COMPANY
WITH QUALITY SYSTEM
CERTIFIED BY DNV
=ISO 9001/2000=

WATER

Series

USE AND MAINTENANCE MANUAL

PREMISE

The vacuum pumps Farid - division MORO S.p.A. are designed and manufactured in compliance with EC safety standards and subject to risk evaluation according to standard EN 1050; in particular they comply with directive 98/37/CE and later amendments and integrations. This manual includes the Declaration of the Manufacturer as per the above directive and all the indications necessary to the users and manufacturers of equipment to use our product s in safety; thus the manual must always be kept near the vacuum pumps. It is necessary to read carefully the instructions included in this manual before proceeding with any operation with or on the vacuum pumps.

This symbol of danger in the manual means that important safety instructions are given. These are directed to the operator, who is responsible for their respect by him and as well by other people exposed to the risks related to the use of the equipment.

The descriptions and illustrations in this manual are solely indicative. The Manufacturer reserves the right to perform any type of change, at any time.

WARRANTY

When receiving the equipment, verify that all the parts of the vacuum pump are included. Any anomaly or missing part must be notified within 8 days from receipt. The Supplier guarantees that the goods sold are exempt from faults and defects and undertakes, only when such faults are clearly due to the manufacturing process or to the materials used, to repair or, based on its final assessm ent, to replace the defective parts. The Buyer shall be fully charged for labour, travel, transport, and duty expenses (if any). The Seller is not liable for damage compensation except in case of malice or negligence. The parts normally subject to wear are not covered by the warranty. Warranty is void in the following cases:

- The defects are due to accidents or evident negligence of the Buyer.
- The parts have been modified, repaired or fitted by people not authorized by the Seller.
- Failures and breakages have been caused by unsuitable uses or stresses exceeding those indicated in the maintenance booklet provided by the seller.
- The buyer has not complied with contractual payment obligations. The right to the warranty of the Buyer is void if the defects are not noticed to the Seller within 8 days form their discovery, in derogation to the clause 1512 of the Civil Code. The Seller reserves the right to change or improve its products without being obliged to change or improve the previously manufactured and/or delivered units. The Seller is not responsible for incidents or effects of the accidents on persons or goods due to defects of materials and/or manufacturing.

MANDATORY SAFETY SIGNS THAT MUST BE POSITION ED ON THE WORKPLACE AND AROUND THE VACUUM PUMP

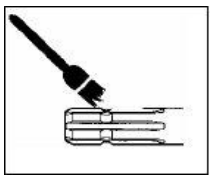
Moving parts

Danger of high temperature

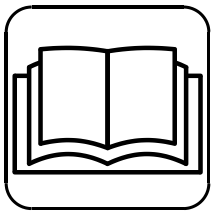
Crushing

Mandatory personal protection devices

Do not enter the work area of the moving cardan transmission, avoid work garments with loose parts.



Periodically lubricate the power takeoff.



Read this manual before starting to use the vacuum pump

Before startup verify the rotation direction of the switch lever to select Aspiration or Compression.

USE CONDITIONS AND LIMITS - LIST OF DANGERS

Installation must comply, f or EC countries, with directive 98/37/CE and later amendments, while for the other countries it must comply with local safety standards.
This vacuum pump is designed to create a vacuum or a pressure inside the connected tank. Inside the vacuum pump no liquid, dust and solid material must enter because they may damage it. It is necessary therefore to provide the equipment with safety overfill valves.

Any use of the vacuum pump, different from the above one, is to be considered as strictly forbidden, not foreseen by the Manufacturer and thus highly dangerous.

Do not use the vacuum pump for fluids, flammable materials, explosives or materials which release flammable gas.

Do not use the vacuum pump in potentially explosive atmospheres.

Never remove the safeties provided on the vacuum pump and check for their efficiency each time the machine is used.

Any work must be performed with machine stopped.

Non compliance with the indications of this manual can generate the following dangers:

Danger of crushing due to the mass of the vacuum pump during handling and transport.

Danger of entanglement in the moving parts in case of removal of the guards.

Thermal dangers due to high temperature reached by the vacuum pump.

Acoustic danger due to the noise generate d and to non use of personal protection devices.

Shearing danger for the operator during test with aspiration and delivery tubes detached from the pump.

Danger of projection of solid and liquid materials due to severe breakage of the vacuum pump.

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1 GENERAL INFORMATION

1.1 VERSIONS OF THE VACUUM PUMP.

The vacuum pumps of the series WATER can be delivered in the following versions:

SERIES WATER	WM	WP	WD	WH
P M 6 0 W	O	O	O	O
P M 8 0 W	O	O	O	O
P M 11 0 W	O	O	O	O

Table 1 O = Available

TECHNICAL SPECIFICATIONS				
Description	Ref.	PM 60…	PM 80…	PM 110…
Free flow rate	c.f.m.	254,4	328,6	498,2
Free flow rate	m3/h	432	558	846
Max. drained power	Hp	24	46	55
Max. vacuum	%	95	95	95
Max. absolute pressure	p.s.i.	42.6	42.6	42.6
Weight	Pound	363	475	612

Table 2

1.1.1 version WM with gearbox

- The power takeoff is driven by acardan shaft at 540 rpm. The v ersion can be recognized by the overgear box and by the identification plate located on the vacuum pump.

1.1.2 version WP with pulley application

- The power takeoff is driven by a drive pulley (not provided) and an idle pulley (provided on request). The version can be recognized by the identification plate located on the vacuum pump.

1.1.3 version WD with power takeoff

- The power takeoff is driven by a cardan shaft at 1000 rpm. The version can be recognized by the grooved coupling DIN 9611 Ø1"3/8 located at the inlet of the vacuum pump and by the identification plate located on the vacuum pump.

1.1.4 version WH with hydraulic power

- The power takeoff is driven by a hydraulic motor (provided on request) and it is recognizable by the support for hydraulic motor and by the identification plate located on the vacuum pump.

1.2 PACKING, STORAGE, HANDLING AND TRANSPORT.

1.2.1 PACKING

The vacuum pumps series WATER are provided with packing made of seaworthy wood crates.

1.2.2 STORAGE

For correct storage, the vacuum pump must be stored:

- indoor, protected from weather conditions;
- in horizontal position, resting on 4 feet.
- The vacuum pumps are lubricated, during test, at our plant, with a specific oil which ensures lubrication of inner components for approx. 6 months. In case of storage, we recommend to clean the inside of the pump with naphtha and oil (as indicated in this manual at paragraph *12.1 - CLEANING*).

1.2.3 HANDLING AND TRANSPORT

Mass of the vacuum pump: (*see Technical Specifications*).

The vacuum pump must be:

1. Slung by metal hooks to be inserted into the eyebolt, or sling.
2. Lifted by forklift (if on pallet), bridge crane, crane.

The vacuum pumps version WATER/WM and WATER/WD are provided, as standard, with protection compliant with EC directives, which must be fitted by the installer using the screws provided. For all versions, two aspiration/discharge curves are provided separately. They shall be fitted by the Installer by means of the screws and washers provided.

2 ASSEMB LY, INSTALLATION, DISASSEMBLY, REASSEMBLY

2.1 LAYOUT OF THE HYDRAULIC SYSTEMS FOR VACUUM PUMPS VERSION …WH.

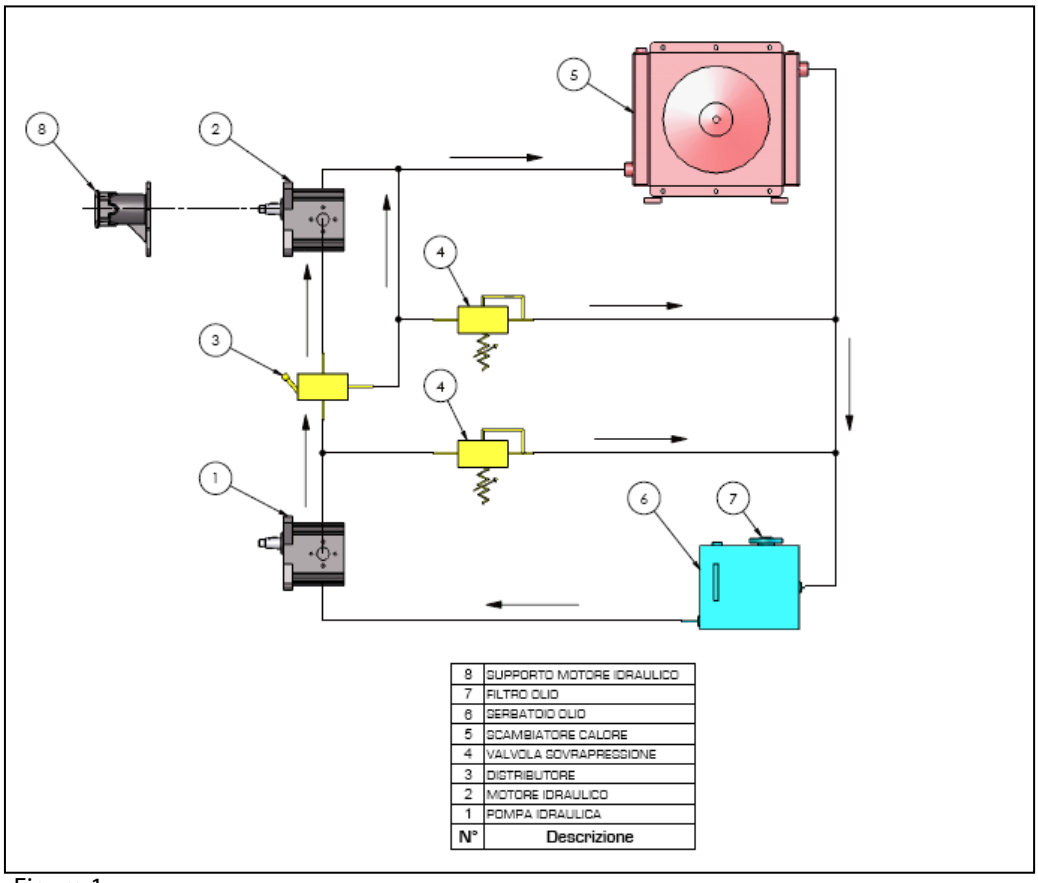


Figure 1

Vacuum pump model	Hydraulic motor model	Hydraulic motor displacement	Max. R.p.M.	Max. pressure	Transmitt ed power
PM 60 WH	KM 40.73	3,6 c.f.m.	1400	1562 p.s.i.	28 Hp
PM 80 WH	KM 40,109	5,4 c.f.m.	1400	2059 p.s.i.	40 Hp
PM 110 WH	KM 40,109	5,4 c.f.m.	1400	2726 p.s.i.	54 Hp

Table 3

The layout of the hydraulic system required for the operation of the vacuum pump PM … WH is indicated in fig. 1 and the technical features of the hydraulic motor in table 3. The keying of the hydraulic motor is of type DIN 5482 Z=23. In case of unidirectional motors, make sure that the direction of rotation is coherent with the connections of the hydraulic circuit.

2.2 HYDRAULIC OIL TANK:

The capacity of the tank must be suitable for the operating conditions of the system (about 3 times the circulating oil). To avoid overheating of the fluid, if necessary, install a heat exchanger. In the tank the return and aspiration ducts must be spaced by a vertical panel to prevent return oil from being immediately aspired again.

2.3 TUBING:

The nominal diameter of the tubing must not be smaller than the diameter of the hydraulic motor inlets and they must be perfectly sealed. We recommend to use a section of flexible hose on the tubing, to reduce the transmission of vibrations. All return tubing must end below the minimum oil level, to avoid the creation of foam.

2.4 FILTERING:

We recommend filtering over the entire system.

2.5 DRAIN HOLE:

In bi-directional motors with drain hole, which we recommend, it is necessary to connect the hole to the oil tank with a tubing with a diameter of at least 22mm. To avoid the creation of foam inside the tank, the tube must be connected below the minimum level.

2.6 HYDRAULIC FLUID:

Use hydraulic fluids compliant with standards ISO/DIN. Avoid mixes of different oils which may cause oil decomposition, reducing its lubricating power.

2.7 COMMISSIONING:

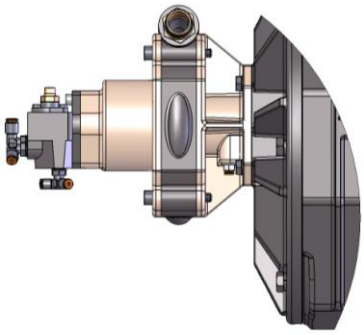
Make sure that all the connections of the circuit are correct and that the system is clean. Introduce the oil in the tank using a filter. Purge the circuit to ease the filling of the system. Set the pressure limiting valves at the lowest possible value. Start the system for a few seconds at minimum speed, then purge again the circuit and check for the oil level in the tanks. If the temperature gap between the motor and the fluid exceeds 10° C, start and stop the system for short periods, to achieve progressive heating. Gradually increase the pressure and the rotation speed until the foreseen operating values are reached, which shall be within the rated limits.

2.8 PERIODIC CHECKS - MAINTENANCE:

Keep clean the external surface. To maintain the fluid clean, periodically replace the filter. According to the work conditions of the system, the oil level must be checked and periodically replaced.

3 COOLING SYSTEM.

3.1 GENERAL



The vacuum pumps series WATER are provided, as standard, with a pump for the circulation of the coolant. The water pump provided has a double rotation direction and a capacity of approx. 40 litres with a max. head of about 0.4 bar. To reverse the rotation of the water pump it is necessary to rotate the scroll. It is directly fitted to the motor shaft in the rear of the vacuum pump together with the automatic lubrication pump. We recommend not to exceed the rated head when installing vacuum pump/heat exchanger.

To reverse the rotation of the water pump, it is necessary to rotate the scroll. The maximum temperature of the coolant, in the system, shall not exceed 60°C. Please notice that the performance of the vacuum pump increases when the operating temperature decreases (fig. 4).

3.2 COOLING CIRCUIT

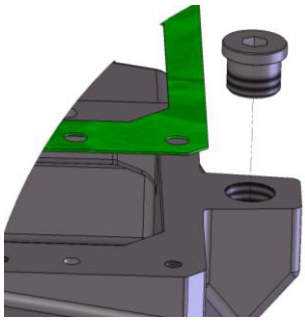


Figure 2

Before commissioning, it is necessary to completely fill the cooling circuit. To perform this operation, unscrew the iron cap (fig. 2 and 3) located in the top area of the vacuum pump body and introduce the liquid by means of the supply tank until the fluid overflows from the abovementioned hole.

Figure 3

3.2.1 COOLING CIRCUIT WI TH EXCHANGER AND ELECTRIC FAN

The cooling circuit can be provided with a heat exchanger to cool the liquid circulating in the system. This system is strongly recommended if the vacuum pump is used for extended periods, even if occasionally. The specifications of this system are indicated in the table 4-5 – figure 4 below.

1	Compensatory tank.	6	Return of the liquid
2	Heat exchanger	7	Battery 12 – 24 V
3	Thermostat	8	Electric fan 12 – 24 V

4	Liquid recycle pump	9	Fuse 8A
5	Liquid delivery	10	Partial closure cock

Table 4

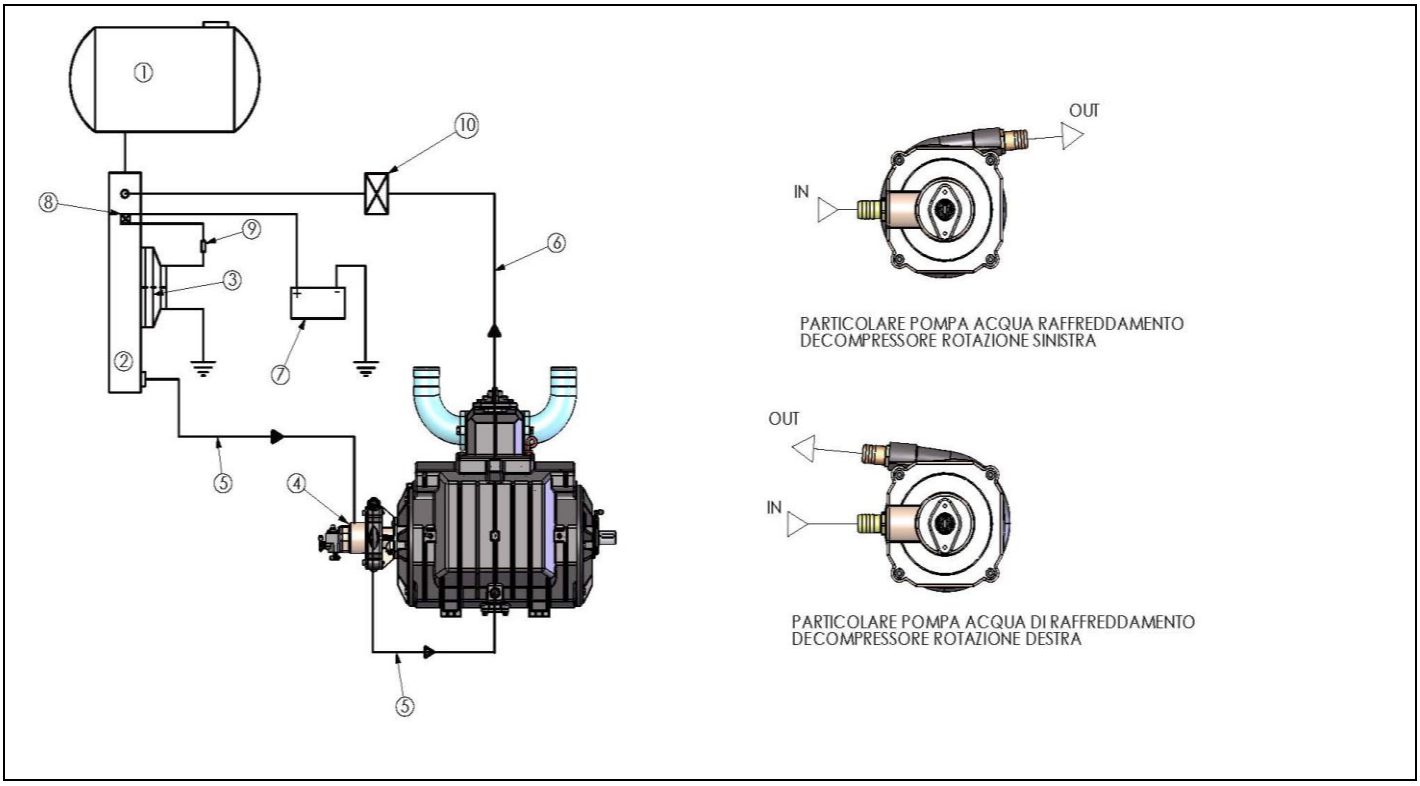


Figure 4

Vacuum pump model	Flow rate water pump (c.f.m.)	Rotation speed (RpM)	Capacity of the compensatory tank (USA pint)	Diameter of the connection tubing (")	Heat to be dissipated (kJ/h)
PM 60 W…	1,62	1400	10.6 – 14.8	¾" - 1"	10000
PM 80 W…	1,62	1400	10.6 – 14.8	¾" - 1"	13000
PM 110W…	1,62	1400	14.8 – 21.1	¾" - 1"	15000

Table 5

3.3 THERMOSTAT

The cooling system can be provided with a thermostat which, after calibration, enables automatic operation of the electric fan when the set temperature is reached.

3.4 PRESCRIPTIONS

- *Always introduce antifreeze liquid in the cooling circuit, according to the amount recommended by the suppliers.*
- *Completely fill the cooling circuit, introducing water by means of the supply tank.*

- *Make sure that no air remains in the circuit , since water circulation would be blocked and the liquid would heat.*
- *In case of anomaly or malfunction of the cooling circuit, the operating time shall be significantly reduced.*

4 ASSEMBLY, MOUNTING, INSTALLATION.

During the above operations, we recomme nd to use the personal protection devices listed in this manual.

All the operations must be performed with maximum care by skilled personnel, with the vacuum pump switched off and the power take off disengaged.

It is absolutely mandatory to avoid the penetration of foreign bodies or liquid in the vacuum pump. This may cause the breakage of components of the pump such as, for instance, the blades or the impeller or the pump body.

4.1 INSTALLATION LAYOUT OF VACUUM PUMP SERIES WATER.

It is necessary to provide the system with:

- Primary valve (ref. 1)
- Secondary valve (ref. 2)
- Aspiration filter (ref. 3)
- Overpressure valve (ref. 4)
- Vacuum regulation valve (ref. 5)
- Vacuum gauge (ref. 6)
- Air-water heat exchanger (ref. 7)
- Silencer with oil recovery (ref. 8)

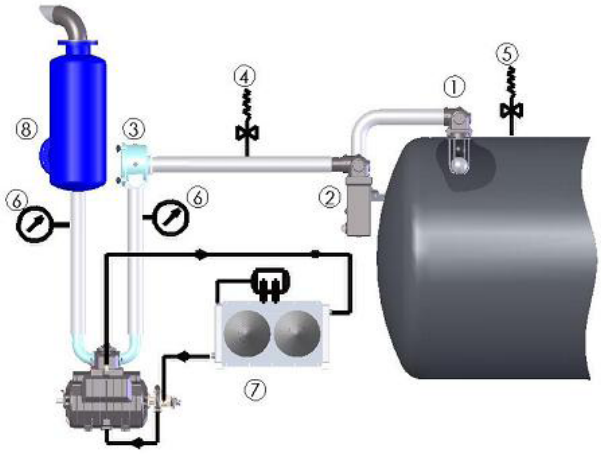
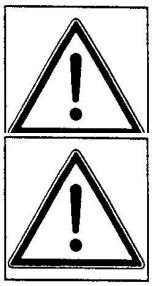


Figure 5



Maintenance, inspection and controls, repairs, must be performed with maximum care, with the auxiliary motor switched off and the power take off disengaged.

It is absolutely mandatory to avoid the penetration of foreign bodies in the vacuum pumps. The penetration of sewage is responsible for the breakage of the blades and, consequently, of the rotor. It is thus necessary to provide the system with a primary valve "1" and a secondary valve "2" between the vacuum pump and the tank (Figure 4).

4.2 ASSEMBLY – MOUNTING – INSTALLATION – UNINSTALLATION

The vacuum pump must be assembled and installed following this procedure:

4.2.1 – Assemble the vacuum pump in horizontal position with its feet facing downward. Its position on the vehicle must be easily accessible and protected. It is necessary as well to provide sufficient space for aspiration and delivery tubing. It is necessary not to exceed a longitudinal angle of 5° on the horizontal plane. Fasten the vacuum pump to its support by means of specific screws to be positioned inside the specific slots at the feet of the vacuum pump.

4.2.3P – To install the vacuum pump version PM … WP (pulley drive), it is necessary to insert an idle pulley on the shaft of the power takeoff (PTO) and fasten it by means of a screw located in the front area of the shaft. The idle pulley can be directly mounted on the cylindrical shaft, bringing the radial load as near as possible to the front bearing. Never transmit axial loads. Connect the idle pulley to the drive pulley by means of drive belts of suitable length. The number and type of belts must be calculated based on the power to be transmitted. At the end of the operation, it is necessary to install the guard required to protect the drive organs (pulleys and belts) preventing access by the operators.

The tension of the belts must be such as, with tightened belts, they can be tightened by further 2 cm. Excessive tightening of the belts may damage the shaft.

4.2.3M – To connect the vacuum pump PM … WM, connect the cardan shaft between the 540 RpM drive and the PTO shaft of the vacuum pump.

4.2.3D – To connect the vacuum pump PM … WD, connect the cardan shaft between the 1000 RpM drive and the PTO shaft of the vacuum pump.

Do not exceed the maximum allowed angle of the c ardan shaft; refer to the instructions of the manufacturer of the cardan shaft.

4.2.3H – To install the vacuum pump version PM … WH, fit an hydraulic motor (4 hole SAE/C flange – ANSI 127 -4) on the support of the motor, by means of the specific screws, a nd connect it to the dedicated hydraulic pump (see chapter 3 – Layout of the hydraulic system).

4.2.1 – Connect the aspiration/delivery rubber hose to the valves on the tank, fastening it by metallic clamps to the aspiration curve.

4.2.5 – Then connect the coolant circuit by means of rubber hoses suitable for the temperature reached by the fluid.

4.3 UNINSTALLATION

4.3.1 – Stop the power takeoff, drive pulley or hydraulic drive;
4.3.2 – Disconnect the motion transmission organs;
4.3.3 – Remove all connection tubing (aspiration, delivery, hydraulic, cooling, etc.) between the vacuum pump and the system;
4.3.4 – Remove the screws which fasten the vacuum pump to the support plate.

5 COMMISSIONING:

5.1 DIRECTION OF ROTATION

Before starting the vacuum pump, make sure that the shaft of the power takeoff rotates freely and that the direction of rotation is the same as that indicated by the arrow on the vacuum pump, above the power takeoff.

The vacuum pump shall never rotate in the direction opposite to the designed one (indicated by the arrow), because the damage of some parts as well as wrong operation of the vacuum pump are likely. If it is necessary to reverse the direction of rotation, contact the supplier of the system.

6 LUBRICATION SYSTEM

All the vacuum pumps series Water b y Farid – divisione Moro - are provided, as standard, with an automatic lubrication pump. With this system, lubrication is performed at all stages by means of an adjustable piston pump located at the rear of the vacuum pump, driven by the motor shaft.

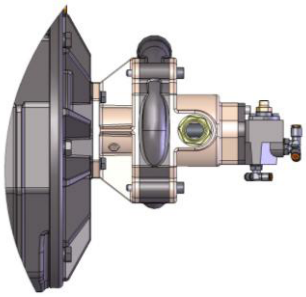


Figure 6 – Water pump and oil pump

6.1 OIL TO BE USED

The vacuum pump is provided WITHOUT lubrication oil inside the tank and the overgear, if present. Only use the following types of mineral oil:

OIL TANK: Mineral oil ISO VG 100

OVERGEAR BOX: Mineral oil ISO VG 460.

Never use hydraulic or detergent oil.

6.2 OIL LEVEL

Vacuum pump version PM … WP/WD/WH/WM: the oil level inside the oil tank can be checked by means of dipstick (figure 6) located on the tank; the dipstick has two notches: the lower one indicates the minimum level while the other one indicates the maximum level inside the tank. The purpose of the hole in the dipstick is as well to fill the oil tank.
Vacuum pumps version PM … WM: the overgear box is provided with an oil filling cap (1) in the top area of the overgear and an oil level cap (2), in the side area of the gearbox, which enables to check the level (figure 8). For correct lubrication, the oil must always be visible in the oil level. (2-figure 8).

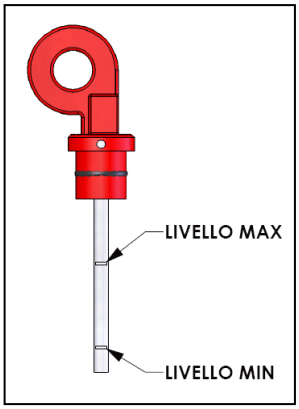


Figure 7

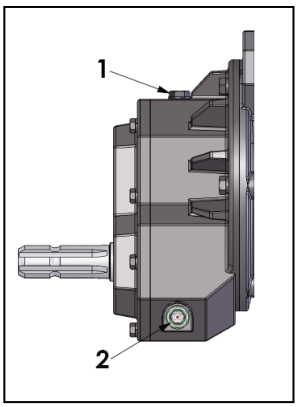


Figure 8

Oil tank capacity (USA Gallon)		
PM 60 W	PM 80 W	PM 110 W
0.40	0.66	1.27

Table 6

6.3 LUBRICATION CHECK

Before starting the vacuum pump. make sure that there is oil in the lubrication circuit and that its level is not below the minimum level. During operation of the vacuum pump, it is necessary to perform the following operations:

- Verify that the oil level in the tank is never below the minimum level, otherwise the oil pump aspirates air, sending it into the tubing, compromising its operation.
- If air is aspirated , detach the delivery hose from its fitting, then operate the vacuum pump until oil free of air flows out of the hose. Then reconnect the hose to the fitting.
- Check, by means of the transparent lubrication hose, for optimum oil flow in the circuit.

6.3.1 Lubrication oil regulation

Standard regulation of oil delivery, in automatic lubrication, is carried out at our plant during the final test of the vacuum pump. If, due to a specific reason, a different regulation is required, proceed as follows (figure 9):

- remove cover "3"
- loosen counternut "4"
- operate the register pin "5" with a flat tip screwdriver

Reduced oil delivery is achieved by rotating clockwise (-); increased oil delivery is achieved by rotating anticlockwise (+). When the regulation is over, tighten the counternut "4" and tighten the cover "3".

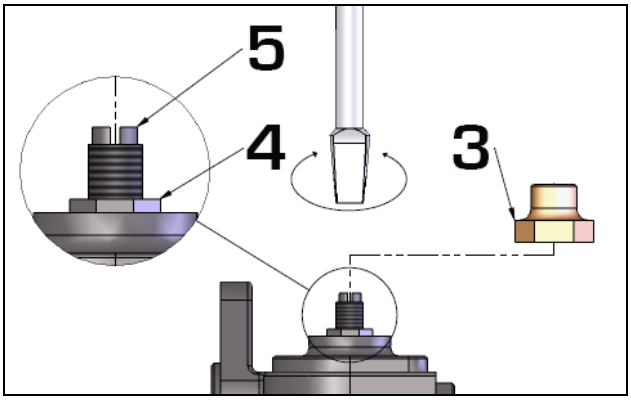


Figure 9

6.3.2 Amount of lubrication oil

During vacuum pump operation, verify that the amount of oil indicated in Table 7 flow out from the oiler:
When necessary, add to the tank new, clean, mineral oil only.
Version AM: in the overgear box change the oil after approx. 100 hours of operation and then every 300 hours of operation.

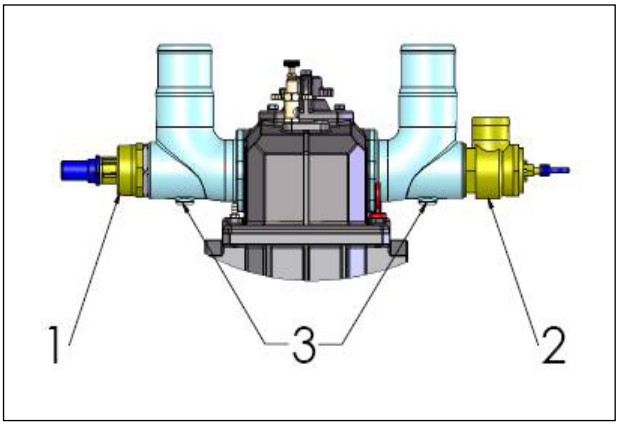
Pump model	Flow rate	Oil tank capacity
	c.f.m.	USA Pint
PM60W	4.53	3.17
PM80W	5.09	5.28
PM110W	5.66	10.14

Table 7

7 OVERPRESSURE AND VACUUM REGULATION VALVES

The vacuum pumps series WATER are provided, as standard, without overpressure and vacuum regulation valve. These accessories can be ordered separately, together with the aspiration curves in aluminium (3) which house them or with the valve support kit in cast iron.
The diameter of the installation threading is Ø 2" (overpressure) and Ø 1" 1/2 (vacuum regulation).

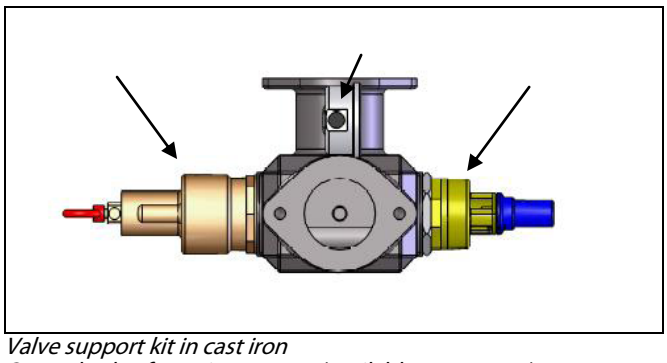
Vacuum: excessive vacuum can cause ovalization and undulation of the body or breakage of the blades. For this reason, we recommend to use a vacuum regulation valve (ref. 1) set to a max. value of -0.80 bar.



No. 2 valve support curves in aluminium
First valve fastening system (available on request)

Pressure: max. allowed pressure is 3 bar absolute (2 bar relative). In order not to exceed this value, or to achieve a lower max. pressure, it is necessary to apply an overpressure valve (ref. 2) dimensioned to discharge the excess air flow.

To fit pressure gauges, use the threaded hole (ref. 3), on the two aluminium curves which can be provided on request, Ø 1/4" gas.



Valve support kit in cast iron
Second valve fastening system (available on request)

Valve regulation is performed operating on the throttle located on the valve (overpressure valve) or operating the nut and counternut (vacuum regulation valve).

In case of check of pump operation without the connection to the aspiration and delivery tubes, there is the danger of shearing for the operators due to the possibility to access the inner parts of the machine.

In these conditions there is as well the risk to aspire foreign matters inside the machine.

Current standards require that overpressure valves discharge all the air generated by the pump, which would increase the max. pressure allowed inside the tank. For these reasons, use table 8 below to determine the number of valves required to achieve the above purpose.

Overpressure valves nominal flow rates according to I.S.P.E.S.L. E.1.D.2.			
DN Valve	Inlet surface Sq. in	P reference pressure Prelative / Pabsolute (p.s.i.)	Flow rate Q (c.f.m.)
1"1/4	1.24	7.1 / 21.48	22.7
		14.2 / 2.013	30.2
		21.3 / 35.68	37.8
1"1/2	1.85	7.1 / 1.513	33.8
		14.2 / 21.48	45
		21.3 / 35.68	56.2
2"	3.04	7.1 / 1.513	55.7
		14.2 / 21.48	74.1
		21.3 / 35.68	92.5
2"1/2 (free discharge)	4.37	7.1 / 1.513	80.1
		14.2 / 21.48	106.6
		21.3 / 35.68	133.1

Table 8

8 TEST AND RUN -IN

8.1 TEST

Before testing the vacuum pump, verify the items above, using if necessary a workbench. Make sure that the PTO shaft rotate s freely and that the direction of rotation is the same as that indicated by the arrow.

In case of check of pump operation without the connection to the aspiration and delivery tubing, there is the danger to aspire foreign matters inside the machine.

8.2 RUN -IN

The run-in period of the vacuum pump is about 50 hours of operation.

9 START -UP – OPERATION – STOP

9.1 START -UP

The vacuum pump is not provided with a start switch. To start it, start the transmission after connecting it to the cardan shaft if versi on ….WM and …WD; by means of pulleys and belts in version …WP, or operating the hydraulic pump after connecting it to the hydraulic motor in version …WH.

Before starting the vacuum pump, make sure that the guards of all the moving parts are in place and ef ficient. Any damaged or missing part must be replaced and correctly installed before using the transmission.

9.2 OPERATION

Do not use the vacuum pump with pressure, temperature and time values higher than those indicated in table 8. During use, do not exce ed speed and power conditions set by the manual. Avoid overloads and engagements under load of the power takeoff.

Verify the following operating parameters:

PARAMETER	MAX. SPEED	OPERATING SPEED
Speed M (RpM)	540	400 - 450
Speed P, D, H (RpM)	1400	1000 - 1100
Absolute pressure (bar)	42.6	35.5
Vacuum (%)	95	80
Temperature (°C)	180	160
Maximum time of continuous operation. (h)	5	4

Table 9

Non compliance with these prescriptions may damage the health of the operator or the vacuum pump. If the density of the aspired material is significant, dilute or mix the material. The operating time must be such to avoid reaching max. temperature. A long operation time without stops may cause, besides excessive heating, damages to blades.

9.3 STOP

To stop the vacuum pump, stop the transmission and disengage the PTO to avoid involuntary operation.

9.4 CONTROL DEVICES

A manual switch lever on the top of the manifold is provided as standard to control aspiration and compression. To establish in which direction to turn the switch lever to select one of the two phases, comply with the indications provided by the manufacturer of the equipment

The selection of aspiration or compression by the switch lever must be carried out with the vacuum pump stopped.

9.4.1 OPTIONAL DEVICES

Two accessories are available (on request) for remote control of the switch lever rotation; the first device is called Pneumatic Actuator (figure 10) which, connected to an air compressor, enables switch lever rotation.

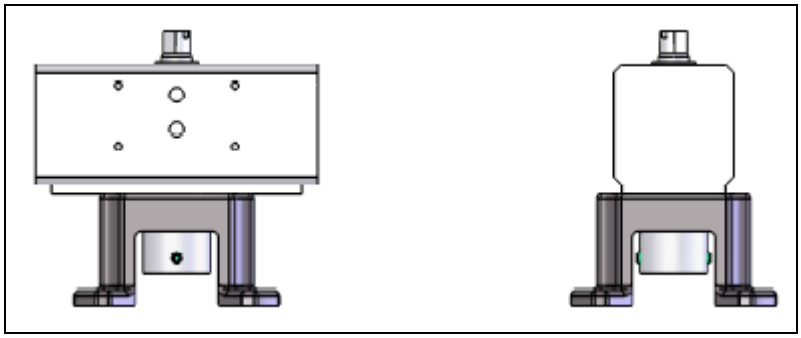


Figure 10

The second device (figure 11), analogous to the first and called Hydraulic Rotative Cylinder, is driven hydraulically by a hydraulic pump usually available on tractors and trucks. Functionally, it is the same as the pneumatic one and both are fastened directly to the switch lever located inside the manifold fixed to the vacuum pump.

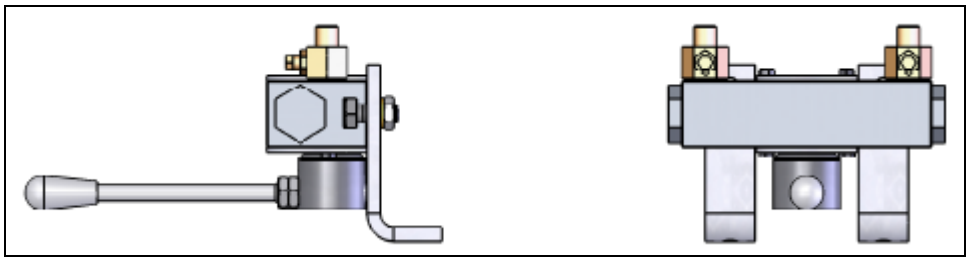


Figure 11

9.5 PROTECTION DEVICES USED

The vacuum pump series Water, when installed on a machine, must be provided with a protection device so that operators cannot access moving parts.

It is necessary as well to protect the vacuum pump to avoid the remote danger of projection of materials in case of seve re failure.

Versions PM …WM and WD are provided as standard with a protection device in plastic material marked CE, to protect the PTO shaft during rotation. Such protection is to be installed by the User.

9.6 PERSONAL SAFETY DEVICES

During the use of th e vacuum pump series Water, it is necessary to use the personal protection devices required by the Manufacturer of the machine on which the vacuum pump is installed.

11 MALFUNCTION, FAILURE, BREAKDOWN

ANOMALY DETECTED	CAUSE	SOLUTION
Insufficient vacuum or pressure	Blades worn.	Replace the blades.
	Some blades jammed in the rotor.	Disassemble the vacuum pump, clean and wash rotor, blades, and pump body.
	Air infiltration or leakage from the system.	Remove infiltrations.
	Pump body undulated.	Grind or replace the pump body.
	Switch lever not correctly positioned in the manifold.	Remove and reposition correctly the switch lever.
Excessive heating of the vacuum pump	Flange assembly too tight.	Add a gasket on the front or rear flange.
	Excessive pressure or vacuum.	Reduce pressure or vacuum.
	Excessive speed.	Reduce the speed.
	Excessive operation time.	Reduce operation time.
	Blades too long.	Crop the blades up to the measure indicated.
	Insufficient cooling system.	Update the cooling system.
	Lack of prelubrication.	Perform prelubrication.
	Leak of coolant.	Replace the seals in the recycle pump.
Lack of lubrication or insufficient lubrication.	Lack of lubrication.	Verify oil level in the tank and oil pump operation.
	Aspiration of air from fittings.	Replace the fittings.
	Lubrication tube not correctly inserted in the fittings.	Insert it correctly.
Beat against the external surface of the pump body.	Insufficient speed.	Increase speed.
	Excessive vacuum.	Reduce vacuum.
Leak of sewage from the discharge.	Malfunction of the valves.	Check the valves.
Leak of smoke from the discharge.	Excessive lubrication.	Adjust lubrication and reduce vacuum.
The PTO does not rotate.	One or several blades broken.	Replace the blades and verify the rotor pin if bent.

	A foreign body has entered the vacuum pump.	Remove the foreign body and verify blades and rotor.
The vacuum pump does not aspirate/compress	The switch lever on the manifold is not correctly positioned.	Position correctly the switch lever.
	Switch lever not correctly positioned in the manifold.	Correctly position the switch lever.
	The vacuum pump turns in reverse direction.	Reverse the direction of rotation.
	All the blades are stuck in the slots.	Disassemble the vacuum pump, clean and wash rotor, blades, pump body.
	The blades protrude from the rotor slots not correctly.	Disassemble the vacuum pump, clean and wash rotor, blades, pump body.
	The rubber ball closes the primary valve.	Increase air flow around the rubber ball of the primary valve.

Table 10

12 MAINTENANCE, TESTS AND CONTROLS, REPAIRS, TECHNICAL SERVICE

During maintenance, inspection and controls, repairs, we recommend to always use the personal protection devices listed in the manual.
The operations shall be carried out by trained personnel.

Maintenance, inspection and controls, repairs, must be performed with maximum care, with the vacuum pump switched off and the power take off disengaged.

12.1 CLEANING

12.1.1 Cleaning of the pump body.

If a little amount of sewage enters the vacuum pump, immediately clean the inside of the pump body, aspirating naphtha or oil, by means of the discharge, with the pump compressing. After this operation, have oil aspirated. The same operation is to be carried out when the vacuum pump does not operate for a long time. In that case, remove the aspiration and delivery hose connected to the valves and hermetically close the air entry and exit in the vacuum pump, because the gases created inside the tank, flowing into the vacuum pump,cause rust inside the

pump body and on the rotor, which may cause the breakage of the blades when the pump is restarted. Do not use water, to avoid as well the creation of rust.
If you wash the pump body after having disassembled it, perform a preliminarywashing with detergents (e.g. thinner).

12.1.2 Washing the oil tank

At least once a year, wash the oil tank with suitable detergents.

12.1.3 Washing the lubrication pump

Carefully wash the oil pump with suitable solvents at least once a year or when the equipment does not operate for a long period.

12.1.4 Washing and cleaning the valves

At least once a month, wash and clean the valves. Disassemble the valves and wash with water or non corrosive detergents.

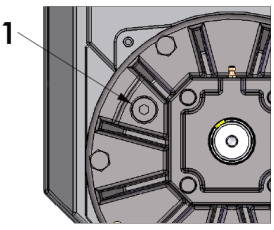
12.2 CHECK OF THE VALVES

Periodically check that all valves, both overfill valves and pressure/vacuum valves, are always perfectly efficient.

12.3 INSPECTION AND REPLACEMENT OF THE BLADES

12.3.1 Information about the blades

The vacuum pumps series Water are provided, as standard, with blades featuring a special composition. These blades have good mechanical specifications, are highly resistant to heat and extended use.
Besides normal wear, blades replacement can be necessary due to a wrong use of the vacuum pump. The most frequent causes are excessive heat, lack of lubrication, excessive wear, entry of sewage, excessive pressure or vacuum, creation of rust inside the pump body due to long stops, entry of solid, foreign matters into the pump body.
Excessive heat creates blisters on blade surface, increasing blade thickness and preventing their free exit from the rotor slots; this issue is more frequent in standard blades than in special blades. If lubrication is insufficient, the blades, as well as the inside of the pump, remain dry, their fragility increases and breakage is likely. The same kind of breakage may be caused by the entry of sewage and/or fine dusts or by excessive operating pressure. Excessive vacuum causes beating of the blades against the cylinder with ensuing damage of the external face of the blades. Besides, a inner liner undulation is caused.

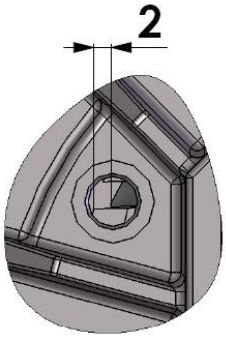


12.3.2 Blades inspection:

To verify the wear of the blades in the vacuum pump, proceed as follows:

- remove the threaded inspection cap (1), located as well on the rear.
- rotate the rotor to align a blade with the inspection hole.

- measure the distance (2) between the external surface of the rotor and the external face of the blade.
- if such distance exceeds the original height of the blade by 10÷15%, replace the entire series of blades.



IMPORTANT: Before inserting the new blades , carefully check their dimension and, if necessary, shorten them until their length is the same as the rotor.

12.3.3 Blades replacement

- Verify if there is enough space for easy operation on the rear of the vacuum pump, otherwise remove the vacuum pump from its support.
- Remove the rear section;
- Remove the blades from the rotor;
- Clean pump body interior, rotor and flange;
- Replace the blades;
- Refit the rear of the vacuum pump replacing the gasket.

12.3.4 Dimensions of the blades

Vacuum pump model	Blade quantity	Dimensions of the blades (inch)
PM 60 W	6	11.02 x 2.7 x 0.3
PM 80 W	6	14.2 x 2.7 x 0.3
PM 110 W	6	18.8 x 2.7 x 0.3

Table 11

12.4 TECHNICAL SERVICE

For technical service and provision of accessories and spare parts, contact the Supplier of the equipment.

12.5 PERIODIC MAI NTENANCE

Maintenance to be carried out	Execution method	Frequency
Check for lubrication flow.	Examine the transparent hoses.	Once a day.
Check for oil level in the tanks.	Use the oil level dipstick located on the manifold.	Once a day.
Check for blade wear.	Remove the threaded cap.	Every approx. 600 hours of operation.
Check for correct operation of overpressure valves and vacuum regulation valves.	Remove the valves.	Once a week.
Check for coolant level.	Inspect the coolant supply tank.	Once a week.
W ashing the oil tank.	Remove the manifold.	Once a year.
Washing the inside of the pump body.	Add oil and naphtha (after cleaning, only lubricate with oil before commissioning).	Each time sewage enters or when the equipment does not operate for a long period.
Washing the lubrication pump.	Use brush and compressed air.	Once a year or in case of long stop.
Check for correct operation of overfill valves.	Remove the valves.	Once a month.
Washing and cleaning of the overpressure and vacuum valves.	Remove the valves.	Once a month.
Emptying condensate vessels.	Open discharge cocks.	Several times every day.

Table 12

13 DECOMMISSIONING AND DEMOLITION

Before the demolition of the vacuum pump, it is necessary to sort the following materials:

- Lubrication oil;
- Parts i n rubber and plastics;
- Parts in cast iron and steel;

disposing of them appropriately.
Do not dispose of the vacuum pump in the environment.
For the disposal of the lubrication oil, use specialized treatment services.