Boulton Pumps

ESN/ESH

Single Stage Norm Centrifugal Pumps

Instructions for operation and maintenance

Boulton Pumps

Instructions for Installation, Operation and Maintenance.

Boulton pumps

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Content

1. GENERAL 3
1.1. IDENTIFICATION OF SAFETY AND WARNING SYMBOLS 3
1.2. GENERAL INSTRUCTIONS 3
1.3. SAFETY INSTRUCTIONS 4
1.3.1. CE signs and approvals 4
1.3.2. Explosive atmosphere 5
1.3.3. Monitoring 8
1.3.4. Constructional requirements 8
1.3.5. Personnel qualification and training 8
1.4. RECYCLING 8
2. ESN/ESH PUMPS 9
2.1. GENERAL 9
2.1.1. Pump Description 9
2.1.2. Applications 9
2.1.3. Pump Designation 9
2.1.4. Pump Nameplate 9
2.1.5. Technical Data 10
2.2. UNPACKING, HANDLING AND STORAGE 10
2.2.1. Unpacking 10
2.2.2. Handling 10
2.2.3. Storage 11
2.3. INSTALLATION ON SITE 11
2.3.1. Bare Shaft Pump 11
2.3.2. Preparation for Installation 12
2.3.3. Installation Site 12
2.3.4. Installation of the Piping System 14
2.3.5. Coupling Adjustment 18
2.3.6. Minimum Flow 19
2.3.7. Electrical Connections 19
2.3.8. Final Controls 20
2.4. START UP / SHUT DOWN 21
2.4.1. Preparation 21
2.4.2. Start Up the Pump 21
2.4.3. Shut Down the Pump 22
2.4.4. Checks to be Made While The Pump is Running 22
2.5. LUBRICATION 23
2.5.1. Application of Oil on Bearings 23
2.5.2. Application of Grease on the Bearing 24
2.6. DISASSEMBLY, REPAIR AND REASSEMBLY 24
2.6.1. Disassembling the Pump 24
2.6.2. Tightening Torques 27
2.6.3. Assembling the Pump 27
2.6.4. Shaft seal 28
2.7. SPARE PARTS 29
2.8. FAULTS, CAUSES and REMEDIES 30
2.9. EXPECTED NOISE VALUES 31
2.10. PUMP DIMENSION GROUP AND WEIGHTS 32
2.11. SECTIONAL DRAWINGS 33

1. GENERAL

This manual is intended to be a reference guide for users of pumps providing information on:

- Instruct the users on installation, dismounting, maintenance and repair of the pump.
- Describe methods of start-up, operation and stop of the pump.

1.1. IDENTIFICATION OF SAFETY AND WARNING SYMBOLS

Safety instructions in this manual which could cause danger to life if not observed.

The presence of a dangerous electric current.

ATTENTION

Non – observance to this warning could damage the machine or affect its functions.

Information to prevent explosion in the explosive atmosphere as per EC Directive 2014/34/UE (ATEX).

1.2. GENERAL INSTRUCTIONS

- This manual should be kept in a safe place and always be available to the qualified operating and maintenance personnel responsible for the safe operation and maintenance of the pumps.

- Qualified personnel should be experienced and knowledgeable of safety standards.

- To avoid faulty operation and malfunctioning of pumps the instructions in this manual are to be carefully studied and followed at all stages of the pump installation and operating life.

- The user is responsible for ensuring that authorized and qualified personnel who have studied this manual carefully carry out inspection and installation.

- The pump should be used only in the operating conditions given on the order for which the pump and materials of the construction have been selected and tested.

- If the pump is to be used for a different application please contact sales office or representative of the manufacturer. BOULTON PUMPS refuses to assume any responsibility if the pump used for different applications without prior written permission.

- If the pump is not to be installed and operated soon after arrival, it should be stored in a clean and dry place with moderate changes in ambient temperature. Extreme low or high temperatures may severely damage the pump unless suitable precautions are taken. The user is responsible for the verification of the ambient conditions where the pump will be stored or installed.

- BOULTON PUMPS does not guarantee repairs or alterations done by user or other unauthorized personnel. The use of original spare parts and accessories authorized by manufacturer will ensure safety.

- This manual does not take into account any site safety regulation, which may apply.

1.3. SAFETY INSTRUCTIONS

Strictly obey to the following instructions to prevent personal injuries and/or equipment damages:

- Pump should be used only in the specified operating conditions.

- Any weight, stress or strains on the piping system should not be transmitted to the pump.

- Electrical connections on the motor or accessories must always be carried out by authorized personnel and in accordance to the local codes.

- Any work on the pump should be only carried out when the unit has been brought to standstill.

- Always disconnect the power to the motor and make sure not be switched on accidentally before working on the pump or removing the pump from installation.

- Any work on the pump should be carried out by at least two persons.

- When approaching the pump always be properly dressed and/or wear safety equipment suitable for the work to be done.

- Do not work on the pump when it is hot.

- Do not touch the pump or piping with temperatures higher than 80 °C. User must take suitable precaution to warn the persons (e.g. using warning signs, barrier).

- Always be careful when working on pumps that handling dangerous liquids (e.g. acids or hazardous fluids).

- Do not work on the pump when the pump and piping connected to the pump are under pressure.

- After completion of the work always fix the safety guards back in places previously removed.

- Do not run the pump in the wrong direction of rotation.

- Do not insert hands or fingers into the pump openings or holes.

- Do not step on the pump and/or piping connected to the pump.

1.3.1. CE signs and approvals

It is a legal requirement that machinery and equipment put into service within certain regions of the world shall conform with the applicable CE Marking Directives covering Machinery and, where applicable, Low Voltage Equipment, Electromagnetic Compatibility (EMC), Pressure Equipment Directive (PED) and Equipment for Potentially Explosive Atmospheres (ATEX).

Where applicable, the Directives and any additional Approvals, cover important safety aspects relating to machinery and equipment and the satisfactory provision of technical documents and safety instructions. Where applicable this document incorporates information relevant to these Directives and Approvals. To confirm the Approvals applying and if the product is CE marked, check the serial number plate markings and the Certification, see the last page of this document.

1.3.2. Explosive atmosphere

This section should be read carefully for the pumps operating at explosive atmospheres.

Only the products certificated for the explosive atmospheres should be used at the explosive atmospheres.

Detailed information about the operating conditions at the explosive atmospheres are found in Directive on Equipment for Potentially Explosive Atmospheres 2014/34/UE (ATEX).

The pumps to be used at the explosive atmospheres should never be used at areas apart from the specified areas.

1.3.2.1. Intended use - ATEX

The centrifugal pumps of the series ESN-EX or ESH-EX are Category 2 equipment according to the European Directive 2014/34/EU. They are designed to operate in Zone 1 (due to the presence of flammable gases or vapours of subgroups IIIA and/or IIIB) and in Zone 21 (due to the presence of combustible dust of dust subgroups IIIA, IIIB and IIIC).

The assembly is suitable for operation with flammable liquids of sub-group IIA or IIB (ZONE 1).

The user must verify that the equipment purchased is suitable for operation in his facilities, according to the existing zone classification and the characteristics of the products present.

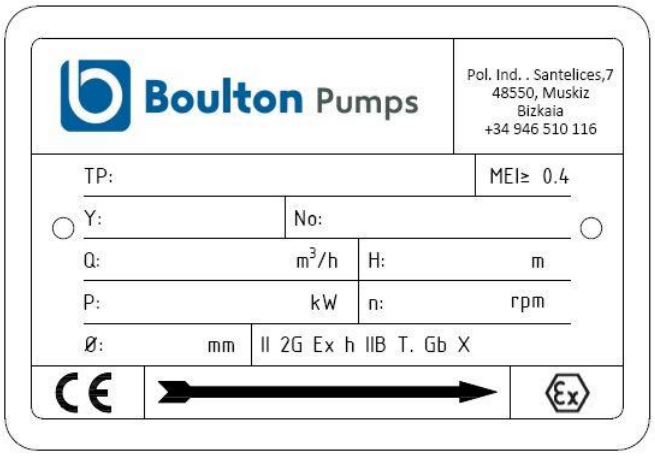
The marking of these centrifugal pumps according to Directive 2014/34/EU is:

CE Ex II 2GD Ex h IIB IIIC TX Gb Db X

or also

CE Ex II 2G Ex h IIB T. Gb X

CE Ex II 2D Ex h IIIC T...°C Db X



The "X" in the marking indicates "Special Conditions of Use":

1) It is a prerequisite for ensuring the safety of the equipment against the risk of explosion according to the requirements of Category 2 that **the centrifugal pump must at all times be operated in a primed condition with liquid inside**. The user who must ensure a sufficient liquid level to cover the impeller must observe this requirement.

2) The maximum surface temperature of the equipment depends on the pumped fluid:

Temperature class of the centrifugal pump	Maximum surface temperature	Maximum fluid temperature
T3	200ºC	180ºC
T4	135ºC	110ºC

Table 1

The user must check that the minimum ignition temperature of the flammable substances present or pumped is:

- For pumps marked T4: Higher than 135°C for flammable gases and vapours or temperature class T4, T3, T2 or T1.
- For pump with T3 marking: Over 200°C for flammable gases and vapours or temperature class T3, T2 or T1.

For ESN-EX or ESH-EX pumps with marking for areas with combustible dust, the user must observe the following safety margins, specified in EN 1127-1 and EN 60079-14, with regard to the minimum cloud (TMIN) and layer (TMIC) ignition temperatures of the substances that may be present:

- $(2/3 \times TMI_{Nube}) \geq$ Temperature marking in °C of the centrifugal pump.
- $(TMI_{Capa} - 75K) \geq$ Temperature marking in °C of the centrifugal pump.

Therefore, the powdery substances present must have a self-ignition temperature:

- For pumps marked **T4 or T135°C**: greater than 203°C in a cloud and 210°C in a layer.
- For pumps with **T3 or T200°C** markings: over 300°C in a cloud and 270°C in a layer.

The manufacturer does not guarantee the safety of the ESN-EX or ESH-EX centrifugal pump against the risk of an explosive atmosphere if the instructions given in this manual are not strictly observed.

1.3.2.2. Operation

The centrifugal pumps have been assessed and are ignition safe to operate in a zone classified as ZONE 1 and ZONE 2 for flammable gases/vapours (IIA and IIB) and as ZONE 21 and ZONE 22 for combustible dust (IIIA, IIIB and IIIC). Also to operate with flammable liquids (IIA or IIB) indoors, under the conditions defined for ZONE 1 in internal parts. (*)

(*) The following definitions apply (Directive 1999/92/EC):

- "ZONE 1" as "working area in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is likely to occur in normal operation occasionally".

- "ZONE 2" means a "place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will persist for a short period only".

- "ZONE 21" as "working area in which an explosive atmosphere in the form of a cloud of combustible dust in air is likely to occur occasionally in normal operation".

- “ZONE 22" as a "place of work in which an explosive atmosphere in the form of a cloud of combustible dust in air is not likely to occur in normal operation or, if it does occur, will persist for a short period only".

Centrifugal pumps must always be primed, with liquid inside by submerging the impeller. The user must ensure this by the method he considers most appropriate.

The user of the pump must ensure that the pump does not operate against a closed outlet

The pump must be installed and operated in a horizontal position.

In the case of pumps with oil-lubricated bearings, the oil level in the bearing housing must be visible through the built-in sight glass.

The pump and its associated parts (motor, baseplate, pipes, etc.) must be equipotential and properly grounded.

1.3.2.3. Equipment with ATEX marking

The centrifugal pumps of the ESN-EX and ESH-EX series can be supplied with ATEX marked equipment from other manufacturers (motor, flexible coupling, mechanical seal). The installed electrical and/or mechanical equipment, with a given ATEX marking by third party manufacturers, must be checked and maintained according to the instructions given by the manufacturers of such equipment and with the frequency indicated in their corresponding manuals.

Inspections and maintenance of ATEX electrical equipment that may affect its ignition protection (according to its ATEX marking) must always be carried out in accordance with the EN 60079-17 standard.

The user must ensure that, after maintenance work, the installed electrical equipment has been connected in accordance with the instructions of the equipment manufacturer and in conformity with EN 60079-14.

1.3.2.4. Equipotentiality and Grounding

All metal parts of the assembly are equipotential. The equipotentiality is guaranteed by means of metal braids joining the different parts of the equipment or by means of the metal-metal joint. The equipotential connections must be checked periodically.

Special attention should be paid to the equipotential connection of the metal parts of the assembly, especially after maintenance work involving the disassembly of parts of the assembly. After such maintenance, the metal braids of the equipotential connection must be reconnected and it must be checked that there are no isolated metal parts.

The whole assembly must be properly grounded.

The user must ensure proper grounding of the installations. This grounding must be periodically checked as established in the Low Voltage Electrotechnical Regulations or equivalent national legislation.

1.3.2.5. Chemical compatibility

The user must ensure that the chemicals (gaseous or solid) that are or may be present in his premises are compatible with the construction materials of the pneumatic conveying system. These substances must not cause corrosion, exothermic reactions or physic-chemical alterations to the parts and components of the assembly (metal or non-metal parts, internal or external).

1.3.2.6. Lubricants

The lubricants used in the conveyor system must be chemically compatible and not generate exothermic reactions with the products that are or may be present inside the conveyor system or at its location.

These lubricants must have an ignition temperature of at least 185 °C (for T4 pumps) or 250 °C (for T3 pumps), which is 50K higher than the maximum surface temperature marked for the equipment.

1.3.2.7. Maintenance

The correct tightness of the pump parts and bolted elements must be checked periodically.

Special attention should be paid to the moving parts of such equipment: air gaps, seal bearings, shaft alignment, etc. Periodic checks should be made of:

- Condition of the bearings in order to detect possible wear or premature failure and to replace them if necessary. Special attention should be paid to signs such as abnormal noise, difficult rotation, loss of lubricant, discoloration, etc.
- Condition of seals, seals, etc., checking that they maintain protection against the entry of solid or liquid elements into the shafts.
- Correct alignment of shafts, verifying the absence of signs of friction between metallic elements.

1.3.2.8. Cleaning

Periodic cleaning of the external parts of the equipment should be carried out to prevent the accumulation of dust deposits, in particular in the vicinity of moving parts. Accumulations of dust thicker than 5mm should be avoided.

1.3.3. Monitoring

Pump and/or pumpset should be operated according to duty point and the limit described in nameplate.

The technical personnel should operate the pump within these limits and the status monitoring system should be used for the pump set.

Use of the monitoring system is important especially for the following areas of the pump:

- Temperature values on the pump casing.
- Temperature values in the sealing area.

In the systems where buffer liquid is supplied or double mechanical seal is available the buffer liquid should be observed.

- Temperature values in the bearing area.

For proper operation of the bearings, it would also be useful to monitor vibration and temperature values in the roller bearing.

- The pump should be operated according to ordered duty point.

1.3.4. Constructional requirements

When explosive fluid is pumped, all parts under pressure should be made of ductile material.

Coupling protection housings should be made of non-sparking materials.

Mechanical seals should never be operated dry. The sealing area should be filled with liquid completely as long as the pump operates. If you are not sure that the sealing area is filled with liquid, then the buffer liquid may be applied.

Frame of the pump and/or pump set should always be earthed.

1.3.5. Personnel qualification and training

All personnel involved in the operation, installation, inspection and maintenance of the unit must be qualified to carry out the work involved. If the personnel in question do not already possess the necessary knowledge and skill, appropriate training and instruction must be provided. If required the operator may commission the manufacturer / supplier to provide applicable training.

Always co-ordinate repair activity with operations and health and safety personnel, and follow all plant safety requirements and applicable safety and health laws and regulations.

1.4. RECYCLING

For products and arts, which will not be used and scraped, use the local or private waste collection services. If it is not possible, consult the nearest authorized service centre of Boulton Pumps.

ESN/ESH PUMPS

2.1. GENERAL

2.1.1. Pump Description

ESN/ESH series pumps are horizontal, radially split volute casing, single stage, end suction centrifugal pumps with closed impeller.

Dimensionally complies with EN 733.

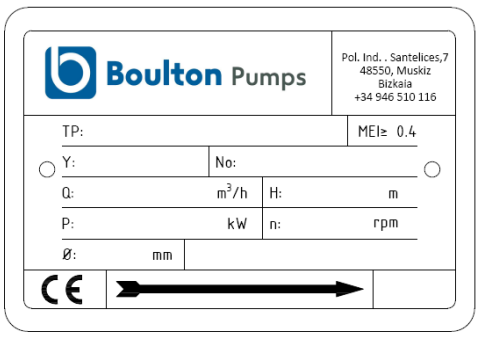
2.1.2. Applications

ESN/ESH series pumps are suitable for clean or slightly contaminated (max. 20 mg/dm$_3$) liquids with low viscosities and temperatures up to 140°C. The main application areas, among others, are:

- Water supply, water treatment and irrigation systems.
- Heating, chilled and cooling water systems.
- Water systems for industrial uses.
- Industrial circulating systems.
- Firefighting.
- Chemical and petrochemical industries.

2.1.3. Pump Designation

2.1.4. Pump Nameplate



- TP: Pump Type and Size
- Y: Production Year
- No: Serial Number
- Q: Capacity
- H: Head
- P: motor Power
- n: Speed
- Ø: Impeller Diameter
- → Direction of Rotation

2.1.5. Technical Data

Discharge Nozzle	: DN 32 up to 150 mm
Operating Temperature	: -20 °C - 100 °C with uncooled soft packing
	: 100 °C – 140 °C with cooled soft packing *
	: -20 °C – 140 °C with mechanical seal
Casing Pressure (max)	: 10 bar (16 bar)*
Permissible Liquids	: see section 2.1.2.

The service life of this product as determined and announced by the ministry is 10 years.

(*) Note: Contact our company for more detail.

2.2. UNPACKING, HANDLING AND STORAGE

2.2.1. Unpacking

- Check whether the package has been damaged during transportation.
- Remove unpackaged pump and accessories (if any) carefully. Check whether they have been damaged during transportation.
- If any damage has occurred during transportation, notify Boulton Pumps and shipping company about it immediately.
- Check whether all materials in the shipping list have been delivered. If there is any missing article, advise Boulton Pumps.
- Remove the liquid inside the pump, for preventing corrosion due to transportation.

2.2.2. Handling

2.2.2.1. General warnings

- Follow the rules at work to prevent occurrence of any accidents.
- Wear gloves, steel-tooled shoes and helmet during handling.
- You may use forklift, crane or hoisting ropes to lower wooden crates, packages, pallets or boxes depending on volume, weight and construction of them.

2.2.2.2. Lifting

- Prior to lifting and moving the pump or pump and motor on a common base plate find out the following:

  - Total weight and center of gravity.
  - Maximum outside dimensions.
  - Lifting points location.

- The load lifting capacity should comply with the weight of the pump or pump group.
- The pump or pump set must always be raised and transported in horizontal position.
- It is absolutely forbidden to stand beneath or nearby a raised load.
- A load should never remain in a raised position for longer than necessary.
- Accelerating and braking during the lifting process must be performed such that there is no danger to persons.

The pump or pump group should be hoisted as shown in the Figure 1a or Figure 1b in order to avoid from any deformation. (When the group is hoisted as a whole, never use the suspension hook of the electric motor.

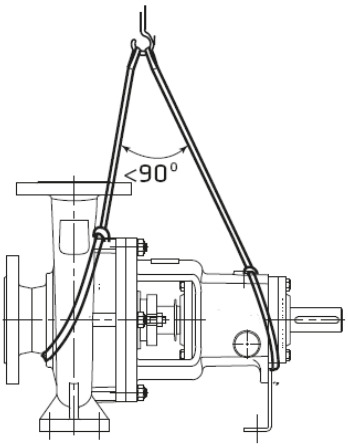


Fig. 1a. *Bare shaft pump*

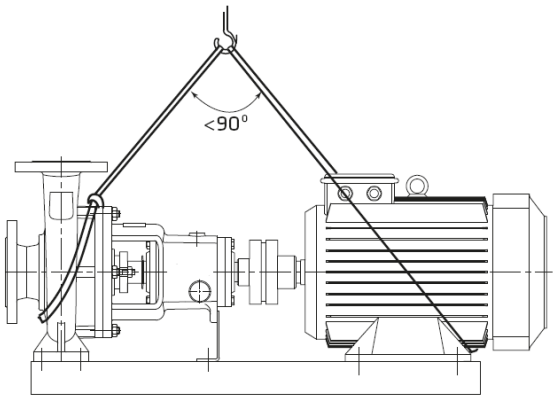


Fig. 1b. *Pump and motor over a baseplate*

2.2.3. Storage

- If the pump will not be installed in place immediately, it should be stored at a clean and dry place free of any frost hazard without excessive change in the ambient temperature.
- If the pump bearings are of grease-applied ones, extra grease should be applied to the bearings to prevent moisture ingress around the shaft.
- Necessary precautions should be taken to protect the pump against humidity, dust, dirt and foreign materials.
- The pump should be rotated manually by some turns occasionally (e.g. once in a week) to prevent pitting on the bearing surfaces and sticking of the pump.

2.3. INSTALLATION ON SITE

ATTENTION Installation has to be carried out in accordance with EN 60204-1.

Installation of the pump on site and levelling and adjustments of it should be performed only by qualified personnel. Improper installation or pump base (foundation) may cause failure. Such situations are excluded from warranty.

2.3.1. Bare Shaft Pump

- If the pump is purchased as bare shaft pump, then first a proper baseplate should be constructed to connect the pump and motor group. The baseplate should be designed and manufactured in such a way that it will have resistance to prevent vibration and deformation.
- If the pump is supplied without motor, proper motor and coupling should be selected before the group is installed.
- Following points should be taken into consideration when selecting motor:

  - Maximum power drawn by the pump along the entire operating range.
  - Running speed of the pump.
  - Applicable power supply (frequence, voltage, etc.).
  - Motor type (TEFC, Exproof, etc.).
  - Motor connection form (pedestal, flanged, horizontal, vertical, etc.).

- Rated motor power, rpm and type of drive should be taken into consideration when selecting coupling.

2.3.2. Preparation for Installation

Prior to installation of the pump in place:

- Suction and delivery flanges should be cleaned thoroughly.
- Protective film on the pump shaft should be removed.
- If the pump has been stored temporarily, the liquid oil in the bearings should be drained completely (in case of pumps manufactured with liquid oil) and the bearings should be cleaned by a proper cleaning agent and then oiled again. This operation is not required for the pumps lubricated by grease and for the pumps using enclosed type of ball bearing.

2.3.3. Installation Site

ATTENTION The pump should be installed at a well-ventilated place free of freezing and explosion risk.

- There should be sufficient space around the pump being installed to allow easy access for maintenance of the pump as well as sufficient space above the pump to hoist it when required.
- Suction pipe of the pump should be short as far as possible.

2.3.3.1. Foundation

ATTENTION You should work carefully for preparation of the pump base and installation of the pump group in place. Improper and careless installation may cause excessive vibration and premature wear of the pump equipment as well as pump failure.

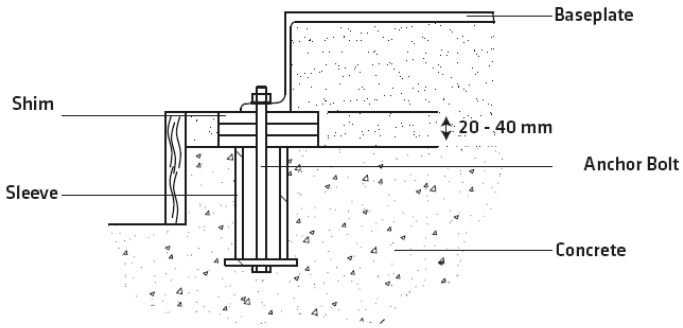


Fig. 2. *Foundation, baseplate and fitting the shims*

- Sizes of the foundation concrete should be determined on basis of minimum 10% excess of the frame dimensions.
- Pump foundation should be independent of other foundation and platforms.
- Pump foundation should be capable to absorb vibrations and bear the loads to apply on the pump unit during operation.
- Place and dimension of the anchor bolts should be determined according to the hole dimensions of the pump unit.
- Washer should be used to prevent tension and distortion when tightening the foundation bolts.
- In order that the foundation bolts should align with the connection holes of the frame exactly and to allow for minor adjustments, the bolts are inserted into the bushings. The bushings should be place in such a way that they will not exceed top surface of the foundation concrete.

2.3.3.2. Placement of the Pump Group

- Preparation and pour of the foundation concrete mass.

  - The concrete mass is formed according to its dimensions.

  -The locations of the anchor bolts are measured and marked carefully and Styrofoam is cut to the dimension, placed and fixed.

  -The concrete is poured.

    Volume ratio: Cement 1: sand 2: gravel 4.
    Concrete hardens within 7 days (hardening may be shortened by use of special cement).

  - Upon hardening of the concrete, the Styrofoam is burned and removed. Locations of anchor bolts appear in the concrete.

  - Top surface of the concrete and holes of the anchor bolts are cleaned.

- Placement of the frame on the foundation concrete mass (first adjustment).

  - Anchor bolts are mounted on the frame.

  - The frame is placed on the flattening chocks and the anchor bolts remain suspended in the holes. Make sure that the anchor bolts remain vertical.

  - Levelness of the frame is controlled in both directions from the pump and engine placement location by use of precise spirit level 0,25 ÷ 0,40 mm/m is acceptable.

  - Anchor holes are fileed with concrete. Anchor bolts are thus fixed.

    Volume ratio: Cement 1: sand 1.5: gravel 3.
    Concrete hardens within 7 days (hardening time may be shortened by use of special cement).

- Fixing of the frame on the foundation concrete mass exactly by adjustment.

  - The area about 30mm between the foundation concrete mass and frame is formed and concrete is poured through the holes in the frame.

    Volume ratio: Cement 1: sand 2.
    Concrete hardens within 2 days.

  - Frame remains adjusted and fixed on the foundation concrete.

2.3.4. Installation of the Piping System

2.3.5.1. General warning

ATTENTION Never use the pump as a point of support or bearer for the piping system.

- The piping system should be supported at points near to the pump. For this purpose, after completion of the installation of the piping system, loosen the bolts of the suction and delivery flanges and control whether the piping system applies any tension on the pump. The maximum allowable forces and moments on the flanges are given in Table 2.
- Rated diameter of the suction and delivery flanges of the pump are not indicator of the correct sizes of the suction and delivery pipes at all. The rated diameter of the pipes and accessories used should be equal to or larger than the inlet diameters of the pump at least. Never use pipes and accessories having smaller diameter than the inlet diameters of the pump. Especially components such as bottom valve, strainer, dirt-retaining filter and check valves with larger free passage area should be preferred. In general, flow rates should not exceed 2m/s for the suction pipe and 3m/s for the delivery pipe. High speeds cause high pressure reduction and it, in turn, cause cavitation conditions on the suction pipe and loss arising from excessive friction on the delivery pipes.
- Pipe connections should be made with the flanges. Flange bolts should be made of proper material and in proper size. The flange bolts should be inserted between the flange bolts and centred in such way that it would not impair flow section.
- In case of excessive vibrations and systems operating with hot liquids, expansion parts should be used in order that any extra forces that may arise from thermal expansion are not transferred to the pump.
- Materials such as welding burrs, metal particles, sand and oakum arising from production of the piping system may remain in the pump and give damage to the pump. The suction and delivery flanges should be sealed blind washers in order to prevent such materials from entering into the pump during the assembly operations. After assembly, all pipe parts should be removed, cleaned, painted and reassembled. If dirt-retainer is used on the suction side of the pump, the dirt-retainer should be cleaned after working for several days.

<u>Allowable Forces and Moments on Flange</u>

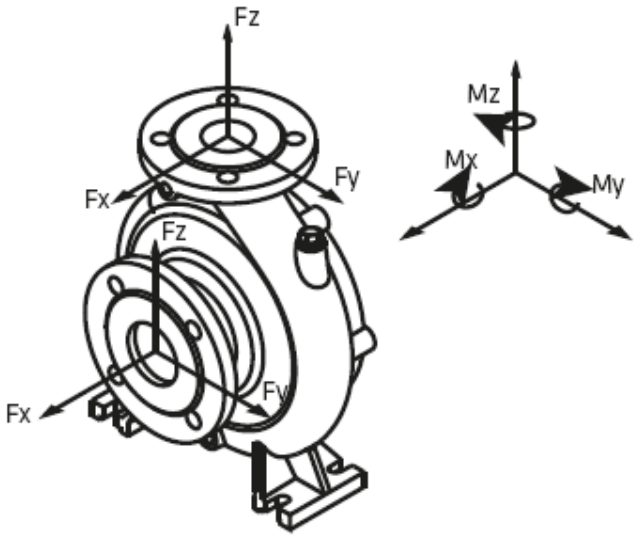


Fig. 3

Pump Type	Suction Flange									Dischage Flange								
	DN	Fx [N]	Fy [N]	Fz [N]	∑F [N]	Mx [Nm]	My [Nm]	Mz [Nm]	∑M [Nm]	DN	Fx [N]	Fy [N]	Fz [N]	∑F [N]	Mx [Nm]	My [Nm]	Mz [Nm]	∑M [Nm]
32-125 32-160 32-200 32-250	50	575	525	465	905	495	345	395	720	32	315	295	365	565	385	260	295	550
40-125 40-160 40-200 40-250 40-315	65	735	645	595	1145	525	385	415	775	40	385	350	435	680	455	315	365	660
50-125 50-160 50-200 50-250 50-315										50	525	465	575	905	495	345	395	720
65-125 65-160 65-200 65-250 65-315	80	875	785	715	1375	555	395	455	820	65	645	595	735	1145	525	385	415	775
65-400 80-160 80-200 80-250 80-315 80-400	100	1175	1045	945	1835	615	435	505	905	80	785	715	875	1375	555	395	455	820
100-160 100-200 100-250 100-315 100-400	125	1380	1245	1115	2160	735	525	665	1120	100	1045	945	1175	1835	615	435	505	905
125-200 125-250 125-315 125-400	150	1745	1575	1400	2735	875	605	715	1280	125	1245	1115	1380	2160	735	525	665	1120
150-200 150-250 150-315 150-400	200	2345	2095	1890	3650	1135	795	925	1650	150	1575	1400	1745	2735	875	605	715	1280

Table 2

Note: Above values are for GG25 material. For cast steel and stainless steel, multiply the above values by 2. For GGG40 material, multiply by 1.3. Please contact our company for more information.

2.3.5.2. Suction pipe

- The suction pipe should be definitely watertight and should not be arranged in a way to cause formation of air pockets. In other words, if it is supplied from a reservoir higher than it (system with elevated suction/supply), the suction pump should be slightly declined towards the pump; and if the pump is supplied from a reservoir lower than it (system with suction depth), than the suction pipe should be gradually inclined slightly towards the pump. Figure 3a and 3b.

- In order to keep the loss from friction, sharp elbows should not be used; and abrupt change of direction and section should be avoided and suction pipe should be made short as far as possible. If it is required to make change of section on a horizontal suction pipe, an eccentric conical spacer with its flat side on the top should be used.

ATTENTION

If the pump is supplied from a reservoir higher than it, an insulation valve should be used to keep the axis on the suction pipe horizontally. This valve should always be open when the pump operates and it should never be used as flow rate adjusting valve (Caution: Throttle of the valve may cause the pump to operate with cavitation).

2.3.5.3. Delivery pipe

- A flow control valve should be connected on the delivery pipe, near the pump as far as possible in order to adjust the flow rate and delivery head.

- If the delivery head of the pump is more than 10 m or the delivery line is quite long, a check valve should be connected between the pump and flow rate adjusting valve on the delivery pipe in order to protect the pump against water hammers when stopping the pump or prevent backflow.

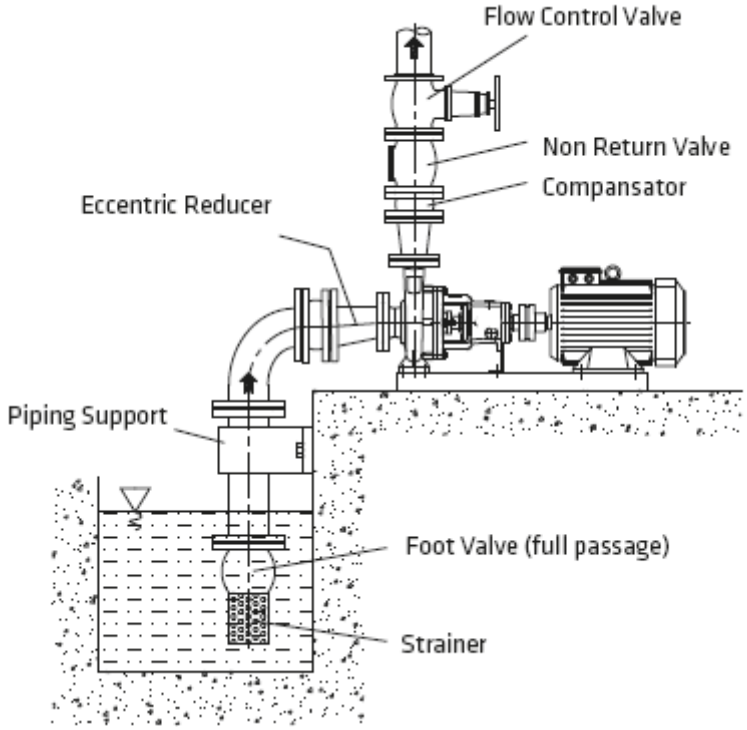


Fig. 4. *Suction Lift*

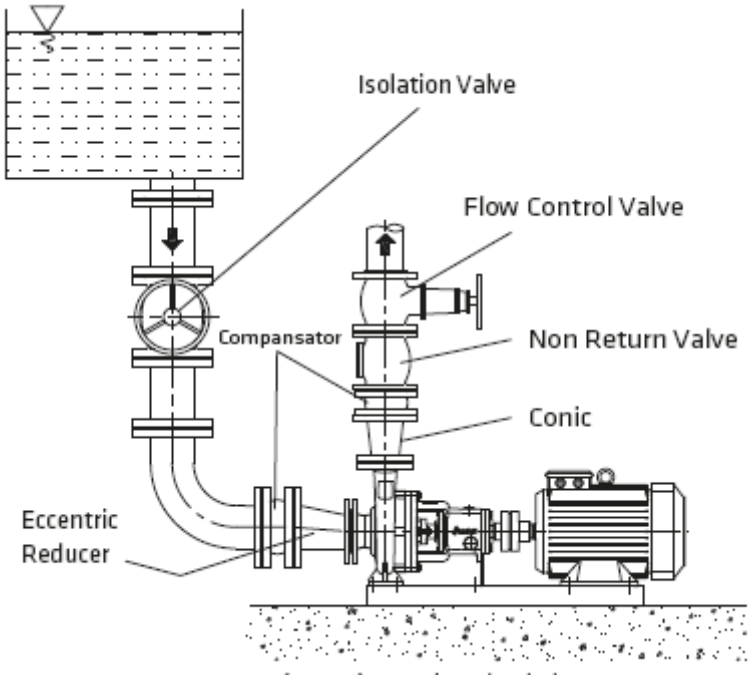


Fig. 5. *Suction Flooded*

ATTENTION After installation of piping system, coupling alignment should be checked and if necessary it should be adjusted again.

2.3.5.4. Auxiliary pipe connections and accessories

Depending on the application auxiliary pipe connection (drainage etc. necessary for the pumping system) and/or accessories to check the operating conditions (pressure gages, temperature gages etc.) may be made up and laid.

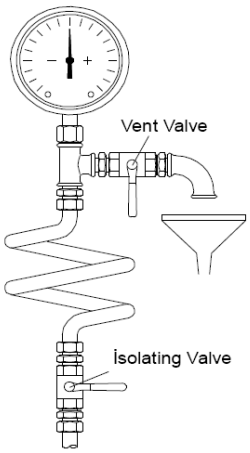


Fig.6

- Pressure and vacuum gauges must be properly anchored and connected at the measuring points located on the pipes approximately 2D close to the flanges with approximately 8 mm diameter tubing with pig tail configuration to lessen pressure fluctuation. For safety purposes isolating and vent valves should be fitter before the gauges (Fig. 6).
- Every pump is fitted with connection on the pump casing to drain the pump (Fig. 7). If required the pump drain can be piped to a suitable reservoir. The pump draining piping must be fitted with an isolating valve and both must be suitable for the maximum operating pressure of the pump.
- Cooling, sealing and flushing of seal piping must be connected only to the designated connections located on the pump (Figure 9, 10).

d1: Pressure gauge (discharge)
d2: Pressure gauge (suction)
d3: Filling or vent
d4: Drain
d5: Oil Filling (if applicable)
d6: Oil Drain (if applicable)
d7: Oil Level Indicator (if applicable)
d8: Seal Water Drain

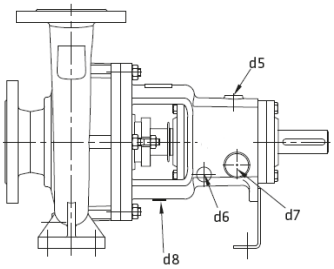


Fig.7

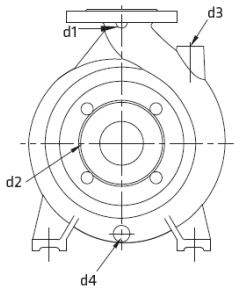


Fig.8

F1: Seal flushing liquid inlet from external source.

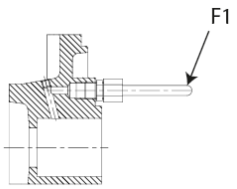


Fig.9

Q1: Mechanical seal quench liquid inlet from external source.
Q2: Mechanical seal quench liquid outlet.

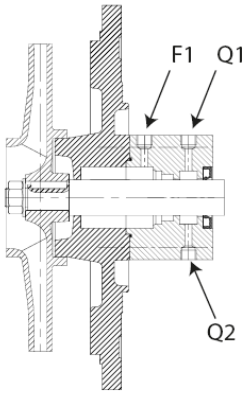


Fig.10

2.3.5. Coupling Adjustment

ATTENTION

After installation of the baseplate and system connections, the coupling adjustment should be controlled finally. The reason that proper adjustment of the entire system is responsibility of the purchaser.

ATTENTION

"Coupling Adjustment" is to ensure that the rotation axes of the motor and pump should be on the same plane. If ESN/ESH type pumps are ordered with motor and baseplate, it is delivered with the coupling adjustments made at the factory. However, this adjustment may be easily impaired during transportation, handling, installation on site and installation of the system. For this reason, the coupling adjustment should be performed again after installation of the group on site, disregarding the adjustment made at the factory.

The most important factor for problem-free operation of the pump group is correct coupling adjustment. The basic reason of a number of problems such as vibration, noise, bearing heating and overload is a coupling unadjusted or improperly adjusted. For this reason, coupling adjustment should be performed very well and controlled frequently.

Elastic coupling should not be regarded as a component to correct an improper adjustment. Elastic coupling does not correct a poor axial adjustment between the pump and motor and does not remove excessively poor adjustments.

A metal part (steel ruler or gauge, etc.) and a precise caliper are required to perform coupling adjustment (special equipment should be used for very fine and precise adjustment). Axial run-out of the coupling (see Figure 11) should not exceed 0.1 mm.

There may be two types of adjusting mistakes on the coupling:

a) Angular mistake.
b) Parallel displacement mistake.

In order to control the angular mistake, the distance between two parts of the coupling should be measured mutually on horizontal and vertical planes. The clearances measures at these four points should be equal (Figure 12a, 12b).

In order to control the parallelism mistake, a gauge with straight edge is pressed on a part of the coupling in parallel to the axis and the position of the gauge related to other part is observed. The gauge should contact with both two parts simultaneously and along its entire edge. This process

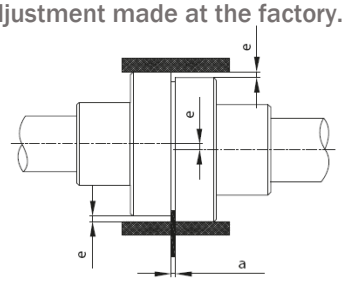


Fig.11. *Aligning a flexible coupling.*

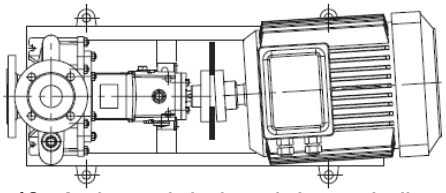


Fig.12a. Angle error in horizontal plane and adjustment.

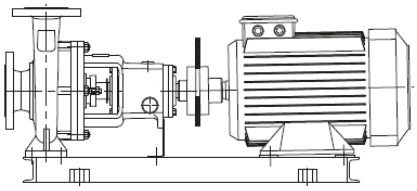


Fig.12b. Angle error in vertical plane and adjustment.

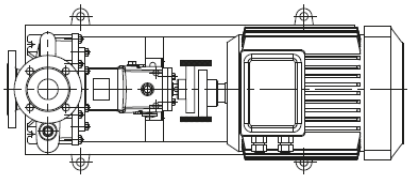


Fig.12c. Parallel sliding error in horizontal plane and adjustment.

should be performed at two opposite places on the horizontal and vertical plane (Figure 12c, 12d).

Adjustment mistakes may be on the horizontal and/or vertical plane. Mistakes on the vertical plane may be made by putting thin metal sheets under the pump or motor mounts and the mistakes on the horizontal plane by benefiting from the gaps in the connection holes or sliding the engine on the horizontal plane. Manner and order of the coupling adjustment is shown in the Figures 12a, 12b, 12c and 12d, respectively.

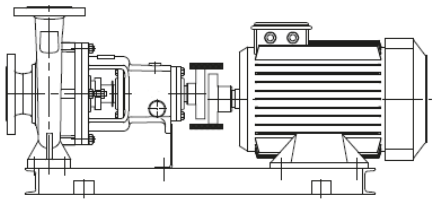


Fig.12d. Parallel sliding error in vertical plane and adjustment.

2.3.6. Minimum Flow

ATTENTION

If there is possibility of the pump operating with its delivery valve is closed completely (that is, at zero flow rate) or almost closed (that is, at very little rate), a by-pass valve should be used on the outlet flange of the pump or on the delivery pipe just after the pump, but in advance of the control valve should be used. If such a valve is not used and the pump operates for a long time, almost all power given by the engine converts to thermal energy and transfers to the delivered liquid. This situation may cause overheating and, consequently, cause significant failures.

2.3.7. Electrical Connections

ATTENTION

- The electrical motors have to be built in accordance with EN 60034-1.
- Enclosures of electrical motors and control systems on the pump unit shall as a minimum give protection in accordance with EN 60529 IP22. But in determining the degree of protection of enclosures of electrical motors and control systems on the pump unit the operating and environmental conditions must be taken into consideration.

- Electrical connection should be done by a qualified electrician. Current national regulation and motor manufacturer's instructions must be observed.
- Take all safety precautions listed in "Safety Instructions". Disconnect all power supplies prior to doing any work.
- The supply cable must be laid in such a way that it never touches the pipework, pump and motor casing.
- Check voltage, phase and frequency on motor nameplate with the mains.
- The electric motor must be protected against overloading by means of circuit breakers and/or fuses. Circuit breakers and fuses must be selected in accordance with full load amperage of the motor appearing on the motor rating plate.
- It is recommended to use PTC (Passive Thermal Control) on motor, but this is optional depending on customer requirement. In case of using PTC, these should be connected via corresponding terminals in the terminal box and the PTC should be connected to the thermal trip mechanism.
- Prior to connecting the electrical wiring rotate the pump shaft by hand to make sure rotor rotates easily.
- Connect the electrical wiring in accordance with local electrical codes and make sure to ground the motor.
- The connection diagram can be found in the terminal box of the motor or in the instruction manual.
- The mains connection on the tagboard depends on the nominal power of the motor, the power supply and the type of connection. The necessary connection of the bridges in the terminal box is shown in the following (Table 3 and Fig. 13a, 13b, 13c).

Type of switch	Motor Power $P_N \leq 4\ kW$	Motor Power $P_N > 4\ kW$
	Power supply 3 ≈ 400 V	Power supply 3 ≈ 400 V
Direct	Y – connection (8b)	Δ - connection (8a)
Y / Δ - start	Impossible	Remove connecting Bridges (8c)

Table 3

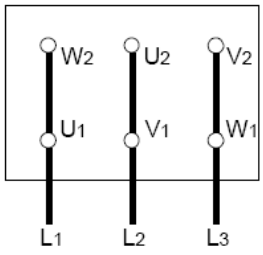


Fig. 13a. *Δ - connection*

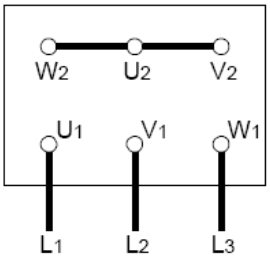


Fig. 13b. *Y – connection*

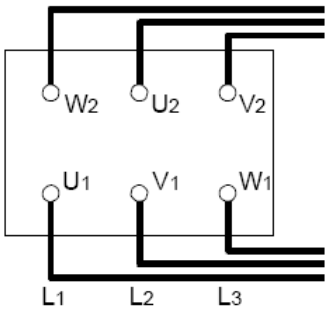


Fig. 13c. *Y / Δ connection*

ATTENTION

In the case of three-phase induction motors with Y / Δ – connection it must be ensured that the change-over points between star and delta follow on from one another very quickly. Longer change-over times may result in pump damage (Table 4).

Motor Power	Y –set time
≤ 30 kW > 30 kW	< 3 sec > 5 sec

Table 4

2.3.8. Final Controls

- After all operations given above are completed, the coupling adjustment should be controlled once more in accordance with the section 2.3.5. And if it is incorrect, it should be corrected.
- The pump rotor should be rotated several times manually to make sure it rotates easily.
- All security guards should be put in place.
- And the pump group should be operated and you should allow until the operating and heating conditions are reached.
- At the end of this term, the pump is stopped and thin metal sheets are put under the motor mounts only to perform coupling adjustment for the last time.
- Final coupling adjustment is especially recommended to be performed at the operating temperature.
- The pump should never be operated before the safety guards are put in place. This is a security and safety rule at workplace which should be definitely observed.

2.4. START UP / SHUT DOWN

2.4.1. Preparation

2.4.1.1. Lubrication Control

- The bearings of ESN/ESH type pump are always lifetime grease lubricated. Lifetime grease lubricated bearings are maintenance-free.
- Grease lubricated bearings are factory packed with grease enough for one year operation before dispatch. Before initial start up pump it should be ascertained that no dirt has penetrated inside the bearing during transport or installation on site. Otherwise, the bearings should be cleaned out and repacked with fresh grease before start up.

ATTENTION

- The oil lubricated bearing housing is delivered without oil and on it, there is a warning symbol for indication. The housing should be filled with oil until the oil comes on the middle (see. Figure 14 and 15).

- Check lubrication (see Section 2.6).

2.4.1.2. Venting and Priming

- Make sure that the pump and suction pipes are completely filled up with water. There is no problem for the pumps which have positive suction head. If there is a valve on suction line, it must be opened and air taps are loosened to enable the water replaces air in the pump, until it is completely full with water.
- If there is a foot valve on the suction line, the air should be emptied out.
- If the system has a vacuum pump, water is brought up in the rising pipe and filled up the pump through this vacuum pump. When water is risen up to the highest point then the pump is started up.

ATTENTION Make sure the pump never runs dry.

2.4.1.3. Checking the direction of rotation

ESN/ESH type pumps rotate in clockwise when it is looked from coupling to the pump. This direction is already indicated on the pump nameplate by an arrow. Check this by switching the pump on, then off again immediately. Fit the coupling guard back in place if you took it out.

2.4.2. Start Up the Pump

- Check if the shut off valve in the suction line is open and the shut off valve in discharge line is closed.
- Switch on the circuit breaker and run the motor.
- Wait until the motor reaches the full speed (on star-delta running motors wait until it switches on delta).
- Open the discharge valve slowly while watching the ampermeter on the control panel (if the discharge line is empty do not turn on the valve fully open on first start up. Turn it on slowly to maintain the value on the ampermeter is under the rated current value of the motor).
- When the valve is if fully open, check the pressure on the manometer and see it is the same with the duty point pressure. If the pressure on the pressure gauge is lower than duty point pressure brings them to the duty point value by slightly closing the valve. If it is higher value, check your installation, particularly head again.

The pump should be shut down at once and the trouble should be corrected if the pump is running at it rated speed and found any of the following faults:

- Pump doesn't deliver any liquid.
- Pump doesn't deliver enough liquid.
- Flow is going down.
- Discharge pressure is not enough.
- Driver overloaded.
- Vibration on pump.
- High noise level.
- Bearing overheating.

2.4.3. Shut Down the Pump

- Slowly close the shut-off valve in the discharge line.
- You may shut down pump without closing the shut-off valve if there is a device for water hammer protection on the discharge line or the water hammer is not a considerable level.
- Switch off the drive. Ensure the pump set runs down smoothly and quietly to a standstill.
- Shut off external sealing liquid supply, if supplied to relieve stuffing box pressure.
- If the set is to remain out of services for a long time close the shut-off valve in the suction pipe. Close off the auxiliary connections. In the event of frost and/or prolonged standstill, drain the pump or otherwise protect against freezing.

2.4.4. Checks to be Made While The Pump is Running

ATTENTION

- The pump must never run dry.
- Never run the pump for a long period against a closed discharge valve (at zero flow).

- The bearing temperature may exceed the ambient temperature by up to 50 °C. But must never rise above 80 °C.
- The valves in the auxiliary lines must remain open while the pump is running.
- If the pump has soft packing type stuffing boxes, these should drip during operation. The gland nuts should only be lightly tightened. In case of excessive leakage from the stuffing box tighten the gland nuts slowly and evenly until the leakage is reduced to the dripping state. Check the stuffing box for overheating by hand. If the gland nuts can not be tightened any further remove the old packing rings. Make sure that each packing ring is cut of correct size. The joint in successive ring should be offset to each other.
- If the pump has a mechanical seal, experience only minor leakage or no visible leakage during operation. It is maintenance free. If there is considerable leakage from the seal, that means the seal surfaces are worn-out and it needs to be replaced. The operation life of the mechanical seal highly depends on the purity of the liquid.
- The flexible coupling elements should be regularly checked and replaced as soon as they are shown signs of wear.
- Occasionally check the motor current. Stop motor if the amperage is higher than usual; there may be jamming or friction in the pump. Make the necessary mechanical and electrical checks.
- Stand-By pumps should be run for a short time at least once a week to ensure they are in constant readiness for operation. Check the integrity of auxiliary connections.

2.5. LUBRICATION

ATTENTION It must be ensured that the bearings are lubricated constantly. Dry operating bearings may cause overheating, spark and permanent damage.

- In general, “lifetime greased” roller bearings are used in ESN/ESH type pumps.
- No maintenance is necessary for lifetime greased bearings.
- The roller bearings lubricated with grease are shipped with grease added in the factory.
- The roller bearings lubricated with oil are shipped without lubrication. The roller bearings of such pumps must be lubricated with a suitable oil at the workplace.

2.5.1. Application of Oil on Bearings

Oiled bearings are shipped without lubrication. Oil must be added on the bearings before the start-up of the pumps.

In order to add oil on the bearings:

- The air vent plug (232) is opened.
- The recommended oil is added from the opened part.

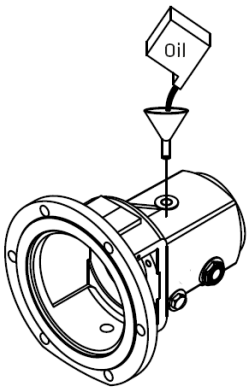


Fig. 14. *Adding Oil*

The oil is added until the oil level on the oil sight glass (234) reaches to the center.

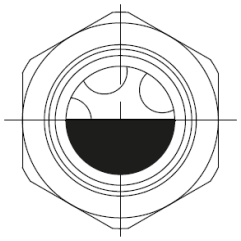


Fig. 15. *Oil sight glass*

ATTENTION The oil level must be monitored. The bearing temperatures may increase if the oil level exceeds the recommended level. The bearings are not lubricated sufficiently and failures may occur if the oil level is low.

The quality of the oil used must be high when adding oil to the bearings. For example; SHELL TELLUS with a viscosity of 46 cSt can be used in pumps.

The bearing types and the necessary oil amounts based on the pump size are given in the table:

Pump Size Group *	Shaft End Ø	Bearing Type	Grease (gr)	Oil (lt)
A	24	2 x 6306	8	0,13
B	32	2 x 6308	10	0,34
C	42	2 x 6310	12	0,50

Table 5

* Refer to Section 2.10. for pump size group.

The oil in the pumps must be replaced at the end of a working period of 3000 hours.

The oil reservoir must be checked frequently. It must be completed when decreased. The used oil must be drained, the oil reservoir must be cleaned and a suitable oil must be filled up to the gauge level at least once a year. The oil must be replaced within this period, if it is contaminated.

2.5.2. Application of Grease on the Bearing

- High quality NLGI 2 or NLGI 3 grease must be used in bearings.
- The grease must be replaced in every 12-14 months or at the end of each 3000 working hours.
- More frequent grease replacement may cause overheating and shortening of the bearing life.

ATTENTION The bearing temperature must never exceed the ambient temperature by maximum 50 °C. Also, it must not exceed 80 °C under no circumstances.

- The bearings of the pumps demounted for repair must be inspected and replaced, if necessary.
- It must be ensured that the greasing equipment and the reservoir are clean before adding grease to the bearings.
- Grease in suitable amounts must be added to the bearings.
- The temperatures of the bearings may increase in the case of adding excessive amount of grease.
- The temperatures of the bearings will decrease to the normal operating temperature when excessive grease is removed.

2.6. DISASSEMBLY, REPAIR AND REASSEMBLY

Before working on the pump, always disconnect the electrical connections and ensure that you take all the necessary actions to prevent undesired operation.

Strictly follow the instructions given in “Safety Instructions” section.

2.6.1. Disassembling the Pump

• Shut off the isolation valves on the suction and delivery line. Open the blind plug (230) and drain the water inside the pump.

• Dismantle the safety guards.

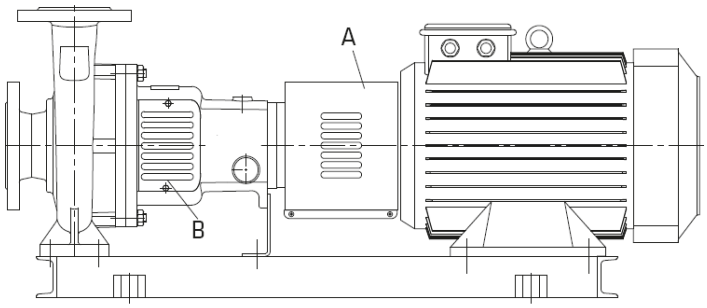


Fig. 16

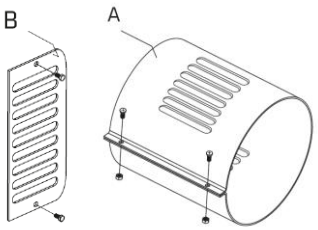


Fig. 17. Safety guards

- Drain the oil by opening the oil drain plug (231) on the bearing housing (030).

ATTENTION Analyse the drained oil. It can be used, if suitable; if not do not use it again and do not discharge it; send it to recycle.

- Disconnect the pump from the piping system by removing the suction and delivery flanges of the pump and auxiliary pipe connections. This procedure is not necessary for the pumps using coupling with spacer. The pump rotor can be removed without disconnecting the volute casing (001) from the piping systems in the pumps using such type of coupling.
- Disconnect the motor from the pump.

  - It is not necessary in spacer coupling applications.
- Remove the rotor section of the pump by demounting it from the baseplate.

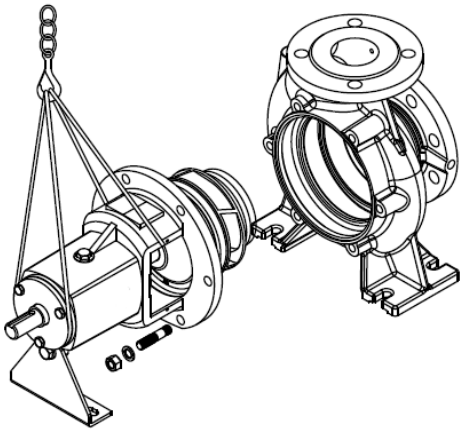


Fig. 18. Demounting the pump rotor group

- Tighten the rope by tying the ropes connected to the lever to the bearing housing.
- Disconnect the bearing housing (030) from the volute casing (001) by removing the studs.
- Remove the spacer coupling on pumps using couplings with spacers.
- Remove the coupling part on the pump shaft (060) with the help of a puller.
- Remove the coupling key (211).
- Remove the impeller nut (065).

ATTENTION The sharp areas on the impeller edges can injure. Use protective gloves.

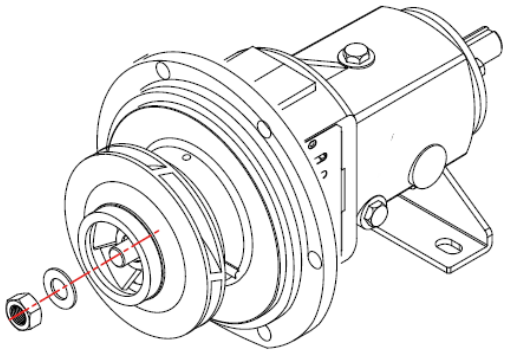


Fig. 19. *Disassembly of impeller*

- Remove the impeller (050) with lever or screwdriver and etc.
- Remove the impeller key (210). Use rust remover solvent, if necessary.
- Remove the O-ring (420).

ATTENTION The O-rings used after dismantling the pump must always be replaced.

Pumps with Soft Packing:

- Remove the soft packing seal cover (040).
- Remove the gland studs (300) and take the gland (042).
- Remove the soft packing (400) and lantern ring (046) respectively.
- Refer to (Section 2.6.4.1) for soft packing.

Pumps with Mechanical Seal:

- Take the mechanical seal spacer sleeve (049) or shaft sleeve (070).
- Remove the mechanical seal (405).

ATTENTION Be careful when removing the mechanical seal. Any potential impact on the stationary element of the mechanical seal may cause the breakdown of the mechanical seal.

- Remove the mechanical seal cover (043).
- Refer to (Section 2.6.4.2) for mechanical seal.

- Remove the bearing cover (034 or 035).
- Remove the circlip (220) from their slots.
- Remove the shaft (060) from the bearing housing (030) by hitting it from the coupling side.
- Remove the bearings on the shaft.

2.6.2. Tightening Torques

ATTENTION The following tightening torques must be taken into consideration when tightening the bolts and nuts during installation.

Thread Diameter	Tightening Torques (Nm)
M6	7
M8	20
M10	40
M12	65
M14	100
M16	130
M18	140
M20	140
M22	140
M24	200

Table 6

2.6.3. Assembling the Pump

2.6.3.1. Getting Prepared for Mounting

- It must be ensured that the parts to be used are clean before starting mounting. Clean the oil, dirt on the parts with a solvent.

ATTENTION Be careful with processed surfaces. The defects on the processed surfaces may cause permanent damages.

- The impeller and the body must be inspected for wear, fraction and breakdown.
- Replacement is necessary if the radial clearances between the impeller and the body exceed 1 mm.
- It must be ensured that the surfaces of the O-ring and/or bolts are clean.

2.6.3.2. Mounting

The mounting procedure is the reverse of the demounting procedure. Exploded view or cross sectional view can be referenced during mounting.

Insulated gloves must be used when heating the bearings. Heated bearings may cause physical damages.

- Heat the bearings (200) up to 95 ºC with bearing heating apparatus.
- Place the heated bearings on a shaft (060) in a suitable manner.
- Wait until the temperature decreases to the ambient temperature after placing the bearings on the shaft.
- Place the circlip (220) in to the bearing housing (030). (The cross sectional view can be referenced for the location of the circlip.)
- Insert the shaft group inside the bearing housing from the coupling side.

- After inserting the shaft group in the bearing housing (030), insert the circlip (220) on the coupling side. Oiled or externally greased bearing housings do not have circlip.
- Place the bearing covers (034 or 035).
- Place the thrower (088).
- Place the seals by connecting the seal covers (040 or 043) with the bearing housing (030). Attach the mechanical seal spacer sleeve (049) or shaft sleeve (070), if used.
- Attach the impeller key (210).
- Insert the impeller (050) and tighten the impeller nut (065).
- Mount the O-ring (420) of the body.
- Connect the rotor group with the volute casing (001).

ATTENTION It must be ensured that the O-rings are seated properly and they are not crushed or compressed during mounting.

- Insert the pump into the baseplate and couple the motor.
- Connect the suction – delivery and auxiliary pipes.
- Start-up the pump group as described in Section 2.4.

2.6.4. Shaft seal

2.6.4.1. Pump with soft packing gland

- While starting to change soft packing thoroughly clean the stuffing box and shaft (or shaft sleeve, if used).
- Cut enough number of pieces suitable length diagonally from suitable size of soft packing. Roll it up over the shaft (or shaft sleeve, if used) and see the ends are in full contact.
- Insert the first packing ring as the joint will place up, and press home using the gland cover.
- Place the second ring as joint will place down. Insert all the packing rings in the same way. If there is a lantern ring put into place too.
- Place the gland and fully tighten, thus the packing rings will take the shape of stuffing box, the loosen it. Slightly tighten by turning the shaft and stop tightening when it slightly brakes the shaft.
- After starting operation, it is necessary that water drip from the packing. This dripping shouldn't be less than 10 cm^3/min and more than 20 cm^3/min. Adjust dripping by uniformly tightening or untightening the gland nuts slightly.
- Check the temperature of soft packing after two hours operation after gland adjustment to avoid overheating.

2.6.4.2. Pump with mechanical seal

• When operating properly the mechanical seal has no visible leakage. Usually mechanical seals do not require maintenance until leakage is visible but its tightness is to be checked regularly.

• Follow the instructions of mechanical seal manufacturers for the pumps having mechanical seal and NEVER RUN IT DRY!

• The mechanical seal diameter and soft packing cross section of ESN/ESH type pumps are given below Table 7.

Pump Dimension Group	Shaft end Diameter Ø	Mechanical Seal Diameter Ø	Soft Packing Dimension
A	24	30	8x8
B	32	40	10x10
C	42	50	12x12

Table 7

Note: Different types of mechanical seals with different diameters can be applied for various applications. Please ask Boulton Pumps for more information.

2.7. SPARE PARTS

BOULTON PUMPS guarantees to supply the spare parts for ESN/ESH type pumps for 10 years.

- You can provide any spare parts easily.
- Lets us know the following details on the name-plate, when you order spare parts.

Pump Type and Size : (ESN-65 - 200)

Motor Power and Speed : (30 kW - 2900 rpm)

Prod. Year and Serial Number : (2019 - 20503)

Capacity and Head : (120 m^3/h - 57 m)

- If you prefer to have spare parts in your stock, we recommend you to have the following quantities for a two years operation depending on the number of same type of pumps ***(Table 5)***.

Part No.	Part Name	Number of pumps in the system						
		2	3	4	5	6-7	8-9	10+
020* - 021*	Wear Rings (set)	1	2	2	3	4	5	50%
050	Impeller	1	1	2	2	3	4	30%
060	Shaft (incl. keys)	1	1	2	2	2	3	30%
070*	Shaft Sleeve	1	1	2	2	2	3	30%
200	Ball Bearings (set)	2	2	3	3	4	5	50%
400	Soft Packing (set)	4	5	6	7	7	8	100%
405*	Mechanical Seal	1	1	1	2	2	3	30%
420	O-Ring	4	6	8	8	10	12	150%

Table 8

2.8. FAULTS, CAUSES and REMEDIES

In this section, you will find operating faults that may arise and their causes (Table 9), and suggested remedies (Table 10).

FAULTS	POSSIBLE CAUSES
Pump does not deliver any water after start-up	1-5-7-10-11-13
Flow is going down or no flow at all	1-2-3-4-6-7-8-14
Driver overloaded	9-12-17-18-19-27-28
Bearing overheating	19-20-21-22-24
Vibration on pump	6-9-15-16-19-23-25
Noise level is high	4-6-26

Table 9

	POSSIBLE CAUSES	REMEDIES
1	May be air in the pump and/or suction line.	Fill the pump and suction pipe with liquid completely and repeat the start-up operation.
2	Air intake from the seal, suction pipe or connections. Pump intakes liquid with air.	Check all connections on the suction pipe. Check the seal and supply pressurized liquid to the seal, if required. Check immersion depth of the suciton pipe or bottom valve and increase the immersion depth, if required.
3	Air pocket in the suction pipe.	Check inclination of the suction line and whether there are parts susceptible to formation of air pockets and if there are mage necessary corrections.
4	There is air in liquid.	Eddies occur due to insu_cient immersion depth of the suction pipe causing to air intake. Check liquid level in the suction reservoir or increase immersion depth of the suction pipe / bottom valve.
5	Too much suction lift.	If there is no obstacle leading to clogging in the suction, check friction loss on the suction line and use suction pipe with large diameter, if required. If the static suction depth is too much, you should either increase the liquid level in the suction reservoir or move the pump to a lower level.
6	Pump is working at cavitation conditions.	NPSH of the plant is very law. Check the liquid level in the suction reservoir. Check whether there is excessive friction loss on the suction line. Check whether the insulation valve on the suction line is completely open. If required, reduce the pump to a lower level and increase load on the pump suction.
7	Insufficient manometric head.	Actual delivery head of the plant is higher than the specified one. Check the total static height and friction loss of the suction pipe. Use of pipe with larger diameter may act as remedy. Check whether the valves are completely open.
8	Increase at total manometric head.	Check whether the valves are completely open. Check whether there is any obstacle causing clogging in the suction pipe.
9	Pump is operating at lower manometric head.	Actual delivery head of the plant is less than the specified one. Machine the impeller diameter in accordance with the manufacturer's recommendation.
10	Reverse rotation.	Check whether the engine's direction of rotation complies with the direction of rotation indicated on the pump casing or name plate.
11	Speed is too low.	Check mains voltage and frequency or whether there is phase faults in the engine.
12	Speed is too high.	Reduce the pump speed, if possible or machine the impeller diameter according to the manufacturer's recommendation.
13	Impeller or check valve or strainer is clogged.	Clean the impeller or check valve or strainer.
14	Impeller or strainer is clogged partially.	Clean the impeller or strainer.
15	Partially clogged impeller.	Clean the impeller.
16	Worn out and defected impeller.	Replace impeller.
17	Mechanical frictions inside the pumps.	Check whether there is obstacle or bending on the pump rotor.
18	Soft seals worn excessively.	Loosen pressure bush of the seal.

19	Coupling misadjusted.	Check coupling rubber and readjust it.
20	Bearing covers are too tight.	Check the covers and make necessary corrections.
21	The pumped flow is less than the minimum flow required.	Increase the flow rate. Use by-pass valve or line, If required.
22	Existence of excess grease.	Remove the excess grease.
23	Bent shaft.	Check the shaft and replace it, if required.
24	Insufficient lubrication or lubricating grease dirty, contaminated.	Check amount of the lubricant. Clean the bearings and bearing housings and lubricate again.
25	Unbalanced rotating parts.	Check stability of the rotating parts.
26	Pump runs out of duty range.	Check the values of the area of operation.
27	The density or viscosity of the liquid pumped is higher than that originally specified.	Use engine of higher power.
28	Defects in motor.	Check the engine. Engine ventilation is not proper due to its position.

Table 10

2.9. EXPECTED NOISE VALUES

Power of motor P_N (Kw)	Sound pressure level (dB) *	
	Pump with motor	
	1450 rpm	2900 rpm
< 0.55	60	64
0.75	60	66
1.1	62	66
1.5	63	68
2.2	64	69
3	65	70
4	66	71
5.5	67	73
7.5	69	74
11	70	76
15	72	77
18.5	73	78
22	74	79
30	75	81
37	75	82
45	76	82
55	77	84
75	78	85
90	79	85
110	80	86
132	80	86
160	80	86

Table 11

(*) Without protective sound hood, measured at a distance of 1 m directly above the driven pump, in a free space above a sound reflecting surface.

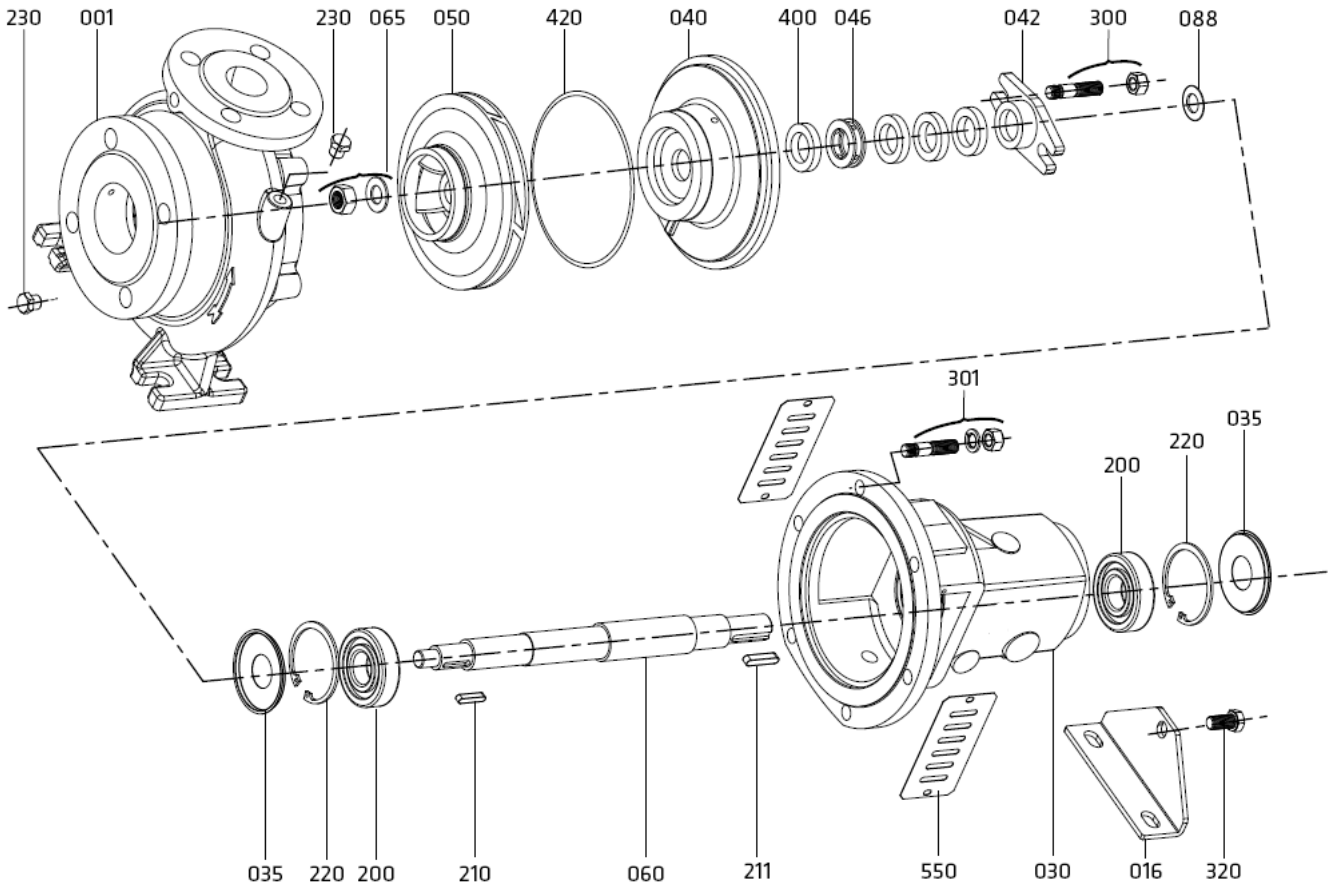
2.10. PUMP DIMENSION GROUP AND WEIGHTS

Type ESN	Dimension Group	Design Form	Shaft Diameter Ø	Weight (kg)
32-125	A	F1	Ø24	32
40-125				33
50-125				34
65-125				40
32-160				39
40-160				40
50-160				42
65-160				46
80-160				49
32-200		F2		41
40-200				45
50-200				48
65-200				51
32-250				53
40-250				57
50-250				57
40-315				67
100-160	B	F1	Ø32	80
80-200				63
100-200				87
125-200				97
150-200				150
65-250		F2		90
80-250				95
100-250				100
125-250				110
150-250				160
50-315				90
65-315				105
80-315				125
100-315				130
65-400				130
125-315	C	F1	Ø42	180
150-315				190
80-400		F2		175
100-400				180
125-400				200
150-400				230

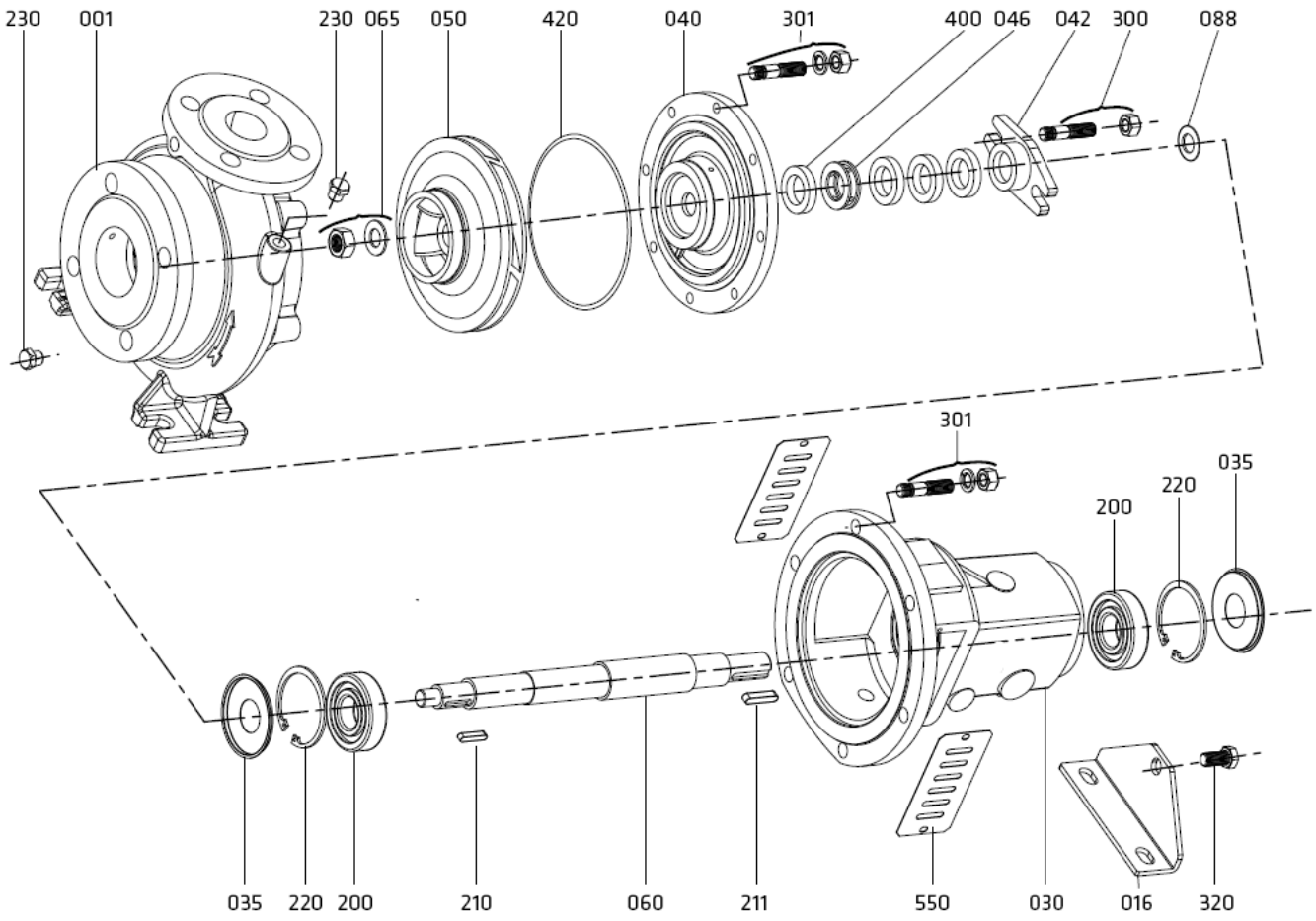
Table 12

2.11. SECTIONAL DRAWINGS

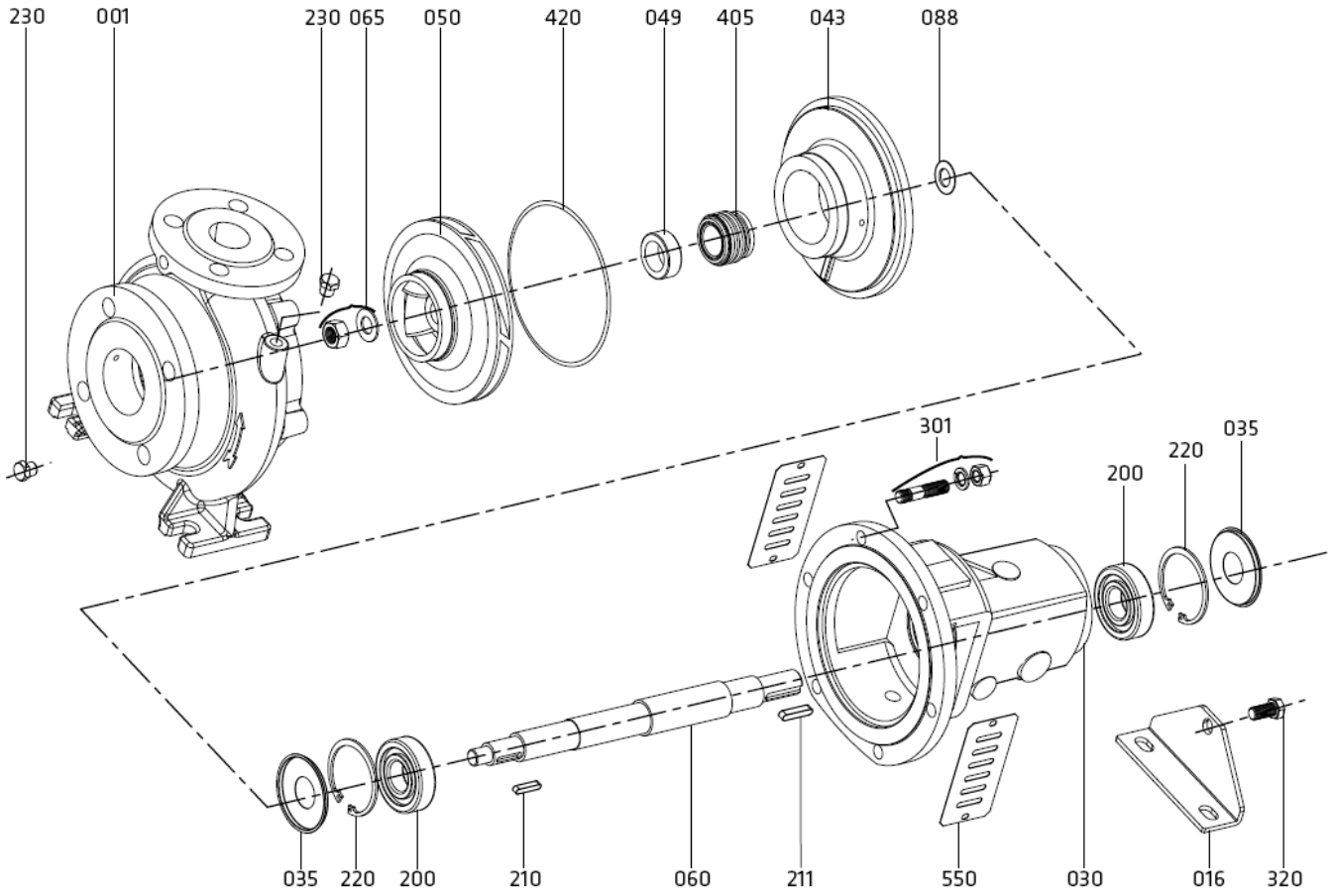
Form: F1 (Pumps with Soft Packing)



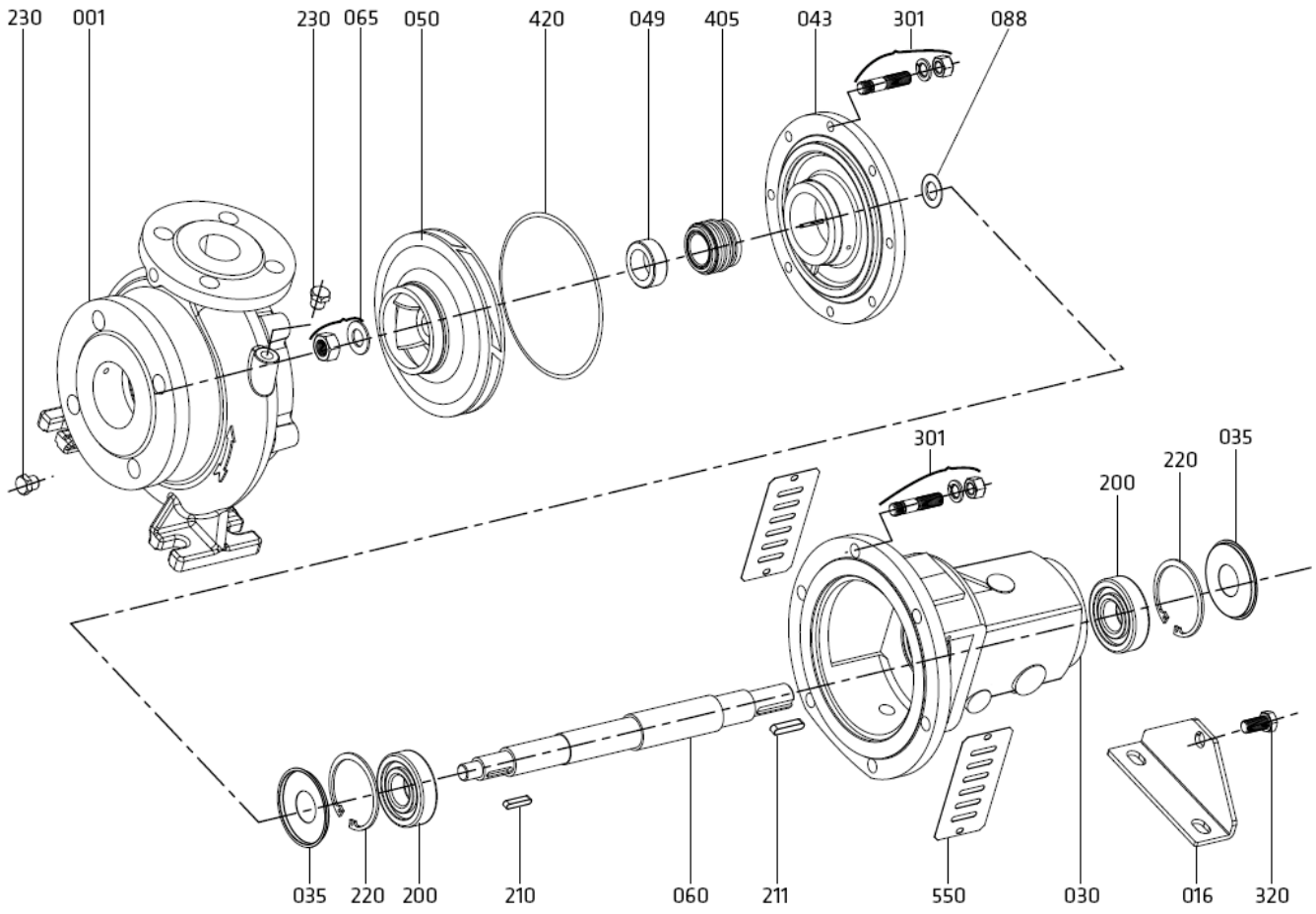
Form: F2 (Pumps with Soft Packing)



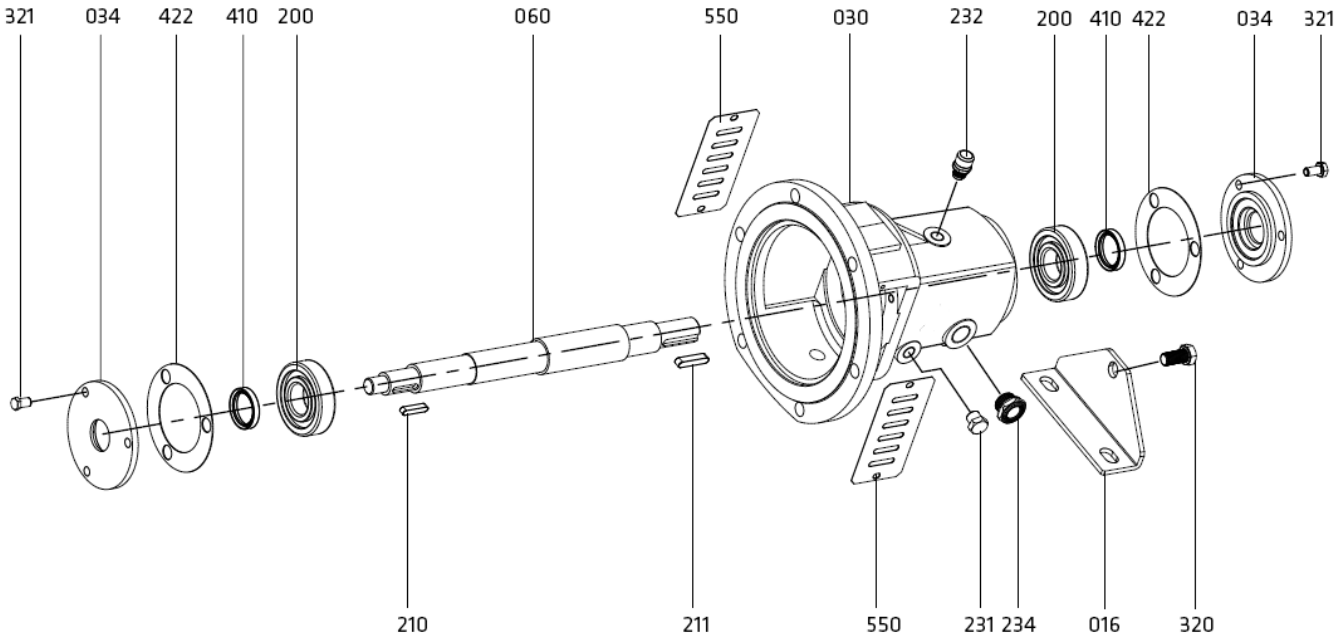
Form: F1 (Pumps with Mechanical Seal)



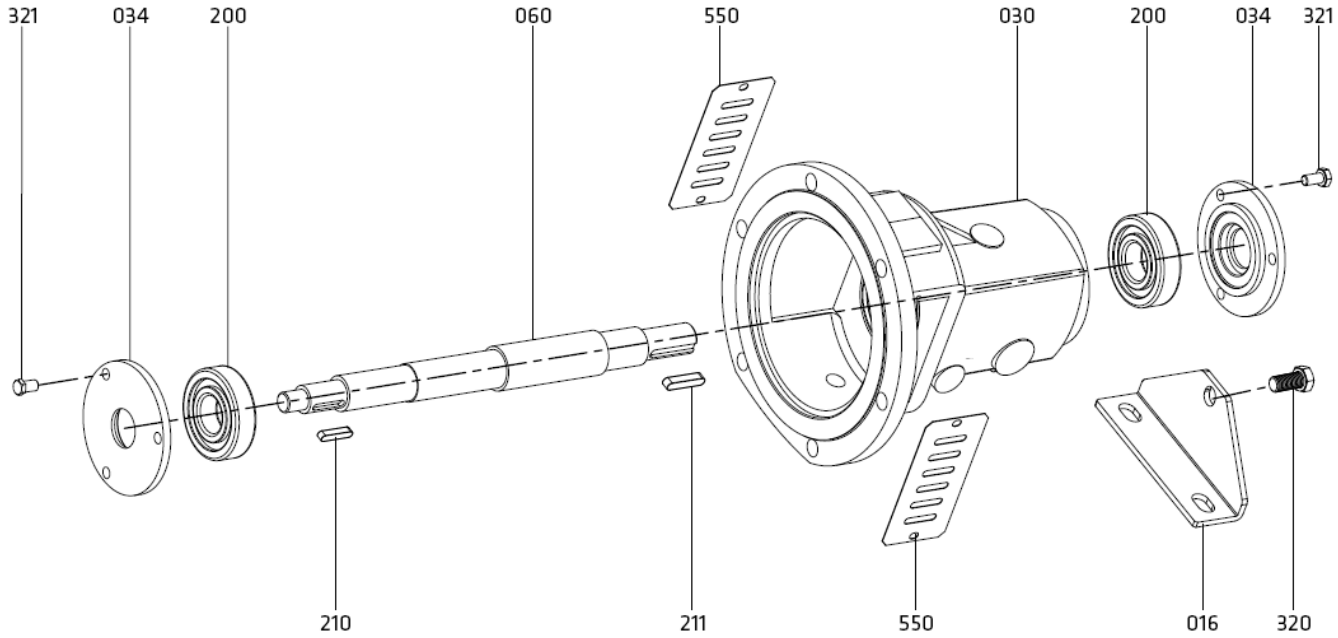
Form: F2 (Pumps with Mechanical Seal)

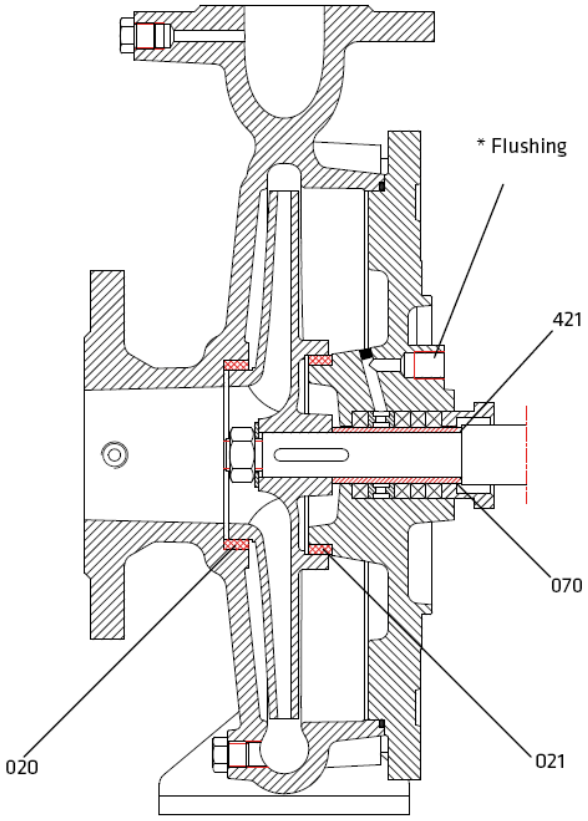


Bearing Housing with Oil Lubrication



Bearing Housing with Grease Lubrication





PART LIST

001	Volute casing	210	Impeller key
016	Support foot	211	Coupling key
020*	Wear ring (casing)	220	Circlip
021*	Wear ring (seal cover)	230	Screw
030	Bearing housing	231*	Screw
034*	Bearing cover (GG)	232*	Oil filling plug and breather
035	Bearing cover (St)	234*	Oil level indicator
040	Soft packing seal cover	300	Gland stud and nut
042	Gland	301	Stud, washer and nut
043*	Mechanical seal cover	320	Screw
046	Lantern ring	321*	Screw
049*	Mechanical seal spacer sleeve	400	Soft packing
050	Impeller	405*	Mechanical seal
060	Shaft	410*	Lip seal
065	Impeller nut and washer	420	O-ring
070*	Shaft sleeve	421*	O-ring
088	Thrower	422*	Gasket
200	Ball bearing	550	Guard

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ESN/ESH

Instructions for Operation and Maintenance

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