# Operation Manual
## Power2 340-H44

505998_1247685_A English
Original Operation Manual

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<th>Document-ID</th>
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ABB Turbocharging
Operating limits and replacement intervals

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

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

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1 Introduction

1.1 Purpose of the manual

Operation Manual
The Operation Manual explains the two-stage turbocharging (Power2) from ABB Turbo Systems and contains instructions for safe operation.

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

Target group
The Operation Manual is aimed at engineers and trained mechanics responsible for the proper operation of the engine and for the Power2 connected to it.

Availability of the Operation Manual
The Operation Manual must be available where the Power2 is used.

All persons operating or working on the Power2 must have read and fully understood the Operation Manual.

1.2 Symbols, definitions

Symbols
The following symbols are used in this document:

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

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

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

Terms used
The following terms are used in this document:
- Two-stage turbocharging (Power2)
- Low-pressure stage (Power2 LP)
- High-pressure stage (Power2 HP)
- Low-pressure and high-pressure stage

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

Official service stations of ABB Turbo Systems
Official service stations are identified in this document as ABB Turbocharging Service Stations. They are regularly audited and certified by ABB Turbo Systems. Also see chapter Contact information →8.
Definition of pictograms

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

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

Table 1: Definition of pictograms

1.3 Registered trademarks

The trademarks of outside companies are used in this document. These are marked with the ® symbol.
1.4 Power2 layout and function

The diagram shows the position of the low-pressure (Power2 LP) and high-pressure stage (Power2 HP) within two-stage turbocharging (Power2). The low-pressure stage is always operated in combination with a high-pressure stage connected in series. The two-stage turbocharging (Power2) supplies the engine with the air volume and associated charging pressure required for operation.

Here, the exhaust gases of the internal combustion engine flow through the turbine (22) of the high-pressure stage and then to the turbine (24) of the low-pressure stage. The compressor (25) of the low-pressure stage sucks in fresh air or the air/gas mixture, respectively. This precompressed air or air/gas mixture flows through the intercooler (26) into the compressor (21) of the high-pressure stage. Here the air or air/gas mixture is compressed further and leaves the two-stage turbocharging (Power2) in the direction of the charge air cooler.
1.5 Storage of new low-pressure and high-pressure stages

Storage of new low-pressure and high-pressure stages and cartridge groups for up to 6 months

New low-pressure and high-pressure stages and cartridge groups from ABB Turbo Systems can be stored in their closed packages for 6 months from the date of delivery without additional mothballing measures (indicated by VCI label on package).

Fig. 2: Volatile Corrosion Inhibitor (VCI)

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

Storage of new low-pressure and high-pressure stages and cartridge groups for more than 6 months (VCI)

**WARNING**

Health protection when handling VCI

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

- Ensure proper space ventilation.
- Do not eat, drink or store food at the workplace while working with VCI.
- Wear safety gloves.
- Clean hands and face after working with VCI.
- For more information, see www.branopac.com.

Every 6 months, the following mothballing measures are required:

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

ABB Turbo Systems will prepare low-pressure and high-pressure stages or cartridge groups for long-term storage if requested in the purchase order. The package is equipped with a hygrometer (see illustration).

![Package with hygrometer](image)

**Fig. 3: Package with hygrometer**

Every 6 months, the following measures are required:

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

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

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

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

Replacement components which are ready for operation

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

Contact information for the ABB Turbocharging Service Stations is available online.

Scan the QR code to access our website.

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

www.abb.com/turbocharging
Safety

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1 Safety

1.1 Introduction

The two-stage turbocharging system (Power2) manufactured by ABB Turbo Systems is state of the art and complies with the respective health and safety standards in effect at the time the system was built. Thus Power2 is safe to operate. Nevertheless, there may be some residual risks during operation of the Power2 and work on Power2 components, such as low-pressure stage and high-pressure stage, which:

- Are caused by Power2 itself or its accessories.
- Are caused by the operating equipment used or supplies and materials.
- Are a consequence of insufficient compliance with safety instructions.
- Are a consequence of insufficient or inappropriate performance of maintenance and inspection work.

The operating company is responsible for defining measures that regulate safe access to and safe handling of the Power2.

All instructions contained in this chapter must be observed for safe and trouble-free operation of the Power2 and during all work on the Power2 components.

All further safety instructions contained and specifically identified in every chapter of this document (see section Definition of safety instructions) must also be observed.

1.2 CE conformity

Information

Low-pressure and high-pressure stages from ABB Turbo Systems comply with the Machinery Directive 2006/42/EC and are partly completed machinery as defined by Article 2 g.
# 1.3 Definition of mandatory signs

<table>
<thead>
<tr>
<th>To be worn at all times</th>
<th>Safety footwear to protect against mechanical hazard and risk of falling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protective clothing</td>
<td></td>
</tr>
<tr>
<td>Safety footwear</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>To be worn specific to the respective task</th>
<th>Safety goggles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety glasses</td>
<td>Safety goggles</td>
</tr>
<tr>
<td>Safety goggles to protect against</td>
<td>Safety goggles</td>
</tr>
<tr>
<td>- Mechanical hazard</td>
<td>Safety goggles</td>
</tr>
<tr>
<td>- Chemical hazard</td>
<td>Safety goggles</td>
</tr>
<tr>
<td>- Thermal hazard</td>
<td>Safety goggles</td>
</tr>
<tr>
<td>- Electrical hazard</td>
<td>Safety goggles</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>To be worn specific to the respective task</th>
<th>Respiratory mask to protect against</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety helmet</td>
<td>Respiratory mask to protect against</td>
</tr>
<tr>
<td>Ear protection</td>
<td>Respiratory mask to protect against</td>
</tr>
<tr>
<td>- Dusts</td>
<td>Respiratory mask to protect against</td>
</tr>
<tr>
<td>- Gases</td>
<td>Respiratory mask to protect against</td>
</tr>
</tbody>
</table>

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

# 1.4 Definition of safety instructions

⚠️ **WARNING**

Definition of Warning

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

> Warning signs must always be observed.

⚠️ **CAUTION**

Definition of Caution

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

> Caution signs must always be observed.
1.5 Intended use

Use on internal combustion engines

Power2 from ABB Turbo Systems is intended for charging internal combustion engines.

To ensure compliance with the machinery directive 2006/42/EC when using on gas engines, the Power2 must be operated in an engine room classified as "not at risk of explosion". This is in accordance with the position paper [2] relating to ATEX issued by EUROMOT [1].

For use on pre-mix gas engines with ignitable propellants in the gas control system, the enginebuilder must implement appropriate safety measures for explosion protection [3] (such as flame barriers in the inlet system, for example) to assure that the transient pressure increase upstream of low-pressure and high-pressure stages does not exceed the following values in the event of deflagration.

| Transient pressure increase with Power2 LP to $P_{\text{max}}$: | $\leq 12$ bar |
| Transient pressure increase with Power2 HP to $P_{\text{max}}$: | $\leq 15$ bar |

Table 3: Transient pressure increase in the event of deflagration

The specific operating limits of Power2 were determined on the basis of information from the enginebuilder about the intended use. This data is given on the rating plate and is generally different for the low-pressure stage and high-pressure stage.

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

[1] Euromot = The European Association of Internal Combustion Engine Manufacturers

**WARNING**

Unapproved operation

Operation of the Power2 outside of the operating limits can be hazardous to personnel.

- Power2 must only be operated within the operating limits.
- Power2 must only be operated by trained personnel.

The intended use of the Power2 includes compliance with all regulations and conditions. In particular, the following must be observed:

- The Operation Manual
- The instructions of the enginebuilder

State of the art

The Power2 is designed and built according to the state of the art and is safe to operate.
Perfect condition

The Power2 must be used in a technically perfect condition and in compliance with its intended use.

ABB Turbo Systems excludes any liability for damage resulting from unauthorized modifications to the Power2 or improper operation.

1.6 Deflagration on gas engines

Low-pressure stages from ABB Turbo Systems can tolerate a deflagration with a transient pressure increase of 12 bar (guideline value).

High-pressure stages from ABB Turbo Systems can tolerate a deflagration with a transient pressure increase of 15 bar (guideline value).

After a deflagration event ABB Turbo Systems recommends verifying the following points on the low-pressure and high-pressure stages:

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

If during external inspection anomalies are found or if a particularly strong deflagration event has taken place, it is also recommended to check the bearings of the low-pressure and high-pressure stages before the next start. This inspection and evaluation must be carried out by an ABB Turbocharging Service Station.
1.7 Warning plates on the low-pressure and high-pressure stage

Warning plates are attached to the low-pressure and high-pressure stage, and must be complied with. The warning plates must always be present in the intended locations and must be legible.

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

Low-pressure and high-pressure stages supplied to the enginebuilder without insulation must be retrofitted with warning plates to be affixed to the insulation. This is the responsibility of the enginebuilder.
1.8 Rating plate of the high-pressure and low-pressure stage

Fig. 2: Rating plate

Operating limits
1 Operating limits at engine overload (110 %). In test rig operation only, unless otherwise agreed with the enginebuilder.
2 Operating limits during operation

Table 4

Recommended inspection and replacement intervals
3 Inspection interval of plain bearings in 1000 h
4 Replacement interval of compressor in 1000 h
5 Replacement interval of turbine in 1000 h

Table 5

Further data
6 Power2 designation
7 Power2 serial number
8 Power2 stage
9 Serial number of the low or high-pressure stage
10 Year of construction of the low or high-pressure stage
11 Weight of the low or high-pressure stage
12 Part number of the customer of the low or high-pressure stage

Table 6
Explanations of the rating plate

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

The operating limits of the low-pressure stage are generally different from the operating limits of the high-pressure stage.

Operation above the indicated values $n_{B_{\text{max}}}, t_{B_{\text{max}}}$ can considerably shorten the recommended replacement intervals. In such cases ABB recommends contacting the nearest ABB Turbocharging Service Station.

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

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

Locations of the rating plates

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

1.9 Periodic check of the pressure vessels

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

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

⚠️ WARNING

Danger due to pressure vessels

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

- Pressure equipment must not be operated if defects are present.
1.10 Lifting of loads

**WARNING**

**Suspended loads**

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

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

Wear safety gloves to protect against mechanical hazards.

Wear safety helmet.

![Fig. 3: Attachment of loads on the crane hook](image)

![Fig. 4: Attachment angle](image)

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

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

Responsibility of the operating company

In awareness of its responsibility, the operating company must ensure that only authorised personnel work on the Power2, who:

- Are versed in the general and locally applicable regulations for occupational safety and accident prevention
- Are equipped with the prescribed personal protective equipment
- Have read and understood the Operation Manual
- Have been instructed in the use of the Power2.

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

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

Only authorised personnel may remain in the vicinity of the Power2 when the engine is running.

Competence of personnel

The Power2 may only be operated and serviced by trained and authorised personnel. Basic mechanical training is a prerequisite.

Modifications to the Power2

Modifications to the Power2 must be approved by ABB Turbo Systems.

Original parts and safety

Original parts and accessories must be specially designed by ABB Turbo Systems for the ABB Power2.

![WARNING]

Use original parts

Operation of the Power2 with non-original parts can impair the safety of the Power2 and can cause serious damage to property and injury to personnel.

- Only use original parts from ABB Turbo Systems.

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

Noise hazards

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

**WARNING**

Noise hazards

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

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

Wear ear protection.

Hazards due to hot surfaces

Surfaces of the low-pressure and high-pressure stage, attached parts and operating fluids (lubricating oil) get hot during operation. The surface temperature depends on the efficacy of the existing insulation. The temperature may rise to a level that can cause burns.

**WARNING**

Danger of burns

Touching hot surfaces or contact with hot operating fluids can cause severe burns.

- Do not touch hot surfaces. Observe the warning plate on the low-pressure and high-pressure stage.
- Wear heat-resistant safety gloves and protective clothing.
- Wait for the low-pressure and high-pressure stage to cool down before carrying out any work.

Wear safety gloves to protect against thermal hazards.
1.12 Hazards during operation and maintenance

**WARNING**

Hot surfaces on the non-insulated low-pressure and high-pressure stage

Non-insulated low-pressure and high-pressure stages can cause serious injuries to personnel (burns).

ABB Turbo Systems supplies the low-pressure and high-pressure stage with or without insulation in accordance with the purchase order received from the enginebuilder. If supply is without insulation, the enginebuilder is responsible for providing the low-pressure and high-pressure stage with proper insulation and for providing protection against contact with hot surfaces.

- Compliance with the instructions and specifications given by the enginebuilder to protect against contact with hot surfaces on the low-pressure and high-pressure stage is compulsory.

Wear safety gloves to protect against thermal hazards.

Hazards due to rotating parts

**WARNING**

Physical hazards due to rotating parts

Contact with rotating parts can cause severe injury. The low-pressure stage must never be used without the filter silencer or air inlet casing, respectively. With the engine stopped, the rotor can rotate due to the stack draught alone.

- Operate the low-pressure and high-pressure stage in compliance with the specifications.
- Secure the rotor against unintentional rotation during maintenance.

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

Mechanical hazards during operation

During standard operation, no mechanical hazards are caused by the low-pressure and high-pressure stage, provided that it has been properly installed.

Low-pressure and high-pressure stages are not designed for sudden pressure loss that may occur due to the piping system between the compressor or the turbine stages bursting.

1.13.1 Safety during commissioning and operation

Safety during commissioning and operation

- Visually inspect your working environment before starting work.
- Remove any obstacles and objects littering the workplace.
- Check all pipes to and from the Power2 for damage and leaks before commissioning.
- Check Power2 for recognisable damage or defects every 12 hours of operation or at least once a day.
- Report any damage and any alterations of operational characteristics to the responsible department immediately.
- In case of damage, take the Power2 out of operation immediately and safeguard against accidental/unauthorised use.
- When switching on operating energy supplies (hydraulics, pneumatics, electricity), pay attention to the risks that may occur as a consequence of this energy input.
1.14 Safe maintenance

Occupational safety

**WARNING**

**Injuries to persons**

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

- When working on the Power2, always wear safety footwear and protective clothing to protect against mechanical hazards.
- Keep personal protective equipment in perfect condition.
- Obey mandatory signs.
- Observe the general rules for occupational safety and prevention of accidents.
- Only perform operations that are described in this chapter.
- Only perform operations for which you have received instruction or training.

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

Wear protective clothing.

**WARNING**

**Risk of falling**

When work is performed on the low-pressure or high-pressure stage, there is a risk of falling.

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

- Only perform work on the low-pressure or high-pressure stage when you are in a physically and psychologically stable condition.
- Only work with suitable tools, equipment and appliances that function properly.
- Keep the workplace clean; clear away any loose objects and obstacles on the floor.
- Keep the floor, equipment and the low-pressure and high-pressure stage clean.
- Have oil binding agents ready and provide or keep oil pans at hand.

**Use of assembly devices**

Assembly devices are specially constructed and designed for the defined use; they are not commercially available products.
Use assembly devices only for the described applications.

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

**Safety during cleaning**
If cleaning agents or solvents are used for cleaning, the corresponding material safety data sheet and the safety instructions in section Hazards due to operating materials and supplies must be observed.
- Observe the material safety data sheet for the cleaning agent or solvent.
- Wear personal protective equipment (PPE) according to the material safety data sheet.
- Inspect the electric cables for abrasion and damage before and after your cleaning work.

**Safety during disassembly, assembly, maintenance and repair**
- Observe the procedures for set-up, service and inspection work and the inspection intervals.
- Inform the operating staff before starting any service or repair work. Make sure the engine is not started while work is being conducted on the Power2.
- Before taking off any cover or removing any guard from the low-pressure or high-pressure stage, switch off the engine and wait until the low-pressure stage and the high-pressure stage have come to a standstill.
- Make sure that the oil supply is interrupted, especially with an external oil supply.
- Only restart the engine after all parts have been properly fitted again and oil supply is ensured.

⚠️ **CAUTION**

**Mechanical operations on the low-pressure and high-pressure stage**
Components of the low-pressure or high-pressure stage can be damaged or destroyed due to improper use.
- Only perform operations that are described in this manual.
- Only perform operations for which you have received instruction or training.

**Safety when taking out of operation or preparing for mothballing**
- Observe the material safety data sheet for the cleaning and mothballing agents.
Wear personal protective equipment (PPE) according to the material safety data sheet.

**Mechanical hazards when working on the low-pressure and high-pressure stage**

**WARNING**

Physical hazards due to rotating parts
The rotor can rotate due to the stack draught alone. Contact with rotating parts can cause severe injury.

- Secure rotor against turning.

**Hazards due to operating materials and supplies**

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

**WARNING**

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

- Do not breathe in these substances and avoid contact with the skin.
- Ensure proper ventilation.
- Observe the information in the material safety data sheet for the operating materials and supplies.
- Wear personal protective equipment (PPE) according to the material safety data sheet.
- Comply with local legislation.

- Wear safety goggles.
- Wear safety gloves to protect against chemical hazards.
- Wear a respiratory mask to protect against gases.
**WARNING**

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

- Observe the information in the material safety data sheet for the operating materials and supplies.
- Comply with local legislation.
- Do not allow any exposed flame or ignition source during cleaning work.
- Carry out cleaning in the open or provide sufficient ventilation.

**CAUTION**

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

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

**Hazards due to the handling of insulation materials**

**WARNING**

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

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

- Wear safety goggles.
- Wear a respiratory mask to protect against dusts.
- Wear safety gloves to protect against chemical hazards.
## Safety data sheets

### Power2 340-H44

<table>
<thead>
<tr>
<th>Name</th>
<th>Hardware ID</th>
<th>Page</th>
</tr>
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<tr>
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</tr>
<tr>
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<td>1211507</td>
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# Safety data sheet

## Power2 340-H44 1247685

Low-pressure stage 1247657

---

### Power2 340-H44

<table>
<thead>
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<tr>
<td>Stage ID</td>
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<td>Rotor speed (1/s)</td>
<td>$n_{\text{max}}$ 678</td>
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<tr>
<td>Year</td>
<td>2020</td>
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Application according to the Operation Manual

Made in Switzerland

---

### Additional Safety Data:

#### Maximum permissible temperatures

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<th>Exhaust gas inlet temperature</th>
<th>$t_{\text{Mmax}}$ [°C]</th>
<th>$t_{\text{Bmax}}$ [°C]</th>
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<tbody>
<tr>
<td>At engine overload (110 %) in test rig operation only, unless otherwise agreed with the enginebuilder</td>
<td>620</td>
<td>600</td>
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<td>During operation</td>
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Safety data sheet

Power2 340-H44 1247685
Low-pressure stage 1247658

Additional Safety Data:

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<td>Exhaust gas inlet temperature</td>
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<td>During operation</td>
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Safety data sheet

Power2 340-H44 1247685
High-pressure stage 1211506

Additional Safety Data:

<table>
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<th>Maximum permissible temperatures</th>
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</thead>
<tbody>
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<td>Exhaust gas inlet temperature</td>
</tr>
<tr>
<td>Compressor inlet temperature after intercooler</td>
</tr>
<tr>
<td>Compressor inlet temperature after intercooler</td>
</tr>
</tbody>
</table>
Safety data sheet

Power2 340-H44  1247685
High-pressure stage  1211507

Additional Safety Data:

### Maximum permissible temperatures

| Exhaust gas inlet temperature | During operation | \( t_{\text{Bmax}} \) [°C] | 650 |
| Compressor inlet temperature after intercooler | During operation | \( t_{\text{Cmax}} \) [°C] | 50 |
# Product description

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# Introduction

## 1.1 Related documents

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<tr>
<td>Operation Manual / 2 Safety</td>
<td>HZTL4020</td>
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<tr>
<td>Operation Manual / 3 Safety data sheet *)</td>
<td>Serial number of Power2</td>
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</table>

*) This chapter is only present in serialised operation manuals.
1.2 Power2 layout and function

The diagram shows the position of the low-pressure (Power2 LP) and high-pressure stage (Power2 HP) within two-stage turbocharging (Power2). The low-pressure stage is always operated in combination with a high-pressure stage connected in series. The two-stage turbocharging (Power2) supplies the engine with the air volume and associated charging pressure required for operation.

Here, the exhaust gases of the internal combustion engine flow through the turbine (22) of the high-pressure stage and subsequently through the bellows (23*) of the gas pipe to the turbine (24) of the low-pressure stage. The compressor (25) of the low-pressure stage sucks in fresh air or the air/gas mixture, respectively. This precompressed air or air/gas mixture flows through the intercooler (26) into the compressor (21) of the high-pressure stage. Here the air or air/gas mixture is compressed further and leaves the two-stage turbocharging (Power2) in the direction of the charge air cooler.

*) If present

The diagram shows the position of the low-pressure (Power2 LP) and high-pressure stage (Power2 HP) within two-stage turbocharging (Power2). The low-pressure stage is always operated in combination with a high-pressure stage connected in series. The two-stage turbocharging (Power2) supplies the engine with the air volume and associated charging pressure required for operation.

Here, the exhaust gases of the internal combustion engine flow through the turbine (22) of the high-pressure stage and subsequently through the bellows (23*) of the gas pipe to the turbine (24) of the low-pressure stage. The compressor (25) of the low-pressure stage sucks in fresh air or the air/gas mixture, respectively. This precompressed air or air/gas mixture flows through the intercooler (26) into the compressor (21) of the high-pressure stage. Here the air or air/gas mixture is compressed further and leaves the two-stage turbocharging (Power2) in the direction of the charge air cooler.
1.3 Layout and function of the low-pressure stage

Fig. 2

01 Air suction branch / filter silencer
02 Compressor casing
03 Diffuser
04 Bearing casing
05 Thrust bearing
06 Radial bearings
07 Turbine
08 Gas outlet casing
09 Support
10 Gas outlet flange
11 Nozzle ring
12 Turbine casing
13 Turbine-end bearing flange
14 Compressor-end bearing flange
15 Compressor wheel
The low-pressure stage (Power2 LP) is a turbomachine and its main components are a turbine and a compressor. These components are installed on a common shaft and form the rotor (see Fig. 2: →6).

In the low-pressure stage (Power2 LP) shown in the cross section (see Fig. 2: →6), the exhaust gas flows through the turbine casing (12) and the nozzle ring (11) and then reaches the turbine (07). The turbine uses the energy contained in the exhaust gas to drive the rotor. The exhaust gases then reach the atmosphere through the gas outlet flange (10), the gas outlet casing (08) and the exhaust gas pipe connected to it.

The rotor runs in two radial plain bearings (06) which are located in the bearing casing (04) between compressor and turbine. The axial thrust bearing (05) is located between the two radial plain bearings. The plain bearings are connected to a central lubricating oil duct which is normally supplied by the lubricating oil circuit of the engine. The oil outlet always lies at the deepest point of the bearing casing (04).

The compressor wheel (15) is also located on the rotor. The compressor wheel sucks in fresh air or an air/gas mixture through the air suction branch or filter silencer (01). In the compressor wheel, the energy required for building up the pressure is transferred to the air or air/gas mixture. As the air or air/gas mixture flows through the diffuser (03), the compressor casing (02) and the intercooler (26), it is compressed further, cooled and then guided into the HP compressor (21).
1.4 Layout and function of the high-pressure stage

Fig. 4: Layout of the high-pressure stage

- 01 Air suction branch
- 02 Bellows
- 03 Compressor casing
- 04 Diffuser
- 05 Bearing casing
- 06 Thrust bearing
- 07 Radial bearings
- 08 Turbine
- 09 Gas outlet casing
- 10 Support
- 11 Gas outlet flange
- 12 Nozzle ring
- 13 Turbine casing
- 14 Turbine-end bearing flange
- 15 Compressor-end bearing flange
- 16 Compressor wheel
The high-pressure stage (Power2 HP) is a turbomachine and its main components are a turbine and a compressor. These components are installed on a common shaft and form the rotor (see Fig. 4: Layout of the high-pressure stage →8).

In the high-pressure stage (Power2 HP) shown in the cross section (see Fig. 4: Layout of the high-pressure stage →8), the exhaust gas flows through the turbine casing (13) and the nozzle ring (12) and reaches the turbine (08). The HP turbine uses the energy contained in the exhaust gas to drive the rotor. The exhaust gases then flow through the gas outlet flange (11), the gas outlet casing (09) and the exhaust gas pipe connected to it before they reach the turbine of the low-pressure stage (Power2 LP).

The rotor runs in two radial plain bearings (07) which are located in the bearing casing (05) between compressor and turbine. The axial thrust bearing (06) is located between the two radial plain bearings. The plain bearings are connected to a central lubricating oil duct which is normally supplied by the lubricating oil circuit of the engine. The oil outlet lies at the deepest point of the bearing casing (05).

The HP compressor wheel (16) connected to the shaft sucks in the precompressed air or an air/gas mixture from the low-pressure stage (25) through the air suction branch (01). The air is compressed further in the HP compressor (16) and the down-circuit diffuser (04) and subsequently supplied to the charge air cooler via the compressor casing (03).
1.5 **Warning plates on the low-pressure and high-pressure stage**

Warning plates are affixed at the following locations of the high and low-pressure stage:

*Fig. 6 Low-pressure stage*

*Fig. 7 High-pressure stage*
If warning plates are not present in the designated locations or not readable, proceed as follows:

- Order new warning plates from ABB Turbocharging Service Stations.
- Remove any warning plates that have become unreadable.
- Clean and degrease the areas designated for the warning plates.
- Fit new warning plates and remove protective sheets.

**Non-insulated high and low-pressure stages**

High and low-pressure stages supplied to the enginebuilder without insulation must be equipped later with warning plates to be attached to the insulation. This is the responsibility of the enginebuilder.

### 1.6 Locations of the rating plates

One rating plate is attached on the left of the bearing casing and another is attached on the right.
2 Removal and installation

For more information on how to remove and install the low-pressure stage, see document Operation Manual / Power2 ... / 4.1 Low-pressure stage.

For more information on how to remove and install the high-pressure stage, see document Operation Manual / Power2 ... / 4.2 High-pressure stage.
3 Commissioning

3.1 Oil supply

3.1.1 Introduction
In all operating states, a functioning and carefully executed oil supply is an important prerequisite for trouble-free operation of the low-pressure and high-pressure stage.

The low-pressure and high-pressure stage are usually lubricated with oil from the engine oil circulation.

▶ The directives of the enginebuilder on the selection of the lubricating oil and the oil change intervals must be followed.

3.1.2 Pre-lubrication
Before the engine is started, the plain bearings of the low-pressure and high-pressure stage must be pre-lubricated. You can do this by using an electrically driven oil pump.

▶ Switch on the oil pump.
▶ Build up oil pressure. Lubricating oil pressure → 17
▶ Do not exceed a pre-lubrication time of 2 minutes.
▶ Start the engine.
▶ Let the oil pump run until the pump driven by the engine generates sufficient pressure.

ABB Turbo Systems recommends integrating the entire pre-lubrication cycle into the engine control.

3.1.3 Oil filtering
Lubricating oil filtering with a filter mesh width of ≤ 0.034 mm is sufficient for these low-pressure and high-pressure stages.

3.1.4 Oil pressure
Comply precisely with the oil pressure before the low-pressure and high-pressure stage for trouble-free operation.

The admissible values are specified in chapter Monitoring during operation → 17.

3.1.5 Oil orifice on the low-pressure and high-pressure stage
With an oil inlet pressure of more than 3 bar (when engine under load) before the low-pressure or high-pressure stage, the bearing casings are equipped as standard with an orifice at the oil inlet.
3.2 Inspection procedures

3.2.1 Introduction

Inspection procedures include preventative visual controls, monitoring and measuring work before and during commissioning. Inspection procedures enable changes to the low and high-pressure stage to be detected. Engine damage can be prevented.

3.2.2 Checks before commissioning

Filter mat (if available)
► Check for damage and contamination.

Lubricating system

⚠️ CAUTION

Contaminated oil
Serious damage to engine or property can be caused by dirt and solid material particles in the oil.
► For the initial commissioning phase and after all service work, flush the complete lubricating system with warm oil.
► Use special running-in filters when running in the engine and after all service work on the lubricating system.

► Check that the oil filter is clean before commissioning.
► Check the oil pressure in the oil supply pipes.

Warning plates
► Check whether warning plates are present and legible.
► Check whether the protective sheets have been removed.
Water cooling in the bearing casing (if present)

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

**CAUTION**

**Failure of the bearing casing cooling**

Any prolonged failure of the water cooling will negatively affect the oil tightness of the low-pressure or high-pressure stage and increase their thermomechanical fatigue.

- Ensure the correct assembly of the water pipes and the cooling water supply.

### 3.2.3 Checks after commissioning (engine in idle mode)

**Lubricating system**

- Check the oil pressure in the oil supply pipes.
- Check oil inlet temperature.

The admissible values are specified in chapter *Monitoring during operation →17.*

**Leaktightness of pipes**

**WARNING**

**Risk of burning from hot gas**

Escaping gases are hot and will lead to serious burns in the event of contact.

- Check all pipes for leaks in accordance with the enginebuilder’s instructions.

### 3.2.4 Checks when starting up the engine

- Measure speed, oil pressure and charging pressure at various engine performances.
- Measure the exhaust gas temperature before and after the turbine.
- Measure the air temperature before and after the compressor.
- Compare the measured values with the values of the acceptance report. Different operating conditions indicate a malfunction (see Chapter *Troubleshooting →35*).

**Escape of oily fluids**

Lubricants and pastes used during assembly can liquefy or vaporise and escape as oily fluids during the initial hours of operation. Continual escape of an oily fluid indicates an oil leak.

- If there is a leak, contact an ABB Turbocharging Service Station.
3.3 Commissioning after taking out of operation

If present
- Remove cover plates (blind flanges) from the compressor casing, the gas inlet and the gas outlet.
- Remove protective film from oil connections on bearing casing foot.
- Remove the locking screws on the water connections and fit the water pipe.

General
- Check the exhaust gas pipe before and after the turbine for combustion residues or water residues and clean it. Remove any foreign objects that may be present.
- Check and clean filter silencer or air supply line, and remove any foreign objects that may be present.
- With the high-pressure stage, check the bellows located between the radial air suction branch and the compressor casing for damage and replace if necessary.
- Put engine-side oil circulation to the low-pressure and high-pressure stage into operation.
- Prepare the low-pressure and high-pressure stage for operation according to section Checks before commissioning.
- The low-pressure and high-pressure stage is now operational.
4 Monitoring during operation

4.1 Lubricating oil pressure

**CAUTION**

Assuring lubricating oil pressure

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

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

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

![Diagram](image)

**Fig. 8**

01 Contact surfaces of the low-pressure and high-pressure stage
02 Oil inlet
03 Oil outlet
M Oil pressure measuring point
T Oil temperature measuring point

1) If the drain pipe is vented, the oil temperature measuring point can be installed at the outlet in the vent tank. Otherwise the measurement should be taken in the drain pipe as close to the low-pressure and high-pressure stage as possible.

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

Table 2: Lubricating oil pressure at oil inlet before turbocharger

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4.2 Lubricating oil temperature

Lubricating oil temperature at the inlet

⚠️ CAUTION

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

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

<table>
<thead>
<tr>
<th>Power2 Status for operation</th>
<th>Oil temperature at the inlet $T_{\text{oil,inlet}}[^\circ\text{C}]$</th>
</tr>
</thead>
<tbody>
<tr>
<td>340 Admissible</td>
<td>30 ... 105</td>
</tr>
<tr>
<td>Temporarily admissible ( &lt; 1 h ) → alarm</td>
<td>&gt; 105</td>
</tr>
<tr>
<td>Not admissible → stop engine</td>
<td>&gt; 110</td>
</tr>
<tr>
<td>Not admissible → do not start engine (before start: preheat oil)</td>
<td>&lt; 30</td>
</tr>
</tbody>
</table>

Table 3

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 speeds of the low-pressure and the high-pressure stages
- 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 operation of the low and high-pressure stage and must be monitored according to the current regulations.

<table>
<thead>
<tr>
<th>Power2 Status for operation</th>
<th>Oil temperature at the outlet $T_{\text{oil,outlet}}[^\circ\text{C}]$</th>
</tr>
</thead>
<tbody>
<tr>
<td>340 Admissible</td>
<td>≤ 160</td>
</tr>
<tr>
<td>Temporarily admissible</td>
<td>&gt; 160</td>
</tr>
<tr>
<td>Not admissible → stop engine</td>
<td>&gt; 180</td>
</tr>
</tbody>
</table>

Table 4

If the low or high-pressure stage was operated for a longer period of time outside of the admissible range, ABB Turbo Systems recommends to have the low or high-pressure stage inspected by an ABB Turbocharging Service Station.
4.3 **Speeds**

4.3.1 **Introduction**

Speed measurement systems enable the constant monitoring of the speeds of the low-pressure and the high-pressure stage.

4.3.2 **Layout and overview**

![Diagram showing low-pressure and high-pressure stages with components labeled](image)

- **86505** Speed sensor
- **86515** Cable connector
- **86526** F/I converter
- **86528** Tachometer
- **32109** Sealing disc with cams
- **42188** Screw plug
- **42189** Gasket
- **01** Plug with integrated voltage limiter
- ***) Alternative mounting position for speed sensor
4.3.3 Differences in speed between the low-pressure or high-pressure stages on one engine

The speeds of the low-pressure stages differ significantly from the speeds of the high-pressure stages.

A Power2 turbocharging system for V-engines, for example, can consist of multiple low-pressure and multiple high-pressure stages. In this case the speeds of the low-pressure stages only differ a little from each other. The same also applies to the high-pressure stages.

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

If this admissible difference range is exceeded, the following steps must be performed:

- Reduce the engine performance until the maximum speed of all low and high pressure stages does not exceed 70% of \( n_{B\text{max}} \).
- If the engine cannot be stopped, it can continue to be driven with this reduced engine performance or at this low-pressure and high-pressure stage speed.
- If a low-pressure or high-pressure stage surges continuously, the engine performance must be reduced further.
- Measure the temperatures in the air lines and exhaust gas pipes from and to the low-pressure and high-pressure stages and compare with normal values.
- Check the pressure loss of the alternative air inlet and compare it with normal values.

If the engine can be stopped temporarily:

- Inspect air lines, exhaust gas pipes and the low-pressure and high-pressure stages and remedy any malfunctions.
- In any case, contacting the nearest ABB Turbocharging Service Station is recommended.
4.3.4 Replacing the speed sensor

**WARNING**

**Hot cable connector and hot speed sensor**
Danger of burns. The cable connector and speed sensor can reach temperatures in excess of 100 °C during operation.
- When disassembling the cable connector and speed sensor, wear safety gloves.

> Wear safety gloves to protect against thermal hazards.

- Reduce the engine performance to idling and then stop the engine. Observe post-lubrication time (see section Stopping the engine).
- Switch off the lubricating oil supply to the low or high-pressure stage.
- Disconnect the cable connector from the speed sensor.
- Screw out defective speed sensor.
- Screw in new speed sensor to the stop.
- For the tightening torque of the low-pressure stage speed sensor, see document Operation Manual / Power2 ... / Low-pressure stage / Disassembly and assembly / Table of tightening torques.
- For the tightening torque of the high-pressure stage speed sensor, see document Operation Manual / Power2 ... / High-pressure stage / Disassembly and assembly / Table of tightening torques.

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

- Connect the cable connector with the speed sensor.
- Switch on lubricating oil supply to the low-pressure or high-pressure stage.

4.3.5 Malfunction of the speed measurement system

In the case of malfunctions of the speed measurement system, refer to the chapter entitled Troubleshooting/Speed measurement system →42.
5 Operation and service

5.1 Noise emission

⚠️ WARNING

Danger due to noise

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

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

Wear ear protection.

The emission sound pressure level (A-weighted) is measured at a distance of 1 metre from the low-pressure and high-pressure stage.

The highest value of the emission sound pressure level[^1] reaches a maximum of 105 dB(A) near the compressor end (compressor casing, filter silencer, air suction branch).

The following prerequisites must be fulfilled with regard to the low-pressure and high-pressure stage to observe this limit value:

- Air inlet system and piping fitted
- All standard, noise-reducing measures[^2] have been fitted
- Bellows at the air outlet has been properly acoustically insulated by the enginebuilder ([see Fig. 9: Noise insulation, bellows \(\rightarrow\) 23])
- Bellows between radial air inlet and compressor casing of the high-pressure stage has been acoustically insulated

The enginebuilder is also responsible for insulating other components such as the charge air/scavenging air lines and the cooler.

[^1]: Directive 2006/42/EC, 1.7.4.2 / u / Paragraphs 5 + 7: A-weighted emission sound pressure level
[^2]: The enginebuilder must provide acoustically equivalent measures in case of deviating insulation versions
**Suggestion for noise insulation, bellows**

Fig. 9: Noise insulation, bellows

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Compressor casing</td>
</tr>
<tr>
<td>02</td>
<td>Bellows</td>
</tr>
<tr>
<td>03</td>
<td>Charge air duct / scavenging air duct</td>
</tr>
<tr>
<td>04</td>
<td>Insulation cushion</td>
</tr>
<tr>
<td>05</td>
<td>Insulation mat (at least 15 mm)</td>
</tr>
<tr>
<td>06</td>
<td>Sheet metal cover</td>
</tr>
</tbody>
</table>
5.2 Service work

Service work includes visual controls, monitoring, measuring and inspection as well as function checks. Service work enables the detection and rectification of changes to the low and high-pressure stage and ensures full operability of the low and high-pressure stage.

**CAUTION**

**Service intervals**

Service work on the low-pressure and high-pressure stage that is omitted or performed too late can cause excessive contamination and wear as well as operating failures.

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

**CAUTION**

**Shortened service intervals**

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

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

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

5.2.1 Service work every 25 ... 50 hours

**CAUTION**

**Unknown operational changes**

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

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

- Visual check for air, exhaust gas, water and oil leaks.
- Record operating data and enter in the engine logbook.
- In case of deviations, determine the cause.

5.2.2 Service work at 100 hours after commissioning

- Clean or replace the oil filter located in the supply pipe to the low-pressure and high-pressure stage while the engine is stopped.
5.2.3 Service work according to instructions of enginebuilder

► Clean or replace the oil filter located in the supply pipe to the low-pressure and high-pressure stage while the engine is stopped.

5.2.4 Service work every 10000 ... 20000 hours

The rotor and bearing parts must be checked and assessed by an ABB Turbocharging Service Station.

► Remove low-pressure and high-pressure stage from the engine and dismantle according to chapter Disassembly and assembly. Measure clearances.
► Clean nozzle ring, turbine casing, and compressor casing, and check for cracks and erosion/corrosion.

Additional measures in conjunction with the high-pressure stage:

► Replace gaskets every time after disassembly.
► Check bellows between air-inlet casing and compressor casing for cracks and clean (see also chapter Cleaning the high-pressure stage bellows (if present) →34).
5.2.5 Entries in the engine logbook

The monitoring of the engine enables conclusions to be drawn on the behaviour of the low-pressure and high-pressure stage.

The following operating data and measured values must be entered regularly in the engine logbook of the enginebuilder:

- Performance and speed of the engine
- Air intake temperature
- Pressure of the charge air
- Pressure loss in the charge air cooler and intercooler
- Lubricating oil pressure and lubricating oil temperature

If present:

- Speed of low-pressure and high-pressure stage
- Air temperature before and after the compressor and after the charge air cooler
- Exhaust gas temperature before and after the turbine
- Atmospheric humidity of the suction air (before the low-pressure stage)

5.3 Expected replacement intervals

For information on the expected replacement intervals of the components of the low-pressure stage, see document Operation Manual / Power2 … / 4.1 Low-pressure stage.

For information on the expected replacement intervals of the components of the high-pressure stage, see document Operation Manual / Power2 … / 4.2 High-pressure stage.
5.4 Stopping the engine

Oil-cooled bearing casing variant

- Run the engine for 5 to 10 minutes at idling speed before stopping it (only diesel engines).
- Observe the oil pressure for engine idling: $0.5 < p_{\text{oil}} \leq 2.5$ bar.
- Stop the engine.
- Carry out post-lubrication of the low-pressure and high-pressure stage in accordance with the following table.

<table>
<thead>
<tr>
<th>Turbine inlet temperature when stopping the engine $t_{\text{TE}}$ [$^\circ$C]</th>
<th>Post-lubrication</th>
<th>Duration of post-lubrication [min]</th>
<th>Oil pressure during post-lubrication (engine stopped) $p_{\text{oil}}$ [bar]</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\geq$ 550</td>
<td>imperative</td>
<td>15 ... 20</td>
<td>$0.5 &lt; p_{\text{oil}} \leq 1.0$</td>
</tr>
<tr>
<td>$&lt; 550$</td>
<td>necessary until the rotor comes to a standstill</td>
<td>10 recommended</td>
<td>$0.5 &lt; p_{\text{oil}} \leq 1.0$</td>
</tr>
</tbody>
</table>

Table 5

Water-cooled bearing casing variant

- Post-lubricate as long as the rotor is turning.
- Observe the oil pressure while performing post-lubrication: $0.5 < p_{\text{oil}} \leq 1.0$.
- Switch off post-lubrication as soon as the rotor has come to a standstill.

Deviating procedures must be coordinated with ABB Turbo Systems.

**CAUTION**

Water cooling (if present)

If the residual heat in the low-pressure stage is not sufficiently dissipated by the circulating cooling water, machine damage could occur.

- Allow water cooling to continue for 20 ... 30 minutes after stopping the engine.
6 Periodic maintenance

6.1 Foreword to maintenance

Maintenance work includes regular visual controls and cleaning operations which are intended to ensure the trouble-free functioning of the low-pressure and high-pressure stage. In this process, the exterior condition and the degree of contamination of the components on which maintenance work is to be performed are determined.

<table>
<thead>
<tr>
<th>Component to be maintained</th>
<th>Recommended cleaning interval*</th>
<th>Operating state</th>
</tr>
</thead>
<tbody>
<tr>
<td>LP &amp; HP compressor ***</td>
<td>24 ... 72 h</td>
<td>Engine load: 50 ... 85 %</td>
</tr>
<tr>
<td>LP filter silencer **</td>
<td>500 h</td>
<td>Engine stopped</td>
</tr>
<tr>
<td>HP bellows**</td>
<td>At every disassembly</td>
<td>Engine stopped</td>
</tr>
</tbody>
</table>

Table 6

** If the recommended cleaning intervals are incompatible with operation of the engine, contact ABB Turbo Systems.

** If present

*** If compressor cleaning present

Compressor cleaning

We recommend cleaning the HP compressor after the LP compressor.

On V-engines with several low-pressure and/or high-pressure stages per engine, ABB Turbo Systems recommends the parallel cleaning of the LP compressors as well as the parallel cleaning of the HP compressors.

This cleaning process is faster and reduces the risk of surging of the low-pressure and high-pressure stages.
6.2 Cleaning the compressor during operation

6.2.1 Prerequisite

- The enginebuilder approves the cleaning process and its specifications are adhered to.
- Instructions from ABB Turbo Systems are adhered to.

6.2.2 Introduction

The contamination of the compressor stage (compressor wheel and diffuser) depends on the degree of purity of the sucked-in air.

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

Consequences of contamination:

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

Periodic cleaning of the compressor during operation prevents or delays any great increase in the contamination, but never replaces the regular service work where the low and high-pressure stages are completely dismantled and the compressors are mechanically cleaned.

Cleaning process

The compressor is cleaned during operation using the wet cleaning method. This cleaning method is tested and approved by ABB Turbo Systems.
Principle of wet cleaning
To clean the compressor stage during operation, water is injected before the compressor wheel.

The water does not act as a solvent. The coating is removed by the mechanical action of the impacting droplets. The process is particularly suitable as long as the fouling is not too advanced.

6.2.3 Prerequisites for wet cleaning of compressor
- Engine load of 50 ... 85%

⚠️ CAUTION
Volume of water
Uncontrolled volumes of water can damage the pressure stages and the engine.
- Never connect injection tubes directly to a water pipe or a larger metering container other than that specified by ABB Turbo Systems.

⚠️ CAUTION
Corrosion and deposits when cleaning
Salt water and cooling water treatment substances damage and adversely affect parts of the low-pressure and high-pressure stage.
- Never use salt water, but only pure water for cleaning.
6.2.4 **Wet cleaning of compressor**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>50 … 85 %</td>
<td>0.4</td>
<td>5 … 30</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 7: Parameters for wet cleaning of compressor

**Executing wet cleaning**

- Remove sealing plug (27005).
- Fill container with 0.4 dm³ pure water.
- Screw in sealing plug (27005) again.
- Push the valve activator (03) against the spring and hold for 10 … 15 seconds until the whole volume of water is injected.
- Continue to operate the engine for at least five more minutes to dry the compressor stage.

The cleaning process can be repeated up to three times.

The success of the cleaning can be recognised based on the charging pressure or the exhaust gas temperature.

If the cleaning is still unsuccessful after three processes and the engine values are unsatisfactory, it is recommended to have the low-pressure and / or high-pressure stage checked and cleaned by an ABB Turbocharging Service Station.
6.3 Cleaning the LP filter silencer

Cleaning the filter ring (if present)

- Remove filter ring (81265).
- Clean filter ring (81265) as required or every 500 hours of operation and replace after the fifth cleaning process at the latest. Contamination of the filter ring depends on the degree of purity of the sucked-in air.
- Rinse the filter ring (81265) with water and mild detergent or, in the case of heavy contamination, soak and carefully push through. Rinse in cold water. Avoid high mechanical loads (water jet).
- Let the filter ring dry completely before assembling.
- Dirty water and mild detergent must be disposed of in compliance with locally applicable regulations.
Cleaning the absorption segments  
(see Fig. 10: Cleaning the filter silencer →32)  
► Loosen the tension bands (81270).
► Remove the cover grid (81266).
► Pull out and bend up the sheet-metal coverings (81137), and remove the absorption segments (81136).
► Clean the absorption segments (81136).  
  When cleaning, note that the absorption segments (81136) must only be cleaned lightly with compressed air, a soft brush or a moist cleaning cloth.
► Have any heavily contaminated absorption segments replaced by an ABB Turbocharging Service Station.

Fitting the filter silencer  
(see Fig. 10: Cleaning the filter silencer →32)  
► Insert the absorption segments (81136) into the sheet-metal coverings (81137).
► Bend the sheet-metal coverings (81137) back to their original shape and insert into the slotted guides in the filter silencer body (81135).
► Fit the cover grid (81266).
► Fit the tension bands (81270) and tighten them at the locks (81271).
► Any tension bands that have become damaged must be replaced.
► Fit the filter ring (81265), if present.
6.4 Cleaning the high-pressure stage bellows (if present)

The disassembly and assembly of the bellows (82300) is described in chapter "Disassembly and assembly".

The following maintenance work must be carried out on the bellows (82300):

- Remove insulation (if present).
- Perform a visual inspection for cracks, deposits and corrosion damage.
- Always replace cracked bellows with a new bellows.
- If deposits and water residue are present, clean the bellows with water.
- Perform a visual inspection of the sealing points (flange connection to the compressor casing and air suction branch).
- Always replace bellows with a damaged sealing point with a new bellows.
7 Troubleshooting

7.1 Malfunctions when starting

Delayed start-up

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-pressure or high-pressure stage</td>
<td>Pressure stage contaminated</td>
</tr>
<tr>
<td></td>
<td>Bearing damaged</td>
</tr>
<tr>
<td></td>
<td>Rotor rubbing</td>
</tr>
<tr>
<td></td>
<td>Foreign object in pressure stage</td>
</tr>
</tbody>
</table>

Table 8: Malfunctions when starting – Delayed start-up

Vibrations

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine</td>
<td>Vibrations from engine</td>
</tr>
<tr>
<td>Low-pressure or high-pressure stage</td>
<td>Rotor unbalance</td>
</tr>
<tr>
<td></td>
<td>Turbine or compressor damaged</td>
</tr>
<tr>
<td></td>
<td>Bearing damaged</td>
</tr>
</tbody>
</table>

Table 9: Malfunctions when starting – Vibrations

Rubbing of rotating parts

Normal behaviour, not a malfunction

Low-pressure or high-pressure stage | A minimal and uniform wear at the circumference of the rotor components caused by slight local rubbing against adjacent components is permitted. This causes the compressor or turbine blades to be somewhat shortened. To prevent significant loss of efficiency, specific tolerances must be fulfilled.
| |
| | - If there is any doubt about the extent of the rubbing, contact an ABB Turbocharging Service Station.|
| | - Have a dimension check carried out by an ABB Turbocharging Service Station.|

Table 10: Malfunctions when starting – Rubbing of rotating parts
7.2 Malfunctions during operation

**Lubricating oil pressure too low**

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

Table 11: Malfunctions during operation – Lubricating oil pressure too low

**Drop in low-pressure stage speed**

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine</td>
<td>Defects on the connected cylinders</td>
</tr>
<tr>
<td>Low-pressure stage</td>
<td>Heavy contamination of the turbine</td>
</tr>
<tr>
<td></td>
<td>Damaged rotor components or bearing</td>
</tr>
<tr>
<td></td>
<td>Change of operating state of high-pressure stage</td>
</tr>
<tr>
<td>Pipes</td>
<td>Defects, such as leaks, in the exhaust gas pipes or charge air ducts</td>
</tr>
</tbody>
</table>

Table 12: Malfunctions during operation – Power2 LP speed reductions

**Increase in low-pressure stage speed**

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-pressure stage</td>
<td>Heavy contamination of the nozzle ring</td>
</tr>
</tbody>
</table>

Table 14: Malfunctions during operation – Power2 LP speed increases
### Increase in high-pressure stage speed

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-pressure stage</td>
<td>Contact ABB Turbocharging Service Station</td>
</tr>
<tr>
<td>Heavy contamination of the nozzle ring</td>
<td></td>
</tr>
<tr>
<td>Low-pressure stage defective</td>
<td>Contact ABB Turbocharging Service Station</td>
</tr>
<tr>
<td>Pipes</td>
<td>Repair</td>
</tr>
<tr>
<td>Leak in exhaust gas pipe before the low-pressure stage</td>
<td></td>
</tr>
</tbody>
</table>

Table 15: Malfunctions during operation – Power2 HP speed increases

### Exhaust gas temperature too high

#### Engine performance and engine speed unchanged

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine</td>
<td>Repair or contact manufacturer</td>
</tr>
<tr>
<td>Malfunction in the injection system</td>
<td></td>
</tr>
<tr>
<td>Low-pressure or high-pressure stage</td>
<td>Clean</td>
</tr>
<tr>
<td>Insufficient air, for example, because filter silencer is blocked by contamination</td>
<td>Clean or repair boiler or exhaust gas silencer</td>
</tr>
<tr>
<td>Compressor/turbine contaminated</td>
<td></td>
</tr>
<tr>
<td>Exhaust gas back pressure too high</td>
<td>Clean or repair boiler or exhaust gas silencer</td>
</tr>
<tr>
<td>Turbine damaged or eroded</td>
<td>Contact ABB Turbocharging Service Station</td>
</tr>
<tr>
<td>Charge air cooler/inter-cooler</td>
<td>Clean</td>
</tr>
<tr>
<td>Cooler contaminated</td>
<td></td>
</tr>
<tr>
<td>Cooling water volume too low</td>
<td>Fill</td>
</tr>
<tr>
<td>Inlet temperature of cooling water too high</td>
<td>Check/clean cooling system</td>
</tr>
<tr>
<td>Insufficient ventilation</td>
<td>Improve ventilation</td>
</tr>
</tbody>
</table>

Table 16: Malfunctions during operation – Exhaust gas temperature too high
### Charge air pressure too low

Engine performance and engine speed unchanged, suction condition normal

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Engine</strong></td>
<td></td>
</tr>
<tr>
<td>Air receiver not sealed</td>
<td>Repair</td>
</tr>
<tr>
<td>Gas piping between engine and turbine not sealed</td>
<td></td>
</tr>
<tr>
<td>Injection mistimed</td>
<td>Set correctly</td>
</tr>
<tr>
<td>Valve control misadjusted</td>
<td></td>
</tr>
<tr>
<td><strong>Low-pressure or high-pressure stage</strong></td>
<td></td>
</tr>
<tr>
<td>Manometer display not correct</td>
<td>Replace manometer</td>
</tr>
<tr>
<td>Supply pipe to manometer not sealed</td>
<td>Repair leak</td>
</tr>
<tr>
<td>Filter silencer contaminated, therefore pressure drop too high</td>
<td>Clean</td>
</tr>
<tr>
<td>Compressor/turbine contaminated</td>
<td></td>
</tr>
<tr>
<td>Compressor/turbine damaged</td>
<td>Contact ABB Turbocharging Service Station</td>
</tr>
<tr>
<td>Exhaust gas back pressure too high</td>
<td>Clean or repair boiler or exhaust gas silencer</td>
</tr>
</tbody>
</table>

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

### Charge air pressure too high

Engine performance and engine speed unchanged, suction condition normal

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Engine</strong></td>
<td></td>
</tr>
<tr>
<td>Malfunction in the injection system</td>
<td>Repair or contact manufacturer</td>
</tr>
<tr>
<td>Injection mistimed</td>
<td>Set correctly</td>
</tr>
<tr>
<td>Engine performance higher than expected</td>
<td>Check engine performance</td>
</tr>
<tr>
<td><strong>Low-pressure or high-pressure stage</strong></td>
<td></td>
</tr>
<tr>
<td>Manometer display not correct</td>
<td>Replace manometer</td>
</tr>
</tbody>
</table>

Table 18: Malfunctions during operation – Charge air pressure too high
Contamination of the compressor

Reduced compressor performance/efficiency and therefore engine performance losses

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-pressure or high-pressure</td>
<td>Clean the compressor</td>
</tr>
<tr>
<td>stage</td>
<td>Optimize oil separation</td>
</tr>
<tr>
<td></td>
<td>Correct the influx of ventilation gases in accordance with the</td>
</tr>
<tr>
<td></td>
<td>enginebuilder’s instructions.</td>
</tr>
<tr>
<td>Increased vibration, compressor</td>
<td></td>
</tr>
<tr>
<td>blade damage due to the influx</td>
<td></td>
</tr>
<tr>
<td>of ventilation gases</td>
<td></td>
</tr>
</tbody>
</table>

Table 19: Malfunctions during operation – Compressor 1 contamination

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

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-pressure or high-pressure</td>
<td>Correct the influx of ventilation gases in accordance with the</td>
</tr>
<tr>
<td>stage</td>
<td>enginebuilder’s instructions.</td>
</tr>
<tr>
<td>Material of the compressor wheel</td>
<td></td>
</tr>
<tr>
<td>corroded due to the influx of</td>
<td>Prevent exhaust gas leakages in the engine space</td>
</tr>
<tr>
<td>ventilation gases containing</td>
<td>Clean the compressor</td>
</tr>
<tr>
<td>corrosive components</td>
<td></td>
</tr>
<tr>
<td>Material of the compressor</td>
<td></td>
</tr>
<tr>
<td>wheel corroded due to intake</td>
<td></td>
</tr>
<tr>
<td>air containing exhaust gases or</td>
<td></td>
</tr>
<tr>
<td>salt</td>
<td></td>
</tr>
</tbody>
</table>

Table 20: Malfunctions during operation – Compressor 2 contamination

Blow-by too high

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-pressure or high-pressure</td>
<td></td>
</tr>
<tr>
<td>stage</td>
<td>A measurement system is available for the pressure in the bearing</td>
</tr>
<tr>
<td></td>
<td>casing to identify the triggering stage.</td>
</tr>
<tr>
<td>Damage to the sealing system (</td>
<td>Contact an ABB Turbocharging Service Station</td>
</tr>
<tr>
<td>damaged piston ring at</td>
<td></td>
</tr>
<tr>
<td>compressor or turbine end) at</td>
<td></td>
</tr>
<tr>
<td>the low or high-pressure stage</td>
<td></td>
</tr>
</tbody>
</table>

Table 21: Malfunctions during operation – Blow-by too high
7.3 Surging of the low-pressure or high-pressure stage

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine</td>
<td>Protective grating downstream of high-pressure stage contaminated or damaged</td>
</tr>
<tr>
<td>Low-pressure or high-pressure stage</td>
<td>Filter silencer or diffuser contaminated Heavy dirt deposits in the turbine or in the nozzle ring</td>
</tr>
<tr>
<td>Charge air cooler/intercooler</td>
<td>Cooler contaminated Charge air duct blocked</td>
</tr>
</tbody>
</table>

Table 22: Surging of the low-pressure or high-pressure stage

⚠️ CAUTION

Continuous or periodic surging
If the low-pressure or high-pressure stages surge continuously or periodically, their components may be damaged.
- Gradually reduce the engine load.
- Have the cause clarified and remedied immediately by an ABB Turbocharging Service Station.
- Have parts assessed for damage and, if necessary, replaced by an ABB Turbocharging Service Station.

Sporadic surge blows
Surging of the low-pressure stage can occur during certain operating states, such as when reducing the engine performance quickly when manoeuvring. When this happens, the flow direction in the compressor is momentarily reversed. Such sporadic surge blows do not impair the safe operation of the low-pressure stage.
- A surge blow is accompanied by a loud bang and escape of hot air or air/gas mixture from the filter silencer of the low-pressure stage. There is no escape of air or air/gas mixture from the high-pressure stage.
### 7.4 Malfunctions when stopping

#### Runout noises

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-pressure or high-pressure stage</td>
<td>Pressure stage contaminated</td>
</tr>
<tr>
<td></td>
<td>Bearing damaged</td>
</tr>
<tr>
<td></td>
<td>Rotor rubbing</td>
</tr>
<tr>
<td></td>
<td>Foreign object in the pressure stage</td>
</tr>
</tbody>
</table>

Table 23: Malfunctions when stopping – Runout noises

#### Runout time too short

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-pressure or high-pressure stage</td>
<td>Pressure stage contaminated</td>
</tr>
<tr>
<td></td>
<td>Bearing damaged</td>
</tr>
<tr>
<td></td>
<td>Rotor rubbing</td>
</tr>
<tr>
<td></td>
<td>Foreign object in the pressure stage</td>
</tr>
</tbody>
</table>

Table 24: Malfunctions when stopping – Runout time too short
7.5 Speed measurement system

No signal or poor signal amplitude of the speed measurement

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

Table 25: Speed measurement – poor signal amplitude

Measured speed too high

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

Table 26: Speed measurement – speed too high

Measured speed too low

<table>
<thead>
<tr>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-pressure or high-pressure stage</td>
<td>Contact an ABB Turbocharging Service Station</td>
</tr>
</tbody>
</table>

Table 27: Speed measurement – speed too low

Other causes of malfunction

If none of the measures described above remedy the malfunction, have the speed measurement system checked by an ABB Turbocharging Service Station.
For more information on the disassembly and assembly of the low-pressure stage, see document Operation Manual / Power2 ... / 4.1 Low-pressure stage.

For more information on the disassembly and assembly of the high-pressure stage, see document Operation Manual / Power2 ... / 4.2 High-pressure stage.
9 Taking out of operation at short notice

For more information on briefly taking the low-pressure stage out of operation, see document Operation Manual / Power2 … / 4.1 Low-pressure stage.

For more information on briefly taking the high-pressure stage out of operation, see document Operation Manual / Power2 … / 4.2 High-pressure stage.
10 Mothballing the low-pressure and high-pressure stage

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

State of the engine lubricating oil

The low-pressure and high-pressure stage normally remains attached to the engine. The measures to be taken for mothballing of the low-pressure and high-pressure stage 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

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 low-pressure and high-pressure stage
- 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
- Completely fit low-pressure and high-pressure stage.

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 operation, the following variants are possible with regard to the low-pressure and high-pressure stage:

- Low-pressure and high-pressure stage remain attached to the engine.
- The casings of the low-pressure and high-pressure stage remain attached to the engine, the rotor and the bearing parts are dismantled by an ABB Turbocharging Service Station and stored separately.
- Low-pressure and high-pressure stage are completely removed, either as whole units or in single parts.

For the measures always necessary for preparing the low-pressure and high-pressure stage for mothballing, see section Taking the engine out of operation for up to 12 months, subsection Preparations for mothballing.

If the low-pressure and the high-pressure stage remain attached to the engine, see section Taking the engine out of operation for up to 12 months, subsection Rotation of the rotor in the stack draught.

If the complete low-pressure and high-pressure stage are removed or if the low-pressure and high-pressure stage are reassembled from their individual components:

- Seal all openings of the low-pressure and high-pressure stage with paraffin paper and wooden lids.

Only dry rooms with 40-70 % atmospheric humidity, in which no water condensation can form, are suitable for mothballing.

State of the mothballed low-pressure and high-pressure stage

- Check the low-pressure and high-pressure stage parts annually for corrosion
- If there are signs of rust: Thoroughly clean parts and renew corrosion protection.
11 Disposing of low-pressure and high-pressure stage components

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

The low-pressure and high-pressure stages mainly consist 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.

---

**WARNING**

Handling damaged thermal insulation

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

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

- Wear safety goggles.
- Wear a respiratory mask to protect against dusts.
- Wear safety gloves to protect against mechanical hazards.

- Dispose of thermal insulation as hazardous waste.
12 Spare parts

- For more information on spare parts for the low-pressure stage, see document Operation Manual / Power2 ... / 4.1 Low-pressure stage.

- For more information on spare parts for the high-pressure stage, see document Operation Manual / Power2 ... / 4.2 High-pressure stage.
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## Low-pressure stage

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<tr>
<th>Chapter</th>
<th>Document number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation Manual / Power2 / 1 Introduction</td>
<td>HZTL4003 or HZTL4004</td>
</tr>
<tr>
<td>Operation Manual / Power2 / 2 Safety</td>
<td>HZTL4020</td>
</tr>
<tr>
<td>Operation Manual / Power2 300-H / 4 Product description</td>
<td>HZTL4050</td>
</tr>
</tbody>
</table>

Table 1: Further applicable documents
2 Removal and installation

2.1 Transport / weight

Lifting gear with a sufficient load limit must be used for removing and installing low-pressure and high-pressure stages. The following weight specifications apply to the heaviest variant possible. Depending on the specification, the weight specified on the rating plate may be lower than the standard values specified here.

<table>
<thead>
<tr>
<th>Complete low-pressure stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suspension</td>
</tr>
<tr>
<td>Complete low-pressure stage</td>
</tr>
</tbody>
</table>

Table 2: Transport / weight of low-pressure stage

2.2 Removing the low-pressure stage

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

Version with water-cooled bearing casing:

- Disconnect the water connections according to the instructions of the enginebuilder. Close the openings of the water connections with locking screws.

⚠️ CAUTION

**Freezing of the cooling water in the bearing casing**

Serious damage to property can be the consequence if the cooling water freezes in the pipes and in the bearing casing.

- For transport and storage of the low-pressure stage, drain the cooling water from the bearing casing via one of the two bottom openings of the water connections.
If present:

- Unplug the plug to the speed sensor (86505) and secure the rolled-up cable (2 m) on the low-pressure or high-pressure stage. This protects the plug from being crushed.

**NOTICE**

**Assembly safety device**

Depending on the version of the bracket (04), a pin (03) may have been inserted to ensure the safe assembly of the low-pressure stage. Therefore always remove the low-pressure stage from and install it on the bracket vertically.

---

**Fig. 1: Removing the low-pressure stage**

1. Attach the lifting gear to the suspension lug / eye and additionally loop it around the gas outlet casing (61001).
2. Loosen and remove the fixing screws (01) and the fixing screws (05) on the support (61300).
3. Remove the low-pressure stage vertically.
4. Cover the oil connections (02) in the bracket (04) to protect them from dirt.
2.3 Installing the low-pressure stage

2.3.1 Inserting gaskets

**CAUTION**

**Inserting the gaskets**

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

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

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

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

![Fig. 2: Inserting gaskets into the bracket](image)

| 01 Bracket | 02 Oil supply | 03 Oil drain | 04 Slot for gasket | 05 O-rings | 06 Pin (optional) |

**NOTICE**

**Pin (06) as installation safety device**

The low-pressure stage can have an oil inlet either on its right or left side, and this can be different for the low-pressure stage fitted on the left and right engine bank.

A pin can be installed in the support as an installation safety device to prevent inadvertent incorrect fitting. This pin fits into the respective slot on the foot of the bearing casing. Instructions of the enginebuilder must be observed.
2.3.2  Placing the low-pressure stage on the bracket and aligning

The screws for attaching the low-pressure stage are not included in the ABB Turbo Systems scope of delivery. Ensure the following:

- Property class 10.9 / 12.9
- Use in accordance with DIN EN ISO 898 Part 1
- Lightly oiled thread.

1. Make sure that the O-rings are placed correctly in the slots of the bracket (04).
2. Attach the lifting gear to the suspension lug / eye and additionally loop it around the gas outlet casing (61001).
3. Clean the contact surfaces of the fixing screws (01) in the bearing casing.
4. Place the low-pressure stage on the bracket (04) and align it. The oil inlet of the low-pressure stage must fit the oil supply of the bracket. A positioning pin (03) may have been fitted in the bracket to ensure correct positioning.
5. Fit the fixing screws (01). Observe the steps for fastening the low-pressure stage (see following section).
6. If present, fit the support (61300) on the bracket. To do this, slightly loosen the screw (61003) connecting the gas outlet casing (61001) and the support (61300). Once the support can be turned, the three fixing screws (05) can be fitted. Observe the steps for fastening the low-pressure stage (see following section).
2.3.3 Steps for fastening the low-pressure stage

Fig. 4: Low-pressure stage, tightening the fixing screws.

- Tighten the fitted fixing screws (01) according to the following table:

<table>
<thead>
<tr>
<th>Power2</th>
<th>Fixing screws (01) [mm]</th>
<th>Tightening torques [Nm] (friction coefficient µ=0.12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>340 LP</td>
<td>M20</td>
<td>455</td>
</tr>
</tbody>
</table>

Table 3: Fixing screw tightening torque (01)

- If a support is present, tighten the fixing screws (05) according to the following table:

<table>
<thead>
<tr>
<th>Power2</th>
<th>Fixing screws (05) [mm]</th>
<th>Tightening torques [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>340 LP</td>
<td>M16</td>
<td>180</td>
</tr>
</tbody>
</table>

Table 4: Fixing screw tightening torque (05)

- Then tighten the hexagon-head screw (61003).

<table>
<thead>
<tr>
<th>Power2</th>
<th>Hexagon-head screws (61003) [mm]</th>
<th>Tightening torques [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>340 LP</td>
<td>M20</td>
<td>320</td>
</tr>
</tbody>
</table>

Table 5: Tightening torque (61003)

- Remove lifting gear.
- Connect the cable connector (86515) to the speed sensor (86505) (see Fig. 3: Placing the low-pressure stage on the bracket →6).
- Connect all gas pipes and air lines.

Version with water-cooled bearing casing

- Remove the screw plugs on the water connections.
- Fit the water pipes according to the enginebuilder's instructions.
3 Expected replacement intervals

Rotating components
The recommended replacement intervals for compressor and turbine wheels are specified based on the safety concept for rotating parts (SIKO) and dependant on the operating conditions. These intervals are shown on the rating plate of the low-pressure and high-pressure stage.

Non-rotating components
Depending on the system-specific operating conditions, a differentiation must be made between the intervals to be expected for:
- replacing the bearing parts and
- replacing the non-rotating components exposed to hot gas.

A decisive role is played by various influencing parameters which, in extreme cases, can drastically reduce the replacement interval of these parts.

During the prescribed periodic service work, the individual parts are examined for wear and replaced if necessary.

Expected replacement intervals [h]

<table>
<thead>
<tr>
<th>Part</th>
<th>GAS / MDO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbine casing</td>
<td>25000 … 50000</td>
</tr>
<tr>
<td>Nozzle ring</td>
<td>25000 … 50000</td>
</tr>
<tr>
<td>Gas outlet flange</td>
<td>25000 … 50000</td>
</tr>
<tr>
<td>Heat shield</td>
<td>25000 … 50000</td>
</tr>
<tr>
<td>Rotor components</td>
<td>See rating plate data</td>
</tr>
<tr>
<td>Bearing parts</td>
<td>12000 … 24000</td>
</tr>
<tr>
<td>Other casings</td>
<td>50000</td>
</tr>
</tbody>
</table>

Table 6: Expected replacement intervals [h]

GAS = Gas
MDO = Marine Diesel Oil

The specified values are guideline values and are not guaranteed, see influence parameters.
Influencing parameters

The actual values can deviate considerably from the guideline values, for example, due to the following influences:

- Fuel quality and fuel treatment
- Load profile (thermal cycling, also number of starts/stops, emergency shutdowns)
- Gas inlet temperature
- Frequency and execution of turbine and compressor cleaning
- Specification of the low-pressure stage
- System-specific operating conditions (combustion quality, exhaust gas composition)

For bearing parts

- Lubricating oil quality (oil filtering, oil condition, oil monitoring)
- Load profile (speed, pressure conditions, temperature)
- Number of starts/stops
- Unbalance of the rotor (degree of contamination).
4 Disassembly and assembly

4.1 Introduction

The precondition for the work described in the following is a low-pressure stage that has been removed from the engine (see chapter Removal and installation → 3).

**CAUTION**

Further operations

This Operation Manual may be used to carry out only those operations that are described in it. If the cartridge group is disassembled or assembled incorrectly, this can lead to serious engine damage.

- ABB Turbo Systems recommends having further operations carried out only by trained staff or an ABB Turbocharging Service Station.

- Mark the casing position for assembly.

**WARNING**

Servicing the assembly devices

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

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

**Customer spare part set**

Before starting operations, make sure the required customer spare part sets are available.

- See chapter Spare parts → 37.

**Oil orifice**

- When disassembling the low-pressure stage, an oil orifice fitted in the oil inlet must not be removed (see also chapter Removing the cartridge group → 18).

**Tightening torques for components of the low-pressure stage**

The specified tightening torques of the screw fittings must be observed (see Table 18: Tightening torques [Nm] → 31).
Tightening torques for assembly devices

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

Definition of terms

- **Suspension point**
  Defined loading point on a component or an assembly (blind hole thread, eyelet, lug).

- **Assembly device**
  Devices that are fitted on the low-pressure or high-pressure stage in order to obtain a suspension point. Assembly devices are specially constructed and designed for the defined use; they are not trading goods. Use assembly devices only for the described applications.

- **Lifting gear**
  Equipment for the lifting and transporting of loads (ropes, chain block, crane). Lifting gear is not supplied by ABB Turbo Systems AG.

Swivel lifting eyes to be used

To safely lift the loads of individual components, two swivel lifting eyes are required for each thread size. These are not included in the ABB Turbo Systems scope of delivery.

<table>
<thead>
<tr>
<th>Swivel lifting eyes</th>
<th>Thread:</th>
<th>M12</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Length:</td>
<td>21 mm</td>
</tr>
<tr>
<td></td>
<td>Minimum load limit:</td>
<td>250 kg</td>
</tr>
</tbody>
</table>

Table 7: Swivel lifting eyes to be used
4.2 Weights of assemblies

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

![Diagram of parts](image)

Fig. 5: Weights of the assemblies

<table>
<thead>
<tr>
<th>Designation</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 Filter silencer</td>
<td>40</td>
</tr>
<tr>
<td>02 Radial air suction branch</td>
<td>13</td>
</tr>
<tr>
<td>03 Axial air suction branch</td>
<td>6</td>
</tr>
<tr>
<td>04 Compressor casing</td>
<td>65</td>
</tr>
<tr>
<td>05 Wall insert</td>
<td>15</td>
</tr>
<tr>
<td>06 Diffuser</td>
<td>7</td>
</tr>
<tr>
<td>07 Cartridge group</td>
<td>110</td>
</tr>
<tr>
<td>08 Nozzle ring</td>
<td>4</td>
</tr>
<tr>
<td>09 Burst ring</td>
<td>5</td>
</tr>
<tr>
<td>10 Turbine casing * (1 inlet)</td>
<td>120</td>
</tr>
<tr>
<td>11 Gas outlet flange</td>
<td>20</td>
</tr>
<tr>
<td>12 Gas outlet casing</td>
<td>65</td>
</tr>
<tr>
<td>13 Support</td>
<td>11</td>
</tr>
</tbody>
</table>

Table 8: Weights of the assemblies

* Including burst protection
4.3 Removing the gas outlet casing and gas outlet flange

1. Loop around the gas outlet casing (61001) with lifting gear.
2. Remove screw (61003) with Verbus Ripp® washer (61004) and branch (61300).
3. Loosen nuts (51009) and remove with Verbus Ripp® washers (51004).
4. Remove the gas outlet casing (61001).
5. Remove the gasket (61002).
6. Measure radial clearance (R) (see chapter LP-TC: Radial clearances N and R)
7. Press off the gas outlet flange (57002) with screws (S) according to the following table.

<table>
<thead>
<tr>
<th>Press-off screws to be used (strength 8.8)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>6x M10</td>
</tr>
</tbody>
</table>

Table 9: Press-off screws to be used

*Not included in the ABB Turbo Systems scope of delivery.
4.4 Removing air inlets

Fig. 7: Removing the air inlets

1. Loop around the filter silencer (81000) with lifting gear.
2. Loosen the V-clamp (72020).
3. Remove the filter silencer (81000) with the O-ring (81010) or the air suction branch (82000) with the O-ring (82010).
4.5 Removing the compressor casing

Measure radial clearance N before removing the compressor casing (72000) (see chapter LP-TC: Radial clearances N and R).

NOTICE
Loosening the compressor casing with press-off tool
If the compressor casing cannot be loosened, it can be pressed off against the turbine casing with the press-off tool (90042). See section Pressing off the casing →17.

1. Loosen screws (72011) and remove together with fastening strips (72012).
2. Attach swivel lifting eye (01) to the compressor casing and the lifting gear.
3. Remove the compressor casing (72000) and turn it 180°.
4. Remove O-ring (42012).
5. Loosen screws (79041) and remove from the compressor casing (72000) with fixing discs (79040) and diffuser (79000).
Dismantling the wall insert

1. Knock the wall insert (77000) out of the compressor casing (72000) with a nylon hammer.
2. Attach swivel lifting eyes (01) to compressor casing (72000) and lifting gear.
3. Lift up the compressor casing (72000).
4. Remove O-ring (77005).
4.6 Pressing off the casing

⚠️ CAUTION
Axial force of the press-off tool
Using the press-off tool (90042), a high level of axial force can be generated. If the casing is pressed off with too much force on one side, the rotor can be damaged.

- Use the tool on both sides in alternation and make sure not to press off too hard on either side.

Fig. 10: Press off the casing
4.7 Removing the cartridge group

Do not remove oil orifice (if present)

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

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

Fig. 11: Oil orifice

01 Bearing casing
02 Oil orifice
03 Circlip
Removing the cartridge group

**NOTICE**

Loosening the turbine casing with the press-off tool

If the turbine casing cannot be loosened, it can be pressed off against the bearing casing with the press-off tool (90042). See section Pressing off the casing →17.

---

**WARNING**

Looping the lifting gear around the cartridge group

The looped lifting gear can slip off and lead to serious injuries to persons or even to fatal accidents.

- Make sure the surface for the loop on the cartridge group is free from oil.

Wear safety gloves against mechanical risks.

Wear safety helmet.

---

Fig. 12: Removing the cartridge group

1. Treat thread of studs (51006) with penetrating oil and leave to take effect.
2. Loosen nuts (51007) and remove Verbus Ripp® washers (51003) together with fastening strips (51002).
3. Attach the lifting gear to the frame and loop around the bearing casing as shown. With an oil-cooled cartridge group, use the fin instead of the frame (see a).
4. Remove the cartridge group. After the nozzle ring has been removed, the cartridge group can be placed on the service support (90012) (see next section).
Removing the nozzle ring

1. Place the fastening strips (51002) under the nozzle ring.
2. Pull out the nozzle ring (56001) with the two extraction devices (90070) and the service support base (90012).
3. Remove the lamellar sealing ring (56005).
4. Remove the burst ring (57210).

Fig. 13: Removing the nozzle ring
Fixing the cartridge group in place

Fig. 14: Putting the cartridge group into the service support

1. Fit service support (90012) according to the illustration.
2. Fasten the cartridge group on the service support (90012).

4.8 Installing the cartridge group

Nozzle ring compression

For the nozzle ring (56001) to be fixed during operation, it must be clamped between the heat shield (42400) and the turbine casing (51000).

1. Measure dimensions A, B, and S on cleaned surfaces.
2. Calculate compression (PD).

<table>
<thead>
<tr>
<th>Compression PD</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.16 ... 0.16 mm</td>
</tr>
</tbody>
</table>

Table 10: Nozzle ring compression PD

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

1. Fit the lamellar sealing ring (56005) and secure it with adhesive tape (01). At the same time, ensure correct winding of the lamellar sealing ring (see detail A).

2. Insert the nozzle ring into the turbine casing with the cams facing downwards. Align the cams on the nozzle ring to the recesses of the turbine casing (51000).

3. Insert the nozzle ring (56001) into the turbine casing up to the stop. Do not remove the adhesive tape (01).
Installing the cartridge group

**WARNING**

**Looping the lifting gear around the cartridge group**

The looped lifting gear can slip off and lead to serious injuries to persons or even to fatal accidents.

- Make sure the surface for the loop on the cartridge group is free from oil.

Wear safety gloves against mechanical risks.

Wear safety helmet.

Fig. 17: Installing the cartridge group

1. Attach the lifting gear to the suspension eye of the cartridge group. For an oil-cooled cartridge group, see detail A.

2. Lift the cartridge group out of the service support (90012).

3. Additionally, loop the lifting gear around the cartridge group as shown.

4. Carefully lower the cartridge group into the turbine casing.

5. Secure fastening strips (51002) together with nuts (51007) and Verbus Ripp® washers (51003).

<table>
<thead>
<tr>
<th>Part number</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>51007</td>
<td>M12 75</td>
</tr>
</tbody>
</table>

Table 11: Tightening torques (51007)
4.9 Installing the compressor casing

Fitting the wall insert

1. Always replace the O-ring (77005) (see chapter Spare parts $\rightarrow$37).
2. Install the wall insert (77000) in the compressor casing.
3. Secure the diffuser (79000) with fixing discs (79040) and screws (79041).

<table>
<thead>
<tr>
<th>Part number</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>79041</td>
<td>M6 8</td>
</tr>
</tbody>
</table>

Fig. 18: Fitting the wall insert

Table 12: Tightening torques (79041)
Installing the compressor casing

Fig. 19: Installing the compressor casing

1. Thoroughly clean the fastening strips (72012) before assembly.
2. Attach swivel lifting eyes (01) to the compressor casing (72000) and lifting gear.
3. Install compressor casing (72000).
4. Install the fastening strips (72012) with screws (72011).

![Diagram of compressor casing installation]

Table 13: Tightening torques (72011)

<table>
<thead>
<tr>
<th>Part number</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>72011</td>
<td>M12 105</td>
</tr>
</tbody>
</table>

- Always replace the O-ring (42012) (see chapter Spare parts →37).
4.10 Installing air inlets

1. Loop around the filter silencer (81000) with lifting gear.
2. Fit the filter silencer (81000) with the O-ring (81010) or the air suction branch (82000) with the O-ring (82010) and V-clamp (72020).
3. Tighten the V-clamp (72020).

<table>
<thead>
<tr>
<th>Part number</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>72020</td>
<td>M12 60</td>
</tr>
</tbody>
</table>

Table 14: Tightening torques (72020)
4.11 Installing the gas outlet flange and gas outlet casing

1. Fit the gas outlet flange (57002) and measure the radial clearance (R) (see chapter LP-TC: Radial clearances N and R).
2. Coat the threaded stud with high-temperature grease.
3. Insert a new gasket (61002) into the gas outlet casing (61001).
4. Fit the gas outlet casing (61001) with washer (51004) and nut (51009).
5. Tighten nut (51009).
6. Fit branch (61300) with washer (61004) and screw (61003).
7. Tighten screw (61003).

<table>
<thead>
<tr>
<th>Part number</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>51009</td>
<td>M12 65</td>
</tr>
<tr>
<td>61003</td>
<td>M20 320</td>
</tr>
</tbody>
</table>

Table 15: Tightening torques (51009, 61003)
4.12 Radial clearances N and R

![Diagram of measuring clearances N and R]

**Fig. 22: Measuring clearances N and R**

<table>
<thead>
<tr>
<th>Clearance N</th>
<th>Clearance R</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.45 ... 0.90 mm</td>
<td>0.64 ... 1.00 mm</td>
</tr>
</tbody>
</table>

Table 16: Permissible clearances N and R

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

⚠️ **CAUTION**

**Clearances outside the tolerance**

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

- Have the components assessed and, if necessary, replaced by an ABB Turbocharging Service Station.
4.13 Axial clearance A and radial clearance B

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

![Fig. 23: Measuring clearance A and B](image)

<table>
<thead>
<tr>
<th>Axial clearance A</th>
<th>Radial clearance B</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.12 ... 0.21 mm</td>
<td>0.70 ... 1.37 mm</td>
</tr>
</tbody>
</table>

Table 17: Permissible clearances A and B

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

⚠️ CAUTION

Clearances outside the tolerance

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

- Have the components assessed and, if necessary, replaced by an ABB Turbocharging Service Station.
The following tightening torques [Nm] must be observed for the designated screw fittings:

<table>
<thead>
<tr>
<th>Position</th>
<th>Part number</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>82005, 82007</td>
<td>M18x1.5 60</td>
</tr>
<tr>
<td>02</td>
<td>72020</td>
<td>M12 60</td>
</tr>
<tr>
<td>03</td>
<td>79041</td>
<td>M6 8</td>
</tr>
<tr>
<td>04</td>
<td>72011</td>
<td>M12 105</td>
</tr>
<tr>
<td>05</td>
<td>51007</td>
<td>M12 75</td>
</tr>
<tr>
<td>06</td>
<td>51101 / 51103 / 51104</td>
<td>M12 65</td>
</tr>
<tr>
<td>07</td>
<td>51009</td>
<td>M12 65</td>
</tr>
<tr>
<td>08</td>
<td>61005</td>
<td>M18x1.5 60</td>
</tr>
<tr>
<td>09</td>
<td>61003</td>
<td>M20 320</td>
</tr>
<tr>
<td>10</td>
<td>86505</td>
<td>M12x1.5 15</td>
</tr>
<tr>
<td>11</td>
<td>42188</td>
<td>M12x1.5 35</td>
</tr>
</tbody>
</table>

Table 18: Tightening torques [Nm]
5 Taking out of operation at short notice

5.1 Possible emergency repairs

**WARNING**

Danger of fire and explosion due to lubricating oil leaks

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

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

Wear safety gloves 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 blanking off the low-pressure or high-pressure stage on the engine.

- Follow the directives of the enginebuilder.

If the engine has to be brought back into operation again as quickly as possible in the event of a low-pressure or high-pressure stage defect, there are options for emergency repairs:

- If present: Fit replacement cartridge group.
- If a replacement cartridge group is not available: Fit cover plate and contact an ABB Turbocharging Service Station.
- Observe the following sections in connection with the emergency repairs mentioned.
5.2 Installing a replacement cartridge group

The repair of a cartridge group requires special tools and the expertise of an ABB Turbocharging Service Station. The rotating parts turn very fast and are very sensitive to unbalance.

**WARNING**

**Cartridge group**

Incorrect handling of a cartridge group can damage the low-pressure or high-pressure stage and cause injuries to persons.

- Have repairs to the cartridge group carried out by an ABB Turbocharging Service Station only.

**NOTICE**

**Quick recommissioning**

To enable you to put a defective low-pressure or high-pressure stage back into operation quickly, ABB Turbo Systems recommends having a replacement cartridge group available in storage. A replacement cartridge group can be installed within a short period of time, and the low-pressure or high-pressure stage can be operated again. Additionally, losses resulting from an interruption of engine operation can be minimised.

A replacement cartridge group is ready for use immediately and includes the complete bearing casing with bearing and a balanced rotor.

- For information on how to remove and install the cartridge group, see chapter Disassembly and assembly →3.
- Send the defective cartridge group to an ABB Turbocharging Service Station for inspection and repair.
5.3 Fitting the cover plate

- Remove low-pressure stage (see chapter Removal and installation →3).

- **Gas outlet casing removed**
  - Fit the turbine casing with the gas outlet casing into the gas pipe again.
  - Attach cover plate.

- **Gas outlet casing not removed**
  - Fit the turbine casing into the gas pipe and on the gas outlet casing again.
  - Attach cover plate.

![Image of Fitting the cover plate]

Fig. 25: Fitting the cover plate

- Make sure that the oil connections in the bracket are equipped with gaskets.
  1. Close the opening in the turbine casing (51000) with the cover plate (01).
  2. Thoroughly clean the fastening strips (51002) before assembly.
  3. Coat the threads of the studs (51006) with high-temperature grease.
  4. Fasten the cover plate on the turbine casing (51000) with fastening strips (51002), Verbus Ripp® washers (51003) and nuts (51007), and screw it onto the bracket.

<table>
<thead>
<tr>
<th>Part number</th>
<th>51007</th>
<th>51006</th>
<th>51003</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>51002</td>
<td>51000</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>51000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td>51007</td>
<td></td>
</tr>
</tbody>
</table>

**Table 19: Tightening torques (51007)**

<table>
<thead>
<tr>
<th>Part number</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>51007</td>
<td>M12 75</td>
</tr>
</tbody>
</table>
5.4 Cover plate drawing

The cover plate is not included in the ABB Turbo Systems scope of delivery and must be manufactured by the operating company according to the following drawing.


![Diagram of cover plate drawing](image)

Fig. 26: Cover plate drawing

<table>
<thead>
<tr>
<th>B1</th>
<th>B2</th>
<th>B3</th>
<th>B4</th>
<th>B5</th>
<th>B6</th>
<th>B7</th>
<th>ØD1</th>
<th>ØD2</th>
<th>R1</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>± 0.5</td>
<td></td>
<td></td>
<td>± 0.2</td>
<td></td>
<td></td>
<td>± 0.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>98.2</td>
<td>102</td>
<td>190</td>
<td>17.2</td>
<td>2</td>
<td>220</td>
<td>48.2</td>
<td>332.5</td>
<td>25</td>
<td>≤ 153</td>
<td>M10</td>
</tr>
</tbody>
</table>

Table 20: Cover plate dimensions [mm]
6 Spare parts

6.1 Ordering spare parts

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

- Serial number of Power2 (HT……)
- Serial number of the low or high-pressure stage (PT……)
- Designation and part number.

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

- If different model variants are not taken into account in this document, contact an ABB Turbocharging Service Station.

Required customer spare part set (97070) for a low-pressure stage

For the operations described in the Operation Manual, the customer spare part set (97070) is required. These parts are only available in the complete set.

<table>
<thead>
<tr>
<th>Part number</th>
<th>Designation</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>42012</td>
<td>O-ring</td>
<td>1</td>
</tr>
<tr>
<td>61002 *</td>
<td>Gasket</td>
<td>1</td>
</tr>
<tr>
<td>77005</td>
<td>O-ring</td>
<td>1</td>
</tr>
<tr>
<td>79041</td>
<td>Counter-sunk screw</td>
<td>2</td>
</tr>
<tr>
<td>81010 / 82010</td>
<td>O-ring</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 21: Customer spare part set (97070)

* This gasket can only be installed when a gas outlet casing from ABB Turbo Systems is used.

⚠️ CAUTION

Spare part storage

All spare parts that were ordered together with the low-pressure and/or high-pressure stage must be kept intact and ready for use.

- Carefully clean any rusted parts and grease them.

- Dispose of replaced parts and parts that are not reusable in a professional and environmentally compatible manner.
6.2 **View of low-pressure stage with part numbers**

Fig. 27: Low-pressure stage with part numbers

(……) only available in customer spare part set (97070).
### Part numbers

<table>
<thead>
<tr>
<th>Part number</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>10900</td>
<td>Cartridge group</td>
</tr>
<tr>
<td>42008</td>
<td>Socket screw</td>
</tr>
<tr>
<td>42012</td>
<td>(in the customer spare part set)</td>
</tr>
<tr>
<td></td>
<td>O-ring</td>
</tr>
<tr>
<td>51000</td>
<td>Turbine casing</td>
</tr>
<tr>
<td>51002</td>
<td>Fastening strip</td>
</tr>
<tr>
<td>51100</td>
<td>Gas outlet casing</td>
</tr>
<tr>
<td>51105*</td>
<td>Metal C-ring</td>
</tr>
<tr>
<td>56005</td>
<td>Lamellar sealing ring</td>
</tr>
<tr>
<td>61003</td>
<td>Hexagon-head screw</td>
</tr>
<tr>
<td>61004</td>
<td>Washer</td>
</tr>
<tr>
<td>61200</td>
<td>Burst protection</td>
</tr>
<tr>
<td>61300</td>
<td>Support</td>
</tr>
<tr>
<td>57002</td>
<td>Gas outlet flange</td>
</tr>
<tr>
<td>61002*</td>
<td>(in the customer spare part set)</td>
</tr>
<tr>
<td></td>
<td>Gasket</td>
</tr>
<tr>
<td>57003*</td>
<td>Metal C-ring</td>
</tr>
<tr>
<td>56001</td>
<td>Nozzle ring</td>
</tr>
<tr>
<td>51500</td>
<td>Burst protection</td>
</tr>
<tr>
<td>57210</td>
<td>Burst ring</td>
</tr>
<tr>
<td>72000</td>
<td>Compressor casing</td>
</tr>
<tr>
<td>72011</td>
<td>Hexagon-head screw</td>
</tr>
<tr>
<td>72012</td>
<td>Fastening strip</td>
</tr>
<tr>
<td>72020</td>
<td>V-clamp</td>
</tr>
<tr>
<td>77000</td>
<td>Wall insert</td>
</tr>
<tr>
<td>77005*</td>
<td>(in the customer spare part set)</td>
</tr>
<tr>
<td></td>
<td>O-ring</td>
</tr>
<tr>
<td>79000</td>
<td>Diffuser</td>
</tr>
<tr>
<td>79040</td>
<td>Fixing disc</td>
</tr>
<tr>
<td>79041*</td>
<td>(in the customer spare part set)</td>
</tr>
<tr>
<td></td>
<td>Counter-sunk screw</td>
</tr>
<tr>
<td>81000</td>
<td>Filter silencer</td>
</tr>
<tr>
<td>81010*</td>
<td>(in the customer spare part set)</td>
</tr>
<tr>
<td></td>
<td>O-ring</td>
</tr>
<tr>
<td>82000</td>
<td>Air suction branch</td>
</tr>
<tr>
<td>82010*</td>
<td>(in the customer spare part set)</td>
</tr>
<tr>
<td></td>
<td>O-ring</td>
</tr>
<tr>
<td>86505*</td>
<td>Speed sensor</td>
</tr>
<tr>
<td>86515*</td>
<td>Cable connector</td>
</tr>
<tr>
<td>86526*</td>
<td>F/I converter</td>
</tr>
<tr>
<td>86528*</td>
<td>Tachometer</td>
</tr>
</tbody>
</table>

### Table 22: Low-pressure stage with part numbers

* Depending on the specification of the low-pressure stage
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<th>Title</th>
<th>Page</th>
</tr>
</thead>
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</tr>
<tr>
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<td>Removal and installation</td>
<td>3</td>
</tr>
<tr>
<td>2.1</td>
<td>Transport / weight</td>
<td>3</td>
</tr>
<tr>
<td>2.2</td>
<td>Removing the high-pressure stage</td>
<td>4</td>
</tr>
<tr>
<td>2.3</td>
<td>Installing the high-pressure stage</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>Expected replacement intervals</td>
<td>13</td>
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</tbody>
</table>
## 1 Further applicable documents

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Document number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation Manual / Power2 / 1 Introduction</td>
<td>HZTL4003 or HZTL4004</td>
</tr>
<tr>
<td>Operation Manual / Power2 / 2 Safety</td>
<td>HZTL4020</td>
</tr>
<tr>
<td>Operation Manual / Power2 300-H / 4 Product description</td>
<td>HZTL4050</td>
</tr>
</tbody>
</table>

Table 1: Further applicable documents
2 Removal and installation

2.1 Transport / weight

Two swivel lifting eyes are required for the safe lifting of loads. These are not included in the ABB Turbo Systems scope of delivery.

<table>
<thead>
<tr>
<th>Swivel lifting eyes to be used</th>
<th>Thread: M12</th>
<th>Length: 21 mm</th>
<th>Minimum load limit: 200 kg</th>
</tr>
</thead>
</table>

Table 2: Swivel lifting eyes to be used

Lifting gear with a sufficient load limit must be used for removing and installing low-pressure and high-pressure stages. The following weight specifications apply to the heaviest variant possible. Depending on the specification, the weight specified on the rating plate may be lower than the standard values specified here.

<table>
<thead>
<tr>
<th>Complete high-pressure stage</th>
<th>Suspension</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>280 kg</td>
</tr>
</tbody>
</table>

Table 3: Transport / weight of high-pressure stage
2.2 Removing the high-pressure stage

Preparing for removal

► Disconnect all pipes according to the instructions of the enginebuilder.

1. Loosen and remove the screws between the bellows (82300) and the compressor casing (72000). The air suction branch (82000) with the bellows does not have to be dismantled from the air line. To protect the bellows, the high-pressure stage must not be lifted up together with the radial air suction branch and the bellows.

2. If present: Unplug the plug to the speed sensor (86505) and secure the rolled-up cable (2 m) to the low-pressure or high-pressure stage. This protects the plug from being crushed.

3. Treat the threads of the threaded rods (42191) and fixing screws (02) of the support (61300) with penetrating oil and allow it to take effect. Do not oil the pressure screws of the clamping nut (42201).

4. Attach lifting gear to high-pressure stage with two swivel lifting eyes (03).

5. Loosen and remove the fixing screws (02) of the support (61300).

► Loosen the clamping nuts (42201) in accordance with the following section.
2.2.1 Loosening the clamping nut

⚠️ CAUTION
Incorrect procedure can make loosening impossible
If individual pressure screws are fully relieved, the pressure screws can become compressed, making it impossible to loosen them.
> Comply with the following steps for loosening the pressure screws.

⚠️ CAUTION
Do not clean pressure screws
The pressure screws are equipped with a permanent sliding layer that must not be removed. In case of non-compliance, it cannot be ensured that the necessary tension force is reached.
> Do not clean pressure screws.
> Do not lubricate pressure screws.

If a screw jams, the previously loosened screw must be tightened again a little.

Fig. 2: Loosening the clamping nut

1. Working in a circle, break loose each pressure screw (≤ 20°).
2. Working in a circle, loosen each pressure screw by 45° in 4 rounds.
3. Working in a circle, loosen each pressure screw by 90° in 1...5 rounds until all of the pressure screws have been relieved.
> Loosen clamping nut by hand.
Removing the high-pressure stage

1. Unscrew the threaded rods (42191) until they are completely removed from the engine support and the centre sleeve (42193).
2. Check whether the threaded rods (42191) can be moved.
3. Screw the threaded rods back into the centre sleeve by a few revolutions.
4. Manually lift threaded rods (42191) until the centering bush (42193) is in the bearing casing. If necessary, shake the threaded rods until the centre sleeves (42193) release themselves from the engine console.
5. Screw down clamping nuts (42201) to stop for expansion bush (42190). The threaded rod remains in position.
6. Remove the high-pressure stage.
7. Cover the oil connections (01) in the bracket to protect them from dirt.

Fig. 3: Removing the high-pressure stage
2.3 Installing the high-pressure stage

2.3.1 Inserting gaskets

**CAUTION**

Inserting the gaskets

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

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

Fig. 4: Gaskets in the slots of the bearing casing

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>42001</td>
<td>Bearing casing</td>
</tr>
<tr>
<td>42198</td>
<td>O-ring</td>
</tr>
<tr>
<td>42199</td>
<td>O-ring</td>
</tr>
<tr>
<td>01</td>
<td>Oil supply</td>
</tr>
<tr>
<td>02</td>
<td>Oil drains</td>
</tr>
</tbody>
</table>

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

- Insert the O-rings (42198 and 42199) into the slots of the bearing casing.
2.3.2 Placing the high-pressure stage on the bracket

Fig. 5: Preparing the fastening elements of the high-pressure stage

1. Insert expansion bush (42190) into bearing casing.
2. Screw the clamping nut (42201) flush onto the threaded rod (42191). The hexagon of the thread screw is at the top.
3. Place thrust washer (01) of clamping nut onto expansion bush.
4. Lead threaded rod (42191) with screwed-on clamping nut through thrust washer, expansion bush and bearing casing.
5. Screw the centering bush (42193) flush onto the threaded rod from below.
2.3 Installing the high-pressure stage

1. Lightly lubricate hole into which centering bush (42193) is inserted with screw grease.
2. Position threaded rod with centering bush into bracket and insert until stop.
3. Carefully lower high-pressure stage onto bracket and position using the centering bushes (42193) located in the bracket.
4. Check value \( x \).
   - If value \( x \) is not reached, the high-pressure stage must be lifted up from the bracket and realigned.
5. Screw threaded rod into bracket up to value \( L \) using hexagon.
   - If value \( L \) is not reached or the threaded rod jams while being screwed in, the threaded rod must be loosened by no more than ½ revolution (this will loosen the centering bush which may have jammed the rod). Then continue screwing in.
   - If value \( L \) is not reached, undo the screw connection, carefully take the high-pressure stage off the bracket and repeat the procedure starting with Step 1.

Observe the steps for fastening the high-pressure stage (see following section).

<table>
<thead>
<tr>
<th>Value ( X )</th>
<th>Value ( L )</th>
</tr>
</thead>
<tbody>
<tr>
<td>106 ±2 mm</td>
<td>60 mm</td>
</tr>
</tbody>
</table>

Table 4: Values \( X \) and \( L \)
2.3.3 Steps for fastening the high-pressure stage

**WARNING**

**Support (61300)**

In radial gas outlet casings, the gas forces cause high torques to act on the high-pressure stage. If the high-pressure stage is fastened improperly, this can damage the high-pressure stage and cause serious injuries to persons or even fatal accidents.

- When using a radial gas outlet casing, only operate the high-pressure stage with a completely fitted support (61300).

---

Fig. 7: Steps for fastening the high-pressure stage

<table>
<thead>
<tr>
<th>Power2</th>
<th>Part number</th>
<th>Thread size and tightening torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>340 HP</td>
<td>01</td>
<td>M12 110 Nm</td>
</tr>
<tr>
<td>340 HP</td>
<td>61003</td>
<td>M16 180 Nm</td>
</tr>
</tbody>
</table>

Table 5: Tightening torque (01, 61003)

1. Tighten the clamping nuts (42201) (see section Tightening the clamping nut).
2. Tighten the fixing screws (01) of the support (61300) according to the following table.
3. Tighten the screw (61003) of the connection between gas outlet casing (61001) and support (61300).
   - Connect the cable connector (86515) to the speed sensor (86505).
   - Connect all gas pipes and air lines.
2.3.4 Tightening the clamping nut

Preparations for tightening the clamping nut

⚠️ CAUTION
Do not clean pressure screws (04)
The pressure screws are equipped with a permanent sliding layer that must not be removed.
Do neither clean nor lubricate the pressure screws. In case of non-compliance, it cannot be ensured that the necessary tension force is reached.
▶️ Do not clean pressure screws.
▶️ Do not lubricate pressure screws.

In order to correctly fit the clamping nuts, the pressure screws (04) must not protrude from the clamping nuts (03) in the direction of the thrust washer (02).
▶️ Make sure the pressure screws do not protrude in the direction of the thrust washer.

Fig. 8: Preparing the clamping nut for the tightening procedure

1. Clean the thread of the bolt (01) and the contact surface.
2. Lightly oil the bolt thread.
3. Position the thrust washer (02) in place.
4. Tighten clamping nut (03) by hand.
5. Unscrew clamping nut (03) by ¼ of a turn (90°).

The distance between the thrust washer and the clamping nut is now about 1 mm.
2.1 Tightening pressure screws

1. Screw in pressure screws crosswise by hand until reaching the stop.
2. Tighten pressure screws crosswise to 50% of the tightening torque specified in the table.
3. Tighten pressure screws crosswise to 100% of the tightening torque specified in the table.
4. Work in a circle to tighten all pressure screws to 100% of the tightening torque specified in the table.
5. Tighten pressure screws to 100% in 5 … 7 rounds until the required residual tightening angle of < 20° is achieved.
3 Expected replacement intervals

Rotating components

The recommended replacement intervals for compressor and turbine wheels are specified based on the safety concept for rotating parts (SIKO) and dependant on the operating conditions. These intervals are shown on the rating plate of the low-pressure and high-pressure stage.

Non-rotating components

Depending on the system-specific operating conditions, a differentiation must be made between the intervals to be expected for:

- replacing the bearing parts and
- replacing the non-rotating components exposed to hot gas.

A decisive role is played by various influencing parameters which, in extreme cases, can drastically reduce the replacement interval of these parts.

During the prescribed periodic service work, the individual parts are examined for wear and replaced if necessary.

Expected replacement intervals [h]

<table>
<thead>
<tr>
<th>Component</th>
<th>GAS / MDO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbine casing</td>
<td>25000 ... 50000</td>
</tr>
<tr>
<td>Nozzle ring</td>
<td>25000 ... 50000</td>
</tr>
<tr>
<td>Gas outlet flange</td>
<td>25000 ... 50000</td>
</tr>
<tr>
<td>Heat shield</td>
<td>25000 ... 50000</td>
</tr>
<tr>
<td>Heat sheet metal</td>
<td>25000 ... 50000</td>
</tr>
<tr>
<td>Collecting grid in gas outlet casing</td>
<td>20000</td>
</tr>
<tr>
<td>Rotor components</td>
<td>See rating plate data</td>
</tr>
<tr>
<td>Bearing parts</td>
<td>12000 ... 24000</td>
</tr>
<tr>
<td>Other casings</td>
<td>50000</td>
</tr>
</tbody>
</table>

Table 7: Expected replacement intervals [h]

GAS = Gas
MDO = Marine Diesel Oil

The specified values are guideline values and are not guaranteed, see influence parameters.
Influencing parameters

The actual values can deviate considerably from the guideline values, for example, due to the following influences:

- Fuel quality and fuel treatment
- Load profile (thermal cycling, also number of starts/stops, emergency shutdowns)
- Gas inlet temperature
- Frequency and execution of turbine and compressor cleaning
- Specification of the high-pressure stage
- System-specific operating conditions (combustion quality, exhaust gas composition)
- Atmospheric humidity after the intercooler.

For bearing parts

- Lubricating oil quality (oil filtering, oil condition, oil monitoring)
- Load profile (speed, pressure conditions, temperature)
- Number of starts/stops
- Imbalance of the rotor (degree of contamination).
4 Disassembly and assembly

4.1 Introduction

The precondition for the work described in the following is a high-pressure stage that has been removed from the engine (see chapter Removal and installation →3).

⚠️ CAUTION

Further operations

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

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

- Mark the casing position for assembly.

Identification of the assembly devices

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

⚠️ WARNING

Servicing the assembly devices

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

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

Customer spare part set

Before starting operations, make sure the required customer spare part set is available (see chapter Spare parts).

Oil orifice

- When disassembling the high-pressure stage, an oil orifice fitted in the oil inlet must not be removed (also see chapter Removing the cartridge group).

Tightening torques for components

The specified tightening torques of the screw fittings must be observed (see Table 18: Tightening torques [Nm] →32).
Tightening torques for assembly devices

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

Definition of terms

- **Suspension point**
  Defined loading point on a component or an assembly (blind hole thread, eyelet, lug).

- **Assembly device**
  Devices that are fitted on the low-pressure or high-pressure stage in order to obtain a suspension point. Assembly devices are specially constructed and designed for the defined use; they are not trading goods. Use assembly devices only for the described applications.

- **Lifting gear**
  Equipment for the lifting and transporting of loads (ropes, chain block, crane). Lifting gear is not supplied by ABB Turbo Systems.

Swivel lifting eyes to be used

To safely lift loads, two swivel lifting eyes are required for each thread size. These are not included in the ABB Turbo Systems scope of delivery.

<table>
<thead>
<tr>
<th>Swivel lifting eyes</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thread:</td>
<td>M12</td>
<td>M8</td>
</tr>
<tr>
<td>Length:</td>
<td>21 mm</td>
<td>13 mm</td>
</tr>
<tr>
<td>Minimum load limit:</td>
<td>200 kg</td>
<td>200 kg</td>
</tr>
</tbody>
</table>

Table 8: Swivel lifting eyes to be used
4.2 Weights of assemblies

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

Fig. 10: Weights of the assemblies

<table>
<thead>
<tr>
<th>Designation</th>
<th>Weight [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 Radial air suction branch</td>
<td>30</td>
</tr>
<tr>
<td>02 Axial air suction branch</td>
<td>12</td>
</tr>
<tr>
<td>03 Bellows</td>
<td>18</td>
</tr>
<tr>
<td>04 Compressor casing</td>
<td>50</td>
</tr>
<tr>
<td>05 Wall insert</td>
<td>9</td>
</tr>
<tr>
<td>06 Diffuser</td>
<td>4</td>
</tr>
<tr>
<td>07 Cartridge group</td>
<td>50</td>
</tr>
<tr>
<td>08 Nozzle ring</td>
<td>2</td>
</tr>
<tr>
<td>09 Turbine casing</td>
<td>70</td>
</tr>
<tr>
<td>10 Gas outlet flange</td>
<td>9</td>
</tr>
<tr>
<td>11 Radial gas outlet casing</td>
<td>21</td>
</tr>
<tr>
<td>12 Support</td>
<td>7</td>
</tr>
<tr>
<td>13 Axial gas outlet casing</td>
<td>12</td>
</tr>
</tbody>
</table>

Table 9: Weights of the assemblies
4.3 Removing the gas outlet casing

Mark the casing position for assembly.

1. Loop the lifting gear around the gas outlet casing (61001).
2. Loosen screw (61003) and remove with Verbus Ripp® washer (61004).
3. Remove the support (61300).
4. Loosen nuts (51009) and remove with Verbus Ripp® washers (51004) and lugs (51015).
5. Remove the gas outlet casing (61001).
6. Remove the metal C-rings (57004) and (51026).

Measure clearance R (see chapter Radial clearances N and R →30).
4.4 Removing air inlets

Mark the casing position for assembly.

Fig. 12: Removing air inlets

1. Loop the lifting gear around the radial air suction branch (82000).
2. Loosen hexagon-head screws (72013) and remove with washers (72014).
3. Remove the bellows (82300) together with the radial air suction branch (82000) or the axial air suction branch (82000) with the O-ring (82010), respectively.

Measure clearance N (see chapter Radial clearances N and R → 30).
4.5 Removing the compressor casing

- Mark the casing position for assembly.
- Measure radial clearance N before removing the compressor casing (72000) (see chapter Radial clearances N and R →30).
- Remove expansion bushes and threaded rods from bearing casing.

Fig. 13: Removing the compressor casing

1. Loosen screws (72011) and remove together with fastening strips (72012).
2. Screw two swivel lifting eyes (01) into compressor casing (72000) and secure lifting gear.
3. Remove compressor casing (72000) and place on soft surface.
4. Loosen nuts (77022) and remove with washer (77021). Wall insert (77000) is loose.
5. Remove O-ring (77005).
4.6 Removing the cartridge group

Mark the casing position for assembly.

Do not remove oil orifice (if present)

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

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

Fig. 14: Oil orifice in the bearing casing

01 Bearing casing
02 Oil orifice
03 Circlip
WARNING
Looping the lifting gear around the cartridge group
The looped lifting gear can slip off and lead to serious injuries to persons or even to fatal accidents.

- Make sure the surface for the loop on the cartridge group is free from oil.

Wear safety gloves to protect against mechanical hazards.

Wear safety helmet.

Fig. 15: Removing the cartridge group

1. Treat threads of studs (51006) with penetrating oil and leave to take effect.
2. Loosen nuts (51007) and remove Verbus Ripp® washers (51003) together with fastening strips (51002).
3. Attach swivel lifting eyes (01) to the cartridge group (10900).
4. Secure lifting gear to swivel lifting eye and loop around the cartridge group (10900) (see illustration above).
5. Remove the cartridge group and turn it 90°.
6. Place cartridge group with fitted expansion sleeves (42190) on service support (90012).
7. Hand-tighten the cartridge group with the threaded rod (42191) and the clamping nut (42201) on the service support (90012).
8. Remove metal C-ring (51105).

Removing the gas outlet flange / nozzle ring

Fig. 16: Removing the gas outlet flange / nozzle ring

1. Pull out the nozzle ring (56001) by hand. If the nozzle ring does not loosen, the gas outlet flange (57002) must be removed first.
2. Screw in swivel lifting eyes (01) on the turbine casing (51000) and attach the lifting gear.
3. Turn the turbine casing 180° and lay it down on a soft base.
4. Loosen and remove screws (51005).
5. With screws (51005), press off the gas outlet flange (57002) from the turbine casing (51000). The nozzle ring (56001) loosens, if it has not already been removed.
6. Remove the gas outlet flange (57002).
7. Remove the lamellar sealing ring (56005) from the nozzle ring and replace it with a new one after cleaning the nozzle ring.
## 4.7 Installing the cartridge group

### Nozzle ring compression

For the nozzle ring (56001) to be fixed during operation, it must be clamped between the heat shield (43001) and the turbine casing (51000).

1. Measure dimensions A, B, and S on cleaned surfaces.
2. Calculate compression (PD).

<table>
<thead>
<tr>
<th>Compression PD</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.09 ... 0.31 mm</td>
</tr>
</tbody>
</table>

Table 10: Nozzle ring compression PD

- If the calculated value (PD) lies outside the specified range, contact an ABB Turbocharging Service Station.
Installing the gas outlet flange / nozzle ring

**NOTICE**

Chamfering (02) on the nozzle ring and turbine casing

The nozzle ring (56001) can be fitted into the turbine casing (51000) only if both of the chamferings (02) on diameter D are aligned with one another.

---

1. Install the gas outlet flange (57002) with the screws (51005) in the turbine casing (51000).
2. Tighten the screws (51005).
3. Attach swivel lifting eyes (01) on the turbine casing (51000) and the lifting gear.
4. Turn the turbine casing 180°.
5. Fit the lamellar sealing ring (56005) in the nozzle ring (56001). Make sure the lamellar sealing ring is fitted correctly in the right slot (see above illustration).
6. Insert the nozzle ring into the turbine casing up to the stop and check for correct positioning, chamfering (02).

<table>
<thead>
<tr>
<th>Part number</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>51005</td>
<td>M8 25</td>
</tr>
</tbody>
</table>

Table 11: Tightening torque (51005)
Installing the cartridge group

**WARNING**

Looping the lifting gear around the cartridge group
The looped lifting gear can slip off and lead to serious injuries to persons or even to fatal accidents.

- Make sure the surface for the loop on the cartridge group is free from oil.
- Wear safety gloves to protect against mechanical hazards.
- Wear safety helmet.

Fig. 19: Installing the cartridge group

1. Insert new metal C-ring (51105) into turbine casing (51000).
2. Screw in swivel lifting eyes (01) on cartridge group (10900) and secure lifting gear.
3. Lift cartridge group out of service support (90012) and remove expansion bush (42190).
4. Rotate cartridge group by 90° and also loop lifting gear around cartridge group (10900) as shown.
5. Move cartridge group into turbine casing. When doing this, ensure that the metal C-ring (51105) is not crushed at one side.
6. Secure fastening strips (51002) together with nuts (51007) and secure and tighten the Verbus Ripp® washers (51003).

<table>
<thead>
<tr>
<th>Part number</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>51007</td>
<td>M10 45</td>
</tr>
</tbody>
</table>

Table 12: Tightening torque (51007)
4.8 Installing the compressor casing

Always replace the O-rings (42012 and 77005) with new ones (see Table 22: Customer spare part set (97070) →39).

Fig. 20: Installing the compressor casing

1. Fit new O-ring (77005) into wall insert (77000).
2. Screw two swivel lifting eyes (01) into compressor casing (72000) and secure lifting gear.
3. Lower compressor casing (72000) onto wall insert (77000) and fit with washer (77021) and nuts (77022).
4. Thoroughly clean the fastening strips (72012) before assembly.
5. Fit the diffuser (79000) with screw (42007).
7. Position compressor casing (72000) on cartridge group (109000).
8. Fit the fastening strips (72012) with screws (72011) and tighten.

<table>
<thead>
<tr>
<th>Part number</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>42007</td>
<td>M8 25</td>
</tr>
<tr>
<td>72011</td>
<td>M10 75</td>
</tr>
<tr>
<td>77022</td>
<td>M8 40</td>
</tr>
</tbody>
</table>

Table 13: Tightening torques (42007, 72011, 77022)
4.9 Installing air inlets

- Always replace the O-ring (82010) with a new one (see Table 22: Customer spare part set (97070) → 39).
- Measure clearance N (see chapter Radial clearances N and R → 30).

![Diagram of air inlet installation]

Fig. 21: Installing the air inlet

1. Install the radial air suction branch (82000) with the bellows (82300) or the axial air suction branch together with the O-ring (82010), respectively.

2. Tighten screw (72013).

<table>
<thead>
<tr>
<th>Part number</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>72013</td>
<td>M12 85</td>
</tr>
</tbody>
</table>

Table 14: Tightening torque (72013)
4.10 Installing the gas outlet casing

Measure clearance R (see chapter Radial clearances N and R → 30)

1. Clean the sealing surfaces of the C-rings (57004, 51026) on the turbine casing (51000) and the gas outlet casing (61001).
2. Insert new C-rings (57004, 51026) and position with high-vacuum grease.
3. Coat the threaded stud (51008) with high-temperature grease.
4. Loop the lifting gear around the gas outlet casing (61001).
5. Place gas outlet casing (61001) on turbine casing (51000).
6. Fit gas outlet casing (61001) with lugs (51015), Verbus Ripp® washers (51004) and nuts (51009) and tighten.
7. Fit support (61300) with Verbus Ripp® washer (61004) and screw (61003) and tighten.

<table>
<thead>
<tr>
<th>Part number</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>51009</td>
<td>M10 45</td>
</tr>
<tr>
<td>61003</td>
<td>M16 180</td>
</tr>
</tbody>
</table>

Table 15: Tightening torques (51009, 61003)
4.11 Radial clearances N and R

Fig. 23: Measuring clearances N and R

\[ N = \frac{N1 + N2}{2} \]

\[ R = \frac{R1 + R2}{2} \]

Table 16: Permissible clearances N and R

<table>
<thead>
<tr>
<th>Clearance N</th>
<th>Clearance R</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.30 ... 0.55 mm</td>
<td>0.45 ... 0.70 mm</td>
</tr>
</tbody>
</table>

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

**CAUTION**

Clearances outside the tolerance

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

- Have the components assessed and, if necessary, replaced by an ABB Turbocharging Service Station.
4.12 Axial clearance A and radial clearance B

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

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

**Table 17: Permissible clearances A and B**

<table>
<thead>
<tr>
<th>Axial clearance A</th>
<th>Radial clearance B</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.17 ... 0.35 mm</td>
<td>0.77 ... 1.29 mm</td>
</tr>
</tbody>
</table>

**CAUTION**

Clearances outside the tolerance

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

- Have the components assessed and, if necessary, replaced by an ABB Turbocharging Service Station.
4.13 Table of tightening torques

Fig. 25: Overview of tightening torques

The following tightening torques [Nm] must be observed for the designated screw fittings:

<table>
<thead>
<tr>
<th>Part number</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 72005, 82005, 82007</td>
<td>M18x1.5 60</td>
</tr>
<tr>
<td>02 82022</td>
<td>M12 85</td>
</tr>
<tr>
<td>03 72013</td>
<td>M12 85</td>
</tr>
<tr>
<td>04 77022</td>
<td>M8 40</td>
</tr>
<tr>
<td>05 42007</td>
<td>M8 25</td>
</tr>
<tr>
<td>06 72011</td>
<td>M10 75</td>
</tr>
<tr>
<td>07 42009</td>
<td>M16 20</td>
</tr>
<tr>
<td>08 51007</td>
<td>M10 45</td>
</tr>
<tr>
<td>09 51005</td>
<td>M8 25</td>
</tr>
<tr>
<td>10 51009</td>
<td>M10 45</td>
</tr>
<tr>
<td>11 51028, 61005</td>
<td>M18x1.5 60</td>
</tr>
<tr>
<td>12 61003</td>
<td>M16 180</td>
</tr>
<tr>
<td>13 86505</td>
<td>M12x1.5 15</td>
</tr>
<tr>
<td>14 42188</td>
<td>M12x1.5 35</td>
</tr>
</tbody>
</table>

Table 18: Tightening torques [Nm]
5 Taking out of operation at short notice

5.1 Possible emergency repairs

⚠️ WARNING

Danger of fire and explosion due to lubricating oil leaks

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

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

Wear safety gloves to protect against thermal hazards.

⚠️ CAUTION

Directives for taking out of operation

Serious damage to engine or property can be caused by non-compliance with the directives for blanking off the low-pressure or high-pressure stage on the engine.

- Follow the directives of the enginebuilder.

If the engine has to be brought back into operation again as quickly as possible in the event of a low-pressure or high-pressure stage defect, there are options for emergency repairs:

- If present: Fit replacement cartridge group.
- If a replacement cartridge group is not available: Fit cover plate and contact an ABB Turbocharging Service Station.
- Observe the following sections in connection with the emergency repairs mentioned.
5.2 Installing a replacement cartridge group

The repair of a cartridge group requires special tools and the expertise of an ABB Turbocharging Service Station. The rotating parts rotate extremely fast, and are sensitive to unbalance.

![WARNING]

**Cartridge group**

Incorrect handling of a cartridge group can damage the low-pressure or high-pressure stage and cause injuries to persons.

- Always have repairs to the cartridge group carried out by an ABB Turbocharging Service Station.

![NOTICE]

**Quick recommissioning**

To enable you to put a defective low-pressure or high-pressure stage back into operation quickly, ABB Turbo Systems recommends having a replacement cartridge group available in stock. A replacement cartridge group can be installed within a short period of time, and the low-pressure or high-pressure stage can be operated again.

A replacement cartridge group is ready for use immediately and includes the complete bearing casing with bearing and a balanced rotor.

- For information on how to remove and install the cartridge group, see chapter Disassembly and assembly.

- Send the defective cartridge group to an ABB Turbocharging Service Station for inspection and repair.
5.3 Fitting the cover plate

The cover plate has two functions. It seals the turbine casing from exhaust gas and the bracket from oil leaks.

- Remove high-pressure stage (see chapter Removal and installation →3).
- Fit the turbine casing with the gas outlet casing into the gas pipe again.
- Attach the cover plate (see following section).

Fig. 26: Attaching a cover plate

1. With the high-pressure stage, make sure that the oil connections of the high-pressure stage are sealed with a gasket under the cover plate (01) or with O-rings inside the cover plate (01). If the O-rings of the high-pressure stage are used, slots must be cut in the contact surface of the cover plate (see Fig. 28: Figure for cover plate, slots for O-rings →37).

2. Close the opening in the turbine casing (51000) with the cover plate (01).

3. Thoroughly clean the fastening strips (51002) before assembly. Coat the threads of the studs (51006) with high-temperature grease.

4. Fasten cover plate (01) to turbine casing (51000) with fastening strips (51002), Verbus Ripp® washers (51003) and nuts (51007) and screw to bracket.

<table>
<thead>
<tr>
<th>Part number</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>51007</td>
<td>M10 45</td>
</tr>
</tbody>
</table>

Table 19: Tightening torque (51007)
5.4 Cover plate drawing

The cover plate is not included in the ABB Turbo Systems scope of delivery and must be manufactured by the operating company according to the following drawing.


Fig. 27: Cover plate drawing

<table>
<thead>
<tr>
<th>B1 (± 0.5)</th>
<th>B2</th>
<th>B3</th>
<th>B4 (± 0.2)</th>
<th>B5</th>
<th>B6</th>
<th>B7 (± 0.2)</th>
<th>ØD1</th>
<th>ØD2</th>
<th>R1</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>82.5</td>
<td>70</td>
<td>158</td>
<td>20</td>
<td>2</td>
<td>212</td>
<td>47.9</td>
<td>251.2</td>
<td>25</td>
<td>≤ 115</td>
<td>M8</td>
</tr>
</tbody>
</table>

Table 20: Cover plate dimensions [mm]
Slots for O-rings in cover plate

Fig. 28: Figure for cover plate, slots for O-rings

Table 21: Dimensions of cover plate, slots for O-rings [mm]

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>J</th>
<th>K</th>
<th>R1</th>
</tr>
</thead>
<tbody>
<tr>
<td>172</td>
<td>86</td>
<td>54</td>
<td>27</td>
<td>3.4</td>
<td>19.5</td>
<td>4.5</td>
<td>2.9</td>
<td>3.4</td>
<td>3.1</td>
<td>16.8</td>
</tr>
</tbody>
</table>
6 Spare parts

6.1 Ordering spare parts

**CAUTION**

Spare part storage

All spare parts that were ordered together with the low-pressure and/or high-pressure stage must be kept intact and ready for use.

- Carefully clean any rusted parts and grease them.

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

- Serial number of Power2 (HT……)
- Serial number of the low or high-pressure stage (PT……)
- Designation and part number.

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

- If different model variants are not taken into account in this document, contact an ABB Turbocharging Service Station.
- Dispose of placed and unusable parts in an environmentally-friendly and professional manner in accordance with the local regulations.
- Dispose of the packaging of new parts in an environmentally-friendly and professional manner in accordance with the local regulations.
Required customer spare part set (97070) for a high-pressure stage

For the operations described in the Operation Manual, the customer spare part set (97070) is required. These parts are only available in the complete set.

<table>
<thead>
<tr>
<th>Part number</th>
<th>Designation</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>42010</td>
<td>O-ring</td>
<td>1</td>
</tr>
<tr>
<td>42012</td>
<td>O-ring</td>
<td>1</td>
</tr>
<tr>
<td>42198</td>
<td>O-ring</td>
<td>1</td>
</tr>
<tr>
<td>42199</td>
<td>O-ring</td>
<td>1</td>
</tr>
<tr>
<td>51005</td>
<td>Socket screw</td>
<td>3</td>
</tr>
<tr>
<td>51026</td>
<td>Metal C-ring</td>
<td>1</td>
</tr>
<tr>
<td>51105</td>
<td>Metal C-ring</td>
<td>1</td>
</tr>
<tr>
<td>56005</td>
<td>Lamellar sealing ring</td>
<td>1</td>
</tr>
<tr>
<td>57004</td>
<td>Metal C-ring</td>
<td>1</td>
</tr>
<tr>
<td>77005</td>
<td>O-ring</td>
<td>1</td>
</tr>
<tr>
<td>82010</td>
<td>O-ring</td>
<td>1</td>
</tr>
<tr>
<td>61007</td>
<td>Metal C-ring (Standard with axial gas outlet casings)</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 22: Customer spare part set (97070)
6.2  View of high-pressure stage with part numbers

* Depending on the specification of the high-pressure stage
(……) only available in customer spare part set (97070).
<table>
<thead>
<tr>
<th>Part number</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>10900</td>
<td>Cartridge group</td>
</tr>
<tr>
<td>42009</td>
<td>Screw plug</td>
</tr>
<tr>
<td>42010</td>
<td>O-ring</td>
</tr>
<tr>
<td>42012</td>
<td>O-ring</td>
</tr>
<tr>
<td>42190</td>
<td>Expansion bush</td>
</tr>
<tr>
<td>42191</td>
<td>Threaded rod</td>
</tr>
<tr>
<td>42193</td>
<td>Centering bush</td>
</tr>
<tr>
<td>42196</td>
<td>Orifice, oil inlet</td>
</tr>
<tr>
<td>42197</td>
<td>Locking ring</td>
</tr>
<tr>
<td>42198</td>
<td>O-ring</td>
</tr>
<tr>
<td>42199</td>
<td>O-ring</td>
</tr>
<tr>
<td>42201</td>
<td>Clamping nut</td>
</tr>
<tr>
<td>51000</td>
<td>Turbine casing</td>
</tr>
<tr>
<td>51002</td>
<td>Fastening strip</td>
</tr>
<tr>
<td>51015</td>
<td>Fastening strip</td>
</tr>
<tr>
<td>51026</td>
<td>Metal C-ring</td>
</tr>
<tr>
<td>51105</td>
<td>Metal C-ring</td>
</tr>
<tr>
<td>57002</td>
<td>Gas outlet flange</td>
</tr>
<tr>
<td>57004</td>
<td>Metal C-ring</td>
</tr>
<tr>
<td>56001</td>
<td>Nozzle ring</td>
</tr>
<tr>
<td>56005</td>
<td>Lamellar sealing ring</td>
</tr>
<tr>
<td>61001</td>
<td>Gas outlet casing</td>
</tr>
<tr>
<td>61003</td>
<td>Hexagon-head screw</td>
</tr>
<tr>
<td>61004</td>
<td>Verbus Ripp® Washer</td>
</tr>
<tr>
<td>61007</td>
<td>Metal C-ring</td>
</tr>
<tr>
<td>61205</td>
<td>Protective grid</td>
</tr>
<tr>
<td>61300</td>
<td>Support</td>
</tr>
<tr>
<td>72000</td>
<td>Compressor casing</td>
</tr>
<tr>
<td>72012</td>
<td>Fastening strip</td>
</tr>
<tr>
<td>77000</td>
<td>Wall insert</td>
</tr>
<tr>
<td>77005</td>
<td>O-ring</td>
</tr>
<tr>
<td>79000</td>
<td>Diffuser</td>
</tr>
<tr>
<td>82000</td>
<td>Air suction branch</td>
</tr>
<tr>
<td>82010</td>
<td>O-ring</td>
</tr>
<tr>
<td>82500</td>
<td>Bellows</td>
</tr>
<tr>
<td>86505*</td>
<td>Speed sensor</td>
</tr>
<tr>
<td>86515*</td>
<td>Cable connector</td>
</tr>
<tr>
<td>86526*</td>
<td>F/I converter</td>
</tr>
<tr>
<td>86528*</td>
<td>Tachometer</td>
</tr>
</tbody>
</table>

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