pompetravaini

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OPERATING MANUAL
LIQUID RING VACUUM PUMPS

TRVK - TRSK

CE

OPERATING MANUAL FOR INSTALLATION, START-UP AND MAINTENANCE FOR LIQUID RING VACUUM PUMPS

This manual applies to TRAVAINI liquid ring pumps single stage series **TRVK**, **TRSK**.
NOTE: Unless otherwise specified, the term **pump** used throughout this manual means also pump/motor **assembly** or **system** type HYDROSYS.

Manufacturer:

POMPETRAVAINI S.p.A.

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WARRANTY: All products manufactured by POMPETRAVAINI are guaranteed to meet the conditions listed on the general terms & conditions of sales and/or conditions listed on the order confirmations.
Failure to strictly adhere to the instructions and recommendations listed in this manual, will void the manufacturer's warranty.

The liquids and the gases handled by the pumps and also their parts could be potentially dangerous for persons and environment: provide their eventual disposal in conformity with the laws into force and a proper environment management.

The present manual is not assigned for pumps subjected to the ATEX 94/9/CE directive. In case the pump is assigned in environments subjected to the application ATEX 99/92/CE directive or in case the pump is provided with a nameplate indicating the ATEX stamp, it strictly forbidden proceed to start up the pumps but necessary to consult POMPETRAVAINI for clarifications.
For pumps subjected to the ATEX 94/9/CE directive it is available a dedicated integrative manual.

According to what expected from 2012/19/UE Directive on Waste Electric and Electronic Equipment the electrical pump assembly from us supplied (pump coupled with an electrical motor of Pompetravaini supply or customer supply) placed on the market after the 15th of August 2018 fell within the limits of application of the Directive. As a consequence, conforming to article 14 of the 2012/19/UE Directive of the European Parliament of the 4th of July 2012, Pompetravaini Spa is registered on the Italian list of EEE manufacturer.
The electrical pump assembly supplied by Pompetravaini Spa that should be discontinued from use must not be disposed with common waste because it is composed of different materials that can be recycled at the appropriate facilities. If it is not intended to proceed autonomously at the management of the electrical pump assembly at authorized disposal companies it is possible to contact the Pompetravaini branch closer to you that will give you the necessary information on a proper disposal in accordance with mandatory laws.
The pump unit must be previously cleaned up by the pumped product upon disposal.
After reclamation the electrical pump assembly is not potentially dangerous for human health and environment, not containing harmful substances according to 2011/65/UE (RoHs) Directive, but if abandoned in the environment will have a negative impact on the ecosystem.
Sending the electrical pump assembly to an adequate process of disposal and recovery of materials protect the environment and help to limits consumption of available resources with effective recycling of materials.
The abandonment in the environment of the apparatus or the illegal disposal of the same are punished by law.

Pompetravaini ensures that its documentation is compliant in Italian and English languages.

Technical documentation and manuals provided in languages other than these two are subject to a translation by third parties

Documentation and manuals in the two official languages are available on the Pompetravaini website.

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In preparing this manual, every possible effort has been made to help the customer and operator with the proper installation and operation of the pump and/or system. Should you find errors, misunderstandings or discrepancies please do not hesitate to bring them to our attention.

1 - GENERAL INSTRUCTIONS

This manual is intended to provide reference to:
- application and operating safety
- installation and maintenance for pump or system
- starting, operating and stopping procedures for pump or system

NOTE: All references made to pumps are also applicable to systems that employ these pumps, unless otherwise specified.

Upon receipt of this manual, the operator should complete page at the end with the requested data. The manual should then be read **CAREFULLY** and kept in a safe file for future reference. It should always be available to the qualified operating and maintenance personnel responsible for the safe operation of the pump or system.
(Qualified personnel should be experienced and knowledgeable of Safety Standards, should be recognised by the safety department manager as being capable to effectively act on safety issues, should the need arise. A knowledge of first aid should also be required).

The pump is to be used only for the applications specified on the confirming order for which POMPETRAVAINI has selected the design, materials of construction and tested the pump to meet the order specifications. Therefore, the pump or system **CANNOT** be used for applications other than those specified on the order confirmation.

In the event the pump is to be used for different applications, please consult POMPETRAVAINI or representative of the manufacturer. POMPETRAVAINI declines to assume any responsibility if the pump is used for different applications without prior written consent.
The user is responsible for the verification of the ambient conditions where the pump will be stored or installed. Extreme low or high temperatures may severely damage the pump or system unless proper precautions are taken.
POMPETRAVAINI does not guarantee repairs or alterations done by user or other unauthorised personnel.
Special designs and constructions may vary from the information given in this manual. Please contact POMPETRAVAINI should you have any difficulty or doubt.

NOTE: Drawings appearing in this manual are only schematics. These drawings are not for construction.
For construction drawings contact POMPETRAVAINI or the authorised local representative.

1.2 - READING THE INFORMATIONS MARKED ON PUMP'S NAMEPLATES AND SERVICE CARDS

The machinery Directive 2006/42/EC and the ATEX Directive 2014/34/EU require the marking of certain information on the pump's nameplates. The pump nameplate must be applied so that it is not easily removable and remains legible for long time.
Furthermore, according to the regulations in force, it is necessary to provide the machines with a document, the Declaration of Conformity, to the safety requirements imposed by the Machinery Directive for all pumps (usually named as EC Declaration of Conformity) and to the ATEX Directive for pumps intended for use in environments subject to the directive (usually named ATEX Declaration of Conformity).
Pompetravaini has chosen to make each Declaration supplied with the pump's documentation unique, applying on it an adhesive tag that incorporate the information of the pump nameplate applied on the pump.
In this way each Declaration of conformity is uniquely identified with the same serial number as the pump for which it was issued. By convention in Pompetravaini this tag is called Service Card.

Markings on nameplates of pumps and vacuum systems

The pump nameplate must bear all the all the mandatory information required by the applicable directives (Machinery Directive and ATEX Directive if requested). The appearance and arrangement of the markings on the nameplate may differ depending on the type of pump and the recipient of the pump. Or for some branches of Pompetravaini customized executions are provided. The minimum information required by the regulations remains present in the various possible configurations.
The vacuum system packages are provided with a single nameplate that identify them as an assembly of pump, or pumps, with vessel and accessories. The system nameplate is applied on the body of the vacuum pump (or on the pumps if the system has more than one) and the serial number is unique for the whole system.
For Pompetravaini everything that is supplied as a vacuum package, identified by the serial number on the nameplate and for the bill of material associated to the serial number, it is integral part of the package and therefore included in the EC Declaration of Conformity and also ATEX Declaration of Conformity if required by the Order Confirmation.

Pompetravaini nameplate shows:

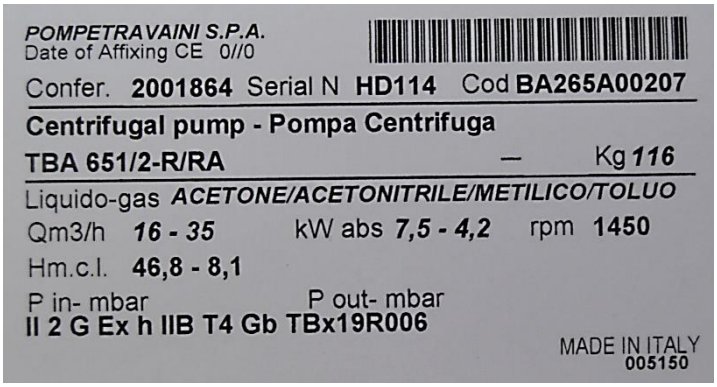
- Name of the manufacturer and address: *Pompetravaini spa*
- Pump type, es.: *Centrifugal pump- Pompa centrifuga*
- Model, es.: *TCH 40-125/1-R/A3*
- Serial number es.: *HG533*
- Year (of production), es.: *2020*
- Number of Item (of the customer), es.: *459.25*
- Turn by minute/rpm, es.: *2900*
- Weight, kg, es.: *160*
- Pumped fluid, liquid or gas, es.: *Water and glycol*
- Absorbed power, kW abs, es.: *2,2*
- Requested flow, Q, m3/h: *24*
- Pump head, m.c.l., es.: *18*
- ATEX markings (when applicable), es.: *II 3 G Ex h IIB T3 Gc*
- Second line of ATEX markings (when applicable), es.: *II 3 D Ex h IIIB T150°C Dc*

The lasts are the ATEX markings, that begin with a string of characters identifying the level of protection of the pump. The first row is the ATEX marking that refer to a use in a Zone classified for Gas. The second row is the ATEX marking that refer to a use in a Zone classified for Dust.
There could be another string, for example for the Technical File 8TCx19R006) if necessary.
There are also symbols identifying some particularities of the pumps and systems.
The EC symbol CE identify a product subject to the Machinery Directive 2006/42/CE.

The trash bin symbol identify a product subject to the WEEE Directive 2012/19/EU

The symbol EX identify a pump that is also subject to the ATEX Directive 2014/34/EU

Markings on Service Card of pumps and vacuum systems



The Service Card tag applied on the Declaration of Conformity of the pump or vacuum system shows:

La Service Card applicata sulle Dichiarazioni di Conformità della pompa o dell'impianto riporta:

- Name of the manufacturer and address: *Pompetravaini spa*
- Issue date of the Service Card, es.: *01/04/2020*
- Barcode identifying the production order
- Confirmation of Order number, es.: *2001864*
- Serial number es.: HD*114*
- Pump code, es.: *BA265A00207*
- Pump type, es.: *Centrifugal pump- Pompa centrifuga*
- Model, es.: *TBA 651/2-R/RA*
- Weight, kg, es.: *116*
- Pumped fluid, liquid or gas, es.: *Acetone*

- Portata richiesta, Q, m3/h: *16*
- Potenza assorbita, kW, es.: *7,5*
- Turn by minute/rpm, es.: *1450*
- Pump head, for centrifugal pumps, m.c.l., es.: *46,8*
- Suction pressure, for vacuum pumps, P in mbar, or discharge P out – mbar, for vacuum pumps
- ATEX markings (when applicable), es.: *II 2 G Ex h IIB T4 Gb TBx19R006*

The Service Card bears all the information of the pump nameplate and still others more as complement.
For the management system of Pompetravaini, starting with the serial number of the pump or vacuum system it is possible to uniquely identify the product code and its bill of material.
This allows to associate everything provided with the order confirmation sent to the customer.
The code shown on the Service Card includes the pump as the main element, but also the electric motor, vessel or other equipment and instruments included in the supply and included in the bill of material corresponding to the code.
On the Service Card are not marked the same symbols of the nameplate because it is requested by the norms and to have more space for other information.

The EC Declaration of Conformity on which the Service Card is applied, such as the declaration of conformity to the ATEX Directive, they are thus inclusive of everything that is part of the bill of materials associated with the specific code.
Pompetravaini has taken care of assessing that all other equipment and accessories supplied and included in the bill of material are compliant with CE and ATEX requirements and guarantee a degree of protection equal to or higher than that of the pump they are coupled to.
Each device, instrument or accessory has been selected and assembled by Pompetravaini according to the manufacturer's instructions and so as not to compromise its certifications which are provided together with the Pompetravaini documentation.
In the case of pump assemblies coupled with other accessories subject to the ATEX Directive 2013/34 / EU, all the certifications of the individual components issued by their manufacturer remain valid, Pompetravaini has brought everything together in a functional whole.

An example od nameplate for a vacuum system:

- Name of the manufacturer and address: *Pompetravaini spa*
- Pump type, es.: *Vacuum System*
- Model, es.: *HYS 3 2) TRVB 40-110/1C-M/A3*
- Serial number es.: *HD580*
- Year (of production), es.: *2020*
- Number of Item (of the customer), es.: ---
- Turn by minute/rpm, es.: *1450*
- Weight, kg, es.: *780*
- Pumped fluid, liquid or gas, es.: *Air + Ethanol + Ethilacetate*
- Absorbed power, kW abs, es.: ---
- Requested power, Q, m3/h: *43*
- Pump head, m.c.l., es.: *200*
- ATEX markings (when applicable), es.: *II 1/2 G Ex h IIB T4 Ga/Gb PTB06ATEX4001X – 1370*

In this case the ATEX marking is for a vacuum system intended for an application with an atmosphere classified as Zone 0 inside and Zone 1 outside, therefore it includes the code of the certificate received from the Notified Body (*PTB06ATEX4001X*) and the code of the Notified Body that deals with production surveillance (*1370*).

2 - SAFETY INSTRUCTIONS

CAUTION: CAREFULLY READ FOLLOWING INSTRUCTIONS.
STRICTLY ADHERE TO THE INSTRUCTIONS LISTED BELOW TO PREVENT PERSONAL INJURIES AND/OR EQUIPMENT DAMAGE.

- **ALWAYS** apply the pump for the conditions outlined on the confirming order.
- Electrical connections on the motor or accessories must **ALWAYS** be carried out by authorised personnel and in accordance to the local codes.
- Any work on the pump should be carried out by at least 2 people.
- When approaching the pump **ALWAYS** be properly dressed (avoid use of clothes with wide sleeves, neckties, necklaces, etc.) and/or wear safety equipment (hard hat, safety glasses, safety shoes, etc.) adequate for the work to be done.
- Be **ALWAYS** informed on locations of first aid sites inside the company and carefully read safety and medical first aid prescriptions in force.
- **ALWAYS** disconnect the power to the motor prior to working or removing the pump from the installation.
- **ALWAYS** stop the pump prior to touching it, for whatever the reason.
- **NEVER** work on the pump when it is hot.
- After completion of the work **ALWAYS** re-install the safety guards previously removed.
- **ALWAYS** be careful when handling pumps that convey acids or hazardous fluids.
- **ALWAYS** have a fire extinguisher in the vicinity of the pump installation.
- **DO NOT** operate the pump in the wrong direction of rotation.
- **NEVER** put hands or fingers in the pump or system openings or cavities.
- **NEVER** step on pump and/or piping connected to the pump.
- Pump or piping (connected to the pump) must **NEVER** be under pressure or vacuum when maintenance or repair is carried out.

NOTE: There are materials in the pump that may be hazardous to people suffering from allergies. Maintenance and operating personnel should consult the tab. 1 for such materials.
Take care of their eventual disposal according to the laws into force and to a safe local environment management.

Tab. 1

MATERIAL	USE	POSSIBLE DANGER
Oil and Grease	General lubrication, ball or roller bearings	Skin and eye irritation
Plastic and elastomer components	O-Ring, V-Ring, Splash ring, Oil seals	Release of fumes and vapours when overheated
Teflon & Kevlar fibres	Packing rings	Release of dangerous powders, release of fumes when overheated
Varnishes	Exterior pump surface	Release of powder and fumes in case of rework, flammable
Liquid compound	Gasket between flat surfaces	Skin, eye and breathing organs irritation
Protective liquid	Pump inside surface	Skin and eye rash

3 - IN CASE OF EMERGENCY

Should the pump break down leak gas and/or service liquid, immediately disconnect the electrical power following the instructions given in chapter 11. Alert the maintenance personnel, at least two people should intervene using precautions as it is required for the specific installation: pump may be handling dangerous and/or hazardous fluids.
After correction of all the problems that created the emergency situation, it is necessary to carry out all the recommended starting procedures (see chapter 10).

3.1 - BASIC FIRST AID

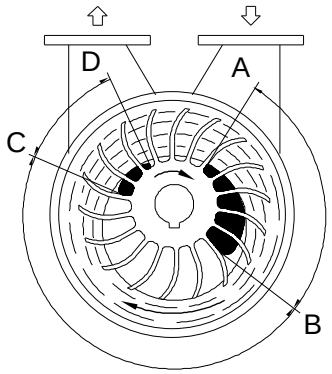
In the event dangerous substances have been inhaled and/or have come in contact with the human body, immediately contact the medical staff and follow the instructions given by the company's internal medical safety procedures.

4 - PUMP OUTLINES

The instructions given in this manual are for liquid ring vacuum pumps and compressors and for systems type HYDROSYS which utilise said pumps.

NOTE: Capacities, vacuum and pressures are nominal and are the maximum attainable values under standard operating conditions. Please contact POMPETRAVAINI for data on liquid ring compressors series TR…

TRVK	Single stage liquid ring vacuum pumps Capacity to 22500 m^3/h, max vacuum 40 mbar
TRSK	Two stage liquid ring vacuum pumps Capacity to 37000 m^3/h, max vacuum 180 mbar



4.1 - PRINCIPLE OF OPERATION (see figure at side)

The aspirated gas enters the pump chamber A-B via the pump suction flange. The gas is trapped between 2 impeller vanes. The impeller rotates eccentrically in relation to the centreline of the liquid ring that, by centrifugal force, assumes the shape of the impeller casing. The progressive change of volume between the 2 vanes, the impeller hub and the liquid ring first creates a vacuum and then a compression of the gas in the B-C area till the gas is discharged, together with a portion of the liquid, through the discharge port C-D. The lost liquid must then be replenished.

4.2 - SERVICE LIQUID PROPERTIES

For a good operation the liquid ring pumps must be supplied with a service liquid which is clean, non abrasive and free of any solids.

The service liquid temperature should not exceed 80°C and the gas handled should be maximum 100°C; the liquid density should be between 800 and 1200 g/dm^3 and the viscosity should be less than 40 cSt (the pump performance will change if the service liquid has properties different than those of water at 15°C). All engineering data is based on the use of 15°C as service liquid, see chapter 17 for additional information.

Contact POMPETRAVAINI before using liquids with properties outside the ranges listed above.

4.3 - PUMP MODELS AND TABLES FOR MATERIAL OF CONSTRUCTION

On the pump nameplate are printed the pump serial number, the year of manufacture and the pump model. Refer to the following example for understanding the coding of the pump model.
Every letter or number in the pump model designation has a specific meaning relating to the pump design.

Example of pump model number:

T R V K 3003 / 1 - B / F			
T	⇨ Manufacturer POMPETRAVAINI	**…3**	⇨ Performance project number
R	⇨ Liquid ring pump	**1**	⇨ Mechanical project number
V	⇨ V = Single stage pump with high vacuum S = Single stage pump with medium vacuum	**B**	⇨ B = Shaft sealing by stuffing box C = Shaft sealing by mechanical seal
K	⇨ Revision of hydraulic design	**F**	⇨ Material of construction
300…	⇨ Ø Flange size (mm)		

For additional details regarding standard or special materials contact POMPETRAVAINI.

5 - UNCRATING, LIFTING AND MOVING INSTRUCTIONS

Upon receipt verify that the material received is in exact compliance with that listed on the packing slip.

When uncrating follow the instructions listed below:
- check for visible damages on the crate that could have occurred during transport
- carefully remove the packaging material
- check that pump/or accessories such as tanks, piping, valves, etc. are free from visible markings such as dents and damage which may have occurred during transportation
- in the event of damage, report this immediately to the transport company and to POMPETRAVAINI's customer service department.

Take immediate actions to dispose of eventual packaging parts that may generate injuries or risks (for example edges, nails, splinters, etc.) and of materials subjected to controlled and differentiate disposal (for example plastic, cartoon, polystyrene materials, etc.) according to the laws into force and to a safe local environment management. according to the laws into force and to a safe local environment management.

ATT.: If the pump will be stored, as foreseen in our Operating Manuals, we recommend a proper care to avoid oil dropping on the ground.

The pump or assembly must **ALWAYS** be moved and transported in the horizontal position.
Prior to moving the unit find the following:
- total weight
- centre of gravity
- maximum outside dimensions
- lifting points location.

For safe lifting to prevent material damages and/or personal injuries, it is recommended to use ropes, or belts properly positioned on the pump and/or lifting eyebolts and make correct movements.
Lifting eyebolts fitted on single components of the assembly (pump or motor) should not be used to lift the total assembly.

The fig. 1 and 2 show several additional examples of lifting.
Avoid lifts whereby the ropes or straps, form a triangle with the top angle over 90°(see fig. 3).

The methods of lifting as shown in fig. 4 are to be **absolutely avoided**. Lifting the pump from the shaft end must be avoided. Should the pump relocation be required, after it has been in use,the pump and its respective auxiliary piping and interior must be emptied and cleared of service liquid. All its openings which lead to the inside of the pump have to be well closed and sealed; for removal from the installation see chapter 15.

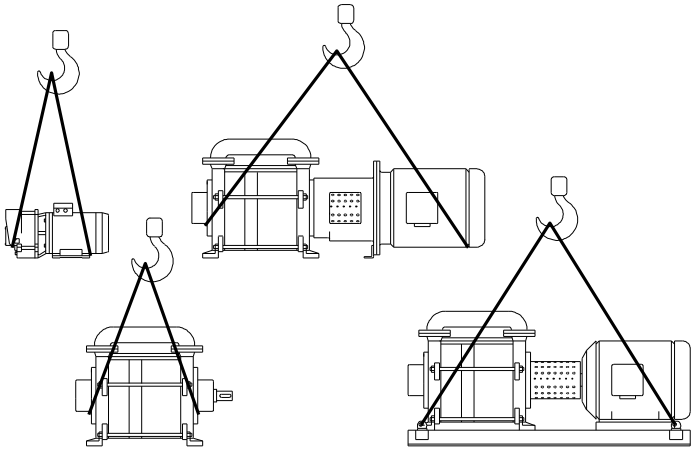


Fig. 1

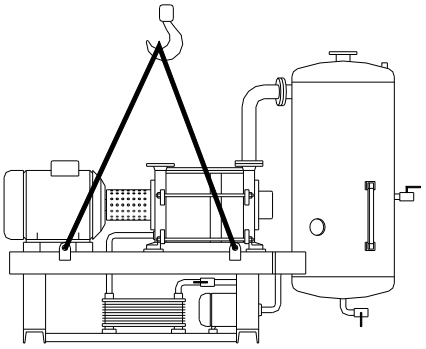
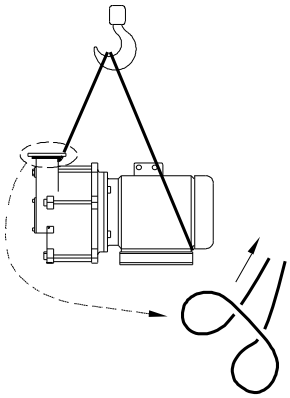


Fig. 2



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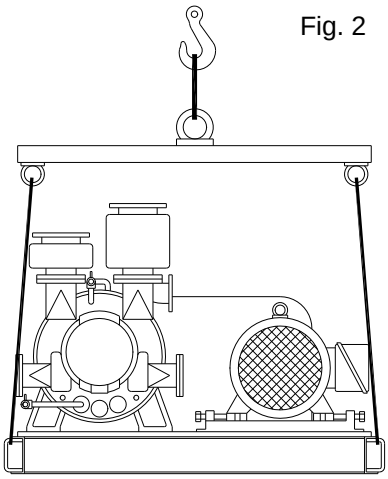
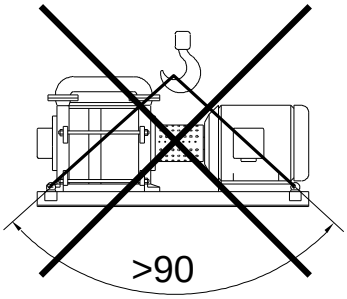


Fig. 3



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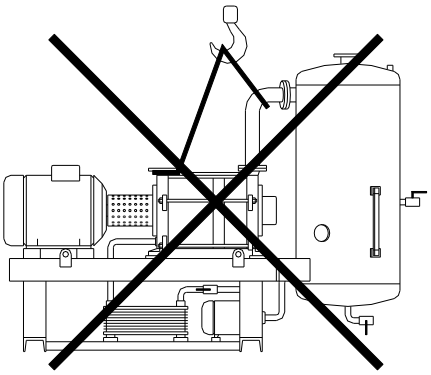
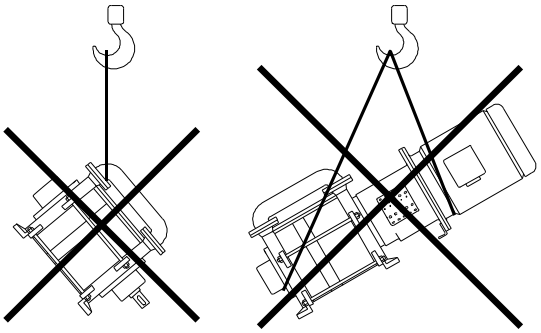
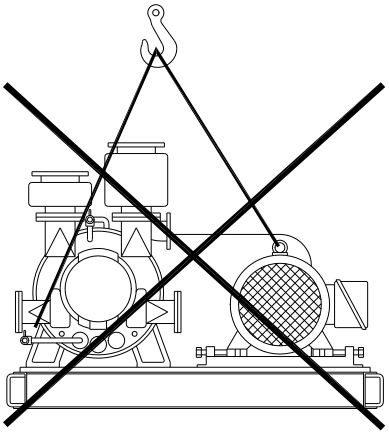


Fig. 4





6 - STORAGE INSTRUCTIONS

After receipt and inspection, if not immediately installed, the unit must be repackaged and stored.
For a proper storage proceed as follows:

- store the pump in a location that is closed, clean, dry and free of vibrations
- do not store in areas with less than 5°C temperature (for lower temperature it is necessary to completely drain the pump of any liquids that are subject to freezing)

FREEZING DANGER!
Where the ambient temperature is less than 5°C it is recommended to drain the pump, piping, separator, heat exchanger, etc. or add an anti-freeze solution to prevent damage to the equipment.

- fill the pump with a rust-preventative liquid that is compatible with the pump gaskets and elastomers. Rotate the shaft by hand to impregnate all internal surfaces. Drain the excessive liquid from the pump and associated piping (see chapter 11).
  Please note that the pumps with cast iron internal parts have been treated at the factory, prior to shipment, with a rust-preventative liquid: this liquid is capable of protecting the pump against rust for a period of 3 to 6 months.
  A further solution, for long term storage, is to fill the pump with the rust inhibitor, rotate the pump shaft by hand to eliminate any air pockets (the liquid must be suitable with gasket, elastomers and pump materials).
- plug all openings that connect the pump internals to the atmosphere
- protect all machined surfaces with an anti-rust material (grease, oils, etc.)
- cover the unit with plastic sheet or similar protective material
- rotate pump shaft at least every three months to avoid possible rust build-up or seizing
- pump accessories should be subjected to similar procedure.

7 - MOUNTING AND ALIGNMENT INSTRUCTIONS

7.1 - ASSEMBLY OF BASE MOUNTED PUMP UNIT

If the pump has been purchased with free shaft end, a proper baseplate is required to mount the pump/motor assembly. The baseplate must be properly designed for maximum rigidity to prevent vibrations and distortions. It is recommended the use of a fabricated baseplate manufactured with rigid “U” shaped channel (fig. 16 illustrates an example).
When the pump has been purchased without the electric motor, it is then required to select the proper motor before proceeding to the installation of the unit. Selection of motor must consider the following:

- maximum power absorbed by the pump over the total operating range
- pump operating speed (RPM)
- available power (Hertz, voltage, etc.)
- motor enclosure type (CVE, AD-PE, ODP, TEFC, EX.PR., etc.)
- motor mount (B3, B5, horizontal, vertical, C-flange, D-flange, etc.).

Flexible couplings are selected considering:

- nominal motor horsepower
- motor operating speed
- coupling guard must meet safety standards as dictated by EN 294, OSHA, etc.

Flexible couplings must be properly aligned. Bad alignments will result in coupling failures and damage to pump and motor bearings.

Assembly instructions for MONOBLOCK design are listed on paragraph 7.3 steps 1, 2, 4, 5, 6.
Assembly instructions for PUMP-MOTOR ON BASEPLATE are listed on paragraph 7.3 steps 7, 1, 8, 5, 9, 10, 11.
For the belt drive alignment procedures follow instructions in paragraph 7.4.

7.2 - ALIGNMENT PROCEDURES FOR MONOBLOCK AND FOR PUMP/MOTOR ASSEMBLY ON BASEPLATE.

The pump/motor assembly is properly aligned by POMPETRAVAINI prior to shipment.
It is however required to verify the alignment prior to the start-up. Misalignment can occur during handling, transportation, grouting of assembly, etc.
For alignment procedures of MONOBLOCK design see paragraph 7.3 steps 3, 4, 5, 6.
For alignment procedure of BASEPLATE design see paragraph 7.3 steps 7, 5, 9, 10, 11.

PLEASE NOTE: Coupling sizes and permissible coupling tolerances listed in this manual are applicable to the particular coupling brand installed by POMPETRAVAINI as a standard. For sizes and tolerances of other type of couplings, follow the instructions given by their respective manufacturer.

7.3 - ALIGNMENT INSTRUCTIONS

NOTICE: Alignment should be done at ambient temperature, obviously with power to the motor disconnected and following the safety procedures to avoid accidental starting (see chapter 2).

Should the pump operate at high temperatures that could upset the coupling alignment, it is necessary to check the alignment to secure proper working operation at such operating temperatures.
It is recommended the use of proper hand protections such as gloves, when carrying out the operations listed below (schematics for various assemblies are shown).
NOTE: The following points must be followed with the sequence stated above and depending upon the type of operation: alignment **assembly** or alignment **verification**.

1 - Thoroughly clean motor/pump shaft ends and shaft keys, place the shaft keys in the proper key way slots and fit the coupling halves in line with the shaft ends. The use of rubber hammers and even pre-heating of the metal half couplings may be required (see fig. 5). Lightly tighten the set screws. Verify that both pump and motor shafts rotate freely.

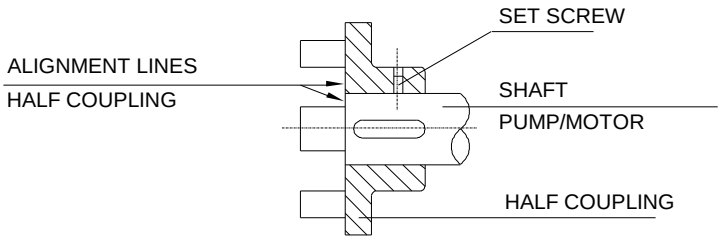


Fig. 5

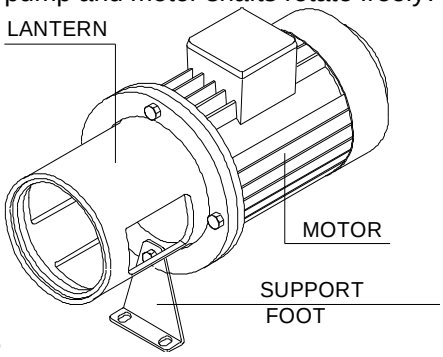


Fig. 6

2 - Insert the perforated metal sheet coupling guard inside the lantern so that the coupling is accessible from one of the lateral openings. Couple the electric motor to the pump lantern engaging the two coupling halves, hands may reach the coupling halves through the lateral opening (see fig. 7) tighten the assembly with bolts supplied with the unit and install the supporting foot, when applicable (see fig. 6).

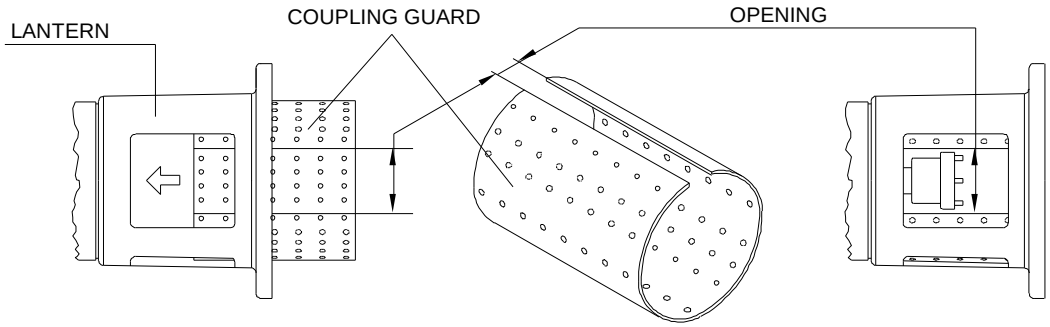


Fig. 7 - PREPARING TO ASSEMBLE THE MONOBLOCK DESIGN

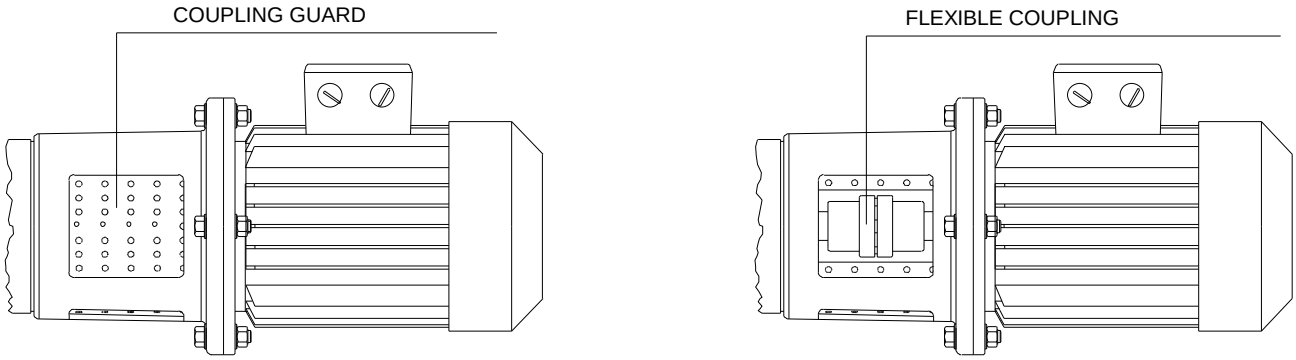


Fig. 8 - CHECKING THE ALIGNMENT 0N MONOBLOCK DESIGN

3 - Applying slight hand pressure to the coupling guard, rotate it so that one opening of the lantern is accessible (see fig. 8).
4 - Rotate by hand the coupling through the lateral opening of the lantern to make sure the pump is free.
5 - With a feeler gauge, check the distance between the two coupling halves. The gap value "S" should be as listed on table 2 or as given by the coupling manufacturer.
In the event an adjustment is necessary, loosen the set screws on the coupling half and with a screw driver move the coupling half to attain the gap "S" (see fig. 12). Then tighten the set screw and rotate the rotor by hand to make sure, once more, that there is no obstruction.

6 - Rotate back the coupling guard by hand through the two openings of the lantern so that both openings are completely covered. This will complete the alignment verification of the MONOBLOCK design.
7 - Remove the coupling guard and its extension (if there is one) attached to the pump, by removing the two locking screws (see fig. 9 and 10).

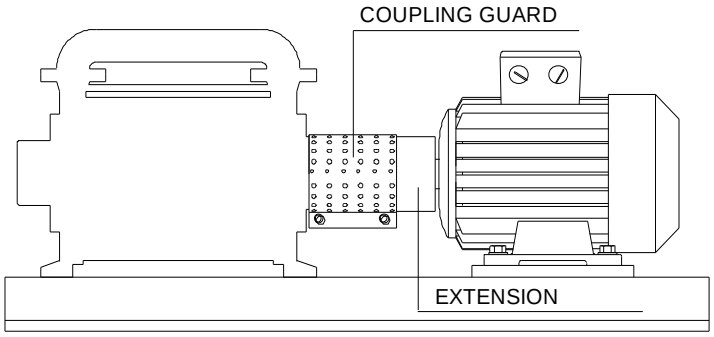


Fig 9 - CHECKING ALIGNMENT ON BASE MOUNTED PUMP DESIGN

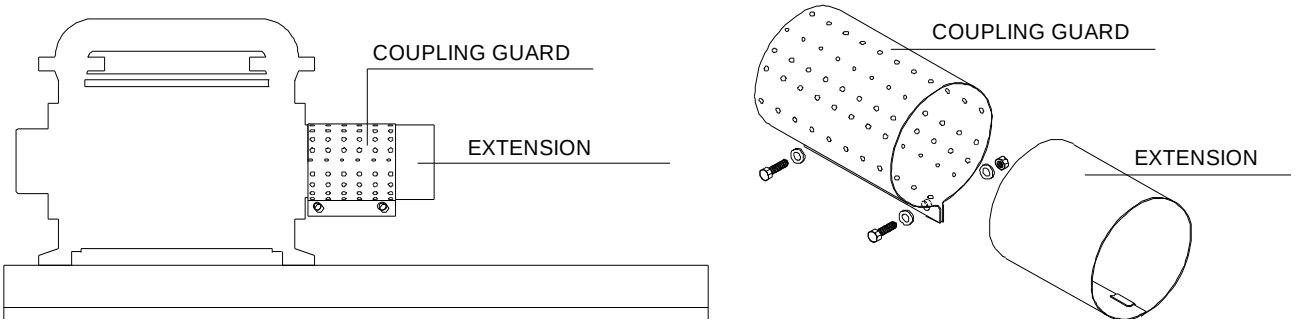


Fig. 10 - ASSEMBLING THE UNIT ON THE BASEPLATE

8 - Place the electric motor on the baseplate and bring the two coupling halves together with approx. 2 mm gap between them keeping the motor axially aligned with the pump shaft.
In the event the two shaft heights do not align, proper shimming under the pump or motor feet will be required.
Mark the motor and/or pump anchoring bolt holes.
Remove motor and/or pump, drill and tap the holes, clean and mount pump and/or motor in place and lightly tighten the bolts (see fig. 11).

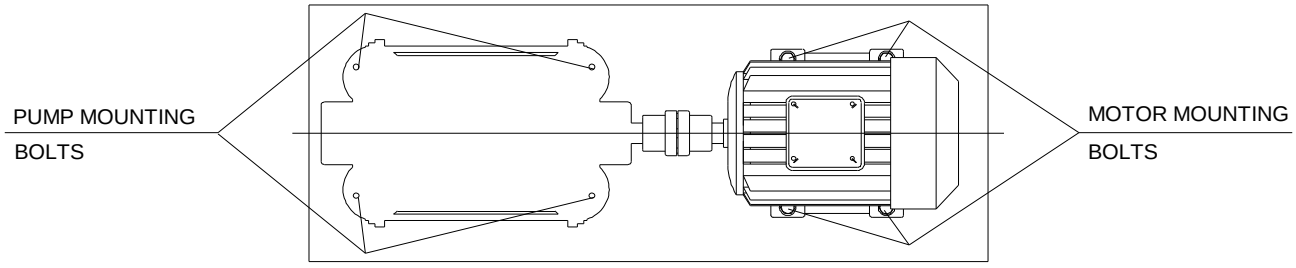


Fig. 11

9 - With a straight edge ruler check the parallelism of the two coupling halves at several points, 90° from each other (see fig. 13).
NOTE: Easier and more accurate readings can be attained with instruments such as Dial Indicators (if readily available).

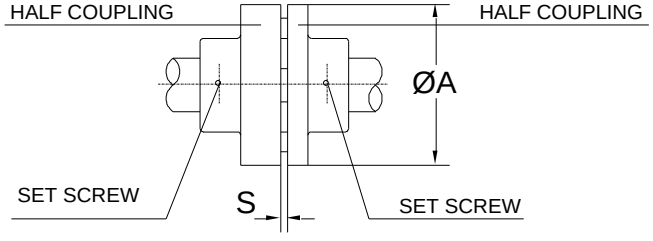


Fig. 12

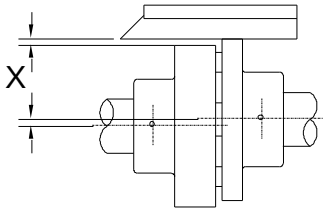


Fig. 13

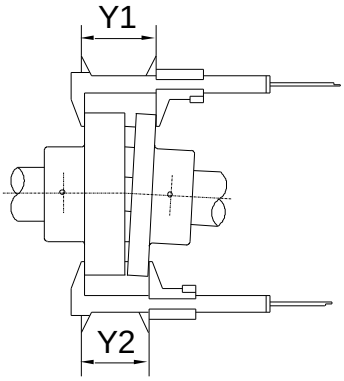


Fig. 14

If the maximum value of "X" is higher than that listed in the tab. 2 (for the given coupling size) it will be required to correct the alignment by using shims under the pump or motor feet.
When the measured values fall within the tolerances, the pump and motor mounting bolts can be tightened.

10 - Angular misalignment can be measured with a Calliper. Measure the outside coupling dimension at several points (see fig. 14).
Find the minimum and maximum width of the coupling, the difference between these two readings "Y" (Y1-Y2) should no exceed the value listed in tab. 2 for the given coupling size.
Should this value be greater it will be necessary to correct the alignment by shimming the pump and/or motor.
Following this operation it is recommended to check once more the value "X" to make sure that both values are within the allowed tolerance (see point 9).
Make sure that both set screws on the coupling halves are properly secured.

Tab. 2

COUPLING “Ø A” mm	GAP “S” mm	PARALLEL "X" mm	ANGULAR "Y" mm
60 to 80	2 to 2,50	0,10	0,20
100 to 130	2 to 2,50	0,15	0,25
150 to 280	3 to 3,75	0,15	0,30
315 to 400	4 to 5	0,25	0,40

11 - Install the coupling guard and its extension (if applicable) on the pump, secure the two locking bolts.
The gap between motor frame and the guard should not be greater than 2 to 3 mm (see fig. 15).

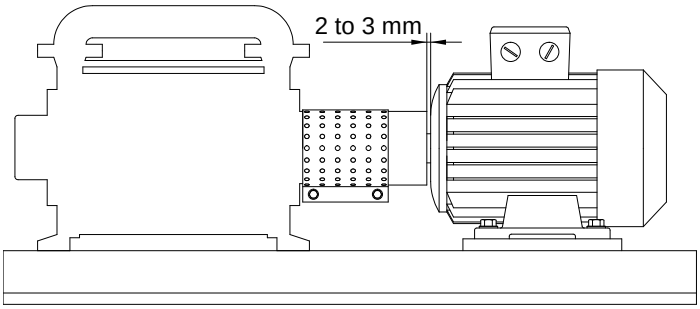


Fig. 15

7.4 BELT DRIVE ALIGNMENT PROCEDURE

If the pump is fitted with belt drive, it is necessary to verify the tension of the belts at the first start-up and periodically (at least every 6 months) as described (see figure 16).

- Disconnect the electrical power from the motor of the pump, with the **PUMP STOPPED** remove the guard from the pulley/belt assembly.
- Rotate the pulleys, finding the tension indicator printed on the back of the belt
- Measure the distance between the 2 stamped reference points verifying that it corresponds to the indicated dimension. In the case of non-conformance, it is necessary to reset the center distance between the two pulleys (pump and motor) using the screws of the sliding base placed under the motor.
- Rotate the pulleys a few revolutions and re-check the length between the two reference points: if the distance is correct their mounting tension is also correct.
- Replace the guard on the pulley/belt assembly.

WARNING: Belt over-tension can cause serious damage to the bearings of the pump and electric motor, belt under-tension can cause a premature wear of the belts.

NOTE: During the first period of operation, it may be noted the presence of dust due to settling wear of the belts, this is a normal phenomena.

For more information consult Pompetravaini.

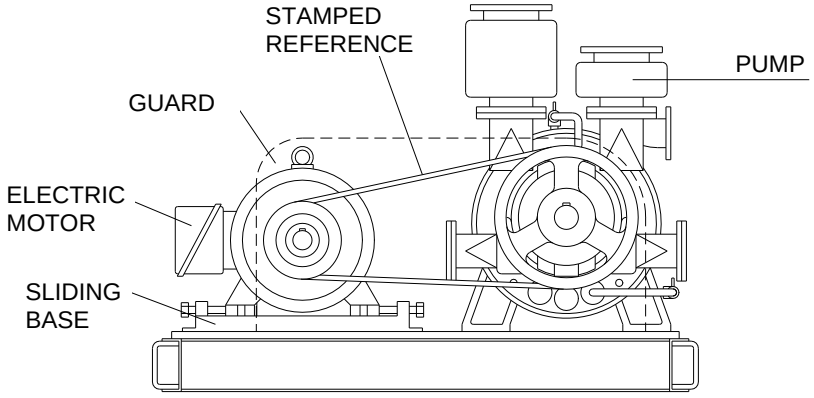


Fig. 16

8 - ELECTRICAL CONNECTIONS

Electrical connections must be made exclusively by qualified personnel in accordance with the instructions from the manufacturer of the motor or other electrical components and must adhere to the local National Electrical Code.

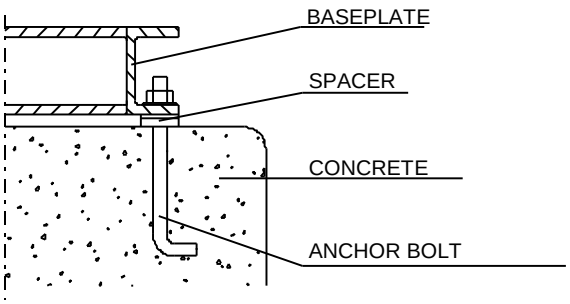
FOLLOW ALL SAFETY PRECAUTIONS AS LISTED IN CHAPTER 2.
BEFORE DOING ANY WORK TO THE INSTALLATION DISCONNECT ALL POWER SUPPLIES.

It is recommended that electric motors be protected against overloading by means of circuit breakers and/or fuses.
Circuit breakers and fuses must be sized in accordance with the full load amperage appearing on the motor nameplate.
It is advisable to have an electrical switch near the pump for emergency situations.
Prior to connecting the electrical wiring, turn the pump shaft by hand to make sure that it rotates freely.
Connect the electrical wiring in accordance with local electrical codes and be sure to ground the motor.
Motor connection should be as indicated on the motor tag (frequency and voltage) and as discussed in the motor instruction manual. It is recommended that motors over 5.5 kW be wired for Star-Delta start-up, to avoid electrical overloads to the motor and mechanical overloads to the pump. Be sure to replace all safety guards before switching on the electrical power. If possible check the direction of rotation before the motor is coupled to the pump but protect the motor shaft to prevent any accidents.
When this is not possible briefly jog the pump to check its direction of rotation(see arrow on pump for correct rotation).
If the direction must be changed two of the three electrical wire leads must be alternated with each other (at the terminal box or at the motor starter).
Please be aware that rotation in the wrong direction and/or pump running dry may cause severe pump damage.
Electrical instrumentation such as solenoid valves, level switches, temperature switches, etc. which are supplied with the pump or systems must be connected and handled in accordance with the instructions supplied by their respective manufacturers.
When the pump is coupled on baseframe carry out the ground connection also for the baseframe on the preposed position with screw or through hole marked by the ground connection symbol.
Remove a portion of the paint on the connection point to ensure electrical continuity between the base and the earthing cable.

9 - INSTALLATION INSTRUCTIONS

Information to determine the piping sizes and floor space requirements can be obtained from dimension drawings and other engineering data.
The information required is:
- size and location of suction and discharge flanges
- size and location of service liquid connection and connections for cooling, heating, flushing, draining, etc.
- location and size for mounting bolts for monoblock pump and/or baseplate and/or frame.

In the event additional accessories are required to complete the installation such as separators, piping, valves, etc. refer to chapters 9.1 to 9.3. Proper lifting devices should be available for installation and repair operations.
Pump assembly should be installed in an accessible location with adequate clear and clean space all around for maintenance, so that an efficient and proper installation can be made.
It is important to have proper room around the unit for ventilation of motor and air cooled radiator, if applicable. Avoid installing the unit in hidden locations, dusty and lacking of ventilation.
Select a mounting pad that will minimise vibrations or torsion of the pump baseplate or frame. It is generally preferred to have a concrete base or sturdy steel beams.
It is important to provide adequate anchor bolting for the pump frame or baseplate to be firmly attached to the foundations (see fig. 17).



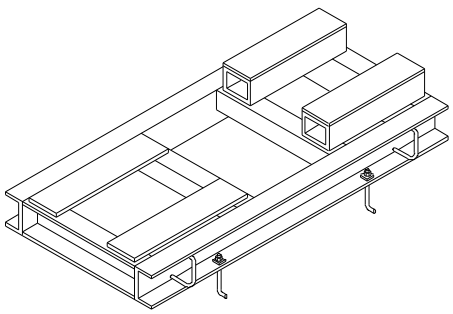


Fig. 17

Concrete pads and other concrete works must be aged, dry and clean before the pump assembly can be positioned in place. Complete all the work relating to the foundations and grouting of the pump assembly, before proceeding with the mechanical and electrical portion of the installation.

9.1 - PIPING CONNECTIONS

Identify first locations and dimensions of all connections required to interconnect the pump with the installation, then proceed with the actual piping: connect the pump suction and discharge flanges, the service liquid line and all other service connections (packing box flushing, drainage, etc.)

BE SURE TO PIPE THE CORRECT CONNECTION FROM THE INSTALLATION TO THE RESPECTIVE PUMP CONNECTION !

To prevent foreign matters from entering the pump during installation, do not remove protection cap from flanges or cover from openings until the piping is ready for hook-up.
Verify that all foreign objects such as welding bits, bolts, nuts, rags and dirt are removed from piping, separators, etc. before these are connected to the pump.
Flanges should be connected parallel with each other, without stress and with bolt holes lined up.
The flange gaskets should not interfere with the inside diameter of piping and/or flange.
All piping must be independently supported, easily located and must not transmit forces or torque to the pump due to the weight or to thermal expansions.
Piping size must never be less than the respective connection on the pump.
Suction and discharge flanges are vertical and identified with arrows.
To minimise friction losses and back-pressures, the discharge piping should be one size larger than the pump connection size. To avoid back-pressure and possibility of flooding the pump when it stops, it is recommended to limit the rise of the discharge piping to approximately 50 cm above the pump discharge flange.
Upon completion piping and connections should be tested for leakage under vacuum.
N.B.: The pump series TRVK –TRSK are supplied with a discharge manifold capable of separating gas from the service liquid. If it is desired to implement separation in a separate tank, it is necessary to close the service liquid discharge connection located at the manifold.

9.2 - ACCESSORIES

Listed below are common accessories that may be supplied with the pump or added at a later date.

Non return valve (check valve)
Prevent back-flow of gas and liquid in the suction piping and/or discharge piping when the pump stops.
Is installed on the pump suction flange in the case of vacuum service or on the pump discharge flange in the case of compressor service.

Vacuum relief valve
It is used to protect the pump from cavitation or to regulate the suction minimum pressure (or max vacuum).
When the pump capacity exceeds the system load at a given vacuum, the relief valve opens letting in atmospheric air or gas (if connected to the discharge separator) keeping constant the pre-set vacuum.

Automatic draining valve
It is used to drain the pump to the shaft centreline when the pump stops so to prevent that the pump has excessive liquid for the next start-up.
Starting the pump full or with too much liquid could severely damage the pump.

Vacuum gauge
Usually installed under the pump suction flange , will provide an indication of the pump operating vacuum (pressure).

Discharge reservoir separator
It separates the service liquid from the gases at the pump discharge.
It is provided as a standard for the pump series TRVK – TRSK.

Heat exchanger
It cools the service liquid for those systems with total liquid recovery: it can be plate and frame type, shell and tube type or radiator type, depending upon the application.

Filter
Required to stop solids from entering the pump suction.
Sizing of the filter is very important as it could create excessive pressure drops which would affect the pump performance.

9.3 - INSTALLATION SCHEMATICS FOR LIQUID RING VACUUM PUMPS

The working principle of the vacuum pump requires a continuous flow of fresh and clean liquid that enters the pump at the service liquid connection identified by the letter “Z” (see following chapter). The liquid is discharged together with the handled gas through the pump discharge flange.

Take care of their disposal according to the laws into force and to a safe local environment management.

The quantity of said liquid will vary with pump size and degree of working vacuum (see performance curves).
The service liquid absorbs the compression heat generated by the pump compression therefore its temperature will rise by some 4°C to 8°C according to working point.
There are three basic installation schematics listed below that may be considered, depending upon the quantity of service liquid that is desired and possible to be recycled.

9.3.1 - Service liquid: Once-through system (no recovery)

All the service liquid is supplied from an external source.
The liquid is separated from the gas in the manifold separator and drains directly through the discharge connection located at the bottom of the manifold separator itself.
This is the most common installation scheme and can be applied when it is available an abundant constant flow of fresh liquid and/or when the liquid contamination problem never exist, liquid that can be harmful for the surrounding environment: therefore provide a proper disposal according to laws into force.
The service liquid should be supplied at the pump connection with a pressure of 0.2 to 0.4 bar maximum to avoid flooding the pump with too much liquid.
If this is not possible it is recommended to install a reservoir fitted with a float valve, this tank is supplied with the liquid that is then pulled by the pump as required by the operating conditions.
The liquid level in the reservoir should be approximately at the pump shaft centreline.
Schematic fig. 18 illustrates the once-through system.

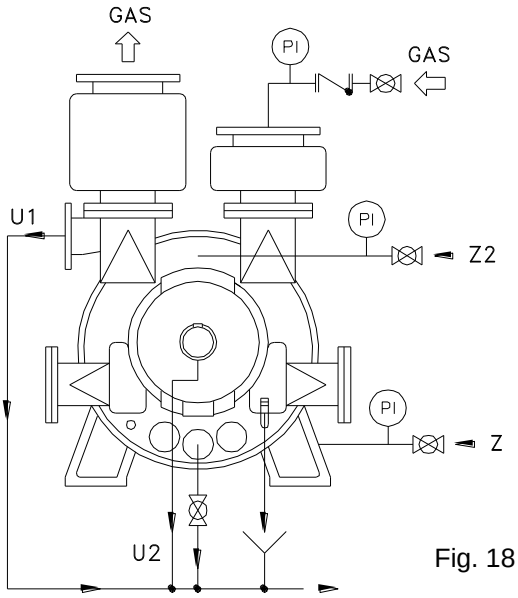


Fig. 18

9.3.2 - Service liquid: Partial recovery system

This type of installation is used where it is desired to minimise the use of fresh service liquid.
The service liquid enters and leaves (take care of its eventual disposal according to the laws into force and to a safe local environment management) the pump same as the once through system, however part of the liquid is recycled from the discharge separator and the balance is continuously supplied from an external source. The excessive liquid is drained through the separator overflow connection.
The temperature of the mixed liquid supplied to the pump will be higher than the temperature of the make-up liquid. Its final temperature will depend upon the amount of the recycled liquid.
It is important to remember that with higher service liquid temperature the pump performance will decrease (see chapter 17) with the possibility of operating the pump in the cavitation area.
When the separator tank is installed along side of the pump (our type HSP), its liquid level should not be above the pump shaft centreline.
Schematic fig. 19 illustrates the system with partial recovery of the service liquid.

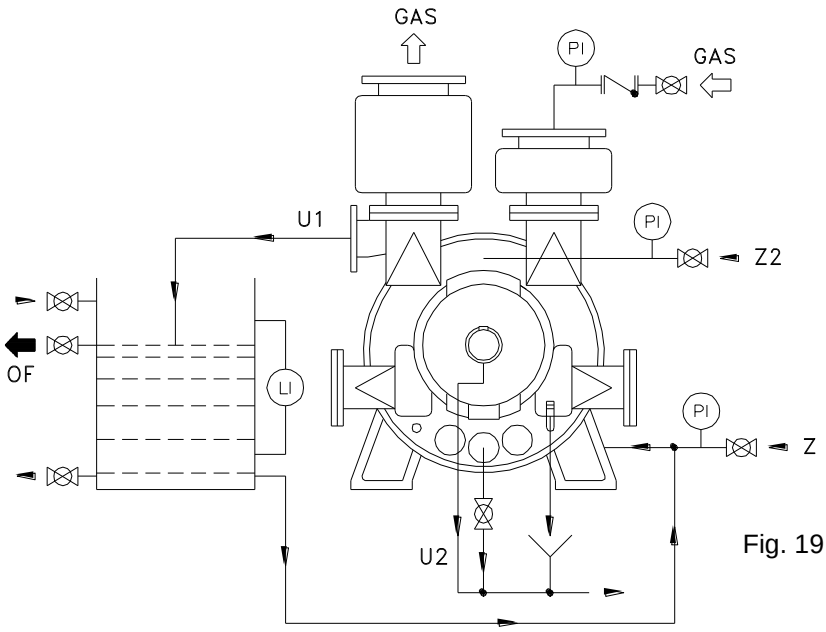


Fig. 19

C = Cooling circuit
OF = Overflow
U1 = Service liquid discharge
U2 = Packing flushing liquid discharge
Z = Service liquid inlet
Z2 = Inlet flushing liquid for packing

9.3.3 - Service liquid: Total recovery system

This system has total recycle of the service liquid without fresh liquid make-up from an outside source.

A heat exchanger is required to lower and control the temperature of the recycled service liquid: for sizing and calculations of heat loads consult Pompetravaini.

A circulating pump will be required for those applications where the vacuum pump operates for extended period of times in the pressure ranges above 400/600 mbar or when there are high pressure drops in the closed loop including the heat exchanger (over approximately 1.5 m).

The liquid level in the separator tank should not be above the pump shaft centreline.

Losses of liquid from the closed loop must be compensated with an equal amount from an outside source.

Schematic fig. 20 illustrates the system with total recovery of the service liquid.

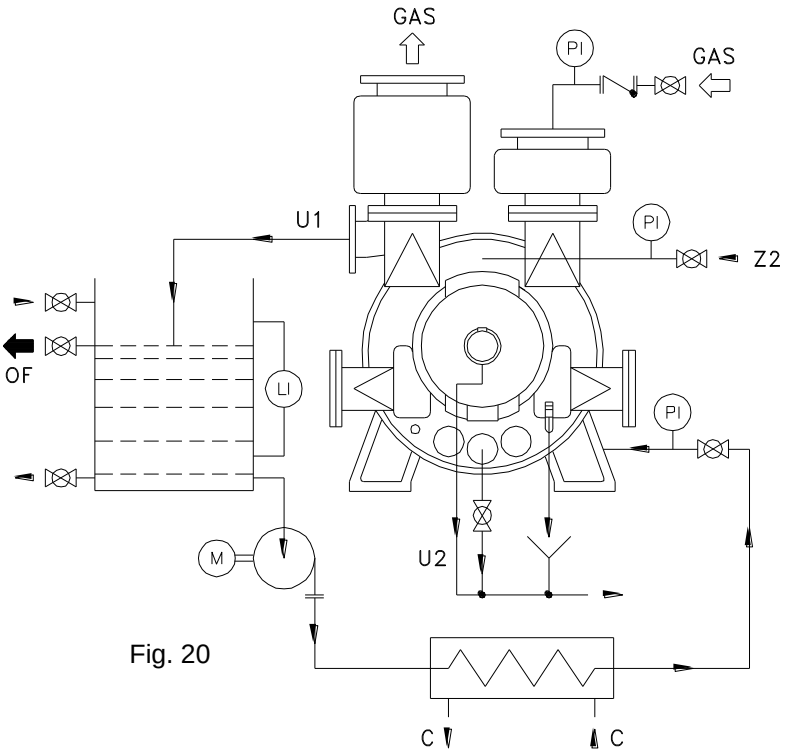


Fig. 20

9.4 - PUMP ENGINEERING DATA

Tab. 3

PUMP MODEL	Weight, Bare pump	Operating Speed RPM		Installed Motor size kW		Installed Motor Frame size (indicative)		Weight of Electric Motor (indicative) kg	
	kgs	from	to	from	to	from	to	from	to
TRVK 1502/1	850	565	880	30	55	200L	250M	260	410
TRVK 1503/1	1043	590	920	45	90	225M	280M	320	650
TRVK 2003/1	705	500	740	55	110	250M	315S	410	1000
TRVK 2503/1	790	370	660	75	160	280S	315L	550	1160
TRVK 3003/1	1060	370	530	132	250	315M	355M	1100	1700
TRVK 3503/1	1005	270	470	160	315	315L	355L	1160	1850
TRVK 4003/1	1130	240	400	200	500	315L	450	1270	3020
TRVK 5003/1	1295	210	330	315	630	355L	450	1850	3430
TRSK 2002/1	1470	472	640	55	75	250M	280S	410	550
TRSK 2004/1	1850	490	640	75	110	280S	315S	550	1000
TRSK 2005/1	1680	470	740	55	110	250M	315S	410	1000
TRSK 2502/1	2400	385	510	90	132	280M	315M	650	1100
TRSK 3000/1	3050	372	550	110	200	315S	315L	1000	1270
TRSK 3002/1	3300	330	472	110	160	315S	315L	1000	1160
TRSK 3004/1	3600	330	472	132	250	315L	355M	1270	1700
TRSK 3006/1	4000	350	420	90	250	280M	355M	650	1700
TRSK 3500/1	4350	330	490	160	315	315L	355L	1160	1850
TRSK 3504/1	5600	266	372	160	250	315L	355M	1160	1700
TRSK 4000/1	6560	276	395	200	400	315L	400L	1270	2260
TRSK 4002/1	7900	220	298	200	315	315L	355L	1270	1850
TRSK 4004/1	8600	220	298	200	355	315L	400	1270	2260
TRSK 4504/1	10200	236	330	315	500	355L	450	1850	3020
TRSK 5002/1	11500	197	276	315	500	355L	450	1850	3020
TRSK 5004/1	12500	220	298	400	630	400	450	2260	3430
TRSK 5008/1	13950	197	312	400	710	400	450	2260	3650

10 - CHECK LIST PRIOR TO START-UP

If pump is designated to be used in environments subjected to the application of the ATEX 99/92/CE directive or the pump is provided with a nameplate indicting the ATEX stamp, it strictly forbidden proceed to start up the pumps but necessary to consult POMPETRAVAINI for clarifications.

All questions listed below must have **POSITIVE** answers prior to proceeding to the pump start-up.
Please note that the following is a partial list. Special installations may require further precautions therefore, additional safety steps must be taken as the cases dictate.

- **This manual has been completely read, including the following chapters, and is understood in its entirety?**
- **The piping system has been flushed of any foreign particles, welding impurities, etc.?**
- **Have all piping and pump obstruction been removed?**
- **All connections and piping are leak proof and there are no external forces or moments applied to the piping or pump flanges?**
- **Pump and motor are properly lubricated, per instructions?**
- **Pump/motor alignment has been checked?**
- **Mechanical seal flushing line has been connected, where required?**
- **All valves in the installation are in the correct position?**
- **All safety guards are in place?**
- **Pump direction of rotation has been checked by jogging the motor?**
- **The pump Stop switch is clear and visible?**
- **Pump as well as installation are ready for start-up?**

11 - STARTING, OPERATING AND STOPPING PROCEDURES

Upon receipt and/or completion of installation, before turning on the power to the electric motor, rotate the pump shaft by hand to make sure that the pump rotor is free. In the event the shaft does not turn, try to free it up by applying a torque to the pump coupling with a pipe wrench.
In the event the pump does not become free with the above procedures, fill up the pump with a suitable solvent or lubricating liquid, let it rest for several hours to allow softening of the rust build-up inside the pump, drain the pump and apply torque to the pump shaft as described above to finally free the rotor.
NOTE: The selected solvent or lubricating fluid must be compatible with the pump, seals and gasketing materials.

CHECK PUMP-MOTOR COUPLING ALIGNMENT!
This must be done prior to the first start-up and before every start-up if pump or motor has been removed from the installation for maintenance or other reasons (see chapter 7.2).

Prior to starting the pump verify that all auxiliary components are available, ready for use and, where required, they are in the open position (i.e.: double mechanical seals are pressurised with buffer liquid, cooling liquid to heat exchanger is open, etc.) and the pump bearings are lubricated.
If the gas and/or service liquid temperatures are in the dangerous levels, it is recommended to insulate the pump, piping and separator to avoid direct contact with their surface, avoid freezing, thermal shock or loosing heat energy.

11.1 - START-UP

Open valve at gas discharge if installed and partially open the valve at the suction side.
When pump is fitted in a partial recovery or total recovery or HYDROSYS systems, as built by POMPETRAVAINI, it is required to have drain valve at separator in the closed position, flow regulating valve and overflow valve in the open positions. Separator overflow valve should be piped to drain (or collecting container). Before start-up fill the pump to the shaft centreline, separator and piping of system with service liquid through pump inlet flange or fill connection. Check all components for leakage.
NOTE: If a separator tank is installed, please pay attention that service liquid will flow from the overflow valve: so it is necessary to provide for a proper pipe to receive adequately the outlet of such liquid.
If the automatic drain valve is installed, the overflow valve must be closed after the filling.
Start all accessories (temperature switches, level switches, pressure switches, etc.) open cooling and flushing lines (see chapter 13.3).
Start the pump and open the service liquid valve, soon after start the circulating pump and adjust the service liquid flow.
Gradually open the valve at gas suction side till the required vacuum level is reached.
Check the system for abnormal conditions (see chapters 12 and 14).
If the system is fitted with a circulating pump and/or the service liquid has an excessive pressure the by-pass valve or regulating valve can be adjusted to reduce the service liquid flow to the vacuum pump and/or optimise the thermodynamic efficiency of the heat exchanger.
A gauge located at the service liquid suction port of the pump will have to indicate a pressure between 0.2 and 0.4 bar more than that of the gas discharge (generally atmospheric pressure).

NOTE: HYDROSYS systems engineered with multiple pumps are fitted with isolating valves at suction, discharge, and service liquid lines of each pump. When one or more pumps are not operating it is required to isolate the idle pump(s) by closing these valves. When the pumps are put back into service the said valves (at suction and discharge) must be opened.

11.2 - OPERATION

After starting the vacuum pump check the following:

- the vacuum level is as desired or adjust the flow regulating valve to the required vacuum
- flow and temperature of service liquid and/or cooling liquid are as expected (within 25% tolerance)
- motor does not draw more amperage than shown on its nameplate
- the pump-motor assembly does not have abnormal vibrations and noises such as cavitation
- the operating temperature at full load, does not exceed approximately 85°C
- there are no leaks from mechanical seals, joints and flushing or cooling liquid lines
- liquid level in separator is between the minimum and the maximum
- the packing stuffing boxes are correctly flushed.

NEVER OPERATE THE PUMP DRY!

If the gas discharge is not open to the immediate atmosphere but it is piped to other locations, the pump discharge should be checked for back-pressures that could cause higher power consumption and loss of pump capacity.

11.3 - SHUT DOWN

First close the service liquid flow and cooling liquid flow (if applicable) then shut down the circulating pump (if there is one).
Where possible, gradually decrease the vacuum level to 400/900 mbar in about 10 seconds max.
The discharged service liquid from pump helps producing a slow deceleration rather than sadden stop.
Turn off the power to motor and close any accessories and flushing lines.
Make sure the non return valves, or similar, at suction and discharge lines are leak tight.
Should the system be idle for an extended period of time it is recommended to disconnect the electricity to the motor panel, drain all liquids from pump, separator and piping. Refer to chapter 6 for storage procedures.

12 - OPERATING MAINTENANCE

Periodically check the working conditions of the system by means of the instrumentation on the installation (pressure gauges, vacuum gauges, temperature gauges, ampmeters, etc.) and if the pump is consistently handling the application for which it was selected.
The operation of the pump should be without abnormal vibrations or noises, if any of these problems is noticed, the pump should be stopped immediately, search for the cause and make the necessary corrections.
It is good practice to check the pump/motor alignment, the running conditions of the bearings and of the mechanical seals (see chapter 13) at least once a year, even if no abnormalities have been noticed.
If there is a deterioration of the pump performance, which is not attributable to changes in system demands, the pump must be stopped and proceed with necessary repairs or replacement.
If the mechanical seals are fitted with external flushing and/or quenching lines their pressures, temperatures and flows must be checked constantly.

NEVER ALLOW THE PUMP TO OPERATE IN THE CAVITATION AREA!

Cavitation has the characteristic metallic sound, like if gravel was rotating inside the pump, and it causes also high pump vibrations. This happens when the pump is running at absolute pressures close to the vapour tension of the service liquid at the running conditions.
This is a damaging condition for the impellers, port plates and casings. The cavitation causes erosion taking away metal particles and attacking the surface of the pump components. This is particularly damaging if the pump is handling corrosive gases, see chapter 14 for suggestions to correct the problem.
The pump series TRVK can be pre-fitted with an anti-cavitation system.
Such a system allows connection of each discharge plate (at the gas discharge port side) to the upper part of the separator tank so that only air can be aspirated when the limits of cavitation are reached.
Alternatively, the above-mentioned connection can be fitted with a valve for the introduction of air to the pump.
Such a system permits a reduction in cavitation without excessively reducing the performance of the pump while guaranteeing high vacuum.
During operation it must be avoided to have sudden and frequent variations from high to low vacuum. (e.g.: suddenly opening the suction valve when the pump is operating at pressures lower than 200 mbar).
This would flood the pump creating high power absorption that would put heavy stress on the motor and coupling.
Particular attention should be put on the quantity of the service liquid flow. The flow will depend upon the type of installation (see chapter 9), the pump size, and/or the desired temperature rise.

The flow of service water at 15°C, for standard pumps and normal operating conditions at various vacuum levels, is listed on the specific pump curves.
Usually the temperature rise of service water, when handling dry air at 20°C, is approximately 4 to 8°C.
When condensable (e.g.: vapours) are present in the gas stream the heat load to be removed by the service water will be higher, therefore the service water temperature rise will be higher.
The service liquid flow and its temperature will affect the pump performance (see chapter 17).
Generally the low service liquid flow will decrease the pump capacity, while a high service liquid flow will increase the absorbed power by flooding the pump.
Hard service water will generate lime build-up inside the pump. The severity of the deposit will vary with the water temperature. Lime or mineral deposits on the surface of the internal pump components will cause an increase of absorbed power, wear of the components and eventually will seize the pump.
It is recommended to monitor the water hardness and, if too high, treat the water. If there are no alternatives, there should be periodical flushing of the pump with a solution that will remove the specific deposits, or the pump must be periodically disassembled, cleaned of all incrustations and re-assembled.
Systems with total service liquid recovery require periodical change of the service liquid contained in the closed loop.
The heat exchanger must be kept well cleaned of all mineral deposits for an effective thermodynamic heat exchange.
During operation, a closed loop system will loose some of the service liquid, due to evaporation and/or saturation of the discharged gases. It will be required to periodically make-up fresh liquid into the system.
Systems that handle condensable will experience a rise in the level of the service liquid in the separator. The excessive liquid will be overflowed through the overflow valve or connection.

13 - BEARINGS AND MECHANICAL SEALS MAINTENANCE

WARNING: The maintenance must be carried out with the pump turned off and the electrical power, or other driving mechanism, must be disconnected. The power should only be turned back on by the same person doing the maintenance. It is however recommended to have at least a team of two workers doing the maintenance and the supervisors should be fully aware of the work in progress.

CAREFULLY FOLLOW THE SAFETY PROCEDURES LISTED IN CHAPTER 2.

13.1 - BEARINGS

During assembly the bearings are already lubricated with high quality grease with working temperature limits -20°C +180°C.
The bearings used in a pump normal operating conditions must be carefully cleaned and newly greased after approximately 2000/2500 working hours using a good lubricating grease quality.
Bearing temperature should not exceed the 85°C during normal working conditions and normal environments.
Bearings can overheat for reasons such as too much grease, misalignment of flexible coupling, wrong bearings, excessive vibrations, bearing wear. See following table for bearing numbers and type used for each pump.

Tab. 4

PUMP MODEL	Bearing, Drive end	Bearings, Non drive end	
TRVK 1502/1	NU 216	NU 216	n° 2) 7212AC
TRVK 1503/1			
TRVK 2003/1	NU 222	NU 222	n° 2) 30222
TRVK 2503/1	NU 226	NU 226	n° 2) 30226
TRVK 3003/1	NU 230	NU 230	n° 2) 30230
TRVK 3503/1	NU 234	NU 234	n° 2) 30234
TRVK 4003/1	NU 238	NU 238	n° 2) 30238
TRVK 5003/1	NU 244	NU 244	n° 2) 30244

PUMP MODEL	Bearing, Drive end	Bearings, Non drive end
TRSK 2002/1	NU 222	n°2) 30222
TRSK 2004/1		
TRSK 2005/1		
TRSK 2502/1	NU 226	n°2) 30226
TRSK 3000/1		
TRSK 3002/1	NU 230	n°2) 30230
TRSK 3004/1		
TRSK 3006/1		
TRSK 3500/1		
---	NU 234	n°2) 30234
TRSK 3504/1		
TRSK 4000/1		
TRSK 4002/1	NU 238	n°2) 30238
TRSK 4004/1		
TRSK 4504/1		
TRSK 5002/1	NU 244	n°2) 30244
TRSK 5004/1		
TRSK 5008/1		

13.2 - MECHANICAL SEALS

Mechanical seals can be with many types of materials, design and installations (see fig. 21).
Their selection has been evaluated by POMPETRAVAINI at the time of pump design, in function of the fluid and working conditions.
The seals are supplied with the proper flow of liquid for their lubrication, through internal pump passages. Upon request, the pump can be provided with seal lubrication coming from an outside source; the set-up must be such that the seals are guaranteed the liquid quantity and pressure as recommended by POMPETRAVAINI or by the seal manufacturer.
Mechanical seals normally fitted in the vacuum pumps are to DIN 24960 standards.
Normally mechanical seals do not require maintenance until there is a visible liquid loss (leakage).

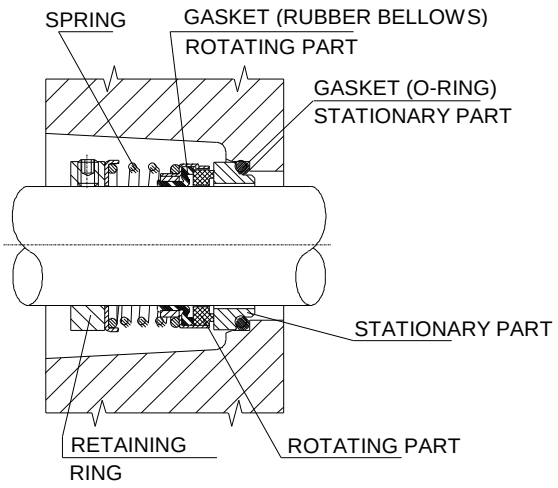


Fig. 21

Mechanical seals **MUST NOT** run dry! When seals are operated without lubricant and/or flushing liquid their faces and the elastomers may suffer damages beyond repair. It is suggested to check the conditions of the seal faces every approximately 4000 working hours.

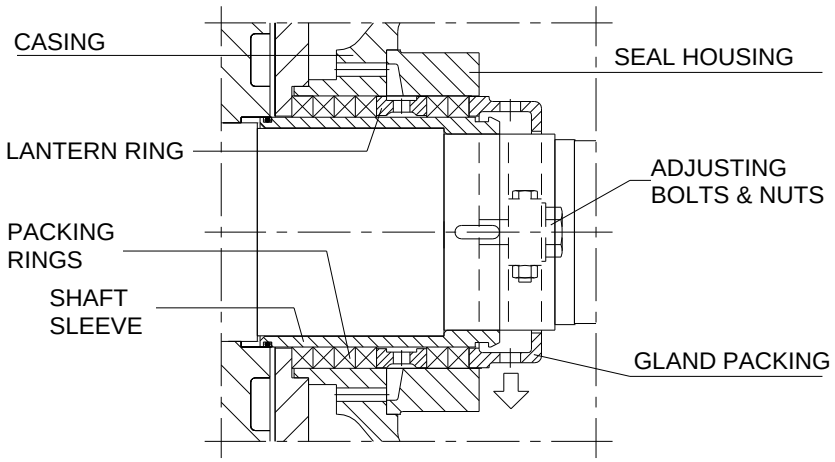
ATT.: Take particular care of possible mechanical seals leaks of the pumped medium that, due to its characteristics, might be dangerous for the environment.

N.B.: The data provided refers to the pumps of standard construction. For special constructions contact Pompetravaini.

13.3 - PACKED STUFFING BOXES

Pumps fitted with packed stuffing boxes require packing flushing either from an external source or directly from the pumped media through pump internal passages.
This liquid is necessary to remove the friction heat generated between the shaft and the packing.
For the exact locations and dimensions of the flushing connections, see the pump dimension drawings.
In the pumps predisposed with external flushing to packing, the quantity of clean liquid for a correct flushing will have to be determined using a flow regulation valve and reading on the pressure gauge (PI) a positive pressure of 0.2 to 0.4 bar over that of the pump discharge pressure (see fig. 19 and 20).
If it is necessary to have flushing to the packing from the pump internal it is necessary to turn the seal housing by 180°, allow the number 4 stamped on the casting to be at the upper position (see fig. 23 and 24).
This will guarantee the correct quantity of flushing liquid with a consistent flow thanks to the special channel provided within the pump. This operation must be carried out by trained personnel, whit the **PUMP STOPPED**.

Fig. 22



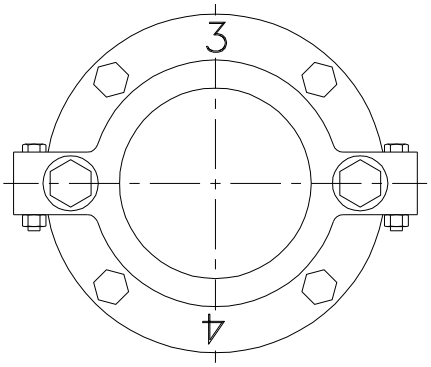


Fig. 23
External flushing to the packing

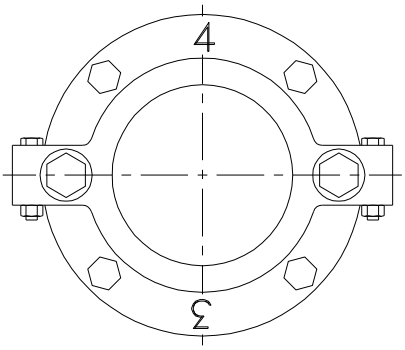


Fig. 24
Internal flushing to the packing

13.3.1 - ADJUSTMENT OF THE PACKING

All adjustment operations must be performed with the PUMP STOPPED following the safety measures given in chapter 2. After completion of the work ALWAYS re-install the safety guards previously removed.

At first start up loosen the nuts of the packing gland allowing a steady flow of liquid to drain out (see fig. 22).

After obtaining a steady flow of leakage gradually tighten the gland nuts until attaining a steady dripping within the limit of the above recommended temperature.

The magnitude of leakage depends proportionally to the size of the pump and from the operating pressure in the packing housing: in any case, the discharging liquid temperature from the packing housing must not be more than 50°C when the liquid enters the pump at ambient temperature.

A few hours time span may be required to establish a steady dripping at low temperatures.

Packing adjustment is required when the liquid leakage increases.

When adjustment is no longer possible, the packing material should be replaced with new one (see following chapter).

In the event the pump remains out of service for more than 6 months it is recommended to replace the packing rings, prior to start-up.

13.3.2 – REPLACEMENT OF THE PACKING RINGS

The replacement of the packing rings can be implemented without disassembling the pump with the following steps. Slide the packing gland as much as possible towards the bearing after removing from the studs the adjustment nuts for the packing gland.

With a suitable tool remove the packing ring and the lantern ring.

Thoroughly clean the packing housing and the shaft sleeve, removing any possible incrustation, oxidations and residues from the washing liquid.

Install new packing rings one at a time and the lantern ring in the packing housing, keeping close attention to position the rings with the joints offset by 90° (see fig. 25).

Reinstall the packing gland with the respective adjustment nuts and make the necessary adjustments as described in the previous chapters.

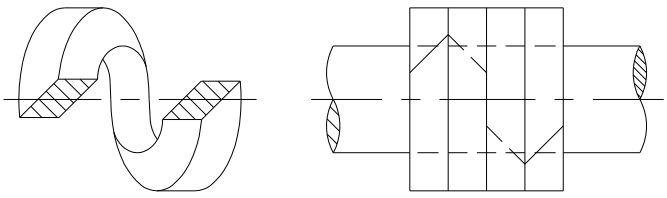


Fig. 25

14 - TROUBLE SHOOTING: PROBLEMS, CAUSES AND SOLUTIONS

Consult the following tab. 4 when problems are experienced, if solutions are not found in this chart or should there be any doubts, do not hesitate to contact POMPETRAVAINI or your local representative.

Tab. 4 - **LIST OF PROBLEMS**

PROBLEM	LIST OF POSSIBLE CAUSES
Pump does not create or the vacuum is too low	1 – 2 – 3 – 4 – 9 – 11 – 18 – 19 – 22 – 23 – 24 – 25 – 26
Excessive noise	1 – 4 – 5 – 6 – 7 – 10 – 24 – 26 – 27
High power consumption	1 – 5 – 6 – 8 – 9 – 15 – 24 – 25 – 26 – 27
Vibration	5 – 6 – 7 – 8 – 10 – 12 – 13 – 24 – 26 – 27
Mechanical seal leaking	11 – 14
Pump looses liquid	11 – 19 – 23
Bearing failure	5 – 6 – 7 – 27
Pump does not start	1 – 6 – 20 – 21 – 26
Shaft partially or totally locked	6 – 10 – 15 – 16 – 21 – 26
Cavitation	3 – 4 – 8 – 9 – 17 – 24

	CAUSES	SOLUTIONS
1	Defective motor or wired wrong	Check the voltage, the frequency, motor type, power consumption, rotation, wiring connections, phase consistency
2	Leakage in suction piping	Repair piping; check valves for leakage
3	Service liquid high temperature	Lower the service liquid temperature; check the level of the service liquid; adjust the cooling liquid flow; adjust the radiator thermostat to lower temperature setting
4	Low service liquid flow	Increase the service liquid flow
5	Coupling misalignment	Re-align the coupling and the pump/motor assembly
6	Faulty bearing	Replace the bearing
7	Cavitation	Open the anti-cavitation valve or set the relief valve to a lower vacuum
8	High service liquid flow	Reduce the service liquid flow; adjust the by-pass valve
9	High back pressure	Check the discharge line for obstructions or high friction losses; reduce the back-pressure to maximum 0.1 bar
10	Wrong pump/motor assembly	Verify that the base surface is level and that all pump feet are resting on the surface, add spacers if required
11	Mechanical seal failure	Change the mechanical seal
12	Wrong pump mounting	Remount the pump
13	Piping weight resting on pump	Support the piping with hangers or other means
14	Inadequate seal lubrication	Check flushing liquid temperature, flow and pressure
15	Mineral deposits from hard water	Clean the pump
16	Foreign particles in pump	Disassemble the pump to remove the foreign objects
17	Low suction pressure	Open the vacuum regulating valve and/or the anti-cavitation valve (vacuum relief valve)
18	Wrong pump rotation	Reverse the rotation
19	Bad gaskets	Replace the defective gaskets
20	Wrong motor connections	Check the electrical connections (connectors, fuses, breakers) and the power supply line
21	Pump seized	Disassemble and repair the pump
22	Pump undersized	Select a pump with higher capacity
23	Pump worn-out	Disassemble and repair the pump
24	Excessive liquid flow through suction line	Reduce the liquid flow through the pump suction; install a centrifugal separator (cyclone) before the pump
25	Instrumentation out of calibration	Check the working characteristics, replace if required
26	Insufficient tension for the belt	Reset the correct tension of the belt
27	Excessive tension for the belt	Reset the correct tension of the belt

15 - REPAIRING AND REMOVING PUMP FROM THE INSTALLATION

Should there be the need for pump repair a knowledge is required.

FOLLOW THE SAFETY PRECAUTION MEASURES OUTLINED IN CHAPTER 2.

Before working on the pump it is important to:
- procure and wear the proper safety equipment (hard hat, safety glasses, gloves, safety shoes, etc.)
- disconnect the electrical power supply and, if required, disconnect the electrical cable from the motor
- close the isolating valves at pump inlet, outlet and service liquid
- let the pump cool down to ambient temperature if it has been handling hot fluids
- adopt safety measures if the pump has been handling hazardous liquids
- drain the pump internals of the pumped liquid through the draining connections, if necessary rinse with neutral liquid.

To remove the pump and the motor from the installation proceed as follows:
- remove bolts from pump suction and discharge flanges
- remove the coupling guard
- remove the spacer of the coupling, if there is one
- if required, remove the motor anchor bolts on the baseplate
- remove the pump anchor bolts on the baseplate
- remove the pump from the installation. Avoid damaging other system components.

After pump repairs, re-install following the steps from "Assembly and Alignment" procedures and after (see the applicable chapters).

16 - SPARE PARTS

When ordering the pump it is good practice to also order the necessary spare parts, especially when there are no stand-by pumps in the installation.
This will minimise unnecessary down times in the event of pump failure or routine maintenance.
It is therefore, recommended to stock the following spare parts for each pump size:

1	Impeller set / Complete shaft assembly
1 or 2	Shaft protection sleeve set
1 or 2	Bearing set
1 or 2	Mechanical seal set
1	Gasket set
1	Coupling insert set
1	Packing seal set
1	Belt set

For better parts management, the VDMA 24296 standards suggest to stock the number of parts as a function of the number of pumps being used in the plant.
On the pump nameplate are printed pump model, year of manufacture and pump serial number. When ordering spare parts always provide this information. Pump type, parts item number (VDMA) and description as per the pump sectional drawing and parts list is useful information that helps to supply correct spare parts for your pump.

We recommend the use of original spares: in case this is not respected, POMPETRAVAINI declines any responsibility for eventual damages and not correct running caused by not original spare parts.

17.1 - INFLUENCE OF SERVICE LIQUID TEMPERATURE, SPECIFIC GRAVITY AND VISCOSITY ON PUMP PERFORMANCE

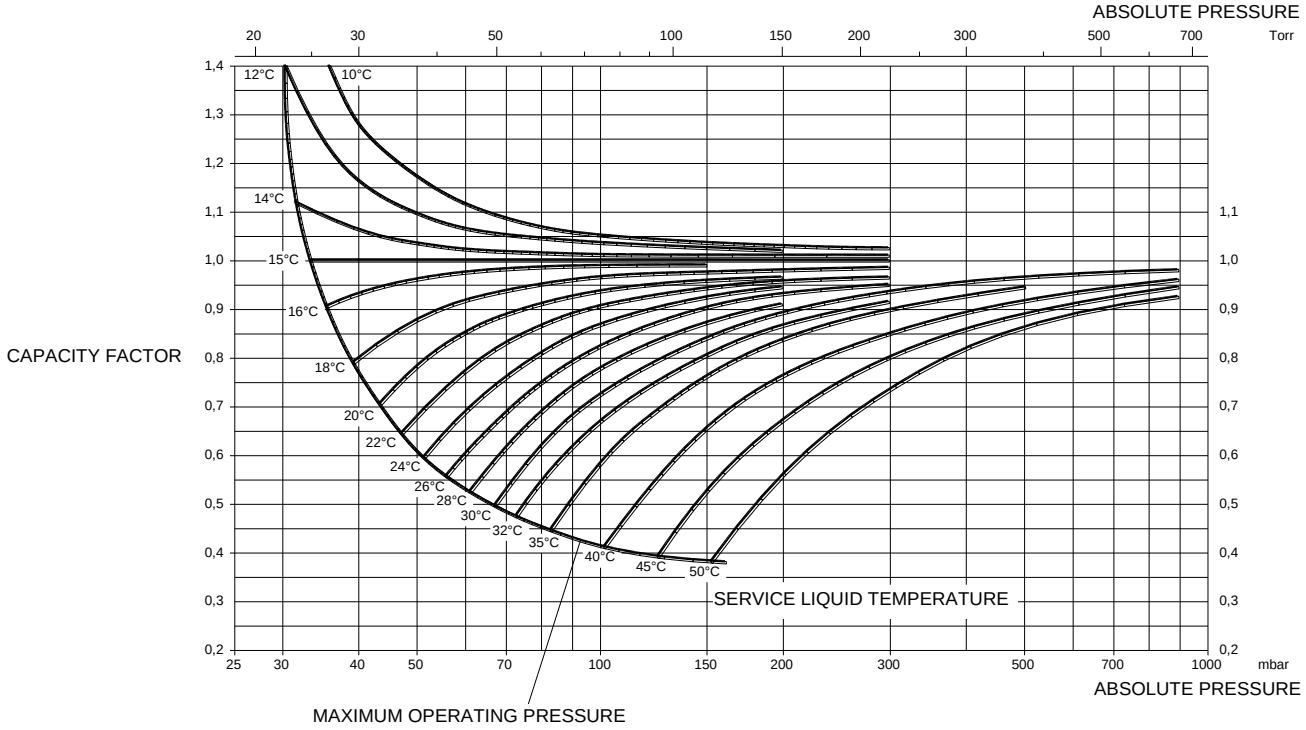
The performance of liquid ring vacuum pumps is based on the use of water at 15°C as service liquid. With water at different temperatures the pump capacity and the maximum attainable vacuum level will vary in function of the type of pump, as illustrated by the curve sets of fig.26.

EXAMPLE: Pressure = 60 mbar - Water temperature = 24°C - Pump series TRVK - Capacity (15°C) = 12000 m^3/h From curves of fig. 26 we find the correcting factor of 0,85, therefore the actual capacity for the pump at the given conditions will be: 12000 x 0,85 = 10200 m^3/h.

The maximum suction pressure before incurring cavitation will be approximately 52 mbar.

Regarding the performance variation due to changes of specific gravity and viscosity, it can be assumed a proportional variation in power consumption however, the changes in capacity at different pressures must be analysed case by case. Please refer the conditions to POMPETRAVAINI when these corrections are needed.

Fig. 26



17.2 - SERVICE LIQUID TEMPERATURE CHANGE ACROSS THE PUMP

The service liquid of a liquid ring pump absorbs total heat Q_T as follows:

$$Q_T\,(kJ/h) = Q_c + Q_K + Q_R$$

where:

Q_C = 0,9 x P x 3600 = Isothermal compression heat
Q_K = m_V x r = Condensation heat
Q_R = m_g x c_p x ΔT_a = Cooling heat (generally negligible, ignored in calculation of Q_T)

m_v = mass condensed incoming vapour in kg/h
m_g = mass incoming gas in kg/h
P = absorbed power at operating point in kW
c_P = gas specific heat in kJ/Kg x K
r = heat of vaporisation in kJ/Kg
ΔT_a = differential temperature in K, between incoming gas T_G and service liquid discharge temperature (T_2 + ΔT)
K = Kelvin temperature

Once the Q_T is known it is possible to calculate the differential temperature ΔT of the pump service liquid:

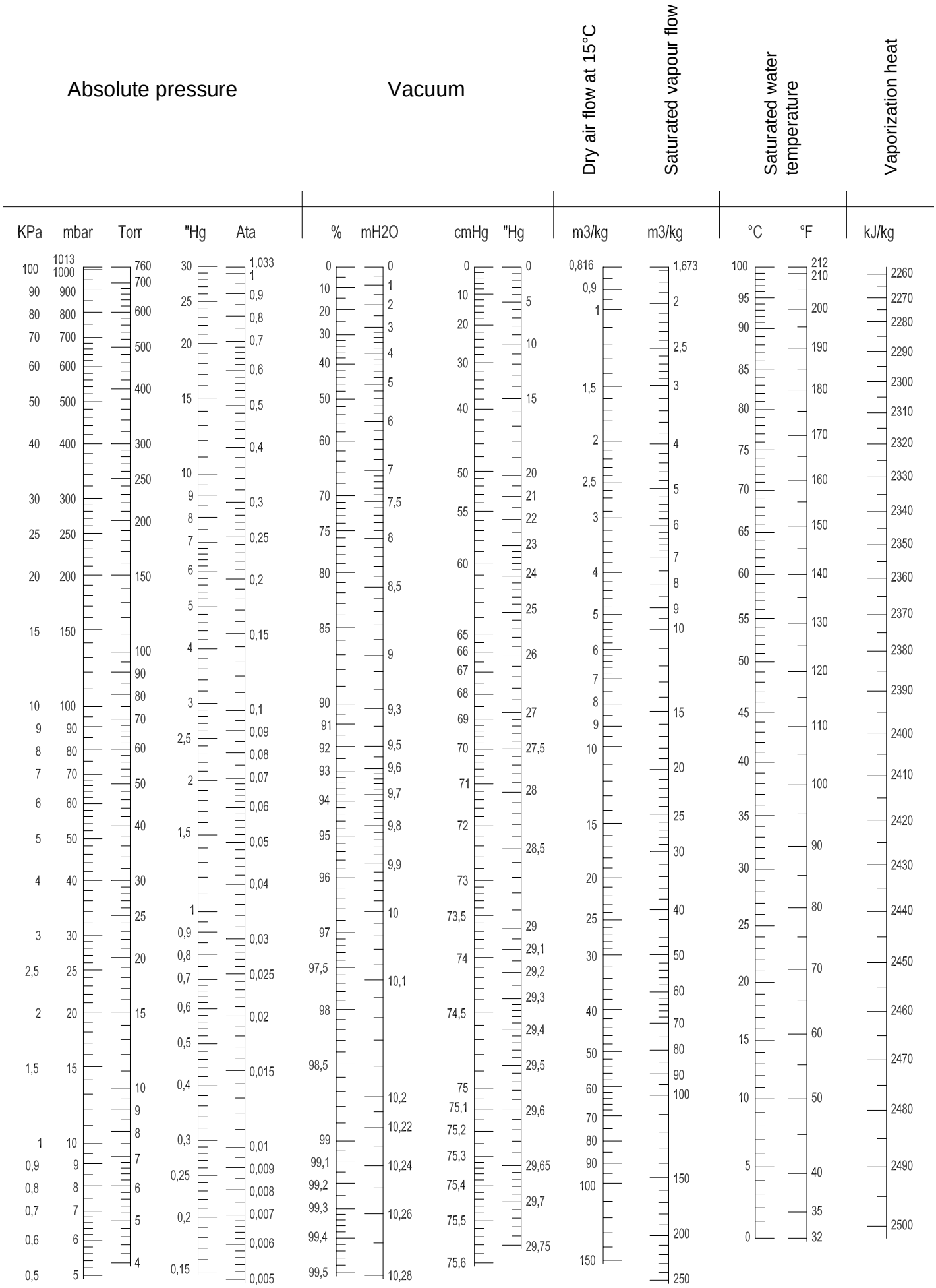
$$\Delta T = \frac{Q_T}{Q_A \cdot \rho \cdot c_p}$$

where:

Q_T = total heat load before calculated in kJ/h
Q_A = pump service liquid flow in m^3/h
ρ = service liquid density in kg/m^3 (water = 1000)
c_P = service liquid specific heat in kJ/kg x K
(Some values for c_P: Water = 4,2 - Air = 1,0 - Water Vapour = 1,84)

NOTE: It can be assumed that the discharge gas and service liquid have same temperature.

17.3 - UNIT CONVERSION TABLE



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NL Deze verklaring zal ongeldig zijn, indien een modificatie op dit product heeft plaatsgevonden, zonder toestemming van de fabrikant, of bij onjuist gebruik.
DK Dette certifikat er ikke længere gyldigt, såfremt maskinen modificeres på en måde, der ikke er godkendt af producenten eller i tilfælde af uhensigtsmæssig brug af maskinen.
S Om ändringar görs av maskin eller felaktig användning utan godkännande av producent kommer detta certifikat att ogiltigförklaras.
FIN Tämä vakuutus ei ole voimassa jos koneeseen tehdään muutoksia joita ei ole hyväksytetty valmistajalla tai jos konetta käytetään väärin.
PL Certyfikat traci ważność w przypadku modyfikacji dokonaych bez wiedzy i zgody producenta dołączonej do urządzenia, a także w przypadku nieprawidłowego użytkowania urządzenia.

I Il Presidente e responsabile tecnico
GB The President and Technical Manager
F Le Président et le Directeur Technique
D Der Geschäftsführer und Technische Manager
E El presidente y el director técnico
NL De algemeen en technisch directeur
DK Direktøren og Teknisk Chef
S Verkställande direktör eller Teknisk chef
FIN Toimitusjohtaja ja Tekninen Johtaja
PL Prezes Zarządu i Dyrektor Techniczny

Sig. Carlo Travaini

Service Card