Operation Manual
TPS61-R

HT593829 English
Original Operation Manual

1 Introduction  HZTL4005_EN_F

2 Safety  HZTL4027_EN_A

3 Safety data sheet  HT593829

4 Product description  HZTL4042_EN_C
Operating limits and replacement intervals

The recommended replacement intervals and the corresponding operating limits in chapter 3 are jointly defined with the enginebuilder. This information is specific to the product.

Non-observance of the recommended replacement intervals and the operating limits increases the risk of unpredictable component failures.
# Introduction

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1 Introduction

1.1 Purpose of the manual

This Operation Manual belongs to the turbocharger with the identical serial number (01), see chapter 3 (Safety data sheet) and the rating plate on the turbocharger.

Operation Manual
The Operation Manual explains the turbocharger and contains instructions for safe operation.

The Operation Manual is a complement to and expansion of existing national regulations for occupational safety, accident prevention and environmental protection.

Target group
The Operation Manual is aimed at engineers and trained mechanics responsible for the proper operation of the engine and for the turbocharger connected to it.

Availability of the Operation Manual
The Operation Manual must be available where the turbocharger is used.

All persons operating or working on the turbocharger must have read and fully understood the Operation Manual.
1.2 Symbols, definitions

Symbols
The following symbols are used in this document:

- Indicates an action step.
- Indicates a numbered action step.
- Refers to a page number.

Definition of Note

**NOTICE**

Note
The note provides advice which facilitates the work.

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

Caution and warning signs are described in chapter Safety.

ABB Turbo Systems

ABB Turbo Systems Ltd is identified as ABB Turbo Systems in this document.

Official service stations of ABB Turbo Systems

Official service stations are identified in this document as ABB Turbocharging Service Stations. They are regularly audited and certified by ABB Turbo Systems. Also see chapter Contact information →7.
Definition of pictograms

The following pictograms can occur in this document. These point out actions that must be taken in accordance with the meaning of the relevant pictogram.

<table>
<thead>
<tr>
<th>Pictogram</th>
<th>Meaning</th>
<th>Pictogram</th>
<th>Meaning</th>
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<tbody>
<tr>
<td>![Pictogram]</td>
<td>Tighten with specified torque</td>
<td>![Pictogram]</td>
<td>Affix</td>
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<tr>
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<td>Tighten over specified tightening angle</td>
<td>![Pictogram]</td>
<td>Measure</td>
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<td>![Pictogram]</td>
<td>Hand-tight, tighten without tools</td>
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<td>Oil</td>
<td>![Pictogram]</td>
<td>Visually inspect</td>
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<td>![Pictogram]</td>
<td>Apply screw locking paste (e.g. Loctite)</td>
<td>![Pictogram]</td>
<td>Please note text for numbered work step</td>
</tr>
<tr>
<td>![Pictogram]</td>
<td>Apply high-temperature grease</td>
<td>![Pictogram]</td>
<td>See document</td>
</tr>
<tr>
<td>![Pictogram]</td>
<td>Apply other paste in accordance with specifi-</td>
<td>![Pictogram]</td>
<td>Dispose of in an environmentally compatible, professional way and in compliance with locally applicable regulations</td>
</tr>
<tr>
<td>![Pictogram]</td>
<td>Oil free, grease free and dry</td>
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<td></td>
</tr>
</tbody>
</table>

Table 1: Definition of pictograms
1.3 Storage of new turbochargers and spare parts

Storage of new turbochargers and spare parts for up to 6 months

New turbochargers and spare parts can be stored in their closed packages for 6 months from the date of delivery without additional mothballing measures, indicated by the VCI label on the package.

![VCI]

Only dry rooms with 40...70 % atmospheric humidity, in which no water condensation can form, are suitable as storage locations.

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

**WARNING**

Health protection when handling VCI

VCI products are not hazardous in terms of the Ordinance on Hazardous Substances. Nevertheless, the following points must be observed when handling VCI:

- Observe information in material safety data sheet
- Ensure proper space ventilation.
- Do not eat, drink or store food at the workplace while working with VCI.
- Clean hands and face after working with VCI.

For more information, see www.branopac.com.

Wear safety gloves to protect against mechanical hazards.

Every 6 months, the following mothballing measures are required:

- Open package.
- Remove VCI corrosion protection emitter from package and replace with a new VCI corrosion protection emitter of the same kind. New VCI corrosion protection emitters can be obtained from www.branopac.com.
- Old VCI corrosion protection emitters must be disposed of in an environmentally compatible, professional way and in compliance with locally applicable regulations.
- Close package. The more tightly the package is sealed, the longer the protection duration.
Long-term storage of replacement turbochargers or spare parts

The turbochargers or cartridge groups will be prepared for long-term storage if requested in the purchase order. The package is equipped with a hygrometer (see illustration).

Fig. 3: Package with hygrometer

Every 6 months, the following measures are required:

- Check the hygrometer (02) in the sight-glass. There is an opening (01) in the wooden crate to enable you to perform this check. If the 70% indicator field has changed colour, the maximum admissible atmospheric humidity has been exceeded. In this case, the turbocharger or cartridge group must be checked and repackaged by an ABB Turbocharging Service Station.

- Check the package for damage. If the package is damaged, the turbocharger or cartridge group must be checked and repackaged by an ABB Turbocharging Service Station.

After every 3 years, the following steps must be carried out by an ABB Turbocharging Service Station:

- Checking the component
- Replacing the desiccant
- Repackaging the component.

**NOTICE**

Replacement components which are ready for operation

If the 70% field of the hygrometer (02) has not changed colour and the package is not damaged, the replacement turbocharger or replacement cartridge group can be put into operation without previously having been checked by an ABB Turbocharging Service Station.

Unpackaging replacement turbochargers or spare parts

Once the material has been unpackaged from the VCI package, the corrosion protection is no longer effective.

To prevent condensation, the temperature of the package contents must be the same as the ambient temperature.
1.4 Contact information

Contact information for the ABB Turbocharging Service Stations 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
## Safety

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1 Safety

1.1 Introduction

Turbochargers manufactured by ABB reflect the state of the art. The respective safety and health protection requirements are met. This ensures safe operation of the turbocharger. Nevertheless, there may be some residual risks during operation of and work on the turbocharger which:

- Are caused by the turbocharger itself or its accessories.
- Are caused by the operating equipment used or supplies and materials.
- Are a consequence of insufficient compliance with safety instructions.
- Are a consequence of insufficient or inappropriate performance of maintenance and inspection work.

The operating company is responsible for defining measures that regulate safe access to and safe handling of the turbocharger.

All instructions contained in this chapter must be observed for safe and trouble-free operation of the turbocharger and during all work on the turbocharger.

All further safety instructions contained and specifically identified in every chapter of this manual (Definition of safety instructions →3) must also be observed.

1.2 CE conformity

Information

ABB turbochargers comply with the Machinery Directive 2006/42/EC and are partly completed machinery as defined by Article 2 g in this directive.
1.3 **Definition of mandatory signs**

**To be worn at all times**

| Protective clothing | Safety footwear to protect against mechanical hazard and risk of falling |

Table 1: Personal protective equipment to be worn at all times

**To be worn specific to the respective task**

| Safety glasses | Safety goggles |
| Safety gloves to protect against | Respiratory mask to protect against |
| - Mechanical hazard | - Dusts |
| - Chemical hazard | - Gases |
| - Thermal hazard |  |
| - Electrical hazard |  |
| Safety helmet | Ear protection |

Table 2: Personal protective equipment to be worn specific to the respective task

1.4 **Definition of safety instructions**

![WARNING]

**Definition of Warning**

Non-compliance or inaccurate compliance with working or operating instructions indicated by this symbol and the word **WARNING** can lead to serious injuries to personnel and even to fatal accidents.

> **Warning signs must always be observed.**

![CAUTION]

**Definition of Caution**

Non-compliance or inaccurate compliance with working or operating instructions indicated by this symbol and the word **CAUTION** can lead to serious damage to engine or property with grave consequences.

> **Caution signs must always be observed.**
1.5 Intended use

Use on internal combustion engines in general

ABB turbochargers are intended for charging internal combustion engines. The turbocharger supplies the engine with the air volume or air/gas mixture and the associated charging pressure required for operation.

The turbocharger is solely intended to be operated with a clockwise direction of rotation as viewed from the turbine end.

The specific operating limits of the turbocharger were determined on the basis of information from the enginebuilder about the intended use. These data are given on the rating plate.

ABB accepts no liability and rejects all warranty claims for any non-intended uses.

![WARNING]

**Unapproved operation**

Any operation of the turbocharger outside of its operating limits can be hazardous to personnel.

- Only operate the turbocharger within the operating limits.
- Only trained personnel must operate the turbocharger.

The intended use of the turbocharger includes compliance with all regulations and conditions. In particular, the following must be observed:

- Operation Manual
- Instructions of the enginebuilder

**State of the art**

The turbocharger is designed and manufactured according to the state of the art and is safe to operate.

**Perfect condition**

The turbocharger must only be used when it is in a technically flawless condition and operated in compliance with its intended use.

ABB excludes any liability for damage resulting from unauthorized modifications to the turbocharger or improper operation.
1.6 Warning plates on the turbocharger

Warning plates are attached to the turbocharger, which must be observed. The warning plates must always be present in the intended locations and must be legible.

![Warning plate]

If warning plates are not present in the intended locations or are not legible, they must be replaced with new warning plates. The necessary information can be found in the Operation Manual, Chapter 4 Product description.

Turbochargers supplied to the enginebuilder without insulation must be equipped later with warning plates on the insulation. This is the responsibility of the enginebuilder.
1.7 Turbocharger rating plate

Fig. 2: Rating plate

Operating limits
01 Turbocharger operating limits at engine overload (110 %).
   In test rig operation only, unless otherwise agreed with the enginebuilder.
02 Turbocharger operating limits during operation

Recommended inspection and replacement intervals of turbocharger components
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 for special design
08 Weight of turbocharger in kg
09 Turbocharger type
10 Serial number
11 Year of construction of turbocharger
12 Manufacturing plant
Explanations regarding the rating plate

The recommended inspection and replacement intervals and the corresponding operating limits are jointly defined with the enginebuilder. 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 a case, we recommend that you contact the nearest official service station of ABB Turbo Systems.

$n_{B_{\text{max}}}$, $t_{B_{\text{max}}}$ normally apply only when running at overload (110 %) during trials on the engine test bed. These limit values 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 inspection and replacement intervals increases the risk of unpredictable component failures.

Locations of the rating plates

The locations of the rating plates are defined in the Operation Manual, Chapter 4 Product description.
1.8  **Lifting of loads**

**WARNING**

**Suspended loads**

Loads that are not attached according to regulations can cause injury to personnel or fatal accidents.

- Loads must always be fastened to properly functional lifting gear with a sufficient load limit.
- Pay attention to the correct attachment of loads on the crane hook.
- People must not stand beneath suspended loads.

- Wear safety gloves to protect against mechanical hazards.
- Wear safety helmet.

---

Fig. 3: Attachment of loads on the crane hook

If there are two or more suspension points, the attachment angle of 45° must not be exceeded. This prevents excessive loading due to diagonal pull.

- Before looping around the components of the turbocharger, let them cool down (maximum 80°C).
- Attach components of the turbocharger as described in the respective action steps.
- Use a suitable edge guard if there are sharp edges.
- The assembly devices must be completely screwed in and must not unscrew during use.
- Use assembly devices only for the described applications.
- Put down dismantled components of the turbocharger in such a way that they cannot tip over.
1.9 Prerequisites for operation and maintenance

Responsibility of the operating company

In awareness of its responsibility, the operating company must ensure that only authorised personnel work on the turbocharger, who:

- Are versed in the general and locally applicable regulations for occupational safety and accident prevention
- Are equipped with the prescribed personal protective equipment
- Have read and understood the Operation Manual
- Have been instructed in the use of the turbocharger.

The safety-conscious work of the personnel and adherence to the Operation Manual must be checked periodically.

Suitable working materials and personal protective equipment must be kept in a perfect condition.

Only authorised personnel may remain in the vicinity of the turbocharger when the engine is running.

Competence of personnel

The turbocharger must only be operated and serviced by trained and authorised personnel. Basic mechanical training is a prerequisite.

Modifications to the turbocharger

Modifications to the turbocharger must be approved by ABB Turbo Systems.

⚠️ WARNING

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.

Original parts and accessories are specially designed for ABB turbochargers.

ABB accepts no liability for any damage resulting from the use of non-original parts and corresponding accessories.
1.10 Hazards during operation and maintenance

Noise hazards
The turbocharger’s noise emission is influenced by its installation and operating conditions. A noise level exceeding 85 dB(A) is harmful.

⚠️ WARNING
Danger due to noise
Exposure to noise can harm the hearing system, impair health and the psychological state and may lead to lack of attention and irritation.
- When the engine is running, always wear ear protection.
- Always wear ear protection if the sound pressure level exceeds 85 dB(A).

Wear ear protection.

Hazards due to hot surfaces
Surfaces of the turbocharger, attached parts and operating fluids (lubricating oil) get hot during operation. The surface temperature depends on the efficacy of the existing insulation. The temperature may rise to a level that can cause burns.

⚠️ WARNING
Danger of burns
Touching hot surfaces or contact with hot operating fluids can cause burns.
- Do not touch hot surfaces. Observe the warning plate on the turbocharger.
- Wear heat-resistant safety gloves and protective clothing.
- Wait for the turbocharger to cool down before carrying out any work.

Wear safety gloves to protect against thermal hazards.
WARNING

Hot surfaces on a non-insulated turbocharger
Non-insulated turbochargers can cause serious injuries to personnel (burns).
The turbocharger is supplied with or without insulation in accordance with
the purchase order received from the enginebuilder. If supply is without ins-
ulation, 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 en-
ginebuilder to protect against hot turbocharger surfaces is compulsory.

Wear safety gloves to protect against thermal hazards.

Hazards due to rotating parts

WARNING

Physical hazards
Contact with rotating parts can cause severe injury. The turbocharger must
never be used without the filter silencer or the air suction branch. With the
engine stopped, the rotor can rotate due to the stack draught alone.

▶ Operate the turbocharger in compliance with the specifications.
▶ Secure the rotor against unintentional rotation during maintenance.

Wear safety gloves to protect against mechanical hazards.
1.11 Safe operation

Mechanical hazards during operation

During standard operation, no mechanical hazards are caused by the turbocharger itself if it has been properly installed.

Safety during commissioning and operation

- Visually inspect your working environment before starting work.
- Remove any obstacles and objects littering the workplace.
- Check all pipes to and from the turbocharger for damage and leaks before commissioning.
- Check turbocharger for recognisable damage or defects every 12 hours of operation or at least once a day.
- Report any damage and any alterations of operational characteristics to the responsible department immediately.
- In case of damage, take the turbocharger out of operation immediately and safeguard against accidental/unauthorised use.
- When switching on operating energy supplies (hydraulics, pneumatics, electricity), pay attention to the risks that may occur as a consequence of this energy input.
1.12 Safe maintenance

Occupational safety

**WARNING**

**Injuries to persons**
Severe injuries to personnel or fatal accidents can be caused by mechanical influences as a consequence of hazardous and inadequate operational procedures or non-compliance with safety and health standards.

- When working on the turbocharger always wear safety footwear and protective clothing to protect against mechanical hazards.
- Keep personal protective equipment in perfect condition.
- Obey mandatory signs.
- Observe the general rules for occupational safety and prevention of accidents.
- Only perform operations that are described in this manual.
- Only perform operations for which you have received instruction or training.

- Wear safety footwear to protect against mechanical hazard and risk of falling.

- Wear protective clothing.

**WARNING**

**Risk of falling**
When working on the turbocharger, there is a risk of falling.

- Do not climb onto the turbocharger or onto attached parts and do not use them as climbing aids.
- Use suitable climbing aids and working platforms for work above body height.

- Comply with the general accident prevention regulations.
- Only perform work on the turbocharger when you are in a physically and psychologically stable condition.
- Only work with suitable tools, equipment and appliances that function properly.
- Power tools must be grounded and cables must be undamaged.
- Keep the workplace clean; clear away any loose objects and obstacles on the floor.
- Keep the floor, equipment, and turbocharger clean.
- Have oil binding agents ready and provide or keep oil pans at hand.
- Clean up any spills.
- Have fire protection means and extinguishing agents available.
Use of assembly devices
Assembly devices are specially constructed and designed for the defined use; they are not commercially available products.

- Use assembly devices only for the described applications.

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 vicinity 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 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 materials and supplies 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 repair
- Observe the procedures for set-up, service and inspection work and the inspection intervals.
- Inform the operating staff before starting any service or repair work. Make sure the engine is not started while work is being conducted on the turbocharger.
- Before taking off any cover or removing any guard from the turbocharger, switch off the engine and wait until the turbocharger has come to a standstill.
- Make sure that the oil supply is interrupted, especially with an external oil supply.
- Only restart the engine after all parts have been properly fitted again and oil supply is ensured.

**CAUTION**

Mechanical operations on the turbocharger
Components of the turbocharger can be damaged or destroyed as a result of improper procedures.

- Only perform operations that are described in this chapter.
- Only perform operations for which you have received instruction or training.
Safety when taking out of operation or preparing for mothballing

- Secure rotor against turning. The rotor can rotate due to the stack draught alone.
- Observe the material safety data sheet for the cleaning and mothballing agents.
- Wear personal protective equipment (PPE) according to the material safety data sheet.

Mechanical hazards when working on the turbocharger

**WARNING**

Physical hazards due to rotating parts

The rotor can rotate due to the stack draught alone. Contact with rotating parts can cause severe injury.
- Secure rotor against turning.

**WARNING**

Mechanical hazard

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 chapter.
- Only perform operations for which you have previously received instruction or training.
Hazards due to operating materials and supplies

Operating materials and supplies are substances required for the operation of the turbocharger or for the performance of maintenance work. Oils, greases, coolants, detergents and solvents, acids and similar substances can be classified as hazardous substances.

**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.

**WARNING**

**Danger of fire or explosion**

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

- Observe the information in the material safety data sheet for the operating materials and supplies.
- 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 ventilation.

---

**CAUTION**

**Environmental hazard**

Improper handling of operating materials and supplies can lead to environmental damage.

- Observe the information in the material safety data sheet for the operating materials and supplies.
- Comply with local legislation.
# Safety data sheet

## TPS61-R

### TPS61R35-162850A

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February 2020

Application according to the Operation Manual

made in Switzerland
Product description

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1 Introduction

1.1 Essential information

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.

Please contact an ABB Turbocharging Service Station if you have any 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.

1.2 Registered trademarks
The trademarks of outside companies are used in this document. These are marked with the ® symbol.

1.3 Related documents

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Table 1:Related documents

*) This chapter is only present in serialised operation manuals.
1.4 Layout and function of the turbocharger

Fig. 1: Layout and function of TPS61-R

01 Air suction branch
02 Compressor casing
03 Diffuser
04 Bearing casing
05 Axial thrust bearing
06 Plain bearing bush
07 Turbine
08 Turbine casing
09 Nozzle ring
10 Compressor wheel
Mode of operation

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

- Turbine
- Compressor.

These components are installed on a common shaft and form the rotor (see Fig. 1: Layout and function of TPS61-R → 4).

The exhaust gases of the internal combustion engine flow through the turbine casing (08) and the nozzle ring (09) onto the turbine (07). The turbine (07) uses the energy contained in the exhaust gas to drive the rotor and thus the compressor wheel (10). The exhaust gases then reach the atmosphere through the exhaust gas pipe connected to the turbine casing.

The compressor wheel (10) sucks in air through the air suction branch (01). In the compressor wheel (10), the energy required for building up the pressure is transferred to the air. By flowing through the diffuser (03) and the compressor casing (02), the air is compressed further and is then directed to the engine cylinders.

The rotor runs in two radial plain bearing bushes (06) which are located in the bearing casing (04) between the compressor and turbine. The axial thrust bearing (05) is located in front of the two radial plain bearing bushes.

The bearings are connected to a central lubricating oil duct which is normally supplied by the lubricating oil circuit of the engine. The oil outlet lies at the deepest point of the bearing casing (04).

## 1.5 Locations of the rating plates

![Fig. 2: Locations of the rating plates](image)

One rating plate (01) each is attached on the left and the right side of the turbocharger bearing casing.

Explanations regarding the rating plate can be found in the chapter dealing with safety.
1.6 Warning plates on the turbocharger

Warning plates are affixed at the following locations:

![Warning plates on the turbocharger](image)

Fig. 3: Warning plates on the turbocharger

ABB does not supply insulation for this turbocharger. If the turbocharger is insulated at a later date and warning plates are covered, the warning signs must be attached to the insulation. This is the responsibility of the enginebuilder.

If warning plates are not present in the designated locations or not readable, proceed as follows:

- Order new warning plates (72080) from ABB Turbocharging Service Stations (see chapter Ordering spare parts →38).
- Remove any warning plates that have become unreadable.
- Clean and degrease the areas designated for the warning plates.
- Fit new warning plates and remove protective sheets.
 Removing and Installing

2.1 Turbocharger weight and transportation

Lifting gear with a sufficient load limit must be used for removing, installing and transporting the turbocharger. The weight specified below applies to the heaviest variant possible. Depending on the specification, the weight specified on the rating plate may be lower than the standard value specified here.

⚠️ CAUTION

Damage to bellows

The turbochargers are supplied without fitted pipe sections and bellows. The parts are delivered separately, because they can be damaged or destroyed during turbocharger transport if they are fitted.

► Never transport turbocharger with bellows fitted.

Fig. 4: Turbocharger transport

<table>
<thead>
<tr>
<th>Product</th>
<th>Weight of complete turbocharger unit [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPS61-R</td>
<td>720</td>
</tr>
</tbody>
</table>

Table 2: Weight of complete turbocharger unit
2.2 Removing the turbocharger

⚠️ WARNING

Danger of burns
Touching hot surfaces or contact with hot operating fluids can cause burns.
- Do not touch hot surfaces. Observe the warning plate on the turbocharger.
- Wear heat-resistant safety gloves and protective clothing.
- Wait for the turbocharger to cool down before carrying out any work.

Wear safety gloves to protect against thermal hazards.

⚠️ CAUTION

Do not put the speed measurement cables under strain by pulling them
If you pull the speed measurement cables too hard, contacts can be pulled out.
- Do not strain the speed measurement cables by pulling.

- Disconnect all pipes according to the instructions of the enginebuilder.
- Unplug the cable connector at the speed sensor (86505).

Fig. 5: Removing the turbocharger

1. Ensure that the oil connections have been dismantled.
2. Remove the bellows.
3. Attach lifting gear to the turbocharger.
4. Loosen and remove screws.
5. Lift turbocharger from engine support vertically upwards.
The compressor casing (72000) can be lower than the turbocharger support depending on the casing position.

![Diagram of compressor casing and turbocharger]

Fig. 6: Putting down the turbocharger

- Put the turbocharger down onto a solid surface so that the turbocharger cannot tip over. Support the turbocharger if necessary.

### 2.3 Installing the turbocharger

#### Requirements for the fixing screws (01)

The fixing screws (01) that are required for attaching the turbocharger bracket (02) to the engine support (03) are not included in the ABB Turbo Systems scope of delivery. These parts depend on the version of the engine-side bracket.

![Diagram of fixing screws requirements]

Fig. 7: Requirements for fixing screws

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TPS61-R</td>
<td>Ø18 / M16</td>
<td>M16</td>
<td>≥ 30</td>
<td>120</td>
<td>10.9</td>
<td>300 Nm</td>
</tr>
</tbody>
</table>

Table 3: Requirements for fixing screws
2.3.1 Attaching the turbocharger to the bracket

**CAUTION**

**Damage to bellows**

If the axes of the flanges of the turbine casing do not align with the piping, the bellows can be damaged or destroyed.

- During installation of the bellows, ensure that the axes of the flanges of the turbine casing align with the piping. If necessary, correct alignment of the turbocharger on the engine support.

---

![Diagram of turbocharger attachment](image)

Fig. 8: Placing the turbocharger on the bracket

<table>
<thead>
<tr>
<th>Product</th>
<th>Screw position</th>
<th>Tightening torque (assumed friction coefficient $\mu = 0.12$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPS61-R</td>
<td>01</td>
<td>M16 300 Nm</td>
</tr>
<tr>
<td>TPS61-R</td>
<td>02</td>
<td>M16 325 Nm</td>
</tr>
</tbody>
</table>

Table 4: Tightening torque for turbocharger fixing screws

1. Attach lifting gear to turbocharger and place turbocharger onto bracket.
2. Fit hexagon head screws (01) but do not tighten them yet.
3. Coat thread of hexagon-head screws (02) with high-temperature grease such as Loctite® 8009. Fit bellows with hexagon-head screws (02), Verbus Ripp® washers and nuts. Observe the tightening torque.
4. Tighten hexagon-head screws (01). Observe the tightening torque.
5. Connect the oil supply. Ensure that the connection is tight.
6. Connect cable to speed sensor (86505).
7. Remove the lifting gear.

- Connect all gas and air lines according to the instructions of the enginebuilder.
3 Commissioning

3.1 Oil supply

3.1.1 Introduction

In all operating states, a functioning and carefully executed oil supply is an important prerequisite for trouble-free operation of the turbocharger.

The lubrication of the turbocharger is usually carried out with oil from the engine oil circulation.

- Comply with the enginebuilder’s specifications regarding the selection of lubricating oil and the oil change intervals.

3.1.2 Pre-lubrication

Pre-lubrication must be carried out as follows:

- Switch on the oil pump.
- Build up oil pressure.
- Do not exceed a pre-lubrication time of 2 minutes.
- Start the engine.
- Let the oil pump run until the pump driven by the engine generates sufficient pressure.

3.1.3 Oil filtering

Filtering the lubricating oil with a filter mesh width of ≤ 0.034 mm is sufficient for this turbocharger.

3.1.4 Oil pressure

Comply precisely with the oil pressure before the turbocharger for trouble-free operation. The admissible values are specified in chapter Monitoring operation →15.
3.2 Inspection procedures

3.2.1 Introduction

Inspection procedures include preventative visual controls, monitoring and measuring work before and during commissioning. Inspection procedures enable changes to the turbocharger to be detected. Machine damage can be prevented.

3.2.2 Checks before commissioning

Lubricating system

⚠️ CAUTION

Contaminated oil
Serious damage to engine or property can be caused by dirt and solid material particles in the oil.

► For the initial commissioning phase and after all service work, flush the complete lubricating system with warm oil.
► Use special running-in filters when running in the engine and after all service work on the lubricating system.

► Check that the oil filter is clean before commissioning.
► Adhere to lubricating oil pressure at the inlet.
► Adhere to lubricating oil temperature at the inlet.
► For permissible values, see chapter Monitoring operation →15.

Warning plates

► Check whether warning plates are present and legible.
► Check whether the protective sheets have been removed.
3.2.3 Checks after commissioning (engine in idle mode)

Lubricating system

- Keep to the lubricating oil pressure at the inlet.
- Keep to the lubricating oil temperature at the inlet.
- Refer to chapter Monitoring operation → 15 for admissible values.

Leaktightness of pipes

**WARNING**
Risk of burning from hot gas
Escaping gases are hot and will lead to serious burns in the event of contact.
- Check all pipes for leaks in accordance with the enginebuilder’s instructions.

Wear safety gloves to protect against thermal hazards.

3.2.4 Checks when starting up the engine

If present:
- Measure speed, oil pressure and charging pressure at various engine performances.
- Measure the exhaust gas temperature before and after the turbine.
- Measure the air temperature before and after the compressor.
- Compare the measured values with the values of the acceptance report. Different operating conditions indicate a malfunction (see chapter Eliminating malfunctions → 28).

Lubricants and pastes used during assembly can liquefy or vaporise and escape as oily fluids during the initial hours of operation. Continual escape of an oily fluid indicates an oil leak. If there is a leak, contact an ABB Turbocharging Service Station.
3.3 Commissioning after taking out of operation

If present

- Remove cover plates (blind flanges) from the compressor casing, the gas inlet and the gas outlet.

General

- Check the exhaust gas pipe before and after the turbine for combustion residues or water residues and clean it. Remove any foreign objects that may be present.
- Check and clean the air supply system, and remove any foreign objects that may be present.
- Put engine-side oil circulation to the turbocharger into operation.
- Prepare the turbocharger for operation according to section "Checks before commissioning".
- The turbocharger is now ready for operation.
4 Monitoring operation

4.1 Oil pressure, oil temperature

Lubricating oil pressure, oil inlet

To limit the oil flow rate through the turbocharger to the admissible values with the engine at full load, an oil orifice is mandatory or already fitted at the turbocharger oil inlet if the oil inlet pressure is > 3 bar.

**CAUTION**

Assuring lubricating oil pressure

Serious damage to the engine or property can result from a missing or insufficient lubricating oil supply.

- The lubricating oil pressure must be monitored during operation and the necessary pressure assured at the oil inlet.

<table>
<thead>
<tr>
<th>Status for operation</th>
<th>Pressure at oil inlet upstream of the turbocharger [bar] Overpressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal operation</td>
<td>2.0 ( \leq p_{oil} \leq 4.5 )</td>
</tr>
<tr>
<td>Engine start: Cold oil, admissible for a maximum of 15 minutes</td>
<td>(&lt; 8.0)</td>
</tr>
<tr>
<td>Engine idling, admissible for a maximum of 1 hour</td>
<td>0.2 (&lt;p_{oil} \leq 2.5)</td>
</tr>
<tr>
<td>Pre-lubrication and post-lubrication (engine stopped)</td>
<td>0.2 (&lt; p_{oil} \leq 1.0)</td>
</tr>
<tr>
<td>Warning signal: ( (n \geq 0.5 \times n_{Bmax}) )</td>
<td>(&lt; 1.25)</td>
</tr>
<tr>
<td>Alarm signal: Not admissible. Stop the engine immediately.</td>
<td>(&lt; 0.2)</td>
</tr>
</tbody>
</table>

Table 5: Lubricating oil pressure at oil inlet before turbocharger

Fig. 9: Arrangement of oil temperature and oil pressure measuring points

P Oil pressure measuring point

T Oil temperature measuring point

For monitoring the lubricating oil pressure, ABB Turbo Systems recommends installing a "P" manometer immediately upstream of the turbocharger oil inlet before the orifice. If the pressure is controlled electronically, the relevant signals should be triggered at the warning and alarm values.
*) If the drain pipe is vented, the lubricating oil temperature measuring point can be installed at the outlet in the vent tank. Otherwise the measurement should be taken in the drain pipe as close to the turbocharger as possible.

The measuring points for temperature (T) and pressure (P) in the oil supply pipe should be attached as closely to the turbocharger as possible. No reducing installations such as orifices or valves may be attached at the engine side between the measuring point and the turbocharger oil inlet. The temperature and pressure are measured to monitor the lubrication.

### Lubricating oil temperature at the inlet

**CAUTION**

**Machine damage**

If the oil temperature at the oil inlet exceeds the admissible range, this may lead to engine damage.

- Observe oil temperature at the oil inlet according to the following table.

<table>
<thead>
<tr>
<th>Status for operation</th>
<th>Oil temperature at the inlet</th>
<th>$T_{oil,inlet}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admissible</td>
<td></td>
<td>8 … 105 °C</td>
</tr>
<tr>
<td>Temporarily admissible (&lt; 1 h) → Alarm</td>
<td></td>
<td>&gt; 105 °C</td>
</tr>
<tr>
<td>Not admissible → stop engine</td>
<td></td>
<td>&gt; 110 °C</td>
</tr>
<tr>
<td>Not admissible → do not start engine (before start: preheat oil)</td>
<td></td>
<td>&lt; 8 °C</td>
</tr>
</tbody>
</table>

Table 6: Lubricating oil temperature at the inlet

### Lubricating oil temperature at the outlet

The oil temperature at the outlet is mainly dependant on:

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

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

<table>
<thead>
<tr>
<th>Status for operation</th>
<th>Oil temperature at the outlet</th>
<th>$T_{oil,outlet}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admissible</td>
<td></td>
<td>≤ 160 °C</td>
</tr>
<tr>
<td>Temporarily admissible → alarm</td>
<td></td>
<td>&gt; 160 °C</td>
</tr>
<tr>
<td>Not admissible → stop engine</td>
<td></td>
<td>&gt; 180 °C</td>
</tr>
<tr>
<td>Admissible</td>
<td></td>
<td>$≤ T_{oil,inlet} + 55$ K</td>
</tr>
<tr>
<td>Temporarily admissible → alarm</td>
<td></td>
<td>$&gt; T_{oil,inlet} + 55$ K</td>
</tr>
</tbody>
</table>

Table 7: Lubricating oil temperature at the outlet
If the turbocharger was operated for a longer period of time outside of the admissible range, ABB Turbo Systems recommends to have the turbocharger inspected by an ABB Turbocharging Service Station.
4.2 **Exhaust gas temperature before turbine**

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Factors influencing replacement intervals</strong></td>
</tr>
<tr>
<td>Operation above the operating limits defined on the rating plate can shorten the recommended replacement intervals considerably.</td>
</tr>
<tr>
<td>▶ Measure exhaust gas temperature upstream of turbine.</td>
</tr>
<tr>
<td>▶ Comply with operating limits on rating plate.</td>
</tr>
</tbody>
</table>

- Definition and explanations concerning rating plate: refer to chapter 2 of Operation Manual / Safety.
- Operating limits: refer to chapter 3 of Operation Manual / Safety data sheet or examine rating plate.

4.3 **Turbocharger speed**

4.3.1 **Introduction**

A speed measuring system enables the constant monitoring of the turbocharger speed.

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Do not put the speed measurement cables under strain by pulling them</strong></td>
</tr>
<tr>
<td>If you pull the speed measurement cables too hard, contacts can be pulled out.</td>
</tr>
<tr>
<td>▶ Do not strain the speed measurement cables by pulling.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Machine damage</strong></td>
</tr>
<tr>
<td>Operation above the operating limits defined on the rating plate can shorten the recommended replacement intervals considerably and cause machine damage.</td>
</tr>
<tr>
<td>▶ Measure turbocharger speed.</td>
</tr>
<tr>
<td>▶ Comply with operating limits on rating plate.</td>
</tr>
</tbody>
</table>

- Definition and explanations concerning rating plate: refer to chapter 2 of Operation Manual / Safety.
- Operating limits: refer to chapter 3 of Operation Manual / Safety data sheet or examine rating plate.

If no speed measurement system is present, the system below can be ordered from an ABB Turbocharging Service Station (see chapter Ordering spare parts →38).
4.3.2 Layout and overview

![Diagram of speed measurement system]

Fig. 10: Speed measurement system

86505  Speed sensor (cable not integrated)
86515  Cable connector to 86505
32109  Sealing disc
01     Screw plug
02     Gasket

4.3.3 Malfunctions on the speed measurement system

In the case of malfunctions of the speed measurement system, refer to the chapter entitled Troubleshooting/Speed measurement system →33.
4.3.4 Replacing the speed sensor

**WARNING**

Hot speed sensor

Danger of burns. The speed sensor can reach temperatures of more than 100 °C during operation.

- Wear safety gloves when disassembling the speed sensor.

Wear safety gloves to protect against thermal hazards.

The speed sensor supplied by ABB is equipped with a sealing lip and an O-ring. No additional gasket is required during assembly.

![Image of speed sensor fitting](image)

**Fig. 11: Fitting the speed sensor**

<table>
<thead>
<tr>
<th>Part number</th>
<th>Tightening torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>86505</td>
<td>15 Nm</td>
</tr>
</tbody>
</table>

Table 8: Tightening torque (86505)

- Reduce the engine performance to idling and then stop the engine. Pay attention to post-lubrication (Stopping the engine →27).
- Switch off the lubricating oil supply to the turbocharger.
- Disconnect cable connector (86515) from speed sensor (86505).
- Unscrew and remove defective speed sensor (86505).
- Screw in new speed sensor (86505) as far as it will go and tighten.
- Connect cable connector (86515) to speed sensor (86505).
- Switch on lubricating oil supply to the turbocharger.
5 Operation and service

5.1 Noise emission

⚠️ WARNING

Noise hazards

Exposure to noise can harm the hearing system, impair health and the psychological state and may lead to lack of attention and irritation.

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

Wear ear protection.

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

The highest value of the emission sound pressure level\(^1\) reaches a maximum of 105 dB(A) near the air inlet. The following prerequisites must be fulfilled with regard to the turbocharger to observe this limit value:

- Air-inlet system has been fitted
- All standard, noise-reducing measures\(^2\) have been fitted
- Bellows at the air outlet has been acoustically insulated by the enginebuilder (see Fig. 12: Noise insulation, bellows → 22).

The enginebuilder is 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) The enginebuilder must provide acoustically equivalent measures in case of deviating insulation versions
Suggestion for noise insulation, bellows

Fig. 12: Noise insulation, bellows

01 Compressor casing
02 Bellows
03 Charge air duct / scavenging air duct
04 Insulation cushion
05 Insulation mat (at least 15 mm)
06 Sheet metal cover
5.2 Service work

Service work includes visual controls, monitoring, measuring and inspection as well as functional checks. Service work enables the detection and rectification of changes to the turbocharger and ensures full operability of the turbocharger.

⚠️ CAUTION

Service intervals

Any service work on the turbocharger that is omitted or performed too late can cause excessive contamination, wear and operating failures.

- Carry out the service work at the specified time intervals.

⚠️ CAUTION

Specific service interval

Exceptional stresses such as a high number of starts and stops, harsh environmental conditions, poor fuel quality or high system vibrations can lead to untimely machine damage even if the prescribed service intervals are observed.

- Agree on a specific service interval with ABB Turbo Systems.

To prevent machine damage caused by ageing and downtime, we recommend having an inspection carried out by an ABB Turbocharging Service Station no later than 5 years after the last service.
5.2.1 Service work every 24 ... 48 hours

Pipes

- Check all the inlet and outlet pipes of the turbocharger for leaks.

Operating data

![CAUTION]

**Unknown operational changes**

Impairment to the degree of a possible operating failure can be the consequence.

- Have any unknown causes clarified by an ABB Turbocharging Service Station.

Monitoring the engine’s operating data makes it possible to draw conclusions about the operating behaviour of the turbocharger.

- The following operating data and measured values must be entered every 24 ... 48 hours in the engine logbook of the enginebuilder.
  - Performance and speed of the engine
  - Air intake temperature
  - Charging pressure
  - Pressure loss in the charge air cooler
  - Lubricating oil pressure and lubricating oil temperature.

If present:

- Speed of the turbocharger
- Pressure in air inlet system

- In case of different values, determine the cause.

5.2.2 Service work at 100 hours after commissioning

- Clean or replace the oil filter located in the supply pipe to the turbocharger while the engine is stopped, in accordance with the instructions of the enginebuilder.

5.2.3 Service work according to instructions of enginebuilder

- Clean or replace the oil filter located in the supply pipe to the turbocharger while the engine is stopped, in accordance with the instructions of the enginebuilder.
5.2.4 Service work according to data on the rating plate

**WARNING**

Incorrect handling of a cartridge group

The disassembly and assembly of the cartridge group, as well as the assessment of the rotor and bearing parts, requires the expertise of an ABB Turbocharging Service Station. The rotor parts rotate extremely quickly and are sensitive to unbalance. Incorrect handling of a cartridge group can damage the turbocharger and cause injuries to persons.

- Ensure that the disassembly and assembly of the cartridge group is only carried out by an ABB Turbocharging Service Station.

The following service work must be carried out by an ABB Turbocharging Service Station.

- Dismantle turbocharger and measure clearances.
- Clean nozzle ring, turbine casing and compressor casing mechanically.
- Check nozzle ring, turbine casing and compressor casing for cracks and erosion/corrosion.
- Check and assess rotor and bearing parts.

The following work can be carried out as preparation.

- Remove the turbocharger from the engine (see chapter Removing and Installing →7).
### 5.3 Expected replacement intervals

<table>
<thead>
<tr>
<th>Component</th>
<th>Operating hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbine casing</td>
<td>25000 ... 50000</td>
</tr>
<tr>
<td>Nozzle ring</td>
<td>50000</td>
</tr>
<tr>
<td>Gas outlet flange</td>
<td>50000</td>
</tr>
<tr>
<td>Partition wall</td>
<td>50000</td>
</tr>
<tr>
<td>Rotating components</td>
<td>See rating plate information 1)</td>
</tr>
<tr>
<td>Bearing parts</td>
<td>12000 ... 24000</td>
</tr>
<tr>
<td>Other casings</td>
<td>50000</td>
</tr>
</tbody>
</table>

Table 9: Expected replacement intervals [h]

1) The recommended replacement intervals of the compressor and turbine wheels are specified with the aid of the safety concept for rotating parts (SIKO) and dependent on the operating conditions.

### Influencing parameters

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

- Fuel quality and fuel treatment
- Load profile (thermal cycling, also number of starts/stops, emergency shutdowns, operating point)
- Gas inlet temperature
- Turbocharger specification
- System-specific operating conditions (combustion quality, exhaust gas composition)

For bearing parts

- Lubricating oil quality (oil filtering, oil condition, oil monitoring)
- Load profile (speed, pressure conditions, temperature)
- Number of starts/stops
- Unbalance of the rotor (degree of contamination).
6 Stopping the engine

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-lubrication</td>
</tr>
</tbody>
</table>

If the heat in the turbocharger is not dissipated after the engine stops, damage may result.

- Perform post-lubrication 15 … 20 minutes after stopping the engine.
7 Eliminating malfunctions

7.1 Malfunctions when starting

Delayed start-up

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
<td></td>
</tr>
<tr>
<td>Turbocharger contaminated</td>
<td>Clean the turbocharger</td>
</tr>
<tr>
<td>Bearing damaged</td>
<td>Replace the bearing</td>
</tr>
<tr>
<td>Rotor rubbing</td>
<td>Check clearances</td>
</tr>
<tr>
<td>Foreign object in the turbocharger</td>
<td>Remove foreign object</td>
</tr>
</tbody>
</table>

Table 10: Malfunctions when starting – Delayed start-up

Vibrations

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
<td></td>
</tr>
<tr>
<td>Rotor unbalance</td>
<td>Balance the rotor</td>
</tr>
<tr>
<td>Turbine or compressor damaged</td>
<td>Replace damaged parts</td>
</tr>
<tr>
<td>Bearing damaged</td>
<td>Replace the bearing</td>
</tr>
<tr>
<td>Engine</td>
<td></td>
</tr>
<tr>
<td>Vibrations from engine</td>
<td>Contact enginebuilder</td>
</tr>
</tbody>
</table>

Table 11: Malfunctions when starting – Vibrations

Rotating parts rubbing

Normal behaviour, not a malfunction

| Turbocharger | A minimal and uniform wear on the circumference of the rotor components is permitted. This wear can be caused by slight local rubbing against adjacent components. This causes the compressor or turbine blades to be somewhat shortened. To prevent significant loss of efficiency, specific tolerances must be fulfilled. |

Table 12: Malfunctions when starting - Rotating parts rubbing
7.2 Malfunctions during operation

Lubricating oil pressure too low

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
<td>Axial clearance of the rotor excessive</td>
</tr>
<tr>
<td>Engine</td>
<td>Oil filter heavily contaminated</td>
</tr>
<tr>
<td></td>
<td>Oil pump in lubricating system defect-</td>
</tr>
<tr>
<td></td>
<td>ive</td>
</tr>
<tr>
<td></td>
<td>Manometer displays incorrectly</td>
</tr>
</tbody>
</table>

Table 13: Malfunctions during operation – Lubricating oil pressure too low

Speed reduces

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
<td>Turbine and/or nozzle ring severely con-</td>
</tr>
<tr>
<td></td>
<td>taminated</td>
</tr>
<tr>
<td></td>
<td>Rotor components or bearing damaged</td>
</tr>
<tr>
<td>Engine</td>
<td>Defects on the connected cylinders in</td>
</tr>
<tr>
<td></td>
<td>pulse charging</td>
</tr>
<tr>
<td>Pipes</td>
<td>Defects, such as leaks, in the exhaust</td>
</tr>
<tr>
<td></td>
<td>gas pipes or charge air ducts</td>
</tr>
</tbody>
</table>

Table 14: Malfunctions during operation – Speed reduces

Speed increases

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
<td>Light to medium contamination of the</td>
</tr>
<tr>
<td></td>
<td>turbine and/or nozzle ring</td>
</tr>
</tbody>
</table>

Table 15: Malfunctions during operation – Speed increases
### Exhaust gas temperature too high

**Engine performance and engine speed unchanged**

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
<td>Compressor/turbine contaminated</td>
</tr>
<tr>
<td></td>
<td>Clean the compressor/turbine</td>
</tr>
<tr>
<td>Exhaust gas back pressure too high</td>
<td>Check the exhaust gas system.</td>
</tr>
<tr>
<td>Turbine damaged or eroded</td>
<td>Replace damaged parts</td>
</tr>
<tr>
<td>Air inlet system</td>
<td>Insufficient air, for example, if the air filter is blocked</td>
</tr>
<tr>
<td></td>
<td>Clean or replace the air filter.</td>
</tr>
<tr>
<td>Engine</td>
<td>Malfunction in the injection system</td>
</tr>
<tr>
<td></td>
<td>Repair or contact manufacturer</td>
</tr>
<tr>
<td>Charge air cooler</td>
<td>Cooler contaminated</td>
</tr>
<tr>
<td></td>
<td>Clean</td>
</tr>
<tr>
<td></td>
<td>Cooling water volume too low</td>
</tr>
<tr>
<td></td>
<td>Fill</td>
</tr>
<tr>
<td></td>
<td>Inlet temperature of cooling water too high</td>
</tr>
<tr>
<td></td>
<td>Check/clean cooling system</td>
</tr>
<tr>
<td></td>
<td>Insufficient ventilation</td>
</tr>
<tr>
<td></td>
<td>Improve ventilation</td>
</tr>
</tbody>
</table>

Table 16: Malfunctions during operation – Exhaust gas temperature too high

### Charge air pressure too low

**Engine performance and engine speed unchanged, suction condition normal**

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
<td>Compressor end and/or turbine end contaminated</td>
</tr>
<tr>
<td></td>
<td>Compressor/turbine damaged</td>
</tr>
<tr>
<td>Air inlet system</td>
<td>Insufficient air, for example, if the air filter is blocked</td>
</tr>
<tr>
<td>Engine</td>
<td>Air receiver not sealed</td>
</tr>
<tr>
<td></td>
<td>Gas piping between engine and turbine not sealed</td>
</tr>
<tr>
<td></td>
<td>Injection mistimed</td>
</tr>
<tr>
<td></td>
<td>Valve control misadjusted</td>
</tr>
<tr>
<td>Pipes</td>
<td>Pipes downstream to the compressor outlet not sealed</td>
</tr>
<tr>
<td></td>
<td>Exhaust gas back pressure too high</td>
</tr>
</tbody>
</table>

Table 17: Malfunctions during operation – Charge air pressure too low
Charge air pressure too high

Engine performance and engine speed unchanged, suction condition normal

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine</td>
<td>Malfunction in the injection system</td>
</tr>
<tr>
<td></td>
<td>Injection mistimed</td>
</tr>
<tr>
<td></td>
<td>Engine performance higher than indicated</td>
</tr>
</tbody>
</table>

Table 18: Malfunctions during operation – Charge air pressure too high

Reduced compressor performance / efficiency and therefore engine performance losses

⚠️ CAUTION

Compressor damage

A severely contaminated or corroded compressor wheel can reduce the compressor wheel's fatigue endurance limit and result in the turbocharger being damaged.

▸ Rectify malfunction in accordance with the following table.

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
<td>Compressor components severely contaminated by the ventilation gases that have been fed in</td>
</tr>
<tr>
<td></td>
<td>Increased blade vibration, compressor blade damage due to the ventilation gases that have been fed in</td>
</tr>
<tr>
<td></td>
<td>Material of the compressor wheel corroded due to the feeding in of ventilation gases containing corrosive components</td>
</tr>
<tr>
<td></td>
<td>Material of the compressor wheel corroded due to intake air containing exhaust gases or salt</td>
</tr>
<tr>
<td></td>
<td>Prevent exhaust gas leakages in the engine space</td>
</tr>
</tbody>
</table>

Table 19: Malfunctions during operation – Engine performance losses
7.3 Turbocharger is surging

**WARNING**
Hot air escapes from the air inlet system
A surge blow is accompanied by a loud bang and escape of hot air from the air inlet system. This may result in injury to personnel.
- Keep a distance from the air inlet while the turbocharger is surging.

**Turbocharger surges continuously or periodically**

**CAUTION**
Continuous or periodic surging
If the turbocharger surges continuously or periodically, parts of the turbocharger may be damaged.
- Gradually reduce the engine load.
- Immediately clarify and remedy the cause.
- Examine components for damage and replace if necessary.

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
<td>Diffuser contaminated</td>
</tr>
<tr>
<td></td>
<td>Heavy contamination deposits in the turbine or in the nozzle ring</td>
</tr>
<tr>
<td>Air inlet system</td>
<td>Air inlet filter contaminated</td>
</tr>
<tr>
<td>Engine</td>
<td>Protective grating in front of the turbocharger contaminated or damaged</td>
</tr>
<tr>
<td>Charge air cooler</td>
<td>Cooler contaminated</td>
</tr>
<tr>
<td></td>
<td>Charge air duct blocked</td>
</tr>
</tbody>
</table>

Table 20: Malfunction – Turbocharger surging

**Sporadic surge blows**

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine</td>
<td></td>
<td>Engine load changed quickly. When this happens, the flow direction in the compressor is momentarily reversed. Such sporadic surge blows do not impair the safe operation of the turbocharger.</td>
</tr>
</tbody>
</table>

Table 21: Malfunction – Sporadic surge blows
## 7.4 Malfunctions when stopping

### Runout noises

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
<td>Turbocharger contaminated</td>
</tr>
<tr>
<td></td>
<td>Clean the turbocharger</td>
</tr>
<tr>
<td>Bearing damaged</td>
<td>Replace the bearing</td>
</tr>
<tr>
<td>Rotor rubbing</td>
<td>Check clearances</td>
</tr>
<tr>
<td>Foreign object in the turbocharger</td>
<td>Remove foreign object</td>
</tr>
</tbody>
</table>

Table 22: Malfunctions when stopping – Runout noises

### Runout time too short

The runout time must be noted down as a reference. Because the runout time depends on the oil viscosity, the runout time must always be measured at the same oil temperature.

If the runout time is significantly shorter in comparison to a previous measurement, the following table must be observed.

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
<td>Turbocharger contaminated</td>
</tr>
<tr>
<td></td>
<td>Clean the turbocharger</td>
</tr>
<tr>
<td>Bearing damaged</td>
<td>Replace the bearing</td>
</tr>
<tr>
<td>Rotor rubbing</td>
<td>Check clearances</td>
</tr>
<tr>
<td>Foreign object in the turbocharger</td>
<td>Remove foreign object</td>
</tr>
</tbody>
</table>

Table 23: Malfunctions when starting – Delayed start-up

## 7.5 Speed measurement system

### No signal or poor signal amplitude of the speed measurement

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
<td>The speed sensor was accidentally fitted with an additional gasket. An enlarged distance between the sensor tip and the signal-emitting sealing disc reduces the voltage amplitude of the speed signal.</td>
</tr>
<tr>
<td></td>
<td>The screw plug for the sensor is fitted with an additional gasket (copper ring). For information regarding the disassembly and assembly of the speed sensor, refer to chapter Replacing the speed sensor →20. Install the speed sensor without the additional gasket (copper ring).</td>
</tr>
<tr>
<td>Sensor or cable defective</td>
<td>Order new speed sensor (86505) (refer to chapter Ordering spare parts →38). Replacing the speed sensor →20.</td>
</tr>
</tbody>
</table>

Table 24: Malfunction of the speed measurement system – No signal or poor signal amplitude
Measured speed too high

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
<td>Sensor tip contaminated, since it is magnetic and can attract metallic particles. This reduces the distance to the signal-emitting sealing disc, which can lead to amplification of the noise component and therefore to false triggering. For information regarding the disassembly and assembly of the speed sensor, refer to chapter Replacing the speed sensor →20. Dismantle the sensor, clean the sensor tip, and fit the sensor back on with the specified tightening torque.</td>
</tr>
</tbody>
</table>

Table 25: Malfunction of the speed measurement system – Measured speed too high

Measured speed too low

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
<td>Turbocharger contaminated</td>
</tr>
<tr>
<td></td>
<td>Bearing damaged</td>
</tr>
<tr>
<td></td>
<td>Rotor rubbing</td>
</tr>
</tbody>
</table>

Table 26: Malfunction of the speed measurement system – Measured speed too low
8 Mothballing the turbocharger

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

State of the engine lubricating oil

The turbocharger normally remains attached to the engine. The measures to be taken for mothballing the turbocharger depend on the state of the lubricating oil. No measures are required under the following conditions:

- Acid number (TAN) < 2 mg KOH/g
- The engine lubricating oil is replaced by a preservative oil and circulated with the pre-lubrication pump before the engine is taken out of operation. Residues of old engine oil are flushed away in this way and the bearing parts are largely protected against corrosion.

Preparations for mothballing

**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.

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

- Remove turbocharger (see chapter Removing and Installing →7).
- Have turbocharger dismantled, cleaned, oiled and fitted again by an ABB Turbocharging Service Station.
8.2 Taking the engine out of operation for more than 12 months

If the engine is taken out of operation, the following variants are possible with regard to the turbocharger:

- Turbocharger remains attached to the engine
- The casings of the turbocharger remain attached to the engine, the rotor and bearing parts are dismantled by an ABB Turbocharging Service Station and stored separately
- The turbocharger is completely removed, either as a whole unit or in individual parts

For the measures always necessary for preparing the turbocharger parts for mothballing, see section Taking the engine out of operation for up to 12 months, subsection Preparations for mothballing.

If the turbocharger remains attached to the engine, see section Taking the engine out of operation for up to 12 months →35, subsection Rotor turning in stack draught.

If the complete turbocharger is removed or the turbocharger is assembled again from the individual parts:

- Seal all openings of the turbocharger with paraffin paper and wooden lids.

Only dry rooms with 40 ... 70 % atmospheric humidity, in which no water condensation can form, are suitable as storage locations.

State of the mothballed turbocharger

- Check the turbocharger parts annually for corrosion.
- If there are signs of rust: Thoroughly clean parts and renew corrosion protection.
9 Disposing of turbocharger components

Disposal must be environmentally compatible, competent 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 (gaskets), lubricants (engine oil) and electronic parts (speed sensor and associated components).

- 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.
10  Spare parts

10.1  Ordering spare parts

**CAUTION**

**Spare part storage**

All spare parts that were ordered together with the turbocharger must be kept intact and ready for use.

- Carefully clean any rusted parts and grease them.

Please quote the following data when making queries and ordering spare parts:

- Turbocharger type
- Serial number of the turbocharger
- Designation and part number.

Spare parts can be ordered from any ABB Turbocharging Service Station.

- If different model variants are not taken into account in this document, contact an ABB Turbocharging Service Station.
- Dispose of placed and unusable parts in an environmentally-friendly and professional manner in accordance with the local regulations.
- Dispose of the packaging of new parts in an environmentally-friendly and professional manner in accordance with the local regulations.

10.2  Spare parts of the speed measurement system

**Fig. 13:** Spare parts of the speed measurement system

<table>
<thead>
<tr>
<th>Part number</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>86505</td>
<td>Speed sensor</td>
</tr>
<tr>
<td>86515</td>
<td>Cable connector</td>
</tr>
</tbody>
</table>

Table 27: Spare parts of the speed measurement system
## Important technical data and characteristics

<table>
<thead>
<tr>
<th>Important technical data and characteristics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight, complete [kg]</td>
<td>720</td>
</tr>
<tr>
<td>Pressure at oil inlet before turbocharger [bar]</td>
<td>2.0 &lt; poil ≤ 4.5</td>
</tr>
<tr>
<td>Lubricating oil temperature at the inlet [°C]</td>
<td>8….105</td>
</tr>
<tr>
<td>Lubricating oil temperature at the outlet [°C]</td>
<td>≤ 160</td>
</tr>
<tr>
<td>Maximum speed [rps]</td>
<td>511</td>
</tr>
<tr>
<td>Maximum sound pressure level [dB]</td>
<td>105</td>
</tr>
<tr>
<td>Volume flow [m³/s]</td>
<td>up to 6.0</td>
</tr>
<tr>
<td>Pressure ratio</td>
<td>up to 4.6</td>
</tr>
<tr>
<td>Turbocharger efficiency [%]</td>
<td>up to 67</td>
</tr>
<tr>
<td>Residual rotor unbalance on compressor end [gr/mm]</td>
<td>&lt;68.0</td>
</tr>
<tr>
<td>Residual rotor unbalance on turbine end [gr/mm]</td>
<td>&lt;47.0</td>
</tr>
<tr>
<td>Clearance between compressor wheel blades and wall insert [mm]</td>
<td>0.64 ... 0.80</td>
</tr>
<tr>
<td>Axial clearance of the rotor [mm]</td>
<td>0.15 ... 0.19</td>
</tr>
</tbody>
</table>

Table 28: Important technical data and characteristics

Operating limits: refer to chapter 3 of Operation Manual / Safety data sheet or examine rating plate.
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