Fire-Fighter System Pumps

ENM SERIES

OPERATING MANUAL

Mas Grup

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EC DECLARATION OF CONFORMITY

AT UYGUNLUK BEYANI

Manufacturer / *İmalatçı* **: MAS DAF MAKİNA SANAYİ A.Ş.**

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Name and address of the person authorized to compile the technical file
Teknik Dosyayı Derleyen Yetkili Kişi ve Adresi
Vahdettin YIRTMAÇ
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Tuzla - İSTANBUL / TÜRKİYE

The undersigned Company certifies under its sole responsibility that the item of equipment specified below satisfies the requirements of the mainly Machinery Directive 2006/42/EC which is apply to it.
The item of equipment identified below has been subject to internal manufacturing checks with monitoring of the final assessment by **MAS DAF MAKİNA SANAYİ A.Ş.**
Aşağıda tanımlanmış olan ürünler için Makine Emniyeti yönetmeliği 2006 / 42 / AT' nin uygulanabilen gerekliliklerinin yerine getirildiğini ve sorumluluğun alınmış olunduğunu beyan ederiz.
Aşağıda tanımlanan ürünler iç üretim kontrollerine bağlı olarak **MAS DAF MAKİNA SANAYİ A.Ş.** *tarafından kontrol edilmiştir.*

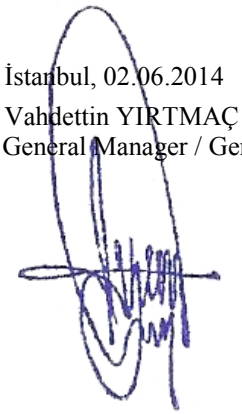
Equipment / *Ürün* : Tek Kademeli, Uçtan Emişli Salyangoz Tip Pompalar
Single Stage, End Suction Volute Type Pumps
Seri / *Model-Tip* : ENM Serisi / *ENM Series*

For pumps supplied with drivers/ *Elektrikli Pompa Üniteleri* **Related Directives /** *Yönetmelikler*
2006/42/EC Machinery Directive **/ 2006/42/AT** *Makine Emniyeti Yönetmeliği*
2014/35/EU Low Voltage Directive **/ 2014/35/AB** *Alçak Gerilim Yönetmeliği*
2014/30/EU Electromagnetic Compatibility Directive **/ 2014/30/AB** *Elektromanyetik Uyumluluk Yönetmeliği*
EUP 2009/ 125 /EC Electric Used Products Directive/ *Elektrik Kullanan Ekipmanlar Direktifi (EUP)*

Regulations applied acc. to harmonize standards / *Uygulanan Uyumlaştırılmış Standartlar*
TS EN ISO 12100:2010, TS EN 809+A1, TS EN 60204-1:2011.

We hereby declare that this equipment is intended to be incorporated into, or assembled with other machinery to constitute relevant machinery to comply with essential health and safety requirements of Directive The machinery covered by this declaration must not be put into service until the relevant machinery into which it is to be incorporated has been declared in conformity with provisions of the directive.
Ekipman, uygun bir makina oluşturmak amacıyla diğer ekipmanlar ile birleştirilirken ya da monte edilirken gerekli sağlık ve güvenlik yönetmeliklerine uyulması gerekmektedir.
Bu bildiri kapsamında yönetmelikte belirtilen bütün hükümler yerine getirilmeden makinanın devreye alınmaması gerekmektedir.

Place and date of issue / Yer ve Tarih **:** İstanbul, 02.06.2014
Name and position of authorized person **:** Vahdettin YIRTMAÇ
Yetkili Kişinin Adı ve Görevi General Manager / Genel Müdür
Signature of authorized person **:**
Yetkili Kişinin İmzası



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INTRODUCTION


- This manual contains instructions for the installation, operation and maintenance of the ENM series single stage, end suction volute type pumps of **MAS DAF MAKINA SANAYI A.Ş.**
- Please read carefully this manual and apply all the instructions to operate pumps without problems. Pumps shall be used for their intended duties. In this manual, there are information on operating conditions, installation, starting-up, settings and main controls of pumps.
- These operating and maintenance instructions contain **MAS DAF MAKINA SANAYI A.Ş**.`s suggestions. The special operating and maintenance information of the plumbing that a pump is fitted to is not considered in these instructions. This information must be given by the plumbing constructors only.
- **Please refer to instructions of plumbing constructors.**
- Please pay attention to the warnings in this manual and ensure that it is read before the installation-start up process. **MAS DAF MAKINA SANAYI A.Ş.** is not responsible for the accidents resulting from negligence.
- If you cannot find an answer to your questions in this manual, it is suggested that you contact **MAS DAF MAKINA SANAYI A.Ş.** Please inform us about the rated value and especially the serial number of the pump when you get in contact for help.
- The safety instructions in this manual cover the current national accident protection regulations. Beside all of these, an operation, work and safety measure imposed by the costumer has to be applied.

The Signs Used in This Operation Manual


Read the instructions carefully in this operating manual and keep it for your future reference.

Warning sign against the electrical risks

Sign for the operator's safety.

1. IMPORTANT SAFETY PRECAUTIONS

In order to minimize the accidents during the mounting and putting into service of the pump, the following rules have to be applied:

1. Do not work without taking safety measures relevant to equipment. Cable, mask and safety band must be used when necessary.
2. Be sure there is adequate amount of oxygen and there is no toxic gaseous around
3. Before using welding or any electrical equipment make sure that there is no risk of explosion.
4. Check the cleanliness of the area to take care of your help. (Dust , smoke, etc.)
5. Do keep in mind that there is a risk of having accidents related to electricity
6. Do not lift the pump before you check the transport equipment.
7. Be sure you have a by-pass line
8. Use helmet, eye glasses and protective shoes for your safety
9. Place a protective barrier around the pump within the necessary safety area
10. Dust, liquids and gaseous that may cause overheating, short circuit, corrosion and fire must be kept away from the pump unit.
11. By checking the noise level of the pump unit , necessary measures to avoid noisy operation of the pump that can have harmful effects on the personnel and environment.
12. Be careful about the direction of transport and storage.
13. Cover appropriately the moving parts to avoid possible injury of the personnel. Mount the coupling guard and belting before starting-up the pump
14. All the electrical and electronic applications must be performed by authorized person conforming EN60204-1 and /or domestic instructions.
15. Protect the electrical equipment and motor against overloading
16. If flammable and explosive liquids are pumped, ground connection of electricity should be carried out properly
17. Do not expose the pump unit to sudden temperature variations
18. All personnel who work with the waste water system need to be vaccinated in case of contagious diseases.
19. If the pump contains hazardous liquids, one must use protective helmet against the risk of splatter. One also must accumulate the liquid in a proper container against any risk of leakage.

All Other Health and Safety Rules, Laws and Regulations Must Be Applied

2. GENERAL

2.1. Definition of Pump and Usage Areas

ENM series pumps are single stage, end suction volute type pumps. They are used in

- Water networks and pressurization facilities
- Industrial and social facilities
- Fire boat
- Ships
- Large fire extinguishing systems

Thin, clean, non-aggressive and non-explosive liquids free from large solid particles or fibres.

CAUTION

Please contact MAS DAF MAKINA SANAYI A.Ş. for liquids that have different chemical and physical specifications.

Technical specifications of ENM type pumps

Suction Flange:	DN 300-DN 500
Discharge Flange:	DN 250-DN 400
Operating Pressure:	10 bar.
Capacity:	400-4000m^3/h
Hm:	60-150m.
Speed:	1500-1800 RPM

Figure 1: Pump Label

2.2. Performance Information

Actual performance of the pump can be obtained from the order page and/or from the test report. This information is given on the pump label.
The performance curves given in the catalog are valid for water whose density and viscosity are ρ=1 kg/dm^3 and v=1 cst. respectively. For those liquids whose densities and viscosities are different from those of water, please consult with **MAS DAF MAKINA SANAYI A.Ş.** since the performance curves vary with density and viscosity

CAUTION

Do not operate the pump with a motor that has a different power except for the given catalog and label values.

The pump is not to be operated at off-design point given in the order and supplied from the firm.
It is necessary to ensure that the instructions are obeyed for the safe running of the pump.

2.3. Warranty Conditions

The entire products in our selling program are warranted by **MAS DAF MAKINA SANAYİ A.Ş.**

The warranty conditions will only be valid when all the instructions about installation and start-up operations of the pump unit are taken into account.

2.4. Test

All Pumps are dispatched for sale when all the performance and pressure tests are completed. Proper assurance of material and fault-free operation of pumps whose performance tests are made is under the warrantyof **MAS DAF MAKINA SANAYI A.Ş.**

2.5. Pressure Limit

Pressure at the discharge flange must not exceed 10 Bar. A special order is necessary for applications with higher pressures.

3. SAFE OPERATING CONDITIONS

This manual contains main safety instructions for the installation, operation and maintenance. It must be read by the personnel who are responsible for installation and operation. This manual should always be kept near the installation location. It is important to comply with safety precautions stated in page 1 along with the general safety instructions as well as preventive measures repeated in other sections of this manual.

3.1. Training of Personnel

Installation, operation and maintenance personnel must have necessary knowledge in order to accomplish the given job. The responsibility, adequacies and controlling duties of such personnel must be determined by the costumer. It has to be certain that these personnel comprehend totally the content of the operating manual.
If the personnel do not have enough knowledge, required training must be given by the costumer. If training support is needed by the costumer, it will be provided by the manufacturer/seller.

CAUTION

Untrained personnel and unwillingness to comply with safety instructions may be risky for both machine and environment. **MAS DAF MAKINA SANAYI A.Ş.** is not responsible for this kind of damages.

3.2. Hazardous Conditions That May Occur When One does not Comply With the Safety Instructions

Incompliance with safety regulations may put the personnel, the environment and the machine in danger and thus may cause damages. Incompliance with safety regulations may give rise to situations listed below.

Important operational functions of the factory may stop.
Maintenance may get difficult.
One may get injured by electrical, mechanical or chemical hazards.

3.3. Safety Measures for Operator

Dangerous, hot or cold components in the pump area must be covered so that one cannot touch them.
Moving components of the pump (such as coupling) must be covered so that one cannot touch them. Those covers must not be dismounted while the pump is running. Dangers that results from electrical connections must be removed. To get more information about this subject, you can refer to domestic electrical instructions.

3.4. Safety Measures for Maintenance and Installation

The costumer must assure that all maintenance, check and installment tasks are performed by qualified personnel. Repair work must only be performed while the machine is not running.
The pump and its auxiliary system must be cleaned thoroughly if it contains hazardous liquids. At the end of the repair work, all safety and protective equipment must be re-installed.

3.5. Spare Parts Replacement

Replacement of spare parts and all modifications must be done after contacting with the manufacturer. Spare parts and accessories certified by the manufacturer are important for the safe operation of the system.

Notice: MAS DAF MAKINA SANAYI A.Ş. is not responsible from the usage of improper spare parts.

4. TECHNICAL INFORMATION

4.1. Design

Horizontal type, single stage, single entry, horizontal volute type pumps with a horizontal suction flange and the discharge flange on the top.

ENM pump impellers are of double incline type. The impellers are dynamically balanced to the base. The axial thrust is compensated by rear back wear rings and balance holes.

Pump and engine are separate components, connected to each other via a coupling and mounted on a common base plate.
There are 4 type of ENM pumps which are ENM 250-550, ENM 300-550, ENM 350-550, ENM 400- 550.

The construction is compact thanks to the short distance between the bend-resistant shaft and bearing and the volute. This feature allows it to be used in space-restricted (eg. Marine Fire Brigade).

4.1.1. Volute Casing

The axis of suction opening is horizontal while the axis of discharge opening is vertical and the pumps have volute type casings.

4.1.2. Locations of Flange – Flanges

Suction Flange:	DN 300-DN 500
Discharge Flange	DN 250-DN 400

4.1.3. Auxiliary Fittings

Please refer to the technical drawing of the pump for necessary auxiliary fittings.

4.1.4. Impeller

The impellers of NM type pumps are (full) radial types. The impellers are balanced dynamically in an electronic balance machine. The thrust (axial force) is balanced with the back wear ring and balance holes.

4.1.5. Shaft

The pumps are provided with the rigid shaft capable of supporting different loading conditions. Since the shaft diameter is highly resistant to bending and the distance between the bearing and the sealing is short, pump can operate at optimal conditions for the sealing.

4.1.6. Bearing and Lubrication

Two types of bearings are used in ENM design which are ball bearing and sleeve bearing. The ball bearing is mounted to the motor side and the sleeve bearing is mounted other side.

4.1.7. Seals

The standard shaft seal arrangement is soft gland packing rings lubricated and cooled by the pump water.

5. TRANSPORT AND STORAGE

Suction, discharge and all auxiliary fittings must be closed during transport and storage. Dead-end covers must be removed while the pump unit is being installed.

5.1. Transport

Pump and pump group must be carried safely to the installation location by lifting equipments.

CAUTION

Current general lifting safety instructions must be applied. Please use a suspension system shown in figure while you are carrying and lifting the pump unit. The suspension rings may be broken because of the excessive load and may result in a damage of the pump. Prefer fabric cable for suspension.

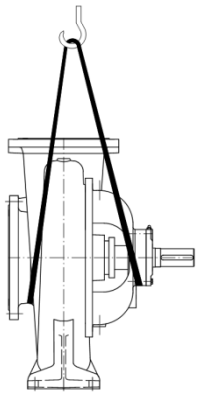


Figure 2: Transport of Pump Group

Incorrect lifting may damage the pump unit and cause injuries.

Damages caused in transport

Check the pump when it is delivered to you. Please let us know of there is any damage.

5.2. Storage

Please keep the unit clean and dry area during storage.

If the pump is out of use for a long time, please consider the instructions below.

1. If there is water inside the pump, drain it.
2. Clean the pump casing and impeller by jetting clean water for a short time.
3. Empty water inside the pump casing, suction line and discharge line.
4. Add small amount of antifreeze inside the pump casing if it is not possible to empty it completely. Rotate the pump shaft by hand to mix the antifreeze.
5. Close the suction and discharge exits with gasket
6. Spray an anti-corrosive into the pump casing.
7. Rotate the pump shaft by hand once in every month, in order to protect it from freezing and to lubricate the bearings.

6. ASSEMBLY / INSTALLATION

6.1. Installation

In our standard production, the pump and the motor have been installed in a common base plate.

6.1.1. Location of Installation

Pump shall be installed in a location where the control and the maintenance of the pump are easily made. The pump room shall be suitable for operation of lifting systems such as freight elevator, forklift, etc.

The pump group should be installed in the lowest possible location of the pumping system in order to achieve the highest suction pressure.

6.1.2. Location of Installation- Local Ambient Temperature

When the local ambient room temperature exceeds +40°C in a pumping system, suitable ventilation should be provided in order to remove the heat dissipated to the environment and supply fresh air.

6.2. Type of Connection

Type of connection depends on the design type and the size of the pump and the motor, as well as the local installation conditions. Foot-mounted horizontal pump-motor units have been installed in a common base plate.

6.3. Foundation

6.3.1. General

Base plate of the pump must be grouted. The foundation shall be of concrete or steel framework.

NOTICE: The foundation shall distribute the weight of the pumping group evenly.

6.3.2. Main Properties of the Steel Framework Bases

Foundations with steel framework shall be designed in such a way that the base plate is bolted or welded contacting to all area.

CAUTION

If base plate is supported from only four points, pump group will stay in the middle, causing misalignment of the coupling and increasing the noise level.

6.4. Coupling Alignment

6.4.1. General

For a proper operation of a pump group, a good alignment of the coupling is necessary. Vibration, noise, overheating of the bearings, overcharge problems can be attributed to the misalignment of coupling or using an improper coupling.

Flexible coupling does not correct the axial misalignments between the pump and the motor axes. However, it allows pinpointing the misalignments.
In order to avoid overheating, vibration, noise and wearing of the rolling bearings, alignment of the coupling has to be made properly and checked often.
Do not use a different coupling other than the original type installed on pumping group.

6.4.2. Method of Coupling Alignment

In order to make the alignment of the coupling, it is required to have at least two pieces of about 10 cm tall, smooth-edged metal parts (e.g. a steel ruler or a gauge stick) and one precision calipers. (Figure 4) (For more precision alignments, special apparatus can be used).
Coupling misalignments in general are of two kinds:

1. Paralel Axis Misalignment (Figure 4-Figure 6)
In order to control parallel axis misalignment, a smooth edged gauge stick is pressed axially over the upper half of the coupling. Then, the gauge stick is checked for the other half of the coupling. For alignment, the gauge stick shall be in contact with both of the halves at the same time. This procedure shall be repeated for four sides of the coupling. (i.e. top, bottom, left and right sides of the coupling). When all four sides give reasonably accepted results, alignment of the coupling has been ensured.

2. Angular Misalignment (Figure 5-Figure 7)
In order to control the angular misalignment, the distance between the two halves of the coupling is measured in both horizontal and vertical planes. Measurements taken at four points shall be in agreement for the alignment.

Misalignments can be in horizontal or vertical planes. Misalignments in horizontal plane can be fixed by placing sheet iron at the bottom of the pump or motor base, while misalignments in vertical plane can be fixed by sliding the pump or the motor in horizontal plane.

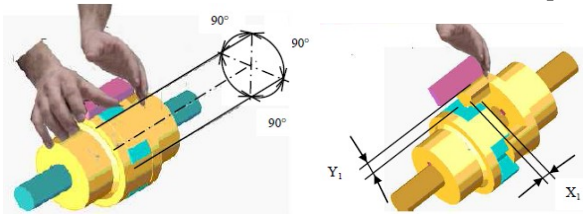


Figure 3: The Control of the Coupling Alignment in Horizontal and Vertical Planes

Figures below illustrate the possible coupling misalignments and the methods to correct them.

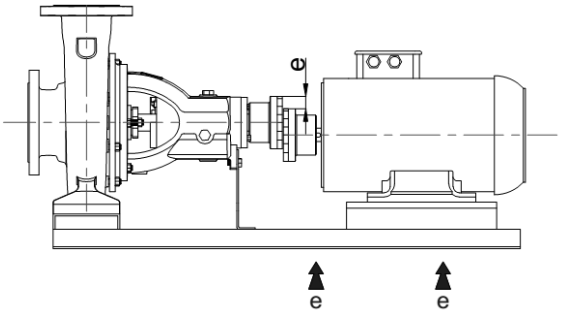


Figure 4: Paralel Axis Misalignment in Vertical Plane and Its Correction

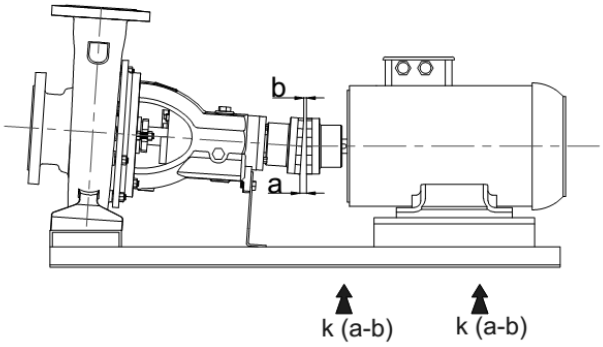


Figure 5: Angular Misalignment in Vertical Plane and Its Correction

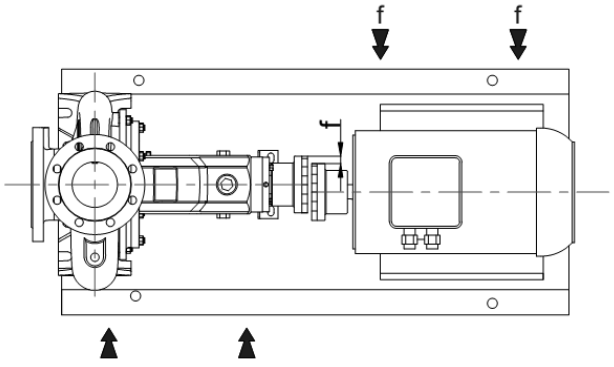


Figure 6: Parallel Axis Misalignment in Horizontal Plane and Its Correction

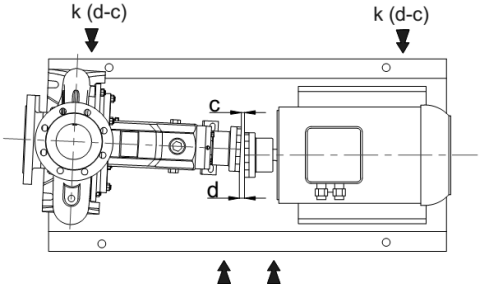


Figure 7: Angular Misalignment in Horizontal Plane and Its Correction

Install the coupling guard only when the alignment of the coupling is checked.

6.4.3. Pump and Motor Mounting (Coupling)

If the coupling of the pump group is to be mounted on site, the following procedure should be followed.

1. Coat the shaft tip of the pump and the motor sides with a sheet of molybdenum disulfide.
2. Push the coupling halves with a driving apparatus towards the pump and the motor shafts, until the shaft is fit to snag to the hub of the coupling. If a driving apparatus is not available, heating coupling halves (with coupling rubbers off) to an approximately 100 °C may help the pushing. It is important that axial force is prevented from occurring while mounting the coupling. Support pump shaft from the impeller side, and motor shaft from the fan side while mounting the coupling. If necessary, dismantle the fan cover.
3. Screw the two bolts in coupling hub.
4. Make sure that a suitable spacing is left between the coupling halves while mounting pump and the rotor.
5. Horizontal pump groups mounted on the base plate or directly mounted on the base, alignment of the coupling shall be as described in 6.4.2.
6. Put into place the coupling guard.

According to the accident prevention regulations, all preventions and protective devices should be in their intended place and in operational form.

6.5. Piping

6.5.1. General

- Do not use the pump as the hinged support for the piping system.
- Put enough supports under the piping system in order to carry the weight of the pipe and fittings.
- Avoid piping system loads on pump by installing flexible components (compensator) to suction and discharge of the pump.
- By mounting flexible supporting items, take into consideration the fact that these items may elongate under the pressure.
- Suction pipe shall be in a constantly increasing slope to the pump. Air in the suction pipe shall be arranged to move into the pump
- Discharge piping shall be in a constantly increasing slope to the reservoir or discharge point, without up and downs which can cause air pockets in the piping system. At locations where forming of air pockets is possible, special items like air valve and air cock are mounted to evacuate the trapped air.
- It is important that pipe diameter and fittings are at least as much as the pump opening diameter or preferable one or two size higher. One should never use fittings with smaller diameters than the pump exit diameter. In particular, preferred fittings like foot valve, strainer, filter, check valves and valves shall have large free passing area, and low friction loss coefficient.
- For piping systems with hot liquids, thermal expansions are to be taken into account and compensators shall be mounted in accordance with these expansions. Caution shall be exercised to avoid the loading of pump in this installation.

6.5.2. Specification of Work in Piping Installation

In installation of pipes, follow the procedures below certainly.

- Install the pump on the concrete base as illustrated in Figure 3.
- Take out the guards (placed by the manufacturer) from suction and discharge openings of the pump.
- Close the suction and discharge flanges with rubber gaskets. This precaution is important to avoid the undesired substances (weld crust, weld slag, sand, stone, wood piece etc.) get into the pump. Do not take off this gasket until the installation is completed.
- Start the installation of piping from the pump side. Do the necessary assembling and welding of the parts in a successive order.
- In these operations, do not neglect to put the necessary supports in their respected locations.
- Following above procedure, complete all piping system at suction side up to the suction tank (or foot valve if available), at discharge side up to do discharge collector and discharge pipe.
- When all installation and welding process is done and the heat dissipated by welding is removed, dismantle all the bolted connections from the suction tank to discharge pipe. Take out all demountable parts.
- Clean these parts and then paint body coat completely inside and outside.
- Mount the parts again in their intended places. However, this time start from the discharge line and move downward to the pump. In this instance, do not forget to check the flange gaskets. If needed, (for example deformation during welding) replace them.
- Concerning the connection of the pump flanges to piping, in case of misalignment of axis and flange holes, do not force the system to eliminate the misalignment. Forcing the system may cause difficult-to-correct problems.
- If there is an axial misalignment between the flanges of the pump and the pipe, due to the welding or any other reasons, cut the pipe from a suitable location in order to fix the problem. Connect the pipe (pump side) to the pump. After carrying out the necessary correction, connect the parts again by welding..
- Dismantle and clean the last welded part. Repaint again and mount on its place.
- After all these processes are accomplished, remove the rubber gasket from the suction and discharge openings. Open their holes and mount them again on their intended place.

6.5.3. Specification of Work after Installation of Piping and Piping System

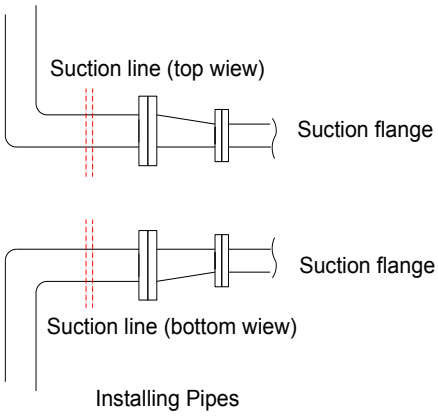


Figure 8: Piping System

An illustrative piping system is shown in Figure 20. Appropriate manometers shall be mounted on suction and discharge pipe lines.

Complete the auxiliary pipe connections in piping system if exist (cooling to bearing housing, and stuffing box (seal), relief pipe, oil pipe etc.)

7. COMMISSIONING, START UP AND OPERATING

7.1. Preparations Before Start Up

OIL CHECK: ENM type pumps are provided with self-greased rolling bearings requiring no servicing in life long. Therefore, it is not necessary to check the oil.

- Check pump seals
- Make sure that the pump and the suction pipe is completely filled with water before the starting. If the pump operates on a positive suction head, no problem will be encountered. Suction valve is opened and air drains are un-tightened.
- Pumps with foot valve are filled with water by opening the pump filling tap or, one takes advantage of the water accumulated in the discharge pipe and by using a small valve the check valve is bypassed and the pump is filled.
- In vacuum pump driven pumps, by operating the vacuum pump one achieves to fill the pump via increasing the water level in the suction pipe.

CAUTION

Do not start your pump dry (WITHOUT WATER).

7.2. Start up Procedure

- Check if the suction valve is open and the discharge valve is closed. Start the motor
- Wait until the motor reaches sufficient speed. (In Star-delta connections, wait until the engine passes to delta connection.)
- Keeping an eye on the amperage shown on the panel, open the discharge valve slowly.
- In the primary operation, if the discharge pipe is empty, do not open the valve completely. By keeping an eye on the amperage, open the valve with care regarding that it should not exceed the value indicated on pump's label.
- After opening the valve completely, check the pressure from the pump exit manometer and make sure that this value is the pump operating pressure value and is indicated on pump's label.
- If the value one reads is less than the pump label value when the valve is completely open, it means that the height is miscalculated. Increase the value by narrowing the valve and bring it to pump's label value.
- If the value one reads is greater than the pump label value when the valve is completely open, it means that the height is calculated less than what it should be in reality. The device is pumping less than what is requested. Check the installation and the calculations.
- **Minimum flow rate:** If the pump is working with zero flow rates (closed valve) from time to time during its operation, the water inside the pump may endanger the pump by getting warmed up. In such cases, a minimum flow valve must be connected to the pump exit.

CAUTION

Stop the motor if the pump gets too hot. Wait until it gets cold. Then start the system up again carefully.

7.3. Shut Down Procedure

CAUTION

During sudden start ups and stops, a pressure reducing valve must be placed at the exit section of high flow rate pumps whose discharge pipelines are long, in order to reduce water hammer effect. Water hammer may explode the pump.
In normal conditions (apart from sudden power shut down, etc), stop the pump as below:

- Close the discharge valve slowly
- Switch the power off, stop the motor. Notice that the rotor slows down.
- Do not start up the motor at least before 1 to 2 minutes.
- If the pump will be out of use for a long time, close the suction valve and auxiliary circuits. If the pump is outside and if there exists a danger of frost, remove all drain taps and empty all the water inside the pump. (5.2. Storage)

CAUTION

If the pump is outside and if there exists a danger of frost, remove all drain taps and empty all the water inside the pump.

8. MAINTENANCE

CAUTION

Maintenance operations must be done by authorized personnel with protective clothing only. The personnel must also beware of high temperatures and harmful and/or caustic liquids. Make sure that the personnel read carefully the manual.

- The instructions in Safety Precautions must be executed during maintenance and repair
- Continuous monitoring and maintenance will increase the engine's and pump' s lives.

The instructions below should be applied.

8.1. The Checks During the Operation

- Pump must never be operated without water.
- Pump must not be operated for a long time with the discharge valve closed (zero capacity).
- Bearing temperature must never exceed 80°C if the ambient temperature is 30°C
- Precautions must be taken against flare up when the component temperatures are over 60°C. "Hot Surface" warnings must be placed over necessary areas.
- All the auxiliary systems must be in use while the pump is operating.
- Gland nuts must not be tightened too much. If the amount of water increases after a long operation time, the nuts may be tightened by 1/6 turns
- If the pump has mechanical sealing, there is no need for excessive maintenance. Water leakage from the mechanical sealing indicates the fact that the sealing is worn out and therefore needs to be replaced.
- If the system consists of a substitute pump, keep it ready by operating it once a week. Check also the auxiliary systems of the substitute pump.
- Check the elastic components of the coupling. Replace them when necessary.

8.1.1. Component Check

CAUTION

To make possible the visual control, one must be able to reach the pump from any direction. Especially, to be able to dismount the internal units of the pump and the engine, sufficient free space must be created around them for maintenance and repair. Furthermore, one must make sure that the piping system can easily be dismounted.

8.1.2. Bearing and Lubrication

ENM type pumps are provided with two (lifelong) carefree rolling bearings in accordance to DIN 625. The usual service life of the rolling bearings attains at least the operating hours indicated in the technical specifications of DIN ISO 5199.

8.1.3. Shaft Seal Maintenance

8.1.3.1. Packing

- Before replacing the soft packing, the gland must be dismounted first. Used packing rings may be taken off by a sharp pointed tool. Take off the lantern ring if it exists, then clean the interiors of the sealing box, the gland and the lantern ring.
- Wrap a proper sized, good quality sealing over the shaft bush and make sure that the bush tip is completely covered.
- Place the first ring, its joint facing upwards and push it to its bed by using the gland
- If it exists push the watering ring to its bed.
- Place also the other rings to their beds alternating, i.e., their joints facing upwards and downwards.
- After placing the last ring, position the gland and tighten it completely. Thus, the squeezed sealing rings take the shape of the sealing box.
- Then un-tighten the nuts. Rotating the shaft tighten them slowly again. When you feel that the shaft is put on a brake, stop the tightening.
- Water must come from the seals drop by drop as soon as the pump is started. The number of drops must not be less than 10 and not more than 30 per minute. Find the proper setting by tightening and un-tightening the opposite gland nuts.

- Ensure that the water leaking from the sealing is collected and/or discharged in a manner which is appropriate in terms of safety and environmental criteria.
- Check the sealing temperature two hours after the gland adjustment is made. For a system which pumps water at ambient temperature, the sealing temperature must not exceed 80°C.

Cooling seal arrangements are provided for pumps working with high temperature liquids.

CAUTION

When tightening the gland nuts do not work with long sleeve shirts. Otherwise it is possible to get caught by the turning shaft and get injured.

8.1.3.2. Mechanical Seal

Mechanical Seals are absolutely leak tight and needs less maintenance than soft packing.

Mechanical seal;

1. **Provides leak proof operation in heavy operating conditions (in waste water pumps, chemical process and refinery pumps).**
2. **Easily mountable and needs less maintenance.**
3. **Does not cause wearing on the shaft**
4. **Sealing operation does not depend on the quality of shaft finishing.**

8.1.4. Coupling

As mentioned in Section 6.4, coupling adjustment must be checked regularly.

Worn out elastic bands must be replaced.

8.1.5. Drive

Apply to the operating instructions of the motor manufacturer.

8.1.6. Auxiliary Components

Check regularly the fittings and the gaskets, replace the worn out pieces.

8.2. Service

Our Customer Service Department offers after-sale service. Manager should employ authorized and trained personnel for mounting/dismounting procedures. Before these procedures, one must make sure that pump interior is clean and empty.

This criterion is also valid for the pumps which are sent to our factory or to our service points.

Maintain the safety of the personnel and the environment in every field procedure.

8.3. Spare Parts

The spare parts of ENM type pumps are guaranteed for 10 years by **MAS DAF MAKINA SANAYI A.Ş.**

In your spare parts requests, please indicate the below listed values that are indicated on your pump's label.

Pump type and size:
Motor power and speed:
Pump serial number:
Capacity and head:

If you wish to keep spare parts in store, depending on the number of same type of pumps, for two operation years, the quantities which are listed in the table below are recommended.

Component Name	The Number of Equivalent Pumps in the Installation						
	1-2	3	4	5	6-7	8-9	10+
Shaft (Wedge included) (quantity)	1	1	2	2	2	3	%30
İmpeller (quantity)	1	1	1	2	2	3	%30
Sleeve and Ball Bearing	1	1	2	2	3	4	%50
O-Ring for casting (kit+1)	1	1	1	2	2	3	%40
O-Ring for shaft (if exist) (kit)	1	1	2	2	3	4	%50
Soft packing (kit)	2	2	2	3	3	4	%50
Sealing bush(if exist)	1	1	1	2	2	3	%30
Coupling rubber sleeves (kit)	1	2	2	3	3	4	%50

Table 1: Spare Part List

9. DISASSEMBLY, REPAIR AND REASSEMBLY

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

Fallow the safety precautions outlined in “Safety instructions”.

9.1. Disassembly

- Close all valves in the suction and discharge lines, drain the pump by the drain plug.
- Drain oil from the bearing hosing if the pump is oil lubricated.
- Remove coupling guard and other safety guards.
- If a Spacer Type Coupling is used between the pump and the motor, there is no need to disconnect the motor, from the Baseplate. To take out the Spacer Part is enough.
- Thanks to “Back Pull Out Design”; the impeller, shaft and other rotating parts being removable no need to disconnect the suction and delivery pipes.
- If to take out the complete pump is necessary, disconnect pump from the driver, suction and discharge pipes and detach the baseplate.
- Disconnect the casing nuts and take out the pump rotor assembly (Impeller + Shaft + Bearing Housing + Bearings + Bearing Covers + Stuffing box etc.)
- Take out the pump coupling half from the shaft using a pull-off device and remove the coupling key.
- Unscrew the impeller end nut and take out the impeller and impeller key. Use rust remover solvent during dismountling if necessary.
- Unscrew the nuts bearing housing to the stuffing box.
- If there is the mechanical seal, unscrew the seal cover. Separate the stuffing box from the bearings. Mechanical seal will remain on the shaft.
- For pumps with soft packing, you can pull out stuffing box directly.
- Dismantle the bearing covers.
- Dismantle bearing by using a pull-off device. Do not use metal hammer for this operation.

9.2. Reassembly

- Reassembly proceeds in reverse sequence to disassembly as described in section 9.1. You may find the attached drawings useful.
- Coat the seats and screw connections with graphite, silicon or similar slippery substance before reassembly. If you can not find any of the above you may use oil.
- Never use the old gaskets, make sure the new gaskets and o-rings are the same size as the old ones.
- Start mounting from the bearings. Place ball bearing on their places on the shaft by slightly heating or by using press.
- Wait until bearings get cool. (Cool if it is possible). Put this part to the bearing housing from the coupling side. (With press or plastic hummer)
- Put the bearing covers at both ends to their places. Place stuffing box and impeller and tighten the impeller nut.
- On pumps with packing is used; put the stuffing box gland in position. And fixed the gland nuts gently.
- Mount stuffing box to bearing housing.
- At this stage you can insert the stuffing box and irrigation ring.
- Replace impeller key and pump impellers. Tighten the impeller nuts.
- Now reassembly of the rotor group is completed.
- Finally mount rotor assembly to the volute casing. (In the repair shop or on site.)
- Make sure the gaskets and o-rings are evenly placed without sliding and not damaged or not squeezed at all.

10. POSSIBLE FAILURES, CAUSES, SOLUTIONS

Possible failures and solution strategies are listed in the table below. Please apply to the Customers' Service Department of our company when a generic solution is not found to your problem.

While the failures are repaired the pump must always be dry and un-pressurized.

POSSIBLE FAILURE	CAUSES	SOLUTIONS
The pump delivers insufficient capacity	• Discharge head too high • Very high counter pressure • Pump and/or pipe cannot discharge air, cannot suck • Occurrence of air pockets inside the pipe • NPSH is too low	• Readjust the operating point • See if there is any undesired material inside the pipe • Vent completely the pump and the pipe • Change the piping configuration • Increase the liquid level
Motor overload	• System pressure is lower than the requested pressure level • Speed too high • Liquid pumped of different specific gravity and viscosity than that for which pump is rated • Engine works at two phases	• Adjust the operating pressure to the label value • Decrease the speed • Increase the engine power • Replace the fuse and control the electrical connections
Pump head is too high	• System pressure is higher than the requested pressure level	• Set the operating pressure to the label value.
Bearing temperatures are high	• Worn out coupling • Too much, too little or improper lubrication • Increase in axial forcing	• Replace the coupling • Change the oil, decrease or increase its quantity • Clean the balance holes on the impeller disc
Excessive leakage from the stuffing box	• Worn out gland • Loose gland	• Use brand new gland • Change the stuffing bush • Tighten the gland nuts
Noisy operation	• Worn out motor or pump ball bearings • Cavitation • Worn out or misaligned coupling • Operation in the far left or right of the performance curve	• Replace • Close the delivery partially in order to reduce the capacity. • Replace the coupling or align it • Operate the pump at its label setting
Excessive increase in pump temperature	• Pump and/or pipe can neither discharge, nor aspirate air • Too low capacity	• Bleed completely the pump and the pipe • Open more the valve
Vibration	• Pump and/or pipe can neither discharge, nor aspirate air • NPSH is too low • Internal components of the pump are worn out • System pressure is lower than the requested pressure level • Coupling is misaligned • Too much, too little or improper lubrication • Rotor unbalanced • Improper bearings	• Bleed completely the pump and the pipe • Increase the liquid level • Replace the worn out components • Adjust the operating pressure to the label value • Align the coupling • In case of continuous overload, decrease the impeller diameter • Change the oil, decrease or increase its quantity • Balance the impeller again • Use new bearings

Table 2 - Possible Failures, Causes, Solutions

11. ENM PUMP DIMENSIONS TABLE AND WEIGHTS

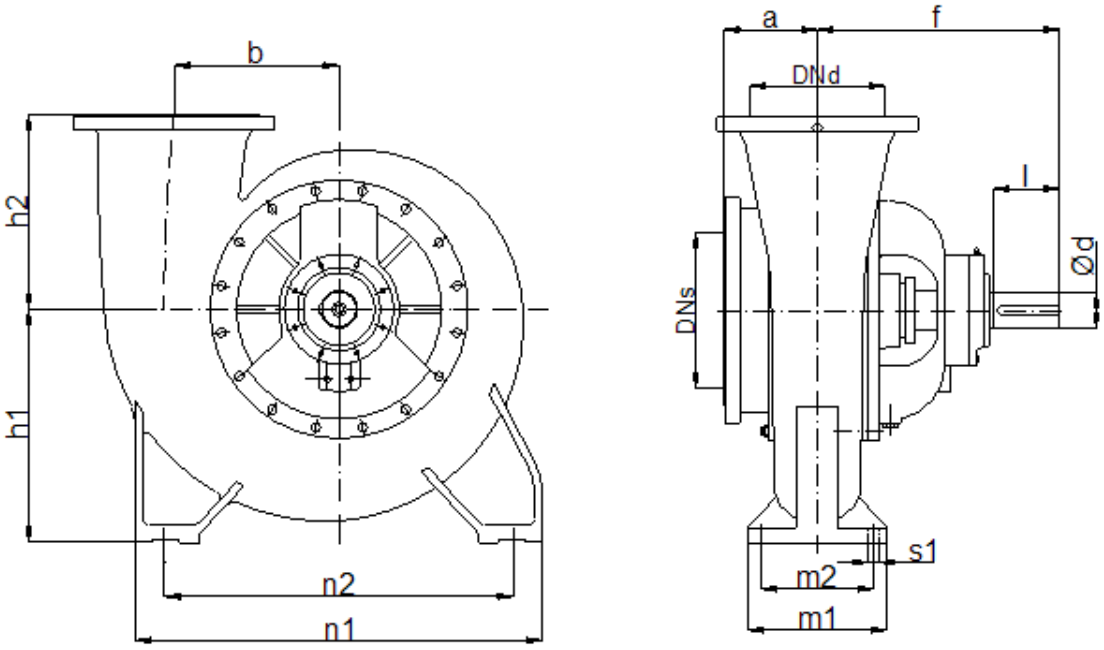


Figure 9: ENM Pump Dimensions Figure

No	Pump Type	a	f	h1	h2	b	m1	m2	n1	n2	s1	d	l	Weight (kg)
1	ENM 250-550	230	544	500	425	400	300	240	800	650	30	75	140	670
2	ENM 300-550	230	544	550	500	400	300	240	800	650	30	75	140	720
3	ENM 350-550	240	625	600	500	425	360	290	1050	900	30	90	170	890
4	ENM 400-550	280	640	600	550	400	360	290	1050	900	30	90	170	1063

Table 3 - ENM Pump Dimensions Table and Weights

12. TIGHTENING TORQUES

THREAD DIAMETER	TIGHTENING TORQUEMAX (Nm)	
	Property Classes	
	8.8	10.9
M4	3.0	4.4
M5	5.9	8.7
M6	10	15
M8	25	36
M10	49	72
M12	85	125
M14	135	200
M16	210	310
M18	300	430
M20	425	610
M22	580	820
M24	730	1050
M27	1100	1550
M30	1450	2100
M33	1970	2770
M36	2530	3560

Table 4 - Tightening Torques Table

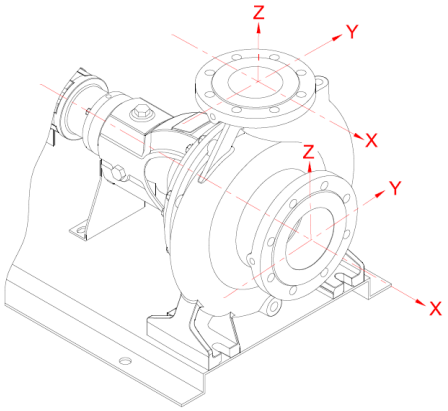
13. FORCES AND MOMENTS AT THE PUMP FLANGES

All of the applied load sif not reached the maximum allowable value, to provide that the following additional conditions, one of these loads may exceed the normal limit:

- Any component of a force or a moment, must be limited1.4times of the maximum allowable value,
- The actual force sand moments acting on each flange, should provide the following formula:

$$\left(\frac{\sum|F|_{\text{actual}}}{\sum|F|_{\text{maximum allowable}}}\right)^2+\left(\frac{\sum|M|_{\text{actual}}}{\sum|M|_{\text{maximum allowable}}}\right)^2\le 2$$

In here, $\sum|F|$ and $\sum|M|$ arearithmetic sum of the loads for each flange at the pump level, without regard of the algebraic signs of the actual and maximum allowable values.



Pump Type	Forces								Moments					
	Flanges DN		Suction Flange			Discharge Flange			Suction Flange			Discharge Flange		
	Suction	Discharge	N			N			Nm			Nm		
			F_y	F_z	F_x	F_y	F_z	F_x	M_y	M_z	M_x	M_y	M_z	M_x
ENM 250-550	300	250	3410	3067	3810	2571	3181	2838	1200	1391	1695	1200	1391	1695
ENM 300-550	350	300	3410	3067	3810	3581	4438	3981	1200	1391	1695	2095	2419	2952
ENM 300-550	400	350	5124	4610	5695	4095	5067	4552	3238	3733	4552	2629	3029	3695
ENM 300-550	500	400	5695	5124	6324	4095	5067	4552	3905	4495	5505	2629	3029	3695

Table 5 - Forces and Moments at The Pump Flanges

Forces at the pump flanges were calculated according toTS EN ISO 5199 standard. The calculations are valid for the materials of cast iron and bronze. Forces and moments at the flanges that made of stainless material will be approximately twice as moments in the table.

14. ENM SECTIONAL DRAWING AND PARTS LIST

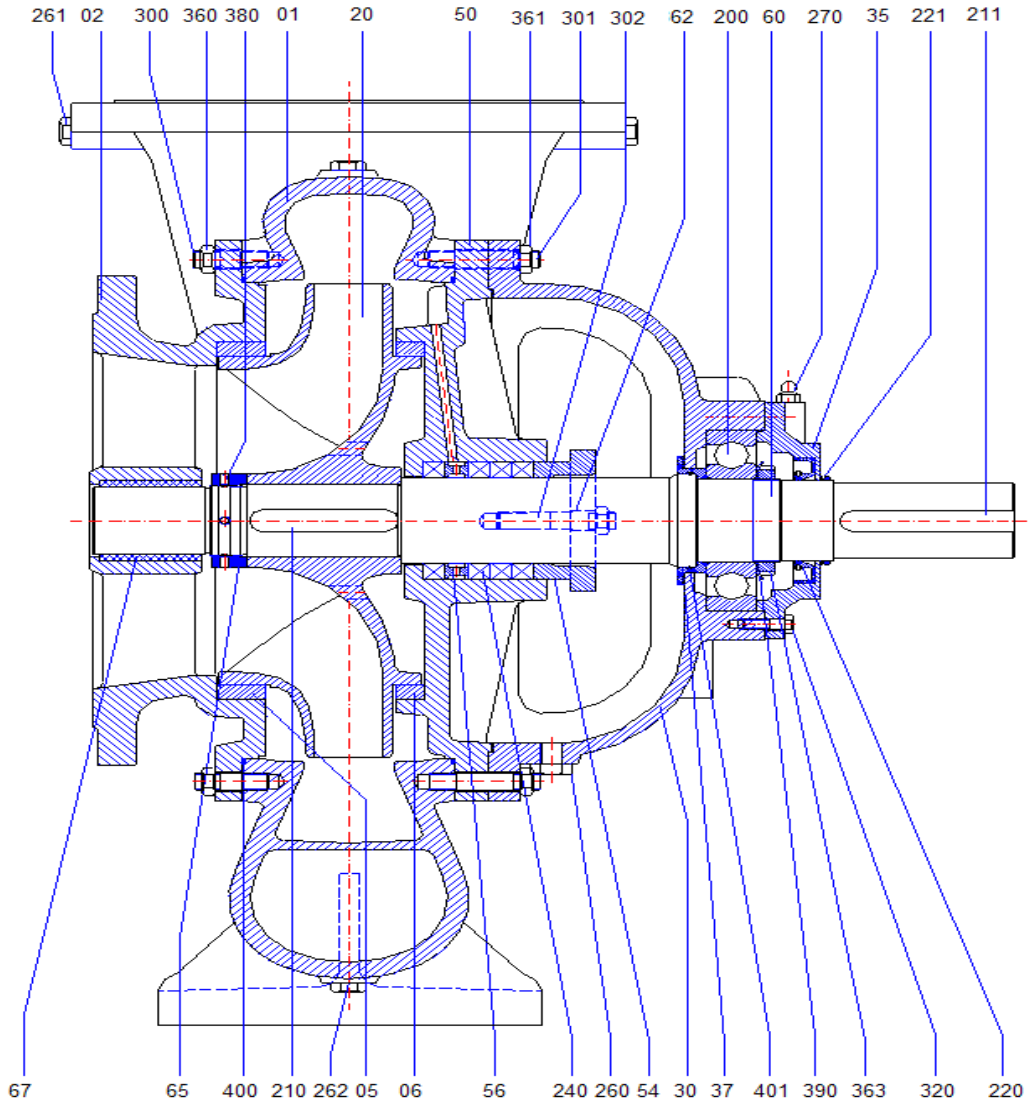


Figure 10: Design with the Packing

Part No	Name of the Part	Part No	Name of the Part	Part No	Name of the Part
01	Pump Casing	65	Impeller nut	300	Suction Flange Stud
02	Suction Flange	67	Sliding Bearing Sleeve	301	Pump Casing Stud
05	Impeller Wear Ring (Front)	200	Ball Bearing	302	Gland Stud
06	Impeller Wear Ring (Back)	210	Impeller Key	320	Hex Bolt
20	Impeller	211	Coupling Key	360	Nut
30	Bearing Housing	220	Oil Seal	362	Gland Nut
35	Bearing Cover	221	V Ring	363	Ball Bearing Nut
37	Water Disc	240	Soft packing	380	Set-Screw
50	Stuffing Box	260	Plug	390	Safety Ring
54	Gland	261	Plug	400	O-Ring
56	Lantern ring	262	Plug	401	O-ring
60	Shaft	270	Plug (For Grease)		

Table 6: ENM Sectional Part List

15. ENM SECTIONAL DRAWING AND PARTS LIST OF HYDRAL KIT

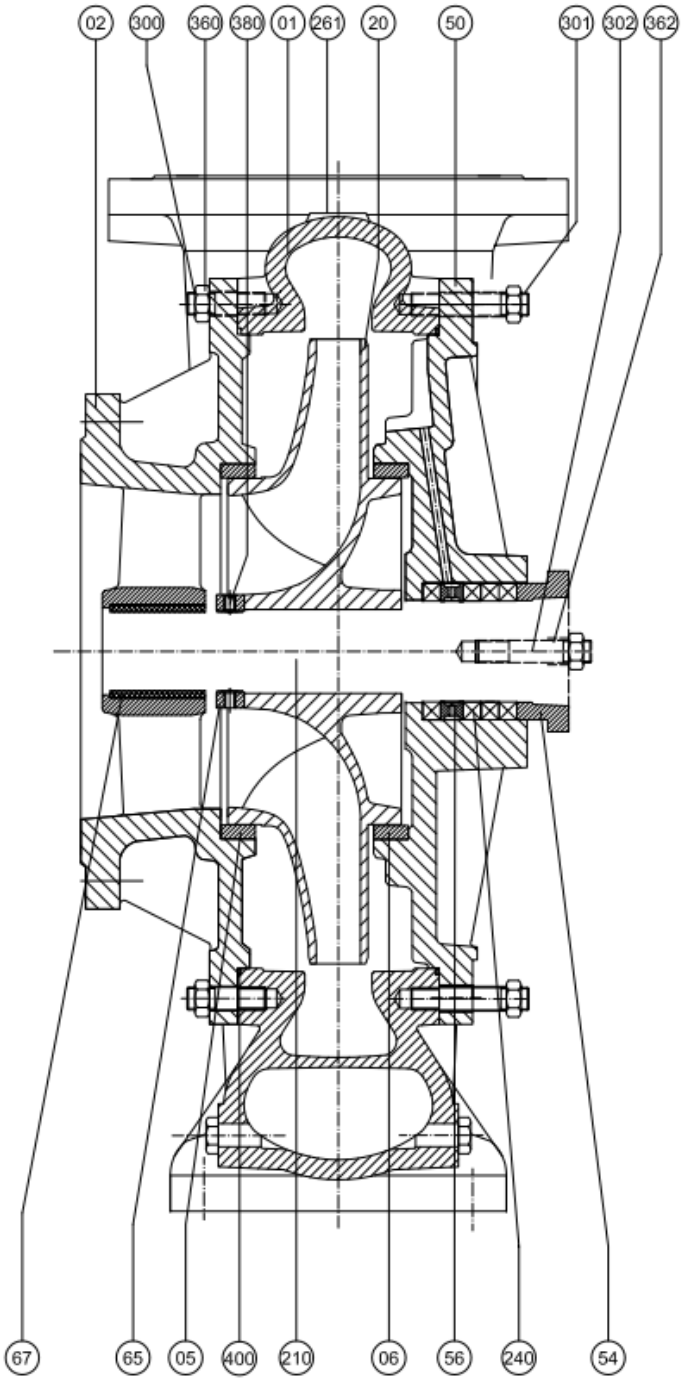


Figure 11: Design of Hydral Kit

Part No	Name of the Part
01	Pump Casing
02	Suction Flange
05	Impeller Wear Ring (Front)
06	Impeller Wear Ring (Back)
20	Impeller
50	Stuffing Box
54	Gland
56	Lantern ring
65	Impeller nut
67	Sliding Bearing Sleeve
240	Soft packing
261	Plug
300	Suction Flange Stud
301	Pump Casing Stud
302	Gland Stud
360	Nut
362	Gland Nut
380	Set-Screw
400	O-Ring

Table 7: ENM Sectional Part List of Hydral Kit

16. FIGURE LIST

17. TABLE LIST

Mas Grup

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