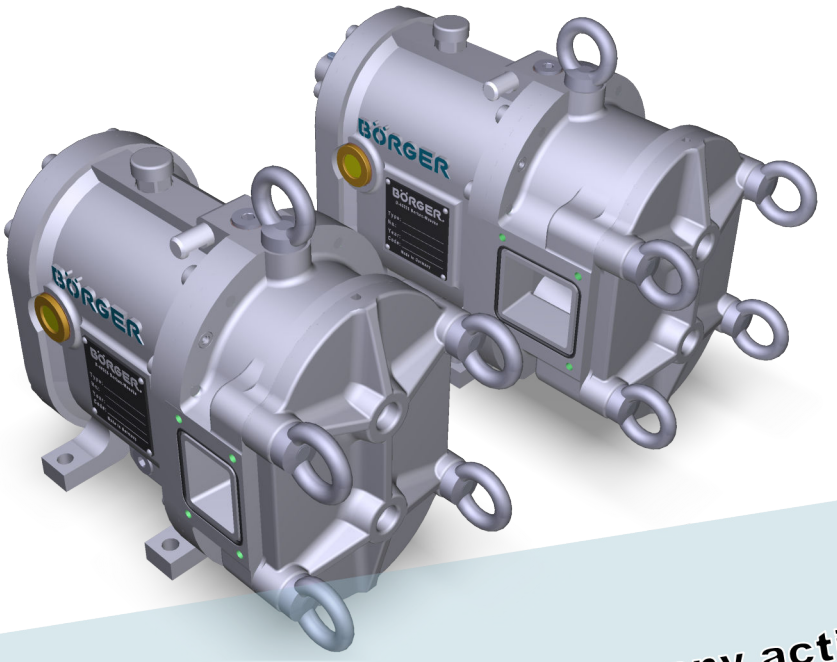
BÖRGER Innovation

Operating Manual

Börger Rotary Lobe Pump

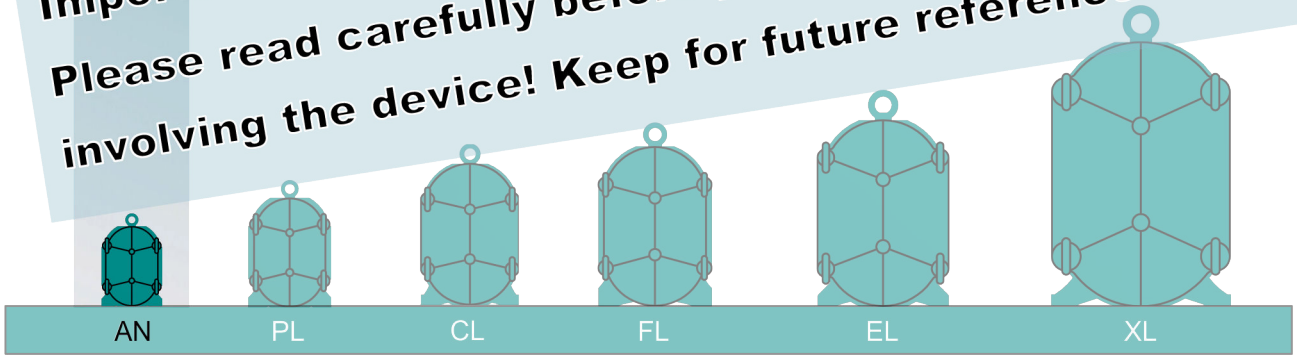
Classic AN

AN Series



Important!

Please read carefully before performing any activity involving the device! Keep for future reference!



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Product Specifications

Unit:	
Product group:	Rotary lobe pump
Type:	AN 040, AN 070
	Precise product specifications for your unit, with the exception of control units, can be found in the data sheet enclosed with this operating manual.
Manufacturer's address:	
Company:	Börger GmbH
Address:	Benningsweg 24
Town / city:	46325 Borken-Weseke, Germany
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E-mail:	service@boerger.de
Spare parts orders and customer service in other countries:	
	See separate contact data for your regional sales partner
Document data:	
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Language:	English translation of the German original, available at service@boerger.de

Table of Contents

1 General information

1.1 Introduction

This operating manual is an important aid for the correct and safe operation of the Börger machine.

It contains important information for operating the Börger machine in a safe, proper and economical manner.

Adhering to these instructions will help avoid associated dangers, reduce repair costs and downtimes and increase the reliability and service life of the Börger machine.

The operating manual must be made available at all times. All personnel who work on or with the Börger machine must read and adhere to the manual. This work includes:

— Operation and troubleshooting
— Maintenance (machine care, maintenance and repairs)
— Transportation.

1.2 Notes on copyrights and property rights

This operating manual must be treated as confidential. It may only be made accessible to authorized persons. The manual may only be passed on to third parties following written approval from Börger GmbH.

All documents are protected according to the copyright laws. The distribution and reproduction of documents, in whole or in part, plus the exploitation and distribution of all associated content is forbidden unless expressly authorized in writing.

Violations will be prosecuted and may lead to claims for compensation. All rights for exercising industrial property rights are reserved by Börger GmbH.

1.3 Information for the operator

The operating manual is an integral part of the Börger machine. The operator is responsible for making the operating personnel aware of this manual.

Additionally, the operator is obligated to ensure the notice and observance of national regulations for accident prevention and environmental protection, plus the notice and observance of supervision and reporting duties taking special operational aspects into account, e.g. regarding work organization, work processes and personnel.

Aside from the operating manual and the currently valid accident prevention regulations in the country of operation and at the installation site, all recognized special regulations for safe and proper operation must be observed.

The operator is not permitted to make or arrange for any changes, modifications or alterations to the Börger machine without approval from Börger GmbH.

Any spare parts used must comply with the technical requirements specified by Börger GmbH. This is always guaranteed when original spare parts are used. Only original spare parts may be used during the warranty period, failing which the warranty is void.

Only trained or instructed personnel may be assigned to operate, maintain, repair or transport the Börger machine. Clearly define the personnel responsible for operation, maintenance, repair and transportation.

1.4 Training and instruction

As the operator, you are obligated to inform and, if necessary, instruct your operating personnel in regard to the applicable legal and accident prevention regulations, as well as the available safety equipment on the Börger machine.

This obligation also applies to all other safety equipment on and around the Börger machine. The different technical qualifications of the operating personnel must be taken into account. The operating personnel must have fully understood the instructions, and adherence to the instructions must be guaranteed. Only then can your personnel work safely and be fully aware of associated risks.

Adherence to instructions must be checked on a regular basis. As the operator, you should therefore have each instructed staff member confirm their training participation in writing.

Sample training topics and a sample form for confirming participation in the training/instruction can be found on the following pages.

Börger GmbH, their regional subsidiaries or your local sales partner will be happy to help you regarding staff instruction. They can also carry out training on the functionality, commissioning, maintenance and repair of the Börger machine, on request.

Contact us for a detailed quotation.

1.5 Sample training topics

1. Operational safety

- Accident prevention regulations
- General legal regulations
- General safety instructions
- Measures in the event of emergencies
- Safety instructions for operating the Börger machine
- Using the safety equipment on the Börger machine
- Safety equipment on and around the Börger machine
- Explanation of symbols and signs

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2. Operating the Börger machine

— Using the operating elements on the Börger machine
— Explanation of the operating manual for operating personnel
— Specific experiences in using the Börger machine
— Troubleshooting / dealing with malfunctions

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3. Repair and maintenance regulations

— Correct handling of cleaning agents and lubricants
— Specific experiences regarding repair, maintenance, cleaning and care of the Börger machine

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Confirmation of training		
Training topic		
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No.	Surname, first name	Signature
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2 Safety

2.1 General Information

The Börger machine has been developed and constructed according to current state-of-the-art technology and recognized safety guidelines in observance of the valid safety regulations in the country of manufacture.

However, operation of the Börger machine may endanger the operating person and cause damage to the Börger machine or other material assets in the following circumstances:

— When operated by untrained or uninstructed personnel
— When not used properly
— When not maintained or repaired properly

2.2 Notes on signs and symbols

The following terms, signs and symbols are used in this operating manual, and indicate particularly important information.

DANGER!

Warns of an immediate hazardous situation with unavoidable serious injuries or death as a result if the instructions shown are not strictly adhered to.

WARNING!

Warns of a hazardous situation with the possible risk of subsequent serious injuries or death if the instructions shown are not strictly adhered to.

CAUTION!

Warns of a possible hazardous situation with the risk of subsequent moderate or light injuries and material damage if the instructions shown are not strictly adhered to.

NOTICE!

Indicates a possible hazardous situation or unsafe, dangerous work processes that may lead to damage to the machine or surrounding area.

NOTE!

Offers useful information on safe and proper operation.

→ Arrow symbols describe work and/or operational steps. These steps must be carried out in the sequence of the numbering.

— Indents indicate lists.

↳ *Arrow symbols indicate references to further chapters.*

NOTE!
Illustration of work steps:

Some of the diagrams and photographic images used in this operating manual, which are only used to illustrate a function or a particular work step, show a different type of device, however the functional principle or work step is the same.

2.3 Proper use

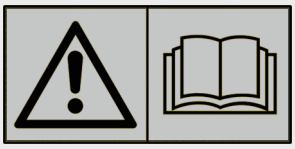
The rotary lobe pump is a self-priming, valveless positive displacement pump.

The rotary lobe pump delivers the pumped medium specified in the data sheet continuously, at speed-proportional flow rates, in a gentle, low-pulsation procedure.

NOTE!
Proper use

The Börger machine or unit is configured exclusively for the operating conditions entered in your request/order and specified in the order confirmation and enclosed data sheet.

— Observe the technical specifications in the data sheet.
— Therefore, proper use is restricted to the specified pumped medium, temperatures, speeds and output only.



Proper use includes compliance with the instructions on

— safety,
— operation and control,
— repairs and maintenance,

specified in this operating manual.

Any other use or use over and above these specifications is deemed as improper use. The operator of the Börger machine is solely liable for any resulting damage.

2.4 Residual risk

Even when all safety instructions are adhered to, there are residual risks involved in operating the Börger machine as detailed below.

All persons that work on and with the Börger machine must be aware of these residual risks and observe the associated instructions to avoid accidents or damage caused by these residual risks.

It may be necessary to remove on-site safety equipment during installation and when making modifications. This causes a residual risk and potential danger that each operating person must be aware of:

DANGER!
Risk of fatal injury due to electric power!

There is an immediate risk of fatal electric shock if live components are touched. Damage to the insulation of the individual components can be fatal.

- Have all work on the electrical equipment performed by skilled electricians.
- In the event of damage to the insulation, cut off the power supply immediately and initiate repairs.
- Before working on live components of electrical systems and equipment, de-energize these components and secure them in this state for the duration of the work. Adhere to the following safety rules in this regard:
  - Disconnect.
  - Secure against restart.
  - Verify that components have been de-energized.
  - Ground and short-circuit.
  - Cover or shield any adjacent live components.
- Never bypass or disable any fuses. Comply with the correct amperage specification when replacing fuses.
- Keep moisture away from all live components. This may lead to short circuits.

DANGER!
Risk of injury due to rotating parts!

Moving parts can cause severe injury.

— Do not reach into rotating parts or handle rotating parts when the machine is in operation.
— Never open protective covers when in operation.
— Perform work on the Börger machine only when stationary.
— Observe the delay time: Prior to opening protective covers, make sure that all components have stopped moving.
— Shut down the Börger machine and upstream and downstream system components as described in *Chapter 5.3 “Downtimes” on page 94* before carrying out any work on the Börger machine or accessories.
— The operating person is obligated to check that all safety equipment is installed as described in *Chapter 2.8 “Description of the safety equipment” on page 25* and fully functional before putting the machine into operation.
— The Börger machine must only be switched on when the inlet and outlet connections have been established and the maintenance openings have been securely installed.

WARNING!
Risk of fatal injury due to suspended loads!

Loads can swing and fall during lifting operations. This can cause severe injury, including death.

— Never stand under or within the swinging range of suspended loads.
— Do not move loads unsupervised.
— Only use approved hoists and slings with sufficient load-bearing capacity.
— Do not use torn or worn hoists such as ropes and belts.
— Do not place hoists such as ropes and belts near sharp corners and edges and do not tie them together or twist them.
— Put the load down when leaving the operating site.

CAUTION!
Risk of burns!

Particularly when used outside at correspondingly high ambient temperatures and high medium temperatures, individual parts of the Börger machine can become hot and should not be touched during operation.

Stop the feed and shut down the Börger machine prior to any troubleshooting, maintenance and repair work on the Börger machine and the accessories.

Allow the system to cool down completely, if necessary, before carrying out troubleshooting, maintenance and repair work.

Avoid dust formation as this contributes to heat build-up.

WARNING!
Risk of serious injuries caused by liquid spouting out or escaping gases!

Gases or liquids may escape uncontrollably from seals and screw connections. Especially when flange connections are released and maintenance openings are opened, pressurized liquid can spout out at the cover.

Never loosen connections when the unit is pressurized.

— Ensure that all valves and shut-off devices on the inlet and outlet are closed.
— Depressurize and empty the Börger machine through a drainage device, if available.
— Immediately absorb escaping media using suitable agents and dispose of it in accordance with the applicable local regulations.
— Therefore, wear your personal protective equipment (PPE) as described in ↳ *Chapter 2.6 “Personal protective equipment” on page 23* when opening the cover and take all necessary precautions.

Health protection

CAUTION!
Health hazard due to residues of dangerous medium inside and on the Börger machine!

There is an increased health hazard from contact with the medium and contaminated components.

Generally, the following applies:

— When using dangerous or health-endangering media, take all necessary safety measures when performing work on the Börger machine.
— Avoid direct contact with the medium (skin/eye contact, swallowing, inhaling).
— Remove spillage from your skin without delay.
— Do not store or consume beverages, food or tobacco in the working area.

2.5 Qualifications for operating personnel

WARNING!
Personnel with insufficient qualifications represent a hazard!

Insufficiently qualified personnel are not able to assess the risks when using the machine and expose themselves and others to the risk of serious or fatal injuries.

— All work must only be performed by personnel with the appropriate qualifications.
— Keep insufficiently qualified personnel away from the working area.

The various tasks described in this manual impose different requirements on the qualifications of personnel who are entrusted with these tasks.

Only personnel of whom it can be expected that they perform these tasks reliably, are approved for all tasks. Persons whose capability to react is impaired, for instance through drugs, alcohol, or medication, are not approved.

The operating personnel must have been informed or instructed on the applicable legal and accident prevention regulations as well as the safety equipment on and around the Börger machine. The operating personnel must have fully understood the instructions, and adherence to the instructions must be guaranteed. Only then can all personnel work safely and in full awareness of the associated risks.

— Appoint only trained or instructed personnel.
— Clearly define the personnel responsible for operation, installation, maintenance and repair.
— In addition, also specify the area of responsibility for the operating persons and allow them to reject unsafe instructions from others.

Manufacturer
Certain work may be carried out by manufacturer's qualified personnel only. Other personnel is not authorized to carry out this work. To have this work carried out, please contact our customer service.

Mechanics
Mechanics have completed professional training or are able to provide evidence of having completed further training which enables them to perform the special tasks mentioned in these instructions on the system and its components.

The skills acquired during training or further training enable mechanics to identify and evaluate hazards associated with the system and its components.

These include:

— Knowledge about health and safety at work
— Knowledge about the basics of first aid
— Technical knowledge
— Knowledge about assembly, maintenance and repair
— Knowledge about machine operation, system management and system operation

Operating person
Operating persons are able to provide evidence of having completed further training which enables them to perform the simple tasks mentioned in these instructions on the system and its components.

The knowledge acquired during further training enables operating persons to identify and evaluate hazards associated with the system and its components.

These include:

— Knowledge about health and safety at work
— Knowledge about the basics of first aid
— Technical knowledge
— Knowledge about assembly, maintenance and repair
— Knowledge about machine operation, system management and system operation

Qualified electricians

Qualified electricians have completed professional training in electrical engineering or are able to provide evidence of having completed further training which enables them to perform the special tasks mentioned in these instructions on the electrical system and its components.

The skills acquired during training or further training enable qualified electricians to identify and evaluate hazards associated with the system and its components.

These include:

— Knowledge about health and safety at work
— Knowledge about the basics of first aid
— Basics of electrical engineering
— Construction, wiring and checking of circuits
— Effects and dangers associated with electricity
— Troubleshooting and documentation of the electrical system
— Installation of electrical systems
— Special regulations

Warehouse worker

Warehouse workers are able to provide evidence of having completed further training which enables them to perform the special transport and storage tasks mentioned in these instructions with the system and its components.

The knowledge acquired during further training enables warehouse workers to identify and evaluate hazards associated with the system and its components during transport and storage.

These include:

— Knowledge about health and safety at work
— Knowledge about the basics of first aid
— Receiving goods and checking them for completeness and integrity
— Selecting storage locations with regard to technical and safety-related aspects
— Storing goods using handling equipment, taking into consideration the type, character, volume and weight of the products
— Selecting handling systems or hoists depending on the product type, quantity and distance

2.6 Personal protective equipment

Personal protective equipment serves to protect personnel from adverse effects to safety and health whilst working. Staff must wear personal protective equipment whilst carrying out various work on the plant. The individual sections of these instructions make specific reference to the requirements.

Light respiratory protection
Light respiratory protection protects against harmful dusts.

Occupational safety clothing, chemical resistant
The chemical-resistant occupational safety clothing is used to protect the skin from contact with chemicals which are a health hazard.

Safety gloves, chemical-resistant
Chemical-resistant safety gloves are used to protect the hands from corrosive chemicals.

Safety goggles
Safety goggles (closed on all sides) are used to protect the eyes from flying particles and liquid spray.

Safety shoes
Safety shoes protect the feet from crushing, falling parts and prevent slipping on a slippery floor.

2.7 Securing the machine against restart

WARNING!
Risk of fatal injury if the plant is switched back on uncontrolledly or without authorization!

Switching the Börger machine on without authorization or uncontrolledly can cause serious injuries.

— Before switching back on, make sure that all safety devices are fitted and fully functional and that staff are not at any risk.
— Always adhere to the sequence to secure the plant to prevent it from being switched back on according to *Chapter 2.7 “Securing the machine against restart” on page 24*.

1. Shut off the media supply by closing the respective shut-off valves.
2. Shut off the energy supply.
3. Inform the person responsible that work is being carried out in the danger area.
4. Attach a sign to the control cabinet to indicate that work is being carried out in the danger area and that switching on is prohibited. The sign must include the following information:
   — Switched off on:
   — Switched off at:
   — Switched off by:
   — Important notice: Do not switch on!
   — Important notice: Do not switch on before ensuring that personnel are at no risk.

2.8 Description of the safety equipment

WARNING!
Risk of fatal injury if safety devices are not fully functional!

Non-functional or overridden safety features may cause severe injuries, including death.

— Check whether all safety features are functional and correctly installed before starting work with the machine.
— Never override or bypass safety features.
— Ensure that all safety features are accessible at all times.

The Börger machine is equipped with the required safety equipment according to the applicable legal guidelines in the country of manufacture, current state-of-the-art technology and recognized safety regulations.

2.8.1 EMERGENCY STOP

When pressing the EMERGENCY STOP button, the machine is shut down by the energy supply being switched off or the machine being mechanically disconnected from the drives. Once the EMERGENCY STOP switch has been activated, it must be turned in order to reset it and restart the machine.

WARNING!
Risk of fatal injury if the plant is switched back on uncontrolledly or without authorization!

Switching the machine on without authorization or uncontrolledly can cause serious injuries.

— Ensure that the cause of the EMERGENCY STOP has been eliminated and all safety features are installed and functional prior to a restart.
— Do not reset the EMERGENCY STOP switch before the danger has been eliminated.

2.8.2 Coupling guard

The rotating shafts between the drive and functional unit are connected by a coupling, and must be secured by a fixed safety guard against reaching in and blockages caused by falling parts.

Börger GmbH delivers units with couplings and drives including a screw-fixed coupling guard as standard.

This coupling guard may not be removed, and must always be reinstalled carefully following removal due to maintenance.

If your Börger machine is delivered without an installed drive, you must attach the supplied coupling guard (or another suitable coupling guard) after the drive is installed.

This also applies to the V-belt/chain guards on overhead mounted drive assemblies and to the coupling lanterns on units with hydraulic drives and coupling lanterns.

2.8.3 Intermediate chamber

The intermediate chamber separates the hydraulic pump part from the timing gear. It is used for monitoring the integrity of the mechanical seals on rotary lobe pumps with single-acting mechanical seals.

Overflowing caused by penetrating pumped medium indicates that the mechanical seals must be replaced immediately in order to prevent the pumped medium from entering the gear unit.

The vent hole in the intermediate chamber must not be sealed or plugged.

When the vent hole is closed tightly or has become blocked, emerging pumped medium from the pump chamber cannot escape through the intermediate chamber and will penetrate the gear unit if the mechanical seal is defective. This could damage the gear unit.

2.8.4 Optional monitoring devices

If the Börger machine is equipped with additional monitoring devices, then the corresponding safety instructions can be found in the manufacturer’s operating manual in the appendix.

If your Börger machine was supplied with such monitoring devices, you must ensure that these devices function correctly.

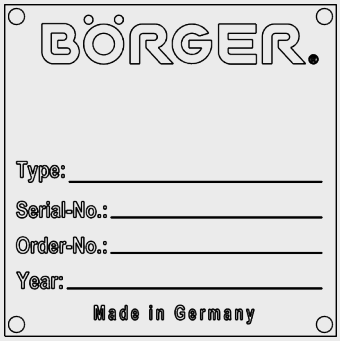
2.9 Markings and signs

The symbols and information signs below are located in the work area. They refer to the immediate environment in which they are attached.

WARNING!
Danger due to illegible signage!

Over time, stickers and signs can get soiled or become illegible due to other reasons, so that dangers are not recognized and necessary operating instructions cannot be observed. This poses a risk of injury.

— Do not remove any safety notes, warnings and operating instructions.
— Keep them completely legible.
— Replace damaged signs or stickers immediately.



Meaning:
Nameplate according to Directive 2006/42/EC (Machinery Directive) and DIN EN 809

Location:
In a clearly visible position on the machine

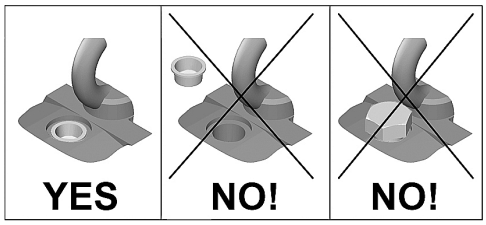
CE marking not applicable for incomplete machines
where only a declaration of incorporation may be delivered, and in certain other cases.

Meaning:
Grounding (bore hole for ground screw or terminal)

Location:
On the base frame

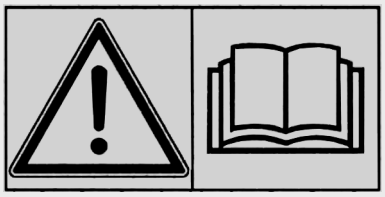
Meaning:
Do not touch rotating parts, risk of serious, permanent injury

Location:
In a clearly visible position on the rotary lobe pump



Meaning:
Close the safety opening of the intermediate chamber with a safety plug, do not leave it open, do not close it with a screw, do not close it tightly with a screw plug

Location:
In a clearly visible position on the machine



Meaning:
Please read the operating manual carefully before performing any activity involving the device! Keep for future reference!

Location:
In a clearly visible position on the packaging of the operating manual

2.10 Markings and signs to be attached by the operator

The operator is obligated to label the pumped medium and the flow direction on the rotary lobe pump (see chapter ↳ *Chapter 4.5.3 “Checking the flow direction” on page 85*).

The operator may also be required to attach additional markings and signs on or around the Börger machine.

These additional markings and signs may relate to regulations for wearing personal protective equipment, for example.

2.11 Safety instructions for operating personnel

The Börger machine may only be operated while it is in perfect working condition and only for its intended purpose, in a safe and risk-conscious manner having regard to this operating manual. All malfunctions must be rectified immediately, especially those affecting safety.

Every person assigned with commissioning, operation or maintenance work must have fully read and understood this operating manual beforehand – specifically *Chapter 2 “Safety” on page 13*. Consulting the manual during work is already too late. This applies especially to personnel that only work occasionally on the Börger machine.

The operating manual must always be kept accessible next to the Börger machine.

No liability will be assumed for any damage and accidents caused by non-compliance with the operating manual.

Adhere to the applicable accident prevention regulations and all other generally recognized safety regulations and guidelines for occupational health at work.

Clearly specify the responsible parties for the various maintenance and repair tasks and adhere thereto. Only then can handling errors be avoided, especially in dangerous situations.

The operator must make personal protective equipment mandatory for operating and maintenance personnel. This applies to safety shoes, protective goggles and protective gloves. Always wear this protective equipment when working on the Börger machine.

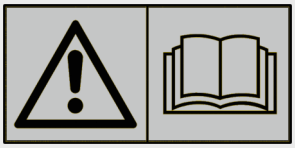
Keep long hair tied and do not wear loose clothing or jewelry. There is always a danger of getting caught, pulled in or dragged along by moving components.

2.11.1 General work on the Börger machine

NOTE!
Work on the Börger machine!

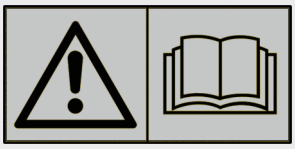
— Work on the Börger machine may only be carried out by trained, reliable personnel.
— Personnel in training or requiring instruction, as well as persons currently in vocational training, may only operate the Börger machine under the constant supervision of an experienced staff member.

Personnel:	■ Mechanics ■ Operating person ■ Warehouse worker ■ Manufacturer
Protective equipment:	■ Occupational safety clothing, chemical resistant ■ Safety shoes ■ Safety gloves, chemical-resistant ■ Safety goggles ■ Light respiratory protection
Tool:	■ Tools, general



Further operating manuals / supplementary operating manuals

— You must completely read the separate operating manuals and/or supplementary operating manuals for components and/or special versions and consider the **instructions and safety regulations** accordingly.



Supplier documentation

— You must completely read the separate supplier documentation and consider the **instructions and safety regulations** accordingly.

If malfunctions occur on the Börger machine:

1. Shut down the Börger machine and downstream and upstream system components as described in *Chapter 5.3 “Downtimes” on page 94*.
2. Secure the Börger machine against unauthorized or uncontrolled reactivation as described in *Chapter 2.7 “Securing the machine against restart” on page 24*.
3. Report the malfunction to the responsible department/person.
   — This especially applies to safety-related alterations to the Börger machine.

NOTE!

Adhere to the prescribed intervals for regular maintenance and inspections or those specified herein and in the operating manuals of the components.

- Aside from the special tools specified in *Chapter 9.4.1 “Tools / installation aid” on page 163*, suitable customary workshop equipment is essential for carrying out maintenance work.
- Modifications, repairs, maintenance and troubleshooting may only be carried out when the Börger machine is switched off. Accidental restarting of the unit must be prevented completely.
- To the extent necessary, amply secure the surrounding area when performing maintenance. Cordon off the working area with a red and white safety chain and a warning sign.
- Also observe any
  - supplementary operating manuals
  - operating manuals of the components

  in the appendix.
- Large assemblies and components must be carefully attached and secured to hoists when they are removed or replaced so that associated dangers are minimized. Only appropriate hoists and lifting media in technically perfect working condition with sufficient load capacities may be used.
  - Never stand under suspended loads.
- At the start of maintenance, repairs or machine care, clean any dirt or cleaning agents off the connections and screw connections. Do not use any aggressive cleaning agents. Use lint-free cleaning cloths.
- During installation, always tighten any screw connections that have been loosened for maintenance and repair work. Tighten to the prescribed torque, where this is specified.
- Dispose of operating materials and replacement parts in a safe and environmentally-friendly manner.

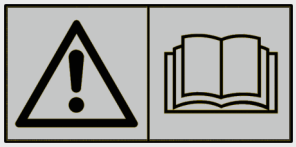
2.11.2 Work on the electrical system of the Börger machine

DANGER!
Risk of fatal injury due to electric power!

There is an immediate risk of fatal electric shock if live components are touched. Damage to the insulation of the individual components can be fatal.

- Have all work on the electrical equipment performed by skilled electricians.
- In the event of damage to the insulation, cut off the power supply immediately and initiate repairs.
- Before working on live components of electrical systems and equipment, de-energize these components and secure them in this state for the duration of the work. Adhere to the following safety rules in this regard:
  - Disconnect.
  - Secure against restart.
  - Verify that components have been de-energized.
  - Ground and short-circuit.
  - Cover or shield any adjacent live components.
- Never bypass or disable any fuses. Comply with the correct amperage specification when replacing fuses.
- Keep moisture away from all live components. This may lead to short circuits.

Personnel:	■ Qualified electricians
Protective equipment:	■ Occupational safety clothing, chemical resistant ■ Safety shoes ■ Safety gloves, chemical-resistant ■ Safety goggles
Tool:	■ Tools for electrical work



Operating manuals of electronic parts

- Pay attention to all the **instructions and safety regulations** contained in the operating manuals for electronic components in the appendix.

NOTE!

Adhere to the prescribed intervals for regular maintenance and inspections of the electrical system and/or components or to those intervals specified herein and in the operating manuals of the components.

- The electrical system may only be opened, maintained and repaired by qualified electricians, while having proper regard to the attached electric circuit diagrams.
- Carry out modifications, repairs, maintenance and trouble-shooting on the control unit only when the electrical system is switched off. Accidental restarting of the unit must be prevented completely.
- To the extent necessary, amply secure the surrounding area when performing maintenance. Cordon off the working area with a red and white safety chain and a warning sign.
- Aside from the special tools specified in *Chapter 9.4.1 “Tools / installation aid” on page 163*, suitable customary workshop equipment is essential for carrying out maintenance work.
- Also observe any
  - supplementary operating manuals
  - operating manuals of the components
  - operating manuals of electronic parts

  in the appendix.
- Protect the electronic components from moisture and impurities. Clean the electronic components with suitable agents according to the manufacturers' operating manuals only. Do not use aggressive cleaning agents to clean the surface. Use lint-free cleaning cloths.
- Dispose of any replacement parts in a safe and environmentally-friendly manner.

2.12 Safety instructions for maintenance and rectifying malfunctions

WARNING!
Risk of injury due to inadequate troubleshooting, maintenance and repair work!

Inadequate troubleshooting, maintenance and repair work can lead to severe injury and significant damage to property.

- Ensure sufficient installation space before commencing work.
- Keep the installation site clean and tidy! Loosely stacked or scattered components and tools cause accidents.
- Ensure correct installation where components have been removed, reinstall all fastening elements and observe the tightening torques of screws.
- Ensure the following before putting the machine back into operation:
  - Ensure that all troubleshooting, maintenance and repair work is performed and completed as per the information and notes provided in this manual.
  - Ensure that nobody enters the hazardous area.
  - Ensure that all covers and safety features are installed and function correctly.

WARNING!
Risk of fatal injury if the plant is switched back on uncontrolledly or without authorization!

Switching the Börger machine on without authorization or uncontrolledly can cause serious injuries.

- Before switching back on, make sure that all safety devices are fitted and fully functional and that staff are not at any risk.
- Always adhere to the sequence to secure the plant to prevent it from being switched back on according to *Chapter 2.7 “Securing the machine against restart” on page 24*.

WARNING!
Risk of fatal injury if safety devices are not fully functional!

Non-functional or overridden safety features may cause severe injuries, including death.

— Check whether all safety features are functional and correctly installed before starting work with the machine.
— Never override or bypass safety features.
— Ensure that all safety features are accessible at all times.

WARNING!
Risk of injury when using unsuitable spare parts!

The use of unsuitable spare parts can cause malfunctions which can lead to severe injury, including death, and to significant material damage.

— Only use suitable spare parts.
— Always contact the manufacturer if in doubt.

WARNING!
Severe injury due to residual pressure!

Despite having depressurized the Börger machine, it may be under residual pressure in the event of congestion or lump formation in the medium.

— Take extra care when removing the flange connections and maintenance openings to prevent accidents caused by the release of residual pressure.

NOTICE!
Risk of severe material damage due to a delayed shut-down in the event of a malfunction!

A delayed shut-down in the event of malfunction can cause permanent damage to the Börger machine.

— In the event of a malfunction, shut down the Börger machine and all upstream and downstream system components immediately until the cause has been rectified.

NOTICE!
Risk of damage caused by frost!

Frost can cause damage to the Börger machine.

— Protect the Börger machine and its connections against frost.

NOTICE!
Improper cleaning of the Börger machine can lead to malfunctions and damage!

— Do not use water jets.
— Do not use aggressive cleaning agents, solvents or sandpaper, as these can damage the metallic and plastic surfaces, casing coating and seals.
— Do not use metal objects such as scrapers and screwdrivers for cleaning coated machine parts.
— Never clean sensitive components with hard scrubbing and strong mechanical pressure.
— Do not use a vacuum cleaner or a hand brush with plastic bristles etc. to clean electronic components because the production of static electricity can damage the electronic components.

NOTICE!
Risk of material damage due to impermissible changes to limit values.

The settings at the evaluation units or at the frequency converter must not be changed. Non-compliance may lead to material damage.

NOTE!
Presettings of parameters

Unit-specific values, limits as well as variable parameters are preset by factory default according to the order specifications for the particular case.

ENVIRONMENT!
Danger due to incorrect handling of environmentally hazardous substances!

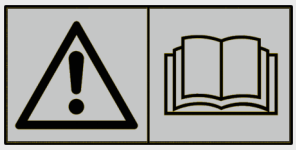
Inappropriate handling of environmentally hazardous substances, especially incorrect disposal, can cause significant damage to the environment.

- Especially water-polluting materials such as grease and lubricating oil must not pollute the soil or enter the sewage system during installation, repair and maintenance work.
  - These materials must be collected, stored, transported and disposed of in suitable containers.
- When handling oil, grease and other chemical substances, pay attention and adhere to the applicable regulations and safety data sheets issued by the respective manufacturer relating to storage, handling, correct use and disposal.
- Comply with the legal obligations regarding waste avoidance and the proper recycling/disposal of waste during all work

NOTE!
When using frequency converters

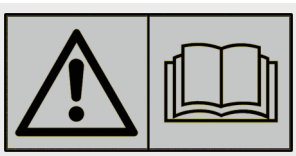
Due to their working principle, frequency converters generate leakage current.

- For proper operation of a frequency converter at a residual current device, the use of an AC/DC sensitive **residual current device (type B)** according to **EN50178/VDE0160** is required due to the DC component of the leakage current.



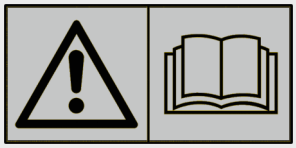
Further operating manuals / supplementary operating manuals

- You must completely read the separate operating manuals and/or supplementary operating manuals for components and/or special versions and consider the **instructions and safety regulations** accordingly.



Supplier documentation

- You must completely read the separate supplier documentation and consider the **instructions and safety regulations** accordingly.



Operating manuals of electronic parts

— Pay attention to all the **instructions and safety regulations** contained in the operating manuals for electronic components in the appendix.

2.13 Information on special dangers

2.13.1 Oil, grease and other chemical substances

ENVIRONMENT!
Danger due to incorrect handling of environmentally hazardous substances!

Inappropriate handling of environmentally hazardous substances, especially incorrect disposal, can cause significant damage to the environment.

- Especially water-polluting materials such as grease and lubricating oil must not pollute the soil or enter the sewage system during installation, repair and maintenance work.
  - These materials must be collected, stored, transported and disposed of in suitable containers.
- When handling oil, grease and other chemical substances, pay attention and adhere to the applicable regulations and safety data sheets issued by the respective manufacturer relating to storage, handling, correct use and disposal.
- Comply with the legal obligations regarding waste avoidance and the proper recycling/disposal of waste during all work

When handling oil, grease and other chemical substances, pay attention and adhere to the applicable regulations and safety data sheets issued by the respective manufacturer relating to storage, handling, correct use and disposal.

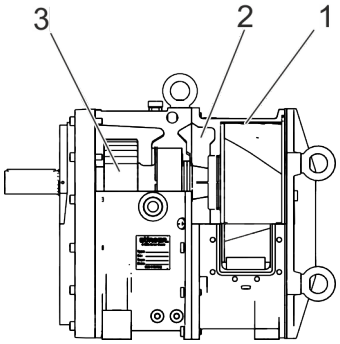
2.13.2 Noise

The A-weighted equivalent continuous noise level on the workstations is below 80 dB(A) during normal operation of the Börger machine. Higher noise levels may occur at the Börger machine installation site due to local conditions. In this case, the operator is obligated to provide operating personnel with appropriate protective equipment.

3 Product Description

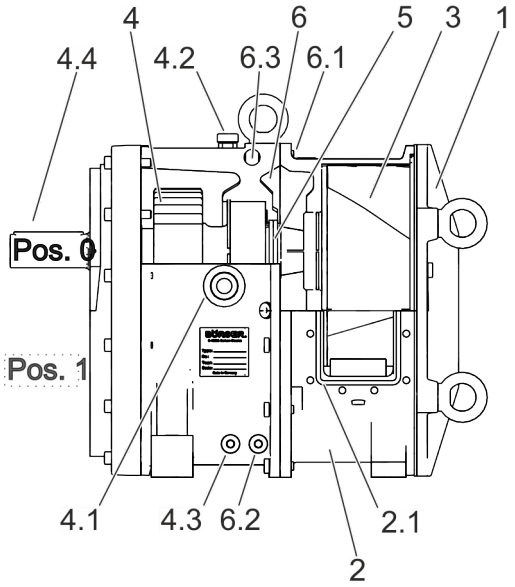
3.1 Construction of the Börger machine

Components:



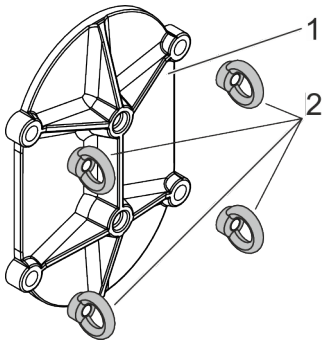
1 Pump chamber
2 Intermediate chamber
3 Gear unit

Construction:



1 Quick-release cover
2 Pump casing
2.1 Connection flange (inlet, outlet)
3 Rotors
4 Timing gear
4.1 Oil sight glass
4.2 Breather, oil filler for gear unit
4.3 Oil drain for gear unit
4.4 Two shafts with parallel axes; drive shaft can optionally be at position 0 or 1
5 Shaft seal on pump chamber
6 Intermediate chamber (quench)
6.1 Intermediate chamber fill hole
6.2 Drain from intermediate chamber
6.3 Breather

3.1.1 Quick-release cover



The Börger MIP principle (Maintenance in Place) starts with the quick-release cover (1). This cover enables easy access to the interior of the casing and to all parts subject to wear in the Börger machine. The pipes on the inlet and outlet can remain connected.

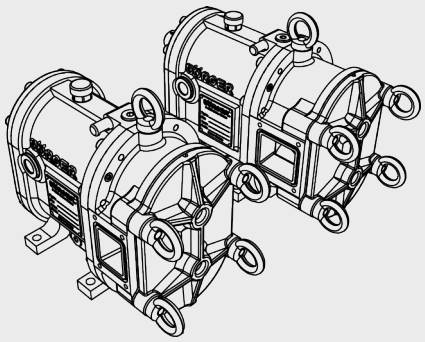
The quick-release cover can be removed after loosening the four ring nuts (2), (see *Chapter 6.3.1 “Notes on repair work” on page 123* and *Chapter 6.3.2 “Opening and closing the quick-release cover” on page 124*).

The Börger machine can be inspected, serviced and repaired directly at its point of installation.

The supplementary operating manual in the Appendix contains a description of other cover types, if these types have been supplied.

3.1.2 Casing

The AN rotary lobe pump is available in two casing depths. The performance data of your rotary lobe pump depends on this depth, among other things:

Depths	
	— AN 040 — AN 070

Also see *Chapter 3.3 “Technical data” on page 53*.

The block-type, one-piece casing is equipped as standard with an internal casing protection plate towards the gear unit and one towards the quick-release cover.

The casing is manufactured from high-quality gray cast iron, spheroidal cast iron or stainless steel.

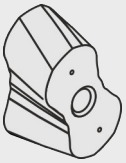
The pump chamber can also be completely covered with optional radial MIP® casing liners.

3.1.3 Rotors

A wide variety of different rotors are available for Börger rotary lobe pumps.

NOTE!
Material resistance of the rotors / lobe tips

The rotor or lobe tip **material** used in your rotary lobe pump with regard to the resistance to the pumped medium is defined according to the attached data sheet.

	— **Type 4**	**Dius rotor**, Dual-lobe, screw profile — Polymers Pos. 9.5 in the spare parts list
	— **Type 4S, 4E**	**Dius rotor**, Dual-lobe, screw profile — Steel, stainless steel Pos. 9.5 in the spare parts list

3.1.4 Timing gear

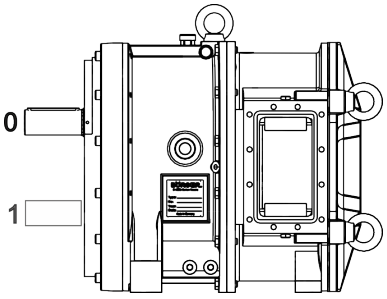


Fig. 1: Example: Classic FL series

The rotors are driven synchronously and exactly through the carrier shafts by two gear wheels.

The shafts of the rotary lobe pump are seated on one side inside the carrier gear unit.

As the gear unit is completely separate from the pump chamber, disassembly is not necessary for any maintenance work.

Depending on the ordered version, the drive shaft is installed in position 0 or position 1.

The rotary lobe pump can also be delivered with two drive shafts, e.g. a rotary lobe pump driven mechanically by means of the PTO shaft, where the direction of rotation can be changed by switching the PTO shaft.

The timing gear is equipped with a breather system to compensate for increased pressure due to rising temperatures. The breather system must always be installed on the highest point of the rotary lobe pump, compare the illustrations of the versions for the different mounting positions in *Chapter 3.1.7 “Designs, mounting positions” on page 45*.

3.1.5 Shaft seal

Börger rotary lobe pumps are equipped as standard with mechanical seals designed specifically for this pump type. These are used to completely seal off the pump chamber from the gear unit, or from the intermediate chamber (see *Chapter 3.1.6 “Intermediate chamber (quench)” on page 45*). These seals can be quickly accessed through the working chamber without removing the machine, and can be replaced easily.

Mechanical seals are available in a variety of material combinations.

Information about any special seals that apply to your Börger machine can be found in the additional documentation in the appendix.

3.1.6 Intermediate chamber (quench)

NOTICE!
Risk of damage to the gear unit when the intermediate chamber is closed tightly!

When the vent hole is closed tightly or has become blocked, emerging medium from the working chamber cannot escape through the intermediate chamber and will penetrate the gear unit if the mechanical seal is defective. This could damage the gear unit.

— The safety opening in the intermediate chamber is used for monitoring the integrity of the mechanical seal, and may not be closed.
  — Overflowing of the intermediate chamber indicates a seal malfunction.

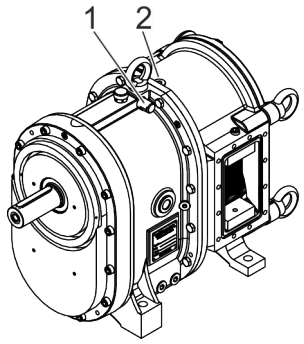


Fig. 2: Example: Classic FL series

The pump chamber and gear chamber are separated by an intermediate chamber filled with quench fluid as standard.

The heat-absorbing quench fluid prevents the mechanical seals from running dry and captures any medium that enters the intermediate chamber due to leaks in a mechanical seal. This **quench** function also prevents the gear unit from being damaged by intrusion of the medium.

The contact area between the shaft and rotors is also lubricated with quench fluid, thus preventing corrosion.

A safety plug seals the fill hole of the intermediate chamber. The safety plug must be able to move out of the fill hole without pressure when fluid overflows in the event of a seal leakage. The safety opening on the intermediate chamber can be positioned in a visible location via an extension pipe for special applications, e.g. on submerged devices.

The intermediate chamber is sealed from the gear unit with DUO lip seals.

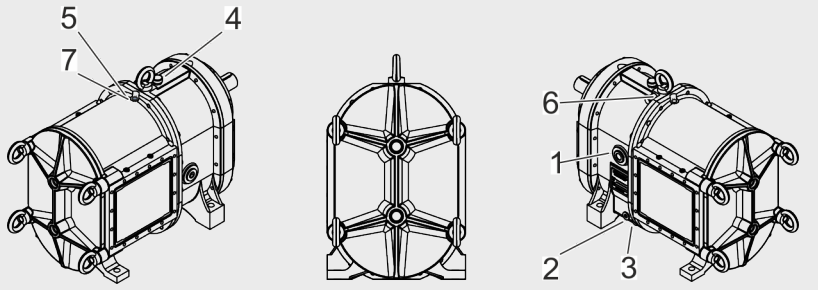
3.1.7 Designs, mounting positions

Depending on the pump type and the mounting position, the position of the oil sight glass, breathers, fill holes as well as the drain holes for the gear unit and for the intermediate chamber can vary.

Observe the assembly drawing (*Chapter 9.3 “Assembly drawing” on page 159*) and the spare parts list (*Chapter 9.4 “Spare parts list” on page 160*) of your rotary lobe pump.

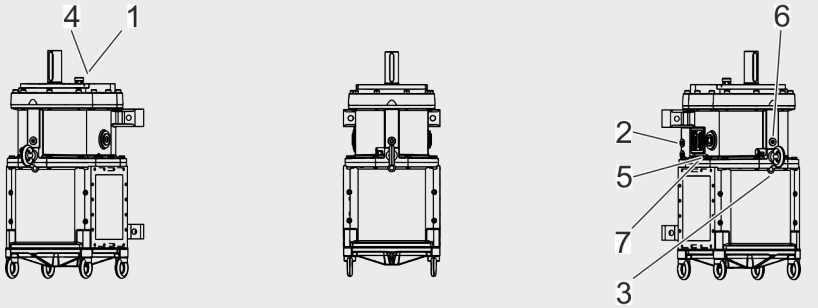
NOTE!
Special version

On immersion models (special version), the fill holes and breathers have been relocated e.g. with extension pipes to the visible area or, depending on usage, are optionally closed completely.



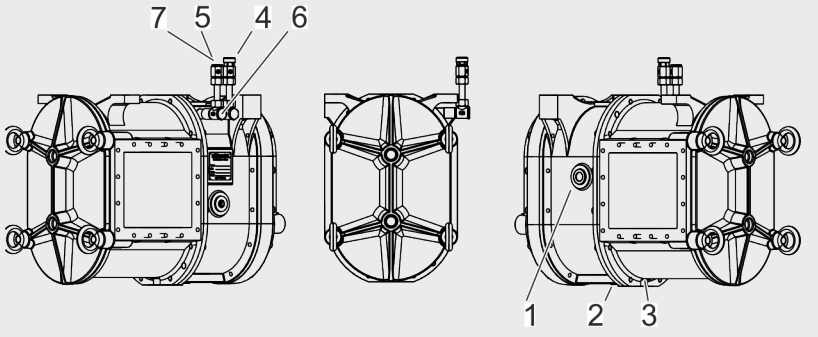
Example: Classic FL series

Mounting position M1
- Upright
- Feet at bottom
- Horizontal shafts



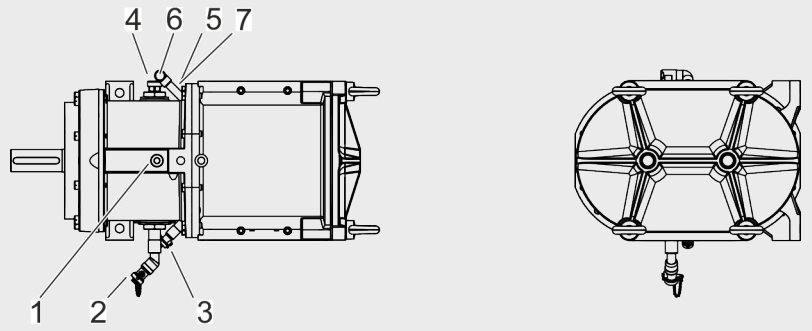
Example: Classic FL series

Mounting position M2
- Vertical
- Quick-release cover at bottom
- Feet at side
- Vertical shafts
- Drive shaft pointing upwards



Example: Classic FL series

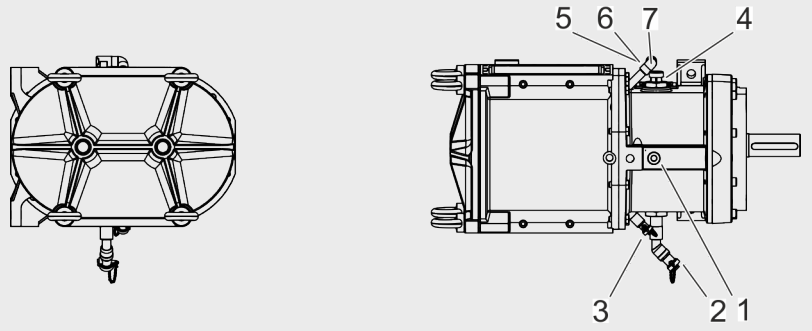
Mounting position M3
- Upside-down
- Feet upwards
- Horizontal shafts



Example: Classic FL series

Mounting position M5

— Turned 90° to the left
— Feet to the right
— Horizontal shafts



Example: Classic FL series

Mounting position M6

— Turned 90° to the right
— Feet to the left
— Horizontal shafts

1	Oil level check on gear unit (oil sight glass / oil dipstick)	5	Fill hole on intermediate chamber
2	Oil drain for gear unit	6	Breather for the intermediate chamber
3	Drain from intermediate chamber	7	Intermediate chamber fill level indicator
4	Fill hole for gear unit, with breather system		

3.1.8 Pipe connections on inlet and outlet

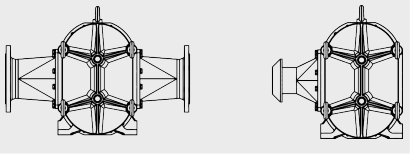
In most cases, two-shaft Börger machines are equipped with pipe connectors on the inlet and outlet that have been specially designed for the different applications and mounting conditions.

The inlet and outlet can be equipped with the same or different pipe connectors. Pipe connectors are available with a variety of connections, for example:

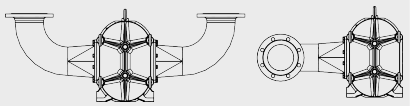
— DIN EN flange
— ANSI/ASME flange
— Quarter turn coupling
— Quick-release coupling, e.g. Perrot, female adapter (optional male)
— Dairy screw connections, and others

The pipe connectors can be equipped with optional additional fittings, **e.g.** screw sockets G½" or G 1" or screw sockets with NPT threads, for the connection of pressure gauges, shut-off devices or breather systems.

Pipe connectors (sample designs)

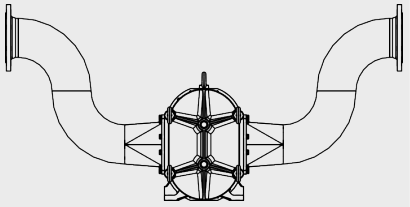


Short, straight pipe connector



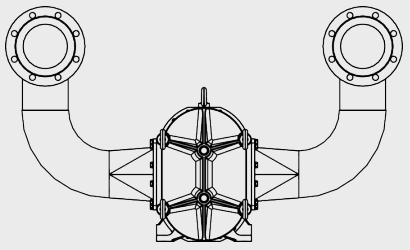
90° pipe bend

— connection towards the front, back, top or bottom



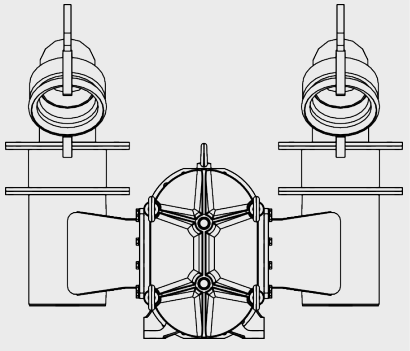
Gooseneck version

— connection towards the front, back or side



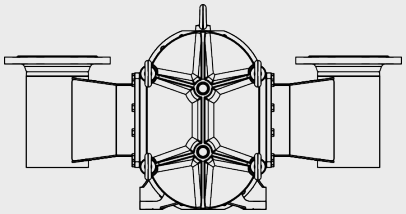
Double bend upwards

— connection towards the front, back, top, bottom or side



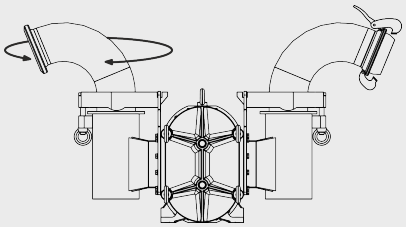
Angled version

— connection towards the front, back or side



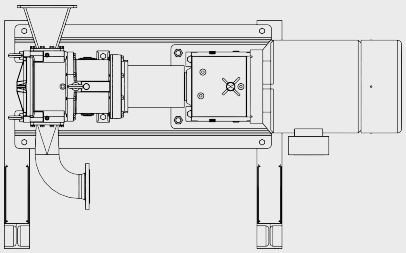
Angled version for narrow installations

— connection towards the front, back, top or bottom



Continuous, fully-pivotable suction and pressure connection

— with quick-release coupling, e.g. Perrot system



Intake hopper on the inlet

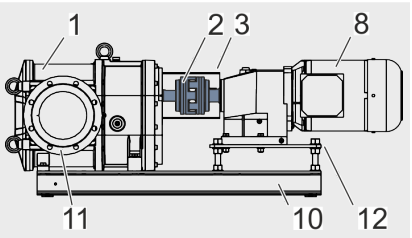
— For highly viscous but still fluid material, a 90° turned Börger machine can be equipped with an **intake hopper on the inlet** instead of a pipe connector

3.1.9 Units / drive options

The majority of Börger machines are delivered as a complete unit, i.e. with mounted drive fixed on a base frame.

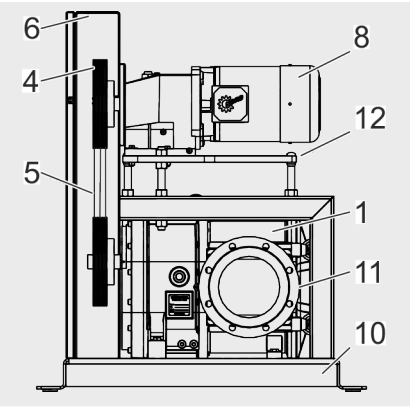
The most common unit variations are as follows:

Standard unit



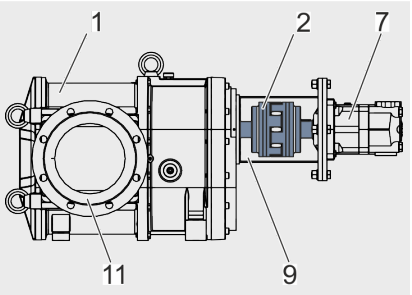
1	Börger-Rotary lobe pump
2	Torsionally flexible coupling
3	Coupling guard
8	Drive (with gear reducer in this example)
10	Base frame
11	Pipe connector (short, straight pipe connector with flange in this example)
12	Motor plate

Overhead mounted drive assembly (piggyback)



1	Börger-Rotary lobe pump
4	V-belt pulley / chain drive
5	V-belt (up to five belts, depending on the drive) or chain drive
6	V-belt/chain guard
8	Drive (with gear reducer in this example)
10	Base frame
11	Pipe connector (short, straight pipe connector with flange in this example)
12	Motor plate

Unit with hydraulic drive



1	Börger-Rotary lobe pump
2	Torsionally flexible coupling (does not apply for directly flanged hydraulic drive)
7	Hydraulic drive
9	Coupling lantern (adapter flange on directly flanged hydraulic drive)
11	Pipe connector (short, straight pipe connector with flange in this example)

3.1.10 Options and accessories

NOTE!
Special equipment

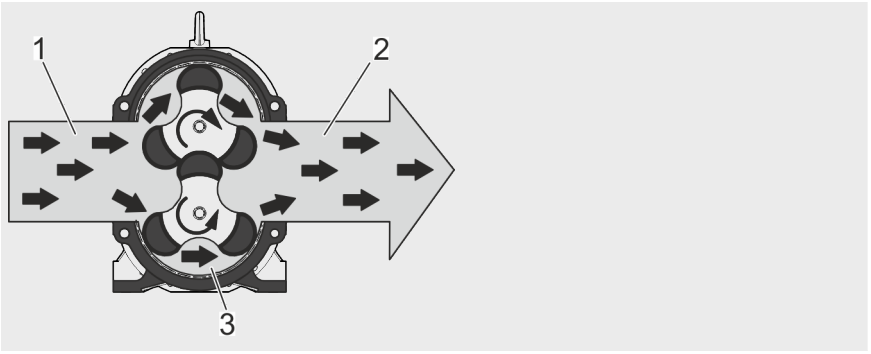
A variety of special equipment and additional accessories (cf. *Chapter 8 “Accessories” on page 153*) are available for the safe operation of the Börger machine according to its application. You will find explanations referring to the special equipment and any delivered accessories in the appendix.

NOTICE!
Risk of material damage due to non-compliance with the operating manuals for accessories!

Non-compliance with supplementary operating manuals for special equipment or accessories can lead to damage to the Börger machine.

— If your Börger machine is equipped with special equipment, then you must first read the corresponding supplementary operating manual for the equipment or accessories before carrying out any installation, commissioning, maintenance or repair work on the machine.

3.2 Operating principle



1	Suction chamber
2	Transfer from suction chamber to pressure chamber
3	Pressure chamber

Börger rotary lobe pumps are self-priming, valveless, positive displacement pumps.

The rotors are turned in opposite directions via an external drive using two parallel shafts.

The geometry of the rotors results in a complete separation of the suction chamber (1) and pressure chamber (3).

The synchronous rotation of the rotor pairs creates a vacuum on the priming side of the pump, which can be defined by the direction of rotation of the drive. This vacuum draws the liquid into the pump chamber.

The dynamic transfer from the suction chamber to the pressure chamber (2) allows low-pulsation pumping, and nearly pulsation-free pumping when screw rotors are used. The pumped medium is forced into the pressure lines on the pressure side (3) through the rotating, intermeshing rotors.

The symmetrical construction of the rotary lobe pump means that the flow direction can be changed by reversing the direction of rotation, provided this is allowed by the system.

Depending on the rotor type, up to six chamber charges are displaced with each drive rotation.

3.3 Technical data

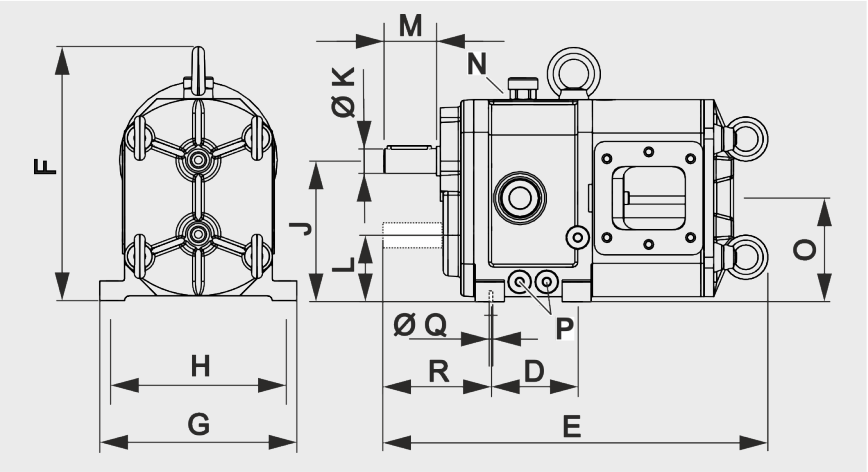
Börger machines are configured individually for the application requirements. This leads to a wide range of variations that have been optimized for specific applications. Therefore, only the data of some of the standard versions can be listed here as examples.

Detailed specifications for your Börger machine or unit can be found in the data sheet and the **individual dimensional drawing** sent when the machine was ordered.

Please contact Börger customer service if you require a copy of this drawing.

3.3.1 Dimensions

Rotary lobe pump without attachment parts



Dimensions without attachment parts (approx.)

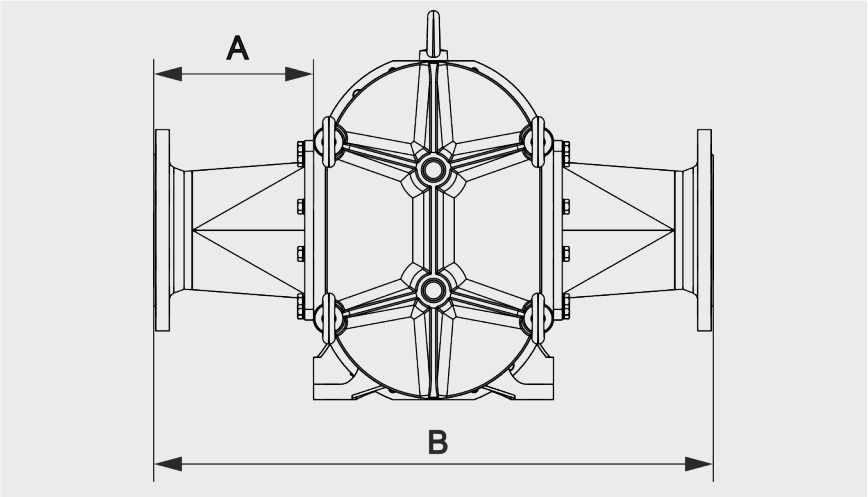
Dimensions	[mm]		[inch]	
	AN 040	AN 070	AN 040	AN 070
D	130	130	5.12	5.21
E	427	457	16.81	17.99
F	316	316	12.44	12.44
G	188	188	7.40	7.40
H	164	164	6.46	6.46
J	172	172	6.77	6.77
K	Ø 30	Ø 30	1.18	1.18
L	82	82	3.23	3.23
M	60	60	2.36	2.36
N	G 1/2”	G 1/2”	G 1/2”	G 1/2”
O	127	127	5.00	5.00
P	G 3/8”	G 3/8”	G 3/8”	G 3/8”
Q	Ø 13	Ø 13	0.51	0.51
R	114	114	4.49	4.49

	approx. [kg]		approx. [lb]	
	AN 040	AN 070	AN 040	AN 070
Weight	53.0	58.0	117.0	128.0

Pipe connectors

The pipe connectors are designed according to the dimensional drawing created for the order. We deliver short, straight pipe connectors as standard, with flanges (selectable) according to:

— DIN EN 1092-1, type 11
— ANSI/ASME B 16.5 RF Class 150.



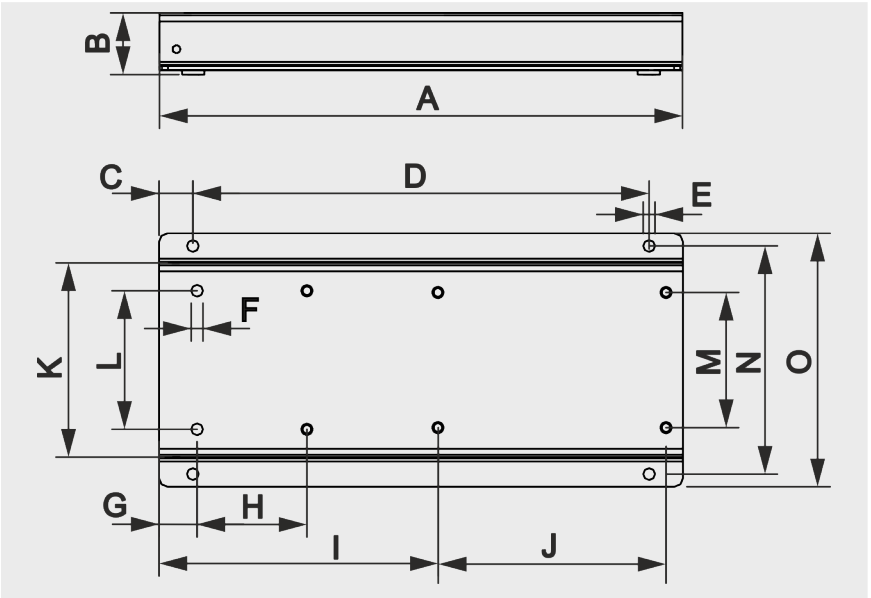
Dimensions A and B in [mm] (approx.)

	AN 040				AN 070			
Standard:	**DIN / DIN EN**		**ANSI / ASME**		**DIN / DIN EN**		**ANSI / ASME**	
Dimension:	**A**	**B**	**A**	**B**	**A**	**B**	**A**	**B**
Nominal diameter:								
DN 25	156	500	172	532	-	-	-	-
DN 32	156	500	171	530	-	-	-	-
DN 40	156	500	173	534	156	500	173	534
DN 50	156	500	175	538	156	500	175	538
DN 65	156	500	181	550	156	500	181	550
DN 80	156	500	176	540	156	500	176	540
DN 100	206	600	230	648	206	600	230	648
DN125	206	600	240	668	206	600	240	668
DN150	206	600	240	668	206	600	240	668

Dimensions A and B in [inch] (approx.)

	AN 040				AN 070			
Standard:	**DIN / DIN EN**		**ANSI / ASME**		**DIN / DIN EN**		**ANSI / ASME**	
Dimension:	**A**	**B**	**A**	**B**	**A**	**B**	**A**	**B**
Nominal diameter:								
1"	6.14	19.70	6.77	20.94	-	-	-	-
1¼"	6.14	19.70	6.73	20.87	-	-	-	-
1½"	6.14	19.70	6.81	21.02	6.14	19.70	6.81	21.02
2"	6.14	19.70	6.90	21.18	6.14	19.70	6.90	21.18
2½"	6.14	19.70	7.13	21.65	6.14	19.70	7.13	21.65
3"	6.14	19.70	6.93	21.26	6.14	19.70	6.93	21.26
4"	8.11	23.62	9.06	25.51	8.11	23.62	9.06	25.51
5"	8.11	23.62	9.45	26.30	8.11	23.62	9.45	26.30
6"	8.11	23.62	9.45	26.30	8.11	23.62	9.45	26.30

Base frame



Base frame

Dimensions	approx. [mm]	approx. [inch]
A	620	24.41
B	73	2.87
C	40	1.57
D	540	21.26
E	Ø 14	0.55
F	Ø 14	0.55
G	45	1.77
H	130	5.12
I	330	12.99
J	270	10.63
K	230	9.06
L	164	6.46
M	160	6.30
N	270	10.63
O	300	11.81

	approx. [kg]	approx. [lb]
Weight	10.4	23.0

Complete unit

The dimensions can be found in the specific dimensional drawing created for the order. The dimensions and weights of the drive and gear unit etc. can be found in the corresponding manufacturer's documentation. The weight of the complete unit is specified in the data sheet.

3.3.2 Performance data and maximum loads

Rotary lobe pump

The specification of the pump output for which the rotary lobe pump was actually configured can be found in the data sheet.

The geometric displacement volume of the pump series is as follows:

Pump output per revolution

AN 040	approx. 0.46 l	approx. 0.12 gal
AN 070	approx. 0.73 l	approx. 0.19 gal

The actual pump output depends on several factors, such as pressure, viscosity, speed and pump configuration.

The permissible working pressure and differential pressure for which your rotary lobe pump unit was designed are also specified in the data sheet.

The following limits should be taken into account, especially for rotary lobe pumps delivered without drives:

General limits:

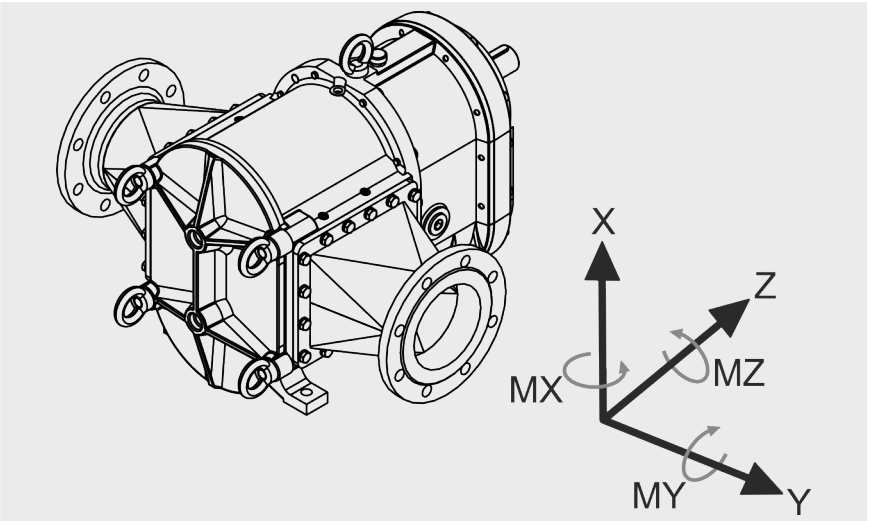
AN...	Flow rate Q [m^3/h / gpm]		Speed n [rpm]		Vacuum	Working pressure
	Recommended	Permitted	Recommended	Permitted	p_s	max.
040	4.1 - 11 (18.0 - 48.4)	1.4 - 22.1 (6.2 - 97.3)	150 - 400	50 - 800	-0.7 bar (21" HG vac)	5 bar[1)] (72.5 psi)[1)]
070	6.6 - 17.5 (29.1 - 77.1)	2.2 - 35 (9.7 - 154.1)	150 - 400	50 - 800	-0.7 bar (21" HG vac)	5 bar[1)] (72.5 psi)[1)]

[1)] Pumps that are switched in series can have a higher maximum permitted working pressure at the second pump (see data sheet). The limit mentioned here applies to the **difference in pressure** between the inlet and outlet, which must also be observed in pumps switched in series.

Maximum differential pressure Δ p, depending on the speed

AN...	Speed n [rpm]					
	100	200	300	400	500	600
040	8 bar (116 psi)	8 bar (116 psi)	8 bar (116 psi)	8 bar (116 psi)	8 bar (116 psi)	8 bar (116 psi)
070	5 bar (72.5 psi)	5 bar (72.5 psi)	5 bar (72.5 psi)	5 bar (72.5 psi)	5 bar (72.5 psi)	5 bar (72.5 psi)

Pipe connections



Example: Classic FL series

Pipe connections

Forces and torques on metal pipe connectors (short, straight pipe connectors)

Value:	Pipe nominal diameter (mm)	Forces N max				Torques Nm max			
		F_x	F_y	F_z	$F_{(total)}$	M_x	M_y	M_z	$M_{(total)}$
Valid for Börger machine	**25, 32, 40, 50, 65, 80, 100, 125, 150**	4300	6000	4300	8542	890	770	1070	1590
For comparison: Specification acc. to **EN 14847**	200		930		1320		500		735

The values Fx, Fy and Fz as well as Mx, My and Mz may never be used simultaneously as maximum values.

The specified values are calculated, and may deviate in practice due to casting tolerances and structural changes. It is therefore recommended not to exceed the limits specified in terms of EN ISO 14847 for rotary positive displacement pumps, pipe diameter 200 mm, wherever possible.

4 Transportation, Storage and Installation

4.1 Transportation

WARNING!
Risk of fatal injury due to suspended loads!

Loads can swing and fall during lifting operations. This can cause severe injury, including death.

— Never stand under or within the swinging range of suspended loads.
— Do not move loads unsupervised.
— Only use approved hoists and slings with sufficient load-bearing capacity.
— Do not use torn or worn hoists such as ropes and belts.
— Do not place hoists such as ropes and belts near sharp corners and edges and do not tie them together or twist them.
— Put the load down when leaving the operating site.

WARNING!
Risk of injury by falling or tilting packages!

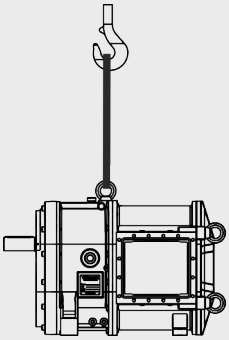
Packages can have their center of gravity elsewhere than in the middle. If not properly aligned, the package can tilt and fall. Falling or tilting packages can cause severe injuries.

— Lift the package carefully and monitor whether it tilts. Realign if necessary.

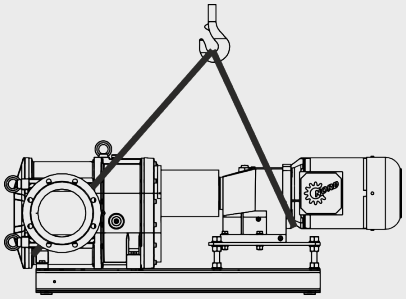
Tool: ■ Hoists

— Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.

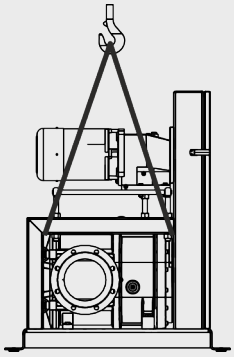
1. Observe the specifications in the hoist instructions, especially for the inclination angle allowed.
2. Transport the Börger machine using a suitable hoist.
3. If a special base frame with additional lifting lugs or forklift pockets was delivered, use them accordingly.



— Without attachment parts, Börger machines can be lifted using the ring bolt.



— Standard Börger machines with electric drives can be transported safely using the method shown here, for example.



— Overhead mounted drive assemblies can be transported safely using the method shown here, for example.

4.2 As-delivered condition

— Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.

The Börger machine is delivered in a pre-assembled, packed state. Optional accessories may be included in separate packaging.

1. Observe the applicable delivery conditions for the order.
2. Check that the delivery is complete when you receive it.
3. Inspect the delivery immediately for any signs of transport damage.

4. Ensure that the unit is not put into operation in the event of incorrect or incomplete delivery, or transport damage.
5. Inform the shipping agent immediately of any transport damage and contact Börger GmbH.

4.3 Storage and interim storage

4.3.1 Storage

NOTICE!
Risk of damage caused by frost!

Frost can cause damage to the Börger machine.

— Protect the Börger machine and its connections against frost.

NOTICE!
Inadequate maintenance can result in malfunctions and damage!

— When the machine is stored for longer periods, rotate the shafts several times after about six months (or more often, depending on the storage conditions), according to *Chapter 4.5.1 “Checking smooth running following storage and long downtimes” on page 82*.
  — This way the gears, bearings and shaft seals are moved and coated again with lubricant.

NOTE!
Storage conditions

If the Börger machine is not used immediately, then appropriate storage conditions are as important as the correct installation and maintenance for subsequent trouble-free operation.

- Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.
- **Always adhere to the following storage conditions for the Börger machine:**
  - The storage room must be evenly ventilated and free of dust and vibrations
  - The relative humidity must be below 65% and the temperature between 15 °C and 25 °C (59 °F and 77 °F)
  - Avoid exposure to direct heat sources (sunlight, heating)

1. Repair any damage to the external coating, galvanized components and corrosion protection on bare metal parts caused by external influences.
2. Protect the Börger machine from cold, particularly from frost, as well as from moisture, contamination and mechanical influences. Close the inlet and outlet connections in particular (flange, coupling etc.), plus any other openings to the interior with covers impermeable to moisture.
3. Before commissioning / recommissioning at a later date, remove all protective covers and anti-corrosion coatings.

If the device was stored for two years or more, or if the storage conditions detailed above could not be met:

— Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.

— To the extent necessary, amply secure the surrounding area when performing maintenance. Cordon off the working area with a red and white safety chain and a warning sign.

— Remove the quick-release cover in accordance with *Chapter 6.3.2 “Opening and closing the quick-release cover” on page 124*.

1. Replace the lubricants before commissioning as described in *Chapter 6.2.2 “Lubricant fill level and changing the lubricants” on page 115*.
2. Check all O-rings that come into contact with the medium and the mechanical seal and replace them if necessary as described in *Chapter 6.3.5 “Replacing the mechanical seal” on page 138*
3. Observe the **drive** manufacturer’s instructions for storing the drive.
4. Observe the manufacturer’s instructions for storing any **accessories**.

NOTE!
Börger customer service

If you have any questions on troubleshooting, installation, maintenance and repair work, contact Börger customer service.

4.3.2 Interim storage

For the interim storage of a used Börger machine, the following applies:

— Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.

— To the extent necessary, amply secure the surrounding area when performing maintenance. Cordon off the working area with a red and white safety chain and a warning sign.

1. Clean the Börger machine thoroughly in accordance with *Chapter 6.1 “Machine care” on page 106*.
2. Apply suitable corrosion protection to the machine.
3. Follow the storage instructions in accordance with *Chapter 4.3.1 “Storage” on page 62*.

4.4 Installation

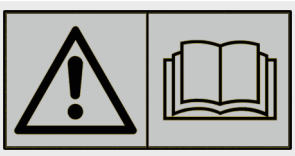
Incorrect installation

WARNING!
Risk of fatal injury as a result of incorrect installation!

Errors during installation may lead to extremely dangerous situations and cause severe material damage.

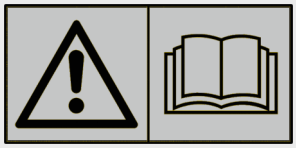
— Install the component parts professionally. Observe specified screw tightening torques.

— Please observe the following prior to initial commissioning.
  — Ensure that all installation work is performed and completed as per the information and notes provided in this manual.
  — Ensure that all covers and safety features are installed and function correctly.
  — Ensure that nobody enters the hazardous area.



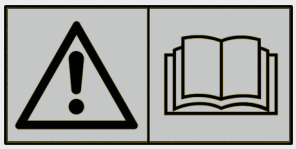
Further operating manuals / supplementary operating manuals

— You must completely read the separate operating manuals and/or supplementary operating manuals for components and/or special versions and consider the **instructions and safety regulations** accordingly.



Supplier documentation

— You must completely read the separate supplier documentation and consider the **instructions and safety regulations** accordingly.



Operating manuals of electronic parts

— Pay attention to all the **instructions and safety regulations** contained in the operating manuals for electronic components in the appendix.

4.4.1 Preparation for installation

NOTICE!
Risk of material damage due to non-compliance with the operating manuals for accessories!

Non-compliance with supplementary operating manuals for special equipment or accessories can lead to damage to the Börger machine.

— If your Börger machine is equipped with special equipment, then you must first read the corresponding supplementary operating manual for the equipment or accessories before carrying out any installation, commissioning, maintenance or repair work on the machine.

NOTE!
Pipe layout

Check that the original pipe layout is still correct before installing the pump.

— A change in pipe diameter, length etc. can completely change the suction and pressure conditions in the system.
— Börger rotary lobe pumps are configured for different mounting positions. Refer to the diagram in ↬ *Chapter 3.1.7 “Designs, mounting positions” on page 45* for the mounting position of your rotary lobe pump.
  — Depending on the design, it may be necessary to replace the temporary shipping plugs in the intermediate chamber and gear unit with the breather (intermediate chamber) and the breather system (gear unit).

— Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.

1. Check all specifications in the technical data sheet and only install the rotary lobe pump if it is suitable for the intended application.
2. Apart from the performance data of the rotary lobe pump, also check that the materials are compatible with the pumped medium.
3. Check that any accessories for the operation of the rotary lobe pump are available and make sure that the accessories are ready for operation according to the operating manual of the manufacturer.

Incomplete machine

Tool:
- Hammer drill
- Torque wrench

If an incomplete unit has been delivered by request, fully assemble the machine first.

— Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.

— To the extent necessary, amply secure the surrounding area when performing installation. Cordon off the working area with a red and white safety chain and a warning sign.

1. **Base frame**

   Attach the Börger machine to a solid, rigid surface.

2. **Drive**

   Connect the Börger machine which is installed on a Börger base frame or a suitable rigid surface to a suitable drive.

   Observe the appropriate speed and sufficient torque, and take all necessary parameters into account, such as viscosity and the solid content of the medium.

3. Attach a suitable cover (coupling guard) for the rotating parts.

4. **Pipe connectors**

   If your two-shaft Börger machine was delivered without pipe connectors (with standard rectangular flanges on the inlet and outlet), the appropriate pipe connectors must be attached as follows:

   Use:

   - Suitable flange screws
   - Suitable spring washers to secure the flange screws
   - Seals made from materials compatible with the medium
     - O-ring seals must be used as standard, and are to be installed in the O-ring groove of the rectangular flange on the inlet/outlet.

       Optionally, gaskets are also used, e.g. in the agricultural sector.

5. Gradually tighten the flange screws used to install the pipe connectors on the inlet and outlet crosswise so that the leak tightness of the connection is guaranteed.

   - Make sure that the seals and the spring washers are not damaged and not to squeeze out the rubber gaskets (NBR, EPDM, FKM).

4.4.2 Positioning

Risk of frost

NOTICE!
Risk of damage caused by frost!

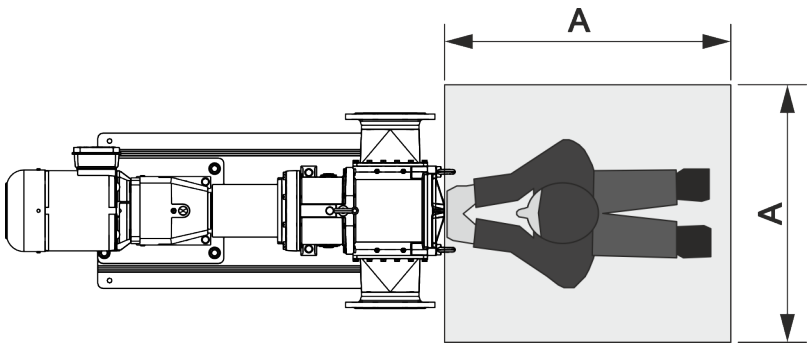
Frost can cause damage to the Börger machine.

— Protect the Börger machine and its connections against frost.

Sufficient air circulation

NOTICE!
Sufficient air circulation at the drive!

— Ensure that there is sufficient circulation of air around the drive; see the drive manufacturer's operating manual.



Standard units are installed ready for operation on a rigid base frame together with elastic shaft connections, a coupling guard and pipe connectors.

The recommended service space (A x A) is 1.0 x 1.0 m (3.28 ft x 3.28 ft).

A space of at least 0.8 m x 0.8 m (2.62 ft x 2.62 ft) is necessary to access the unit easily for maintenance and repair work.

NOTE!
Base frame installation

The nuts underneath the base frame must be accessible with a wrench from the front and back. If realignment is required or the machine is reinstalled on the base frame (e.g. following repairs or replacement), then it must be possible to hold the nuts in place with a wrench.

Only set the base frame in concrete if a suitable special base frame has been delivered as agreed upon in advance.

Tool: ■ Hammer drill

Versions with base frames

— Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.
— To the extent necessary, amply secure the surrounding area when performing installation. Cordon off the working area with a red and white safety chain and a warning sign.

1. Position the base frame without subjecting it to stress.
2. Compensate for any unevenness in the floor, e.g. by using washers or shims.
3. Install the base frame onto the reinforced surface without subjecting it to stress, e.g. using four suitable anchor bolts and appropriate resin capsules or four other safe fixing systems suitable for the surface and the application.

Example: anchor bolts

Series	Anchor bolts
AL, AN	M12 x 130 mm (5.1 ")
PL, CL, FL, EL	M16 x 160 mm (6.3 ")
XL	M20 x 160 mm (6.3 ")

Other versions

— **Mobile units** must be operated on a solid surface and be secured in place. Double-check this.
— **Börger machines that are operated on a vehicle** must be fixed to the vehicle frame. Double-check this.
— When installing **special versions**, check whether a supplementary operating manual is enclosed in the appendix and, if so, follow the instructions.

4.4.3 Installing the inlet and outlet

NOTICE!
Risk of damage due to incorrectly installed pipe system!

Börger machines are robust, and are constructed for use with high loads. However, they must not be used as an anchor point for the pipe under any circumstances. Even at low vibrations, the stress generated on the pipe during operation can lead to cracks on weaker components / weld seams.

— Pipes and any additional components such as valves, check valves etc. must not subject the machine and flange connections to stress.
— Avoid misalignment between the machine pipe connectors and the pipe.
— All attachment parts must be supported as close to the machine as possible according to the valid general technical rules.

NOTICE!
Risk of severe material damage due to cavitation!

Cavitation can cause permanent damage to the Börger machine.

— In order to avoid cavitation, the Börger machine should only have to negotiate a minimal priming height or no priming height at all.
— The NPSH value on the system ($NPSH_{avail.}$/ $NPSH_A$) must always be sufficiently larger than the required NPSH value on the pump ($NPSH_{req.}$ / $NPSH_R$). The following applies here: **$NPSH_{avail.}$ > $NPSH_{req.}$ + 0.5 m (1.64 ft)** and/or $NPSH_A$ > $NPSH_R$ + 0.5 m (1.64 ft).
— Depending on the application (e.g. when used with gas-emitting media) and pipe construction, it may be advisable to equip the pipe system with vents at high points.
  — Ensure that no pockets of air can build up upstream or downstream of the pump.

Suitable seals are required for installing the inlet and outlet pipe connectors to the pipes / hoses, i.e. gaskets are required on flange connections. These must be resistant against the medium.

The type, design, nominal diameter and nominal pressure of the connection flanges (or any special connections) are specified in the order confirmation / data sheet. Only suitable counter flanges / connectors may be attached in combination with the appropriate seals.

The pipes to be connected must correspond to the specifications in the order (material, DN, PN, $NPSH_A$ value etc.).

1. Clean all connection flanges and all other connections before installation and ensure that they are not damaged.
2. On flange connections, ensure that the flanges are positioned exactly face to face, even without being fixed by screws. They must not be inclined, nor pressed together, nor spring backwards due to tensile forces.
3. Prevent any stress on the pipes connected to the Börger machine by taking suitable measures.
4. Use seals that are suitable for the connections.
5. Install the connections to the matching pieces on the pipes or hoses without stress. When necessary, apply the appropriate torque for the connection. Consult the manufacturer's instructions for coupling connections.

4.4.4 Aligning the unit

NOTE!
Coupling guard and V-belt/chain guard

The coupling guard and V-belt/chain guard are safety-relevant protective devices.

— They prevent reaching into the rotating parts and protect the rotating elements from coming into contact with other parts and thereby generating sparks.

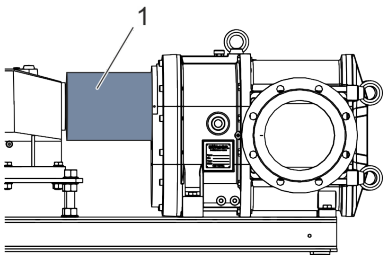
Version with torsionally flexible coupling

After the Börger machine is installed, in order to rule out damage caused by displacement, you must check the alignment of the coupling on units mounted on a base frame that have gear motors.

— Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.

— Read and observe the instructions from the coupling manufacturer in the appendix.

— To the extent necessary, amply secure the surrounding area when performing installation. Cordon off the working area with a red and white safety chain and a warning sign.



1. Loosen the fastening screws of the coupling guard and pull the coupling guard out of the groove of the fastening ring, if available (depending on version).
2. Bend up the coupling guard (1) shown here slightly.
3. Lift off the coupling guard (1).
4. Check the alignment of the coupling in several positions using a suitable tool (straightedge, laser-optical sensor).
5. When necessary, carefully correct any misalignment according to the specifications of the coupling manufacturer, e.g. using the set screws on the motor plate.
6. Reattach the coupling guard (1) correctly. Retighten all fastening screws.

7. Check the screws used to fasten the Börger machine to the base frame and retighten them, if necessary.

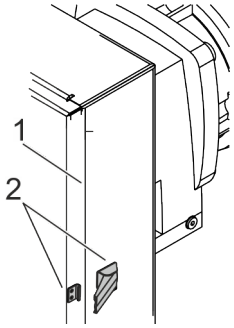
Version with belt or chain drive

The correct belt pre-tension or chain tension is necessary for correct belt drive or chain drive functionality and a long service life for the V-belts/chains.

— Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.

— Read and observe the instructions from the V-belt or chain manufacturer in the appendix.

— To the extent necessary, amply secure the surrounding area when performing installation. Cordon off the working area with a red and white safety chain and a warning sign.



1. Open the retaining clamps (2) on the V-belt/chain guard and lift off the protection cover (1).

2. Check that the V-belts or chains are positioned correctly and that the pre-tension is correct according to the manufacturer's specifications.

3. Put the protection cover (1) of the V-belt/chain guard with the pins back into the corresponding bores of the base frame and fasten the cover with the retaining clamps (2).

4. Check the screws used to fasten the Börger machine to the base frame and retighten them, if necessary.

4.4.5 Electrical connection

DANGER!
Risk of fatal injury due to electric power!

There is an immediate risk of fatal electric shock if live components are touched. Damage to the insulation of the individual components can be fatal.

- Have all work on the electrical equipment performed by skilled electricians.
- In the event of damage to the insulation, cut off the power supply immediately and initiate repairs.
- Before working on live components of electrical systems and equipment, de-energize these components and secure them in this state for the duration of the work. Adhere to the following safety rules in this regard:
  - Disconnect.
  - Secure against restart.
  - Verify that components have been de-energized.
  - Ground and short-circuit.
  - Cover or shield any adjacent live components.
- Never bypass or disable any fuses. Comply with the correct amperage specification when replacing fuses.
- Keep moisture away from all live components. This may lead to short circuits.

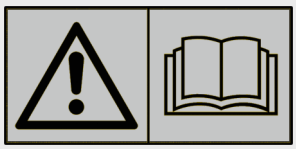
NOTE!
Completion of installation

- The Börger machine must be completely installed before establishing the electrical connections.

NOTE!
When using frequency converters

Due to their working principle, frequency converters generate leakage current.

— For proper operation of a frequency converter at a residual current device, the use of an AC/DC sensitive **residual current device (type B)** according to **EN50178/VDE0160** is required due to the DC component of the leakage current.



Operating manuals of electronic parts

— Pay attention to all the **instructions and safety regulations** contained in the operating manuals for electronic components in the appendix.

The Börger machine must be completely installed before establishing the electrical connections.

— Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.

— To the extent necessary, amply secure the surrounding area when performing installation. Cordon off the working area with a red and white safety chain and a warning sign.

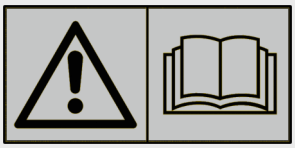
1. Connect all electrical monitoring devices according to the operating manuals from the manufacturers.
2. Connect the drive **on versions with an electric drive** according to the operating manual from the manufacturer.
3. Ground the Börger machine properly, see operating manual of the drive manufacturer. Also use the bore hole for the ground terminal.

4.4.6 Hydraulic connection

DANGER!
Risk of fatal injury due to hydraulic oil spurting out under pressure!

Hydraulically actuated moving parts can cause severe injury.

— Have all work on the hydraulic system performed by hydraulic specialists.
— Depressurize the hydraulic system completely before starting work on it. Depressurize the pressure accumulator completely.
— Do not reach into moving parts or handle moving parts when the machine is in operation.
— Never hold body parts or any objects into the jet of liquid. Keep personnel away from the hazardous area.
— Activate the EMERGENCY STOP immediately. If required, take further measures to reduce the pressure and stop the jet of liquid.
— Have defective components repaired immediately.
— Collect any escaping fluid properly and dispose of it.



Operating manual of drive manufacturer

— Pay particular attention to all **instructions and safety regulations** contained in the operating manual of the drive manufacturer.

The Börger machine must be completely installed before establishing the hydraulic connections.

— Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.
— To the extent necessary, amply secure the surrounding area when performing installation. Cordon off the working area with a red and white safety chain and a warning sign.

→ Connect the hydraulic connections on Börger machines with a hydraulic drive according to the operating manual from the drive manufacturer.

4.4.7 PTO shaft connection

DANGER!
Risk of injury due to rotating parts!

Moving parts can cause severe injury.

— Do not reach into rotating parts or handle rotating parts when the machine is in operation.
— Never open protective covers when in operation.
— Perform work on the Börger machine only when stationary.
— Observe the delay time: Prior to opening protective covers, make sure that all components have stopped moving.
— Shut down the Börger machine and upstream and downstream system components as described in *Chapter 5.3 “Downtimes” on page 94* before carrying out any work on the Börger machine or accessories.
— The operating person is obligated to check that all safety equipment is installed as described in *Chapter 2.8 “Description of the safety equipment” on page 25* and fully functional before putting the machine into operation.
— The Börger machine must only be switched on when the inlet and outlet connections have been established and the maintenance openings have been securely installed.

Operating manual for PTO shaft components

— Pay particular attention to all **instructions and safety regulations** contained in the operating manuals for PTO shaft components.

The Börger machine must be completely installed before connecting the PTO shaft.

— Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.

— To the extent necessary, amply secure the surrounding area when performing installation. Cordon off the working area with a red and white safety chain and a warning sign.

1. **On versions with a PTO shaft drive**, ensure that the drive side of the PTO shaft is properly connected to the drive.
2. Connect the suitable PTO shaft - which has to be mounted properly to the drive - with the corresponding shaft end of the Börger machine according to the operating manual from the PTO shaft manufacturer.
3. Check the length of the PTO shaft and adjust it if necessary.

4.5 Checks before commissioning

DANGER!
Risk of injury due to rotating parts!

Moving parts can cause severe injury.

— Do not reach into rotating parts or handle rotating parts when the machine is in operation.

— Never open protective covers when in operation.

— Perform work on the Börger machine only when stationary.

— Observe the delay time: Prior to opening protective covers, make sure that all components have stopped moving.

— Shut down the Börger machine and upstream and downstream system components as described in *Chapter 5.3 “Downtimes” on page 94* before carrying out any work on the Börger machine or accessories.

— The operating person is obligated to check that all safety equipment is installed as described in *Chapter 2.8 “Description of the safety equipment” on page 25* and fully functional before putting the machine into operation.

— The Börger machine must only be switched on when the inlet and outlet connections have been established and the maintenance openings have been securely installed.

NOTICE!
Inadequate maintenance can result in malfunctions and damage!

— When the machine is stored for longer periods, rotate the shafts several times after about six months (or more often, depending on the storage conditions), according to *Chapter 4.5.1 “Checking smooth running following storage and long downtimes” on page 82*.
  — This way the gears, bearings and shaft seals are moved and coated again with lubricant.

4.5.1 Checking smooth running following storage and long downtimes

Following long storage periods and downtimes, check that the mechanical seals (or any special seals) and the rotating parts run smoothly before commissioning the Börger machine again:

— Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.
— To the extent necessary, amply secure the surrounding area when performing maintenance. Cordon off the working area with a red and white safety chain and a warning sign.

1. Open the quick-release cover, see *Chapter 6.3.2 “Opening and closing the quick-release cover” on page 124*.
2. Attach a hexagon socket wrench or ratchet to one of the hexagon socket head cap screws that fasten the rotating parts to the shafts. Use the tool to rotate the shaft **clockwise**. The shafts and the rotating parts must not become jammed.
3. On used machines, remove any foreign bodies that may cause the rotating parts to jam. If this does not solve the problem, then removal and possibly replacement of the mechanical seals or rotating parts is necessary.
4. Install the quick-release cover in accordance with *Chapter 6.3.2 “Opening and closing the quick-release cover” on page 124*.

4.5.2 Checking readiness for operation

NOTE!
Integration into the EMERGENCY STOP system

A Börger machine must be integrated in an **EMERGENCY STOP system**.

— It is only permissible to do without an emergency stop device if the emergency stop device would not reduce the stopping time and if it would not enable the special measures required to deal with the risk to be taken.
— The normal shutdown equipment must then be labeled accordingly.

NOTE!

The quench fluid is used for monitoring the integrity of the mechanical seals, and also for protection, lubrication and cooling of the mechanical seals, see *Chapter 3.1.5 “Shaft seal” on page 44* and *Chapter 3.1.6 “Intermediate chamber (quench)” on page 45*.

— Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.
— Ensure that the Börger machine is integrated into an **emergency stop** system, or, if such a system is not mandatory, that the shutdown device is adequately labeled.

1. If your Börger machine was delivered with special **accessories**, then ensure that these accessories are installed correctly and ready for operation. This especially applies to devices used for safety and monitoring system functionality. Adhere to the relevant operating manuals for the accessories.
2. Ensure that you have removed the **transport lock from the breather system on the drive** if one was present according to the operating manual of the drive manufacturer.

3. Check the **oil level in the gear unit of the Börger machine**. On standing versions, the oil level must reach at least halfway up the oil sight glass. If this is not the case, the gear oil (cf. data sheet) must be refilled, see *Chapter 6.2.2 "Lubricant fill level and changing the lubricants" on page 115*.
4. Ensure that the **breather system at the gear unit** is properly installed.
5. Ensure that the **breather at the intermediate chamber** is properly installed and the quench fluid can drain off freely in the event of a seal leakage, or, when no medium must be released into the atmosphere, that a suitable drain system is installed.
6. Check whether the **delivered quench fluid** (see enclosed data sheet) is suitable or whether an alternative fluid must be used in order to observe environmental protection regulations, or for biological or other reasons. This must be compatible with the medium, and must not adversely affect the O-rings of the mechanical seals. Consult Börger GmbH regarding this, if necessary.
7. Check the **fill level in the intermediate chamber**. On standing versions, the quench fluid must reach halfway up the top shaft. Otherwise, the quench fluid (cf. data sheet) must be refilled. If there is much more fluid in the intermediate chamber than the optimum fill level when the mechanical seal is intact, some of the fluid should be drained off in order to prevent premature overflowing. Otherwise, the functionality of the leak monitor may be compromised. In this regard, also see *Chapter 6.2.2 "Lubricant fill level and changing the lubricants" on page 115*.
8. Check that the **coupling guard or the V-belt or chain guard** is positioned correctly and fixed securely.
9. Ensure that the **supply lines** to the drive are connected and secured according to the relevant regulations.
10. Ensure that the unit is properly **grounded**.
11. Check that the **pipe connectors** are attached correctly and do not leak (torque for the connection between Börger machine and pipe connector according to *Chapter 4.4.1 "Preparation for installation" on page 67*).
12. Check that all **screws and nuts**, which may have become loose during transportation and installation, are tight.

13. Rectify all errors determined by this check.

4.5.3 Checking the flow direction

NOTICE!
Risk of damage due to frictional heat!

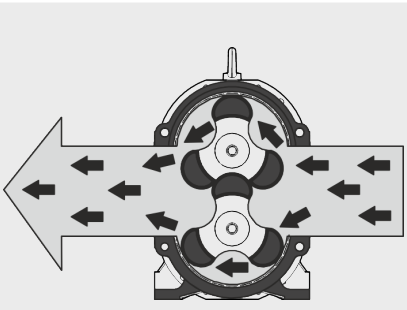
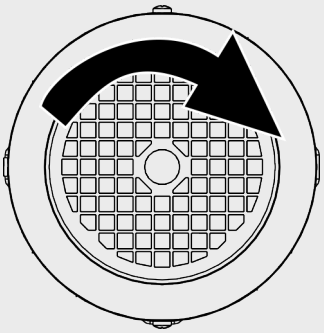
The frictional heat that develops can cause damage to the pump components.

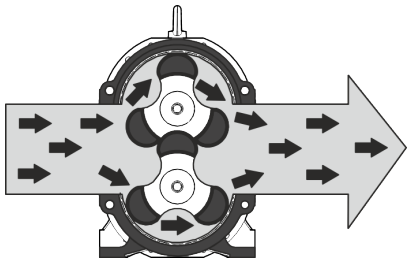
— A rotary lobe pump with rubber-coated rotors should not run dry, i.e. without pumped medium, **for longer than 15 seconds** at a normal speed under any circumstances.

— **The rotary lobe pump must not be put into operation during the following function test.**
  — Ensure that all valves and shut-off devices are closed.

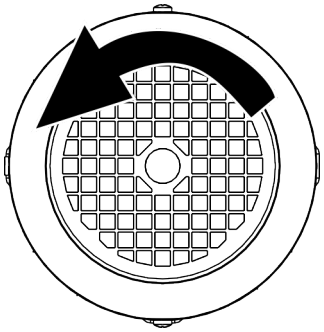
The flow direction on Börger rotary lobe pumps can be reversed, and is defined by the direction of rotation of the drive.

After establishing the electrical connections, check if the flow direction of the rotary lobe pump is correct by means of the direction of rotation of the drive shaft.

Example: Standard drive with <u>two-stage</u> helical gear unit	
View of quick-release cover:	**View of drive with drive shaft at the top[1]:**
	
Flow direction from **right to left**, when the upper shaft turns counter-clockwise	⇒ Required direction of rotation of the shaft / the fan wheel **<u>when looking at the drive</u>: clockwise**
View of quick-release cover:	**View of drive with drive shaft at the top[1]:**



Flow direction from **left to right**, when the upper shaft turns clockwise



⇒ Required direction of rotation of the shaft / the fan wheel **when looking at the drive: counter-clockwise**

[1] If the lower shaft is the drive shaft, the motor of a version with a **two-stage** helical gear unit must turn in the other direction (when looking at the drive) than shown here.

— Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.
— To the extent necessary, amply secure the surrounding area when performing maintenance. Cordon off the working area with a red and white safety chain and a warning sign.
— Open the quick-release cover in accordance with *Chapter 6.3.2 “Opening and closing the quick-release cover” on page 124*.

1. Consult the operating manual from the drive manufacturer for details on checking the direction of rotation. With three-stage gear units, the motor must turn in the opposite direction for example (when looking at the drive). This is different from two-stage gear units which are used as an example here.

2. Check the direction of rotation of the drive shaft, for example, by briefly switching on the motor and observing the fan wheel of the motor.

3. If the direction of rotation and therefore the flow direction are incorrect, change the direction of rotation of the drive or switch the PTO shaft for versions with two drive shafts.

4. Mark the selected flow direction on the Börger machine using the adhesive label provided.

5. **Special drives**

   Make sure the direction of rotation of the drive shaft for the required flow direction is correct according to the function description above as described in the operating manual of the drive manufacturer.

6. Close the quick-release cover as described in *Chapter 6.3.2 “Opening and closing the quick-release cover” on page 124*.

5 Operation

WARNING!
Risk of injury as a result of improper operation!

Improper operation may cause severe injury and considerable material damage.

- Prior to commissioning, ensure that all installation work is performed and completed as per the information and notes provided in this manual.
- Ensure that all operating steps are performed as per the information and notes provided in this manual.
- Ensure the following before starting work:
  - Ensure that all covers and safety features are installed and function correctly.
  - Ensure that nobody is in the hazardous area.
- Never bridge or disable safety features during operation.

NOTICE!
Risk of severe material damage caused by running a Börger machine against closed valves!

Running against closed valves may cause permanent damage to your Börger machine.

- The Börger machine must not be run against closed valves.
  - Make sure that the pipes are open when the Börger machine is switched on, e.g. by a suitable control unit.

NOTICE!
There is a danger of considerable material damage if the limits are not complied with!

Failure to comply with the limits can cause permanent damage to the Börger machine and its components.

— The values may neither exceed nor fall below the limits specified in *Chapter 3.3 “Technical data” on page 53* and the specifications on the data sheet.
— On Börger machines that operate with a frequency converter, make sure that the operating speed is sufficiently below the maximum permissible speed (for speed limit based on machine configuration, see enclosed data sheet).
— Take all necessary precautions to ensure that the permissible differential pressure between the inlet and outlet of the Börger machine is not exceeded.
— Make sure that the pressure on the outlet does not exceed the permissible pressure of the pipe system and the Börger machine, and not overload the drive and its elastic connections.
— The temperature values according to the data sheet may not exceed or fall below the limits. Double-check this.

NOTICE!
Risk of material damage due to blockage and imbalances of the drive shaft!

Inadequate cleaning and foreign bodies can cause permanent damage to your Börger machine.

— Make sure that long-fibrous particles and other foreign bodies which might result in a blockage of the drive shaft do not enter the working chamber.
— Make sure that the unit does not become imbalanced, e.g. due to inadequate cleaning (adhesive residues of the pumped medium) or foreign bodies.
— Take the appropriate precautions if necessary (install a macerator and/or stone trap upstream).

NOTICE!
Risk of damage caused by frost!

Frost can cause damage to the Börger machine.

— Protect the Börger machine and its connections against frost.

ENVIRONMENT!
Danger due to incorrect handling of environmentally hazardous substances!

Inappropriate handling of environmentally hazardous substances, especially incorrect disposal, can cause significant damage to the environment.

— Especially water-polluting materials such as grease and lubricating oil must not pollute the soil or enter the sewage system during installation, repair and maintenance work.
  — These materials must be collected, stored, transported and disposed of in suitable containers.
— When handling oil, grease and other chemical substances, pay attention and adhere to the applicable regulations and safety data sheets issued by the respective manufacturer relating to storage, handling, correct use and disposal.
— Comply with the legal obligations regarding waste avoidance and the proper recycling/disposal of waste during all work

NOTE!
Contamination caused by production residues!

Börger machines may contain residues from the manufacturing process, e.g. grease or oil. Contamination caused by packaging and transport cannot be ruled out.

— If necessary, thoroughly rinse the Börger machine with a suitable agent as part of the test run (↳ *Chapter 5.1 “Commissioning” on page 91*) while adhering to the limits before commissioning the machine for the first time.

5.1 Commissioning

NOTICE!
Risk of damage to the mechanical seal due to a lack of quench fluid!

Risk of damage to the mechanical seal due to a lack of quench fluid!

— The heat-absorbing quench fluid prevents the mechanical seal from running dry and captures any medium that enters the intermediate chamber due to leaks in the mechanical seal.
— This quench function also prevents the gear unit from being damaged by the ingress of medium.
— Make sure that the fill level in the intermediate chamber is sufficient.

NOTE!
Rotary lobe pumps are self-priming positive displacement pumps.

However, we recommend filling the pump with medium for suction operation before switching it on. This shortens the priming process and prevents dry run with increased wear.

— Suitable equipment for filling and venting may be required in the suction and pressure lines.
  — The pump should be prepared so that venting is possible directly behind the pump, on the pressure side, during the initial priming process.
  — If the suction line is flooded with medium (e.g. gravity feed), only the pipes need to be free and all valves open to ensure the unrestricted transportation of pumped medium and any air remaining in the pipe.

5.1.1 Test run with medium

This test run may only be made when

— all safety instructions have been read and adhered to according to *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.
— all measures detailed in the previous chapter are completed, see *Chapter 4.4 “Installation” on page 65*,

— the unit is completely ready for operation, see *Chapter 4.5.2 “Checking readiness for operation” on page 83*,
— all errors have been rectified and
— the functional checks without medium have shown the required smooth running and the desired direction of rotation, see *Chapter 4.5 “Checks before commissioning” on page 81*.

1. Adhere to the manufacturers' operating manuals for all attached control components.
2. First, switch on all additional devices, especially those with measurement and control functions relevant to safety.
3. Open the pipe shut-off devices on the inlet and the outlet side.
4. Switch on the drive of the Börger machine.
5. Check all pipe connectors, the quick-release cover, etc., for leaks.
6. Check that the function/display of all additional devices is working properly.
7. Check that the Börger machine runs quietly and vibration-free. If the Börger machine or drive emits uneven, rattling sounds, then the cause must be determined.
8. Check the power consumption of the drive. Compare the values with those in the drive operating manual.
9. Check the development of noises and temperature on the drive.

5.1.2 Complete commissioning

The Börger machine can be operated properly when all functions run correctly and no leaks are detected.

NOTE!
Checklist for commissioning

A checklist for commissioning the Börger machine can be found in *Chapter 9.6 “Checklist for commissioning” on page 166*.

5.2 Continuous operation

— Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.

Börger rotary lobe pumps are suitable for continuous operation.

1. Make sure that the unit does not become imbalanced due to inadequate cleaning (adhesive residues of the pumped medium, threads wrapped around the rotors) or foreign bodies.
2. On Börger rotary lobe pumps that operate with a frequency converter, make sure that the operating speed is sufficiently below the maximum permissible speed (for speed limit based on machine configuration, see enclosed data sheet).
3. Observe the maintenance and inspection intervals according to *Chapter 6.2 “Maintenance and inspection” on page 113*.

5.3 Downtimes

— Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.

1. Switch off the Börger machine (or the pumps or the gravity feed, depending on the system).
2. Close the valves on the suction and pressure line if required by the system.
3. The flow medium can be left in the Börger machine during normal downtimes, provided the flow medium type does not prevent this (e.g. medium hardens when cooling down).

   — Clean the Börger machine in these cases and before long downtime periods as described in *Chapter 6.1 “Machine care” on page 106*.

5.4 Emergency shut-down

NOTE!
EMERGENCY STOP

The **EMERGENCY STOP button** as an **EMERGENCY STOP** enables the **immediate shut-down** of the Börger machine.

In cases of emergency, the Börger machine must be shut down as fast as possible, the energy supply must be switched off and pressure must be released.

Please proceed as follows in emergencies:

1. Activate the EMERGENCY STOP by pressing the EMERGENCY STOP button immediately.
2. If a risk to your own life can be excluded, evacuate other persons from the danger zone.
3. If necessary, initiate first aid measures.
4. Alert emergency personnel.
5. Inform person responsible on site.
6. Switch off the Börger machine and secure against restart.
7. Clear access routes for emergency personnel.
8. Brief emergency personnel.
9. Commission qualified personnel with troubleshooting.

WARNING!
Risk of fatal injury if the plant is switched back on uncontrolledly or without authorization!

Switching the machine on without authorization or uncontrolledly can cause serious injuries.

— Ensure that the cause of the EMERGENCY STOP has been eliminated and all safety features are installed and functional prior to a restart.
— Do not reset the EMERGENCY STOP switch before the danger has been eliminated.

5.5 Malfunctions

WARNING!
Risk of injury due to inadequate troubleshooting, maintenance and repair work!

Inadequate troubleshooting, maintenance and repair work can lead to severe injury and significant damage to property.

- Ensure sufficient installation space before commencing work.
- Keep the installation site clean and tidy! Loosely stacked or scattered components and tools cause accidents.
- Ensure correct installation where components have been removed, reinstall all fastening elements and observe the tightening torques of screws.
- Ensure the following before putting the machine back into operation:
  - Ensure that all troubleshooting, maintenance and repair work is performed and completed as per the information and notes provided in this manual.
  - Ensure that nobody enters the hazardous area.
  - Ensure that all covers and safety features are installed and function correctly.

WARNING!
Risk of injury when using unsuitable spare parts!

The use of unsuitable spare parts can cause malfunctions which can lead to severe injury, including death, and to significant material damage.

- Only use suitable spare parts.
- Always contact the manufacturer if in doubt.

NOTICE!
Risk of severe material damage due to a delayed shut-down in the event of a malfunction!

A delayed shut-down in the event of malfunction can cause permanent damage to the Börger machine.

- In the event of a malfunction, shut down the Börger machine and all upstream and downstream system components immediately until the cause has been rectified.

NOTE!

Observe the note regarding the sequence of the measures at the end of this chapter.

Fault	Possible causes	Fault elimination
The pump does not start, or runs with difficulty after a downtime	Drive not switched on, not installed correctly or defective	— Establish the correct drive function by connecting it to the power supply, installing it correctly etc.
	Incorrect parameterization of the control unit or frequency converter	— Correct the setting — Check that the frequency converter is suitable (it must emit a constant torque)
	Pressure line (side of outlet) is closed or blocked	— Open shut-off device — Clean the pressure line
	Long-fibrous or film-like particles have become wrapped around the rotors	— Remove all foreign bodies — Install a macerator (Multicrusher, Multichopper) and a stone trap upstream, if necessary
	Sediment of the pumped medium has been deposited in the pump chamber following a lengthy downtime of the rotary lobe pump	— Clean the pump chamber — Close the valve of the inlet line and clean the pump chamber before longer downtimes
	Polymer rotors have expanded and press too strongly against the casing wall	— Determine the chemical composition and temperature of the pumped medium and use rotors made from suitable materials (test plates for testing the expansion are available from Börger GmbH)
	Drive output too low	— Install a more powerful drive

Fault	Possible causes	Fault elimination
The pump does not generate suction	Incorrect drive direction of rotation, therefore incorrect flow direction	— Change the direction of drive rotation
	Suction line (side of inlet) closed or blocked	— Open shut-off device — Clean the suction line
	Suction connection is leaky	— Tighten the screws on the flange connection cross-wise with uniform strength — Check the seal and replace, if necessary — Check the pipes for damage and rectify, if necessary — Rule out any leaks on components (pressure gauges, ball valves etc.)
	Suction line completely empty	— Lower the pump* and prevent emptying of the pump chamber, e.g. with 90° pipe bend at the inlet — Otherwise provide start-up volume
	Suction height too large (> 8 m / 26.25 ft)*	— Reduce the suction height (lower the pump)*
	Diameter of the suction line (side of inlet) too large*	— Adjust the pipe diameter to the pump output of the rotary lobe pump*
	Several or all suction lines open with cross-linked pipes	— Only open the shut-off device of the suction line which is currently in pump operation
	Viscosity of pumped medium too high*	— Reduce the viscosity when possible* — Change the pump position* or install an auger upstream
	Build-up of air pockets (pump could not discharge air on pressure side)	— Provide venting
	Rotors damaged due to dry run	— Replace the rotors — Replace mechanical seal (strongly recommended if rotors were damaged due to dry run) — Determine the cause of dry run and eliminate it
	Rotors damaged due to foreign bodies	— Replace the rotors — Install a macerator (Multicrusher, Multichopper) and a stone trap upstream, if necessary

Fault	Possible causes	Fault elimination
The pump does not generate suction	Rotors worn as part of regular use	— Replace the rotors
	Wear on casing liners or pump casing	— Replace worn parts

Fault	Possible causes	Fault elimination
The pump emits rattling noises	Speed too high*, pump chambers only partially filled	— Reduce the speed
	Foreign bodies in the pump chamber	— Remove foreign bodies — Install a macerator (Multicrusher, Multichopper) and a stone trap upstream, if necessary
	Diameter of the suction line (side of inlet) too large or too small*	— Adjust the pipe diameter to the pump output of the rotary lobe pump*
	Suction height too large (> 8 m / 26.25 ft)*	— Reduce the suction height (lower the pump)*
	Gas-emitting medium	— Reduce the speed — Reduce the suction height (lower the pump)*
	Pipe not supported or not supported close enough to the unit	— Support the pipes sufficiently, taking the weight of the pumped medium into account
	Rotors incorrectly installed (e.g. fastening screw of the rotors not tightened with the specified torque)	— Install the rotors properly
	Rotors or other components broken by hard foreign bodies	— Replace damaged parts — Install a macerator (Multicrusher, Multichopper) and a stone trap upstream, if necessary — Only use the rotary lobe pump for its intended purpose
	Drive incorrectly installed, e.g. coupling not aligned correctly	— Install drive correctly; align coupling
	Cam ring (coupling) or V-belt etc worn	— Replace cam ring or V-belt
	Damage to the pump gear unit or drive gear unit	— Please contact Börger customer service

Fault	Possible causes	Fault elimination
Pumped volume below the nominal value	Suction height too large (> 8 m / 26.25 ft)*	— Reduce the suction height (lower the pump)*
	Diameter of the suction line (side of inlet) too large or too small*	— Adjust the pipe diameter to the pump output of the rotary lobe pump*
	Diameter of the pressure line (side of outlet) too small	— Adjust the pipe diameter to the pump output of the rotary lobe pump*
	Shut-off devices not open or not open completely, or pipes blocked	— Open shut-off device — Clean the pipes
	Counter-pressure too high for other reasons	— Reduce the counter-pressure — Install pressure monitoring equipment
	Speed too low*	— Increase the speed*
	Viscosity of pumped medium too high*	— Reduce the viscosity when possible* — Change the pump position* or install an auger upstream
	Rotors damaged due to dry run	— Replace the rotors — Replace mechanical seal (strongly recommended if rotors were damaged due to dry run) — Determine the cause of dry run and eliminate it
	Rotors damaged due to foreign bodies	— Replace the rotors — Install a macerator (Multicrusher, Multichopper) and a stone trap upstream, if necessary
	Rotors worn as part of regular use	— Replace the rotors
	Wear on casing liners or pump casing	— Replace worn parts

Fault	Possible causes	Fault elimination
Fluid escapes from the vent hole and/or the safety opening	Temperature-related expansion with too much fluid in intermediate chamber	— Drain some quench fluid — Adhere to temperature limits — Use suitable quench fluid
	Rotor seal damaged	— Replace damaged parts
	Shaft seal of the working chamber (pump chamber) damaged	— Replace the mechanical seals or MultiSeal cartridges

Fault	Possible causes	Fault elimination
Complete loss of quench fluid	Unsuitable, quickly evaporating quench fluid	— Use suitable quench fluid — Adhere to temperature limits
	Maintenance intervals exceeded	— Adhere to maintenance intervals — Fill intermediate chamber — Exclude consequential damage to the seals by performing regular fill level checks and by checking the quality of the gear oil

* Observe the information on proper use as detailed in chapter 2 "Safety" and chapter 4.4 "Installation" of the standard operating manual.

* Please observe the information in *Chapter 2.3 “Proper use” on page 15* and *Chapter 4.4.3 “Installing the inlet and outlet” on page 72*.

NOTE!
Decreasing pump output!

In the event of decreased pump output, Börger GmbH recommends first checking the condition of the rotors.

Replace the rotors when they exhibit signs of significant wear.

— If these measures are not successful and the original pump output is still not reached following the installation of new rotors, the casing protection plates must be inspected.

If one of the gear-side and cover-side casing protection plates exhibits significant signs of wear, it must be replaced, whereby the cover-side casing protection plate can be turned once before replacing it.

If a gap still remains between the rotor body tips and the radial casing wall following the installation of new rotors – while the pump output remains too low – then we also recommend replacing the pump casing.

Before replacing wear parts, take advantage of the possibility of increasing the speed of the pump drive (and thus, the pump output).

— On electric motors, this can be an increase in frequency on your frequency converter (this can also be above the mains frequency). For example, the speed can be varied on some drive types by adjusting the drive speed (hand wheel on the control gear motor or gas lever on the combustion motor) or oil quantity (on hydraulic drives).
— Observe the maximum loads according to chapter 3.3 “Technical data” of the standard operating manual.
— If in doubt, contact Börger customer service regarding the physical limitations of your unit.

NOTE!
Börger customer service

If you have any questions on troubleshooting, installation, maintenance and repair work, contact Börger customer service.

5.6 Measures following on demand work!

Following completion of the work and before starting the unit, carry out the following steps:

— Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.

1. Check all screws that have been loosened previously for firm seat.
2. Check whether all safety devices and covers that have been removed previously are reinstalled properly.
3. Ensure that all tools, materials and other equipment used have been removed from the work area.
4. Clean the work area and remove any spilled substances, e.g. liquids, processing material or similar.
5. Reset the emergency stop devices, if required.
6. Confirm malfunctions at the control unit.
7. Ensure that nobody enters the hazardous area.
8. Ensure that all safety features of the unit function perfectly.
9. Take the unit into operation again according to *Chapter 5.2 “Continuous operation” on page 93*.

6 Maintenance and Repairs

WARNING!
Risk of injury due to inadequate troubleshooting, maintenance and repair work!

Inadequate troubleshooting, maintenance and repair work can lead to severe injury and significant damage to property.

- Ensure sufficient installation space before commencing work.
- Keep the installation site clean and tidy! Loosely stacked or scattered components and tools cause accidents.
- Ensure correct installation where components have been removed, reinstall all fastening elements and observe the tightening torques of screws.
- Ensure the following before putting the machine back into operation:
  - Ensure that all troubleshooting, maintenance and repair work is performed and completed as per the information and notes provided in this manual.
  - Ensure that nobody enters the hazardous area.
  - Ensure that all covers and safety features are installed and function correctly.

WARNING!
Risk of injury when using unsuitable spare parts!

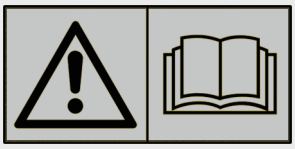
The use of unsuitable spare parts can cause malfunctions which can lead to severe injury, including death, and to significant material damage.

- Only use suitable spare parts.
- Always contact the manufacturer if in doubt.

NOTE!
Minimum requirements

The instructions described in this chapter are to be understood as the minimum requirements.

— Depending on the operating conditions, further work may be necessary to maintain the Börger machine in an optimum condition.
— The maintenance tasks detailed in this chapter may only be carried out by trained personnel employed by the operator.
— Repair work on the Börger machine may only be carried out by qualified, authorized specialists employed by the operator.



Further operating manuals / supplementary operating manuals

— You must completely read the separate operating manuals and/or supplementary operating manuals for components and/or special versions and consider the **instructions and safety regulations** accordingly.

— Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.

1. Observe the assembly drawing, the spare parts list and the wear parts list when carrying out repairs or ordering spare parts, *Chapter 9.2 “Wear parts” on page 156* to *Chapter 9.4 “Spare parts list” on page 160*.
2. Read and strictly comply with the applicable regulations, manufacturer's safety data sheets and operator's instructions in respect of the storage, handling, use and disposal of oils, grease and other chemical substances.
3. Dispose of operating materials and replaced parts in a safe and environmentally-friendly manner, see also *Chapter 7 “Disposal” on page 151*.

6.1 Machine care

Appropriate machine care helps to maintain the functionality of the Börger machine in the long term. In general, regular cleaning of dust and deposits from all surfaces is sufficient.

CAUTION!
Health hazard due to residues of dangerous medium inside and on the Börger machine!

There is an increased health hazard from contact with the medium and contaminated components.

Generally, the following applies:

— When using dangerous or health-endangering media, take all necessary safety measures when performing work on the Börger machine.
— Avoid direct contact with the medium (skin/eye contact, swallowing, inhaling).
— Remove spillage from your skin without delay.
— Do not store or consume beverages, food or tobacco in the working area.

NOTICE!
Improper cleaning of the Börger machine can lead to malfunctions and damage!

— Do not use water jets.
— Do not use aggressive cleaning agents, solvents or sandpaper, as these can damage the metallic and plastic surfaces, casing coating and seals.
— Do not use metal objects such as scrapers and screwdrivers for cleaning coated machine parts.
— Never clean sensitive components with hard scrubbing and strong mechanical pressure.
— Do not use a vacuum cleaner or a hand brush with plastic bristles etc. to clean electronic components because the production of static electricity can damage the electronic components.

ENVIRONMENT!
Danger due to incorrect handling of environmentally hazardous substances!

Inappropriate handling of environmentally hazardous substances, especially incorrect disposal, can cause significant damage to the environment.

— Especially water-polluting materials such as grease and lubricating oil must not pollute the soil or enter the sewage system during installation, repair and maintenance work.
  — These materials must be collected, stored, transported and disposed of in suitable containers.
— When handling oil, grease and other chemical substances, pay attention and adhere to the applicable regulations and safety data sheets issued by the respective manufacturer relating to storage, handling, correct use and disposal.
— Comply with the legal obligations regarding waste avoidance and the proper recycling/disposal of waste during all work

6.1.1 Cleaning the outside

Protective equipment: ■ Light respiratory protection

— Read and follow the safety instructions detailed in ↬ *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.
— Shut down the Börger machine and downstream and upstream system components as described in ↬ *Chapter 5.3 “Downtimes” on page 94*.

1. Keep all markings on the Börger machine in a legible state at all times.
2. Only clean the outside of the Börger machine by wiping or brushing it down. Use lint-free cleaning cloths.
3. When required, use a standard aqueous industrial cleaner.

6.1.2 Pressure relief

WARNING!
Risk of serious injuries caused by liquid spouting out or escaping gases!

Gases or liquids may escape uncontrollably from seals and screw connections. Especially when flange connections are released and maintenance openings are opened, pressurized liquid can spout out at the cover.

Never loosen connections when the unit is pressurized.

— Ensure that all valves and shut-off devices on the inlet and outlet are closed.
— Depressurize and empty the Börger machine through a drainage device, if available.
— Immediately absorb escaping media using suitable agents and dispose of it in accordance with the applicable local regulations.
— Therefore, wear your personal protective equipment (PPE) as described in *Chapter 2.6 “Personal protective equipment” on page 23* when opening the cover and take all necessary precautions.

WARNING!
Severe injury due to residual pressure!

Despite having depressurized the Börger machine, it may be under residual pressure in the event of congestion or lump formation in the medium.

— Take extra care when removing the flange connections and maintenance openings to prevent accidents caused by the release of residual pressure.

CAUTION!
Health hazard due to residues of dangerous medium inside and on the Börger machine!

There is an increased health hazard from contact with the medium and contaminated components.

Generally, the following applies:

— When using dangerous or health-endangering media, take all necessary safety measures when performing work on the Börger machine.
— Avoid direct contact with the medium (skin/eye contact, swallowing, inhaling).
— Remove spillage from your skin without delay.
— Do not store or consume beverages, food or tobacco in the working area.

— Read and follow the safety instructions detailed in ↳ *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.
— Shut down the Börger machine and downstream and upstream system components as described in ↳ *Chapter 5.3 “Downtimes” on page 94*.
— Secure the Börger machine against unauthorized or uncontrolled reactivation as described in ↳ *Chapter 2.7 “Securing the machine against restart” on page 24*.
— To the extent necessary, amply secure the surrounding area when performing maintenance. Cordon off the working area with a red and white safety chain and a warning sign.

1. Close all valves and shut-off devices so that no medium can enter the working chamber of the Börger machine.

2. Release the pressure and empty the Börger machine via a drainage device (if available).

— Collect any leakage of medium by suitable means and dispose of it in accordance with the applicable local guidelines.

3. Close the drainage device, if available.

6.1.3 Cleaning the inside

WARNING!
Severe injury due to residual pressure!

Despite having depressurized the Börger machine, it may be under residual pressure in the event of congestion or lump formation in the medium.

— Take extra care when removing the flange connections and maintenance openings to prevent accidents caused by the release of residual pressure.

CAUTION!
Health hazard due to residues of dangerous medium inside and on the Börger machine!

There is an increased health hazard from contact with the medium and contaminated components.

Generally, the following applies:

— When using dangerous or health-endangering media, take all necessary safety measures when performing work on the Börger machine.
— Avoid direct contact with the medium (skin/eye contact, swallowing, inhaling).
— Remove spillage from your skin without delay.
— Do not store or consume beverages, food or tobacco in the working area.

ENVIRONMENT!
Danger due to incorrect handling of environmentally hazardous substances!

Inappropriate handling of environmentally hazardous substances, especially incorrect disposal, can cause significant damage to the environment.

— Especially water-polluting materials such as grease and lubricating oil must not pollute the soil or enter the sewage system during installation, repair and maintenance work.
  — These materials must be collected, stored, transported and disposed of in suitable containers.
— When handling oil, grease and other chemical substances, pay attention and adhere to the applicable regulations and safety data sheets issued by the respective manufacturer relating to storage, handling, correct use and disposal.
— Comply with the legal obligations regarding waste avoidance and the proper recycling/disposal of waste during all work

— Read and follow the safety instructions detailed in ↳ *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.
— Shut down the Börger machine and downstream and upstream system components as described in ↳ *Chapter 5.3 “Downtimes” on page 94*.
— Secure the Börger machine against unauthorized or uncontrolled reactivation as described in ↳ *Chapter 2.7 “Securing the machine against restart” on page 24*.
— To the extent necessary, amply secure the surrounding area when performing maintenance. Cordon off the working area with a red and white safety chain and a warning sign.
— Relieve the pressure in the Börger machine according to ↳ *Chapter 6.1.2 “Pressure relief” on page 108*.

1. Remove the required flange connections and maintenance openings to get to the working chamber of the Börger machine.
2. Thoroughly clean the rotating parts and the working chamber of the machine from deposits and contamination.
3. Thoroughly clean all parts before reinstalling removed parts.

4. Check all removed parts for wear and only reuse them if they are undamaged.
5. Only replace worn components, seals, screws, nuts etc., but especially the wetted parts, with original spare parts.
6. Reassemble the flange connections and maintenance openings that have been loosened previously.

6.2 Maintenance and inspection

6.2.1 Maintenance and inspection plan

NOTICE!
Risk of material damage due to improper maintenance!

— Also observe the maintenance intervals detailed in the operating manuals for the drive gear unit, motor etc., which are included in the appendix.
— Prepare a maintenance schedule adapted to the operating conditions.

NOTE!
Maintenance intervals

The following intervals are guidelines. These intervals can be significantly reduced depending on the operating conditions.

when necessary

Checking the outer surfaces for dust deposits and dirt

— If necessary, clean the outer surfaces as described in *Chapter 6.1 “Machine care” on page 106*

daily

Audible check for smooth running

— In the event of a malfunction: suitable measures as described in *Chapter 5.5 “Malfunctions” on page 96*

Visual check for leaks (including overflow check at the ventilation opening of the intermediate chamber)

— Replace the seals, if necessary, as described in *Chapter 6.3.5 “Replacing the mechanical seal” on page 138*
— Correct the fill level of the intermediate chamber if a seal leakage can be excluded, see *Chapter 6.2.2 “Lubricant fill level and changing the lubricants” on page 115*

weekly

Checking the functions and flow rate

— suitable measures as described in *Chapter 5.5 “Malfunctions” on page 96*
— Replace damaged parts, if necessary

monthly

Checking the oil level of the machine gear unit on the oil sight glass

— Refill, if necessary, see *Chapter 6.2.2 “Lubricant fill level and changing the lubricants” on page 115*
— If there are leaks in the gear unit / lip seal, contact Börger customer service or send the Börger machine for repair in accordance with *Chapter 6.3.6 “Other repairs” on page 148*

quarterly

Checking the Börger machine and attachment parts for tight fit and possible damage

— Tighten any loosened parts
— Replace damaged parts

Checking all safety notes, warnings and operating instructions

— If necessary, replace damaged signs or stickers immediately

biannually

Checking the quality of the quench fluid

— Replace quench fluid, see *Chapter 6.2.2 “Lubricant fill level and changing the lubricants” on page 115*
— Replace seals, if necessary, in accordance with *Chapter 6.3.5 “Replacing the mechanical seal” on page 138*

yearly

— **Checking the electrical system and control unit for integrity and proper function**

every 2 years

Changing the lubricants

— According to *Chapter 6.2.2 “Lubricant fill level and changing the lubricants” on page 115*

every 10 years

General overhaul (includes checking the carrier shafts)

— Contact Börger customer service or send the Börger machine for a general overhaul in accordance with *Chapter 6.3.6 “Other repairs” on page 148*

6.2.2 Lubricant fill level and changing the lubricants

CAUTION!
Health hazard due to residues of dangerous medium inside and on the Börger machine!

There is an increased health hazard from contact with the medium and contaminated components.

Generally, the following applies:

— When using dangerous or health-endangering media, take all necessary safety measures when performing work on the Börger machine.
— Avoid direct contact with the medium (skin/eye contact, swallowing, inhaling).
— Remove spillage from your skin without delay.
— Do not store or consume beverages, food or tobacco in the working area.

NOTICE!
Risk of severe material damage if the quench fluid is not compatible with the medium!

Loss of seal function if the quench fluid is not compatible with the medium may lead to severe material damage.

— Observe the detailed specifications and instructions on changing the lubricants in the lubricant list (*Chapter 9.8 “Lubricant list” on page 170*), which is part of this operating manual, as well as the specifications in the data sheet regarding the lubricants used.
— **Regarding the quench fluid, especially consider:** Due to the possibility, though unlikely, of quench fluid entering the working chamber and thus intruding on the process itself, the quench fluid must be compatible with the medium in addition to the other materials (especially with the material of the O-rings).

NOTE!
Behavior of the quench fluid

The level of quench fluid may not drop below the minimum indicated on the level indicator.

— The quench fluid can rise to the rim of the fill hole due to its function and depending on the operating temperature. A leak of the mechanical seal can only be assumed if the fluid overflows.
— A slow and slight loss of quench fluid may occur due to evaporation as well as due to lubrication of the mechanical seal.
— A sudden and persistently strong or complete loss of quench fluid in vacuum operation is indicative of a leak in the mechanical seal.

NOTE!
Quench function

The quench fluid can rise to the rim of the fill hole due to its **quench function** and depending on the operating temperature. A leak of the mechanical seal can only be assumed if the fluid overflows. The fill level specified below relates to the optimal volume of pure lubricant.

ENVIRONMENT!
Danger due to incorrect handling of environmentally hazardous substances!

Inappropriate handling of environmentally hazardous substances, especially incorrect disposal, can cause significant damage to the environment.

— Especially water-polluting materials such as grease and lubricating oil must not pollute the soil or enter the sewage system during installation, repair and maintenance work.
  — These materials must be collected, stored, transported and disposed of in suitable containers.
— When handling oil, grease and other chemical substances, pay attention and adhere to the applicable regulations and safety data sheets issued by the respective manufacturer relating to storage, handling, correct use and disposal.
— Comply with the legal obligations regarding waste avoidance and the proper recycling/disposal of waste during all work

Check oil level and quench fluid

The intervals for changing the lubricants can vary significantly and be reduced considerably depending on the operating conditions, such as high levels of humidity, high temperatures, temperature variations, aggressive atmospheres etc.

— Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.
— Shut down the Börger machine and downstream and upstream system components as described in *Chapter 5.3 “Downtimes” on page 94*.
— Secure the Börger machine against unauthorized or uncontrolled reactivation as described in *Chapter 2.7 “Securing the machine against restart” on page 24*.

1. Observe the operating manual and maintenance instructions for the drive regarding the lubricants, lubricant fill level and changing the lubricants in drive components.
2. In accordance with the maintenance and inspection plan (see *Chapter 6.2.1 “Maintenance and inspection plan” on page 113*) or more often depending on the operating conditions, check
   — the oil level and oil quality of the gear unit on the oil sight glass and
   — the level and quality of the quench fluid.
      — Use an oil dipstick, when necessary.

Optimum fill level

Design / Mounting position	Gear unit	Intermediate chamber
M1 standing	Center of oil sight glass	Top shaft, center to covered
M2 vertical	Completely filled[1)]	Lower edge, test bore[2)]
M3 upside-down	Center of oil sight glass	Top shaft, center to covered
M5, M6 turned 90°	Center of oil sight glass	Approximately up to the bend in the fill hole

[1)] In this case: Expansion of the gear oil caused by the temperature cannot be compensated. The operating temperature must not exceed the temperature specified in the order.

[2)] For submerged machines: approx. 10 cm (3.94") below the edge of the extension pipe

Correcting the lubricant fill levels

If necessary, correct the fill level of the intermediate chamber, unless a seal leakage is to be assumed, and the fill level of the gear unit according to the following description.

— Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.
— Shut down the Börger machine and downstream and upstream system components as described in *Chapter 5.3 “Downtimes” on page 94*.
— Secure the Börger machine against unauthorized or uncontrolled reactivation as described in *Chapter 2.7 “Securing the machine against restart” on page 24*.

1. Observe the operating manual and maintenance instructions for the drive regarding the lubricants, lubricant fill level and changing the lubricants in drive components.
2. Use a safe drip pan when draining used lubricant.
3. Position of drain and fill holes: see *Chapter 3.1.7 “Designs, mounting positions” on page 45*.

Filling:

1. Remove the closure from the fill hole.
2. Fill the lubricant up to the optimum fill level having regard to the information in *Chapter 9.8 “Lubricant list” on page 170*.
3. Properly close the fill hole with the closure removed previously.

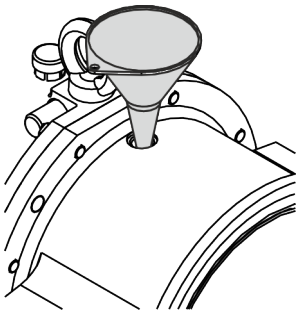


Fig. 3: Example: Classic FL series

Draining:

1. Carefully loosen the screw plug at the drain hole and drain some lubricant until the optimum fill level is reached.
2. Tightly close the drain hole with the screw plug.

NOTE!
Changing the lubricant

Observe the detailed information and notes for changing the lubricant as described in *Chapter 9.8 “Lubricant list” on page 170*, for the lubricants used in the data sheet.

Changing the lubricants

Change the lubricants according to the following description after approximately 10,000 operating hours (or earlier, depending on the operating conditions) or after two years, whichever occurs first.

Change the lubricants earlier if they are heavily contaminated (see also *Chapter 9.8 “Lubricant list” on page 170*).

- Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.
- Shut down the Börger machine and downstream and upstream system components as described in *Chapter 5.3 “Downtimes” on page 94*.
- Secure the Börger machine against unauthorized or uncontrolled reactivation as described in *Chapter 2.7 “Securing the machine against restart” on page 24*.

1. Use a safe drip pan when draining used lubricant.
2. Position of drain and fill holes: see *Chapter 3.1.7 “Designs, mounting positions” on page 45*.
3. For draining the lubricant, remove the screw plug from the drain hole and drain the lubricant.
4. Tightly close the drain hole.
5. Remove the closure from the fill hole for filling.
6. Fill the lubricant up to the optimum fill level having regard to the information in *Chapter 9.8 “Lubricant list” on page 170*.
7. Properly close the fill hole with the closure removed previously. If the breather had to be removed, reinstall it with the opening facing downwards.

Fill quantity

Design / Mounting position	Gear unit (approx.)	Intermediate chamber (approx.)
M1 standing	0.82 l (0.22 gal)	0.6 l (0.16 gal)
M2 vertical	0.95 l (0.25 gal)	0.5 l (0.13 gal)
M3 upside-down	0.82 l (0.22 gal)	0.6 l (0.16 gal)
M5, M6 turned 90°	0.82 l (0.22 gal)	0.6 l (0.16 gal)

6.3 Repairs

WARNING!
Risk of injury due to inadequate troubleshooting, maintenance and repair work!

Inadequate troubleshooting, maintenance and repair work can lead to severe injury and significant damage to property.

- Ensure sufficient installation space before commencing work.
- Keep the installation site clean and tidy! Loosely stacked or scattered components and tools cause accidents.
- Ensure correct installation where components have been removed, reinstall all fastening elements and observe the tightening torques of screws.
- Ensure the following before putting the machine back into operation:
  - Ensure that all troubleshooting, maintenance and repair work is performed and completed as per the information and notes provided in this manual.
  - Ensure that nobody enters the hazardous area.
  - Ensure that all covers and safety features are installed and function correctly.

CAUTION!
Health hazard due to residues of dangerous medium inside and on the Börger machine!

There is an increased health hazard from contact with the medium and contaminated components.

Generally, the following applies:

- When using dangerous or health-endangering media, take all necessary safety measures when performing work on the Börger machine.
- Avoid direct contact with the medium (skin/eye contact, swallowing, inhaling).
- Remove spillage from your skin without delay.
- Do not store or consume beverages, food or tobacco in the working area.

6.3.1 Notes on repair work

- Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.
- Shut down the Börger machine and downstream and upstream system components as described in *Chapter 5.3 “Downtimes” on page 94*.
- Secure the Börger machine against unauthorized or uncontrolled reactivation as described in *Chapter 2.7 “Securing the machine against restart” on page 24*.
- To the extent necessary, amply secure the surrounding area when performing maintenance. Cordon off the working area with a red and white safety chain and a warning sign.
- Relieve the pressure in the Börger machine according to *Chapter 6.1.2 “Pressure relief” on page 108*.
- Clean the interior of the Börger machine as described in *Chapter 6.1.3 “Cleaning the inside” on page 110*.

1. Thoroughly clean all parts and the working chamber of the machine before reinstalling removed parts.
2. Check all removed parts for wear and only reuse them if they are undamaged.
3. Only replace worn components, seals, screws, nuts etc., but especially the wetted parts, with original spare parts according to the following instructions.

NOTE!
Assembly drawing / spare parts list

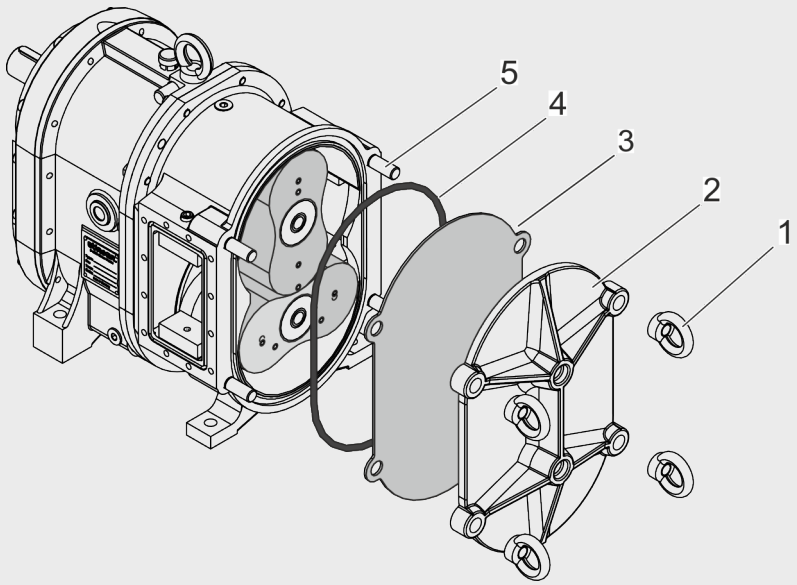
- Observe the assembly drawing of the Börger machine (*Chapter 9.3 “Assembly drawing” on page 159*).
- Observe the spare parts list of the Börger machine, *Chapter 9.4 “Spare parts list” on page 160*.

6.3.2 Opening and closing the quick-release cover

WARNING!
Severe injury due to residual pressure!

Despite having depressurized the Börger machine, it may be under residual pressure in the event of congestion or lump formation in the medium.

— Take extra care when removing the flange connections and maintenance openings to prevent accidents caused by the release of residual pressure.



Example: Classic FL series

1	Ring nut
2	Quick-release cover
3	Cover-side casing protection plate
4	O-ring
5	Stud screw

All parts on the Börger machine that are subject to wear are accessible after the quick-release cover has been removed.

— Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.

— Shut down the Börger machine and downstream and upstream system components as described in *Chapter 5.3 “Downtimes” on page 94*.

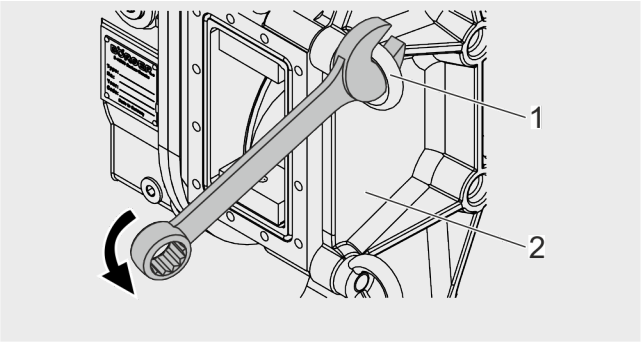
— Secure the Börger machine against unauthorized or uncontrolled reactivation as described in *Chapter 2.7 “Securing the machine against restart” on page 24*.

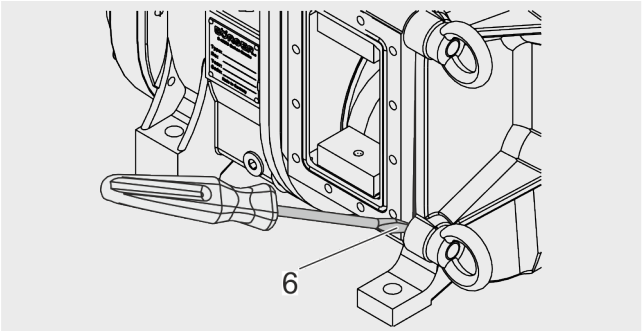
— To the extent necessary, amply secure the surrounding area when performing maintenance. Cordon off the working area with a red and white safety chain and a warning sign.

— Relieve the pressure in the Börger machine according to *Chapter 6.1.2 “Pressure relief” on page 108*.

1. **Opening the quick-release cover:**

Use a suitable cover to prevent the medium from spouting out.





2. Place a drip pan underneath.

3. Loosen the four ring nuts (1) uniformly by approx. 5 mm (.20") using a wrench.

4. Initially, only open the cover (2) at the bottom (6, on standing versions) by a small gap (approx. 5 mm (.20")) to allow all residual pressure to escape and catch any medium that spouts out.

5. Completely loosen and remove the four ring nuts (1).

6. Remove the quick-release cover (2).

7. Remove the cover-side casing protection plate (3).

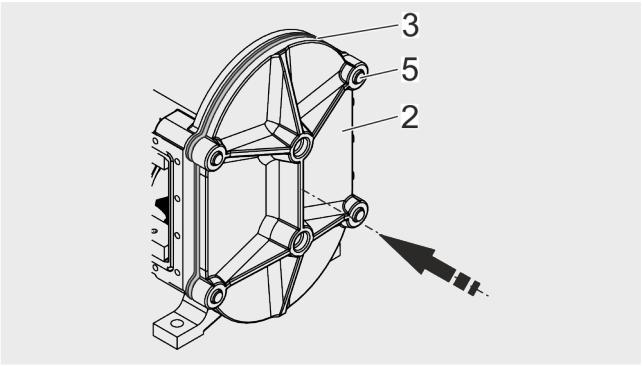
8. Clean the interior of the Börger machine as described in *Chapter 6.1.3 “Cleaning the inside” on page 110*.

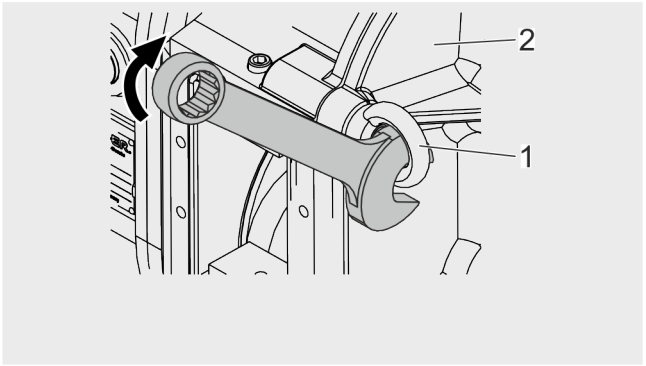
9. Check the O-ring (4). Replace the O-ring (4) if it shows signs of damage.
10. Clean the O-ring groove before inserting/reinserting the O-ring (4).
11. Press the O-ring seal (4) carefully into the O-ring groove.
12. Clean the cover-side casing protection plate (3) and check it for wear.

    If the cover-side casing protection plate (3) exhibits signs of wear, the plate (3) has to be turned and inserted with the unused side. If both sides are already worn, the casing protection plate has to be replaced.

13. **Closing the quick-release cover:**

    Attach the cover-side casing protection plate (3).





14. Push the quick-release cover (2) over the stud screws (5) and fasten it with the ring nuts (1).
15. Tighten the ring nuts (1) crosswise with uniform strength using a wrench. Take care not to damage the O-ring (4) or to push it out of position.

    Make sure that the ring nuts (1) are fastened tight enough so they cannot be loosened by hand.

6.3.3 Rotors, removal and replacement

DANGER!
Risk of injury due to rotating parts!

Moving parts can cause severe injury.

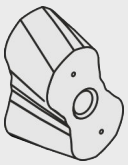
— Do not reach into rotating parts or handle rotating parts when the machine is in operation.
— Never open protective covers when in operation.
— Perform work on the Börger machine only when stationary.
— Observe the delay time: Prior to opening protective covers, make sure that all components have stopped moving.
— Shut down the Börger machine and upstream and downstream system components as described in *Chapter 5.3 “Downtimes” on page 94* before carrying out any work on the Börger machine or accessories.
— The operating person is obligated to check that all safety equipment is installed as described in *Chapter 2.8 “Description of the safety equipment” on page 25* and fully functional before putting the machine into operation.
— The Börger machine must only be switched on when the inlet and outlet connections have been established and the maintenance openings have been securely installed.

NOTICE!
Risk of damage due to switching on the machine without rotors being installed properly!

If the rotors are not properly installed, the parallel key cannot reliably fix the rotating seal holding bushes. This may cause permanent damage to the rotary lobe pump.

— Never switch the rotary lobe pump on, even for testing or cleaning, if the rotors are not properly installed.

	— **Type 4**	**Dius rotor**, Dual-lobe, screw profile — Polymers Pos. 9.5 in the spare parts list

	— **Type 4S, 4E**	**Dius rotor**, Dual-lobe, screw profile — Steel, stainless steel Pos. 9.5 in the spare parts list

Tool:

- W... rotor puller
- W... rotor puller for auxiliary puller
- Z... auxiliary puller, dual-lobe
- Torque wrench

— Read and follow the safety instructions detailed in ↳ *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.

— Shut down the Börger machine and downstream and upstream system components as described in ↳ *Chapter 5.3 “Downtimes” on page 94*.

— Secure the Börger machine against unauthorized or uncontrolled reactivation as described in ↳ *Chapter 2.7 “Securing the machine against restart” on page 24*

— To the extent necessary, amply secure the surrounding area when performing maintenance. Cordon off the working area with a red and white safety chain and a warning sign.

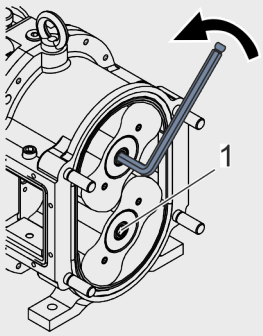
— Relieve the pressure in the Börger machine according to ↳ *Chapter 6.1.2 “Pressure relief” on page 108*.

— Clean the interior of the Börger machine as described in ↳ *Chapter 6.1.3 “Cleaning the inside” on page 110*.

— Open the quick-release cover in accordance with ↳ *Chapter 6.3.2 “Opening and closing the quick-release cover” on page 124*.

1. Block the carrier shafts by clamping an object with no sharp edges between the rotors, e.g. a lint-free cloth.

2. **Loosening the hexagon socket head cap screw**

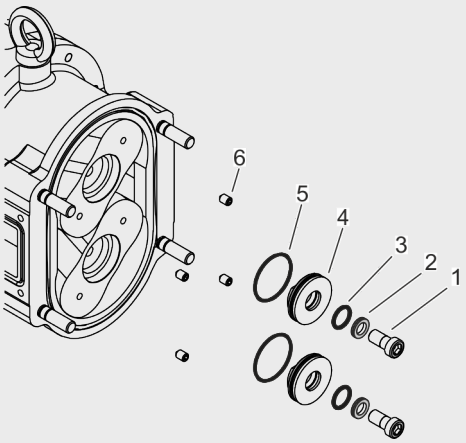


1	Hexagon socket head cap screw

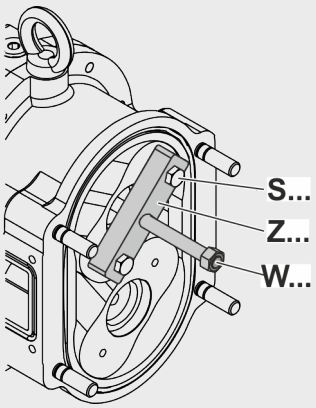
Loosen the hexagon socket head cap screws (1) using a hexagon socket wrench, then remove them.

3. **Removing the Dius rotor (steel / stainless steel):**

Dius rotor (steel / stainless steel)



Removing the Dius rotor (steel / stainless steel)



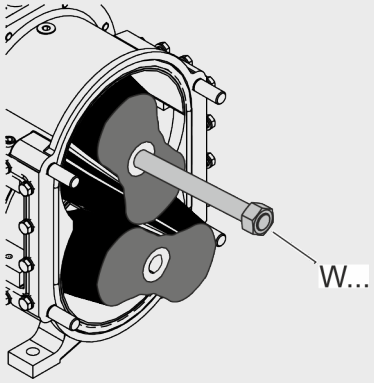
1	Hexagon socket head cap screw	S...	Hexagon head screws
2	Pair of wedge-shaped lock washers	W...	Rotor puller
3	O-ring	Z...	Auxiliary puller
4	Cover disk		

5	O-ring for cover disk		
6	Grub screws		

— In each case, remove the pair of wedge-shaped lock washers (2).
— In each case, remove the cover disk (4) and the O-rings (3/5) using a suitable hook or two slotted screwdrivers.
— Unscrew the grub screws (6) from the auxiliary disassembly threads of the rotors using a suitable hexagon socket wrench.
— Screw two suitable screws [S...] into the threaded bores of the rotors through the outer bores of the auxiliary puller [Z...].
— Screw one rotor puller [W...] into the auxiliary puller [Z...] and remove the rotor by pulling it from the carrier shaft [W] in uniform steps.
  — Repeat the procedure for the second rotor.

4. Removing the Dius rotor (polymer):

Removing the Dius rotor (polymer)



W...	Rotor puller

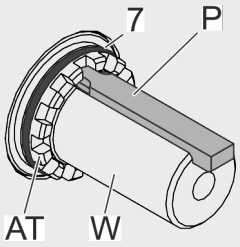
— Screw one rotor puller [W...] into the rotor and remove the rotor by pulling it from the carrier shaft [W] in uniform steps.
  — Repeat the procedure for the second rotor.

5. Thoroughly clean all parts and the pump chamber before reinstalling removed parts.

6. Check all removed parts for wear and only reuse them if they are undamaged.

7. Clean and oil the carrier shafts [W].

Cleaning the carrier shafts



7	O-ring
AT	Rotating seal holding bush
P	Parallel key
W	Carrier shaft

NOTE!

Some quench fluid may escape from between the rotating seal holding bushes [AT] and carrier shafts [W] as a result of the normal lubricating function. This is not a malfunction.

8. Check the O-rings (7) on the rotating seal holding bushes and replace them when necessary.

NOTE!
Börger GmbH recommends:

— Always replace the O-rings as well in this situation.

9. Check the condition and correct positioning of the parallel keys (P) in the carrier shafts [W] according to *Chapter 6.3.5 “Replacing the mechanical seal” on page 138*.

NOTICE!
Risk of material damage if the rotating seal holding bushes are adjusted incorrectly!

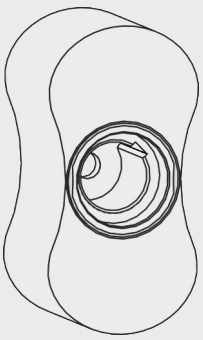
— Adjust the rotating seal holding bushes by means of the special tool / Multitool (**M**) as described in *Chapter 6.3.5 “Replacing the mechanical seal” on page 138*.
  — If the rotating holding bush with thread is not secured when the shafts are turned, the position of the holding bush can imperceptibly change while the second bush is being adjusted.

NOTE!

Use only rotors made from suitable materials and of the correct type.

10. Clean the fit bores of the rotors.

Cleaning the fit bores



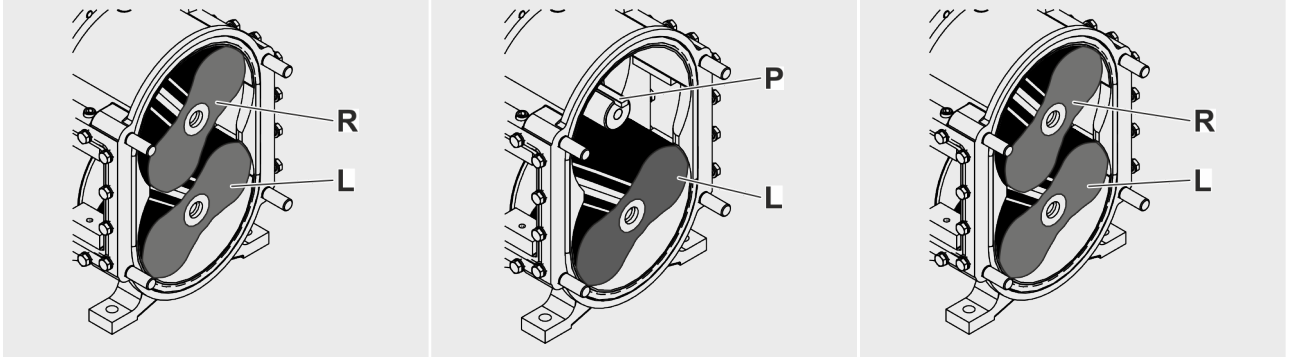
11. Lubricate the fit bores of the rotors with a suitable oil/lubricant that is compatible with the medium, and also lubricate the O-ring (7) of the rotating holding bush if its resistance allows this.

12. **Attach the (new) rotors.**

NOTE!

— For polymer rotors pay attention to the exact positioning so that the rubber coating is not damaged:

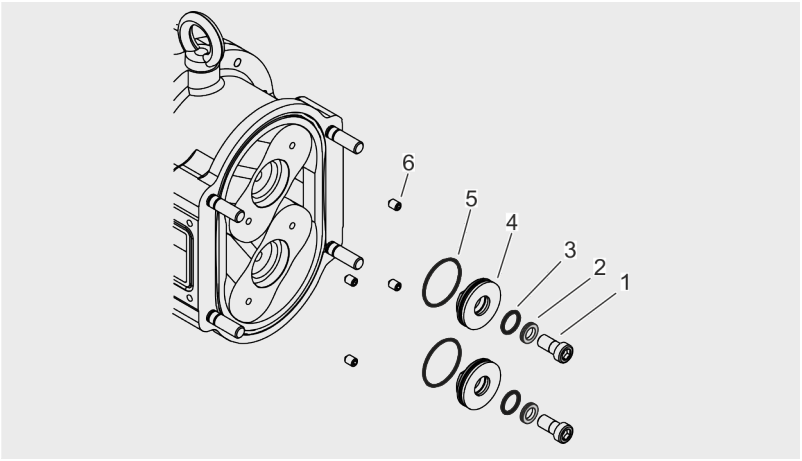
Ex. Rotor installation



L	ccw screw rotors
P	Parallel key
R	cw screw rotors

For screw rotors: Attach the rotors uniformly in pairs, one clockwise and one counter-clockwise screw rotor each.

13. Rotate the shafts so that the parallel keys (P) are at **12 o'clock**.
14. Insert the rotor with counter-clockwise screw profile [L] at the bottom.
15. Make sure that the upper parallel key (P) is still at 12 o'clock, i.e. the carrier shaft has not been moved.
16. Insert the rotor with clockwise screw profile [R] at the top.
17. **For rotors made from steel or stainless steel:**



1	Hexagon socket head cap screw
2	Pair of wedge-shaped lock washers
3	O-ring
4	Cover disk
5	O-ring for cover disk
6	Grub screws

- Screw the grub screws (6) back into the auxiliary disassembly threads.
- Use new O-rings (3/5) and coat them depending on their resistance, e.g. with oil or flushing agent.
- Use new cover disks (4) if required.
- In each case, push on the cover disk (4) with the O-ring (5) correctly fitted into the groove so that the recess points towards the parallel key (P).
- Use a new pair of wedge-shaped lock washers (2) for the rotor fastening screws (1).

18. Screw in the hexagon socket head cap screws (1) using a suitable hexagon socket wrench and tighten them (1) with a torque wrench.

19. Check that the installed rotors run smoothly. The easiest way of doing this is by turning the drive shaft **clockwise** with an appropriate amount of force using a hexagon socket wrench or a ratchet.

    If correct true-running is not obtained, the cause must be determined and the installation must be corrected.

NOTE!
Smooth running

"Smooth running" means a uniform, trouble-free true-running (concentricity) without any blocking.

— Providing the pumped medium and materials used allow this, the rotors can be coated with liquid (e.g. soft soap) for the smooth running check.
— When dry, polymer rotors can only be rotated with a certain degree of force, as they are positioned close to the pump casing.

20. Attach the cover-side casing protection plate and quick-release cover in accordance with *Chapter 6.3.2 “Opening and closing the quick-release cover” on page 124*.

21. Before releasing the rotary lobe pump, check once again that it runs smoothly by switching the drive on **briefly**.

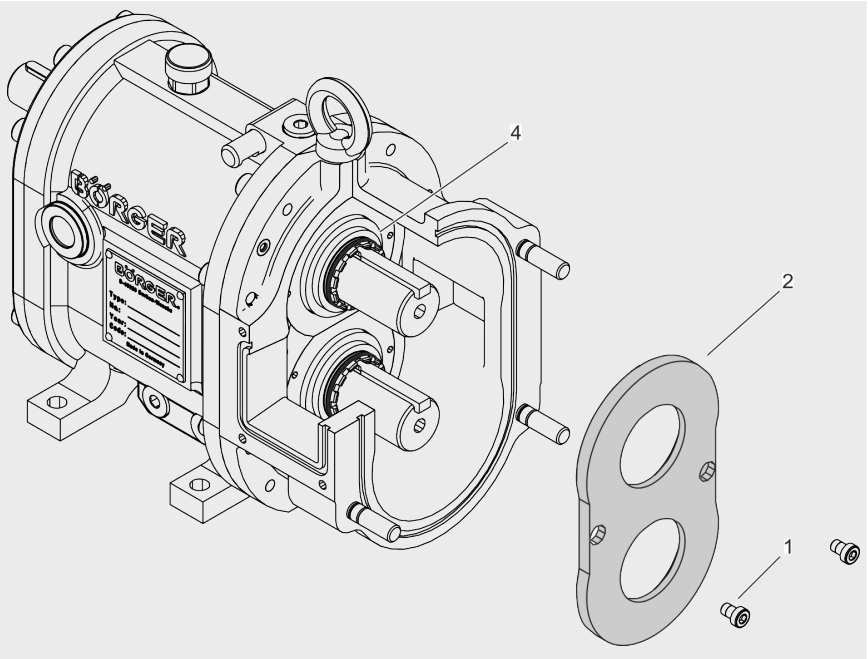
    If correct true-running is not obtained, the cause must be determined and the installation must be corrected.

Tightening torques of rotor fastening screws

Size	Fastening screw	Pump [Nm]		Counter bearing [Nm]		Counter bearing with mechanical seal [Nm]	
		Steel (10.9)	Stainless steel	Steel (10.9)	Stainless steel	Steel (10.9)	Stainless steel
AL	M 12	100	50	70	40	-	-
AN	M 12	100	50	-	-	-	-
PL	M 16	240	130	180	100	-	-
CL	M 16	240	130	180	100	-	-

Size	Fastening screw	Pump [Nm]		Counter bearing [Nm]		Counter bearing with mechanical seal [Nm]	
		Steel (10.9)	Stainless steel	Steel (10.9)	Stainless steel	Steel (10.9)	Stainless steel
FL	M 20	480	250	350	180	-	-
EL	M 20	480	250	350	180	480	-
XL	M 24	800	400	600	300	800	-

6.3.4 Replacing the gear-side casing protection plate



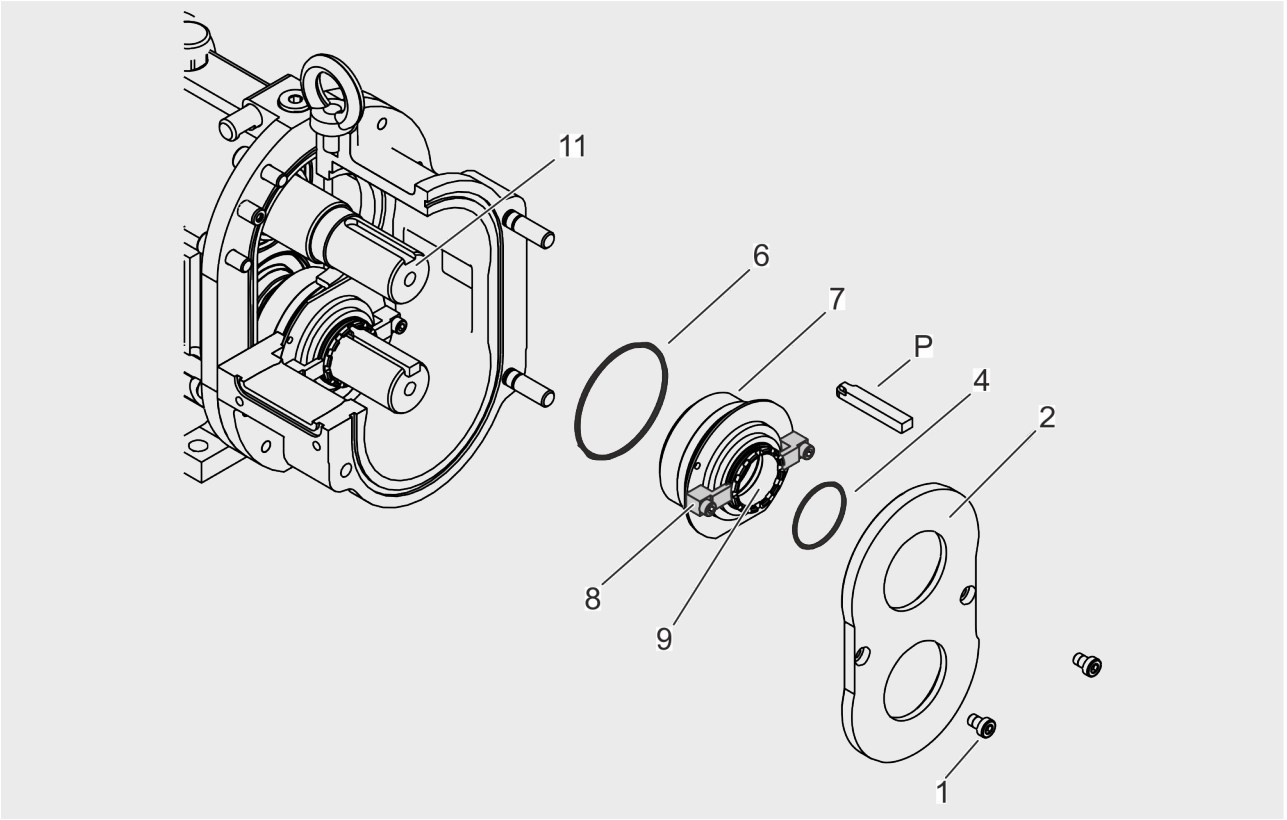
1	Hexagon socket head cap screw
2	Gear-side casing protection plate
4	O-ring

— Read and follow the safety instructions detailed in ↳ *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.
— Shut down the Börger machine and downstream and upstream system components as described in ↳ *Chapter 5.3 “Downtimes” on page 94*.
— Secure the Börger machine against unauthorized or uncontrolled reactivation as described in ↳ *Chapter 2.7 “Securing the machine against restart” on page 24*
— To the extent necessary, amply secure the surrounding area when performing maintenance. Cordon off the working area with a red and white safety chain and a warning sign.
— Depressurize and clean the interior of the Börger machine as described in ↳ *Chapter 6.1.3 “Cleaning the inside” on page 110*.
— Observe the relevant safety instructions and take the necessary precautions with regard to the medium and the quench fluid, see ↳ *Chapter 6.2.2 “Lubricant fill level and changing the lubricants” on page 115*.

1. Open the quick-release cover in accordance with *Chapter 6.3.2 “Opening and closing the quick-release cover” on page 124*.
2. Remove the rotors according to *Chapter 6.3.3 “Rotors, removal and replacement” on page 127* depending on the rotor type.
3. Unscrew the hexagon socket head cap screws (1) from the gear-side casing protection plate.
4. Remove the casing protection plate.
5. Clean the rear wall of the machine casing.
6. Insert the new gear-side casing protection plate and fasten it using the screws (1).
7. Replace the O-rings (1) on the rotating seal holding bushes.
8. Install the rotors according to *Chapter 6.3.3 “Rotors, removal and replacement” on page 127* depending on the rotor type.
9. Attach the cover-side casing protection plate and quick-release cover, see *Chapter 6.3.2 “Opening and closing the quick-release cover” on page 124*.

6.3.5 Replacing the mechanical seal

Replacing the FC mechanical seals



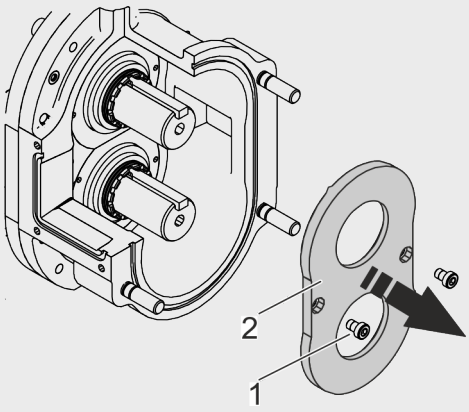
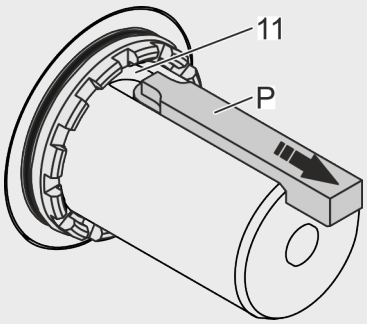
1	Hexagon socket head cap screw	7	Mechanical seal cartridge
2	Gear-side casing protection plate	8	Alignment clamps
4	O-ring – rotating holding bush	9	Rotating holding bush
6	O-ring – cartridge	11	Shaft with keyway
		P	Parallel key

Tool: ■ Multitool (M)

Replacing the mechanical seals is necessary according to ↳ *Chapter 6.2 “Maintenance and inspection” on page 113* when pumped medium enters the mechanical seal and the buffer fluid escapes.

— Read and follow the safety instructions detailed in ↳ *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.
— Shut down the Börger machine and downstream and upstream system components as described in ↳ *Chapter 5.3 “Downtimes” on page 94*.
— Secure the Börger machine against unauthorized or uncontrolled reactivation as described in ↳ *Chapter 2.7 “Securing the machine against restart” on page 24*
— To the extent necessary, amply secure the surrounding area when performing maintenance. Cordon off the working area with a red and white safety chain and a warning sign.
— Relieve the pressure in the Börger machine according to ↳ *Chapter 6.1.2 “Pressure relief” on page 108*.
— Open the quick-release cover in accordance with ↳ *Chapter 6.3.2 “Opening and closing the quick-release cover” on page 124*.
— Clean the interior of the Börger machine as described in ↳ *Chapter 6.1.3 “Cleaning the inside” on page 110*.

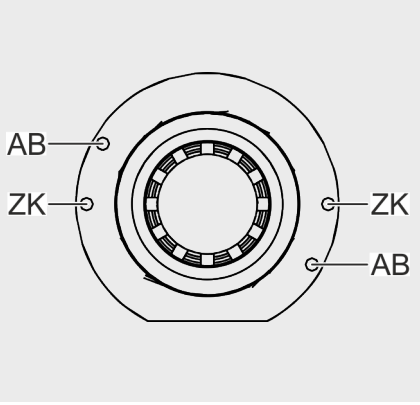
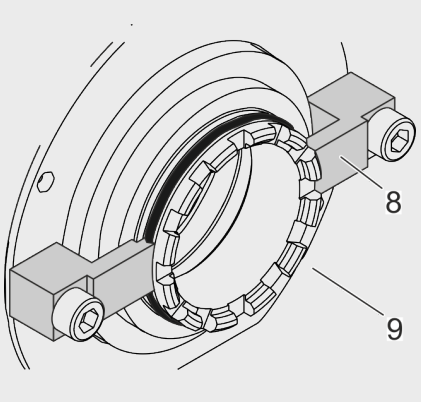
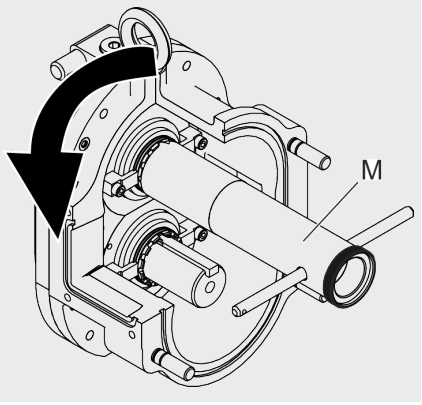
1. Remove the rotors as detailed in *Chapter 6.3.3 “Rotors, removal and replacement” on page 127*.
   — Take precautions for pumps turned 90° to ensure the parallel key cannot fall into the inlet/outlet opening.
2. Remove the gear-side casing protection plate (2) as detailed in *Chapter 6.3.4 “Replacing the gear-side casing protection plate” on page 136*.

Dismantling the casing protection plate	Removing the parallel key
	

1	Hexagon socket head cap screw
2	Gear-side casing protection plate
11	Shaft with keyway
P	Parallel key

3. Lift each parallel key (P) out of the keyway (11) using a suitable tool (e.g. small lever). Make sure that the parallel key is not damaged while doing this.

4. Dismantling a mechanical seal cartridge:

Mechanical seal cartridge hole pattern	Installing the alignment clamps	Unscrewing the mechanical seal cartridge
		

8	Alignment clamp
9	Rotating seal holding bush
M	Multitool
AB	Jacking threads
ZK	Bore of alignment clamp

Install the alignment clamps (8) delivered with the rotary lobe pump together with the suitable hexagon socket head cap screws.

— For this purpose, screw the alignment clamps along with the hexagon socket head cap screws into the threaded bores [**ZK**].

5. Start by tightening the screws and then undo them by ½ a turn to prevent stress.

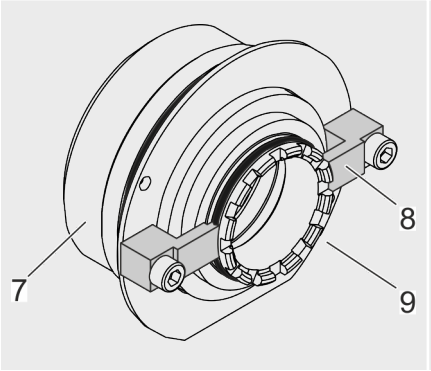
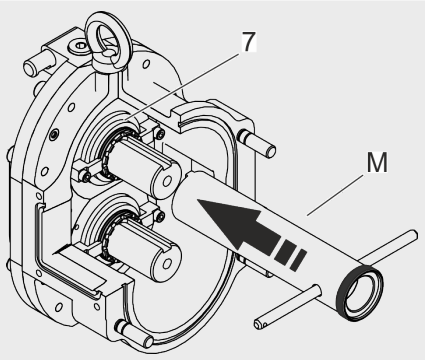
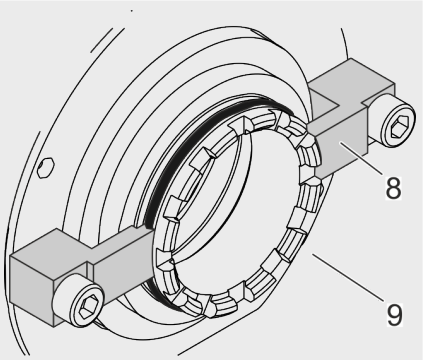
6. Unscrew the mechanical seal cartridge (7) with rotating seal holding bush (9) using the Multitool [**M**] and pull it off the shaft.

7. Remove the second mechanical seal cartridge accordingly.

8. Clean the pump casing, the shafts and the seats of the mechanical seal cartridges (rear pump wall, gear unit wall).

9. Installing a mechanical seal cartridge:

Take the new mechanical seal cartridge out of the package.

Mechanical seal cartridge	Pushing on the mechanical seal cartridge	Removing the alignment clamps
		

7	Mechanical seal cartridge
8	Alignment clamp
9	Rotating seal holding bush
M	Multitool

NOTICE!
Risk of consequential damage caused by improper handling of the new mechanical seal cartridges!

— Ensure that the new or repaired mechanical seal cartridges are not damaged. The seals must be clean and should not be scratched.
— The cartridges are delivered with alignment clamps (8) installed. They must not be removed before installing the cartridges.

NOTICE!
Risk of material damage if the seal cartridges with rotating seal holding bushes are installed incorrectly!

If the seal cartridge is not secured when the shafts are turned, then the position of the seal cartridge can imperceptibly change while the second cartridge is being aligned.

— Using the Multitool [**M**], first align one seal cartridge according to the following description and secure it with the parallel key before aligning the second seal cartridge on the second shaft.

10. Remove the temporary shipping plugs.
11. Brush the contact surfaces of the shafts and the new seal cartridges with an adequate (not sparing) amount of high-performance assembly paste (Anti-Seize) to allow the seal cartridges to be pushed on smoothly and to prevent any damage due to contact corrosion later on.
12. Undo the screws on the alignment clamps (8) by approx. half a turn.
13. Push the mechanical seal cartridge onto the shaft.
    — The straight edge of the upper seal must point downward.
    — The straight edge of the bottom seal must point upward.
14. Remove the alignment clamps (8).

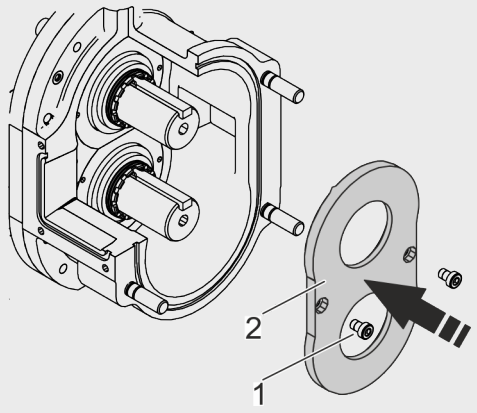
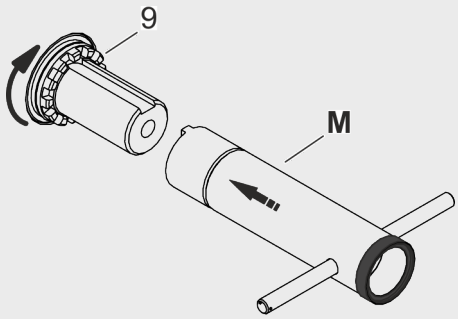
NOTE!
Storing the alignment clamps

— Store the alignment clamps and the screws for removing the seals later on.

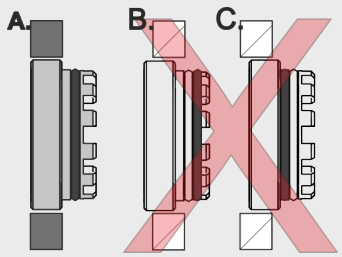
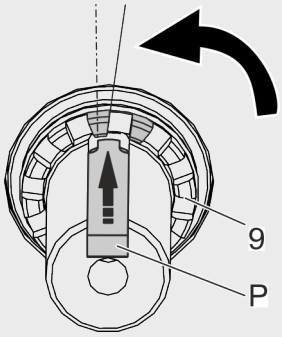
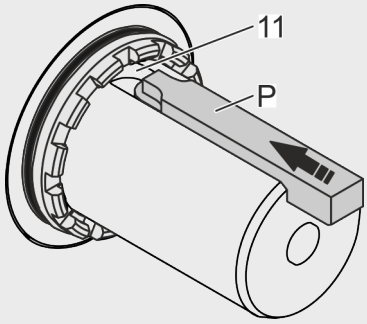
15. Repeat the procedure for the second mechanical seal cartridge.

16. **Aligning the rotating seal holding bush:**

    Install the gear-side casing protection plate (2) as described in *Chapter 6.3.4 “Replacing the gear-side casing protection plate” on page 136*.

Installing the casing protection plate	Screw in the rotating seal holding bush flush with the casing protection plate.
	

1	Hexagon socket head cap screw
2	Gear-side casing protection plate
9	Rotating seal holding bush
M	Multitool

Rotating seal holding bush flush!	Aligning the rotating seal holding bush	Inserting the parallel key
		

A	**Flush installation**	9	Rotating seal holding bush
B	Recessed	11	Shaft with keyway
C	Protruding	P	Parallel key

17. Screw in the rotating holding bush (9) on the seal cartridge (7) flush with the gear-side casing protection plate (2) and then unscrew it until the first groove is aligned with the keyway of the shaft, using the special tool [M].

18. Insert the parallel key (P) so that it fits into the groove of the rotating holding bush on the seal cartridge (7) and the keyway of the shaft (10).

NOTE!
Alignment of the parallel key

- The bridge of the parallel key must be fitted into the groove of the rotating holding bush on the seal cartridge.
- The straight front of the parallel key must point towards the quick-release cover.

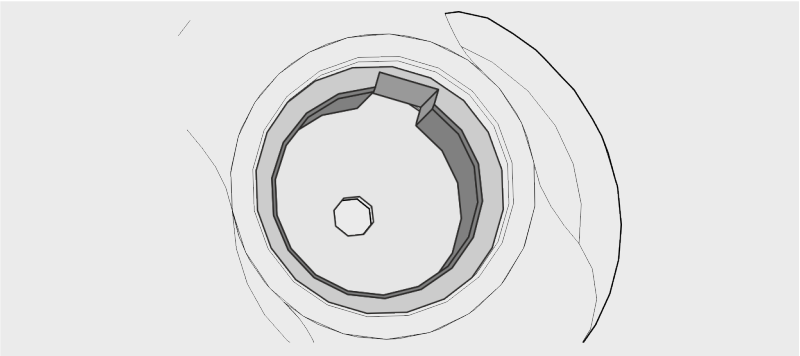
19. Fit the new O-ring (4) onto the rotating seal holding bush (9) on the seal cartridge (7). Only reuse an old O-ring when damage can be completely ruled out.

20. Now position the second rotating holding bush on the second seal cartridge (7) the same way and fit the O-ring (4).

21. **Checking for smooth running:**

Clean the fit bores of the rotors and the outer shaft surfaces.

Cleaning the fit bore



22. Lubricate the fit bores of the rotors and the outside surfaces of the shafts with a suitable oil/lubricant that is compatible with the medium, and also lubricate the O-ring (4) if its resistance allows this.

NOTE!
EPDM

The use of oils in contact with EPDM is prohibited.

— In these cases, an alternative lubricant must be selected for the buffer or the circulation system, as described in ↳ *Chapter 9.8 “Lubricant list” on page 170*.

23. Reinstall the rotors as described in ↳ *Chapter 6.3.3 “Rotors, removal and replacement” on page 127*.

    ⇨ **Observe the proper torques when doing this.**

24. Check the smooth running of the rotors by turning the carrier shafts by hand according to ↳ *Chapter 6.3.3 “Rotors, removal and replacement” on page 127*.

    ⇨ — If a seal cartridge with rotating seal holding bush was screwed in too far, then the rotors will rub against the gear-side casing protection plate and will be difficult or impossible to move.

    — Remove the rotors and unscrew the rotating holding bush on the seal cartridge by 1/12th of a turn (one groove).

    — If a rotating seal holding bush on the seal cartridge was not screwed in far enough, the rotors will protrude on the pump cover side. In this case, they will rub or become jammed on the cover-side casing protection plate when the ring nuts are tightened.

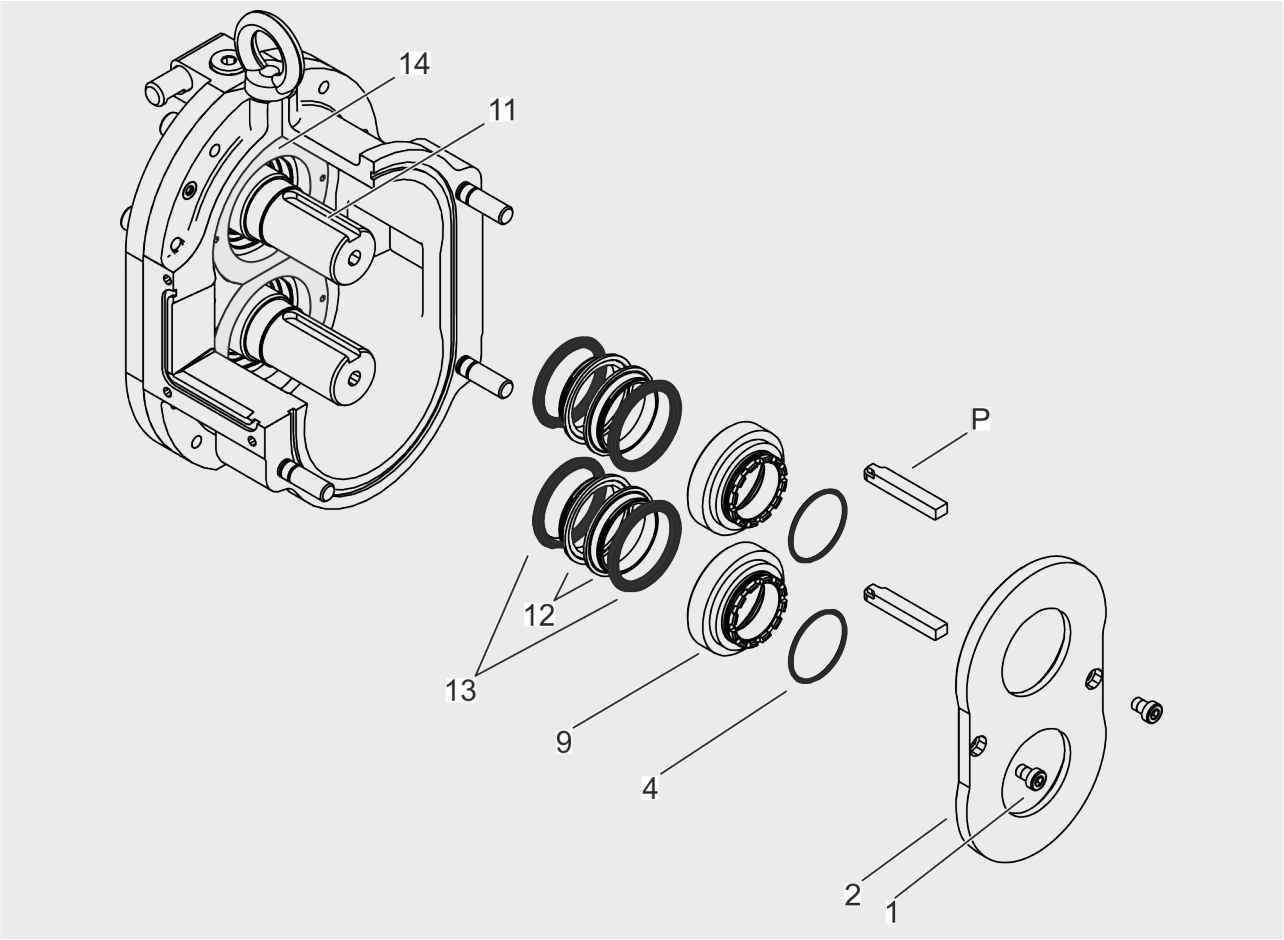
    — Ensure that the rotors do not protrude. If necessary, screw in the rotating holding bush further by 1/12th of a turn (one groove).

25. Fill the intermediate chamber in accordance with ↳ *Chapter 6.2.2 “Lubricant fill level and changing the lubricants” on page 115*

26. Attach the cover-side casing protection plate and quick-release cover, see ↳ *Chapter 6.3.2 “Opening and closing the quick-release cover” on page 124*.

27. Check the smooth running of the rotors again by switching on the drive briefly with the quick-release cover closed.

Replacing the LW mechanical seals



1	Hexagon socket head cap screw	11	Shaft with keyway
2	Gear-side casing protection plate	12	Seal faces
4	O-ring – rotating holding bush	13	O-rings
9	Rotating seal holding bush	14	Stationary seal holding bush
		P	Parallel key

Tool: ■ Multitool (M)

— Read and follow the safety instructions detailed in ↳ *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.
— Shut down the Börger machine and downstream and upstream system components as described in ↳ *Chapter 5.3 “Downtimes” on page 94*.
— Secure the Börger machine against unauthorized or uncontrolled reactivation as described in ↳ *Chapter 2.7 “Securing the machine against restart” on page 24*
— To the extent necessary, amply secure the surrounding area when performing maintenance. Cordon off the working area with a red and white safety chain and a warning sign.
— Relieve the pressure in the Börger machine according to ↳ *Chapter 6.1.2 “Pressure relief” on page 108*.
— Clean the interior of the Börger machine as described in ↳ *Chapter 6.1.3 “Cleaning the inside” on page 110*.

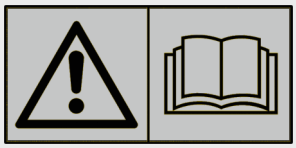
6.3.6 Other repairs

If repairs to your Börger machine are required that are not covered by the described repair and maintenance measures, we recommend contacting Börger customer service.

The factory can only accept repair orders if a completed safety certificate / declaration of decontamination accompany the device submitted for repair, as well as any necessary safety data sheets for the medium and / or cleaning agent.

The relevant form is also available as a download from our website under the service menu.

6.3.7 Maintenance instructions for special equipment



Further operating manuals / supplementary operating manuals

— You must completely read the separate operating manuals and/or supplementary operating manuals for components and/or special versions and consider the **instructions and safety regulations** accordingly.

6.3.8 Measures following repair and maintenance work!

Following completion of the work and before starting the unit, carry out the following steps:

— Read and follow the safety instructions detailed in *Chapter 2.12 “Safety instructions for maintenance and rectifying malfunctions” on page 35*.

1. Check all screws that have been loosened previously for firm seat.
2. Check whether all safety devices and covers that have been removed previously are reinstalled properly.
3. Ensure that all tools, materials and other equipment used have been removed from the work area.
4. Clean the work area and remove any spilled substances, e.g. liquids, processing material or similar.
5. Reset the emergency stop devices, if required.
6. Confirm malfunctions at the control unit.
7. Ensure that nobody enters the hazardous area.
8. Ensure that all safety features of the unit function perfectly.
9. Take the unit into operation again according to *Chapter 5.2 “Continuous operation” on page 93*.

6.3.9 Queries

Börger machines are easy to maintain. We hope that we have clearly described all the relevant operating steps in this operating manual. Nevertheless, Börger machines are customized and developed for the specific requirements of the operator so that not all questions can be fully answered in a general operating manual.

— If you have any questions, please contact Börger customer service. We will be happy to help.

We would also be grateful to receive feedback on any errors or unclear passages in this operating manual. This will help us to improve and develop this document and to offer you and all of our customers the best possible service.

7 Disposal

7.1 Environmental protection

ENVIRONMENT!
Danger due to incorrect handling of environmentally hazardous substances!

Inappropriate handling of environmentally hazardous substances, especially incorrect disposal, can cause significant damage to the environment.

- Especially water-polluting materials such as grease and lubricating oil must not pollute the soil or enter the sewage system during installation, repair and maintenance work.
  - These materials must be collected, stored, transported and disposed of in suitable containers.
- When handling oil, grease and other chemical substances, pay attention and adhere to the applicable regulations and safety data sheets issued by the respective manufacturer relating to storage, handling, correct use and disposal.
- Comply with the legal obligations regarding waste avoidance and the proper recycling/disposal of waste during all work

7.2 Oil, oily waste and grease

Oil, oily waste and grease pose a significant risk to the environment. Therefore, disposal of such materials must be handled by a specialist company.

→ Collect any oil and oily waste and only dispose of them according to the legal requirements through authorized waste disposal companies/authorities.

7.3 Plastics

1. → Sort any plastic waste as thoroughly as possible.
2. → Dispose of plastics according to the legal requirements through authorized waste disposal companies/authorities.

7.4 Metals

1. Sort and separate different metal types.
2. Dispose of these metals according to the legal requirements through authorized waste disposal companies/authorities.

7.5 Electrical and electronic waste

Electrical and electronic waste must be disposed of separately. Electrical and electronic waste must not be disposed of with domestic waste.

- Only dispose of electrical or electronic waste according to the legal requirements through authorized waste disposal companies/authorities, e.g. recycling plants.

7.6 Final decommissioning

- Check which materials can be recycled and make the appropriate arrangements.

8 Accessories

The range of accessories supplied by Börger GmbH is as multi-faceted as the areas of application for Börger machines.

If your Börger machine was delivered with accessories, the corresponding operating manuals can generally be found in the appendix or in the packaging of the units, if delivered as originally packed.

8.1 Frequency converter

The machine can be operated with a frequency converter. Only frequency converters that deliver a constant torque are suitable for the Börger machine.

NOTE!
When using frequency converters

Due to their working principle, frequency converters generate leakage current.

— For proper operation of a frequency converter at a residual current device, the use of an AC/DC sensitive **residual current device (type B)** according to **EN50178/VDE0160** is required due to the DC component of the leakage current.

NOTE!
External drive cooler

An external drive cooler may be necessary if the motor frequency is set very low.

8.2 Monitoring equipment

8.2.1 Dry run protection

Long dry run periods (i.e. operation without pumped medium) should be avoided. This especially applies to rotary lobe pumps with rubber-coated rotors. Components on the rotary lobe pump are damaged when frictional heat is generated.

In processes in which dry running cannot be fully excluded, e.g. when containers are emptied using the rotary lobe pump, dry run protection is recommended through the temperature monitoring device or a conductivity sensor as a level control indicator, both in combination with a connected controller.

Temperature sensor

You can obtain the PT100 temperature sensors and control units from Börger GmbH.

If the temperature in the pump chamber rises to a preset value due to a lack of pumped medium, the rotary lobe pump / system equipped with a PT100 temperature sensor is switched off by means of a control unit. This then prevents the rotary lobe pump from running dry.

PT100 temperature sensors can also be used for temperature monitoring of optional packings. For example, this is necessary when such seals are used in potentially explosive atmospheres.

Conductivity sensor

Conductivity sensors as level control indicators measure the electrical conductivity on the pump inlet and switch the rotary lobe pump / system off by means of a control unit when the value drops beneath a specified limit.

8.2.2 Pressure monitoring devices as overpressure protection

Exceeding the maximum permissible working pressure can cause lasting damage to parts of the Börger machine and all attachment parts. There is also a risk of leakage and subsequent risks to personnel and the environment, depending on the medium.

Pressure monitoring devices of different manufacturers offer protection from damage due to overpressure. The Börger machine or the system can thus be switched off when a preset pressure is exceeded, or other measures for reducing the pressure can be carried out.

8.2.3 Pressure relief valve with bypass

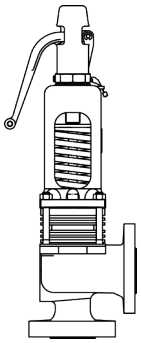


Fig. 4: Example: safety valve

By using a bypass with pressure relief valve (safety valve), it is possible to close the pressure line completely for a short period without switching off the pump.

While the pressure line is closed, the pump delivers the medium back to the suction side through the opened pressure relief valve. The causes of overpressure can now be rectified.

When the pressure decreases or the pressure line opens again, the pressure relief valve closes and operation can be continued without delay.

8.2.4 Level monitor with float switch

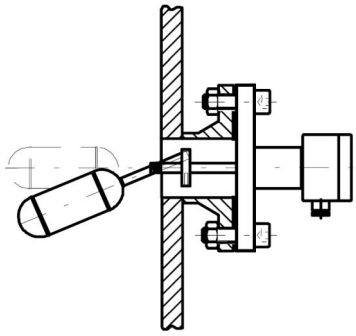


Fig. 5: Example: float switch

Float switches and floating magnetic switches are used for monitoring or controlling the fill level, and can also be used for dry run protection (depending on the version).

8.3 Auger feed

An auger feed with a feed hopper at the inlet of the Börger machine allows non-flowing or hardly flowing media that are just able to be pumped to be conveyed in certain cases.

9 Appendix

9.1 Data sheet

The data sheet is enclosed separately with the operating manual. The data sheet contains all relevant data for your Börger machine.

Especially consider the operating conditions and limits mentioned in the data sheet. They may deviate from the information mentioned in this operating manual if the machine has special equipment.

9.2 Wear parts

WARNING!
Risk of injury when using unsuitable spare parts!

The use of unsuitable spare parts can cause malfunctions which can lead to severe injury, including death, and to significant material damage.

— Only use suitable spare parts.
— Always contact the manufacturer if in doubt.

The following wear parts list includes the quantity, designation and position number of the elements that are replaced during the corresponding repair work. Also observe the assembly drawing according to *Chapter 9.3 “Assembly drawing” on page 159* and the spare parts list according to *Chapter 9.2 “Wear parts” on page 156*.

The required number of individual parts will to some extent depend on your Börger machine. Take note of the number of parts removed during repair work, cf. also figures in the repair chapters.

NOTE!
Spare parts orders!

The data below are required:

- **Serial number**
  - see nameplate
- **Type code**
  - according to data sheet
    (Important! - comparison with serial number!)

Börger GmbH will then obtain the information for **the appropriate spare parts for you from the production documents of your machine**.

- Record all modifications made to the equipment after the initial delivery, such as changes to rotating components (type, material) or seals.
- In order to avoid incorrect deliveries, always quote all modifications made when ordering spare parts.

Replacing the rotors

Pos. no.	Art. no.	Designation	Quantity
33	Z49604	Hexagon socket head cap screw DIN 6912 M12x25-10.9	2
34	Z50618	Pair of wedge-shaped lock washers	2
35	O80010	O-ring 18	2
38	O80520	O-ring 44	4
46	R8881L9	Dius rotor AN 040 ccw screw profile	1
	R8891L9	Dius rotor AN 070 ccw screw profile	1
47	R8881R9	Dius rotor AN 040 cw screw profile	1
	R8891R9	Dius rotor AN 070 cw screw profile	1
53	O80515	O-ring 195	1

Replacing the casing protection plates

Pos. no.	Art. no.	Designation	Quantity
28	B91011	Gear-side casing protection plate AN	1
33	Z49604	Hexagon socket head cap screw DIN 6912 M12x25-10.9	2
34	Z50618	Pair of wedge-shaped lock washers	2
35	O80010	O-ring 18	2
38	O80520	O-ring 44	4
39	Z48209	Hexagon socket head cap screw DIN 6912 M8x12-A4	2
48	B91013	Cover-side casing protection plate AN	1
53	O80515	O-ring 195	1

Replacing the FC cartridge

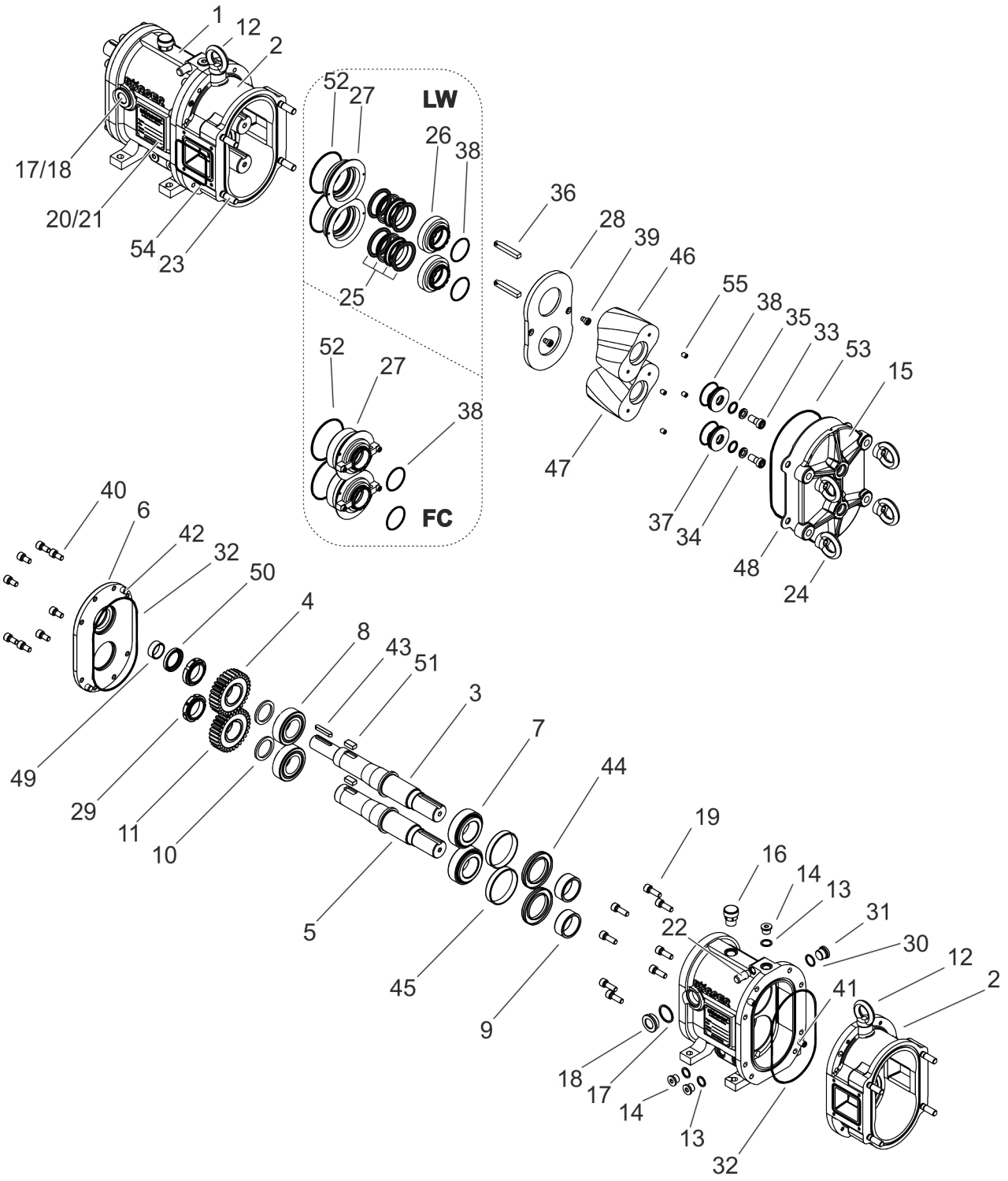
Pos. no.	Art. no.	Designation	Quantity
27	S27600	FC cartridge AN 1.4404, TC/TC, NBR	2
33	Z49604	Hexagon socket head cap screw DIN 6912 M12x25-10.9	2
34	Z50618	Pair of wedge-shaped lock washers	2
35	O80010	O-ring 18	2
38	O80520	O-ring 44	4
53	O80515	O-ring 195	1
52	O45708	O-ring 80	2

Replacing the LW mechanical seals

Pos. no.	Art. no.	Designation	Quantity
25	D45008	Mechanical seal, PL Duronit/NB	2
33	Z49604	Hexagon socket head cap screw DIN 6912 M12x25-10.9	2
34	Z50618	Pair of wedge-shaped lock washers	2
35	O80010	O-ring 18	2
38	O80520	O-ring 44	4
53	O80515	O-ring 195	1

9.3 Assembly drawing

The assembly drawing shows the positions of the spare parts as described in *Chapter 9.4 “Spare parts list” on page 160*.



9.4 Spare parts list

WARNING!
Risk of injury when using unsuitable spare parts!

The use of unsuitable spare parts can cause malfunctions which can lead to severe injury, including death, and to significant material damage.

— Only use suitable spare parts.
— Always contact the manufacturer if in doubt.

NOTE!
Spare parts orders!

<u>The data below are required:</u>

— **Serial number**
  — see nameplate
— **Type code**
  — according to data sheet
    (Important! - comparison with serial number!)

Börger GmbH will then obtain the information for **the appropriate spare parts for you from the production documents of your machine**.

— Record all modifications made to the equipment after the initial delivery, such as changes to rotating components (type, material) or seals.
— In order to avoid incorrect deliveries, always quote all modifications made when ordering spare parts.

Pos. no.	Art. no.	Designation	Quantity
1	A30500	Gear casing AN	1
2	B90000	Pump casing AN 040	1
	B90100	Pump casing AN 070	1
3	W51515	Drive shaft with keyway AN 040	1
	W51516	Drive shaft with keyway AN 070	1
4	E12806	Gear wheel with keyway AN in foot center	1
5	W51525	Short shaft, AN 040	1
	W51526	Short shaft, AN 070	1
6	A30600	Gear casing cover AN	1
7	S14123	Tapered roller bearing, 33109	2
8	S14122	Tapered roller bearing, 33108	2
9	S26810	Inner ring, 45x55x22	2
10	ST-1104	Spacer ring AN	2
11	E12807	Gear wheel with keyway AN in tooth center	1
12	Z39508	Eye bolt DIN 580 M12 galvanized	1
13	K32405	Sealing washer DIN 7603-A 17x23x1, 5-Cu	5
14	Z29305	Screw plug DIN 908-G3-8 galvanized	5
15	B91000	Pump casing cover AN	1
16	Z19108	Breather 1/2"	1
17	K22108	Sealing washer DIN 7603-A 33x39x2-Cu	1
18	Z18508	Oil sight glass, G1, brass	1
19	Z93000	Hexagon socket head cap screw DIN EN ISO 4762 M10x30-10.9 galvanized	8
20		Nameplate	8
21		Grooved dowel pin ISO 8746 A 3x8	4
22	MECH-3053	Breather G1/4” male thread	1
23	Z42105	Stud screw DIN 939 M12x35-8.8 galvanized	4
24	Z42305	Ring nut DIN 582 M12 galvanized	4
25	D45008	Mechanical seal, PL Duronit/NB	2
26	D55180	Rotating holding bush with thread, AN LW	2
27	D55270	Stationary holding bush AN LW	2
	S27600	FC cartridge AN 1.4404, TC/TC, NBR	2
28	B91011	Gear-side casing protection plate AN	1
29	S30057	Shaft nut M40 KMFE8	2
30	K22408	Sealing washer DIN 7603-A 21x26x1, 5-Cu	1
31	Z19308	Screw plug DIN 908-G1-2 galvanized	1
32	O80514	O-ring 180x3	2
33	Z49604	Hexagon socket head cap screw DIN 6912 M12x25-10.9	2

Pos. no.	Art. no.	Designation	Quantity
34	Z50618	Pair of wedge-shaped lock washers	2
35	O80010	O-ring 18x3	2
36	S24800	Parallel key DIN 6885 AB 10x8x34.5 modified with bridge	2
	S24802	Parallel key DIN 6885 AB 10x8x64.5 modified with bridge	2
37	C95014	Cover disk AN	2
38	O80520	O-ring 44x2.5	4
39	Z48209	Hexagon socket head cap screw DIN 6912 M8x12-A4	2
40	Z37709	Hexagon socket head cap screw DIN EN ISO 4762 M10x20-8.8 galvanized	10
41	Z33709	Dowel pin, DIN EN ISO 8735 12x32-St	2
42	Z43505	Dowel pin, DIN EN ISO 8735 12x24-St	2
43	S24325	Parallel key, DIN 6885-1 A 8x7x45	1
44	S16108	Lip seal, DUO 55x80x10	2
45	ST-1103	Spacer sleeve AN	2
46	R8881L9	Dius rotor AN 040 ccw screw profile	1
	R8891L9	Dius rotor AN 070 ccw screw profile	1
47	R8881R9	Dius rotor AN 040 cw screw profile	1
	R8891R9	Dius rotor AN 070 cw screw profile	1
48	B91013	Cover-side casing protection plate AN	1
49	S26805	Inner ring, 30x35x13	1
50	S26605	Lip seal, AS, 35x50x7	1
51	S24801	Parallel key DIN 6885-1 B 12x8x24	2
52	O45708	O-ring 80x3	2
53	O80515	O-ring 195x3	1
54	O80030	O-ring 74x3 (AN 040)	2
	O80525	O-ring 87x3 (AN 070)	2
55	Z41150	Grub screw DIN EN ISO 4027 M8x12 galvanized	4

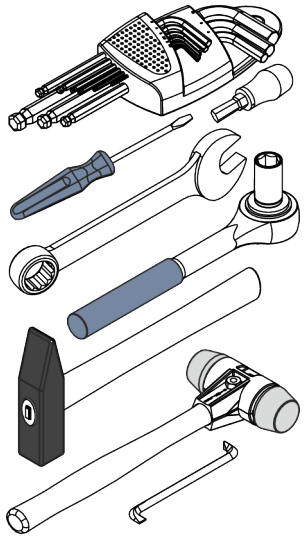
9.4.1 Tools / installation aid

The tools below are needed to carry out the required checks and correct installation:

Standard tools

Tools for electrical work

— These tools shall comply with the international standard **IEC 60900** (identical to **EN 60900** for Europe and **DIN EN 60900** for Germany).
  — The standard applies to “Insulated and insulating hand tools” used for live working and work near live parts, with voltage ratings up to 1000V AC or 1500V DC.
— Products designed and manufactured according to this standard contribute to the user’s safety, provided they are used by qualified electricians in compliance with the safe working practices and the operating manual (if applicable).

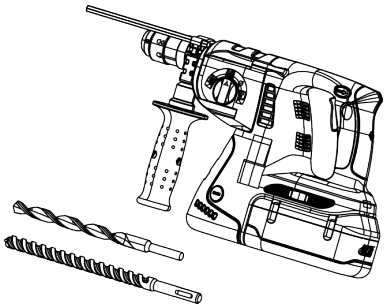


Tools, general

— Various hexagon socket wrenches and/or sockets for hexagon socket head cap screws.
— Various open-end / ring spanners and/or sockets for hexagon head screws.
— Hammer
— Soft face hammer
— Screw drivers in various sizes
— Lever

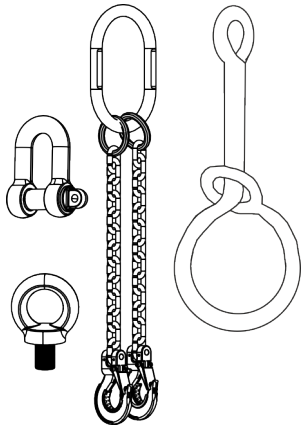
Special tools

Hammer drill



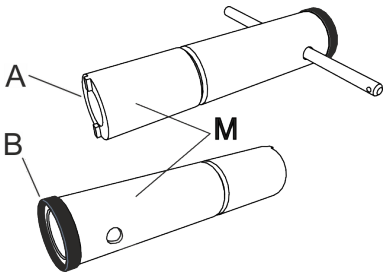
— A hammer drill is a power tool to drill holes into mineral material, e.g. stone or concrete. Through the impact, the cutting edge of the drill pulverizes the material

Hoists



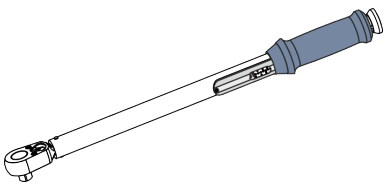
Lifting and slinging gear must be designed and dimensioned adequately according to the particular hazard and the loads occurring during transport.

Multitool (M)



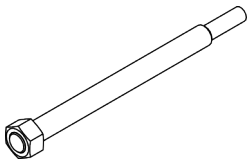
— Special tool (A) for rotating seal holding bushes
— Push-in tool (B) for mechanical seals
  — (Remove handle!)

Torque wrench

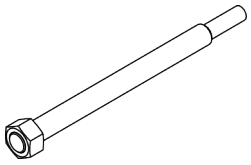


— A torque wrench is a hand-held fastening tool, with which a defined torque can be applied to a connecting element (screw or nut), so as to ensure the required clamping force between the connecting components even at maximum operating forces.

W... rotor puller



— for all rubber-coated rotors
  — 2x for screw rotors

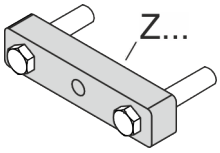


W... rotor puller for auxiliary puller
Dual-lobe rotors

— The W... rotor puller in combination with the Z... auxiliary puller and two suitable screws (not included in the scope of supply) is to be used for dual-lobe rotors with cover disk.
  — 2x for screw rotors

Tri-lobe rotors

— The W... rotor puller in combination with the Z... auxiliary puller and three suitable screws (not included in the scope of supply) is to be used for tri-lobe rotors with cover disk.
  — 2x for screw rotors



Z... auxiliary puller, dual-lobe

— The Z... auxiliary puller in combination with the W... rotor puller and two suitable screws (not included in the scope of supply) is to be used for dual-lobe rotors with cover disk.
  — 2x for screw rotors

9.5 Parallel keys

The following parallel key lengths must be adhered to and checked.

NOTICE!

Risk of material damage when operated with an incorrect or damaged parallel key!

Imprecise parallel key lengths can lead to misalignment of the rotating holding bush and can cause mechanical damage to the Börger machine or to the complete unit.

Version	Parallel key dimensions approx.	
	for rotors without separate cover disk	for rotors with separate cover disk
AN 040	— 10 x 8 x 34.5 mm — 0.39 x 0.31 x 1.36 "	— 10 x 8 x 34.5 mm — 0.39 x 0.31 x 1.36 "
AN 070	— 10 x 8 x 64.5 mm — 0.39 x 0.31 x 2.54 "	— 10 x 8 x 64.5 mm — 0.39 x 0.31 x 2.54 "

9.6 Checklist for commissioning

This checklist can be used as an additional aid when commissioning a Börger machine. It is not a substitute for careful reading of the operating manual before commissioning the unit.

Customer:	**Börger order confirmation no.:**
Machine number:	**Type code:**
Your project:	**Order number:**
Commissioning date:	**Delivery date:**

	Test point	Carried out by: (date/signature)	Checked by: (date/signature)
1	Operating manual and appendices read and understood		
2	Application data and operating parameters according to data sheet correspond to application		
3	Base frame fixed correctly to solid, even surface		
4	Coupling alignment within the permitted tolerance, coupling guard attached; in case of overhead mounted drive assembly, V-belt / chain tension OK, V-belt / chain attached		
5	Pipes laid correctly on inlet and outlet side, pipes fixed and not leaking, flow direction complies with the marking		
6	Optional safety equipment installed correctly, connected and functions checked		
7	Electrical connections and grounding OK, direction of rotation of drive shaft correct		
8	Oil level in drive OK, transport lock removed from breather system (if present)		
9	Oil level in the gear unit of the Börger machine OK; in M2 mounting position: screw plug replaced by breather system		
10	Fluid level in the intermediate chamber OK, breather installed in the correct position and open		
11	All valves in pipes opened; check valves installed correctly		
12	Noise and vibration levels normal when drive is switched on		
13	Pipes checked for leaks again with Börger machine switched on		
14	Power consumption of drive checked to guarantee correct installation		
15	Flow rate and working pressure checked		
16	Maintenance and inspection intervals organized for the machine		

9.7 EU Declaration of Conformity / EU Declaration of Incorporation

9.7.1 EU Declaration of Conformity

EU Declaration of Conformity

Börger GmbH | Benningsweg 24 | 46325 Borken-Weseke | Germany

We hereby declare that the following products:

Product description:	Rotary lobe pump
Product line:	BLUEline
Type descriptions:	AL, AN, PL, CL, FL, FLA, EL, XL
Version:	
Serial number:	from 1000 0000
Year of manufacture:	from 2018

are in compliance with all relevant provisions of the **Machinery Directive (2006/42/EC)**.

The machines are further in compliance with all provisions of the **Electrical Equipment (2014/35/EU)** and **Electromagnetic Compatibility (2014/30/EU)** Directives.

The following harmonized standards were applied:
— DIN EN ISO 13857
— DIN EN 809
— DIN EN 12162

Name and address of the authorized representative: Ansgar Riers - Börger GmbH

Borken-Weseke,	01.07.2019
Town / city	Date

Alois Börger

Alois Börger - Managing Director

9.7.2 EU Declaration of Incorporation

EU Declaration of Incorporation

Börger GmbH | Benningsweg 24 | 46325 Borken-Weseke | Germany

We hereby declare that the following products:

Product description:	Rotary lobe pump
Product line:	BLUEline
Type descriptions:	AL, AN, PL, CL, FL, FLA, EL, XL
Version:	
Serial number:	from 1000 0000
Year of manufacture:	from 2018

are in compliance with the requirements of the **Machinery Directive (2006/42/EC)**: Annex I, para. 1.1.2, 1.1.3, 1.1.5, 1.3.2, 1.3.4 and 1.5.1.

The incomplete machine is further in compliance with all provisions of the **Electrical Equipment (2014/35/EU)** and **Electromagnetic Compatibility (2014/30/EU)** Directives.

The incomplete machine may only be put into operation when it has been determined that the machine in which the incomplete machine is to be installed is in compliance with the provisions of the Machinery Directive (2006/42/EC).

The manufacturer is obligated to electronically submit the specific documentation for the incomplete machine to the authorities of individual member states upon request.

The specific technical documentation associated with the machine has been created in accordance with Annex VII Part B.

Name and address of the authorized representative: Ansgar Riers - Börger GmbH

Borken-Weseke,	01.07.2019
Town / city	Date

Alois Börger

Alois Börger - Managing Director

9.8 Lubricant list

Area of validity

Unless subject to special agreements, this lubricant list is part of the operating manual and applies to all standard Börger pump versions, Powerfeed units, macerating units, Bioselect units and submersible mixers.

Deviations can be agreed upon individually for special applications. In such cases, only the agreement applies instead of this lubricant list, according to *Chapter 9.8.7 “Customer approval for special lubricants (example)” on page 181*.

On delivered drives, the corresponding operating manual and lubricant list from the drive manufacturer applies.

ENVIRONMENT!
Danger due to incorrect handling of environmentally hazardous substances!

Inappropriate handling of environmentally hazardous substances, especially incorrect disposal, can cause significant damage to the environment.

- Especially water-polluting materials such as grease and lubricating oil must not pollute the soil or enter the sewage system during installation, repair and maintenance work.
  - These materials must be collected, stored, transported and disposed of in suitable containers.
- When handling oil, grease and other chemical substances, pay attention and adhere to the applicable regulations and safety data sheets issued by the respective manufacturer relating to storage, handling, correct use and disposal.
- Comply with the legal obligations regarding waste avoidance and the proper recycling/disposal of waste during all work

9.8.1 Börger gear units

Oil quality

Only oils containing active substances for improving corrosion protection and aging resistance and reducing wear in gear units are permitted for use in Börger gear units.

Additionally, the gear oils must also meet the following quality requirements:

— Suitable for lip seal material and gear casing material
— Compatible with residual oil originally used by the manufacturer
— Sufficient viscosity for the relevant temperature range

NOTICE!

Risk of material damage and loss of warranty when using low-quality lubricants!

The oil classification and viscosity must be adhered to according to the factory-supplied lubricant specified in the data sheet.

The lubricants used must meet the quality standards as detailed above. Otherwise, the warranty supplied by Börger GmbH is void. Deviations are only permitted following consultation with Börger GmbH.

If the actual operating conditions on or after commissioning deviate from those specified in the order, then a change of lubricant must be considered. Any such actions must be approved by Börger GmbH.

Lubricants suitable for use in Börger gear units are listed in ↳ *Chapter 9.8.4 “Oil types” on page 175*. However, the lubricant manufacturers are solely liable for the suitability and quality of their products.

According to the manufacturer's specifications, the listed lubricants are available globally in compliance with the necessary quality.

Oil change

The purity of the lubricant influences the service life of the oil and gear unit, plus general operating safety.

Therefore, always ensure that the gear unit contains clean oil!

Instructions for changing the oil/lubricant contained in the operating manual of the Börger device must be strictly adhered to.

The amount of remaining used oil in the gear unit must be kept as low as possible, even when the same oil type is used for the oil change.

NOTE!

Gear oils of different types or from different manufacturers must not be mixed together.

When necessary, a confirmation of oil compatibility with the used oil must be obtained from the manufacturer of the new oil.

If the composition of the new oil type deviates greatly from the used oil (e.g. additives), then the used oil must be completely removed from the gear unit. **In this case, the gear unit must be flushed carefully with the new oil.** Gear oils must not become contaminated with other substances, including any residue from cleaning agents (e.g. petrol). Therefore, flushing with petrol or other cleaning agents is not permitted.

9.8.2 Buffer fluid

Any fluids with good lubricant qualities that do not react with any of the materials they come into contact with are suitable as buffer fluids.

Pay attention to compatibility with the residual buffer fluid when filling or refilling.

In order to rule out damage to the gear unit as comprehensively as possible, even in the exceptional case that buffer fluid enters the gear unit (e.g. due to improper maintenance of the gear unit), the buffer fluid should also be compatible with the gear oil. See *Chapter 9.8.4 “Oil types” on page 175*.

NOTICE!

Risk of material damage when using wrong lubricants!

Due to the possibility, though unlikely, of buffer fluid entering the pump/cutting chamber and thus intruding on the process itself, the buffer fluid must be compatible with the pumped/flow medium in addition to the other materials (O-rings).

NOTICE!

Risk of material damage and loss of warranty when using unsuitable lubricants!

Supply media such as highly purified water, antifreeze, silicon oils, oils for automatic transmissions, diesel and methanol are **unsuitable** as lubricants.

The lubricants used must meet the quality standards as detailed above.

NOTICE!

Risk of material damage when using wrong lubricants!

Versions for special applications and/or with special sealing compounds may require special lubricants.

Filling with these lubricants is approved/tested specifically for the supplied version and is indicated in the data sheet. In such cases, the same buffer fluid must be used exclusively when filling or refilling. Otherwise, there is a risk of material damage, which can be significant depending on the application.

9.8.3 Oil properties

Operating temperatures

Compared to mineral oils, synthetic oils can be used in a wider operating temperature range, whereupon the temperature-related viscosity deviation is lower (higher viscosity index). In addition, synthetic oils have a higher thermal stability and a higher ignition point.

With medium temperatures of more than 80°C (176°F) or ATEX units, you should therefore use synthetic, high-quality industrial gear oil with an ignition point above 200°C (392°F) in the gear unit and as a buffer fluid only.

Alternatively, a synthetic high-performance hydraulic oil with an ignition point above 200°C (392°F) can be used in the buffer.

The use of oils in contact with EPDM is prohibited. In these cases, an alternative lubricant must be selected for the buffer or the circulation system.

All gear oils and buffer fluids used in the food and feed industry must be food safe (e.g. NSF-H1).

NOTE!

Special lubricants can be supplied upon request. In this case, the agreed limits apply.

All values specified are recommended guidelines. Consult the **technical data sheets of the relevant lubricant manufacturer** for their specified operating temperature ranges and other oil property details.

Oil service life

Please observe the service life indicated in the relevant operating manuals for your Börger machine.

9.8.4 Oil types

Suitable lubricants for Börger gear units

Mineral lubricants			
Manufacturer	**Designation**	**Type**	**Viscosity [T=40°C (104°F)]**
Aral	Degol	BG	220
BP	Energol	GR-XP	220
Castrol	Alpha	EP	220
Chevron	Meropa	-	220
Mobil	Mobilgear	630	220
Lukoil	Stello	HAST	220
Shell	Omala	S2 G	220
Texaco	Meropa	-	220
Petronas	Gear	MEP	220
Total	Carter	EP	220

Synthetic lubricants			
Manufacturer	**Designation**	**Type**	**Viscosity [T=40°C (104°F)]**
Aral	Degol	BAB	220
BP	Enersyn	HTX	220
Castrol	Alphasyn	T	220
Chevron	Tegra Syn	Synthetic EP	220
Mobil	Mobilgear	SHC 630	220
Lukoil	Stello	S	220
Shell	Omala	S4 GX	220
Texaco	Pinnacle	EP	220
Petronas	Gear Syn	IG	220
Lubriplate	Syn Lube	-	220
Total	Carter	SY	220

Food-safe lubricants				
Manufacturer	**Designation**	**Type**	**Viscosity [T=40°C (104°F)]**	**Notes**
Castrol	Optileb	GT	220	NSF-H1
Shell	Cassida	GL	220	NSF-H1
Mobil	SCH	Cibus	220	NSF-H1
Klüberoil	4	UH1	220	NSF-H1
Lubriplate	FMO-1000	AW	220	NSF-H1

Lubricants suitable as buffer fluid

Mineral lubricants			
Manufacturer	**Designation**	**Type**	**Viscosity [T=40°C (104°F)]**
Aral	Vitam	GF	68
BP	Energol	CS	68
Castrol	Magna	-	68
Chevron	Meropa	-	68
Mobil	Mobilgear	626	68
Lukoil	Geyser	ZF	68
Shell	Omala	S2 G	68
Texaco	Meropa	-	68
Petronas	Gear	MEP	68
Lubriplate	ZF	HLP	68
Total	Carter	EP	68

Synthetic lubricants			
Manufacturer	**Designation**	**Type**	**Viscosity [T=40°C (104°F)]**
Aral	Degol	BAB	68
BP	Enersyn	HTX	68
Castrol	Alphasyn	HTX	68
Chevron	Cetus	PAO	68
Mobil	Mobilgear	SHC 626	68
Lukoil	Stello	S	68
Shell	Omala	S4 GX	68
Texaco	Cygnus	PAO	68
Petronas	Gear Syn	IG	68
Lubriplate	Syn Lube	-	68

Lubricants suitable for EPDM seals				
Manufacturer	**Designation**	**Type**	**Viscosity [T=40°C (104°F)]**	**Application temperature**
LANXESS/Dow	Propylene glycol	pure	19.5	up to 100°C (212°F)
LANXESS/Dow	Water/Glycerin	70%/30%	1.4	up to 60°C (140°F)
Klüber	Sugar dissolving oil	NH1 6-10	12.0	up to 60°C (140°F)

Food-safe lubricants					
Manufacturer	**Designation**	**Type**	**Viscosity [T=40°C (104°F)]**	**Application temperature**	**Notes**
LANXESS/Dow	Propylene glycol	pure	19.5	up to 100°C (212°F)	USP/EP
LANXESS/Dow	Water/Glycerin	70%/30%	1.4	up to 60°C (140°F)	USP/EP
Klüber	Sugar dissolving oil	NH1 6-10	12.0	up to 60°C (140°F)	USDA-H1
Klüber	Paraliq	P12	22.0	up to 60°C (140°F)	medicinal white oil NSF-H1
Klüber	Klüberoil	4 UH1-15AF	15	up to 110°C (230°F)	NSF-H1 ATEX-compatible; ignition temperature > 200°C
Klüber	Klüberfluid	NH1 4-005	5	up to 100°C (212°F)	NSF-H1
Castrol	Optileb	DAB8	43	up to 60°C (140°F)	medicinal white oil NSF-H1
Castrol	Optileb	HY	68	up to 100°C (212°F)	NSF-H1
Lubriplate	FMO-350	AW	68	up to 60°C (140°F)	NSF-H1

Suitable lubricants for circulation systems					
Manufacturer	**Designation**	**Type**	**Viscosity [T=40°C (104°F)]**	**Application temperature**	**Notes**
LANXESS/Dow	Propylene glycol	pure	19.5	up to 100°C (212°F)	USP/EP
LANXESS/Dow	Water/Glycerin	70%/30%	1.4	up to 60°C (140°F)	USP/EP
Klüber	Paraliq	P12	22	up to 60°C (140°F)	medicinal white oil NSF-H1
Klüber	Klüberoil	4 UH1-15AF	15	up to 110°C (230°F)	NSF-H1 ATEX-compatible; ignition temperature > 200°C
Klüber	Klüberfluid	NH1 4-005	5	up to 100°C (212°F)	NSF-H1
Castrol	Optileb	DAB8	43	up to 60°C (140°F)	medicinal white oil NSF-H1
Aral	Aralux	RP	4.0	up to 100°C (212°F)	ATEX-compatible; ignition temperature > 200°C

List of abbreviations

— **FDA** (Food and Drug Administration)
— **H1** (Approval acc. to FDA 21 CFR 178.357c)
— **USP** (United States Pharmacopeia)
— **EP** (European Pharmacopeia)
— **USDA** (U.S. Department of Agriculture)
— **NSF** (National Sanitation Foundation)

9.8.5 Oil filling quantity of the Börger units

Rotary lobe pumps			Gear unit		Intermediate chamber	
- BLUEline - Multi-crusher	Design (Code)	Design (Description)	approx. [l]	approx. [gal]	approx. [l]	approx. [gal]
AL HAL	M1/M3	standing / upside-down	0.4	0.10	0.3	0.08
	M5	turned 90°	0.4	0.10	0.3	0.08
	M2	vertical	0.8	0.20	0.4	0.11
PL HPL	M1/M3	standing / upside-down	1.5	0.40	0.7	0.18
	M5	turned 90°	1.0	0.26	0.6	0.16
	M2	vertical	2.2	0.58	0.8	0.21
PL Protect	M1/M3	standing / upside-down	3.3	0.87	does not apply	
	M5	turned 90°	2.4	0.63	does not apply	
	M2	vertical	5.0	1.32	does not apply	
CL HCL	M1/M3	standing / upside-down	3.3	0.87	1.0	0.26
	M5	turned 90°	3.3	0.87	0.8	0.21
	M2	vertical	5.1	1.35	1.2	0.32
FL518 FL776	M1/M3	standing / upside-down	5.6	1.48	3.8	1.00
	M5	turned 90°	4.8	1.27	3.4	0.90
	M2	vertical	9.0	2.38	4.2	1.11
FL 1036 FL 1540	M1/M3	standing / upside-down	5.6	1.48	2.4	0.63
	M5	turned 90°	4.8	1.27	2.4	0.63
	M2	vertical	9.0	2.38	2.4	0.63
EL	M1/M3	standing / upside-down	16.0	4.23	3.3	0.87
	M5	turned 90°	12.5	3.30	3.3	0.87
	M2	vertical	24.5	6.47	3.3	0.87
XL	M1/M3	standing / upside-down	26.5	7.00	13.0	3.43
	M5	turned 90°	19.0	5.01	9.5	2.51
	M2	vertical	36.0	9.51	14.0	3.70

Rotary lobe pumps			Gear unit		Intermediate chamber	
ONIXline	Design (Code)	Design (Description)	approx. [l]	approx. [gal]	approx. [l]	approx. [gal]
BJ	M1/M3	standing / upside-down	5.1	1.34	0.1	0.03
	M5	turned 90°	3.8	1.00	0.1	0.03
	M2	vertical	5.6	1.48	0.2	0.06
BL	M1/M3	standing / upside-down	10.5	2.77	0.13	0.035
	M5	turned 90°	7.9	2.09	0.13	0.035
	M2	vertical	12.6	3.33	0.26	0.7

Multichopper			Gear unit		Intermediate chamber	
P series	Design (Code)	Design (Description)	approx. [l]	approx. [gal]	approx. [l]	approx. [gal]
	M1/M3	standing / upside-down	does not apply		0.8	0.21
	M5	turned 90°	does not apply		0.8	0.21
	M2	vertical	does not apply		does not apply	

Powerfeed twin			Gear unit		Intermediate chamber	
	Design (Code)	Design (Description)	approx. [l]	approx. [gal]	approx. [l]	approx. [gal]
	M1	standing / upside-down	16.0	4.23	3.3	0.87

Submersible mixer		Gear unit		Intermediate chamber	
B-MX	Size	approx. [l]	approx. [gal]	approx. [l]	approx. [gal]
New	9	4.0	1.06	0.2	0.05
	3	4.0	1.06	0.2	0.05
	18	4.5	1.19	0.2	0.05
	22	4.5	1.19	0.2	0.05
Old	9	2.5	0.66	0.1	0.025
	3	4.0	1.06	0.1	0.025
	18	4.0	1.06	0.1	0.025
	22	does not apply		does not apply	

9.8.6 Lubricant orders

NOTE!
Lubricant orders

You can order lubricants by quoting the article number from the enclosed spare parts list.

The data below are required:

- **Serial number**
  - see nameplate
- **Type code**
  - according to data sheet
    (Important! - comparison with serial number!)

Börger will then obtain the information for the appropriate lubricants for you from the production documents of your machine.

Record all modifications made to the equipment after the initial delivery, such as changes to rotating components (type, material) or seals.

In order to avoid incorrect deliveries, always quote all modifications made when ordering lubricants.

Article number	Lubricants	Abbreviation
DAD.034	Gear oil	CLP 220
DAD.030	Synthetic gear oil	CLP 220 SYN
DAD.032	Food-safe gear oil	Castrol Optileb GT 220
DAD.035	Hydraulic oil	HLP 68
DAD.031	Synthetic gear oil	CLP 68 SYN
DAD.033	Food-safe hydraulic oil	Castrol Ortlieb HY 68
DAD.072	Medicinal white oil	Castrol Ortlieb DAB 8
DAD.028	Sugar dissolving oil	Klüberfood NH1 - 6 - 10
DAD.027	Glycerine/Water	$Glycerine_{(30\%)}/Water_{(70\%)}$
DAD.076	Propylene glycol	Propylene glycol
DAD.077	Synthetic oil	Klüberoil 4 UH1 - 15AF
DAD.075	Synthetic oil	Klüberfluid NH1 - 4-005

9.8.7 Customer approval for special lubricants (example)

Kunde: Customer:	Mustermann Synthecta AG – Borken-Weseke (D)
Produktbezeichnung: Type of machinery:	Rotary lobe pump
Produktlinie: Product line:	BlueLine
Typenbezeichnungen: Model:	PL 200
Ausführung: Version:	Classic
Auftragsnummer: Order No.:	16002546
Medientemperatur [°C]: Fluid temperature [°C]:	20 - 58
Drehzahl [U/min]: Revolution [rpm]:	150 - 350
Bemerkungen: Remarks	Pump for feed additives acc. to directive on food (1935 – 2004 – EU)

Commissioning date:	**Delivery date:**

Sonderschmierstoff für Gleichlaufgetriebe:
Special lube for timing gear:
— PETRO-CANADA: PURITY™ FG SYNTHETIC EP GEAR FLUID 220

Sonderschmierstoff für Zwischenkammer:
Special lube for intermediate chamber:
— PETRO-CANADA: PURITY™ FG WO WHITE MINERAL OIL 68

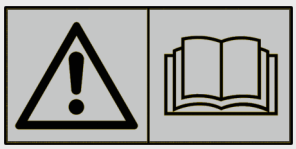
Sonderschmierstoff für Umlaufsystem:
Special lube for circulation system:
—

Bemerkungen:
Remarks:
— Change of lubricant according to specifications listed in operating manual

BÖRGER GmbH

Verantwortlich In authority	**Stempel + Unterschrift** Stamp + Signature	**Ort + Datum** Location + Signing Date
Ansgar Riers Abnahmebeauftragter Inspection representative	*Ansgar Riers*	Borken-Weseke - 01.02.2017 Deutschland Germany

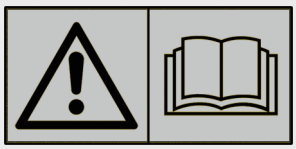
9.9 Additional documentation



Further operating manuals / supplementary operating manuals

— You must completely read the separate operating manuals and/or supplementary operating manuals for components and/or special versions and consider the **instructions and safety regulations** accordingly.

9.10 Supplier documentation



Supplier documentation

— You must completely read the separate supplier documentation and consider the **instructions and safety regulations** accordingly.

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