M PUMPS SRL
Via dell'artigianato, 120
45015 Corbola (RO) – Italia
Tel. +39 0426 346304 Fax + 39 0426 349126 1
info@mpumps.it

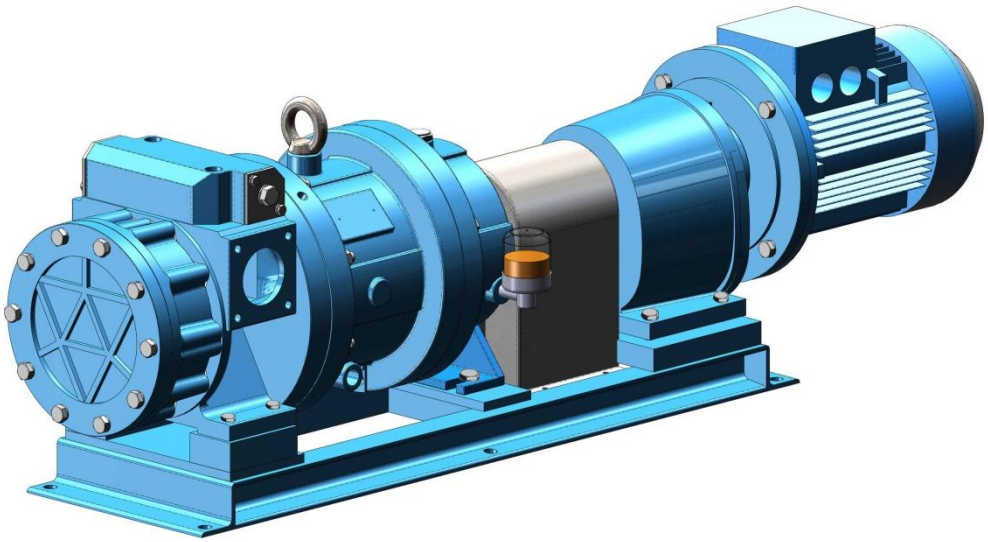
Setting Innovative Standards

MAGNETIC DRIVE PUMPS
OSCILLATING HOLLOW DISC PUMPS

- **Series MHV MAG-M**

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

The present instruction are a translation of the original manual;
Keep it together to the original Italian manual.



MODEL: pump on baseplate in bare frame version



CAUTION

These instructions are intended to qualified personnel that will:
- install the Pump;
- use the pump;
- carry out maintenance / repair of the pump.

Read carefully this instruction manual before using the pump

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THIS INSTRUCTION MANUAL is intended to guide those responsible for the installation, operation and maintenance of *M PUMPS* MHV MAG-M series seal-less magnetic drive pumps. Please read it carefully, before you install and operate your *M PUMPS* pump. Useful information can also be obtained from: - Hydraulic Institute Standards (USA) regarding pump installation. – *M PUMPS* inspection standards ISP 01.9001 regarding performance and test.

1. GENERAL WARNINGS AND SAFETY

This manual was prepared by *M PUMPS* pump to provide the buyer all necessary information for its proper use and regular maintenance. In this manual is not contained the manual of the electric motor when the pump is supplied with this.
For safety and hygiene of the workplace and to ensure a fair and sustainable use of the pump, the manual should be kept for any consultation.
As part of the pump, this manual must go with it.
For any given non-deductible or not included in this manual is recommended that you contact *M PUMPS*.

Do not use the pump before you have read and assimilated all safety rules and instructions in this manual.
In case of damage or loss of the manual, ask for a copy to *M PUMPS* promptly.
The failure on following instructions in this manual, exempt *M PUMPS* from any liability.
The pump and the instructions are intended for operators who make professional use and should be used by qualified personnel adequately trained, aware of uses, operation and risk that the pump generates during its use, the user with experience is the best form of qualification.

M PUMPS reserves at any time the right to make changes deemed necessary to improve the pump, taking care to update this manual as soon as possible. This reflects the state of the art at the marketing pump. In case of transfer of the pump, the user is encouraged to report to *M PUMPS* the address of the new owner to facilitate the transmission of any additions to the manual to the new user. *M PUMPS* reserves all rights to this manual, no total or partial reproduction is allowed without written permission.
Symbols used in the manual
In the text to indicate the risk of maneuvers or possible dangerous situations, warnings have been included, each of which consists of a symbol followed by a warning.

MAGNETIC 	Persistence of a magnetic field. This field may represent an immediate danger to individuals who have electronic medical devices, metal heart valves, metal or any other metal objects, impairing its functionality. *M PUMPS* declines any responsibility for any damages to people who did not keep a safe distance of at least 1metre, where it is shown that symbol

DANGER 	Indicates a potential risk to operators who are using the pump and / or the integrity of the pump, which could result in damaging itself and / or serious injury to people concerned.

CAUTION 	Calls attention to important details that the staff must know and keep in mind for the proper use and operation of the pump.

FORBIDDEN 	Calls attention to transactions that are absolutely prohibited, not respecting the prohibition you may damage the pump and / or operators. *M PUMPS* declines responsibility for damages to things or people for not having complied with the prohibitions set.

2. WARRANTY

Valid for one year from the date of the pump sale. *M PUMPS* do not assume any liability for any warranties explicit or implied, nor as regards the possibility to sell or the suitability of the items supplied.
The warranty will not be applied if:
– the repair and / or maintenance was not carried out strictly in accordance with the instructions;
– the pump has not been installed and put into service as instructed;
– the repairs were not made by staff *M PUMPS* or were made without consulting *M PUMPS*;
– spare parts are not original were used;
– lubricants were used different from those recommended;
– the parts supplied were not used according to their nature and / or destination;
– the parts supplied were used carelessly, negligently, improperly;
– the parts supplied were damaged due to external circumstances.
All wear parts are excluded from warranty.

3. NAMEPLATE

The pump for installation in ordinary environments has the nameplate on the side of the support as shown: only the fields are compiled must be considered relevant and therefore valid for identification.

-PUMP UNIT SUPPLIED WITH ELECTRICAL MOTOR:

O O

M PUMPS SRL
Via dell'artigianato, 120
45015 Corbola (RO) – Italia
Tel. +39 0426 346304
Fax + 39 0426 34912
www.mpumps.it
info@mpumps.it

CE

MOD.:	_ _ _ _ _ _ _			S.Nr.:	_ _ _ _ _
Q.:	_ _ _ _ _(mc/h)	H _ _ _ _	(m)	Year:	_ _ _ _ _
Mot.:	_ _ _ _ _ _ rpm	P _ _ _ _	(kW)	Item Nr.:	_ _ _ _ _
Impeller D.:	_ _ _ _ _				

O O

-PUMP UNIT SUPPLIED WITHOUT ELECTRICAL MOTOR:

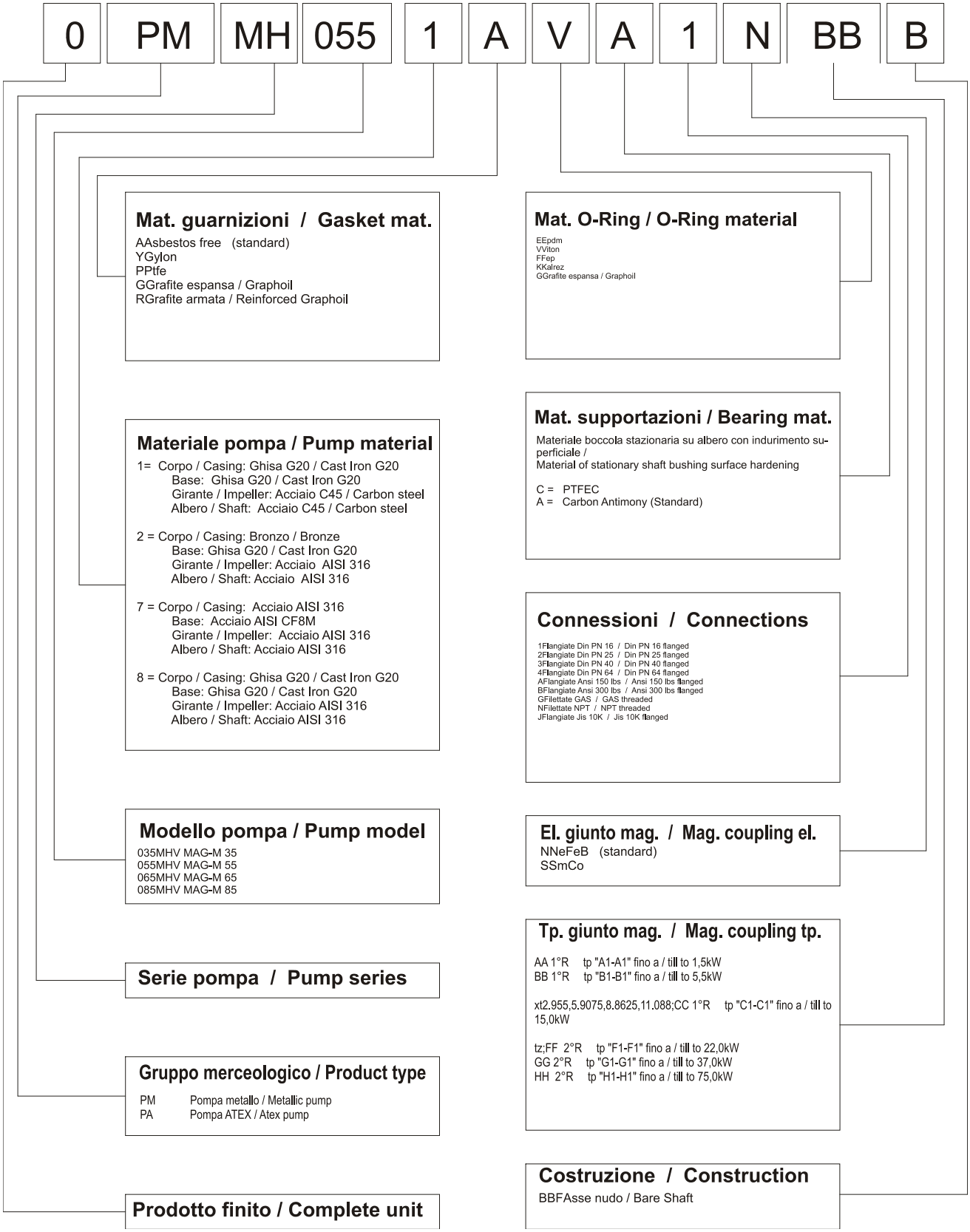
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MOD.:	_ _ _ _ _ _ _			S.Nr.:	_ _ _ _ _
Q.:	_ _ _ _ _(mc/h)	H _ _ _ _	(m)	Year:	_ _ _ _ _
Mot.:	_ _ _ _ _ _ rpm	P _ _ _ _	(kW)	Item Nr.:	_ _ _ _ _
Impeller D.:	_ _ _ _ _				

O O

The serial number of the pump, here called serial number (s.nr) defines the type of components installed in the pump:



4. PUMP DESCRIPTION

Key feature of magnetic drive pumps is that the fluid that have to be moved never comes into direct contact with engine parts, ensuring the physical separation between the motor and the pump and the transmission is delivered via a coaxial magnetic coupling.
The pump consists of a part (outer rotor) that is coupled to an electric motor-gear box through elastic coupling (bare shaft version) and a part (internal rotor integral with the pump impeller) that allows the pumping fluid. The outer rotor is composed of a series of magnetic elements with features and size variations to the torque to be transmitted. The inner and outer rotor magnets are a magnetic circuit, characterized by pairs of polar opposites, overlooked. At the start of the electric motor the outer rotor rotating drives synchronously the internal rotor, thus the power is transmitted to the impeller pump, which acts as the pumping of liquid in the pump body itself. A static containment can, called rear casing, located between the two rotors, separates the liquid from the atmosphere, making the pump seal.

LET'S SEE IN DETAIL HOW THE M PUMPS MHV MAG-M SERIES WORKS:

The operating principle of the pump is outlined in figures 1a – 2a – 3a – 4a – 5a – 6a

Figure 1a:

The area in black represents the liquid drawn in. The area in white represents the liquid pumped out, equivalent to the priming volume of the pump.
The hollow plate is pivoted eccentrically on the shaft. Rotation of the shaft causes the hollow plate to oscillate about the baffle-plate which separates the suction and discharge ports.
The hollows plate remains tangential to the outer and inner fixed cylindrical surfaces, forming two moving hydraulic seals.

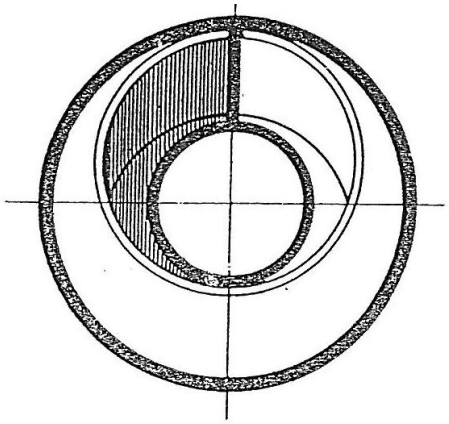


Fig. 1A

M PUMPS MHV MAG-M series pumps are of modular construction.
The pump is built in two main parts:

a) The base, supporting the shaft, bearings, internal magnet and suction and discharge ports.
b) The pump assembly, consisting of the stationary body and rotating hollow plate, which is connected to the shaft by the capped spring.

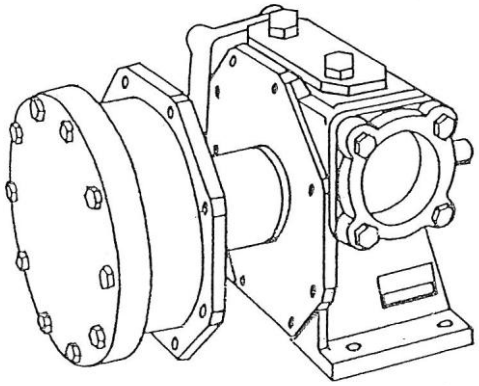


Figure 2a:
Four successive positions of the hollow plate (or rotor) are shown, indicating how it oscillates, progressively changing its interior and exterior swept volume as it moves past the inlet and discharge ports.

POSITION 1

The left inferior of the rotor is filled with the fluid already drawn in, while the right inferior and the whole exterior of the rotor hold the fluid to be pumped out.

POSITION 2

The rotor oscillates on the shaft, sweeping the stationary inner cylindrical surface of the pump body. A partial vacuum is created at the inlet port, drawing more fluid into the left inferior of the rotor.
At the same time, the fluid in the right inferior of the rotor, and in its external volume, is forced through the discharge port.
Note that as it rotates and oscillates, the rotor maintains both an interior and an exterior volume which increase and then decrease progressively.

POSITION 3

Fluid continues to be expelled from the right exterior volume of the rotor. The left side of the pump body and the whole inferior of the rotor are now full of fluid sucked in.

POSITION 4

The fluid contained in the right inferior volume of the rotor now starts to be expelled, together with the remaining fluid from the right exterior, volume. The cycle then repeated.

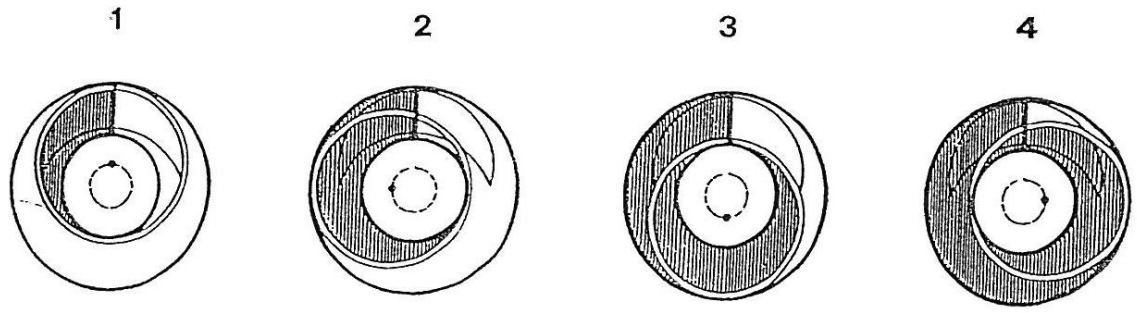


Figure 3a:

M PUMPS MHV MAG-M series pumps have a powerful self-priming action, able to generate a vertical lift of 6/7 meters of water or a 0,75 bar vacuum when started empty, without the use of auxiliary devices. Tha maximum practical self-priming lift is of course influenced by the volatility, density and viscosity of the pumped liquid, and by the bore and configuration of the inlet line. The pump can handle substantial amounts

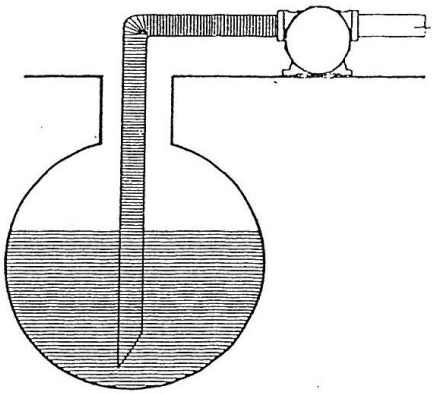


Fig. 3A

of entrained gases without losing its prime.

Figure 4a:

M PUMPS MHV MAG-M series pumps can handle suspended solid matter of substantial size.
To allow suspended solid particle to pass through the pump, and to automatically compensate for wear and thermal expansion, there is a capped spring between the shaft and the pivot of the hollow plate. The capped spring takes up any movement of the plate to allow the passage of solid particles. Large or sharp particles capable of scoring the body and the rotor should be kept out of the pump. Pumping of abrasives for extended periods will cause accelerated wear, although the spring device provides automatic compensation for rotor and body wear, enabling the pump to remain efficient over long period of use.
Compensation for thermal expansion and contraction over a wide temperature range is automatically achieved by the same means.

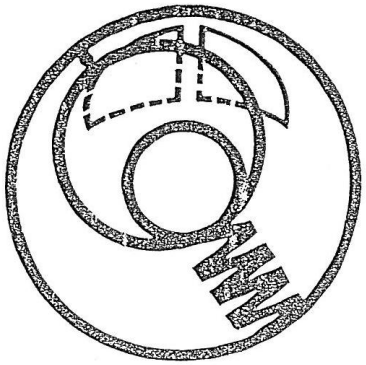


Fig. 4A

Figure 5a:

M PUMPS MHV MAG-M series pumps are fully reversible. They work with equally high volumetric efficiency in either direction. This makes them ideal for many reversible transfer and batch cycling operations including tanker loading and offloading. Pipework can be completely emptied.

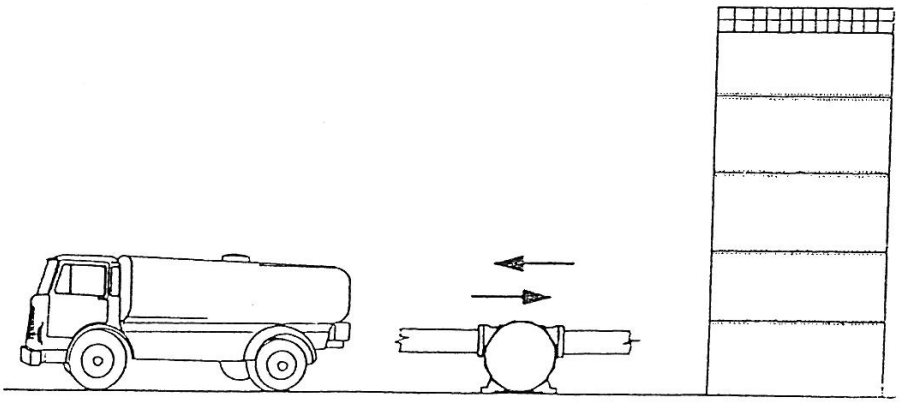


Fig. 5A

Figure 6a:

M PUMPS MHV MAG-M series pumps are fully balanced. The rotating assembly is hydraulically balanced both radially and axially. The pressure resultants, both inside and outside the hollow plate, always lie in a plane perpendicular to the pump axis and tangential to the circle described by the center of plate. With no radial component of differential pressure, there is no risk of liquid blow-by and loss of flow and pressure during operation. Bearing loads and power absorption are uniform at every stage of the pumping cycle.

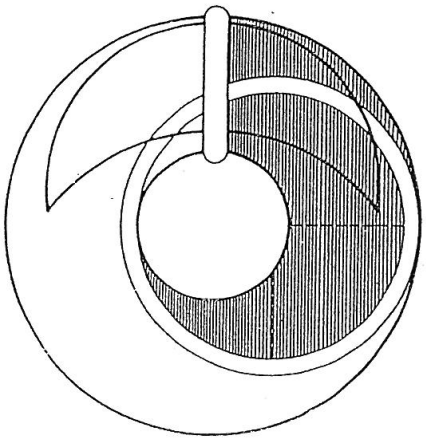


Fig. 6A

Applications
– the maximum working pressure of the plant, the temperature suitable and the maximum rotation speed depends on the type of pump and it is specified in the "TECHNICAL DATA".
Other uses are not permitted because you must comply with the conditions of use in "TECHNICAL DATA": the use of a pump in a plant or in fluid conditions different from those for which the pump was designed, can lead to dangerous situations for the user.

5. TECHNICAL DATA

The pumps described in this manual have the following characteristics:

Available in bare shaft configuration or block, with the engine directly keyed to the pump support.

MHV MAG-M

- Nozzle: ANSI 150 and 300lbs;
- Magnetic Drive, Self-priming up to 6/7 m
- Fully reversible
- Max viscosity: 10000 cps;
- Max system pressure: ☒ 25BAR (standard)
  ☐ 150 BAR (HP version)
  ☐ (special version on request)
- Flow up to 30 mc/h;
- Discharge pressure up to 7 bar;
- Working temperature from -50°C to 200°C
- Installable motor power: from 0,55kW to 30kW;
- Speed: between 50 and 300 rpm for long life;

CAUTION	– CAUTION: If the pump is driven by inverter, remain within the recommended limits of rotation

6. Operating limits and performances

CHOICE OF THE PUMP ROTATION SPEED

GUIDELINE FOR SELECTION OF MHV MAG-M series PUMPS

1) The following variables must be known :

- TYPE OF LIQUID - FLOW - HEAD - SPECIFIC GRAVITY - VISCOSITY -

2) Carefully check viscosity of liquid at pumping temperature.
(See note on viscous liquid behaviour pag. 7).

3) When the liquid viscosity has been established, select the pump rotating speed using **TABLE 9/892.**

If the viscosity is less than 30° Engler, the optimum rotating speed is as indicated in TABLE 9/892. For viscosities above 30° E, use TABLE MHV 10/892 to correct the rotating speed given by TABLE 9/892.

4) When the optimum rotating speed has been established, use diagrams **MHV 11-12-13-14** to select the pump size needed to give the required flow rate.

5) Check the required differential pressure. If a total manometric head is given, convert it to differential pressure using the liquid specific gravity.

6) Calculate the required motor power by the same diagrams **MHV 11-12-13-14.**

7) When the motor power and the rotating speed have been established, calculate the following value given by the formula :

$$V = f \times (P\ [kW] / r.p.m.)$$

f = 1150.00 for MHV 35 & 55 f = 1250.00 for MHV 65 & 85

and select the magnet coupling from **TABLE A and B.**

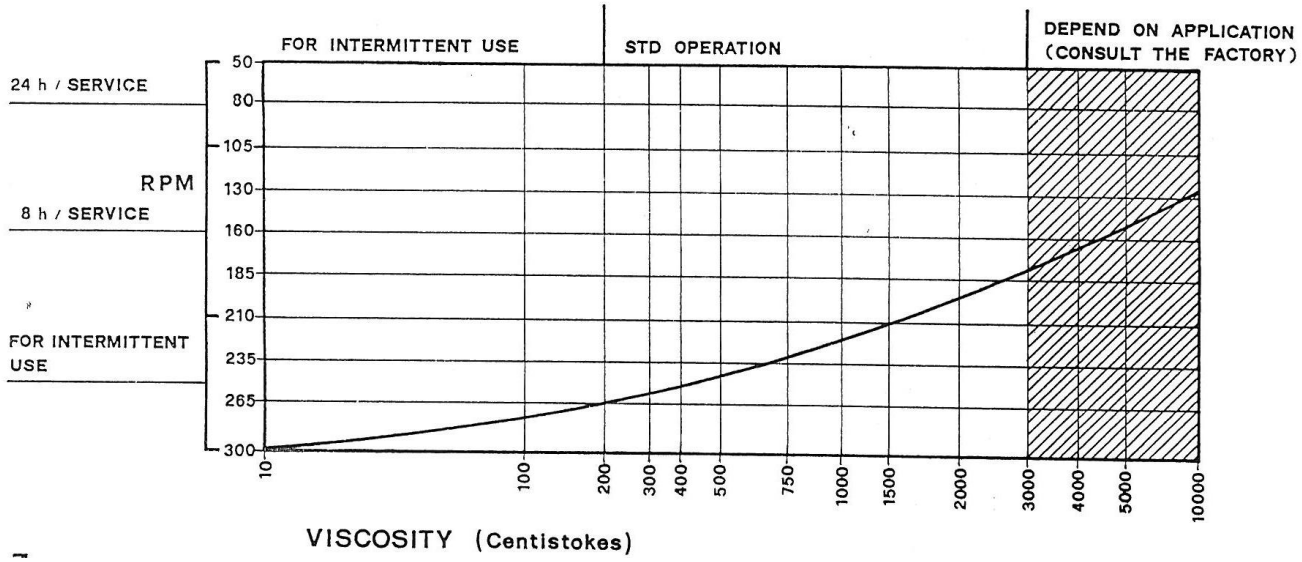
8) Choose pump materials compatible with pumped liquid.

- TABLE A -

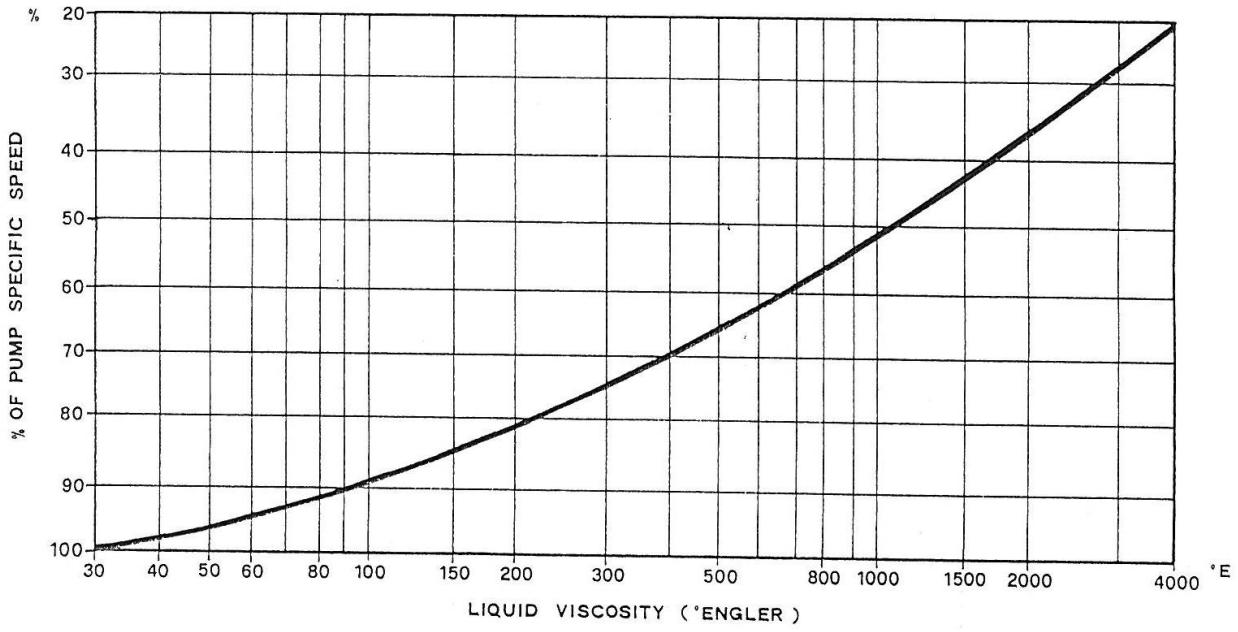
FOR PUMPS MHV MAG-M 35-55					
MAGNETIC COUPLING	A1-A1 1°R	A1-B1 1°R	B1-B1 1°R	C1-C1 1°R	C1-C1 1°R
V	5	7	8	10	11

- TABLE B -

FOR PUMPS MHV MAG-M 65-85					
MAGNETIC COUPLING	F1-F1 2°R	G1-G1 2°R	H1-H1 2°R	L1-L1 2°R	
V	13	19	25	38	

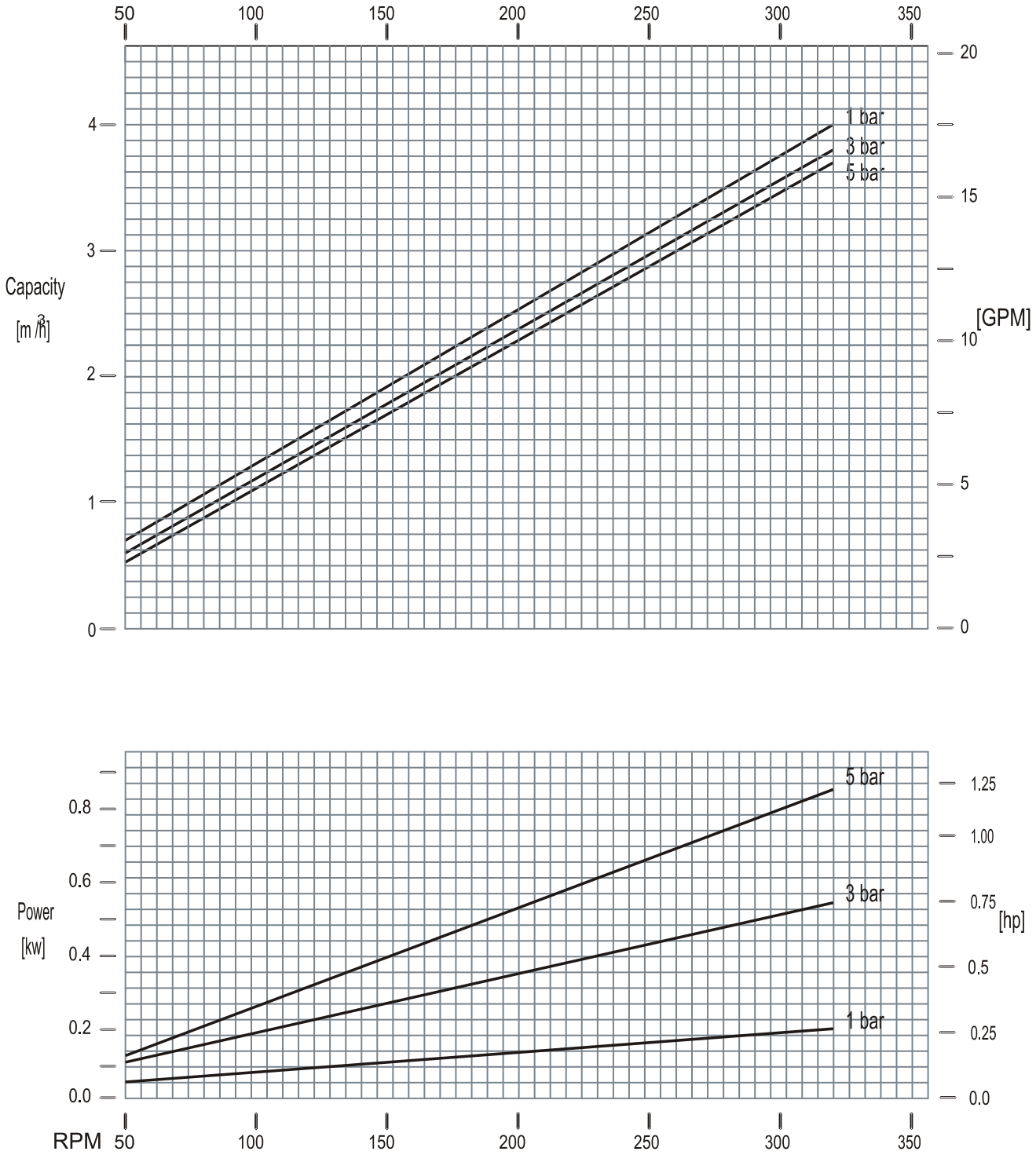


09/892

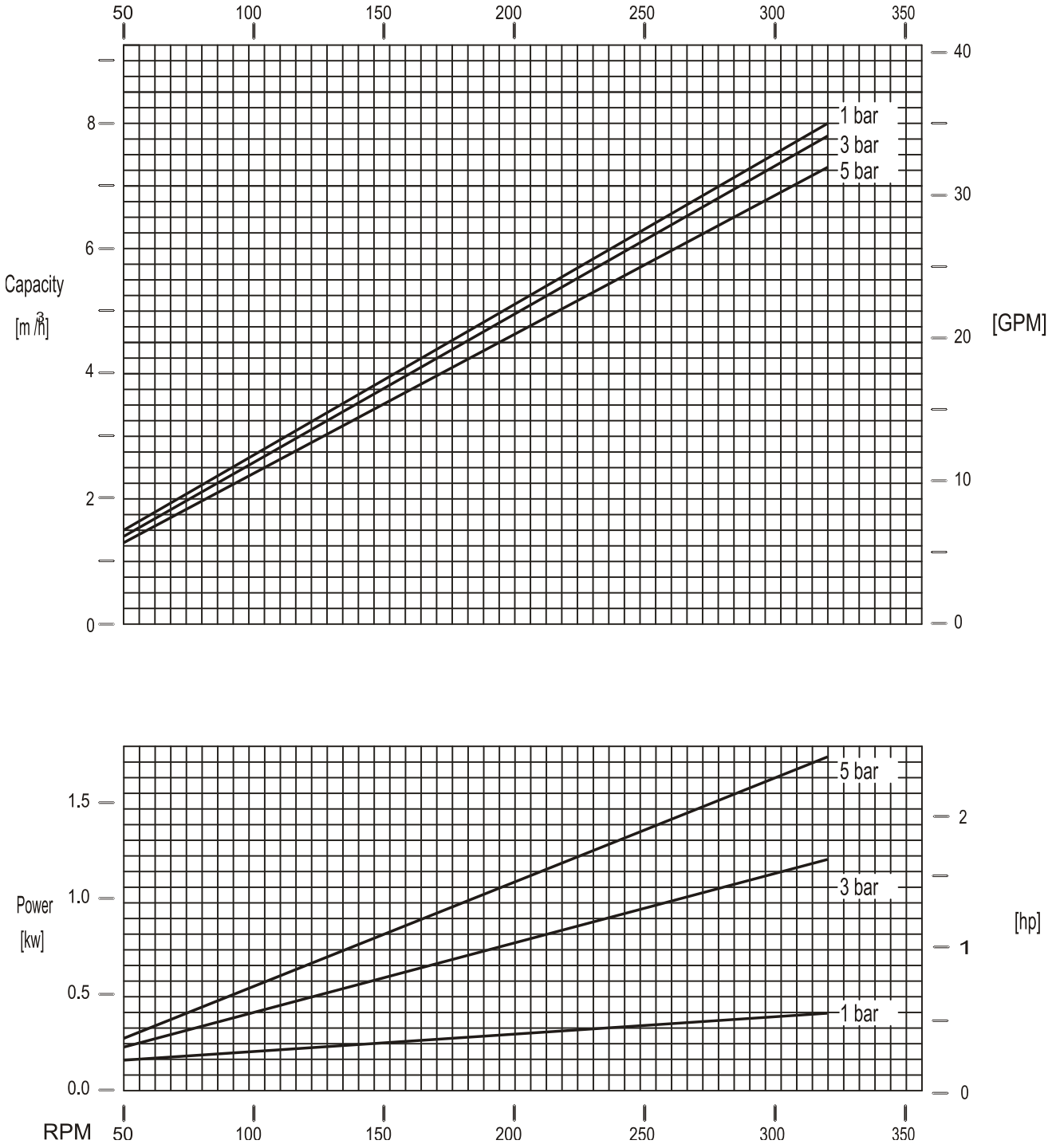


10/892

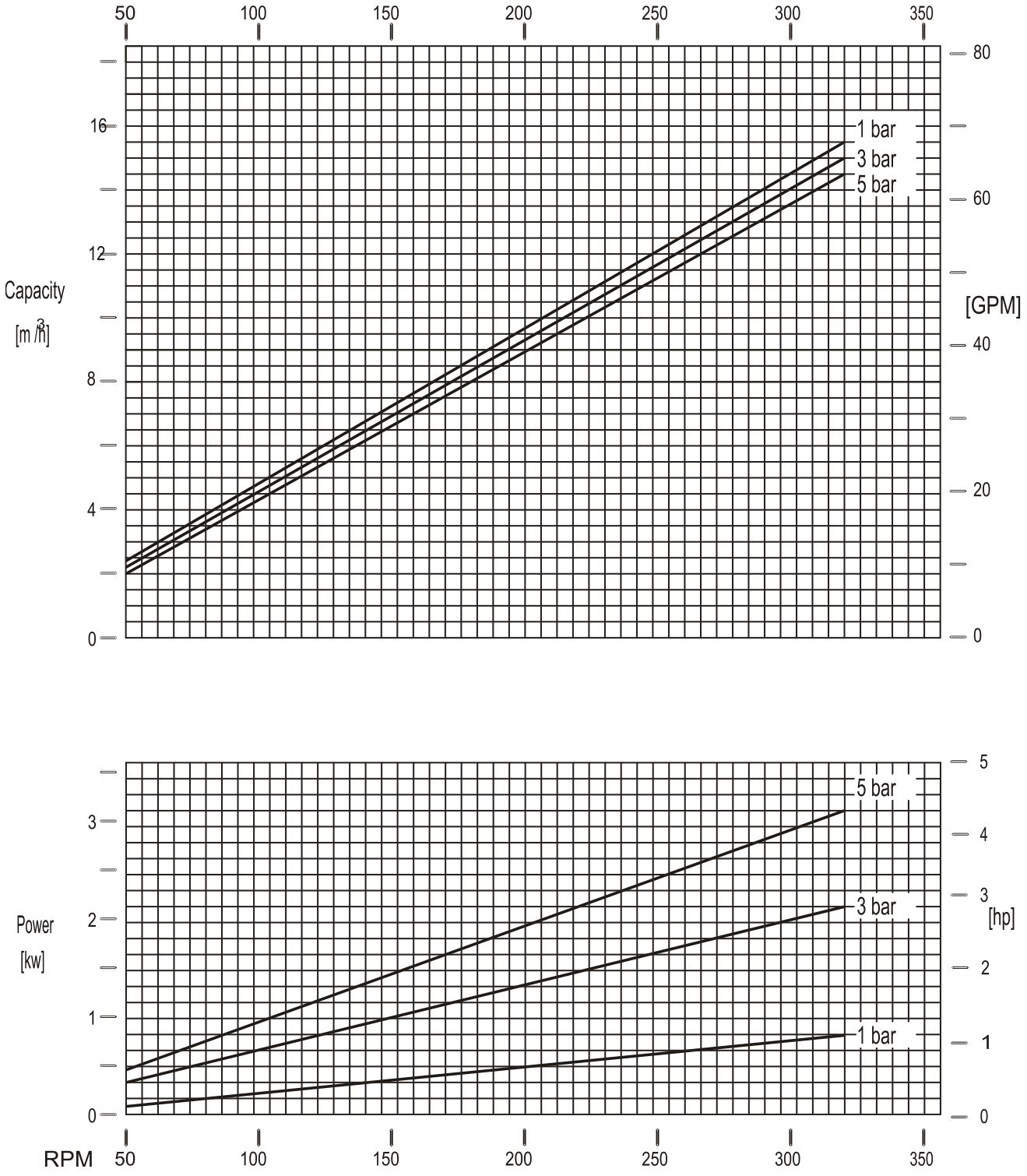
MODEL: MHV MAG-M35



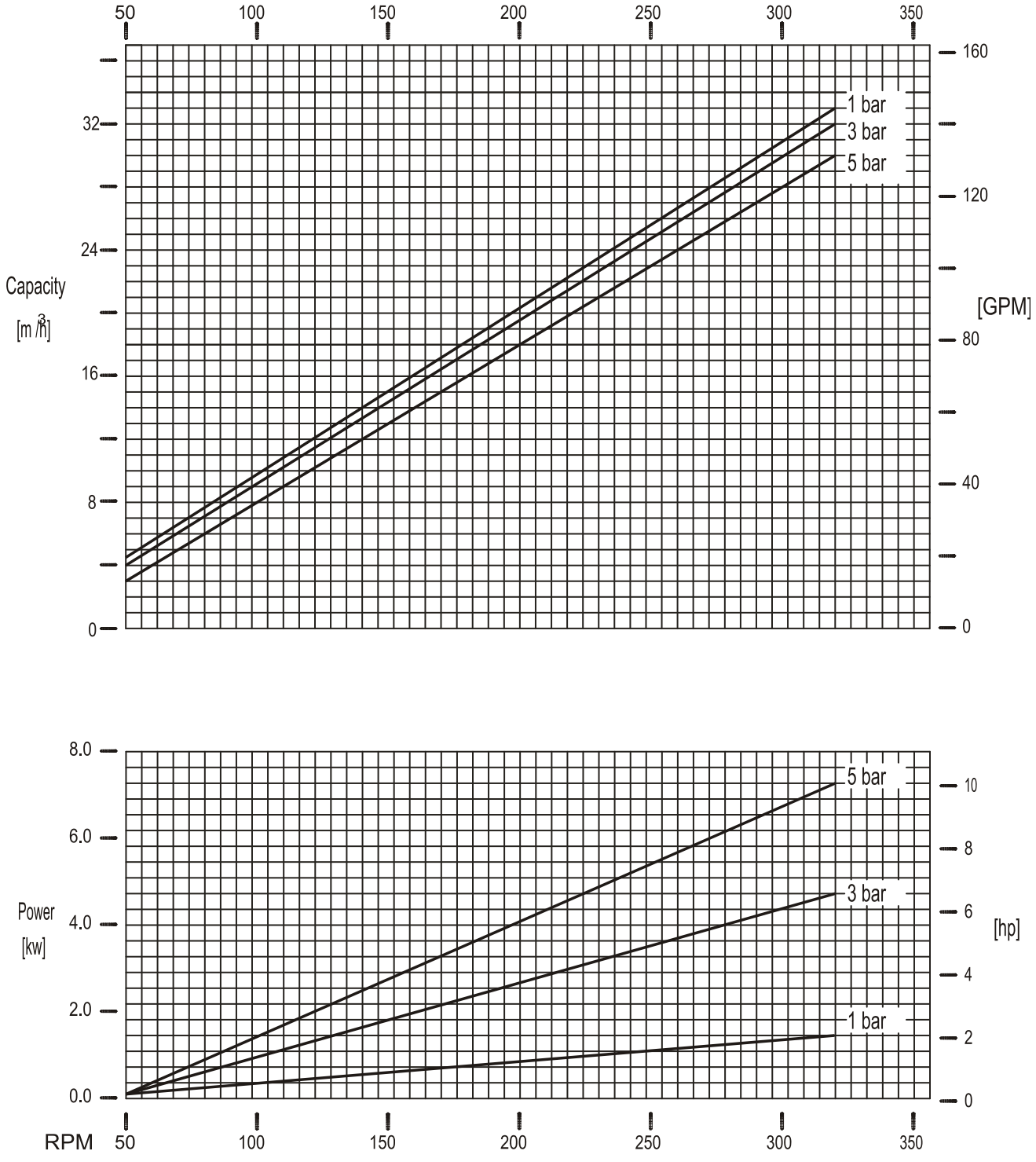
MODEL: MHV MAG-M55



MODEL: MHV MAG-M65



MODEL: MHV MAG-M85



7. OVERALL DIMENSIONS

See specific documentation provided with this manual.

8. NOISE AND VIBRATION

The pump noise depends primarily on the operating conditions. The operating condition of the pump during the measurements is: the coupling of the pump with the electric motor on the bench with pumping fluids.
The A-weighted sound pressure level to front and side of the pump is below 85 dB (A).

9. RADIATION IONISING

The pump does not emit any kind of ionising radiation that could endanger persons.

10. CHECKS TO PUMP DELIVERY, STORAGE

All *M PUMPS* pumps are tested before shipment and carefully packed for transport: at the reception of the pump make sure that the pump has not been damaged during the transport. If there are problems, contact immediately the carrier and inform *M PUMPS* about what happened.
So that the pump is preserved over time as best as possible, we recommend storing it away from the sun, bad weather and dust, if not immediately installed or used for long periods.
Stoppers closing the input and output connections of the fluid must not be removed until installation. If provided with electric motor, observe also the motor manufacturer's storage formality.
The maximum allowable temperature range during storage, preservation and use must be between -15 e +40 °C with humidity between 10 e 90%.

11. SHIPPING AND HANDLING

You should carry out a precautionary check of the pump at the receiving to detect and report any damage in the transport and handling operations. In case of breakages contact immediately *M PUMPS*.
The precautions to ensure the stability of the pump concern the possible slips and overturning caused by handling and transport, which must be prevented by setting the pump casing of the pump with ropes to the vehicle frame.
Pump and motor assembly cannot be moved manually due to its high weight.
To move a pump positioned on a pallet, enlarge as maximum as possible the forks and then operate.

PROHIBITION



- It is forbidden to lift the pump using different lugs from the ones specially designed and reported, as points of anchorage.
- You cannot lift a pump and motor assembly using the eye-bolt of the electric motor only.
- During the lifting the entire surrounding area is considered as a danger zone and must be cleared by personnel not engaged in those operations.

It is indicated the possibility of transporting and handling the pump using the lugs designed for that use: you must ensure that chains and shackles are able to withstand the weight of the pump (as shown in "TECHNICAL DATA").

12. ASSEMBLY, INSTALLATION, CONNECTIONS, COMMISSIONING AND SETTING

12.1. Assembly

Install the pump on a solid foundation as close as possible to the liquid to be pumped, in a position to facilitate maintenance and inspection.
Ensure that the pump doesn't take rough shacks as this may damage the magnets of the internal and external rotor or carbon bearings.
Ensure that the heated air from other units does not affect the pump; the air temperature must not exceed 40 °C, for higher temperatures contact your distributor *M PUMPS*; ensure also the free circulation of air cooling of at least ¼ the engine diameter, because either the pump or the motor should be able to dissipate the heat by natural air convection. Insufficient cooling could lead to high surface temperatures of the bearings

seat, poor lubrication and premature failure of bearings. Useful is the monitoring of the surface bearings' temperature.
It is always responsibility of the operator to keep low the temperature of the liquid so that not to superheat the pump: in case of irregular pressure fluctuations and flow drop turn off the pump.

CAUTION 	– Normally you should mount the pump horizontally. If mounted vertically or inclined, the pump, or rather the suction flange shall be placed in the lowest point. Leave a space of at least 50 cm between the pump and any walls or pipes. – When pumping liquid can reach high temperatures: form 60 °C upwards you must install protections to prevent contact with hot pump parts; – Connect to the ground the entire pump casing to prevent accumulation of static electricity; – If the pumped liquid can be dangerous to people and environment, the user must take precautions for a simple and quick block in case of leakage for breakage/ replacement/ pump maintenance.

12.2. Connection of the pump to suction and discharge pipes

For a proper assembly aimed at an optimal use of the pump, you must follow these requirements:

- pipes must be supported and kept in line regardless of the pump, until its connections, so that not to impose on it;
- links must not be subjected to stresses during the job ;
- inlet pipes should be constructed with as few restrictions as possible in order to have the highest available NPSH;
- the length of pipes , particularly that of the inlet pipe must be minimized;
- the pipe must be placed so that it is not possible the formation of air; if this is not possible, it should be calculated the possibility of bleeding the air from the highest point ;
- during suction use full section valves only;

if there is a possibility that the maximum working pressure can be overcome, for example due to excessive suction pressure, you should take appropriate measures, like choosing for the integrate by-pass valve or by including a safety valve in the pipe;
Avoid using quick-closing valves, because sudden changes of pressure cause water hammer very dangerous for the pump and the pipes;
Before installing the pump, make sure the suction line is clean especially when you start the installation for the first time, in order to avoid any damage to the rotating parts.

1.3. Electrical connections:

DANGER 	The pump is **provided with or without electric motor: only qualified personnel** should carry out mechanical connection of the pump to the motor (for the model without motor) and the electrical connections of the motor to the electrical system. Please read carefully the instructions of the manufacturer of the motor or the manual before you complete the installation.

Make sure that the motor doesn't start during maintenance jobs.

12.4. Checks for the proper operation

We recommend installing a pressure gauge on both inlet and outlet pipes to allow the operator to easily control the proper pump functioning in relation to the required operating point: in case of cavitation or other malfunctions, there will be obvious pressure fluctuations.

Check the differential pressure of the pump between the suction and discharge connections to verify that it works in the point of work provided.
Check that the absolute pressure at suction is not so low to cause the cavitation.

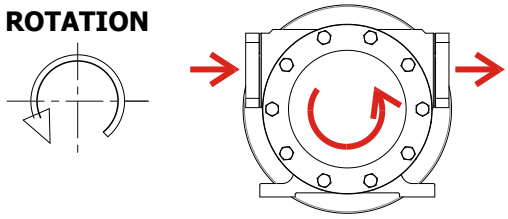
CAUTION	The absolute pressure at pump suction (m) must be at least 0,5 to 1 m, the vapour pressure of the pumped liquid, in order to avoid cavitation.
	Cavitation should always be avoided as it is very dangerous for the structure of the pump. Do not dry run the pump!

12.5. Commissioning and operator training

- Fully open the inlet valve and fill the pump and suction line;
- Ensure there are no obstacles to the free rotation of the pump impeller.

The *M PUMPS* series MHV MAG-M **are reversible** so the rotation can be reversed.
The usual direction is**:**
To control the direction of rotation, give and immediately remove voltage, then observe the direction of rotation.

ROTATION



Make sure that rotating parts, such as flexible coupling or other related organs, are always protected when the pump is running.

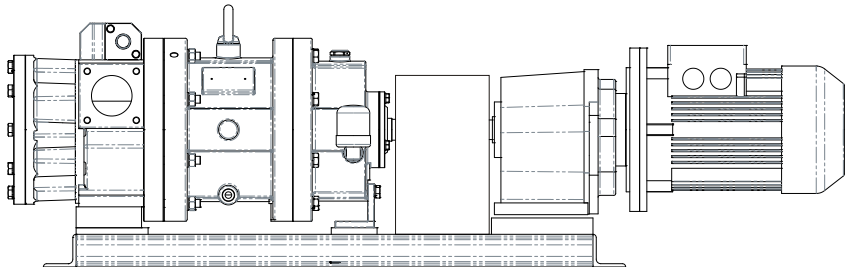
Operators using the pump must have read this manual in the sections committed to the functioning, use and maintenance, as well as being qualified to fully understand the features and to be able to identify the problems of the pump.
By carrying out the functions mentioned in the previous section and all controls listed in the register maintenance, the pump is ready for use.

12.5.1. Self-priming pumps and non self-priming pumps

MHV MAG-M pumps are self-priming: in case that the suction head is negative compared to the discharge, the dry run should not be operated for more than 2 minutes.

12.6. Coupling of the pump to the motor

If the pump and the motor are coupled respect the following sequences to proceed with the installation:



Fit two elastic coupling halves on the pump and the motor.
Position the pump on the base plate.
Place the motor, leave a space of 3mm between the two elastic coupling halves, and then block the motor with the provided screws.

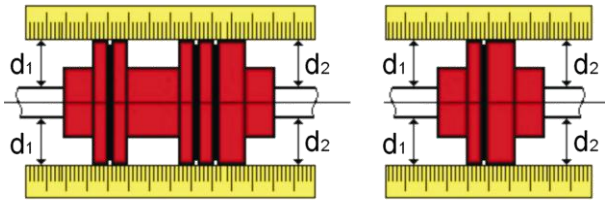
12.7. Features and installation of pump and motor assembly

The shafts of the pump and the motor have already been adjusted and aligned as an extension of one another.
For installation of the plant it is necessary to respect the sequence of actions:

- The base plate must be affixed to an horizontal plane, using also thickness;
- Tighten the nuts of the bolts;
- Check the shafts alignment and the motor alignment and repeat these actions if necessary (described in the paragraph "Alignment of the coupling").

12.8. Alignment of the coupling

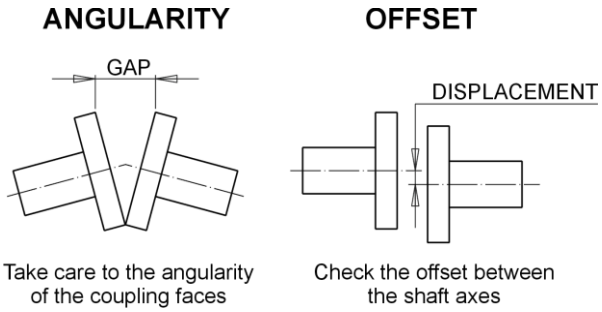
- Place a straight edge on the coupling. Insert or remove any thickness necessary to bring the motor at the correct height, so that the bottom edge of the ruler is placed on both halves of the coupling for the entire length;
- Repeat the same check on both sides of the coupling, at the height of the shaft. Turn the motor shaft so that the bottom edge of the straight edge touches both halves of the coupling for the entire length;
- Reinstall the protection.



12.8.1. Alignment tolerances and coupling

The maximum allowed tolerances for the two halves alignment of the coupling, to be verified with the comparator, are:

TYPE OF COUPLING	OFFSET	ANGLE
Short flexible coupling (3000 rpm)	0.05mm	0.04mm for coupling with diameter 100mm.
Flexible coupling with spacer (3000 rpm)	0.07mm for spacer 100mm.	0.04mm for coupling with diameter 100mm.



13. INTENDED USE OF THE PUMP. IMPROPER USE. DESCRIPTION OF FUNCTIONING.PERSONAL PROTECTIVE EQUIPMENT DURING USE.

13.1. Intended use of the pump

The magnetic drive pump, thanks to its decoupling between the pump and the motor, never enters into direct contact with motor parts, providing a friction effect on the impeller of the pump. The pump works correctly if the parameters specified in the paragraph "TECHNICAL DATA" are followed.

13.2. Instructions for proper use reasonably foreseeable

Before starting work you must check that:

- All maintenance actions were properly carried out according to the time intervals set by *M PUMPS*;
- There are no damaged parts of the pump;

- All the warning stickers and safety licence plates are present and in good condition and are operating the emergency stop buttons (check through a test).

13.3. Not permitted use

While maintaining the conditions of use indicated in the paragraph "TECHNICAL DATA", the ways in which the pump should not be used are given here. To avoid damaging the pump, it is forbidden to use it in the following conditions:

PROHIBITION



- Run the pump dry for more than 2 minutes;
- Mare the pump work with inlet valve and /or outlet closed: the heat generated by the impeller, by magnetic coupling and bearings will boil the liquid, which will cause pump cavitation/vibration, the impeller damaging and the bearings collapse;
- The pump flow should never be adjusted by the valve located in the suction pipe, which must be kept fully open, start and or make the pump work if there are losses;
- Start the pump if there are losses;
- Change working condition of the pump without having consulted the *M PUMPS* technical office;
- loosen the pump connections while under pressure;
- try to clean the pump while it is running;
- run the pump in the opposite direction to that shown in the pump casing;
- run the pump over nominal temperature and pressure;
- pumping liquids containing ferromagnetic particles of any size, or substances that can attack chemically or erode the inside of the pump;
- remove guards and shelters while the pump is running;
- act on electrical parts installed without first removing the tension, not to alter the safety devices installed, do not activate repeatedly the command buttons.

DANGER



It is incorrect any use of the pump other than that mentioned in the paragraph "Instructions for a proper use reasonably foreseeable".
M PUMPS disclaims any liability damages to things and people related to uses for which the pump was not specifically designed and constructed.

Also the ways in which certain situations of danger might present as a result of improper use, are prohibited.

14. RESIDUAL RISKS AND PROTECTION MEASURES TO BE TAKEN

14.1. Description of the residual risks that remain

Despite adopted measures incorporated in the pump, the main dangers associated with the use of the pump and the solutions identified are the followings:
Danger of sketches projection of process fluid that can be corrosive or burning, as a result of improper installation and sudden ruptures of the pump casing and hydraulic lines;
Danger of cuts to the hands due to the presence of smears on the pump casing;
Explosion of the pump is due to a formation of explosive mixture inside the pump casing as a result of an improper use.

14.2. Protection measures to be taken by the user and instructions

PROHIBITION



It is absolutely forbidden to the user to tamper with safety devices. Before using the pump check the proper couplings mechanical protection. Any tampering nullifies the warranty and liability of *M PUMPS* towards the pump users.

Only maintenance personnel can perform maintenance operation affecting safety devices.

14.3. Personal protective equipment to wear

Protection measures that have to be taken during this phase are adopting antacid and antistatic coverall, chemical-resistant glasses, gloves to protect from mechanical and chemical agents and safety shoes.
Avoid the use of accessories (necklaces, bracelets, etc.) and clothes unshackled; torn or dangling that could get entangled in parts of the structure.

15. OPERATIONAL LIMITS, DESCRIPTION OF HAZARDS NOT EXCLUDED FROM THE SECURITY MEASURES TAKEN

Dangers that have not been reduced/ eliminated with the security measures adopted on the pump can be reduced/eliminated if operators apply measures on management as a result of having to:

- Keep all the safety warnings of and all plaques and labels intact and replace them when necessary, periodically checking their good condition;
- Don't employ substances which may affect the physical ability or the mental faculty (alcoholic beverages, medicines, drugs, etc);
- Don't use without permission spare parts not identical to the originals or components not approved by *M PUMPS*;
- Don't perform any modification or structural intervention without the approval of *M PUMPS*;
- After shocks accidentally suffered by the pump, check the pump integrity and perform a check to
- *M PUMPS*;
- After a long period of pump detention check the pump integrity and functionality of stakeholders to wear. If necessary perform the replacement with identical spare parts to the originals.

CAUTION



Each of the misuse or negligence listed here causes:

- immediate cancellation of *M PUMPS* assistance.
- cancellation of *M PUMPS* responsibility for damage to property, animals or people.

15.1. Safety information present on the pump

Safety warnings applied to the pump must be respected and restored in case of illegibility, and are as follow:

Warning	Description signs applied	Symbol/indication	Quantity	Notes
1.	Marking plate *M PUMPS*.	As described in paragraph "PLATE"	1	1
2.	Hydro-test label		1	3
3.	Label quality control assembly		1	Internal use

INSTRUCTIONS AND PROCEDURES FOR THE TRAINING OF THE PERSONEL AND FOR EMERGENCIES

Operators responsible for the various life stages of the pump must be:
-for assemblers: staff formed and trained on good practices for handling of goods with the use of tools and lifting equipment;
-for installers of pipes and electrical connections: qualified and trained staff to operate on electrical plants, staff with experience in hydraulic installations;
-for users: professional staff trained in the instruction for use of this pump.
In case of emergency:
-alert who is close to the situation of danger, even waving his arms;
-stop the pump by pressing the nearest emergency stop button;

15.2. Recovery mode

To return to normal operating conditions, you must delete all the causes that have generated the emergency, possibly repairing or replacing the components that caused the failure.

CAUTION



After the intervention of security devices, you must find the cause of action before continuing operations.

15.3. Fire-fighting equipment to be used:

In case of fire involving the pump, you can use water or foam liquid only after removing the voltage, or a powder type fire extinguisher with extinguishing agent. Do not use CO2 as being launched at -79 ° C may react violently with the hot parts.

15.4. Emission / dispersion of harmful substances

The fluid in the plant might be released in the atmosphere following an intervention or the pump break.

16. MALFUNCTIONING, FAILURE, BREAKDOWN, ACCIDENT. MOST FREQUENT PROBLEMS: CAUSES AND REMEDIES

There aren't pump details which provide such cases of malfunctioning as to restrict or make its use dangerous.
In paragraph "Most frequent drawbacks: causes and remedy" is discussed with more details in this section.

16.1. Malfunctioning

16.2. Failure

In case of failure of mechanical parts you must immediately restore the original terms of security by replacing or repairing the parts that have deficiencies.
In case of failure of the pump, proceed as follows:

- Turn the motor off;
- close the inlet and outlet valves;
- find the cause of the failure by checking the section " Most frequent drawbacks: problems, causes, remedies, residual risks".

The failure of a pumping plant can be attributed to:

- a pump failure;
- a failure or defect in the pipe;
- a failure due to an installation or a start not correctly executed;
- wrong choice of pump.

16.3. Breakdown

In the event of failure of pump alert verbally the staff present in the nearness of the damage that is verifying.

16.4. Accident

In case of accident, you must report the emergency to the plant responsible for the installation, in order to secure the plant to reach with the emergency team the place where the accident happened.

16.5. Most frequent drawbacks: problems, causes, remedies, residual risks

INSUFFICIENT FLOWS	
Causes	**Remedies / actions to be taken**
The head requested exceeds the pump head expected.	Increase the speed rotation if possible. Mount an impeller of greater diameter Reduce the total head of the system if possible. Increase the diameter of the discharge pipe. Check that the discharge valve is fully open. Replace the pump. Ask your *M PUMPS* distributor.
The pump rotates in the opposite direction.	Check the direction of rotation. Refer to section 3.5 of this manual
Air or steam trapped in the suction.	Check the presence of air or steam trapped. Refer to section 3.4 of this manual.
The liquid contains air or steam. The liquid produces foam.	Check the presence of vortices in the suction line. Enter some in the fuel tank to prevent the formation of vortices. Install a tank of sufficient capacity in the suction line to allow gas to drag.
Insufficient inlet pressure, with the generation of cavitation and loss of efficiency.	Increase the static height at the suction. Check that the intake is not blocked or are no bottlenecks. Reduce the liquid temperature. Increase the diameter of the intake pipes. Reduce the length of inlet pipes. Open completely the inlet valve. Check the viscosity of the liquid; refer to "technical data" section of this manual, increase the temperature of the liquid if necessary.
The temperature of the liquid is close to boiling point	Reduce the liquid temperature.
NO FLOW	
Causes	**Remedies / actions**
The pump is defused	Re-prime the pump. Refer to section 3.5.1 of this manual. Check for air leaks in the suction line
Suction line blocked	Ensure that there are no blind pipes, obstructed or valves closed.

The magnetic coupling decouples	Reduce the flow: partially close the discharge valve. Reduce the density of the liquid, if possible. Reduce the prevalence of the pump (check in advance with your distributor *M PUMPS*). Make sure the pump turns freely; inspect the inside in case this does not happen. Reduce the engine power installed (check in advance with your distributor *M PUMPS*). Adopt star-delta starting.
The motor stopped	Check the power of the motor. Check the status of the motor.
EXCESSIVE FLOW	
Causes	**Remedies / actions**
The head required is lower than that provided by the pump	Reduce the speed of rotation, if possible; reduce the impeller diameter; partially close the discharge valve.
OVERHEATING OR MOTOR STOP	
Excessive pumped liquid density	Reduce the flow by closing the valve outlet partially
The pump has sized or is about to seize.	Check the free rotation of the impeller. Check for internal obstruction.
The motor and pump are misaligned	Refer to section 3.8 of this manual
The motor bearings are damaged or worn.	Replace the motor bearings, investigate the causes of breakage.
Motor under dimensioned	Mount a more powerful motor (check in advance with your distributor *M PUMPS*).
Motor overload threshold set incorrectly	Check the security settings of the motor
The guard against the motor dry running (where present) has failed or has been set incorrectly.	Control flow decreases or fluid intake.
FUNCTIONING WITH NOISE DEFECTS AND/OR VIBRATIONS	
Causes	**Remedies / actions**

Insufficient inlet pressure, consequent cavitation, insufficient lubrication of the bearings (with mechanical damages if the condition persists). STOP IMMEDIATELY THE PUMP!	Refer to paragraphs 3.4, 3.5, 4.1, 4.2, 4.3 of this manual
Wear, erosion and immediate damage to the impeller and internal bearings.	Check inside the pump damages or obstructions.
Wear of the coupling motor-pump	Replace the coupling and proceed to the realignment of pump and motor.
Ball bearings or motor failure.	Check and replace them if necessary.
Uninsured motor or base plate.	**Make sure that the motor and base plate are firmly anchored to foundations and do not produce any abnormal vibration.**
Misalignment or improper anchoring of the pipes.	Check correct alignment of pipes and supports, refer to section 3.2 of this manual.
The pump was started while still rotating in the opposite direction, for a previous start.	Stop immediately the pump and drain all the liquid from the discharge line before restarting.
OVERHEATING OF EXTERNAL BEARINGS (bare shaft versions)	
Lack of oil or wrong type of oil in the bearing frame.	**Check the oil level: fill up or empty, and replace it if necessary. Replace the bearings.**
Excessive oil temperature into the bearing frame.	Fill the bearing frame with oil ras indicated in the paragraph to restore the correct working temperatures.

17. PERIODIC AND EXTRAORDINARY MAINTENANCE

Proper maintenance and use are essential factors to ensure the functionality and pump lifetime.

17.1. Cleaning components and magnet

To clean all surfaces of the couplings and centering surfaces, use possibly methyl alcohol. Use paper towels instead. Do not use solvents and other corrosive liquids on magnet to avoid damaging it; any dirt can be removed from the magnets by using gummed paper. Do not hack or put pressure on the magnet during its handling, it would cause them, damages because of their fragility.

17.2. Periodic preventive maintenance

Instructions relating to maintenance activities whose implementation do not require specific skills that can then be made by users of the pump, are given. They are operations and inspections planned on issues considered important for technical, operational and security staff, determined on the basis of the knowledge gained from *M PUMPS*. If the hydraulic pump is washed with jet in pressure, prevent the entry of water into the terminal of the motor.

DANGER 	Do not throw water on the pump hot components: components can explode in case of sudden cooling generating projection of metallic material and leakage of hot fluid in pressure and hazardous to health. Do not give strokes and pressures on the bearings, you would cause the formation of micro-cracks which can cause serious damages.

N.	Description control / intervention: implementation rules	Warnings and protective measures be taken to perform the maintenance properly and safely	Time
1	Ball bearing frame	Top up the oil until the middle of the eye plug	Weekly. Replace oil every 5,000 hours.
2	Internal bearings	Check the status of bushings, sleeve bearings and thrust bearings, replace them if worn	After 2500 hours, check any premature wear, then every 5,000hours or every year.
3	Motor bearings	Unless other specifications, motor bearings are greased for life, so there is not a maintenance schedule, anyway it is recommended to check the condition of the bearings and replace them when worn	

RECOMMENDED: (TABLE OILS for ambient temperatures exceeding 15 ° c, by classification ISO VG 68)

 **CAUTION**

BP HPL 68
CHEVRON EP industrial oil 68
Texaco Rando Oil HDC 68
TOTAL Azolla 68
Shell Tellus 68
Mobil DTE Heavy Medium ISO 68
STATOIL HYDRAWAY HV 68
Esso Teresso 68 / AGIP OSO 68

In **Appendix A** is a list of periodic maintenance and inspections to be completed each time you perform such operations.

17.2.1. Emptying of the fluid contained in the pump

Before disassembling, you must empty the liquid from the pump according to the following steps:

- Operate the pump with empty suction line, until all the pumped product is pushed to the discharge side
- Close the valve located into discharge line

If hazardous to health liquids are pumped, wear suitable personal protective equipment.

17.2.2. Draining the oil contained in the pump

If the pump is lubricated with oil (bare shaft versions):

- remove the oil drain plug;
- drain the oil and collected it without dispersing into the environment;
- replace the drain plug .

If there are fluids hazardous to health, wear personal protective equipment suitable before coming into contact with the liquid.

17.3. Extraordinary maintenance

The extraordinary maintenance operations concern the activities that are beyond those typically programmable and executable; they require precise technical expertise by qualified personnel, and then you should contact *M PUMPS*. Delivery is the one shown in the header of every page of this manual.

DANGER 	If it becomes necessary to disassemble the pump, you must remember that the liquid should be collected and disposed in accordance to existing environmental laws. If the pump should be sent to *M PUMPS* it must be drained, and should not contain any traces of liquid pumped.

18. REPAIR AND PARTS REPLACEMENT

The pump must always be kept in optimum conditions of operation.

Most of the spare parts have clear and comprehensive references for their identification. It is important that the spares are replaced by similar ones so that they can be considered equivalent in quality and safety: to order original spare parts, contact *M PUMPS* referring to the model of the pump, employee number, description of the component and the quantity needed.

When you see elements with rust, cracks, etc, you must perform all replacements/repairs necessary to re-establish the conditions of the pump safe working. In any case you should always ask an opinion *M PUMPS* before any intervention.

The periodic maintenance specified in the" PERIODIC AND EXTRAORDINARY MAINTENANCE"

To allow a smooth running for a long time is necessary to make the required maintenance.

Operators should make frequent visual inspections to check that the pump is running smoothly without noise or vibration, and that the discharge pressure is holding steady, without fluctuation, at the correct figure. Over-heating of the pump or motor bearings is cause for alarm. The bearing housing should not be more than 50°C above ambient temperature, nor should it exceed 80°C (too hot to touch) in any event. If the bearings overheat, shut the pump down immediately, investigate the cause, and take corrective action.

18.1. Pump disassembling

If the pump has pumped hot liquids, make sure that it has been cooled before disassembly. The pump may have pumped liquid hazardous to health is therefore necessary to wear personal protective equipment.
Before to proceed with disassembling, follow carefully the decommissioning instructions, at paragraph 20.2.
The activities of disassembly and maintenance of the pump should be conducted in full compliance with current health and safety regulations. Some spare parts may have potential health risk to the operators:

CAUTION 	*M PUMPS* disclaims any liability for damage to property and people and will invalidate the warranty if you install non original.
MAGNETIC 	The pumps built by *M PUMPS* contain extremely strong magnets. The use of tools and work surfaces not ferromagnetic is highly recommended. The department in which you perform maintenance must be clean and free of iron particles that may be attracted by magnets. **Pay attention to the strong magnetic attraction** when you work in proximity of the internal or external magnets. Tools can be strongly attracted by magnets, or slip from the hands causing damages to fingers and hands, moreover, the magnets maybe strongly attracted by ferromagnetic devices present in the area.

For dismantling and maintenance instructions, refer to specific documentation.

18.2. Pump reassembling

To reassemble the pump, follow maintenance procedure in reverse order. Clean each component before assembly; make sure that all parts are free from dirt, metallic particles, etc.

19. DECOMMISSIONING, DISMANTLING AND DISPOSAL OF MATERIALS

19.1. Decommissioning

For an eventual long time decommissioning, it is advisable to apply some simple precautions to preserve correctly the pump.
Make the pump run with clean water (or other suitable solvent compatible with the materials of the pump) for several minutes, in order to avoid the risk of liquid precipitation or deposits. Disconnect from the electric power / liquid supply and place it in a protected site.
During the commissioning after a long period of stocking, carefully follow all recommendations for commissioning described at paragraph 3.5 of this manual.

CAUTION 	A good stocking will guarantee against unpleasant incidents during the restarting of the pump. *M PUMPS* disclaims any responsibility for machines stored incorrectly. If you intend to stop using this pump it is recommended to make it inoperative.

19.2. Demolition and dismantling

The user must comply with the legislation on environmental conservation and will have to deal with the disposal and elimination of materials and harmful substances of the pump components. It is recommended to destroy the identification plates of the pump and any other document.

20. EXPLODED VIEW PART LIST

See attached documents.

21. NOTES

22. APPENDIX A – Register of maintenance and periodic checks of the pump

It is provided a list of maintenances to be carried out and their respective ranges; you must register these operations.

Commissioning date: _____

Main maintenance operations to be performed by the second year of use onwards:

N.	**Required check**	Warnings and protective measures be taken to perform maintenance properly and safely	**Range**
1	Check oil level at bearing frame	Top up the oil until the middle of the eye plug	Weekly. Replace the oil every 5000 hours.
2	Internal bearings	Check the condition of bushings, sleeve bearings and thrust bearing if worn replace them, reassemble using new gaskets	After 2500 hours, check any premature wear, then every 5,000 hours or every year.
4	Motor bearings	Unless other specifications, motor bearings are greased for life, so there is not a maintenance schedule, anyway it is recommended to check the condition of the bearings and replace them when worn	

DATE	DESCRIPTION OF OPERATION (report the numbers associated with intervention and any operations carried out in addition)	OPERATOR SIGNATURE

M PUMPS s.r.l. Via dell'Artigianato, 120
45015 - Corbola (RO) – Italy
info@mpumps.it
www.mpumps.it
Tel. +39 0426 34 63 04
Fax. +39 0426 34 91 26

Member of CISQ Federation
RINA
ISO 9001:2008
Sistema Qualità Certificato
ISO 14001:2004
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FSC