AquaMas®
Flow Systems

Instruction for Operation and Maintenance



ECO SNT

Single Stage Norm Centrifugal Pumps

Instructions for Installation, Operation and Maintenance

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1. GENERAL

The objective of this manual is to:

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

1.1 Safety Signs



General Risk
Signifies safety precautions which if not applied may cause vital.



Electrical Risk
Warnings about the electrical current



Warning
Safety instructions that if not applied may cause damage to the machine or operation.



Explosive atmosphere
Information to prevent explosion in the explosive atmosphere as per EC Directive 94/9/EC (ATEX)

1.2 General Instructions



This manual should be made available at a safety place easily accessible by personnel responsible for safe operation and maintenance of the pump the qualified

- The authorized personnel should be experienced and well - informed about the related standards.
- The instructions given in this manual should be carefully read and applied at any phase of the installation and operating process of the pump.
- The user is responsible to ensure that the inspection and installation are performed by the authorized and qualified personnel, who read this manual thoroughly.
- The pump should never be operated beyond the operating conditions set forth in the purchase order. The reason is that the operating conditions set forth in the purchase order have been taken into consideration in the selection of the pump material and trial of the pump.
- If the pump is required to be operated apart from the conditions set forth in the purchase order, please contact with **AquaMas Flow Systems**. AquaMas Flow Systems does not assume any responsibility for any damages that may arise from operation of the pump beyond the specified conditions without written consent.
- If the pump will not be installed at its place immediately after delivery, it should be stored at a clean and dry place where the ambient temperature does not change excessively. If the proper pre cautions are not taken, excessively low or high temperatures may cause serious damages to the pump.
- **AquaMas Flow Systems** does not accept any responsibility under warranty for any repair or replacement performed by the user or any other unauthorized persons.
- This manual does not include safety rules applicable at the place of use.

1.3 Safety Instructions



Always observe the following instructions to prevent any physical and/or property damages.

- Operate the pump only under the specified pump.
- Any tension, contraction and strain on the piping system should never transfer to the pump.
- Electric wiring of the engine and auxiliary components should definitely comply with the local rules and be performed by the authorized personnel.
- Never perform any work on the pump before the pump set is stopped completely.



Always disconnect power connection with the engine before you perform any work on the pump and make sure that no connection is made accidentally.

- Any work on the pump should always be performed by at least two workers.
- Clothing of the personnel to work on the pump should always be suitable for the works they will perform and/or the personnel should use necessary safety equipment.
- Never perform any work on the pump when it is hot.
- Never touch the hot pump and pipes by naked hand. The user personnel should take necessary warning precautions (e.g. warning signs, barricades, etc.).
- Always be careful when working on the pumps delivering hazardous liquids (e.g. acid or hazardous fluids).
- When the pump and pipes connected to the pump are under pressure, do not perform any work on the pump definitely.
- Once the work on the pump is over, put in place all safety shields previously removed.
- Never operate the pump in reverse direction.
- Never insert pour hands and fingers into any hole or openings of the pump.
- Do not trace on the pump and/or pipes 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.

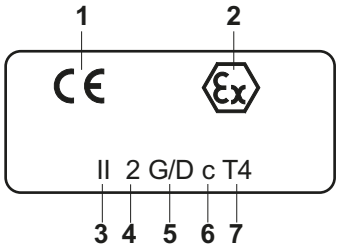
Only the products certificated for the explosive atmospheres should be used at the explosive atmospheres.

Detailed information about the operating conditions at the explosive atmospheres are found in Directive on Equipment for Potentially Explosive Atmospheres 94/9/EC (ATEX 95).

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

1.3.3 Labelling

Label on the pump is related with the pump only.



1- CE logo
2- Ex logo
3- Group
4- Category
5- Explosive Atmosphere [Gas(G) and/or Dust(D)]
6- Protection Type (Constructional Safety as per EN 13463-5)
7- Temperature Class

Example II 2 G/D c T4
II 2 G/D : Group II, Category 2 Gas (G) and/or Dust (D) ambient.
c : Constructional Safety (c)
T4 : Temperature Class (T4)

Coupling: It should be informed by the coupling manufacturer and the coupling should have ATEX sign on it.
Motor: It is required to be documented and labelled by the engine manufacturer.

1.3.4 Temperature classes and limits

During the pumping applications, the highest temperature occurs in the areas of the bearing area, sealing area and volute casing. The volute casing temperature is almost same with that of the fluid delivered by the pump. If the pump casing is heated externally, the technical personnel should keep the temperatures under control according to the temperature classes.

Temperature classes given in the **Table 1** and the highest permissible temperature for the pump during operation are shown in the following table.

Temperature Limits

Temperature Class	Maximum Surface Temperature	Maximum Permissible Fluid Temperature
T3	200 °C	180°C
T4	135°C	110°C

Table 1

1.3.5 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 buer 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.

1.3.6 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 buer liquid may be applied.
Frame of the pump and/or pump set should always be earthed.

1.3.7 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 **AquaMas Flow Systems.**

2- GENERAL PUMP DESCRIPTION

2.1- Pump Description

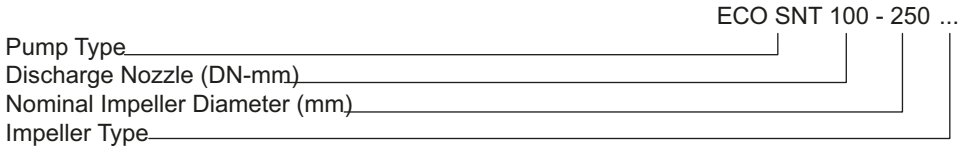
- ECO SNT series pumps are horizontal, radially split volute casing, single stage, end suction centrifugal pumps with closed impeller.
- Dimensionally complies with EN 733.

2.2- Application Areas

ECO SNT series pumps are suitable for clean or slightly contaminated (max. 20^3mg/dm) liquids with low viscosities and temperatures up to 140 º 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,
- Fire fighting,
- Chemical and petrochemical industries.

2.3- Pump Designation

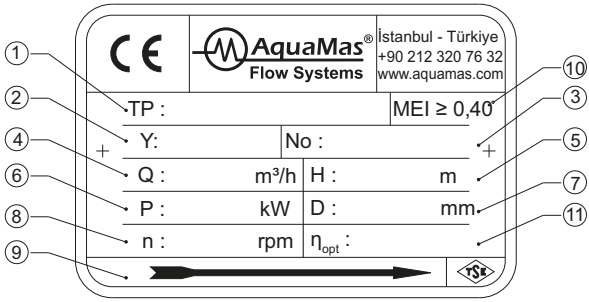


2.4- Product information according to European Commission's Regulation EU 547/2012

Relevant Pump Series
Water pump, end suction own bearing (ESOB) -ECO SNT
Water pump, end suction close coupled (ESCC) - ECO SNM
Water pump, end suction close coupled inline (ESCCi) - ECO SNL

Minimum efficiency index: MEI>=0,4
The benchmark for most efficient water pumps is MEI>= 0,7
Year of production: Please see the pump label.
Manufacturer's name or trademark: **AquaMas Flow Systems**.
Place of production: Turkey
Product's type and size indicator: Please see the pump label and data sheets.
Pump performance curves, including efficiency characteristics: see documented characteristic curve
The efficiency of a pump with a trimmed impeller is usually lower than that of a pump with full impeller diameter. Trimming of the impeller will adapt the pump to a fixed duty point, leading to reduced energy consumption. The minimum efficiency index (MEI) is based on the full impeller diameter.
Operation of this water pump with variable duty points may be more efficient and economic when controlled, for example, by the use of a variable speed drive that matches the pump duty to the system.
Information relevant for disassembly, recycling or disposal at end of life: see installation/operating manual section 1.4
Information on benchmark efficiency graph is available at www.europump.org/efficiency charts

2.5- Pump Nameplate



1- Pump Type and Size
2- Production Year
3- Serial No
4- Capacity
5- Head
6- Motor Power
7- Impeller Diameter
8- Speed
9- Direction of Rotation
10- Minimum efficiency index
11- Efficiency

2.6- Technical Information

Discharge Nozzle : DN 32 … DN 150 mm
Operation Temperature : -20 ºC - 100ºC with uncooled soft packing
100 ºC - 140 º C with cooled soft packing*
-20 ºC - 140 ºC with mechanical seal
Casing Pressure (max) : 10 bar (16 bar)*
Permissible Liquids : See Section 2.2
The service life of this product as determined and announced by the Ministry is 10 years.
(*) Note: Contact our company for more detail.

3- UNPACKING, HANDLING and STORAGE

3.1- 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 SERVICE DEPARTMENT, **AquaMas Flow Systems** and SHIPPING COMPANY about it immediately.
- Check whether all materials in the shipping list have been delivered. If there is any missing article, advise SERVICE DEPARTMENT, **AquaMas Flow Systems**.
- Remove the liquid inside the pump, for preventing corrosion due to transportation.

3.2- Handling

3.2.1- 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.

3.2.2- Lifting operation

ATTENTION

● Determine the following points prior to lifting and handling the pump or pump and motor group on the joint frame.

- Total weight and centre of gravity,
- The largest outer dimensions, and
- Location of the lifting points.

● The load lifting capacity should comply with the weight of the pump or pump group.
● The pump or pump group should always be lifted and handled horizontally.
● Never stand under or near the load being lifted.
● Do not keep the load lifted longer than necessary.
● Accelerating and braking operations during the hoisting should not be performed in such a way that may be dangerous for the working personnel.

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.

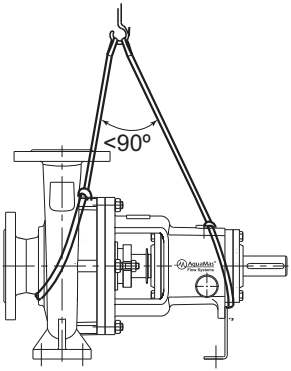


Figure 1a. *Bare shaft pump*

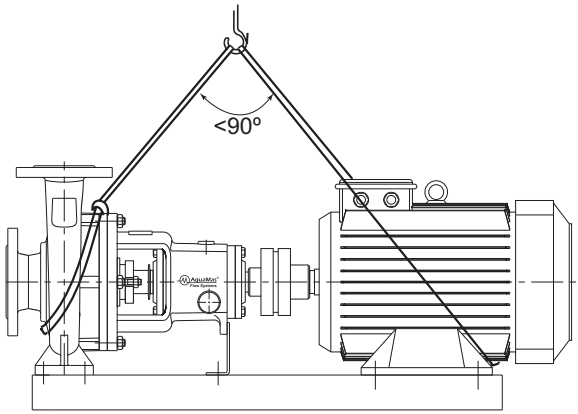


Figure 1b. *Pump and motor on a common baseplate*

3.3- 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.

4- INSTALLATION ON SITE

ATTENTION Installation on site should be performed as per EN 60204-1 standard.

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.

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

4.2- 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.

4.3- Installation Site

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

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

4.3.1- General characteristics of the pump foundation (baseplate)

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.

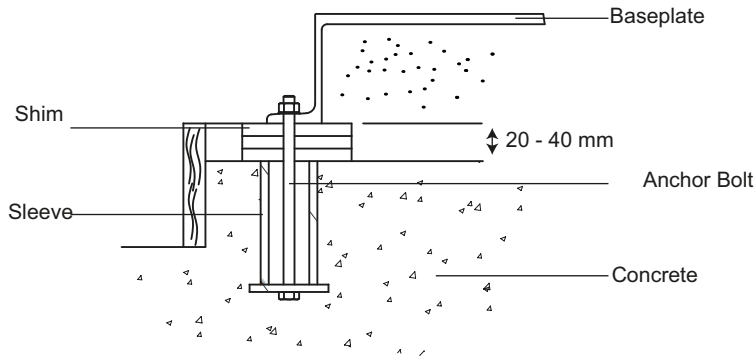


Figure 2. *Foundation, baseplate and anchor bolt*

- 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.

4.3.2- Placement of the Pump Group

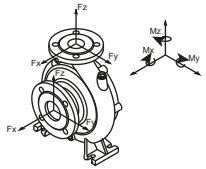
- Preparation and pour of the foundation concrete mass.
  - -The concrete mass is formed according to its dimensions.
  - -The locations of the anchor bolts are measured and marked carefully and Styrofoam is cut to the dimension, placed and fixed.
  - -The concrete is poured
    Volume ratio: Cement 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).

Allowable Forces and Moments on Flange

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.



- 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.

4.4- Installation of the Piping System

4.4.1- 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. Especıally 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 fhe 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.

4.4.2- 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).

4.4.3- 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.

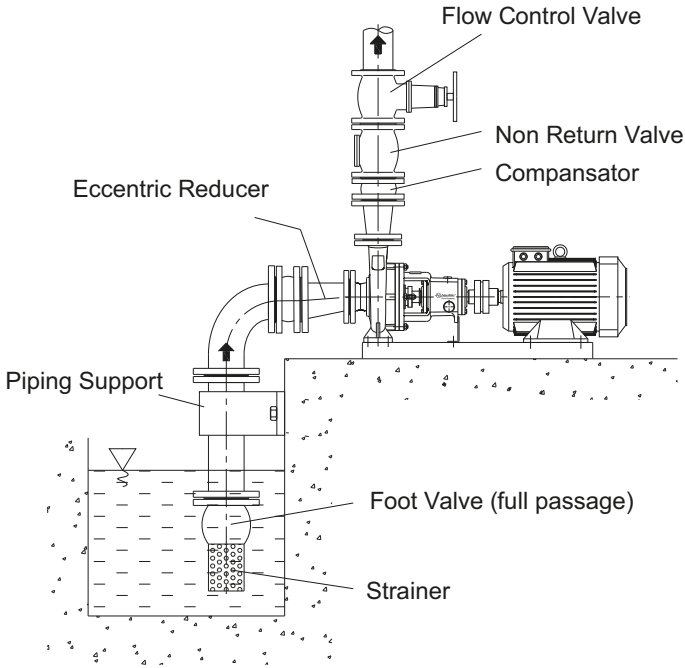


Figure 3a. Suction Lift

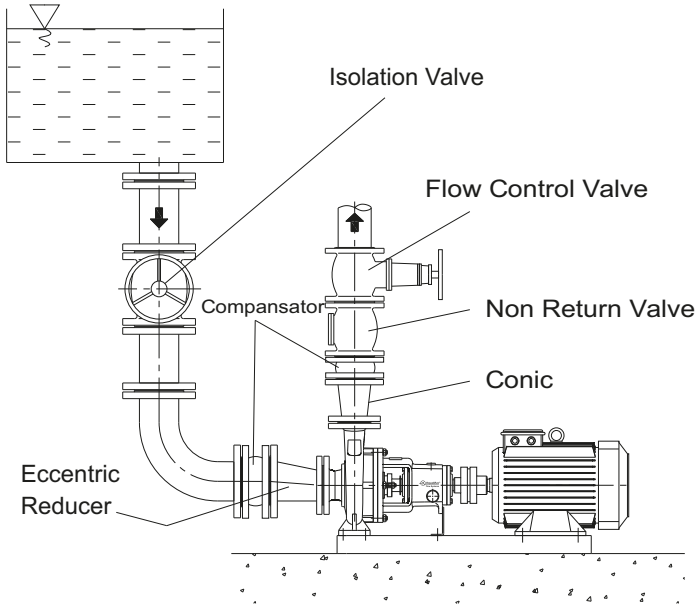


Figure 3b. Suction Flooded

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

4.4.4- Auxiliary pipe connections and accessories

• Depending on the application auxiliary pipe connections (for cooling, sealing and flushing of seal, drainage etc. necessary for the pumping system) and/or accessories to check operating conditions (pressure gauges, temperature gauges etc.) may be made up and lail.

• Pressure and vacuum gauges must be properly anchored and connected at the measuring points located on the pump flanges by means of or on the pipes close to the flanges approximately 8 mm diameter tubing with pig tail configuration to lessen pressure fluctuation. For safety purposes isolating and vent valves should be fitted before the gauges **(Figure 4)**.

• Every pump is fitted with connections on the pump casing to drain the pump and the bearing bracket to evacuate the seal leakage from the stung box **(Figure 5,6)**. If required the pump drain and seal leakge 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 mus be connected only to the designated connections located on the pump **(Figure 7,8)**.

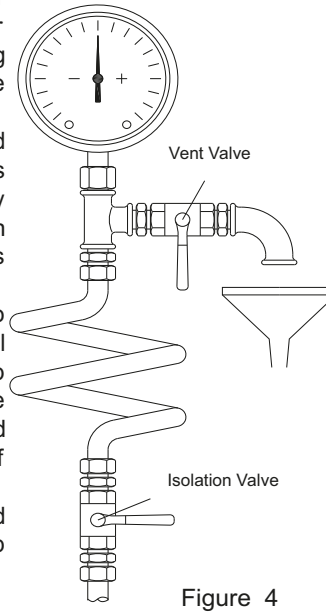


Figure 4

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

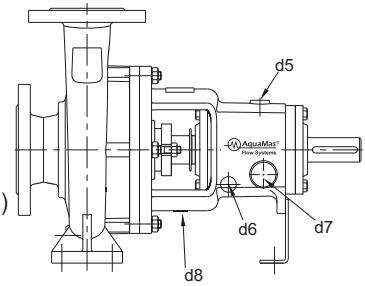


Figure 5

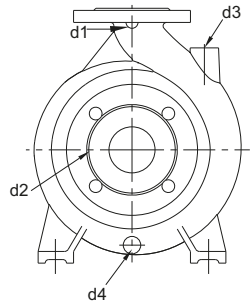


Figure 6

F1 : Seal flushing liquid inlet from external source

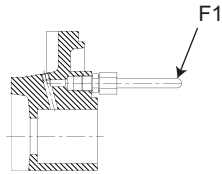


Figure 7

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

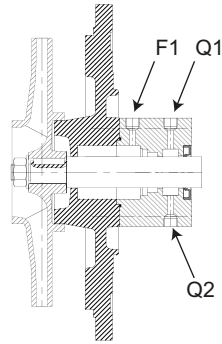


Figure 8

4.5- 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 ECO SNT 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 9) 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 10a,10b).

• 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 should be performed at two opposite places on the horizontal and vertical plane (Figure 10c, 10d).

• 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 inthe Figures 10a, 10b, 10c and 10d, respectively.

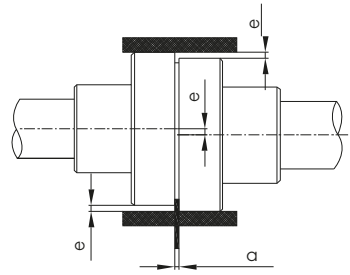
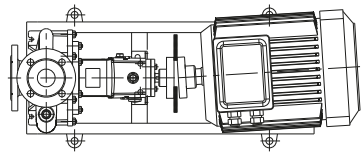
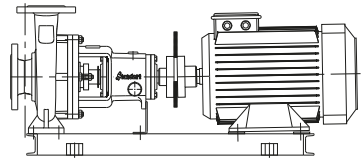
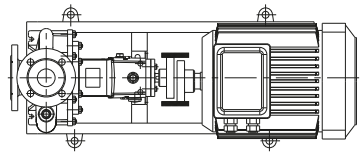
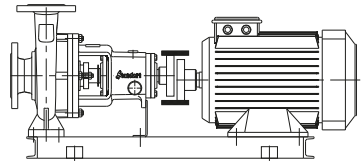


Figure 9. Alligning a flexible coupling


Figure 10a. Angle error in horizontal plane and adjustment


Figure 10b. Angle error in vertical plane and adjustment


Figure 10c. Parallel sliding error in horizontal plane and adjustment.


Figure 10d. Parallel sliding error in vertical plane and adjustment.

4.6- 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.

4.7- 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 have 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.**

- Electirical 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, bu 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 connection 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 terminal box depends on the nominal power of the motor, the power supply and the type of connection. The necessary conecction of the bridges in the terminal box is shown in the following **(Table 3 ve Figure 11a, 11b, 11c)**.

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 **(11b)**	Δ – connection **(11a)**
Y / Δ - start	Impossible	Remove connection bridges **(11c)**

Table 3

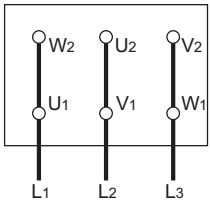


Figure 11a. Δ - connection

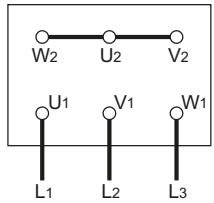


Figure 11b. Y – connection

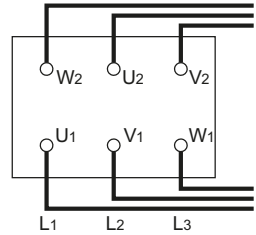


Figure 11c. Y/Δ - connection

ATTENTION **In the case of three-phase induction motors with Y -Δ connection it must be ensurred 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	< 3 second
> 30 kW	> 5 second

Table 4

4.8- Final Controls

- After all operations given above are completed, the coupling adjustment should be controlled once more in accordance with the section 4.5. 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.

5- START UP / SHUT DOWN

5.1- Preparation

5.1.1- Lubrication control

- The bearings of ECO SNT 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 12 and 13).

- Check lubrication (see Section 6).

5.1.2- 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.**

5.1.3- Checking the direction of rotation

- ECO SNT 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.

5.2- Start Up The Pump

- Check if the shut o valve in the suction line is open and the shut o 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, especially geometric height again.

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

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

5.3- Shut Down The Pump

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

5.4- Checks to be Made While The Pump is Running

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

- The bearing temperature may exceed the ambient temperature by up to 50 ºC. But must never rise above 80 ºC.
- The valves in the auxiliary lines must remain open while the pump is runing.
- If the pump has soft packing type stung boxes, these should drip during operation. The gland nuts should only be lightly tightened. In case of excessive leakage from the stung box tighten the gland nuts slowly and evenly until the leakage is reduced to the dripping state. Check the stung 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 oset 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.

6- 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 ECO SNT 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.

6.1- 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.

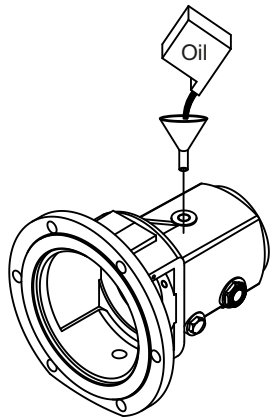


Figure 12. Adding Oil

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

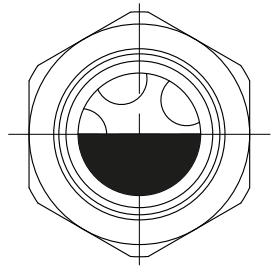


Figure 13. Oil sight glass

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 suciently 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 *	Shaftend 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 11 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.

6.2- 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.

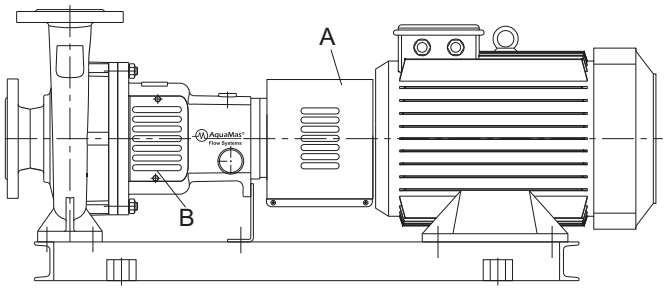
7- DISASSEMBLY AND REASSEMBLY

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.

7.1- Disassemblying the Pump

- Shut o 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.



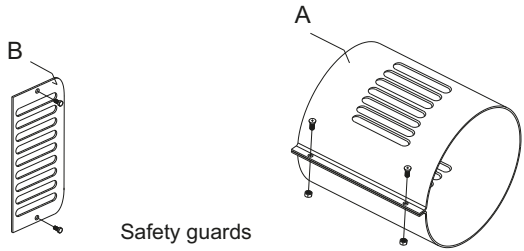


Figure 14

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

ATTENTION **Analyze 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 de-mounting it from the baseplate.

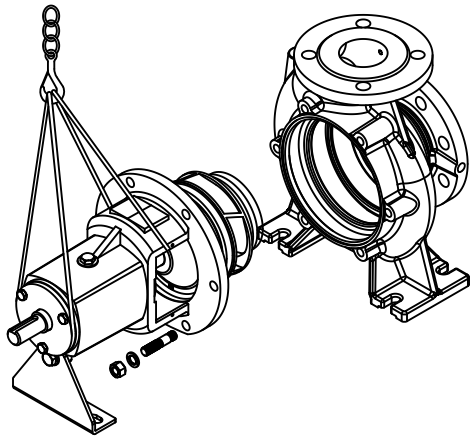


Figure 15. Demounting the pump rotor group

- 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.**

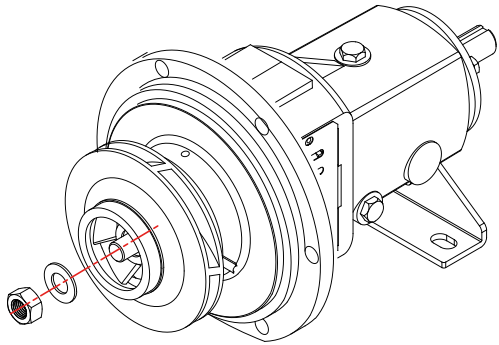


Figure 16. Disassembly of impeller

- 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 7.4.1) 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 7.4.2) 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.

7.2- 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

7.3- Assembling the Pump

7.3.1- 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.

7.3.2- 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 C 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 5.

7.4- Shaft Seal

7.4.1- Pump with soft packing gland

- While starting to change soft packing thoroughly clean the stung box and shaft (or shaft sleeve, if used).
- Cut enough number of pieces suitable lenght 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 stung 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 drips 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 slighly.
- Check the temperature of soft packing after two hours operation after gland adjustment to avoid overheating.

7.4.2- 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 ECO SNT 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: Dierent types of mechanical seals with dierent diameters can be applied for various applications. Please ask AquaMas Flow Systems for more information.

Mechanical Seal Application

MG1 G6
MG1 G60

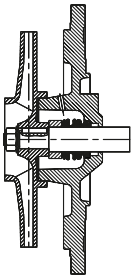


Figure 17a

M3N
M37G

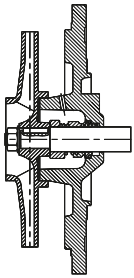


Figure 17b

M7N

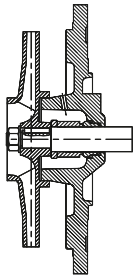


Figure 17c

H12N
H75N

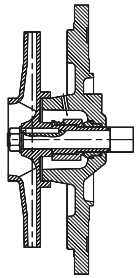


Figure 17d

RMG 12 G606

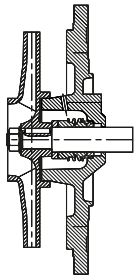


Figure 17e

CARTEX SN

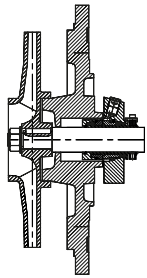


Figure 17f

8- SPARE PART

- AquaMas Flow Systems guarantees to supply the spare parts for ECO SNT type pumps for 10 years. You can procure any spare parts easily.
- Lets us know the following details on the name-plate, when you order spare parts.

Pump Type and Size : (ECO SNT 65-200)
Motor Power and Speed : (30 kW – 2900 r/min)
Prod. Year and Serial Number : (..... – .....)
Capacity and Head : (120 m³/h – 57 m)

- If you prefer to have spare parts in your stock, we recommed you to have the following quantities for two years operation depending on the number of same of pumps **(Table 8).**

Part Number	Part Name	Number of Pumps in the Systems						
		2	3	4	5	6-7	8-9	10+
020*-021*	Wear Rings (set)	1	2	2	3	4	5	50%
050	Impeller (piece)	1	1	2	2	3	4	30%
060	Shaft (incl. keys) (piece)	1	1	2	2	2	3	30%
070*	Shaft Sleeve (piece)	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 (piece)	1	1	1	2	2	3	30%
420	O-Ring (piece)	4	6	8	8	10	12	150%

(*) optional

Table 8

9- FAULTS, CAUSES AND REMEDIES

In this section you will find operating faults which 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
Bearings 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	REMEDY METHODS
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 mixed 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	Air in the liquid	Eddies occur due to insucient 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	Suction depth too much	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 operates with cavitation	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 loadon the pump suction.
7	Delivery head of the pump is insucient	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	Increased delivery head	Check whether the valves are completely open. Check whether there is any obstacle causing clogging in the suction pipe.
9	Pump operates at a lower delivery 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	Pump returns reverse.	Check whether the engine's direction of rotation complies with the direction of rotation indicated on the pump casing or name plate.

Table 10

	POSSIBLE CAUSES	REMEDY METHODS
11	Low speed	Check mains voltage and frequency or whether there is phase faults in the engine
12	Speed too high	Reduce the pump speed, if possible or machine the impeller diameter according to the manufacturer's recommendation.
13	Impeller, check valve or strainer clogged	Clean the impeller, check valve or strainer.
14	Impeller or strainer partly clogged	Clean the impeller or strainer.
15	Impeller partly clogged.	Clean the impeller.
16	Worn or broken impeller	Replace the impeller
17	Mechanical friction on the pump	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 too tight	Check the covers and make necessary corrections.
21	Flow rate is less than the required minimum flow rate	Increase the flow rate. Use by-pass valve or line, If required.
22	Too much grease on the bearing	Remove the excess grease.
23	Bent shaft	Check the shaft and replace it, if required.
24	Insuciet lubrication or lubricant contaminated.	Check amount of the lubricant. Clean the bearings and bearing housings and lubricate again.
25	Instable rotating parts	Check stability of the rotating parts.
26	Pump operates beyond the area of operation	Check the values of the area of operation
27	Density or viscosity of the delivered liquid is more than the specified value.	Use engine of higher power.
28	Enging fault	Check the engine. Engine ventilation is not proper due to its position.

Table 10 (continue)

10- EXPECTED NOISE VALUES

Motor Power - P_N (kW)	Sound Pressure level (dBA)* (Pump and 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

Table 11

Motor Power - P_N (kW)	Sound Pressure level(dBA)* (Pump and Motor)	
	1450 rpm	2900 rpm
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 (continue)

(*)The values measured at a distance of 1 m from the pump in the free area on the sound reflecting surface without sound curtain

(*)These values apply if the pump is operated in normal ordered operating values without cavitation.

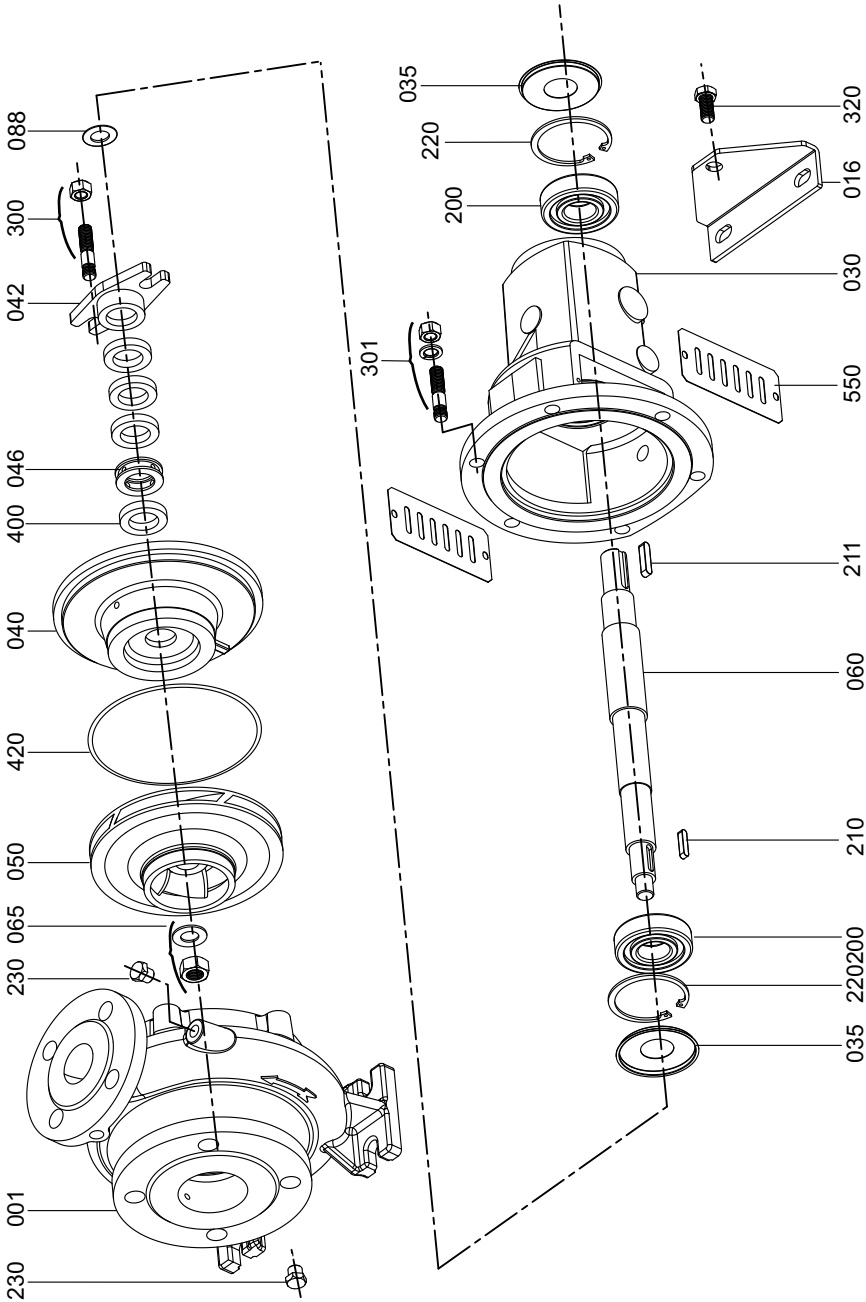
(*)If the pump is operated at 60 Hz; increase the values in the table by 1 dB for 1800 rpm and by 2 dB for 3600 rpm.

11- PUMP DIMENSION GROUPS AND WEIGHTS

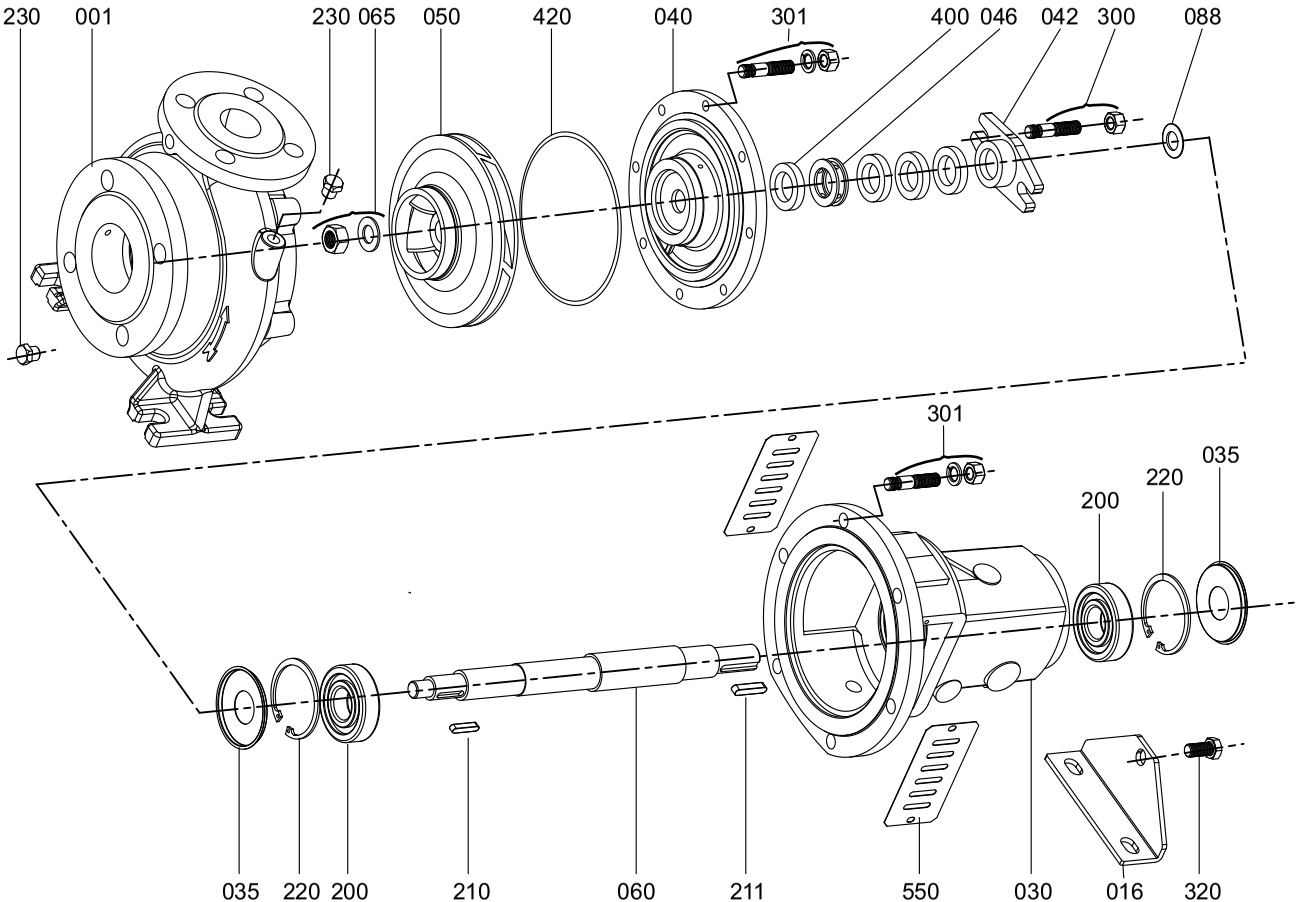
Type ECO SNT	Dimension Group	Design Form	Characteristic Dimensions Shaft Diameter / f (length)	Weight (kg)
32-125	A	F1	ø 24	32
40-125				33
50-125				34
65-125				40
32-160				39
40-160				40
50-160				42
65-160				46
80-160				49
32-200		F2		41
40-200				45
50-200				48
65-200				51
32-250				53
40-250				57
50-250				57
40-315				67
100-160	B	F1	ø 32	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	ø 42	180
150-315				190
80-400		F2		175
100-400				180
125-400				200
150-400				230

Table 12

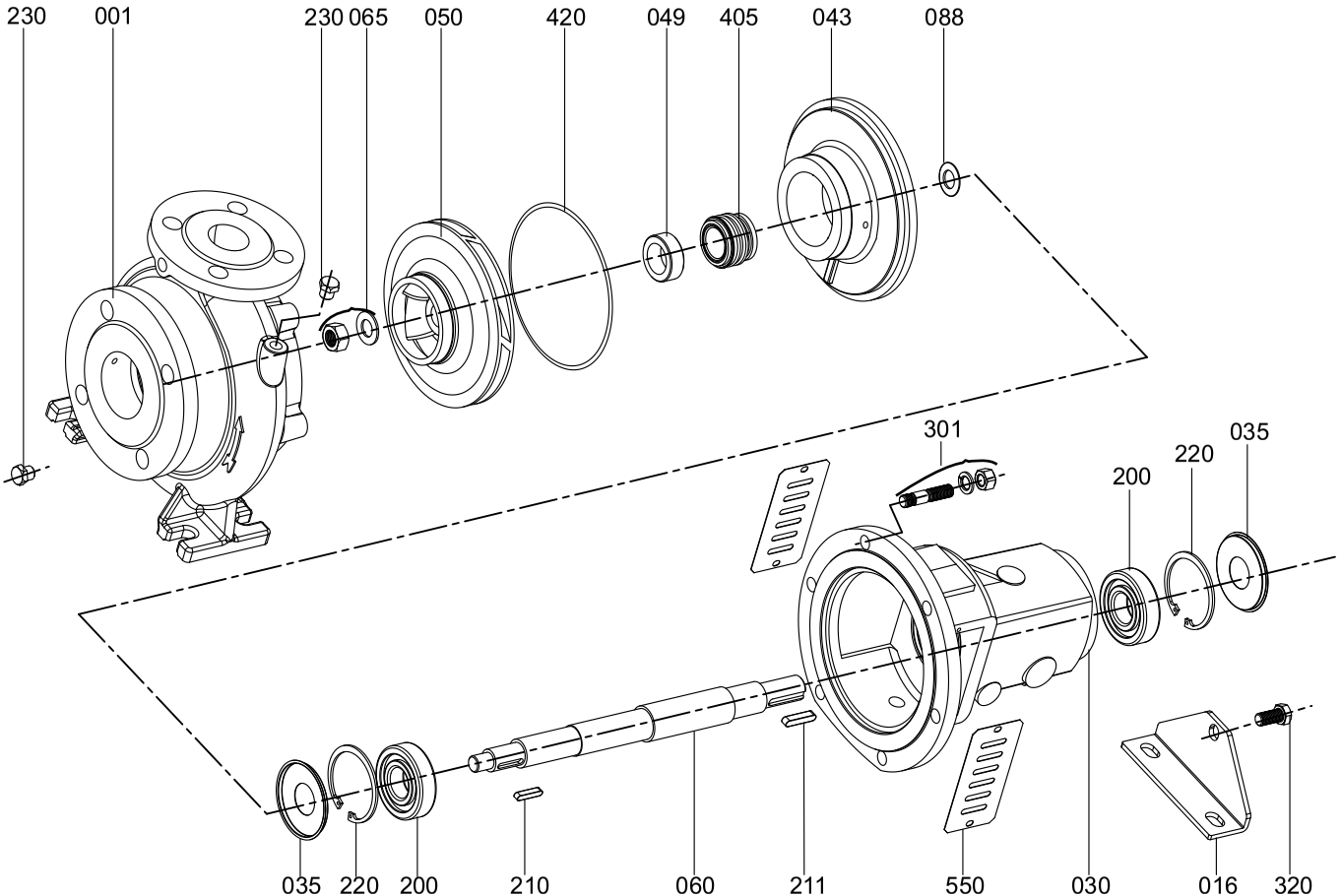
12- SECTIONAL DRAWINGS



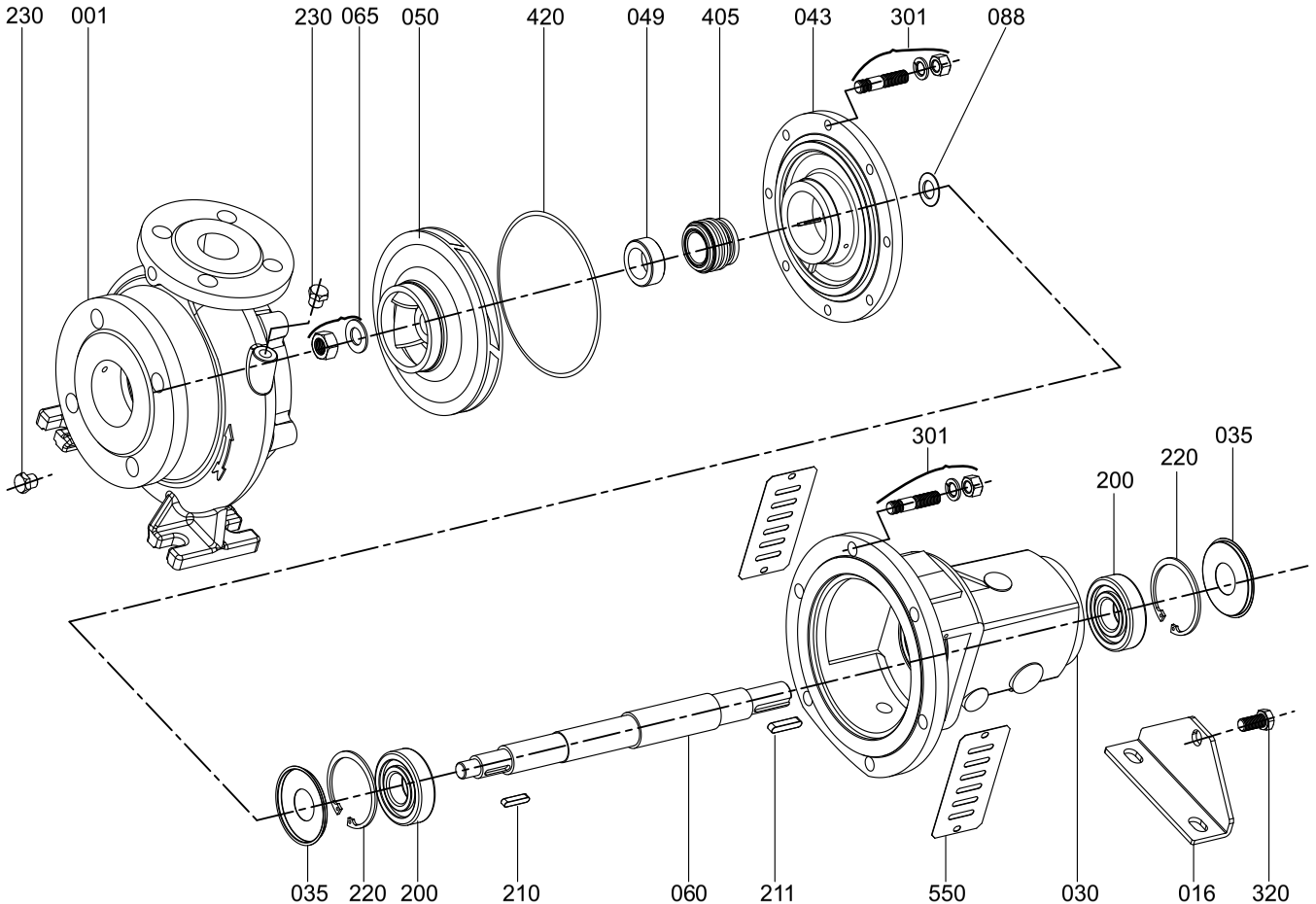
Form: F2(Pump with Soft Packing)



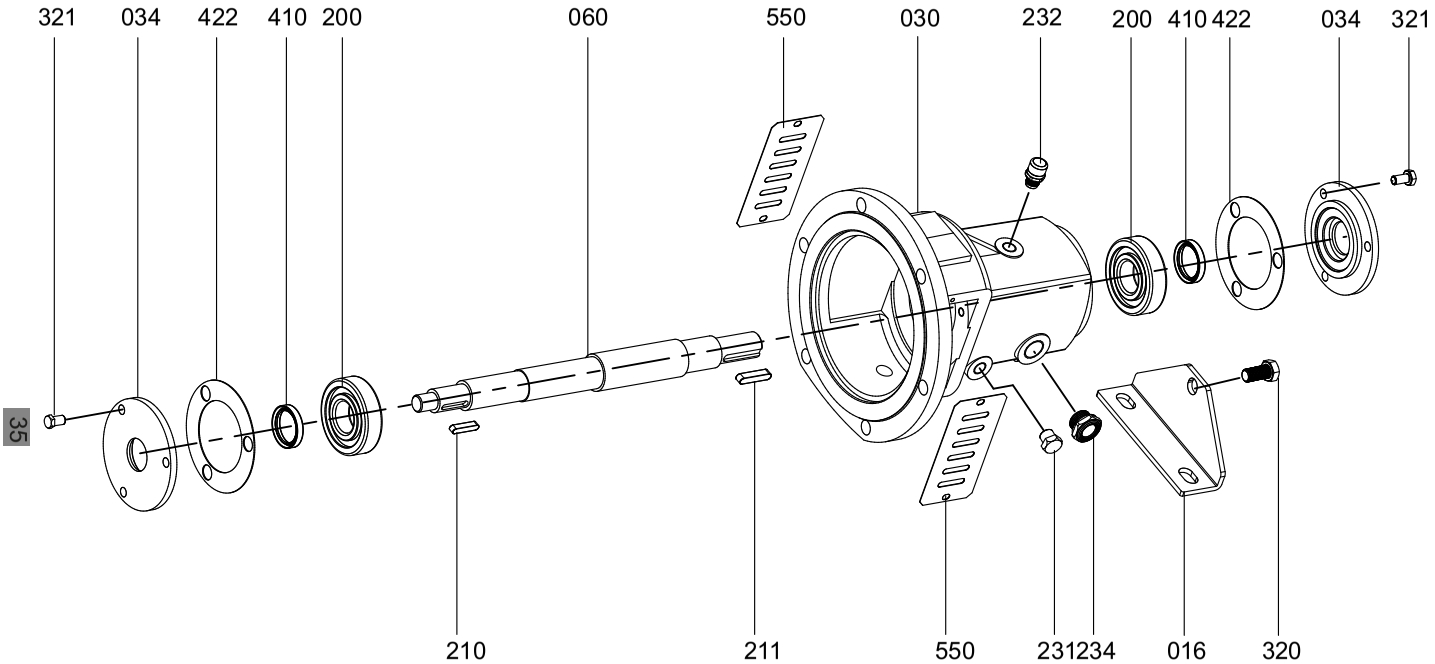
Form: F1 (Pump with Mechaical Seal)



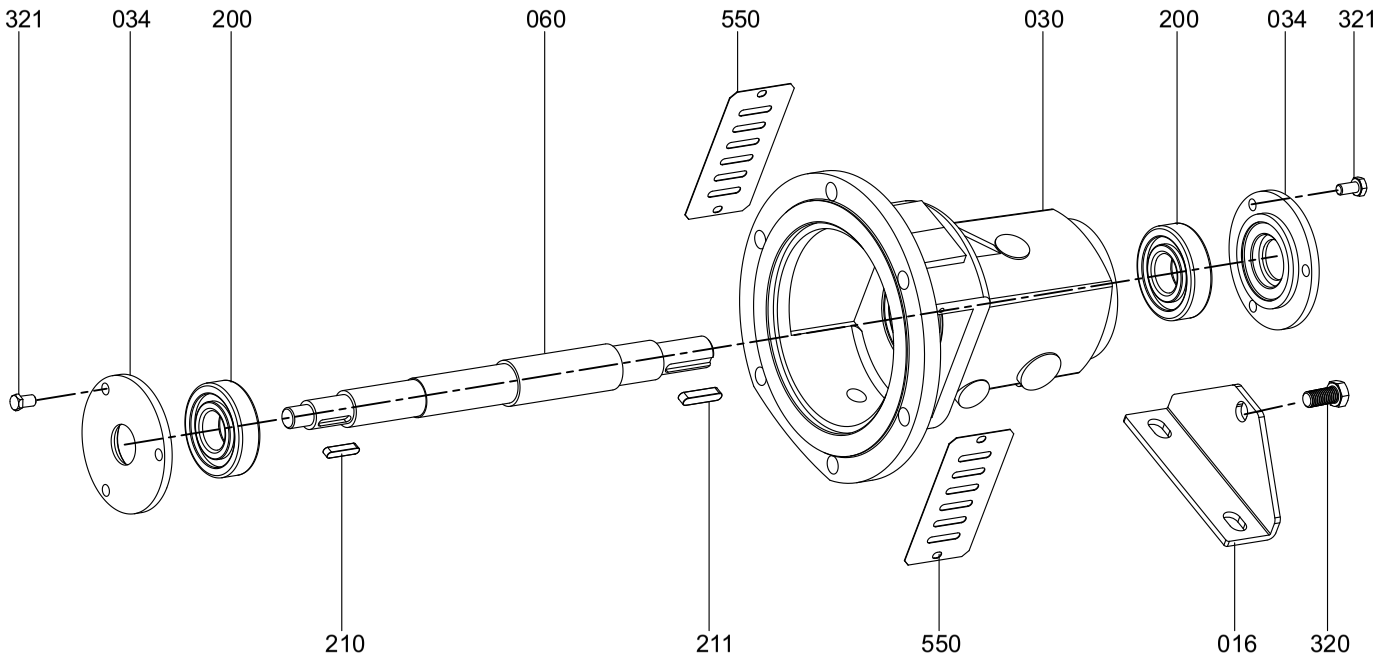
Form: F2 (Pump with Mechaical Seal)

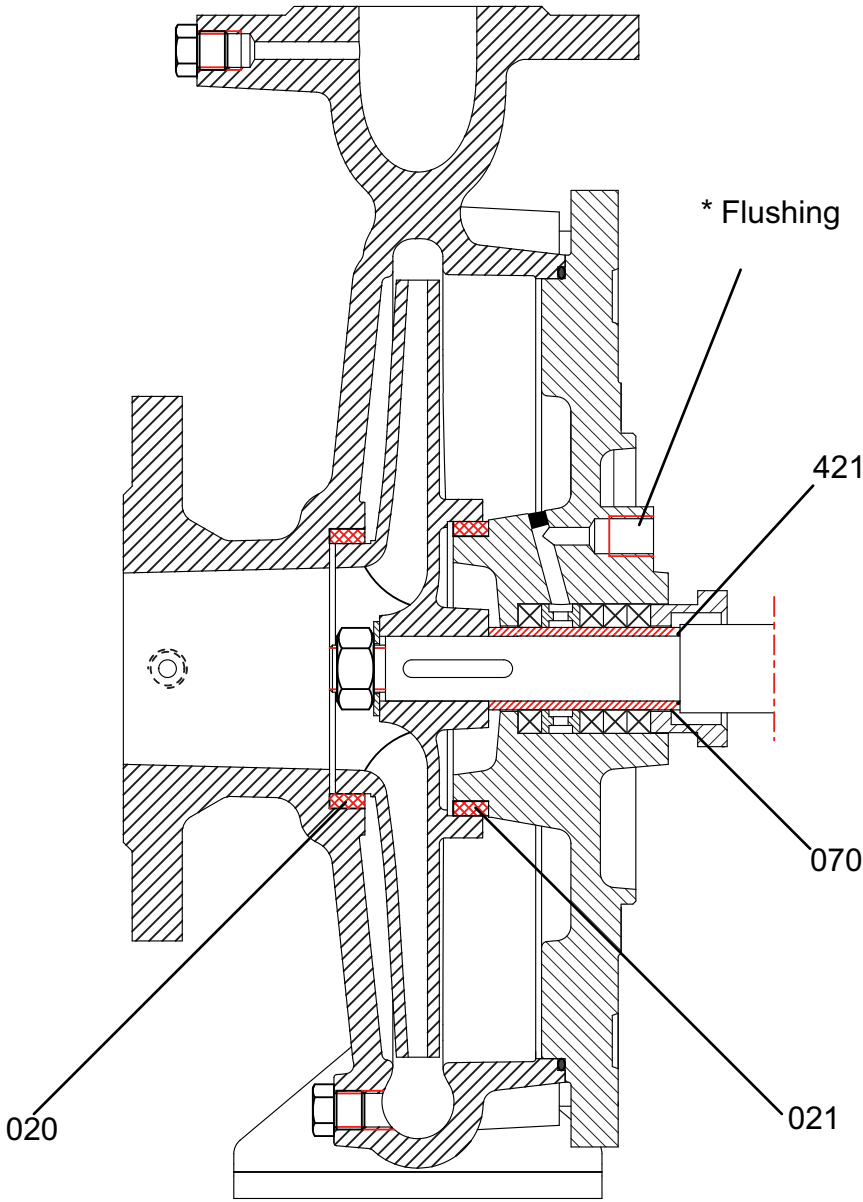


Bearing Bracket with Oil Lubrication



Bearing Bracket with Grease Lubrication




* Flushing
421
070
020
021

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

(*) Optional

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Flow Systems

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