Operation Manual
TPS44-H33

HT588474 English

Original Operation Manual

ABB Turbocharging

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

1 Introduction

1.1 Purpose of the manual

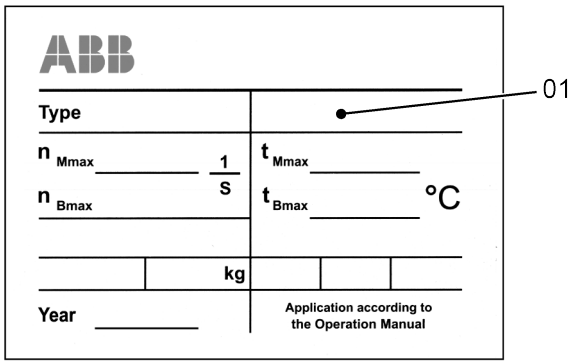


Fig. 1: Serial number (01) on the rating plate

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.

1. 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.

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

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.

Fig. 2: **V**olatile **C**orrosion **I**nhibitor (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).

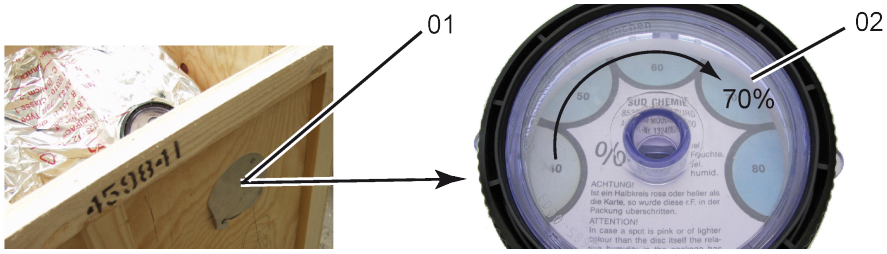


Fig. 3: Package with hygrometer

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

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 - Mechanical hazard - Chemical hazard - Thermal hazard		**Respiratory mask** to protect against - Dusts - Gases
	**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 turbocharging internal combustion engines.

To ensure compliance with the machinery directive 2006/42/EC when using on gas engines, the turbocharger must be operated in an engine room classified as "not at risk of explosion". This is in accordance with the position paper [2] relating to ATEX issued by EUROMOT [1].

For use on pre-mix gas engines with ignitable propellents in the gas control system, the enginebuilder must implement appropriate safety measures for explosion protection [3] (such as flame barriers in the inlet system, for example) to assure that there is no transient pressure increase exceeding a maximum of 12 bar before the turbocharger in case of a deflagration.

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.

[1] Euromot = The European Association of Internal Combustion Engine Manufacturers
[2] Directive 94/9/EC concerning equipment and protective systems intended for use in potentially explosive atmospheres (ATEX) The Euromot Position as of November 2003, ATEX Euromot Position 191103
[3] Guidelines for proper safety design of inlet systems on gas engines, RWTÜV Essen, 1991

⚠ 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 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. An ABB Turbocharging Service Station should be instructed to carry out this inspection.

1.7 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.

Fig. 1: 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.

1.8 Turbocharger rating plate

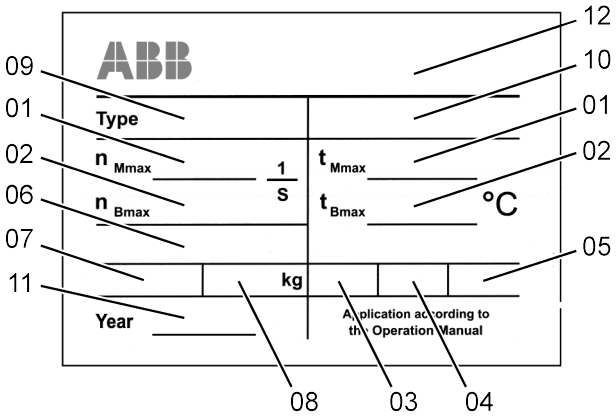


Fig. 2: Rating plate

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_{Bmax}, t_{Bmax} 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_{Mmax}, t_{Mmax} 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_{Mmax} and t_{Mmax} 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.

1.9 Periodic check of the pressure vessels

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

- The locally applicable legal regulations regarding periodic checks of the pressure vessels must be observed.
- The operating company is responsible for the safe operation of the pressure vessel.

⚠ WARNING

Danger due to pressure vessels

The operating company must make sure the pressure vessels are in proper working condition and monitor them. Necessary repair or maintenance work must be performed promptly, and the required safety measures must be taken.

▶ Pressure equipment must not be operated if defects are present.

1.10 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.

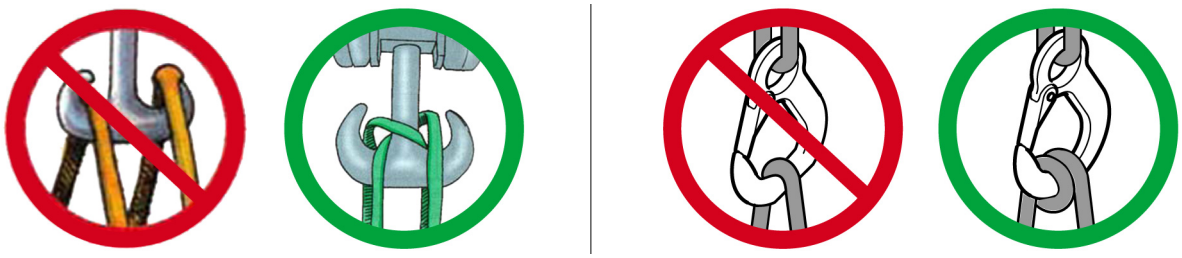


Fig. 3: Attachment of loads on the crane hook

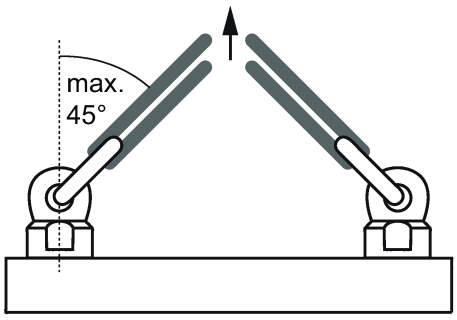


Fig. 4: Attachment angle

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.

1.11 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 Turbo Systems.

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

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

1.12 Hazards during operation and maintenance

Noise hazards

The turbocharger's noise emission during operation 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 the 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 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 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.

Hazards due to electrical installations (if present)

⚠ WARNING

Dangers during work on electrical installations

Electrical installations use voltages that can lead to severe injury to personnel or accidents resulting in fatalities.

At the same time, electrical or electronic components and parts can also be damaged or destroyed.

- ▶ Only specially trained personnel should perform work on, or with, electrical components.
- ▶ Observe national regulations.

⚠ WARNING

Absence of grounding on electrical installations

Missing or incorrectly fitted grounding conductors can lead to severe injury to personnel or accidents resulting in fatalities.

Electric shock or elevated electromagnetic disturbances can damage or destroy electrical and electronic components.

- Ground electrical installations properly with grounding conductors.
- Check the grounding connections on a regular basis and make sure they are properly connected.

- Switch off the power supply before working on any electrical installations.
- After switching off the power supply, wait for 5 minutes to allow capacitors to discharge and hot components to cool down.
- Ensure the power supply is switched off when working on electrical installations.
- Do not carry out any tests with regard to insulation resistance or voltage on the electrical components.

1.13 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.

1.14 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.

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 manual.
- 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 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 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.

Hazards due to the handling of insulation materials

⚠ WARNING

Danger from insulation materials

Dust or fibres from insulation materials can have adverse effects on the health or cause irritations. Unsuitable and combustible insulation materials are a fire hazard.

- ▶ Only use suitable and non-combustible insulation materials.
- ▶ Ensure good ventilation at the workplace.
- ▶ Avoid whirling up dust.
- ▶ Use dust-free tools and working methods.
- ▶ Remove package at the workplace only.
- ▶ Proceed with particular care when removing old insulation materials.
- ▶ Dispose of insulation materials properly and in an environmentally compatible manner in compliance with the legal regulations.

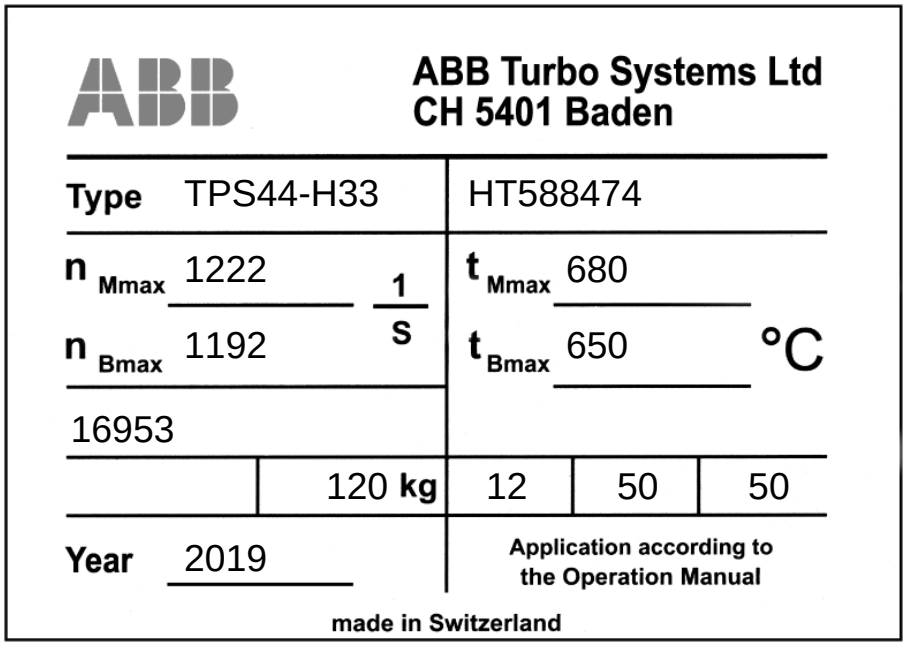
Wear safety goggles.

Wear a respiratory mask to protect against dusts.

Wear safety gloves to protect against chemical hazards.

Safety data sheet

TPS44-H33 HT588474



Product description

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

Chapter	Document number
Operation Manual / 1 Introduction	HZTL4005
Operation Manual / 2 Safety	HZTL4026
Operation Manual / 3 Safety data sheet *)	Serial number of the turbocharger

Table 1: Related documents

*) This chapter is only available in serialised operation manuals.

1.4 Layout and function of the turbocharger

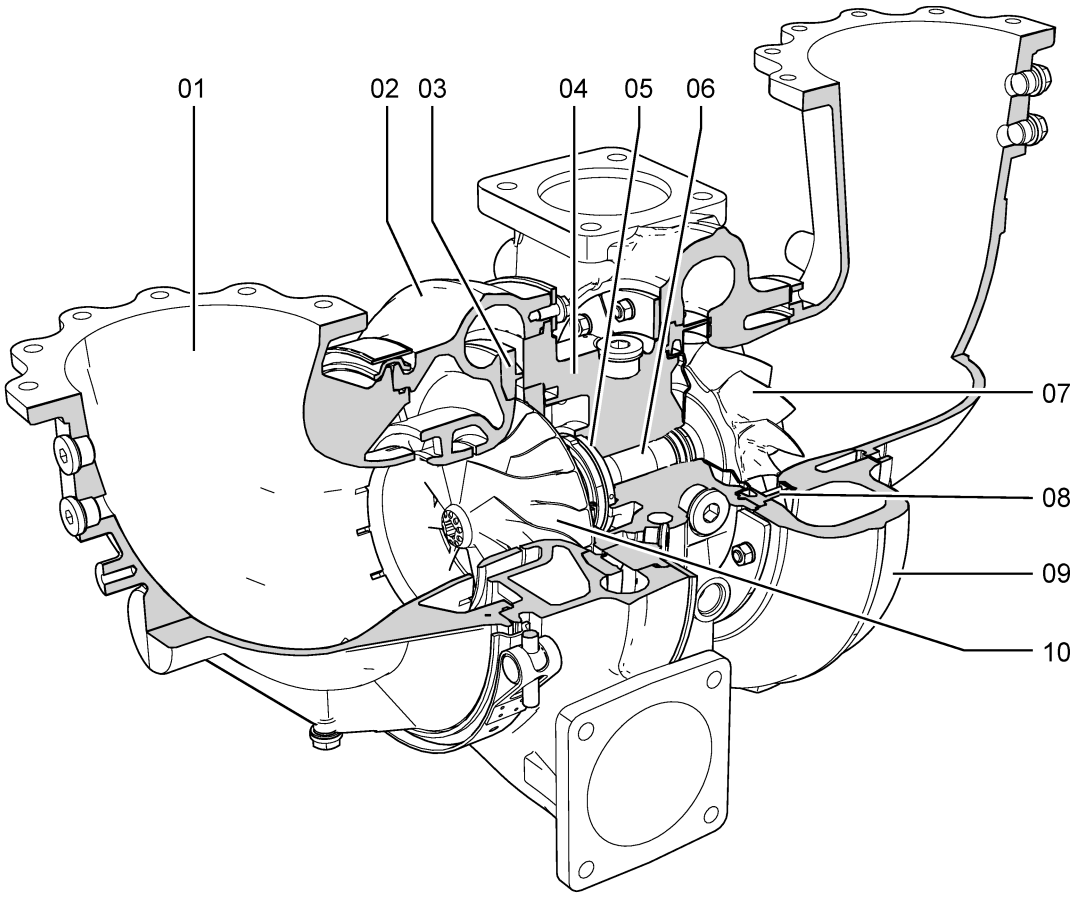


Fig. 1: Layout and function of the turbocharger

01	Air suction branch / filter silencer	06	Plain bearing bush
02	Compressor casing	07	Turbine
03	Diffuser	08	Nozzle ring
04	Bearing casing	09	Turbine casing
05	Axial thrust bearing	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 the turbocharger →4).

The exhaust gases of the internal combustion engine flow through the turbine casing (09) and the nozzle ring (08) onto the turbine (07). The turbine (07) uses the energy contained in the exhaust gas to drive the rotor and, with this, 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 or a mixture of gas and air through the air suction branch (01) or the filter silencer. 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 a radial plain bearing bush (06) that is located in the bearing casing (04) between the compressor and the turbine. The axial thrust bearing (05) is located in front of the radial plain bearing bush.

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 lowest point of the bearing casing (04).

1.5 Position of the rating plate

The rating plate (01) is attached at the top on the bearing casing of the turbocharger. Explanations regarding the rating plate can be found in the chapter dealing with safety.

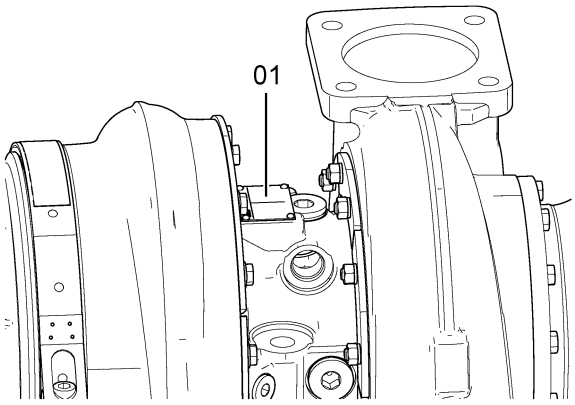


Fig. 2: Position of the rating plate

1.6 Warning plates on the turbocharger

Warning plates are affixed at the following locations:

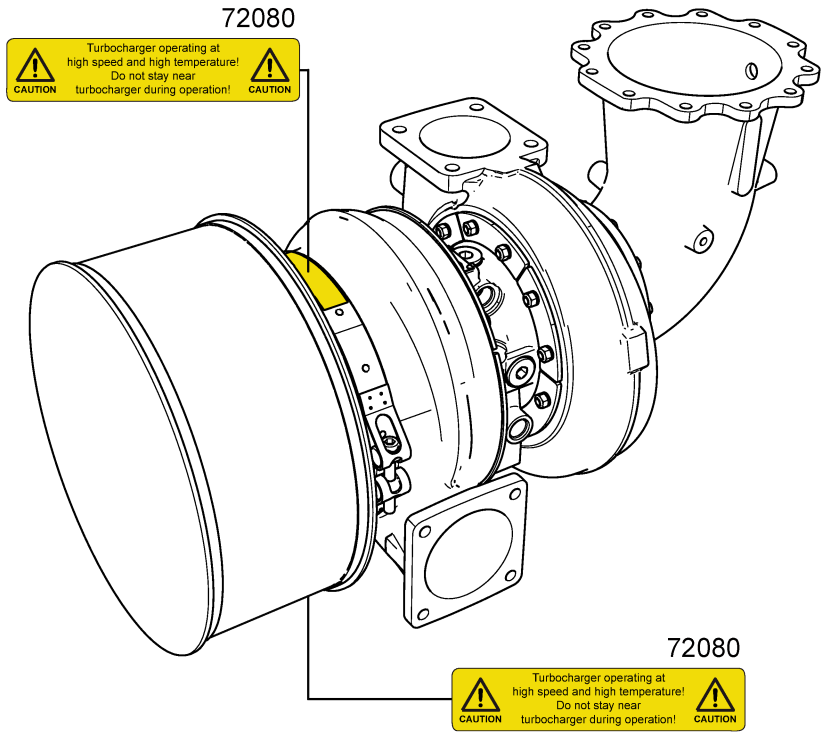


Fig. 3: Warning plates on the turbocharger

Turbochargers supplied to the enginebuilder without insulation must be equipped later with warning plates on 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 →75).
- 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.

2 Removing and Installing

2.1 Turbocharger weight and transportation

Lifting gear with a sufficient load limit must be used for removing and installing the turbocharger. The following weight specification 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.

Product	Weights [kg]
TPS44	120
TPS48	180
TPS52	250

Table 2: Weight of the turbocharger

One swivel lifting eye (S) is required to safely lift this turbocharger. This is not included in the ABB Turbo Systems scope of delivery.

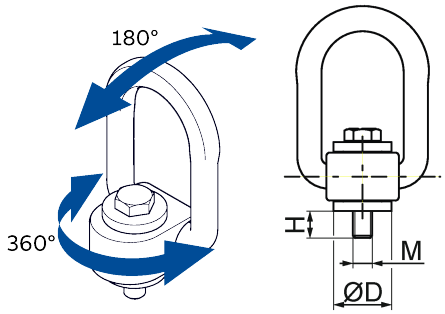
Swivel lifting eye (S) to be used	Product	Thread	Length H [mm]	Diameter D [mm]	Minimum load limit [kg]
	TPS44	M8	≤ 12	≤ 25	300
	TPS48	M8	≤ 12	≤ 25	300
	TPS52	M10	≤ 15	≤ 25	400

Table 3: Swivel lifting eye (S) to be used

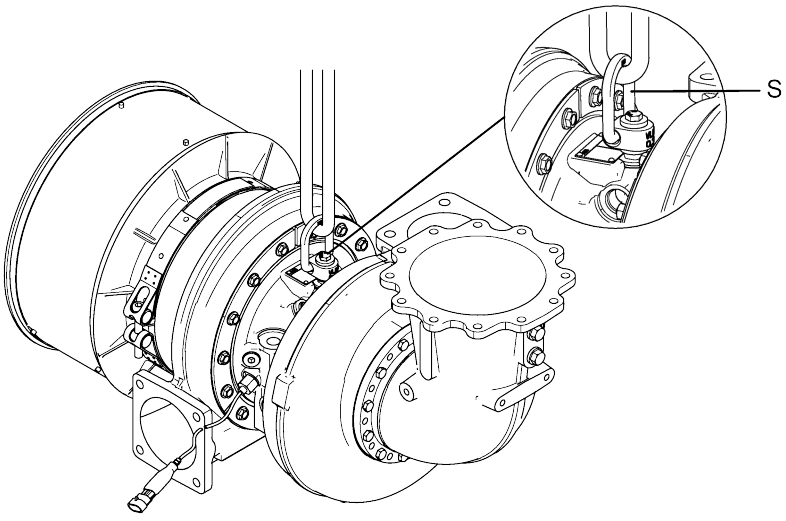


Fig. 4: Turbocharger transport

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 strain cables

If you pull the speed measurement cables too hard, contacts can be pulled out.

- ▶ Do not strain the speed measurement cables by pulling.

NOTICE

Gas outlet casing (61001)

The gas outlet casing (61001) can remain fitted in the exhaust gas pipe if the locking to the turbine casing is accessible. Otherwise the complete turbocharger unit including gas outlet casing must be removed.

- ▶ Disconnect all pipes according to the instructions of the enginebuilder.
- ▶ Loosen and remove water connections.
- ▶ Close the openings of the water connections with screw plugs.

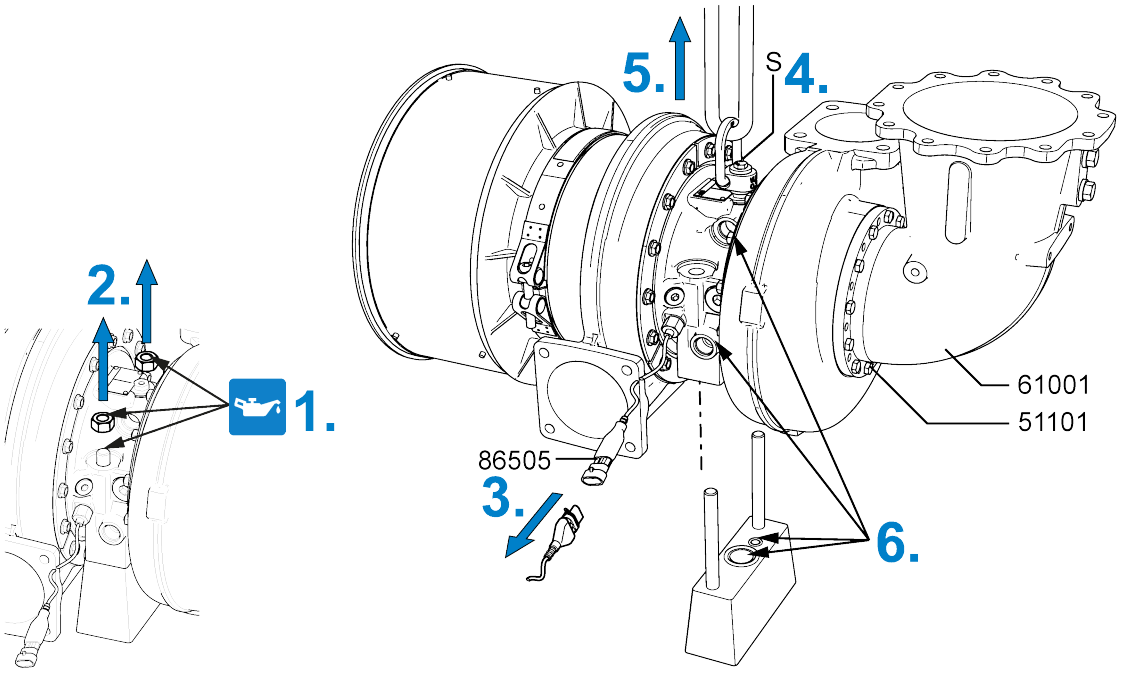


Fig. 5: Removing the turbocharger

1. Treat the threads of studs and nuts with penetrating oil and allow to work in.
2. Loosen and remove nuts.
3. If present: Disconnect the plug to the speed sensor (86505) and secure the rolled-up cable on the turbocharger. This protects the plug from being crushed.
4. Install the swivel lifting eye (S) and attach the lifting gear to it.
5. Lift the turbocharger away from the support vertically. The bracket-turbocharger connection may be in the form of a pin with the TPS52-H.
6. Cover the connections.

Version with water cooling

⚠ CAUTION

Freezing of the cooling water in the bearing casing

If cooling water freezes in the bearing casing, this can lead to severe damage.

▶ For transport and storage of the turbocharger, drain the cooling water from the bearing casing via one of the two bottom openings of the water connections.

2.3 Installing the turbocharger

2.3.1 Inserting gaskets

⚠ CAUTION

Inserting the gaskets

Gaskets that are forgotten, damaged or improperly inserted will lead to oil leaks.

- ▶ Always use new gaskets and insert them carefully into the slot.

The oil is supplied (02) and drained (03) through the bracket (01).

The necessary sealing is provided by O-rings. The O-rings are not included in the ABB Turbo Systems scope of delivery.

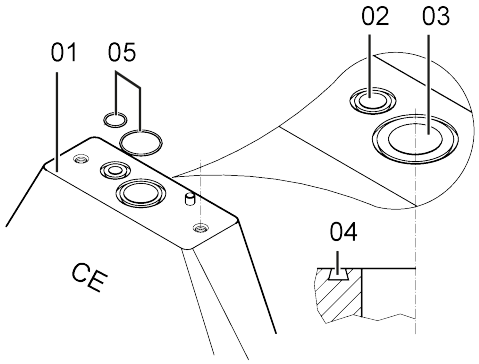


Fig. 6: Inserting O-rings into bracket

01	Bracket
02	Oil supply
03	Oil drain
04	Slot for O-ring
05	O-rings
CE	Compressor end

2.3.2 Fitting threaded rods

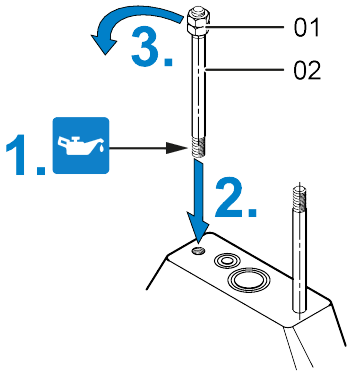


Fig. 7: Inserting threaded rods into the bracket

1. Lightly oil the surfaces of the threaded rods (02) to be screwed in.
2. Screw the threaded rods into the bracket with the aid of locknuts (01).
3. Remove nuts (01) again.

Requirements for the threaded rods (02)

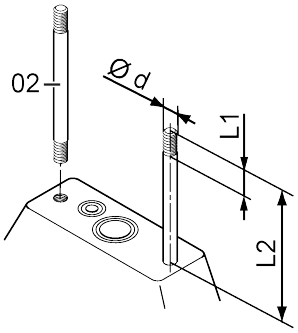


Fig. 8: Requirements for threaded rods

Product	Diameter Threaded rod [mm]	Material DIN / ISO 898 (Part 1)	Thread length L1 [mm]	Length of threaded rod L2 [mm]
TPS44	Ø 16 / M16	10.9 / 12.9	≥ 30	150
TPS48	Ø 16 / M16	10.9 / 12.9	≥ 30	170
TPS52	Ø 20 / M20	10.9 / 12.9	≥ 30	195

Table 4: Requirements for threaded rods

Fastening material scope of delivery

The threaded rods and nuts for fastening the turbocharger on the bracket are not included in the ABB Turbo Systems scope of delivery. These parts depend on the version of the engine-side bracket.

2.3.3 Attaching the turbocharger to the bracket

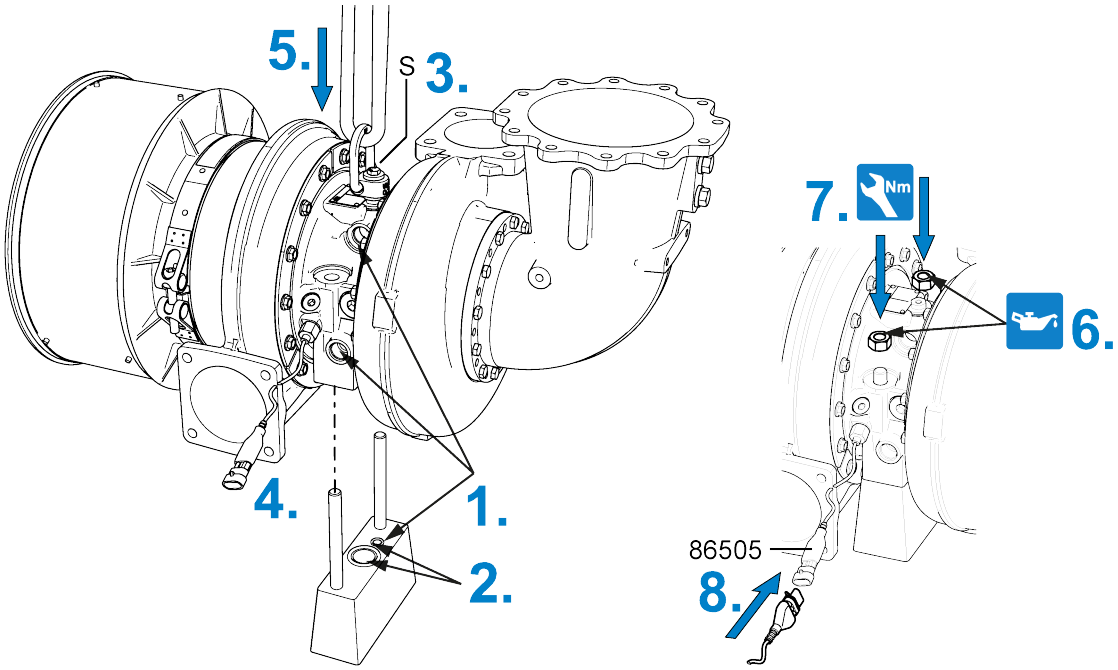


Fig. 9: Placing the turbocharger on the bracket

Product	Through hole in bearing casing [mm]	Fixing screws [mm]	Tightening torque [Nm] (assumed friction coefficient μ = 0.12)
TPS44	Ø 17	M16	280
TPS48	Ø 17	M16	280
TPS52	Ø 20	M20	560

Table 5: Tightening torque for turbocharger fixing screws

1. Make sure that covers of the oil and water connections are removed.
2. Make sure that the gaskets are not damaged and are positioned correctly in the slots.
3. Install the swivel lifting eye (S) and attach the lifting gear to it.
4. Align the turbocharger over the threaded rods of the bracket.
5. Place the turbocharger on the bracket.
6. Lightly oil the hexagon nuts.
7. Fit the hexagon nuts. Observe the tightening torque.
8. Connect cable to speed sensor (86505).

▶ Remove the lifting gear.

▶ Connect all the gas pipes and air lines according to the enginebuilder's instructions.

▶ If the gas outlet casing from ABB has not been dismantled with the turbocharger, refer to chapter Installing the gas outlet casing →68.

▶ Fit the water pipes 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 (see Table 6: Lubricating oil pressure at oil inlet before turbocharger →17).
- 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 →17.

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. Engine damage can be prevented.

3.2.2 Checks before commissioning

Filter mat (if available)

- ▶ Check for damage and contamination.

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 →17.

Warning plates

- ▶ Check whether warning plates are present and legible.
- ▶ Check whether the protective sheets have been removed.

Version with water-cooled bearing casing

⚠ CAUTION

Failure of bearing casing cooling

Any prolonged failure of the water cooling will shorten the lifetime of the turbocharger.

- ▶ Make sure that an uninterrupted supply of cooling water is provided during operation.

- ▶ Check whether the water pipes are fitted on the bearing casing.

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 →17 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.

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 →39).

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.
- Remove the locking screws on the water connections and fit the water pipe.

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 filter silencer or air supply line, 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 oil inlet of the bearing casing if the oil inlet pressure is > 3 bar.

⚠ CAUTION

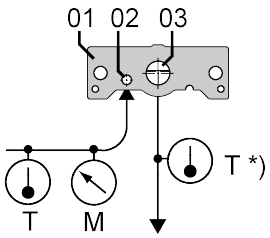
Assuring lubricating oil pressure

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

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

Status for operation	Pressure at oil inlet before turbocharger [bar]
Normal operation	$2.0 < p_{oil} \leq 4.5$
Engine start: Cold oil, admissible for maximal 15 minutes	< 8.0
Engine idling, admissible for maximal 1 hour	$0.5 < p_{oil} \leq 2.5$
Pre-lubrication and post-lubrication (engine stopped)	$0.5 < p_{oil} \leq 1.0$
Warning signal: ($n \geq 0.5 \times n_{Bmax}$)	< 1.25
Alarm signal: Not admissible. Stop the engine immediately.	< 0.5

Table 6: Lubricating oil pressure at oil inlet before turbocharger



01 Turbocharger contact surface
02 Oil inlet
03 Oil outlet
M Oil pressure measuring point
T Oil temperature measuring point

For monitoring the lubricating oil pressure, ABB Turbo Systems recommends installing an "M" manometer immediately before the turbocharger. If the pressure is controlled electronically, the appropriate signals are to be triggered at the warning and alarm values.

*) If the drain pipe is vented, the measuring point for lubricating oil temperature 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.

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.

Status for operation	Oil temperature at the inlet $T_{oil,inlet}$
Admissible	30 … 105 °C
Temporarily admissible (< 1 h) → alarm	> 105 °C
Not admissible → stop engine	> 110 °C
Not admissible → do not start engine (before start: preheat oil)	< 30 °C

Table 7: 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.

Status for operation	Oil temperature at the outlet $T_{oil,outlet}$
Admissible	≤ 160 °C
Temporarily admissible → alarm	> 160 °C
Not admissible → stop engine	> 180 °C
Admissible	≤ $T_{oil,inlet}$ + 55 K
Temporarily admissible → alarm	> $T_{oil,inlet}$ + 55 K

Table 8: 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

⚠ CAUTION

Factors influencing replacement intervals

Operation above the operating limits defined on the rating plate can shorten the recommended replacement intervals considerably.

- ▶ Measure exhaust gas temperature upstream of turbine.
- ▶ Comply with operating limits on rating plate.

- ▶ 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.

⚠ CAUTION

Do not strain cables

If you pull the speed measurement cables too hard, contacts can be pulled out.

- ▶ Do not strain the speed measurement cables by pulling.

⚠ CAUTION

Machine damage

Operation above the operating limits defined on the rating plate can shorten the recommended replacement intervals considerably and cause machine damage.

- ▶ Measure turbocharger speed.
- ▶ Comply with operating limits on rating plate.

- ▶ 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 →75).

4.3.2 Layout and overview

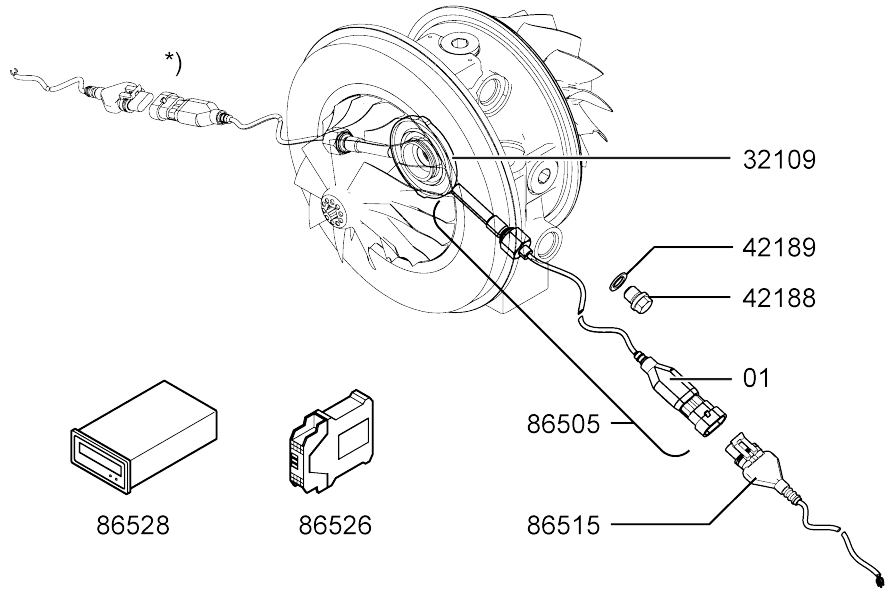


Fig. 10: Layout and overview of the speed measurement system

86505	Speed sensor	42188	Screw plug
86515	Cable connector	42189	Gasket
86526	F/I converter	01	Plug with integrated voltage limiter
86528	Tachometer	*)	Alternative mounting position for speed sensor
32109	Sealing disc		

4.3.3 Speed differences with several turbochargers per engine

The speeds of all turbochargers on an engine vary only slightly from each other in standard operation.

The difference between the highest and the lowest turbocharger speed must not be more than 3 %, relative to the speed limit n_{Bmax}.

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

- Reduce the engine performance immediately to the point at which the maximum turbocharger speed does not exceed 70 % of n_{Bmax}.
- If the engine cannot be stopped, it can continue to be driven at this reduced engine load or turbocharger speed.
- If a turbocharger surges continuously, the engine performance must be reduced further.
- Measure the temperatures in the air lines and gas piping from and to the turbochargers and compare with normal values. If clear deviations of temperature are found, the nearest ABB Turbocharging Service Station has to be contacted.
- Check the pressure loss of the alternative air inlet and compare it with normal values.

If the engine can be stopped temporarily:

- Inspect air lines, gas piping and the turbochargers and remedy any malfunctions.
- In any case, contacting the nearest ABB Turbocharging Service Station is recommended.

4.3.4 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 →45.

4.3.5 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.

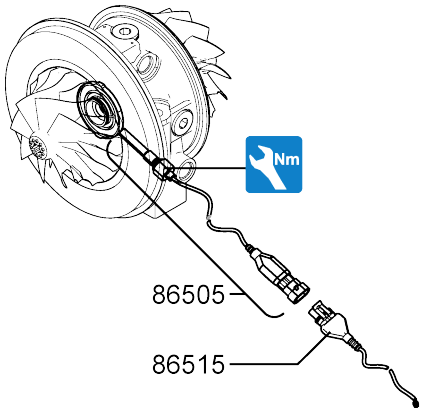


Fig. 11: Fitting the speed sensor

Part number	TPS44	TPS48	TPS52
86505	M12 x 1.5 15 Nm	M12 x 1.5 15 Nm	M12 x 1.5 15 Nm

Table 9: Tightening torque (86505)

- ▶ Reduce the engine performance to idling and then stop the engine. Pay attention to post-lubrication (Stopping the engine →29).
- ▶ 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

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.

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 filter silencer. 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 →24).

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

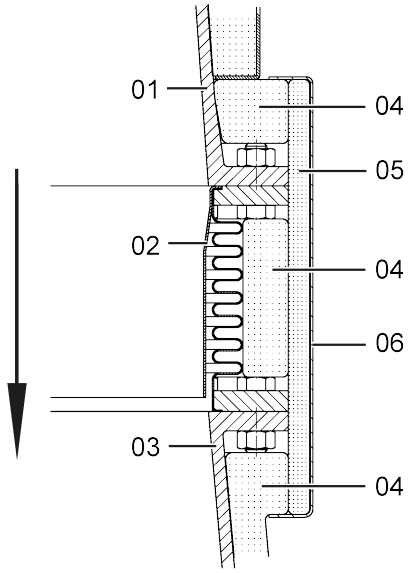


Fig. 12: Noise insulation, bellows

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 inspections, monitoring, measuring and inspection work as well as function checks. Service work enables to detect and rectify 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

Shortened service intervals

Exceptional stresses such as several starts/stops per day, 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 shortened service interval with ABB Turbo Systems.

NOTICE

5-year service inspection

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
- Air temperature after the compressor and after the charge-air cooler
- Exhaust gas temperature before and after the turbine
- Pressure loss in the filter silencer.

▶ 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.

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.

5.2.4 Service work according to data on the rating plate

⚠ WARNING

Incorrect handling of a cartridge group

Incorrect handling of a cartridge group can damage the turbocharger and cause injuries to persons.

- ▶ Have disassembly and assembly of the cartridge group carried out by an ABB Turbocharging Service Station only.

NOTICE

Specialist knowledge of an ABB Turbocharging Service Station

Assembly and disassembly of the cartridge group and assessment of the rotor and bearing parts requires the specialist knowledge of an ABB Turbocharging Service Station. The rotor parts turn very fast and are very sensitive to unbalance.

The rotor and bearing parts must be checked and assessed by an ABB Turbocharging Service Station. The following work can be carried out as preparation.

- ▶ Remove turbocharger from engine (see chapter Removing and Installing →7).
- ▶ Dismantle the turbocharger and measure the clearances (see chapter Dismantling and fitting →46).
- ▶ Mechanically clean the nozzle ring, the turbine casing and compressor casing (see chapter Periodic maintenance work →30).
- ▶ Check the nozzle ring, turbine casing and compressor casing for cracks and erosion/corrosion.

5.3 Expected replacement intervals

Component	GAS / MDO
Turbine casing	25000 … 50000
Nozzle ring	25000 … 50000
Heat sheet metal	25000 … 50000
Rotating components	See rating plate information [1)]
Bearing parts	12000 … 24000
Other casings	50000

Table 10: Expected replacement intervals [h]

GAS = Gas
MDO = Marine Diesel Oil
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 considerably 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

Water-cooled turbocharger variant

- Post-lubricate as long as the rotor is turning.
- Observe the oil pressure while performing post-lubrication: $0.5 < p_{oil} \leq 1.0$.
- Switch off post-lubrication as soon as the rotor is stationary or after no more than two minutes.

Deviating procedures must be coordinated with ABB Turbo Systems.

⚠ CAUTION

Water cooling after stopping the engine

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

- Allow the water cooling of the turbocharger to continue operating for 15 to 20 minutes after stopping the engine.

7 Periodic maintenance work

7.1 Foreword to maintenance

Maintenance work includes regular visual controls and cleaning operations which are intended to ensure the trouble-free functioning of the turbocharger.

Maintenance interval	Maintenance work	Operating status
Similar to the service interval (usually every 8000 … 12000 h) [1)]	Cleaning components mechanically →30	Engine stopped

Table 11: Maintenance table

[h] = Hours of operation

[1)] ABB Turbo Systems recommends having mechanical cleaning carried out by an ABB Turbocharging Service Station during the service work.

7.2 Cleaning components mechanically

7.2.1 Preparation

⚠ CAUTION

Component damage and corrosion

If mechanical cleaning is carried out incorrectly, this can lead to damage and corrosion on the components.

- ▶ Pay attention to the specifications in this chapter pertaining to mechanical cleaning.

⚠ CAUTION

Selection of cleaning tools

Turbocharger components are sensitive and easily sustain mechanical damage. The use of needle descalers (for example) or other striking tools damages the components. Depending on the specification, nozzle rings or turbine casings may have protective coatings which can also be damaged.

- ▶ Use only soft tools such as rags, brushes or wire brushes.
- ▶ In case of heavy contamination, the cleaning methods described in this chapter (such as soaking, for example) can be repeated until a satisfactory result is achieved.

The disassembly and assembly of the components is described in chapter Dismantling and fitting →46.

- ▶ Contaminated water and cleaning agents must be disposed of in an environmentally compatible, professional way and in compliance with locally applicable regulations.

7.2.2 Cleaning the filter silencer

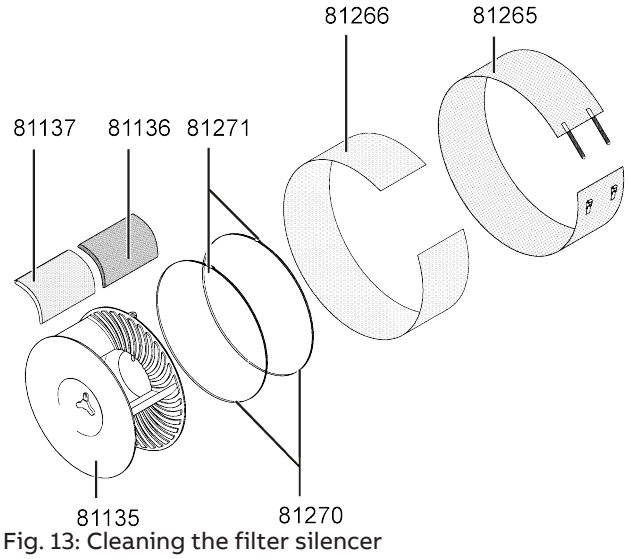


Fig. 13: Cleaning the filter silencer

81135	Filter silencer body	81266	Cover grid
81136	Absorption segment	81270	Tension band
81137	Sheet-metal covering	81271	Lock
81265	Filter ring		

Cleaning the filter ring (if present)

- ▶ Remove filter ring (81265).
- ▶ Clean filter ring (81265) as required or every 500 hours of operation and replace after the fifth cleaning process at the latest.
  Contamination of the filter ring depends on the degree of purity of the sucked-in air.
- ▶ Rinse the filter ring (81265) with water and mild detergent or, in the case of heavy contamination, soak and carefully push through. Rinse in cold water. Avoid high mechanical loads (water jet).
- ▶ Let the filter ring dry completely before assembling.
- ▶ Dirty water and mild detergent must be disposed of in compliance with locally applicable regulations.

Cleaning the absorption segments

(see Fig. 13: Cleaning the filter silencer →31)

- Loosen the tension bands (81270).
- Remove the cover grid (81266).
- Pull out and bend up the sheet-metal coverings (81137), and remove the absorption segments (81136).
- Clean the absorption segments (81136).
  When cleaning, note that the absorption segments (81136) must only be cleaned lightly with compressed air, a soft brush or a moist cleaning cloth.
- Have any heavily contaminated absorption segments replaced by an ABB Turbocharging Service Station.

Fitting the filter silencer

(see Fig. 13: Cleaning the filter silencer →31)

- Insert the absorption segments (81136) into the sheet-metal coverings (81137).
- Bend the sheet-metal coverings (81137) back to their original shape and insert into the slotted guides in the filter silencer body (81135).
- Fit the cover grid (81266).
- Fit the tension bands (81270) and tighten them at the locks (81271).
- Any tension bands that have become damaged must be replaced.
- Fit the filter ring (81265), if present.

7.2.3 Compressor-end, non-rotating parts

⚠ 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.

The following parts, which are relevant in terms of performance, can be cleaned in accordance with the description below.

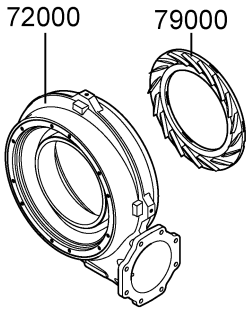


Fig. 14: Cleaning the compressor casing, diffuser mechanically

72000 Compressor casing
79000 Diffuser

- ▶ Steam-clean the above-mentioned components or soak in diesel oil or water with household cleaning agents. After soaking, remove contamination with a brush.
- ▶ Dry components completely.
- ▶ Spray cleaned surfaces with penetrating oil. Do not spray exterior surfaces of the turbocharger.
- ▶ Dispose of contaminated water and cleaning agents in accordance with the information in the material safety data sheet.

7.2.4 Turbine-end, non-rotating parts

⚠ 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.

Baked layers of contamination, for example, from heavy fuel oil or coked oil occur at the turbine end. The following parts, which are relevant in terms of performance, can be cleaned in accordance with the description below.

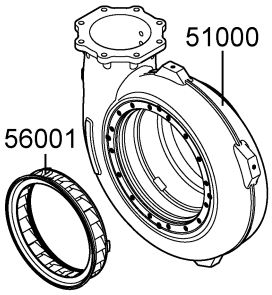


Fig. 15: Cleaning the nozzle ring, turbine casing mechanically

56001 Nozzle ring
51000 Turbine casing

- Place contaminated parts in hot water or in a liquid such as brake cleaner to soften the contamination.
- Brush away the contamination or remove with a steam cleaner.
- If necessary, repeat soaking and brushing.
- Use clean water to completely clean parts of any solvents.
- Dry components completely.
- Spray cleaned surfaces with penetrating oil. Do not spray the outer surfaces of the turbocharger.

- Dispose of contaminated water and cleaning agents in accordance with the information in the material safety data sheet.

7.2.5 Cartridge group, general

⚠ CAUTION

Corrosion

If the cartridge group is not put back into operation immediately after cleaning, parts may corrode.

- Immediately after cleaning, install the cartridge group and put it back into operation.

Compressor wheels can be heavily contaminated due to poorly filtered suction air; turbines can be heavily contaminated due to coked oil. Contamination such as this must be removed during the standard service intervals (see service work chapter).

- Remove turbocharger from engine (see chapter Removing and Installing →7).
- Remove cartridge group (see chapter Dismantling and fitting →46).

First clean the compressor end and then the turbine end according to the following description.

7.2.6 Cleaning the cartridge group on compressor end

⚠ CAUTION

Selection of the cleaning agent

Cleaning agents which contain chlorine attack metals.

- Use only pH-neutral cleaning agents which do not attack metals.
- Observe safety data sheet.

⚠ CAUTION

Water and contamination in the cartridge group

If water or contamination penetrates the cartridge group, this can impair the function of the turbocharger and damage parts inside the cartridge group.

- Make sure that no water or contamination can enter into the cartridge group.

- Clean the compressor wheel with a rag or soft brush which has been soaked in water with a household cleaning agent. Do not use wire brushes!
- Dry the compressor wheel and the gap between the compressor and the bearing casing with low-pressure pressurized air.
- Lightly spray the compressor wheel and the gap between the compressor and the bearing casing with penetrating oil.

- Dispose of dirty water and cleaning agents in accordance with the material safety data sheet.

7.2.7 Cleaning the cartridge group on turbine end

Soaking the contamination

Baked layers of contamination from fuel residue or coked oil may occur at the turbine end. The contamination can be removed by soaking and brushing. The procedure for soaking the layers of contamination as well as for cleaning the turbine are described in the following.

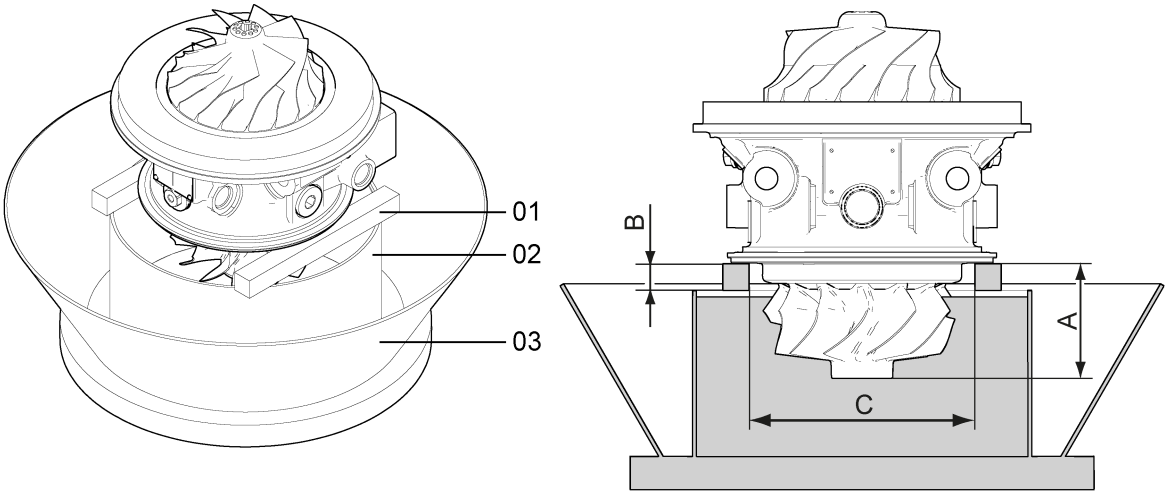


Fig. 16: Soaking contamination of the turbine

Product	A [mm]	B [mm]	C [mm]
TPS44	115	20	155
TPS48	115	29	180
TPS52	135	35	215

Table 12: Dimensions of the cleaning container

To soak the layers of contamination on the turbine, the cartridge group can be immersed vertically in a container (02) with fluid.

- Place the container (02) inside a larger container (03) so that the overflowing fluid can be collected.

⚠ CAUTION

Selection of the cleaning agent

Cleaning agents which contain chlorine attack metals.

- Use only pH-neutral cleaning agents which do not attack metals.
- Observe safety data sheet.

- Fill the container (02) with soaking fluid. To shorten the soaking time, the fluid can be heated up to a maximum of 60 ºC.

⚠ WARNING

Heating up of cleaning agents and operating fluids

When cleaning agents or operating fluids are heated up, explosive vapours can be produced which are hazardous to health.

- ▶ Observe the information in the material safety data sheet.

Wear a respiratory mask according to material safety data sheet.

⚠ CAUTION

Water and contamination in the cartridge group

If water or contamination penetrates the cartridge group, this can impair the function of the turbocharger and damage parts inside the cartridge group.

- ▶ Place the cartridge group on suitable supports (01) made of wood or metal.
- ▶ Observe dimension (B) for the supports (01) so that the cartridge group is not immersed too deeply.

- ▶ Let the layers of contamination on the turbine soak for four hours.

Removing dirt

⚠ WARNING

Health hazard due to soot particles

If soot particles enter the eyes or respiratory tract, this can be harmful to health.

- ▶ 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 safety goggles.

Wear safety goggles.

Wear a respiratory mask to protect against dusts.

Wear safety gloves to protect against mechanical hazards.

- ▶ Lift up the cartridge group and align it horizontally.
- ▶ Remove dirt manually using a soft brush or a wire brush.

⚠ CAUTION

Water and contamination in the cartridge group

If water or contamination penetrates the cartridge group, this can impair the function of the turbocharger and damage parts inside the cartridge group.

- ▶ Make sure that no water or dirt enters the gap between the heat sheet metal and the turbine.

⚠ CAUTION

Non-permissible rotor unbalance after cleaning

Unevenly distributed residual contamination deposits lead to rotor unbalance. This can result in bearing or turbocharger damage.

- ▶ Remove all traces of contamination from the turbine.

- ▶ After brushing off the dirt, fill the container (02) with clean water, not salt water.
- ▶ Immerse the turbine of the cartridge group in clean water so that any loose dirt comes off.
- ▶ Lift up the cartridge group and align it horizontally.
- ▶ Clamp the heat sheet metal to the bearing casing.
- ▶ Dry the turbine and the gap between the turbine and the heat sheet metal with low-pressure pressurized air.
- ▶ Lightly spray the turbine and the gap between the turbine and the heat sheet metal with penetrating oil.
- ▶ Dispose of contaminated water and cleaning agents in accordance with the information in the material safety data sheet.

8 Eliminating malfunctions

8.1 Malfunctions when starting

Delayed start-up

Possible causes		Remedy
Turbocharger	Turbocharger contaminated	Clean (see chapter Periodic maintenance work →30)
	Bearing damaged	Contact ABB Turbocharging Service Station
	Rotor rubbing	
	Foreign object in the turbocharger	

Table 13: Malfunctions when starting – Delayed start-up

Vibrations

Possible causes		Remedy
Turbocharger	Rotor unbalance	Contact ABB Turbocharging Service Station
	Turbine or compressor damaged	
	Bearing damaged	
Engine	Vibrations from engine	Contact enginebuilder

Table 14: 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. ■ If there is any doubt about the extent of the rubbing, contact an ABB Turbocharging Service Station. ■ Have a dimension check carried out by an ABB Turbocharging Service Station.

Table 15: Malfunctions when starting - Rotating parts rubbing

8.2 Malfunctions during operation

Lubricating oil pressure too low

Possible causes		Remedy
Turbocharger	Axial clearance of the rotor excessive	Contact ABB Turbocharging Service Station
Engine	Oil filter heavily contaminated	Clean
	Oil pump in lubricating system defective	Check/replace
	Manometer displays incorrectly	Replace manometer

Table 16: Malfunctions during operation – Lubricating oil pressure too low

Speed reduces

Possible causes		Remedy
Turbocharger	Turbine and/or nozzle ring severely contaminated	Clean (see chapter Periodic maintenance work →30)
	Rotor components or bearing damaged	Contact ABB Turbocharging Service Station
Engine	Defects on the connected cylinders in pulse charging	Contact enginebuilder
Pipes	Defects, such as leaks, in the exhaust gas pipes or charge air ducts	Repair

Table 17: Malfunctions during operation – Speed reduces

Speed increases

Possible causes		Remedy
Turbocharger	Light to medium contamination of the turbine and/or nozzle ring (with 4-stroke application)	Clean (see chapter Periodic maintenance work →30) or contact an ABB Turbocharging Service Station

Table 18: Malfunctions during operation – Speed increases

Exhaust gas temperature too high

Engine performance and engine speed unchanged

Possible causes		Remedy
Turbocharger	Insufficient air, for example, when filter silencer is blocked by contamination	Clean (see chapter Periodic maintenance work →30)
	Compressor/turbine contaminated	
	Exhaust gas back pressure too high	Clean or repair boiler or exhaust gas silencer
	Turbine damaged or eroded	Contact ABB Turbocharging Service Station
Engine	Malfunction in the injection system	Repair or contact manufacturer
Charge air cooler	Cooler contaminated	Clean
	Cooling water volume too low	Fill
	Inlet temperature of cooling water too high	Check/clean cooling system
	Insufficient ventilation	Improve ventilation

Table 19: Malfunctions during operation – Exhaust gas temperature too high

Charge air pressure too low

Engine performance and engine speed unchanged, suction condition normal

Possible causes		Remedy
Turbocharger	Manometer display not correct	Replace manometer
	Supply pipe to manometer not sealed	Repair leak
	Filter silencer contaminated, therefore pressure drop too high	Clean (see chapter Periodic maintenance work →30)
	Compressor end and/or turbine end contaminated	
	Compressor/turbine damaged	Contact ABB Turbocharging Service Station
	Exhaust gas back pressure too high	Clean or repair boiler or exhaust gas silencer
Engine	Air receiver not sealed	Repair
	Gas piping between engine and turbine leaking	
	Injection mistimed	Set correctly
	Valve control misadjusted	
Pipes	Pipes downstream to the compressor outlet not sealed.	Repair.

Table 20: Malfunctions during operation – Charge air pressure too low

Charge air pressure too high

Engine performance and engine speed unchanged, suction condition normal

Possible causes		Remedy
Turbocharger	Manometer display not correct	Replace manometer
	Increased speed due to contamination of nozzle ring	Clean (see chapter Periodic maintenance work →30) or contact an ABB Turbocharging Service Station
Engine	Malfunction in the injection system	Repair or contact manufacturer
	Injection mistimed	Set correctly
	Engine performance higher than indicated	Check engine performance

Table 21: 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.

Possible causes		Remedy
Turbocharger	Compressor components severely contaminated by the ventilation gases that have been fed in	Clean (see chapter Periodic maintenance work →30)
		Optimize oil separation
	Increased blade vibration, compressor blade damage due to the ventilation gases that have been fed in	Correct the feed of ventilation gases according to instructions of enginebuilder.
	Material of the compressor wheel corroded due to the feeding in of ventilation gases containing corrosive components	Correct the feed of ventilation gases according to instructions of enginebuilder.
	Material of the compressor wheel corroded due to intake air containing exhaust gases or salt	Prevent exhaust gas leakages in the engine space
		Clean (see chapter Periodic maintenance work →30)

Table 22: Malfunctions during operation – Engine performance losses

8.3 Turbocharger is surging

⚠ WARNING

Hot air escapes from the filter silencer

A surge blow is accompanied by a loud bang and escape of hot air from the filter silencer. Personal injury can result.

- ▶ Keep distance from the filter silencer 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.
- ▶ Have the cause clarified and remedied immediately by an ABB Turbocharging Service Station.
- ▶ Have parts assessed for damage and, if necessary, replaced by an ABB Turbocharging Service Station.

Possible causes		Remedy
Turbocharger	Filter silencer or diffuser contaminated	Clean (see chapter Periodic maintenance work →30)
	Heavy contamination deposits in the turbine or in the nozzle ring	
Engine	Protective grating in front of the turbocharger contaminated or damaged	Clean/replace
Charge air cooler	Cooler contaminated	Clean
	Charge air duct blocked	

Table 23: Malfunction – Turbocharger pumping

Sporadic surge blows

Possible causes		Remedy
Engine	Engine load reduced quickly when manoeuvring. 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.	- -

Table 24: Malfunction – Sporadic surge blows

8.4 Malfunctions when stopping

Runout noises

Possible causes		Remedy
Turbocharger	Turbocharger contaminated	Clean (see chapter Periodic maintenance work →30)
	Bearing damaged	Check clearances (see chapter Axial clearance A and radial clearance B →59). If clearances are outside the tolerance or if in doubt, contact an ABB Turbocharging Service Station.
	Rotor rubbing	Check clearances (see chapter Radial clearances N and R →67). If clearances are outside the tolerance or if in doubt, contact an ABB Turbocharging Service Station.
	Foreign object in the turbocharger	Dismantle turbocharger (see chapter Dismantling and fitting →46). In case of damage, replace the corresponding parts or contact an ABB Turbocharging Service Station.

Table 25: 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.

Possible causes		Remedy
Turbocharger	Turbocharger contaminated	Clean (see chapter Periodic maintenance work →30)
	Bearing damaged	Check clearances (see chapter Axial clearance A and radial clearance B →59). If clearances are outside the tolerance or if in doubt, contact an ABB Turbocharging Service Station.
	Rotor rubbing	Check clearances (see chapter Radial clearances N and R →67). If clearances are outside the tolerance or if in doubt, contact an ABB Turbocharging Service Station.
	Foreign object in the turbocharger	Dismantle turbocharger (see chapter Dismantling and fitting →46). In case of damage, replace the corresponding parts or contact an ABB Turbocharging Service Station.

Table 26: Malfunctions when stopping – Runout time too short

8.5 Speed measurement system

No signal or poor signal amplitude of the speed measurement

Possible causes		Remedy
Turbocharger	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.	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 →22. Install the speed sensor without the additional gasket (copper ring).
	Sensor or cable defective	Contact an ABB Turbocharging Service Station. Order new speed sensor (86505) (refer to chapter Ordering spare parts →75). Replacing the speed sensor →22.

Table 27: Malfunction of the speed measurement system – No signal or poor signal amplitude

Measured speed too high

Possible causes		Remedy
Turbocharger	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, hence, to false triggering.	For information regarding the disassembly and assembly of the speed sensor, refer to chapter Replacing the speed sensor →22. Dismantle the sensor, clean the sensor tip, and fit the sensor back on with the specified tightening torque.

Table 28: Malfunction of the speed measurement system – Measured speed too high

Measured speed too low

Possible causes		Remedy
Turbocharger	- -	Contact ABB Turbocharging Service Station

Table 29: Malfunction of the speed measurement system – Measured speed too low

If none of the measures described above remedy the malfunction, have the speed measurement system checked by an ABB Turbocharging Service Station.

9 Dismantling and fitting

9.1 Introduction

The condition for the work described below is that the turbocharger has been removed from the engine (see chapter Removing and Installing →7).

⚠ 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

Cutting injuries when working on the turbocharger

Some parts on the turbocharger may have sharp edges. There is a risk of a cutting injury.

- ▶ Wear safety gloves against mechanical risks when conducting assembly and disassembly work.

Wear safety gloves to protect against mechanical hazards.

⚠ CAUTION

Further operations

This Operation Manual may be used to carry out only those operations that are described in it. Further operations that are executed in an incorrect way can lead to serious damage to the machine.

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

9.1.1 Customer spare part set (97070)

The customer spare part set (97070) is required for the operations described. These parts are only available in a complete set (see chapter Ordering spare parts →75). The content of the set can be viewed via the following QR code or URL link.

http://www.abb.com/abblibrary/DownloadCenter/?CategoryID=9AAC179494&View=Result&DocumentKind=Catalogue&QueryText=spare+parts+set&SortBy=Score&CountryCode=CH&AdditionalLanguage=*

Identification of the assembly devices

Not all assembly devices are marked with a part number. Identification is guaranteed by the tool list. This list is enclosed with the toolbox.

⚠ WARNING

Servicing the assembly devices

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

- ▶ Visually inspect for corrosion, cracks, deformation and wear.
- ▶ Damaged assembly devices must no longer be used and must be replaced.

Tightening torques for assembly devices

Unless described otherwise, the screws and nuts of the assembly devices supplied by ABB must be tightened so they rest firmly against the surface.

⚠ WARNING

Suspended loads

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

- ▶ Only fasten the turbocharger, assemblies or individual parts on properly functional lifting gear with 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.

Definition of terms

- **Suspension point**
  Defined loading point on a component or an assembly (blind hole thread, eyelet, lug).
- **Assembly device**
  Devices that are fitted on the turbocharger in order to obtain a suspension point. 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.
- **Lifting gear**
  Equipment for the lifting and transporting of loads (ropes, chain block, crane). Lifting gear is not supplied by ABB.

One swivel lifting eye (S) is required to safely lift this turbocharger. This is not included in the ABB Turbo Systems scope of delivery.

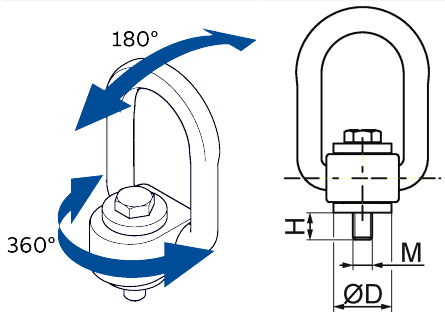
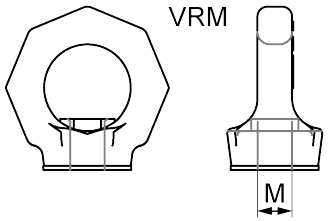
Swivel lifting eye (S) to be used	Product	Thread	Length H [mm]	Diameter D [mm]	Minimum load limit [kg]
	TPS44	M8	≤ 12	≤ 25	300
	TPS48	M8	≤ 12	≤ 25	300
	TPS52	M10	≤ 15	≤ 25	400

Table 30: Swivel lifting eye (S) to be used

Two ring nuts are required for safer lifting of the cartridge group, which are not included in the ABB Turbo Systems scope of delivery.

Ring nuts to be used (VRM)	Product	Thread
	TPS44	M16
	TPS48	M16
	TPS52	M20

Starpoint ring nut VRM

Table 31: Ring nuts to be used

9.2 Weights of individual parts

The specified weights of the individual parts or assemblies are rounded-up standard values.

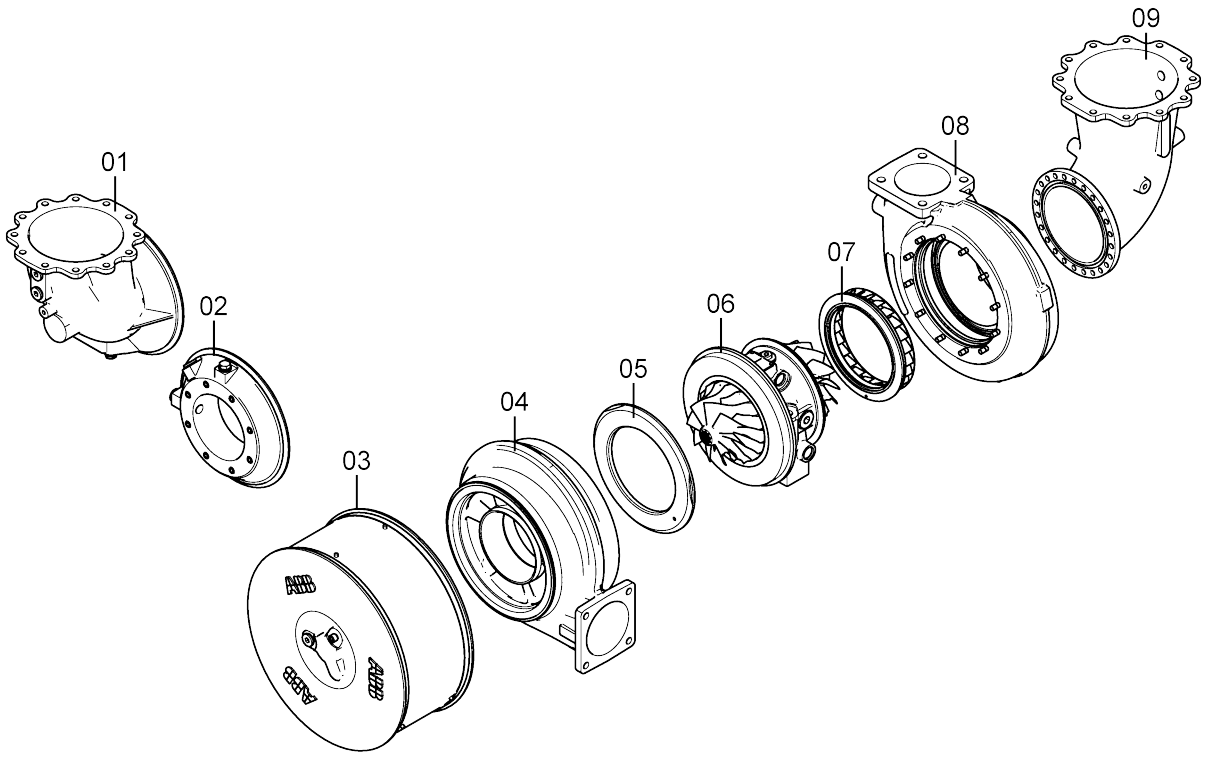


Fig. 17: Overview of assemblies

	Designation	TPS44	TPS48	TPS52
01	Radial air suction branch	5	6	8
02	Axial air suction branch	3	4	4
03	Filter silencer	15	- -	- -
04	Compressor casing	17	30	45
05	Diffuser	2	3	4
06	Cartridge group	24	40	65
07	Nozzle ring	1	2	3
08	Turbine casing 1 inlet	30	45	70
09	Gas outlet casing	16	18	25

Table 32: Weights of the assemblies [kg]

9.3 Removing the gas outlet casing

▶ Mark the casing position for assembly.

Note: Gas outlet casings which are not from ABB may also be secured with studs and nuts.

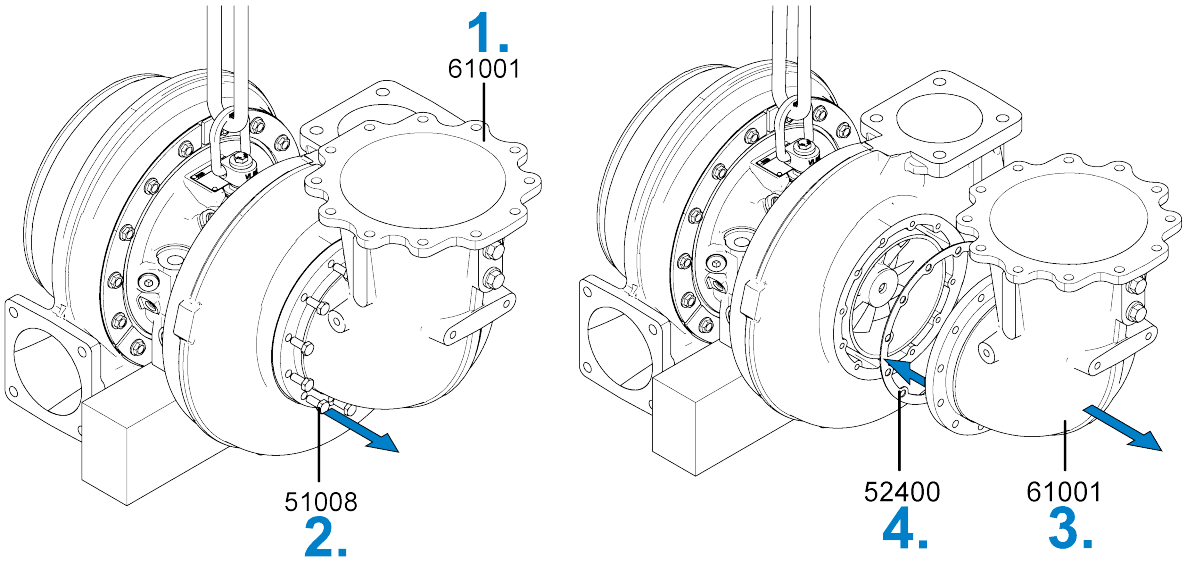


Fig. 18: Removing the gas outlet casing

1. Manually secure the gas outlet casing (61001).
2. Loosen and remove screws (51008).
3. Remove the gas outlet casing (61001).
4. Remove the gasket (52400).

9.4 Removing air inlets

▶ Mark the casing position for assembly.

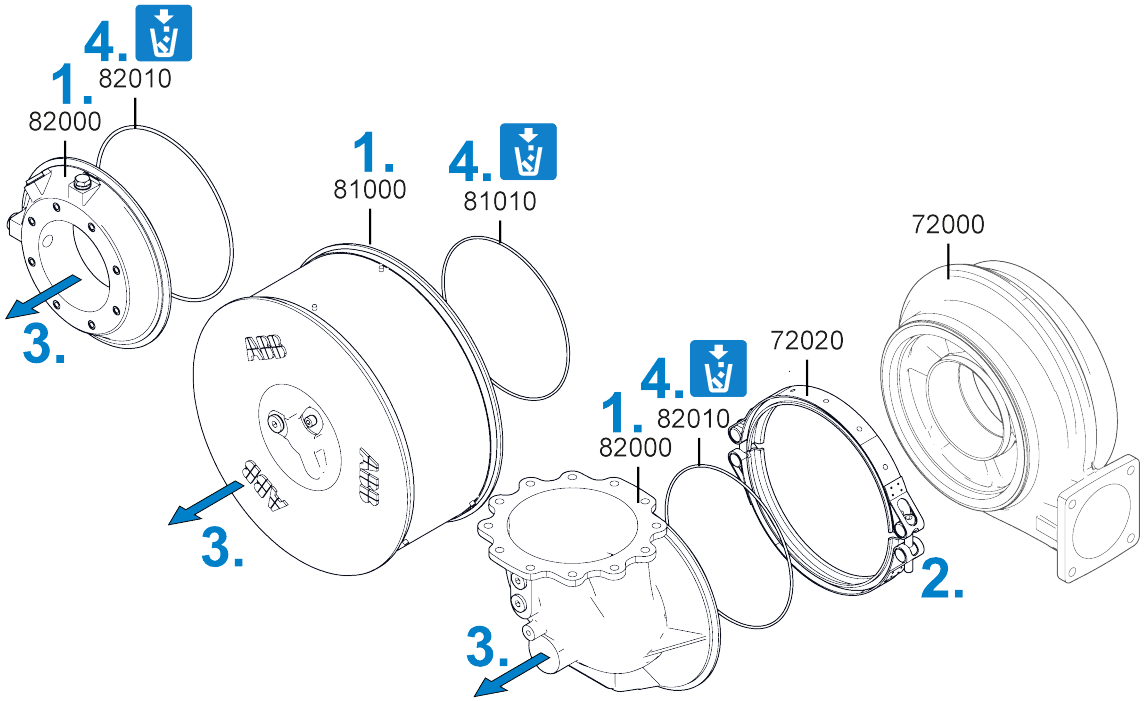


Fig. 19: Removing the air inlets

1. Manually secure the filter silencer (81000) or air suction branch (82000).
2. Loosen and remove V-clamp (72020).
3. Remove the filter silencer (81000) or air suction branch (82000).
4. Remove and dispose of O-ring (81010 / 82010) (refer to Disposing of turbocharger components →74).

9.5 Removing the compressor casing

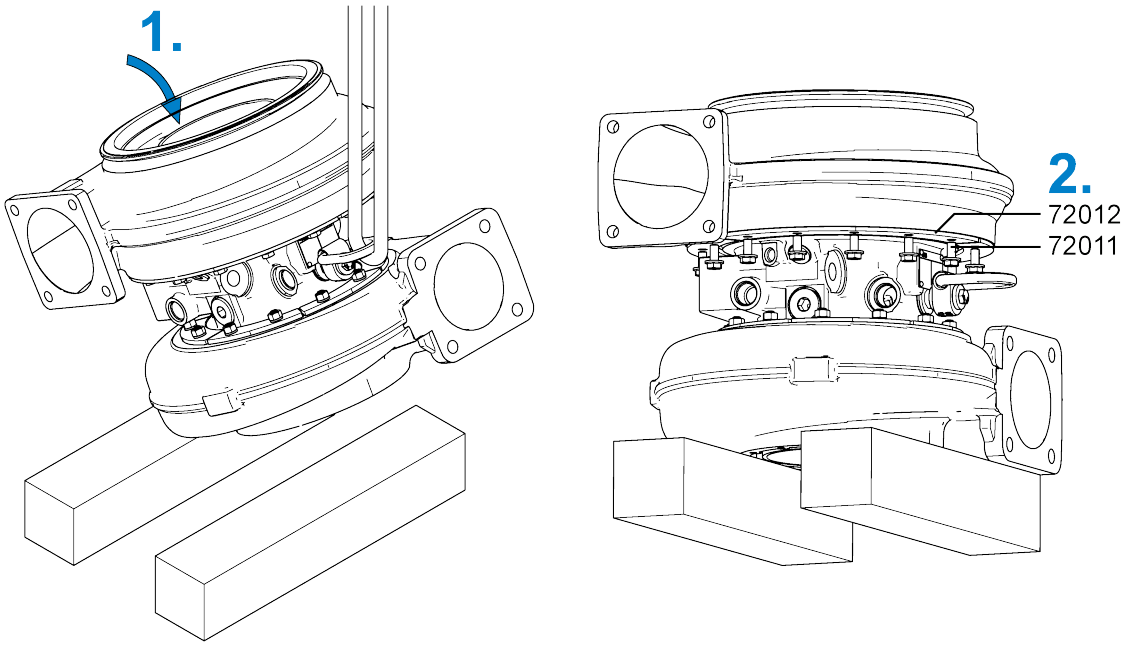


Fig. 20: Removing the compressor casing (1/2)

1. Place the turbocharger in a vertical position on a soft underlay.
2. Loosen the hexagon-head screws (72011) and remove them with fastening strips (72012).

▶ Mark the casing position for assembly.

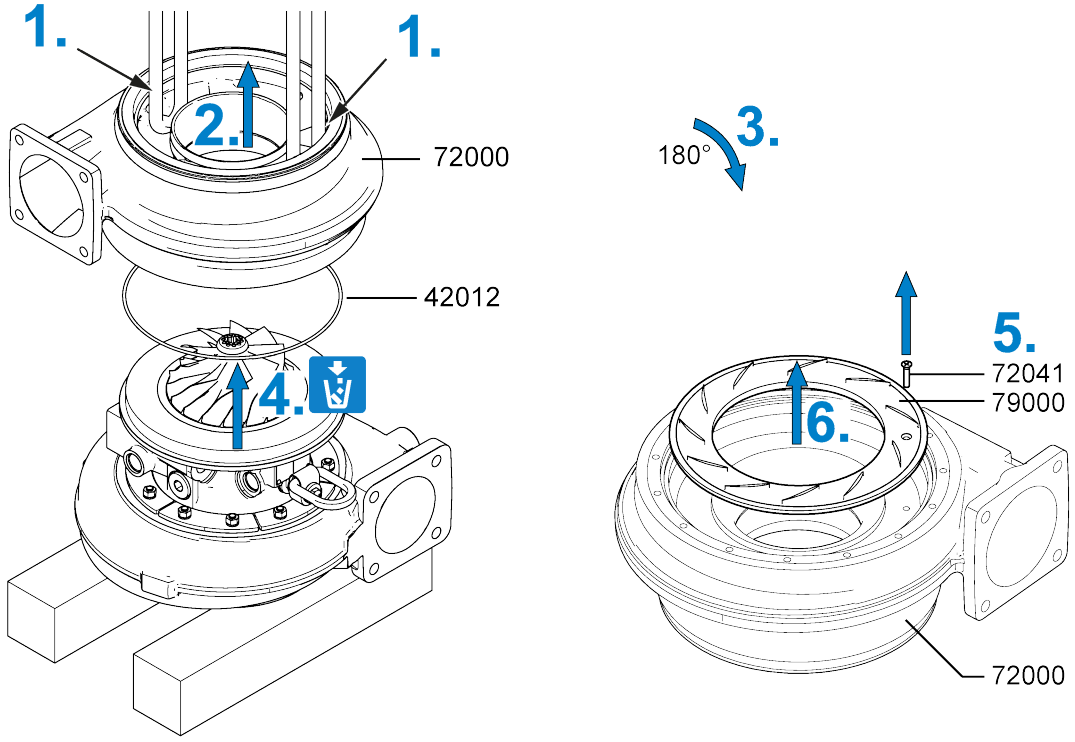
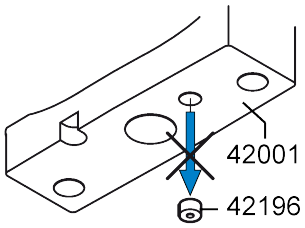


Fig. 21: Removing the compressor casing (2/2)

1. Secure lifting gear to compressor casing (72000).
2. Remove the compressor casing (72000) vertically.
3. Rotate the compressor casing (72000) through 180° and put it in place.
4. Remove and dispose of O-ring (42012) (refer to chapter Disposing of turbocharger components →74).
5. Remove screw (72041).
6. Remove the diffuser (79000) vertically from the compressor casing.

9.6 Removing the cartridge group

Do not remove oil orifice (if present)



42001	Bearing casing
42196	Oil orifice in the oil inlet

To limit the oil flow rate through the bearing casing during operation (engine under load) to the admissible values, an oil orifice is mandatory at the oil inlet of the bearing casing if the oil inlet pressure is > 3 bar (overpressure).

If an oil orifice is fitted in the oil inlet of the bearing casing, it must not be removed.

Do not loosen screw plugs

⚠ CAUTION

Oil leaks

These screw plugs must not be removed for maintenance work. If a screw plug is loosened, the gasket can be damaged. This can result in an oil leak.

- ▶ Do not loosen screw plugs.
- ▶ If any screw plugs have been loosened accidentally, have these properly fitted by an ABB Turbocharging Service Station.

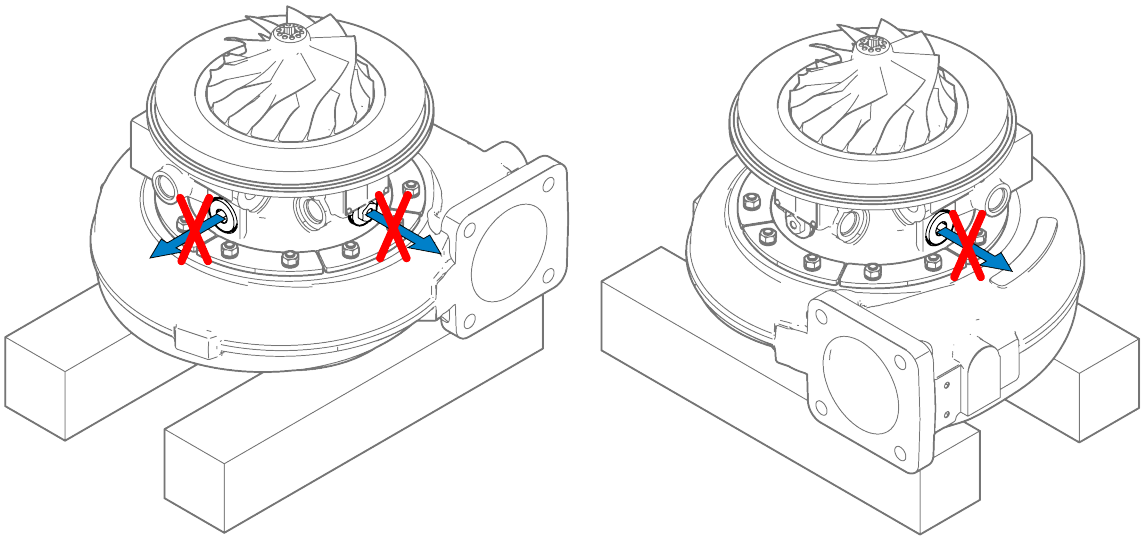


Fig. 22: Do not loosen screw plugs

Removing the turbine-end fastening strips

▶ Mark the casing position for assembly.

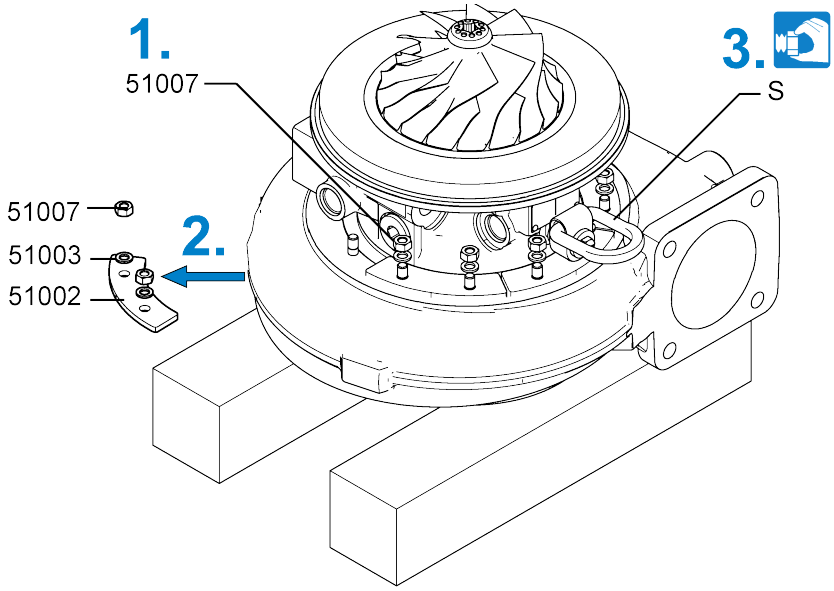


Fig. 23: Removing the cartridge group (1)

1. Loosen the hexagon nuts (51007).
2. Remove hexagon nuts (51007), Verbus Ripp®discs (51003) and fastening strips (51002).
3. Screw in the swivel lifting eye (S) up to the stop.

Removing the cartridge group

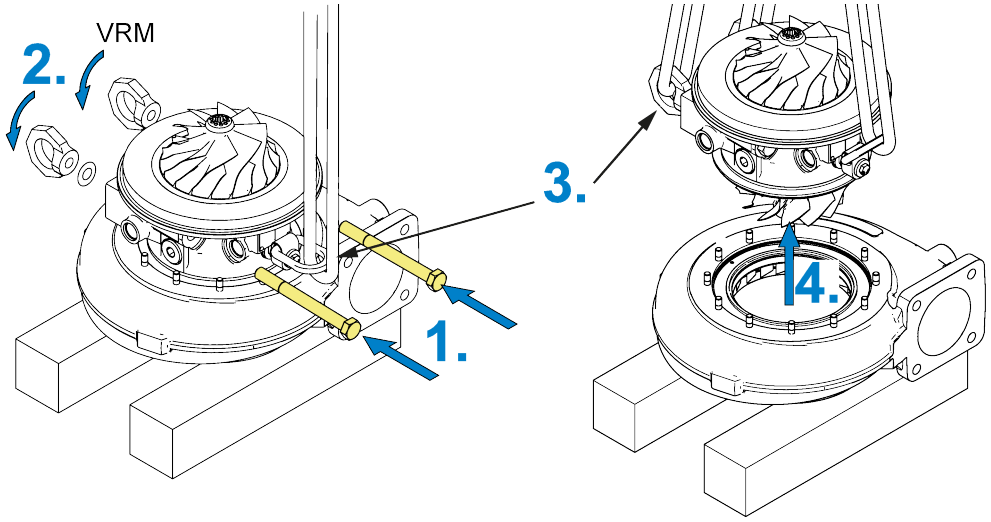


Fig. 24: Removing cartridge group 2

1. Insert screws from service support into cartridge group.
2. Secure ring nuts (VRM) onto the screws with washers.
3. Secure the lifting gear to the ring nuts and swivel lifting eye as shown.
4. Remove the cartridge group vertically from the turbine casing.

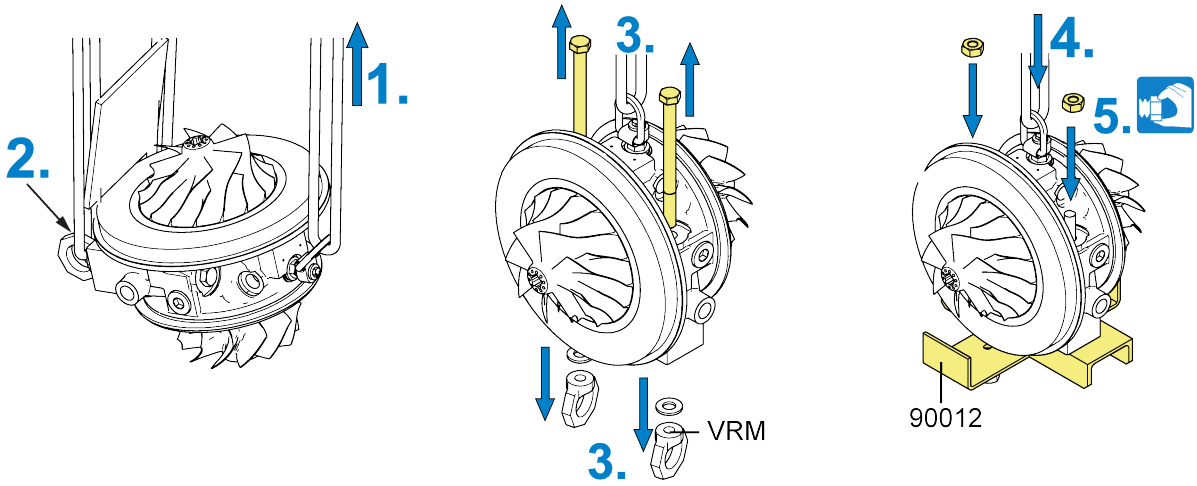


Fig. 25: Rotating the cartridge group and fitting the service support

1. Lift the cartridge group and rotate in the horizontal position.
2. Remove the lifting gear from the ring nuts.
3. Remove the ring nuts (VRM) and screws from the service support.
4. Place the cartridge group onto the fitted service support (90012).
5. Fit and hand-tighten nuts.

▶ Measure: Axial clearance A and radial clearance B →59.

9.7 Removing nozzle ring

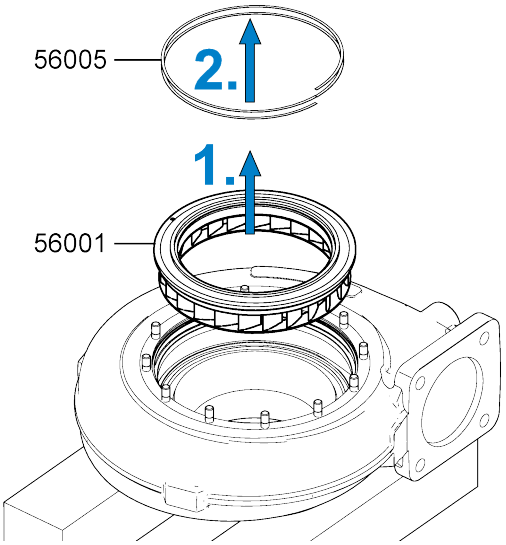


Fig. 26: Removing the nozzle ring

1. Remove the nozzle ring (56001) vertically.
2. Remove the lamellar sealing ring (56005).

9.8 Axial clearance A and radial clearance B

- ▶ Measure and record clearances A and B after the removal and before the installation of the cartridge group.
- ▶ Attach the dial indicator and align it for the respective clearance as per the illustration.

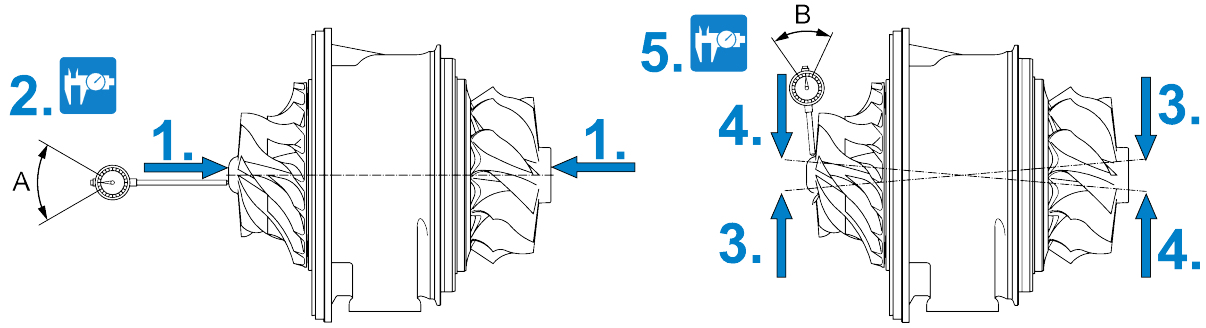


Fig. 27: Measuring clearance A and B

Product	A [mm]	B [mm]
TPS44	0.10 ... 0.18	0.69 ... 1.27
TPS48	0.11 ... 0.19	0.86 ... 1.52
TPS52	0.13 ... 0.22	0.98 ... 1.68

Table 33: Permissible clearances A and B

1. Move the rotor to and fro up to the stop. In order to obtain a correct measurement, elevate the turbine a little.
2. Measure clearance A and compare it with the permissible values in the table.
3. Raise the compressor and push the turbine down at the same time.
4. Raise the turbine and push the compressor down at the same time.
5. Measure clearance B and compare it with the permissible values in the table.

⚠ CAUTION

Clearances outside the tolerance

Serious damage to engines or property can be caused by clearances outside the tolerance and excessively worn parts.

- ▶ Have the components assessed and, if necessary, replaced by an ABB Turbocharging Service Station.

9.9 Nozzle ring compression PD

For the nozzle ring (56001) to be fixed during operation, it must be clamped between the bearing casing (42001) and the turbine casing (51000).

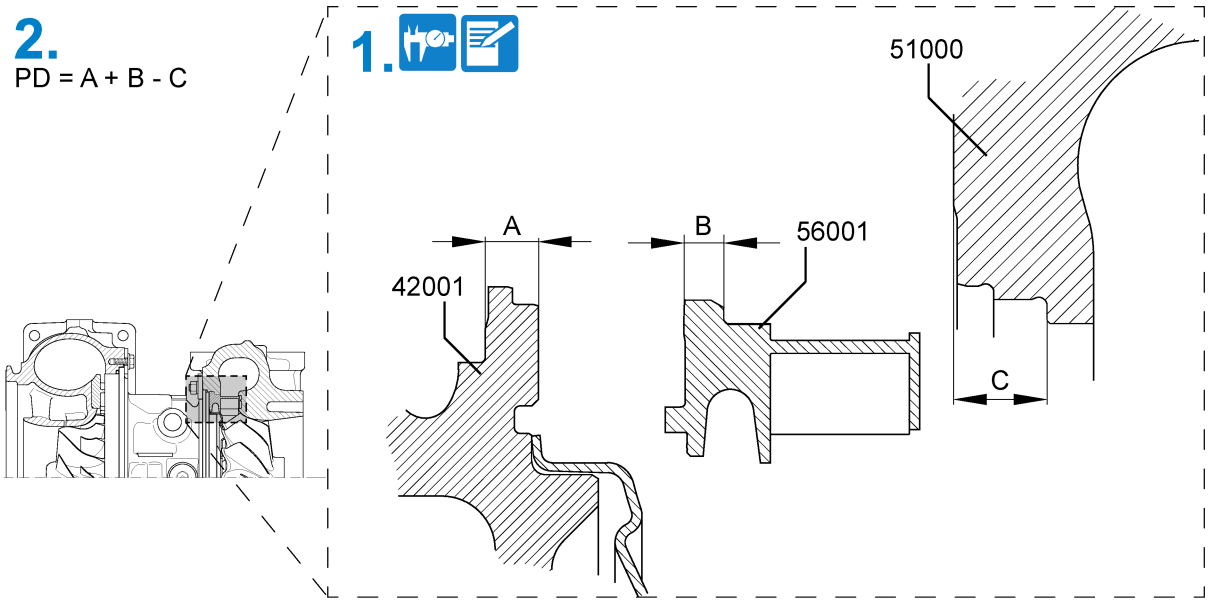


Fig. 28: Measuring nozzle ring compression

42001 Bearing casing
51000 Turbine casing
56001 Nozzle ring

1. Measure dimensions A, B, and C on cleaned surfaces.
2. Calculate the compression (PD) and compare it with the permissible values in the following table.

Product	Compression PD [mm]
TPS44	-0.23 ... 0.23
TPS48	-0.23 ... 0.23
TPS52	-0.24 ... 0.24

Table 34: Permitted nozzle ring compression PD

▶ If the calculated value (PD) lies outside the specified range, contact an ABB Turbocharging Service Station.

9.10 Fitting the diffuser

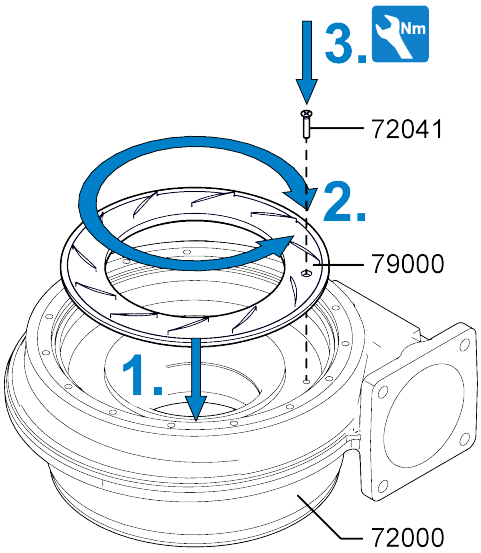


Fig. 29: Fitting the diffuser

Part number	TPS44	TPS48	TPS52
72041	M5 5 Nm	M5 5 Nm	M6 10 Nm

Table 35: Tightening torque (72041)

1. Position the diffuser (79000) in the compressor casing (72000).
2. Rotate the diffuser until its bore is aligned with the bore in the compressor casing.
3. Fit and tighten screw (72041).

9.11 Installing the cartridge group

Lifting the cartridge group and rotating it by 90°

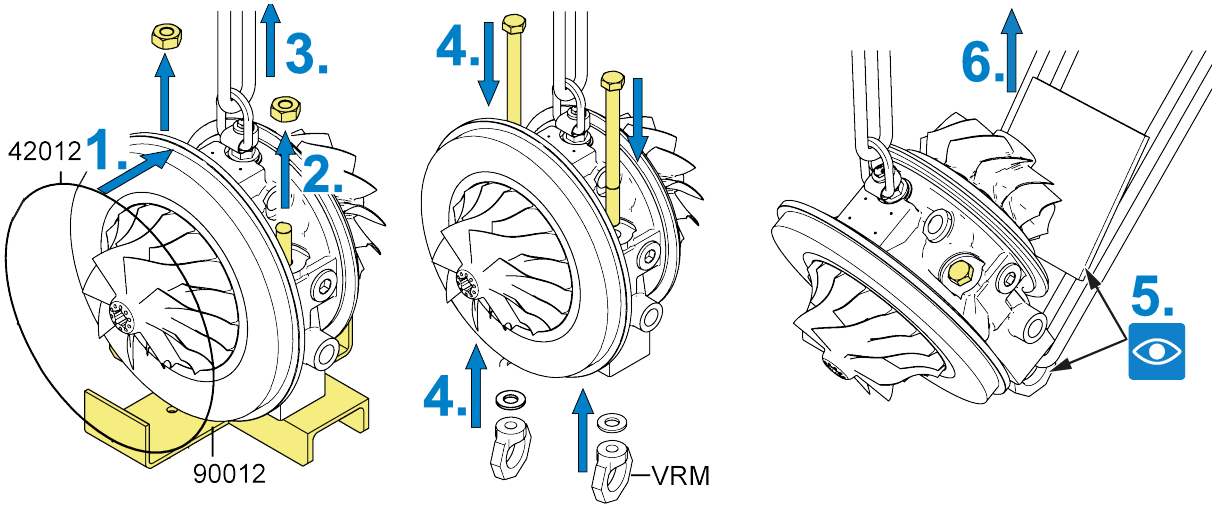


Fig. 30: Lifting the cartridge group and rotating it by 90°

1. Fit a new, high temperature-resisting O-ring (42012, red or green) (see Customer spare part set (97070) →47).
2. Loosen and remove nuts.
3. Lift the cartridge group out of the service support (90012).
4. Insert the screws of the service support from above and fit ring nuts (VRM) with washers.
5. Attach lifting gear to the ring nuts (VRM).
6. Lift cartridge group at the side of the ring nuts (VRM) and turn it into a vertical position (compressor wheel facing downwards). Use edge guard between turbines and lifting gear.

Fitting the cartridge group

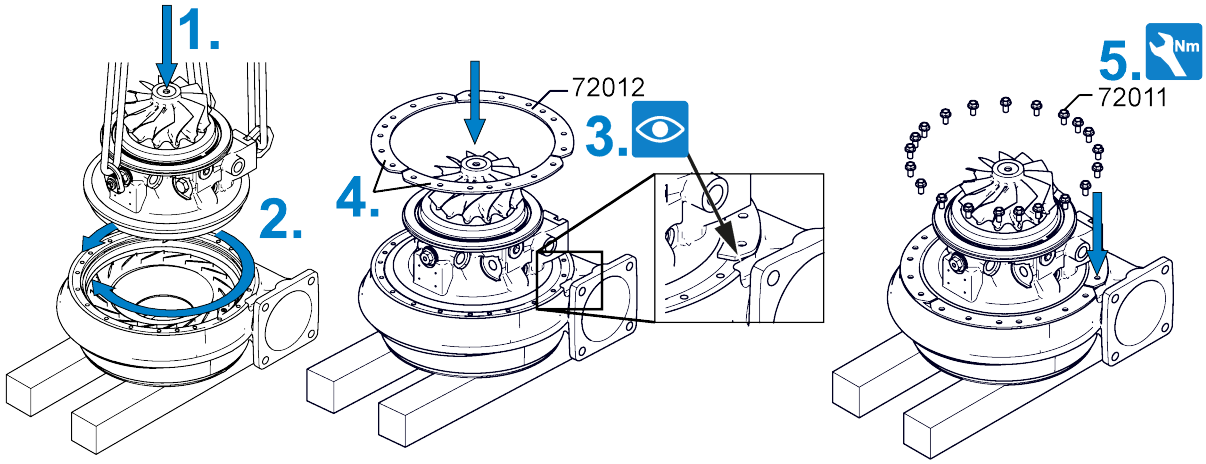


Fig. 31: Fitting the cartridge group

Part number	TPS44	TPS48	TPS52
72011	M8 40 Nm	M8 40 Nm	M10 80 Nm

Table 36: Tightening torque (72011)

1. Lower cartridge group carefully into the compressor casing.
2. Align cartridge group to the marking.
3. Place first fastening strip (72012) according to illustration.
4. Place remaining fastening strips (72012).
5. Fit and tighten hexalobular-head screws (72011).

9.12 Installing nozzle ring

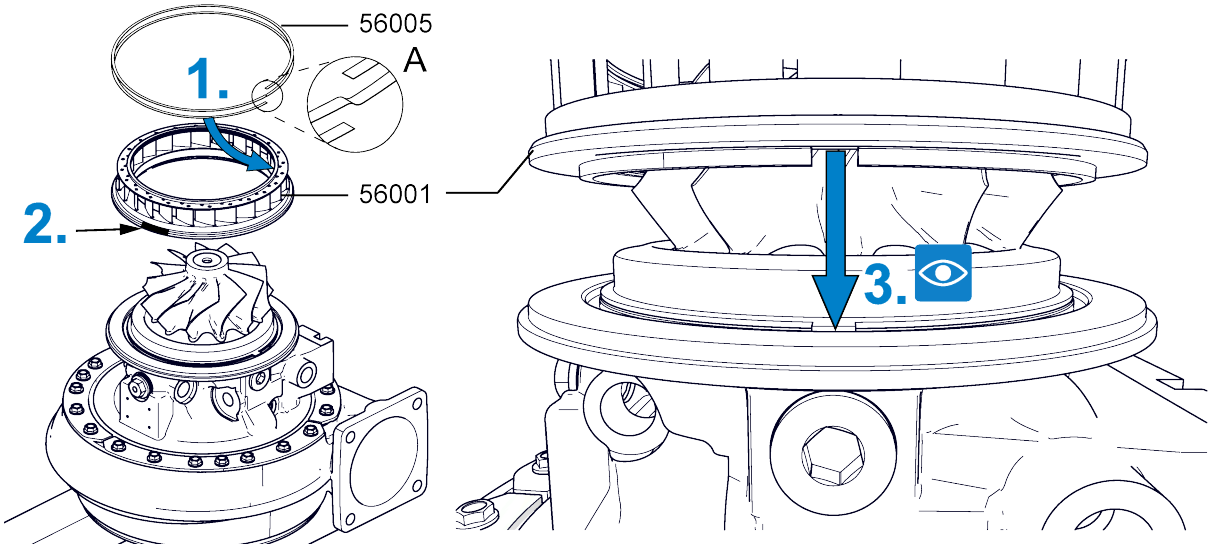


Fig. 32: Installing the nozzle ring

1. Fit lamellar sealing ring (56005) in the slot of the nozzle ring. When doing this, pay attention to correct winding of the lamellar sealing ring (see detail A).
2. Secure the lamellar sealing ring (56005) with adhesive tape.
3. Installing the nozzle ring. Ensure correct position according to illustration.

9.13 Fitting the turbine casing

Fitting the turbine casing

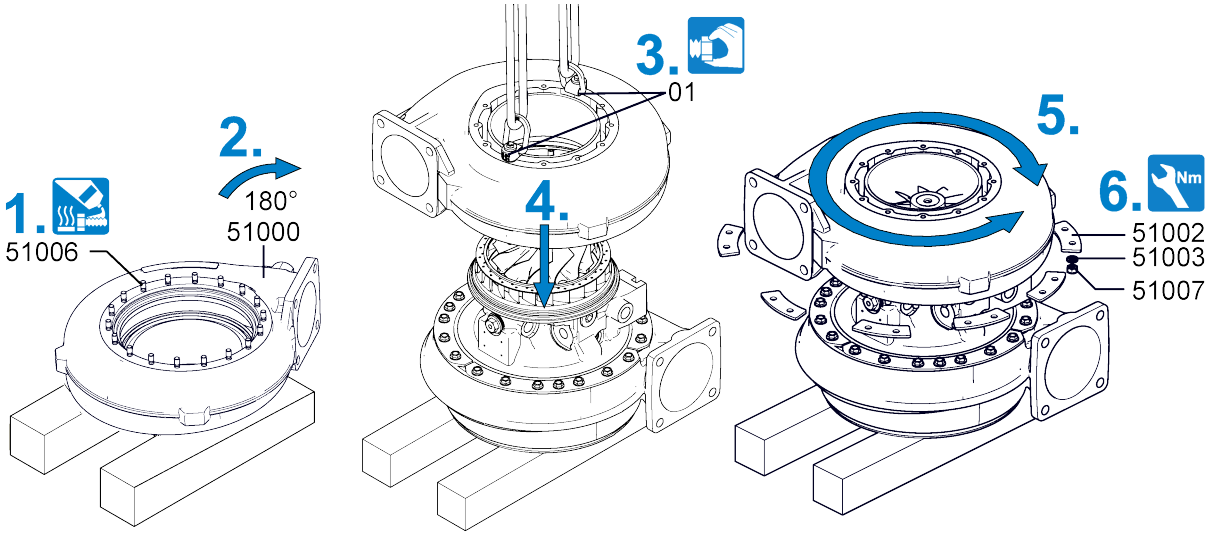


Fig. 33: Fitting the turbine casing

Part number	TPS44	TPS48	TPS52
51007	M8 30 Nm	M8 30 Nm	M10 60 Nm

Table 37: Tightening torque (51007)

1. Coat the threads of the studs (51006) with high-temperature grease.
2. Turn the turbine casing (51000) by 180°.
3. Fit two swivel lifting eyes (01) on the turbine casing. Secure lifting gear to the swivel lifting eyes.
4. Place the turbine casing onto the cartridge group.
5. Align turbine casing to the marking.
6. Install the fastening strips (51002) with Verbus Ripp® washers (51003) and hexagon nuts (51007). Observe the tightening torque.

9.14 Rotating the turbocharger

Rotating the turbocharger

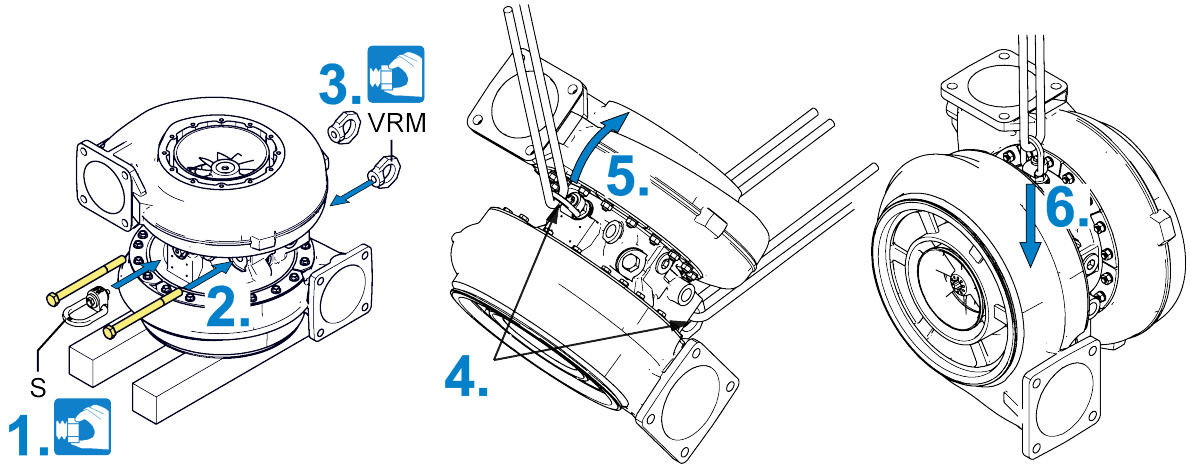


Fig. 34: Rotating the turbocharger

1. Fit swivel lifting eye (S).
2. Insert screws from the service support.
3. Fit ring nuts (VRM).
4. Attach lifting gear.
5. Elevate and rotate the turbocharger.
6. Place the turbocharger on a soft underlay.

▶ Measure: Radial clearances N and R →67.

9.15 Radial clearances N and R

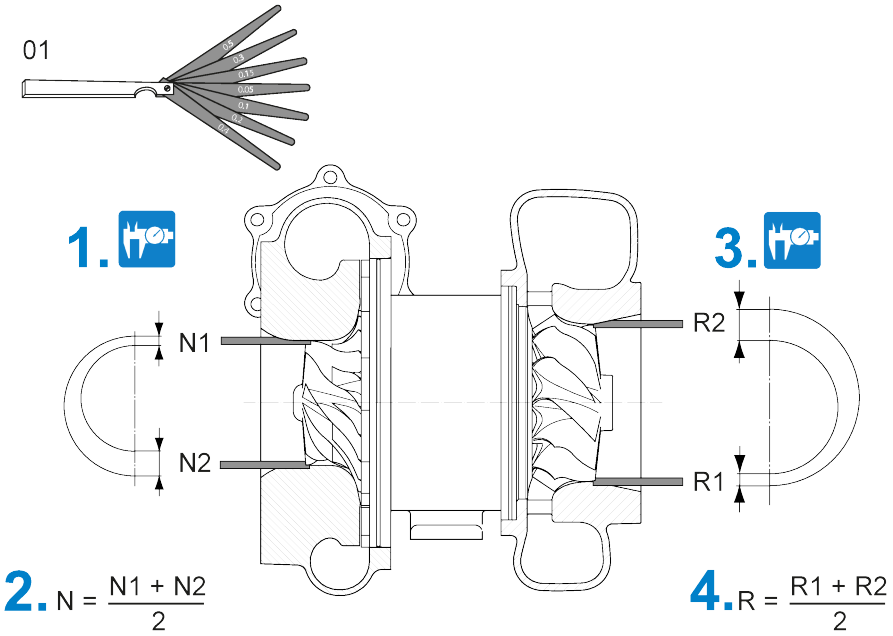


Fig. 35: Measuring clearances N and R

Product	N [mm]	R [mm]
TPS44	0.25 ... 0.50	0.40 ... 0.70
TPS48	0.30 ... 0.60	0.50 ... 0.80
TPS52	0.40 ... 0.70	0.60 ... 0.95

Table 38: Permissible clearances N and R

1. Push the feeler gauges (01) into the gap such that there is no clearance. The upper direction (N1) and lower direction (N2) must be covered simultaneously.
2. Calculate clearance N and compare it with the permissible values in the table.
3. Push the feeler gauges (01) into the gap such that there is no clearance. The upper direction (R2) and lower direction (R1) must be covered simultaneously.
4. Calculate clearance R and compare it with the permissible values in the table.

⚠ CAUTION

Clearances outside the tolerance

Serious damage to engines or property can be caused by clearances outside the tolerance and excessively worn parts.

▶ Have the components assessed and, if necessary, replaced by an ABB Turbocharging Service Station.

9.16 Installing the gas outlet casing

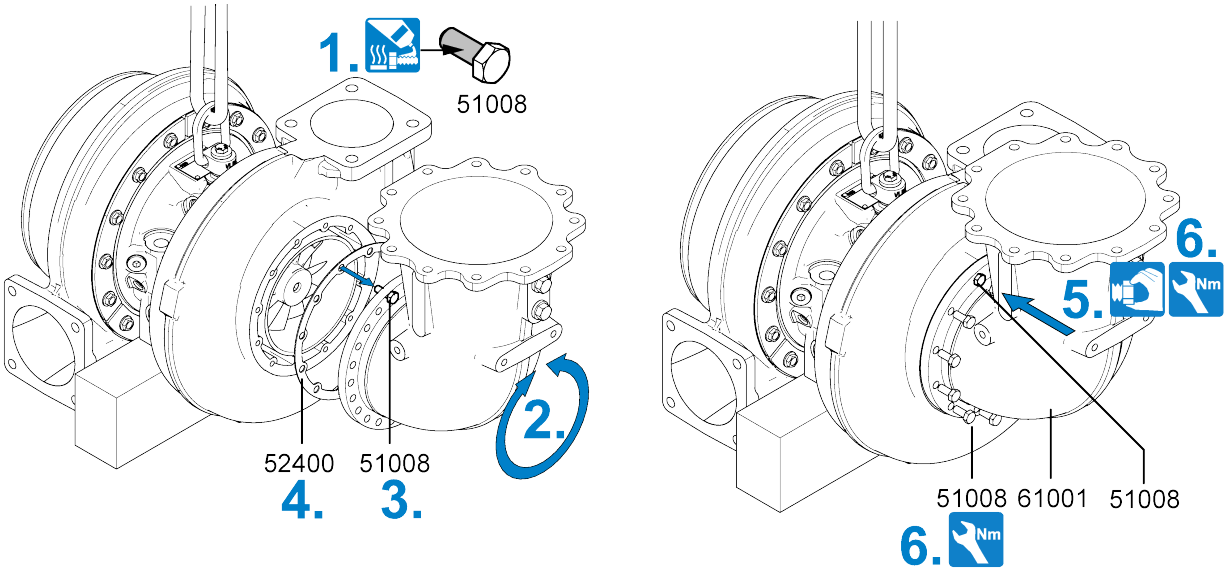


Fig. 36: Fitting the gas outlet casing

Part number	TPS44	TPS48	TPS52
51008	M8 25 Nm	M8 25 Nm	M10 50 Nm

Table 39: Tightening torque (51101)

1. Coat the threads of the hexagon-head screws or studs (51008) with high-temperature grease.
2. Align the casing position of the gas outlet casing (61001) to the marking.
3. Fit two hexagon-head screws (51008) in the upper area of the gas outlet casing.
4. Position the gasket (52400) on the threads of the hexagon-head screws (51008).
5. Install the gas outlet casing (61001) on the turbine casing with the two screws.
6. Fit the remaining screws (51008), then tighten all the screws.

9.17 Installing air inlets

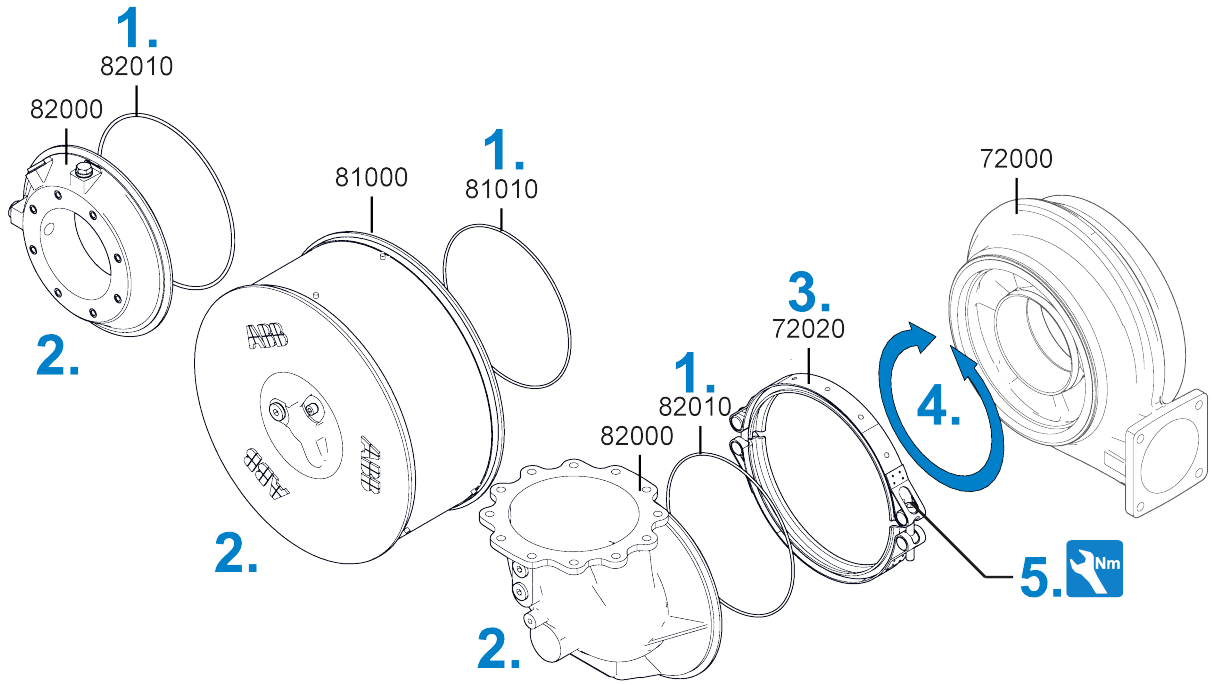


Fig. 37: Installing the air inlets

Part number	TPS44	TPS48	TPS52
72020	M10 30 Nm	M10 30 Nm	M10 30 Nm

Table 40: Tightening torque (72020)

1. Fit the new O-ring (81010 / 82010) to the filter silencer (81000) or the air suction branch (82000).
2. Manually position the filter silencer (81000) or the air suction branch (82000) on the compressor casing (72000).
3. Fit the V-clamp (72020).
4. Align the casing position of the filter silencer (81000) or the air suction branch (82000) to the marking.
5. Tighten the V-clamp (72020).

9.18 Table of tightening torques

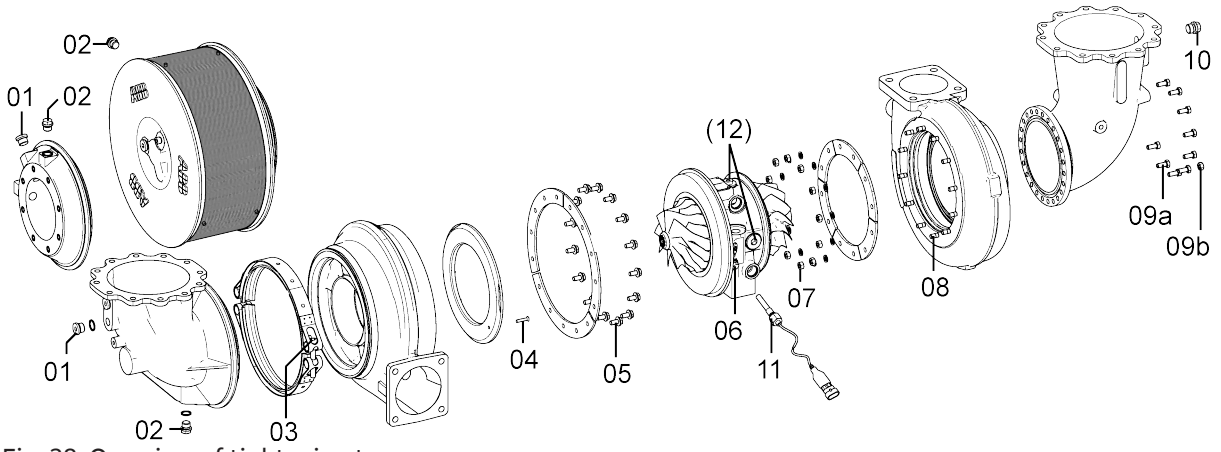


Fig. 38: Overview of tightening torques

Position	Part number	TPS44	TPS48	TPS52
01	82007	M18 x 1.5 60 Nm	M18 x 1.5 60 Nm	M18 x 1.5 60 Nm
02	82005 / 81005	M16 x 1.5 50 Nm	M16 x 1.5 50 Nm	M16 x 1.5 50 Nm
03	72020	M10 30 Nm	M10 30 Nm	M10 30 Nm
04	72041	M5 5 Nm	M5 5 Nm	M6 10 Nm
05	72011	M8 40 Nm	M8 40 Nm	M10 80 Nm
06	42188	M12 x 1.5 35 Nm	M12 x 1.5 35 Nm	M12 x 1.5 35 Nm
07	51007	M8 30 Nm	M8 30 Nm	M10 60 Nm
08	51006	M8 25 Nm	M8 25 Nm	M10 45 Nm
09a / 09b	51008 / 51009	M8 25 Nm	M8 25 Nm	M10 50 Nm
10	61005	M18 x 1.5 60 Nm	M18 x 1.5 60 Nm	M18 x 1.5 60 Nm
11	86505	M12 x 1.5 15 Nm	M12 x 1.5 15 Nm	M12 x 1.5 15 Nm
12 *)	- -	90 Nm	90 Nm	90 Nm

Table 41: Overview of tightening torques

*) These screw plugs must not be removed for maintenance work. If the screw plug is loosened, the tightness is no longer guaranteed.

10 Taking out of operation at short notice

10.1 Possible emergency repairs

⚠ WARNING

Danger of fire and explosion due to lubricating oil leaks

Leaking oil may ignite on hot surfaces. This can result in serious injuries to personnel or fatal accidents.

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

Wear safety gloves to protect against thermal hazards.

⚠ CAUTION

Directives for taking out of operation

Serious damage to engine or property can be caused by non-compliance with the directives for blanking the turbocharger off the engine.

- ▶ Follow the directives of the enginebuilder.

To enable you to quickly put an engine back into operation after a turbocharger has sustained damage, ABB Turbo Systems recommends having a replacement turbocharger or appropriate spare parts available in storage (see chapter Storage of new turbochargers and spare parts). The defective turbocharger can be removed and the replacement turbocharger installed within a short period of time.

- ▶ Remove defective turbocharger (see chapter Removing and Installing →7).
- ▶ Install replacement turbocharger (see chapter Removing and Installing →7).
- ▶ Send the defective turbocharger to an ABB Turbocharging Service Station for inspection and repair.

11 Mothballing the turbocharger

11.1 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 necessary under the following conditions:

- Acid number (TAN) < 2 mg KOH/g
- Before taking out of operation, the engine lubricating oil is replaced with a preservative oil and circulated with the pre-lubrication pump. 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 taking out of operation:

- ▶ Remove turbocharger (see chapter Removing and Installing →7).
- ▶ Dismantle turbocharger (see chapter Dismantling and fitting →46).
- ▶ The rotor and bearing parts must be dismantled and refitted by an ABB Turbocharging Service Station.

- ▶ Clean all parts.
- ▶ Coat the plain surfaces of steel and cast parts with anti-corrosive oil.
- ▶ Fit turbocharger completely.

⚠ CAUTION

Rotation of the rotor in the stack draught

The rotor can rotate in the stack draught. If the bearings are not lubricated, this can result in wear.

- ▶ Install blind flange between gas outlet casing and exhaust gas pipe.

11.2 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, subsection Rotation of the rotor in the 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.

12 Disposing of turbocharger components

⚠ WARNING

Handling damaged thermal insulation

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 dusts (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.

13 Spare parts

13.1 Spare part overview

The overview of spare parts for the TPS-H can be accessed via the following QR code and URL link.

http://search.abb.com/library/Download.aspx?DocumentID=HZTL95048&Language-Code=en&DocumentPartId=&Action=Launch

13.2 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.

Figures

Tables