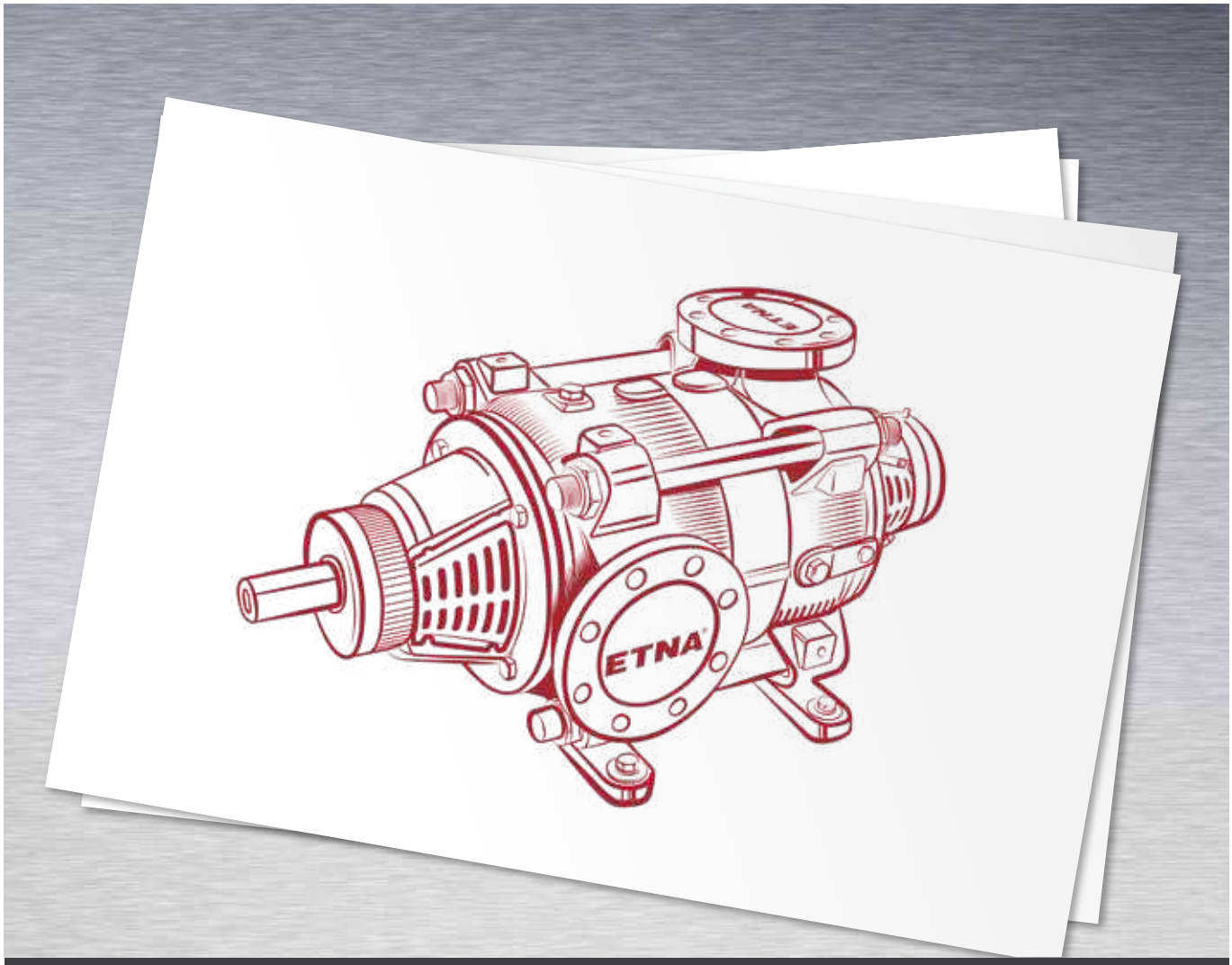
ETNA®



EKP/ EKP-R/ EKP-A/ EKP-V
High Pressure Multi-Stage Pumps
Installation, Operation, and Maintenance Manual

İÇİNDEKİLER

1. TASARIM VERSİYONLARI

EKP

- U-turn diffuser with closed radial impeller design
- Horizontal shaft design
- Radial suction flange (left, top, right)
- Radial discharge flange (left, top, right)
- Discharge side driven (optional) suction side drive
- Radial axial bearing drive side
- Radial bearing suction side
- Axial thrust balancing bearing
- Shaft sealing at suction and discharge
- Pump with or without a motor
- Pressure resistance up to 40 bar
- Electric motor or fuel engine powered

EKP-R

- U-turn diffuser with closed radial impeller design
- Horizontal shaft design
- Radial suction flange (left, top, right)
- Radial discharge flange (left, top, right)
- Discharge side driven
- Radial axial bearing discharge side
- Slide bearing suction side
- Axial thrust balancing bearing
- Shaft sealing only at discharge
- Pump with or without a motor
- Pressure resistance up to 10 bar
- Electric motor or fuel engine powered

EKP-A

- U-turn diffuser with closed radial impeller design
- Horizontal shaft design
- Axial suction flange
- Radial discharge flange (left, top, right).
- Discharge side driven
- Radial axial bearing discharge side
- Slide bearing suction side
- Axial thrust balancing bearing
- Shaft sealing only at discharge
- Pump with or without a motor
- Pressure resistance up to 10 bar
- Electric motor or fuel engine powered

EKP-V

- U-turn diffuser with closed radial impeller design
- U-turn diffuser with closed radial impeller design
- Vertical shaft design
- Radial suction flange (0-90°, 180°, 270°)
- Radial discharge flange (0-90°, 180°, 270°)
- Discharge side driven
- Radial axial bearing discharge side
- Slide bearing suction side
- Axial thrust balancing bearing
- Shaft sealing only at discharge
- Pump with or without a motor
- Pressure resistance up to 10 bar
- Electric motor or fuel engine powered

1.1 Description

EKP series horizontal and vertical multi-stage casing pumps with high efficiency and durability, deliver high performance in applications with high flow rate. They feature a long stainless steel shaft design that reduces axial forces during suction. The discharge and suction flanges are available in radial and axial configurations. The pump casing and stages are connected with 4 studs. These studs allow for easy repair and maintenance of the stages without removing one of the pump casings from the system.

Fields of Use

- Water Supply and Pressurization
- Fire-fighting
- Agricultural Irrigation and Drainage
- HVAC
- Industrial Plants
- Mining
- Marine Applications

Pump Specifications

- Pump Casing: GG25 Cast Iron/GGG40 Nodular Cast Iron
- Pump Shaft: AISI420 Stainless Steel
- Impeller: GGG40 Nodular Cast Iron/Bronze
- Seal Type: Oil Seal/Mechanical Seal

Technical Specifications

- Max. Flow Rate: 1250 m^3/h
- Max. Discharge Head: 225 mwc
- Flange: DIN 2501
- Connection: DN 50-DN 65-DN 80-DN 100
- Max. Operating Pressure: 25 bar
- Maximum Ambient Temperature: 40°C
- Fluid Temperature: 0-105°C
- Liquid Quality: Clean, solid abrasive particle-free, non-hard chemically neutral water

The purpose of this manual is to provide necessary information for the following:

- Installation
- Operation
- Maintenance

CAUTION:

Read this manual carefully before installing and using the product. Improper use of the product may result in injury and material damage and may void the warranty.

1.1.1. WARNING:

Keep this manual for future reference and keep it available at the unit's location.

1.1.2 Inexperienced Users

WARNING:

This product is designed to be operated by qualified personnel only.

Pay attention to the following warnings:

- This product should not be used by individuals with physical or mental disabilities, or by those lacking sufficient experience and knowledge, unless they have been given instructions regarding the use of the equipment and the related risks, or are supervised by a responsible person.
- Children must be supervised to ensure they do not play with or around the product.

1.2 Safety Terminology and Symbols - About Safety Messages

Before using the product, it is extremely important to read, understand, and follow all safety messages and regulations. These are established to help prevent:

- Personal injuries and health issues
- Damage to the product and its surroundings
- Product malfunction

Hazard levels

Hazard Level	Indication
DANGER:	A hazardous situation which will result in death or serious injury if not avoided.
WARNING:	A hazardous situation which could result in death or serious injury if not avoided.
CAUTION:	A hazardous situation which could result in minor or moderate injury if not avoided.
NOTICE:	Used when there is a risk of equipment damage or reduced performance, but not personal injury.

Special symbols

Read this manual carefully before installing and using the product. Improper use of the product may result in injury and material damage and may void the warranty.

Electrical Hazard	Magnetic Field Hazard
	

Hot Surface Hazard	
	Hot surface hazards are indicated with a special symbol that replaces typical hazard level symbols.

CAUTION:

Description of user and installer symbols	
	Special information for personnel responsible for installing the product in the system (piping and/or electrical components) or maintenance.
	Special information for users of the product.

Instructions

The instructions and warnings provided in this manual apply to the standard version described in the sales document. Special model pumps can be supplied with additional instruction booklets. Refer to the sales agreement for any changes or special model features. For instructions, situations, or events not covered in this manual or sales document, contact the local Service Center.

1.3 Disposal of Packaging and Product

Follow the applicable local laws and regulations for waste disposal.

1.4 Warranty

Refer to sales agreement for information about warranty.

1.5 Spare Parts

WARNING:
Only use original spare parts to replace worn or faulty components. Using non-original parts may cause failure, damage, or injury and may void the warranty.

CAUTION:
When requesting technical information or spare parts from the sales department, be sure to provide the full product type and part number.

For more information on spare parts, visit the website of the sales network.

2. TRANSPORT AND STORAGE

2.1 Checking the Delivery

- Check for any visible damage on the outer packaging.
- If there are visible signs of damage to the product, inform our distributor within eight days from the delivery date.

Unpacking the Unit

Follow the relevant step:

- If the unit is packaged in cardboard, remove the staples and open the cardboard.
- If the unit is packaged in a wooden crate, open the lid carefully, paying attention to the tabs and straps.

Remove the fixing screws or straps from the wooden base.

2.1.1 Inspecting the Unit

1. Remove the packaging from the unit. Dispose of all packaging in accordance with local regulations.
2. Check the product for any damaged or missing parts.
3. Open the product by removing any screws, bolts, or straps. For your personal safety, be careful when handling nails and straps.
4. If you encounter any problems, contact your local sales representative

2.2 Transportation Instructions

Precautions:

WARNING:
- Follow the applicable accident prevention regulations.
- Risk of crushing. The unit and the components may be heavy. Always use appropriate lifting equipment and wear steel-toe safety shoes.
- Check the gross weight on the packaging to chose the appropriate lifting equipment.

Positioning and securing
The pump or pump unit must only be transported laterally. During transport, ensure that the pump or pump unit is safely secured and cannot tip over or fall. Figure 1

WARNING:
Do not use the eye bolts attached to the motor to lift the entire electric pump unit.

Do not move the pump, motor, or unit using the shaft end of the pump
or motor. Figure 1

- Eye bolts attached to the motor are intended to support the motor only or, in case of unbalanced weight distribution, to partially lift the unit vertically without lateral movement.
- Always secure and transport the pump unit as shown in Figure 1.

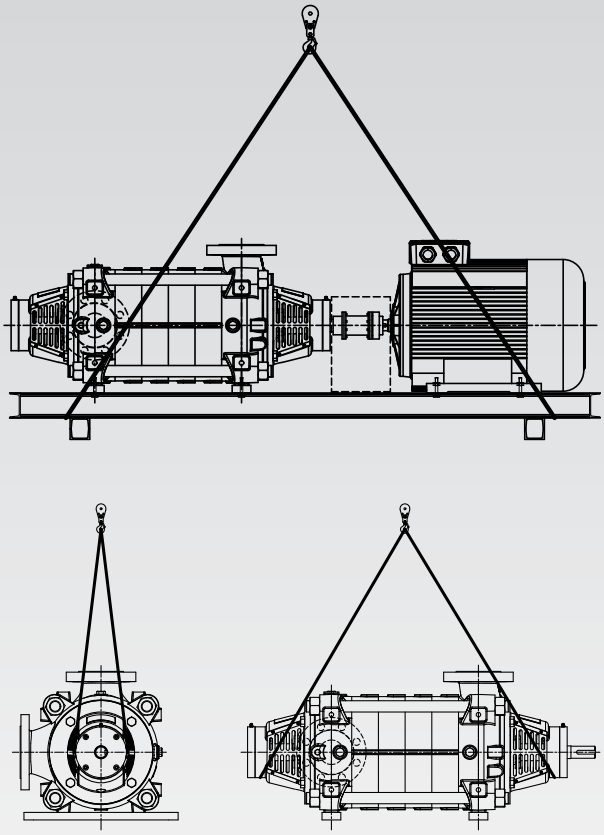


Figure 1

WARNING:
In line with Machinery Directive 2006/42/EC, a pump and a motor/engine purchased separately and then coupled together are considered a new machine. The person making the coupling is responsible for all safety aspects and the CE marking of the combined unit.

2.3 Storage Instructions

Storage Location
The product must be stored in a closed and dry location, free of heat, dirt, and vibration.

WARNING:
Protect the product against moisture, heat sources, and mechanical damage.

WARNING:
Do not place heavy objects on top of the packaged product.

2.3.1 Long-Term Storage

If the unit will be stored for more than 6 months, the following are required:

- Store in a closed and dry location.
- Keep the unit away from heat, dirt, and vibration.
- Manually rotate the shaft several times at least once every three months.

For long-term storage procedures, consult the drive unit and coupling manufacturers.

If you have any questions about possible long-term storage services, please contact your local sales and service representative.

Ambient temperature

The product must be stored at ambient temperatures between -5°C and +40°C (23°F to 104°F).

3. PRODUCT DESCRIPTION

3.1 Pump Design

The pump is a split-case horizontal or vertical multi-stage centrifugal pump connected to standard electric motors or diesel engines.

It can be used with:

- Cold or warm water
- Clean liquids
- Liquids that will not cause chemical or mechanical damage to pump materials.

The product may be supplied either as a pump unit (pump and electric motor) or as a bare pump.

WARNING:

If you have purchased a bare pump make sure the motor is suitable for connection to the pump.

Intended use

The pump is suitable for:

- Municipal facilities, waterworks, drainage and flood control, tunnels, recycling, booster systems
- Water supply and treatment
- Cooling and hot water supply in industrial and construction services
- Irrigation and sprinkler systems
- Heating systems
- Marine
- Mining
- District heating
- General industry
- All manufacturing industries: steel, sugar, rubber and plastic, paper, food and beverage, fire-fighting, Seawater, water transfer, mining applications

Improper use

WARNING:
Improper use of the pump may lead to hazardous situations and may result in personal injury, and material damage. Improper use also voids the warranty.

Examples of improper use:
- Liquids incompatible with the pump construction materials
- Hazardous liquids (such as toxic, explosive, flammable or corrosive liquids)
- Potable liquids other than water (e.g. wine or milk)

Examples of improper installation:
- Hazardous locations (e.g. explosive or corrosive environments)
- Locations with excessively high ambient temperatures or poor ventilation.
- Outdoor installations without protection against rain or freezing temperatures.

DANGER:
Do not use this pump to handle flammable and/or explosive liquids.

WARNING:
- Do not use this pump to handle liquids containing abrasive, solid, or fibrous materials.
- Do not use the pump at flow rates exceeding the specified flow rates on the nameplate.

Special applications
Contact your local sales and service representative in cases below:
- If the pumped liquid's density and/or viscosity exceeds that of water, such as glycol/water mixtures, this may require a more powerful motor.
- If the pumped liquid has been chemically treated (e.g. softened, deionized, or demineralized).
- Any situation that differs from the stated information and is related with the quality of the liquid.

3.2 Pump Nomenclature
Pump nomenclature code description and an example.

3.3 NAMEPLATE
The pump nameplate is located on the bearing bracket. It lists the basic product specifications.

It includes information on the impeller and casing materials, mechanical seal and its materials. For more information see technical section on page 36.

IMQ, TUV, IRAM, or marks (only for electric pumps)

Unless specified otherwise, the electrical safety approval mark on products only applies to the electric pumps.

3.4 Pump Description
EKP 40/EKP-R 40/EKP-A 40/EKP-V 40
EKP 50/EKP-R 50/EKP-A 50/EKP-V 50
EKP 65/EKP-R 65/EKP-A 65/EKP-V 65
EKP 80/EKP-R 80/EKP-A 80/EKP-V 80

3.5 Material

The metal parts of the pump that come into contact with water consist of the following:

Material Code	Material Casing/Impeller	Standard/Optional
CC	Cast iron/Cast iron	Standard
CB	Cast iron/Bronze	Standard
DC	Nodular cast iron/Cast iron	Standard
DB	Nodular cast iron/Bronze	Standard

3.6 Application Limits

Operating limits

The operating limits for pressure, temperature, performance, and speed are shown in the product data sheet.

- Do not exceed the output values specified on the motor nameplate.
- Avoid sudden temperature changes (thermal shocks).
- The pump and motor should run smoothly without vibration; check at least once a week.

3.7 Number of Switchgear Per kW

kW	0.25-3	4-7.5	11-15	18.5-22	30-37	45-75	90-160
Starts per hour	60	40	30	24	16	8	4

Noise level

For sound pressure levels of the pumps with the standard motors.

EKP PUMP SOUND PRESSURE LEVEL [dB(A)]

MOTOR POWER [kW]	SOUND P. LEVEL [dB(A)]	
	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	76	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

Sound pressure level measurements were made with 50 Hz electric motors in a noise-free environment.

4. INSTALLATION

Precautions

WARNING:
- Follow the applicable accident prevention regulations.
- Use appropriate equipment and protection.
- Always refer to local and/or national regulations, legislation, and laws regarding the selection of the installation site, piping, and power connections.

Electrical Hazard:
- Ensure all connections are made in accordance with applicable regulations.
- Before starting work on the unit, make sure that the unit and control panel are isolated from the power supply and cannot receive any power. This also applies to the control circuit.

Grounding

Electrical Hazard:
- Always connect the external protective conductor to the grounding terminal before making any other electrical connections.
- All electrical equipment must be grounded. This applies to pump equipment, drive, and monitoring equipment. Test the grounding cable to verify correct connection.
- If the motor cable is accidentally loosened, the grounding conductor must be the last to be disconnected from its terminal. Ensure the grounding conductor is longer than the phase conductors. This applies to both ends of the motor cable.
- Add additional protection against fatal electric shock. Install a high-sensitivity differential switch (30 mA) (residual current device, RCD).

4.1 Site Requirements

4.1.1 Pump location

DANGER:
Do not use this unit in environments that may contain flammable/explosive or chemically aggressive gases or dust.

Instructions

Follow these instructions regarding product location:
- Ensure that there are no obstructions blocking the normal flow of cooling air from the motor fan.
- Make sure the installation area is protected against liquid leaks or flooding.
- If possible, place the pump slightly above floor level.
- Ambient temperature should be between 0°C and +40°C (32°F to 104°F).
- Relative humidity of the ambient air at +40°C (104°F) should be less than 50%.
- Contact the Sales and Service Department in cases below:

- If ambient humidity exceeds those specified.
- If room temperature exceeds +40°C (104°F).
- If the unit is located more than 1000 meters (3000 ft) above sea level. Motor derating or a more powerful motor may be required

Pump locations and clearance
Provide sufficient light and clearance around the pump. Ensure easy access for installation and maintenance work.

Installation above the liquid source (suction head)
The theoretical maximum suction head of a pump is 10.33 m. In practice, the following affect the suction capacity of the pump:
- Liquid temperature
- Altitude (in an open system)
- System pressure (in a closed system)
- Pipe resistance
- Internal flow resistance of the pump
- Height differences

The equation below is used to calculate the maximum height at which the pump can be installed above the liquid level:

(pb 10,33 + Z) ≥ (NPSH + 0,5) + Hf + Hpv

- **Pb:** Barometric pressure (in meters) (Pb = 1.013 bar × 10.2 = 10.33)
- **NPSH:** Internal flow resistance of the pump (in meters)
- **Hf:** Total loss in meters due to liquid flow in pump suction piping, such as fittings, check valve, etc.
- **Hpv:** Ratio of evaporation pressure of the liquid at operating temperature to its specific gravity (in meters)
- **Z:** Suction distance between the pump liquid axis and water surface in the suction tank. Levels below the pump axis are always negative.
- **0.5:** Safety factor.

WARNING:
Do not exceed the suction capacity of the pump, as this may cause cavitation and damage to the pump.

4.1.2 Piping Requirements

Precautions

WARNING:
- Use pipes rated for the maximum operating pressure of the pump. Failure to do so may result in risk of injury along with perforation of the system.
- Ensure that all connections are made by qualified technicians and in compliance with applicable regulations.

WARNING:
If the pump is connected to a municipal water system, comply with all regulations issued by the authorities and the utility company. If necessary, install a suitable backflow prevention device on the suction side.

Piping Requirements Checklist

Check that the following requirements are met:
- Pipes are supported independently; do not allow them to rest on the pump.
- Flexible pipes or couplings are used to prevent vibrations from being transmitted from the pump to the pipes and vice versa.

- Large elbows are used; use of elbows which cause excessive flow resistance is avoided.
- The suction piping is perfectly sealed and airtight.
- If the pump is used in an open circuit, the diameter of the suction pipe is suitable for the installation conditions. The suction pipe is not smaller than the suction port of the pump.
- If the suction pipes need to be larger than the suction port of the pump, an eccentric pipe reducer is installed.
- If the pump is installed above the liquid level, a foot valve is installed at the end of the suction pipe.
- The foot valve is fully submerged in the liquid so that no air can enter from the suction vortex when the liquid is at minimum level and the pump is installed above the liquid source.
- To allow for pump capacity regulation, pump control, and maintenance, shut-off valves of appropriate size are installed on both the suction and discharge pipes (in the direction of flow toward the check valve).
- To allow for pump capacity regulation, pump control, and maintenance, a shut-off valve of appropriate size is installed on the discharge pipe (in the direction of flow toward the check valve).
- A check valve is installed on the discharge pipe to prevent backflow into the pump when it is off.

WARNING:
Do not use the pump with the shut-off valve on the discharge side closed for more than a few seconds. If the discharge side of the pump must remain closed for more than a few seconds, a bypass circuit must be installed to prevent overheating of the liquid inside the pump.

For images of piping requirements, see Figures 7-8 on page 22.

4.2 Electrical Requirements

- Applicable local regulations override the requirements stated herein.
- In case of fire-fighting systems (hydrants and/or sprinkler systems) check applicable local regulations.

Electrical connection checklist
Check that the following requirements are met:

- Electrical terminals are protected from excessive heat, vibrations, and interference.
- The power supply line includes:
- Short-circuit protection device
- A main isolating switch with a minimum contact gap of 3 mm

Electrical control panel checklist

WARNING:
The control panel must match the electrical specifications of the pump. Motor may not be protected adequately with incorrect combinations.

Check that the following requirements are met:
- The control panel must protect the motor against overload and short-circuit.
- Proper overload protection is installed (thermal relay or motor protector).

Pump Type	Protection
Three-phase electric pump*	• Thermal protection (must be provided by the installer) • Short-circuit protection (must be provided by the installer)

- The control panel must include a protection system against dry running connected to a pressure switch, float switch, probes or another suitable device.
- The following devices are recommended on the suction side of the pump: Use a proper pressure switch when pumping liquid from a water system. Use a float switch or probes when pumping from a storage tank or reservoir.
- When using thermal relays, phase-failure sensitive relays are recommended.

Motor checklist

WARNING:
If using a non-standard motor, read the operating instructions to ensure that a protection device is included. If the motor is equipped with automatic thermal protectors, be aware of the risk that unexpected restarts may occur after overloading. Do not use these motors in fire-fighting applications.
- Only use dynamically balanced motors with a half-sized wedge on the shaft extension (IEC 60034-14) and normal vibration speed (N).
- The mains voltage and frequency must match the specifications on the nameplate.

Motors can generally operate under the following mains voltage tolerances:

Frequency Hz	Phase ~	UN [V] ± %
50	1	220-240 ±6
	3	230/400 ±10
		400/690 ±10
60	1	220-230 ±6
	3	220/380 ±5
		380/660 ±10

Use cables that comply with the 3-lead (2+ground) rules for single-phase models and 4-lead (3+ground) rules for three-phase models.

4.3 Pump Installation

4.3.1 Mechanical Installation

Check the following before installation:
- Use concrete with a compressive strength class of C12/15, meeting the requirements of exposure class XC1 according to EN 206-1.
- The installation surface must be level and completely flat.
- Pay attention to the specified weights.

Pump set installation
For horizontal installations, check that the foundation has been prepared according to the dimensions provided in the draft drawing/general layout drawing.
1. Place the pump set on the foundation and adjust the level using the water level indicator placed on the discharge port. The allowed deviation is 0,2 mm/m.
2. Remove the plugs that close the ports.
3. Align the pump and piping flanges on both sides of the pump. Check the alignment of the bolts.
4. Secure the piping to the pump with bolts.

5. If needed, use shims to adjust the height. If shims are used, always place them immediately to the left and right of the foundation bolts between the frame and foundation. For distances between bolts (U) greater than 800 mm,insert additional shims in the center of the distance between the bolt holes.
6. Ensure that all shims are perfectly aligned. Figure 2
7. Insert foundation bolts into the provided holes.
8. Use concrete to secure the foundation bolts to the foundation.
9. Wait until concrete is fully cured, then level the frame.
10. Tighten the base bolts evenly and securely. Figure 3

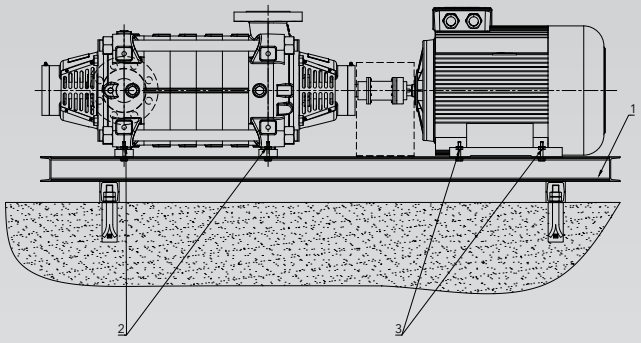
Note:

- For frames, grouting with low-shrinkage concrete is recommended.
- If vibration isolation is provided between the pump and the foundation.

Install the pump on a frame

Ensure that the following are observed:

- A rigid frame that does not bend or vibrate during operation (resonance)
- The installation surfaces of the pump feet and the motor on the frame are flat (machining recommended).
- The pump and motor are securely coupled.
- Depending on the type of coupling used, there is a sufficient clearance between the pump or motor shaft.
- A suitable shim is placed between the pump and frame to allow the same height to be adjusted between bottom and center lines in case of replacement. Figure 2



1 Frame, **2** Shims, **3** Bolts

Figure 2

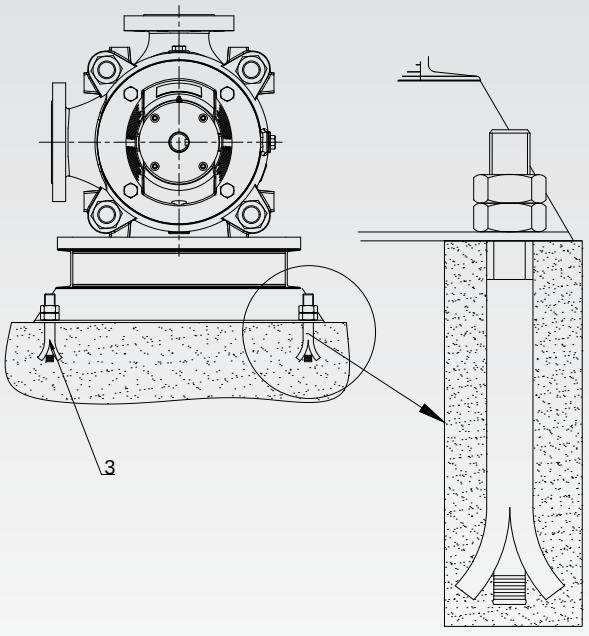


Figure 3

4.3.2 Piping Checklist

Check that the following are observed:

- The suction head line is laid with an upward slope in the downward sloping positive suction load line towards the pump. See Figure 8 on page 22.
- The nominal diameters of the pipe lines are at least equal to the nominal diameters of the pump ports.
- The piping is fixed near the pump and connected without transferring any tension or stress, see Figure 7 on page 22.

CAUTION:

Welding residues, scale, and other foreign objects in the piping can damage the pump.

- Clean the piping of foreign objects.
- Install a filter if necessary.

4.3.3 Coupling Alignment

After installation on the foundation and connection of the piping, the coupling must be re-aligned, even if the unit is delivered fully mounted on the frame.

Remove the coupling guard

"Perforated sheet" and/or flat sheet type
For information see Figure 4
1. Remove the Fixing Bolts (2).
2. Open the lifting housing (1).

– Do not loosen the screws, washers, and nuts.

"Flat sheet" type

1. Remove the fixing bolts - side (2).
2. Remove the fixing bolts - top (2).
3. Remove the coupling guard - upper half (1).
4. Remove the fixing bolts - bottom (2).
5. Remove the coupling guard.

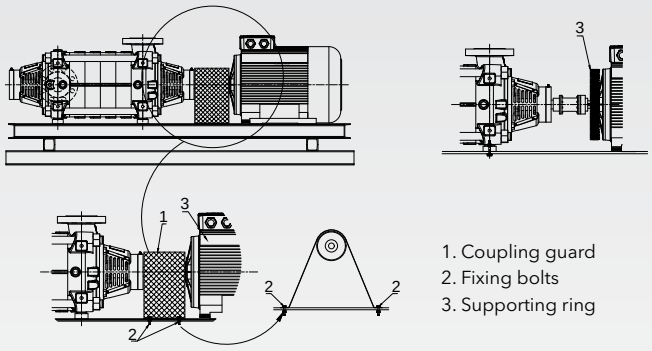


Figure 4

Alignment

For information see Figure
1. Loosen the screws on the support and pump foot.
2. Place the ruler (1) axially on both coupling parts.
3. Leave the ruler (1) in this position and turn the coupling by hand.

- The coupling is correctly aligned if the distances **"a"** and **"b"** to the relevant shafts are the same at all points around the circumference.
- The radial and axial misalignment between the two coupling halves must not exceed the values specified by the manufacturer when the unit is off, at operating temperature, and under inlet pressure.

Figure 5

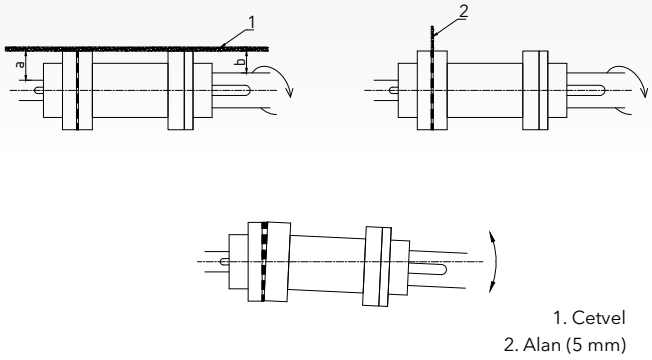


Figure 5

4. Use a measuring device (2) to check the distance between the two coupling halves around the circumference.

- The coupling is correctly aligned if the distance between the two halves of the coupling is the same at all points around the circumference.
- The radial and axial misalignment between the two coupling halves must not exceed the values specified by the manufacturer when the unit is off, at operating temperature, and under inlet pressure.

5. Re-tighten the screws of the support and pump foot without transferring any tension or stress.

Dial gauges can be used instead of rulers and thickness gauges.

For any requests or information, please contact your local sales and service representative.

NOTE: Check the alignment of the connection under hot operating status and, if present, at system pressure, and adjust if necessary. Make sure that the unit can be easily turned by hand.

WARNING:
Misalignment of the unit may cause damage to the coupling and the unit.

Install the coupling guard

CAUTION:
Do not operate the pump without the coupling guard properly installed.

"Perforated sheet" type
1. Open and position the guard (1) so that it wraps around the bearing cover and the support/adjustment ring (3).
2. Press the support/adjustment ring (3) axially onto the motor.
3. Screw in the fixing devices (2).

4.3.4 Electrical Installation
1. Remove the screws from the terminal box cover.
2. Connect and secure the power cables according to the applicable wiring diagram. For wiring diagrams see Figure 6 on page 20. The diagrams are also available on the back of the terminal box cover.
 a) Connect the grounding cable. Ensure that the grounding cable is longer than the phase cables.
 b) Connect the phase cables.
3. Install the terminal box cover.

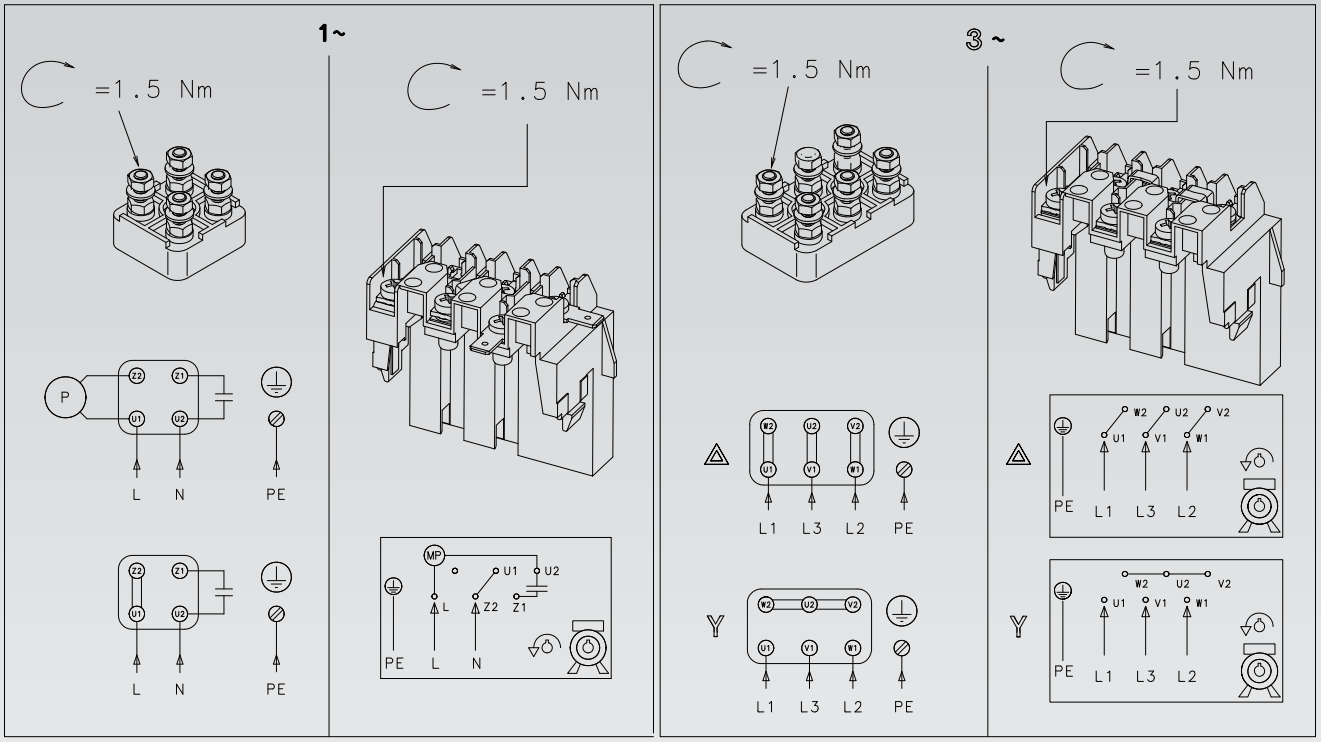


Figure 6

WARNING:
Tighten the cable glands carefully to prevent cable slippage and moisture in the terminal box.

4. If the motor does not have automatic reset thermal protection, set the overload protection according to the following list.

- If the motor is operating at full load, set the value to the nominal current value of the electric pump (nameplate).
- If the motor is operated with partial load, adjust the value to the operating current (measured, for example, with a current clamp).
- If the pump has a star-delta starter system, set the thermal relay to 58% of the nominal current or operating current (only for three-phase motors).

5. COMMISSIONING, START-UP, OPERATION, AND SHUTDOWN

Precautions

WARNING:
- Ensure that the drained fluid does not cause damage or injury.
- Motor protectors may cause the motor to restart unexpectedly. This could result in serious injury.
- Do not operate the pump without the coupling guard properly installed.

CAUTION:
- The outer surfaces of the pump and motor may exceed 40°C (104°F) during operation. Do not touch any part of the casing without protective equipment.
- Do not place flammable materials near the pump.

WARNING:
- Do not operate the pump dry or below the minimum nominal flow without being full.
- Never operate the pump for more than a few seconds with the discharge SHUT-OFF valve closed.
- Never operate the pump with the suction SHUT-OFF valve closed.
- Do not expose an idle pump to freezing conditions. Drain all liquid inside the pump. Otherwise the liquid may freeze and damage the pump.
- The total of the pressure on the suction side (from supply or storage tank) and the maximum pressure generated by the pump must not exceed the maximum allowable operating pressure (nominal pressure PN) of the pump.
- Do not operate the pump in case of cavitation.
- Cavitation may damage internal components.

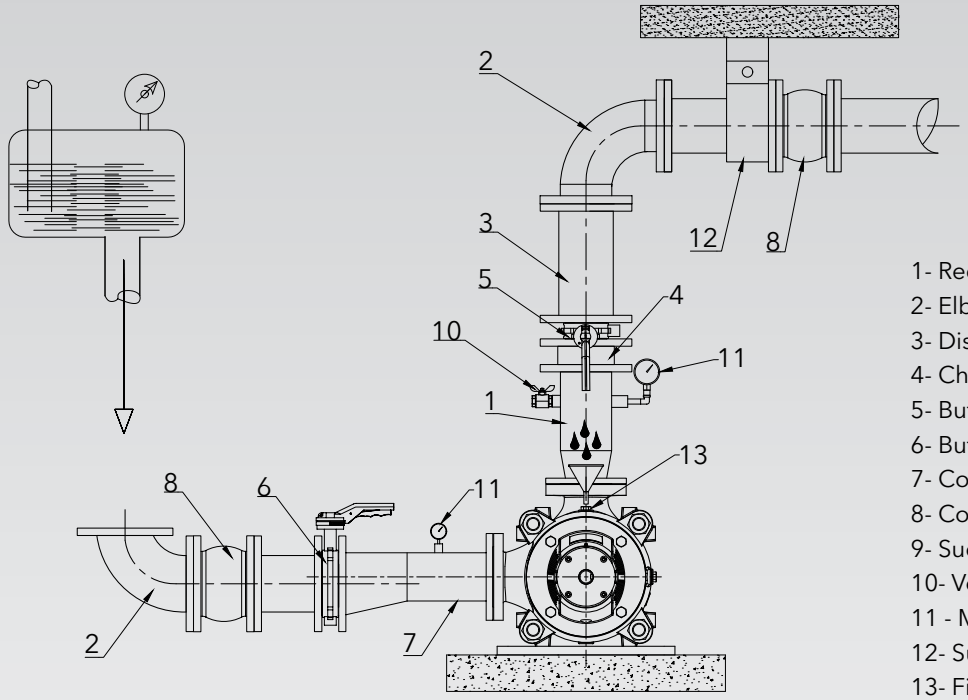
5.1 Installing The Pump Casing

For information about pump plugs, see image 1.
Installations where the liquid level is above the pump (suction head)

1. Close the shut-off valve located downstream of the pump.
2. Remove the filling plug (13) or the inspection plug (11), and open the shut-off valve upward until water flows out of the opening. Close the filling or inspection plug (11&13). Figure 7-8

Image 1

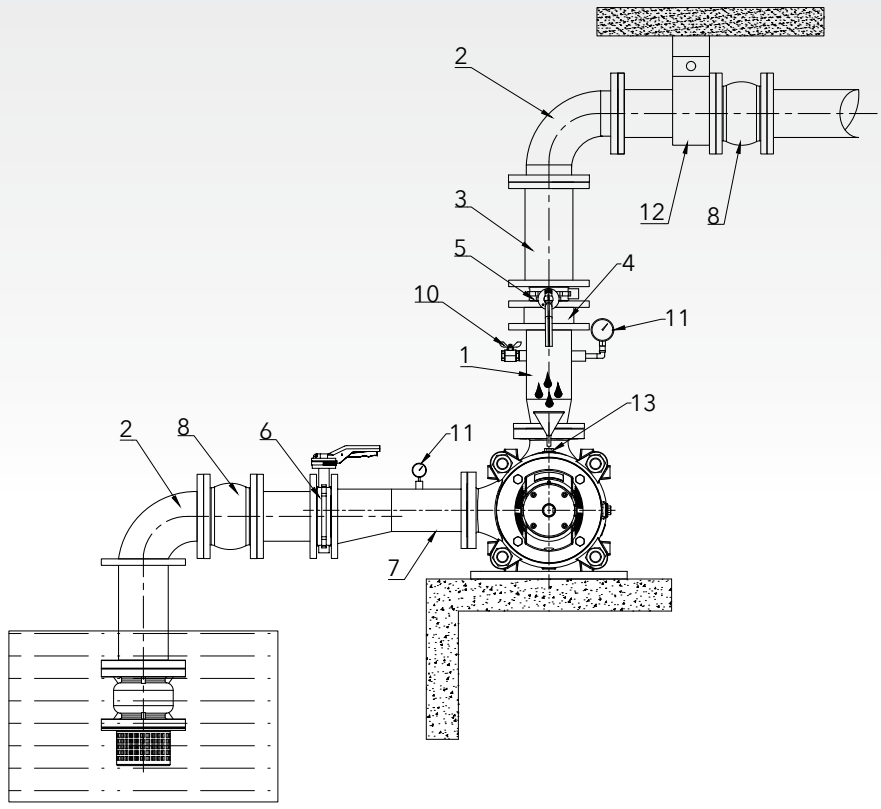
Positive Suction Head Pump



1- Reduction
2- Elbow
3- Discharge pressure
4- Check valve
5- Butterfly valve
6- Butterfly valve
7- Concentric reduction
8- Compensator
9- Suction valve
10- Vent valve
11 - Manometer
12- Support
13- Filling plug

Figure 7

Negative Suction Head Pump



1- Reduction
2- Elbow
3- Discharge pressure
4- Check valve
5- Butterfly valve
6- Butterfly valve
7- Concentric reduction
8- Compensator
9- Suction valve
10- Vent valve
11 - Manometer
12- Support
13- Filling plug

Figure 8

Installations where the liquid level is below the pump (suction head)

For illustration showing the location of the pump plugs see Image 1.

1. The entire pipe system is empty:
a) Open the shut-off valve located upstream of the pump.
b) Remove the filling plug (13) and the inspection plug (11). Use a funnel to fill the pump through the filling port until water flows out of the opening.
c) Tighten the filling plug (13) and inspection plug (11), see page 22.

2. Drain pipe system is filled:
a) Open the shut-off valve located upstream of the pump and the downstream shut-off valve.
b) Remove the inspection plug (11) until water flows out of the opening.
c) Tighten the inspection plug (11), see Figures 7-8 on page 22.

5.2 Checking the Direction of Rotation (Three-Phase Motors)
Perform this procedure before starting.

1. Locate the arrows on the adapter or motor fan cover indicating the correct direction of rotation.
2. Start the motor.
3. Quickly check the direction of rotation via the coupling guard or motor fan cover.
4. Stop the motor.
5. If the direction of rotation is incorrect, proceed as follows:
a) Disconnect the power supply.
b) On the motor terminal board or in the electrical control panel, swap the positions of two of the three power supply cables. For wiring diagrams see Figure 6 on page 18.
c) Recheck the direction of rotation.

5.3 Starting the Pump
The installer or product owner is responsible for ensuring correct flow and fluid temperature.

Before starting the pump, ensure that:
- The pump is correctly connected to the power supply.
- The pump has been properly filled according to the instructions in filing the pump section (section 5).
- Shut-off valve downstream of the pump is closed.

1. Start the motor.
2. Gradually open the shut-off valve on the discharge side of the pump.

Under expected operating conditions, the pump should run smoothly and quietly, if not see Troubleshooting section on pages 32–35.

6. MAINTENANCE

Precautions
Electrical Hazard: Disconnect and lock out the power supply before installing or servicing the unit.

WARNING:
- Maintenance and servicing must only be performed by qualified and trained personnel.
- Follow the applicable accident prevention regulations.
- Use appropriate equipment and protection.
- Ensure that the drained fluid does not cause damage or injury.

6.1. Service
If the user wants to plan regular maintenance intervals, it will be based on the type of liquid being pumped and the operating conditions of the pump.

For any request or information related to regular maintenance or servicing, contact your local sales and service representative.

Extraordinary maintenance may be necessary to clean the pump's liquid end and/or replace worn components.

Pumps with lifetime-greased bearings
Pumps with lifetime-greased bearings do not require any scheduled regular maintenance.

Pumps with re-greasable bearings
- Re-grease every 4,000 operating hours or at least once a year, whichever comes first.

Clean the lubrication nipples (SN) first.
- Use NLGI Grade 2 grease or an equivalent material.

For any requests or information, please contact your local sales and service representative.

Motor bearings
After approximately five years, the grease in motor bearings ages significantly, and it is recommended to replace the bearings. Bearings should be replaced after 25,000 operating hours or according to maintenance instructions of the motor supplier, whichever comes first.

Motor with re-greasable bearings
Follow maintenance instructions of the motor supplier.

Coupling
Check the clearance around the coupling components regularly, at least once a year. We recommend checking every 1,000 operating hours or every three months, whichever comes first.

6.2. Inspection Checklist

Check the coupling	Inspect the flexible components of the coupling. If there are any signs of wear, replace the relevant parts and check the alignment.
Check the mechanical seal	Check the mechanical seal for any leakage. If it is leaking, replace the mechanical seal.
Check the soft seals	Check whether the axial sealing rings mounted on the shaft are properly seated. The sealing lip should only be in light contact with the shaft.
Check for quiet operation	Use vibration measuring instruments to frequently check whether the pump is operating quietly.

7. PUMP DISASSEMBLY AND REPAIR

7.1 General Instructions

Repairs on the pump or pump system must only be carried out by authorized qualified personnel or by the manufacturer's specialized personnel.

When disassembling the pump, observe the instructions in sections 1 and 2.

If hazardous fluids are being pumped, the fluid must be properly disposed of before disassembling the pump. Even in drained pumps, residues of the pumped fluid may remain. If necessary, the pump must be rinsed or decontaminated. Regulations must be followed, otherwise health hazards may arise!

- Before disassembly, the pump must be secured against accidental startup.
- The pump casing must be completely drained and depressurized.
- All shut-off devices in the suction and discharge pipes must be closed.
- All parts must be at ambient temperature.

Secure disassembled pumps, units, or individual parts to prevent tipping or rolling.

If there is no fire hazard, use an open flame (e.g. blow torch) during disassembly only with caution, as it may cause explosion or the release of harmful vapors. Never apply heat to remove the impeller. Using heat may lead to serious personal injury and material damage.

Only use original spare parts. Ensure that the materials and design are appropriate.

7.2 General

Work involving blows (hammering) must only be carried out outside explosive environments, or non-sparking tools must be used.

7.3 Disassembling the Pump

- Drain the pump using the drain plug. Image 1
- Remove the coupling guard.
- Remove the spacer-type coupling and the coupling using a puller. Image 2
- Remove the bearing cover. Image 3
- Loosen the lock nut using a suitable wrench while holding the shaft in place by attaching a coupling and using a lever, then remove and dispose of the lock nut and washer. Image 4
- Unscrew the bolts of the bearing housing and remove it, check the bearing and oil seal, and replace them if necessary. Image 5

a) Remove the soft seal cover, replace the soft seal set and lube ring if necessary. (For soft seal models). Image 6-7

b) Remove the mechanical seal housing, check the mechanical seal, and replace if necessary. (For mechanical seal models). Image 8-9

- Remove the main pump studs (Image 10) and disassemble the pump suction casing side (Image 11), impeller (Image 12), and diffuser (Image 13) and replace worn parts in sequence.
- To remove the pump shaft, first remove the bearing cover, lock nut, and bearing thrust washer (Image 4) from the pump suction casing side, then pull the shaft out from the opposite end.
- Check the bushings and O-rings on the shaft and replace worn parts with new ones.


Image 1


Image 2


Image 3


Image 4


Image 5


Image 6


Image 7


Image 8


Image 9


Image 10


Image 11


Image 12


Image 13

All PTFE and graphite sealing elements are designed for single use only.

In most cases, it is necessary to replace the mechanical seal and bearings, regardless of whether they are damaged or not.
Deposits on the impeller, in the diffuser body, or in the seal section of the casing cover must be cleaned.

7.4 Removing the Mechanical Seal

Refer to the mechanical seal cross-section drawing and data sheet for this procedure.

- Remove and disassemble the pump in accordance with the Installation, Operation, and Maintenance Instructions in section 7.
- Remove the rotating part of the mechanical seal from the seal bushing. Image 14.
- Remove the stationary part of the mechanical seal from the seal housing. Image 15.


Image 14


Image 15

Reusing mechanical seals that have been in service for a long time may cause leakage on the seal surfaces after re-installation. Therefore, it is recommended to replace the mechanical seal with a new one. Removed mechanical seal may be refurbished by the manufacturer and reused as spare seal.

7.5 Installing the Mechanical Seal

Refer to the mechanical seal cross-section drawing and data sheet for this procedure

Only mechanical seals with a certificate of conformity in accordance with Directive 94/9/EC may be installed. If the type or manufacturer of the mechanical seal changes, the maximum operating temperature and temperature class of the pumped medium must be rechecked.

Ensure maximum cleanliness! Particularly, seal surfaces must be clean, dry, and undamaged.
Do not lubricate the mechanical seal surfaces.

If a lubricant is supplied with the spare mechanical seal, only use this lubricant.

Only use mineral grease or oil if you are absolutely certain that the mechanical seal elastomers are resistant to oil. Do not use silicone.

Only use lubricants that you are sure will not cause a hazardous reaction with the pumped medium.

Prepare all necessary components to complete the installation quickly. Lubricants are only effective for a short time. After that, axial mobility and therefore the automatic adjustment of the elastomers is no longer possible.

Never push elastomers over sharp edges. Use installation tools if necessary.

- Press the stationary part of the mechanical seal evenly into the seal housing. Use a soft surface stamp if necessary. Uneven pressure may cause the seal surface to crack.
- Do not damage the seal surface!
- Ensure that the stationary ring is in full axial contact with the housing. The seal surface must be installed perpendicular to the shaft.
- Make sure the mechanical seal is properly seated in its housing. Install the rotating part of the mechanical seal onto the seal bushing and push it up to the snap ring (Image 16). Replace the O-ring on the shaft and push the seal bushing and mechanical seal set up to the balancing disc (Image 17). Insert the wedge and fasten it with a hex socket head bolt (Image 18). Then install the seal thrust bushing (Image 19). Install the seal housing and tighten the bolts. Image 20
- During installation, lightly lubricate the inner surface of the rotating seal part and the outer surface of the bushing to facilitate installation.


Image 16


Image 17


Image 18


Image 19


Image 20

7.6 Installing the Soft Seal

Use the cross-sectional drawing and the seal housing for the seal box, see figure 13 on page 36.

Remove and disassemble the pump in accordance with the installation, operation, and maintenance manual. A seal box is the hole section that protects the barrier between the inner and outer diameters of the pump shaft or sleeve, keeps the seal around the pump shaft, and allows the shaft to rotate within the casing to prevent leakage.

The watering ring inside the seal box is a simple circular component located between the pump shaft's sealing rings to protect the seal. The seal box must contain 4 sealing rings and 1 watering ring. By surrounding the watering ring with the seal, a tight sealing can be achieved within the compression unit, commonly known as the seal.

The function of the seal box and watering ring in all designs is not only to ensure more efficient discharge from the pump but also to prevent the entry of contaminants, abrasives, and chemicals into the pump.

Sealing Rings
Pumps that require lubrication are equipped with sealing rings. The pump seal includes watering rings that serve several critical functions:

- To facilitate lubrication distribution over the seal material
- To distribute cooling water to the sealing rings
- To assist in removing chemicals from the seal
- To keep debris and contaminants out of the seal box

These functions directly contribute to the pump's service life, making the correct installation of watering rings an important part of pump maintenance.

Purpose of the Watering Ring
In pump operation, the watering ring has one of the most critical roles since it serves multiple functions simultaneously. Since shaft or sleeve damage is one of the most common causes of pump failure, the importance of the watering ring becomes even more evident. This means that the quality and efficiency of the watering ring are integral to the overall functionality of the system.

Another major benefit is that the lantern ring is designed to lubricate the contact points to reduce friction. This helps minimize wear, offers corrosion protection, and reduces the amount of excess heat generated within the system. Watering ring designs also distribute water to the seal and to the shaft or shaft sleeve, thereby helping regulate temperature by dispersing generated heat. We recommend using the original watering ring.

Another equally important purpose of the watering ring is to ensure extended service time for the sealing system. Not only does the watering ring improve durability, but it also makes it easier for personnel to perform maintenance, allowing service and repair tasks to be completed much faster.

Installation and Maintenance of the Watering Ring
The holes in the watering ring typically allow a cooling medium, usually water, to reach the pump's seal and shaft or shaft sleeve In order to rinse the shaft and prevent failures, the watering ring must be installed correctly. If the ring is incorrectly positioned, it may actually block the coolant flow.
Using a low-quality watering ring might save money but increases the likelihood of deformation due to heat and collapse. Therefore, always use the original watering ring.

The pump seal includes watering rings that serve several critical functions.
- To facilitate lubrication distribution over the seal material.
- To distribute cooling water to the sealing rings.
- To assist in removing chemicals from the seal.
- To keep debris and contaminants out of the seal box.

Pump maintenance is essential to ensure your pump operates properly, but there are a few common maintenance mistakes to avoid about the watering rings:

- Make sure you do not forget to reinstall the watering ring.
- Do not guess the position of the watering ring. Note down all rings before removing them for maintenance.
- The watering ring must align with the spray hole in the seal box.
- Avoid adding extra seal during maintenance, as it leaves less space for the watering ring to perform effective lubrication.

Ensuring that your sealing rings are correctly placed and have enough space to function properly will ensure smooth pump operation. Careful maintenance and the use of high-quality sealing rings will be beneficial in extending the pump's life.


Image 21


Image 22

7.7 Removing Impellers and Diffusers

- Follow pages 26–28.
- Remove the 4 bolts of the pump bearing cover (Image 3).
- Attach the coupling to the shaft and use a lever to hold it steady while removing the lock nut and washer (Image 4). Remove the bearing housing (Image 5). Check the bearing and replace it if necessary.
- Pull off the seal thrust bushing and for models with oil seals, remove the seal thrust (Image 6). Check the soft seal set (Image 7). Check the seal bushing and O-ring on the shaft (Image 21). Replace if necessary.
- For mechanical seal models, remove the mechanical seal housing (Image 8). Check the mechanical seal set (Image 9), seal bushing and O-ring on the shaft (Image 21).
- Check the balancing disc and balancing bushing (Image 22), by removing the discharge casing. Replace worn components if necessary.
- Remove the diffuser body and impellers respectively (Images 11, 12, 13).


Image 23


Image 24

- Replace the O-rings in the diffuser with new ones (Image 23). For EKP-R/EKP-A/EKP-V models, check the slide bearings in the suction casing and replace them if worn (Image 24).
- If there are wear rings in the pump, replace them with new ones.
- If the pump is disassembled for inspection, take care to replace all elastomer parts with new ones when reassembling.


Image 25

For spiral bodies with wear rings and cover seal chamber with wear rings, the correct clearance can be restored using the following options:

a) Replace the impeller and the wear rings. The original measurements are then restored.
b) To avoid replacing the impeller, a customized wear ring (properly tightened) can be supplied. Please contact the factory for details.

If the impeller is in good condition, the wear rings can be replaced to restore pump performance. For details and assistance, please contact the factory.

7.8 Installation

Re-install the pump by following the steps for disassembly in reverse order. However, the following must be observed:

- Take maximum care to ensure cleanliness during re-installation.
- For housings and bearing housings, as well as low-tolerance parts like threads, apply a suitable anti-friction compound (e.g. Molykote) to facilitate both installation and future disassembly.
- The pump shaft assembly has 4 mm of axial play inside the casing. When tightening the pump lock nut, leave a clearance of 1 mm at the front and 2 mm at the back between the seal bushing and the bearing on the shaft (Figure 25), or use shims between the bearing housing and the bearing (Image 25 on page 27)
  .

The anti-friction compound must be compatible with the pump.

- Screws must be tightened to the following torques:

Location	Screw Size	Screw torque in Nm	
		Lubricated Threads	Dry Threads
Casing screws	M8	10	25
	M10	20	50
	M12	35	50
	M16	105	150
	M20	210	305
All other screws	M10	35	50
	M12	60	90
	M65	150	220

- Refer to the separate “Mechanical Seal Installation” instructions for installing the mechanical seal.
- Before installing new bearings, heat them in an oil bath up to 80°C or use a bearing heater. If necessary, use a pipe to force the inner ring onto the shaft by tapping it lightly with a hammer and/or using a hydraulic press.
- Before installing the shaft assembly into the lower half of the housing, insert the retaining ring into both inner and outer grooves. The clearance between the outer surface of the bearing and the groove for the retaining ring should be 0.5–1 mm. Adjust with shims if necessary. Then fit the retaining rings to both the inner and outer shaft bearings.
- Use the torque table to fasten the casing bearing on both the inside and outside (downward).

8. TROUBLESHOOTING

8.1 Troubleshooting for Users

Main switch is on but electric pump is not running.

Cause	Solution
The thermal protector (if present) in the pump is activated.	Wait until the pump cools down. The thermal protector will reset automatically.
The dry-running protection device is activated.	Check the fluid level in the tank or the supply pressure.

The electric pump is running, but the thermal protection is activated after a while.

Cause	Solution
There are foreign objects (solid or fibrous materials) stuck in the impeller inside the pump.	Contact the Sales and Service Department.
The pump is overloaded due to pumping a highly dense and viscous liquid.	Check the actual power requirements according to the characteristics of the pumped liquid, then contact the Sales and Service Department.

Pump runs but delivers very little or no liquid.

Cause	Solution
Pump is clogged.	Contact the Sales and Service Department.

8.2 Main Switch is On but Electric Pump is Not Running

Cause	Solution
No power supply.	• Restore the power supply. • Ensure that all electrical connections to the power supply are secure.
The thermal protector (if present) in the pump is activated.	Wait until the pump cools down. The thermal protector will reset automatically.
The thermal relay or motor protector on the electrical control panel is activated.	Reset thermal protection.
The dry-running protection device is activated.	**Check the following:** • The liquid level in the tank or the supply pressure. • Protective device and connection cables.
The fuses for the pump or auxiliary circuits are tripped.	Change the fuses.

8.3 Electric Pump Runs but Thermal Protection is Activated or The Fuses Trip Immediately

Cause	Solution
The power cord is damaged.	Check the cable and replace it if necessary.
Thermal protection or fuses are not suitable for the motor current	Check the components and replace them if necessary
The electric motor has short-circuited.	Check the components and replace them if necessary
Motor is overloaded.	Check the operating conditions of the pump and reset the protection.

8.4 Electric Pump Runs but Thermal Protection is Activated or Fuses Trip After a Short Time

Cause	Solution
The electrical panel is in an excessively heated area or is exposed to direct sunlight.	Protect the electrical panel from heat sources and direct sunlight
The power supply voltage is not within the operating limits of the motor.	Check the operating conditions of the motor
A power phase is missing.	**Check the following:** • Power supply • Electrical connection

8.5 Electric Pump Runs but Thermal Protection is Activated After a Short Time

Cause	Solution
There are foreign objects (solid or fibrous materials) stuck in the impeller inside the pump.	Contact your local sales and service representative.
The discharge rate of the pumps exceeds the limits specified on the nameplate.	Partially close the shut-off valve downstream until the discharge rate is equal to or lower than the limits specified on the nameplate.
The pump is overloaded due to pumping a highly dense and viscous liquid.	Check the actual power requirements based on the characteristics of the pumped liquid and replace the motor accordingly.
The motor bearings are worn out.	Contact your local sales and service representative.

8.6 Electric Pump Runs but System General Protection is Activated

Cause	Solution
Short-circuit in the electrical system.	Check the electrical system.

8.7 Electric Pump Runs but Residual Current Device (RCD) is Activated

Cause	Solution
There is a grounding leak.	Check the isolation of electrical system components

8.8 Pump Runs But Delivers Very Little or No Liquid

Cause	Solution
There is air in the pump or piping.	• Release the air
There is a grounding leak.	**Stop the pump and repeat the priming procedure.** If the problem persists: • Check that the mechanical seal is not leaking. • Check the tightness of the suction pipe. • Replace all leaking valves.
There is a grounding leak.	• Open the valve.

Cause	Solution
The valves are locked in the closed or partially closed position.	Remove and clean the valves.
Pump is clogged.	Contact local sales representative
Piping is clogged.	Check and clean the pipes.
Impeller rotates in the wrong direction (three-phase model)	Swap the positions of the two phases on the motor terminal board or electrical control panel
The suction head is too high or the flow resistance in the suction pipes is too high.	**Check the operating conditions of the pump. If needed, do the following:** • Reduce the suction head • Increase the diameter

8.9 Electric Pump Stops and Then Runs in Reverse

Cause	Solution
There is a leak in one or both of the following components: **• Suction pipe** **• Foot valve or check valve**	Repair or replace the faulty component.
There is air in the suction pipe.	• Release the air.

9. TECHNICAL APPENDIX

10. MOTOR SPECIFICATIONS

Mains Connection: 3*400 V, 50 Hz
Motor Speed: 2900 rpm
Motor Power: 90-315 kW
Motor Efficiency: IE2
Protection Class: IP55
Insulation Class: F

11. PUMP IDENTIFICATION CODE

EKP Horizontal Multistage Pump Identification Code

EKP / / / /
1 2 3 4 5

EKP-R Horizontal Multistage Pump Identification Code

EKP-R / / / /
1 2 3 4 5

EKP-A Horizontal Multistage Pump Identification Code

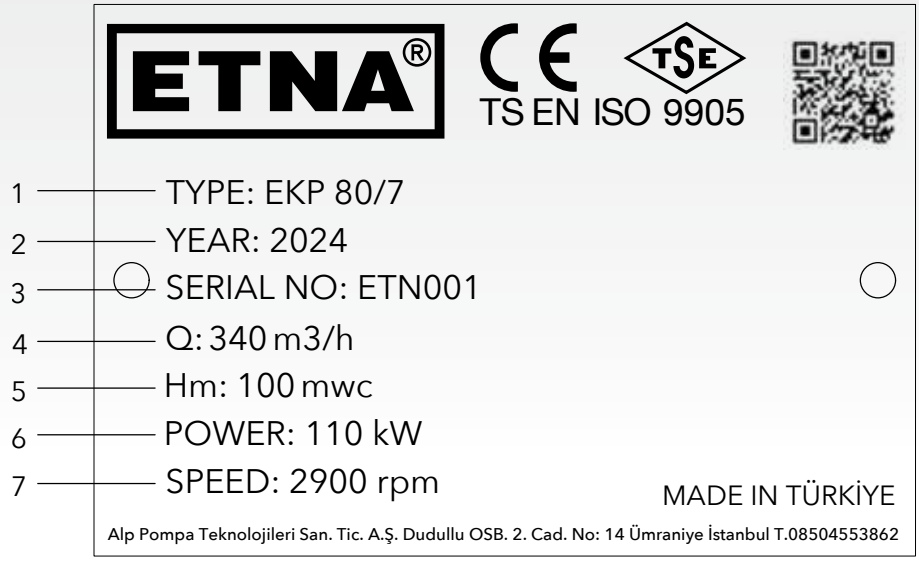
EKP-A / / / /
1 2 3 4 5

EKP-V Vertical Multistage Pump Identification Code

EKP-V / / / /
1 2 3 4 5

1. Pump Series **2.** Discharge Flange Diameter (DN-mm) **3.** Number of Stages **4.** Flange Location **5.** kW

12. NAMEPLATE

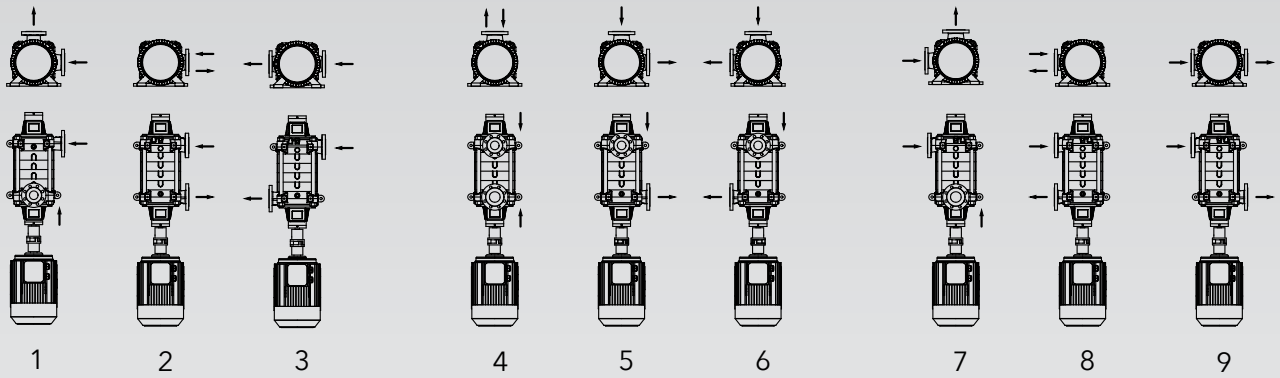


1. Pump Type **2.** Year of Manufacture **3.** Pump Serial Number **4.** Flow Rate **5.** Discharge Head **6.** Pump Power **7.** Speed

Figure 10

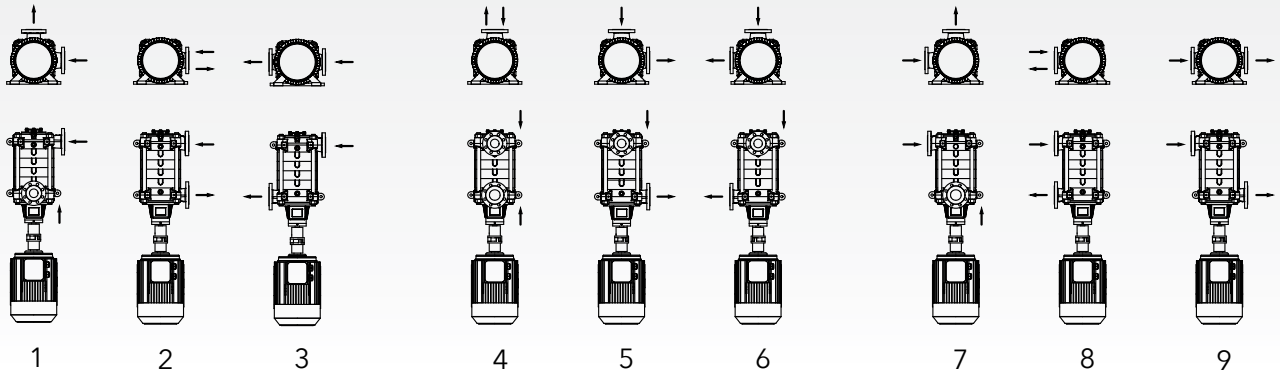
13. EKP PUMP FLANGE POSITIONS

EKP PUMP FLANGE POSITIONS



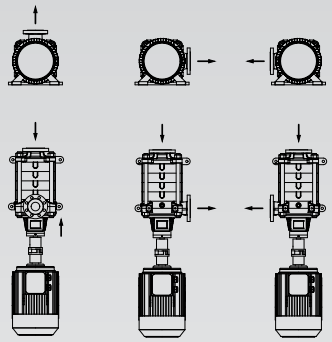
Note: When viewed from above, the pump discharge flange is always on the motor side of the pump set.

EKP-R PUMP FLANGE POSITIONS



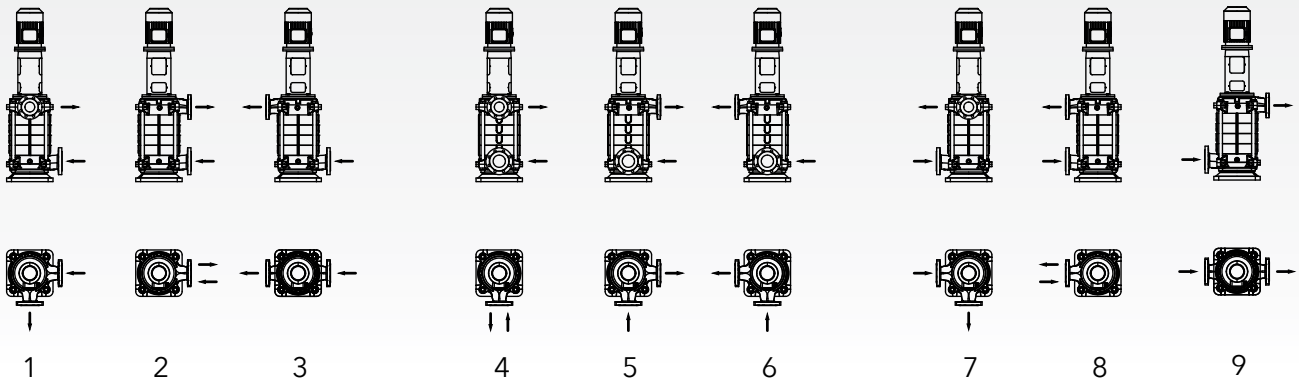
Note: When viewed from above, the pump discharge flange is always on the motor side of the pump set.

EKP-A PUMP FLANGE POSITIONS



Note: When viewed from above, the pump discharge flange is always on the motor side of the pump set.

EKP-V PUMP FLANGE POSITIONS



Note: When viewed from above, the pump discharge flange is always on the motor side of the pump set.

14. SECTIONAL DATA FOR SOFT SEAL SET

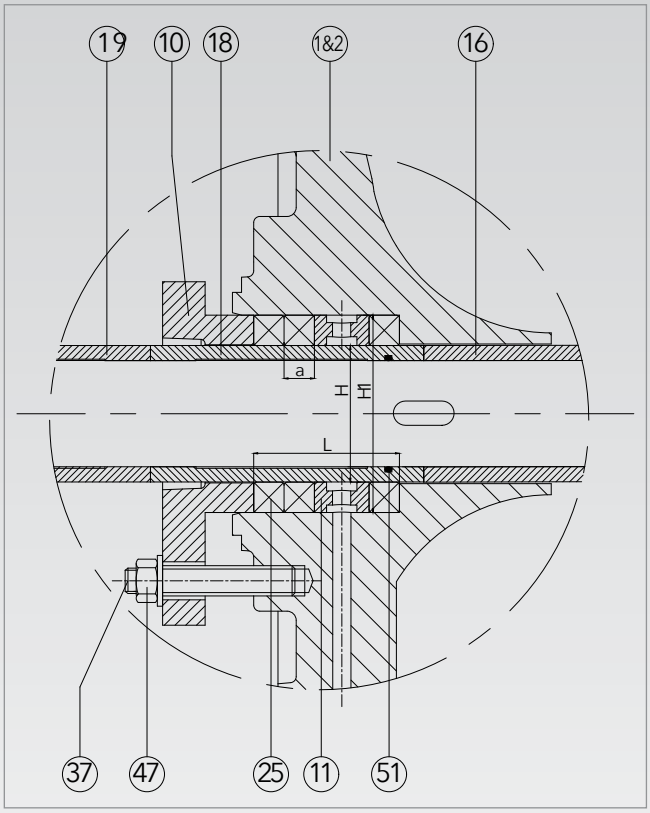


Figure 13

No	Part Name
1&2	PUMP CASING
10	SEAL THRUST COVER
11	LUBE RING
16	IMPELLER THRUST BUSHING
18	SEAL BUSHING
19	SEAL THRUST BUSHING
25	SOFT SEAL
37	STUD
47	NUT
51	O-RING

Pump Type	Soft Seal Dimensions (mm)	
	Length	Diameter
EKP 50	200	10x10
EKP 65	200	10x10
EKP 80	230	12x12

Type	Bearing (Suction Side)	Bearing (Discharge Side)	Seal (Soft Seal) (H1xHxaxL) mm	Seal
EKP 40	6305 (25x62x17)	6305 (25x62x17)	Ø50xØ35x8x30	2x (4 Seal + 1 Lube Ring)
EKP 50	6306 (30x72x19)	6306 (30x72x19)	Ø65xØ45x10x40	2x (4 Seal + 1 Lube Ring)
EKP 65	6307 (35x80x21)	6307 (35x80x21)	Ø65xØ45x10x50	2x (4 Seal + 1 Lube Ring)
EKP 80	3308 (40x90x36.5)	3308 (40x90x36.5)	Ø75xØ50x12x60	2x (4 Seal + 1 Lube Ring)

Type	Bearing (Suction Side)	Bearing (Discharge Side)	Seal (Soft Seal) (H1xHxaxL) mm	Seal
EKP-R-A-V 40	Tungsten Carbide (16x30x20)	6305 (25x62x17)	Ø50xØ35x8x30	1x (4 Seal + 1 Lube Ring)
EKP-R-A-V 50	Tungsten Carbide (16x30x20)	6306 (30x72x19)	Ø65xØ45x10x40	1x (4 Seal + 1 Lube Ring)
EKP-R-A-V 65	Tungsten Carbide (20x36x20)	6307 (35x80x21)	Ø65xØ45x10x50	1x (4 Seal + 1 Lube Ring)
EKP-R-A-V 80	Tungsten Carbide (20x36x20)	3308 (40x90x36.5)	Ø75xØ50x12x60	1x (4 Seal + 1 Lube Ring)

15. SECTIONAL DATA FOR MECHANICAL SEAL SET

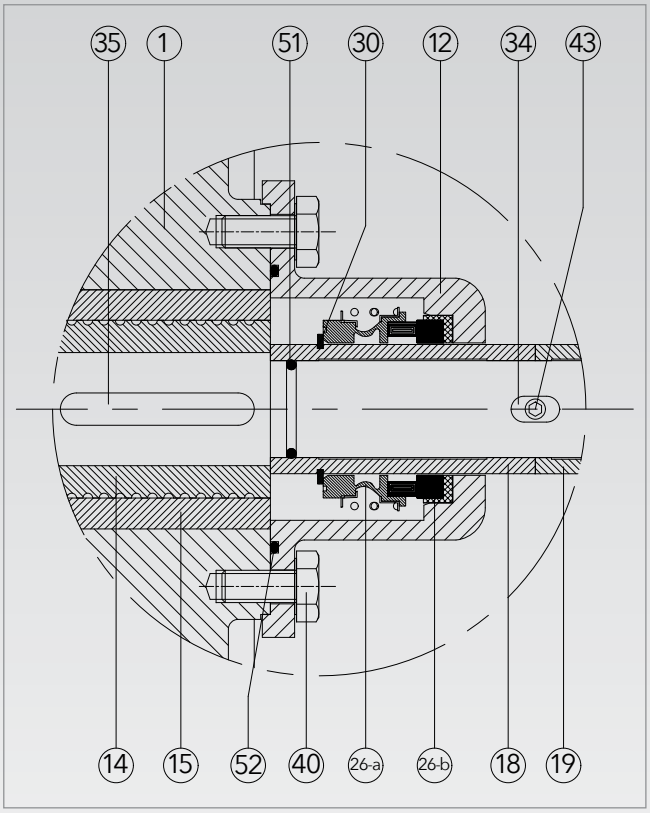


Figure 14

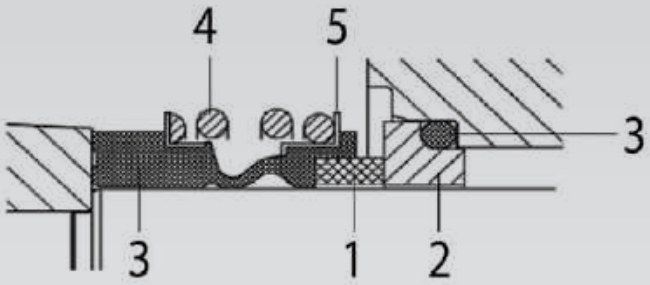
No	Part Name
1	PUMP CASING
12	MECH. SEAL HOUSING
14	BALANCING DISC
15	BALANCING DISC BUSHING
18	MECH. SEAL BUSHING
19	SEAL THRUST BUSHING
26-a	MECH. SEAL ROTATING PART
26-b	MECH. SEAL STATIONARY PART
30	SNAP RING
34	WEDGE
35	WEDGE
40	HEXAGON BOLT
43	HEX SOCKET BOLT
51	O-RING
52	O-RING

Type	Bearing (Suction Side)	Bearing (Discharge Side)	Seal (Mechanical Seal)	Seal
EKP 40	6305 (25x62x17)	6305 (25x62x17)	MG12-30	M106K/CE/EPDM/SUS304
EKP 50	6306 (30x72x19)	6306 (30x72x19)	MG12-35	M106K/CE/EPDM/SUS304
EKP 65	6307 (35x80x21)	6307 (35x80x21)	MG12-40	M106K/CE/EPDM/SUS304
EKP 80	3308 (40x90x36.5)	3308 (40x90x36.5)	MG12-45	M106K/CE/EPDM/SUS304

Type	Bearing (Suction Side)	Bearing (Discharge Side)	Seal (Mechanical Seal)	Seal
EKP-R-A-V 40	Tungsten Carbide (16x30x20)	6305 (25x62x17)	MG12-30	M106K/CE/EPDM/SUS304
EKP-R-A-V 50	Tungsten Carbide (16x30x20)	6306 (30x72x19)	MG12-35	M106K/CE/EPDM/SUS304
EKP-R-A-V 65	Tungsten Carbide (20x36x20)	6307 (35x80x21)	MG12-40	M106K/CE/EPDM/SUS304
EKP-R-A-V 80	Tungsten Carbide (20x36x20)	3308 (40x90x36.5)	MG12-45	M106K/CE/EPDM/SUS304

16. MECHANICAL SEAL FOR EKP PUMPS

Mechanical seal connection dimensions in accordance with EN 12756 and ISO 3069



List of Materials

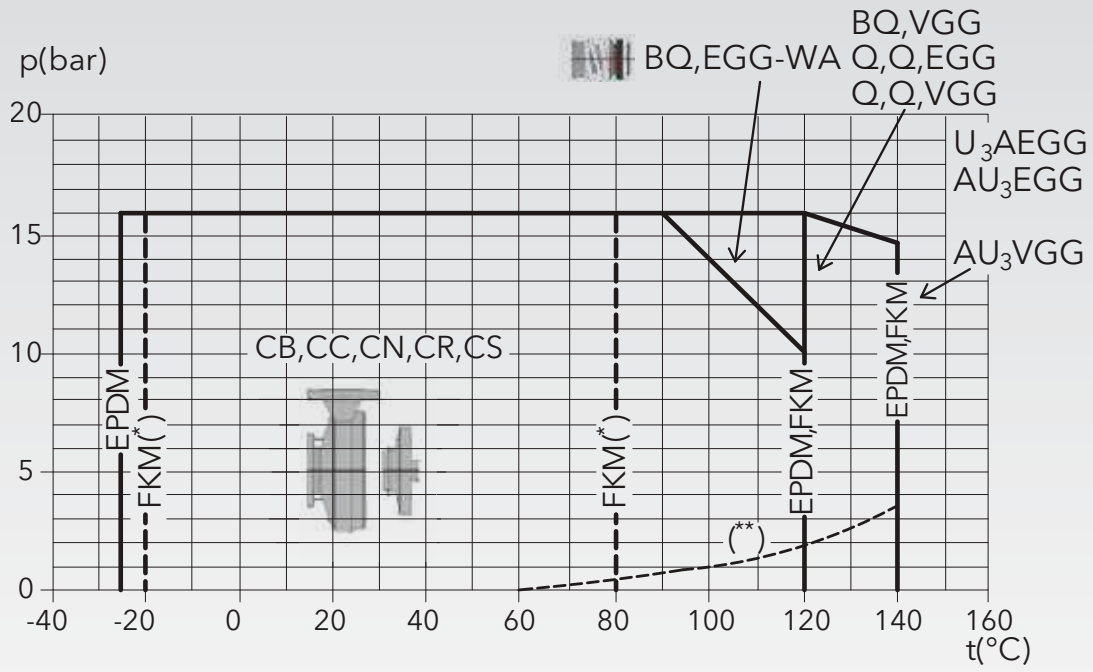
Positions 1-2	Position 3	Positions 4-5
B: Resin impregnated carbon	E: EPDM	G: AISI 304
V: Ceramic	V: FKM (FPM)	
Q1: Silicium Carbide	P: NBR	
U3: Tungsten Carbide		
A: Antimony-Impregnated Carbon		

Seal Type for EKP Pumps

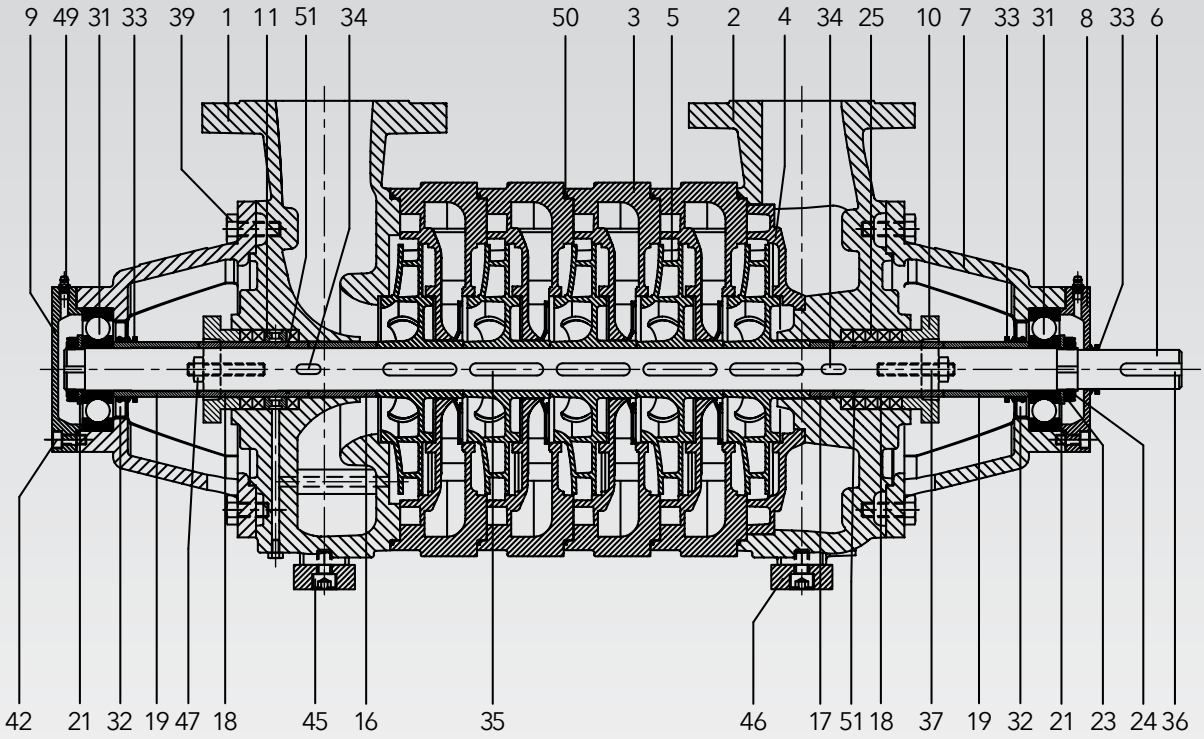
Type	Position					Temperature (°C)
	1. Rotating Parts	2. Stationary Part	3. Elastics	4. Springs	5. Other Parts	
Standard Mechanical Seal						
B V E G G	B	V	Y	G	G	-30/+120
Other Mechanical Seal Types						
V B V G G	V	B	V	G	G	-10/+120
Q_1 B V G G	Q_1	B	V	G	G	-10/+120
Q_1 Q1 V G G	Q_1	Q_1	V	G	G	-10/+120
V B E G G	V	B	Y	G	G	-30/+120
Q_1 B E G G	Q_1	B	Y	G	G	-30/+120
Q_1 Q1 E G G	Q_1	Q_1	Y	G	G	-30/+120
A U3 E G G	A	U_3	Y	G	G	-25/+140

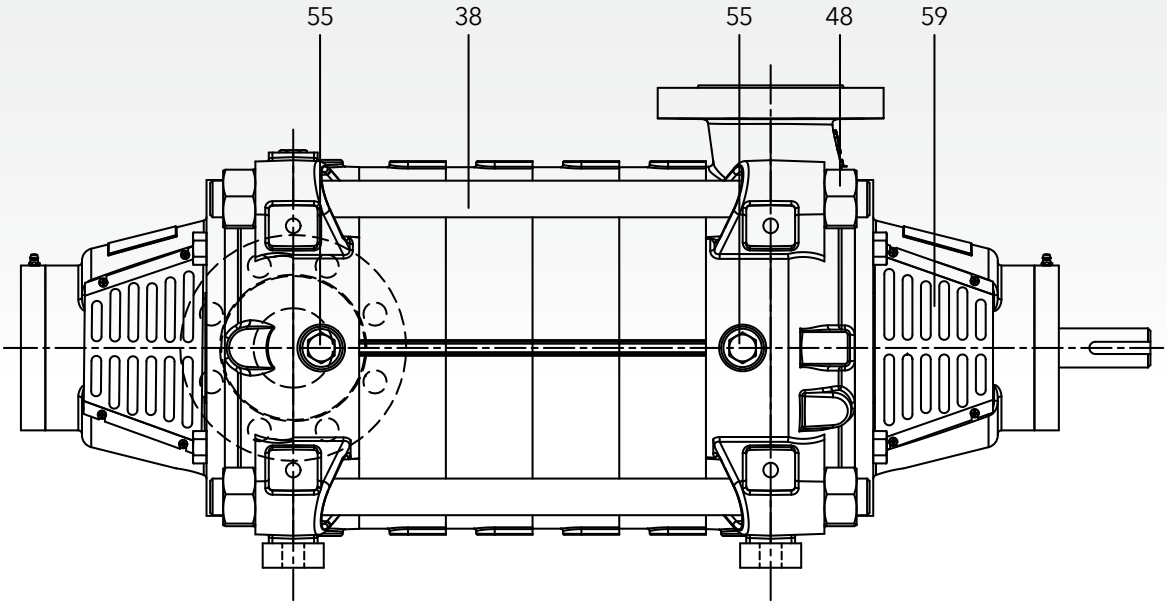
Seal Type for EKP Pumps

Type	Position					Temperature (°C)
	1. Rotating Parts	2. Stationary Part	3. Elastics	4. Springs	5. Other Parts	
Standard Mechanical Seal						
B V E G G	B	V	Y	G	G	-30/+120
Other Mechanical Seal Types						
Q1 B V G G	Q1	B	V	G	G	-10/+120
Q1 Q1 V G G	Q1	Q1	V	G	G	-10/+120
A U3 E G G	A	U3	Y	G	G	-25/+140



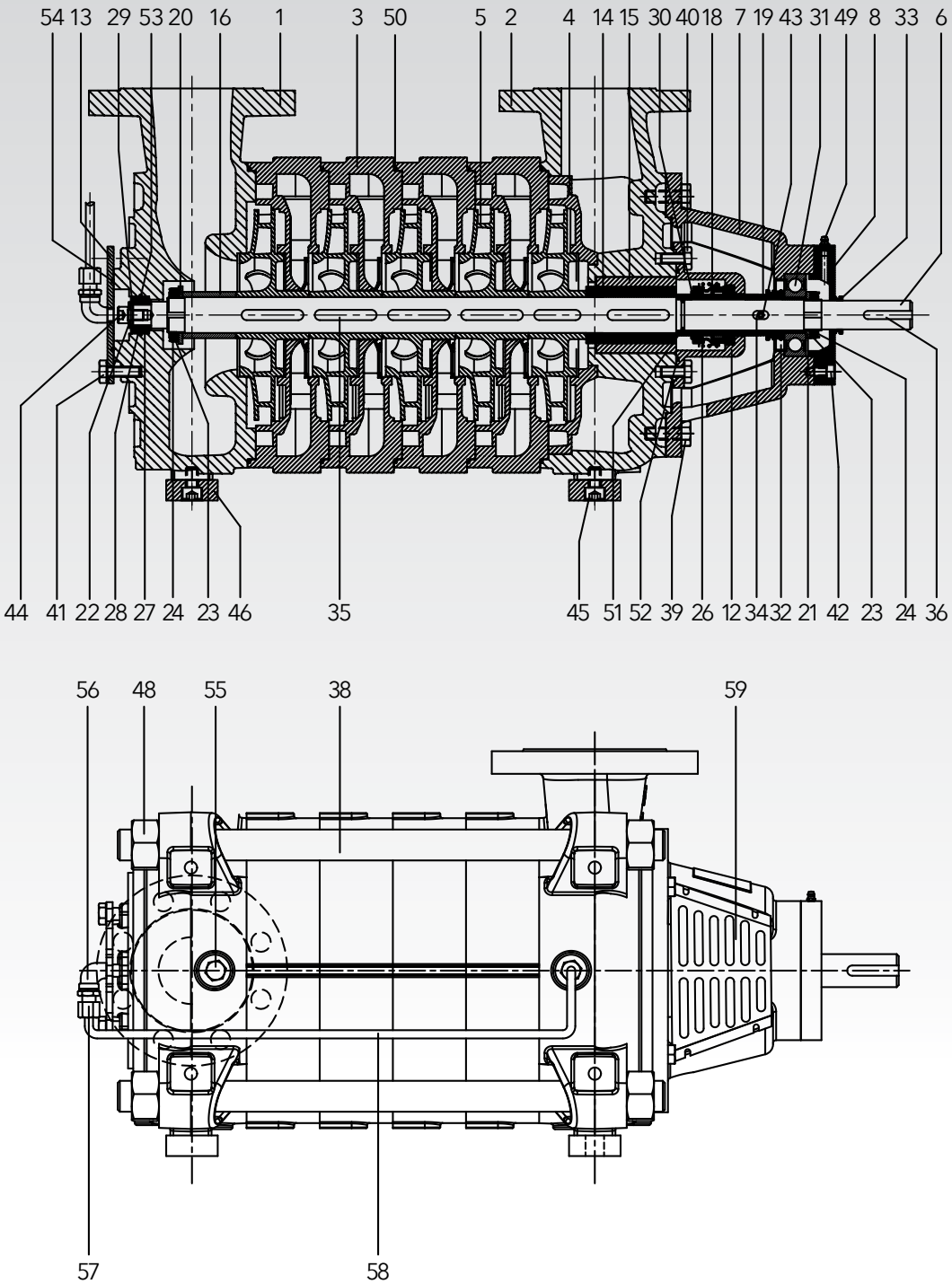
17. EXPLODED VIEW FOR EKP PUMP WITH SOFT SEAL





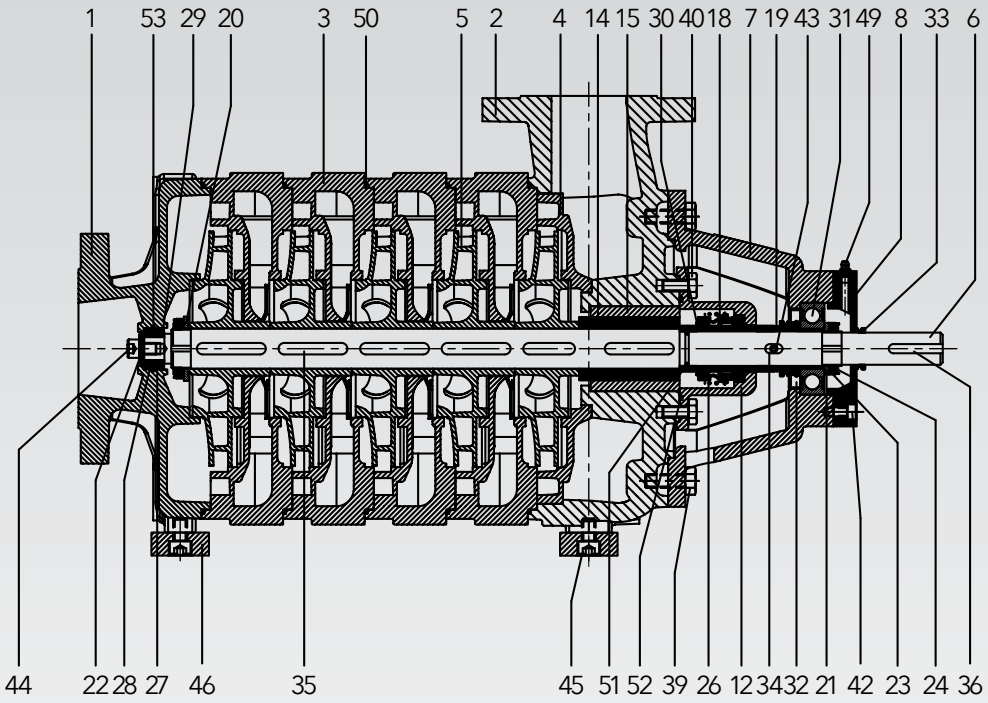
No	Part Name	Qty	Material Information
1	PUMP SUCTION CASING	1	Nodular Cast Iron
2	PUMP DISCHARGE CASING	1	Nodular Cast Iron
3	STAGE WITH DIFFUSER		Nodular Cast Iron
4	FINAL STAGE DIFFUSER	1	Nodular Cast Iron
5	PUMP IMPELLER		Nodular Cast Iron
6	PUMP SHAFT	1	AISI 420
7	BEARING HOUSING	2	Nodular Cast Iron
8	BEARING COVER MOTOR SIDE	1	Nodular Cast Iron
9	BEARING COVER CLOSED	1	Nodular Cast Iron
10	SEAL THRUST COVER	2	Nodular Cast Iron
11	LUBE RING	1	Bronze
16	IMPELLER THRUST BUSHING SUCTION	1	AISI 420
17	IMPELLER THRUST BUSHING DISCHARGE	1	AISI 420
18	SEAL BUSHING	2	AISI 420
19	SEAL THRUST BUSHING	2	AISI 420
21	BEARING THRUST WASHER	2	AISI 420
23	LOCK WASHER	2	AISI 420
24	LOCK NUT	2	AISI 420
25	SOFT SEAL	8	Buraflon
31	BEARING	2	Please see Bearing Table
32	OIL SEAL	2	DIN 3760 (ISO 6194/1)
33	W-RING	3	DIN 3760 (ISO 6194/1)
34	BUSHING WEDGE	2	DIN 6885-C45K
35	IMPELLER WEDGE		DIN 6885-C45K
36	COUPLING WEDGE	1	DIN 6885-C45K
37	STUD	4	AISI 304
38	STUD	4	AISI 304
39	HEXAGON BOLT	8	Class 10.9
42	HEX SOCKET BOLT	8	Class 10.9
45	HEX SOCKET BOLT	4	Class 10.9
46	BOTTOM LEG	2	St 37
47	NUT	4	Class 10.9
48	NUT	8	Class 10.9
49	GREASE NIPPLE	2	CuZn37 (Ms63)
50	O-RING	2	NBR
51	O-RING		NBR
55	BLIND PLUG	4	CuZn37 (Ms63)
59	SEAL SLEEVE PLATE	4	AISI 316

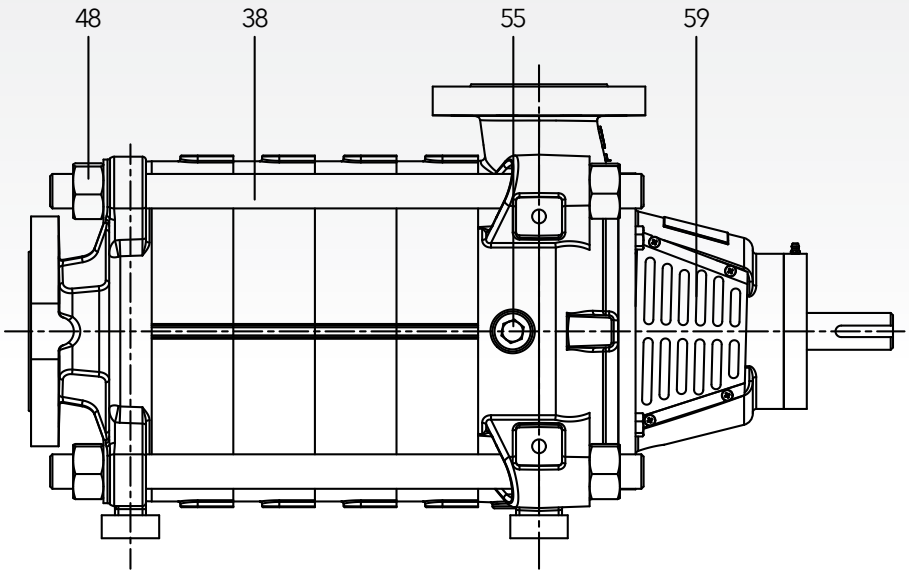
18. EXPLODED VIEW FOR EKP-R PUMP WITH MECHANICAL SEAL



No	Part Name	Qty	Material Information
1	PUMP SUCTION CASING	1	Nodular Cast Iron
2	PUMP DISCHARGE CASING	1	Nodular Cast Iron
3	STAGE WITH DIFFUSER		Nodular Cast Iron
4	FINAL STAGE DIFFUSER	1	Nodular Cast Iron
5	PUMP IMPELLER		Nodular Cast Iron
6	PUMP SHAFT	1	AISI 420
7	BEARING HOUSING	1	Nodular Cast Iron
8	BEARING COVER MOTOR SIDE	1	Nodular Cast Iron
12	MECHANICAL SEAL HOUSING	1	Nodular Cast Iron
13	CARBIDE THRUST COVER	1	Nodular Cast Iron
14	BALANCING DISC	1	AISI 420
15	BALANCING DISC BUSHING	1	AISI 420
16	IMPELLER THRUST BUSHING SUCTION	1	AISI 420
18	MECHANICAL SEAL BUSHING	1	AISI 420
19	SEAL THRUST BUSHING	1	AISI 420
20	IMPELLER THRUST WASHER	1	AISI 420
21	BEARING THRUST WASHER	1	AISI 420
22	CARBIDE THRUST WASHER	1	AISI 420
23	LOCK WASHER	1	AISI 420
24	LOCK NUT	1	AISI 420
26	MECHANICAL SEAL	1	M106K/CE/EPDM/SUS304
27	SHAFT BUSHING	1	TUNGUSTEN CARBIDE INNER RING
28	BEARING BUSHING	1	TUNGUSTEN CARBIDE INNER RING
29	RETAINING WIRE	1	AISI 304
30	SNAP RING	1	DIN 471
31	BEARING	1	Please see Bearing Table
32	OIL SEAL	1	DIN 3760 (ISO 6194/1)
33	W-RING	2	
34	BUSHING WEDGE	1	DIN 6885-C45K
35	IMPELLER WEDGE		DIN 6885-C45K
36	COUPLING WEDGE	1	DIN 6885+C45K
38	STUD	4	AISI 304
39	HEXAGON BOLT	4	Class 10.9
40	HEXAGON BOLT	4	Class 10.9
41	HEXAGON BOLT	4	Class 10.9
42	HEX SOCKET BOLT	4	Class 10.9
43	HEX SOCKET BOLT	1	Class 10.9
44	HEX SOCKET BOLT	1	Class 10.9
45	HEX SOCKET BOLT	4	Class 10.9
46	BOTTOM LEG	2	St 37
48	NUT	8	Class 10.9
49	GREASE NIPPLE	1	CuZn37 (Ms63)
50	O-RING	1	NBR
51	O-RING	1	NBR
52	O-RING	1	NBR
53	O-RING	1	NBR
54	O-RING	1	NBR
55	BLIND PLUG	4	CuZn37 (Ms63)
56	ELBOW	1	CuZn37 (Ms63)
57	UNION	2	CuZn37 (Ms63)
58	COPPER PIPE	1	CuZn37 (Ms63)
59	SEAL SLEEVE PLATE	2	AISI 316

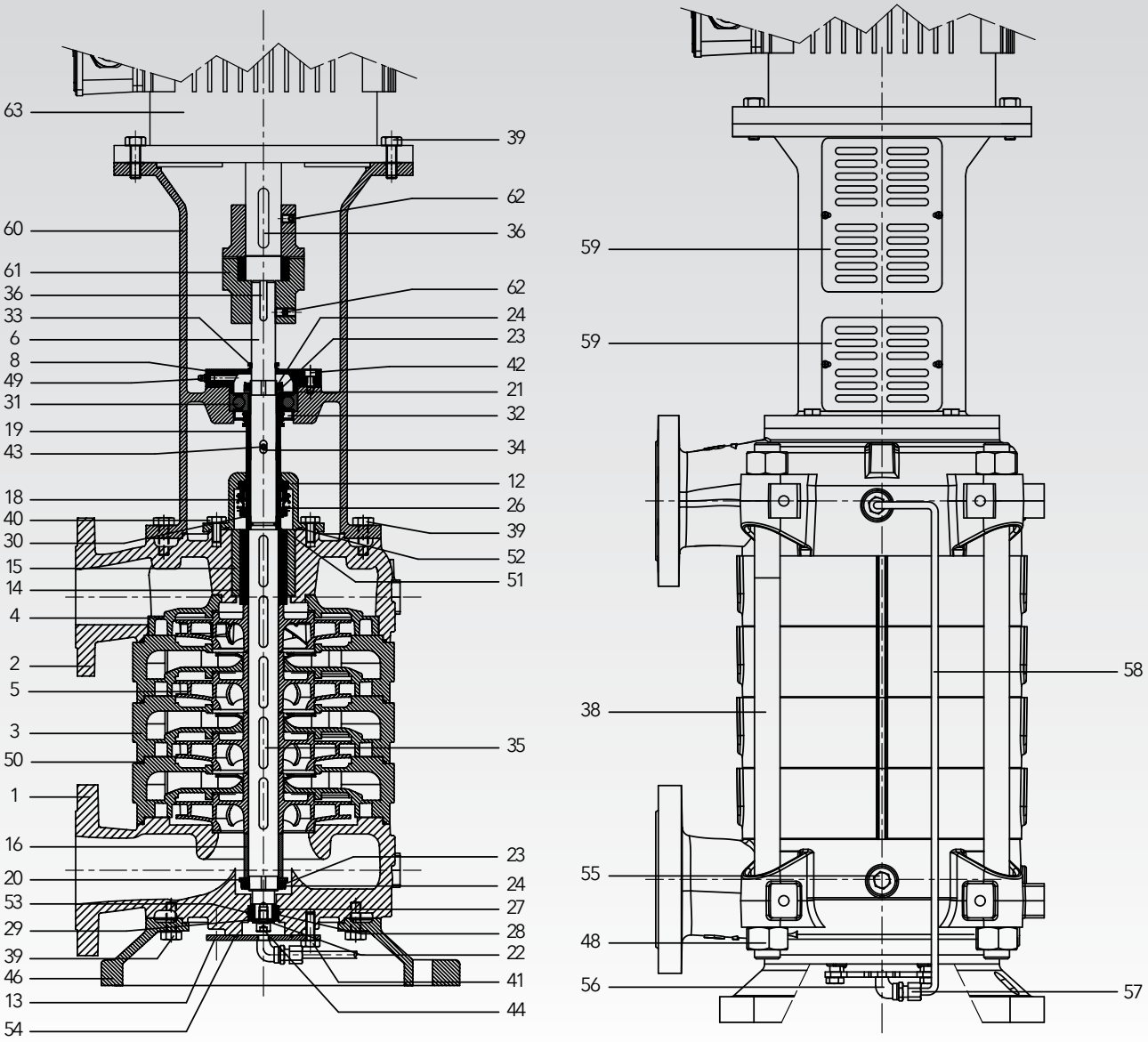
19. EXPLODED VIEW FOR EKP-A PUMP WITH MECHANICAL SEAL





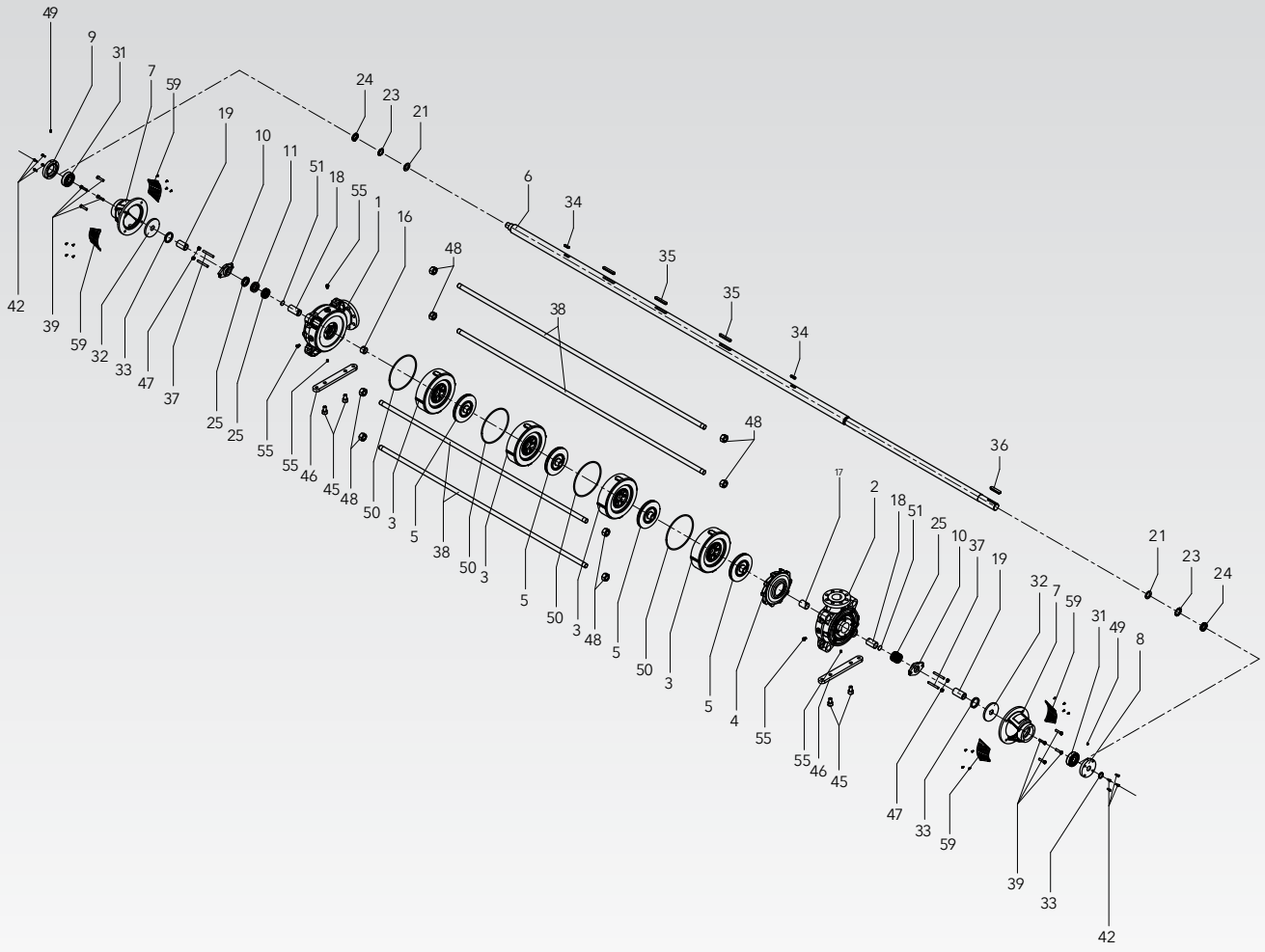
No	Part Name	Qty	Material Information
1	PUMP SUCTION CASING	1	Nodular Cast Iron
2	PUMP DISCHARGE CASING	1	Nodular Cast Iron
3	STAGE WITH DIFFUSER		Nodular Cast Iron
4	FINAL STAGE DIFFUSER	1	Nodular Cast Iron
5	PUMP IMPELLER		Nodular Cast Iron
6	PUMP SHAFT	1	AISI 420
7	BEARING HOUSING	1	Nodular Cast Iron
8	BEARING COVER MOTOR SIDE	1	Nodular Cast Iron
12	MECHANICAL SEAL HOUSING	1	Nodular Cast Iron
14	BALANCING DISC	1	AISI 420
15	BALANCING DISC BUSHING	1	AISI 420
18	MECHANICAL SEAL BUSHING	1	AISI 420
19	SEAL THRUST BUSHING	1	AISI 420
20	IMPELLER THRUST WASHER	1	AISI 420
21	BEARING THRUST WASHER	1	AISI 420
22	CARBIDE THRUST WASHER	1	AISI 420
23	LOCK WASHER	1	AISI 420
24	LOCK NUT	1	AISI 420
26	MECHANICAL SEAL	1	M106K/CE/EPDM/SUS304
27	SHAFT BUSHING	1	TUNGUSTEN CARBIDE INNER RING
28	BEARING BUSHING	1	TUNGUSTEN CARBIDE INNER RING
29	RETAINING WIRE	1	AISI 304
30	SNAP RING	1	DIN 471
31	BEARING	1	Please see Bearing Table
32	OIL SEAL	1	DIN 3760 (ISO 6194/1)
33	W-RING	2	
34	BUSHING WEDGE	1	DIN 6885-C45K
35	IMPELLER WEDGE		DIN 6885-C45K
36	COUPLING WEDGE	1	DIN 6885-C45K
38	STUD	4	AISI 304
39	HEXAGON BOLT	4	Class 10.9
40	HEXAGON BOLT	4	Class 10.9
42	HEX SOCKET BOLT	4	Class 10.9
43	HEX SOCKET BOLT	1	Class 10.9
44	HEX SOCKET BOLT	1	Class 10.9
45	HEX SOCKET BOLT	4	Class 10.9
46	BOTTOM LEG	2	St 37
48	NUT	8	Class 10.9
49	GREASE NIPPLE	1	CuZn37 (Ms63)
50	O-RING	1	NBR
51	O-RING	1	NBR
52	O-RING	1	NBR
53	O-RING	1	NBR
55	BLIND PLUG	4	CuZn37 (Ms63)
59	SEAL SLEEVE PLATE	2	AISI 316

20. EXPLODED VIEW FOR EKP-V PUMP WITH MECHANICAL SEAL



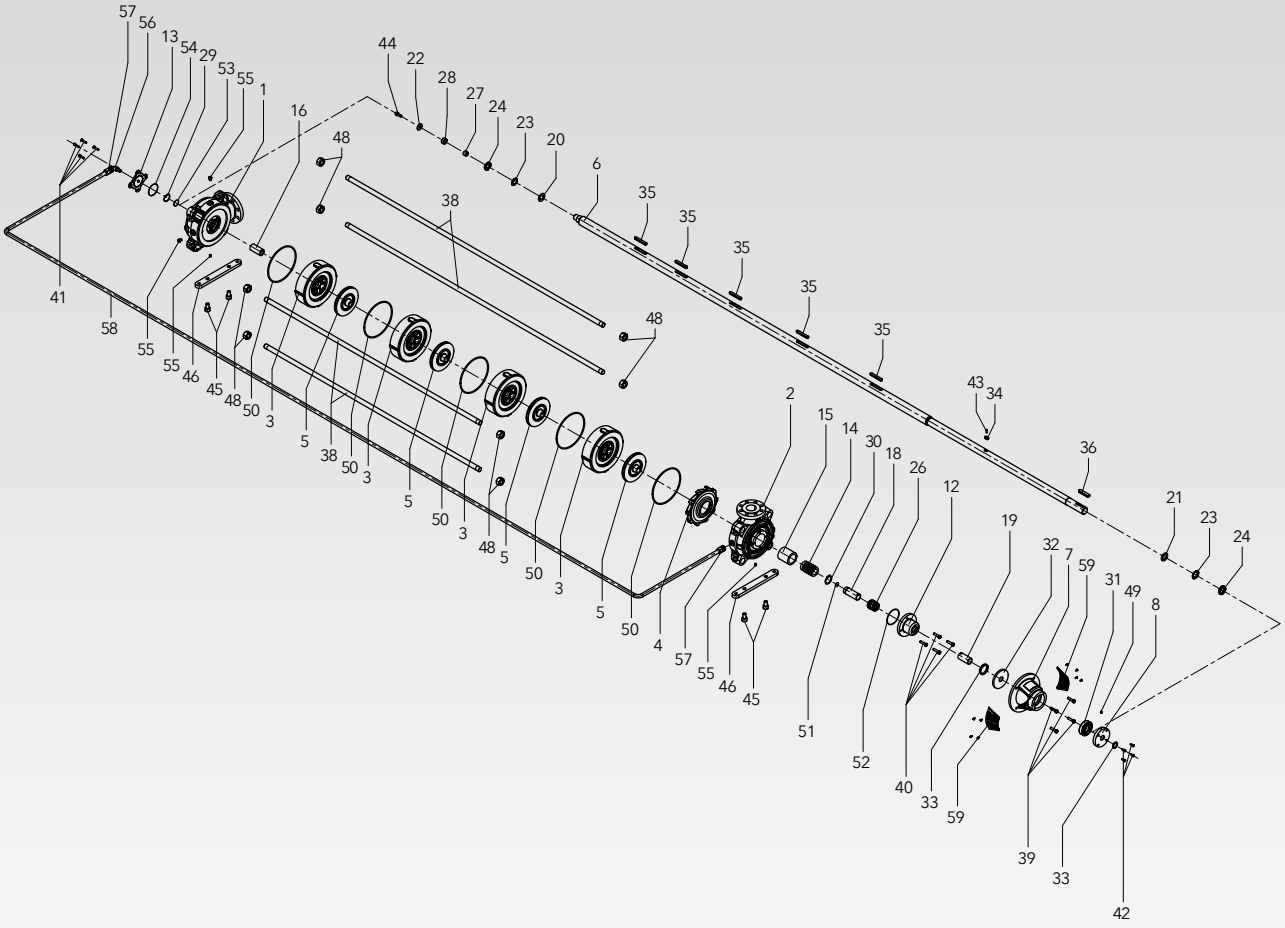
No	Part Name	Qty	Material Information
1	PUMP SUCTION CASING	1	Nodular Cast Iron
2	PUMP DISCHARGE CASING	1	Nodular Cast Iron
3	STAGE WITH DIFFUSER		Nodular Cast Iron
4	FINAL STAGE DIFFUSER	1	Nodular Cast Iron
5	PUMP IMPELLER		Nodular Cast Iron
6	PUMP SHAFT	1	AISI420
8	BEARING COVER MOTOR SIDE	1	Nodular Cast Iron
12	MECHANICAL SEAL HOUSING	1	Nodular Cast Iron
13	CARBIDE THRUST COVER	1	Nodular Cast Iron
14	BALANCING DISC	1	AISI420
15	BALANCING DISC BUSHING	1	AISI420
16	IMPELLER THRUST BUSHING SUCTION	1	AISI420
18	MECHANICAL SEAL BUSHING	1	AISI420
19	SEAL THRUST BUSHING	1	AISI420
20	IMPELLER THRUST WASHER	1	AISI420
21	BEARING THRUST WASHER	1	AISI420
22	CARBIDE THRUST WASHER	1	AISI420
23	LOCK WASHER	1	AISI420
24	LOCK NUT	1	AISI420
26	MECHANICAL SEAL	1	M106K/CE/EPDM/SUS304
27	SHAFT BUSHING	1	TUNGUSTEN CARBIDE INNER RING
28	BEARING BUSHING	1	TUNGUSTEN CARBIDE INNER RING
29	RETAINING WIRE	1	AISI 304
30	SNAP RING	1	DIN 471
31	BEARING	1	Please see Bearing Table
32	OIL SEAL	1	DIN 3760 (ISO 6194/1)
33	W-RING	2	
34	BUSHING WEDGE	1	DIN 6885-C45K
35	IMPELLER WEDGE		DIN 6885-C45K
36	WEDGE	1	DIN 6885-C45K
38	STUD	4	AISI 304
39	HEXAGON BOLT	12	Class 10.9
40	HEXAGON BOLT	4	Class 10.9
41	HEXAGON BOLT	4	Class 10.9
42	HEX SOCKET BOLT	4	Class 10.9
43	HEX SOCKET BOLT	1	Class 10.9
44	HEX SOCKET BOLT	1	Class 10.9
46	BOTTOM LEG	1	Nodular Cast Iron
48	NUT	8	Class 10.9
49	GREASE NIPPLE	1	CuZn37 (Ms63)
50	O-RING	1	NBR
51	O-RING	1	NBR
52	O-RING	1	NBR
53	O-RING	1	NBR
54	O-RING	1	NBR
55	BLIND PLUG	4	CuZn37 (Ms63)
56	ELBOW	1	CuZn37 (Ms63)
57	UNION	2	CuZn37 (Ms63)
58	COPPER PIPE	1	CuZn37 (Ms63)
59	SEAL SLEEVE PLATE	2	AISI 316
60	MOTOR FLANGE	1	Nodular Cast Iron
61	COUPLING	1	
62	SET SCREW	1	Class 10.9
63	ELECTRIC MOTOR	1	

21. EXPLODED VIEW FOR EKP PUMP WITH SOFT SEAL



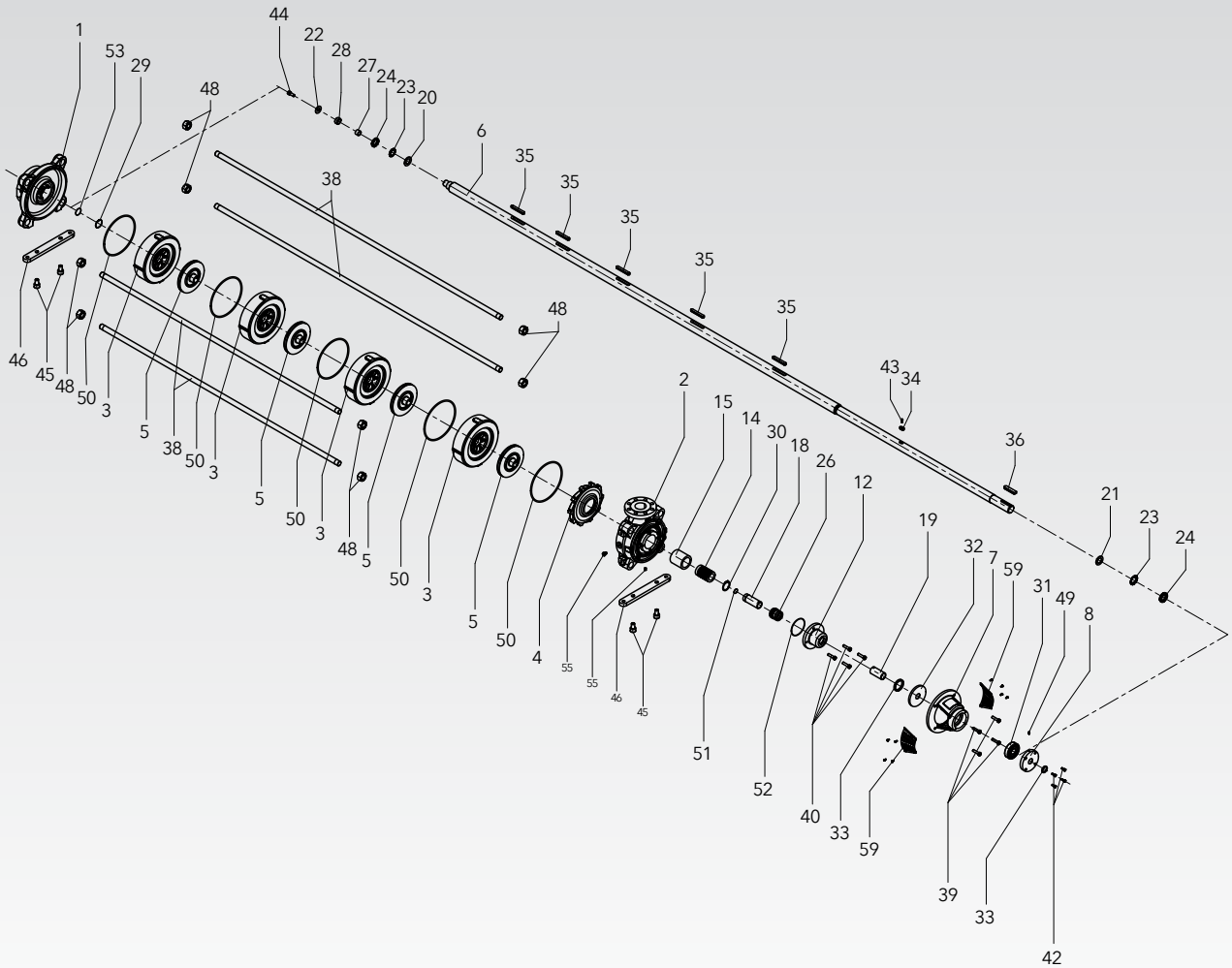
No	Part Name	Qty	Material Information
1	PUMP SUCTION CASING	1	Nodular Cast Iron
2	PUMP DISCHARGE CASING	1	Nodular Cast Iron
3	STAGE WITH DIFFUSER		Nodular Cast Iron
4	FINAL STAGE DIFFUSER	1	Nodular Cast Iron
5	PUMP IMPELLER		Nodular Cast Iron
6	PUMP SHAFT	1	AISI 420
7	BEARING HOUSING	2	Nodular Cast Iron
8	BEARING COVER MOTOR SIDE	1	Nodular Cast Iron
9	BEARING COVER CLOSED	1	Nodular Cast Iron
10	SEAL THRUST COVER	2	Nodular Cast Iron
11	LUBE RING	1	Bronze
16	IMPELLER THRUST BUSHING SUCTION	1	AISI 420
17	IMPELLER THRUST BUSHING DISCHARGE	1	AISI 420
18	SEAL BUSHING	2	AISI 420
19	SEAL THRUST BUSHING	2	AISI 420
21	BEARING THRUST WASHER	2	AISI 420
23	LOCK WASHER	2	AISI 420
24	LOCK NUT	2	AISI 420
25	SOFT SEAL	8	Buraflon
31	BEARING	2	Please see Bearing Table
32	OIL SEAL	2	DIN 3760 (ISO 6194/1)
33	W-RING	4	DIN 3760 (ISO 6194/1)
34	BUSHING WEDGE	2	DIN 6885-C45K
35	IMPELLER WEDGE		DIN 6885-C45K
36	COUPLING WEDGE	1	DIN 6885-C45K
37	STUD	4	AISI 304
38	STUD	4	AISI 304
39	HEXAGON BOLT	8	Class 10.9
42	HEX SOCKET BOLT	8	Class 10.9
45	HEX SOCKET BOLT	4	Class 10.9
46	BOTTOM LEG	2	St 37
47	NUT	4	Class 10.9
48	NUT	8	Class 10.9
49	GREASE NIPPLE	2	CuZn37 (Ms63)
50	O-RING	2	NBR
51	O-RING		NBR
55	BLIND PLUG	4	CuZn37 (Ms63)
59	SEAL SLEEVE PLATE	4	AISI 316

22. EXPLODED VIEW FOR EKP PUMP WITH SOFT SEAL



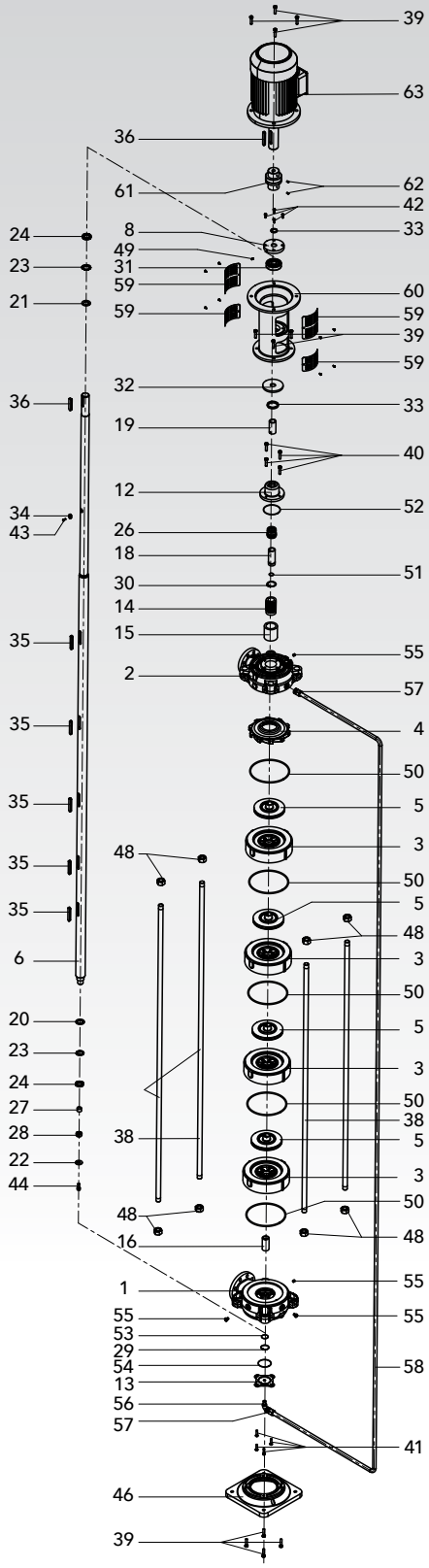
No	Part Name	Qty	Material Information
1	PUMP SUCTION CASING	1	Nodular Cast Iron
2	PUMP DISCHARGE CASING	1	Nodular Cast Iron
3	STAGE WITH DIFFUSER		Nodular Cast Iron
4	FINAL STAGE DIFFUSER	1	Nodular Cast Iron
5	PUMP IMPELLER		Nodular Cast Iron
6	PUMP SHAFT	1	AISI 420
7	BEARING HOUSING	1	Nodular Cast Iron
8	BEARING COVER MOTOR SIDE	1	Nodular Cast Iron
12	MECHANICAL SEAL HOUSING	1	Nodular Cast Iron
13	CARBIDE THRUST COVER	1	Nodular Cast Iron
14	BALANCING DISC	1	AISI 420
15	BALANCING DISC BUSHING	1	AISI 420
16	IMPELLER THRUST BUSHING SUCTION	1	AISI 420
18	MECHANICAL SEAL BUSHING	1	AISI 420
19	SEAL THRUST BUSHING	1	AISI 420
20	IMPELLER THRUST WASHER	1	AISI 420
21	BEARING THRUST WASHER	1	AISI 420
22	CARBIDE THRUST WASHER	1	AISI 420
23	LOCK WASHER	1	AISI 420
24	LOCK NUT	1	AISI 420
26	MECHANICAL SEAL	1	M106K/CE/EPDM/SUS304
27	SHAFT BUSHING	1	TUNGUSTEN CARBIDE INNER RING
28	BEARING BUSHING	1	TUNGUSTEN CARBIDE INNER RING
29	RETAINING WIRE	1	AISI 304
30	SNAP RING	1	DIN 471
31	BEARING	1	Please see Bearing Table
32	OIL SEAL	1	DIN 3760 (ISO 6194/1)
33	W-RING	3	
34	BUSHING WEDGE	1	DIN 6885-C45K
35	IMPELLER WEDGE		DIN 6885-C45K
36	COUPLING WEDGE	1	DIN 6885-C45K
38	STUD	4	AISI 304
39	HEXAGON BOLT	4	Class 10.9
40	HEXAGON BOLT	4	Class 10.9
41	HEXAGON BOLT	4	Class 10.9
42	HEX SOCKET BOLT	4	Class 10.9
43	HEX SOCKET BOLT	1	Class 10.9
44	HEX SOCKET BOLT	1	Class 10.9
45	HEX SOCKET BOLT	4	Class 10.9
46	BOTTOM LEG	2	St 37
48	NUT	8	Class 10.9
49	GREASE NIPPLE	1	CuZn37 (Ms63)
50	O-RING	1	NBR
51	O-RING	1	NBR
52	O-RING	1	NBR
53	O-RING	1	NBR
54	O-RING	1	NBR
55	BLIND PLUG	4	CuZn37 (Ms63)
56	ELBOW	1	CuZn37 (Ms63)
57	UNION	2	CuZn37 (Ms63)
58	COPPER PIPE	1	CuZn37 (Ms63)
59	SEAL SLEEVE PLATE	2	AISI 316

23. EXPLODED VIEW FOR EKP-A PUMP WITH MECHANICAL SEAL



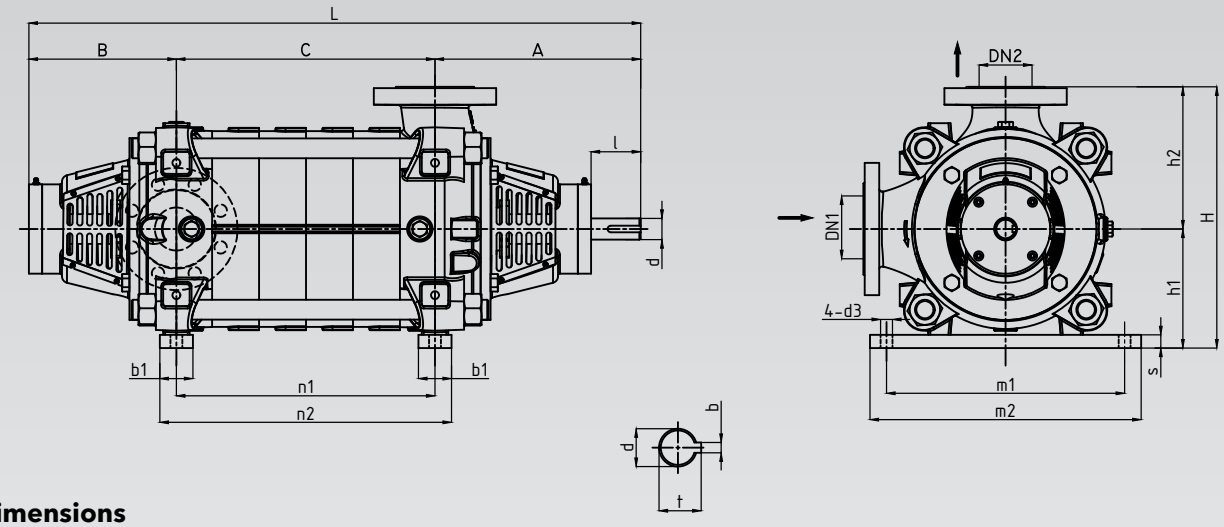
No	Part Name	Qty	Material Information
1	PUMP SUCTION CASING	1	Nodular Cast Iron
2	PUMP DISCHARGE CASING	1	Nodular Cast Iron
3	STAGE WITH DIFFUSER		Nodular Cast Iron
4	FINAL STAGE DIFFUSER	1	Nodular Cast Iron
5	PUMP IMPELLER		Nodular Cast Iron
6	PUMP SHAFT	1	AISI 420
7	BEARING HOUSING	1	Nodular Cast Iron
8	BEARING COVER MOTOR SIDE	1	Nodular Cast Iron
12	MECHANICAL SEAL HOUSING	1	Nodular Cast Iron
14	BALANCING DISC	1	AISI 420
15	BALANCING DISC BUSHING	1	AISI 420
18	MECHANICAL SEAL BUSHING	1	AISI 420
19	SEAL THRUST BUSHING	1	AISI 420
20	IMPELLER THRUST WASHER	1	AISI 420
21	BEARING THRUST WASHER	1	AISI 420
22	CARBIDE THRUST WASHER	1	AISI 420
23	LOCK WASHER	1	AISI 420
24	LOCK NUT	1	AISI 420
26	MECHANICAL SEAL	1	M106K/CE/EPDM/SUS304
27	SHAFT BUSHING	1	TUNGUSTEN CARBIDE INNER RING
28	BEARING BUSHING	1	TUNGUSTEN CARBIDE INNER RING
29	RETAINING WIRE	1	AISI 304
30	SNAP RING	1	DIN 471
31	BEARING	1	Please see Bearing Table
32	OIL SEAL	1	DIN 3760 (ISO 6194/1)
33	W-RING	2	
34	BUSHING WEDGE	1	DIN 6885-C45K
35	IMPELLER WEDGE		DIN 6885-C45K
36	COUPLING WEDGE	1	DIN 6885-C45K
38	STUD	4	AISI 304
39	HEXAGON BOLT	4	Class 10.9
40	HEXAGON BOLT	4	Class 10.9
42	HEX SOCKET BOLT	4	Class 10.9
43	HEX SOCKET BOLT	1	Class 10.9
44	HEX SOCKET BOLT	1	Class 10.9
45	HEX SOCKET BOLT	4	Class 10.9
46	BOTTOM LEG	2	St 37
48	NUT	8	Class 10.9
49	GREASE NIPPLE	1	CuZn37 (Ms63)
50	O-RING	1	NBR
51	O-RING	1	NBR
52	O-RING	1	NBR
53	O-RING	1	NBR
55	BLIND PLUG	4	CuZn37 (Ms63)
59	SEAL SLEEVE PLATE	2	AISI 316

24. EXPLODED VIEW FOR EKP-V PUMP WITH MECHANICAL SEAL



No	Part Name	Qty	Material Information
1	PUMP SUCTION CASING	1	Nodular Cast Iron
2	PUMP DISCHARGE CASING	1	Nodular Cast Iron
3	STAGE WITH DIFFUSER		Nodular Cast Iron
4	FINAL STAGE DIFFUSER	1	Nodular Cast Iron
5	PUMP IMPELLER		Nodular Cast Iron
6	PUMP SHAFT	1	AISI 420
8	BEARING COVER MOTOR SIDE	1	Nodular Cast Iron
12	MECHANICAL SEAL HOUSING	1	Nodular Cast Iron
13	CARBIDE THRUST COVER	1	Nodular Cast Iron
14	BALANCING DISC	1	AISI 420
15	BALANCING DISC BUSHING	1	AISI 420
16	IMPELLER THRUST BUSHING SUCTION	1	AISI 420
18	MECHANICAL SEAL BUSHING	1	AISI 420
19	SEAL THRUST BUSHING	1	AISI 420
20	IMPELLER THRUST WASHER	1	AISI 420
21	BEARING THRUST WASHER	1	AISI 420
22	CARBIDE THRUST WASHER	1	AISI 420
23	LOCK WASHER	1	AISI 420
24	LOCK NUT	1	AISI 420
26	MECHANICAL SEAL	1	M106K/CE/EPDM/SUS304
27	SHAFT BUSHING	1	TUNGUSTEN CARBIDE INNER RING
28	BEARING BUSHING	1	TUNGUSTEN CARBIDE INNER RING
29	RETAINING WIRE	1	AISI 304
30	SNAP RING	1	DIN 471
31	BEARING	1	Please see Bearing Table
32	OIL SEAL	1	DIN 3760 (ISO 6194/1)
33	W-RING	2	
34	BUSHING WEDGE	1	DIN 6885-C45K
35	IMPELLER WEDGE		DIN 6885-C45K
36	WEDGE	1	DIN 6885-C45K
38	STUD	4	AISI 304
39	HEXAGON BOLT	12	Class 10.9
40	HEXAGON BOLT	4	Class 10.9
41	HEXAGON BOLT	4	Class 10.9
42	HEX SOCKET BOLT	4	Class 10.9
43	HEX SOCKET BOLT	1	Class 10.9
44	HEX SOCKET BOLT	1	Class 10.9
46	BOTTOM LEG	1	Nodular Cast Iron
48	NUT	8	Class 10.9
49	GREASE NIPPLE	1	CuZn37 (Ms63)
50	O-RING	1	NBR
51	O-RING	1	NBR
52	O-RING	1	NBR
53	O-RING	1	NBR
54	O-RING	1	NBR
55	BLIND PLUG	4	CuZn37 (Ms63)
56	ELBOW	1	CuZn37 (Ms63)
57	UNION	2	CuZn37 (Ms63)
58	COPPER PIPE	1	CuZn37 (Ms63)
59	SEAL SLEEVE PLATE	2	AISI 316
60	MOTOR FLANGE	1	Nodular Cast Iron
61	COUPLING	1	
62	SET SCREW	1	Class 10.9
63	ELECTRIC MOTOR	1	

25. DIMENSIONS & WEIGHT FOR EKP PUMPS



Dimensions

Type	DN1	DN2	A	B	L	h1	h2	H	n1	n2	m1	m2	s	b1	d3	l	d	b	t
EKP 40	50	40	258	185	C+443	165	175	340	C	C+50	270	320	20	50	Ø15	65	24	8	27,3
EKP 50	65	50	275	212	C+487	165	190	355	C	C+50	310	360	20	50	Ø15	65	24	8	27,3
EKP 65	80	65	308	220	C+528	180	215	395	C	C+50	360	410	20	50	Ø18	75	28	8	31,3
EKP 80	100	80	385	300	C+685	210	265	475	C	C+50	340	410	20	50	Ø18	90	32	10	35,3

Dimension C according to number of stages

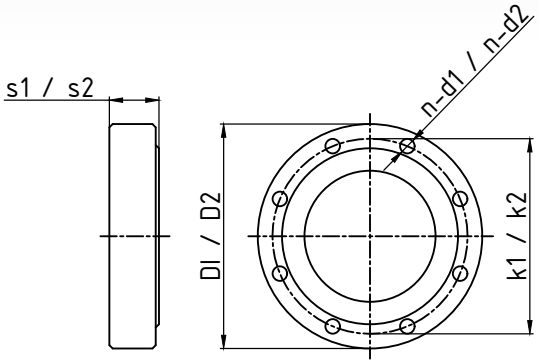
Type	2	3	4	5	6	7	8	9	10	11	12	13	14	15
EKP 40	133	188	243	298	353	408	463	518	573	628	683	738	793	848
Kg	102	120	138	156	174	192	210	228	246	264	282	300	318	336

EKP 50	174	236	298	360	422	484	546	608	670	732	732
Kg	118	135	152	169	186	203	220	237	254	271	288

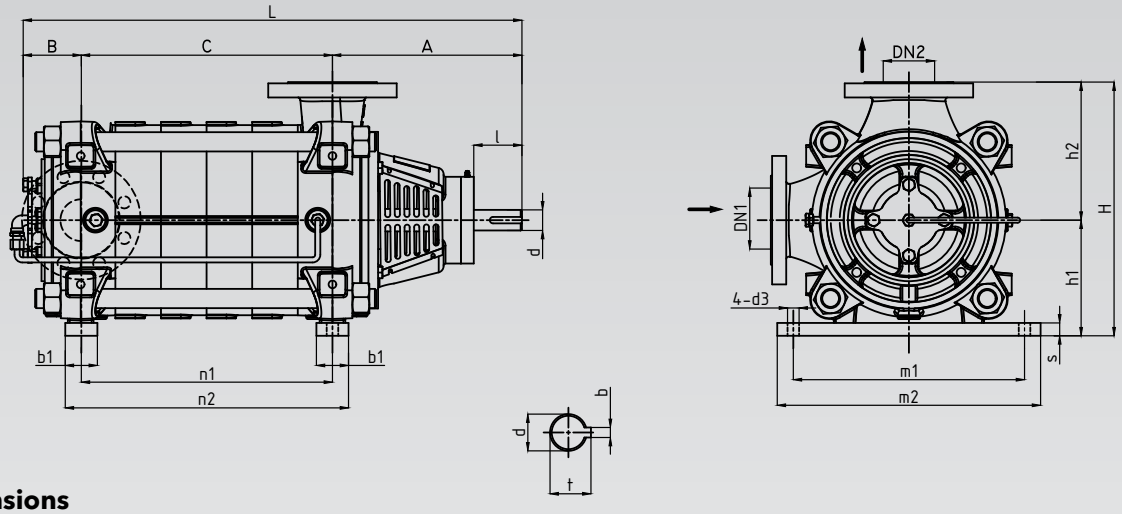
EKP 65	178	249	320	391	462	533	604	675	746	817
Kg	135	156	177	198	219	240	261	282	303	324

EKP 80	178	249	320	391	462	533	604	675	746	817
Kg	215	235	255	275	295	315	335	355	375	395

	DIN 2635 - PN40				
DN1 / DN2	40	50	65	80	100
k1 / k2	150	165	145	160	180
D1 / D2	110	125	185	200	220
s1 / s2	20	22	26	26	30
nd1 / nd2	4 - ø18	4 - ø18	8 - ø18	8 - ø18	8 - ø18



26. DIMENSIONS & WEIGHT FOR EKP-R PUMPS



Dimensions

Type	DN1	DN2	A	B	L	h1	h2	H	n1	n2	m1	m2	s	b1	d3	l	d	b	t
EKP-R 40	50	40	258	50	C+308	165	175	340	C	C+50	270	320	20	50	Ø15	65	24	8	27,3
EKP-R 50	65	50	275	75	C+350	165	190	355	C	C+50	310	360	20	50	Ø15	65	24	8	27,3
EKP-R 65	80	65	308	100	C+408	180	215	395	C	C+50	200	360	20	50	Ø18	75	28	8	31,3
EKP-R 80	100	80	385	135	C+520	210	265	475	C	C+50	340	410	20	50	Ø18	90	32	10	35,3

Dimension C according to number of stages

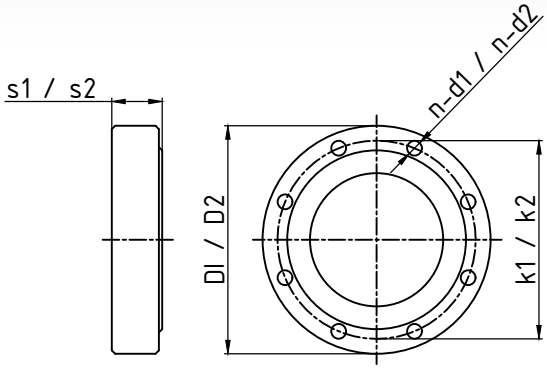
Type	2	3	4	5	6	7	8	9	10	11	12	13	14	15
EKP-R 40	133	188	243	298	353	408	463	518	573	628	683	738	793	848
Kg	67	89	111	133	155	177	199	221	243	265	287	309	331	353

EKP-R 50	174	236	298	360	422	484	546	608	670	732	732
Kg	83	108	133	158	183	208	233	258	283	308	333

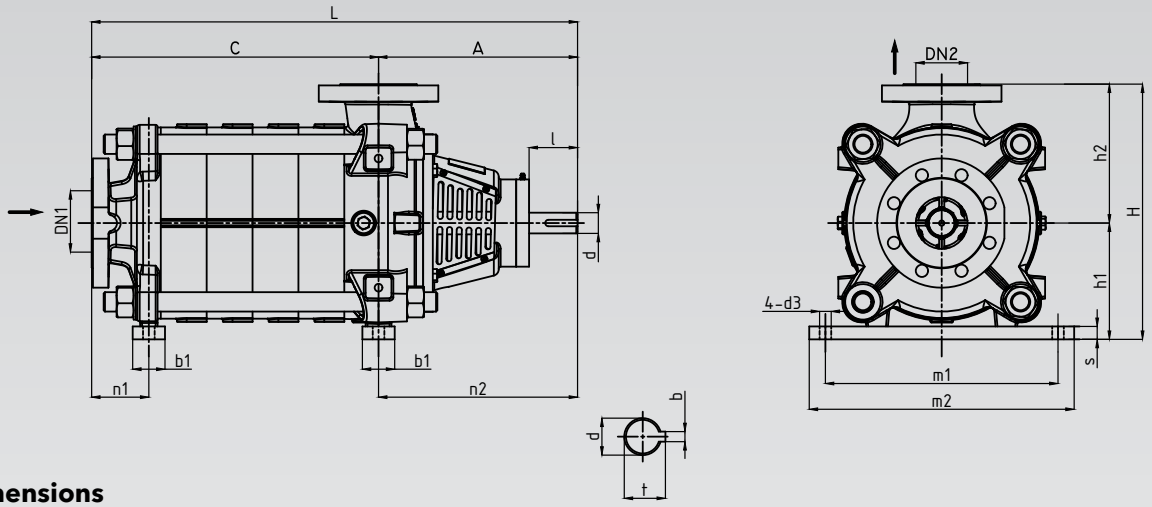
EKP-R 65	178	249	320	391	462	533	604	675	746	817
Kg	106	125	144	163	182	201	220	239	258	277

EKP-R 80	178	249	320	391	462	533	604	675	746	817
Kg	137	171	205	239	273	307	341	375	409	443

	DIN 2635 - PN40				
DN1 / DN2	40	50	65	80	100
k1 / k2	150	165	145	160	180
D1 / D2	110	125	185	200	220
s1 / s2	20	22	26	26	30
n-d1 / n-d2	4 - ø18	4 - ø18	8 - ø18	8 - ø18	8 - ø18



27. DIMENSIONS & WEIGHT FOR EKP-A PUMPS



Dimensions

Type	DN1	DN2	A	L	h1	h2	H	n1	n2	m1	m2	s	b1	d3	l	d	b	t
EKP-A 40	50	65	258	C+258	165	175	340	C	C+50	270	320	20	50	Ø15	65	24	8	27,3
EKP-A 50	65	50	275	C+275	165	190	355	C	C+50	310	360	20	50	Ø15	65	24	8	27,3
EKP-A 65	80	65	308	C+308	180	215	395	90	308	200	360	20	50	Ø18	75	28	8	31,3
EKP-A 80	100	80	385	C+385	210	265	475	110	385	340	410	20	50	Ø18	90	32	10	35,3

Dimension C according to number of stages

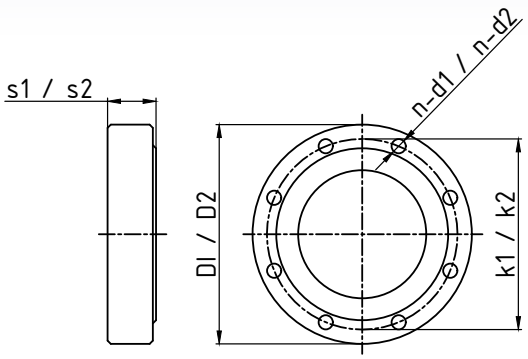
Type	2	3	4	5	6	7	8	9	10	11	12	13
EKP-A 40	187	242	297	352	407	462	517	572	627	682	737	792
Kg	78	92	106	120	134	148	162	176	190	204	218	232

EKP-A 50	225	287	349	411	473	535	597	659	721	783	845
Kg	92	105	118	131	144	157	170	183	296	209	222

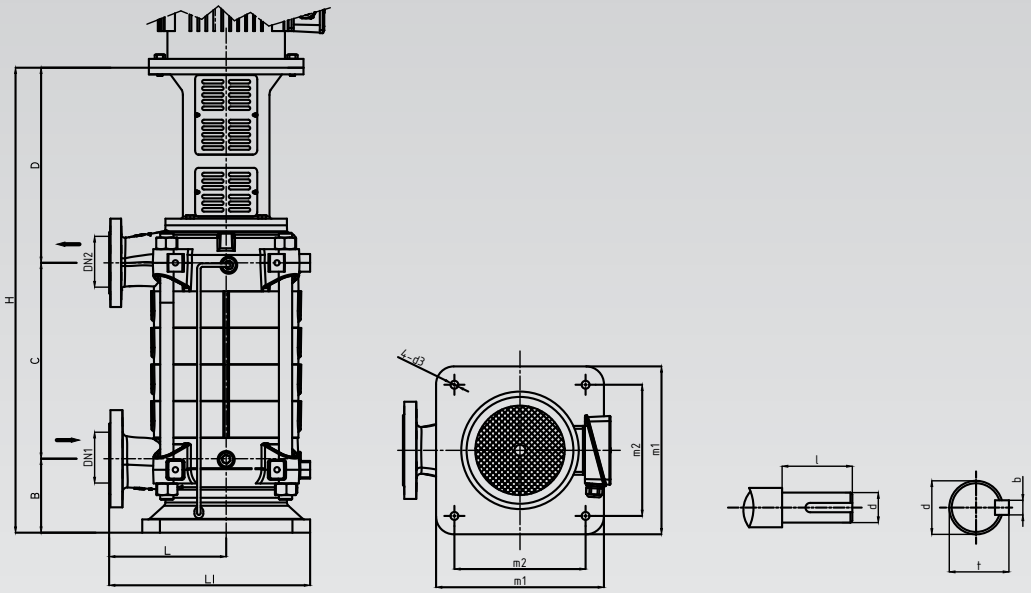
EKP-A 65	231	302	373	444	515	586	657	728	799	870
Kg	113	132	151	170	189	208	227	246	265	284

EKP-A 80	278	361	444	527	610	693	776	859	942	1025
Kg	140	165	190	215	240	265	290	315	340	365

	DIN 2635 - PN40				
DN1 / DN2	40	50	65	80	100
k1 / k2	150	165	145	160	180
D1 / D2	110	125	185	200	220
s1 / s2	20	22	26	26	30
n-d1 / n-d2	4 - ø18	4 - ø18	8 - ø18	8 - ø18	8 - ø18



28. DIMENSIONS & WEIGHT FOR EKP-V PUMPS



1450 d/dk

Type	Motor Housing Type	DN1	DN2	B	D	H	L	L1	m1	m2	d3	l	d	b	t
EKP-V 40	90	50	40	105	305	C+410	175	325	300	215	Ø18	65	24	8	27,3
	100				315	C+420									
	112				315	C+420									
	132				335	C+440									
EKP-V 50	100	65	50	115	400	C+515	190	340	350	250	Ø18	65	24	8	27,3
	112				400	C+515									
	132				420	C+545									
	160				450	C+565									
EKP-V 65	100	80	65	135	460	C+595	220	450	380	300	Ø18	75	28	8	31,3
	112				460	C+595									
	132				480	C+615									
	160				510	C+645									
	180				520	C+655									
EKP-V 80	132	100	80	170	495	C+665	265	495	380	300	Ø18	90	32	10	35,3
	160				525	C+695									
	180				535	C+705									
	200				535	C+705									
	225				565	C+735									

2900 d/dk

Type	Motor Housing Type	DN1	DN2	B	D	H	L	L1	m1	m2	d3	l	d	b	t
EKP-V 40	132	50	40	105	335	C+440	175	325	300	215	Ø18	65	24	8	27,3
	160				365	C+470									
	180				365	C+470									
	200				365	C+470									
	225				395	C+500									
EKP-V 50	160	65	50	115	450	C+565	190	340	350	250	Ø18	65	24	8	27,3
	180				450	C+565									
	200				450	C+565									
	225				450	C+565									
	250				460	C+595									
EKP-V 65	160	80	65	135	510	C+645	220	450	380	300	Ø18	75	28	8	31,3
	180				520	C+655									
	200				520	C+655									
	225				520	C+655									
	250				520	C+655									
	280				520	C+655									
EKP-V 80	200	100	80	170	535	C+705	265	495	380	300	Ø18	90	32	10	35,3
	225				535	C+705									
	250				560	C+730									
	280				560	C+730									

Dimension C according to number of stages

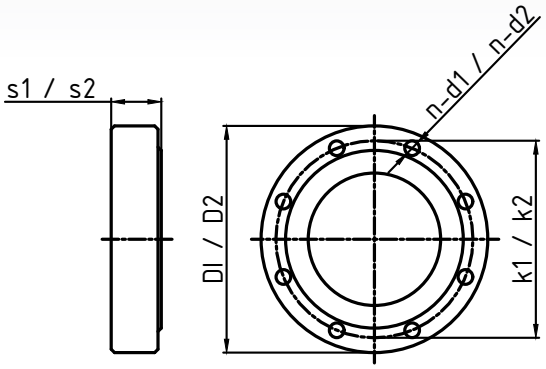
Model	2	3	4	5	6	7	8	9	10	11	12	13	14	15
EKP-V 40	133	188	243	298	353	408	463	518	573	628	683	738	793	848
Kg	102	129	156	183	210	237	265	291	318	345	372	399	426	453

EKP-V 50	174	236	298	360	422	484	546	608	670	732	732
Kg	109	141	173	205	237	269	301	333	365	397	429

EKP-V 65	178	249	320	391	462	533	604	675	746	817
Kg	117	143	169	195	221	247	273	299	325	351

EKP-V 80	178	249	320	391	462	533	604	675	746	817
Kg	168	209	250	291	332	373	414	455	496	537

	DIN 2635 - PN40				
DN1 / DN2	40	50	65	80	100
k1 / k2	150	165	145	160	180
D1 / D2	110	125	185	200	220
s1 / s2	20	22	26	26	30
n-d1 / n-d2	4 - ø18	4 - ø18	8 - ø18	8 - ø18	8 - ø18



29. EVAPORATION PRESSURE Pv AND SPECIFIC WEIGHT OF WATER

t	T	Pv	γ
°C	K	bar	kg/dm³
0	273,15	0,00611	0,9998
1	274,15	0,00657	0,9999
2	275,15	0,00706	0,9999
3	276,15	0,00758	0,9999
4	277,15	0,00813	1,0000
5	278,15	0,00872	1,0000
6	279,15	0,00935	1,0000
7	280,15	0,01001	0,9999
8	281,15	0,01072	0,9999
9	282,15	0,01147	0,9998
10	283,15	0,01227	0,9997
11	284,15	0,01312	0,9997
12	285,15	0,01401	0,9996
13	286,15	0,01497	0,9994
14	287,15	0,01597	0,9993
15	288,15	0,01704	0,9992
16	289,15	0,01817	0,9990
17	290,15	0,01936	0,9988
18	291,15	0,02062	0,9987
19	292,15	0,02196	0,9985
20	293,15	0,02337	0,9983
21	294,15	0,24850	0,9981
22	295,15	0,02642	0,9978
23	296,15	0,02808	0,9976
24	297,15	0,02982	0,9974
25	298,15	0,03166	0,9971
26	299,15	0,03360	0,9968
27	300,15	0,03564	0,9966
28	301,15	0,03778	0,9963
29	302,15	0,04004	0,9960
30	303,15	0,04241	0,9957
31	304,15	0,04491	0,9954
32	305,15	0,04753	0,9951
33	306,15	0,05029	0,9947
34	307,15	0,05318	0,9944
35	308,15	0,05622	0,9940
36	309,15	0,05940	0,9937
37	310,15	0,06274	0,9933
38	311,15	0,06624	0,9930
39	312,15	0,06991	0,9927
40	313,15	0,07375	0,9923
41	314,15	0,07777	0,9919
42	315,15	0,08198	0,9915
43	316,15	0,09639	0,9911
44	317,15	0,09100	0,9907
45	318,15	0,09582	0,9902
46	319,15	0,10086	0,9898
47	320,15	0,10612	0,9894
48	321,15	0,11162	0,9889
49	322,15	0,11736	0,9884
50	323,15	0,12335	0,9880
51	324,15	0,12961	0,9876
52	325,15	0,13613	0,9871
53	326,15	0,14293	0,9862
54	327,15	0,15002	0,9862

t	T	Pv	γ
°C	K	bar	kg/dm³
55	328,15	0,15741	0,9857
56	329,15	0,16511	0,9852
57	330,15	0,17313	0,9846
58	331,15	0,18147	0,9842
59	332,15	0,19016	0,9837
60	333,15	0,1992	0,9832
61	334,15	0,2086	0,9826
62	335,15	0,2184	0,9821
63	336,15	0,2286	0,9816
64	337,15	0,2391	0,9811
65	338,15	0,2501	0,9805
66	339,15	0,2615	0,9799
67	340,15	0,2733	0,9793
68	341,15	0,2856	0,9788
69	342,15	0,2984	0,9782
70	343,15	0,3116	0,9777
71	344,15	0,3253	0,9770
72	345,15	0,3396	0,9765
73	346,15	0,3543	0,9760
74	347,15	0,3696	0,9753
75	348,15	0,3855	0,9748
76	349,15	0,4019	0,9741
77	350,15	0,4189	0,9735
78	351,15	0,4365	0,9729
79	352,15	0,4547	0,9723
80	353,15	0,4736	0,9716
81	354,15	0,4931	0,9710
82	355,15	0,5133	0,9704
83	356,15	0,5342	0,9697
84	357,15	0,5557	0,9691
85	358,15	0,5780	0,9684
86	359,15	0,6011	0,9678
87	360,15	0,6249	0,9671
88	361,15	0,6495	0,9665
89	362,15	0,6749	0,9658
90	363,15	0,7011	0,9652
91	364,15	0,7281	0,9644
92	365,15	0,7561	0,9638
93	366,15	0,7849	0,9630
94	367,15	0,8146	0,9624
95	368,15	0,8453	0,9616
96	369,15	0,8769	0,9610
97	370,15	0,9094	0,9602
98	371,15	0,9430	0,9596
99	372,15	0,9776	0,9586
100	373,15	1,0133	0,9581
102	375,15	1,0878	0,9567
104	377,15	1,1668	0,9552
106	379,15	1,2504	0,9537
108	381,15	1,3390	0,9522
110	383,15	1,4327	0,9507
112	385,15	1,5316	0,9491
114	387,15	1,6362	0,9476
116	389,15	1,7465	0,9460
118	391,15	1,8628	0,9445

t	T	Pv	γ
°C	K	bar	kg/dm³
120	393,15	1,9854	0,9429
122	395,15	2,1145	0,9412
124	397,15	2,2504	0,9396
126	399,15	2,3933	0,9379
128	401,15	2,5435	0,9362
130	403,15	2,7013	0,9346
132	405,15	2,867	0,9328
134	407,15	3,041	0,9311
136	409,15	3,223	0,9294
138	411,15	3,414	0,9276
140	413,15	3,614	0,9258
145	418,15	4,155	0,9214
155	428,15	5,433	0,9121
160	433,15	6,181	0,9073
165	438,15	7,008	0,9024
170	433,15	7,920	0,8973
175	448,15	8,924	0,8921
180	453,15	10,027	0,8869
185	458,15	11,233	0,8815
190	463,15	12,551	0,8760
195	468,15	13,987	0,8704
200	473,15	15,550	0,8647
205	478,15	17,243	0,8588
210	483,15	19,077	0,8528
215	488,15	21,060	0,8467
220	493,15	23,198	0,8403
225	498,15	25,501	0,8339
230	503,15	27,976	0,8273
235	508,15	30,632	0,8205
240	513,15	33,478	0,8136
245	518,15	36,523	0,8065
250	523,15	39,776	0,7992
255	528,15	43,246	0,7916
260	533,15	46,943	0,7839
265	538,15	50,877	0,7759
270	543,15	55,058	0,7678
275	548,15	59,496	0,7593
280	553,15	64,202	0,7505
285	558,15	69,186	0,7415
290	563,15	74,461	0,7321
295	568,15	80,037	0,7223
300	573,15	85,927	0,7122
305	578,15	92,144	0,7017
310	583,15	98,70	0,6906
315	588,15	105,61	0,6791
320	593,15	112,89	0,6669
325	598,15	120,56	0,6541
330	603,15	128,63	0,6404
340	613,15	146,05	0,6102
350	623,15	165,35	0,5743
360	633,15	186,75	0,5275
370	643,15	210,54	0,4518
374,15	647,30	221,20	0,3154

30. PRESSURE LOSS TABLE FOR 100 m STRAIGHT PIPE

DEBİ			Nominal Diameter mm & inches																	
m³/h	l/min		15 1/2"	20 3/4"	25 1"	32 1 1/4"	40 1 1/2"	50 2	65 2 1/2"	80 3"	100 4"	125 5"	150 6"	175 7"	200 8"	250 10"	300 12"	350 14"	400 16"	
0,6	10	v hr	0,94 16	0,53 3,94	0,34 1,33	0,21 0,40	0,13 0,13			Resistances must be multiplied by the following coefficients. 0.71 for galvanized or steel pipe 0.54 for stainless steel or copper pipes 0.47 for PVC or PE pipes										
0,9	15	v hr	1,42 33,9	0,80 8,35	0,51 2,82	0,31 0,85	0,20 0,29													
1,2	20	v hr	1,89 57,7	1,06 14,21	0,68 4,79	0,41 1,44	0,27 0,49	0,17 0,16												
1,5	25	v hr	2,36 87,2	1,33 21,5	0,85 7,24	0,52 2,18	0,33 0,73	0,21 0,25												
1,8	30	v hr	2,83 122	1,59 30,1	1,02 10,1	0,62 3,05	0,40 1,03	0,25 0,35												
2,1	35	v hr	3,30 162	1,86 40,0	1,19 13,5	0,73 4,06	0,46 1,37	0,30 0,46												
2,4	40	v hr		2,12 51,2	1,36 17,3	0,83 5,19	0,53 1,75	0,34 0,59	0,20 0,16											
3	50	v hr		2,65 77,4	1,70 26,1	1,04 7,85	0,66 2,65	0,42 0,89	0,25 0,25											
3,6	60	v hr		3,18 108	2,04 36,6	1,24 11,0	0,80 3,71	0,51 1,25	0,30 0,35											
4,2	70	v hr		3,72 144	2,38 48,7	1,45 14,6	0,93 4,93	0,59 1,66	0,35 0,46											
4,8	80	v hr		4,25 185	2,72 62,3	1,66 18,7	1,06 6,32	0,68 2,13	0,40 0,59											
5,4	90	v hr			3,06 77,5	1,87 23,3	1,19 7,85	0,76 2,65	0,45 0,74	0,30 0,27										
6	100	v hr			3,40 94,1	2,07 28,3	1,33 9,54	0,85 3,22	0,50 0,90	0,33 0,33										
7,5	125	v hr			4,25 142	2,59 42,8	1,66 14,4	1,06 4,86	0,63 1,36	0,41 0,49										
9	150	v hr				3,11 59,9	1,99 20,2	1,27 6,82	0,75 1,90	0,50 0,69	0,32 0,23									
10,5	175	v hr				3,63 79,7	2,32 26,9	1,49 9,07	0,88 2,53	0,58 0,92	0,37 0,31									
12	200	v hr				4,15 102	2,65 34,4	1,70 11,6	1,01 3,23	0,66 1,18	0,42 0,40									
15	250	v hr				5,18 154	3,32 52,0	2,12 17,5	1,26 4,89	0,83 1,78	0,53 0,60	0,34 0,20								
18	300	v hr					3,98 72,8	2,55 24,6	1,51 6,85	1,00 2,49	0,64 0,84	0,41 0,28								
24	400	v hr					5,31 124	3,40 41,8	2,01 11,66	1,33 4,24	0,85 1,43	0,54 0,48	0,38 0,20							
30	500	v hr					6,63 187	4,25 63,2	2,51 17,6	1,66 6,41	1,06 2,16	0,68 0,73	0,47 0,30							
36	600	v hr						5,10 88,6	3,02 24,7	1,99 8,98	1,27 3,03	0,82 1,02	0,57 0,42	0,42 0,20						
42	700	v hr						5,94 118	3,52 32,8	2,32 11,9	1,49 4,03	0,95 1,36	0,66 0,56	0,49 0,26						
48	800	v hr						6,79 151	4,02 42,0	2,65 15,3	1,70 5,16	1,09 1,74	0,75 0,72	0,55 0,34						
54	900	v hr						7,64 188	4,52 52,3	2,99 19,0	1,91 6,41	1,22 2,16	0,85 0,89	0,62 0,42						
60	1000	v hr							5,03 63,5	3,32 23,1	2,12 7,79	1,36 2,63	0,94 1,08	0,69 0,51	0,53 0,27					
75	1250	v hr							6,28 96,0	4,15 34,9	2,65 11,8	1,70 3,97	1,18 1,63	0,87 0,77	0,66 0,40					
90	1500	v hr							7,54 134	4,98 48,9	3,18 16,5	2,04 5,57	1,42 2,29	1,04 1,08	0,80 0,56					
105	1750	v hr							8,79 179	5,81 65,1	3,72 21,9	2,38 7,40	1,65 3,05	1,21 1,44	0,93 0,75					
120	2000	v hr								6,63 83,3	4,25 28,1	2,72 9,48	1,89 3,90	1,39 1,84	1,06 0,96	0,68 0,32				
150	2500	v hr								8,29 126	5,31 42,5	3,40 14,3	2,36 5,89	1,73 2,78	1,33 1,45	0,85 0,49				
180	3000	v hr									6,37 59,5	4,08 20,1	2,83 8,26	2,08 3,90	1,59 2,03	1,02 0,69	0,71 0,28			
210	3500	v hr									7,43 79,1	4,76 26,7	3,30 11,0	2,43 5,18	1,86 2,71	1,19 0,91	0,83 0,38			
240	4000	v hr									8,49 101	5,44 34,2	3,77 14,1	2,77 6,64	2,12 3,46	1,36 1,17	0,94 0,48			
300	5000	v hr										6,79 51,6	4,72 21,2	3,47 10,0	2,65 5,23	1,70 1,77	1,18 0,73			
360	6000	v hr										8,15 72,3	5,66 29,8	4,16 14,1	3,18 7,33	2,04 2,47	1,42 1,02			
420	7000	v hr											6,61 39,6	4,85 18,7	3,72 9,75	2,38 3,29	1,65 1,35	1,21 0,64		
480	8000	v hr											7,55 50,7	5,55 23,9	4,25 12,49	2,72 4,21	1,89 1,73	1,39 0,82		
540	9000	v hr											8,49 63,0	6,24 29,8	4,78 15,5	3,06 5,24	2,12 2,16	1,56 1,02	1,19 0,53	
600	10000	v hr												6,93 36,2	5,31 18,9	3,40 6,36	2,36 2,62	1,73 1,24	1,33 0,65	

31. FLOW RESISTANCE (FITTINGS) - FLOW RESISTANCE TABLE FOR ELBOWS, CHECK VALVES, AND VALVES

Flow resistance is calculated based on the following table using the equivalent pipe length method

ACCESSORY TYPE	DN											
	25	32	40	50	65	80	100	125	150	200	250	300
	Equivalent pipe length (m)											
45° Elbow	0.2	0.2	0.4	0.4	0.6	0.6	0.9	1.1	1.5	1.9	2.4	2.8
90° Elbow	0.4	0.6	0.9	1.1	1.3	1.5	2.1	2.6	3.0	3.9	4.7	5.8
90° Wide Elbow	0.4	0.4	0.4	0.6	0.9	1.1	1.3	1.7	1.9	2.8	3.4	3.9
Sleeve T or Cross-Piece	1.1	1.3	1.7	2.1	2.6	3.2	4.3	5.3	6.4	7.5	10.7	12.8
Valve	-	-	-	0.2	0.2	0.2	0.4	0.4	0.6	0.9	1.1	1.3
Check Valve	1.1	1.5	1.9	2.4	3.0	3.4	4.7	5.9	7.4	9.6	11.8	13.9

- The table is for Hazen Williams coefficient, and C equals to 100 (cast iron pipe installation)
- The coefficient for steel pipe installations is 1.41
- The coefficient for stainless steel, copper pipe and galvanized cast iron pipe installations is 1.85
- When an equivalent pipe length is determined, the friction resistance is obtained from the flow resistance table.
- The given values are approximate values for models and especially for valves and check valves, and should be compared with the values provided by the manufacturer.

Water temperature reference at 4°C and hydraulic pressure loss above sea level

Water temperature °C	20	40	60	80	90	110	120
Suction loss (m)	0.2	0.7	2.0	5.0	7.4	15.4	21.5

Altitude (m)	500	1000	1500	2000	2500	3000
Suction loss (m)	0.55	1.1	1.65	2.2	2.75	3.3

Notes

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