

User manual
BA series



Pumps for results



Product and Dealer information

Note

For the specifications of the pump, drive unit and enclosure, refer to the corresponding type plates.

Delivery date : _____

Product information

Model : _____

Product identification number : _____

Motor serial number : _____

Pump serial number : _____

Trailer serial number
(optional) : _____

Customer's product number : _____

Dealer's product number : _____

Dealer information

Name : _____

Address : _____

City : _____

Country : _____

Dealer contact Telephone number Email

Sales : _____

Parts : _____

Service : _____

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This user manual is for the BA series of pumps. The original version was written in Dutch by BBA Pompen en Buizen BV.

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Despite the care that has been put into the compilation of the text and illustrations, neither the author nor the publisher can be held liable for any consequential damages resulting from possible errors in this publication.

The original manual was written in Dutch. Versions in other languages are translations of the original instructions. A translation may contain information that differs from the original due to interpretation of the content and meaning of the original text.

In the case of such discrepancies, the original Dutch-language instructions will be considered the sole authentic source for the purpose of determining the content and meaning of the text.

This manual reflects the state of the art in technology at the time of publication.

BBA Pumps BV reserves the right to make changes to technical and design specifications at any time without prior notice.

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Introduction

This user manual contains information for the installation, use and user maintenance of a pump from the BA series. The information in this manual must therefore be strictly followed. Read and understand the manual completely before installing and commissioning the pump.

Contact BBA Pumps BV if you have any questions or anything is unclear.

BBA Pumps cannot be held responsible for accidents and/or damage that result from failure to follow the guidelines in this manual.

Keep this manual with the pump. You can order an extra copy of the manual from BBA Pumps BV.

This manual is part of the pump. If the pump is transferred to another user, this manual must accompany it.

Depending on which drive motor/engine is used, this user manual may be accompanied by the manual for the drive motor/engine. Read the supplied manual carefully and follow the procedures and safety instructions.

Version and application

The BA series consists of different types of pumps in various versions. The pump is available as a separate component or as a complete installation. The complete pump unit can be driven by an electric motor or diesel engine and can be mounted on an open frame, on a half-closed frame or in a noise attenuating enclosure. From this point forward we simply refer to an enclosure. For movement around the site, the pump frame can be equipped with wheels and a tow bar.

The pumps are suitable for pumping clean and polluted liquids.

If the pump is equipped with a vacuum system, the pump is also self-priming.

Note

Because the BA series consists of a large number of different types of pumps in various versions, the illustrations in this manual may not match the actual situation.

1 Description, application and working principle

1.1 Description

The BA series of pumps, with their large solids handling capacity and good wear resistance, are perfect for pumping both clean and partially polluted liquids.

The solids handling capacity is specified on the data sheet that accompanies the pump unit.

The pumps are fitted with a half open or closed impeller and a wear plate or wear ring which can be replaced quickly. Because few moving parts come into contact with the liquid, the pump is subject to minimal wear.

The design includes large cleaning covers so the pump can be cleaned internally.

The design of the pump shaft seal is dependent on the application. The standard configuration includes oil cooling of the pump shaft seal. This characteristic is indicated by a code in the type designation.

The data sheet that accompanies the pump includes all data for the pump or pump unit.

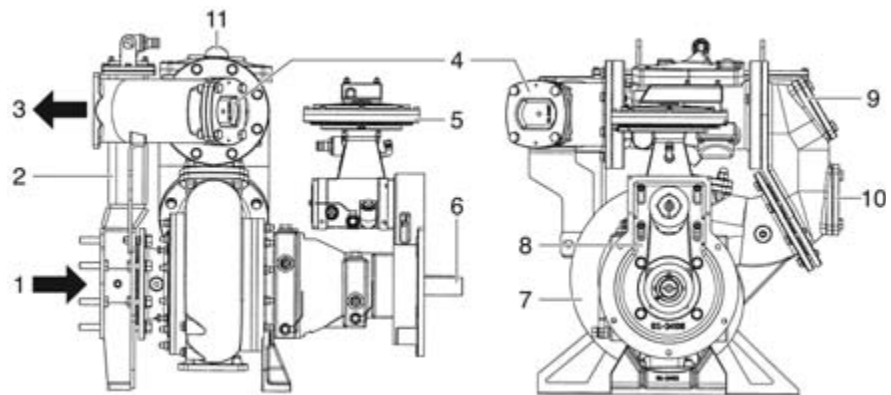
Before the pump or pump unit is connected, an assessment must always be made to determine whether it is suitable for the intended application.

1.2 Construction and working principle of the pump

Construction

The pump consists of the following main components:

1. Suction side
2. Float chamber
3. Pressure side
4. Cleaning cover
5. Vacuum pump
6. Drive shaft
7. Pump housing
8. Vacuum pump drive
9. Cleaning cover
10. Cleaning cover
11. Non-return valve



Working principle of the vacuum system

The BA dry-prime centrifugal pump distinguishes itself from the normal-priming centrifugal pump through the inclusion of a separate vacuum pump. The vacuum pump is usually driven by the drive shaft via a belt. In special cases the vacuum pump is driven by a separate drive system, such as an electric or hydraulic drive unit.

The vacuum pump draws the air out of the suction line and pump housing via a float chamber.

To ensure that vacuum develops in the suction line and the pump housing, a non-return valve is present on the pressure side of the pump.

Once sufficient vacuum has developed, the pump housing fills itself with liquid and the pump begins moving the liquid.

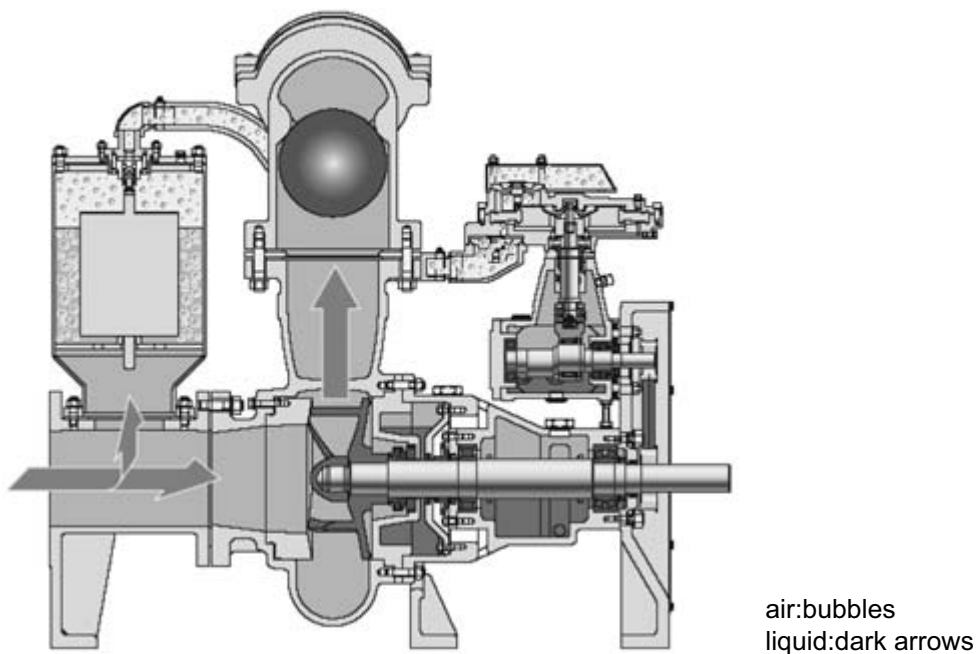


WARNING

To prevent damage to the pump it is important that the pump does not run dry for more than five minutes.

The designation 'self-priming centrifugal pump' indicates that the pump housing does not have to be filled before the pump is started, which is a big advantage.

The drawing below is an exploded-view of a BA dry-prime centrifugal pump. The arrows indicate the flow of the liquid and air through the pump housing.



1.3 Intended use

- The BA series pump is suitable for pumping viscous liquids up to 50 mm²/s (cSt). For a higher value contact BBA Pumps.
- The maximum liquid temperature is 70 °C (158 °F), which depends in part on the materials used in the pump as well as the liquid, operating pressure and pump position.
- For more detailed information, see the pump specification sheet.

The BA series of pumps are suitable for use in the following sectors:

- contracting
- rental
- industry
- shipping
- waste water
- environmental protection
- water boards
- irrigation projects
- agriculture
- horticulture
- mining industry

Note

The BA series is not designed for food processing but can be used for such applications if they are not subject to any special hygiene standards.

The materials used in the selected pump version must in all cases be checked in advance for their suitability for the concerned foodstuff.

1.4 Unintended use

- It is not permitted to use the pump for pumping flammable and/or explosive substances.
- It is not permitted to deploy a standard pump or pump unit in an environment in which there is a danger of fire and/or explosion.
- It is not permitted to deploy a standard pump or pump unit in an ATEX environment.
- Use the pump only for those applications listed on the pump specification sheet.
- It is not permitted to use the pump for any application and/or field of activity other than that for which the pump was originally specified and installed without written permission from BBA Pumps.



WARNING

BBA Pumps is not responsible for incorrect use and/or application of the pump.

1.5 Warranty

See the BBA warranty book for the warranty conditions.

2 Data

2.1 Specification sheets

For a detailed overview of the data, sizes and weights, see the specification sheet for the pump concerned.

2.2 Explanation of type code

General abbreviations for BBA Pumps

Type

BA	BA pump series, self-priming centrifugal pump
BA-C	BA-C series, self-priming centrifugal pump
BA... H..	BA pump with high-pressure impeller, suitable for slightly polluted water
BA... E..	BA pump with E impeller, suitable for polluted water
BA... K..	BA pump with K impeller, suitable for polluted water
BA-C... H..	BA-C pump with high-pressure impeller, suitable for slightly polluted water
BA-C... S..	BA-C pump with S impeller, suitable for polluted water
BA... D...	D in combination with number indicates impeller diameter
BA-C... D..	D in combination with number indicates impeller diameter
BA... D.. SM	SM after D with number indicates throttle plate
BA-C...D..SM	SM after D with number indicates throttle plate
BA...F..	Narrow float chamber

Construction

...MC...	electrically driven
...NMC...	for electric-drive via push-on shaft
...BF...	basic frame
...TF...	tank frame
...GL...	sound attenuated

Drive

...PE... Perkins
 ...HA... Hatz

Control box

...LC... level control
 ...ALC... auto level control

Curve number

example

235FBFPELC 235 = curve number
 F = narrow float chamber
 BF = basic frame
 PE = Perkins
 LC = level control

MSDS Material Safety Data Sheet

A data sheet containing all the properties of a particular substance

NPSH Net Positive Suction Head

This is the suction height from which the pump can pump liquid after deduction of the losses within the pump.

2.3 Sound level

Because the pump, with or without the drive unit, is usually part of a complete installation, the final configuration is usually not known at the time of delivery. The sound level also depends in part on the sound production of the other components in the installation.

BBA Pumps conducts random sound measurements on a complete installation. The measurements are taken at a distance of 1 m (3.3 ft) and a height of 1.6 m (5.2 ft). The average of the measured values is less than 80 dB(A).

These measurements do not take the drive system or piping into consideration. It is assumed, however, that the pump is set up/installed in accordance with the instructions and is operating without cavitation.

Correction in dB(A) as a function of the distance from the sound source

Distance (metric)	Distance (imperial)	Correction
metres	feet	dB(A)
1	3.3	8.0
2	6.6	14.0
3	9.9	17.5
4	13.2	20.0
5	16.5	22.0
6	19.8	23.5
7	23.1	24.9
8	26.4	26.0
9	29.7	27.1
10	33	28.0
15	49.5	31.5
20	66	34.0
25	82.5	35.9
30	99	37.5
35	115.5	38.9
40	132	40.0
45	148.5	41.0
50	165	42.0
55	181.5	42.8
60	198	43.5
70	231	44.9
80	264	46.0
90	297	47.1
100	330	48.0
110	363	48.8
120	396	49.6
130	429	50.3
140	462	50.9
150	495	51.5
160	528	52.1
170	561	52.6

LwA value +/- Correction = dB(A)

Example:

Measured LwA value	90
Distance	7 m (23.1 ft)
Correction	24.9 dB(A)

Sound level	65.1 dB(A)
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2.4 Applied directives and standards

The pumps from the BA series are affixed with the CE marking. This means that these pumps conform to the applicable European directives on health and safety. The applied directives are listed in the EC Declaration of Conformity.

The pumps from the BA series also conform to the harmonised standard NEN-EN 809:1998+A1:2009, IDT 'Pumps and pump units for liquids - Common safety requirements'.

3 Warnings and safety instructions

3.1 Warning and safety symbols

This manual contains warning and safety symbols. Do not ignore the instructions. They are provided for the benefit of your health and safety and to prevent damage to the environment and the pump or pump unit.



DANGER

When the danger symbol with the text DANGER is shown, it is accompanied by information that is of great importance for the safety of everyone concerned. Ignoring the information can result in injury (possibly severe) or even death.



WARNING

When the warning symbol with the text WARNING is shown, it is accompanied by information that is of great importance for everyone concerned with the pump or pump unit. Ignoring the information can result in injury or damage (possibly severe) to the pump or pump unit.

3.2 Safety instructions – general

The pump or pump unit conforms to the European Machinery Directive. However, this does not exclude the possibility of accidents if used incorrectly.

Use of the pump for an application and/or deployment of the pump in an environment other than defined at the time of purchase is strictly prohibited and can result in a hazardous situation. This is particularly true for corrosive, poisonous or other hazardous liquids.

The pump or pump unit may only be installed, operated and maintained by persons who are familiar with it and are aware of the dangers of working with it.

The installer, operator and maintenance personnel must comply with the local safety regulations.

The company management is responsible for ensuring that all work is performed by qualified personnel in a safe manner.

It is not permitted to make changes to the pump or pump unit without written permission from BBA Pumps.

If any changes are made to the pump without the written permission of BBA Pumps, BBA Pumps disclaims all liability.

Hearing protection must be worn if the sound emission level exceeds 85 dB(A).

It is not permitted to tow a pump unit fitted with wheels and a tow bar on public roads. These features are only intended for moving the pump unit within the site.

3.3 Safety instructions – pump

Do not exceed the limit values of the pump curves. See the specification sheet for the pump concerned.

Make sure that hot/cold and rotating parts of the pump are shielded adequately to prevent unintentional contact.

It is not permitted to start the pump if such guards are missing or damaged.

The company management must ensure that everyone who works with/on the pump or pump installation is aware of the type of liquid that is being pumped. These persons must know what measures are to be taken in the event of leakage.

Dispose of any liquids that have leaked, in a responsible manner. Observe local regulations.

If pumping liquids with a temperature of 70 °C (158 °F) or higher, the hot surfaces of the pump and piping must be shielded.

Apply 'hot surface' warning symbols.

If volatile and/or hazardous liquids are being pumped, the hazards of these substances must be taken into consideration when performing work on the pump or pump installation. Make use of personal protective equipment and provide sufficient ventilation.

Never allow a pump unit with a drive power in excess of 11 kW (14.7 hp) to run with a blocked pressure line. The heat build-up could lead to an explosion.



WARNING

It is not permitted to pump volatile or hazardous substances with BA series pumps. Contact BBA Pumps if you wish to pump such liquids.

3.4 Safety instructions – electrically driven pump unit

The electrical system must be in compliance with the regulations of the local electricity producer and the EN 60204-1 standard.

The electrical system to which the pump unit is connected must be equipped with a reliable safety circuit.

If the electrical system is deficient in any way, the pump unit may not be started.

3.5 Safety instructions – diesel engine driven pump unit

Never run the engine in an enclosed space.

Provide a proper gas-tight discharge for exhaust gases.

Provide sufficient ventilation.

Never fill the fuel tank while the engine is running.

Wear hearing protection while in the vicinity of a running engine.



DANGER

Exhaust gases contain carbon monoxide.

Carbon monoxide is a colourless, odourless and deadly gas which, when inhaled, prevents the body from absorbing oxygen, resulting in asphyxiation. Severe carbon monoxide poisoning can result in brain damage or death.

3.6 Safety instructions – during maintenance and repair

Work may only be performed on the pump or pump unit when the pump or pump unit has been put out of operation.

Follow the procedure described in this manual to put the pump or pump installation out of operation.

Make sure all pressure within the pump or pump unit has been relieved before beginning the work.

When opening the pump follow all the instructions for handling the pumped liquid, such as those concerning protective clothing, safety goggles, no smoking, etc.

Consult the Material Safety Data Sheet (MSDS) for the pumped liquid.

If the pump or pump unit is being used to pump a hazardous liquid, it must first be cleaned and neutralised.

Protect the drive motor against unintended and unauthorised activation throughout the duration of the work activities.

Maintenance work on the electrical system may only commence after the power supply has been disconnected and may only be performed by personnel who have been trained and authorised to do so.

In the interest of safety, only use parts purchased from or approved by the supplier.

Modifications to the pump or pump installation or the application are only permitted after consultation with the suppliers. The reliability of the pump or pump unit can only be guaranteed when the pump is used for the application and in the manner for which it is intended, as specified at the time of delivery.

When the work is complete, all the safety provisions and protective measures must be reinstalled and made operative.

Review the operating instructions before restarting the pump or pump unit.

3.7 Training and knowledge level of personnel

The company management must ensure that all the maintenance, inspection and installation work is performed by authorised and qualified personnel who possess the required level of knowledge concerning the BBA pump.

The responsibilities of the concerned personnel and the personnel responsible for their supervision must be explicitly defined by the company management. If the personnel have insufficient knowledge, the company management must arrange for suitable training, provided by the supplier or manufacturer of the pump.

The company management must also ensure that the content of this manual is clear to all employees who work with/on the pump.

3.8 Environmental protection

Pollution poses a serious threat to the environment. The following rules must be observed to prevent environmental pollution:

- Check the pump and the connected piping for leaks on a regular basis.
- If an external fuel tank is used, the connections and routing of the piping must be checked carefully. If the piping is connected incorrectly or is susceptible to damage (leakage), this can harm the environment.
- Do not dispose of any environmentally harmful substances in drains, sewers or on the ground. This is illegal and punishable.
- Keep environmentally harmful substances separate and submit them to a designated disposal facility for processing or destruction.
- Maintain the pump or pump unit in accordance with the instructions.

3.9 Designations on the pump or pump unit

Symbols are applied to the pump or pump installation as applicable to the specific version. Make sure these symbols are and remain legible.

4 Receiving, transport and storage

4.1 Receiving

Carefully check the pump or pump unit upon receipt for any damage that may have occurred during transport. Check whether the shipment matches the bill of lading.

Report any damage or incomplete shipment to the transporter straight away. The transporter must immediately note this on the shipping documentation.

4.2 Transport



WARNING

Only use certified lifting equipment with an adequate lifting capacity and always lift from directly above. Lifting from an angle can lead to dangerous situations.

Lifting work may only be performed by appropriately authorised personnel.

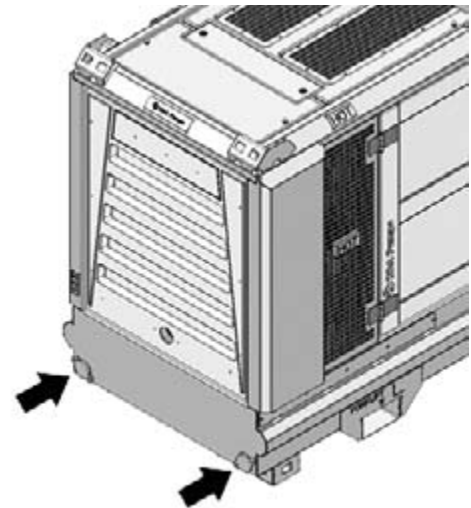
Because many different versions of the pump or pump installation are available, only general instructions are provided. See the specification sheet for the particular pump or pump installation for the weight and dimensions.

Note

Contact BBA Pumps if you have any questions or concerns.

To prevent liquids from leaking and causing dangerous situations during transport of the pump or pump unit, the following precautionary measures must be taken:

- Disconnect the suction and pressure pipes from the pump.
- If an external fuel tank was used, the fuel lines from the external tank must be disconnected. Take necessary measures to capture any draining fuel.
- Drain any liquid that is present in the pump or pump unit.
- Flush the pump or pump unit.
- Drain the drip tray under the tank via the drain plugs.

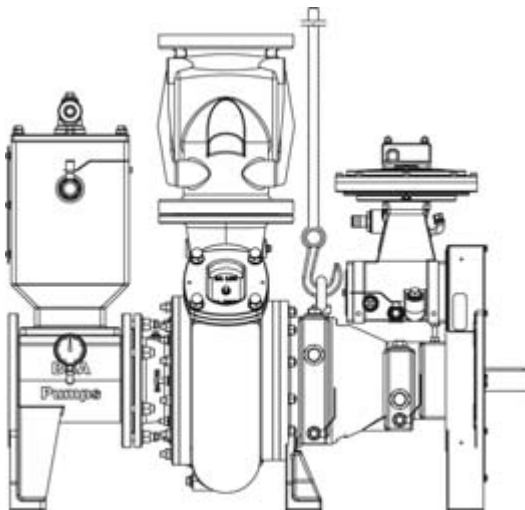


4.3 Lifting instructions for pump only

**DANGER**

It is prohibited for persons to be under a raised load.

- Always use a lifting yoke.
- Attach a lifting eye to the top of the bearing housing (see figure).
- Raise the pump carefully until it is just above the floor. Check whether the pump is hanging horizontally.

**WARNING**

Neither the lifting eye on the engine nor the lifting eye of the pump may be used for transport of the pump or pump unit.

4.4 Lifting instructions for pump unit

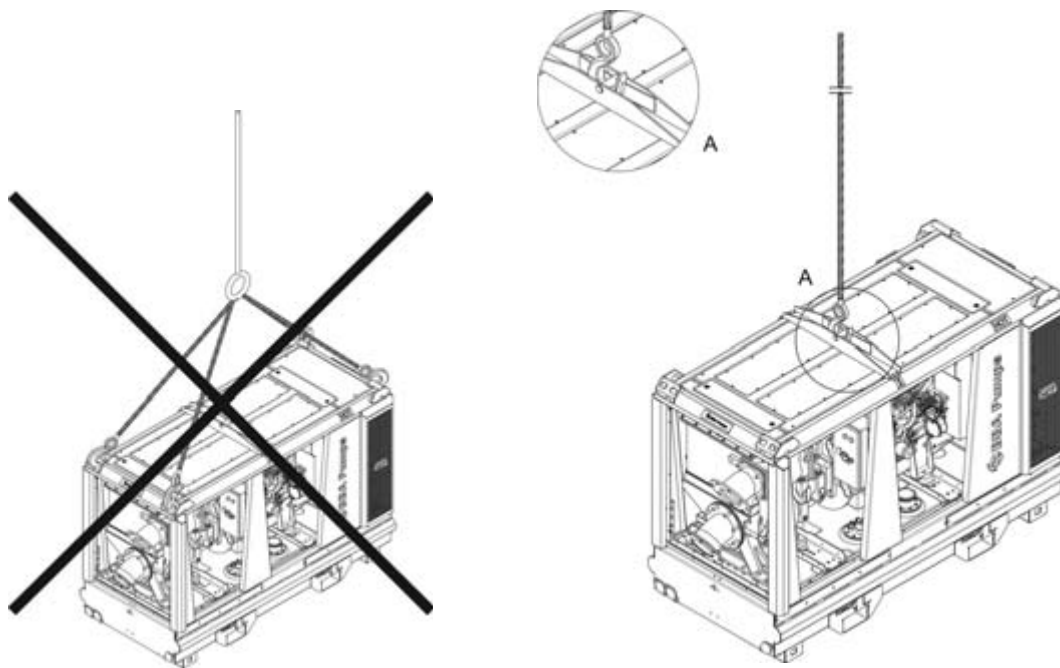


DANGER

Never walk under a raised load. This can result in a life-threatening situation.

Pump unit in enclosure

There is a lifting eye located on the top of the enclosure.
Only lift the unit from this lifting eye



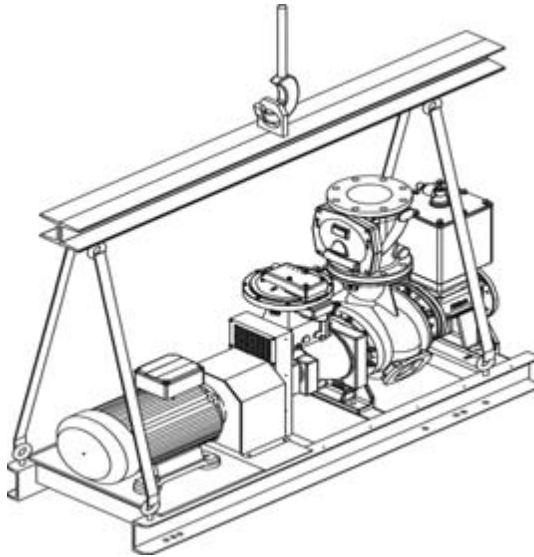
Pump unit on frame

- Attach lifting eyes to the corners of the frame.
- Connect a lifting beam with lifting straps to the lifting eyes.
- Raise the pump carefully until it is just above the floor. Check whether the pump is hanging horizontally.



WARNING

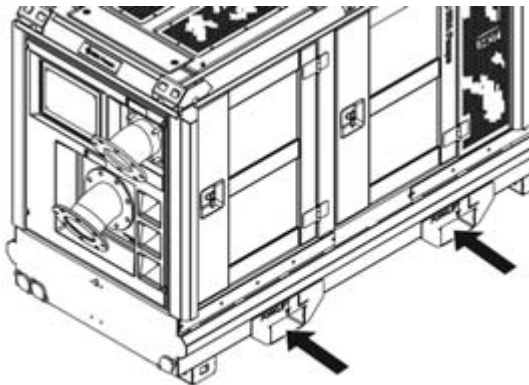
Neither the lifting eye on the engine nor the lifting eye of the pump may be used for transport of the pump or pump unit.



4.5 Moving the pump unit with a forklift

Forklift pockets (if present) can be used for moving the pump unit with a forklift.

The forks of the forklift must be inserted into these pockets to lift the pump unit.

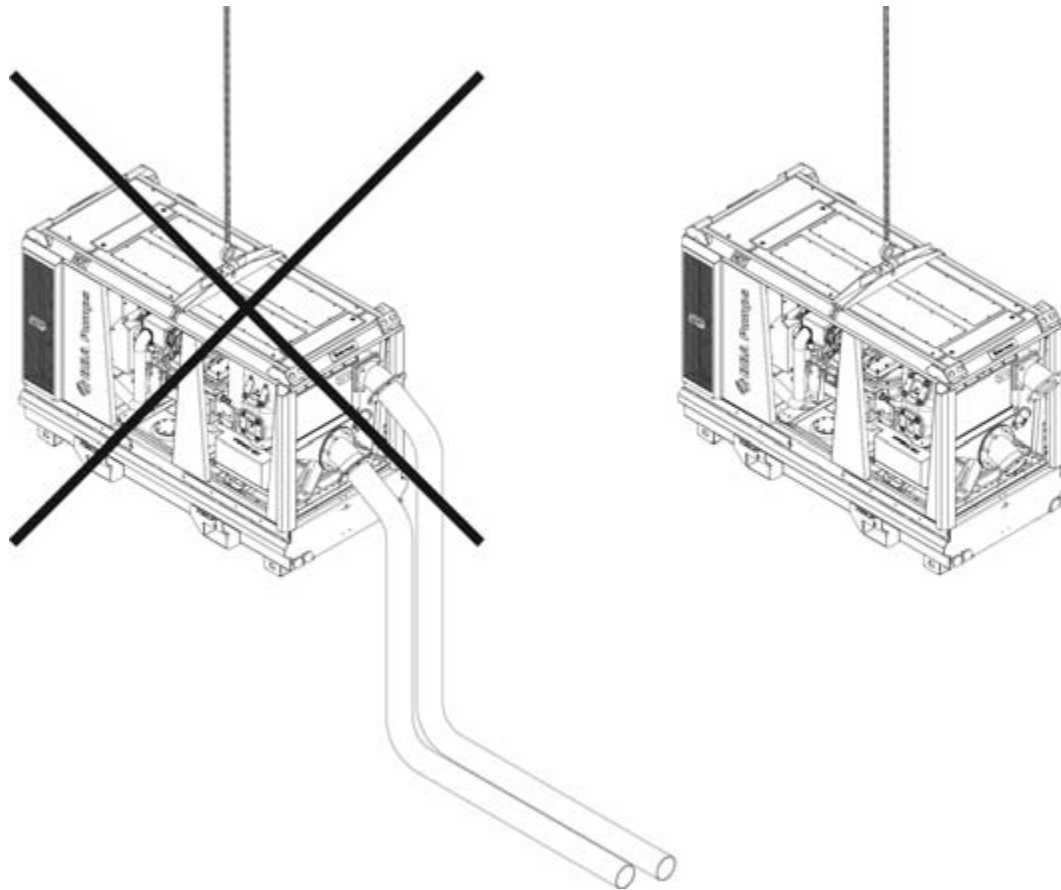


It is not permitted to move the pump unit with a forklift if no forklift pockets are provided in the bottom of the frame.



WARNING

Always disconnect all connections before moving the pump unit.



4.6 Storage/preservation 6-12 months

When pumps are shipped they may be coated with a preservation agent. This remains effective for 6-12 months.

The pump must be stored in a covered, well-ventilated area. Temperatures below freezing and high humidity must be avoided.

Note

During storage, manually turn the driveshaft one complete revolution each week.



WARNING

The pump units may be stacked for storage purposes. Do not stack pump units more than two high.

4.7 Storage longer than 6-12 months

For storage longer than 6-12 months, take the following measures:

1. Apply a layer of preservation agent to all unpainted parts and rotating parts.
2. Seal the suction flange liquid-tight.
3. Seal the connection for flushing, circulation or cooling (if present).

Note

The type of preservation agent to be used depends on the materials and the application. Consult BBA Pumps for the correct preservation agent.

4. Fill the pump with preservation agent.
5. Slowly rotate the driveshaft one revolution by hand.
6. Seal the pressure flange liquid-tight.



WARNING

The pump units may be stacked for storage purposes. Do not stack pump units more than two high.

4.8 Inspection during storage

1. Make sure the pump units are not stacked more than two high (if applicable).
2. Check the level of the preservation agent once every three months. Top off the preservation agent if necessary.
3. Slowly rotate the driveshaft one revolution by hand.

4.9 Transport of pump with preservation agent

Prior to transport, check the pump for leakage of preservation agent.



WARNING

Leakage of preservation agent can cause the floor to become dangerously slippery and may lead to preservation agent entering the environment.

4.10 Removal of preservation agent

Mineral-based lubrication oil is used as the preservation agent.

Drain the preservation agent before putting the machine in operation.

If the preservation agent is detrimental to the pumped liquid, flush the pump thoroughly.

1. Drain the preservation agent. Capture the liquid. See chapter 10.
2. Flush the pump thoroughly. Capture the liquid.
3. Fit the cleaning cover and the drain plugs.
4. Dispose of the preservation agent and flushing liquid in a responsible manner.

Note

If preservation agent is to be applied again, do not reuse the old preservation agent.

5 Pump unit installation

5.1 Placement – general

Note

Instructions for connecting the drive system to a separate pump are provided in the installation instructions.



WARNING

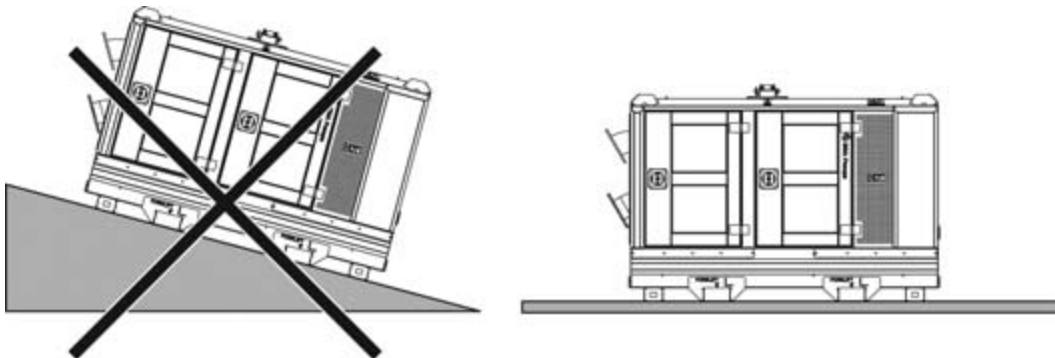
Failure to follow the guidelines for the placement and installation of the pump unit can result in danger to the user and/or severe damage to the pump or pump unit.

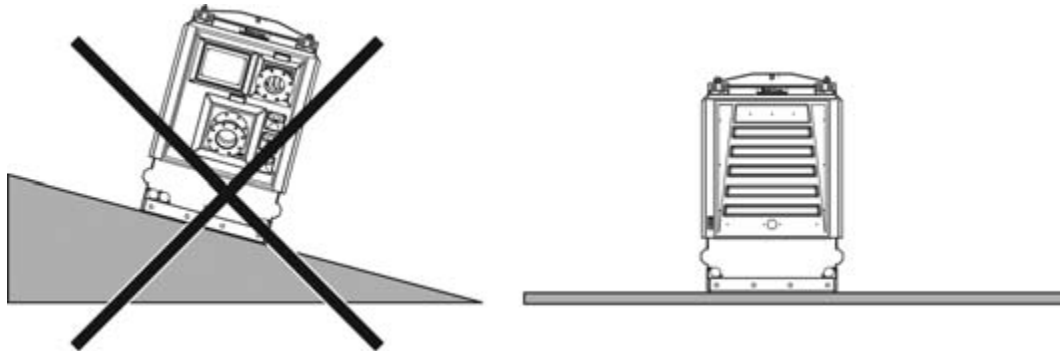
BBA Pumps is not responsible for accidents and damage that result from failure to follow the guidelines in this manual. Such use results in forfeiture of the right to assert any warranty or damage compensation claims.

Note

Because many different versions of the pump unit are available, only general instructions are provided. See the specification sheet for the particular pump unit for technical data. Contact BBA Pumps if you have any questions or concerns.

- Place the pump unit on a flat surface capable of supporting the load.





- Make sure the pump unit is placed in such a manner that it is not subjected to any distorting forces.
- Make sure there is sufficient space around the pump unit for operation and maintenance activities.



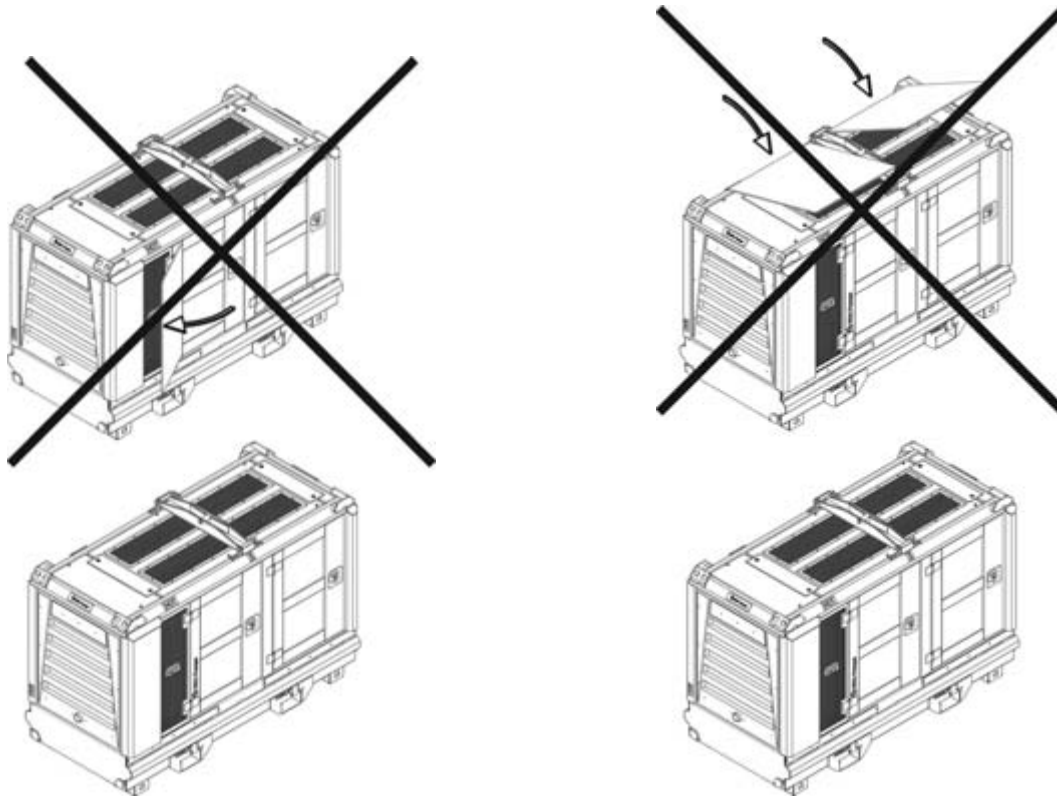
WARNING

Make sure the top of the pump unit is not covered. This is important because the diesel engine driven pump unit draws in fresh air from the top.



WARNING

Make sure the front and sides of the pump unit are not covered. This is important because the diesel engine driven pump unit expels heat on these sides. See figures.



- Install shields to prevent contact with hot surfaces > 70 °C (158 °F). Affix warning symbols where necessary.
- If the pump and motor are provided separately, check the alignment after installation.
- When pumping hot liquids make sure there is sufficient air circulation to prevent bearings and lubricants from overheating.
- Connect an electrically driven pump unit in conformance with local regulations. The cables must be dimensioned in accordance with the specifications.
- For placement of an electrically driven pump unit, see also chapter 8 'Pump unit with electric drive'.
- For placement of a diesel engine driven pump unit, see also chapter 9 'Pump unit with Perkins diesel engine drive'.
- Install the prescribed safeguard(s) in the correct manner.
The pump unit can be fitted with safeguards for the following parameters:
 - temperature
 - overpressure
 - under pressure
 - direction of rotation
 - oil level
 - overload

5.2 Outdoor use

The pump or pump unit may only be placed outdoors if the construction of the pump or pump unit allows this.

In addition to the general instructions, the following additional requirements must be met:

- The pump unit must be designed for outdoor use. Pay attention to the protection class of the pump unit.
- Make sure there is sufficient free space around the cooling air inlet so the engine is able to draw as much cooling air as it needs.
- Make sure there is sufficient free space around the hot air outlet. Maintain at least 2 m (6.6 ft) of clearance.
- Avoid dusty conditions and locations where corrosion or erosion can occur.
- In the case of electric drive: do not exceed the ratings of the electric motor in terms of insulation class and protection class.
- In the case of an electric motor not supplied by BBA Pumps, follow the guidelines provided with the motor.

5.3 Indoor use

In addition to the general instructions, the following additional requirements must be met:

- Make sure the area has adequate ventilation.
- Make sure there is sufficient free space around the cooling air inlet so the motor is able to draw as much cooling air as it needs.
- Prevent high ambient temperature and humidity.
- Avoid dusty conditions and locations where corrosion or erosion can occur.
- In the case of electric drive: do not exceed the ratings of the electric motor in terms of insulation class and protection class.
- In the case of a motor not supplied by BBA Pumps, follow the guidelines provided with the motor.

5.4 Placement in an area with a potentially flammable or explosive atmosphere

The standard pump unit is not suitable for placement in a potentially flammable or explosive atmosphere. In some cases, after consultation with BBA Pumps and implementation of the prescribed measures, written approval may be provided by BBA Pumps for use of the pump or pump unit in the specified situation.



DANGER

Failure to follow the guidelines for use of the pump unit in a potentially flammable or explosive atmosphere can create an extremely dangerous situation.

5.5 Piping guidelines – general

The piping must comply with the following guidelines:

- Select the diameter and length of the suction and pressure pipes as well as those of any additional components such that the inlet pressure remains above the minimum allowable value. The operating pressure must not exceed the maximum allowable value.
The power rating of the installed drive system must be sufficient. NPSH graphs are available on request.
- The diameters of the pipes must be equal to or greater than the connection sizes on the pump.
- See the specification sheet for the particular pump or pump installation to obtain the prescribed pipe diameters.
- If possible, the transition between various pipe diameters must be made with a transition angle of approx. 8 degrees.
- The pipe must be properly aligned with the pump connection.
- It must be possible to connect the flanges of the pipes and pump together without putting any of the parts under stress.
- In the case of vibration and/or hot liquids, install expansion elements in the pipes.
- Support the pipes directly in front of the pump. The weight of the pipes and fittings may not be supported by the pump.
- Install shut-off valves in the suction and pressure pipes as close as possible to the connection flanges in order to allow isolation of the pump for maintenance and repair work. The shut-off valves must be of a type that allows straight-line flow, such as gate or globe valves. The internal diameter of the shut-off valve must be the same as that of the pipe.
- If there is a possibility that a backflow of liquid could cause the pump to turn in the opposite direction when stopped, a non-return valve must be placed in the piping to prevent this.
- Install measurement instruments in the piping for monitoring during operation.
- If applicable, connect the pump unit to a suitable safety system. This is left to the judgement of the designer of the installation.
- Insulate or shield hot pipes.
- Observe specific regulations that pertain to the suction and pressure pipes.
- Thoroughly clean all parts that come into contact with the transported liquid before putting the pump unit in operation.

Note

When pumping viscous liquids, there can be significant pressure losses in the suction and pressure pipes. Components placed in the piping system, such as shut-off valves, bends, suction strainers, filters and foot valves, will make the pressure losses greater.



WARNING

The designer of the installation that includes the pump unit is responsible for installing the pump unit correctly.

Failure to follow the guidelines can result in an excessive load on the pump unit and/or piping, which can cause severe damage to the pump unit and/or piping.

Possible leakage of liquid can lead to a dangerous situation.

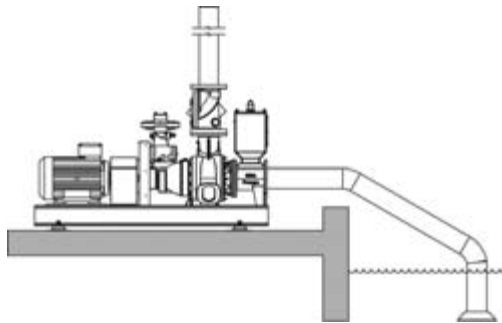
**WARNING**

The designer of the installation that includes the pump unit is responsible for taking the necessary measures to prevent an internal explosion and, in the event an internal explosion nevertheless occurs, to stop it and limit the consequences.

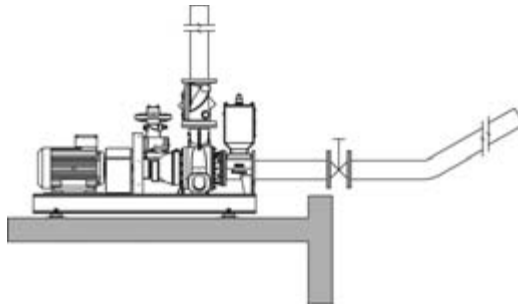
5.6 Suction pipe

The suction pipe must meet the following requirements:

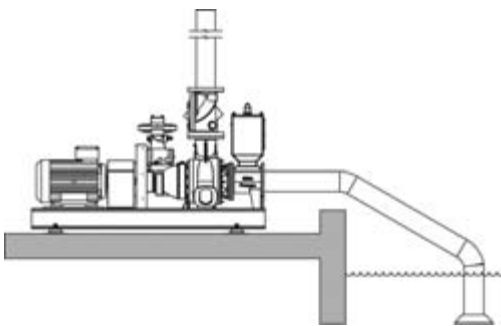
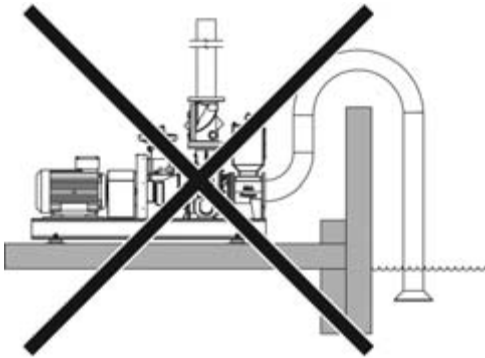
- Place the pump or pump unit as close as possible to the pumped liquid.
- The pipe must be as short as possible.
- Run the pipe so it slopes upwards toward the pump to prevent the formation of air pockets.



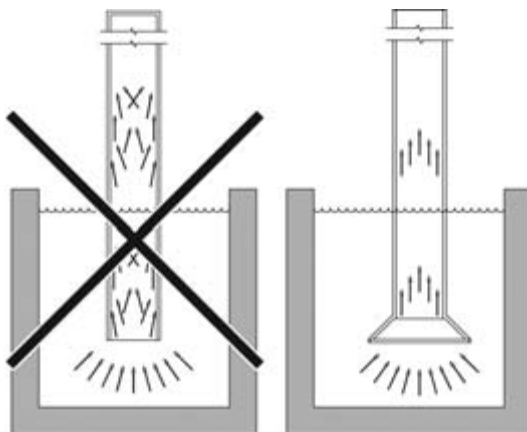
- If the pipe tapers, the pipe must slope downwards toward the pump. Place a shut-off valve between the float chamber and MP to prevent overpressure on the MP.



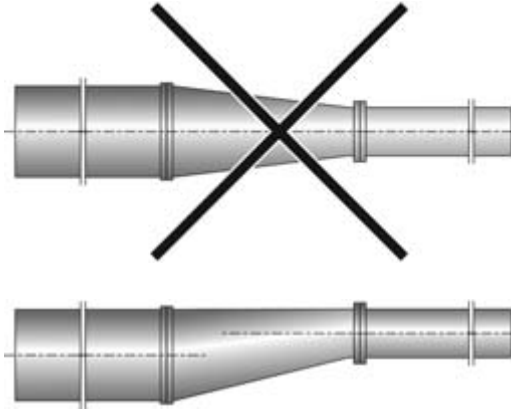
- Lay the pipe so as to prevent the formation of air pockets.



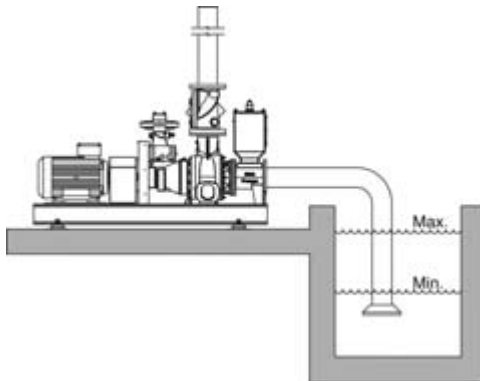
- Use the least possible number of bends.
- Bends must have the largest possible radius.
- The pipe system must be completely airtight.
- In the case of a non-self-priming pump, in which the liquid does not flow towards the pump, install a foot valve with a sufficiently large flow capacity.
- In the case of polluted liquids, always install a suction strainer or solids separation screen with a sufficiently large net opening area. The filtration particle size of the suction strainer must be equal to or less than the solids handling specification of the pump.



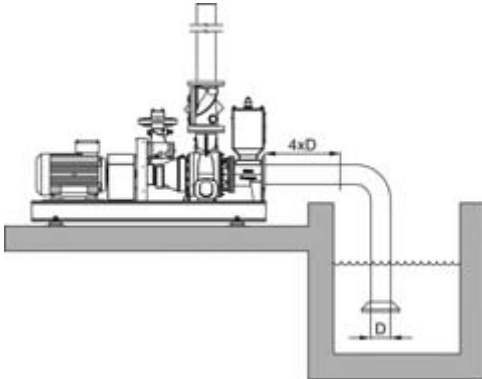
- When there is a change of diameter in the piping, use an eccentric reducer to prevent the accumulation of air.



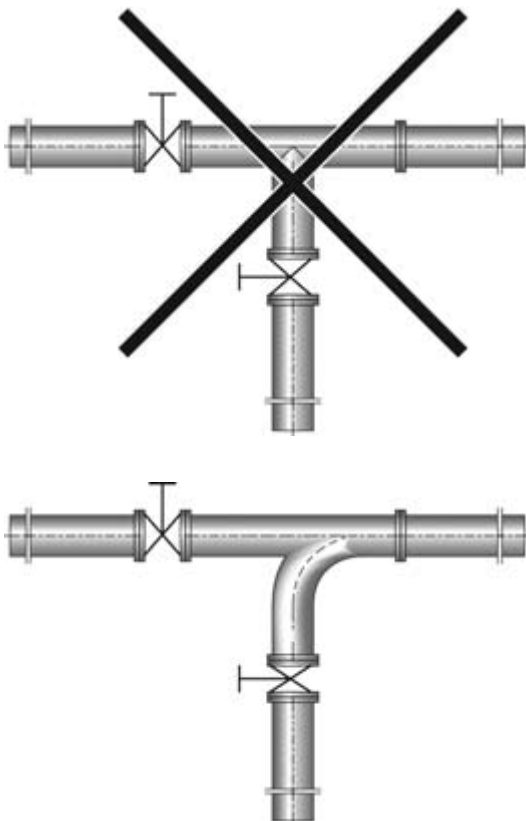
- Make sure that the liquid intake will remain sufficiently submerged beneath the liquid surface so no air will be drawn in even when the liquid is at its lowest level.



- Make sure the length of the pipe between a bend and the pump is at least four times the diameter of the pipe, especially when there is little margin between the available and required NPSH. A bend prevents the smooth inflow of liquid to the pump impeller and can have a negative impact on the suction conditions.



- When a T-junction is installed, use one with an inflow bend.



Note

In the case of self-priming pumps fitted with a separate suction bend, this bend must never be removed or rotated.

- For liquids with a low viscosity, either install a foot valve with a diameter equal to or greater than that of the suction valve or install the piping without a foot valve in a U-configuration (see technical specifications BA series).
- Do not install a foot valve when pumping high viscosity liquids. The foot valve causes extra pipe losses.
- To eliminate any air or gases present in the pump or suction pipe, the pressure pipe can be fitted with a bypass line.
The use of a bypass line will eliminate air from the pump more quickly. See also 'Pressure pipe'.
- In some situations the temperature of the liquid may be so high that the pump requires pre-pressure relative to the NPSH in the line (see technical specifications BA series).



WARNING

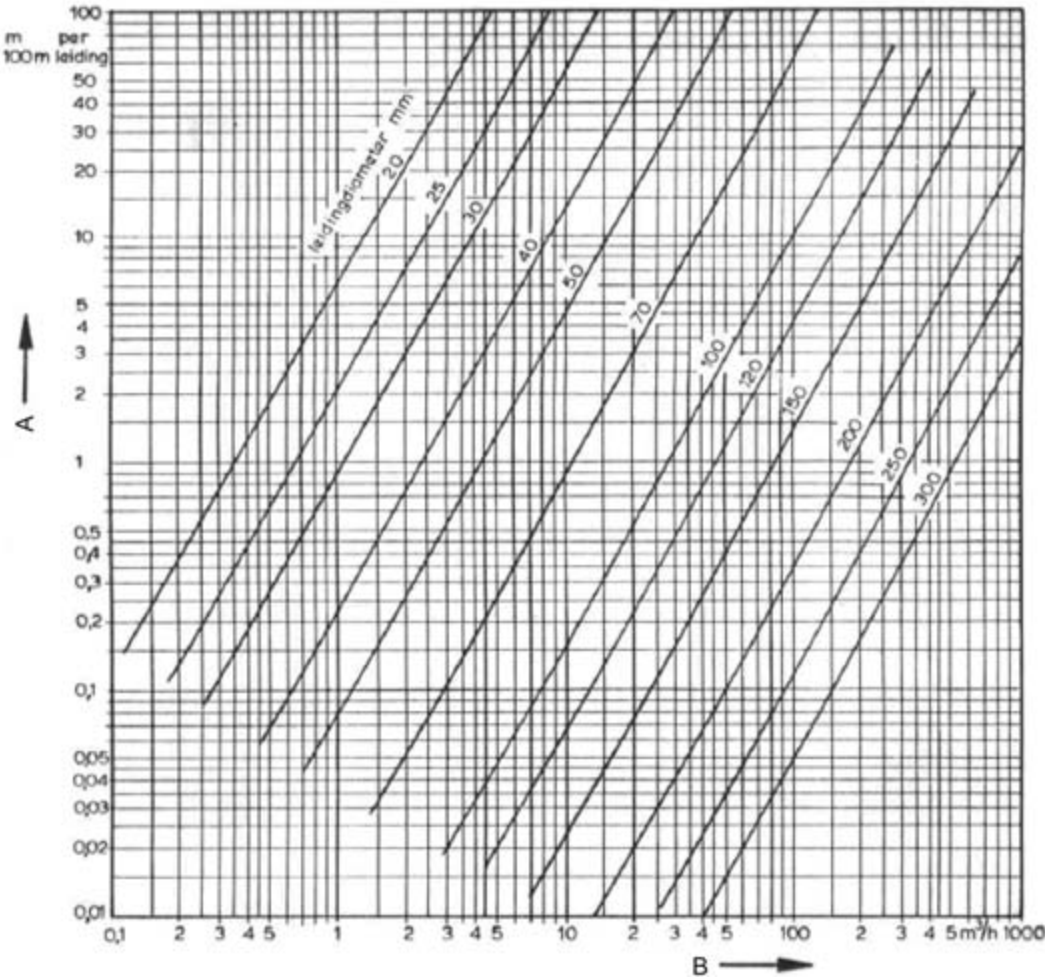
In all cases in which pre-pressure is desired you must contact BBA Pumps for advice. Pre-pressure may not be employed without written permission from BBA Pumps.



WARNING

Piping with an inadequate diameter, an excessively long suction pipe or a clogged suction strainer can cause the pipe losses to increase to the point that the available NPSH (NPSHa) falls below the required NPSH (NPSHr). This results in cavitation of the pump. This is damaging to the pump and has a negative impact on the operation of the pump unit.

- Piping causes a resistance. This is referred to as 'piping resistance'. This is shown in the table below. Nomogram for the calculation of the piping resistances, valid for liquids with a viscosity of 1 cSt (e.g. water).



A: Piping resistance
B: Volume flow

- The fittings that are used also have resistance. The table below shows the resistance of the fittings converted to the equivalent length of straight pipe (smooth steel pipe).

Internal pipe diameter	Resistance in:					
	Bends		Tee	Shut-offs		Non-return valve
	90°	45°		Gate	Globe	
mm	m	m	m	m	m	m
20	0.6	0.3	1.5	0.15	7.5	2.0
25	0.7	0.4	1.8	0.2	8.7	2.2
30	0.8	0.45	2.1	0.25	10.0	2.7
40	1.0	0.6	2.7	0.3	13.5	3.4
50	1.2	0.75	3.4	0.35	17.0	4.3
70	2.0	1.0	4.7	0.5	24.0	6.0
100	2.5	1.5	6.7	0.7	34.0	8.5
120	3.0	1.8	8.0	0.85	41.0	10.0
150	3.7	2.25	10.0	1.1	51.0	12.7
200	5.0	3.0	13.5	1.4	68.0	17.0
250	6.2	3.75	16.5	1.75	85.0	21.2
300	7.5	4.5	20.0	2.1	99.5	25.5

Internal pipe diameter	Resistance in:					
	Bends		Tee	Shut-offs		Non-return valve
	90°	45°		Gate	Globe	
inch	ft	ft	ft	ft	ft	ft
0.787	1.97	0.98	4.92	0.49	24.6	6.6
0.984	2.30	1.31	5.91	0.66	28.5	7.2
1.18	2.62	1.48	6.89	0.82	32.8	8.9
1.57	3.28	1.97	8.86	0.98	44.3	11.2
1.97	3.94	2.46	11.2	1.15	55.8	14.1
2.75	6.56	3.28	15.4	1.64	78.7	19.7
3.94	8.20	4.92	22.0	2.30	112	27.9
4.72	9.84	5.91	26.2	2.79	135	32.8
5.90	12.1	7.38	32.8	3.61	167	41.7
7.87	16.4	9.84	44.3	4.59	223	55.8
9.84	20.3	12.3	54.1	5.74	279	69.6
11.8	24.6	14.8	65.6	6.89	326	83.7

- See the specification sheet for the particular pump or pump installation for the prescribed pipe diameters.
- The pipe diameter must be equal to or greater than the prescribed dimension. See the following table:

Recommended diameter of the suction pipe

Maximum flow rate in suction pipe = 4 m/s (13.28 ft/s)

m/h	US gallons	FLOW (L/sec)	2" 50	3" 75	4" 100	5" 125	6" 150	8" 200	10" 250	12" 300	14" 350	16" 400	18" 450	20" 500
7.2	31.7	2	1.02	0.45	0.25	0.16	0.11	0.06	0.04	0.03	0.02	0.02	0.01	0.01
14.4	63.4	4	2.04	0.91	0.51	0.33	0.23	0.13	0.08	0.06	0.04	0.03	0.03	0.02
21.6	95.1	6	3.06	1.36	0.76	0.49	0.34	0.19	0.12	0.08	0.06	0.05	0.04	0.03
28.8	126.8	8	4.07	1.81	1.02	0.65	0.45	0.25	0.16	0.11	0.08	0.06	0.05	0.04
36	158.5	10	5.09	2.26	1.27	0.81	0.57	0.32	0.20	0.14	0.10	0.08	0.06	0.05
43.2	190.2	12	6.11	2.72	1.53	0.98	0.68	0.38	0.24	0.17	0.12	0.10	0.08	0.06
50.4	221.9	14	7.13	3.17	1.78	1.14	0.79	0.45	0.29	0.20	0.15	0.11	0.09	0.07
57.6	253.6	16	8.15	3.62	2.04	1.30	0.91	0.51	0.33	0.23	0.17	0.13	0.10	0.08
64.8	285.3	18	9.17	4.07	2.29	1.47	1.02	0.57	0.37	0.25	0.19	0.14	0.11	0.09
72	317	20	10.19	4.53	2.55	1.63	1.13	0.64	0.41	0.28	0.21	0.16	0.13	0.10
90	396.3	25	12.73	5.66	3.18	2.04	1.41	0.80	0.51	0.35	0.26	0.20	0.16	0.13
108	475.5	30	15.28	6.79	3.82	2.44	1.70	0.95	0.61	0.42	0.31	0.24	0.19	0.15
144	634	40	20.37	9.05	5.09	3.26	2.26	1.27	0.81	0.57	0.42	0.32	0.25	0.20
180	792.5	50	25.46	11.32	6.37	4.07	2.83	1.59	1.02	0.71	0.52	0.40	0.31	0.25
216	951	60	30.56	13.58	7.64	4.89	3.40	1.91	1.22	0.85	0.62	0.48	0.38	0.31
252	1109.5	70	35.65	15.84	8.91	5.70	3.96	2.23	1.43	0.99	0.73	0.56	0.44	0.36
288	1268	80	40.74	18.11	10.19	6.52	4.53	2.55	1.63	1.13	0.83	0.64	0.50	0.41
324	1426.5	90	45.84	20.37	11.46	7.33	5.09	2.86	1.83	1.27	0.94	0.72	0.57	0.46
360	1585	100	50.93	22.64	12.73	8.15	5.66	3.18	2.04	1.41	1.04	0.80	0.63	0.51
403.2	1775.2	112	57.04	25.35	14.26	9.13	6.34	3.57	2.28	1.58	1.16	0.89	0.70	0.57
432	1902	120	61.12	27.16	15.28	9.78	6.79	3.82	2.44	1.70	1.25	0.95	0.75	0.61
468	2060.5	130	66.21	29.34	16.55	10.59	7.36	4.14	2.65	1.84	1.35	1.03	0.82	0.66
504	2219	140	71.30	31.69	17.83	11.41	7.92	4.46	2.85	1.98	1.46	1.11	0.88	0.71
540	2337.6	150	76.39	33.95	19.10	12.22	8.49	4.77	3.06	2.12	1.56	1.19	0.94	0.76
576	2536	160	81.49	36.22	20.37	13.04	9.05	5.09	3.26	2.26	1.66	1.27	1.01	0.81
612	2694.6	170	86.58	38.48	21.65	13.85	9.62	5.41	3.46	2.41	1.77	1.35	1.07	0.87
648	2853.1	180	91.67	40.74	22.92	14.67	10.19	5.73	3.67	2.55	1.87	1.43	1.13	0.92
684	3011.6	190	96.77	43.01	24.19	15.48	10.75	6.05	3.87	2.69	1.97	1.51	1.19	0.97
720	3170.1	200	101.86	45.27	25.46	16.30	11.32	6.37	4.07	2.83	2.08	1.59	1.26	1.02
756	3328.6	210	106.95	47.53	26.74	17.11	11.88	6.68	4.28	2.97	2.18	1.67	1.32	1.07
792	3487.1	220	112.05	49.80	28.01	17.93	12.45	7.00	4.48	3.11	2.29	1.75	1.38	1.12

m/h	US gallons	FLOW (L/sec)	2" 50	3" 75	4" 100	5" 125	6" 150	8" 200	10" 250	12" 300	14" 350	16" 400	18" 450	20" 500
828	3645.6	230	117.14	52.06	29.28	18.47	13.02	7.32	4.69	3.25	2.39	1.83	1.45	1.17
864	3804.1	240	122.23	54.32	30.56	19.56	13.58	7.64	4.89	3.40	2.49	1.91	1.51	1.22
900	3962.6	250	127.32	56.59	31.83	20.37	14.15	7.96	5.09	3.54	2.60	1.99	1.57	1.27
936	4121.1	260	132.42	58.85	33.10	21.19	14.71	8.28	5.30	3.68	2.70	2.07	1.63	1.32
972	4279.6	270	137.51	61.12	34.38	22.00	15.28	8.59	5.50	3.82	2.81	2.15	1.70	1.38
1008	4438.1	280	142.60	63.38	35.65	22.82	15.84	8.91	5.70	3.96	2.91	2.23	1.76	1.43
1044	4596.6	290	147.70	65.64	36.92	23.63	16.41	9.23	5.91	4.10	3.01	2.31	1.82	1.48
1080	4755.1	300	152.79	67.91	38.20	24.45	16.98	9.55	6.11	4.24	3.12	2.39	1.89	1.53
1116	4913.6	310	157.88	70.17	39.47	25.26	17.54	9.87	6.32	4.39	3.22	2.47	1.95	1.58
1152	5072.1	320	162.97	72.43	40.74	26.08	18.11	10.19	6.52	4.53	3.33	2.55	2.01	1.63
1188	5230.6	330	168.07	74.70	42.02	26.89	18.67	10.50	6.72	4.67	3.43	2.63	2.07	1.68
1224	5389.1	340	173.16	76.96	43.29	27.71	19.24	10.82	6.93	4.81	3.53	2.71	2.14	1.73
1260	5547.6	350	178.25	79.22	44.56	28.52	19.81	11.14	7.13	4.95	3.64	2.79	2.20	1.78
1296	5706.1	360	183.35	81.49	45.84	29.34	20.37	11.46	7.33	5.09	3.74	2.86	2.26	1.83
1332	5864.6	370	188.44	83.75	47.11	30.15	20.94	11.78	7.54	5.23	3.85	2.94	2.33	1.88
1368	6023.1	380	193.53	86.01	48.38	30.97	21.50	12.10	7.74	5.38	3.95	3.02	2.39	1.94
1404	6181.6	390	198.63	88.28	49.66	31.78	22.07	12.41	7.95	5.52	4.05	3.10	2.45	1.99
1440	6340.1	400	203.72	90.54	50.93	32.59	22.64	12.73	8.15	5.66	4.16	3.18	2.52	2.04
1476	6498.6	410	208.81	92.81	52.20	33.41	23.20	13.05	8.35	5.80	4.26	3.26	2.58	2.09
1512	6657.1	420	213.90	95.07	53.48	34.22	23.77	13.37	8.56	5.94	4.37	3.34	2.64	2.14

5.7 Pressure pipe

- The designer of the installation is responsible for including the safeguards, such as protection against overpressure.
- To prevent pipe losses, use the fewest number of bends possible.
- When the pressure pipe is long or when a non-return valve is used in the pressure pipe directly after the pump, install a bypass line, fitted with a shut-off valve. Connect the bypass line to the suction line or suction point.
- To bleed air from the pump more quickly, the bypass line must be connected to the supply tank or suction point.



WARNING

Prevent sudden closure of the pressure pipe that would cause water hammer.

- If there is a danger of water hammer, install a bypass, accumulator or pressure safety valve in the pressure pipe.

5.8 Suction strainer

When pumping polluted liquid or liquid that may contain solid particles, install a suction strainer in the suction opening.

- When selecting the suction strainer, carefully consider the mesh width so pipe losses are kept to a minimum. The net opening area of the suction strainer must be at least three times the cross-sectional area of the suction pipe.
- In the case of polluted liquids, always install a suction strainer with a sufficiently large net opening area. The filtration particle size of the suction strainer must be equal to or less than the solids handling specification of the pump.
- Install the suction strainer such that maintenance and cleaning are possible.
- Make sure the liquid being drawn in has the expected viscosity and can easily flow through the suction strainer. Heat the suction strainer if necessary.
- Consult the technical specifications for the BA series for the maximum allowable particle size (solids handling capacity).

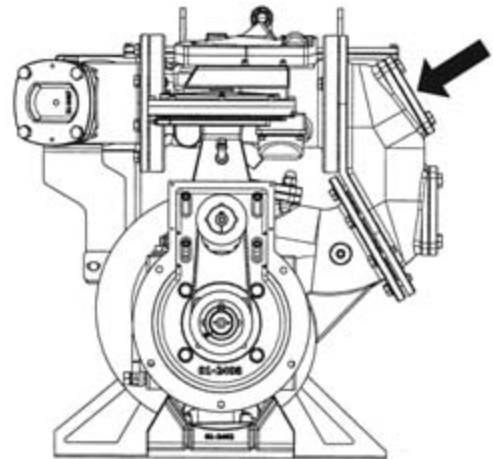
6 Pump – general

6.1 Preparation for starting the pump or pump unit

If the pump is equipped with a vacuum pump, the pump does not have to be filled with the pumped liquid.

If there is no vacuum pump present, the pump must be completely filled with the pumped liquid.

1. Make sure that a non-return valve is installed in the suction pipe.
2. Open the cover on the top of the pump.
3. Completely fill the pump with the pumped liquid.
4. Close the cover.



Note

Filling the pump simultaneously purges the air from the pump.

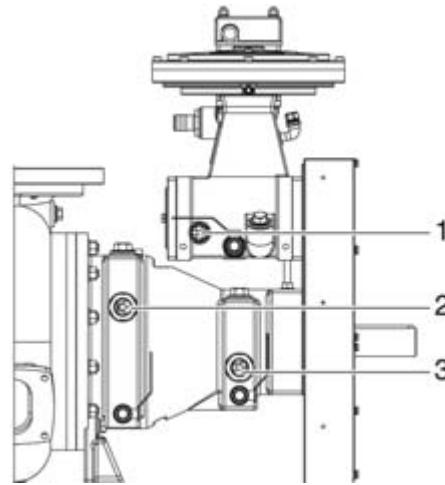
On a BA dry-prime pump, there must be as little back pressure in the pressure pipe as possible while purging air from the suction pipe ('priming') and until the pump begins to pump liquid. This allows the air in the pump unit to be purged more quickly.

6.2 Preparations for starting

Note

In the case of a separate pump, it must first be connected to the system in accordance with the instructions from BBA Pumps. For instructions, contact BBA Pumps.

1. Check the oil levels of the vacuum pump bearings (1), pump seal (2) and pump bearings (3) (see chapter 'Maintenance').
2. If applicable, the pump is now pre-heated to an adequate temperature (whether it is necessary to pre-heat the pump depends on the pumped liquid and the ambient conditions).
3. When barrier fluid is used, check: whether barrier fluid is present, has the correct pressure and can circulate freely. For more information, see the technical manual for the API Plan 54.
4. Completely open the suction and pressure shut-off valves.
5. In the case of a bypass line, open the shut-off valve in the bypass line.
6. If present: check whether the non-return valve is closed.
7. Check whether the direction of rotation of the pump matches that of the motor/engine.



6.3 Starting

The pump must be at a standstill before starting.



WARNING

A backflow of liquid must not be permitted to cause the pump to turn in the opposite direction when stopped. Such a situation can damage the mechanical shaft seals that are designed to work in one direction of rotation only.

If this situation can occur, a non-return or shut-off valve must be installed in the piping to prevent it.

1. Start the pump motor/engine.

Note

When cold-starting a diesel engine driven pump, it must initially be run at low speed. Once the diesel engine is at operating temperature, the speed can be increased to the desired rpm. This ensures that the pipes will be filled gradually and smoothly.

2. In the case of a bypass line, close the shut-off valve in the bypass line once the pump has built up pressure.
3. If the pump or pump unit is used for pumping bentonite, for example, it is also necessary to check whether the supply and return for the flush connections and barrier fluid are open.
4. Check the suction of the liquid (vacuum).



WARNING

If vibration occurs during starting, stop the pump immediately and eliminate the cause before starting again.

5. Check the speed of the pump.
6. Make sure the vacuum pump is not drawing in water via the hose connected to the float chamber.
7. Check the pressure pipe and the shaft seal for leaks.
8. Check the pump for proper operation.



DANGER

Never allow the pump to run long while the pressure shut-off valve is closed. Pumps driven by a motor/engine with a power in excess of 11 kW (14.7 hp) may never be run with a closed pressure shut-off valve. Otherwise there is a danger of explosion. Heating of the liquid beyond design limits can cause damage to the pump.

6.4 Monitoring during operation

1. During operation check the pump regularly for correct functioning, smooth and vibration-free running, abnormal noises and leaks.
2. Prevent situations in which pump runs dry for more than five minutes.
3. Under optimum conditions, mechanical shaft seals permit very little or barely visible (vaporous) leakage to pass.
4. The maximum permissible ambient temperature is 40 °C. The temperature of the bearings may not exceed 85 °C.

Note

Use for higher temperatures is only permitted after consultation with the supplier.

**WARNING**

In the event of a malfunction or incorrect functioning, stop the pump. Determine and correct the cause before restarting the pump.

6.5 Stopping

1. Switch off the drive motor. Observe whether the pump unit comes to a gradual, smooth stop.
2. If a barrier fluid or flushing liquid is being used, close the shut-off valves in the concerned lines.
3. When it is necessary to prevent the liquid from congealing or solidifying, drain the pump and the vacuum pump while the medium is still in liquid form (see chapter 10).

**WARNING**

Use the necessary personal protective equipment in the case of hot, volatile, flammable and hazardous liquids.

**WARNING**

Make sure that all the drained liquid is contained in a proper manner and disposed of in accordance with local regulations.

4. Close the pressure shut-off valve.

Note

If a non-return valve is present and sufficient back pressure remains in the pressure pipe, it is acceptable to leave the pressure shut-off valve open.

5. Close the suction shut-off valve.

**WARNING**

If there is a danger of freezing, completely drain the pump and vacuum pump (if present). Drain the liquid from the drip tray, if present.

Note

For a longer period of disuse, the pump and vacuum pump must be completely drained and preserved (see chapter 5).

6.6 Draining the pump when there is a danger of freezing

If there is a danger of freezing, a pump used to pump a liquid that may freeze must be drained (while at a standstill).

1. Place drain pans under the drain points.
2. Open the drain valves.

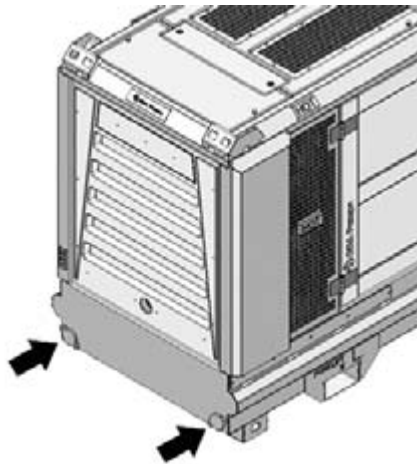


WARNING

Make sure that all the drained liquid is contained in a proper manner and disposed of in accordance with local regulations.

Do not simply allow the water to drain onto the ground, as this could cause the ground to become slippery.

3. Allow the water to drain.
4. Start the pump briefly.
5. Close the drain points.
6. Drain the drip tray of the pump unit via the drain plugs.
7. Close the drain plugs of the drip tray.



7 Pump unit with electric drive

7.1 Safety instructions

Before connecting an electric motor to the mains, consult the applicable local regulations of the power supplier and the EN 60204-1 standard.

The electrical system must be equipped with protective measures to ensure that the user can work with the installation safely at all times.

Before the electric pump is started, the pump must be filled with liquid. Dry running of the pump must be prevented at all times!

Work may only be performed on the installation when it is completely disconnected from electrical power. The installation must be protected against inadvertent starting.



WARNING

It is the employer's responsibility to ensure that the pump or pump unit safety measures (such as protection against excessive current draw) and the resulting actions (such as shut-down of the pump) are included in the safety circuit.



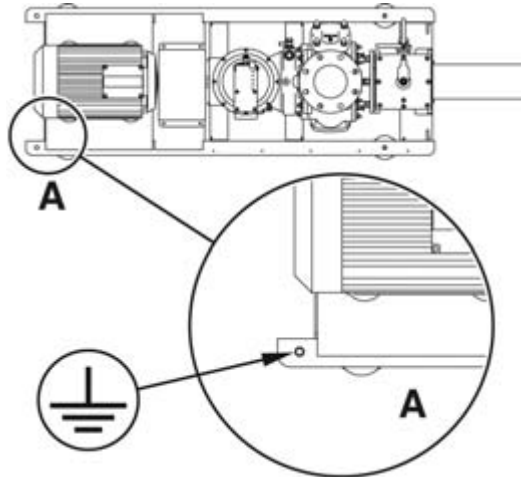
DANGER

Electrical devices, connection terminals and parts of the control system can be at mains voltage even during standstill. Contact can result in death, severe bodily injury or irreparable material damage.

7.2 Connection – general

- Take any necessary measures to ensure that the electrical connections and cables cannot be damaged.
- The voltage and frequency must be checked in advance and must match the motor specifications. This data is shown on the type plate of the motor.
- It is not permitted to use the motor without a motor protection switch.
- For frequency controlled motors, make sure there is sufficient starting torque and make sure the motor is cooled sufficiently at low speeds. Install an independently operating fan if necessary. For the wiring diagram, see technical specifications BA series.

- Establish an earth connection (A) to the pump or pump unit.



- Check whether the motor connection matches the mains voltage. See the type plate for the motor. Check the connections in the terminal box behind the control panel.

7.3 Electrical connection

Motors up to 3 kW (4 hp)

The type plate is labelled 230V/400V.

This means the winding voltage of the motor may not exceed 230V. The 400V indicates the voltage between the phases. 3x400V is three-phase electric power. This means the motor must be connected in **STAR** configuration (see technical specifications BA series).

Motors of 3 kW (4 hp) or more

The type plate is labelled 400V/690V.

This means the winding voltage of the motor may not exceed 400V. Because the maximum voltage is 400V, this motor must be connected in a **DELTA** configuration (see technical specifications BA series).

7.4 Control panel

The pump unit has a control panel that can be fitted with a built-in soft-starter. There are various types of panels for different pump units.

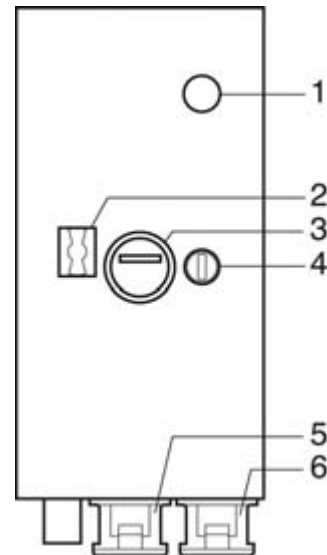
Note

The detailed manual for the soft-starter is available for download at: www.bbapumps.com/softstarter

The actual control panel may therefore differ from the illustration.

1. Malfunction indicator light
2. Control panel lock
3. Hour counter
4. Selection switch
5. Float switch connection 'low liquid level'
6. Float switch connection 'high liquid level'

- Malfunction indicator light (1) lights up in the event of a pump unit malfunction. This could result from activation of a protection circuit, for example.
- The control panel can be opened via the lock (2).
The electrical panel is located behind the control panel.



WARNING

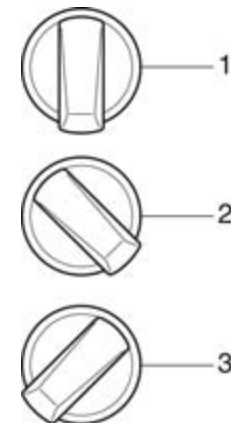
Always switch off the voltage before the control panel is opened.

- The hour counter (3) indicates how long the pump has been in operation. This hour reading is also important for determining when the pump unit requires maintenance.
- Switch (4) has three functions:
- (1) Pump unit is switched off.
- (2) Pump unit is switched on manually and runs continuously.

Note

To prevent damage to the pump it is important that the pump can draw sufficient liquid.

- (3) The pump unit is set to 'auto start'.
This means that the pump unit will switch itself on at certain times.
The activation parameters can be set by the user by means of the two float switches.
If the pump is running in 'auto start' mode, the float switches must be connected to the control panel.
Because the system is designed for delayed start-up it may take some time before the pump unit begins to run.
- Connections (5) and (6) are intended for connection of the float switches for determining the liquid level.



It is also possible to connect a pressure sensor to these connections (available as an option).

Note

The pressure switch is wired differently than the float switches, so it is not possible to use both.

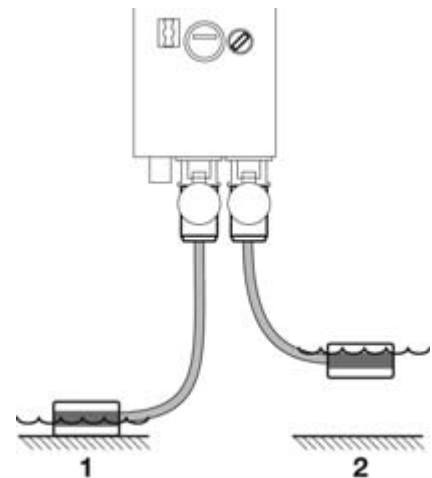
Because the pressure sensor is optional, only the standard float switches are explained.

The float switches that are used are identical. However, which float switch is used for the minimum level (1) and maximum level (2) depends on where the plug is connected on the control panel.

The float switches are made for use in water.
For use in other substances, contact BBA Pumps.

Note

When float switches are used it is important that the pump unit cycle on and off no more than four times per hour. Keep this in mind when positioning the float switches.

**WARNING**

When float switches/pressure sensors are used the pump unit may start automatically. Therefore always switch off the power when working on the pump unit.

7.5 Safeguards

Make sure that if safeguards are required they are installed and the right type of safeguard is used (see technical specifications BA series).

The installation instructions explain when a safeguard must be installed.

Examples of types of safeguards that may be required are:

- temperature
- overpressure
- under pressure
- direction of rotation
- oil level
- overload
- etc.

It is not permitted to use the motor without a motor protection switch.

To protect the motor against overload, a thermal motor protector or thermal/magnetic motor protector must be installed.

Use the nominal power rating of the motor when setting the protector.

7.6 Electric motors

It is possible that (following approval from BBA Pumps) the pump or pump unit will be used in a high-risk environment.

Examples of situations that involve high risk include:

- pumping highly flammable liquids
- dusty environment
- environment with explosive gases in the vicinity

The risk category is defined in accordance with the ATEX Directive.

It is very important that the right pump unit is chosen for such situations.

Guidelines for motor selection in ATEX zones:

Environment	Environment	T1	T2	T3	T4
Gas	3	Ex II 3G EEx-nA-II-T3	Ex II 3G EEx-nA-II-T3	Ex II 3G EEx-nA-II-T3	Ex II 2G Eex-d(e)-T4
Gas	2	Ex II 2G EEx-e-II-T3	Ex II 2G EEx-e-II-T3	Ex II 2G EEx-e-II-T3	Ex II 2G Eex-d(e)-T4
Dust	3	Ex II 3D T125 C	Ex II 3D T125 C	Ex II 3D T125 C	Ex II 3D T125 C
Dust	2	Ex II 2D T125 C Incl. PTC sensor	Ex II 2D T125 C Incl. PTC sensor	Ex II 2D T125 C Incl. PTC sensor	Ex II 2D T125 C Incl. PTC sensor

Take measures to ensure that the electrical connections and cables cannot be damaged.

The voltage and frequency must be determined in advance and match the specifications for the winding configuration of the motor.

This data is shown on the type plate of the motor.

For explosion-safe motors the data from the type plate of the motor must match the temperature class of the flammable/explosive gas/liquid.

Isolation switch

In order to be able to perform work on the pump or pump unit safely, the isolation switch must be placed as close as possible to the pump unit.

It is recommended that an earth leakage circuit breaker also be installed.

The installation must be protected against inadvertent starting. The switching equipment must comply with the local regulations.

7.7 Commissioning

Perform the following steps to commission a pump or pump unit with an electric drive:

- Check the pump type (type plate) and the characteristics of the pump unit, such as: rpm, operating pressure, power consumption, operating temperature, direction of rotation, NPSH, etc.
- Check whether the electrical system has been installed in compliance with local regulations. Also check whether the required measures have been taken to completely eliminate danger to the user.
- Check whether the motor connection matches the mains voltage.
- Check the setting of the motor protector.
- Connect the suction and pressure pipes.
- Fill and bleed the pump (only necessary if there is no vacuum system present).

7.8 Checking the direction of rotation



WARNING

This test may only be performed by personnel with the appropriate training and authorisation.

Check whether the direction of rotation of the motor matches that of the pump.

To check the direction of rotation the motor must be switched on briefly. The motor must not be allowed to reach the normal operating speed.

If the direction of rotation is incorrect, the connection must be changed in the terminal box.

7.9 Starting

Select the desired operating mode with the switch on the control panel.

– Continuous operation

Turn the switch on the control panel to the left (position 2). Due to the built in start-up delay, it may take a moment before the motor actually starts.

– Level protection

Turn the switch on the control panel to the right (position 3). The pump will cycle on and off depending on the level of the liquid being pumped.

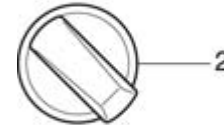
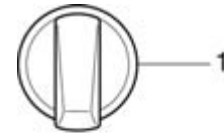
Check the level of both float switches before doing this.

Note

When float switches are used it is important that the pump unit cycle on and off no more than four times per hour. Keep this in mind when positioning the float switches.

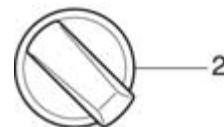
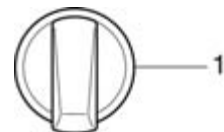
Note

The pump must always be at a complete standstill when the position of the switch is changed.



7.10 Stopping

1. Turn the switch on the control panel to position (1).
2. Observe whether the system comes to a gradual, smooth stop.
3. Perform the general steps for shutting down the pump (see chapter 7).



8 Pump unit with diesel drive

8.1 Safety instructions

- Never run the engine in an enclosed space.
- Provide a proper gas-tight discharge for exhaust gases.
- Provide sufficient ventilation.
- Never fill the fuel tank while the engine is running.
- Wear hearing protection while in the vicinity of a running engine.



WARNING

It is the employer's responsibility to ensure that the safety measures (such as protection against overload) and the resulting actions (such as shut-down of the engine) are included in the safety circuit.



DANGER

Exhaust gases contain carbon monoxide. Carbon monoxide is a colourless, odourless and deadly gas which, when inhaled, prevents the body from absorbing oxygen, resulting in asphyxiation. Severe carbon monoxide poisoning can result in brain damage or death.

8.2 Connection – general

For pump units driven by a combustion engine, the engine manual can be provided upon request. Contact the supplier of your pump unit immediately if this manual is not present.

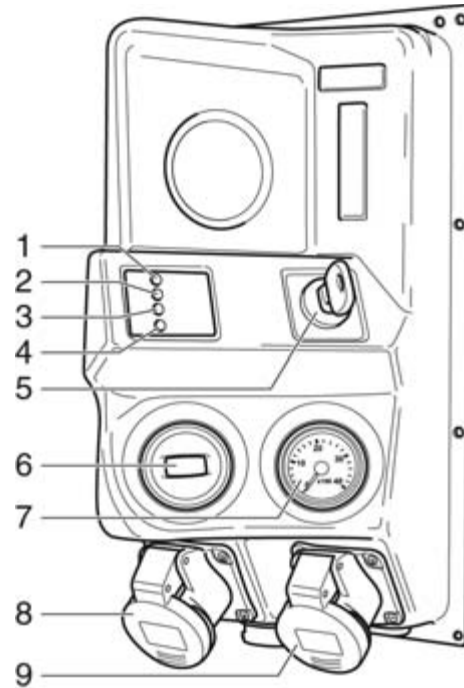
- The following instructions supersede any conflicting information found in the combustion engine manual:
- Observe all applicable local safety instructions.
- Shield the engine exhaust pipe to prevent accidental contact.
- The starting system must automatically disengage when the engine is started.
- The minimum and maximum engine speed set by BBA Pumps may not be changed.
- Before starting, check the following:
 - engine coolant level, if applicable
 - coolant leakage, if applicable
 - engine oil level
 - fuel level
 - fuel lines, for leakage

8.3 Control panel

The pump unit is equipped with an LC20 control panel.

1. Auto standby LED (green)
2. Glow plug LED (yellow)
3. Oil pressure LED (red)
4. Temperature LED (yellow)
5. Selection switch
6. Hour counter
7. RPM meter
8. Float switch connection 'low liquid level'
9. Float switch connection 'high liquid level'

- If the Auto standby LED (green) is on, the key switch is in the auto-start position and the system can be started.
- If the glow plug LED (yellow) is on, the system is being preheated. When the LED goes out the engine can be started.



WARNING

Maintenance on the electrical system may only be performed after the power supply has been disconnected.

These activities may only be performed by personnel with the appropriate training and authorisation.

- The hour counter indicates how long the pump has been in service. This hour reading is also important for determining when the pump unit requires maintenance.

– The selection switch has three functions:

(1) Pump unit is switched off.

(2) Pump unit is switched on manually.

This means that the pump unit will run continuously. To prevent damage to the pump it is important that the pump can draw sufficient liquid.

(3) The pump unit is set to 'auto start'.*

This means that the pump unit will switch itself on at certain times. The activation parameters can be set by the user by means of the two float switches.

If the pump is running in 'auto start' mode, the float switches must be connected to the control panel.

* A wireless remote control is available as an option. If the wireless remote control has been supplied, position (3) is used for the wireless remote control. The manual for the remote control is provided separately.



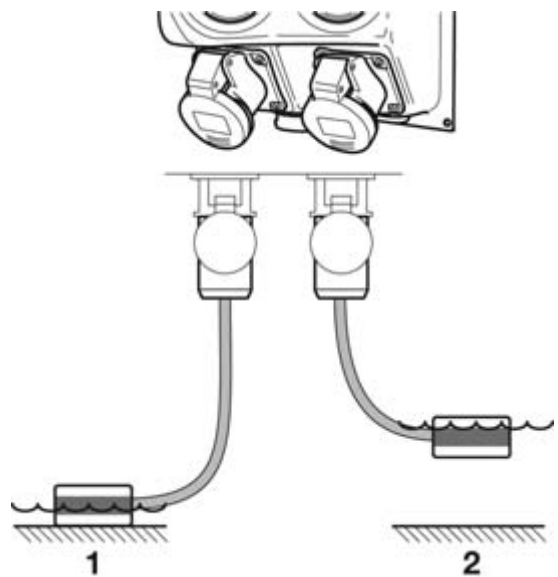
Note

Because the system is designed for delayed start-up it may take some time before the pump begins to run.

- The RPM meter shows the speed of the combustion engine. This speed can be adjusted as desired via the speed regulator.
- The float switch connections are intended to be used for connection of the float switches for determining the level.

The floats that are used are identical. Connection (9) switches on the pump unit when the maximum level (2) is reached. Connection (8) switches off the pump unit when the minimum level (1) is reached.

When float switches are used it is important that the pump unit cycle on and off no more than four times per hour. Keep this in mind when positioning the float switches.



**WARNING**

When float switches are used the pump unit may start automatically. Therefore always switch off the power when working on the pump unit.

8.4 Control panel for electronically regulated engine

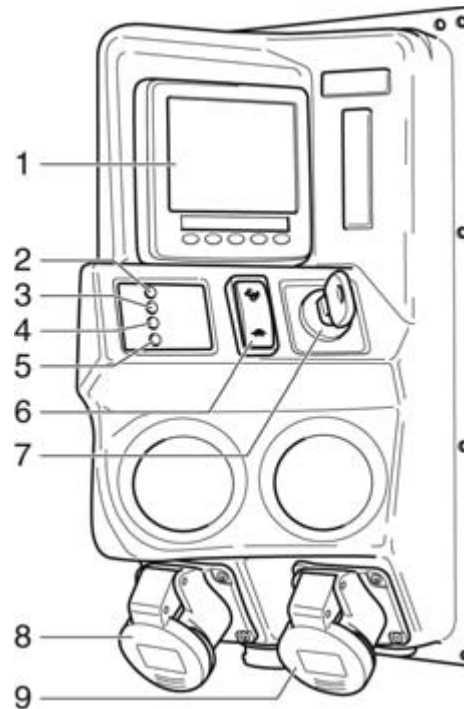
Note

The LC30 can optionally be used for a mechanically regulated engine. In that case, a number of functions on the control panel are unused.

The pump unit is equipped with an LC30 control panel.

1. LCD screen
2. Auto standby LED (green)
3. Glow plug LED (yellow)
4. Stop LED (red)
5. Warning LED (yellow)
6. Button for changing engine speed
7. Selection switch
8. Float switch connection 'low liquid level'
9. Float switch connection 'high liquid level'

- If the Auto standby LED (green) is on, the key switch is in the auto-start position and the system can be started.
- If the glow plug LED (yellow) is on, the system is being preheated. When the LED goes out the engine can be started.
- If the stop LED (yellow) is on, the ECU has stopped the engine due to a fault.
- If the warning LED (yellow) is on, the ECU has issued a warning.

**WARNING**

Maintenance on the electrical system may only be performed after the power supply has been disconnected.

These activities may only be performed by personnel with the appropriate training and authorisation.

– Selection switch, has three functions:

(1) Pump unit is switched off.

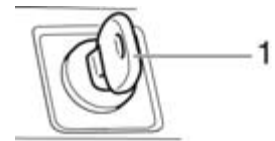
(2) Pump unit is switched on manually.

This means that the pump unit will run continuously.

To prevent damage to the pump it is important that the pump can draw sufficient liquid.

(3) The pump unit is set to 'auto start'.

This means that the pump unit will switch itself on at certain times.



These activation parameters can be set by the user by means of the two float switches.

If the pump is running in 'auto start' mode, the float switches must be connected to the control panel.

Note

Because the system is designed for delayed start-up it may take some time before the engine starts.

– It is also possible to connect a pressure sensor to the LC30 (available as an option).

Note

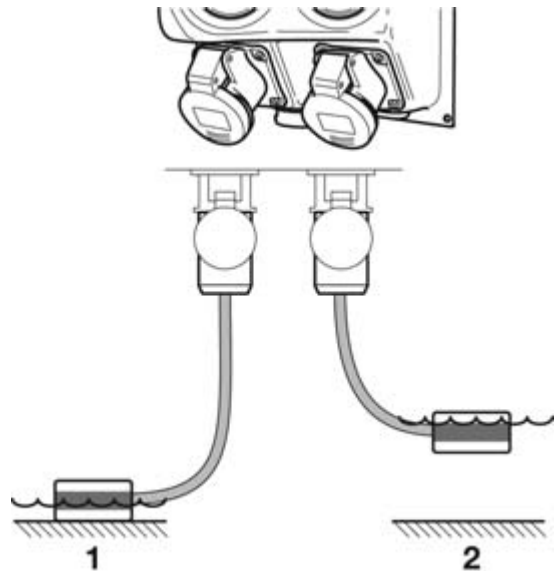
The float switches are made for use in water. For use in other liquids, contact BBA Pumps.

Note

Position the floats so the pump unit starts no more than 4 times per hour.

The two floats that are used are identical.

Connection (9) switches on the pump unit when the maximum level (2) is reached. Connection (8) switches off the pump unit when the minimum level (1) is reached.





WARNING

When float switches are used the pump unit may start automatically. Therefore always switch off the pump unit when working on the pump unit.

– Depending on the configuration of the control unit, several gauges are shown on the display.

1. Button for selecting analogue gauges (four pages of analogue gauges, 16 in total).
2. Button for selecting digital gauges (four pages of digital gauges, 16 in total).
3. Button for choosing several analogue gauges (step through all available analogue gauges).
4. Button for selecting the active alarm page. Displays all the active alarm signals, including a description.
5. Button for configuring gauges. Configures the parameters that are shown on the gauge pages.



Note

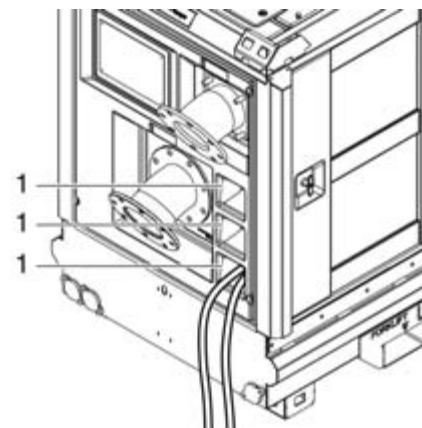
The detailed manual for the LCD screen is available for download at: www.bbapumps.com/lcd

8.5 Connection of auxiliary fuel supply (optional)

See chapter 6 for connection of the lines.

Auxiliary fuel tank (optional)

- Run the supply and return hoses into the pump unit via one of the feed-throughs (1).
- Lead both hoses to the connection points inside the housing and connect the hoses.





WARNING

Connection of the external fuel tank must be performed by the user. The user is responsible for making the connection and installing the necessary safety measures.

Check for fuel leaks after making the connections.



WARNING

Make sure that if a leak should occur no fuel can enter the pump unit.



WARNING

Leakage of fuel can be extremely harmful to the environment. Do everything necessary to prevent fuel leakage.

Note

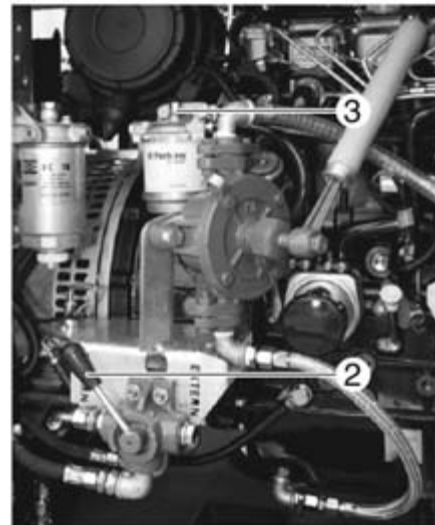
After the lines have been connected, secure them inside the housing. Take measures to prevent them from rubbing against sharp parts.

Selection handle (optional)

- Set the handle (2) to 'EXTERN' to use fuel from the external fuel tank.
- Set the handle (2) to 'INTERN' to use fuel from the internal fuel tank.

Note

If the handle is in the 'INTERN' position, the external tank does not necessarily have to be connected.

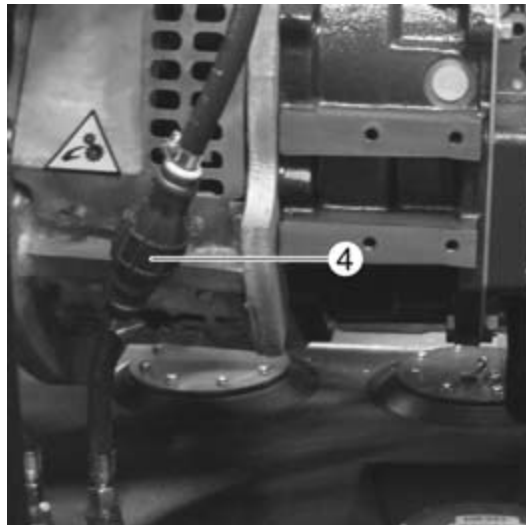
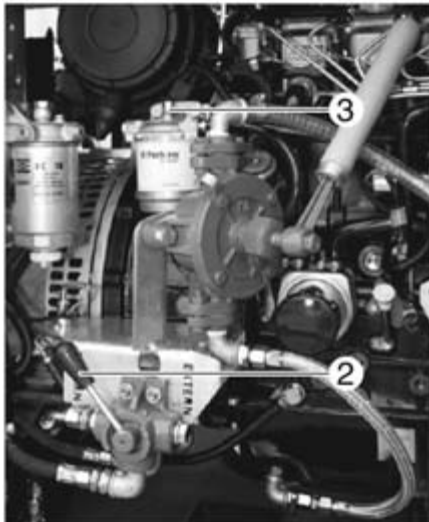


Priming the fuel system

Prime the fuel system before starting the engine for the first time, after the fuel tank has been drained completely or after replacement of the fuel filter(s).

1. Set the fuel handle (2) to the desired position (INTERN or EXTERN).
2. Make sure there is sufficient fuel in the selected tank.
3. Visually inspect the fuel lines for routing and leakage.
4. Open the bleeder screw (3).

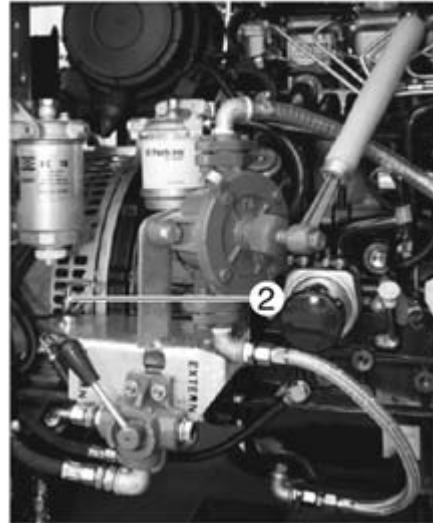
5. Squeeze the manual pump (4), if present, to pump the fuel.
The drive engine may also be equipped with a priming pump. In that case use the priming pump.
Repeat this until fuel exits the bleeder screw (3).
6. Close the bleeder screw (3).
7. Dispose of the discharged fuel.



8.6 Starting

1. Check the pump type (type plate) and the characteristics of the pump unit, such as: rpm, operating pressure, power consumption, operating temperature, direction of rotation, NPSH, etc.
2. Check whether the pump unit is placed in accordance with the instructions. Pay particular attention to the area around the pump unit. Make sure the pump unit can draw adequate fresh air.
3. Check whether the prescribed safety provisions are in place.
4. Connect the hoses (see chapter 6).
5. Fill and bleed the pump (see chapter 7).
6. Perform the daily maintenance.

7. Set the fuel selection handle in the desired position, if present.
8. Make sure there is sufficient fuel in the selected fuel tank.
9. Bleed the fuel system, if necessary.
10. Perform the general steps for starting the pump (see chapter 7).
11. Close the earth switch (2), if present.
12. Select the desired operating mode with the switch on the control panel.



Continuous operation

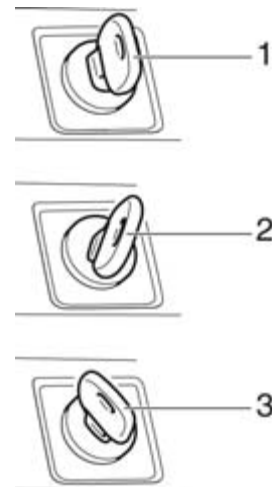
Turn the switch on the control panel to the left (position 2).
Due to the built in start-up delay, it may take a moment before the motor actually starts.

Level protection

Turn the switch on the control panel to the right (position 3).
The pump will cycle on and off depending on the level of the liquid being pumped.

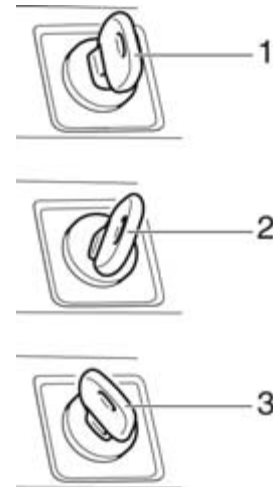
Note

The pump must always be at a complete standstill when the position of the switch is changed.



8.7 Stopping

1. Turn the switch on the control panel to position (1).
2. Observe whether the system comes to a gradual, smooth stop.
3. Perform the general steps for shutting down the pump (see chapter 7).



8.8 Diesel drive engine unit – Hatz

The following information has been reproduced from the Hatz documentation with the permission of Hatz.

Important notes on safe operation of the engine

HATZ diesel engines are economical, strongly built and long-lasting. They are therefore frequently chosen for commercially and industrially operated equipment and machinery.

Since the engine forms part of the finished equipment or machine, its manufacturer will take all the applicable safety regulations into account.

Nevertheless, we give below certain additional comments on operating safety, and would recommend you to note them carefully.

Depending on the manner in which the engine is installed and its intended application, the equipment manufacturer or operator may have to attach additional safety devices and prohibit potentially hazardous aspects of operation, for example:

- Parts of the exhaust system as well as the surface of the engine are of course hot during operation of the engine, but also when it is still cooling down after use, and must not be touched.
- Never run the engine in closed or badly ventilated rooms.
- Do not breathe in emissions - danger of poisoning!
- Also fuel and lubricants could contain poisonous components. Please follow the instructions of the mineral oil producer.
- Stop the engine before performing any maintenance, cleaning- and repair work.
- Stop the engine before refuelling.
- Never add fuel near a naked flame or a source of sparks. Don't smoke. Don't spill fuel.

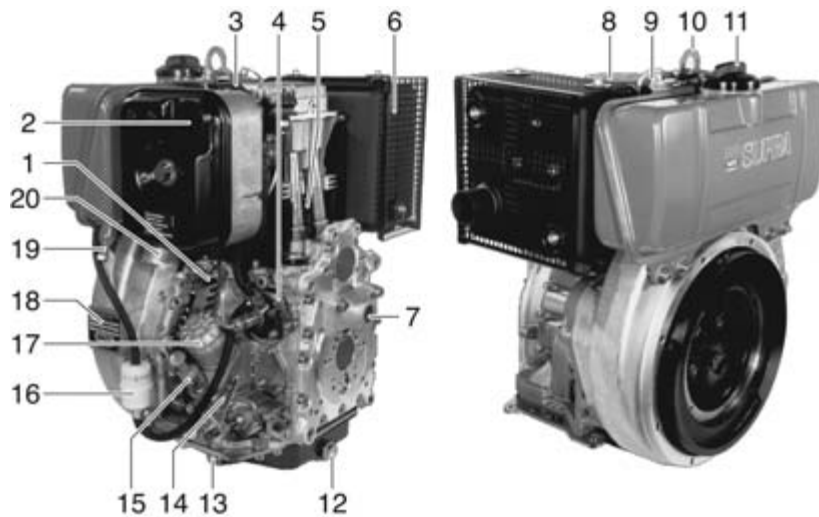
- Keep explosive materials as well as flammable materials away from the engine because the exhaust gets very hot during operation.
- Wear close-fitting clothing when working on a running engine.
- Please don't wear necklaces, bracelets or any other things which you could get caught with.
- Please pay attention to all advice- and warning stickers placed on the engine and keep them in legible condition. Contact your next HATZ service station, if a sticker comes off or is illegible and ask for a new one.
- Note that any unauthorized modification to the engine absolves its manufacturer from liability for the consequences.

Regular servicing in accordance with the details provided in this Instruction Book is essential to keep the engine operating reliably.

In case of doubt, always consult your nearest HATZ service station before starting the engine.

Description of engine

Motor 1D81Z



- | | |
|------------------------------------|-------------------------------------|
| 1 Cooling air inlet | 11 Tank filler cap |
| 2 Dry-type air cleaner | 12 Oil drain plug, governor housing |
| 3 Decompression lever | 13 Oil drain plug, governor side |
| 4 Stop lever | 14 Speed control lever |
| 5 Cooling air outlet | 15 Oil filler pipe and dipstick |
| 6 Silencer (muffler) | 16 Fuel filter |
| 7 Guide sleeve for starting handle | 17 Oil filter |
| 8 Cylinder head cover | 18 Type plate |
| 9 Cold-start oil metering device | 19 Tank drain plug |
| 10 Suspension lug | 20 Combustion air intake |

General description

Technical data

Type	1D81
Engine model	Z
Engine type	air-cooled four-stroke diesel engine
Fuel charging system	direct-fuel injection
Number of cylinders	1
Bore/stroke (mm)	100/85
Displacement (cm ³)	667
Oil capacity w/o filter, approx. (litre)	1.8 ¹⁾
with filter, approx. (litre)	1.9 ¹⁾
Difference max-min, approx. (litre)	0.9 ¹⁾
Lubric. oil consumption at full load	approx. 1% of the fuel consumption (after the running-in period)
Lubrication oil pressure	0.6 bar at 850 rpm at an oil temperature of 100 ± 20 °C
Rotation direction (at the flywheel end)	anti-clockwise
Valve clearance (10 - 30 °C)	Intake 0.10 mm Exhaust 0.20 mm
Weight (incl. fuel tank, air cleaner, exhaust silencer and electric starter)	approx. 91 kg

¹⁾ These data are approximate values. Do not fill above the **max.** mark on the oil dipstick.

Type plate

The type plate is placed on the crankcase resp. on the capsule (chapt. 2) and includes the following engine information:

1. engine type
2. code (only for special equipment)
3. engine number
4. max. engine speed

For any offer as well as spare parts orders it is necessary to mention these data (also see spare parts list, page 1).



Operation

Engine oil

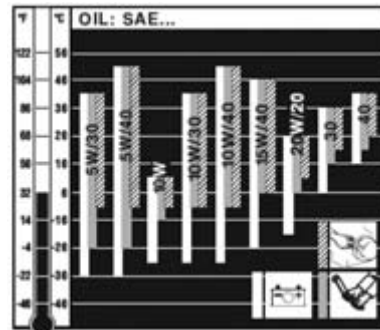
Qualified are all trademark oils which fulfil at least one of the following specifications:

ACEA - B2 / E2 or more significant **API - CD / CE / CF / CF-4 / CG-4** or more significant

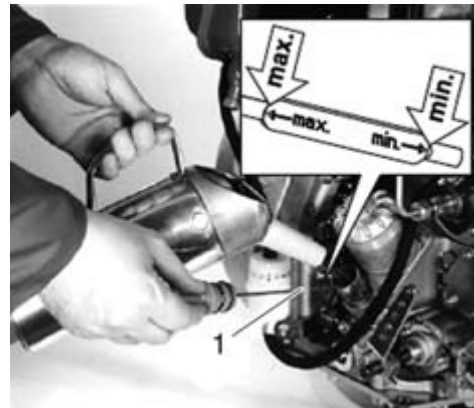
If engine oil of a poorer quality is used, reduce oil change intervals to 150 hours of operation.

Oil viscosity

- Choose a viscosity according to the ambient temperatures where the engine is to be started from cold.
- The engine must be in a horizontal position before adding oil or checking the oil level.



- Pull out dipstick „1“ and add engine oil of the correct specification and viscosity up to the „max“ mark on the dipstick; (Chapter 3.1)



Fuel



WARNING

Only refuel when engine is stopped.



WARNING

Never refuel close to open flames or flammable sparks, don't smoke. Use only pure fuel and clean replenishing cups. Don't spill the fuel.

All diesel fuels sold as fuel and complying with the following minimum specification can be used:

EN 590 or
BS 2869 A1 / A2 or
 ASTM D 975 - 1D / 2D

- If the fuel tank is not mounted on top of the engine, or is at a lower level, operate the lever on the fuel feed pump until fuel is heard to flow back to the tank through the return line.
- At temperatures below 0 °C, winter-grade fuel should be used or paraffin added to the fuel well in advance.



Lowest ambient temperature when starting, in °C	Paraffin content for:	
	Summer fuel	Winter fuel
0 up to -10	20%	-
-10 up to -15	30%	-
-15 up to -20	50%	20%
-20 up to -30	-	50%

Starting the engine



WARNING

Do not run the engine in closed or badly ventilated rooms – danger of poisoning!



WARNING

Before the engine is started, always make sure that nobody is in the danger area (moving parts on engine or machinery) and that all safety guards are in place.

Renew tubular grip if broken, worn drive pin etc.



WARNING
Never use any spray starting aids.



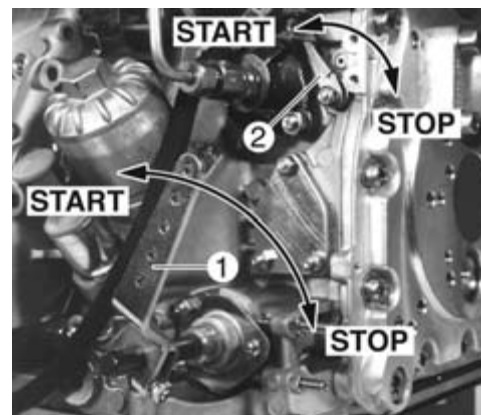
Preparations for starting

- Set speed control lever „1“ to a position between 1/2 START and max. START, according to requirements. Selecting a lower engine speed will reduce smoke when starting.
- Make sure that stop lever „2“ - if fitted - is in the operating „START“ position.

Starting

Starting procedure

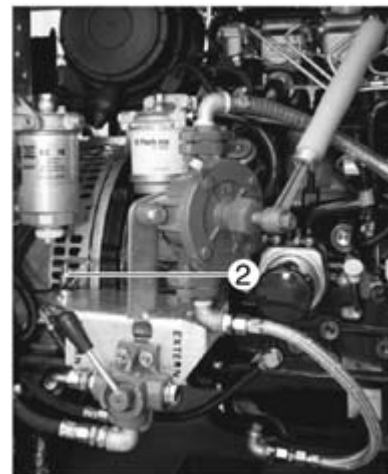
1. Perform the starting preparations.
2. Follow the starting procedure, as described in section 9.5.



WARNING
Never attempt to start a running engine.
Danger of breaking teeth off the flywheel or starter motor pinion.

Important!

If the engine is equipped with a starter motor protection module, before attempting to restart the engine you must return to **position 1** for at least eight seconds after a failed starting attempt or after the engine has been stopped.



Automatic electric shut-down (option)

A unit equipped with this option can be recognised by the fact that the indicator lights are lit briefly when the switch is placed in **position 2/3**.

Important!

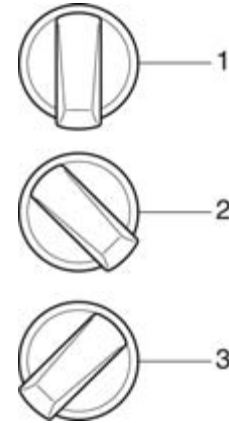
If the engine stops immediately after start-up or shuts down automatically during operation, this may indicate that the protection system is responding to a malfunction signal from the engine protection circuitry. You can recognise this situation because the indicator light on the control panel will be lit.

After the engine stops running the indicator light will remain lit for approx. 12 seconds.
Then the electrical system will switch off automatically.

If the switch is returned to **position 1** and then immediately put in **position 2/3** again, the indicator light will light up again.

Before attempting to restart the engine, first determine what is causing the problem (see chapter 11 'Troubleshooting tables').

The indicator light goes out the next time the engine is started.
Do not trust blindly in the automatic engine shut-down system; check the oil level every 8-15 hours of operation.



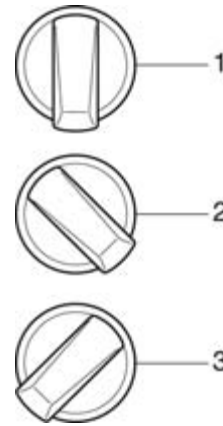
Stopping the engine



WARNING

Never stop the engine with the decompression lever. After use of the engine, protect the switchbox so the engine cannot be started by unauthorised persons.

1. Turn the switch (6) on the control panel to position 1.
2. Observe whether the system comes to a gradual, smooth stop.
3. Perform the general steps for shutting down the pump (see chapter 7).



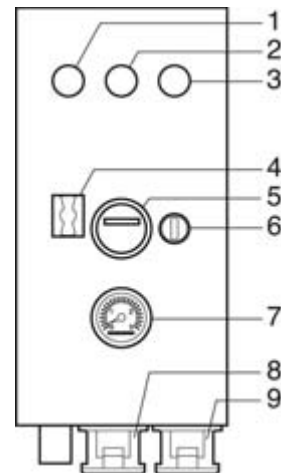
Electrical system

- The charge indicator light (2) and oil pressure light (1) light up.
- Set switch (6) to **position 1**; the indicator lights should now be off.

Note

Engines with automatic engine shut-down (section 4.2.) can be stopped by turning switch (6) back to position 1.

1. Low oil pressure light
2. Charge indicator light
3. Malfunction indicator light
4. Control panel lock
5. Hour counter
6. Selection switch
7. RPM meter
8. Float switch connection 'low liquid level'
9. Float switch connection 'high liquid level'



Maintenance



WARNING

The engine must be stopped before any maintenance work is attempted.

Comply with legal requirements when handling and disposing of old oil, filters and cleaning materials.

Keep the engine's starting key and starting handle out of reach of unauthorized persons.

To immobilize engines with an electric starter, disconnect the negative battery terminal.

At the end of the maintenance work, check that all tools have been removed from the engine and all safety guards, covers etc. replaced in their correct positions.

Before starting the engine, make sure that nobody is in the danger area (engine or driven machinery).

Maintenance overview

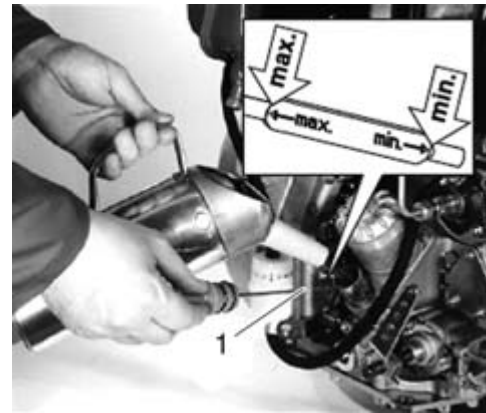
Maintenance interval	Maintenance work
Every 8-15 hours of operation or before daily starting	Check oil level
	Check air intake point
	Check the cooling air zone
	Check the water trap

Maintenance every 8-15 hours of operation

Checking the oil level

When checking the oil level, the engine should be standing level and must not be running.

- Remove any dirt in the dipstick area.
- Check oil level at the dipstick; top up, if necessary, as far as the 'max' mark (see section 4.1.1).



Checking the air intake point

Severe contamination is a sign that air cleaner maintenance intervals should be reduced.

- Check that the dust outlet on the centrifugal dust trap (depending on version) is not blocked, and clean if necessary.

Checking the cooling air zone

Severe contamination is a sign that maintenance intervals should be reduced.

- Check the air inlet and outlet zones for blockage by coarse material such as leaves, large amounts of dust, etc., and clean if necessary.
- If a temperature warning light is provided, it will come on if the engine overheats.



WARNING
If this happens, stop the engine immediately!

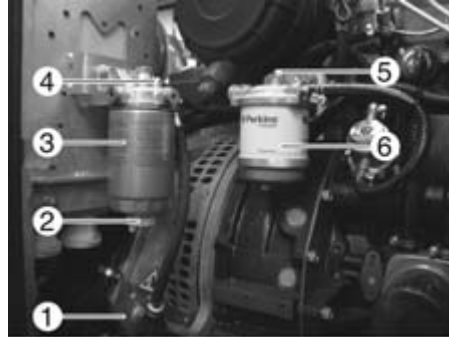
Checking the water trap

The intervals at which you should check the water trap depend entirely on the amount of water in the fuel and the care taken when refuelling.

- Loosen the bottom of the water trap approx. 2-3 rotations.
- Trap the drops which emerge in a transparent (glass) vessel.

Since water has a greater specific gravity than diesel fuel, the water emerges before the diesel fuel. The two substances separate at a clearly visible line.

- As soon as only diesel emerges from the opening, the bottom of the water separator can be tightened again.



If an external water trap is attached, check its water content every day, when the engine oil level is checked.

The water which has collected is separated at a clearly visible line from the diesel fuel above it.

Cleaning the cooling air system



WARNING

Before cleaning, the engine must be stopped and allowed to cool down.

- Remove parts of air duct.

Dry contamination

- Clean all air guide elements and the complete cooling air zones on the cylinder head, cylinder and flywheel blades without making them wet. Blow them dry with compressed air.



WARNING

Persons handling compressed air must wear protective goggles.

Moist or oily contamination

- Disconnect the battery. Clean the complete area with a solvent, cold cleaner, etc. according to its manufacturer's instructions, then spray down with a powerful water jet.
Do not splash electrical devices with water jet or pressure jet during engine cleaning.
- Trace the cause of any contamination with oil and repair the leak (or have it repaired).
- Install the previously removed air guide elements.



WARNING

The engine must never be run without the air guide elements in position.

- Immediately after re-assembly, run the engine until warm to prevent residual moisture from causing rust.

Malfunctions – Causes – Remedies

Malfunction	Possible causes	Remedial action
Engine will not start or start is delayed, although it can be turned over with the starter.	Speed control lever is in stop or idle position. Stop lever in stop position.	Set lever to „START“-position
	No fuel reaching injection pump.	Add. fuel.
	Compression too low.	See workshop manual.
	Injector not operating correctly.	See workshop manual.

Malfunction	Possible causes	Remedial action
Also applicable for engines with mechanical oil pressure monitoring.	Oil pressure lost.	Check engine oil level.
		Activate mechanical oil pressure monitor.

Malfunction	Possible causes	Remedial action
At low temperatures.	Lower starting temperature limit exceeded.	Comply with cold starting instructions. Operate preheat system (optional extra).
	Defective preheat system (optional extra).	See workshop manual.
	Fuel separates has inadequate resistance to low temperatures.	Check whether clear (not turbid) fuel emerges at the fuel line detached from the injection pump. If turbid or separated - either warm up the engine or drain the complete fuel supply system. Refuel with winter-grade fuel to which paraffin has been added.
	Starting speed too low: - Engine oil is too thick.	Refill with a different grade of engine oil.
	- Battery charge is insufficient.	Check the battery; consult a specialist workshop if necessary.

Malfunction	Possible causes	Remedial action
Starter does not run or engine is not turned over.	Fault in electrical system: - Battery and/or other wiring is wrongly connected	Check electrical system incl. indiv. components or contact a HATZ-service station.
	- Wiring connections loose and/or corroded.	
	- Battery defective and/or flat.	
	- Defective starter motor.	
	- Defective relays, monitoring elements etc.	

Malfunction	Possible causes	Remedial action
Engine fires but stops again as soon as starter is switched off.	Fuel filter blocked.	Renew the fuel filter.
	Fuel supply interrupted.	Check through the entire fuel supply systematically.
	Stop signal from monitoring element for automatic shutdown system (optional extra): - oil pressure lost.	Check oil level.
	- cylinder head temperature too high.	Clean cooling air system.
	- alternator has failed.	See workshop manual.

Malfunction	Possible causes	Remedial action	
Engine stops by itself during regular operation.	Fuel supply is interrupted: - Tank run dry.	Add fuel.	
	Fuel filter blocked.	Renew fuel filter.	
	Defective feed pump.	Check through entire fuel supply system.	
	Air in the fuel system.	Check fuel system for penetration of air. Check air vent valve.	
	Mechanical oil pressure monitor stops the engine due to low oil pressure.		Check engine oil level.
			Activate mechanical oil pressure monitor.
Mechanical defects.		See workshop manual.	

Malfunction	Possible causes	Remedial action
In addition, if automatic engine shutdown is installed.	Stop signal from monitoring element because of: - oil pressure too low.	Check engine oil level.
	- cylinder head temperature too high.	Cooling air passages blocked or cooling system otherwise affected.
	- alternator has failed.	See workshop manual.

Malfunction	Possible causes	Remedial action
Low engine power, output and speed.	Fuel supply is obstructed: - Tank run dry.	Add fuel.
	- Fuel filter blocked.	Renew fuel filter.
	- Tank venting is inadequate.	Ensure that tank is adequately vented.
	- Leaks at pipe unions.	Check threaded pipe unions for leaks.
	- Air in the fuel system.	Check fuel system for penetration of air. Check air vent valve.
	- Speed control lever does not remain in selected position.	Prevent speed control from moving.

Malfunction	Possible causes	Remedial action
Low engine power, output and speed, black exhaust smoke.	Air cleaner blocked.	Remove dirt from air cleaner.
	Incorrect valve clearances.	Adjust valve clearances.
	Malfunction at injector.	See workshop manual.

Malfunction	Possible causes	Remedial action
Engine runs very hot. Cylinder head overheat, telltale lamp (optional extra) comes on.	Too much oil in engine.	Drain off engine oil down to upper mark on dipstick.
	Inadequate cooling: - Entire cooling air system contaminated.	Clean cooling air system.
	- Inadequate sealing at air guide plates or capsule elements.	Check that air guide plates and enclosure elements are all present and make a tight seal.

Work on the electrical system



WARNING

Batteries generate explosive gases. Keep them away from naked flame and sparks which could cause them to ignite. Do not smoke.

Protect the eyes, skin and clothing against battery acid. Pour clear water over acid splashes immediately. In case of emergency call doctor.

Do not place any tools on top of the battery.

Always disconnect the negative (-) pole of the battery before working on the electric device.

- The **positive (+)** and **negative (-)** battery terminals must not be accidentally interchanged.
- When **installing the battery**, connect the **positive (+) lead** first, followed by the **negative (-) lead**. Negative pole to earth (ground) on engine block.
- When **removing the battery**, disconnect the **negative (-) lead** first, followed by the **positive (+) lead**.
- In all circumstances, **avoid short circuits** and shorts to earth (ground) at live cables.
- If electrical faults occur, first check for good contact at the **cable connections**.
- Replace a **failed indicator light** without delay.
- Do not take the key out while the engine is running.
- Never **disconnect the battery** while the engine is running. Electric voltage peaks can cause damage to electrical components.
- In case of an **emergency start in manual mode**, leave the battery (which might be discharged) connected to the engine.
- For **emergency operation without battery**, make sure that the plug-and-socket connector to the instrument box is also disconnected before the engine is started.
- Do not splash electrical devices with water jet or pressure jet during engine cleaning.
- When carrying out **welding work** on the engine or attached equipment, attach the earth (ground) clip as near as possible to the welding point,

and disconnect the battery. If an alternator is fitted, separate the plug connector leading to the voltage regulator. The relevant circuit diagrams are supplied with engines which have an electrical system. Additional copies of circuit diagrams can be obtained on request. Contact your local HATZ organisation. HATZ assumes no liability for electrical starting systems not installed in accordance with HATZ circuit diagrams.

8.9 Diesel drive engine unit – Perkins

The following information has been reproduced from the Perkins documentation with the permission of Perkins.

Aftercooler Core - Inspect

Note

Adjust the frequency of cleaning according to the effects of the operating environment.

Inspect the aftercooler for these items: damaged fins, corrosion, dirt, grease, insects, leaves, oil, and other debris. Clean the aftercooler, if necessary.

For air-to-air aftercoolers, use the same methods that are used for cleaning radiators.



WARNING

Personal injury can result from air pressure. Personal injury can result without following proper procedure. When using pressure air, wear a protective face shield and protective clothing.

Maximum air pressure at the nozzle must be less than 205 kPa (30 psi) for cleaning purposes.

After cleaning, start the engine and accelerate the engine to high idle rpm. This will help in the removal of debris and drying of the core. Stop the engine. Use a light bulb behind the core in order to inspect the core for cleanliness. Repeat the cleaning, if necessary.

Inspect the fins for damage. Bent fins may be opened with a "comb".

Note

If parts of the aftercooler system are repaired or replaced, a leak test is highly recommended.

Inspect these items for good condition: Welds, mounting brackets, air lines, connections, clamps, and seals. Make repairs, if necessary.

Alternator - Inspect

Perkins recommends a scheduled inspection of the alternator. Inspect the alternator for loose connections and correct battery charging.

Alternator and Fan Belts - Inspect/Adjust

Inspection

To maximize the engine performance, inspect the belts for wear and for cracking.

Battery Electrolyte Level - Check

When the engine is not run for long periods of time or when the engine is run for short periods, the batteries may not fully recharge. Ensure a full charge in order to help prevent the battery from freezing. If batteries are correctly charged, the ammeter reading should be very near zero, when the engine is in operation.



WARNING

All lead-acid batteries contain sulfuric acid which can burn the skin and clothing. Always wear a face shield and protective clothing when working on or near batteries.

1. Remove the filler caps. Maintain the electrolyte level to the "FULL" mark on the battery.
If the addition of water is necessary, use distilled water. If distilled water is not available use clean water that is low in minerals. Do not use artificially softened water.
2. Check the condition of the electrolyte with a suitable battery tester.
3. Install the caps.
4. Keep the batteries clean.
Clean the battery case with one of the following cleaning solutions:
 - Use a solution of 0.1 kg (0.2 lb) baking soda and 1 L (1 qt) of clean water.
 - Use a solution of ammonium hydroxide. Thoroughly rinse the battery case with clean water.

Driven equipment - Checking

Consult the OEM specifications for more information about the following maintenance recommendations for the driven equipment:

- Inspection
- Adjustment
- Lubrication
- Other maintenance recommendations

Carry out all the maintenance work on the driven equipment that is recommended by the OEM.

Engine - Clean



WARNING

Personal injury or death can result from high voltage

Moisture can create paths of electrical conductivity.

Make sure that the electrical system is OFF. Lock out the starting controls and tag the controls "DO NOT OPERATE".

Notice

Accumulated grease and oil on an engine is a fire hazard. Keep the engine clean. Remove debris and fluid spills whenever a significant quantity accumulates on the engine.

Periodic cleaning of the engine is recommended. Steam cleaning the engine will remove accumulated oil and grease. A clean engine provides the following benefits:

- Easy detection of fluid leaks
- Maximum heat transfer characteristics
- Ease of maintenance

Note

Caution must be used in order to prevent electrical components from being damaged by excessive water when the engine is cleaned. Pressure washers and steam cleaners should not be directed at any electrical connectors or the junction of cables into the rear of the connectors. Avoid electrical components such as the alternator, and the starter. Protect the fuel injection pump from fluids in order to wash the engine.

Engine Air Cleaner Service Indicator - Inspect

Some engines may be equipped with a different service indicator.

Some engines are equipped with a differential gauge for inlet air pressure. The differential gauge for inlet air pressure displays the difference in the pressure that is measured before the air cleaner element and the pressure that is measured after the air cleaner element. As the air cleaner element becomes dirty, the pressure differential rises. If your engine is equipped with a different type of service indicator, follow the OEM recommendations in order to service the air cleaner service indicator.

The service indicator may be mounted on the air cleaner element or in a remote location.

Observe the service indicator. The air cleaner element should be cleaned or the air cleaner element should be replaced when one of the following conditions occur:

- The yellow diaphragm enters the red zone.
- The red piston locks in the visible position.



Test the Service Indicator

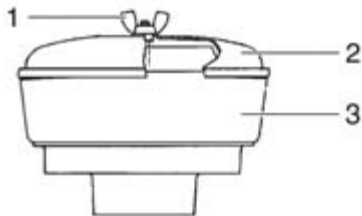
Service indicators are important instruments.

- Check for ease of resetting. The service indicator should reset in less than three pushes.
- Check the movement of the yellow core when the engine is accelerated to the engine rated speed. The yellow core should latch at the greatest vacuum that is attained.

If the service indicator does not reset easily, or if the yellow core does not latch at the greatest vacuum, the service indicator should be replaced. If the new service indicator will not reset, the hole for the service indicator may be restricted.

The service indicator may need to be replaced frequently in environments that are severely dusty.

Engine Air Precleaner - Check/Clean



- (1) Wing nut
- (2) Cover

(3) Body

- Remove wing nut (1) and cover (2). Check for an accumulation of dirt and debris in body (3). Clean the body, if necessary.
- After cleaning the precleaner, install cover (2) and wing nut (1).

Note

When the engine is operated in dusty applications, more frequent cleaning is required.

Engine Oil Level - Check



WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin

Perform this maintenance with the engine stopped.

1. Maintain the oil level between "ADD" mark (Y) and "FULL" mark (X) on oil level gauge (1). Do not fill the crankcase above "FULL" mark (X).

Notice

Operating your engine when the oil level is above the "FULL" mark could cause your crankshaft to dip into the oil. The air bubbles created from the crankshaft dipping into the oil reduces the oil's lubricating characteristics and could result in the loss of power.

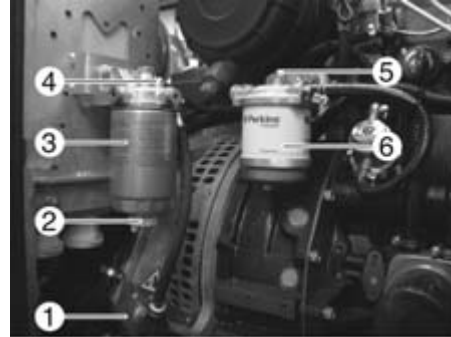
2. Remove the oil filler cap and add oil, if necessary.
Clean the oil filler cap. Install the oil filler cap.

Be careful not to spill any fluids while performing the inspection, maintenance, test, adjustment or repair of the engine. Be prepared to capture the fluid in a suitable container before you open a chamber or remove a component that contains a fluid.

Dispose of all fluids according to local regulations and mandates.

Water separator

Make sure the air has been eliminated from the water separator (3) before you prime the fuel filter (6). It can be bled via the bleeder screw (4).



Fuel System - Prime

Use the following procedure in order to prime the fuel system:

If air enters the fuel system, the air must be purged from the fuel system before the engine can be started. Air can enter the fuel system when the following events occur:

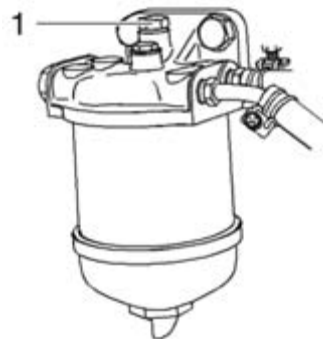
- The fuel tank is empty or the fuel tank has been partially drained.
- The low pressure fuel lines are disconnected.
- A leak exists in the low pressure fuel system.
- The fuel filter is replaced.

Fuel filters

There are three types of fuel filter that may be installed on the engine.

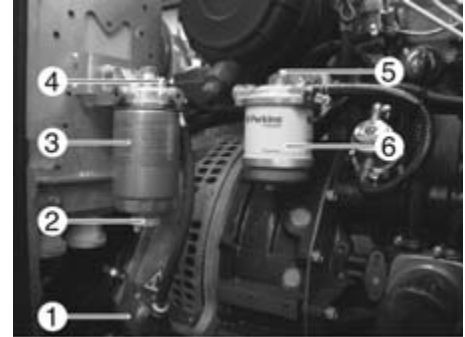
Canister

Vent screw (1) is installed on the fuel filter that has a canister.



Priming the system

Make sure the air has been eliminated from the water separator. Then unscrew the bleeder screw (5) a few turns. Operate the priming pump (1). When fuel exits the bleeder screw (5) without air bubbles, tighten the bleeder screw (5).



Note

Some fuel systems make use of gravity to eliminate air from the pre-filter. For such systems you must make sure the fuel tank is full and that shut-off valves in the fuel line are open.

There are various types of systems that can be mounted on the engine to purge air from the fuel system.

Fuel System Primary Filter/Water Separator - Drain



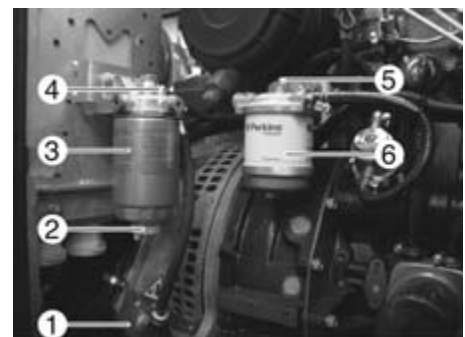
WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the start switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.

NOTICE

The water separator (3) is not a filter. The water separator separates water from the fuel. The engine should never be allowed to run with the water separator more than half full. Engine damage may result.

1. Open drain (2). Catch the draining fluid in a suitable container. Dispose of the drained fluid correctly.
2. Close drain (2).



NOTICE

The water separator is under suction during normal engine operation. Ensure that the drain valve is tightened securely to help prevent air from entering the fuel system.

Fuel Tank Water and Sediment - Drain

NOTICE

Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to local regulations and mandates.

Fuel Tank

Fuel quality is critical to the performance and to the service life of the engine. Water in the fuel can cause excessive wear to the fuel system.

Water can be introduced into the fuel tank when the fuel tank is being filled.

Condensation occurs during the heating and cooling of fuel. The condensation occurs as the fuel passes through the fuel system and the fuel returns to the fuel tank. This causes water to accumulate in fuel tanks. Draining the fuel tank regularly and obtaining fuel from reliable sources can help to eliminate water in the fuel.

Drain the Water and the Sediment

Fuel tanks should contain some provision for draining water and draining sediment from the bottom of the fuel tanks.

Open the drain valve on the bottom of the fuel tank in order to drain the water and the sediment. Close the drain valve.

Check the fuel daily. Allow five minutes after the fuel tank has been filled before draining water and sediment from the fuel tank.

Fill the fuel tank after operating the engine in order to drive out moist air. This will help prevent condensation. Do not fill the tank to the top. The fuel expands as the fuel gets warm. The tank may overflow.

Some fuel tanks use supply pipes that allow water and sediment to settle below the end of the fuel supply pipe. Some fuel tanks use supply lines that take fuel directly from the bottom of the tank. If the engine is equipped with this system, regular maintenance of the fuel system filter is important.

Radiator - Clean

The radiator is not usually supplied by Perkins. The following text describes a typical cleaning procedure for the radiator. Refer to the OEM information for further information on cleaning the radiator.

NOTICE

Adjust the frequency of cleaning according to the effects of the operating environment.

Inspect the radiator for these items: damaged fins, corrosion, dirt, grease, insects, leaves, oil, and other debris. Clean the radiator, if necessary.



WARNING

Personal injury can result from air pressure. Personal injury can result without following proper procedure. When using pressure air, wear a protective face shield and protective clothing.

Maximum air pressure at the nozzle must be less than 205 kPa (30 psi) for cleaning purposes.

Pressurized air is the preferred method for removing loose debris. Direct the air in the opposite direction to the fan's air flow. Hold the nozzle approximately 6 mm (0.25 inch) away from the radiator fins.

Slowly move the air nozzle in a direction that is parallel with the radiator tube assembly. This will remove debris that is between the tubes.

Pressurized water may also be used for cleaning. The maximum water pressure for cleaning purposes must be less than 275 kPa (40 psi). Use pressurized water in order to soften mud. Clean the core from both sides.

Use a degreaser and steam for removal of oil and grease. Clean both sides of the core. Wash the core with detergent and hot water. Thoroughly rinse the core with clean water.

If the radiator is blocked internally, refer to the OEM Manual for information regarding flushing the cooling system.

After cleaning the radiator, start the engine. Allow the engine to operate at low idle speed for three to five minutes. Accelerate the engine to high idle. This will help in the removal of debris and drying of the core. Slowly reduce the engine speed to low idle and then stop the engine. Use a light bulb behind the core in order to inspect the core for cleanliness. Repeat the cleaning, if necessary.

Inspect the fins for damage. Bent fins may be opened with a "comb". Inspect these items for good condition: Welds, mounting brackets, air lines, connections, clamps, and seals.

Make repairs, if necessary.

Walk-Around Inspection

A walk-around inspection should only take a few minutes. When the time is taken to perform these checks, costly repairs and accidents can be avoided.

For maximum engine service life, make a thorough inspection of the engine compartment before starting the engine. Look for items such as oil leaks or coolant leaks, loose bolts, worn belts, loose connections and trash buildup. Make repairs, as needed:

- The guards must be in the correct place. Repair damaged guards or replace missing guards.
- Wipe all caps and plugs before the engine is serviced in order to reduce the chance of system contamination.

NOTICE

For any type of leak (coolant, lube, or fuel) clean up the fluid. If leaking is observed, find the source and correct the leak. If leaking is suspected, check the fluid levels more often than recommended until the leak is found or fixed, or until the suspicion of a leak is proved to be unwarranted.

NOTICE

Accumulated grease and/or oil on an engine is a fire hazard. Remove the accumulated grease and oil. Refer to this Operation and Maintenance Manual, "Engine - Clean" for more information.

- Ensure that the cooling system hoses are correctly clamped and that the cooling system hoses are tight. Check for leaks. Check the condition of all pipes.
- Inspect the water pump for coolant leaks.

NOTICE

The water pump seal is lubricated by the coolant in the cooling system. It is normal for a small amount of leakage to occur as the engine cools down and the parts contract.

Excessive coolant leakage may indicate the need to replace the water pump seal. For the removal of the water pump and the installation of water pump and/or seal, refer to the Disassembly and Assembly Manual, "Water Pump - Remove and Install" for more information or consult your Perkins dealer or your Perkins distributor.

- Inspect the lubrication system for leaks at the front crankshaft seal, the rear crankshaft seal, the oil pan, the oil filters and the rocker cover.
- Inspect the fuel system for leaks. Look for loose fuel line clamps and/or tie-wraps.
- Inspect the piping for the air intake system and the elbows for cracks and for loose clamps. Ensure that hoses and tubes are not contacting other hoses, tubes, wiring harnesses, etc.
- Inspect the alternator belts and any accessory drive belts for cracks, breaks or other damage.

Belts for multiple groove pulleys must be replaced as matched sets. If only one belt is replaced, the belt will carry more load than the belts that are not replaced. The older belts are stretched. The additional load on the new belt could cause the belt to break.

- Drain the water and the sediment from the fuel tank on a daily basis in order to ensure that only clean fuel enters the fuel system.
- Inspect the wiring and the wiring harnesses for loose connections and for worn wires or frayed wires.
- Inspect the ground strap for a good connection and for good condition.
- Disconnect any battery chargers that are not protected against the current drain of the starting motor. Check the condition and the electrolyte level of the batteries, unless the engine is equipped with a maintenance free battery.
- Check the condition of the gauges. Replace any gauges that are cracked. Replace any gauge that can not be calibrated.

Fuel specifications

Classification of the Fuels

Diesel engines have the ability to burn a wide variety of fuels. These fuels are divided into four general groups: Ref to table A.

Fuel Groups	Classification	
Group 1	Preferred fuels	Full life of the Product
Group 2	Permissible fuels	These fuels MAY cause reduced engine life and performance
Group 3	Aviation fuels	These fuels WILL cause reduced engine life and performance
Group 4	Biodiesel	

Group 1 Specifications (Preferred Fuels)

This group of fuel specifications is considered acceptable:

- EN590 DERV Grade A, B, C, E, F, Class 0, 1, 2, 3 and 4
- “ASTM D975”, Grade 2D S15, and Grade 2D S500
- “JIS K2204 Grades 1,2,3 and Special Grade 3”. This grade of fuel must meet the minimum lubricity requirements that are stated in table B.
- “BS2869 Class A2” Off-Highway Gas Oil Red Diesel.

NOTICE

BS2869 can only be used if the sulfur level meets the specifications that are listed in tables C and D. An analysis of a sample of fuel must be conducted in order to check the sulfur level.

NOTICE

The use of LSD fuel and the use of ULSD fuel is acceptable provided that the fuels meet the minimum requirements that are stated in tables B, C and D. The lubricity of these fuels must not exceed wear scar diameter of 0.46 mm (0.0181 inch). The lubricity test must be performed on a HFRR, operated at 60 °C (140 °F). Refer to "ISO 12156-1 ". By using the test methods "ASTM D5453, ASTM D2622, or ISO 20846 ISO 20884", the content of sulfur in LSD fuel must be below 500 PPM 0.05%. By using the test methods "ASTM D5453, ASTM D2622, or ISO 20846 ISO 20884", the content of sulfur in ULSD fuel must be below 15 PPM 0.0015%.

Group 2 Specifications (Permissible Fuels)

This group of fuel specifications is considered acceptable, but these fuels MAY reduce the engine life and performance.

- "ASTM D975", Grade 1D S15, and Grade 1D S500
- • "JP7 (MIL-T-38219)"
- • "NATO F63"

NOTICE

JP7 and NATO F63 can only be used if the sulfur level meets the specifications that are listed in tables C and D. An analysis of a sample of fuel must be conducted in order to check the sulfur level.

Group 3 Specifications (Aviation Fuels)

This group of fuel specification must be used only with the appropriate fuel additive. This fuel WILL reduce engine life and performance.

- "NATO F34 (MIL-DTL-83133E)"
- "NATO F35 (MIL-DTL-83133E)"
- "NATO JP8 (MIL-DTL-83133E)"
- "NATO F-44 (MIL-DTL-5624U)"
- "NATO JP5 (MIL-DTL-5624U)"
- "Jet A (ASTM D1655)"
- "Jet A1 (ASTM D1655)"

NOTICE

All the above fuels can ONLY be used if the sulfur level meets the specifications that are listed in tables C and D. An analysis of a sample of fuel must be conducted in order to check the sulfur level.

NOTICE

These fuels are only acceptable provided that these fuels are used with an appropriate fuel additive. These fuels must meet the requirements that are stated in tables B, C and D. Fuel samples should be analyzed for the compliance. These fuels MUST NOT exceed lubricity wear scar diameter of 0.46 mm (0.0181 inch). The fuel lubricity test must be performed on a HFRR, operated at 60 °C (140 °F). Refer to "ISO 12156-1 ". Fuels must have minimum viscosity of 1.4 centistokes that is delivered to the fuel injection pump. Fuel cooling may be required in order to maintain minimum viscosity of 1.4 centistokes that is delivered to the fuel injection pump.

Perkins Specification for Distillate Diesel Fuel ⁽¹⁾				
Property	UNITS	Requirements	"ASTM"Test	"ISO"Test
Aromatics	%Volume	35% maximum	D1319	"ISO" 3837
Ash	%Weight	0.02% maximum	D482	"ISO" 6245
Carbon Residue on 10% Bottoms	%Weight	0.35% maximum	D524	"ISO" 4262
Cetane Number ⁽²⁾	-	40 minimum	D613/D6890	"ISO" 5165
Cloud Point	°C	The cloud point must not exceed the lowest expected ambient temperature.	D2500	"ISO" 3015
Copper Strip Corrosion	-	No. maximum 3	D130	"ISO" 2160
Density at 15 °C (59 °F) ⁽³⁾	Kg / M 3	801 minimum and 876 maximum	No equivalent test	"ISO 3675", "ISO 12185"
Distillation	°C	10% at 282 °C (539.6 °F) maximum 90% at 360 °C (680 °F) maximum	D86	"ISO" 3405
Flash Point	°C	legal limit	D93	"ISO" 2719

Perkins Specification for Distillate Diesel Fuel ⁽¹⁾				
Property	UNITS	Requirements	"ASTM"Test	"ISO"Test
Thermal Stability	-	Minimum of 80% reflectance after aging for 180 minutes at 150 °C (302 °F)	D6468	No equivalent test
Pour Point	°C	6 °C (42.8 °F) minimum below ambient temperature	D97	"ISO" 3016
Sulfur ^{(1),(4)}	%mass	The level of sulfur that is in the fuel is controlled by emissions regulations. Refer to Tables C and D for more information.	D5453/D26222	"ISO 20846", "ISO 20884"
Kinematic Viscosity ⁽⁵⁾	"MM" ² /S (cSt)"	The viscosity of the fuel that is delivered to the fuel injection pump. "1.4 minimum/4.5 maximum"	D445	"ISO" 3405
Water and sediment	%Weight	0.1% maximum	D1796	"ISO" 3734
Water	%Weight	0.1% maximum	D1744	No equivalent test
Sediment	%Weight	0.05% maximum	D473	"ISO" 3735
Gums and Resins ⁽⁶⁾	mg/100mL	10 mg per 100 mL maximum	D381	"ISO" 6246
Lubricity corrected wear scar diameter at 60 °C (140 °F). ⁽⁷⁾	mm	0.46 maximum	D6079	"ISO" 12156-1

(1) This specification includes the requirements for Ultra Low Sulfur Diesel (ULSD). ULSD fuel will have ? 15 ppm (0.0015%) sulfur. Refer to "ASTM D5453", "ASTM D2622", or "ISO 20846, ISO 20884" test methods. This specification includes the requirements for Low Sulfur Diesel (LSD). LSD fuel will have ? 500 ppm (0.05%) sulfur. Refer to following:"ASTM 5453, ASTM D2622", "ISO 20846", and "ISO 20884 test methods". Refer to Tables C and D.

(2) A fuel with a higher cetane number is recommended in order to operate at a higher altitude or in cold weather.

(3) "Via standards tables, the equivalent API gravity for the minimum density of 801 kg / m³ (kilograms per cubic meter) is 45 and for the maximum density of 876 kg / m³ is 30".

(4) Regional regulations, national regulations or international regulations can require a fuel with a specific sulfur limit. Consult all applicable regulations before selecting a fuel for a given engine application. Perkins fuel systems and engine components can operate on high sulfur fuels in territories that are non-emissions regulated. Fuel sulfur levels affect exhaust emissions. High sulfur fuels also increase the potential for corrosion of internal components. Fuel sulfur levels above 0.5% may significantly shorten the oil change interval. For additional information, refer to this manual, "Fluid recommendations (General lubricant Information)".

(5) The values of the fuel viscosity are the values as the fuel is delivered to the fuel injection pumps. Fuel should also meet the minimum viscosity requirement and the fuel should meet the maximum viscosity requirements at 40 °C (104 °F) of either the "ASTM D445" test method or the "ISO 3104" test method. If a fuel with a low viscosity is used, cooling of the fuel may be required to maintain 1.4 cSt or greater viscosity at the fuel injection pump. Fuels with a high viscosity might require fuel heaters in order to lower the viscosity to 4.5 cSt at the fuel injection pump.

(6) Follow the test conditions and procedures for gasoline (motor).

(7) The lubricity of a fuel is a concern with low sulfur and ultra low sulfur fuel. To determine the lubricity of the fuel, use the "ISO 12156-1 or ASTM D6079 High Frequency Reciprocating Rig (HFRR)" test. If the lubricity of a fuel does not meet the minimum requirements, consult your fuel supplier. Do not treat the fuel without consulting the fuel supplier. Some additives are not compatible. These additives can cause problems in the fuel system.

Territory	Fuel Requirements from 2007		
EPA	Low Sulfur (500 ppm) maximum		
EC	Sulfur/ Power	Low sulfur (300 ppm) maximum for less than or equal to 19 kW	Sulphur (1000 ppm) maximum for greater than 19 kW
	Models	402D-05 and 403D-07	403D-11, 403D-15, 403D-15T, 403D-17, 404D-15, 404D-22, 404D-22T and 404D-22TA
Non- Regulated Territories	Sulfur limit of less than 4000 ppm		

Territory	Fuel Requirements from 2010		
EPA	Ultra Low Sulfur (15 ppm) maximum		
EC	Sulfur/ Power	Ultra Low sulphur (10 ppm) maximum for less than or equal to 37 kW	Low sulphur (300 ppm) maximum for greater than 37 kW
	Models	402D-05, 403D-07, 403D-11, 403D-15, 403D-15T, 403D-17, 404D-15	404D-22, 404D-22T and 404D-22TA
Non Regulated Territories	Sulfur limit of less than 4000 ppm		

Group 4 Biodiesel

Biodiesel is a fuel that can be defined as mono-alkyl esters of fatty acids. Biodiesel is a fuel that can be made from a variety of feedstock. The most commonly available biodiesel in Europe is Rape Methyl Ester (REM). This biodiesel is derived from rapeseed oil. Soy Methyl Ester (SME) is the most common biodiesel in the United States. This biodiesel is derived from soybean oil. Soybean oil or rapeseed oil are the primary feedstocks. These fuels are together known as Fatty Acid Methyl Esters (FAME).

Raw pressed vegetable oils are NOT acceptable for use as a fuel in any concentration in compression engines. Without esterification, these oils gel in the crankcase and the fuel tank. These fuels may not be compatible with many of the elastomers that are used in engines that are manufactured today. In

original forms, these oils are not suitable for use as a fuel in compression engines. Alternate base stocks for biodiesel may include animal tallow, waste cooking oils, or a variety of other feedstocks. In order to use any of the products that are listed as fuel, the oil must be esterified.

NOTICE

Engines that are manufactured by Perkins are certified by use of the prescribed Environmental Protection Agency (EPA) and European Certification fuels. Perkins does not certify engines on any other fuel. The user of the engine has the responsibility of using the correct fuel that is recommended by the manufacturer and allowed by the EPA and other appropriate regulatory agencies.

Recommendation for the use of biodiesel

The neat biodiesel must conform to “EN14214” or “ASTM D675” regulations. A maximum of 10% mixture of biodiesel can be used in mineral diesel fuel. The mineral diesel fuel must conform to “EN590”, “ASTM D975” or “BS2869 Grade A2” regulations.

In North America, biodiesel and mixtures of biodiesel must be purchased from the BQ9000 authorized manufacturers and BQ9000 certified distributors.

In other areas of the world, the use of biodiesel that is authorized and certified by an appropriate biodiesel quality body is required.

NOTICE

When biodiesel, or any blend of biodiesel is used, the user has the responsibility for obtaining the proper local exemptions, regional exemptions, and/or national exemptions that are required for the use of biodiesel in any Perkins engine that is regulated by emissions standards. Biodiesel that meets “EN14214” is acceptable. The biodiesel must be blended with an acceptable distillate diesel fuel at the maximum stated percentages. However, the following operational recommendations must be followed:

- The oil change interval can be affected by the use of biodiesel. Use Services Oil Analysis in order to monitor the condition of the engine oil. Use Services Oil Analysis also in order to determine the oil change interval that is optimum.
- Confirm that biodiesel is acceptable for use with the manufacturer of the fuel filters.
- In a comparison of distillate fuels to biodiesel, biodiesel provides less energy per gallon by 5% to 7%. Do NOT change the engine rating in order to compensate for the power loss. This will help avoid engine problems when the engine is converted back to 100 percent distillate diesel fuel.
- The compatibility of the elastomers with biodiesel is being monitored. The condition of seals and hoses should be monitored regularly.
- Biodiesel may pose low ambient temperature problems for both storage and operation. At low ambient temperatures, fuel may need to be stored in a heated building or a heated storage tank. The fuel system may require heated fuel lines, filters, and tanks. Filters may plug and fuel in the tank may solidify at low ambient temperatures if precautions are not taken. Consult your biodiesel supplier for assistance in the blending and attainment of the proper cloud point for the fuel.

- Biodiesel has poor oxidation stability, which can result in long term problems in the storage of biodiesel. The poor oxidation stability may accelerate fuel oxidation in the fuel system. This is especially true in engines with electronic fuel systems because these engines operate at higher temperatures. Consult the fuel supplier for oxidation stability additives.
- Biodiesel is a fuel that can be made from a variety of feedstock. The feedstock that is used can affect the performance of the product. Two of the characteristics of the fuel that are affected are cold flow and oxidation stability. Contact your fuel supplier for guidance.
- Biodiesel or biodiesel blends are not recommended for engines that will operate occasionally. This is due to poor oxidation stability. If the user is prepared to accept some risk, then limit biodiesel to a maximum of B5. Examples of applications that should limit the use of biodiesel are the following: Standby Generator sets and certain emergency vehicles
- Biodiesel is an excellent medium for microbial contamination and growth. Microbial contamination and growth can cause corrosion in the fuel system and premature plugging of the fuel filter. The use of conventional anti-microbial additives and the effectiveness of conventional anti-microbial additives in biodiesel is not known. Consult your supplier of fuel and additive for assistance.
- Care must be taken in order to remove water from fuel tanks. Water accelerates microbial contamination and growth. When biodiesel is compared to distillate fuels, water is naturally more likely to exist in the biodiesel.

Fuel for Cold Weather Operation

The European standard “EN590” contains climate dependant requirements and a range of options. The options can be applied differently in each country. There are 5 classes that are given to arctic climates and severe winter climates. 0, 1, 2, 3, and 4.

Fuel that complies with “EN590” CLASS 4 can be used at temperatures as low as -44 °C (-47.2 °F). Refer to “EN590” for a detailed discretion of the physical properties of the fuel. The diesel fuel “ASTM D975 Grade 1-D S15 or S500” that is used in the united states of america may be used in very cold temperatures that are below -18 °C (-0.4 °F). In extreme cold ambient conditions, you may also use fuels that are listed in the table E. These fuels are intended to be used in temperatures that can be as low as -54 °C (-65.2°F).

Light Distillate Fuels ⁽¹⁾	
Specification	Grade
"MIL-DTL-5624U	"JP-5
"MIL-DTL-83133E	"JP-8
"ASTM D1655	"Jet-A-1

(1) The use of these fuels is acceptable with an appropriate fuel additive and the fuels must meet minimum requirements that are stated in Tables B, C and D. Fuel samples should be analyzed for the compliance. Fuels MUST NOT exceed 0.46 mm lubricity wear scar diameter that is tested on a HFFR . The test must be performed at 60 °C. Refer to “ISO 12156-1 ”. Fuels must have minimum viscosity of 1.4 centistokes that is delivered to the fuel injection pump. Fuel cooling may be required in order to maintain minimum viscosity of 1.4 centistokes that is delivered to the fuel injection pump.

**WARNING**

Mixing alcohol or gasoline with diesel fuel can produce an explosive mixture in the engine crankcase or the fuel tank. Alcohol or gasoline must not be used in order to dilute diesel fuel. Failure to follow this instruction may result in death or personal injury.

There are many other diesel fuel specifications that are published by governments and by technological societies. Usually, those specifications do not review all the requirements that are addressed in tables B, C and D. To ensure optimum engine performance, a complete fuel analysis should be obtained before engine operation. The fuel analysis should include all of the properties that are stated in the tables B, C and D.

Fuel Additive

Supplemental diesel fuel additives are not generally recommended. This is due to potential damage to the fuel system or the engine. Your fuel supplier or the fuel manufacturer will add the appropriate supplemental diesel fuel additives.

Perkins recognizes the fact that additives may be required in some special circumstances. Fuel additives need to be used with caution. The additive may not be compatible with the fuel. Some additives may precipitate. This action causes deposits in the fuel system. The deposits may cause seizure. Some additives may be corrosive, and some additives may be harmful to the elastomers in the fuel system. Some additives may raise fuel sulfur levels above the maximum that is allowed by the EPA or the other regulatory agencies. Contact your fuel supplier for those circumstances when fuel additives are required. Your fuel supplier can recommend the appropriate fuel additive and the correct level of treatment.

NOTICE

For the best results, your fuel supplier should treat the fuel when additives are required. The treated fuel must meet the requirements that are stated in tables B, C and D.

9 Maintenance

9.1 General

When maintenance is insufficient, incorrect and/or not performed regularly this can lead to malfunctions of the pump or pump unit, danger to the user, high repair costs and lengthy breakdowns. BBA Pumps is not responsible for accidents and damage that result from failure to follow the instructions.

Only the operations described in this manual may be performed. Other operations must be performed by employees of BBA Pumps or authorised maintenance technicians.

To guarantee reliable operation, installed backup pumps must be operated briefly once a week.

For parts, see www.bbapumps.com or contact the BBA Pumps parts department.

Manual for the drive motor

Depending on which drive motor/engine is used, this user manual may be accompanied by the manual for the drive motor/engine. The manual for the drive motor contains detailed information about the procedures that are to be followed and the associated safety instructions. Read the supplied manual carefully and follow the procedures and safety instructions. If the pump is driven by a motor not supplied by BBA Pumps, the maintenance instructions for that motor must be followed.

9.2 Safety instructions during maintenance, repair and inspection

- When necessary, make use of personal protective equipment.
- It is only permitted to work on the pump when it has been put out of operation. To put it out of operation, follow the prescribed procedure.
- Protect the drive motor against unintended and unauthorised activation throughout the duration of the work activities.
- When opening the pump follow all the instructions for handling the pumped liquid, such as protective clothing, no smoking, etc.
- For more information, consult the Material Safety Data Sheet (MSDS) for the pumped liquid.
- Only remove the guard from the coupling when the pump is at a standstill.
- Maintenance work on the electrical system may only commence after the power supply has been disconnected and may only be performed by personnel who have been trained and authorised to do so.
- When the work is complete, all the protective guards must be installed and the protection system must be activated.
- Use only original parts or parts provided or approved by the supplier for repairs.

9.3 Protecting electrically driven pump unit against unintended activation

- Switch off the isolation switch by the pump.
- Switch off the main switch for the pump.
- Block the main switch, and lock it with a padlock if possible, to prevent unauthorised activation. Take the key for the lock with you.
- If it is not possible to do this, remove the corresponding fuse from the pump.
- Place a sign near the main switch or pump fuse holder with the text 'Do not switch on – work in progress!'

9.4 Protecting diesel engine driven pump unit against unintended activation

- Stop the engine and, if applicable, remove the key from the switch. Take the key with you.
- If applicable, switch off the earth switch for the engine. Take the key for the earth switch with you.
- If it is not possible to do this, remove the earth cable from the batteries.
- Place a sign near the earth switch or disconnected battery cable with the text 'Do not switch on – work in progress!'

9.5 Maintenance instructions

- Clean the pump before beginning the work. Make sure the work area is clean.
- Use the correct tools and make sure they are in good condition. Use them in the proper manner.
- Replace damaged bolts, nuts and/or parts with damaged threads with new parts of the same fastener class.
- Replace used seals or tape. Only replace the flat and filled seals under the plugs with original seals from BBA Pumps.

9.6 Daily maintenance of the pump

- Check for leaks from the pump and pipes
- Check the shaft seal for leaks
- Check the pressure and temperature of the barrier fluid and/or flush water, if applicable.
- Check the oil level of:
 - vacuum pump bearings
 - pump bearings
 - shaft seal
- Check the operation of the non-return valve.
- Check the operation of the float.
- Check for contamination of the suction strainer and/or filter, if present.

- If the pump unit is equipped with a roof panel with a rain gutter, check the rain gutters* on both sides to make sure there is no blockage in the drain hoses. These hoses lead to the centre door posts of the pump unit.
These hoses must be cleaned if they are blocked.

*The lifting beam must be removed in order to remove the rain gutters.
After performing maintenance on the rain gutters, make sure the lifting beam is re-installed.
Tighten the six M10 bolts of the lifting beam with a torque of 49 Nm.

9.7 Other pump maintenance

Every 6 months or 500 hours

- Check the tension of the vacuum pump drive belt.
- Check the parts of the electrical system for visible damage.
- Change the oil in the vacuum pump bearings.**
- Change the oil in the pump bearings.**
- Change the oil in the mechanical shaft seal.
- Lubricate the hinges of the pump unit with a grease gun, if applicable.

**First replacement after 250 hours.

Every 12 months

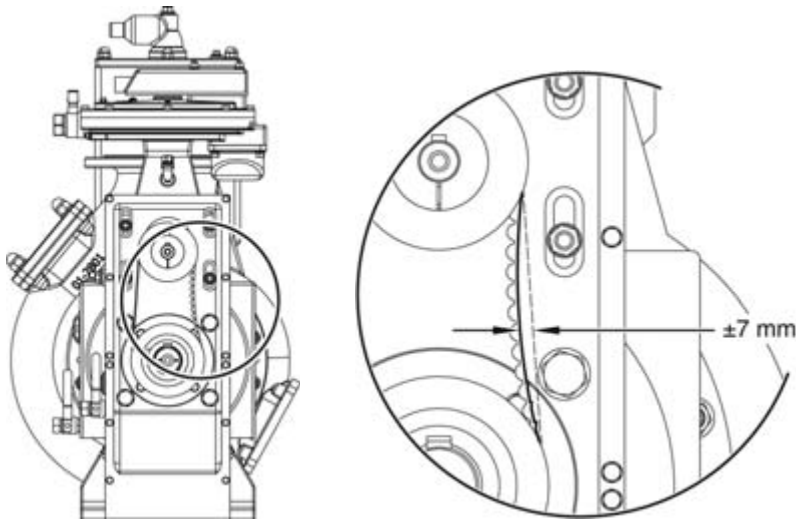
- Change the oil in the shaft seal.



9.8 Maintenance activities – pump

Checking the tension of the vacuum pump drive belt

1. Prevent the pump from being activated.
2. Remove the protective guard.
3. Measure the distance the belt can be depressed in the middle of the span. The distance must be 7 mm (0.26 mm).



4. If the measured distance does not match the specification, adjust the belt so this distance is 7 mm (0.26 mm).
5. Re-install the protective guard.

Note

If the toothed belt is too tight, the bearing life will be reduced and more noise will be produced.

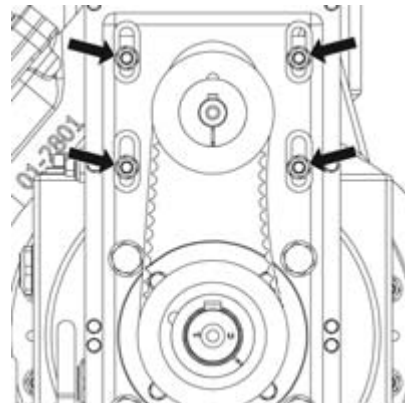
Adjusting the tension of the vacuum pump drive belt

Note

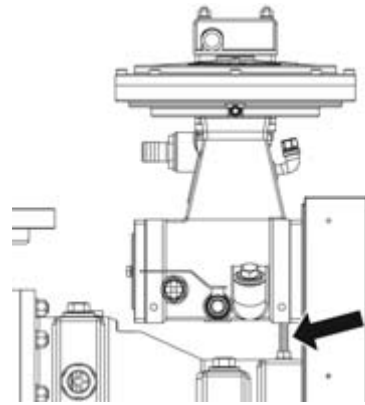
A jig is available from BBA Pumps for correct adjustment of the drive belt.



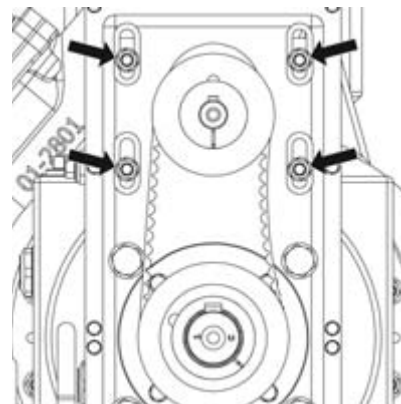
1. Loosen the vacuum pump mounting bolts.



- Set the correct belt tension with the adjustment bolt.
(Attention: The illustration is just an example. Your pump may be designed differently.)

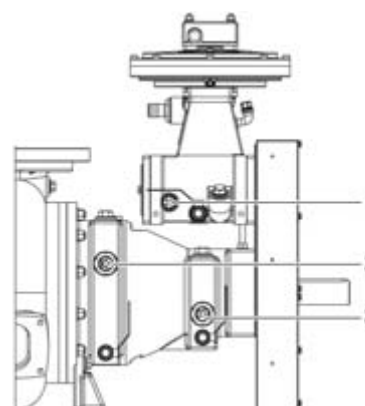


- Re-tighten the vacuum pump mounting bolts.



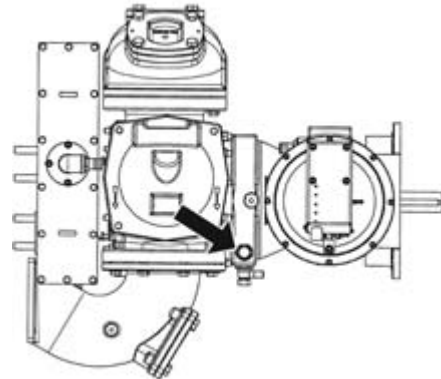
Checking the shaft seal oil level

- Check the oil level with the pump stopped.
- The sight glass (2) must be at least half filled.
- The colour of the oil may range from clear to grey/white.



Note

Due to slight leakage of the seal, the level may rise. This is not a problem until oil escapes from the vent. If this occurs, the shaft seal must be replaced by an authorised technician.



WARNING

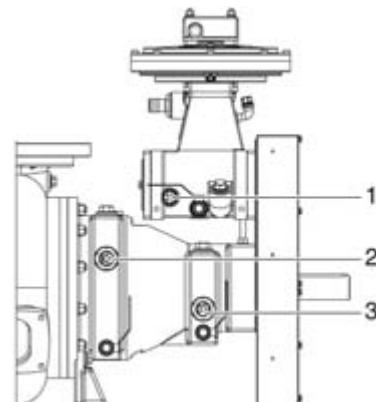
Leakage of oil can be extremely harmful to the environment. Do everything necessary to prevent oil leakage.

Checking the oil level of the bearings in the vacuum pump and pump

1. Check the oil levels with the pump stopped.
2. The sight glasses (1 and 3) must be at least half filled.
3. The oil may not be discoloured.

Note

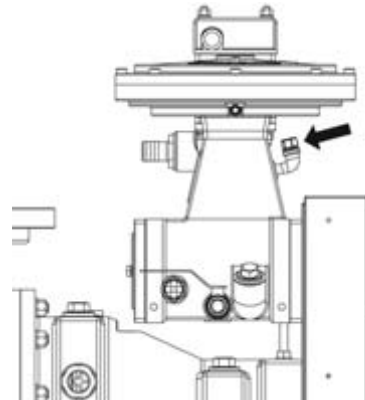
When the oil has become grey/white in colour, this indicates a leak and the pump must be switched off immediately to prevent damage to the bearings. If this occurs, the shaft sealing ring must be replaced by an authorised technician.



Checking the operation of the float

Check whether damp air is coming out of the vacuum pump exhaust.

If so, an authorised technician must check the seal/ adjustment of the float.



Changing the oil in the bearings and shaft seal

Bearing block for BA pump + bearing block for vacuum pump	Standard oil	Temperature	Light/average load	Heavy and jolting load
Applies to all pump models	15W40	-30 °C to 0 °C (-22 °F to 32 °F)	ISO VG 15, 22, 32 machine oil	
	15W40	0 °C to 50 °C (32 °F to 122 °F)	ISO VG 15, 22, 32 bearing or turbine oil	ISO VG 15, 22, 46 bearing or turbine oil
	15W40	50 °C to 80 °C (122 °F to 176 °F)	ISO VG 46, 68, 100 bearing or turbine oil	ISO VG 68, 100, 150 bearing or turbine oil

Pump model	Oil, seal chamber
BA100K D193	15W40
Other models BA80H/ BA100E/BA150E	ISO VG 32 Univis N32 SAE 30

Note

Consult the oil supplier for a product that meets the established specification and to determine the miscibility of the oils.



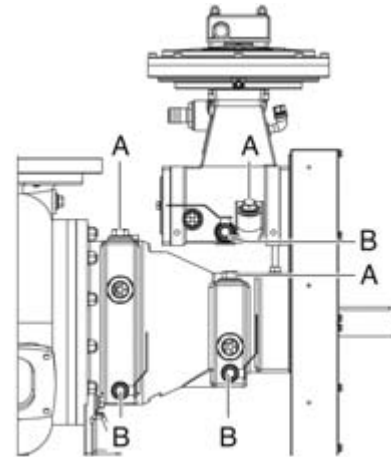
WARNING

Use the same type of lubricating oil the bearing was originally provided with. Some types of lubricating oil are incompatible and if mixed can cause severe damage to the bearings and the pump.

Fill quantity

Pump type	Shaft seal	Pump bearings	Vacuum pump bearings
BA 100	2.5 litre (0.55 gallon)	1.2 litre (0.26 gallon)	0.6 litre (0.13 gallon)
BA 150	2.5 litre (0.55 gallon)	1.2 litre (0.26 gallon)	0.6 litre (0.13 gallon)
BA 200	2.5 litre (0.55 gallon)	1.2 litre (0.26 gallon)	0.6 litre (0.13 gallon)

1. Remove the fill plugs (A).
2. Place a suitable drain pan under the drain plug or valve (B).
3. Remove the plug or open the valve.
4. Allow the oil to drain thoroughly.
5. Re-install the drain plug with a new seal or close the valve.
6. Fill the chamber with the prescribed oil until the level reaches the middle of the sight glass.
7. Re-install the drain plug with a new seal.
8. Dispose of the oil in a responsible manner.



WARNING

The maximum oil level must always be visible in the sight glass. The pump can be damaged by an excessive oil level.

Checking the suction strainer and/or filter for contamination

1. When using a suction strainer and/or suction filter, check whether the inlet pressure at the suction flange of the pump is within the permissible range (see the NPSH graph that corresponds to the pump type).
2. Clean the suction strainer and/or filters regularly. The required cleaning interval depends on the pumped liquid and its level of contamination.

9.9 Shipping the pump or pump unit

If the pump must be sent to the supplier for major maintenance, repair or overhaul, the following conditions must be met:

- The pump must be drained and thoroughly cleaned inside.
- All compartments of the drip tray under the pump and motor/engine must be drained prior to transport.

**WARNING**

Leakage of environmentally harmful liquids can be extremely damaging to the environment. Do everything necessary to prevent this.

- For compliance with the safety and environmental regulations, the shipment must be accompanied by a 'Declaration of no objection'.

Note

BA series pumps may be equipped with a back-pull out system. This makes it possible to remove the bearing block with intermediate housing, mechanical shaft seal, shaft and impeller from the pump housing as a whole without the need to remove the suction and pressure pipes.

9.10 Draining the pump

**WARNING**

Take the necessary precautionary measures in the case of hot, volatile, flammable and hazardous liquids.

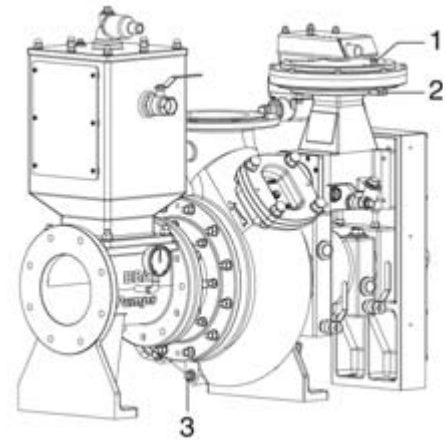
**WARNING**

Leakage of environmentally harmful liquids can be extremely damaging to the environment. Do everything necessary to prevent this.

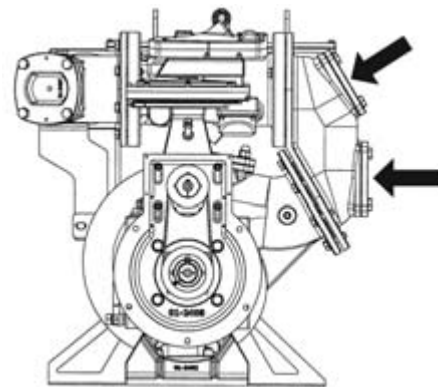
Note

For liquids that congeal at temperatures lower than the operating temperature, close off the suction and pressure pipes and drain the pump and the vacuum pump as soon as the pump has been stopped.

1. Stop the pump.
2. Take measures to prevent unauthorised starting.
3. Allow the pump or pump unit to cool, if the pumped liquid will not congeal.
4. Close off the pressure and suction pipes as close as possible to the pump or pump unit.
5. Place a suitable drain pan under the drain plugs.
6. Remove the drain plugs (1, 2 and 3).



7. Open the inspection/cleaning covers.
8. Flush the passages and chambers in the pump housing, intermediate housing, float chamber and non-return valve. Use the correct flushing agent, compatible with the technical characteristics of the pumped liquid. For more information, consult the MSDS (Material Safety Data Sheet) for the liquid.
9. Dispose of the drained liquid in a responsible manner and in accordance with the local regulations, company regulations and MSDS for the liquid.
10. Switch on the pump briefly to eliminate any condensed water that may be present.
11. Install the cleaning cover with a new seal.
12. Install the drain plugs with new seals.



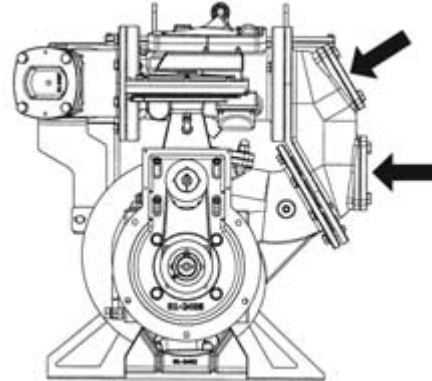
9.11 Internal cleaning of the pump



WARNING

Take the necessary precautionary measures in the case of hot, volatile, flammable and hazardous liquids.

1. Drain the pump.
2. Remove the inspection/cleaning covers.



9.12 External cleaning of the pump or pump unit

A pressure washer may be used, but only in accordance with the following instructions:

- Never clean a pump or pump unit that is in operation.
- Switch off the pump or pump unit before cleaning.
- In the case of an electric drive, switch off the main switch of the electrical system.
- Allow the pump or pump unit to cool before beginning with the cleaning.
- Maintain distance between the spray nozzle and the part being cleaned.
- To prevent penetration of water, never spray directly towards bearings or seals.
- Never spray directly towards connection boxes, connectors, outlets and other electrical connection components.
- Check the protection level of the electrical components. Use a cleaning method appropriate to the protection rating. See the technical specifications of the pump unit.



WARNING

Failure to follow the guidelines above can lead to dangerous situations and cause damage (possibly severe) to the pump.



WARNING

Take the necessary personal protective measures during cleaning, such as protective clothing, safety goggles, etc. Also be especially careful in the case of hot, volatile, flammable and hazardous liquids. Adapt the protective measures accordingly.

10 Troubleshooting tables



WARNING

In the event of a malfunction or abnormal operation, shut off the pump or pump unit immediately to prevent a dangerous situation and/or damage (possibly severe) to the pump or pump unit.

Inform to responsible persons. Determine the cause of the malfunction. Resolve the problem before restarting the pump.

10.1 Troubleshooting table – pump (general)

Problem	Cause	Possible solution
Pump does not deliver any liquid	Incorrect direction of rotation	Reverse direction of rotation
	Vacuum pump does not draw a vacuum	Inspect vacuum pump
	Gas or air is released from the liquid	Ensure that the liquid flows more slowly/ smoothly
	Air pockets form in the suction line	Eliminate air entrapment to the extent possible
	Inlet of the suction pipe is insufficiently submerged	Submerge the suction line more deeply
	Foreign object in the impeller	Clean impeller
	Insufficient lubrication	Lubricate
	Manometric suction height undercalculated	Place pump higher, if possible Otherwise: use a different type of pump
	The suction height is too great or there is too little difference between the geometric height and the vapour tension of the liquid (NPSH too low)	Place pump at a lower height Otherwise: use a different type of pump
	The suction pipe is clogged	Clean
	The pressure pipe is clogged	Clean
	There is a leak in the suction pipe	Eliminate leak

Problem	Cause	Possible solution
Pump provides insufficient capacity	Gas or air is released from the liquid	Ensure that the liquid flows more slowly/ smoothly
	Air pockets form in the suction line	Eliminate air entrapment to the extent possible
	Inlet of the suction pipe is insufficiently submerged	Submerge the suction line more deeply
	Incorrect direction of rotation	Reverse direction of rotation
	The wear plate/ring or impeller is worn	Adjust or replace wear parts
	The impeller is damaged	Repair or replace
	Manometric suction height undercalculated	Place pump higher, if possible Otherwise: use a different type of pump
	The suction height is too great or there is too little difference between the geometric height and the vapour tension of the liquid (NPSH too low)	Place pump at a lower height Otherwise: use a different type of pump
	The operating speed is too low	Increase speed
	The suction pipe is clogged	Clean
	The liquid has a higher s.g. or viscosity than that for which the pump is intended	use a different type of pump
	There is a leak in the suction pipe	Eliminate leak
	Non-return valve is not opening all the way	Make sure the valve has a sufficient flow capacity

Problem	Cause	Possible solution
Pump stops immediately after starting	Vacuum pump does not draw a vacuum	Inspect vacuum pump
	Gas or air is released from the liquid	Ensure that the liquid flows more slowly/smoothly
	Air pockets form in the suction line	Eliminate air entrapment to the extent possible
	Inlet of the suction pipe is insufficiently submerged	Submerge the suction line more deeply
	The suction height is too great or there is too little difference between the geometric height and the vapour tension of the liquid (NPSH too low)	Place pump at a lower height; Otherwise: use a different type of pump
	The suction pipe is clogged	Clean
	There is a leak in the suction pipe	Eliminate leak

Problem	Cause	Possible solution
Pump is demanding abnormal amount of power	Incorrect direction of rotation	Reverse direction of rotation
	Foreign object in the impeller	Clean impeller
	The shafts are not in alignment with one another	Align unit
	The shaft is bent	Replace shaft
	Rotating parts are rubbing against stationary parts	Adjust everything and align if necessary
	The wear plates/ring or impeller is/are worn	Adjust or replace wear parts
	The impeller is damaged	Repair or replace
	The seal is not installed properly	Install properly; replace seal if necessary.
	Inadequate lubrication or insufficient lubricant in the bearing housing, possibly as a result of a leak; can be identified by higher than normal temperature	Follow good service plan
	In this application the pump is not functioning in the intended range	Make changes to the piping system, if possible Otherwise: use a different type of pump
	The liquid has a higher s.g. or viscosity than that for which the pump is intended	Change temperature of liquid, if possible. Otherwise: use a different type of pump

10.2 Troubleshooting table – electric drive

Problem	Cause	Possible solution
Pump does not deliver any liquid	Incorrect direction of rotation	Reverse direction of rotation

Problem	Cause	Possible solution
Pump provides insufficient capacity	Incorrect direction of rotation	Reverse direction of rotation
	The operating speed is too low	Increase speed

Problem	Cause	Possible solution
Pump is demanding abnormal amount of power	Incorrect direction of rotation	Reverse direction of rotation

Problem	Cause	Possible solution
Drive unit is overloaded	Incorrect direction of rotation	Reverse direction of rotation
	The operating speed is too high	Reduce operating speed

Problem	Cause	Possible solution
Pump does not rotate	Defective fuse	Check fuses and replace if necessary
	Not receiving any power	Check electrical connections
	Coupling between motor and pump is defective	Replace the coupling

Note

Only replace a fuse with a fuse of the original type, with the specified rating.

10.3 Troubleshooting table – diesel engine drive

Problem	Cause	Possible solution
Pump provides insufficient capacity	The operating speed is too low	Increase speed

For other diesel engine malfunctions, see the manufacturer's documentation.

11 Disposal

If the pump or pump unit is scrapped and disassembled at the end-of-life, the regulations for waste disposal in force at the time and location of disassembly must be observed.

The pump or pump unit is constructed of common materials.

At the time of construction there were waste disposal methods available for these materials.

After careful cleaning of the pump and pump unit at the time of construction there were no special risks known for persons responsible for the disassembly work.

Observe the environmental regulations in force at the time of disassembly to prevent environmental pollution.

Prior to beginning disassembly, complete the following tasks:

- Drain the pump and clean the inside of the pump (see chapter 10).
- For a diesel engine drive, follow the guidelines provided by the manufacturer of the diesel engine.
- Remove the fuel from the fuel tank.
- Drain the coolant.
- Keep the liquids separate and submit them to a collection centre authorised for their disposal.

12 CE Declaration

IIA Certificate:

Declaration of Conformity

as defined by EC Machinery Directive 06/42/EC, Annex IIA.

Manufacturer: **B.B.A. Pumps BV, Zutphensestraat 242, 7325 WV Apeldoorn**

Product: **BA series pump**

We hereby declare that all the pumps listed above are in conformity with the provisions of:

- the Machinery Directive (2006/42/EC, as last amended)
- the Low Voltage Directive (2006/95/EC, as last amended)
- if equipped with an electric motor – the EMC Directive (2004/108/EC, as last amended)

The pumps comply with the harmonised standards:

- NEN-EN 809:1998+A1:2009/C1:2010 'Pumps and pump units for liquids - Common safety requirements'.
- NEN 1010:2007+C1: 2008
- NEN-EN-IEC 61439-1/2: 2009
- NEN-EN-IEC 60204-1+A1+C11: 2006
- NEN-EN_ISO 12100-1 Safety of machinery: Basic concepts, general principles for design
- NEN-EN_ISO 12100-2 Safety of machinery: Basic concepts, technical principles

NOTE: This declaration is only valid if the pump or pump unit is installed in accordance with the operating guidelines and associated technical specifications.

J. Bruin
BBA Pumps BV



General Manager

CALIFORNIA
Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

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