service work every 30000 hours

The replacement of bearing parts as well as the inspection and assessment of the rotor must be carried out by an ABB Turbocharging Service Station.

▶ Disassemble turbocharger.
▶ Measure clearances.
▶ Clean the turbine and compressor wheels and inspect for damage.
▶ Clean the turbine and compressor casings and inspect for any cracks and erosion or corrosion.
▶ Clean bearing casing and blow air through oil ports.
▶ Inspect and assess rotor and bearing parts.
▶ Replace bearings (original parts from ABB Turbo Systems).
4.3 Replacement intervals for turbocharger components

Rotating components

The recommended replacement intervals for the compressor and turbine wheels due to stress caused by centrifugal forces and load cycles are calculated under consideration of the operating conditions while applying the safety concept for rotating components. They can be found on the turbocharger rating plate. Incalculable influencing parameters can shorten the recommended replacement intervals for the rotor, see Influencing parameters.

Non-rotating components

The expected replacement intervals for non-rotating components and bearing parts are extremely dependent upon system-specific operating conditions, see Influencing parameters.

When the specified, periodic inspections are carried out, the individual components are inspected for wear and tear and replaced if necessary. In this way, trouble-free operation is ensured.

Influencing parameters

The following parameters influence the replacement intervals for turbocharger components:

Parameters influencing bearing parts

- Poor quality of the lubricating oil (lubrication oil filter system, condition of lubricating oil)
- Unusual loads (vibration, start/stop frequency)
- Non-permissible state of rotor unbalance

Parameters influencing non-rotating components exposed to exhaust gas

- Fuel quality (gas, MDO, HFO)
- Load profile (thermal load changes, number of starts/stops)
- Temperature level of exhaust gas
- Turbine cleaning frequency
- Procedure for turbine cleaning
### Parameters influencing rotating components exposed to exhaust gas

- Fuel quality (gas, MDO, HFO)
- Turbine cleaning frequency
- Procedure for turbine cleaning
- Load profile

<table>
<thead>
<tr>
<th>Expected replacement intervals [h]</th>
<th>GAS / MDO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas inlet casing</td>
<td>50000 ... 100000</td>
</tr>
<tr>
<td>Gas outlet casing</td>
<td>50000 ... 100000</td>
</tr>
<tr>
<td>Variable turbine geometry module</td>
<td>15000</td>
</tr>
<tr>
<td>(The variable turbine geometry module can be replaced with a CPEX variable turbine geometry module by an ABB Turbocharging service station.)</td>
<td></td>
</tr>
<tr>
<td>Turbine diffuser / cover ring</td>
<td>35000 ... 50000</td>
</tr>
<tr>
<td>Other casings</td>
<td>100000</td>
</tr>
<tr>
<td>Axial bearing components</td>
<td>24000 ... 36000</td>
</tr>
<tr>
<td>Radial bearing components</td>
<td>24000 ... 36000</td>
</tr>
<tr>
<td>Turbine blades (due to wear)</td>
<td>- -</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recommended replacement intervals [h]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotor components</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GAS</th>
<th>= Gas Engine</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDO</td>
<td>= Marine Diesel Oil</td>
</tr>
</tbody>
</table>

**NOTICE**

The specified values are guides and not guaranteed. *(See Influencing parameters.)*
4.4 Speed measurement

A speed measuring system permits continuous monitoring of the turbocharger speed.

**Do not use cables as a climbing aid**
If you pull the speed measurement cables too hard, contacts can be pulled out.

- Do not tension the speed measurement cables.

<table>
<thead>
<tr>
<th>Part number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>42047</td>
<td>Screw plug</td>
</tr>
<tr>
<td>86505</td>
<td>Speed sensor</td>
</tr>
<tr>
<td>86515</td>
<td>Cable connector for 86505</td>
</tr>
<tr>
<td>86526</td>
<td>F/I converter</td>
</tr>
<tr>
<td>86528</td>
<td>Tachometer</td>
</tr>
</tbody>
</table>
4.4.1 Speed differences with multiple turbochargers per engine

The speeds of all turbochargers on one engine differ only slightly from each other in normal operation.

The difference between the highest and the lowest turbocharger speed must not be more than 3 % relative to the speed limit \( n_{B\text{max}} \).

If this permissible range of difference is exceeded, the following steps must be carried out:

- Reduce engine performance immediately until the highest turbocharger speed no longer exceeds 70% of \( n_{B\text{max}} \).
- If the engine cannot be stopped, continue to run at this reduced engine performance or turbocharger speed.
- If the turbocharger surges continuously, engine performance must be reduced further.
- Measure the temperatures in the air and gas lines to and from the turbochargers and compare them with standard values.

If the engine can be stopped for a short time:

- Inspect the air and gas lines as well as the turbocharger and eliminate any problems.
- In any event, it is recommended that you contact the nearest ABB Turbocharging Service Station.
4.4.2 Assembly

If the speed sensor is not fitted on the turbocharger, the following procedure must be adopted to fit it:

▷ Engine and turbocharger are not running.
▷ The turbocharger lubricating system is switched off.
▷ Remove screw plug (42047) from bearing casing.

**Part position**
The position of the screw plug for measuring the speed is marked "n" on the bearing casing.

▷ Screw in speed sensor (86505) as far as it will go and tighten to torque specified in table. (See chapter Table of tightening torques.)
▷ Connect speed sensor using cable connector (86515).
4.4.3 Replacing the speed sensor

**WARNING**

Hot cable connector and hot speed sensor
Risk of burning. During operation, the cable connector and the speed sensor can reach temperatures exceeding 100 °C.
- Wear safety gloves when removing the cable connector and speed sensor.
- Wear safety gloves against thermal risks.

- Reduce engine performance to the idling speed, then stop the engine.
- Switch off the lubricating oil supply to the turbocharger.
- Disconnect the cable connector from the speed sensor.
- Screw out defective speed sensor.

- Screw in a new speed sensor up to the limit block.
- Observe the tightening torque (see the table of tightening torques in the chapter entitled Disassembly and assembly).

**NOTICE**

Sealing the speed sensor
The speed sensor is designed with a sealing lip and does not require an additional gasket when fitted.

- Connect cable connector to speed sensor.
- Switch on lubricating oil supply to turbocharger.

4.4.4 Failure of speed measuring system

Possible reasons for failure of the speed measuring system are described in the chapter Troubleshooting.
4.5 Emergency operation TPL..VA

In the event of failure of the control system or the drive, the variable turbine geometry module can be fixed by clamping the ring lever (B) using at least 3 washers (C) spaced around the circumference.

When fixing, the position of the variable turbine geometry module and / or the blades must be specified by the enginebuilder.
4.6 Stopping the engine

Stopping the engine
Heat in the turbocharger must be dissipated by the further circulating lubricating oil.

- Allow the engine to continue running at idling speed for a further 10 minutes before stopping.
5 Maintenance

5.1 Foreword to Maintenance

Maintenance and servicing work involves regular visual checks and cleaning to ensure that the turbocharger and its attached units function trouble-free.

- The external condition and how dirty the cleaning points specified in this chapter are, must be established by visual checks at the specified intervals.
- The safety precautions must be observed during all maintenance and servicing work.

The cleaning points described in the following are:

- Filter silencer
- Compressor
- Turbine and Guide Blades
5.2 Cleaning the filter silencer

5.2.1 Filter silencer and connecting rod

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>81265</td>
<td>Filter ring (if provided)</td>
</tr>
<tr>
<td>81269</td>
<td>Connecting rods</td>
</tr>
<tr>
<td>81266</td>
<td>Cover grid</td>
</tr>
<tr>
<td>81272</td>
<td>Screwdriver</td>
</tr>
<tr>
<td>E</td>
<td>Insert unit = absorption segment + sheet-metal covering</td>
</tr>
<tr>
<td>81135</td>
<td>Filter silencer body</td>
</tr>
<tr>
<td>81136</td>
<td>Absorption segment</td>
</tr>
<tr>
<td>81137</td>
<td>Sheet-metal covering</td>
</tr>
<tr>
<td>81138</td>
<td>Lock nut</td>
</tr>
</tbody>
</table>

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Cleaning the filter silencer

5.2
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Removing and cleaning filter silencer

If provided

- Remove filter strip (81265).
- Rinse filter strip (81265) using water with detergent additive or, if very dirty, soak it and squeeze out carefully. Rinse it in cold water. Avoid rough treatment (not a jet of water).

How dirty the filter strip (81265) is, depends on how clean the drawn-in air is. Clean filter strip every 500 hours of service or more frequently if necessary.

- Unscrew and remove lock nuts (81273).
- Unscrew and remove screws (81272) for connecting rods (81269).
- Remove connecting rods (81269).
- Carefully remove cover grids (81266).
- Pull out insert units (E), bend open sheet-metal coverings (81137) and then remove absorption segments (81136).
- Clean the absorption segments (81136). During cleaning, ensure that the absorption segments (81136) are only cleaned with a mild jet of compressed air, soft brush or a damp cloth. Otherwise there is a risk of damage or deformation.

Replace heavily contaminated or damaged parts with original parts from ABB Turbo Systems.
Fitting the filter silencer

- Assemble the insert units (E) by inserting the absorption segments (81136) into the sheet metal coverings (81137).
- Bend sheet metal coverings (81137) back to original shape.
- Insert the insert units (E) into slot guides in filter silencer unit (81135).

- Uniformly place cover grids (81266) in correct position.
- Push connecting rods (81269) through lugs of cover grids (81266).

CAUTION
If the connecting rods (81269) are not correctly positioned in their recesses on the filter silencer unit (81135), the cover grid (81266) can twist and shift. There is then a risk of foreign matter and contamination getting into the compressor.
Join connecting rods (81269) using screws (81272). When tightening the screws (81272), ensure that connecting rods (81269) are located correctly in recesses in filter silencer body (81135). Now tighten screws (81272) alternately until the following maximum torque is reached:

<table>
<thead>
<tr>
<th>Screw</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>81272</td>
<td>20</td>
</tr>
</tbody>
</table>

Screw lock nuts (81273) onto screw (81272) and tighten to following torque:

<table>
<thead>
<tr>
<th>Lock nut</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>81273</td>
<td>40</td>
</tr>
</tbody>
</table>

If provided

Fit filter strip (81265).
5.3 Cleaning the compressor during operation

**NOTICE**

These instructions for wet cleaning apply only when cleaning is carried out with clean water and the enginebuilder permits the process.

The degree of contamination of the compressor stage (compressor wheel and diffuser) depends on how clean the drawn-in air is.

Deposits of dirt can build up in the flow channels if the following substances are in the intake air:

- Oily or salty mist
- Solid combustion residues
- Various kinds of dust

Contamination of the compressor stage has a negative influence on the compressor efficiency and the charging pressure.

This results in higher exhaust gas temperatures and higher fuel consumption by the engine. Contamination of the compressor can also increase rotor unbalance.

Under no circumstances is periodic cleaning of the compressor during operation a substitute for the service work carried out when the turbocharger is completely dismantled and the compressor is cleaned mechanically.

**Cleaning interval**

The interval between periodic cleaning is very dependent on the operating conditions. In general, cleaning should be carried out every 25 to 100 operating hours.

**NOTICE**

*Cleaning intervals*

Should the specified cleaning intervals prove incompatible with engine operation, please contact ABB Turbo Systems.
Cleaning the compressor during operation

5.3

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Cleaning method

Cleaning of the compressor during operation is carried out using the cleaning method described in the following:

- Wet cleaning

This cleaning method has been tested and approved by ABB Turbo Systems.

Principle of wet cleaning

To clean the compressor stage during operation, water is injected in front of the compressor wheel through an injection pipe fitted in the filter silencer or the suction branch.

The water does not act as a solvent, but the dirt deposit is removed by the mechanical impact of the droplets. This is a very suitable process, provided that the degree of contamination is not too high.

CAUTION

Corrosion and deposits when cleaning

Damage and impairment of turbocharger parts due to salt water and cooling water additives

- Don't use salt water for cleaning, but only clean fresh water.

V-engines

In the case of V-engines with several turbochargers on each engine, we recommend parallel cleaning of the compressors. This cleaning process is faster and the risk of turbocharger surging is reduced.
5.3.1 Wet cleaning with orifice plate on filter silencer (XC2)

Operating state prerequisites for cleaning compressor with XC2

To be able to carry out a satisfactory cleaning process which has been tested and is recommended by ABB Turbo Systems, the following prerequisites must be fulfilled:

- Engine load 50 ... 85%
- Start of cleaning cycle in accordance with following description of wet cleaning operation with XC2.

Compressor wet cleaning operation with XC2

- Maintain water pressure before connection to turbocharger (during water injection time) must be maintained as shown in table Cleaning parameters.
- After cleaning, wait at least 5 minutes to allow turbocharger to dry.

If the cleaning process is unsatisfactory, it can be repeated up to 2 times.
If the cleaning result is still not satisfactory after three attempts and the engine values are also unsatisfactory, we recommend that you have the turbocharger inspected and cleaned by an official ABB Turbocharging Service Station.

Cleaning parameters per turbocharger compressor

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TPL65VA32/33</td>
<td>50 ... 85%</td>
<td>3</td>
<td>10</td>
<td>2.1</td>
</tr>
</tbody>
</table>
5.3.2 Wet cleaning using external water-pressure vessel (XC3)

Operating state prerequisites for compressor cleaning with XC3

**NOTICE**

To be able to carry out a satisfactory cleaning process which has been tested and is recommended by ABB Turbo Systems, the following prerequisites must be fulfilled:

- Engine load 50 ... 85%
- Start of cleaning cycle in accordance with following description for wet cleaning operation with XC3.

Compressor wet cleaning procedure with XC3

Operating the water pressure vessel

- It is mandatory to fulfil the operating condition prerequisites before cleaning compressors with XC3.
- Remove the sealing plug (X).
- Fill the vessel with the required volume of clean water (see the Table of cleaning parameters).
Cleaning the compressor during operation

- Screw in the sealing plug (X).
- Push the valve activator (Y) against the spring and hold it for 10 ... 15 seconds until the entire volume of water has been injected.
- After cleaning, wait at least 5 minutes to allow the turbocharger to dry.

**NOTICE**

If the cleaning operation is not satisfactory, it may be repeated up to two times.
If the cleaning results are still not satisfactory after three attempts and the engine values are also unsatisfactory, we recommend that you have the turbocharger inspected and cleaned by an official ABB Turbocharging Service Station.

### Cleaning parameters per turbocharger compressor

<table>
<thead>
<tr>
<th>Product</th>
<th>Engine load</th>
<th>Contents of water vessel [dm³]</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPL65</td>
<td>50 ... 85%</td>
<td>0.4</td>
</tr>
</tbody>
</table>
5.4 Cleaning turbines and guide vanes during operation

**NOTICE**

**HFO applications**
The TPL65VA.. has not been released for HFO applications. Wet cleaning of the turbine blades and guide vanes during operation is thus neither required nor planned.
6 Troubleshooting

6.1 Malfunctions when starting

Sluggish start-up

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
<td>Clean it</td>
</tr>
<tr>
<td>Turbocharger contaminated</td>
<td>Clean it</td>
</tr>
<tr>
<td>Damaged bearing</td>
<td>Contact an ABB Turbocharging Service Station</td>
</tr>
<tr>
<td>Rubbing rotor</td>
<td></td>
</tr>
<tr>
<td>Foreign object in turbocharger</td>
<td></td>
</tr>
</tbody>
</table>

Vibrations

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
<td>Contact an ABB Turbocharging Service Station</td>
</tr>
<tr>
<td>Rotor unbalance</td>
<td>Contact an ABB Turbocharging Service Station</td>
</tr>
<tr>
<td>Damaged turbine or compressor</td>
<td></td>
</tr>
<tr>
<td>Damaged bearing</td>
<td></td>
</tr>
</tbody>
</table>

Rubbing of rotating parts

<table>
<thead>
<tr>
<th>Normal behaviour, no malfunction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
</tr>
<tr>
<td>Minor uniform wear around the periphery of rotor components, caused by slight local rubbing of adjacent components, is permissible. The compressor blades and turbine blades are then shortened somewhat. Certain tolerances must be observed to avoid a significant loss of efficiency.</td>
</tr>
<tr>
<td>▪ If there is any doubt about the extent of rubbing, then an ABB Turbocharging Service Station must be contacted.</td>
</tr>
<tr>
<td>▪ Have a dimension check carried out by an ABB Turbocharging Service Station.</td>
</tr>
</tbody>
</table>
6.2 Surging of the turbocharger

Turbocharger surging

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine</td>
<td>Guard in front of the turbocharger is contaminated or damaged</td>
</tr>
<tr>
<td>Turbocharger</td>
<td>Filter silencer or diffuser contaminated</td>
</tr>
<tr>
<td></td>
<td>Heavy deposits of dirt in the turbine or nozzle ring</td>
</tr>
<tr>
<td>Charge air cooler</td>
<td>Cooler contaminated</td>
</tr>
<tr>
<td></td>
<td>Charge air duct blocked</td>
</tr>
</tbody>
</table>

Prolonged or periodic surging
Possible damage to components, such as the compressor wheel, turbine blades, bearings and filter silencer

- Have the cause clarified immediately by an ABB Turbocharging service station and rectified.
- Have components inspected for damage and, if necessary, replaced by an ABB Turbocharging service station.

Sporadic surge blows

Surging of the turbocharger can occur during certain operating conditions such as when reducing the engine performance quickly when manoeuvring. At the same time, the flow direction in the compressor is momentarily reversed. Such sporadic surge blows do not impair the safe operation of the turbocharger.

- A surge blow is accompanied by a loud bang and escape of hot air from the filter silencer.
6.3 Malfunctions during operation

Lubricating oil pressure too low

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine</td>
<td></td>
</tr>
<tr>
<td>Oil filter heavily contaminated</td>
<td>Clean it</td>
</tr>
<tr>
<td>Defective oil pump in lubricating</td>
<td>Check / replace it</td>
</tr>
<tr>
<td>system</td>
<td></td>
</tr>
<tr>
<td>Manometer display wrong</td>
<td>Replace the manometer</td>
</tr>
<tr>
<td>Turbocharger</td>
<td></td>
</tr>
<tr>
<td>Rotor axial clearance too large</td>
<td>Contact an ABB Turbocharging Service Station</td>
</tr>
</tbody>
</table>

Reduction in speed

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine</td>
<td></td>
</tr>
<tr>
<td>Defects of connected cylinders</td>
<td>Contact the enginebuilder</td>
</tr>
<tr>
<td>when pulse charging</td>
<td></td>
</tr>
<tr>
<td>Turbocharger</td>
<td></td>
</tr>
<tr>
<td>Heavy contamination of the turbine</td>
<td>Clean it</td>
</tr>
<tr>
<td>Damaged rotor components or</td>
<td>Contact an ABB Turbocharging Service Station</td>
</tr>
<tr>
<td>bearing</td>
<td></td>
</tr>
<tr>
<td>Pipes</td>
<td></td>
</tr>
<tr>
<td>Defects such as leaks in the</td>
<td>Make repairs</td>
</tr>
<tr>
<td>exhaust gas pipes or charge air</td>
<td></td>
</tr>
<tr>
<td>ducts</td>
<td></td>
</tr>
</tbody>
</table>

Increase in speed

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
<td></td>
</tr>
<tr>
<td>Heavily contaminated nozzle ring</td>
<td>Contact an ABB Turbocharging Service Station</td>
</tr>
<tr>
<td>(with 4-stroke application)</td>
<td></td>
</tr>
</tbody>
</table>
## Exhaust gas temperature too high

Engine performance and engine speed unchanged

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine Malfunctioning injection system</td>
<td>Repair it or contact the manufacturer</td>
</tr>
<tr>
<td>Turbocharger Air starvation, for example filter silencer clogged with dirt</td>
<td>Clean it</td>
</tr>
<tr>
<td>Turbocharger Compressor / turbine contaminated</td>
<td>Clean it</td>
</tr>
<tr>
<td>Turbocharger Exhaust counterpressure too high</td>
<td>Clean or repair the boiler or exhaust silencer</td>
</tr>
<tr>
<td>Turbocharger Damaged or eroded turbine</td>
<td>Contact an ABB Turbocharging Service Station</td>
</tr>
<tr>
<td>Charge air cooler Cooler contaminated</td>
<td>Clean it</td>
</tr>
<tr>
<td>Charge air cooler Cooling water volume too low</td>
<td>Top up the water</td>
</tr>
<tr>
<td>Charge air cooler Entry temperature of cooling water too high</td>
<td>Inspect / clean the cooling system</td>
</tr>
<tr>
<td>Inadequate ventilation</td>
<td>Improve the ventilation</td>
</tr>
</tbody>
</table>
Malfunctions during operation

### Charge air pressure too low

Engine performance and engine speed unchanged, air intake condition normal

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine</td>
<td></td>
</tr>
<tr>
<td>Air receiver leaking</td>
<td>Make repairs</td>
</tr>
<tr>
<td>Gas piping between the engine</td>
<td></td>
</tr>
<tr>
<td>and the turbine leaking</td>
<td></td>
</tr>
<tr>
<td>Poorly adjusted injection system</td>
<td>Correct it</td>
</tr>
<tr>
<td>Poorly adjusted valve control</td>
<td></td>
</tr>
<tr>
<td>Turbocharger</td>
<td></td>
</tr>
<tr>
<td>Manometer display wrong</td>
<td>Replace the manometer</td>
</tr>
<tr>
<td>Line to manometer leaking</td>
<td>Repair the leak</td>
</tr>
<tr>
<td>Contaminated filter silencer</td>
<td>Clean it</td>
</tr>
<tr>
<td>causing excessive loss of pressure</td>
<td></td>
</tr>
<tr>
<td>Compressor / turbine contaminated</td>
<td></td>
</tr>
<tr>
<td>Damaged compressor / turbine</td>
<td>Contact an ABB Turbocharging Service Station</td>
</tr>
<tr>
<td>Exhaust counterpressure too high</td>
<td>Clean or repair the boiler or exhaust silencer</td>
</tr>
</tbody>
</table>

### Charge air pressure too high

Engine performance and engine speed unchanged, air intake condition normal

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine</td>
<td></td>
</tr>
<tr>
<td>Malfunctioning injection system</td>
<td>Repair it or contact the manufacturer</td>
</tr>
<tr>
<td>Poorly adjusted injection system</td>
<td>Correct it</td>
</tr>
<tr>
<td>Engine performance higher than</td>
<td>Check engine performance</td>
</tr>
<tr>
<td>expected</td>
<td></td>
</tr>
<tr>
<td>Turbocharger</td>
<td></td>
</tr>
<tr>
<td>Manometer display wrong</td>
<td>Replace the manometer</td>
</tr>
</tbody>
</table>
## 6.4 Malfunctions when stopping

### Noises during run-down

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
<td>Clean it</td>
</tr>
<tr>
<td>Turbocharger contaminated</td>
<td>Clean it</td>
</tr>
<tr>
<td>Damaged bearing</td>
<td>Contact an ABB Turbocharging Service Station</td>
</tr>
<tr>
<td>Rubbing rotor</td>
<td>Contact an ABB Turbocharging Service Station</td>
</tr>
<tr>
<td>Foreign object in turbocharger</td>
<td>Contact an ABB Turbocharging Service Station</td>
</tr>
</tbody>
</table>

### Run-down time too short

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
<td>Clean it</td>
</tr>
<tr>
<td>Turbocharger contaminated</td>
<td>Clean it</td>
</tr>
<tr>
<td>Damaged bearing</td>
<td>Contact an ABB Turbocharging Service Station</td>
</tr>
<tr>
<td>Rubbing rotor</td>
<td>Contact an ABB Turbocharging Service Station</td>
</tr>
<tr>
<td>Foreign object in turbocharger</td>
<td>Contact an ABB Turbocharging Service Station</td>
</tr>
</tbody>
</table>
### 6.5 Speed measurement system

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal amplitude non existent or poor</td>
<td>Fitting error. The screw plug for the sensor is fitted with a gasket. When fitting the speed sensor, this gasket must be removed. If it is fitted by mistake, the distance from the sensor tip to the signal-generating sealing disc increases. As a result, the voltage amplitude of the speed signal decreases, which can cause problems for the evaluation electronics. This problem is eliminated by removing the gasket.</td>
</tr>
<tr>
<td>Dirty sensor tip</td>
<td>The sensor tip is magnetic and can thus attract metal particles. As a result, the distance to the auxiliary bearing decreases, which can lead to amplification of the noise component and consequently to faulty triggering. Remove the sensor, clean its tip and refit the sensor using the specified tightening torque.</td>
</tr>
<tr>
<td>Contact ABB Turbocharging service station.</td>
<td></td>
</tr>
<tr>
<td>Contact ABB Turbocharging service station.</td>
<td></td>
</tr>
<tr>
<td>If none of the above measures eliminates the problem, we recommend that you have the speed measuring system inspected by an official ABB Turbocharging service station.</td>
<td></td>
</tr>
</tbody>
</table>
6.6 Variable Turbine Geometry

Variable Turbine Geometry (VTG) not adjustable

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
<td>Heavy turbine contamination</td>
</tr>
<tr>
<td></td>
<td>VTG bearing damaged</td>
</tr>
<tr>
<td>Drive unit (electrical components)</td>
<td>No drive energy</td>
</tr>
<tr>
<td></td>
<td>Contact an ABB Turbocharging Service Station</td>
</tr>
</tbody>
</table>
# 7 Removal and installation

## 7.1 Turbocharger weights

Lifting gear with a sufficient load limit must be used for removing and installing the turbocharger. The following weight specification is the heaviest possibility. This guide value can differ from data on the rating plate, depending on the specification.

<table>
<thead>
<tr>
<th>Weight [kg]</th>
<th>TPL65VA32/33</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1210</td>
</tr>
</tbody>
</table>
7.2 Removing the turbocharger

- Disconnect all gas, air and oil lines in accordance with engine manufacturer's instructions.

**Oil orifice plates**
An orifice plate for adjusting the oil pressure is fitted in each of the two oil inlet channels in the bearing casing. When the cartridge group, the bearing casing or the turbocharger is fitted to the engine, it must be ensured that the orifice plates that are specified for the turbocharger have been installed in the two oil inlet channels.
- Check correct installation of oil orifice plates.

- Unplug the cable connector on the speed sensor.
- Remove the insulation at the suspension ribs.

**TPL65: Version with compressor wheel cooling system**

- Remove air supply line. (See also chapter entitled Preliminary remarks / Layout and functionality)

- Inspect the lifting gear.

- Fasten separate lifting gear to each of the two ribs on the bearing casing provided for this purpose.
Removing the turbocharger

7.2

WARNING

Beware of tilting

If support for the turbocharger is not provided or is inadequate, the turbocharger could tip over during installation or removal and cause a serious or even fatal injury.

► Support the turbocharger at a suitable point.
► If possible secure it using lifting gear.

Wear safety helmet.

► Cover the oil connection.

Ribs (01) not in the middle at the top:

► Completely remove the bearing casing insulation (02) and place a sling around the bearing casing.

► Loosen the fixing screws at the foot.
► Lift the turbocharger off the engine and set it down to one side.
7.3 Installing the turbocharger

- Remove cover from oil connection.
- Inspect lifting gear.
- Fasten separate lifting gear to each of two bearing casing ribs provided for this purpose.

**Oil orifice plates**

An orifice plate for adjusting the oil pressure is fitted in each of the two oil inlet channels in the bearing casing. When the cartridge group, the bearing casing or the turbocharger is fitted to the engine, it must be ensured that the orifice plates that are specified for the turbocharger have been installed in the two oil inlet channels.

- Check correct installation of oil orifice plates.

- Adapt turbocharger to suit engine.
- Tighten fixing screws in foot in accordance with engine builder's instructions.
- Fasten gas, air and oil lines in accordance with engine builder's instructions.

**TPL65: Version with compressor wheel cooling system**

- Fit air supply line. (See also chapter Preliminary remarks / Layout and functioning.)

- Refit removed parts of insulation.
- Plug in cable connector on speed sensor.
8 Disassembly and assembly

8.1 Introduction

Further work
Further tasks, which are not described here, may be carried out only by trained personnel from an ABB Turbocharging service station.

▶ Only carry out those tasks that are described in this chapter.

Marking casing positions for assembly
ABB Turbo Systems recommends that the casing positions are marked before disassembling the turbocharger.

Identifying assembly devices
Not all assembly devices are marked with a part number. They can be identified using the tool list. This list is enclosed in the toolbox.

Maintaining assembly devices
Assembly devices must be checked for damage before and after use.

▶ Visually check for corrosion, cracks, deformation and wear.

▶ Don't use damaged assembly devices, but replace them.

Customer spare parts set
Before beginning work, ensure that the required customer spare parts sets are available.

▶ See chapter Spare parts.
Tightening torques for turbocharger components

The specified tightening torques of screw connections for turbocharger components must be observed. (See section Table of tightening torques.)

Tightening torques for assembly devices of ABB Turbo Systems

If nothing else is described, the screws and nuts of the assembly devices must be tightened down firmly.

**Suspension loads**

Loads not suspended in compliance with regulations may lead to personal injury or accidents with fatal consequences.

- Attach turbochargers, assemblies, or individual components only to lifting gear which is in technically perfect condition and has sufficient load capacity.
- Make sure the load is suspended properly on the crane hook.
- Do not let anyone stand beneath a suspended load.

Wear safety gloves against mechanical risks.

Wear safety helmet.

**Definition of terms**

- **Suspension point**
  Defined load carrying point on a component or an assembly (blind hole thread, eye, lug).

- **Assembly device**
  Devices mounted on the turbocharger to create a suspension point. Assembly devices are calculated and designed especially for the defined application. They are not commercially available products. Use assembly / fitting devices only for the applications described.

- **Lifting gear**
  Equipment for lifting and transporting loads (ropes, chain hoists, cranes). Lifting gear is not supplied by ABB Turbo Systems.
8.2 Module weights

The specified weights of individual parts or assemblies are guides rounded off to the next highest value.

### Assemblies

<table>
<thead>
<tr>
<th>Description</th>
<th>TPL65VA32/33</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radial air suction branch</td>
<td>50</td>
</tr>
<tr>
<td>Axial air suction branch</td>
<td>35</td>
</tr>
<tr>
<td>Filter silencer</td>
<td>130</td>
</tr>
<tr>
<td>Compressor casing</td>
<td>180</td>
</tr>
<tr>
<td>Wall insert</td>
<td>40</td>
</tr>
<tr>
<td>Diffuser</td>
<td>19</td>
</tr>
<tr>
<td>Cartridge group</td>
<td>290</td>
</tr>
<tr>
<td>Turbine diffuser</td>
<td>30</td>
</tr>
<tr>
<td>Variable turbine geometry module</td>
<td>55</td>
</tr>
<tr>
<td>Radial gas inlet casing</td>
<td>50</td>
</tr>
</tbody>
</table>
Complete compressor casing

<table>
<thead>
<tr>
<th>Weight [kg]</th>
<th>TPL65VA32/33</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>240</td>
</tr>
</tbody>
</table>

The total weight of the complete compressor casing is an addition of the weights of the compressor casing, the diffuser and the wall insert.
8.3 Removing and fitting filter silencer or air suction branch

Removing the filter silencer

- Remove insulation where necessary.
- Pass lifting gear through rib on filter silencer.
- Pass lifting gear through lugs on back.
- Unscrew nuts (72027) and remove them together with washers (72018).
- Remove filter silencer and set it down to one side.

Installing the filter silencer

- Install filter silencer in reverse order.
Removing and fitting filter silencer or air suction branch

Removing the air suction branch

- Disconnect all air lines in accordance with the engine builder’s instructions.
- Dismantle the insulation where necessary.
- Pass a lifting gear around the air suction branch. It is permissible to pass the lifting gear through holes possibly provided in the ribs to improve stability.
- Unscrew the nuts (72027) and remove them together with the washers (72018).
- Remove the air suction branch and set it down to one side.

Installing the air suction branch

- Fit the air suction branch in reverse order.
8.4 Axial clearance

Physical hazards due to sharp edges on compressor wheel
The compressor wheel has sharp edges which can result in injury.
► Wear safety gloves.

WARNING
Wear safety gloves against mechanical risks.

The axial clearance (A) must be measured before removing and after fitting the cartridge group.
► Measure and note the axial clearance (A).

Clearance A [mm]

| TPL65VA32/33 | 0.31 … 0.49 |

CAUTION
Clearances out of tolerance and excessively worn components can be the cause of serious damage to machinery and property.
► Have components assessed and, if necessary, replaced by an ABB Turbocharging Service Station.
### 8.5 Removing cartridge group

- Remove insulation.

**Version with compressor wheel cooling system**

- Remove air supply line. (See also chapter entitled Preliminary remarks / Layout and functionality)
- Disconnect oil pipes in accordance with enginebuilder's instructions.

#### Oil orifice plates

An orifice plate for adjusting the oil pressure is fitted in each of the two oil inlet channels in the bearing casing. When the cartridge group, the bearing casing or the turbocharger is fitted to the engine, it must be ensured that the orifice plates that are specified for the turbocharger have been installed in the two oil inlet channels.

- Check correct installation of oil orifice plates.

- Loosen and remove sealing air line (56501) between compressor casing (72000) and variable turbine geometry module (56100).

- Remove three studs (72029) at top.
- Attach lifting device (90190) to compressor casing (72000), then fasten and secure it to crane using lifting gear.
- Unscrew nuts (61037).
- Uniformly press apart compressor casing (72000) using three press-off nuts (61090).
- Slightly lift compressor casing (72000) and withdraw it.
Turn the compressor casing (72000) together with the wall insert and diffuser and set them down with surface (F) on an underlay.

**Tipping the compressor casing**

- Make sure the underlay does not shift.
- Allow the compressor casing to rest only on surface (F).
- Check the underlay and adjust it if necessary.

- Remove the screws (72002).
- Remove the diffuser (79000).
- Remove the wall insert (77000) using swivel lifting eyes (90235).
- Remove the O-ring (77005) from the wall insert.
Unplug the cable connector (86515) and screw out the speed sensor (86505) complete with the O-ring (86506).

Remove the O-ring (42012).

Remove the three screws (61059) and Verbus Ripp® washers (61058).

Fasten separate lifting gear to each of the two ribs on the bearing casing provided for this purpose.

Uniformly press off the cartridge group using the press-off screws (90900) in the holes provided.

If the rotor blades have insufficient or no clearance, the blades and casing could be damaged.

Turn the rotor to check that the blades do not rub against the turbine diffuser.
Withdraw the cartridge group and fit the supports (90450).

Cover the oil connections.
8.6 Removing and fitting turbine diffuser

- Replace two screws (61032) with two studs (90903) in upper section of turbine diffuser.
- Screw out the remaining screws (61032), press off the turbine diffuser (63000) using the press-off screws (90901), then withdraw and remove it.

Fitting the turbine diffuser

- Fit the turbine diffuser in reverse order of removal.

Notices:

- Brush high-temperature grease on all screws at and in the gas outlet casing.
8.7 Removing variable turbine geometry module with gas inlet casing

- Disconnect semi-circular section of sealing air line (A) from variable turbine geometry module.
- Retaining clips (56121) are fitted.
- Unscrew nuts (61042).
- Remove gas inlet casing (51001) together with variable turbine geometry module (56100).

**CAUTION**
After removing screws (56122) and retaining clips (56121), gas inlet casing (51001) is no longer secured.

- Loosen screws (56122) together with retaining clips (56121) and remove with clamping ring (56112).
- Remove clamping ring (56112).
- Carefully separate gas inlet casing (51001) from variable turbine geometry module (56100) and remove it.

**CAUTION**
Have the variable turbine geometry module overhauled by ABB Turbo Systems. ABB Turbocharging Service Stations have variable turbine geometry modules replaced with overhauled ones as part of the CPEX (Customer Part Exchange) programme.
8.8 Fitting the variable turbine geometry module and the gas inlet casing

► Push variable turbine geometry module (56100) over studs
► Push gas inlet casing (56001) over studs
► Slide clamping ring (56112) onto studs
► Tighten nuts (61042) to specified torque
► Fit retaining clips (56121) using screws (56122)
► Fit semi-circular section of sealing air line (A) to variable turbine geometry module
Fit sealing air line (56501) to semi-circular section of line (A).
8.9 Installing cartridge group

**Oil orifice plates**

An orifice plate for adjusting the oil pressure is fitted in each of the two oil inlet channels in the bearing casing. When the cartridge group, the bearing casing or the turbocharger is fitted to the engine, it must be ensured that the orifice plates that are specified for the turbocharger have been installed in the two oil inlet channels.

- Check correct installation of oil orifice plates.

- Remove the cover from the oil connection.
- Fasten separate lifting gear to each of the two ribs on the bearing casing provided for this purpose.
- Remove the supports (90450) and carefully insert the cartridge group.
- Uniformly tighten the screws (61059) together with the Verbus Ripp® washers (61058).
CAUTION

If there is no or insufficient clearance between the rotor turbine blades and the turbine diffuser, the blades and the turbine diffuser (casing) can be damaged.

- Turn the rotor to check that the blades do not rub against the turbine diffuser.

- Remove the lifting gear.
- Fit the O-ring (42012).
- Screw in the speed sensor (86505) along with the O-ring (86506) and plug in the cable connector (86515).
- Fit the O-ring (77005) to the wall insert (77000).
- Fit the lifting gear and the swivel lifting eye (90235).
- Align and fit the wall insert (77000) using the centring screw (90187).
- Place the diffuser (79000) in position using the swivel lifting eye (90235).
- Remove the swivel lifting eye (90235).
- Fit the screws (72002).
1. Attach lifting gear to lifting device (90190) and turn compressor casing (72000).
2. By hand, screw three press-off nuts (61090) onto bearing casing studs, equally spaced around circumference and up to end of thread.
3. Push compressor casing (72000) onto cartridge group to fit snugly and fasten it using nuts (61037).
4. Secure three press-off nuts (61090) against compressor casing (72000) by tightening them to specified torque. (See chapter Table of tightening torques.)
5. Remove lifting device (90190).
6. Fit sealing air line (56501) between compressor casing (72000) and variable turbine geometry module (56100).
Measure and note the axial clearance (A) (see the section on axial clearance).

**Clearances out of tolerance**
Clearances out of tolerance and excessively worn components can be the cause of serious damage to machinery and property.
- Have components assessed and, if necessary, replaced by an ABB Turbocharging Service Station.

Connect oil pipes and all air lines in accordance with engine builder’s instructions.

**Version with compressor wheel cooling system**
- Fit the air supply line. (Also see the chapter Preliminary remarks / Layout and functioning.)

- Fit the filter silencer or air suction branch.
- Fit the insulation.
8.10 Table of tightening torques
# Table of tightening torques

## Tightening torques [Nm]

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<td>M14 100</td>
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</tr>
<tr>
<td>09 61059</td>
<td>M14 160</td>
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<td>56114</td>
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<td>19 61042</td>
<td>M14 130</td>
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<tr>
<td>24 56122</td>
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## Tightening angle [°]

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<tr>
<td>29 56501</td>
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</table>
Taking out of operation at short notice

9.1 Possibilities for emergency repair

### Danger of fire and explosion due to lubricating oil leaks
Leaking oil may ignite on hot surfaces. This can cause severe personal injury or fatal accidents can result.

- Cordon off danger area.
- Sound an alarm and depending on the situation, stop the engine.
- Seal oil leaks.
- Soak up oil and dispose of in an environmentally compatible manner.

Wear safety gloves against thermal risks.

### Directives for taking out of operation
Serious damage to engine or property can be caused by non-compliance with the directives for locking/blanking off the turbocharger on the engine.

- Follow the directives of the enginebuilder.

If the diesel engine must be capable of operation again as soon as possible after damage to the turbocharger (emergency repair), the following possibilities are available:

- Fitting cover plate
- Shutting off inlets and outlets
- Bypass around turbocharger
9.2 Fitting the cover plate

The cover plate (material: General structural steel, in accordance with DIN EN 10025-2) must be manufactured in-house according to the drawing.

<table>
<thead>
<tr>
<th>Cover plate dimensions [mm]</th>
</tr>
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<tr>
<td>Product</td>
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<tr>
<td>TPL65</td>
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<table>
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<th>α 2</th>
<th>α 3</th>
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</thead>
<tbody>
<tr>
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<td>37.5°</td>
<td>24 x 15°</td>
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</table>
Carry out the work as described in the chapter Removal and fitting.

- Remove cartridge group.
Close off opening in gas outlet casing using cover plate.

Fasten cover plate using spacer sleeves and nuts (61037).

Shut off the supply of lubricating oil to the turbocharger.
Further measures and information for operation with a turbocharger with cover plate on 4-stroke engines

4-stroke engine with one turbocharger

No further measures are necessary. The engine can be operated as a naturally-aspirated engine according to the engine builder’s instructions.

4-stroke engine with several turbochargers

Separate receivers

No further measures are necessary on engines with separate air and exhaust gas receivers. The engine can be operated as a naturally-aspirated engine according to the engine builder’s instructions.

Common receiver

The air line must be closed off at the engine end because the undamaged turbochargers build up a receiver pressure.

The engine can be operated according to the engine builder’s instructions. Attention must always be paid to the speed of the undamaged turbocharger. The speed limit \( n_{B_{\text{max}}} \) given on the rating plate must not be exceeded.
9.3 Blocking the inlets and outlets

CAUTION

Shut off the lubricating oil supply to the turbocharger.

NOTICE

Shut off compressor casing outlet, gas inlet and gas outlet by fitting cover plates.

In this respect, refer to the engine manufacturer's instructions.
9.4 Turbocharger bypass

Shut off the lubricating oil supply to the turbocharger.

**CAUTION**

▷ This applies to engines with one turbocharger only:
▷ The connections are ready and pipes for the bypass are available.
▷ Fit bypass around turbocharger.

**NOTICE**

In this respect, refer to the engine manufacturer's instructions.
10 Mothballing the turbocharger

10.1 Taking the engine out of operation for up to 12 months

Condition of engine lubricating oil

The turbocharger normally remains mounted on the engine. Mothballing a turbocharger depends on the condition of the lubricating oil:

- If the total acid number (TAN) is lower than 2 mg KOH/g, no measures have to be taken.
- If the engine lubricating oil is replaced by preserving oil before taking the engine out of operation and this is circulated by the pre-lubrication pump, no measures have to be taken. Any remaining old engine oil will therefore be flushed away and the bearing sections largely protected against corrosion.

Mothballing measures

**WARNING**

Handling operating materials and supplies

Swallowing or inhaling vapours of operating materials and supplies or contact with them may be harmful to health.

- Do not breathe in these substances and avoid contact with the skin.
- Ensure proper ventilation.
- Observe the information in the material safety data sheet for the operating materials and supplies.
- Comply with local legislation.

Wear safety goggles.

Wear safety gloves against mechanical risks.

Wear a respiratory mask to protect against gases.
Mothballing the turbocharger

Taking the engine out of operation for up to 12 months

If the total acid number (TAN) is greater than 2 mg KOH/g, the following mothballing measures are necessary after taking an engine out of operation:

- Dismantle the turbocharger.
- The rotor and the bearing parts must be removed by an official ABB Turbocharging service station and refitted afterwards.
- Clean all parts.
- Machined, bright surfaces of steel and cast parts must be oiled with anticorrosive oil.
- Reassemble complete turbocharger.

Rotor turning in stack draught

If the rotor turns as a result of the stack draught:

- Install blind flange between compressor casing outlet flange and charge air duct.
10.2 Taking the engine out of operation for more than 12 months

If the engine is taken out of service, the following alternatives are possible with the turbocharger:

- The turbocharger remains mounted on the engine.
- The turbocharger casing remains mounted on the engine, but the rotor and the bearing parts are removed and stored separately by an ABB Turbocharging Service Station.
- The turbocharger is removed completely, either as a whole or in individual parts.

See the section Taking out of operation for up to 12 months, under Mothballing measures, for the measures always necessary when mothballing turbocharger parts.

If the turbocharger remains mounted on the engine, refer to the section Taking out of operation for up to 12 months, under Rotating the rotor in stack draught.

If the entire turbocharger is removed, or if the turbocharger is re-assembled from the individual components thereof:

- Close all turbocharger openings using wooden covers and paraffin paper.

Suitable storage locations are only dry rooms where the relative humidity is between 40 … 70 % and no condensation can form.

Condition of the mothballed turbocharger

- Check the mothballed turbocharger parts for corrosion once per annum.
- If there are signs of rust: Clean parts thoroughly and renew protection against corrosion.
11 Disposing of turbocharger components

Handling damaged thermal insulation

WARNING

Damaged thermal insulation can lead to dust exposure. The glass fibres can cause mechanical irritation of the eyes, skin, and respiratory tracts.

➤ Avoid the formation of dust.
➤ Vacuum up dust with a suitable vacuum cleaner.
➤ Wear a respiratory mask to protect against particles (P1 or P2 mask).
➤ Wear work gloves made of leather.

Wear safety goggles.
Wear a respiratory mask to protect against particles.
Wear safety gloves against mechanical risks.

Disposal must be environmentally compatible, professional, and in compliance with locally applicable regulations.

The turbocharger consists largely of metal (cast iron materials, steel, nickel-steel alloys, aluminium and bearing brass).

Further components are: Non-metallic materials (filter components of felt and polyethylene), lubricants (engine oil), electronic parts (speed sensor and associated components), and thermal insulation.

➤ Dispose of metals as scrap metal for recycling.
➤ Dispose of non-metallic materials as waste.
➤ Dispose of residues of lubricants as waste oil.
➤ Dispose of electronic components as electronic waste.
➤ Dispose of thermal insulation as hazardous waste.
12 Spare parts

12.1 Ordering spare parts

When making inquiries or ordering spare parts, the following data must be specified:

- Turbocharger type
- Serial number (HT……)
- Description and part number

Spare parts can be ordered from an official ABB Turbocharging Service Station.

- If different design versions have not been taken into consideration in this document, please contact an ABB Turbocharging Service Station.

CAUTION

Storage of spare parts

All spare parts ordered with the turbocharger must be kept complete and ready for use.

- Parts showing signs of rust should be carefully cleaned and greased.

- Dispose of replaced and unusable parts in a professional and environmentally compatible way.

Required customer spare parts set (97070)

<table>
<thead>
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<th>Quantity</th>
<th>Description</th>
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<tr>
<td>2</td>
<td>Hexagon-head screw</td>
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<tr>
<td>2</td>
<td>Verbus Ripp® Washer</td>
<td>42058</td>
</tr>
<tr>
<td>15</td>
<td>Hexagon-head screw</td>
<td>61056 / 61059</td>
</tr>
<tr>
<td>15</td>
<td>Verbus Ripp® Washer</td>
<td>61057 / 61058</td>
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<tr>
<td>3</td>
<td>Hexagon nut</td>
<td>61037</td>
</tr>
<tr>
<td>1</td>
<td>Gasket</td>
<td>42041</td>
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<tr>
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<td>2</td>
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<td>O-ring</td>
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12.2 View of turbocharger with part numbers
View of turbocharger with part numbers  12.2  Page 117

<table>
<thead>
<tr>
<th>Part number</th>
<th>Description</th>
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<tbody>
<tr>
<td>-</td>
<td>Cartridge group</td>
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<tr>
<td>56100</td>
<td>Variable turbine geometry module</td>
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<tr>
<td>51001</td>
<td>Gas inlet casing</td>
</tr>
<tr>
<td>61001</td>
<td>Gas outlet casing</td>
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<tr>
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<tr>
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<td>Radial air suction branch</td>
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<tr>
<td>82000</td>
<td>Axial air suction branch</td>
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12.3 View of cartridge group with part numbers
## Spare parts

View of cartridge group with part numbers

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<td>Thrust bearing</td>
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<td>32101</td>
<td>Radial bearing at compressor end</td>
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<td>Radial bearing at turbine end</td>
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<td>Auxiliary bearing</td>
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<td>Floating disc</td>
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<td>Axial bearing</td>
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<td>32107</td>
<td>Bearing bush</td>
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