# Operation Manual

## TPS57FV32

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<td>$t_{\text{M_{max}}}$ 650 $^\circ$C</td>
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<tr>
<td>$n_{\text{B_{max}}}$</td>
<td>674</td>
<td>$t_{\text{B_{max}}}$ 620 $^\circ$C</td>
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| Year | 2019 |

Application according to the Operation Manual

Made in Switzerland

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HZTL2411 English
Original Operation Manual

ABB Turbocharging
Operating condition and replacement intervals

The operational limits for the turbocharger $n_B \text{max}$, $t_B \text{max}$, $n_M \text{max}$, $t_M \text{max}$, 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 $n_M \text{max}$, $t_M \text{max}$ 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 serial 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 Suction branch / filter silencer
02 Compressor casing
03 Operating lever
04 Diffuser
05 Bearing casing
06 Axial thrust bearing
07 Nozzle ring guide vanes
08 Radial plain bearing (only visible at turbine end)
09 Turbine
10 Gas outlet flange
11 Turbine casing
12 Turbine-end bearing flange
13 Compressor-end bearing flange
14 Compressor wheel
15 Pressure branch
Mode of operation

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

- Turbine
- Compressor

These are connected with a common shaft.

The exhaust gases from the diesel or gas engine flow through the turbine casing (11) and the adjustable nozzle ring guide vanes (07) to the turbine (09). By adjusting the guide vanes (VTG) via the operating lever (03), the cross-section of the nozzle ring is altered so that the exhaust gas energy from the engine is optimally utilized.

The turbine (09) uses the energy contained in the exhaust gas to drive the compressor wheel (14), whereby fresh air is sucked in through the compressor and precompressed air is forced into the cylinders of the engine.

The exhaust gases reach the atmosphere through the exhaust gas pipe connected to the gas outlet flange (10).

The air that is required for operation of the diesel or gas engine and is compressed in the turbocharger, is routed through the suction branch or filter silencer (01) and into the compressor wheel (14). It flows through the diffuser (04) and exits the turbocharger through the outlet on the compressor casing (02).

The rotor runs in two radial plain bearings (08) which are located in the bearing flanges (12/13) between the compressor and turbine. The axial thrust bearing (06) is located between the two radial plain bearings.

The bearings are connected to a central lubricating oil duct which is supplied by the lubricating oil circuit of the engine. The oil outlet always lies at the deepest point of the bearing casing (05).
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.

State of the art

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

WARNING

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.

Perfect condition

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 to protect against chemical hazards.

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.
Preliminary remarks

Storage of new turbochargers and spare parts

1.4

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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 the Operation Manual, the general statutory regulations for the prevention of accidents and for environmental protection in the country of use must also be observed.

This also applies to the provision and wearing of personal protective equipment.

- The manner in which personnel work on and with the turbocharger with regard to safety and risks is to be checked on a regular basis in accordance with the Operation Manual.

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

- Any modifications, additions or conversions made to the turbocharger, which could impair 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 ®.
Symbols and definitions

The following symbols are used in the documents:

▷ Prerequisite
► Step of a procedure
■ List, first level
  - List, second level
[➙ ] Refers to a page number

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 Turbo-charging Service Stations. They are inspected and certified regularly by ABB Turbo Systems. See also chapter Contact information [➙ 15].
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 inspection and replacement intervals of turbocharger compo-
nents
03 Inspection interval of plain bearings in 1000 h
04 Replacement interval of compressor in 1000 h
05 Replacement interval of turbine in 1000 h

Further data
06 Customer part number
07 Designation of the special design
08 Weight of turbocharger in kg
09 Turbocharger type
10 Serial number
11 Year of construction of turbocharger
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 $n_{b\text{max}}$, $t_{b\text{max}}$ can considerably shorten the recommended replacement intervals. In such cases, we recommend that you contact the nearest official ABB Turbocharging service station. 

$n_{M\text{max}}$ and $t_{M\text{max}}$ 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 $n_{M\text{max}}$ and $t_{M\text{max}}$ 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**

One rating plate (01) each is attached on the left and the right side of the turbocharger bearing casing.
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 Ltd
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>
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<th>To be worn at all times</th>
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<tr>
<td><strong>Protective clothing</strong></td>
<td><strong>Safety footwear</strong> to protect against mechanical hazard and risk of falling</td>
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<th>To be worn according to the specific work</th>
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<tr>
<td><strong>Safety glasses</strong></td>
<td><strong>Safety goggles</strong></td>
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<tr>
<td><strong>Safety gloves</strong> to protect against:</td>
<td></td>
</tr>
<tr>
<td>- Mechanical hazard</td>
<td></td>
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<tr>
<td>- Chemical hazard</td>
<td></td>
</tr>
<tr>
<td>- Thermal hazard</td>
<td></td>
</tr>
<tr>
<td><strong>Respiratory mask</strong> to protect against:</td>
<td></td>
</tr>
<tr>
<td>- Dusts</td>
<td></td>
</tr>
<tr>
<td>- Gases</td>
<td></td>
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<tr>
<td><strong>Safety helmet</strong></td>
<td><strong>Ear protection</strong></td>
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</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**

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**

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

Warning plates are attached to the turbocharger at the following places:

If warning plates are not present at the intended places or are not legible, then proceed as follows:

- Order new warning plates from ABB Turbocharging Service Stations.
- Remove unreadable warning plates.
- Clean and degrease surfaces provided for warning plates.
- Attach new warning plates.

Uninsulated turbochargers

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 in the vicinity of the turbocharger

- When performing welding work in the vicinity of the turbocharger, always cover the filter silencer to prevent the filter mat from being damaged.
- Keep flammable objects and substances out of the range of flying sparks.
- Cover all connections on the turbocharger so that no foreign objects can enter the turbocharger.
- Wear personal protective equipment (PPE) for welding operations.
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

If cleaning agents or solvents are used for cleaning, the corresponding material safety data sheet and the safety instructions in section "Hazards due to operating and auxiliary materials" must be observed.

➤ Observe the material safety data sheet for the cleaning agent or solvent.
➤ Wear personal protective equipment (PPE) according to the material safety data sheet.
➤ Inspect the electric cables for abrasion and damage 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 preparing for 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.
- Observe the material safety data sheet for the cleaning and mothballing agents.
- Wear personal protective equipment (PPE) according to the material safety data sheet.
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**

Severe injuries to personnel or fatal accidents can be caused by mechanical influences as a consequence of hazardous and inadequate operational procedures.

- Observe the general rules for occupational safety and prevention of accidents.
- Ensure workplace safety.
- Only perform operations that are described in this document.
- Only perform operations for which you have previously received instruction or training.
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**
  - 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**
  - 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 to protect against thermal hazards.
Hazards during operation and maintenance

### Hot surfaces on the non-insulated turbocharger

**WARNING**

Non-insulated turbochargers can cause serious injuries to personnel (burns).

The turbocharger is supplied by ABB Turbo Systems without insulation depending on the order from the enginebuilder. If supply is without insulation, the enginebuilder is responsible for providing the turbocharger with proper insulation and for providing protection against contact with hot surfaces.

- Compliance with the instructions and specifications given by the enginebuilder to protect against hot turbocharger surfaces is compulsory.

Wear safety gloves to protect against thermal hazards.

### 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.

**WARNING**

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 to protect against chemical hazards.

Wear a respiratory mask to protect against gases.
Safety

Hazards during operation and maintenance

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Risk of fire, explosion
Flammable and combustible operating materials and supplies can catch fire or resulting vapours can lead to an explosion.

► Observe the details in the material safety data sheets of the operating and auxiliary materials.
► Comply with local legislation.
► Do not allow any exposed flame or ignition source during cleaning work.
► Carry out cleaning in the open or provide sufficient aeration and ventilation.

Risk of environmental damage
The escape of operating and auxiliary materials into the atmosphere or contamination of the ground and water due to improper disposal can lead to environmental damage.

► Handle operating and auxiliary materials carefully.

► Heed the instructions for use, safety data sheets and hazard notices on the containers of the operating and auxiliary materials.
► Wear appropriate protective clothing.
► Avoid inhalation and contact with the skin.
► Ensure that the work space is adequately ventilated.
► Seal containers tightly immediately after use and put them away.
► Collect used working and auxiliary materials safely, store them separately in suitable containers and dispose of them properly and in an environmentally compatible manner in accordance with statutory regulations.
► In the event of leaks or after spilling, immediately spread a suitable binding agent and dispose of it properly and in an environmentally compatible manner in accordance with statutory regulations.
Hazards 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 dusts.

Wear safety gloves to protect against chemical hazards.

- 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 Deflagration on gas engines

ABB turbochargers can tolerate a deflagration with a transient pressure increase of 12 bar.

After a deflagration event ABB Turbo Systems recommends verifying the following points on the turbocharger:

- Position of the turbine and compressor casings to the bearing casing
- Shifting of the bearing casing in relation to the bracket
- Cracks in casings

If during external inspection anomalies are found or if a particularly strong deflagration event has taken place, it is also recommended to check the bearings of the turbochargers before the next start. This inspection and evaluation must be carried out by an ABB Turbocharging Service Station.
2.9 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.

**Hazard 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.
2.10 Lifting loads

**Suspended 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 to protect against mechanical hazards.

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. If a separate lubricating system is used, then emergency lubrication is also to be provided.

▶ Heed the instructions of the engine builder when selecting the lubricating oil and oil-change intervals.

Oil filtration

Depending on the turbine specifications and bearings used, varying amounts of contaminants have to be filtered out of the lubricating oil to avoid dangerous wear of the bearing parts.

The standard oil filter specification for the turbocharger is 34 µm. This means that contaminants larger than 0.034 mm must be filtered out of the oil with a separation efficiency > 99%.

▶ Fit an accessory filter if engine oil filter is not efficient enough.

▶ If the engine is started cold and the flow resistance rises to above 0.5 bar due to deposits of dirt in the accessory filter, a bypass must open which ensures that oil flows to the turbocharger by circumventing the filter.

▶ Check that oil filters are clean before commissioning.

Also follow the enginebuilder’s instructions regarding filter mesh and separation efficiency.
Lubricant

All lubricating oils used for engines are admissible.

Oil inlet viscosity and temperature

The oil-inlet temperature must not exceed 105°C. Permissible oil-inlet viscosities and oil-inlet temperatures are shown in the following chart.

<table>
<thead>
<tr>
<th>Kinematic viscosity (mm²/s = cSt)</th>
<th>Oil-inlet temperature (°C)</th>
<th>Permissible range</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAE 10W</td>
<td>10</td>
<td>A</td>
</tr>
<tr>
<td>SAE 20W</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>SAE 30</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>SAE 40</td>
<td>40</td>
<td></td>
</tr>
</tbody>
</table>

**Falling below the minimum oil inlet temperature**

Serious machine or property damage can be caused by excessively high oil viscosity and the resulting lack of oil in the bearings.

- Do not allow the oil inlet temperature to fall below the minimum 30 °C when starting the engine.
- The oil inlet temperature must never be less than 10 °C.
Oil pressure

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

<table>
<thead>
<tr>
<th>Status for operation</th>
<th>Oil pressure in front of turbocharger [bar]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal operation</td>
<td>2.0 … 4.5</td>
</tr>
<tr>
<td>Engine start: cold oil, permissible for maximum 15 minutes</td>
<td>≤ 8.0</td>
</tr>
<tr>
<td>Engine idling</td>
<td>≥ 0.2</td>
</tr>
<tr>
<td>Pre- and post-lubrication (engine stopped)</td>
<td>≤ 1.0</td>
</tr>
</tbody>
</table>

**Prelubrication**

Serious machine or property damage might result if the turbocharger is not supplied with oil when the engine is starting.

- Activate prelubrication device before starting engine.
Lubricating oil temperature at the inlet

CAUTION
Machine damage
Machine damage may result if the oil temperature at the oil inlet exceeds the permissible range.
Keep the oil temperature at the oil inlet as specified in the following table.

<table>
<thead>
<tr>
<th>Status for operation</th>
<th>Oil temperature at inlet $T_{\text{oil,inlet}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permissible</td>
<td>$30 \ldots 105 ^{\circ} \text{C}$</td>
</tr>
<tr>
<td>Temporarily permissible (&lt; 1 h) → alarm</td>
<td>$&gt; 105 ^{\circ} \text{C}$</td>
</tr>
<tr>
<td>Not permissible → stop engine</td>
<td>$&gt; 110 ^{\circ} \text{C}$</td>
</tr>
<tr>
<td>Not permissible → do not start engine (before starting: preheat oil)</td>
<td>$&lt; 30 ^{\circ} \text{C}$</td>
</tr>
</tbody>
</table>

Lubricating oil temperature at the outlet

The oil temperature at the outlet depends mainly on:

- lubricating oil temperature and pressure at the oil inlet
- engine load and turbocharger speed
- exhaust gas temperature

The maximum permissible oil temperature at the outlet is listed in the following table. The specified oil outlet temperature must be regarded as an alarm value for turbocharger operation and be monitored in accordance with standard regulations.

<table>
<thead>
<tr>
<th>Status for operation</th>
<th>Oil temperature at outlet $T_{\text{oil,outlet}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permissible</td>
<td>$\leq 160 ^{\circ} \text{C}$</td>
</tr>
<tr>
<td>Temporarily permissible → alarm</td>
<td>$&gt; 160 ^{\circ} \text{C}$</td>
</tr>
<tr>
<td>Not permissible → stop engine</td>
<td>$&gt; 180 ^{\circ} \text{C}$</td>
</tr>
<tr>
<td>Permissible</td>
<td>$\leq T_{\text{oil,inlet}} + 55 \text{K}$</td>
</tr>
<tr>
<td>Temporarily permissible → alarm</td>
<td>$&gt; T_{\text{oil,inlet}} + 55 \text{K}$</td>
</tr>
</tbody>
</table>

If the turbocharger has been operated outside the permissible range for a prolonged period of time, ABB Turbo Systems recommends having 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 devices
- Check for correct functioning.

Oil filter
- Check cleanliness before commissioning.

Manometer oil lines
- Check the oil pressure in the oil supply lines.

VTG
- Check that the operating lever of the VTG functions properly.

Air filter mat
- Inspect for damage.

**CAUTION**

Contaminated oil
Particles of dirt and solid matter in the oil can cause serious damage to the machine or property.
- During initial commissioning and after all service work, the complete lubricating system must be flushed thoroughly with warm oil.
- When running in the engine and all service work on the lubricating system, special running-in filters must be used.
- Do not perform any adjustment work or other modifications on the VTG drive.

**CAUTION**

Prelubrication
Serious machine or property damage might result if the turbocharger is not supplied with oil when the engine is starting.
- Activate prelubrication device before starting engine.
3.2.2 Check after start-up (engine at idling speed)

- **Turbocharger speed**
  - Measure (optional, a turbocharger speed gauge is not standard equipment on all turbocharger types)

- **Charging pressure**
  - Measure

- **Temperatures**
  - Measure in front of and after the turbine, compressor and oil feed at various engine outputs.

- **VTG**
  - Check the VTG operating lever's control functionality

- **Gas, air and oil lines**
  - Check all gas, air and oil lines for leaks after starting the engine.
  - Measure the speed, oil pressure, charging pressure and temperatures in front of and after the turbine and compressor at various levels of engine performance.
  - Compare measured values with values in the acceptance test report, taking into account different operating conditions.
3.2.3 Check when running up engine

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

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, an oil leak must be suspected. The first step is to check for leakage of the oil supply to the turbocharger. If this is leaky, 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.
4 Operation

4.1 Noise emissions

Hazard 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 Servicing work according to the engine manufacturer's instructions

- Clean or replace oil filter in supply line to turbocharger when engine is not running.

4.2.3 Service work in accordance with instructions on rating plate

(In general, after 8000 - 12000 hours of operation)

Rotor and bearing parts must be inspected and assessed by an ABB Turbocharging Service Station. The following work can be carried in preparation.

- Remove cartridge group as described in chapter Disassembly and assembly.
- Measure clearances.
- Clean turbine and compressor casings and check them for cracks and erosion / corrosion.
- Clean bearing casing and blow air through oil ports / holes.

4.2.4 Service work every 15000 hours

- Have a variable turbine geometry module replaced with an overhauled module by an ABB Turbocharger service station. For such cases, ABB Turbo Systems offers replacement modules as part of the CPEX program (Customer Part Exchange).

Variable turbine geometry modules are transported fitted to the bearing casing.
4.2.5 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
4.3 Expected exchange intervals

Rotating components

The recommended replacement intervals for compressor wheels and turbine wheels are defined depending on the operating conditions and based on the safety concept (SiKo) for rotating parts. These intervals can be found on the turbocharger rating plate.

Non-rotating components

Depending on the system-specific operating conditions, a distinction is made between:

- the replacement interval for the bearing parts and
- the replacement interval for those non-rotating components that are exposed to hot gases.

Decisive in this respect are various influencing parameters, which can drastically shorten the replacement intervals of these parts in extreme cases.

During the specified periodic service work, the individual components are inspected for wear and, if necessary, replaced.

Expected replacement intervals [h]

<table>
<thead>
<tr>
<th>Component</th>
<th>GAS / MDO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbine casing</td>
<td>25000 … 50000</td>
</tr>
<tr>
<td>Gas outlet flange</td>
<td>50000</td>
</tr>
<tr>
<td>Partition wall</td>
<td>50000</td>
</tr>
<tr>
<td>Rotor components</td>
<td>See the data on the rating plate</td>
</tr>
<tr>
<td>Bearing parts</td>
<td>12000 … 24000</td>
</tr>
<tr>
<td>Other casings</td>
<td>50000</td>
</tr>
</tbody>
</table>

GAS = Natural gas          MDO = Marine diesel oil

The specified values are a guide only and not guaranteed (see following section Influencing parameters).
Influencing parameters

The specified values are only guide values and not guaranteed. The actual values can deviate considerably from the guide values due, for example, to the following influences:

- Fuel quality and preparation
- Load profile (thermal load cycles, also starts / stops, emergency shut-downs)
- Gas inlet temperature
- Frequency and execution of turbine and compressor cleaning
- Turbocharger specification
- System-specific operating conditions (operating point, combustion quality, composition of exhaust gas)

For bearing parts

- Lubricating oil quality (oil filtration, condition of lubricating oil, oil monitoring)
- Load profile (rpm / speed, pressure conditions, temperature)
- State of rotor unbalance (degree of contamination)
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.
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 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 to protect against thermal hazards.

- 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.

<table>
<thead>
<tr>
<th>Part number</th>
<th>TPS57</th>
<th>TPS61</th>
</tr>
</thead>
<tbody>
<tr>
<td>86505</td>
<td>15 Nm</td>
<td>15 Nm</td>
</tr>
</tbody>
</table>
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.

4.4.3 Failure of speed measuring system

Possible reasons for failure of the speed measuring system are described in the chapter Troubleshooting.
4.5 Stopping the engine

Stopping the engine of oil-cooled turbocharger version
Heat in the turbocharger must be dissipated by the further circulating lubricating oil.
► Post-lubricate for 15 … 20 minutes.
► Maintain oil pressure of 0.5 … 1.0 bar for post-lubrication.
5 Maintenance

5.1 Foreword to Maintenance

General maintenance work involves regular visual checks and cleaning tasks which are intended to ensure the trouble-free functioning of the turbocharger.

The cleaning points described in the following are:

- filter silencer
- compressor
5.2 Cleaning the filter silencer

Cleaning the filter ring (if provided)

- Remove filter ring (81265).
- Clean filter ring (81265) as required or every 500 operating hours, and replace after the fifth cleaning operation at the latest. The degree of contamination of the filter ring depends on the cleanliness of the air that is drawn in.
- Wash filter ring (81265) using water containing light-duty detergent or, if very heavily contaminated, soak it while squeezing carefully. Rinse in cold water. Avoid rough handling (do not use a water jet).
- Allow the filter ring to dry out completely before assembly.
- Dispose of dirty water and gentle detergents in accordance with valid local regulations.
Cleaning the absorption segments

- Loosen the tension bands (81270).
- Remove the cover grid (81266).
- Pull out the sheet-metal coverings (81137), bend them up and remove the 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.
- Have absorption segments which are heavily contaminated replaced by an official ABB Turbocharging Service Station.

Fitting the filter silencer

- Insert the absorption segments (81136) into the sheet-metal coverings (81137).
- Bend the sheet-metal coverings (81137) back into their original shape and insert them into the slot guides in the silencer body (81135).
- Fit the cover grid (81266).
- Fit the tension bands (81270) and apply tension at the locks (81271).
- Damaged tension bands must be replaced with new ones.
- If provided, fit the filter ring (81265).
5.3 Cleaning the compressor during operation

The contamination of the compressor stage (compressor wheel, wall insert and diffuser) depends on the degree of purity of the taken-in air.

Deposits can form in the flow channels if salt, oil mist, exhaust gas or dust are sucked in with the air.

Consequences of contamination:

- Impaired compressor efficiency
- Higher exhaust gas temperatures
- Increased fuel consumption
- Increased rotor unbalance

Periodic cleaning of the compressor during operation prevents or delays any major increase in contamination. But it never replaces the regular service work where the turbocharger is completely dismantled and the compressor is mechanically cleaned.

If the coating of dirt is very thick and hard, the compressor can only be cleaned manually when disassembled. This cleaning must be carried out by an ABB Turbocharging Service Station.

Cleaning interval

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

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

Cleaning method

Cleaning the compressor while in operation is carried out as wet cleaning. This cleaning method has been tested and approved by ABB Turbo Systems.

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.

**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.

**CAUTION**

The injection pipe must on no account be connected directly via a cock to a water pipe or a dosing vessel larger than the one supplied. This prevents uncontrolled volumes of water entering the turbocharger and engine, which can lead to serious damage.

**Principle of wet cleaning**

**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.

**Sequential charging**

In the case of sequential charging, care must be taken to ensure that turbocharger compressors are cleaned regularly, especially after periods of operation in the lower performance range.
Cleaning the compressor during operation

5.3.1 Wet cleaning compressor using external water pressure vessel (XC1)

Approval by enginebuilder

These instructions for wet cleaning only apply when cleaning is carried out with clean water and under the precondition that the enginebuilder approves the process.

NOTICE

Supplying water from the externally mounted water vessel is suitable only for those applications where a negative pressure exists in front of the compressor wheel (not used for: blowers connected in front of the compressor or high-pressure compressor stages with two-stage charging).

Operating state prerequisites for cleaning compressor with XC1

NOTICE

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

- Run engine at load from 50 … 85 %.
- Start cleaning cycle according to following description Wet cleaning operation with XC1.
Cleaning the compressor during operation

5.3 Page 61

Procedure for wet cleaning the compressor with XC1

- Remove sealing plug (X).
- Fill the vessel (Z) with clean water.
- Screw in the sealing plug.
- Push the valve activator (Y) against the spring and hold for 10 to 15 seconds until the entire volume of water has been injected.
- Do not repeat the cleaning cycle until a stabilisation period of at least 10 minutes has elapsed.

NOTICE

Whether or not cleaning has been successful can be seen from the charging or flushing pressure and also from the exhaust gas temperatures. 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.

<table>
<thead>
<tr>
<th>Cleaning parameters per turbocharger compressor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>TPS</td>
</tr>
</tbody>
</table>
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></td>
</tr>
<tr>
<td>Dirty turbocharger</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>Clean it or contact an ABB Turbocharging Service Station</td>
</tr>
<tr>
<td>VTG module damaged or dirty</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></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 Surveying of the turbocharger

Turbocharger surveying

<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 dirty or damaged Clean / replace it</td>
</tr>
<tr>
<td>Turbocharger</td>
<td>Filter silencer or diffuser dirty Clean it</td>
</tr>
<tr>
<td></td>
<td>Heavy deposits of dirt in the turbine or nozzle ring</td>
</tr>
<tr>
<td></td>
<td>VTG or VTG mechanism defective Contact an ABB Turbocharging Service Station</td>
</tr>
<tr>
<td>Charge air cooler</td>
<td>Dirty cooler Clean it</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**

Surveying 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>Oil filter heavily contaminated</td>
</tr>
<tr>
<td></td>
<td>Check / replace it</td>
</tr>
<tr>
<td>Defective oil pump in lubricating system</td>
<td>Clean it</td>
</tr>
<tr>
<td>Manometer display wrong</td>
<td>Replace the manometer</td>
</tr>
<tr>
<td>Turbocharger</td>
<td>Rotor axial clearance too large</td>
</tr>
<tr>
<td></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>Defects of connected cylinders when pulse charging</td>
</tr>
<tr>
<td></td>
<td>Contact the engine builder</td>
</tr>
<tr>
<td>Turbocharger</td>
<td>Heavy contamination in the turbine</td>
</tr>
<tr>
<td></td>
<td>Clean it</td>
</tr>
<tr>
<td></td>
<td>Damaged rotor components or bearing</td>
</tr>
<tr>
<td></td>
<td>Contact an ABB Turbocharging Service Station</td>
</tr>
<tr>
<td></td>
<td>VTG module damaged or dirty</td>
</tr>
<tr>
<td></td>
<td>Clean it or contact an ABB Turbocharging Service Station</td>
</tr>
<tr>
<td>Pipes</td>
<td>Defects such as leaks in the exhaust gas pipes or charge air ducts</td>
</tr>
<tr>
<td></td>
<td>Make repairs</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>Very dirty turbine (with 4-stroke application)</td>
</tr>
<tr>
<td></td>
<td>Contact an ABB Turbocharging Service Station</td>
</tr>
<tr>
<td></td>
<td>VTG module damaged or dirty</td>
</tr>
<tr>
<td></td>
<td>Clean it or contact an ABB Turbocharging Service Station</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><strong>Engine</strong></td>
<td>Malfunctioning injection system</td>
</tr>
<tr>
<td></td>
<td>Repair it or contact the manufacturer</td>
</tr>
<tr>
<td><strong>Turbocharger</strong></td>
<td>Air starvation, for example filter silencer clogged with dirt</td>
</tr>
<tr>
<td></td>
<td>Clean it</td>
</tr>
<tr>
<td><strong>Turbocharger</strong></td>
<td>Dirty compressor / turbine</td>
</tr>
<tr>
<td></td>
<td>Clean or repair the boiler or exhaust silencer</td>
</tr>
<tr>
<td></td>
<td>Exhaust counterpressure too high</td>
</tr>
<tr>
<td></td>
<td>Clean or repair the boiler or exhaust silencer</td>
</tr>
<tr>
<td></td>
<td>Damaged or eroded turbine</td>
</tr>
<tr>
<td></td>
<td>Contact an ABB Turbocharging Service Station</td>
</tr>
<tr>
<td><strong>Turbocharger</strong></td>
<td>VTG module damaged or dirty</td>
</tr>
<tr>
<td></td>
<td>Clean it or contact an ABB Turbocharging Service Station</td>
</tr>
<tr>
<td><strong>Charge air cooler</strong></td>
<td>Dirty cooler</td>
</tr>
<tr>
<td></td>
<td>Clean it</td>
</tr>
<tr>
<td></td>
<td>Cooling water volume too low</td>
</tr>
<tr>
<td></td>
<td>Top up the water</td>
</tr>
<tr>
<td><strong>Charge air cooler</strong></td>
<td>Entry temperature of cooling water too high</td>
</tr>
<tr>
<td></td>
<td>Inspect / clean the cooling system</td>
</tr>
<tr>
<td></td>
<td>Inadequate ventilation</td>
</tr>
<tr>
<td></td>
<td>Improve the ventilation</td>
</tr>
</tbody>
</table>
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 line between the engine 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>Dirty filter silencer causing excessive loss of pressure</td>
<td>Clean it</td>
</tr>
<tr>
<td>Dirty compressor / turbine</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>
<tr>
<td>VTG module damaged or dirty</td>
<td>Clean it or contact an ABB Turbocharging Service Station</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 expected</td>
<td>Check engine performance</td>
</tr>
<tr>
<td>Turbocharger</td>
<td></td>
</tr>
<tr>
<td>Manometer display wrong</td>
<td>Replace the manometer</td>
</tr>
<tr>
<td>VTG or VTG mechanism defective</td>
<td>Contact an ABB Turbocharging Service Station</td>
</tr>
</tbody>
</table>
Fouling of the compressor due to the feeding in of ventilation gases

Reduced compressor performance/efficiency, hence engine performance losses

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
<td></td>
</tr>
<tr>
<td>Heavy fouling of the compressor components</td>
<td>Clean compressor</td>
</tr>
<tr>
<td></td>
<td>Optimize oil separation</td>
</tr>
<tr>
<td>Increased vibrations, compressor blade damage</td>
<td>Correct the feed of ventilation gases according to instructions of enginebuilder.</td>
</tr>
</tbody>
</table>

Reduced fatigue strength of the compressor wheel, compressor blade failure.

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
<td></td>
</tr>
<tr>
<td>Material of compressor wheel corroded</td>
<td>Check the fuel and its corrosive components, and change fuel if necessary.</td>
</tr>
</tbody>
</table>
6.4 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></td>
</tr>
<tr>
<td>Heavy turbine contamination</td>
<td></td>
</tr>
<tr>
<td>VTG bearing damaged</td>
<td>Contact an ABB Turbocharging Service Station</td>
</tr>
<tr>
<td>Drive unit (electrical components)</td>
<td>No drive energy</td>
</tr>
</tbody>
</table>
6.5 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></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>

Run-down time too short

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
<td></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>
## 6.6 Speed measurement system

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>No signal or amplitude is poor</td>
<td>Fitting error: The screw plug for the sensor is fitted with an additional gasket (copper ring). When fitting the speed sensor, this gasket must be removed. If the gasket 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>Defective sensor</td>
<td>Contact an ABB Turbocharging Service Station</td>
</tr>
<tr>
<td>Measured speeds too high</td>
<td>Contaminated sensor tip: The sensor tip is magnetic and can thus attract metal particles. As a result, the distance to the signal-generating sealing disc is reduced, which can lead to amplification of the noise component and consequently to faulty triggering. Dismantle the sensor, clean its tip and refit the sensor using the specified tightening torque.</td>
</tr>
<tr>
<td>Measured speed too low</td>
<td>- - Contact an ABB Turbocharging Service Station</td>
</tr>
<tr>
<td>Other sources of errors</td>
<td>- - If none of the above measures eliminates the malfunction, we recommend that you have the speed measuring system inspected by an ABB Turbocharging Service Station.</td>
</tr>
</tbody>
</table>
# Removal and installation

## Transport

<table>
<thead>
<tr>
<th>Suspension of uninsulated turbocharger</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger with oil-cooled bearing casing</td>
<td>Complete turbocharger with gas outlet casing</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Suspension of insulated turbocharger</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger with oil-cooled bearing casing</td>
<td>Complete turbocharger with gas outlet casing</td>
</tr>
</tbody>
</table>
7.2 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>TPS57DV/EV/FV [kg]</th>
<th>TPS61DV/EV/FV [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>680</td>
</tr>
</tbody>
</table>

Turbocharger weights
7.3 **Remove the turbocharger**

- Mark assembled position of operating lever and separate VTG drive from operating lever.

- Disconnect all exhaust gas and air lines according to the instructions of the enginebuilder.

Version with water-cooled bearing casing:

- Disconnect the water pipes according to the instructions of the enginebuilder.

If present, remove hard insulation as follows:

- Remove screws and sheet metal (B) from the bearing casing insulation.

- Remove the remaining screws from the bearing casing insulation (A).

- Pull the bearing casing insulation up and off. The bearing casing insulation can be compressed to facilitate the removal process.

- Unplug the cable connector from the speed sensor.

- Attach lifting gear to bearing casing.

- If a gas outlet bend is present, sling lifting gear around it or secure it to the lifting gear with a swivel lifting eye (C).

- Loosen the fixing screws (D) on the bearing casing.

- Lift the turbocharger from the engine and put it down.

- Cover oil connections.
7.4 Installing the turbocharger

- Remove covers from oil connections.
- Visually inspect O-ring gaskets of oil supply and drain pipe (O-ring gaskets for engine are not delivered by ABB Turbo Systems).

**) When the turbocharger is mounted on the engine support, the bolt threads and screw heads must be lightly oiled (assumed friction coefficient $\mu = 0.12$ for tightening torque)

<table>
<thead>
<tr>
<th>Product</th>
<th>Through hole in bearing casing [mm]</th>
<th>Thread size [mm]</th>
<th>Tightening torque [Nm]</th>
<th>Strength class in acc. with DIN/ISO 898</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPS57</td>
<td>21</td>
<td>M20</td>
<td>455</td>
<td>10.9/12.9</td>
</tr>
<tr>
<td>TPS61</td>
<td>25</td>
<td>M24</td>
<td>780</td>
<td>10.9/12.9</td>
</tr>
</tbody>
</table>

- Attach lifting gear to bearing casing.
- If a gas outlet bend is provided, sling lifting gear around it additionally or fasten it to lifting gear using a swivel lifting eye (C) (see also section Transport / Weights).
- Lift turbocharger, place on bracket and align.
- Tighten fixing screws (D) to the bearing casing in accordance with the table above.
- Fasten all gas, water and air lines in accordance with the enginebuilder's instructions.
If present:

- Fit speed sensor and plug in cable connector.
- Adapt and fit bearing casing insulation (A).
- Adapt and fit sheet metal (B) of bearing casing insulation.

Version with water-cooled bearing casing:

- Remove the screw plugs from the water connections and fit the water pipes in accordance with the enginebuilder's instructions.
- Place operating lever on marked fitting position and fit on VTG drive.
8 Disassembly and assembly

8.1 Introduction

Precondition for the work described below is a turbocharger removed from the engine (refer to the chapter entitled Removal and Installation).

Further work

Only the work described in this Operation Manual may be carried out. Incorrectly performed disassembly and assembly of the cartridge group can lead to serious machine damage.

▶ ABB Turbo Systems recommends having further work carried out only by trained personnel from an ABB Turbocharging Service Station.

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.

Oil orifice

► When disassembling the turbocharger, a fitted oil orifice must not be removed.

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.

Suspended 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 to protect against mechanical hazards.

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 de-
Disassembly and assembly

Introduction

8.1

Philips

fined 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.

**Swivel lifting eye to be used**

Two swivel lifting eyes are required to lift loads safely (not supplied by ABB).

<table>
<thead>
<tr>
<th>Swivel lifting eye</th>
<th>Product</th>
<th>Thread</th>
<th>Length</th>
<th>Minimum load limit (loading capacity)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TPS57</td>
<td>M12</td>
<td>21 mm</td>
<td>350 kg</td>
</tr>
<tr>
<td></td>
<td>TPS61</td>
<td>M12</td>
<td>21 mm</td>
<td>500 kg</td>
</tr>
</tbody>
</table>
8.2 Module weights

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

<table>
<thead>
<tr>
<th>Designation</th>
<th>TPS57 [kg]</th>
<th>TPS61 [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 Filter silencer</td>
<td>40</td>
<td>62</td>
</tr>
<tr>
<td>02 Radial air suction branch</td>
<td>11</td>
<td>21</td>
</tr>
<tr>
<td>03 Axial air suction branch</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>04 Compressor casing</td>
<td>55</td>
<td>90</td>
</tr>
<tr>
<td>05 Wall insert</td>
<td>13</td>
<td>30</td>
</tr>
<tr>
<td>06 Diffuser</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>07 Cartridge group</td>
<td>85</td>
<td>160</td>
</tr>
<tr>
<td>08 Turbine casing with external burst protection</td>
<td>80</td>
<td>130</td>
</tr>
<tr>
<td>09 Burst ring</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>10 Gas outlet flange</td>
<td>16</td>
<td>30</td>
</tr>
<tr>
<td>11 Gas-outlet elbow / bend</td>
<td>40</td>
<td>60</td>
</tr>
</tbody>
</table>
8.3 Disassembling and assembling turbocharger

Removing the compressor casing

**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 to protect against thermal hazards.

- Disconnect all air lines in accordance with the enginebuilder’s instructions.
- Remove the screws for the compressor casing insulation and dismantle the insulation.
- Undo the V-clamp (72020) and remove the filter silencer (81000) or air suction branch (82000).
Slightly loosen screws (72011) and turn compressor casing (72000) until swivel lifting eye can be fastened to lifting gear.

(77006* only provided with wall insert with acceleration aid)
If the compressor casing cannot be removed easily, it can be pressed off using the press-off tool (90042) against the turbine casing. To do this, remove the two cover plates (A+B) from the hard insulation on the turbine casing.

**NOTICE**

**Axial force**

The press-off tool can generate a high axial force and, if it is not used properly (too much pressure on one side), it can damage the rotor.

- It should thus be used alternately on both sides while avoiding excessive pressure on either side.

- Loosen screws (72011) and remove together with fastening strips (72012).
- Move away compressor casing (72000) with wall insert (77000) carefully and horizontally.
- Tap wall insert (77000) out of compressor casing using nylon hammer and remove O-ring seal (77005).

**TPS61 wall insert removal**

- Fasten lifting beam (90258) to wall insert.
- Fasten swivel lifting eye (a) to lifting beam.
- Remove wall insert (77000) using lifting gear.
Installing compressor casing

- Refit wall insert (77000) and O-ring (77005) in reverse order.

**NOTICE**

**O-rings**

Used O-rings must always be replaced with new ones. O-rings are only available as a set (see chapter Spare parts).

- Install compressor casing in reverse order.
- Thoroughly clean fastening strips (72012) before fitting them.
Removing the cartridge group

- Mark the assembled position of the operating lever (42107) and detach the VTG drive at the operating lever.
- Check the lifting gear and fasten it to the bearing casing (42001).

If provided

- Disconnect all pipes in accordance with the engine builder's instructions, remove the insulation, remove the turbocharger and compressor casing together with the filter silencer (also see the previous chapter).

If provided

- Unplug the cable connector (86515) for the speed sensor (86505).
- Loosen both outer hexagon-head screws (54004) on each of the fastening strips (51002) and remove them together with Verbusripp washers (51003).
- Loosen the inner screws (51004), push the fastening strips (51002) outwards and gently tighten the screws again.
- Loosen and remove the fixing screws (C) of the bearing casing (42001).
There are two variants for the holder for the slotted ring (42103). With non-observance, the slotted ring can fall out of the holder during disassembly.

**Version 1**

The slotted ring is secured with the holder. Consequently, the cartridge group can be removed without additionally securing the slotted ring.

**Version 2**

The slotted ring must be secured against falling down before the cartridge group is removed. Cable ties can be used for this.

- Remove the cartridge group.
- The bearing casing is difficult to loosen.
- Push the turbine casing away from the bearing casing using the press-off tool (90042) (see the following picture).

**Axial force**

The press-off tool can generate a high axial force and, if it is not used properly (too much pressure on one side), the rotor can be damaged. It should thus be used alternately on both sides while avoiding excessive pressure on either side.

- Cover the oil connections.
Fitting cartridge group

**NOTICE**

**O-rings**

Used O-rings must always be replaced with new ones. O-rings are only available as a set (see chapter Spare parts).

- Measure axial and radial clearances. (See section Axial and radial clearances.)

Fitting diffuser

- Fit diffuser (79000) and O-ring (42012) with screw (42008).
- Check lifting gear and fasten to bearing casing (42001).
- Unscrew cartridge group and lift it out of service support (90012).
Installing the cartridge group

**Installation damage**
An incorrect attachment of the cartridge group may result in damage during installation. If the blades of the VTG module cannot be moved and the cartridge group is installed, VTG parts may be damaged.
- Only attach the lifting gear to the bearing casing as illustrated.
- Before installing the cartridge group, make sure that each blade can be pressed axially against the spring into the partition wall.

- Check the lifting gear and attach it to the bearing casing (42001).
- Lubricate the centring seats and screw threads with ceramic paste (Antiscuff or similar high-temperature lubricating paste).
- Remove temporary covers on oil connections.

- Fit the cartridge group as far as possible by hand
There are two variants for securing the slotted ring (42103). In variant 1 the slotted ring is secured with the brackets. This enables the cartridge group to be fitted without extra safeguarding of the slotted ring.

In variant 2 the slotted ring must be secured from falling. Cable ties are used for this purpose (see image).

Cartridge groups may be supplied with the slotted ring secured by cable ties. After assembling the cartridge group with fastening strips these cable ties must be removed.

Do not damage or move the gasket rings (A) in the mounting support when assembling the cartridge group. The gasket rings (A) are on the engine side and are not included in the ABB Turbo Systems scope of delivery.

- Loosen the inner screw (51004), slide the fastening strips (51002) inwards and tighten the screw.
- Fit the remaining screws (51004) and Verbus Ripp washers.
- Secure the bearing casing (42001) with fixing screws (C).
- Tighten the fixing screws (C) with the tightening torques according to the following table.

**) When the turbocharger is mounted on the engine support, the bolt threads and screw heads must be lightly oiled (assumed friction coefficient $\mu = 0.12$ for tightening torque).

<table>
<thead>
<tr>
<th>TPS</th>
<th>Hole in bearing casing [mm]</th>
<th>Fixing screws C [mm]</th>
<th>Tightening torques [Nm] **</th>
</tr>
</thead>
<tbody>
<tr>
<td>57</td>
<td>Ø 21</td>
<td>M20</td>
<td>455</td>
</tr>
<tr>
<td>61</td>
<td>Ø 25</td>
<td>M24</td>
<td>780</td>
</tr>
</tbody>
</table>

- Insert the cable connector (86515) into the speed sensor (86505)
- Use the operating lever (42107) to couple the VTG drive at the point marked during assembly.
Removing gas outlet bend and gas outlet flange

If provided

- Disconnect all lines in accordance with engine builder's instructions and remove insulation. (See also preceding chapter.)
- Loop lifting gear around gas outlet bend (51100).
- Remove gas outlet bend (51100) and gasket (52406). Only gas outlet bends from ABB Turbo Systems have the gasket (52406).
- Remove gas outlet flange (52400) and, if fitted, C-ring (52408).
Fitting the gas outlet flange and gas outlet bend

- If provided, fit the C-ring (52408).
- Fit the gas outlet flange (52400).
- In the case of gas outlet bends (51100) from ABB Turbo Systems: always replace the gasket (52406) (see the chapter entitled Spare parts).
- Apply high-temperature grease to contacting surfaces and threads.
- Fit the turbine casing using the nuts (52433) while observing tightening torques specified in the table of tightening torques.

If provided
- Fasten the insulation.
- Attach pipes in accordance with the enginebuilder’s instructions.
8.4 Axial clearance A and radial clearance B

Following removal and before installation of the cartridge group, the axial clearance A and radial clearance B must be measured and noted.

In order to correctly measure the axial clearance A, the turbine must be raised slightly.

**NOTICE**

Risk of injury due to sharp edges on the compressor wheel
The compressor wheel has sharp edges which can cause injuries.

- Wear safety gloves.

Wear safety gloves to protect against mechanical hazards.

<table>
<thead>
<tr>
<th>Axial clearance A and radial clearance B [mm]</th>
<th>TPS57</th>
<th>TPS61</th>
</tr>
</thead>
<tbody>
<tr>
<td>A minimum</td>
<td>0.12</td>
<td>0.15</td>
</tr>
<tr>
<td>A maximum</td>
<td>0.21</td>
<td>0.25</td>
</tr>
<tr>
<td>B minimum</td>
<td>0.72</td>
<td>0.81</td>
</tr>
<tr>
<td>B maximum</td>
<td>1.31</td>
<td>1.55</td>
</tr>
</tbody>
</table>

**CAUTION**

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.
8.5 Radial clearances N and R

N and R

These are the theoretical values of the radial clearance between the compressor wheel and the wall insert and/or turbine wheel and the gas outlet flange.

The minimum and maximum values result from the manufacturing tolerances of the compressor wheel and turbine wheel or the wall insert and gas outlet flange.

N1 and N2 as well as R1 and R2 are each measured at the same time using two feeler gauges.

To measure N1 and N2, the feeler gauges must be pushed between the wall insert and the compressor wheel free of play, in each case above and below.

To measure R1 and R2, the feeler gauges must be pushed between the gas outlet flange and the turbine free of play, in each case above and below.
The mean values measured must be within the permissible values of the radial clearance N and R.

<table>
<thead>
<tr>
<th>Radial clearances N and R [mm]</th>
<th>TPS57</th>
<th>TPS61</th>
</tr>
</thead>
<tbody>
<tr>
<td>N minimum</td>
<td>0.40</td>
<td>0.50</td>
</tr>
<tr>
<td>N maximum</td>
<td>0.86</td>
<td>0.94</td>
</tr>
<tr>
<td>R minimum</td>
<td>0.75</td>
<td>0.90</td>
</tr>
<tr>
<td>R maximum</td>
<td>1.11</td>
<td>1.32</td>
</tr>
</tbody>
</table>

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.
8.6 Table of tightening torques

The following tightening torques must be observed for the specified screw connections:

<table>
<thead>
<tr>
<th>Position</th>
<th>Part number</th>
<th>TPS57</th>
<th>TPS61</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>72020</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>02</td>
<td>42008</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>05</td>
<td>52433</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>06</td>
<td>51004</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>09</td>
<td>72011</td>
<td>105</td>
<td>170</td>
</tr>
<tr>
<td>10</td>
<td>86505</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>
9 Taking out of operation

9.1 Shut down turbocharger

If the turbocharger is damaged and the engine can be shut down for only a short time for emergency repairs, proceed as follows:

▶ Fit the cover plate.

![CAUTION]

Always precisely obey the engine builder's instructions in case of engine operation with a blocked/throttled turbocharger!

Dismantling the turbocharger

▶ Dismantling the turbocharger (see the chapter entitled Dismantling and fitting the turbocharger)
Fitting the cover plate

- Ensure that the oil connections in the bracket have had the gaskets fitted.
- Close the opening in the turbine casing (51000) using the cover plate (A).
- Secure cover plate with fastening strips (51002), Verbus-Ripp washers (51003) and screws (51004).
- Screw cover plate to bracket.

NOTICE
Thoroughly clean the fastening strips (51002) before fitting them. Coat threads of screws (51004) with ceramic paste.
Taking out of operation

Shut down turbocharger

Cover plate drawing

The cover is not included in the scope of delivery of ABB Turbo Systems and must be self-manufactured.

Material: Common structural steel, in compliance with DIN EN 10025-2

Unit [mm]

<table>
<thead>
<tr>
<th>TPS</th>
<th>B1</th>
<th>B2</th>
<th>B3*</th>
<th>B4</th>
<th>B5</th>
<th>B6</th>
<th>D1</th>
<th>D2</th>
<th>R1</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>57</td>
<td>101</td>
<td>100</td>
<td>190</td>
<td>22.6</td>
<td>2</td>
<td>220</td>
<td>379.7</td>
<td>21</td>
<td>≤182</td>
<td>M10</td>
</tr>
<tr>
<td>61</td>
<td>120.5</td>
<td>120</td>
<td>226</td>
<td>27.5</td>
<td>5</td>
<td>260</td>
<td>451.6</td>
<td>25</td>
<td>≤215</td>
<td>M10</td>
</tr>
</tbody>
</table>

*) Distance depending on the version of the support (turbocharger foot), short / long

For more information about the version of the support (short / long) an ABB Turbocharging Service Station can be contacted.
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.
- Wear personal protective equipment (PPE) according to the material safety data sheet.
- Comply with local legislation.

Wear safety goggles.

Wear safety gloves to protect against chemical hazards.

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 dusts.

Wear safety gloves to protect against mechanical hazards.

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

The following data must be specified when making inquiries or ordering spare parts:

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

Our service stations and agents take orders for spare parts.

- Contact an ABB Turbocharger service station or an ABB agent if special versions / cases are not addressed in these general instructions.

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.
Customer spare part set (97070)

The customer spare part set (97070) is required for the work described in this manual. The parts included in the customer spare part set are available only as a complete set.

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hexagon socket head screw</td>
<td>42008</td>
</tr>
<tr>
<td>1</td>
<td>O-ring</td>
<td>42012/ 81010/ 82010</td>
</tr>
<tr>
<td>1</td>
<td>O-ring</td>
<td>77005</td>
</tr>
<tr>
<td>1</td>
<td>Gasket</td>
<td>52406 *</td>
</tr>
<tr>
<td>2</td>
<td>Counter-sunk screw</td>
<td>72041</td>
</tr>
</tbody>
</table>

* This gasket can only be inserted when using a gas outlet casing from ABB Turbo Systems.
12.2 View of turbocharger showing part numbers
### Part number

<table>
<thead>
<tr>
<th>Part number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>42008 (in customer spare part set)</td>
<td>Socket screw</td>
</tr>
<tr>
<td>42012 (in customer spare part set)</td>
<td>O-ring</td>
</tr>
<tr>
<td>51000</td>
<td>Turbine casing</td>
</tr>
<tr>
<td>51002</td>
<td>Fastening strip</td>
</tr>
<tr>
<td>51100</td>
<td>Exhaust bend</td>
</tr>
<tr>
<td>52400</td>
<td>Gas outlet flange</td>
</tr>
<tr>
<td>52406 (in customer spare part set)</td>
<td>Gasket</td>
</tr>
<tr>
<td>57200</td>
<td>Burst protection</td>
</tr>
<tr>
<td>57210</td>
<td>Burst ring</td>
</tr>
<tr>
<td>72000</td>
<td>Compressor casing</td>
</tr>
<tr>
<td>72011</td>
<td>Hexagon-head screw</td>
</tr>
<tr>
<td>72012</td>
<td>Fastening strip</td>
</tr>
<tr>
<td>72020</td>
<td>V-clamp</td>
</tr>
<tr>
<td>72040</td>
<td>Locking disc</td>
</tr>
<tr>
<td>72041 (in customer spare part set)</td>
<td>Counter-sunk screw</td>
</tr>
<tr>
<td>77000</td>
<td>Wall insert</td>
</tr>
<tr>
<td>77005 (in customer spare part set)</td>
<td>O-ring</td>
</tr>
<tr>
<td>77006</td>
<td>O-ring</td>
</tr>
<tr>
<td>79000</td>
<td>Diffuser</td>
</tr>
<tr>
<td>81000</td>
<td>Filter silencer</td>
</tr>
<tr>
<td>81010 (in customer spare part set)</td>
<td>O-ring</td>
</tr>
<tr>
<td>82000</td>
<td>Air suction branch</td>
</tr>
<tr>
<td>82010 (in customer spare part set)</td>
<td>O-ring</td>
</tr>
<tr>
<td>86505(A)</td>
<td>Speed sensor (cable not integrated)</td>
</tr>
<tr>
<td>86505(B)</td>
<td>Speed sensor (cable integrated)</td>
</tr>
<tr>
<td>86515(A)</td>
<td>Cable connector for 86505(A)</td>
</tr>
<tr>
<td>86515(B)</td>
<td>Cable connector for 86505(B)</td>
</tr>
<tr>
<td>86526</td>
<td>F/I converter</td>
</tr>
<tr>
<td>86528</td>
<td>Tachometer</td>
</tr>
</tbody>
</table>
12.3 View of cartridge group showing part numbers
### Part numbers and descriptions

<table>
<thead>
<tr>
<th>Part number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>21000</td>
<td>Shaft</td>
</tr>
<tr>
<td>21002</td>
<td>Piston ring</td>
</tr>
<tr>
<td>25000</td>
<td>Compressor wheel</td>
</tr>
<tr>
<td>32101</td>
<td>Radial bearing</td>
</tr>
<tr>
<td>32103</td>
<td>Circlip</td>
</tr>
<tr>
<td>32105</td>
<td>Thrust ring</td>
</tr>
<tr>
<td>32106</td>
<td>Axial bearing</td>
</tr>
<tr>
<td>32108</td>
<td>Piston ring</td>
</tr>
<tr>
<td>32109</td>
<td>Sealing disc</td>
</tr>
<tr>
<td>32110</td>
<td>Bearing flange</td>
</tr>
<tr>
<td>32111</td>
<td>Auxiliary bearing</td>
</tr>
<tr>
<td>32112</td>
<td>Bearing flange</td>
</tr>
<tr>
<td>32113</td>
<td>Socket screw</td>
</tr>
<tr>
<td>32114</td>
<td>Socket screw</td>
</tr>
<tr>
<td>32221</td>
<td>Bearing cover</td>
</tr>
<tr>
<td>32222</td>
<td>O-ring</td>
</tr>
<tr>
<td>42001</td>
<td>Bearing casing</td>
</tr>
<tr>
<td>42002</td>
<td>Socket screw</td>
</tr>
</tbody>
</table>