WILO Mather and Platt – Large End Suction Pumps

en Installation and Operating Instructions

WILO Mather and Platt _Large End Suction_OIM_20131003_01

Disclaimer

WILO Mather and Platt is very grateful for your interest in its products. The basic objective of this document is to provide instructions for maintaining and operating WILO Mather and Platt Large End Suction Pumps. Instructions are complied for the person having a working knowledge of Large End Suction Pumps and the pumps shall be installed under expert supervision and guidance.

With this document WILO Mather and Platt does not accept any liability for inaccurate installation, operation or maintenance of the product at site. The authorities that install and maintain the pump shall be responsible for hassle free installation operation or maintenance of the product.

This document is prepared with at most care to ensure correct and accurate information, enabling the user to have trouble free installation and operational support. However, there can be few areas for improvement to make this document error free.

We welcome your valuable suggestions to make this document complete in all respects.

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Fig. 1: Lifting of pump: *(See Page No. 13 ; Point no.3.1)*

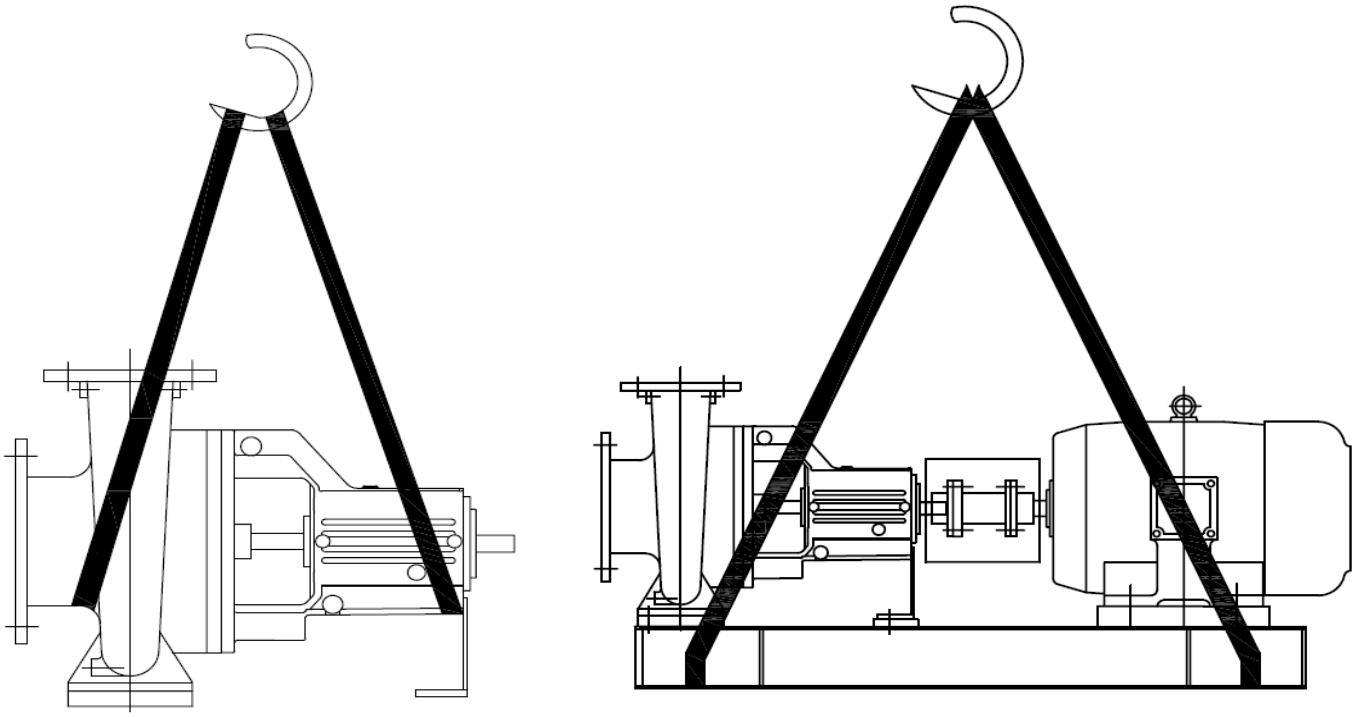


Fig. 2: Foundation Bolt Design: *(See Page No. 15 ; Point no.5.1)*

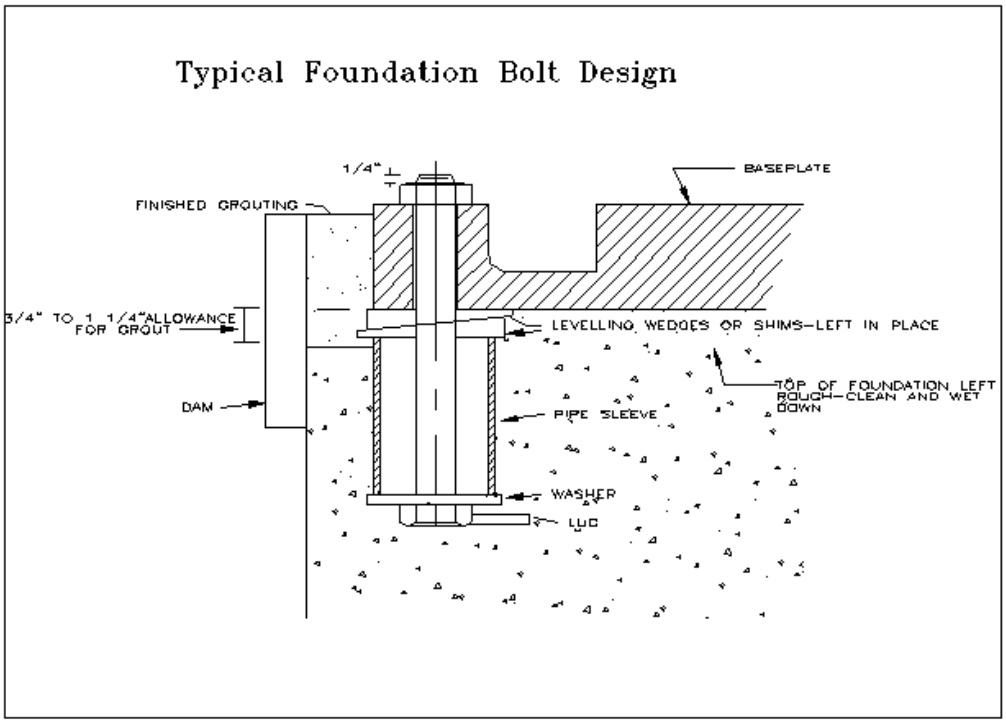


Fig. 3: Incorrect Alignment of pump set: *(See Page No. 16 ; Point no.5.3)*

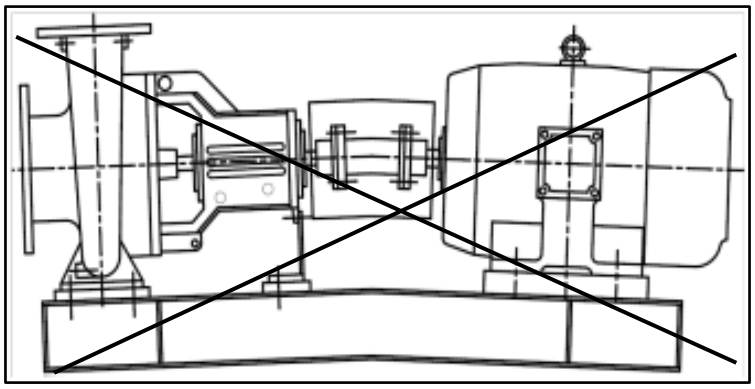


Fig. 4: Installation for Motor drive

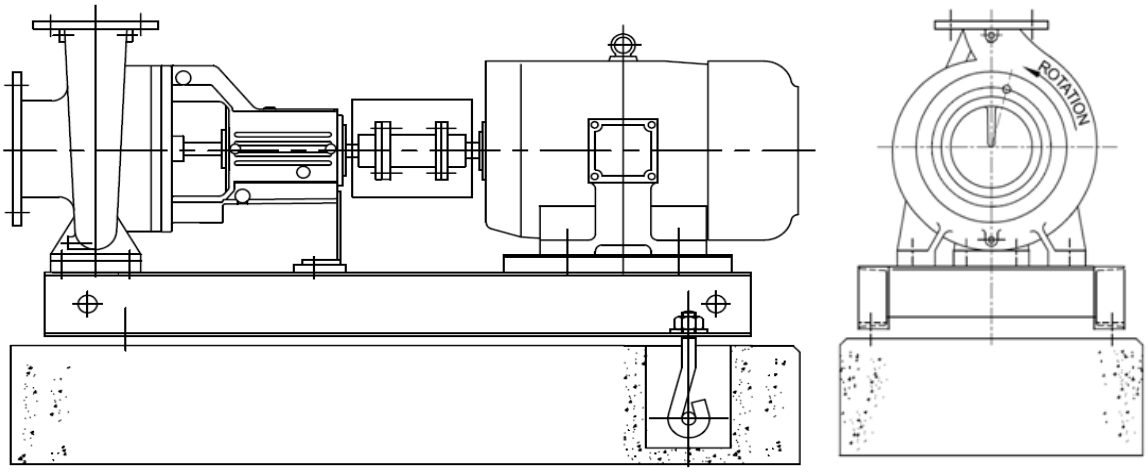


Fig. 5: Installation for Engine drive

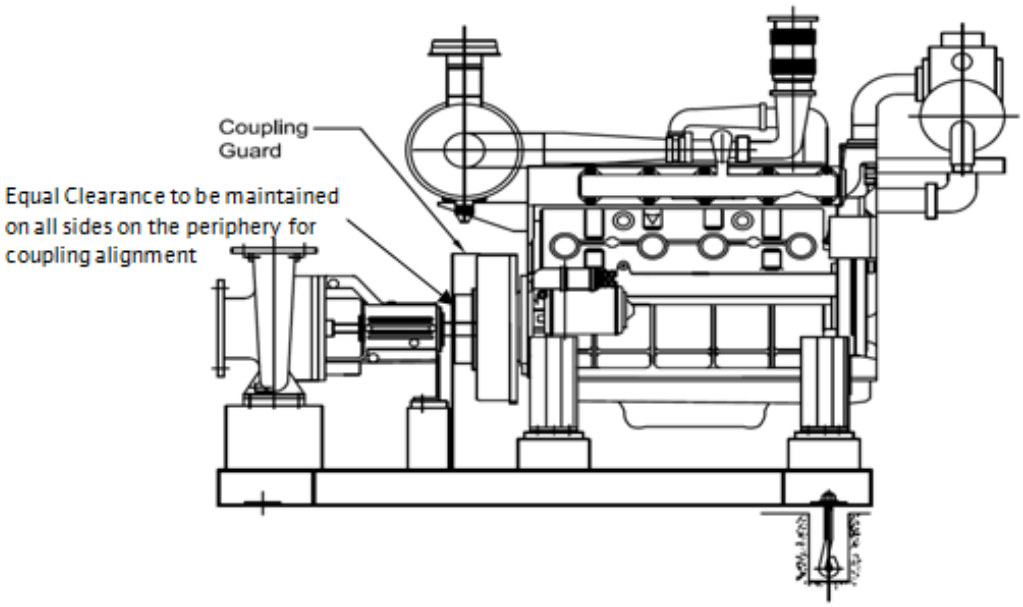


Fig. 6: Coupling Alignment (*See Page No. 16 ; Point no.5.3)*

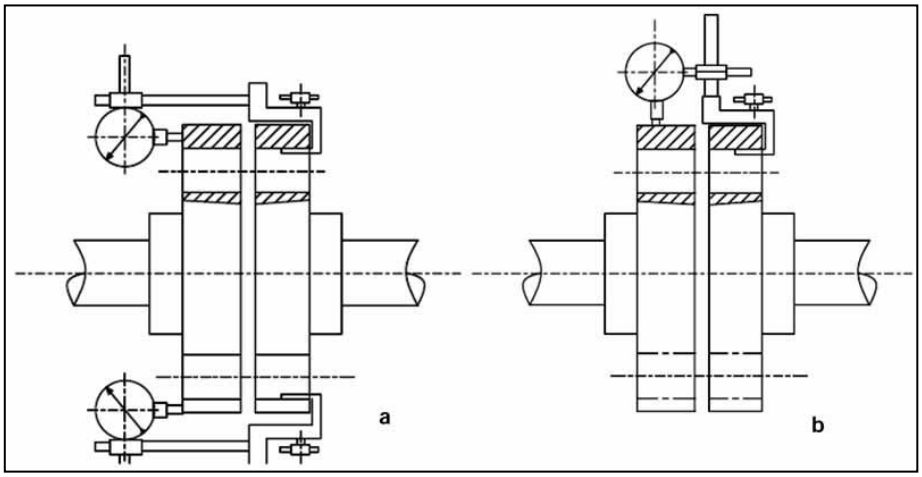


Fig. 7: Piping *(See Page No. 16 ; Point no.5.4)*

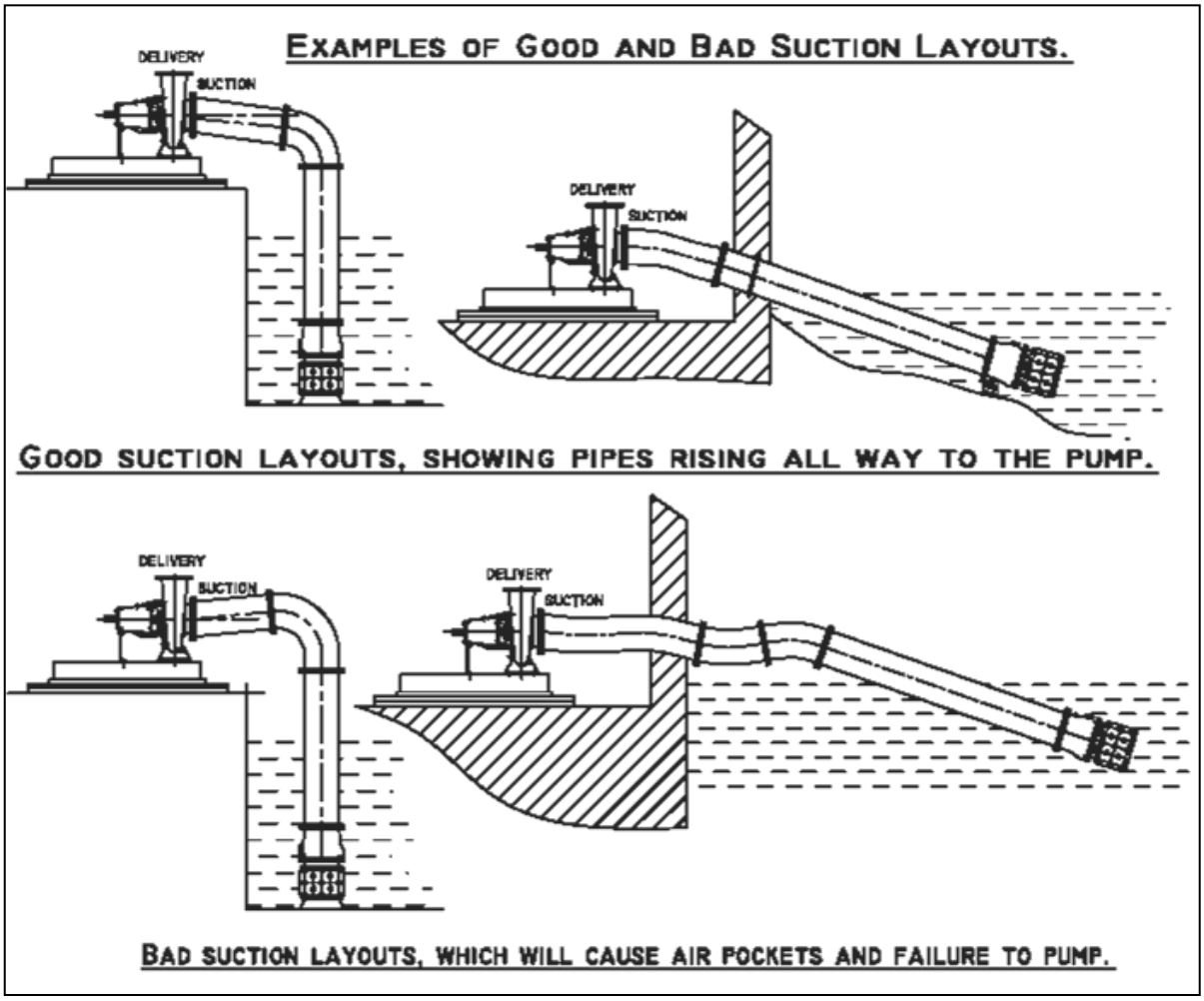


Fig. 8: Installation_positive suction *(See Page No. 15; Point No 5)*

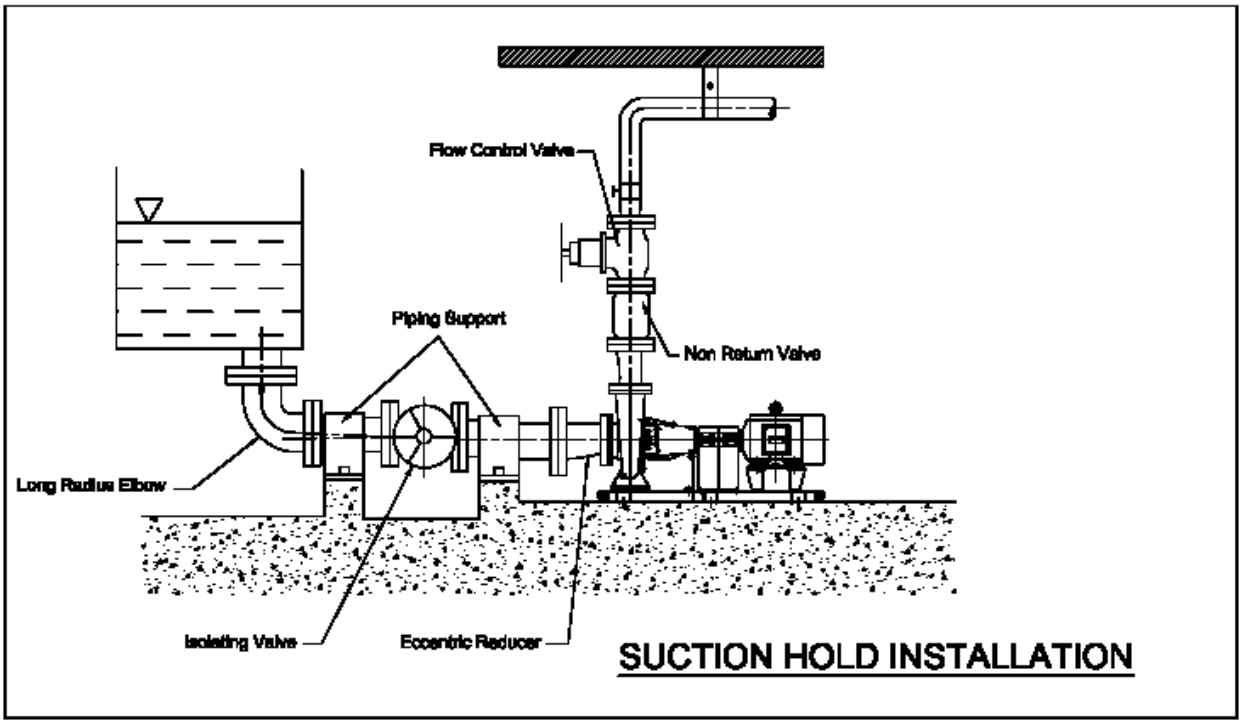


Fig. 9: Installation_Suction lift: *(See Page No. 15; Point No. 5)*

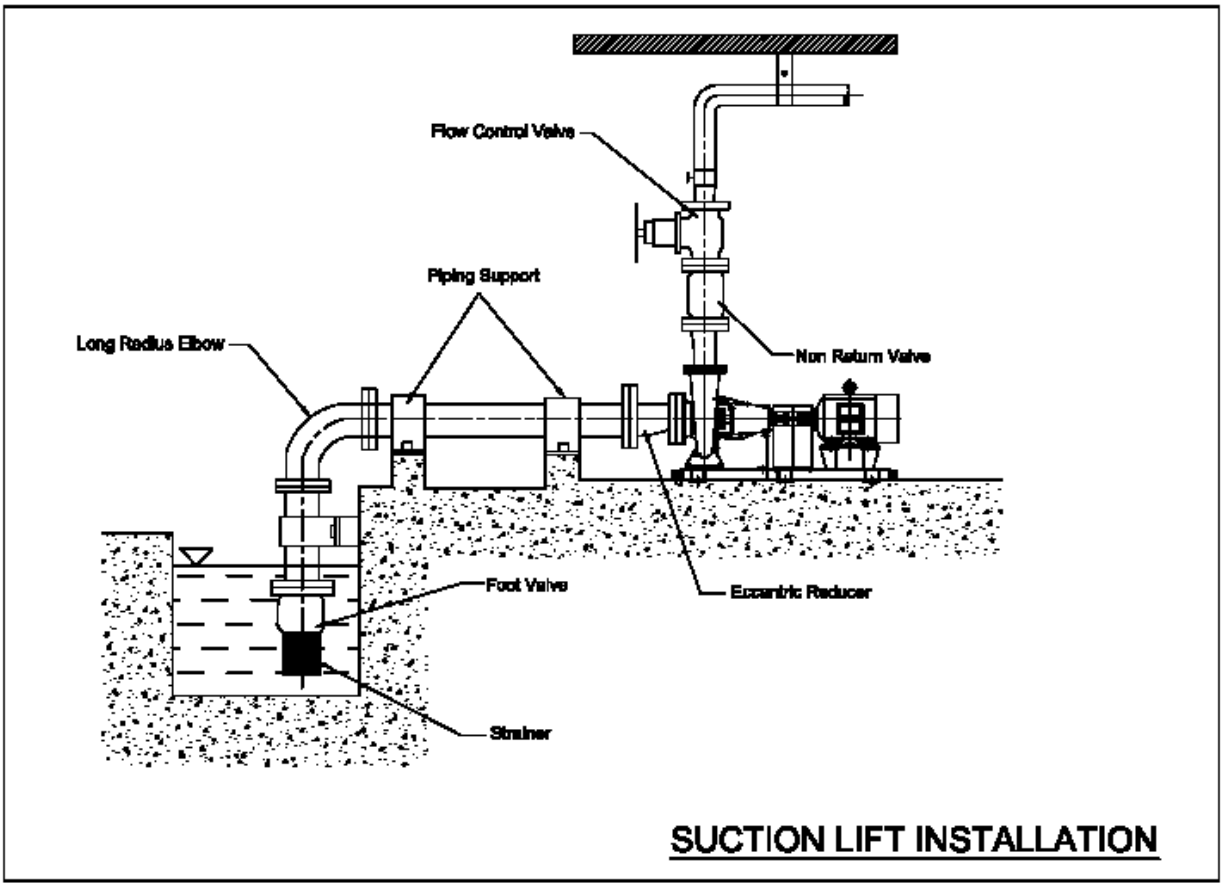
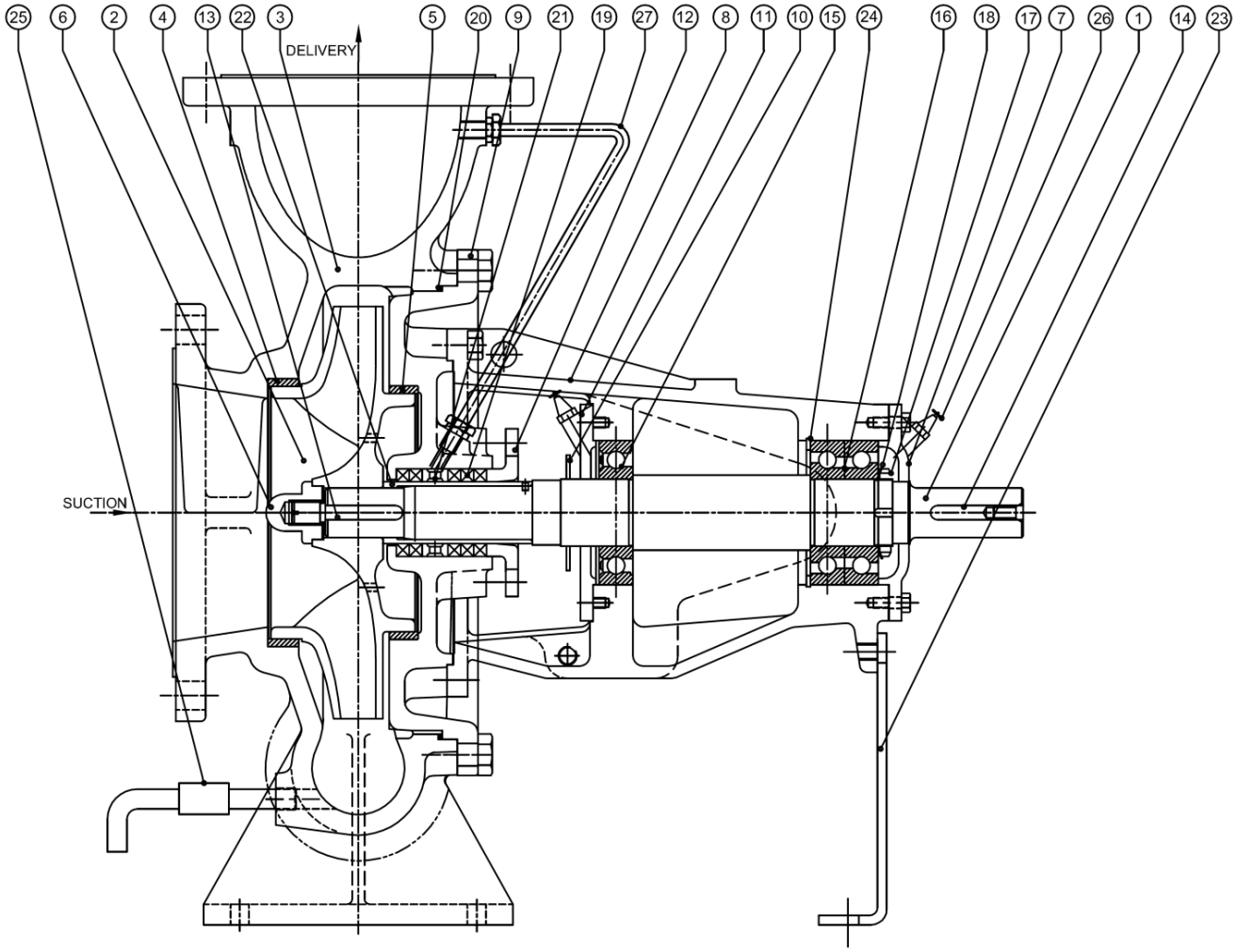
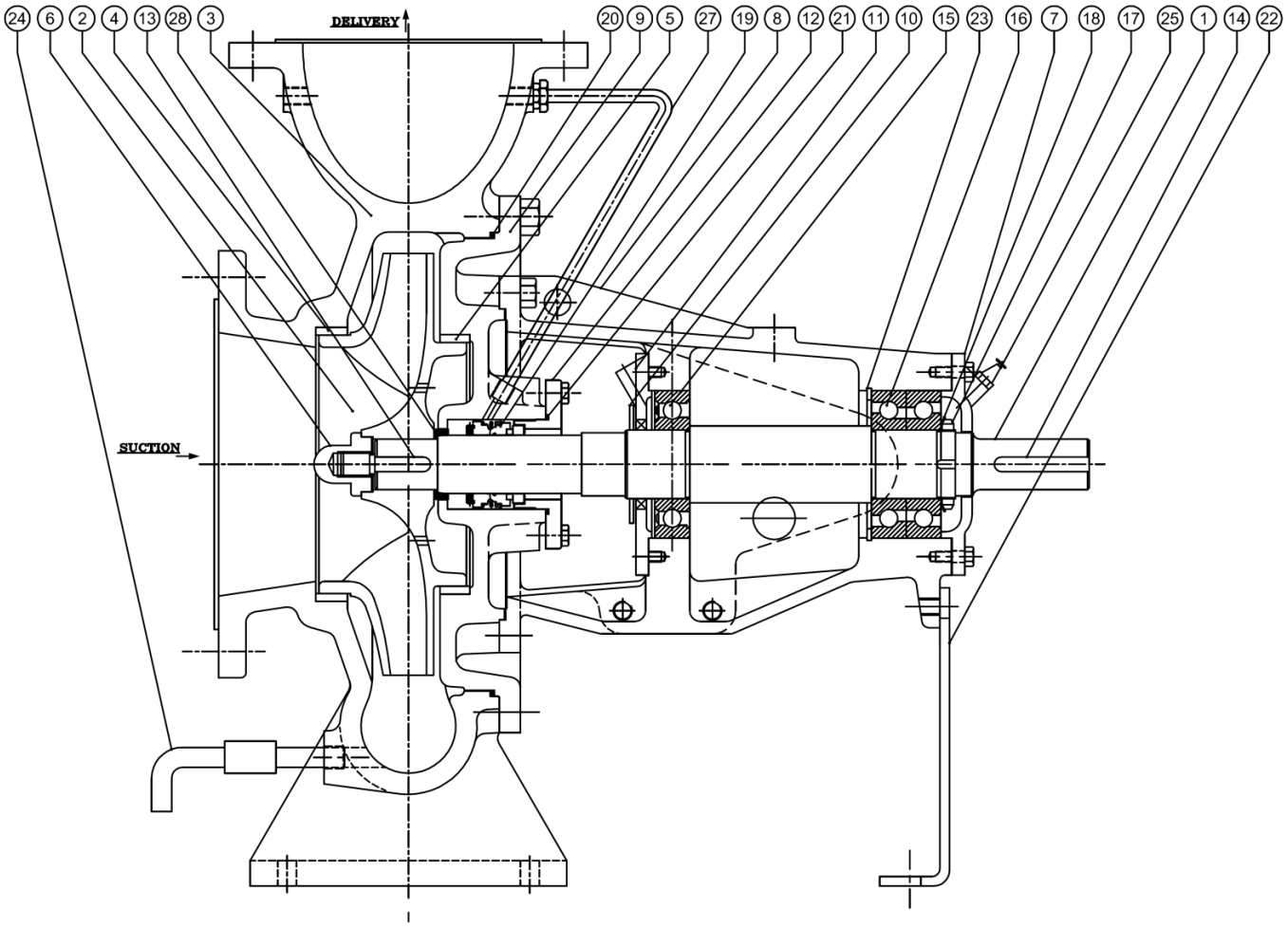


Fig. 10 : Cross Section–Gland Packing Version



14	Coupling Key	1			
13	Impeller Key	1	27	Water Cooling Tube	1
12	Gland	1	26	Grease Nipple	1
11	Bearing Cover (Inner)	1	25	¾" Ball Valve make AUDCO (L&T) with pipe	1
10	Water Thrower	1	24	Circlip Internal	1
9	Back Cover	1	23	Support Foot	1
8	Bearing Bracket	1	22	Sleeve	1
7	Bearing End Cover (Outer)	1	21	Logging Ring	1
6	Nose Cap	1	20	O Ring for Back Cover	1
5	Wear Ring (Back Cover)	1	19	Gland Packing	5
4	Wear Ring (Casing)	1	18	Lock Washer	1
3	Casing	1	17	Lock Nut	1
2	Impeller	1	16	Angular Contact Ball Bearing (BECBP)	1 set
1	Shaft	1	15	Deep Groove Ball Bearing	1
Sr. No.	**Component Description**	**Qty**	**Sr. No.**	**Component Description**	**Qty**

Fig. 11: Cross Section–Mechanical Seal Version



14	Coupling Key	1			
13	Impeller Key	1	28	Short Sleeve	1
12	Gland Plate	1	27	Water Cooling Tube	1
11	Bearing Cover (Inner)	1	25	Grease Nipple	1
10	Water Thrower	1	24	¾" Ball Valve make AUDCO (L&T) with pipe	1
9	Back Cover	1	23	Circlip Internal	1
8	Bearing Bracket	1	22	Support Foot	1
7	Bearing End Cover (Outer)	1	21	O Ring for Gland Plate	1
6	Nose Cap	1	20	O Ring for Back Cover	1
5	Wear Ring (Back Cover)	1	19	Mechanical Seal	1 set
4	Wear Ring (Casing)	1	18	Lock Washer	1
3	Casing	1	17	Lock Nut	1
2	Impeller	1	16	Angular Contact Ball Bearing (BECBP)	2
1	Shaft	1	15	Deep Groove Ball Bearing	1
Sr. No.	**Component Description**	**Qty**	**Sr. No.**	**Component Description**	**Qty**

Fig. 12: Exploded View–Gland Packing version *(See Page No. 21 ; Point no.8)*

12	Logging Ring	1	*	Hex Head Bolt	

11	Back Cover	1	23	Bearing Cover (Outer)	1
10	Wear Ring (Back Cover)	1	22	Lock Nut	1
9	Key coupling	1	21	Lock Washer	1
8	Impeller Key	1	20	SKF Angular Contact Ball Bearing	1
7	Shaft	1	19	Support Foot	1
6	Shaft Sleeve	1	18	Bearing Bracket	1
5	Impeller	1	17	SKF Deep Groove Ball Bearing	1
4	Impeller Washer	1	16	Bearing Cover (Inner)	1
3	Impeller Nose Cap	1	15	Water Thrower	1
2	Wear Ring (Casing)	1	14	Gland	1
1	Casing	1	13	Packing	5
Sr. No.	**Component Description**	**Qty**	**Sr. No.**	**Component Description**	**Qty**

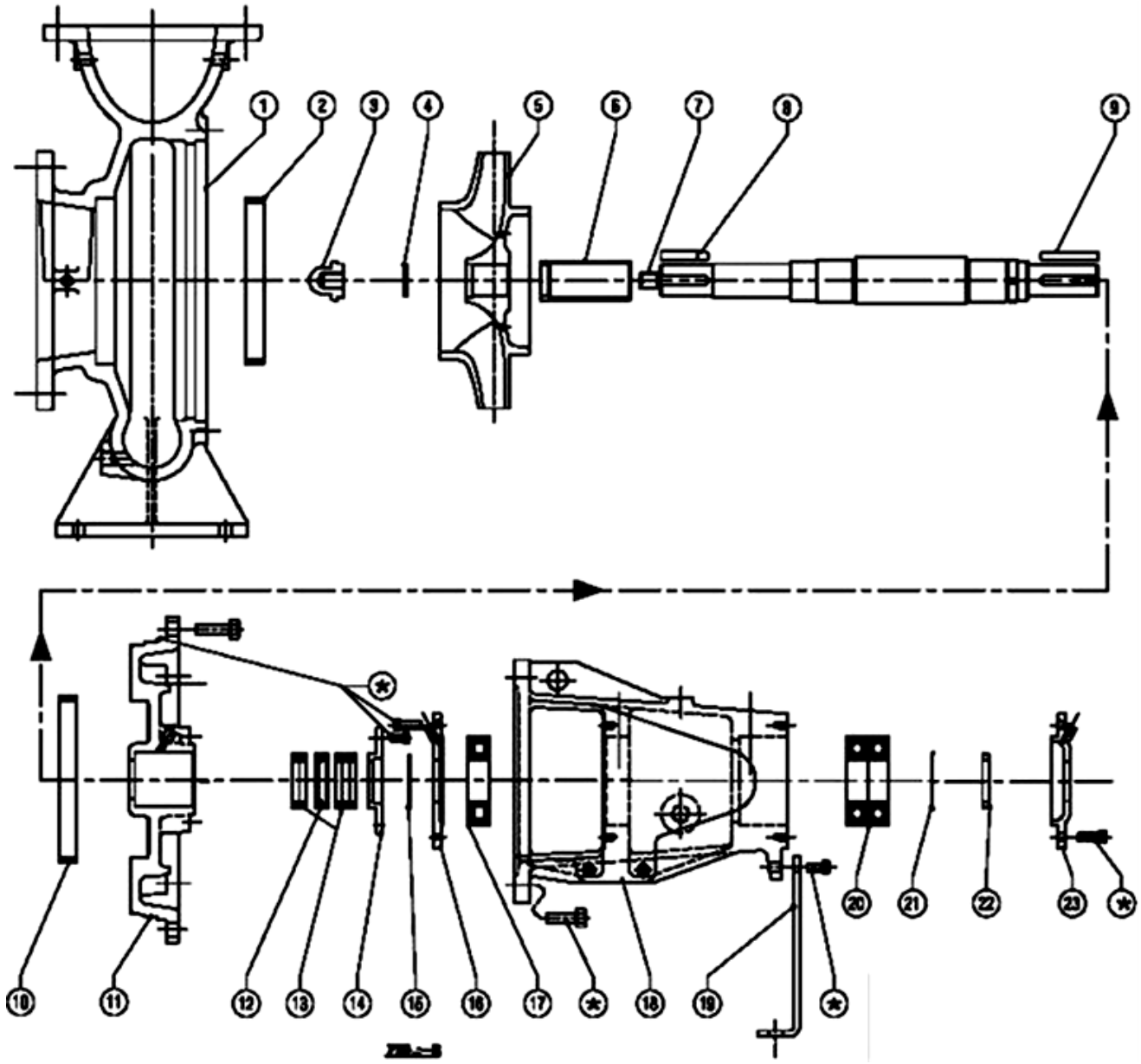
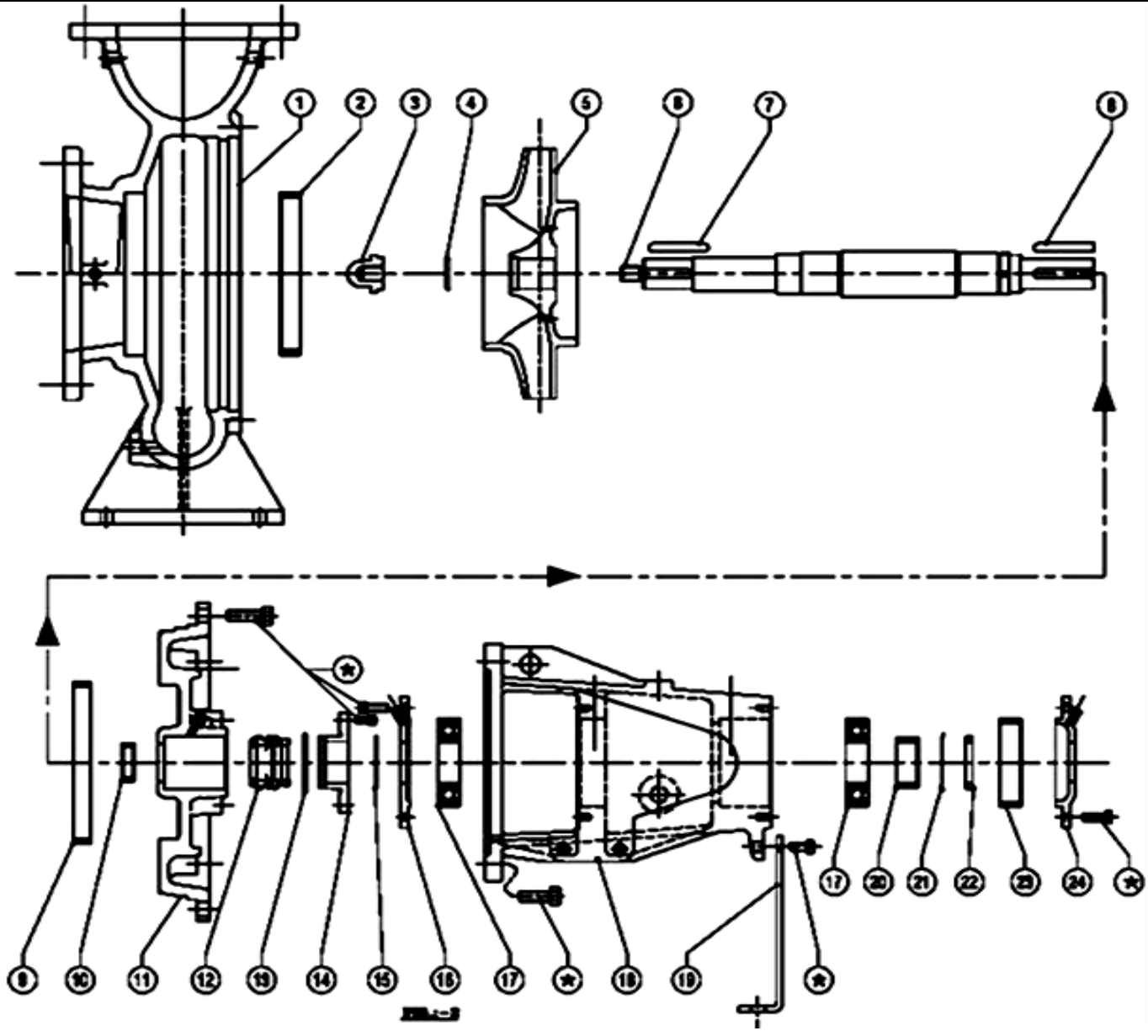


Fig. 13: Exploded view – Mechanical Seal version *(See Page no. 21 ; Point no.8)*

13	O-Ring (Gland Plate)	1			

12	Mechanical Seal	1	*	Hex Head Bolt	
11	Back Cover	1	24	Bearing Cover (Outer)	1
10	Space for Impeller	1	23	Spacer (Outer)	1
9	Wear Ring (Back Cover)	1	22	Lock Nut	1
8	Key coupling	1	21	Lock Washer	1
7	Impeller Key	1	20	Spacer (Inner)	1
6	Shaft	1	19	Support Foot	1
5	Impeller	1	18	Bearing Bracket	1
4	Impeller Washer	1	17	SKF Deep Groove / Angular contact ball bearing	2
3	Impeller Nose Cap	1	16	Bearing Cover (Inner)	1
2	Wear Ring (Casing)	1	15	Water Thrower	1
1	Casing	1	14	Gland Plate	1
Sr. No.	**Component Description**	**Qty**	**Sr. No.**	**Component Description**	**Qty**



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1. General Information

About this document

The language of the original operating instructions is English. All other languages of these instructions are translations of the original operating instructions.

These installation and operating instructions are an integral part of the product. They must be kept readily available at the place where the product is installed. Strict adherence to these instructions is a precondition for the proper use and correct operation of the product.

These installation and operating instructions correspond to the relevant version of the product and the underlying safety standards valid at the time of going to print. Supplied pump will operate trouble free and satisfactorily on the condition that, it is installed with due care and maintained properly.

For hassle free operating life, it is recommended that the pump should operate under specified “Operating conditions”. Pump operating conditions are mentioned on the “Nameplate” affixed to the pump.

If operating parameters deviate from the specified parameters as on the “Nameplate”, please contact manufacturer.”

2. Safety

These operating instructions contain basic information which must be adhered to during installation and operation. For this reason, these operating instructions must, without fail, be read by the service technician and the responsible operator before installation and commissioning. The machine operator list must be filled out completely. By signing this list, all persons working on or with the product confirms that they have received, read and understood this operating & maintenance manual.

It is not only the general safety instructions listed under the main point "safety" that must be adhered to but also the special safety instructions with danger symbols included under the following main points.

2.1 Safety symbols

General danger symbol :

This symbol indicates safety instructions where non-compliance would affect personal safety and could result in loss of life.

Danger due to electrical voltage

This symbol indicates electrical safety instructions where non compliance will involve a high risk to personal safety or the loss of life.

NOTE :

This is not a safety symbol but indicates useful information on using the product. It also draws attention to the possible problems.

Signal words:

DANGER!

Acutely dangerous situation.

Non-observance results in death or the most serious of injuries.

WARNING!

The user can suffer (serious) injuries. “Warning” implies that (serious) injury to persons is probable if this information is disregarded.

CAUTION!

There is a risk of damaging the pump/installation. “Caution” implies that damage to the product is likely if the information is disregarded.

2.2 Personnel qualifications

All personnel involved in the operation, installation, inspection and maintenance of the unit must be qualified to carry out the work involve.

If the personnel in question do not possess the necessary knowledge and skill, appropriate knowledge and training must be provided.

2.3 Danger in event of non-observance of the safety instructions

Non-observance of safety instructions provided in these operating instructions can result in the following risks:

- Failure of important product/installation functions
- Failure of required maintenance and repair procedures
- Danger to persons from electrical, mechanical and bacteriological influences
- Property damage
- Loss of any claims to damages

2.4 Safety instructions for the operator

This appliance is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety. Children should be supervised to ensure that they do not play with the appliance.

- If hot or cold components on the product/the unit lead to hazards, local measures must be taken to guard them against touching.
- Guards protecting against touching moving components (such as the coupling) must not be removed whilst the product is in operation.
- Leakages (e.g. from the shaft seals) of hazardous fluids (which are explosive, toxic or hot) must be led away so that no danger to persons or to the environment arises. National statutory provisions are to be complied with.
- Highly flammable materials are always to be kept at a safe distance from the product.
- Danger from electrical current must be eliminated. Local directives or general directives [e.g. IEC, VDE etc.] and local power supply companies must be adhered to.
- The actual sound pressure, however, depends on several factors. These include, for example, type of prime mover, installation type; fastening of accessories and pipeline, operating site condition, background noise, etc.

- Once the product has been installed, we recommend that the operator makes additional measurements under all operating conditions.

2.5 Safety instructions for installation and maintenance work

The operator must ensure that all installation and maintenance work is carried out by authorized and qualified personnel, who are sufficiently informed from their own detailed study of the operating instructions.
Work on the product/unit must only be carried out when at a standstill. It is mandatory that the procedure described in the installation and operating instructions for shutting down the product/unit be complied with.
Immediately on conclusion of the work, all safety and protective devices must be put back in position and/or re-commissioned.

2.6 Unauthorized modification and manufacture of spare parts

Unauthorized modification and manufacture of spare parts will impair the safety of the product/ personnel and will make void the manufacturer's declarations regarding safety.
Modifications to the product are only permissible after consultation with the manufacturer. Original spare parts and accessories authorized by the manufacturer ensure safety. The use of other parts will absolve us of liability for consequential events.

2.7 Improper use

The operating safety of the supplied product only guaranteed for conventional use. The limit values on any account must not fall under or exceed those specified in the catalogue/data sheet.

2.8 Safety & control devices

Direct controls are applicable when the pump is supplied along with motor/panels. When motor/ panel is in end user's scope of supply, it is advised to go for CE approved motors /panels.
Environmental safety
Disposal of any unwanted/scrap material should be disposed in appropriate way so as not to cause any harm to the environment. No hazardous material is used in Wilo Mather & Platt pumps.

NOTE

To avoid ambiguity in the use of the word
„replace" the words „replace" and „renew" are used in this manual in the following context: Replace – To put back, in its existing state, a part or component that has previously been removed. Renew – To substitute a new part of component for a worn or damaged one.

3. Transport & Interim storage

Immediately check the pump and transport packaging for damage in transit upon receipt. Take the necessary steps within the period defined by the transport company in the event of damage in transit.

DANGER! Risk of getting crushed!

The installation or removal of the product must not be performed by one person alone. Measures should be taken to bar persons from standing beneath a suspended load. Further- more, it is also prohibited to move suspended loads over exposed workplaces where people are present. The fastening devices should be adapted to the conditions at hand (weather, hooking system, load, etc.) Use suitable fastening devices to handle the weight of the product.

CAUTION! Risk of damage to the pump!

Risk of damage due to improper handling during transport and storage.
The pump should be protected against humidity, frost and mechanical damage during transport and interim storage.

3.1 Handling *(Refer Fig. 1; Page no.3)*

CAUTION! Risk of damage to the pump!
Risk of falling!

To lift the pump see lifting diagrams - see also general safety Information, Point 2

- A hoist complying with local regulations must be used to lift heavy parts weighing more than 30 kg. The load-bearing capacity must be adapted to the weight.
- Only lifting hooks or shackles which comply with local safety regulations may be used to lift machines or parts using lugs. The carrying chains or cables must never be passed over or through the lugs or over sharp edges without protection.
- When lifting, ensure that the load limit of a cable is reduced for angled pulling.
- The safety and efficiency of a cable are best guaranteed if, wherever possible, all load-bearing elements are stressed vertically.
- If necessary a lifting arm should be used to which the carrying cable can be attached vertically.
- It is absolutely forbidden to stand beneath a raised load. In this connection the safety zone must be marked out such that there is no danger if the load or part there of slips or the hoist breaks or tears. A load should never remain in a raised position for longer than necessary. Accelerating and braking during the lifting process must be performed such that there is no danger to persons.
- If a block and tackle or a similar hoist is used, it must be ensured that the load is lifted vertically. The raised load must be prevented from swinging.

3.2 Delivery

On arrival, the delivered items must be inspected for damage and check that all parts are present.

If any parts are damaged or missing, the transport company or the manufacturer must be informed on the day of delivery. Any claim made at a later date will be deemed invalid. Damage to parts must be noted on the delivery or freight documentation.

3.3 Storage

Our End Suction Pumps require preparation for storage & regular maintenance during storage. The pump should be considered in storage when it has been delivered to the job site & waiting for installation.

It is suggested that the check of parts & material against the bill of materials be made jointly with the WILO Mather and Platt's representative & customer representative.

NO CLAIMS FOR SHORTAGES WILL BE HONORED BY WILO MATHER AND PLATT AFTER THE MATERIAL HAS BEEN PLACED IN STORAGE.

Here are some general suggestions for short term as well as long term storage. The applicability of all or some of these suggestions depends upon several factors such as type of equipment, length of storage & condition of the environment.

3.3.1 Short-term storage (less than 3 month)

When it is necessary to store a pump for a short time before it can be installed,

- Place it in a dry, clean, well-ventilated place, free from vibration, moisture and rapid or wide variations in temperature.
- Protect the bearings and couplings against sand, grit, or other foreign matter.
- To prevent rusting or seizing, lubricate the unit and turn the rotor several revolutions by hand at least once a week.

3.3.2 Long-Term storage (more than 3 month)

- The storage area must be level and not subject to flooding.
- Packing must be removed from the stuffing box for extended storage for possible pitting on the shaft or sleeve. Spray the interior portion of the pump case and the pump stuffing boxes with a water soluble type of rust preventive.
- The packing gland may be left on the pump shaft, but must be wired or otherwise securely fastened in position.
- In case of pump is operated & then want to keep in storage, Ensure the pump is completely drained out.
- Apply a coat of soluble rust preventive solution internally and externally.
- All the openings such as pump inlet, outlet, and all taps provided for auxiliary connections should be sealed.
- No foreign parts or dust should enter into the pumping unit. This may cause the jamming of the rotating components.
- All machined surfaces and exposed shafting must be coated with rust preventative.
- The pump shall be covered with a weather resistant cover of waterproof paper or plastic to prohibit the buildup of dirt and dust accumulations.
- The pump must be inspected periodically to insure that all preservatives are intact.
- Pump shaft shall be rotated at an intervals of approximately 4 weeks, by hand
- Do the routine checkup periodically.

3.4 Pump returning back to the supplier

Products which are delivered back to the plant must be clean and correctly packaged. In this context, clean means that impurities have been removed and decontaminated if it has been used with materials, which are hazardous to health.

The packaging must protect the product against damage.

CAUTION! Guarantee not applicable!

Products, which are not suitably packaged for back delivery, are no longer covered by guarantee!

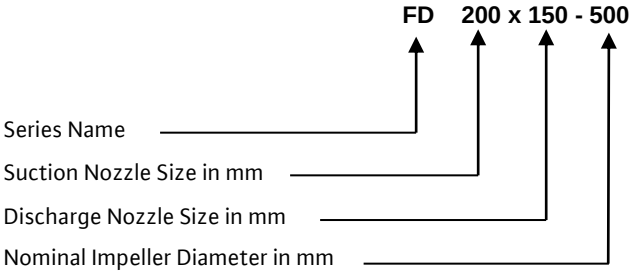
3.5 Intended use

The pump supplied is intended for specific fluid. Refer pump data sheet and order confirmation. For any change in pumped fluid refer WILO Mather and Platt beforehand. If the operating conditions are different of the specifications given in the order, (i.e. type of liquid, temperature or duty point), the end user must ask for written agreement to WILO Mather and Platt on the new operating conditions before starting the pump.

4. Product Description

Single stage, back pull out, centrifugal pump, pump casing volute type, sealed by mechanical seal or packed gland.

4.1 Nomenclature



4.2 Product Range

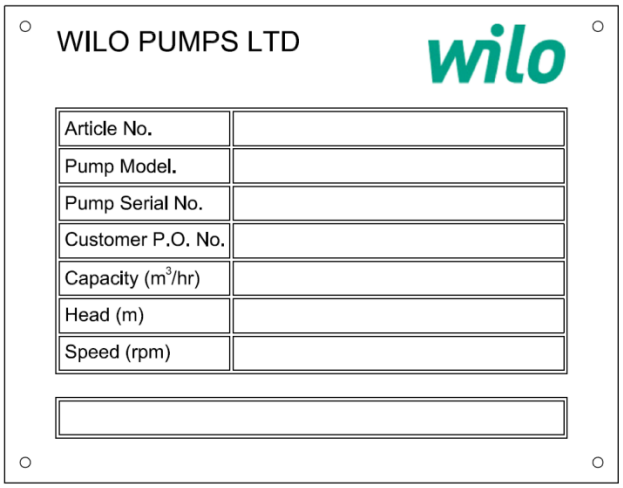
Sr. No.	Model Name	Shaft Group
1	FD200x150-500	1
2	FD200x200-260	1
3	FD250x200-315	1
4	FD250X200-400	1
5	FD250X200-450	1
6	FD250x200-500	2
7	FD250x250-260	1
8	FD300x250-315	1
9	FD300x250-355	1
10	FD300x250-400	2
11	FD300x250-500	2
12	FD300x300-315	1
13	FD350x300-400	2
14	FD350x300-550	2
15	FD350x350-350	2
16	FD400x400-400	2
17	FD400x400-450	2

Limiting conditions

Maximum Capacity (m3/hr) : 2600
Maximum Head (m) : 110
DN Sizes (mm) : 150 to 400
Temperature (°C) Limits,
With Mechanical seal : up to 120 °C
With Gland Pack : up to 100 °C

4.3 Product Name Plate

Product Name plate is affixed on the bearing housing.
The data on the name plate is as below,



5. Installation

5.1 Preparation for foundations (*See Fig. No 2; Pg No. 3)*

The pump must be checked for compliance with the information on the delivery note. Wilo-Mather & Platt must be notified immediately of any damage or missing parts. Check crates, boxes and wrappings for spare parts or accessories which could be enclosed with the pump.

General rules for pump locations

Pumps installed indoors, in poorly lighted and cramped locations, or where dirt and moisture accumulate, are improperly placed for dismantling and repair; they will be neglected and both pump and driver may become damaged. Pumps should be placed in light, dry and clean locations whenever possible.

If a motor driven unit will be operated in a damp, moist, or dusty location, the proper motor must be selected. Pumps and drivers designed for outdoor installation are specially constructed to withstand exposure to weather and usually are readily available for overhaul.

Sufficient room must always be provided for dismantling the pump; that is, enough headroom must be allowed. For large pumps with heavy casings and rotors, a travelling crane or facilities for attaching a hoist should be provided over the pump location.

Pumps should be located as close as possible to the source of liquid supply. When possible, it is advisable to locate the unit below pumping level of the water, to facilitate priming. The manufacturer's recommendations for suction conditions should always be followed.

For most pumping units, more satisfactory service is obtained when rigid foundations are provided.

The suction supply system must provide the pump with Net Positive Suction Head (NPSH) equal to or greater than that required by the pump at any capacity on its operating curve.

5.2 Foundations

The correct planning and execution of stable concrete foundations is a deciding factor for the low-noise operation of pumps.

To increase the stabilizing mass and to compensate for unbalanced forces, direct and rigid connection between the pump unit and the foundation block is recommended. The foundation should be sufficiently substantial to absorb any vibration and to form a permanent, rigid support for the base plate.

This is important in maintaining the alignment of a direct connected unit. In building the foundation, the top of the foundation should be left approximately one inch low to allow for grouting. Foundation bolts of the proper size should be embedded in the concrete, located by template. A pipe sleeve about 2 ½ diameters larger than the bolt should be used to allow movement for the final positioning of the bolts.

5.3 Alignment

Reliable, trouble-free, and efficient operation of a pumping unit requires correct alignment of pump and driver shaft. Misalignment may be the cause of:

- Noisy pump operation
- Vibration
- Premature bearing failure
- Excessive coupling wear

When the unit is received with the pump and driver mounted on a common base plate, it should be placed on the foundation and the coupling halves disconnected. The coupling should not be reconnected until all alignment operations have been completed.

A gap of about 20 to 40mm should be allowed between the base-plate and the foundation to allow for grouting. Adjust the metal supports or wedges until the shafts of pump and driver are level. Check the coupling faces as well as the suction and discharge flanges of the pump for horizontal or vertical position by means of a sprit level. Correct the positions, if necessary, by adjusting the supports or wedges under the base-plate as required. The faces of the coupling halves should be spaced far enough apart such that they cannot strike each other. Due allowance should be made for wear of the thrust bearings. A minimum dimension for the separation of the coupling halves is usually specified by the coupling manufacturer and reference should be made to their instruction Sheet to ensure gap is correct.

Check for angular alignment by inserting a taper gauge or feelers between the coupling faces and comparing the distance between the faces at four points spaced at 90^0 intervals around the coupling. The unit will be in angular alignment when measurements show that coupling faces are the same distance apart at all points.

Check for parallel alignment by placing a straight edge across both coupling rims at the top, bottom and at both sides. The unit will be in parallel alignment when the straight edge rests evenly on the rim at all positions. Allowance may be necessary for temperature changes and for coupling halves that are not of the same outside diameter. Care must be taken to have the straight edge parallel to the axes of the shafts.

Angular and parallel misalignment is corrected by adjusting the shims under the pump or driver, or relocating positioned units on the base-plate. After each change, it is necessary to check the alignment of the coupling halves**.** Adjustment in one direction may disturb adjustment already made in another direction. When alignment is correct, the foundation bolts should be tightened evenly but not too firmly. The unit can then be grouted to the foundation. Foundation bolts should not be fully tightened until the grout has hardened – usually about 48 hours after pouring. After the grout has set and foundation bolts have been properly tightened, the unit should be checked for parallel and angular alignment and, if necessary, corrective measures taken. Alignment should be checked again after unit has been connected to the pipe work.

Direction of rotation of the driver should be checked to make certain that it matches that of the pump. Pump direction of rotation is indicated by a direction arrow on the pump casing. The coupling halves can then be reconnected. Once the pump has been running for about ten hours, the coupling halves should be given a final check for misalignment due to pipe strains or changes in temperature. If the alignment is correct, both pump and driver should be doweled to the base plate.
Both suction and discharge pipes should be supported independently near the pump to ensure that when flange bolts are tightened no strain will be transmitted to the pump casing. A check valve and a gate valve should be installed in the discharge line. The check valve, placed between the pump and the gate valve, is to protect the pump from excessive pressure and to prevent water running back through the pump in case of failure of the driver. The gate valve is used in priming, starting and when shutting down the pump. Except on axial flow and mixed flow pumps, it is advisable to close the gate valve before stopping the pump. This is especially important when the pump is operated against a high static head. If taper pipes are used to increase the size of discharge piping, they should be placed between the check valve and pump from existing manual.

Incorrect alignment of the set can result in damage to coupling and set!

(See Fig. No.3; Pg. No. 4)

In accordance with the statutory provisions the coupling is to be protected by the safety device such that accidents caused by accidentally touching rotating parts are avoided.

5.4 Piping *(See Fig.7; Pg. No. 5)*

Under no circumstances may the pump be used as a fixed support for the pipe! Satisfactory operation cannot be maintained when piping imposes forces and torques on the pump.

Piping should be independently supported near the pump so that no strain will be placed on the pump casing.

A pump can be easily sprung and pulled out of position by drawing up on the bolts in the piping flanges. The alignment can be seriously affected in this way and it is important, therefore, that the alignment should be checked again after the pipes are finally fitted. Piping flanges must be brought squarely together before the bolts are tightened. The suction and discharge piping and all associated valves and similar equipment should be supported and anchored near the pump, but independent of it, so that no strain is transmitted to the pump casing. Where any noise is objectionable, pump should be insulated from the piping with rubber connections. Always keep pipe size as large as possible and use a minimum of fittings to reduce friction losses.

5.4.1 Suction Piping

The major source of trouble in centrifugal pump installations, other than misalignment, is a faulty suction line. The suction piping should be as short and as direct as possible. It should be at least one size larger than suction inlet tapping and should have a minimum of elbows and fittings. If a long suction line is required, the pipe size should be increased to reduce friction losses. The suction piping should be laid out with a continual rise towards the pump, without any high spots, to prevent the formation of air pockets, which invariably cause troubles. Only eccentric reducers, installed straight side up should be between the suction piping and the pump suction flange.

Elbows and other fittings next to the pump suction should be selected and arranged carefully, or the flow into the impeller will be unfavorably disturbed. Long radius elbows are generally preferred for suction lines, as they create less friction and provide a more uniform flow distribution than standard elbows.

The suction pipe must be tight and free of air leaks or pump will not operate properly. After installation, the suction piping should be blanked off and hydrostatically tested for air leaks before the initial start-up.

5.4.2 Discharge Piping

Discharge piping should never be smaller than pump tapping and should preferably be one size larger. Generally, both a check valve and a gate valve are installed in the discharge line. The check valve is placed between the pump and the gate valve and protects the pump against reverse flow and water hammer in the event of unexpected driver failure. The gate valve is used when priming the pump or when shutting it down for inspection and repairs. Except on axial flow and mixed flow pumps, it is advisable to close the gate valve before stopping the pump. This is especially important when the pump is operated against a high static head.

5.5 Electrical connection

Electrical connection should be made by a qualified electrician. Please follow the electrical equipments instructions carefully.

General guidelines are as follows:

- The supply cable must be laid in such a way that it never touches the pipe work and/or the pump and motor casing.
- Check the mains current and voltage.
- Please observe data on the motor rating plate.
- Mains fuse: depends on nominal motor current.
- Observe earthing regulations.
- Never install a pump without proper overload protection

6. Operations and Maintenance

6.1 Priming

The pump must be primed before starting. Centrifugal pumps should almost never be started until they are fully primed, that is, until they have been filled with the liquid pumped and all the air has escaped. The pump casing and suction piping must be filled with liquid before starting since this damage some of the parts of the pump, which depend upon liquid for their lubrication. A hand pump or ejector can be used for priming when desired.

These pumps are not self-priming and if a pump fails to generate its rated pressure in starting, it must be stopped and re-primed.

All that is required to prime pumps with a positive inlet head is to open air cocks at the top of the pump casing and the inlet isolating valve. The liquid will then drive the air through the air cocks, which must be closed when priming is complete, and before the pump is started. It may be advisable to turn the rotating element of smaller by hand, so clearing air, which may be trapped in the pockets formed by curved impeller vanes.

There are two methods of priming pumps drawing from an elevation lower than the suction branch:

- By exhausting the air from the casing. To allow this method, the stuffing boxes must be sufficiently air tight, or they should be liquid sealed from some external supply. Some form of sight gauge is usually fitted to indicate when the casing is properly primed.
- If the suction pipe is fitted with a foot valve, the pump can be primed from some external supply under pressure; the pressure imposed on the pump must not be greater than that for which it is designed.

If the pump is to handle hot fluid, fill slowly to ensure the temperature is raised gradually. Depending on the fluid temperature and the system pressure, if the air cock is completely loosened hot liquid can escape or even shoot out at high pressure. Beware of scalding.

6.2 Final Check before Start-up

After a centrifugal pump has been properly installed and all necessary precautions have been taken in aligning with its driver, it is ready for service on its initial start. The following basic checks should be completed before the pump is started.

- Pump is fully primed
- Bearings filled with the correct amount and type of grease.
- Pump driver alignment is within tolerance.
- Motor direction of rotation is correct.
- Coupling guard is in place and bolted down.
- Pressure gauges mounted on both pump suction and discharge with correctly ranged pressure gauges fitted. Pressure gauges should not be installed at the bends in the piping, where their readings may be affected by the kinetic energy of the fluid.
- All blanks removed and the pump suction valve fully open.
- Pump discharge valve is fully closed.

6.3 Starting Procedures

Start the pump with the discharge valve closed. When the motor reaches its nominal running speed, check that the discharge pressure is normal and steady, without large fluctuations. Otherwise, stop the pump and repeat the priming procedure. If the problem persists, look for air leaks on the suction pipe and check the foot valve & the fluid level. If the motor runs slow, check the connections.

The starting procedure is as follows:

- Prime the pump, opening the suction valve and closing the drains to prepare the pump for operation.
- Start the motor.
- Open the discharge valve slowly.

- Observe the leakage from the stuffing boxes. If the packing is new, do not tighten up on the gland immediately, but let the packing run in before reducing the leakage through the stuffing boxes.
- Check the general mechanical operation of the pump.

Do not allow the pump to run for long periods with discharge valve tightly closed.

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

- Pump does not deliver any water
- Pump does not deliver enough water
- Flow is getting down
- Discharge pressure is not enough
- Driver overloaded
- Vibration on pump
- High noise level
- Bearing overheating

6.4 Stopping Procedure

The stopping procedure is as follows:

- Close the discharge valve.
- If a non-return device is built into the discharge pipe, the valve can remain open provided there is a back pressure.

When switching off the pump the valve on the inlet pipe must not be closed.

- Stop the driver.
- If the pump is out of operation for long periods the valve on the inlet pipe is to be closed
- If the pump is out of operation for long periods and/or there is a risk of freezing, the pump is to be drained or protected against freezing.

6.5 Pump in Operation

The pump should always run quietly and free from vibrations and not be operated at temperatures higher than those given in the catalogue/data specification sheet.

The pump can be switched on and off in different ways, depending on the operating conditions and the degree of automation in system. The following is to be observed:

Start Procedure

- Ensure that the pump is completely full
- Ensure a continuous flow to the pump with a sufficiently large NPSH value.
- Avoid an overly weak back-pressure causing overload.
- To avoid an excessive temperature rise in motor and excessive strain on pump, coupling, motor and bearings, the set should not be turned on more than 10 times/hour.

Stop Procedure

- Avoid reverse operation of the pump
- Do not work for too long with overly small transport (volume of flow) capacities.

6.5.1 Dry Running:

Centrifugal pumps have close clearance leakage joints and cannot run dry at all, or in some cases for longer than a few seconds, without being seriously damaged.

6.5.2 Throttling at suction:

Throttling the suction of a centrifugal pump causes a reduction of the absolute pressure at the inlet to the impeller. This can be made to result in a reduction of capacity by forcing the pump to operate “in the break”, and reducing the delivered capacity by altering the shape of the head-capacity curve. Such operation is harmful to the pump. Pump efficiency is reduced when operated “in the break”, but most important, erosion and premature destruction is caused by cavitations induced when the suction is throttled.

Pump capacity can be reduced simply and safely by throttling the discharge. In this manner, artificial friction losses are induced by throttling, and a new system-head curve is obtained, which intersects the head-capacity curve at the desired flow.

Throttling at the suction is permissible only when the suction pressure exceeds the minimum requirements by a large margin, such as the case of the second pump in series unit. The effect, however, is not to reduce capacity by operation in the break, but rather by the reduction of the total net head generated by the series unit. This causes the head-capacity characteristics and the system-head curve to intersect at a lower rate of flow.

6.5.3 Restarting motor-driven pumps stopped by power failure:

If a check valve protects a pump against reverse flow after a power failure, there is generally no reason why the pump should not be restarted once current has been re-established. The type of motor control used will determine whether or not the pump will start again automatically once the power is restored. Starters are made with low-voltage protection, with low-voltage release, or without either. Starters with low-voltage protection will de-energies under low-voltage conditions, or following power failure, and the units they control must be restarted manually. Starters with low-voltage protection can only be used with momentary contact pilot devices and cannot be used with maintained-contact pilot devices, such as float switches, unless auxiliary relays are incorporated in the controls.

If the starter does not incorporate low-voltage protection, resumption of power will always cause the unit to start again automatically. Because pumps operating on a suction lift may lose their prime during the period when power is off, starters should be provided with low-load protection for such installations. This does not apply, of course, if the pumps are automatically primed, or if some protection device is incorporated so that the pump cannot run unless it is primed.

6.6 Running Checks

- The pump must run smoothly, quietly and free from vibration at all times.
- The pump must never run dry.
- Never run the pump for a long period against a closed discharge valve.
- The bearing temperature may exceed the ambient temperature by up to 50^0C. But must never rise above 80^0C.
- The valves in the auxiliary lines must remain open while the pump is running.

- If the pump has soft packing type stuffing boxes, these should drip during operation. The gland nuts should only be slightly tightened. In case of excessive leakage from the stuffing box, tighten the gland nuts slowly and evenly until the leakage is reduced to the dripping state. Check the stuffing box for overheating by hand. If the gland nuts cannot be tightened any further, remove the old packing rings and clean the packing chamber, insert the new packing rings. Make sure that each packing ring is cut at correct size. The joint in successive rings should offset to each other by 90^0.
- Check the noise level, it should not go beyond the **85dBA**.
- Vibration level is as per Hydraulic Institute of Standard. Please see the point no. 14 Annexure
- If the pump has a mechanical seal, it will experience only minor or no visible leakage during operation. If there is considerable leakage from the seal, that means the seal surfaces are worn out and it needs to be replaced. The life of the mechanical seal highly depends on the purity of the water.
- The flexible coupling elements should be regularly checked and replaced as soon as they show signs of wear.
- Stand-By pumps should be run for a short time at least once a week to ensure they are in constant readiness for operation. Check the integrity of auxiliary connections.

7. Maintenance

7.1 General information

- The operator is responsible for ensuring that inspection and assembly are carried out by authorized and qualified personnel who have studied the operating instructions closely.
- By drawing up a maintenance plan, costly repairs can be avoided with a minimum of maintenance expense and a fault-free pump operation obtained.

Before carrying out any maintenance work, switch off the pump and ensure that it cannot be switched on again by unauthorized people. Never carry out work on a running pump.

Depending on the operating condition of the pump and/or installation (fluid temperature) the entire pump can become very hot.

Avoid touching the pump owing to the risk of burning.

7.2 Daily Observation

Pump installations that are constantly attended should be inspected hourly and daily. A card record system is unnecessary for these inspections, but the operator should immediately report any irregularity in pump operation. A change in the sound of a running pump should be investigated immediately. Bearing temperatures should be observed hourly. An abrupt change in bearing temperature is much more indication of trouble than a constant high temperature.

Stuffing box operation should also be observed hourly. The stuffing box leakage should be checked to see whether it is sufficient to provide cooling and lubrication of the packing but not excessive and wasteful.

The pressure gauges and flow indicator, if these are installed, should also be checked hourly for proper operation. Recording instruments, if available, should be checked daily to ensure that the capacity output, pressure, or power consumption do not indicate that something needs attention.

7.3 Semi-annual Inspection

The stuffing box gland should be checked semi-annually for free movement. The gland bolts and nuts should be cleaned and oiled and inspected to see if the packing needs replacement.

The pump and driver alignment should be checked and corrected if necessary. Bearings should be checked to see if the correct amount of grease is provided and it is still of suitable consistency.

7.4 Annual Inspection

Centrifugal pumps should be very thoroughly inspected once a year. In addition to the semi-annual maintenance procedure, the bearings should be removed, cleaned and examined for flaws. The bearing housings should be carefully cleaned. Bearings should be examined for scratches and wear after cleaning. Immediately after inspection, bearings should be coated with oil or grease to prevent dirt or moisture from getting into them.

The packing should be removed and the shaft sleeves should be examined for wear. The coupling halves should be disconnected and alignment checked. Drains, sealing water piping, and other piping should be checked and flushed.

The pump stuffing boxes should be repacked and the coupling reconnected.

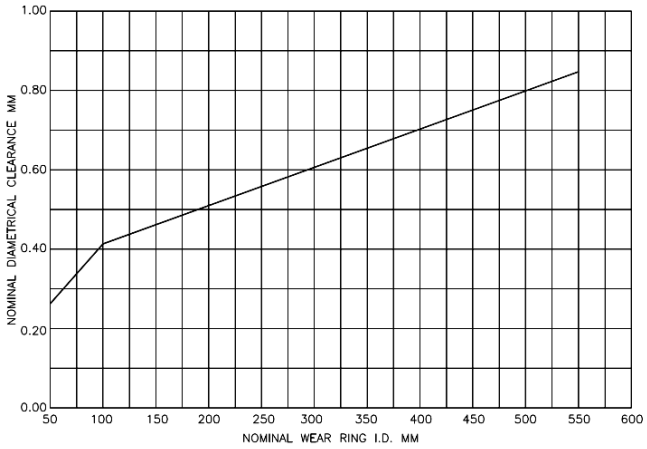
If instrument and metering devices are available, these should be recalibrated and a test made to determine whether proper performance is obtained. If internal repairs are made, the pump should again be tested after completion of the repairs.

7.5 Complete Overhaul

General rules cannot easily be made to determine the proper frequency and regularity of complete overhauls of centrifugal pumps. The type of service for which the pump is intended, the general construction of the pump, the liquid handled, the materials used, the average operating of the pump, and the evaluation of overhaul costs against possible power savings from renewed clearances, all enter into the decision on the frequency of complete overhauls. Some pumps on severe service may need a complete overhaul monthly, where as other applications only require overhaul every two to four years or even less frequently.

7.6 General Maintenance – Wear Rings

Wearing rings are fitted in the casing and back cover (casing wearing ring and back cover wear ring) and frequently on the impeller wearing rings. These wearing rings provide a close running clearance, to reduce the quantity of liquid leaking from the high-pressure side to the suction side. These rings depend on the liquid in the pump for lubrication. They will eventually wear so that the clearance becomes greater and more liquid passes into the suction. This rate of wear depends on the character of the liquid pumped. Figure below gives the nominal clearances between the wear rings. These clearances are good for dissimilar metals, which have a low tendency to gall. However wear rings, which are of the same material, must have more clearance than is recommended in figure below.



7.7 Shaft Seals

Pump with mechanical seal:

- The mechanical seal is mounted directly on the shaft. No adjustment is required after its assembly.
- The life of the mechanical seal is strictly dependent on the particles in the liquid, operating temperatures and dry running.
- When operating properly the mechanical seal has no visible leaks.
- The mechanical seal is maintenance free; its tightness is to be checked regularly.
- The slightest leak is a sign of the start of tightness problem caused by damage to the sliding surfaces, sealing rings, bellows, diaphragm or other components of the mechanical seal.

Pump with gland:

- A properly run-in and well-adjusted gland requires very little maintenance. If over time the leak becomes too big, the gland must be re-tightened.
- If the gland is tightened too far and cannot be re-tightened, it must be re-packed. It is recommended that the gland packing be replaced after two years' operation.
- Before packing the glands, the packing space and the shaft sleeve must be thoroughly cleaned.
- Place the first ring around the shaft and insert into the packing space. Offset each subsequent packing ring joint by 90^0 compared to the previous packing ring joint and insert into packing space individually.
- Bring gland forward and tighten nut by hand. After assembly the shaft must be able to easily turned by hand.
  The gland packing must drip slightly during operation

Routine maintenance			
Parts	**Action**	**Period**	**Remarks**
Mechanical Seal	Check for Leakage	Daily	
Gland Packing	Check for Leakage	Daily	10 to 120 drops/min
	Check for Leakage	Half yearly	If required replace with new packing's
Bearings	Check temperature	Weekly	
Oil / Grease @ Bearing	Replenish	1000 hours	
Discharge Pressure	Check Pressure	Daily	
Flushing	Check Flow	Weekly	Flow through the Flushing pipes must be clear and continuous
Vibration	Vibration	Weekly	
Voltage and Current	Check for the rated values	Weekly	
Rotating element	Check the rotating for wear	Yearly	
Clearances	Check the clearances between wear ring and impeller	Yearly	If value of clearance is more, wear ring should be replaced
Total Dynamic Head	Check Suction and Discharge head	Yearly	
Alignment	Check the alignment of pump with motor	Half yearly	For reference use pump motor GA Drawing

8. Dismantling / Reassembly

(Refer Fig. No. 12, 13; Pg. Nos. 09, 10)

Most pump designers and specialists consider that a centrifugal pump need not be opened for inspection unless either factual or circumstantial evidence indicates that overhaul is necessary.

The following rules must be followed when dismantling the pump:

- Disassembly and re-assembly must be done by skilled personnel.
- List the order of the dismantling of the parts.
- Parts with pressure-tight faces must be handled with the greatest care.
- If it is difficult to remove parts from the shaft, employ the usual penetrating oils or releasing fluids. If this is not enough, heat the jammed parts, beginning at the outside to prevent overheating the shaft more than necessary.
- Repeat the operation several times if necessary, but never use enough force to risk distorting the shaft and never use a hammer or other impact tools.
- The O-ring between the pump casing and back cover must be replaced.
- The reassembly of the pump is carried out in the reverse order of the disassembly.
- Pay attention when fixing the screws for casing/cover and cover/bearing housing.

8.1 Pump Dismantling

Before starting work on the pump set, make sure it is disconnected from the mains and cannot be switched on accidentally.

Centrifugal pumps should be dismantled with great care. These pumps can be dismantled without disturbing the suction and discharge piping. The following procedure should be followed for dismantling of the pumps:

- Close all valves in the suction and discharge lines and drain the pump by opening the drain plug and the air vent screw.
- Disconnect the stuffing boxes flushing pipes.
- Remove coupling guard and other safety guard.
- Remove the coupling and coupling spacer
- Remove support foot hold down bolts and nuts.
- Unscrew and remove all the casing bolts. The back pull-out assembly then can be jacked out straight to prevent damage to internal parts.
- The back pull-out assembly to be carried to a safe working place. This assembly should be removed vertically to prevent damage to the impellers, wear rings and other parts.
- Unfasten the gland-fitting nut and remove the gland with packing and logging ring.
- Impeller with back cover can be drawing off after removing impeller nut.
- Remove bearing cap from bearing housing and unscrew the bearing lock nut and lock washer from shaft, then pull out the shaft with bearing at power end.
- Clean all parts, replace damaged or worn out ones.
- Where coupling without spacer is fitted, it will be necessary to move driving unit away from the pump before these operations.

During dismantling, the various parts removed must be marked to ensure proper reassembly.

8.2 Pump Reassembly

Reassemble the pump by reversing the dismantling procedure as shown in figure. Check the freeness of the rotor by turning the pump with hand.

As soon as all work is finished, all scheduled safety and protective devices must be properly fitted and put into operation.

9. Pump Sealing

9.1 Stuffing Box Packing:

Stuffing box packing troubles are one of the commonest causes of centrifugal pump failure. The conditions that contribute to stuffing box difficulties are:

- Shaft running off centre because of excessive wear in the bearings, a bent shaft, or misalignment. This condition can be readily checked – first by disconnecting the coupling and rechecking the alignment, and secondly by mounting an indicator on the pump casing in the vicinity of the stuffing box to determine whether the shaft revolves concentrically.

- Shaft or shaft sleeves worn and scored at the packing. A routine examination of these parts will reveal whether they must be renewed or repaired.

- Shaft vibration due to unbalance in the rotor, cavitation, operation at extremely light flows or beyond the recommended maximum capacity, or instability in parallel operation.

- Plugging of the water seal connection or improper location of the seal so that no sealing liquid can enter the stuffing box. The presence of dirt or grit in the sealing liquid will similarly cause stuffing box difficulties by scoring the shaft or shaft sleeves.

- Excessive tightening of the gland with resulting absence of the leakage that lubricates the packing. Hourly and daily observation of the pump operation, together with the knowledge that some leakage is necessary for proper stuffing box operation, will prevent troubles from this cause.

- Failure to provide suitable cooling through water-cooled stuffing boxes if the pump is so fitted.

- Excessive clearance between the bottoms of the stuffing box and the shaft or shaft sleeve, which causes the packing to be gradually pushed into the pump interior. This condition can arise when the shaft or shaft sleeves are repaired by grinding them down excessively instead of replacing them or building them up to original dimensions.

- Packing not properly selected for pressure, temperature, or rubbing speed conditions.

- Packing not properly inserted into the stuffing box because the individual rings are too short and the gap between ring ends is excessive, or because the ring joints are not staggered.

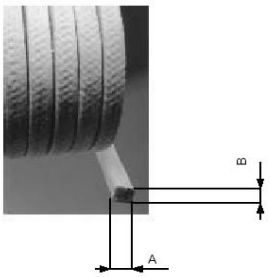
9.2 Installing Gland Packing:

- Loosen and remove the gland from the stuffing box.
- Using a packing puller, begin to remove the old packing rings.
- Remove the split lantern ring and then continue removing packing with the puller.
- After the packing has been removed, check the sleeve for scoring and nicks. If the shaft sleeve or shaft cannot be cleaned up, it must be replaced. For the size of packing please refer to the pump data sheets.
- Wrap the packing tightly around a mandrel, which should be the same size as the pump shaft or sleeve. The number of coils should be sufficient to fill the stuffing box. Cut the packing along one side to form individual rings.
- Assemble the split packing rings on the pump. Each ring should be seated individually, with the split ends staggered 90^0 and the gland tightened to seat and fully compressed the ring. Be sure the lantern ring is reinstalled correctly at the flush connection. Then back off the gland and retighten only finger-tight.
- Allow excess leakage during break-in to avoid the possibility of rapid expansion of the packing, which could score the shaft sleeve or shaft so that leakage could not be controlled.
- Leakage should be generous upon start-up. If the packing begins to overheat at start-up, stop the pump and loosen the packing until leakage is obtained. Restart only if the packing is leaking.

Leakage to Prevent Burning and Sleeve Scoring:

Pressure, lb/in^2 (kPa)	Leakage, drops/min	(cc/min)
0-60 (0-400)	60	4
61-100 (401-700)		190
101-250 (701-1700)		470

Dimensions for Gland Packing



SHAFT GROUP	A	B
1	12	12
2	16	16

9.3 Mechanical Seals

Pumps handling hazardous or expensive liquids, or liquids where the necessary leakage from a packed gland is unacceptable, are often furnished with mechanical seals.

Mechanical seals are made in a wide variety of designs to suit particular applications, The manufacturer's instructions for fitting or replacing the specific seal type used must, therefore, be followed exactly. A mechanical seal is a precision device and must be treated accordingly.

When the pump is equipped with mechanical seal, no attention or adjustment to the seal is normally required. Except for possible slight initial leakage, the seal should operate with negligible attention.

10. Recommended Lubricants

For oil Lubrication:

- We recommend that a colloidal graphite lubricant, e.g. Oil Dag (Achesons) be added by an amount corresponding to 1 ½% to 2% by volume of lubricating oil as shown in the schedule.
- ISO Grade 46 oil (is Viscosity at 40 degree centigrade in centistokes)
- All oils are compatible with each other when fresh.
- It is unsafe to mix oil of two or more grades for use in bearings.

For Grease Lubrication:

- Only lithium base Grease to be used.
- Numbers mentioned stands for consistency.
- Grease of two different grades should not be used.

Grease :

Sr. No.	Manufacturer	Grease Grade
1	Atlantic Refining Co.	Atlantic Lubricant 54
2	Cities Service Oil Co.	Trojan Grease H-2
3	Continental Oil Co.	Conoco Super Lube
4	Gulf Oil Corp.	Gulf Supreme Grease No.2
5	Mobile Oil Co.	Mobilux Grease No.2
6	Pennzoil Co.	Pennzoil 705 HDW
7	Phillips Petroleum Co.	Philube Multi-Purpose L-2
8	Quaker State Oil Refining Corp.	Quaker State Multi-Purpose Lubricant
9	Shell Oil Co. Inc.	Shell Alvania Grease 2
10	Sinclair Refining Co.	Litholine MP Grease
11	Standard Oil Co. Of California.	Chevron Industrial Grease Med.
12	Sun Oil Co.	Sun72 XMP Grease or Prestige 42
13	Texaco, Inc.	Texaco Novatex Grease No.2

NOTE: Do not mix greases while the pump is in operation. Should it be necessary to change make of grease used, bearings and housings.

Oil :

Sr. No.	Manufacturer	Oil Grade
1	American Oil Co.	American Industrial Oil No.15
2	Atlantic Refining Co.	Atlantic Hytherm Oil – C
3	Cities Service Oil Co.	Pacemaker Oil No.1
4	Continental Oil Co.	Conoco Dectol 15 R & O
5	Gulf Oil Corporation	Gulf Harmony 44
6	Mobile Oil Co.	Mobil DTE Oil Light
7	Pennzoil Co.	Pennbell SFI 8
8	Phillips Petroleum Co.	Magnus Oil, Grade Light
9	Quaker State Oil Refining Corp.	Quaker State Motor Oil SAE 10W
10	Richfield Oil Corporation	Eagle Oil R & O, No.10
11	Shell Oil Co., Inc.	Shell Tellus Oil Grade 27
12	Texaco , Inc.	Texaco Regal Oil A (R&O)

11. Recommended Spare Parts

The minimum stock of spare parts for any centrifugal pump should include the following:

For Gland Packing Unit

- set of wear rings,
- shaft sleeve
- set of gland packing
- set of bearings
- lantern ring
- gland

For Mechanical Seal Unit

- set of wear rings,
- mechanical seal
- set of bearing

It is often advisable to carry a complete spare rotating assembly for installation in the pump when examination shows

that the pump rotating assembly has become excessively worn, or if it becomes accidentally damaged. Sufficient stock of spare gland packing for the stuffing boxes and split flange gasket should always be in stock.

For ordering spare parts please provide the pump model and pump serial number as stamped on the nameplate.

12. Decommissioning and recycling

The disposal of all material or debris must be done in order to protect the environment.

WILO Mather and Platt pumps do not contain any hazardous substances. The major part of the pump is recyclable. The disposal and recycling of the pump sets must be done in accordance with the local in force regulations.

The dismounting must be done by qualified personnel with appropriate tooling. It is recommended to ensure clean & dust free, liquid free working area before any transportation or recycling.

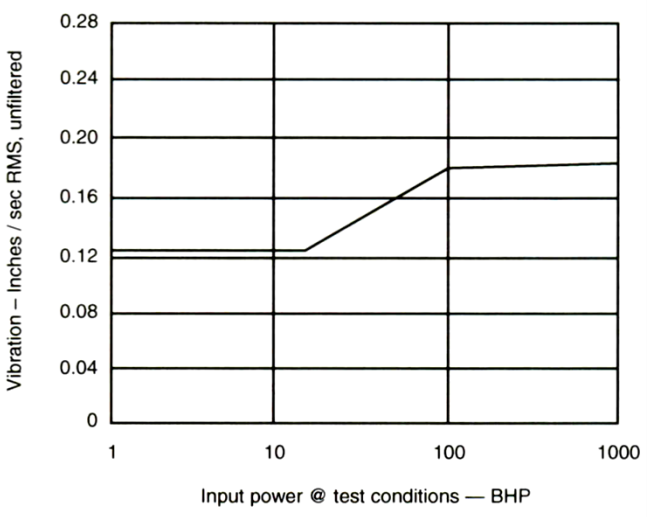
13. Faults, Causes and Remedies

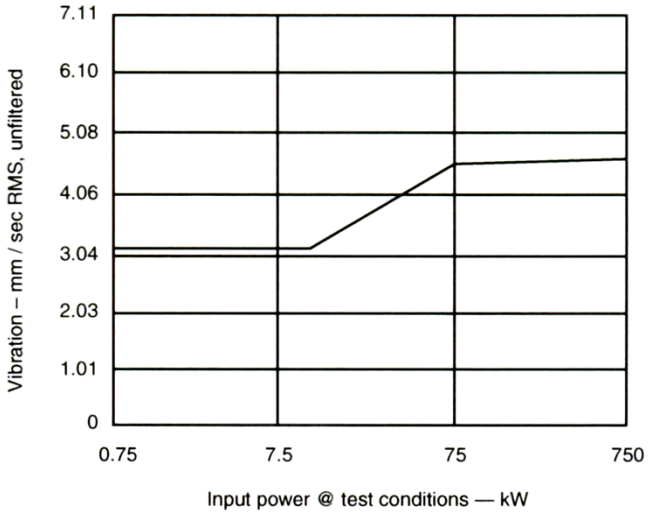
	Symptoms	Possible cause of trouble and remedies (Each number is defined in the table below)
– –	Output too low	1,2,3,4,5
– –	Pump does not prime or only intermittently	6,7,8
– –	Pump leaks	9,10
– –	Temperature of the pump increases	7,11,13
– –	Noisy pump	10,11,14,15
– –	The motor contactor trips	8,10,16,17

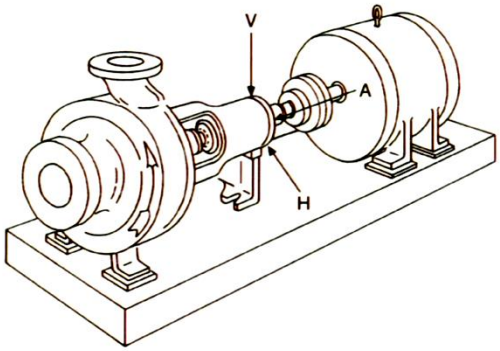
	Causes	Remedies
1	Back pressure too high	Regulate a new the operating point
2	Pump or pipe work ,not completely filled	Vent and fill the pump as well as the suction or in flow line
3	Suction lift too high or positive suction head too low	Check the liquid level; open the shut off valves on the suction side. Clean the filters / strainers
4	Impeller sealing gap too large	Replace worn parts
5	Wrong direction of rotation	Change the motor connection
6	Pump casing ,shaft seal, foot valve or suction line leaks	Replace the casing seal. Check the shaft seal. Check the flange connections
7	Suction lift too high or positive suction head too low	Check the liquid level; open the shut off valves on the suction side. Clean the filters on the suction side
8	Loose or jammed parts in the pump	Open and clean the pump
9	Casing bolts not correctly tightened	Check the tightening torque of the casing bolts
10	Mechanical seal leaks	Check the seal surfaces and rubber material of the mechanical seal. In case of damages exchange mechanical seal
11	Pump or pipe work not completely filled	Vent and fill the pump as well as the suction line or in flow line
12	Pump is running against closed valve	Open the shut off valve on discharge side
13	Pump or pipe work not completely filled	Purge of air the pump and the pipe work
14	Pump is not properly leveled or is distorted	Check the pump leveling and alignment
15	Foreign material in the pump	Dismantle and clean the pump
16	Earth fault	Check the earth connection. Check the potential causes such as damaged wirings or cables, leakages on electrical parts
17	Operating conditions outside of performance range of pump	Refer to pump operating conditions stated in technical data

14. Annexure

- **Allowable pump vibrations as per HIS 9.6.4.4**







9.6.4.4 — End suction foot mounted–ANSI B73.1, B73.3, B73.5

- **Recommended Tightening Torques for fasteners in Nm**

Thread Size	Material Class 8.8	Material Class 10.9
M4	3	4.3
M5	6	8.9
M6	10.3	15.1
M8	25	37
M10	50	74
M12	67	128
M14	139	205
M16	214	316

Thread Size	Material Class 8.8	Material Class 10.9
M20	431	615
M22	586	835
M24	745	1060
M27	1090	1560
M30	1480	2105
M33	2013	2865
M36	2586	3680
M39	3348	4760

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