# Operation Manual

## TPL65-A10

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<th>Type</th>
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<th>HT842248</th>
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<td>2016</td>
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Application according to the Operation Manual

Made in Switzerland

HZTL2482 English
Original Operation Manual
Operating condition and replacement intervals

The operational limits for the turbocharger $n_{B\text{max}}$, $t_{B\text{max}}$, $n_{M\text{max}}$, $t_{M\text{max}}$, inspection- and replacement intervals for the components concerned on the rating plate are valid for the operational mode and compressor inlet condition, which has been agreed upon between the engine builder and ABB.

**Note:** Replacement intervals of components depend on the load profile, turbine inlet temperature, suction air temperature and turbocharger speed. In case the operation conditions differs significantly from what is considered to be normal for the current application, it is recommended to contact ABB for a re-calculation of replacement intervals. Frequent load alterations, high temperatures and high speed lower the life of components. Unless otherwise agreed, the application limits $n_{M\text{max}}$, $t_{M\text{max}}$ are valid for the test operation for a limited time.
# Table of contents

1 Preliminary remarks  
1.1 Purpose of this manual  
1.2 Layout and function  
1.3 Correct use of the turbocharger  
1.4 Storage of new turbochargers and spare parts  
1.5 Essential information  
1.6 Symbols and definitions  
1.7 Turbocharger rating plate  
1.8 Contact address and after-sales service  

2 Safety  
2.1 Introduction  
2.2 CE conformity  
2.3 Definition of mandatory signs  
2.4 Definition of Safety instructions  
2.5 Warning plates on the turbocharger  
2.6 Safe operation and maintenance  
2.7 Hazards during operation and maintenance  
2.8 Periodic checking of the pressure vessel  
2.9 Lifting loads  

3 Start-up  
3.1 Oil supply  
3.2 Inspection work  
3.3 Commissioning after taking out of operation  

4 Operation  
4.1 Noise emissions  
4.2 Servicing work  
4.3 Replacement intervals for turbocharger components  
4.4 Speed measurement  
4.5 Stopping the engine  

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Table of contents

5 Maintenance
  5.1 Foreword to Maintenance
  5.2 Cleaning the filter silencer
  5.3 Cleaning the compressor during operation
  5.4 Cleaning turbine blades and nozzle ring in operation

6 Troubleshooting
  6.1 Malfunctions when starting
  6.2 Surging of the turbocharger
  6.3 Malfunctions during operation
  6.4 Malfunctions when stopping
  6.5 Speed measurement system

7 Removal and installation
  7.1 Turbocharger weights
  7.2 Remove the turbocharger
  7.3 Installing the turbocharger

8 Disassembly and assembly
  8.1 Introduction
  8.2 Module weights
  8.3 Removing and fitting filter silencer or air suction branch
  8.4 Axial clearance
  8.5 Removing cartridge group
  8.6 Dismantling and installing the turbine diffuser and nozzle ring
  8.7 Installing cartridge group
  8.8 Turbine-end removal / fitting of the nozzle ring
  8.9 Table of tightening torques

9 Taking out of operation at short notice
  9.1 Possibilities for emergency repair
  9.2 Fit cover plate
  9.3 Blocking the inlets and outlets
  9.4 Bypass the turbocharger

10 Mothballing the turbocharger
  10.1 Taking the engine out of operation for up to 12 months
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.2</td>
<td>Taking the engine out of operation for more than 12 months</td>
</tr>
<tr>
<td>11</td>
<td>Disposing of turbocharger components</td>
</tr>
<tr>
<td>12</td>
<td>Spare parts</td>
</tr>
<tr>
<td>12.1</td>
<td>Ordering spare parts</td>
</tr>
<tr>
<td>12.2</td>
<td>View of the turbocharger with part numbers</td>
</tr>
<tr>
<td>12.3</td>
<td>View of the cartridge group with part numbers</td>
</tr>
<tr>
<td>12.4</td>
<td>View of turbine cleaning system with part numbers (optional)</td>
</tr>
</tbody>
</table>
1 Preliminary remarks

1.1 Purpose of this manual

This operation manual belongs to the turbocharger with the identical HT number (1), see the cover sheet of the operation manual and the turbocharger rating plate.

Operation Manual

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

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

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

Target group

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

Availability of operation manual

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

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

1 Filter silencer
2 Radial plain bearing
3 Thrust bearing
4 Bearing bush
5 Radial plain bearing
6 Gas outlet casing
7 Gas inlet casing
8 Nozzle ring
9 Turbine wheel
10 Bearing casing
11 Diffuser
12 Compressor wheel
13 Compressor casing
Working principle

The turbocharger is a turbo-machine and consists of the following main components:

- Turbine
- Compressor

These are both mounted on a common shaft.

The exhaust gases from the diesel engine flow through the gas inlet casing (7) and nozzle ring (8) to the turbine wheel.

The turbine wheel (9) uses the energy contained in the exhaust gas to drive the compressor wheel (12), whereby the compressor draws in fresh air, and the compressed air is forced into the cylinders.

The exhaust gases escape to free air through the exhaust manifold which is connected to the gas outlet casing (6).

The air which is necessary for the operation of the diesel engine and which is compressed in the turbocharger is drawn through the suction branch or the filter silencer (1) into the compressor wheel (12). It then passes through the diffusor (11) and leaves the turbocharger through the compressor casing (13).

The rotor runs in two radial plain bearings (2/5). One plain bearing is situated in the bearing bush (4) and one plain bearing is situated in the axial thrust bearing (3) at the compressor side.

The plain bearings are connected to a central lubricating oil channel which is fed with oil from the engine lubrication circuit. The oil outlet is always at the lowest point of the bearing casing (10).
1.3 Correct use of the turbocharger

This turbocharger supplied by ABB Turbo Systems has been developed for use on diesel engines to generate the volume of air and the charging pressure required to operate the engine. The engine builder has provided ABB Turbo Systems with information regarding the intended use of the engine, from which the operating limits specific to the turbocharger shown on the rating plate (such as operating speeds, temperatures, exchange intervals / replacement intervals) have been derived.

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

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

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

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

- The machine may be operated only by trained personnel.

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

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

- Malfunctions which could affect safety must be eliminated immediately.

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

Storage of new turbochargers and spare parts up to 6 months

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

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

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

**Protection of health when handling VCIs**

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

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

Wear safety gloves against chemical risks.

The following mothballing measures are required every 6 months:

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

Storage of new turbochargers and spare parts

1.4

Long-term storage of replacement turbochargers or spare parts

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

The following measures are required every 6 months:

- Check the hygrometer (2) in the sight-glass. There is an opening (1) in the wooden crate which allows this check to be carried out. When the display field has changed colour at the 70% level, the maximum permissible humidity has been exceeded. In this case the turbocharger or rotor must be inspected by an ABB Turbocharging Service Station and repacked.

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

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

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

Replacement components ready for operation

If the 70% display field of the hygrometer (2) has not changed colour and the package is undamaged, the replacement turbocharger or replacement cartridge group can be placed into operation without any prior testing by an ABB Turbocharging Service Station.

Unpacking replacement turbochargers or spare parts

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

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

Organisational measures

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

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

NOTICE

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


NOTICE

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

NOTICE

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

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

**NOTICE**

We herewith expressly state that parts and accessories not supplied by us have also not been tested and approved by us.

**WARNING**

If components and assemblies not manufactured and tested by ABB Turbo Systems are used, this may have a negative effect on the technical design specifications of the turbocharger. Moreover, the active and/or passive safety of the turbocharger may be compromised by the use of non-original parts. Note that such improper use may endanger personnel and the machine.

- Use only original parts from ABB Turbo Systems.

ABB Turbo Systems accepts no liability whatsoever for any damage caused by the use of non-original parts and accessories.

Qualification of personnel

The turbocharger may be operated and maintained only by trained and authorized personnel.

**CAUTION**

Work on mechanical components, such as bearings or rotors, may be carried out only by trained fitters from an official ABB Turbocharging service station.
## Design variants

This operating manual is valid for various turbocharger design variants.

This means that some sections and component descriptions in this operating manual do not apply to your turbocharger.

Our service stations and agencies will gladly answer your questions relating specifically to your model.

## Accuracy of illustrations

The graphics and images shown in this manual are of a general nature and are intended to assist understanding of the work steps and instructions. Differences may exist in certain details.

## Registered Trademarks

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

The following symbols are used in the documents:

- ▶ Prerequisite
- ► Work step
  - Enumeration, first level
  - Enumeration, second level

**Definition of notes**

**Note**

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

**Definition of mandatory signs**

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

**Definition of caution / warning**

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

**ABB Turbo Systems**

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

**Official ABB Turbo Systems service stations**

In this document, official service stations are referred to as ABB Turbocharging Service Stations. They are inspected and certified regularly by ABB Turbo Systems.
1.7 Turbocharger rating plate

Operating limits
1 Turbocharger operating limits at engine overload (110%). Only when operating in the test rig unless otherwise agreed with the engine builder.
2 Turbocharger operating limits during operation

Recommended replacement intervals for turbocharger components
3 Replacement interval for plain bearings in 1000 h
4 Replacement interval for compressor in 1000 h
5 Replacement interval for turbine in 1000 h

Further information
6 Part number for customer
7 Designation of special design
8 Turbocharger weight in kg
9 Turbocharger type
10 Serial number
11 Year of turbocharger construction
1.7.1 **Explanation of the rating plate**

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

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

\( n_{M_{\text{max}}} \) and \( t_{M_{\text{max}}} \) normally apply only when running at overload (110%) during trials on the engine test bed. These limits can also be permitted during operation for special applications. Operation above \( n_{M_{\text{max}}} \) and \( t_{M_{\text{max}}} \) is not permitted. Non-observance of the recommended replacement intervals can increase the risk of unpredictable component failures.

1.7.2 **Positions of the rating plates**

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

Contact address

ABB Turbo Systems AG
Bruggerstrasse 71a
CH-5401 Baden
Switzerland
www.abb.com/turbocharging

After-sales service

Official ABB Turbo Systems Service Stations
A list of the service stations is available in the brochure "Contact Information" or online.
2 Safety

2.1 Introduction

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

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

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

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

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

2.2 CE conformity

Information

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

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

## 2.4 Definition of Safety instructions

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

### Definition of warning

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

- Warning signs must be observed at all times.

### Definition of caution

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

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

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

![Warning plate](image)

<table>
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<th>Part number</th>
<th>Size [mm]</th>
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<tr>
<td>81080</td>
<td>105 x 74</td>
<td>TPL / TPR</td>
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</table>

When uninsulated turbochargers are delivered to the engine builder, the warning plates must be subsequently attached to the insulation. This is the responsibility of the engine builder.
2.6 Safe operation and maintenance

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

Work safety and work area safety

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

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

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

Welding work

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

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

Safety during cleaning

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

- Protect the floor against unintentional penetration of detergents or solvents before starting cleaning operations.
- Wear appropriate protective clothing.
- Inspect the electric cables for abrasion and damaged areas before and after your cleaning work.
Safe operation and maintenance

Safety during disassembly, assembly, maintenance and troubleshooting

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

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

Safety when taking out of operation or mothballing

- Secure the rotor so it cannot turn. The rotor can turn on its own from the force of the stack draught.
- Clean the turbocharger before mothballing it.
- Wear appropriate protective clothing.

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2.7 Hazards during operation and maintenance

Mechanical hazards during operation

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

Risk of injury

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

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

Mechanical hazards when working on the turbocharger

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

WARNING

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

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

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

![WARNING]

**Hazards due to noise**

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

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

Wear ear protection.

---

Hazards due to hot surfaces and substances

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

![WARNING]

**Risk of burning**

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

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

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

2.7

Page 27

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

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

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

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

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

- Wear safety goggles.
- Wear safety gloves against chemical risks.
- Wear a respiratory mask to protect against gases.
Hazards during operation and maintenance

### Risk of fire, explosion

Combustible or easily ignited operating and auxiliary materials can burst into flame, or vapours from them can cause explosions.

- Observe specifications in the safety data sheets of the operating and auxiliary materials.
- Observe local legislation.
- Do not allow any exposed flame during cleaning work.
- Perform cleaning outdoors or ensure for adequate aeration and ventilation.

### Risk of environmental damage

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

- Handle operating and auxiliary materials carefully.

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

### Hazards due to insulating materials

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

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

Wear safety goggles.

Wear a respiratory mask to protect against particles.

Wear safety gloves against chemical risks.

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

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

- All work on or with electrical components may only be performed by trained specialists.
- Heed any country-specific regulations.

2.8 Periodic checking of the pressure vessel

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

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

Hazards from pressure vessels

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

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

Suspended loads

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

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

Wear safety gloves against mechanical risks.

Wear safety helmet.

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

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

3.1 Oil supply

A carefully designed oil supply, which functions under all operating conditions, is an important precondition for trouble-free operation of the turbocharger.

Lubrication of the turbocharger is normally carried out with oil from the engine oil circuit.

NOTICE

Regarding the oil supply, follow the engine manufacturer's instructions concerning selection of lubricating oil, oil change intervals, oil filtration, and oil pressure and temperature.

Oil filtration

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

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

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

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

NOTICE

Oil orifice

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

Lubricating oil temperature at the inlet

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

<table>
<thead>
<tr>
<th>Status for operation</th>
<th>Oil temperature at the inlet $T_{\text{oil,inlet}}$ [°C]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permissible</td>
<td>30 ... 95</td>
</tr>
<tr>
<td>Temporarily permissible (&lt; 1h) -&gt; alarm</td>
<td>&gt; 95</td>
</tr>
<tr>
<td>Not permissible -&gt; stop the engine</td>
<td>&gt; 100</td>
</tr>
<tr>
<td>Not permissible -&gt; Do not start the engine (before starting: preheat the oil)</td>
<td>&lt; 30</td>
</tr>
</tbody>
</table>

Lubricating oil temperature at the outlet

The oil temperature at the outlet is mainly dependant on:

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

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

<table>
<thead>
<tr>
<th>Status for operation</th>
<th>Oil temperature at the outlet $T_{\text{oil,outlet}}$ [°C]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permissible</td>
<td>≤ 145</td>
</tr>
<tr>
<td>Temporarily permissible -&gt; alarm</td>
<td>&gt; 145</td>
</tr>
<tr>
<td>Not permissible -&gt; stop the engine</td>
<td>&gt; 165</td>
</tr>
</tbody>
</table>

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

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

3.2.1 Inspection before commissioning

- Check for correct functioning.
- Inspect for damage.
- Check oil filter for cleanliness before starting up.

Dirty oil

Particles of dirt and solid matter in the oil can cause serious damage to the machine or property.
- During initial commissioning and after all service work, the complete lubricating system must be flushed thoroughly with warm oil.
- When running in the engine and all service work on the lubricating system, special running-in filters must be used.
- Check oil pressure in oil supply lines.
3.2.2 Check after start-up (engine at idling speed)

Lubricating system

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

The permissible values are listed in the section Oil supply.

Gas, air and oil lines

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

3.2.3 Check when running up engine

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

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

NOTICE

Lubricants and pastes used during assembly of the turbocharger liquefy or vaporise and might escape as an oily liquid in the first few hours after commissioning. If oily liquid continues to escape after this period, an oil leak must be suspected. The first step is to check for leakage of the oil supply to the turbocharger. If this is leaky, contact an official ABB Turbocharging service station.

3.2.4 Inspection after 100 service hours

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

If provided

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

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

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

► Start up turbocharger oil circulation system at engine end.

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

► Start up turbocharger.
4 Operation

4.1 Noise emissions

Hazards due to noise

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

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

Wear ear protection.

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

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

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

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

\(^1\) Directive 2006/42/EC, 1.7.4.2 / u / Paragraphs 5 + 7 : A-weighted emission sound pressure level
\(^2\) In the event of divergent insulation designs, the engine builder must ensure that equivalent acoustic insulating measures are taken.
Suggestion for noise insulation of the bellows

A  Compressor casing
B  Bellows
C  Charge air duct / scavenging air pipe
D  Insulation pads
E  Insulation mat (at least 15 mm)
F  Sheet-metal cover
4.2 Servicing work

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

Service intervals

Service work on the turbocharger that is neglected or carried out too late can lead to an excessive dirt build-up as well as wear and operating failures.  
► Carry out service work at specified time intervals.

Shortened service intervals

Despite observance of the service intervals, unusual loads, such as several start-stops per day, harsh environmental influencing factors or heavy installation vibration, can lead to premature machine damage.  
► A shortened service interval must be arranged with ABB Turbo Systems.

Service inspection after 5 years

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

4.2.1 Service work every 25 ... 50 hours

► Check visually for air, exhaust gas, water and oil leaks.  
► Record operating data and enter in engine logbook.  
► Clarify cause of any variances.

Unknown changes during operation

The consequences can range from an impairment to a breakdown.  
► Have unknown causes clarified by an ABB Turbocharging service station.
4.2.2 Entries in engine logbook

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

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

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

If provided

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

4.2.3 Servicing work according to the engine manufacturer's instructions

Oil filter

- Clean or replace oil filter in supply line to turbocharger when engine is not running.
4.2.4 Service work every 8000 … 12000 hours

The inspection and assessment of the rotor and the bearing parts must be carried out by an official ABB Turbocharging service station.

- Disassemble turbocharger.
- Measure clearances.
- Clean the turbine and compressor wheels and inspect for damage.
- Clean the turbine and compressor casings and inspect for any cracks and erosion or corrosion.
- Clean bearing casing and blow air through oil ports.
- Clean nozzle ring and check for cracks and erosion.
- Inspect and assess bearing parts and rotor.

4.2.5 Service work every 24000 … 36000 hours

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

- Disassemble turbocharger.
- Measure clearances.
- Clean the turbine and compressor wheels and inspect for damage.
- Clean the turbine and compressor casings and inspect for any cracks and erosion or corrosion.
- Clean bearing casing and blow air through oil ports.
- Clean nozzle ring and check for cracks and erosion.
- Inspection and assessment of the rotor
- Replace plain bearings with original parts from ABB Turbo Systems.


4.3 Replacement intervals for turbocharger components

**Rotating components**

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

**Non-rotating components**

The expected replacement intervals for non-rotating components and bearing parts greatly depend on system-specific operating conditions, see Influencing parameters.

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

**Influencing parameters**

The following parameters influence the replacement periods for turbocharger components:

**Parameters influencing bearing parts:**

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

**Parameters influencing non-rotating components exposed to exhaust gas**

- Fuel quality (Gas, MDO, HFO)
- Loading profile (thermal load changes, number of starts/stops)
- Temperature level of exhaust gas
- Turbine cleaning frequency
- Procedure for turbine cleaning

**Parameters influencing rotating components exposed to exhaust gas**

- Fuel quality (Gas, MDO, HFO)
- Turbine cleaning frequency
- Procedure for turbine cleaning
- Loading profile
### Replacement intervals for turbocharger components

**Expected replacement intervals [h]**

<table>
<thead>
<tr>
<th>Component</th>
<th>GAS / MDO</th>
<th>HFO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas inlet casing</td>
<td>50000 ... 100000</td>
<td>25000 ... 50000</td>
</tr>
<tr>
<td>Gas outlet casing</td>
<td>50000 ... 100000</td>
<td>35000 ... 100000</td>
</tr>
<tr>
<td>Nozzle ring</td>
<td>35000 ... 50000</td>
<td>25000 ... 50000</td>
</tr>
<tr>
<td>Turbine diffuser / cover ring</td>
<td>35000 ... 50000</td>
<td>25000 ... 50000</td>
</tr>
<tr>
<td>Other casings</td>
<td>100000</td>
<td>100000</td>
</tr>
<tr>
<td>Axial bearing components</td>
<td>24000 ... 36000</td>
<td>24000 ... 36000</td>
</tr>
<tr>
<td>Radial bearing components</td>
<td>24000 ... 36000</td>
<td>24000 ... 36000</td>
</tr>
<tr>
<td>Turbine blades <em>(due to wear)</em></td>
<td>-</td>
<td>≥ 12000</td>
</tr>
</tbody>
</table>

**Recommended replacement intervals [h]**

- **Rotor components**: See the data on the rating plate

---

**NOTICE**

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

---

**GAS** = Gas Engine  
**MDO** = Marine Diesel Oil  
**HFO** = Heavy Fuel Oil
4.4 Speed measurement

A speed-measuring system enables the continuous monitoring of turbocharger speed.

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

4.4.1 Speed differences with multiple turbochargers per engine

The speeds of all turbochargers on one engine differ only slightly from each other in normal operation.
The difference between the highest and the lowest turbocharger speed must not be more than 3 % relative to the speed limit $n_{B_{\text{max}}}$.

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

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

If the engine can be stopped for a short time:

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

### 4.4.2 Assembly

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

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

**Part position**

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

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

**WARNING**

Hot cable connector and hot speed sensor
Risk of burning. During operation, the cable connector and the speed sensor can reach temperatures exceeding 100 °C.

- Wear safety gloves when removing the cable connector and speed sensor.

Wear safety gloves against thermal risks.

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

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

**NOTICE**

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

- Join up cable connector and speed sensor.
- Switch on lubricating oil supply to turbocharger.

4.4.4 Failure of speed measuring system

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

**CAUTION**

Before the engine is shut down, it must be allowed to idle for about 5 to 10 minutes so that the circulating lubricating oil can take away heat from the turbocharger bearings.
5 Maintenance

5.1 Foreword to Maintenance

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

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

The cleaning points described in the following are:

- Filter silencer
- Compressor
- Turbine and nozzle ring
5.2 Cleaning the filter silencer

5.2.1 Filter silencer with tension band

Dismantling and cleaning the filter silencer

If provided

- Remove the filter strip (81265).
- Rinse the filter strip (81265) using water with detergent additive or, if it is very dirty, soak it and carefully squeeze it out. Rinse it in cold water. Avoid high mechanical stress (no jets of water).
Cleaning the filter silencer

How dirty the filter strip (81265) becomes depends on how clean the drawn-in air is. Wash or replace the filter strip as necessary or every 500 hours of operation.

- Loosen the clamping rings (81270) at the locks (81271) and remove them.
- Pull out the insert units (E), bend up the cover sheet-metal (81137 & 81138) and then take out the fleece segments (81136).
- Clean the fleece segments (81136). When cleaning the fleece segments (81136), use only a mild jet of pressurized air and a soft brush or a damp cloth. Otherwise segments may be damaged or lose their shape.

Replace very dirty fleece segments and the filter strip with original parts from ABB Turbo Systems.

Fitting the filter silencer

- Assemble the insert units (E) by putting the fleece segments (81136) into the cover sheet-metal (81137).
- Bend the cover sheet-metal (81137) back to its original shape.
- Put the insert units (E) into the slot guides in the filter silencer body (81135).

During fitting, put the lengthened cover sheet-metal (81138) over the three ribs (A).

- Fit the clamping rings (81270) and apply tension at the locks (81271).

If provided
- Fit the filter strip (81265).
5.2.2 Filter silencer and connecting rod

81265 Filter strip (if provided)  81136 Absorption segment
81269 Connecting rods  81137 Cover sheet metal
81266 Cover grid  81135 Filter silencer body
81272 Screw  81273 Lock nut

E Insert unit = absorption segment + cover sheet metal
Cleaning the filter silencer

5.2

Removing and cleaning filter silencer

If provided

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

![NOTICE]

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

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

![NOTICE]

Replace very dirty or damaged parts with original parts from ABB Turbo Systems.
Mounting filter silencer

- Assemble insert units (E) by putting fleece segments (81136) into cover sheet metal (81137).
- Bend back cover sheet metal (81137) to original shape.
- Put insert units (E) into slot guides in filter silencer body (81135).

- Uniformly lay cover sheet metal (81266) in correct position.
- Push connecting rods (81269) through clips on cover sheet metal halves (81266).

If the connecting rods (81269) are not located correctly in their recesses on the filter silencer body (81135), the cover sheet metal (81266) can turn and shift. There is then a risk of foreign matter and dirt getting into the compressor.
Join connecting rods (81269) using screws (81272). When tensioning screws (81272), ensure that connecting rods (81269) are located correctly in recesses in filter silencer body (81135). Now alternately tighten screws (81272) to following maximum torque:

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

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

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

If provided

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

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

How dirty the compressor stage (compressor wheel and diffuser) becomes, depends on how clean the drawn-in air is.

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

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

Dirty deposits on the compressor stage have a negative influence on the compressor efficiency and the charging pressure.

This results in higher exhaust temperatures and higher fuel consumption by the engine. Dirty deposits on the compressor can also increase rotor unbalance.

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

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

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

Cleaning method

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

- Wet cleaning

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

Principle of wet cleaning

To clean the compressor stage while in operation, water is injected in front of the compressor wheel from an injection pipe that is built in the filter silencer or suction branch.

The water does not act as a solvent in the process, but the deposit is removed by the mechanical impact of the drops. This is a very suitable process, provided that the build-up of deposits is not too advanced.

Corrosion and deposits when cleaning

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

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

V-engines

In the case of V-engines with several turbochargers on each engine, we recommend parallel cleaning of the compressors. This cleaning process is faster and the risk of turbocharger surging is reduced.
5.3.1 **Wet cleaning using external water-pressure vessel (XC3)**

**Operating state prerequisites for compressor cleaning with XC3**

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

- Engine load 50 … 85%
- Start cleaning cycle according to following description *Wet cleaning operation with XC3*.

**Compressor wet cleaning procedure with XC3**

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

5.3 Page 61

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

NOTICE

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

Cleaning parameters per turbocharger compressor

<table>
<thead>
<tr>
<th>Product</th>
<th>Engine load</th>
<th>Contents of water vessel [dm³]</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPL65</td>
<td>50 ... 85%</td>
<td>0.4</td>
</tr>
</tbody>
</table>
5.4 Cleaning turbine blades and nozzle ring in operation

The combustion of heavy fuel oil in diesel engines leaves dirty deposits on the turbocharger turbine blades and nozzle rings. These deposits on the turbine components are caused by the following products of combustion:

- Soot
- Molten ash
- Cinders
- Incompletely burned fuel
- Sodium vanadyl vanadate

It is therefore an advantage if fuels are used which have a low content of ash, sulphur, sodium and vanadium. The fuel, furthermore, must also be stored, prepared and handled correctly.

**NOTICE**

We recommend the use of fuels with a mass ratio of vanadium to sodium less than 3:1, so that the melting point of the sodium vanadyl vanadate is as high as possible.

The dirty deposits increase with time so that regular and proper cleaning is important to remove what has accumulated.

The charging pressure can rise somewhat if the turbine cross-section is reduced by dirty turbine components. The dirty deposits cause a drop in turbine efficiency and a rise in engine temperatures after the cylinders. This may mean that the engine output has to be reduced.

In addition, a dirty turbine results in rotor unbalance. Heavy deposits of dirt can lead to unacceptably high rotor imbalance.

Experience with turbocharger operation shows that, despite periodic cleaning while the installation is running, overhauls during which turbine and nozzle ring are cleaned mechanically cannot be dispensed with. If cleaning is carried out correctly and the cleaning system is properly sized, however, the intervals between overhauls can be extended.
Cleaning turbine blades and nozzle ring in operation

Wet cleaning interval

The interval between periodic cleaning is very dependent on the operating conditions. In general, cleaning should be carried out every 50 to 200 operating hours.

Cleaning method

When cleaning the turbine components during operation, use wet cleaning. This cleaning method has been tested and approved by ABB Turbo Systems.

Prerequisites for wet cleaning are that the engine builder approves the process and his instructions are followed.

Principle of wet cleaning

During wet cleaning using droplets of water, the water does not act as a solvent. Instead, the deposit is removed by the mechanical impact of the drops.

**Corrosion and deposits when cleaning**

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

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

**NOTICE**

Components at the turbine end are not cleaned until the engine has been started or the engine load reduced. The exhaust gas temperature must **not** exceed the value specified in the respective cleaning instructions. (See respective section Operating state prerequisites.)

**CAUTION**

Non-observance of the specified exhaust gas temperature in front of the turbine, the minimum **stabilising time** before as well as between cleaning operations and the drying time after cleaning in accordance with the pertaining cleaning instructions drastically shortens the expected service life of components.

V-engines

For V-engines with **several turbochargers** on each engine, we recommend parallel cleaning of both turbochargers. This cleaning process is faster and the risk of turbocharger surging is reduced. We recommend conducting tests to find the most suitable method.
5.4.1 **Wet cleaning turbine and nozzle ring during operation**

**Prerequisites for turbine wet cleaning**

- **Corrosion and deposits when cleaning**
  - Damage and impairment of turbocharger parts due to salt water and cooling water additives
  - **Don't use salt water for cleaning, but only clean fresh water.**

**Recommended operating state for turbine wet cleaning**

The following operating state and prerequisites have been tested and approved by ABB Turbo Systems for the cleaning process:

- The engine has just been started or the engine load has been reduced as far as possible (best cleaning is achieved at a **load level** of roughly 10 to 15%).
- As soon as the turbine inlet temperature is stable and **below 430°C**, **wait at least another 10 minutes** for the charger parts to cool down.
- Start the cleaning cycle according to following description in **Wet cleaning procedure**.

![Graph](image-url)
Cleaning turbine blades and nozzle ring in operation

Layout of cleaning pipes

1 Water supply (fresh water only)  
2 Regulating valve  
3 Manometer  
4 Air supply with 3-way valve  
5 Water pipe (stainless steel)  
G Pipes on gas inlet casing

6 Other engine  
7 Injection nozzle  
8 Drain pipe  
9 Drain cock  
10 Drain  
11 Flowmeter

Wet cleaning procedure for turbine during operation

- Meet prerequisites and operating condition requirements without fail before cleaning.
- Make sure water supply (1) is connected, turned on and guaranteed.
- Open drain pipe (8,9) if provided.
- Switch over 3-way valve (4) from scavenging air mode to water supply.

**NOTICE**
Set the required volume of water on the flow meter as shown in the table in the following chapter *Cleaning parameters*.

- After injecting required volume of water, shut off water supply again by switching over 3-way valve (4) to scavenging air mode.
- Finish injection procedure this way.
- Close drain hole (if provided) above drain pipe (8,9).
- After cleaning, wait with engine running for at least 10 minutes without changing load to allow turbocharger to dry.

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To obtain the correct water flow rate, a certain pressure in the water pipe is necessary. (See table of Cleaning Parameters). If this water pressure is too low, the water flow rate specified in the table will not be obtained. In this case, cleaning will not be so good. An improvement can be achieved by reducing the load to below 10%.

**NOTICE**

Repeating cleaning cycles immediately after each other must be avoided as this can lead to high mechanical loading and consequently to a reduction in the service life of the components.

If cleaning is unsatisfactory, the length of the process can be extended. If the injection time is extended, it must be ensured that no unacceptable volume of water collects in the gas outlet casing. To avoid this, a drainage system for the gas outlet casing must be installed and open during the cleaning process. If a drainage system is not provided, the injected volume of water can be controlled by a flow meter in the water supply. The maximum volume of water allowed in individual cases must be determined together with an ABB Turbocharging service station. The influence of the cleaning water on peripheral equipment, such as a boiler, must be clarified by the operator.

The following must be observed where drainage of the gas outlet casing is concerned:

- The exhaust gas temperature behind the turbocharger drops significantly when cleaning (by 50 to 150°C).
- Depending on the engine load, water might run out of the drain pipe. This outflow might not start for 2 or 3 minutes, or it might not occur at all.
- If the gas outlet casing is not drained, the turbocharger speed and / or the gas inlet temperature must be monitored during the cleaning process. If the load is too low, water can collect in the gas outlet casing. Signs of this are a sudden significant drop in turbocharger speed or a very strong increase in the gas inlet temperature. In such cases, cleaning must be stopped and the cleaning cycle repeated from the beginning using a lower water pressure or higher engine load.

### Wet cleaning parameters for turbine and nozzle ring

<table>
<thead>
<tr>
<th>Product</th>
<th>Maximum temperature at start of cleaning process ( T_n ) [°C]</th>
<th>Injection time ( t_i ) [min]</th>
<th>Water flow rate per turbocharger at ( p_{\text{water}} = 2 \text{ bar} ) ( M_w ) [l/min]</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPL65-A</td>
<td>430</td>
<td>10</td>
<td>13</td>
</tr>
</tbody>
</table>
6 Troubleshooting

6.1 Malfunctions when starting

Sluggish start-up

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
<td></td>
</tr>
<tr>
<td>Dirty turbocharger</td>
<td>Clean it.</td>
</tr>
<tr>
<td>Damaged bearing</td>
<td>Contact ABB Turbocharging Service Station.</td>
</tr>
<tr>
<td>Touching rotor</td>
<td></td>
</tr>
<tr>
<td>Foreign matter in turbocharger</td>
<td></td>
</tr>
</tbody>
</table>

Vibration

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

Rubbing of rotating parts

Normal behaviour, no malfunction

Turbocharger

Minor uniform wear around the periphery of rotor components, caused by slight local rubbing of adjacent components, is permissible. The compressor blades and turbine blades are then shortened somewhat. Certain tolerances must be observed to avoid a significant loss of efficiency.

- If there is any doubt about the extent of rubbing, then an ABB Turbocharging Service Station must be contacted.
- Have a dimension check carried out by an ABB Turbocharging Service Station.
6.2  Surging of the turbocharger

### Surging of the turbocharger

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine</td>
<td>Protective grating in front of the turbocharger fouled or damaged</td>
</tr>
<tr>
<td>Turbocharger</td>
<td>Filter silencer or diffuser fouled</td>
</tr>
<tr>
<td></td>
<td>Heavy dirt deposits in the turbine or in the nozzle ring</td>
</tr>
<tr>
<td>Charge-air cooler</td>
<td>Cooler fouled</td>
</tr>
<tr>
<td></td>
<td>Charge-air duct blocked</td>
</tr>
</tbody>
</table>

#### Prolonged or periodic surging

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

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

#### Sporadic surge blows

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

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

## Lubricating oil pressure too low

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine</td>
<td></td>
</tr>
<tr>
<td>Very dirty oil filter</td>
<td>Clean it.</td>
</tr>
<tr>
<td>Defective oil pump in lubricating system</td>
<td>Check / replace it.</td>
</tr>
<tr>
<td>Manometer display wrong.</td>
<td>Replace manometer.</td>
</tr>
<tr>
<td>Turbocharger</td>
<td></td>
</tr>
<tr>
<td>Rotor axial clearance too large</td>
<td>Contact ABB Turbocharging service station.</td>
</tr>
</tbody>
</table>

## Drop in speed

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine</td>
<td></td>
</tr>
<tr>
<td>Defects of connected cylinders when pulse charging</td>
<td>Contact engine builder.</td>
</tr>
<tr>
<td>Turbocharger</td>
<td></td>
</tr>
<tr>
<td>Very dirty turbine</td>
<td>Clean it.</td>
</tr>
<tr>
<td>Damaged rotor components or bearing</td>
<td>Contact ABB Turbocharging service station.</td>
</tr>
<tr>
<td>Lines</td>
<td></td>
</tr>
<tr>
<td>Defective exhaust gas lines or charge air lines, such as leaky</td>
<td>Repair them.</td>
</tr>
</tbody>
</table>

## Increase in speed

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger</td>
<td></td>
</tr>
<tr>
<td>Very dirty nozzle ring (with 4-stroke application)</td>
<td>Contact ABB Turbocharging service station.</td>
</tr>
</tbody>
</table>
## Exhaust gas temperature too high

**Engine output and engine speed unchanged**

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Engine</strong></td>
<td>Malfunctioning of injection system</td>
</tr>
<tr>
<td></td>
<td>Repair it, or contact manufacturer.</td>
</tr>
<tr>
<td><strong>Turbocharger</strong></td>
<td>Air starvation, for example filter silencer clogged with dirt</td>
</tr>
<tr>
<td></td>
<td>Clean it.</td>
</tr>
<tr>
<td></td>
<td>Dirty compressor / turbine</td>
</tr>
<tr>
<td><strong>Exhaust counterpressure too high</strong></td>
<td>Clean or repair boiler or exhaust silencer.</td>
</tr>
<tr>
<td><strong>Damaged or eroded turbine</strong></td>
<td>Contact ABB Turbocharging service station.</td>
</tr>
<tr>
<td><strong>Charge air cooler</strong></td>
<td>Dirty cooler</td>
</tr>
<tr>
<td></td>
<td>Clean it.</td>
</tr>
<tr>
<td></td>
<td>Cooling water volume too small</td>
</tr>
<tr>
<td></td>
<td>Top up water.</td>
</tr>
<tr>
<td></td>
<td>Entry temperature of cooling water too high</td>
</tr>
<tr>
<td></td>
<td>Inspect / clean cooling system.</td>
</tr>
<tr>
<td></td>
<td>Inadequate ventilation</td>
</tr>
<tr>
<td></td>
<td>Improve ventilation.</td>
</tr>
</tbody>
</table>
### Charge air pressure too low

Engine output and engine speed unchanged, air intake condition normal

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine</td>
<td></td>
</tr>
<tr>
<td>Air receiver leaky</td>
<td>Repair it.</td>
</tr>
<tr>
<td>Gas line between engine and turbine leaky</td>
<td></td>
</tr>
<tr>
<td>Maladjusted injection system</td>
<td>Correct it.</td>
</tr>
<tr>
<td>Maladjusted valve control</td>
<td></td>
</tr>
<tr>
<td>Turbocharger</td>
<td></td>
</tr>
<tr>
<td>Manometer display wrong</td>
<td>Replace manometer.</td>
</tr>
<tr>
<td>Line to manometer leaky</td>
<td>Repair it.</td>
</tr>
<tr>
<td>Dirty filter silencer, causing excessive loss of pressure</td>
<td>Clean it.</td>
</tr>
<tr>
<td>Dirty compressor / turbine</td>
<td></td>
</tr>
<tr>
<td>Damaged compressor / turbine</td>
<td>Contact ABB Turbocharging service station.</td>
</tr>
<tr>
<td>Exhaust counterpressure too high</td>
<td>Clean or repair boiler or exhaust silencer.</td>
</tr>
</tbody>
</table>

### Charge-air pressure too high

Engine performance and engine speed unchanged, suction condition normal

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine</td>
<td></td>
</tr>
<tr>
<td>Malfunction in the injection system</td>
<td>Repair or contact manufacturer</td>
</tr>
<tr>
<td>Injection misaligned</td>
<td>Set correctly</td>
</tr>
<tr>
<td>Engine performance higher than expected</td>
<td>Check engine performance</td>
</tr>
<tr>
<td>Turbocharger</td>
<td></td>
</tr>
<tr>
<td>Manometer display defective</td>
<td>Replace manometer.</td>
</tr>
</tbody>
</table>
6.4 Malfunctions when stopping

Noises during run-down

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger Dirty turbocharger</td>
<td>Clean it.</td>
</tr>
<tr>
<td>Damaged bearing</td>
<td>Contact ABB Turbocharging service station.</td>
</tr>
<tr>
<td>Touching rotor</td>
<td></td>
</tr>
<tr>
<td>Foreign matter in turbocharger</td>
<td></td>
</tr>
</tbody>
</table>

Run-down time too short

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger Dirty turbocharger</td>
<td>Clean it.</td>
</tr>
<tr>
<td>Damaged bearing</td>
<td>Contact ABB Turbocharging service station.</td>
</tr>
<tr>
<td>Touching rotor</td>
<td></td>
</tr>
<tr>
<td>Foreign matter in turbocharger</td>
<td></td>
</tr>
</tbody>
</table>
# 6.5 Speed measurement system

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

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7 Removal and installation

7.1 Turbocharger weights

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

<table>
<thead>
<tr>
<th>Weights [kg]</th>
<th>TPL65</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1230</td>
</tr>
</tbody>
</table>
7.2 Remove the turbocharger

- Disconnect all gas, air and oil lines in accordance with the engine builder’s instructions.

**NOTICE**

**Oil orifice plate**

An orifice plate is fitted in each of the two oil inlet channels in the bearing casing. In order to obtain the required oil pressure, the diameter of this orifice plate was individually adjusted by the engine builder. Whenever these orifice plates are removed, or if the bearing casing, the cartridge group or the complete turbocharger is replaced, make absolutely sure that the orifice plate with the correct diameter is fitted in the oil inlet channel in which the oil flows.

- Re-use existing orifice plate.

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

- Fasten separate lifting gear to each of the two ribs on the bearing casing provided for this purpose.
Ribs (1) not in the middle at the top:
- Completely remove the bearing casing insulation (2) and place a sling around the bearing casing.
- Loosen the fixing screws at the foot.
- Lift the turbocharger off the engine and set it down to one side.

**Beware of tilting**
If support for the turbocharger is not provided or is inadequate, the turbocharger could tip over during installation or removal and cause a serious or even fatal injury.
- Support the turbocharger at a suitable point.
- If possible secure it using lifting gear.

- Wear safety helmet.

- Cover the oil connection.
7.3 Installing the turbocharger

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

**Oil orifice plate**

An orifice plate is fitted in each of the two oil inlet channels in the bearing casing. In order to obtain the required oil pressure, the diameter of this orifice plate was individually adjusted by the engine builder. Whenever these orifice plates are removed, or if the bearing casing, the cartridge group or the complete turbocharger is replaced, make absolutely sure that the orifice plate with the correct diameter is fitted in the oil inlet channel in which the oil flows.

- Re-use existing orifice plate.

- Adapt turbocharger to suit engine.
- Tighten fixing screws in foot in accordance with engine builder's instructions.
- Fasten gas, air and oil lines in accordance with engine builder's instructions.
- Refit removed parts of insulation.
- Plug in cable connector on speed sensor.
8 Disassembly and assembly

8.1 Introduction

Further work
Further tasks, which are not described here, may be carried out only by trained personnel from an ABB Turbocharging service station. ▶ Only carry out those tasks that are described in this chapter.

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

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

Maintaining assembly devices
Assembly devices must be checked for damage before and after use. ▶ Visually check for corrosion, cracks, deformation and wear. ▶ Don't use damaged assembly devices, but replace them.

Customer spare parts set
Before beginning work, ensure that the required customer spare parts sets are available. ▶ See chapter Spare parts.
Tightening torques for turbocharger components

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

Tightening torques for assembly devices of ABB Turbo Systems

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

**Suspension loads**

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

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

Wear safety gloves against mechanical risks.

Wear safety helmet.

**Definition of terms**

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

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

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

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

<table>
<thead>
<tr>
<th>Assemblies</th>
<th>Weights [kg]</th>
</tr>
</thead>
</table>

| 1                  | Radial air suction branch | 35 |
| 2                  | Axial air suction branch | 25 |
| 3                  | Filter silencer          | 85 |
| 4                  | Compressor casing        | 150|
| 5                  | Wall insert              | 50 |
| 6                  | Diffuser                 | 22 |
| 7                  | Cartridge group          | 220|
| 8                  | Turbine diffuser         | 30 |
| 9                  | Nozzle ring              | 10 |
| 10                 | Radial gas inlet casing  | 50 |
Complete compressor casing

Weights [kg]

| TPL65 | 230 |

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

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

Installing the air suction branch
- Fit the air suction branch in reverse order.
Remove filter silencer.

- Remove insulation where necessary.
- Fit swivel lifting eye (90231) to filter silencer.
  Or
  - Pass lifting gear through rib on filter silencer.
  - Pass lifting gear through lugs at back.
- Unscrew nuts (72027) and remove them together with washers (72018).
- Remove filter silencer and set down to one side.

Installing the filter silencer

- Install filter silencer in reverse order.
8.4 Axial clearance

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

Wear safety gloves against mechanical risks.

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

- Measure and note the axial clearance (A).

<table>
<thead>
<tr>
<th>Axial clearance</th>
<th>TPL65</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clearance A [mm]</td>
<td>0.39 … 0.56</td>
</tr>
</tbody>
</table>

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

- Remove insulation.
- Disconnect oil lines in accordance with engine manufacturer's instructions.

**NOTICE**

**Oil orifice plate**

An orifice plate is fitted in each of the two oil inlet channels in the bearing casing. In order to obtain the required oil pressure, the diameter of this orifice plate was individually adjusted by the engine builder. Whenever these orifice plates are removed, or if the bearing casing, the cartridge group or the complete turbocharger is replaced, make absolutely sure that the orifice plate with the correct diameter is fitted in the oil inlet channel in which the oil flows.

- Re-use existing orifice plate.

- Remove three studs (72029) in upper area.
- Attach lifting device (90190) to compressor casing (72000), fasten to crane using lifting gear and secure.
- Unscrew nuts (61037).
- Uniformly press apart compressor casing (72000) using three press-off nuts (61090).
- Slightly lift compressor casing (72000) and pull out.
- Remove O-ring (42012).
Turn compressor casing (72000) together with wall insert and diffuser and set them down with surface (F) on underlay.

**WARNING**

**Tipping the compressor casing**

Make sure that the underlay does not slip.

- Allow compressor casing to rest only on surface (F).
- Check the underlay and adjust it if necessary.

- Remove the screw (72002).
- Remove the diffuser (79000).
- Carefully press off the wall insert (77000) using the press-off screws (90900) and remove it using the swivel lifting eye (90230).
- Remove the O-rings (77005 & 77006).
Unplug the cable connector (86515) and screw out the speed sensor (86505) complete with the O-ring (86506).

Remove the O-ring (42012).

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

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

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

**CAUTION**

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

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

Cover the oil connections.
8.6 Dismantling and installing the turbine diffuser and nozzle ring

Falling nozzle ring
The nozzle ring hangs only loosely on the positioning pins.

▸ Before removing the turbine diffuser, secure the nozzle to prevent it from falling.

▸ Before disassembling the turbine diffuser, if possible secure the nozzle ring against falling with a lashing strap and a wooden block.
Position clamp (90921) over stud (61036) until it lies flat against inner radius of gas outlet casing.

Insert extension (A) of torque spanner (B) through clamp hole and only loosen screws (61056) one after other.

Do not yet remove the screws (61056) and Verbus Ripp® washers (61057).
Disassembly and assembly

Dismantling and installing the turbine diffuser and nozzle ring

Replace two screws (61056) in the gas outlet casing with two guide studs (90320) in the upper section of the turbine diffuser (63000).

Fit clamps (90921) over the guide studs (90320) and the studs (61036).

To secure the work, screw the nuts (61037) onto the start of stud threads (61036).

Remove the remaining screws (61056) and Verbus Ripp® washers (61057).

Press the turbine diffuser (63000) free using the press-off screws (90901) and pull it out until the clamp (90921) is up against the nut (61037).

Loop the lifting gear around the turbine diffuser (63000) and secure it to a crane.

Remove nuts (61037) and clamps (90921).

Fully withdraw the turbine diffuser and remove it.

Remove the guide studs (90320).

Pull nozzle ring (56001) forward and remove.

Installing the turbine diffuser and nozzle ring

Install the nozzle ring and turbine diffuser in the reverse order of removal.

Coat the screw threads with high-temperature grease.

Align nozzle ring with holes or cams in gas inlet casing.
8.7 Installing cartridge group

**NOTICE**

**Oil orifice plate**
An orifice plate is fitted in each of the two oil inlet channels in the bearing casing. In order to obtain the required oil pressure, the diameter of this orifice plate was individually adjusted by the engine builder. Whenever these orifice plates are removed, or if the bearing casing, the cartridge group or the complete turbocharger is replaced, make absolutely sure that the orifice plate with the correct diameter is fitted in the oil inlet channel in which the oil flows.

► Re-use existing orifice plate.

- Remove the cover from the oil connection.
- Fasten separate lifting gear to each of the two ribs on the bearing casing provided for this purpose.
- Remove the supports (90450) and carefully insert the cartridge group.
- Uniformly tighten the screws (61059) together with the Verbus Ripp® washers (61058).
If there is no or insufficient clearance between the rotor turbine blades and the turbine diffuser, the blades and the turbine diffuser (casing) can be damaged.

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

- Remove the lifting gear.
- Fit the O-ring (42012).
- Screw in the speed sensor (86505) along with the O-ring (86506) and plug in the cable connector (86515).

- Fit the O-rings (77005 & 77006).
- Fit the lifting gear and the swivel lifting eye (90230).
- Align the wall insert (77000) to the threaded holes in the compressor casing (72000) using the lugs on the swivel lifting eyes, then lower it.
- Fit the diffuser (79000).
- Tighten the screw (72002) as far as it will go and then back it off ¼ turn. Do not tighten the screw; the diffuser must be able to move.
Attach lifting gear to lifting device (90190) and turn compressor casing (72000).

Fit O-ring (42012) to bearing casing.

By hand, screw on three press-off nuts (61090), equally spaced around circumference, up to ends of threads of bearing casing studs.

Push compressor casing (72000) onto cartridge group to fit snugly and fasten using nuts (61037).

Secure three press-off nuts (61090) against compressor casing (72000) by tightening to specified torque. (See chapter Table of tightening torques.)

Remove lifting device (90190).

Measure and note the axial clearance (A) (see the section on axial clearance).

**CAUTION**

Clearances out of tolerance and excessively worn components can be the cause of serious damage to machinery and property.

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

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

Fit the filter silencer or air suction branch.

Fit the insulation.
8.8 Turbine-end removal / fitting of the nozzle ring

If only the nozzle ring has to be removed, this can be done at the turbine end.

Removing nozzle ring

- Remove insulation from gas inlet casing (51001).
- Loop rope around gas inlet casing and secure with lifting gear.

When looping the securing line around the casing, make sure that no cleaning pipes are squashed or damaged. Do not fasten the lifting gear to cleaning pipes under any circumstances.

- Remove two hexagon-head screws (61044) together with Verbus Ripp® washers (61043) from the bottom section and replace them with two studs (90177).
To secure, screw hexagon nuts (90178) onto studs (90177).

Loosen and remove the remaining screws (61044) and Verbus Ripp® washers (61043) from the gas inlet casing flange (61001).

Pull gas inlet casing complete with nozzle ring just far enough away from gas outlet casing that nozzle ring (56001) can be lifted away.

Loosen the hexagon nuts (90178) on the studs.

Fully withdraw the gas inlet casing and remove it.

When setting down the gas inlet casing to one side, use suitable underlays and take care not to damage the angles of the insulation.

Remove (optional) gasket (61050).

Fitting the nozzle ring

If provided:

Insert (optional) gasket (61050) into groove in gas inlet casing (61001).

Align gas inlet casing and secure using hexagon nuts (90178) on studs (90177).

Insert nozzle ring (56001) and position it.

Brush screw threads (61044) with high temperature grease.

Fit the gas inlet casing flange to the gas outlet casing using screws (61044) and Verbus Ripp® washers (61043), then tighten it.

Remove the hexagon nuts (90178) from the studs (90177).

Replace the studs (90177) with hexagon-head screws (61044) and Verbus Ripp® washers (61043).

Remove lifting gear from gas inlet casing (51001).

Secure the insulation to the gas inlet casing (51001).
8.9 Table of tightening torques
### Table of tightening torques

<table>
<thead>
<tr>
<th>Item</th>
<th>Part number</th>
<th>TPL65</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>82005</td>
<td>M16x1.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>45</td>
</tr>
<tr>
<td>3 1)</td>
<td>72002</td>
<td>M10</td>
</tr>
<tr>
<td>4</td>
<td>72027</td>
<td>M14</td>
</tr>
<tr>
<td></td>
<td>with washer</td>
<td></td>
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<tr>
<td>5</td>
<td>61036</td>
<td>M14</td>
</tr>
<tr>
<td></td>
<td>72029</td>
<td>30</td>
</tr>
<tr>
<td>6</td>
<td>61044</td>
<td>M14</td>
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<td></td>
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<td>160</td>
</tr>
<tr>
<td></td>
<td>61059</td>
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</tr>
<tr>
<td>6b</td>
<td>61077</td>
<td>M14</td>
</tr>
<tr>
<td></td>
<td>If provided</td>
<td>20</td>
</tr>
<tr>
<td>7</td>
<td>42059</td>
<td>M12</td>
</tr>
<tr>
<td></td>
<td>42064</td>
<td>45</td>
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<tr>
<td>10</td>
<td>61037</td>
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<td></td>
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<td>75</td>
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<td>11</td>
<td>61090</td>
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<td>M18x1.5</td>
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<td></td>
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1) Tighten the screw (72002) as far as it will go and then unscrew it a ¼ turn. The screw must be loose and the diffuser must be able to move.
9 Taking out of operation at short notice

9.1 Possibilities for emergency repair

**WARNING**

Danger of fire and explosion due to lubricating oil leaks
Leaking oil may ignite on hot surfaces. This can cause severe injuries to personnel or accidents resulting in fatalities.

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

Wear safety gloves against thermal risks.

**CAUTION**

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

- Follow the directives of the enginebuilder.

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

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

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

Cover plate dimensions [mm]

<table>
<thead>
<tr>
<th>Product</th>
<th>B1</th>
<th>B2</th>
<th>B3</th>
<th>B4</th>
<th>B5</th>
<th>B6</th>
<th>B7</th>
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</thead>
<tbody>
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<td>8</td>
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<td>6</td>
<td>70</td>
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</table>

<table>
<thead>
<tr>
<th>Product</th>
<th>Ø 1</th>
<th>Ø 2</th>
<th>Ø 3</th>
<th>Ø 4</th>
<th>Ø 5</th>
<th>Ø 6</th>
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<tr>
<td>TPL65</td>
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<td>694</td>
<td>660</td>
<td>16</td>
<td>22</td>
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</table>

<table>
<thead>
<tr>
<th>Product</th>
<th>α 1</th>
<th>α 2</th>
<th>α 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPL65</td>
<td>4 x 90°</td>
<td>37.5°</td>
<td>24 x 15°</td>
</tr>
</tbody>
</table>

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Carry out the work as described in the chapter Removal and fitting.

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

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

Shut off the supply of lubricating oil to the turbocharger.

CAUTION
Further measures and information for operation with a turbocharger with cover plate on 4-stroke engines

4-stroke engine with one turbocharger
No further measures are necessary. The engine can be operated as a naturally-aspirated engine according to the engine builder's instructions.

4-stroke engine with several turbochargers

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

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

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

Shut off the lubricating oil supply to the turbocharger.

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

Notice

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

9.4 Bypass the turbocharger

Shut off the lubricating oil supply to the turbocharger.

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

Notice

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

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

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:

- If the acid number (TAN) is less than 2 mg KOH/g, no measures need to be taken.
- If the engine lubricating oil is replaced with a preservative oil and circulated with the pre-lubrication pump before the engine is taken out of operation, no measures need to be taken either. Residues of old engine oil are flushed away in this way and the bearing parts are largely protected against corrosion.

Preparations for mothballing

**Handling operating materials and supplies**

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

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

Wear safety goggles.

Wear safety gloves against mechanical risks.

Wear a respiratory mask to protect against gases.

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

- Dismantle the turbocharger
Mothballing the turbocharger

Taking the engine out of operation for up to 12 months

- The rotor and bearing parts must be dismantled and subsequently refitted by an ABB Turbocharging Service Station
- Clean all parts
- Coat plain surfaces of steel and cast parts with anticorrosive oil
- Fit turbocharger completely.

Rotation of the rotor in the stack draught

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

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

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

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

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

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

If the complete turbocharger is removed, or if the turbocharger is refitted from its individual components:

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

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

Condition of the mothballed turbocharger

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

**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 for dust (P1 or P2 mask)
- Wear work gloves made of leather
- Wear safety goggles

Wear safety goggles.

Wear a respiratory mask to protect against particles.

Wear safety gloves against mechanical risks.

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

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

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

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

12.1 Ordering spare parts

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

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

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

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

Storage of spare parts

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

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

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

Required customer spare parts set (97070)

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Hexagon-head screw</td>
<td>42059 / 42064</td>
</tr>
<tr>
<td>2</td>
<td>Verbus Ripp® Washer</td>
<td>42058 / 42063</td>
</tr>
<tr>
<td>15</td>
<td>Hexagon-head screw</td>
<td>61044 / 61056 / 61059</td>
</tr>
<tr>
<td>15</td>
<td>Verbus Ripp® Washer</td>
<td>61043 / 61057 / 61058</td>
</tr>
<tr>
<td>3</td>
<td>Hexagon nut</td>
<td>61037</td>
</tr>
<tr>
<td>1</td>
<td>Gasket</td>
<td>42041</td>
</tr>
<tr>
<td>1</td>
<td>Gasket</td>
<td>42045</td>
</tr>
<tr>
<td>1</td>
<td>O-ring</td>
<td>42012</td>
</tr>
<tr>
<td>2</td>
<td>O-ring</td>
<td>77005 / 77006</td>
</tr>
<tr>
<td>1</td>
<td>O-ring</td>
<td>86506</td>
</tr>
</tbody>
</table>
Spare parts set (97078) for turbine cleaning system (if provided)

**Leaks**
Improper assembly of the cleaning pipe and the nozzles can lead to leaks and failure of the turbine cleaning system.

- Work on turbine cleaning system should be carried out only by an ABB Turbocharging service station.

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Locking plate</td>
<td>51255</td>
</tr>
<tr>
<td>3</td>
<td>Nozzle</td>
<td>52208</td>
</tr>
<tr>
<td>6</td>
<td>Sleeve</td>
<td>52212</td>
</tr>
<tr>
<td>6</td>
<td>Strain bolt</td>
<td>52217</td>
</tr>
<tr>
<td>6</td>
<td>Nut</td>
<td>52218</td>
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12.2 View of the turbocharger with part numbers
### Part number

<table>
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<tr>
<th>Part number</th>
<th>Description</th>
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<tbody>
<tr>
<td>51001</td>
<td>Gas inlet casing</td>
</tr>
<tr>
<td>56001</td>
<td>Nozzle ring</td>
</tr>
<tr>
<td>61001</td>
<td>Gas outlet casing</td>
</tr>
<tr>
<td>61036</td>
<td>Stud</td>
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<tr>
<td>61043</td>
<td>Verbus Ripp® Washer</td>
</tr>
<tr>
<td>61044</td>
<td>Hexagon-head screw</td>
</tr>
<tr>
<td>61056</td>
<td>Hexagon-head screw</td>
</tr>
<tr>
<td>61057</td>
<td>Verbus Ripp® Washer</td>
</tr>
<tr>
<td>61058</td>
<td>Verbus Ripp® Washer</td>
</tr>
<tr>
<td>61059</td>
<td>Hexagon-head screw</td>
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<td>61037</td>
<td>Hexagon nut</td>
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<tr>
<td>61076 (if provided)</td>
<td>Centering bolt</td>
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<tr>
<td>61077 (if provided)</td>
<td>Hexagon nut</td>
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<tr>
<td>63000</td>
<td>Turbine diffuser</td>
</tr>
<tr>
<td>68000</td>
<td>Foot</td>
</tr>
<tr>
<td>72000</td>
<td>Compressor casing</td>
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<td>72018</td>
<td>Washer</td>
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<tr>
<td>72029</td>
<td>Stud</td>
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<td>72027</td>
<td>Hexagon nut</td>
</tr>
<tr>
<td>77000</td>
<td>Wall insert</td>
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<tr>
<td>77005 (in customer spare part set)</td>
<td>O-ring</td>
</tr>
<tr>
<td>77006 (in customer spare part set)</td>
<td>O-ring</td>
</tr>
<tr>
<td>79000</td>
<td>Diffuser</td>
</tr>
<tr>
<td>81000</td>
<td>Filter silencer</td>
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<tr>
<td>82000</td>
<td>Radial air suction branch</td>
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<tr>
<td>82000</td>
<td>Axial air suction branch</td>
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12.3 View of the cartridge group with part numbers
<table>
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<tr>
<td>32001</td>
<td>Thrust bearing</td>
</tr>
<tr>
<td>32101</td>
<td>Radial bearing at compressor end</td>
</tr>
<tr>
<td>32102</td>
<td>Radial bearing at turbine end</td>
</tr>
<tr>
<td>32104</td>
<td>Auxiliary bearing</td>
</tr>
<tr>
<td>32105</td>
<td>Floating disc</td>
</tr>
<tr>
<td>32106</td>
<td>Axial bearing</td>
</tr>
<tr>
<td>32107</td>
<td>Bearing bush</td>
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<tr>
<td>42001</td>
<td>Bearing casing</td>
</tr>
<tr>
<td>42002</td>
<td>Hood</td>
</tr>
<tr>
<td>42011</td>
<td>O-ring</td>
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<tr>
<td>42012</td>
<td>O-ring (in customer spare part set)</td>
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<td>Gasket</td>
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12.4 View of turbine cleaning system with part numbers (optional)

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<tr>
<td>51229</td>
<td>Cleaning pipe</td>
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<tr>
<td>52249</td>
<td>Holder complete</td>
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<td>51255 (in spare parts set)</td>
<td>Locking plate</td>
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<tr>
<td>52208 (in spare parts set)</td>
<td>Nozzle</td>
</tr>
<tr>
<td>52212 (in spare parts set)</td>
<td>Bush</td>
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<tr>
<td>52213 (in spare parts set)</td>
<td>Locking plate</td>
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<td>52218 (in spare parts set)</td>
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