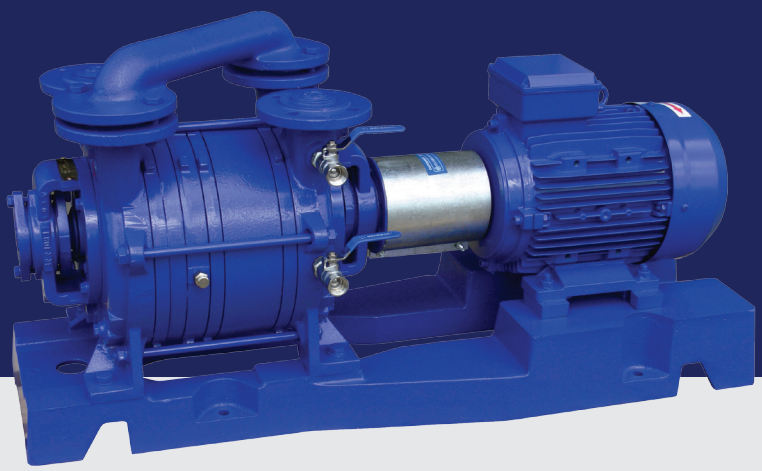
# *PW type vacuum pumps and DW type blowers*



ISO 9001
ISO 14001
PN-N 18001

AC 014
QMS, EMS
BHP

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1862

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## Contents

## Application

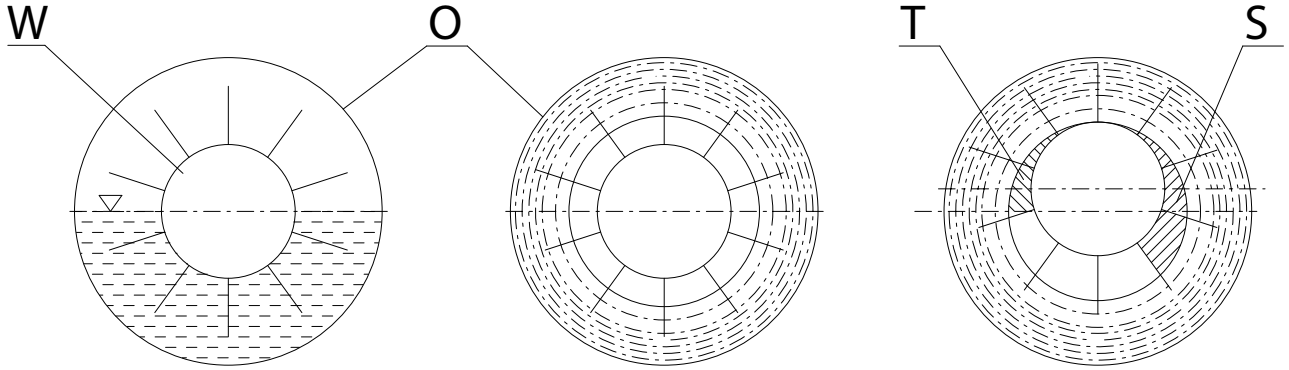
Rotating liquid ring vacuum pumps and blowers (commonly known as compressors) are used in various processes which demand suction and forced flows of oil-free gases, especially in the chemical, pharmaceutical, food processing, paper-making, and textile industries, as well as for the priming of impeller pumps and siphons.

- Catalogue parameters of PW and DW compressors relate to an air of 20°C temperature, atmospheric pressure 1013 hPa with usage of water of 15°C temperature for PW and 40°C for DW as a service liquid (measured at the compressor outlet). If temperature of water is different, vacuum pump capacity will change. Catalogue capacity of vacuum pump should be then corrected using k= f (t, ps) coefficient read from diagram 1 located in further part of technical data.
- It is recommended to use water with hardness about 4 °n – for two-stage vacuum pump, up to 8 °n – for vacuum pumps and blowers.
- It is admissible to pump dry gases with temperature up to 150°C and gases saturated by vapour with temperature up to 100°C with liquid content up to 30% of service liquid requirement with its supply in direct system PB.
- During pumping of saturated gases the volume of service liquid supplied to the compressor through "h" conduit should be reduced by volume of liquid inflowing together with gas in order to avoid a drive overload.
- If temperature of this mixture on the pump's outlet is higher than rated one in the PB system (15°C for water), the gas capacity pumped by PW pump should be corrected accordingly.
- Admissible temperature of service liquid at the compressor's outlet is up to 80°C.
- It is possible to use various kinds of service liquid depending on technological process requirements under condition of: density from 800 to 1200 kg/m$^3$, viscosity up to 60 mm$^2$/s at 20°C.
- Corrosion aggressiveness of service liquid will be in range of resistance of constructional materials of elements of compressor's hydraulic system.
- In case of application of service liquid in circulation with density and viscosity that differ from water parameters, it is required to correct power on the compressor's shaft. Drive power requires consultation with the producer.
- It is admissible to pump gas contaminated by abrasive particles with size up to 0,2 mm in vestigial amounts.
- Application of filters on suction pipeline is recommended to protect compressor against damage.

Pumps and blowers are produced in several material executions what enable for their selection for various operation requirements. They could operate with 50 Hz and 60 Hz drives. Pumps and blowers with rotating liquid ring are rotary, valveless, displacement devices. Construction of blowers doesn't differ fundamentally from vacuum pumps – they are reversible machines. Movable parts are: impeller and bearings fitted on shaft. Shaft is supported from both sides: two rolling bearings, sealed from both sides on the compressor's outlet.

## Principle of Operation. Construction

The principle of operation of a compressor with a rotating liquid ring is as follows: Encased in cylinder „O", part of which is filled with a liquid, there is a blade impeller „W" with a hub of a large diameter. As soon as the pump is started, the rotation of the impeller causes the liquid to circulate and be pushed against the walls of the casing to form a liquid ring. If the impeller is positioned eccentrically relative to the casing, then a liquid-free gap in the form of a crescent is left around the hub; the crescent is divided by the impeller blades into several compartments. The size of the compartments will grow at first, only to decrease after the bottom position is passed. The side walls (screens) provide axial closure to the compartments; now, if two openings are cut in the side walls, one of them (suction window „S") at the beginning of the crescent and the other one (discharge window „T") at the end of it, then the expanding compartment will cause the gas to be sucked into the compartment; then, as the capacity of the compartment is reduced, the gas will be compressed and discharged. Since a portion of the liquid that forms the liquid ring is always forced outside through the discharge window together with the discharged gas, the volume of the liquid has to be made up.




The principle of operation of a pump with rotating liquid rings.



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## Principle of Operation. Construction

The design of compressors with a rotating liquid ring is determined by the above principle of operation. The devices are rotating, valveless, positive-displacement pumps. Part of the working liquid that forms the ring is discharged together with the gas and is made up continuously. The pump consists of fixed parts such as the casing (also referred to as distance body), control disks (also called suction elements and discharge elements), side bodies closing the pump, together with bearing bodies, seals and packings, and moving parts, such as impellers, the shafts, ring seals and bearings mounted on the shaft. Both sides of the shaft are sealed with a cord packing or end-face mechanical seal.

From the point of view of their design, the blowers are not much different from single-stage vacuum pumps - they are reversible devices. The only difference between them lies in their power consumption and has been taken into account in the choice of pumps with propulsion motors.
They are characterized by:

- such features as compact design,
- reliable operation,
- simple maintenance (the working elements need no lubrication),
- low operating costs.

In terms of their technical parameters, the blowers are comparable with products of reputable European manufacturers.

## Operating parameters

a) Vacuum pumps

**capacity Qr:** 4,5 ÷ 1600 $m^3/h$
**suction pressure $ps_{min}$:** 33 (40) hPa abs mm

b) Blowers

**capacity Qr:** 7,5 ÷ 1650 $m^3/h$
**compression pressure (gauge) $pt_{max}$:** 0,15 (0,30) MPa

## General terms of characteristics validity

For all characteristics declared by HYDRO-VACUUM S.A. included in the catalogue:
a) vacuum pumps

- Qr - volume of rarefied air sucked in at the power requirement P.
- characteristic quantities refer to air of 20°C temperature, manometric pressure in the discharge connector pipe with the use of water as a working liquid of temp. 15°C (measured on the pump outlet).

b) blowers

- Q - volume of sucked air compressed to the manometric pressure at the power requirement P.
- characterisitic values refer to air of 20°C temperature, 1013hP atmospheric pressure, manometric pressure drop till 50hPa in suction connector pipe with use of water as a working liquid of temp, below 40°C (measured at outlet of a blower).

## Exploitation requirements

- regardless of the work type the compressor (vacuum pump or blower) must consume the appropriate volume of working liquid. This volume is stated further in the catalogue ("Technical data") and can vary by +10%.

- to obtain catalogue parameters, the temperature of working liquid removed from the vacuum pump and measured on the discharge line cannot be higher than 15°C (when using water). If the water has a higher temperature for some reasons, the operation capacity will decrease. The catalogue capacity should be corrected by coefficient k= f (t, ps) according to the chart presented in the catalogue. The operation point of vacuum pump should be placed above a border curve.

- the container should be cleaned from time to time in order to remove all contamination (rust, dirt) that becomes deposited in tubular lines and on walls of working liquid container. Water with a great content of calcium compounds should be softened when used as a working liquid. Otherwise, one should disassembly the compressor not later than after 6 months and remove deposits and carefully rinse with appropriate chemical solutions e.g. 5% water solution of hydrochloric acid.

- **when the cavitation (clicks) occurs in two-stage vacuum pumps, the operation point is placed below a border curve on the chart k = f (t, ps); then, one should work with the open air admittance valve "I" or decrease the working liquid temperature. If the situation does not change, the further exploitation is prohibited (as it leads to the pump damage).**

## Materials used in vacuum pumps and blowers

Compressors are made of a few types of materials.
It is possible to use other materials both parties agree on.

The fundamental parts of compressors and materials used in their particular types are presented in a table:

| Name of part | Type of compressor | Marking of the material used | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 3 | 4 | 5 | 6 | 7 |
| Pump body | PW/DW.1 | 250 | 250 | ZbCr32 | B101 | 200-400 | G-X5** |
| | PW/DW.4 | | | | | | |
| | PW/DW.5 | | | | | | |
| | PW/DW.7 | | | | | | |
| Seal body | PW/DW.1 | 250 | 250 | ZbCr32 | B101 | 200-400 | G-X5** |
| | PW/DW.4 | | | | | | |
| | PW/DW.5 | | | | | | |
| | PW/DW.7 | | | | | | |
| Suction-discharge members Distance members | PW/DW.1 | 250 | 250 | ZbCr32 | ZbCr32 | 200-400 | G-X5** |
| | PW/DW.4 | | | | | | |
| | PW/DW.5 | | | | | | |
| | PW/DW.7 | | | | | | |
| Impellers | PW/DW.1 | B101 | 400-15 | G-X25** | B101 | B101 | G-X25** |
| | PW/DW.4 | | | G-X5** | | 200-400 | G-X5** |
| | PW/DW.5 | | | | | | |
| | PW/DW.7 | MK80 | | | | | |
| Shaft | PW/DW.1 | 2H13 | 2H13 | 1H18N9T | 1H18N9T | 2H13 | H17N13M2T |
| | PW/DW.4 | | | | | | |
| | PW/DW.5 | | | | | | |
| | PW/DW.7 | | | | | | |
| Gland | PW/DW.1 | itamid | itamid | itamid | itamid | 200-400 | G-X5** |
| | PW/DW.4 | | | | | | |
| | PW/DW.7 | 250 | 250 | ZbCr32 | ZbCr32 | | |
| Soft cord seal on a shaft | PW/DW.1 | Soft cord shaft seal no. 6498 | | | | | |
| | PW/DW.4 | | | | | | |
| | PW/DW.7 | | | | | | |
| Mechanical end-face seal on a shaft | PW/DW.1 | Mechanical end-face shaft seal* | | | | | |
| | PW/DW.4 | | | | | | |
| | PW/DW.5 | | | | | | |
| | PW/DW.7 | | | | | | |

* Requires technical and commercial consulting
** G-X5N and Mo 19.11.2 - austenitic cast steel
*** CrX25CrN and Mo 25.9.3 - special austenitic cast steel

## Constructional execution

Specific configurations are marked by sub-codes comprising the symbols - e $e_1e_2$ - wherein:
e - indicates the temperature of the pumped gas
$e_1e_1$ - indicates the kind and type of the shaft seal
$e_2$ - is a reserve (symbol 0)

The explanation of element structure symbol:
e= 1 for all pumps and blowers tmax = 100°C

$e_1e_1$

- PW/DW.1
$e_1e_1$ = 01 - soft cord seal
$e_1e_1$ = 10 - mechanical seal „ANGA" 22A1
$e_1e_1$ = 11 - mechanical seal „ANGA" 22A3
$e_1e_1$ = 12 - mechanical seal „John Crane" 2100

- PW/DW.4
$e_1e_1$ = 01 - soft cord seal
$e_1e_1$ = 11- mechanical seal „ANGA" 32A3
$e_1e_1$ = 12 - mechanical seal „John Crane" 2100

- PW/DW.5
$e_1e_1$ = 10 - mechanical seal „ANGA" 43Al
$e_1e_1$ = 11- mechanical seal „ANGA" 43A3
$e_1e_1$ = 12 - mechanical seal „John Crane" 2100

- PW/DW.7
$e_1e_1$ = 01 - soft cord seal
$e_1e_1$ = 10 - mechanical seal „ANGA" 80A1
$e_1e_1$ = 11 - mechanical seal „ANGA" 80A3
$e_1e_1$ = 12 - mechanical seal „John Crane" 2100


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## Delivery completeness

1. compressor with a free shaft ending
2. compressor with a complete coupling
3. compressor with a complete coupling and foundation plate
4. compressor according to the completeness 3 + electric motor

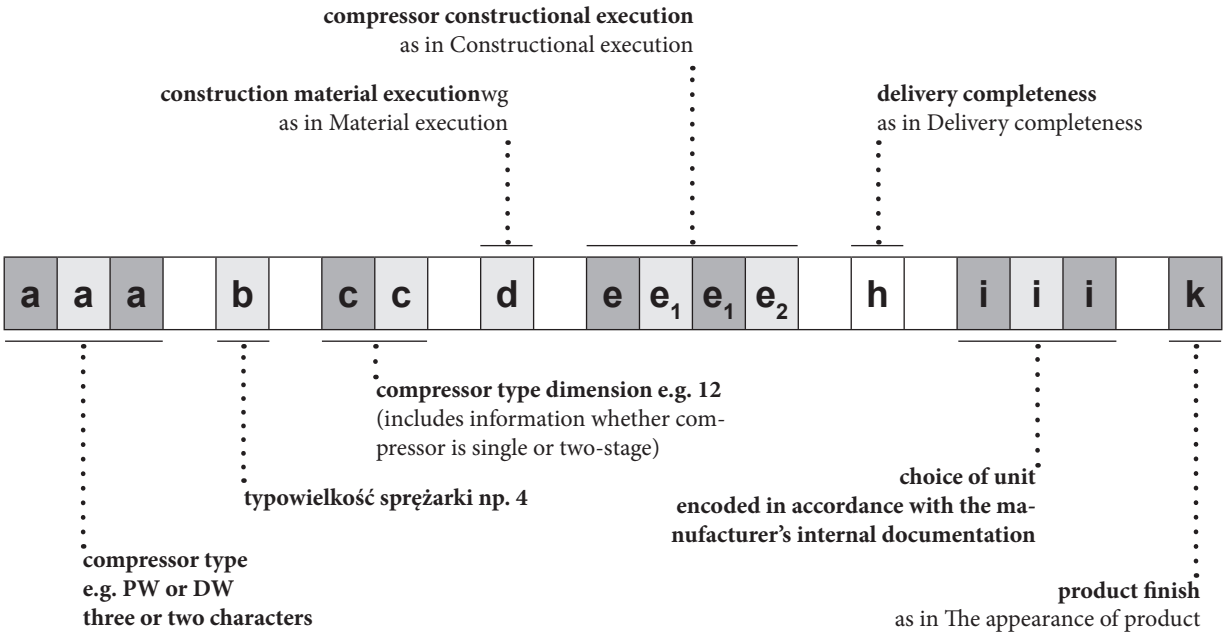
## The appearance of product (protective coating)

1. sstandard
2. special
3. marine
4. export dry tropic
5. export wet tropic

## The structure of product marking

All basic information about the product is coded in its symbol. This symbol is included in both, catalogue and product rating plate. Therefore, it is easier for our customers to choose the most appropriate product and contact us during exploitation e.g. while ordering spare parts.

**The product code is structured as follows:**

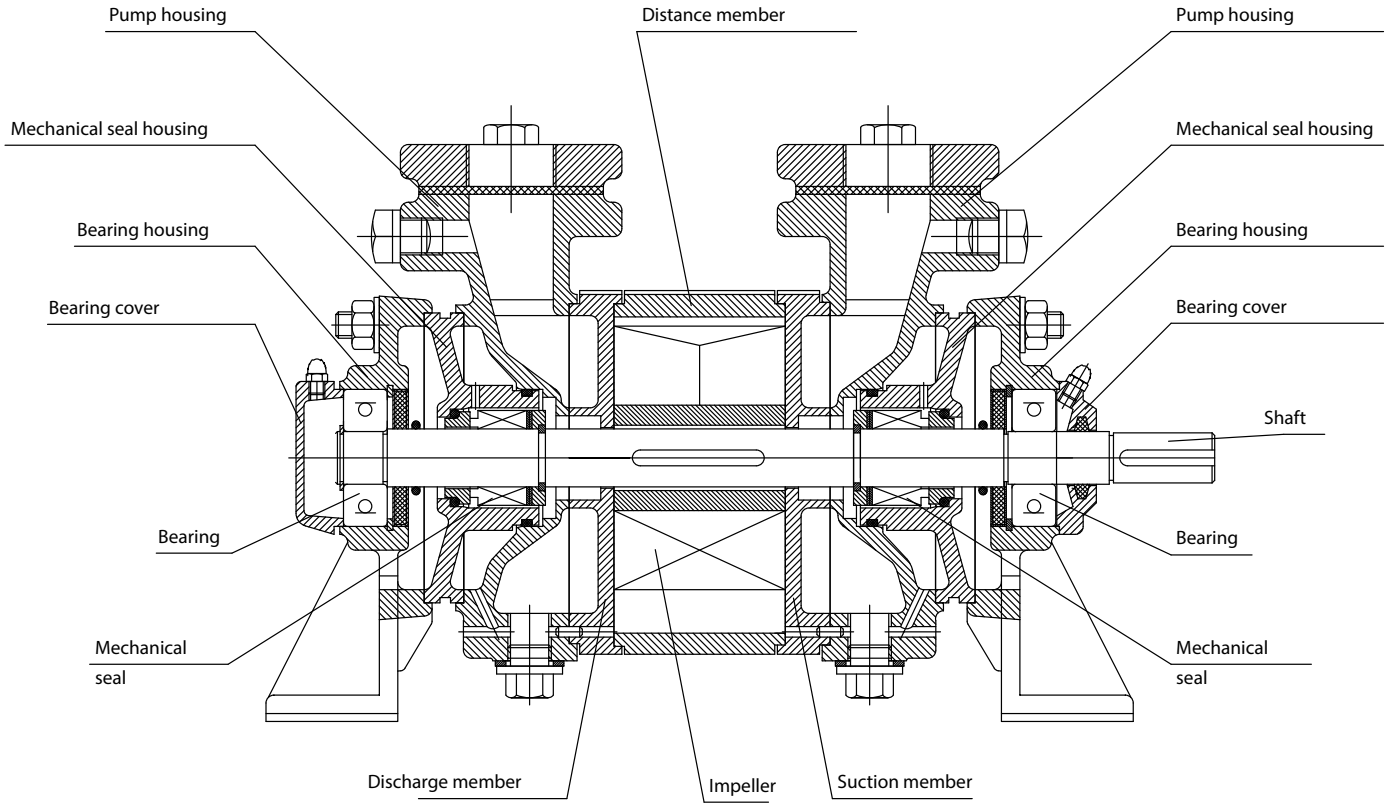



## The example of full product marking

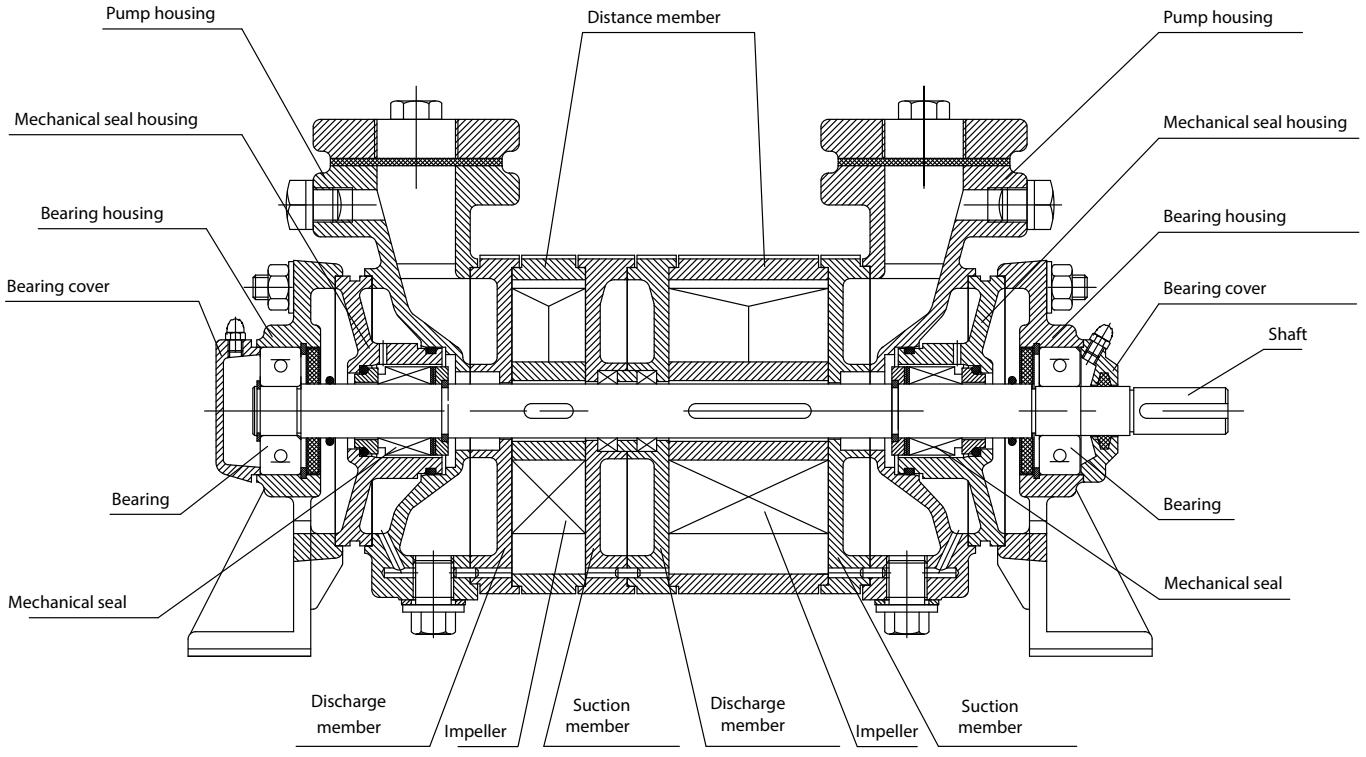
**PW.4.12.1.1010.5.101.1**

Single-stage vacuum pump PW.4.12 in the material execution 1 with a cord seal. The complete set with an electric motor, the choice of unit with a commonly used motor 3x400 V 50 Hz, power 3kW n=1450 rev./min., mechanical size 100L4B. The appearance of product (protective coating) is standard. There is marking on a rating plate up to constructional execution PW.4.12.1.1010.

## The section of pump PW.1.12-13 and DW.1.12-13 with a mechanical seal




## The section of pump PW.1.21-23 and DW.1.21-33 with a mechanical seal



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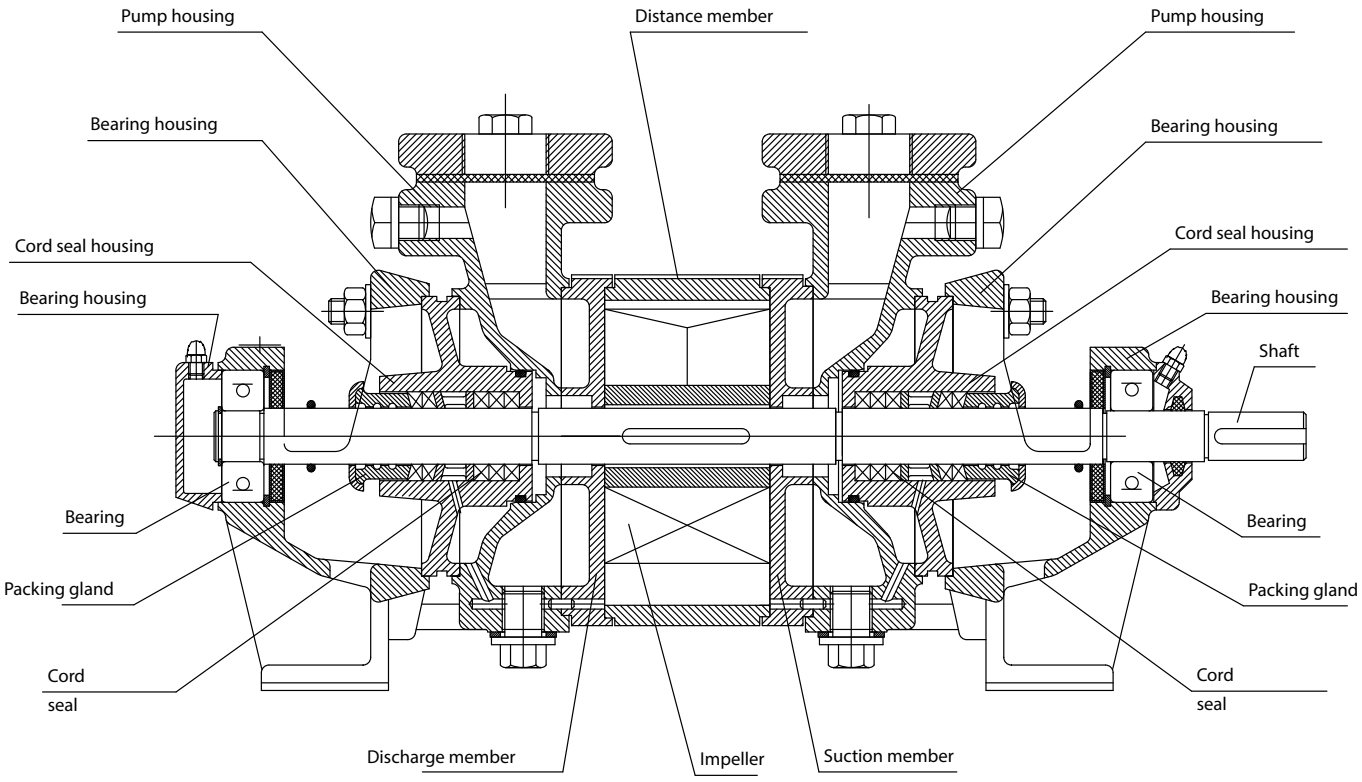
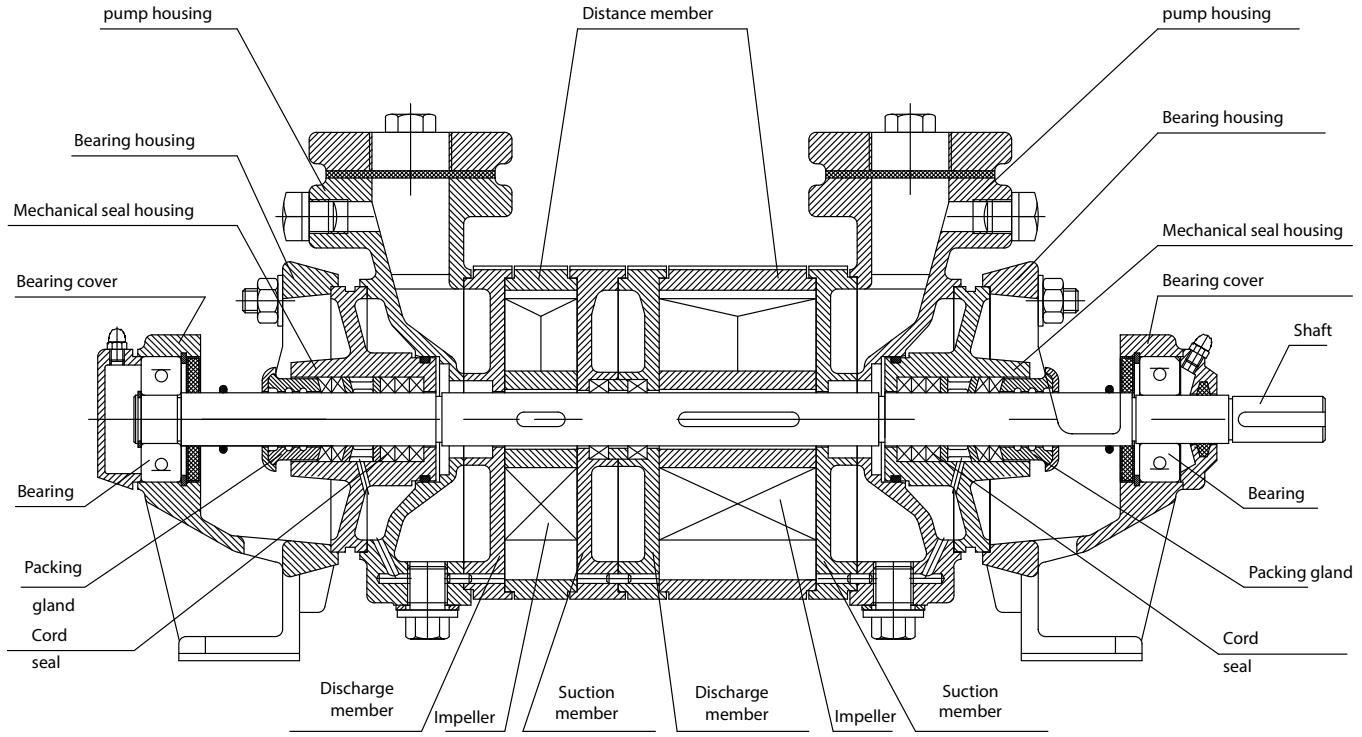
## The section of pump PW.1.12-13 and DW.1.12-13 with a cord seal

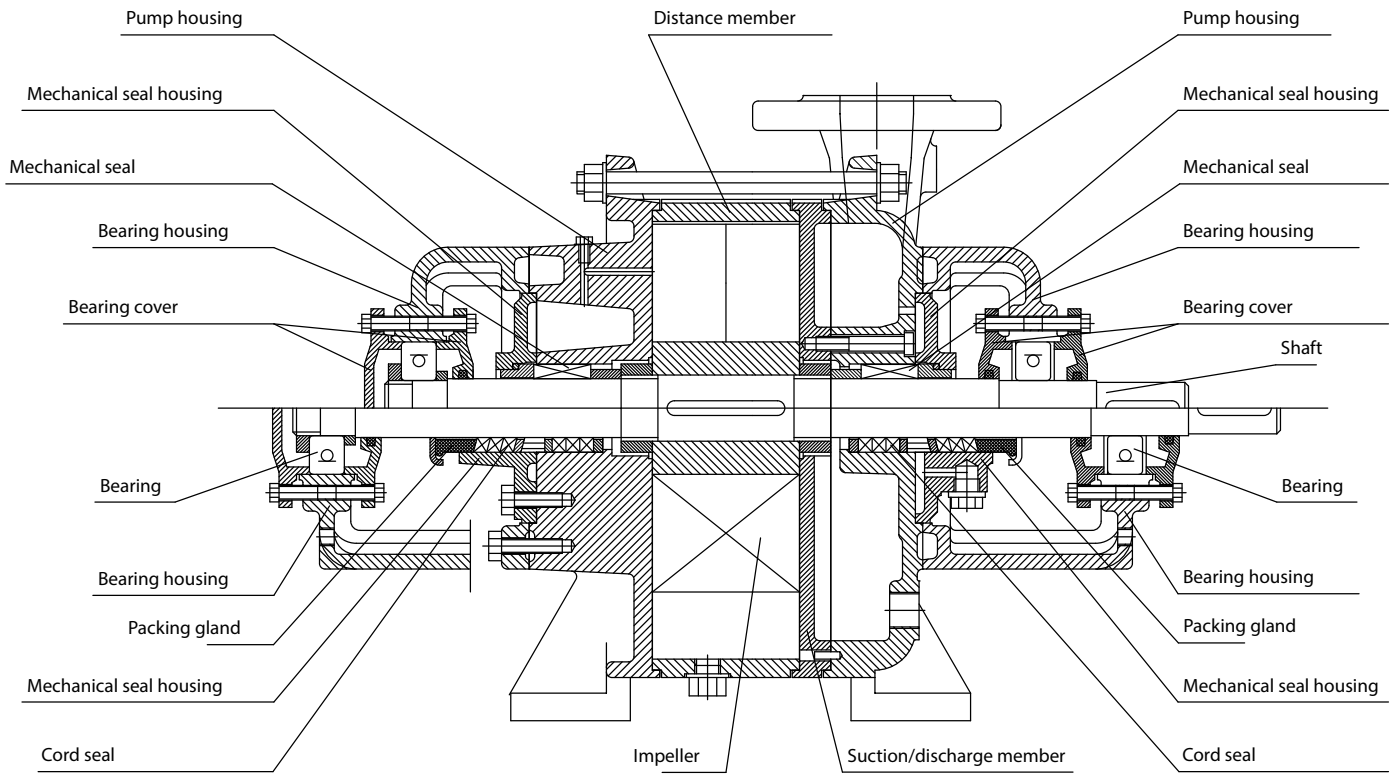



## The section of pump PW.1.21-23 and DW.1.21-23 with a cord seal



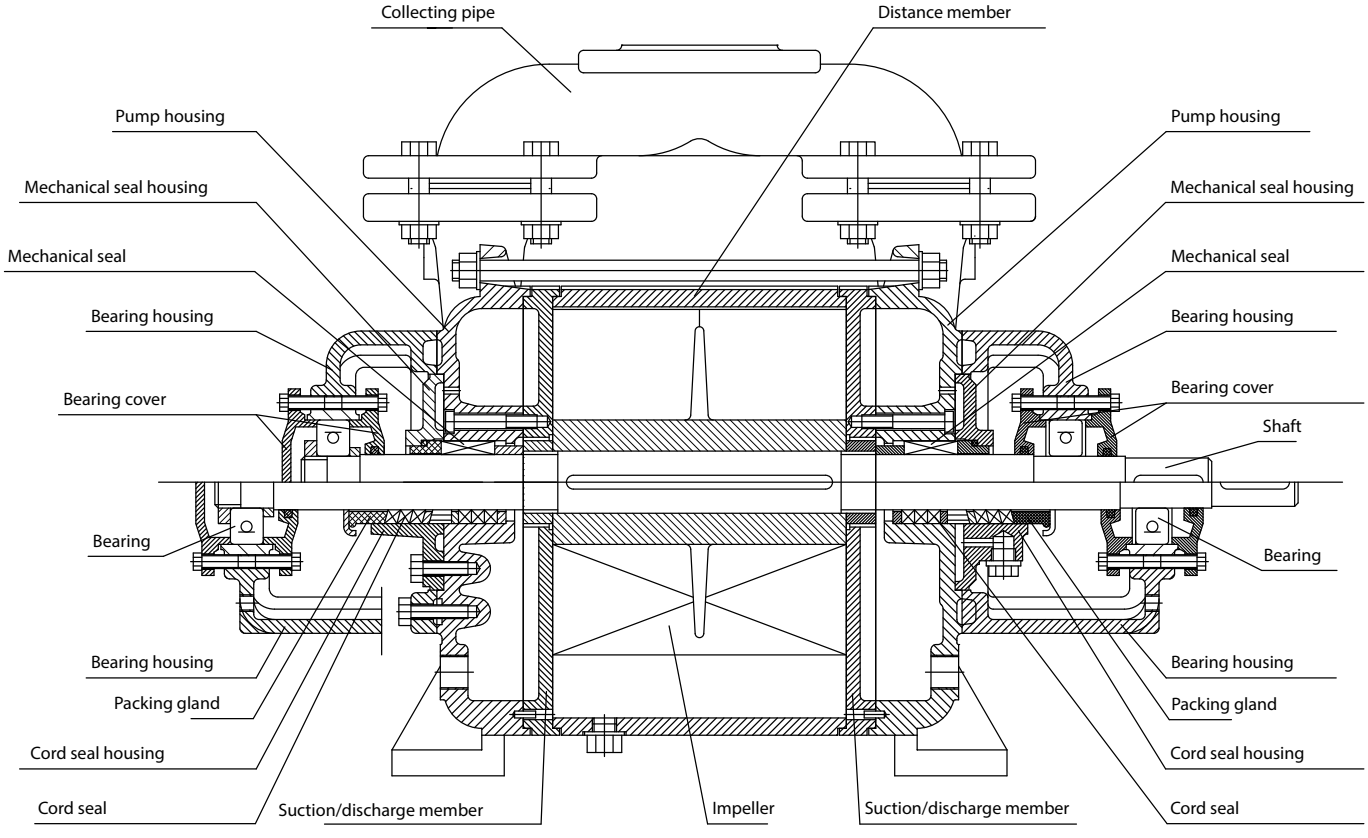
## The section of pump PW.4.11-12 and DW.4.11-12 with a seal

- **above the shaft axis - mechanical**
- **below the shaft axis - cord**




## The section of pump PW.4.13-14 and DW.4.13-14 with a seal

- **above the shaft axis - mechanical**
- **below the shaft axis - cord**



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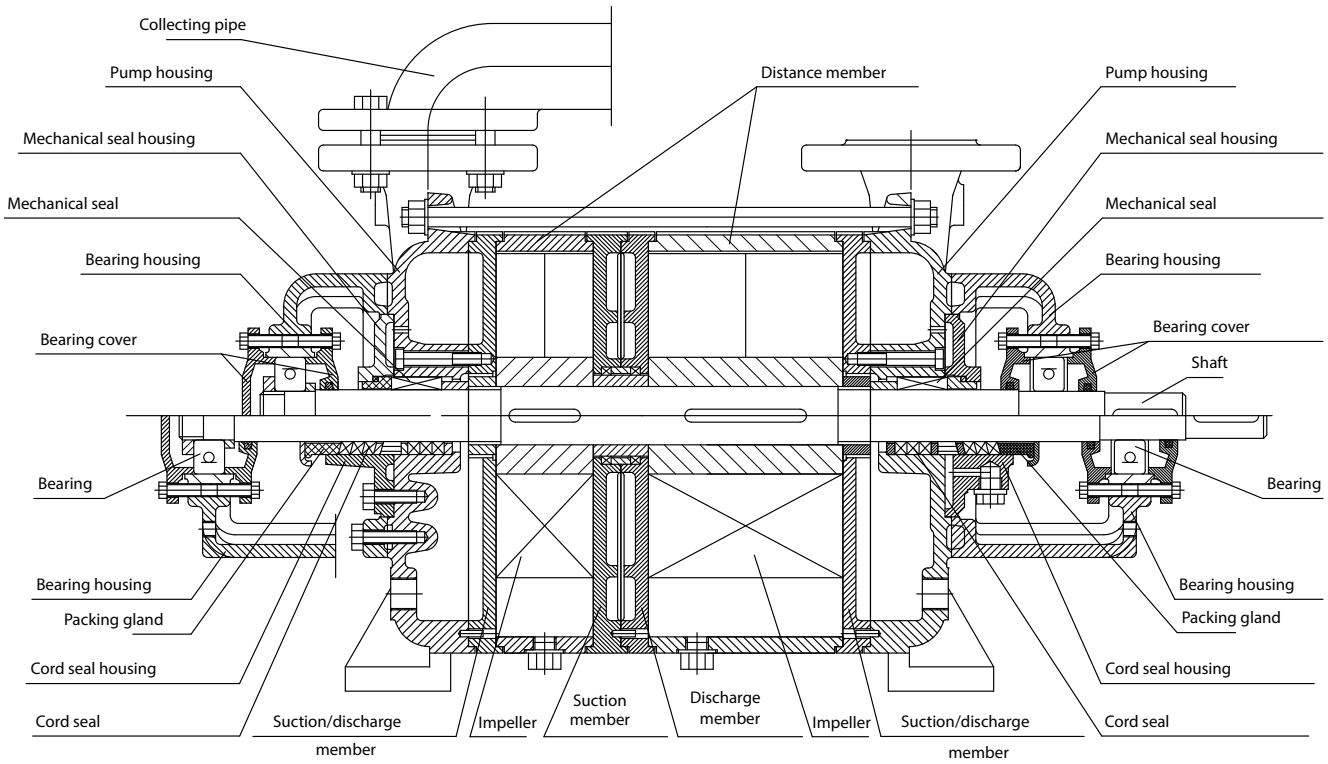
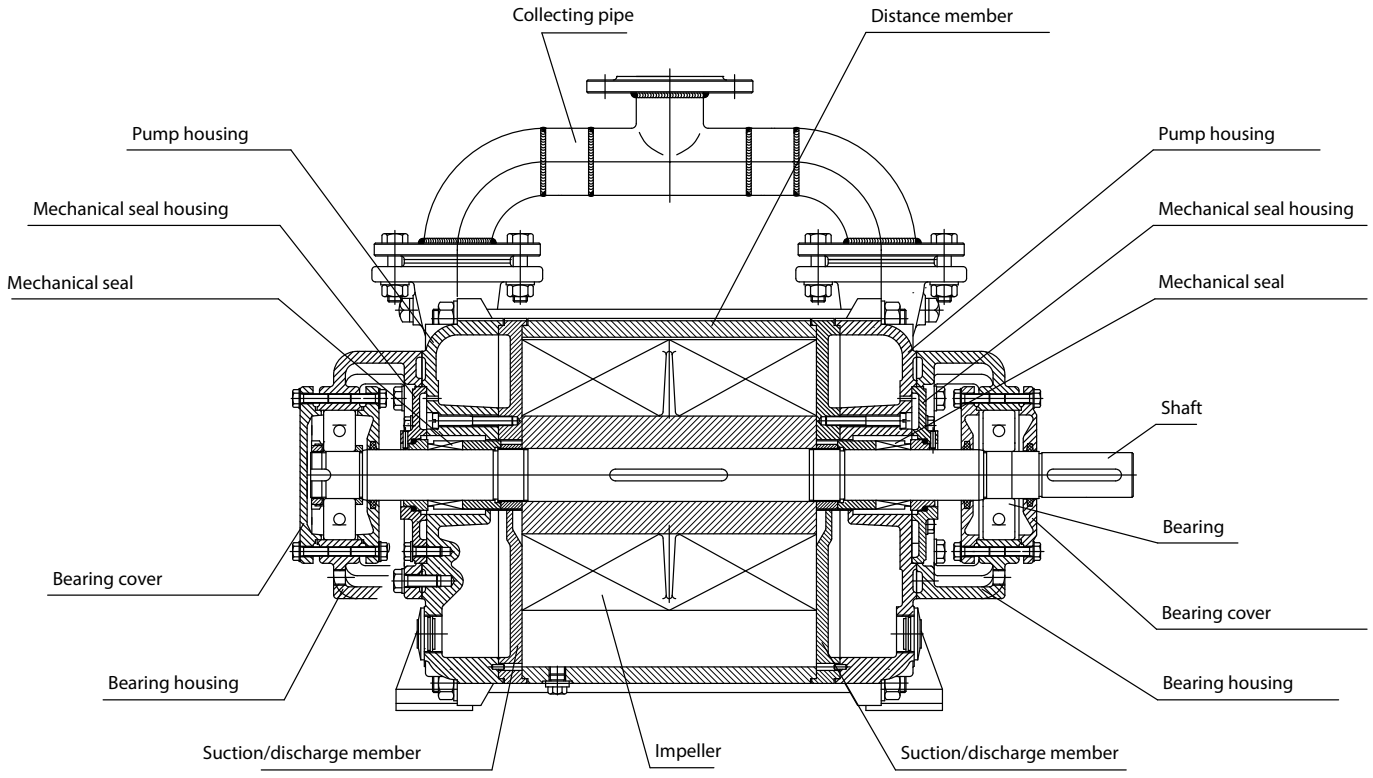
## The section of pump PW.4.21-24 with a seal

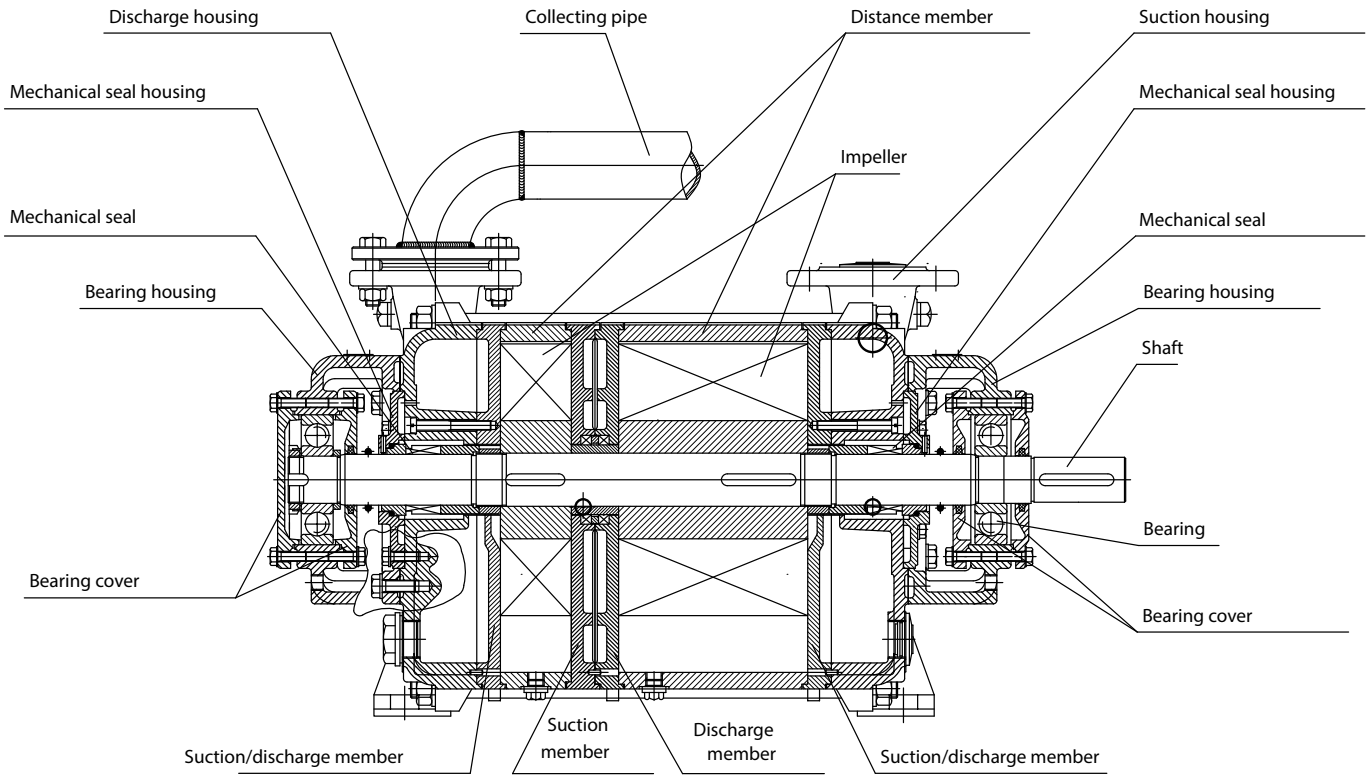
- **above the shaft axis - mechanical**
- **below the shaft axis - cord**




## The section of pump PW.5.12-14 and DW.5.12-14 with a mechanical seal

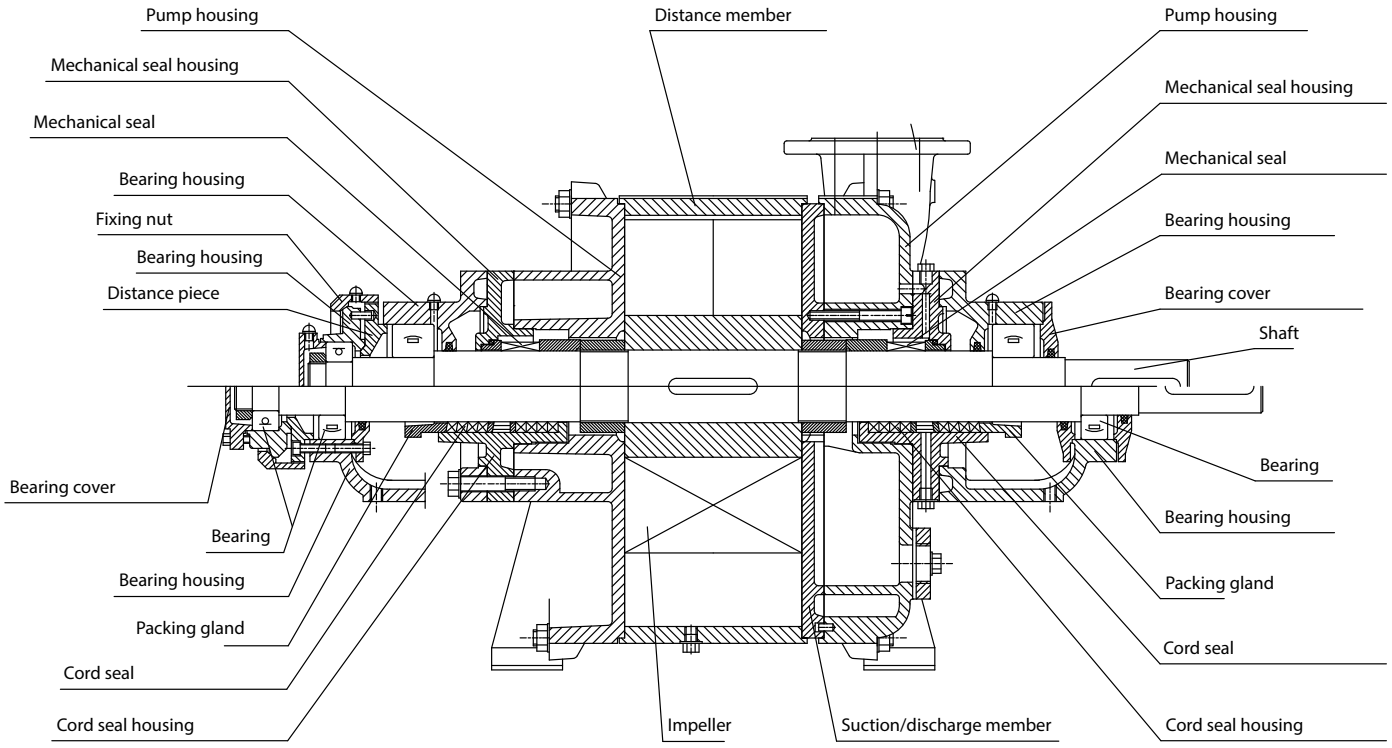


## The section of pump PW.5.21-24 with a mechanical seal




## The section of pump PW.7.11-12 and DW.7.11-12 with a seal

- **above the shaft axis - mechanical**
- **below the shaft axis - cord**



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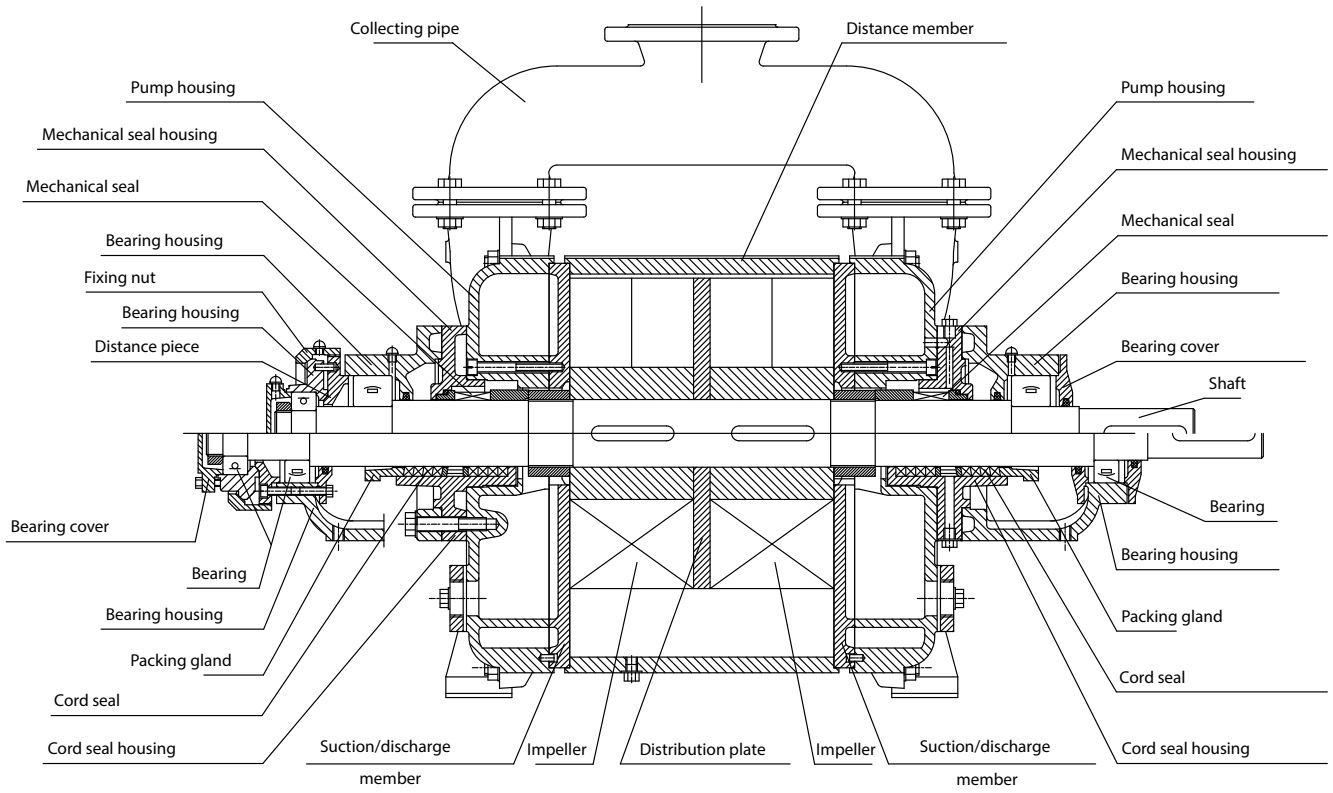
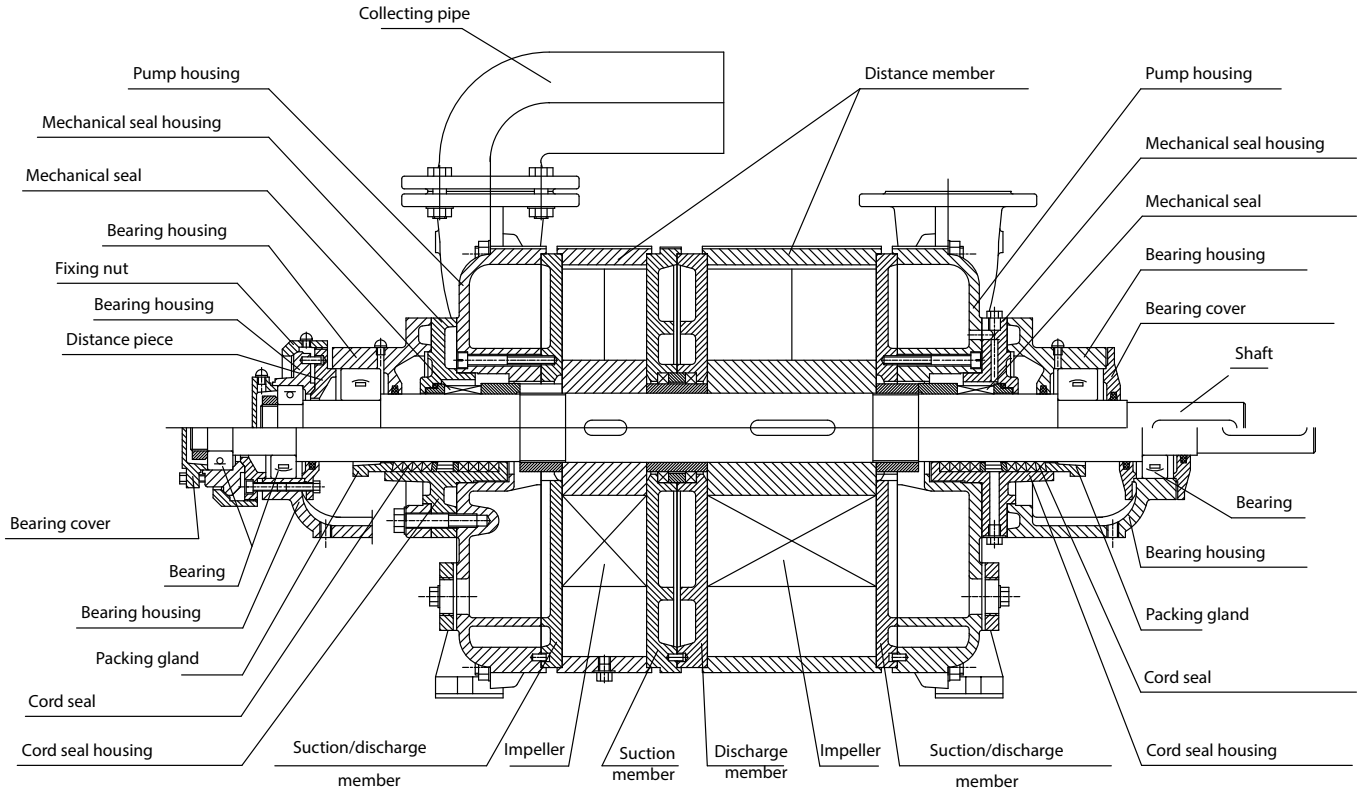
## The section of pump PW.7.13-14 and DW.7.13-14 with a seal

- **above the shaft axis - mechanical**
- **below the shaft axis - cord**



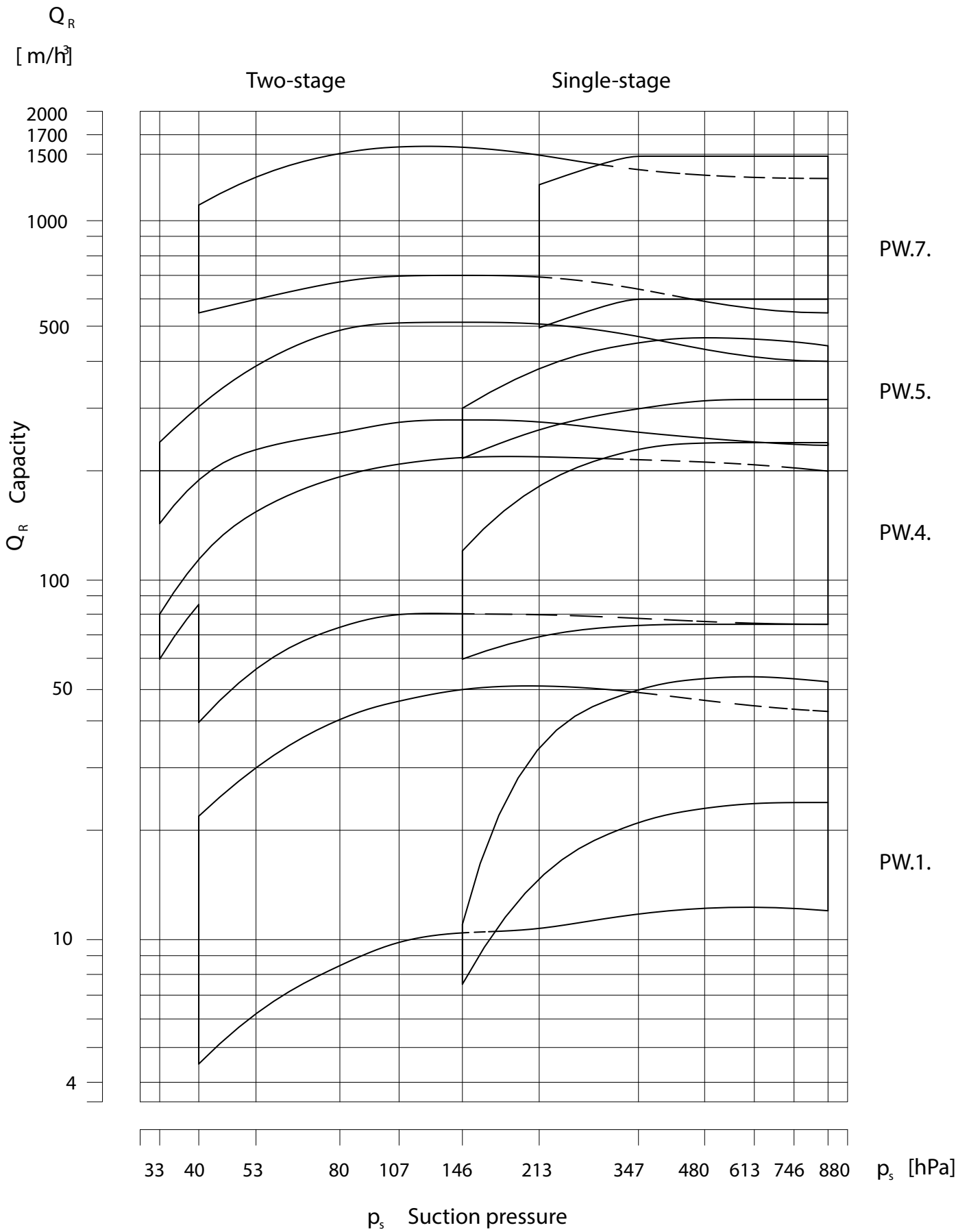

## The section of pump PW.7.21-24 with a seal

- **above the shaft axis - mechanical**
- **below the shaft axis - cord**



## Characteristics

The cumulative chart presenting fields of operation of vacuum pumps PW.1-7 with a rotating liquid ring



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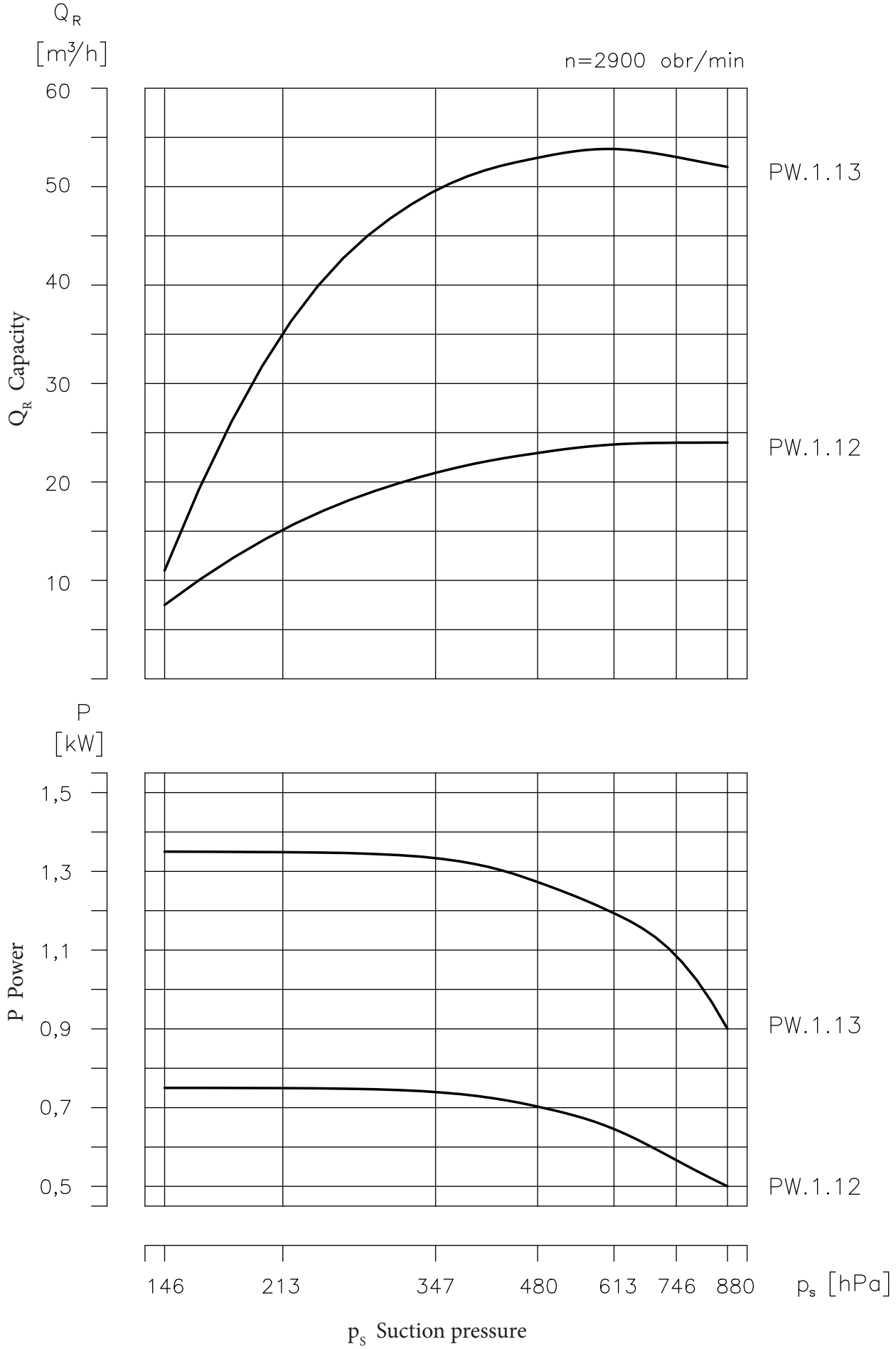
## Characteristics



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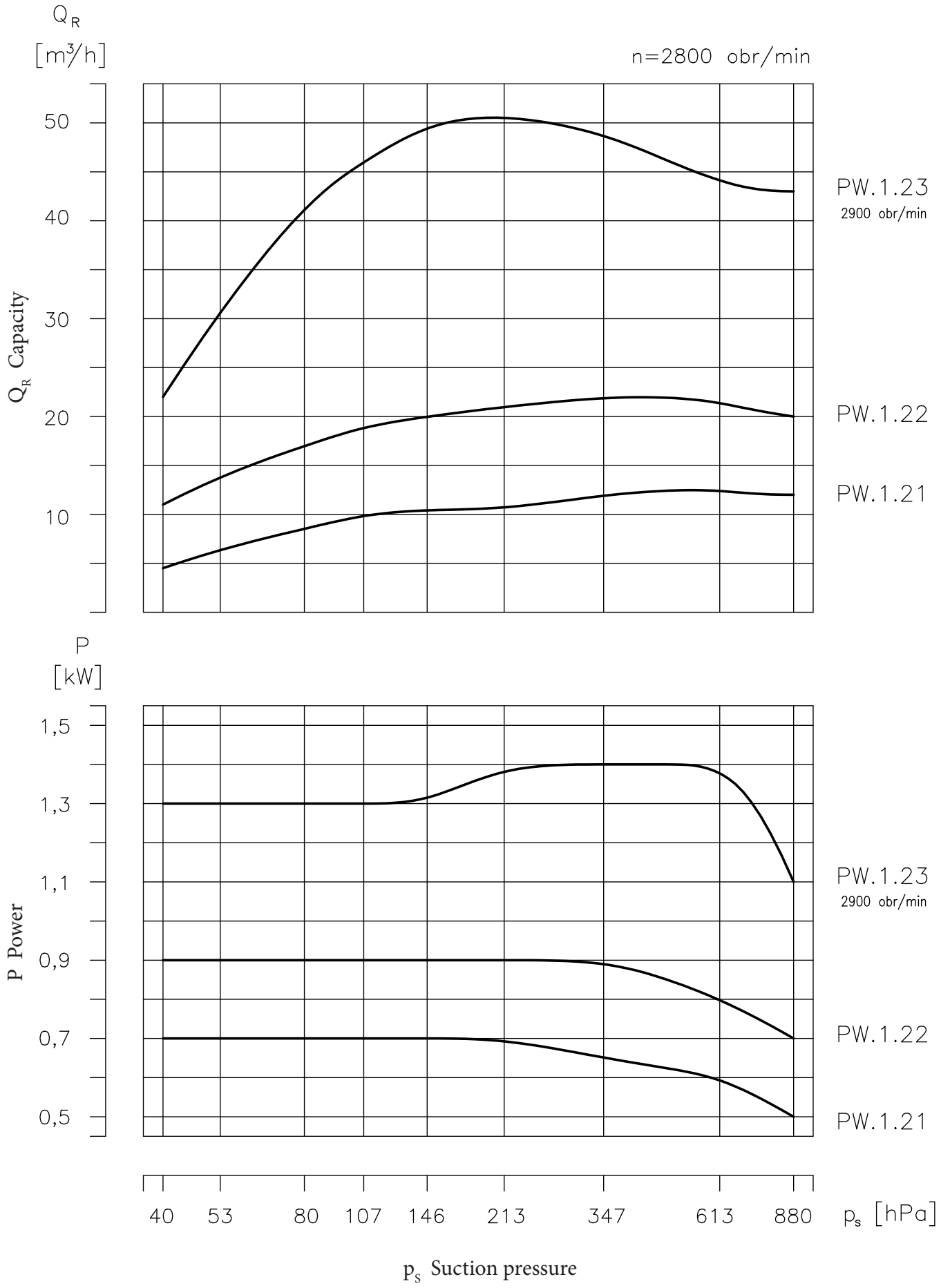




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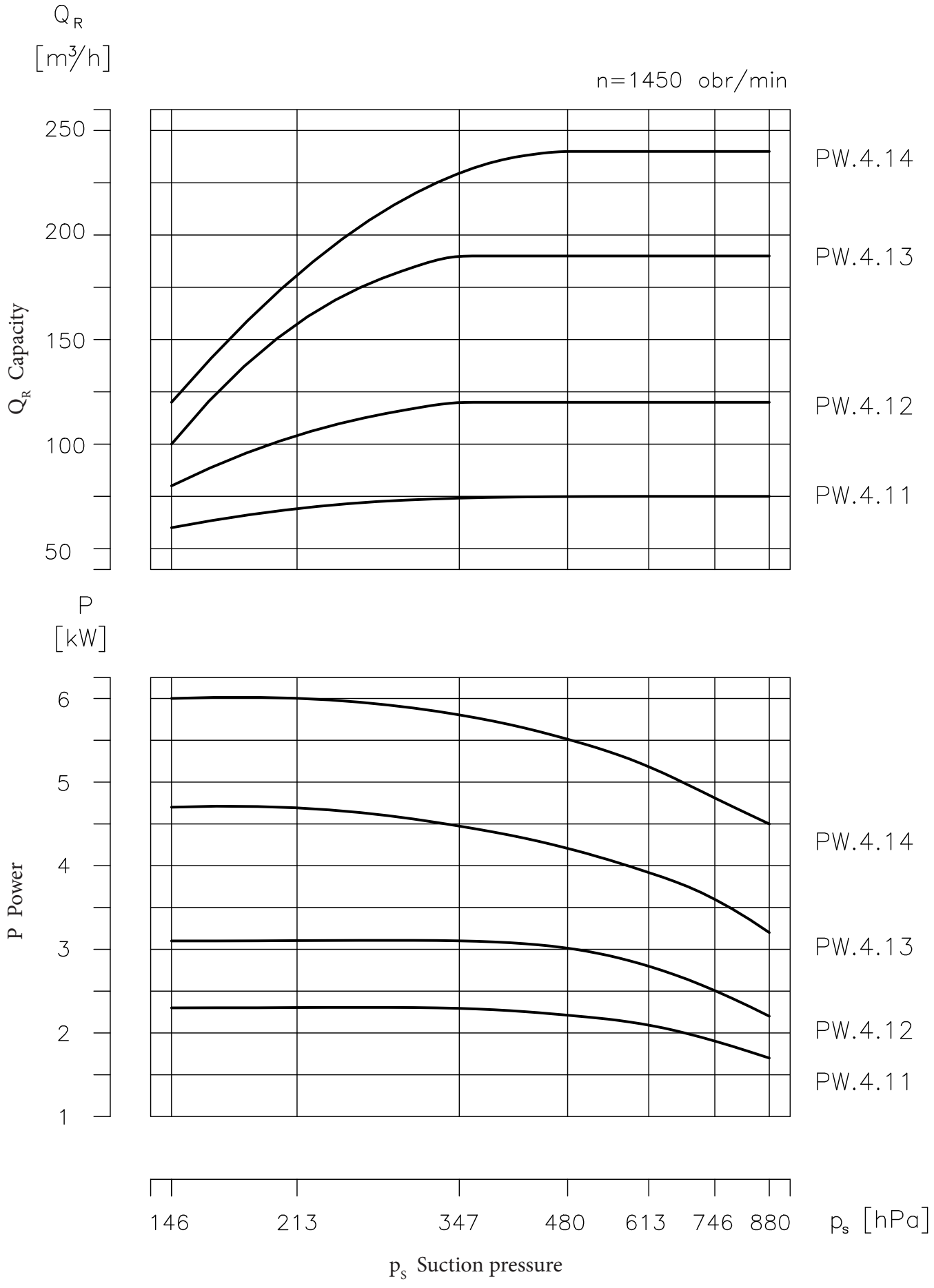

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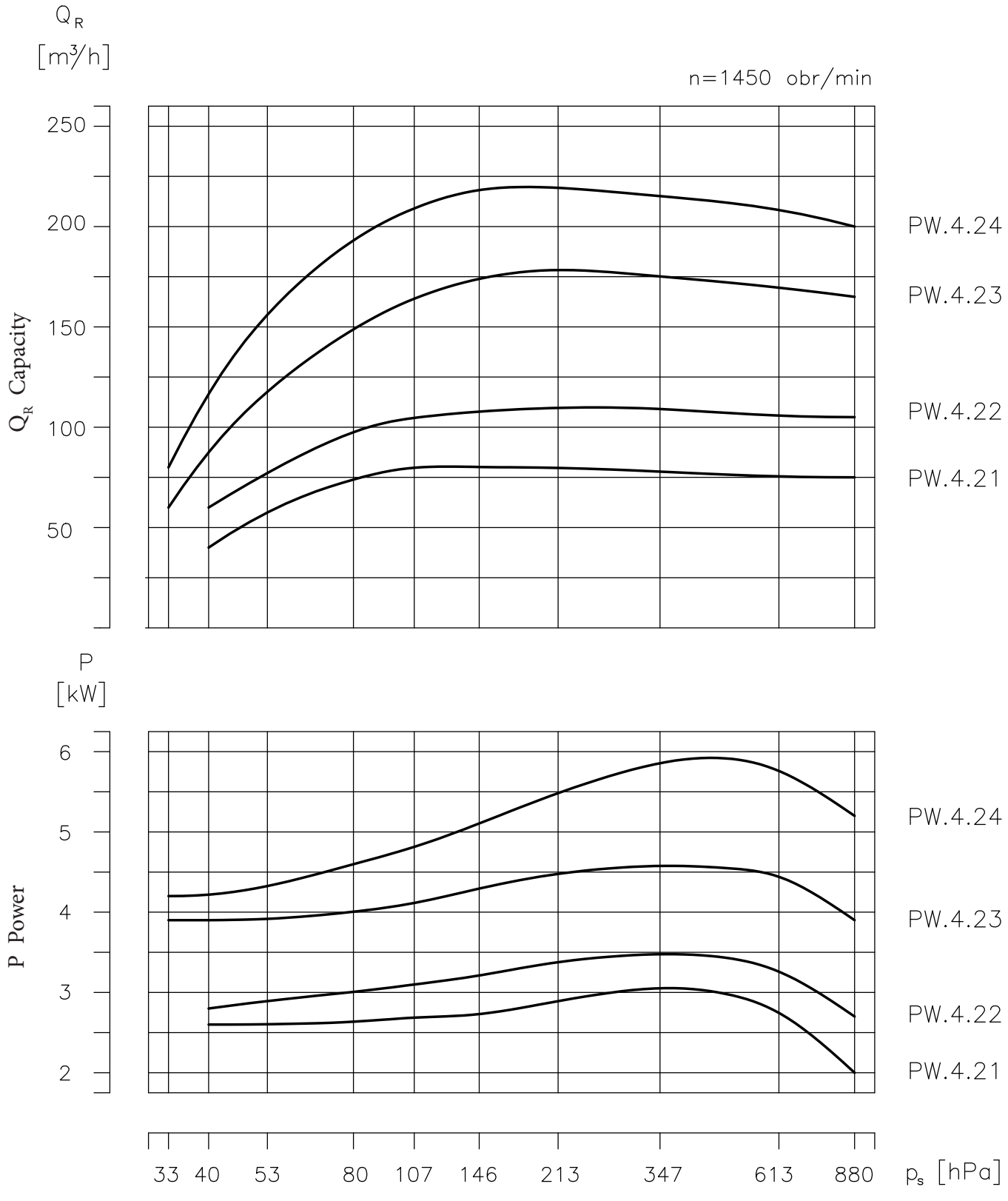


$p_S$ Suction pressure



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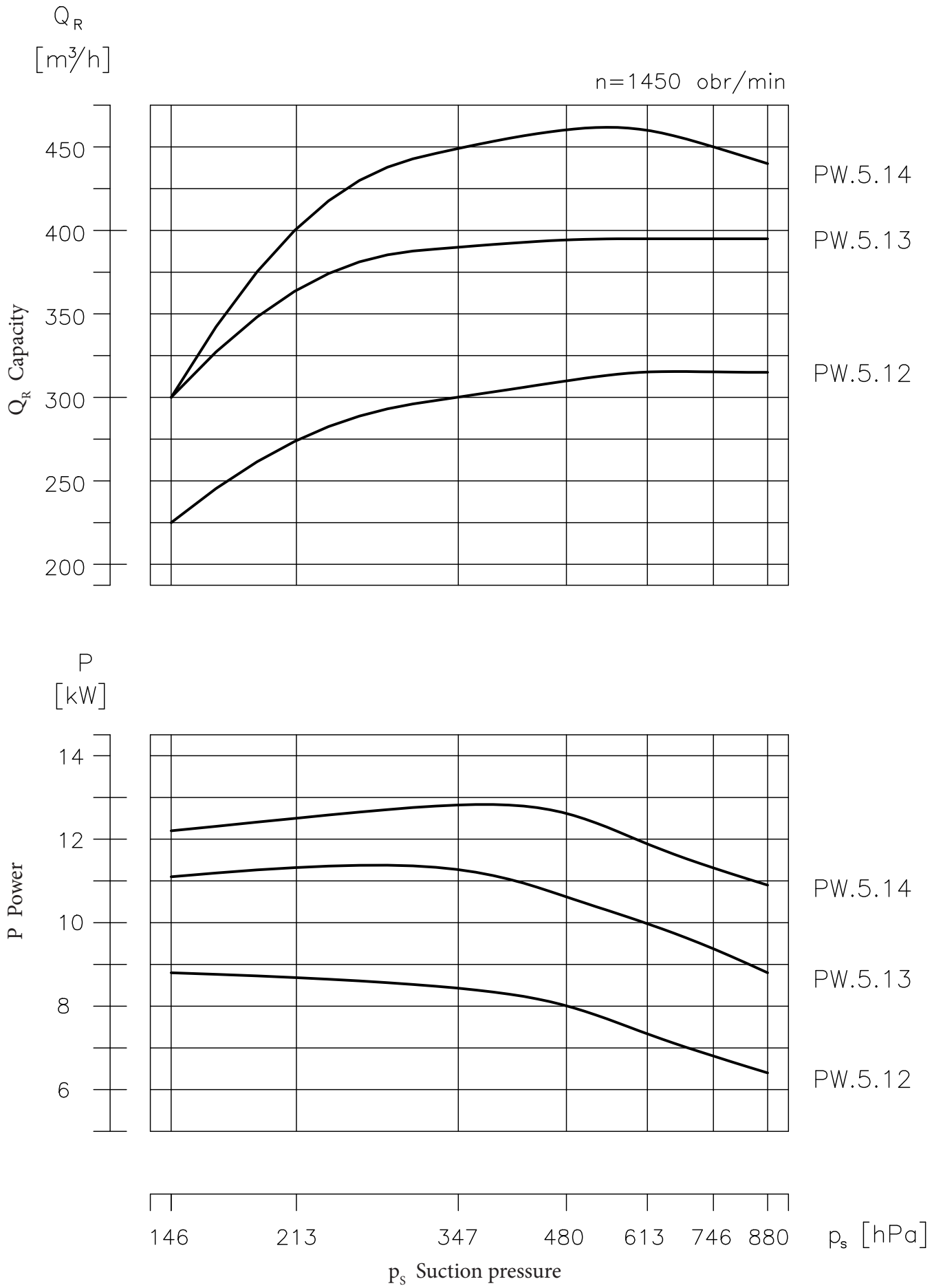

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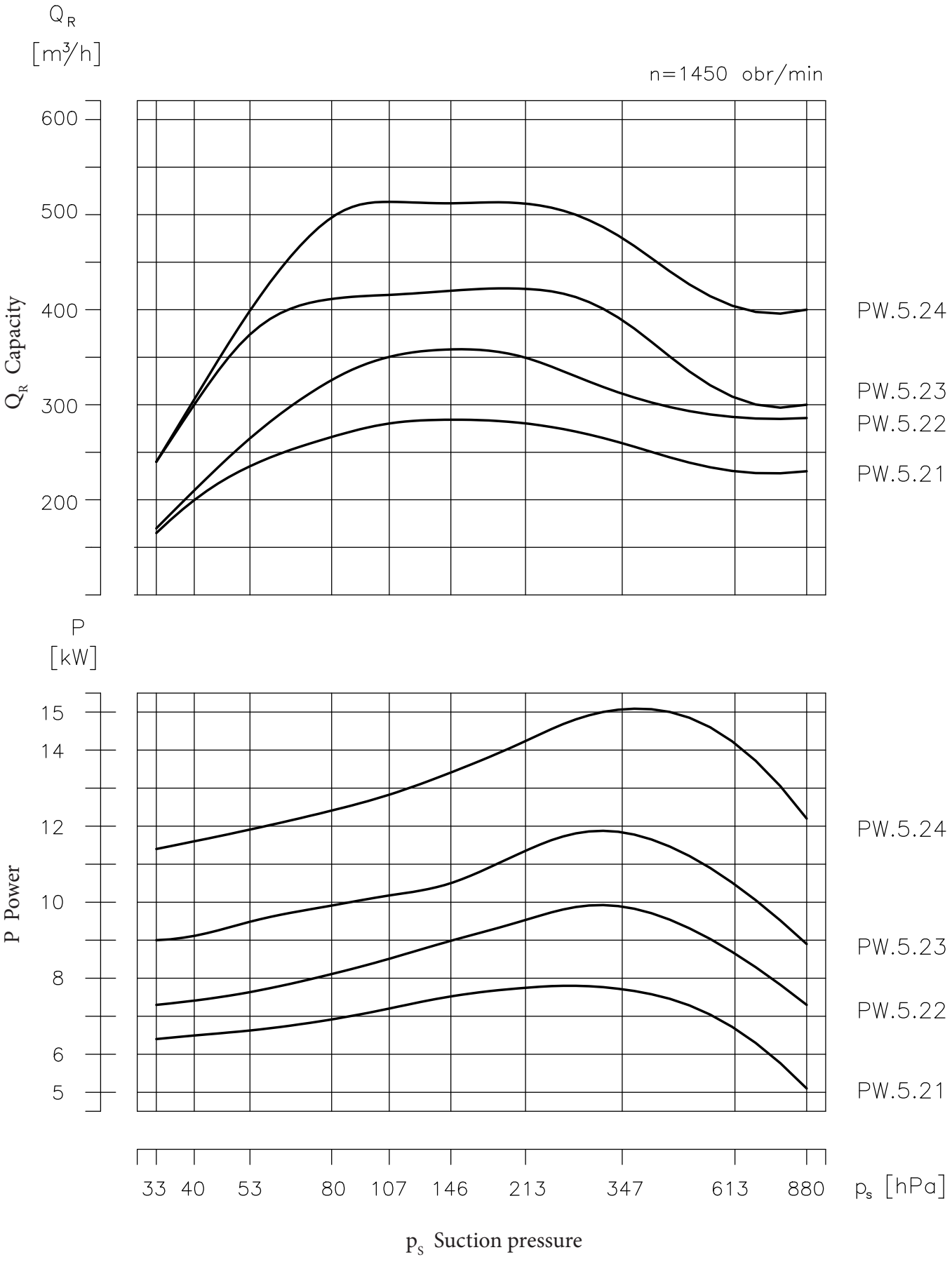




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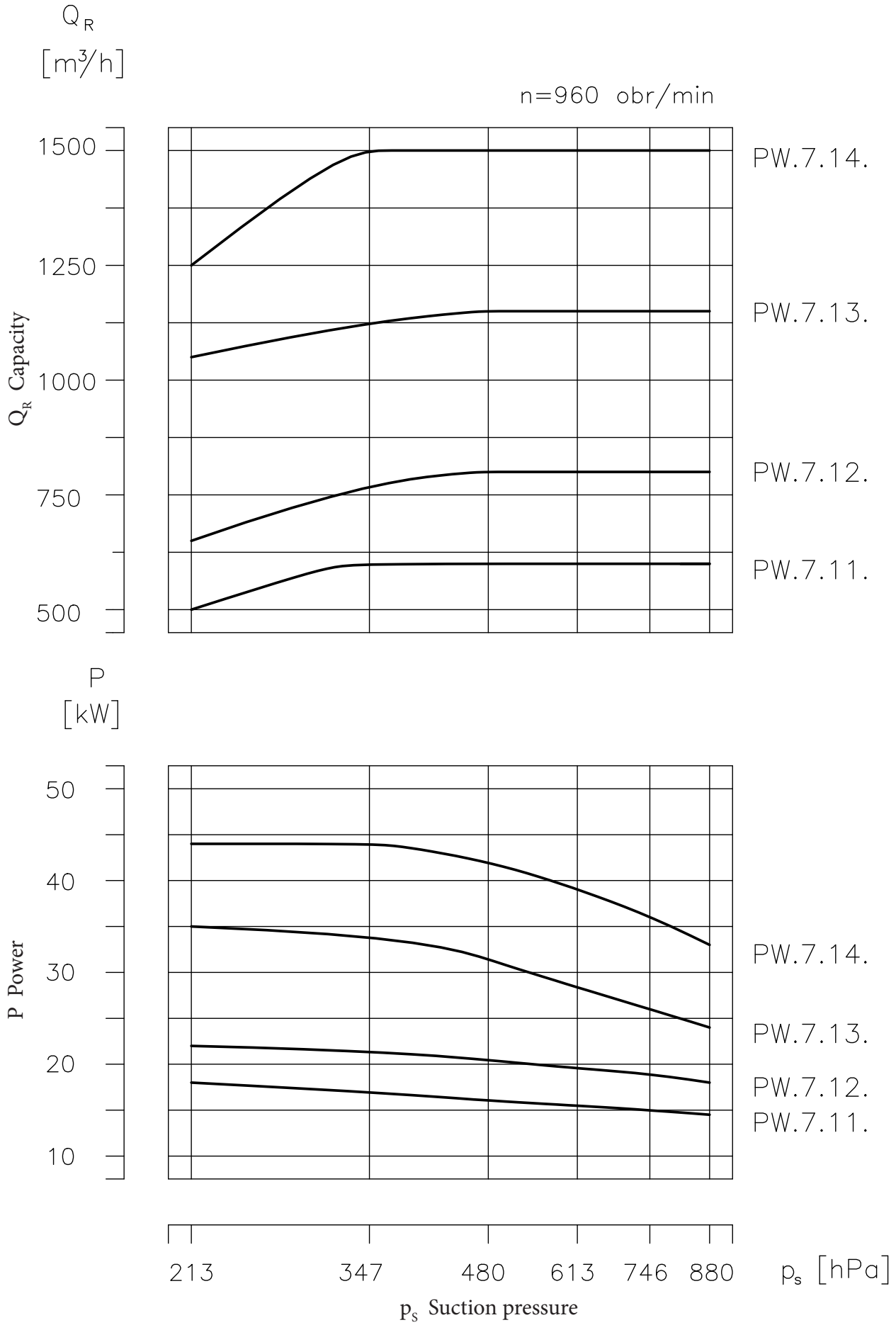

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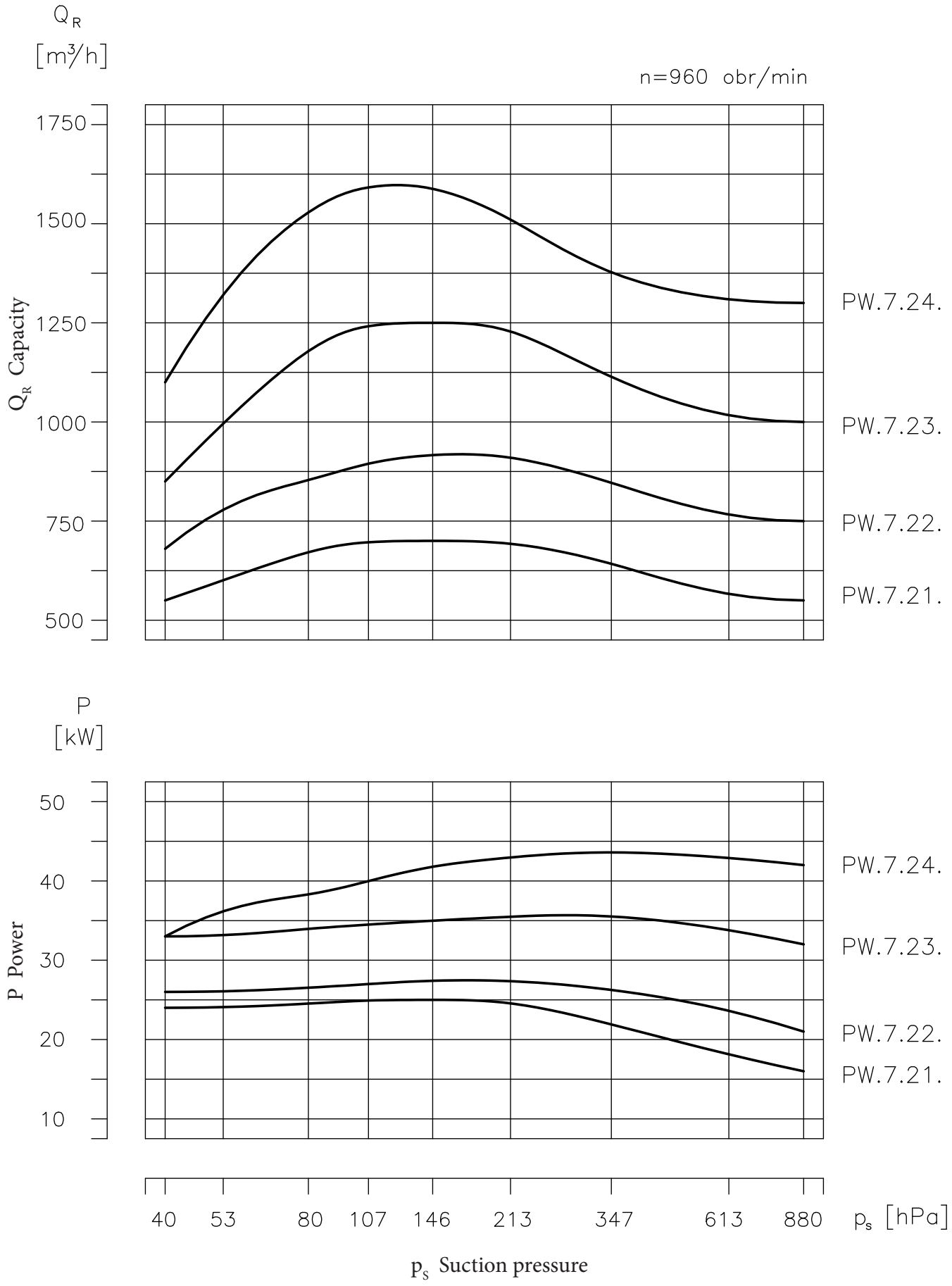




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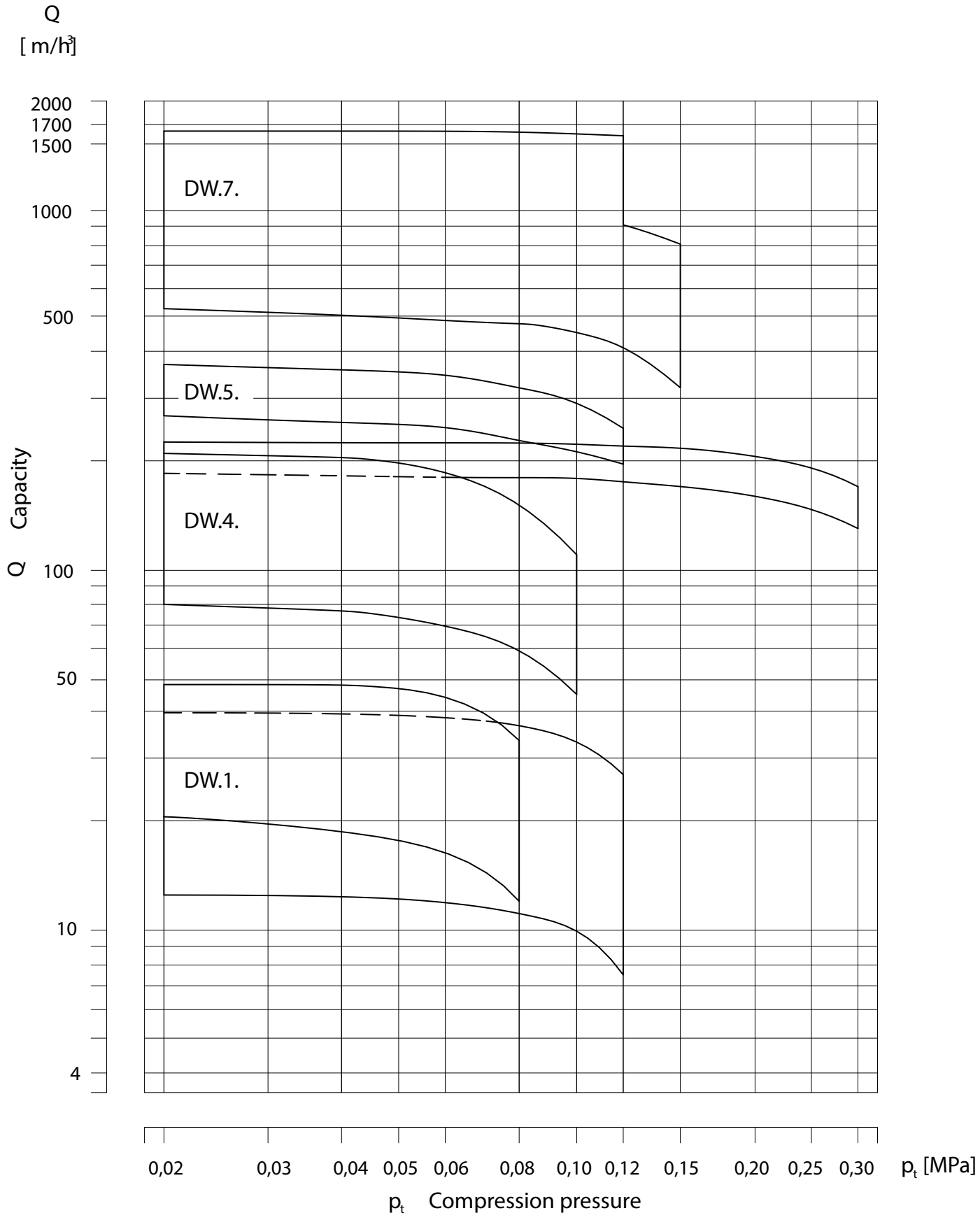
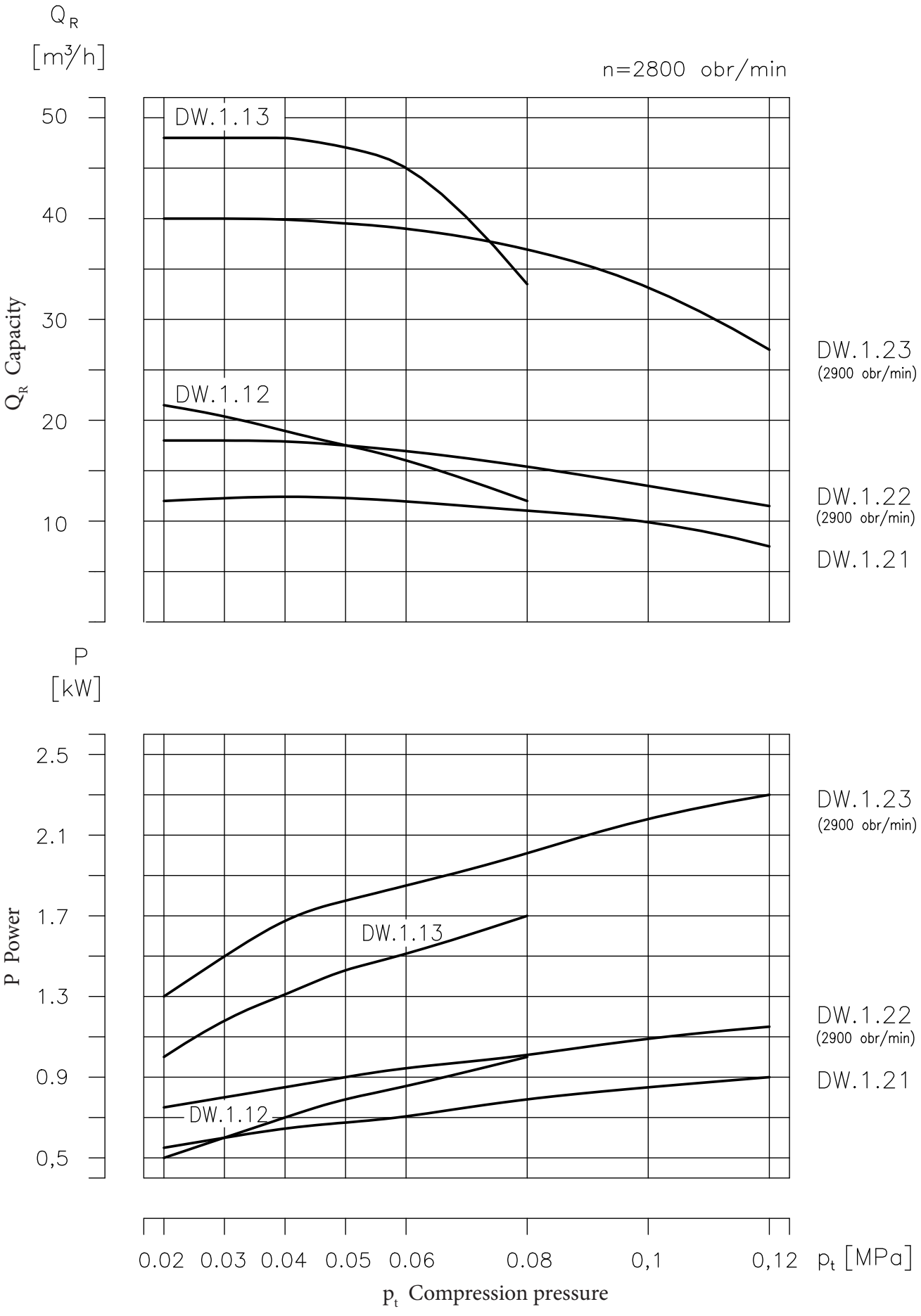
## Characteristics

The cumulative chart presenting fields of operation of blowers DW.1-7 with a rotating liquid ring



## Blower characteristics



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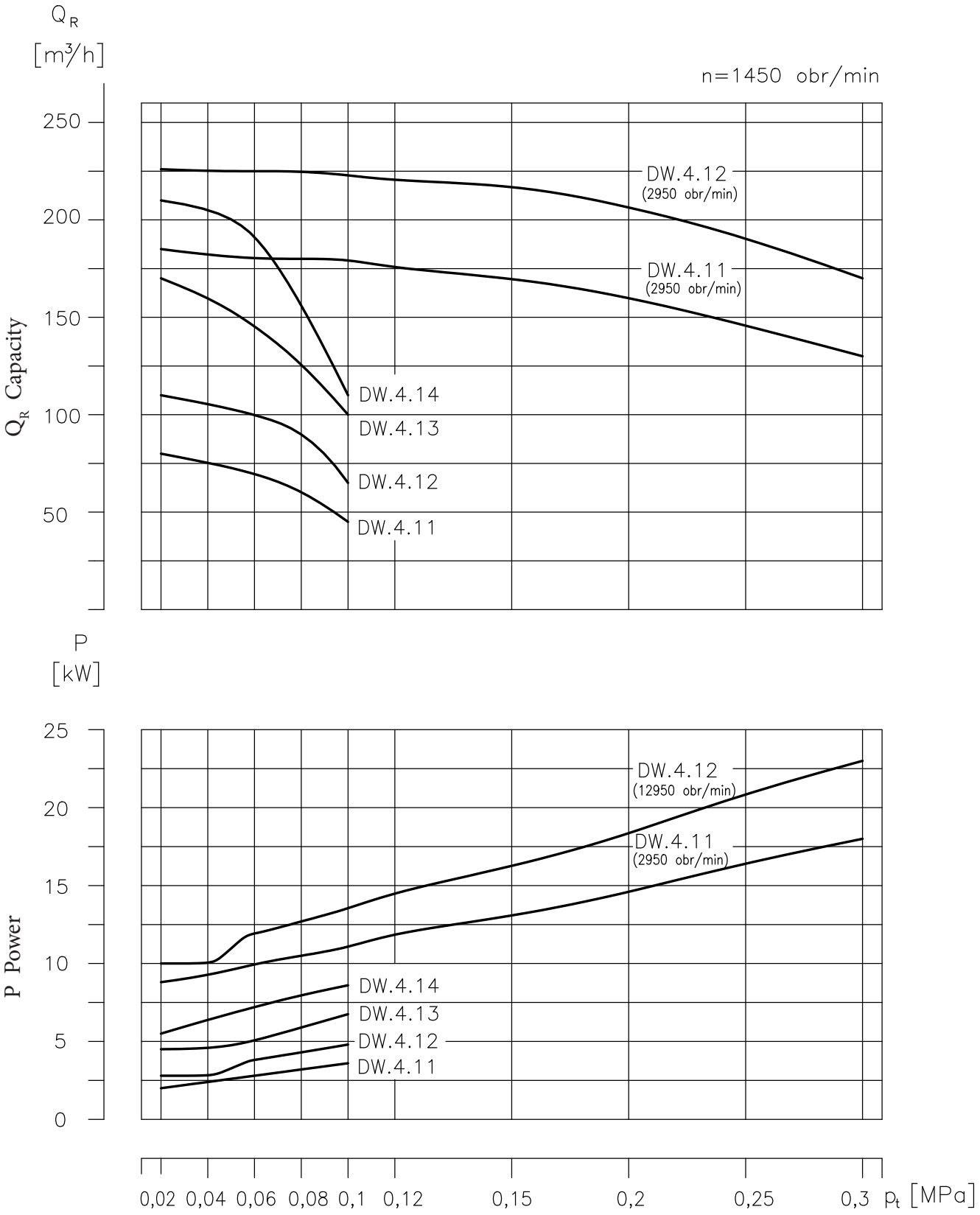
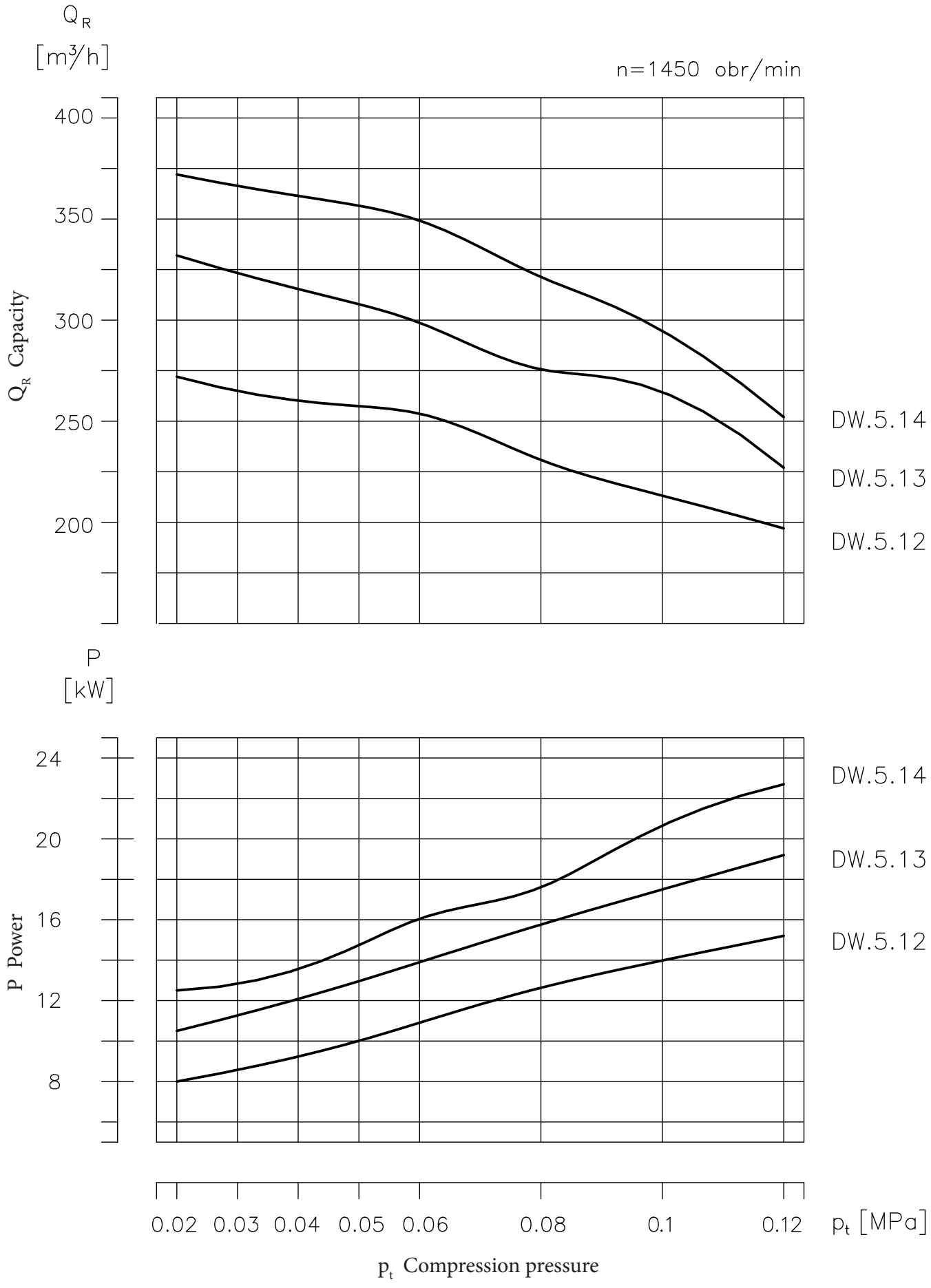
## Blower characteristics




$p_t$ Compression pressure

## Blower characteristics



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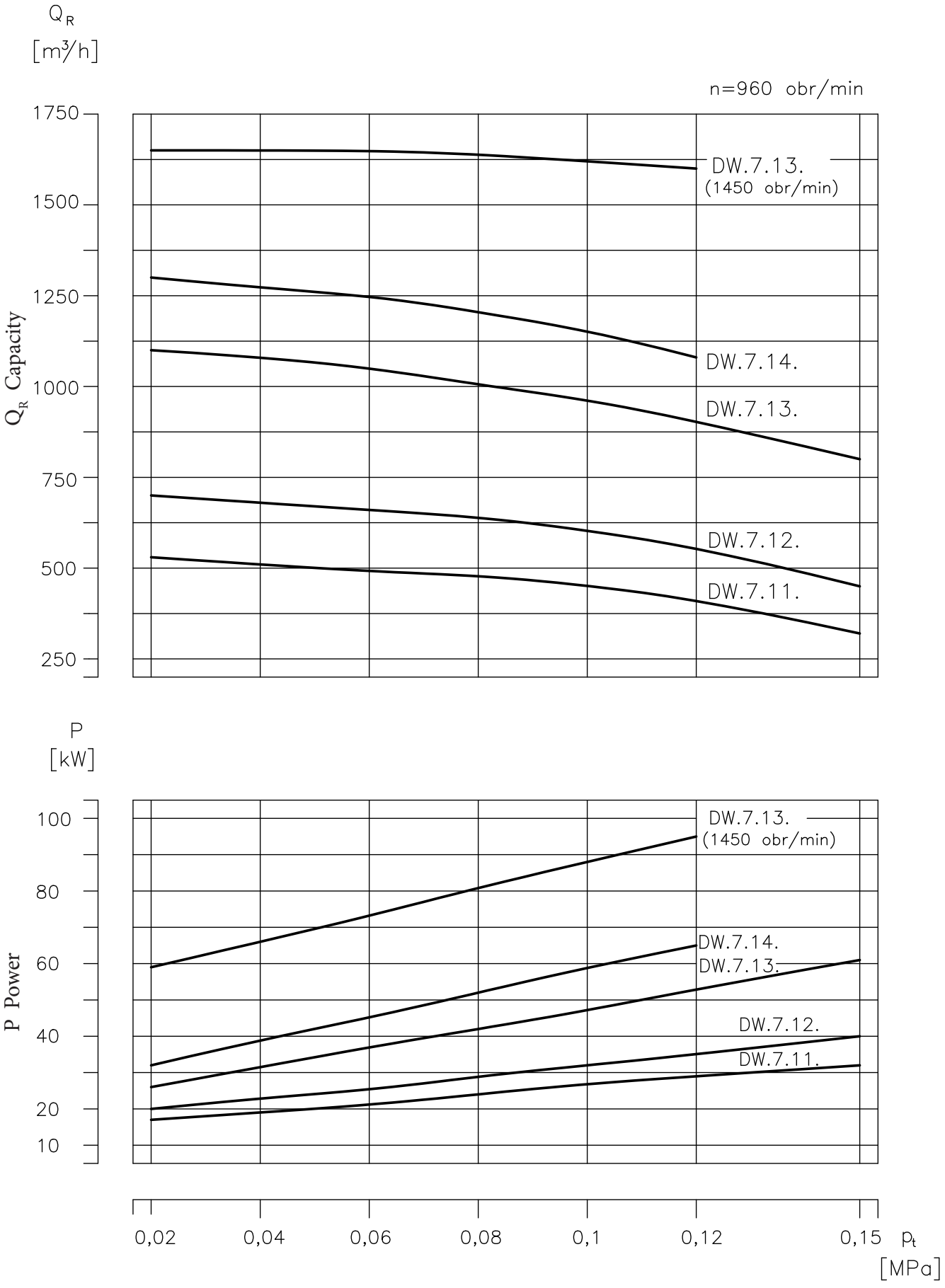
## Blower characteristics




$p_t$ Compression pressure

## Demand for water as working liquid

Vacuum pumps and blowers must have working liquid supplied in the volume indicated in the operation column PB regardless of the operation type (PB or PZ). While using water as working liquid, it is recommended to apply chemically treated water in order to reduce the deposits precipitating from water as they speed up the wear of movable parts.

It is recommended to use water of hardness about 4°*n*- for two-stage pumps and about 8 °*n*- for single-stage pumps
PB - for operation with water supply in the direct system.
PZ - for operation with water supply in the combined system when its part filled up with fresh water returns to the pump.
Δt - water temperature increase in the ring in PZ system, with reference to operation in PB system.

| Absolute suction pressure | | 146 hPa | | | | | 347 hPa | | | | | 480 hPa | | | | | 613 hPa | | | | | 880 hPa | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| vacuum pump symbol | obr/ min | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB |
| | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | |
| | | 10 | 8 | 5 | 2 | - | 10 | 8 | 5 | 2 | - | 10 | 8 | 5 | 2 | - | 10 | 8 | 5 | 2 | - | 10 | 8 | 5 | 2 | - |
| | | Demand for fresh water in l/min | | | | | | | | | | | | | | | | | | | | | | | | |
| PW. 1.12 | 2900 | 0,8 | 1,0 | 1,3 | 2,5 | 5,0 | 0,7 | 0,8 | 1,2 | 2,2 | 4,5 | 0,6 | 0,8 | 1,1 | 2,0 | 4,0 | 0,5 | 0,7 | 1,0 | 1,7 | 3,5 | 0,3 | 0,5 | 0,7 | 1,0 | 1,5 |
| PW. 1.13 | 2900 | 1,3 | 1,5 | 2,2 | 3,3 | 5,5 | 1,2 | 1,3 | 1,8 | 2,8 | 4,5 | 1,0 | 1,2 | 1,6 | 2,6 | 4,0 | 0,8 | 1,0 | 1,5 | 2,2 | 3,5 | 0,5 | 0,7 | 0,8 | 1,2 | 1,5 |

| Absolute suction pressure | | 33/40 hPa | | | | | 146 hPa | | | | | 347 hPa | | | | | 613 hPa | | | | | 880 hPa | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| vacuum pump symbol | obr/ min | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB |
| | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | |
| | | 10 | 5 | 3 | 1 | - | 10 | 5 | 3 | 1 | - | 10 | 5 | 3 | 1 | - | 10 | 5 | 3 | 1 | - | 10 | 5 | 3 | 1 | - |
| | | Demand for fresh water in l/min | | | | | | | | | | | | | | | | | | | | | | | | |
| PW.1.21 | 2800 | 0,6 | 1,2 | 2,0 | 4,0 | 5,0 | 0,8 | 1,2 | 1,8 | 3,5 | 4,5 | 0,5 | 0,8 | 1,6 | 2,8 | 3,5 | 0,4 | 1,0 | 1,3 | 2,3 | 2,5 | 0,3 | 1,0 | 1,4 | 1,5 | 2,0 |
| PW.1.22 | 2800 | 0,6 | 1,5 | 2,2 | 4,7 | 5,0 | 1,0 | 1,5 | 2,1 | 3,5 | 4,5 | 0,8 | 1,5 | 2,0 | 3,0 | 3,5 | 0,7 | 1,2 | 1,3 | 2,3 | 2,5 | 1,0 | 1,2 | 1,4 | 1,5 | 2,0 |
| PW.1.23 | 2800 | 1,3 | 2,2 | 2,8 | 4,2 | 5,5 | 1,3 | 2,0 | 2,7 | 3,8 | 4,5 | 1,2 | 2,0 | 2,5 | 3,7 | 4,0 | 1,0 | 1,5 | 1,8 | 2,5 | 2,5 | 1,0 | 1,2 | 1,4 | 1,5 | 2,0 |

| Manometrie discharge pressure | | 0,02 hPa | | | | | 0,04 hPa | | | | | 0,08 hPa | | | | | 0,12 hPa | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| blower symbol | obr/ min | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB |
| | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | |
| | | 30 | 20 | 10 | 5 | - | 30 | 20 | 10 | 5 | - | 30 | 20 | 10 | 5 | - | 30 | 20 | 10 | 5 | - |
| | | Demand for fresh water in l/min | | | | | | | | | | | | | | | | | | | |
| DW.1.12 | 2800 | 0,2 | 0,3 | 0,5 | 0,8 | 2,5 | 0,2 | 0,3 | 0,7 | 1,0 | 3,5 | 0,3 | 0,5 | 0,8 | 1,7 | 6,0 | - | - | - | - | - |
| DW.1.13 | 2800 | 0,3 | 0,5 | 0,8 | 1,2 | 2,5 | 0,5 | 0,7 | 1,0 | 1,7 | 3,5 | 0,7 | 0,8 | 1,5 | 2,3 | 6,0 | - | - | - | - | - |
| DW.1.21 | 2800 | 0,2 | 0,4 | 0,6 | 0,8 | 2,0 | 0,2 | 0,3 | 0,6 | 1,0 | 3,0 | 0,2 | 0,3 | 0,8 | 1,5 | 5,0 | 0,3 | 0,3 | 1,1 | 2,1 | 6,5 |
| DW.1.22 | 2900 | 0,3 | 0,5 | 0,7 | 1,0 | 2,0 | 0,3 | 0,5 | 0,8 | 1,2 | 3,0 | 0,3 | 0,5 | 1,0 | 1,7 | 5,0 | 0,5 | 0,7 | 1,3 | 2,2 | 6,5 |
| DW.1.23 | 2900 | 0,5 | 0,7 | 1,0 | 1,2 | 2,0 | 0,5 | 0,7 | 1,2 | 1,7 | 3,0 | 0,7 | 1,0 | 1,7 | 2,5 | 5,0 | 0,8 | 1,2 | 2,0 | 3,3 | 6,5 |

| Absolute suction pressure | | 146 hPa | | | | | 347 hPa | | | | | 480 hPa | | | | | 613 hPa | | | | | 880 hPa | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| vacuum pump symbol | obr/ min | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB |
| | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | |
| | | 10 | 8 | 5 | 2 | - | 10 | 8 | 5 | 2 | - | 10 | 8 | 5 | 2 | - | 10 | 8 | 5 | 2 | - | 10 | 8 | 5 | 2 | - |
| | | Demand for fresh water in l/min | | | | | | | | | | | | | | | | | | | | | | | | |
| PW.4.11 | 1450 | 2,8 | 3,3 | 4,7 | 7,7 | 14 | 2,8 | 3,3 | 4,5 | 7,2 | 12 | 2,3 | 2,7 | 3,8 | 6,0 | 10 | 2,0 | 2,3 | 3,0 | 4,3 | 6 | 1,5 | 1,7 | 2,0 | 3,0 | 4 |
| PW.4.12 | 1450 | 2,8 | 3,3 | 4,7 | 7,7 | 14 | 2,8 | 3,3 | 4,5 | 7,2 | 12 | 2,8 | 3,3 | 4,4 | 6,6 | 10 | 2,0 | 2,3 | 3,0 | 4,3 | 6 | 1,9 | 2,1 | 2,6 | 3,2 | 4 |
| PW.4.13 | 1450 | 5,8 | 6,8 | 9,4 | 15,0 | 25 | 7,1 | 8,3 | 11,1 | 16,7 | 25 | 4,3 | 5,0 | 6,6 | 10,0 | 15 | 4,5 | 5,1 | 6,5 | 9,0 | 12 | 3,0 | 3,3 | 4,0 | 5,0 | 6 |
| PW.4.14 | 1450 | 5,8 | 6,8 | 9,4 | 15,0 | 25 | 7,1 | 8,3 | 11,1 | 16,7 | 25 | 5,6 | 6,4 | 8,2 | 11,2 | 15 | 5,3 | 6,0 | 7,4 | 9,0 | 12 | 3,1 | 3,5 | 4,1 | 5,0 | 6 |



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## Demand for water as working liquid

| Absolute suction pressure | | 33/40 hPa | | | | | 146 hPa | | | | | 347 hPa | | | | | 613 hPa | | | | | 880 hPa | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| vacuum pump symbol | obr/ min | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB |
| | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | |
| | | 10 | 5 | 3 | 1 | - | 10 | 5 | 3 | 1 | - | 10 | 5 | 3 | 1 | - | 10 | 5 | 3 | 1 | - | 10 | 5 | 3 | 1 | - |
| | | Demand for fresh water in l/min | | | | | | | | | | | | | | | | | | | | | | | | |
| PW.4.21 | 1450 | 3,0 | 5,0 | 6,8 | 10,7 | 15 | 3,2 | 5,2 | 7,0 | 10,5 | 14 | 3,3 | 5,0 | 6,2 | 8,3 | 10 | 2,7 | 3,7 | 4,4 | 5,3 | 6 | 1,5 | 2,0 | 2,3 | 2,7 | 3 |
| PW.4.22 | 1450 | 3,5 | 5,6 | 7,5 | 11,2 | 15 | 4,0 | 6,2 | 8,0 | 11,2 | 14 | 3,7 | 5,4 | 6,6 | 8,6 | 10 | 2,8 | 3,8 | 4,5 | 5,4 | 6 | 1,6 | 2,0 | 2,3 | 2,7 | 3 |
| PW.4.23 | 1450 | 4,1 | 6,7 | 9,0 | 13,5 | 18 | 4,6 | 7,1 | 9,1 | 12,8 | 16 | 4,5 | 6,4 | 8,0 | 10,3 | 12 | 2,8 | 3,8 | 4,5 | 5,4 | 6 | 1,6 | 2,0 | 2,4 | 2,7 | 3 |
| PW.4.24 | 1450 | 4,1 | 6,7 | 9,0 | 13,5 | 18 | 4,6 | 7,1 | 9,1 | 12,8 | 16 | 4,5 | 6,4 | 8,0 | 10,3 | 12 | 3,0 | 4,0 | 4,6 | 5,4 | 6 | 1,6 | 2,3 | 2,5 | 2,8 | 3 |

| Manometrie discharge pressure | | 0,02 MPa | | | | | 0,06 MPa | | | | | 0,1 MPa | | | | | 0,2 MPa | | | | | 0,3 MPa | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| blower symbol | obr/ min | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB |
| | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | |
| | | 30 | 20 | 10 | 5 | - | 30 | 20 | 10 | 5 | - | 30 | 20 | 10 | 5 | - | 30 | 20 | 10 | 5 | - | 30 | 20 | 10 | 5 | - |
| | | Demand for fresh water in l/min | | | | | | | | | | | | | | | | | | | | | | | | |
| DW.4.11 | 1450 | 0,6 | 0,9 | 1,5 | 2,2 | 4 | 0,9 | 1,3 | 2,3 | 3,5 | 8 | 0,9 | 1,3 | 2,3 | 3,7 | 10 | - | - | - | - | - | - | - | - | - | - |
| DW.4.11 | 2900 | 0,9 | 1,3 | 2,0 | 2,9 | 5 | 1,1 | 1,7 | 2,8 | 4,4 | 10 | 1,1 | 1,7 | 2,8 | 4,5 | 12 | 1,1 | 1,5 | 2,8 | 4,7 | 14 | 1,1 | 1,5 | 2,8 | 4,7 | 14 |
| DW.4.12 | 1450 | 0,6 | 0,9 | 1,5 | 2,2 | 4 | 0,9 | 1,3 | 2,3 | 3,5 | 8 | 0,9 | 1,3 | 2,3 | 3,7 | 10 | - | - | - | - | - | - | - | - | - | - |
| DW.4.12 | 2900 | 0,9 | 1,3 | 2,0 | 2,9 | 5 | 1,1 | 1,7 | 2,8 | 4,4 | 10 | 1,1 | 1,7 | 2,8 | 4,5 | 12 | 1,1 | 1,5 | 2,8 | 4,7 | 14 | 1,1 | 1,5 | 2,8 | 4,7 | 14 |
| DW.4.13 | 1450 | 1,7 | 2,3 | 3,5 | 4,9 | 8 | 2,3 | 3,2 | 5,3 | 8,0 | 16 | 2,3 | 3,3 | 5,7 | 8,9 | 20 | - | - | - | - | - | - | - | - | - | - |
| DW.4.14 | 1450 | 1,7 | 2,3 | 3,5 | 4,9 | 8 | 2,3 | 3,2 | 5,3 | 8,0 | 16 | 2,3 | 3,3 | 5,7 | 8,9 | 20 | - | - | - | - | - | - | - | - | - | - |

| Absolute suction pressure | | 146 hPa | | | | | 347 hPa | | | | | 480 hPa | | | | | 613 hPa | | | | | 880 hPa | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| vacuum pump symbol | obr/ min | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB |
| | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | |
| | | 10 | 8 | 5 | 2 | - | 10 | 8 | 5 | 2 | - | 10 | 8 | 5 | 2 | - | 10 | 8 | 5 | 2 | - | 10 | 8 | 5 | 2 | - |
| | | Demand for fresh water in l/min | | | | | | | | | | | | | | | | | | | | | | | | |
| PW.5.12 | 1450 | 9 | 10 | 15 | 25 | 45 | 10 | 12 | 16 | 25 | 40 | 9 | 10 | 14 | 21 | 32 | 5 | 6 | 8 | 11 | 15 | 3 | 4 | 5 | 6 | 8 |
| PW.5.13 | 1450 | 15 | 18 | 24 | 39 | 62 | 17 | 20 | 27 | 40 | 58 | 14 | 16 | 21 | 31 | 45 | 13 | 15 | 19 | 26 | 35 | 8 | 9 | 11 | 15 | 18 |
| PW.5.14 | 1450 | 16 | 19 | 26 | 42 | 66 | 18 | 21 | 28 | 41 | 62 | 16 | 19 | 25 | 36 | 52 | 16 | 18 | 23 | 32 | 43 | 11 | 13 | 16 | 20 | 25 |

| Absolute suction pressure | | 33/40 hPa | | | | | 213 hPa | | | | | 347 hPa | | | | | 613 hPa | | | | | 880 hPa | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| vacuum pump symbol | obr/ min | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB |
| | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | |
| | | 10 | 5 | 3 | 1 | - | 10 | 5 | 3 | 1 | - | 10 | 5 | 3 | 1 | - | 10 | 5 | 3 | 1 | - | 10 | 5 | 3 | 1 | - |
| | | Demand for fresh water in l/min | | | | | | | | | | | | | | | | | | | | | | | | |
| PW.5.21 | 1450 | 7 | 10 | 14 | 23 | 34 | 8 | 13 | 17 | 26 | 34 | 8 | 13 | 16 | 22 | 27 | 5 | 7 | 9 | 11 | 12 | 2 | 3 | 3 | 4 | 4 |
| PW.5.22 | 1450 | 8 | 13 | 18 | 29 | 40 | 10 | 16 | 21 | 31 | 40 | 11 | 17 | 21 | 28 | 34 | 7 | 9 | 11 | 13 | 15 | 3 | 4 | 4 | 5 | 5 |
| PW.5.23 | 1450 | 9 | 15 | 20 | 32 | 45 | 12 | 18 | 24 | 35 | 45 | 13 | 19 | 24 | 32 | 39 | 8 | 11 | 13 | 16 | 18 | 4 | 5 | 6 | 6 | 7 |
| PW.5.24 | 1450 | 12 | 19 | 26 | 39 | 52 | 15 | 23 | 30 | 42 | 52 | 16 | 23 | 27 | 35 | 40 | 11 | 15 | 17 | 21 | 23 | 5 | 7 | 7 | 8 | 9 |

## Demand for water as working liquid

| Manometrie discharge pressure | | 0,02 MPa | | | | | 0,04 MPa | | | | | 0,08 MPa | | | | | 0,1 MPa | | | | | 0,12 MPa | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| blower symbol | obr/ min | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB |
| | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | |
| | | 30 | 20 | 10 | 5 | - | 30 | 20 | 10 | 5 | - | 30 | 20 | 10 | 5 | - | 30 | 20 | 10 | 5 | - | 30 | 20 | 10 | 5 | - |
| | | Demand for fresh water in l/min | | | | | | | | | | | | | | | | | | | | | | | | |
| DW.5.12 | 1450 | 2 | 3 | 4 | 6 | 10 | 3 | 4 | 6 | 9 | 15 | 4 | 5 | 8 | 12 | 25 | 4 | 5 | 9 | 14 | 32 | 5 | 7 | 11 | 17 | 40 |
| DW.5.13 | 1450 | 3 | 4 | 7 | 9 | 15 | 4 | 6 | 9 | 13 | 22 | 5 | 8 | 13 | 20 | 40 | 6 | 8 | 14 | 21 | 48 | 6 | 9 | 16 | 24 | 55 |
| DW.5.14 | 1450 | 4 | 6 | 9 | 12 | 20 | 5 | 7 | 11 | 16 | 28 | 7 | 10 | 17 | 25 | 50 | 7 | 10 | 17 | 27 | 60 | 8 | 11 | 20 | 31 | 66 |

| Absolute suction pressure | | 213 hPa | | | | | 347 hPa | | | | | 480 hPa | | | | | 613 hPa | | | | | 880 hPa | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| vacuum pump symbol | obr/ min | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB |
| | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | |
| | | 10 | 8 | 5 | 2 | - | 10 | 8 | 5 | 2 | - | 10 | 8 | 5 | 2 | - | 10 | 8 | 5 | 2 | - | 10 | 8 | 5 | 2 | - |
| | | Demand for fresh water in l/min | | | | | | | | | | | | | | | | | | | | | | | | |
| PW.7.11 | 960 | 13 | 15 | 25 | 40 | 80 | 13 | 16 | 22 | 37 | 70 | 18 | 21 | 27 | 39 | 55 | 15 | 17 | 21 | 30 | 40 | 9 | 11 | 13 | 16 | 20 |
| PW.7.12 | 960 | 19 | 22 | 31 | 53 | 100 | 19 | 23 | 32 | 52 | 90 | 24 | 28 | 37 | 53 | 75 | 20 | 23 | 30 | 41 | 55 | 12 | 13 | 16 | 20 | 25 |
| PW.7.13 | 960 | 34 | 40 | 57 | 93 | 165 | 32 | 38 | 53 | 84 | 140 | 39 | 45 | 59 | 83 | 115 | 35 | 40 | 50 | 68 | 90 | 19 | 21 | 26 | 33 | 40 |
| PW.7.14 | 960 | 40 | 48 | 66 | 105 | 175 | 36 | 42 | 58 | 90 | 145 | 39 | 45 | 61 | 87 | 120 | 37 | 42 | 53 | 72 | 95 | 21 | 24 | 29 | 37 | 45 |

| Absolute suction pressure | | 40 hPa | | | | | 107 hPa | | | | | 347 hPa | | | | | 613 hPa | | | | | 880 hPa | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| vacuum pump symbol | obr/ min | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB |
| | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | |
| | | 10 | 5 | 3 | 1 | - | 10 | 5 | 3 | 1 | - | 10 | 5 | 3 | 1 | - | 10 | 5 | 3 | 1 | - | 10 | 5 | 3 | 1 | - |
| | | Demand for fresh water in l/min | | | | | | | | | | | | | | | | | | | | | | | | |
| PW.7.21 | 960 | 19 | 33 | 45 | 85 | 130 | 20 | 34 | 47 | 78 | 115 | 20 | 30 | 39 | 53 | 65 | 13 | 18 | 22 | 27 | 30 | 8 | 11 | 12 | 14 | 15 |
| PW.7.22 | 960 | 22 | 38 | 55 | 95 | 140 | 24 | 40 | 55 | 88 | 125 | 23 | 35 | 43 | 58 | 70 | 16 | 22 | 26 | 31 | 35 | 9 | 11 | 12 | 14 | 15 |
| PW.7.23 | 960 | 28 | 47 | 70 | 105 | 150 | 28 | 45 | 61 | 95 | 130 | 26 | 38 | 47 | 63 | 75 | 18 | 25 | 29 | 36 | 40 | 12 | 15 | 16 | 19 | 20 |
| PW.7.24 | 960 | 34 | 56 | 75 | 115 | 160 | 31 | 51 | 67 | 101 | 135 | 28 | 42 | 52 | 68 | 80 | 21 | 29 | 34 | 40 | 45 | 12 | 15 | 16 | 19 | 20 |

| Manometrie discharge pressure | | 0,04 MPa | | | | | 0,06 MPa | | | | | 0,08 MPa | | | | | 0,1 MPa | | | | | 0,15 MPa | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| blower symbol | obr/ min | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB | PZ | | | | PB |
| | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | | ΔtºC | | | | |
| | | 30 | 20 | 10 | 5 | - | 30 | 20 | 10 | 5 | - | 30 | 20 | 10 | 5 | - | 30 | 20 | 10 | 5 | - | 30 | 20 | 10 | 5 | - |
| | | Demand for fresh water in l/min | | | | | | | | | | | | | | | | | | | | | | | | |
| DW.7.11 | 960 | 6 | 8 | 12 | 17 | 30 | 7 | 9 | 15 | 22 | 40 | 8 | 11 | 18 | 27 | 55 | 8 | 11 | 18 | 29 | 65 | 7 | 10 | 18 | 30 | 80 |
| DW.7.12 | 960 | 7 | 9 | 14 | 20 | 35 | 8 | 11 | 19 | 27 | 50 | 8 | 12 | 20 | 30 | 60 | 8 | 12 | 20 | 31 | 70 | 8 | 11 | 20 | 32 | 85 |
| DW.7.13 | 960 | 12 | 17 | 27 | 38 | 65 | 14 | 20 | 32 | 46 | 85 | 14 | 20 | 33 | 50 | 100 | 13 | 19 | 33 | 51 | 115 | 13 | 18 | 32 | 56 | 150 |
| DW.7.13 | 1450 | 13 | 18 | 29 | 41 | 70 | 15 | 21 | 34 | 49 | 90 | 15 | 21 | 35 | 52 | 100 | 14 | 20 | 34 | 53 | 120 | 13 | 19 | 33 | 64 | 170 |
| DW.7.14 | 960 | 15 | 21 | 33 | 47 | 80 | 17 | 23 | 37 | 54 | 100 | 17 | 24 | 40 | 60 | 120 | 16 | 22 | 38 | 60 | 135 | 15 | 21 | 37 | 60 | 160 |



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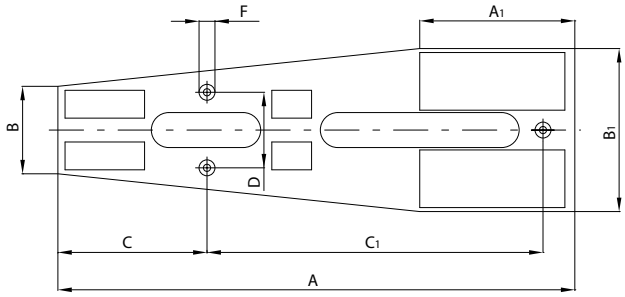
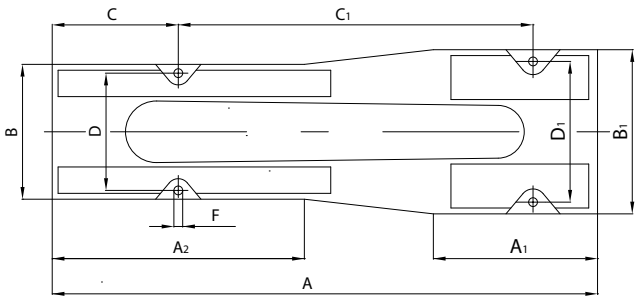
## Foundation plates - dimensions

PW.1/DW.1



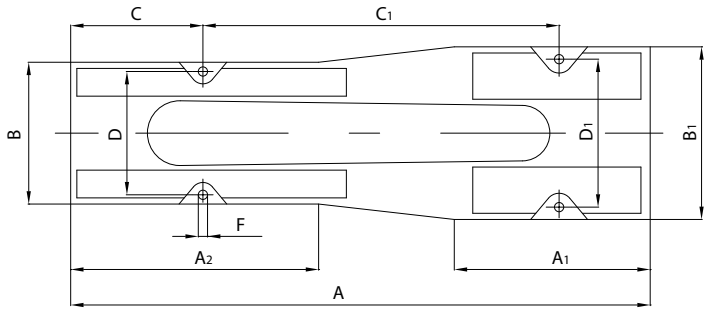

| part no. | A | $A_1$ | B | $B_1$ | C | $C_1$ | D | F |
|---|---|---|---|---|---|---|---|---|
| 60.34.01.1 | 745 | 230 | 145 | 240 | 190 | 520 | 120 | 14 |
| 60.35.01.1 | 825 | 230 | 145 | 240 | 240 | 550 | 140 | 14 |

PW.4/DW.4



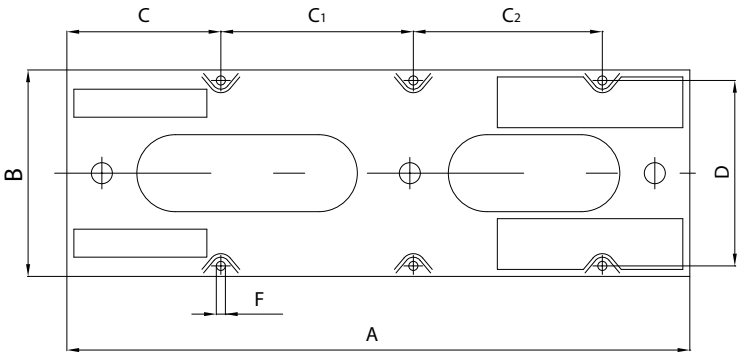

| part no. | A | $A_1$ | $A_2$ | B | $B_1$ | C | $C_1$ | D | $D_1$ | F |
|---|---|---|---|---|---|---|---|---|---|---|
| 60.70.01.1 | 795 | 300 | 335 | 262 | 310 | 180 | 490 | 226 | 274 | 14 |
| 60.71.01.1 | 1046 | 470 | 300 | 266 | 420 | 180 | 595 | 230 | 384 | 14 |
| 60.72.01.1 | 964 | 360 | 350 | 262 | 342 | 240 | 550 | 226 | 306 | 14 |
| 60.73.01.1 | 1016 | 320 | 480 | 262 | 310 | 230 | 625 | 230 | 274 | 14 |

PW.5/DW.5



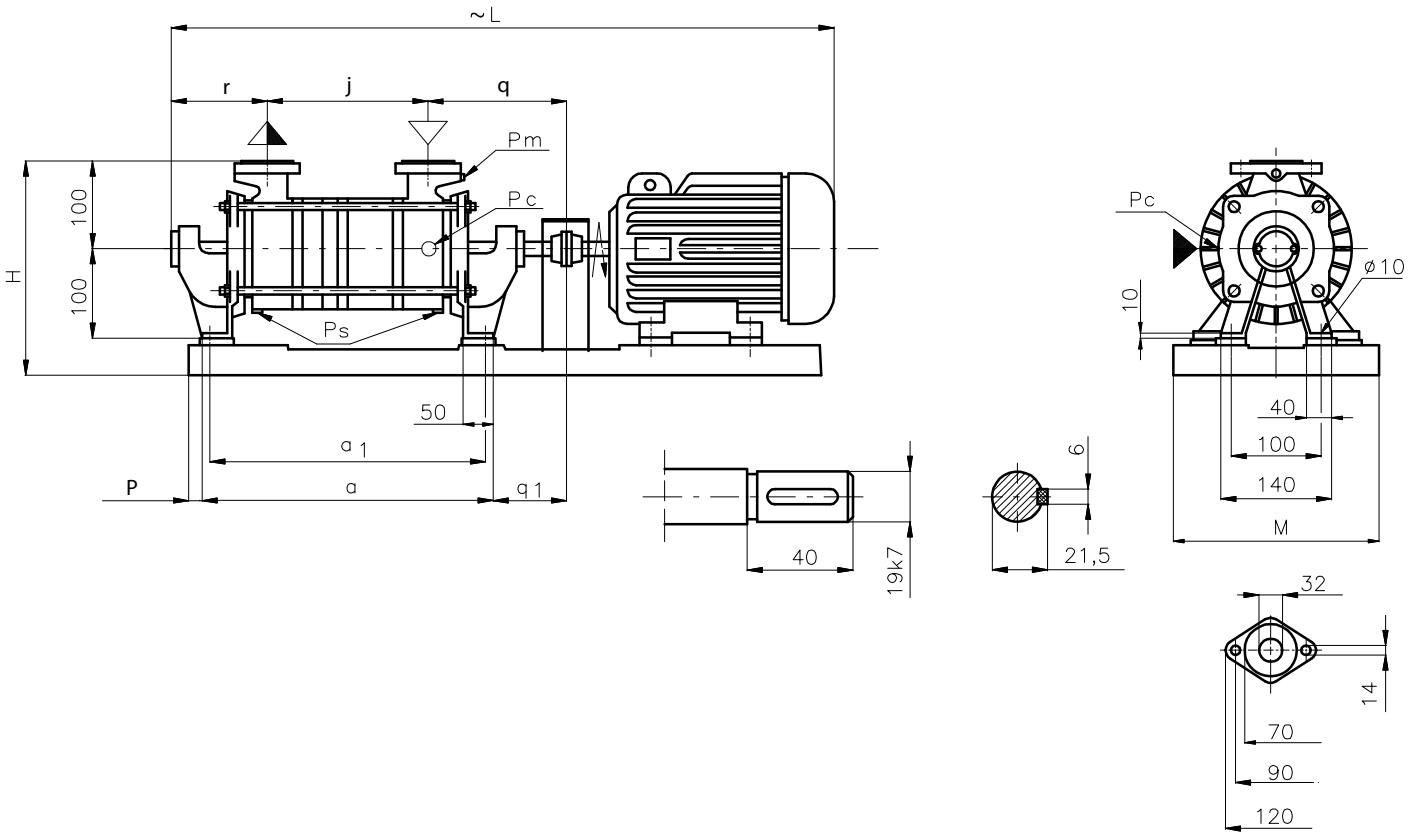

| part no. | A | $A_1$ | $A_2$ | B | $B_1$ | C | $C_1$ | D | $D_1$ | F |
|---|---|---|---|---|---|---|---|---|---|---|
| 60.77.01.1 | 1245 | 480 | 380 | 325 | 415 | 250 | 750 | 277 | 367 | 14 |
| 60.78.01.1 | 1290 | 430 | 540 | 325 | 390 | 300 | 760 | 277 | 342 | 14 |

PW.7/DW.7




| part no. | A | B | C | $C_1$ | C2 | D | F |
|---|---|---|---|---|---|---|---|
| 60.74.01.1 | 1832 | 595 | 400 | 600 | 550 | 520 | 24 |
| 60.75.01.1 | 1932 | 595 | 400 | 630 | 620 | 520 | 24 |
| 60.76.01.1 | 2087 | 595 | 450 | 700 | 670 | 520 | 24 |

## Dimensions and the choice of units




### Dimensions of units and pumps PW.1 and blowers DW.1

with a cord seal

| Type dimension | constructional execution $e_1e_1$ | a | $a_1$ | j | q* | $q_1$ | r | $P_C$ | $P_m$ | $P_s$ |
|---|---|---|---|---|---|---|---|---|---|---|
| PW.1.12<br>DW.1.12 | 01 | 300 | 260 | 108 | 172 | 76 | 128 | R 0,5 | M14x1,5 | R 3/8 |
| PW.1.13<br>DW.1.13 | 01 | 335 | 295 | 143 | | | | | | |
| PW.1.21<br>DW.1.21 | 01 | 336 | 296 | 144 | | | | | | |
| PW.1.22<br>DW.1.22 | 01 | 350 | 310 | 158 | | | | | | |
| PW.1.23<br>DW.1.23 | 01 | 399 | 359 | 207 | | | | | | |

with front packing

| Type dimension | constructional execution $e_1e_1$ | a | $a_1$ | j | q* | $q_1$ | r | $P_C$ | $P_m$ | $P_s$ |
|---|---|---|---|---|---|---|---|---|---|---|
| PW.1.12<br>DW.1.12 | 10<br>12 | 294 | 254 | 108 | 125 | 32 | 80 | R 0,5 | M14x1,5 | R 3/8 |
| PW.1.13<br>DW.1.13 | 10<br>12 | 329 | 289 | 143 | | | | | | |
| PW.1.21<br>DW.1.21 | 10<br>12 | 330 | 290 | 144 | | | | | | |
| PW.1.22<br>DW.1.22 | 10<br>12 | 344 | 304 | 158 | | | | | | |
| PW.1.23<br>DW.1.23 | 10<br>12 | 393 | 353 | 207 | | | | | | |

* Dimension „q" is given with reference to shaft frontal plane

Pc - working liquid connections
Pm - manometer connections
Ps - drain outlet



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## Dimensions and the choice of units (cord seal)

| Delivery completeness | 1 | 2 | 3 | 5 | | Motor | | Foundation plate | | Liquid container** | | Unit dimension | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pump mass | | | | | | | | | | | | | | |
| type size of vacuum pump | with a free shaft end | with a coupling | with a coupling and plate | with a coupling motor and plate | coupling | mechanical size | Power | plate | block | to be set | open standing | P | H | M | L |
| | kg | | | | type | | kW | part no. | | name | | mm | | | |
| PW.1.12 | 18 | 19,0 | 37,0 | 44,9 | EZ1 | 802A | 0,75 | 60.34.01.1 | 68.40.01.1 | ZBN.1 | ZBP.1 | 65 | 200 | 240 | 658 |
| | | | | 47,4 | | 802B | 1,10 | | | | | | | | 678 |
| PW.1.13 | 19 | 20,0 | 38,0 | 48,0 | | | | | | | | 40 | | | 713 |
| | | | | 51,0 | | 90S2 | 1,50 | | 68.40.03.1 | | | | | | 742 |
| PW.1.21 | 20 | 21,0 | 39,0 | 46,9 | | 802A | 0,75 | | 68.40.01.1 | | | | | | 694 |
| | | | | 48,4 | | 802B | 1,10 | | | | | | | | 714 |
| PW.1.22 | 21 | 22,0 | 40,0 | 49,0 | | | | | | | | 20 | | 270 | 728 |
| PW.1.23 | 22 | 23,0 | 43,0 | 56,0 | | 90S2 | 1,50 | 60.35.01.1 | 68.40.03.1 | | | 0 | | | 815 |

| Delivery completeness | 1 | 2 | 3 | 5 | | Motor | | Foundation plate | | Liquid container** | Unit dimension | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pump mass | | | | | | | | | | | | | |
| type size of vacuum pump | with a free shaft end | with a coupling | with a coupling and plate | with a coupling motor and plate | coupling | mechanical size | Power | plate | block | closed standing | P* | H | M | L* |
| | kg | | | | type | | kW | part no. | | | mm | | | |
| DW.1.12 | 18 | 19,0 | 37,0 | 44,9 | EZ1 | 802A | 0,75 | 60.34.01.1 | 68.40.01.1 | ZBP.1 | 65 | 200 | 240 | 658 |
| | | | | 47,4 | | 802B | 1,10 | | | | | | | 678 |
| DW.1.13 | 19 | 20,0 | 38,0 | 48,0 | | 90S2 | 1,50 | | 68.40.03.1 | | 40 | | | 742 |
| | | | | 53,5 | | 90L2 | 2,20 | | | | | | | 767 |
| DW.1.21 | 20 | 21,0 | 39,0 | 46,9 | | 802A | 0,75 | | 68.40.01.1 | | | | | 694 |
| | | | | 48,4 | | 802B | 1,10 | | | | | | | 714 |
| DW.1.22 | 21 | 22,0 | 40,0 | 51,0 | | | | | | | | | 270 | 728 |
| | | | | 52,5 | | 90S2 | 1,50 | | 68.40.03.1 | | | | | 815 |
| DW.1.23 | 22 | 23,0 | 43,0 | 58,5 | | 90L2 | 2,20 | 60.35.01.1 | | | 20 | 212 | | 831 |
| | | | | 65,0 | | 100L2 | 3,00 | | 68.40.02.1 | | | | | 887 |

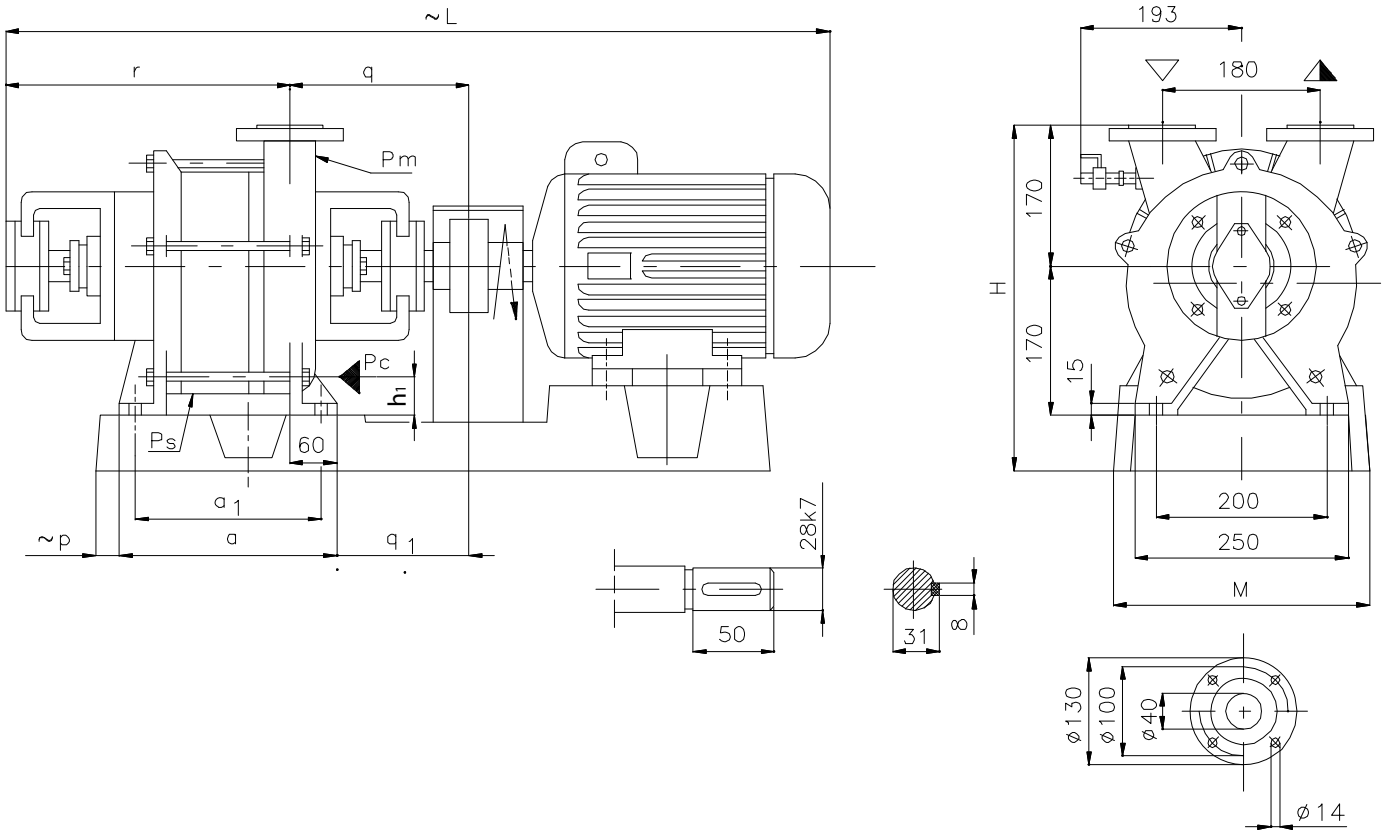
Motor do pompy i dmuchaw należy dobierać z rezerwą mocy około 10%

## Dimensions and the choice of units (mechanical seal)

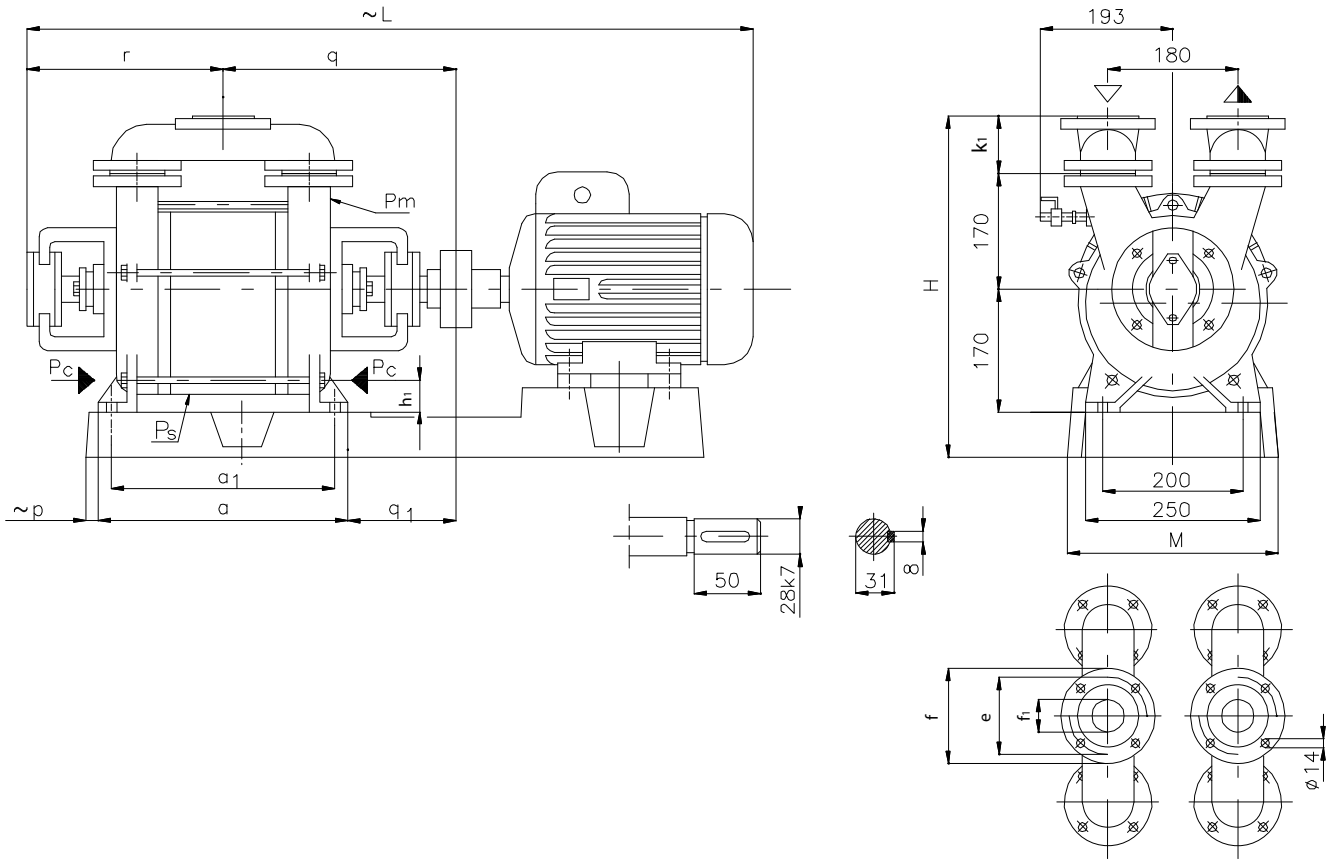
| Delivery completeness | 1 | 2 | 3 | 5 | | Motor | | Foundation plate | | Liquid container | | Unit dimension | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pump mass | | | | | | | | | | | | | | |
| type size of vacuum pump | with a free shaft end | with a coupling | with a coupling and plate | with a coupling motor and plate | coupling | mechanical size | Power | plate | block | to be set | open standing | P* | H | M | L* |
| | kg | | | | type | | kW | part no. | | name | | mm | | | |
| PW.1.12 | 17 | 18,0 | 36,0 | 33,9 | EZ1 | 802A | 0,75 | 60.34.01.1 | 68.40.01.1 | ZBN.1 | ZBP.1 | 100 | 200 | 240 | 582 |
| | | | | 46,4 | | 802B | 1,10 | | | | | | | | 599 |
| PW.1.13 | 18 | 19,0 | 37,0 | 47,0 | | | | | | | | 60 | | | 634 |
| | | | | 50,0 | | 90S2 | 1,50 | | 68.40.03.1 | | | | | | 668 |
| PW.1.21 | 19 | 20,0 | 38,0 | 45,9 | | 802A | 0,75 | | 68.40.01.1 | | | 60 | | | 618 |
| | | | | 47,4 | | 802B | 1,10 | | | | | | | | 635 |
| PW.1.22 | 20 | 21,0 | 39,0 | 48,0 | | | | | | | | 45 | | | 649 |
| PW.1.23 | 21 | 22,0 | 40,0 | 55,0 | | 90S2 | 1,50 | | 68.40.03.1 | | | 0 | | | 732 |

| Delivery completeness | 1 | 2 | 3 | 5 | | Motor | | Foundation plate | | Liquid container | Unit dimension | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pump mass | | | | | | | | | | | | | |
| type size of vacuum pump | with a free shaft end | with a coupling | with a coupling and plate | with a coupling motor and plate | coupling | mechanical size | Power | plate | block | closed standing | P* | H | M | L* |
| | kg | | | | type | | kW | part no. | | | mm | | | |
| DW.1.12 | 17 | 18,0 | 36,0 | 43,9 | EZ1 | 802A | 0,75 | 60.34.01.1 | 68.40.01.1 | ZBP.1 | 100 | 200 | 240 | 582 |
| | | | | 46,4 | | 802B | 1,10 | | | | | | | 599 |
| DW.1.13 | 18 | 19,0 | 37,0 | 47,0 | | 90S2 | 1,50 | | 68.40.03.1 | | 60 | | | 668 |
| | | | | 52,5 | | 90L2 | 2,20 | | | | | | | 693 |
| DW.1.21 | 19 | 20,0 | 38,0 | 45,9 | | 802A | 0,75 | | 68.40.01.1 | | | | | 618 |
| | | | | 47,4 | | 802B | 1,10 | | | | | | | 635 |
| DW.1.22 | 20 | 21,0 | 39,0 | 50,0 | | | | | | | 45 | | | 649 |
| | | | | 51,5 | | 90S2 | 1,50 | | 68.40.02.1 | | | | | 674 |
| DW.1.23 | 21 | 22,0 | 40,0 | 57,5 | | 90L2 | 2,20 | 60.35.01.1 | | | 0 | 212 | 270 | 754 |
| | | | | 64,0 | | 100L2 | 3,00 | | | | | | | 872 |

## Dimensions and the choice of units




**Dimensions of units and pumps PW.4.11-12 and blowers DW.4.11-12**




**Dimensions of units and pumps PW.4.13-14 and blowers DW.4.13-14**



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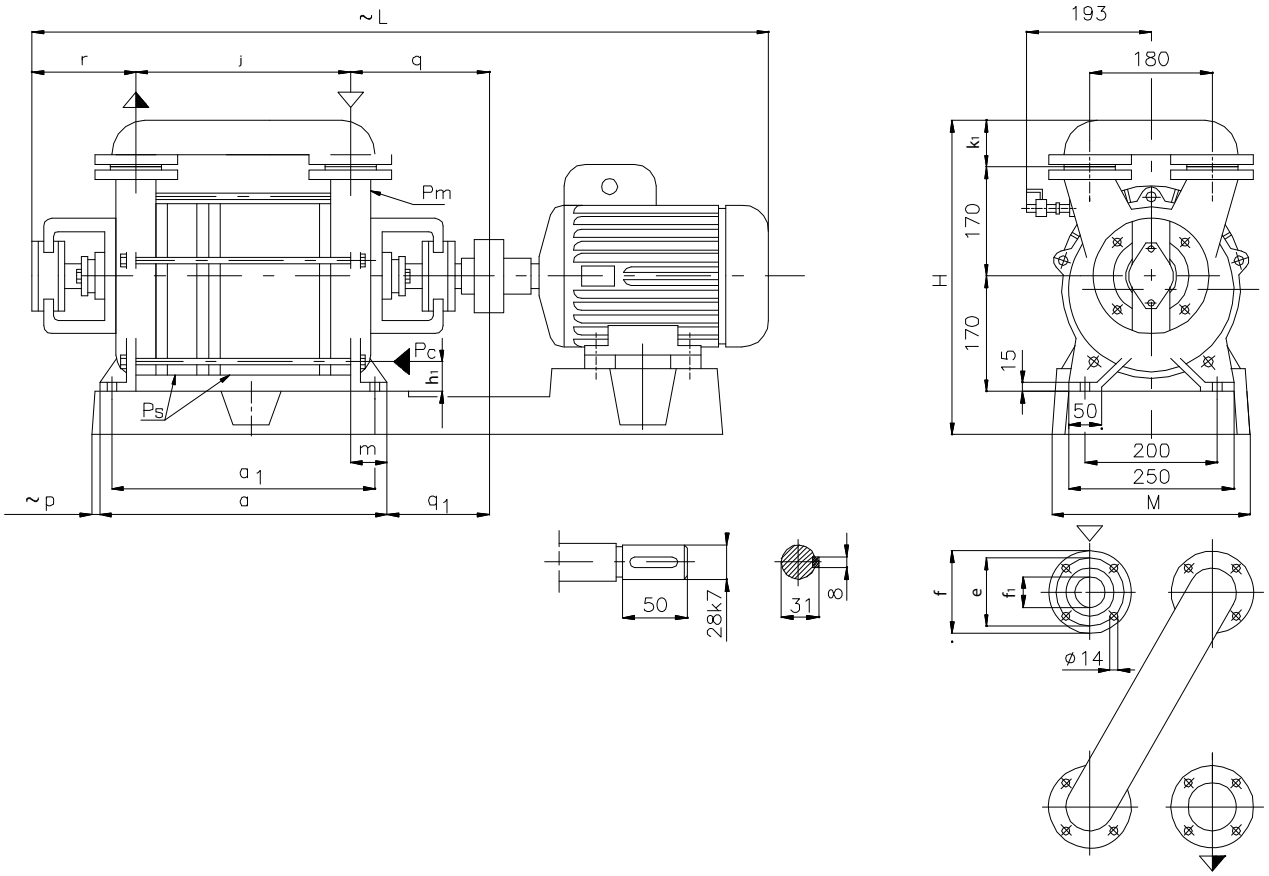
## Dimensions and the choice of units




### Dimensions of units and pumps PW.4.21-24

| Type dimension | constructional execution $e_1e_1$ | a | $a_1$ | e | f | $f_1$ | $h_1$ | j | $k_1$ | q* | $q_1$ | r | $P_C$ | $P_m$ | $P_s$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PW.4.21 | 01 | 312 | 262 | 100 | 130 | 40 | 60 | 209 | 68 89** | 220 | 167 | 165 | R 0,5 | M14x1,5 | M14x1,5 |
| | 11 | | | | | | | | | 170 | 117 | 115 | | | |
| PW.4.22 | 01 | 332 | 282 | | | | | 229 | | 220 | 167 | 165 | | | |
| | 11 | | | | | | | | | 170 | 117 | 115 | | | |
| PW.4.23 | 01 | 402 | 352 | | | | | 299 | | 220 | 167 | 165 | | | |
| | 11 | | | | | | | | | 170 | 117 | 115 | | | |
| PW.4.24 | 01 | 442 | 392 | | | | | 339 | | 220 | 167 | 165 | | | |
| | 11 | | | | | | | | | 170 | 117 | 115 | | | |
| PW.4.11 | 01 | 231 | 181 | 100 | 130 | 40 | 80 | - | 83 127** | 220 | 167 | 308 | | | |
| DW.4.11 | 11 | | | | | | | | | 170 | 117 | 258 | | | |
| PW.4.12 | 01 | 251 | 201 | | | | | | | 220 | 167 | 328 | | | |
| DW.4.12 | 11 | | | | | | | | | 170 | 117 | 278 | | | |
| PW.4.13 | 01 | 318 | 268 | | 140 | 50 | | | | 327 | 167 | 272 | | | |
| DW.4.13 | 11 | | | | | | | | | 277 | 117 | 222 | | | |
| PW.4.14 | 01 | 358 | 308 | | | | | | | 347 | 167 | 292 | | | |
| DW.4.14 | 11 | | | | | | | | | 297 | 117 | 242 | | | |

*) Dimension „q" is given with reference to shaft frontal plane.
**) - $k_1$ = 89 i 127 for the execution of material 6 and 7
Flanges sizes according to PN-ISO7005-1:1996

Pc - working liquid connections
Pm - manometer connections
Ps - drain outlet

## Dimensions and the choice of units

| Delivery completeness | 1 | 2 | 3 | 5 | | Motor | | Foundation plate | | Liquid container | | Unit dimension | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pump mass | | | | | | | | | | | | | | |
| type size of vacuum pump | with a free shaft end | with a coupling | with a coupling and plate | with a coupling motor and plate | coupling | mechanical size | Power | plate | block | to be set | open standing | P* | H | M | L* |
| | kg | | | | type | | kW | part no. | | name | | mm | | | |
| PW.4.11 | 48 | 49,0 | 79,0 | 101,0 | EZ1 | 100L4A | 2,2 | 60.70.01.1 | 68.40.04.1 | ZBN.3 | ZBP.4 | 30 | 410 | 315 | 920 |
| | | | | 105,0 | | 100L4B | 3,0 | | | | | | | | 924 |
| PW.4.12 | 50 | 51,0 | 81,0 | 107,0 | | | | | | | | 10 | | | 952 |
| | | | | 121,0 | | 112M4 | 4,0 | | 68.40.05.1 | | | | | | 967 |
| PW.4.13 | 76 | 77,0 | 112,0 | 152,0 | | | | 60.72.01.1 | | | | 50 | 493 | 342 | 1018 |
| | | 79,0 | 114,0 | 169,0 | EZ3 | 132S4 | 5,5 | | - | | | 10 | | | 1063 |
| PW.4.14 | 82 | 85,0 | 120,0 | 175,0 | | | | | | | | | | | 1103 |
| | | | | 190,0 | | 132M4 | 7,5 | | | | | 40 | 482 | | 1143 |
| PW.4.21 | 72 | 73,0 | 108,0 | 134,0 | EZ1 | 100L4B | 3,0 | | 68.40.04.1 | | | | | | 990 |
| | | | | 148,0 | | 112M4 | 4,0 | | 68.40.05.1 | | | 20 | | | 1013 |
| PW.4.22 | 75 | 76,0 | 111,0 | 137,0 | | 100L4B | 3,0 | | 68.40.04.1 | | | | | | 1010 |
| | | | | 151,0 | | 112M4 | 4,0 | | 68.40.05.1 | | | 50 | | 315 | 1033 |
| PW.4.23 | 83 | 86,0 | 121,0 | 165,0 | EZ3 | 132S4 | 5,5 | 60.73.01.1 | - | | | | | | 1114 |
| | | | | 174,5 | | | | | | | | 10 | | | 1148 |
| PW.4.24 | 88 | 91,0 | 131,0 | 186,0 | | | | | | | | | | | 1188 |
| | | | | 196,0 | | 132M4 | 7,5 | | | | | | | | 1226 |

| Delivery completeness | 1 | 2 | 3 | 5 | | Motor | | Foundation plate | | Liquid container | Unit dimension | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pump mass | | | | | | | | | | | | | |
| type size of vacuum pump | with a free shaft end | with a coupling | with a coupling and plate | with a coupling motor and plate | coupling | mechanical size | Power | plate | block | closed standing | P* | H | M | L* |
| | kg | | | | type | | kW | part no. | | name | mm | | | |
| DW.4.11 | 48 | 49,0 | 79,0 | 104,0 | EZ1 | 100L4B | 3,0 | 60.70.01.1 | 68.40.01.1 | ZBP.4 | 30 | 410 | 315 | 924 |
| | | | | 118,0 | | 112M4 | 4,0 | | 68.40.05.1 | | | | | 947 |
| | | 52,0 | 97,0 | 188,0 | EZ3 | 160M2A | 11,0 | 60.71.01.1 | 68.40.08.1 | | | 449 | 420 | 1160 |
| | | | | 209,0 | | 160M2B | 15,0 | | | | | | | 1160 |
| | | 54,5 | 99,5 | 245,0 | EZ7 | 180M2 | 22,0 | | 68.40.09.1 | | | 500 | 425 | 1200 |
| DW.4.12 | 50 | 51,0 | 81,0 | 121,0 | EZ1 | 112M4 | 4,0 | 60.70.01.1 | 68.40.05.1 | | | 410 | 315 | 974 |
| | | 53,0 | 83,0 | 138,0 | EZ3 | 132S4 | 5,5 | | - | | | | | 1012 |
| | | | 99,0 | 207,0 | | 160M2B | 15,0 | 60.71.01.1 | 68.40.08.1 | | 10 | 449 | 420 | 1180 |
| | | 56,5 | 101,5 | 247,5 | EZ7 | 180M2 | 22,0 | | 68.40.09.1 | | | 500 | 425 | 1220 |
| | | | | 391,0 | | 200L2A | 30,0 | | - | | | | 510 | 1310 |
| DW.4.13 | 76 | 81,0 | 111,0 | 166,0 | EZ3 | 132S4 | 5,5 | 60.72.01.1 | | | 50 | 418 | 342 | 1063 |
| | | | 116,0 | 182,0 | | 132M4 | 7,5 | | | | 10 | 483 | | 1103 |
| DW.4.14 | 82 | 85,0 | 120,0 | 186,0 | | | | | | | | | | 1143 |
| | | 88,5 | 123,0 | 219,5 | | 160M4 | 11,0 | | 68.40.10.1 | | | | | 1257 |

* Dimension P is 50mm bigger while dimension L is 100mm smaller for units with vacuum pumps and blowers of constructional execution 1100.



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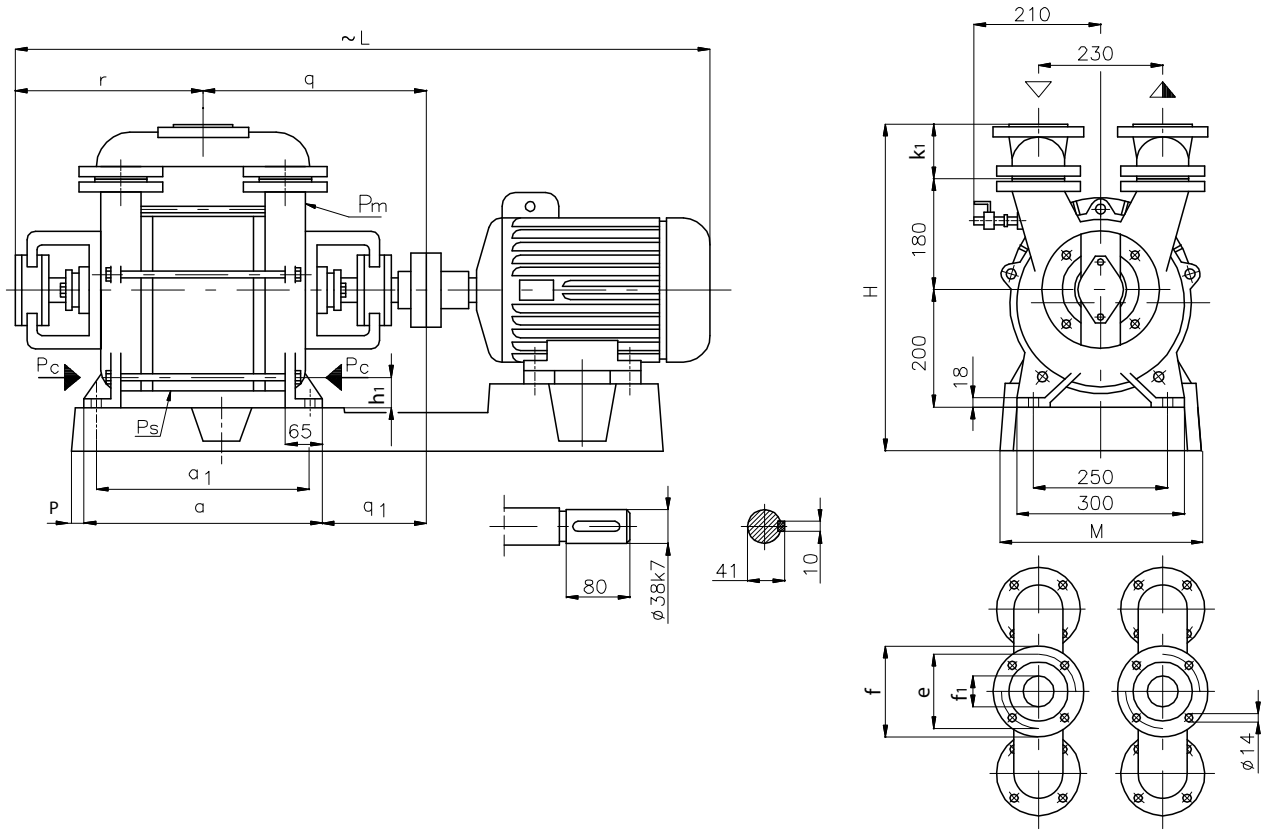
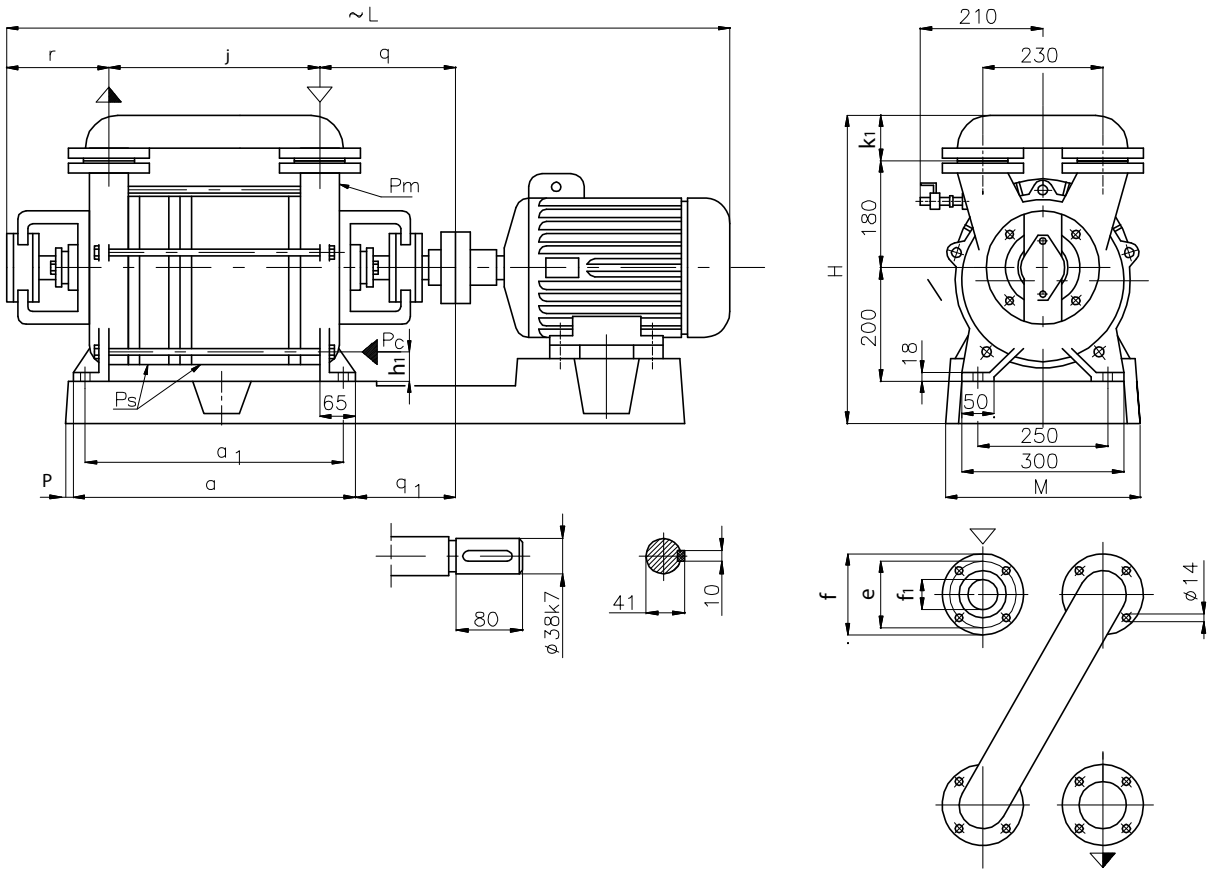
## Dimensions and the choice of units




**Dimensions of units PW.5.12-14 and blowers DW.5.12-14**




**Dimensions of units PW.5.21-24**

## Dimensions and the choice of units

| Type dimension | constructional execution $e_1e_1$ | a | $a_1$ | e | f | $f_1$ | $h_1$ | j | $k_1$ | q* | $q_1$ | r | $P_C$ | $P_m$ | $P_s$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PW.5.21 | 10 (12) | 434 | 382 | 110 | 140 | 50 | 65 | 330 | 113 | 213 | 162 | 133 | G 1” | M14x1,5 | M14x1,5 |
| PW.5.22 | | 474 | 422 | | | | | 370 | | | | | | | |
| PW.5.23 | | 534 | 482 | | | | | 430 | | | | | | | |
| PW.5.24 | | 594 | 542 | | | | | 490 | | | | | | | |
| PW.5.11<br>DW.5.11 | | 384 | 332 | | | | | - | | 354 | | 273 | | | |
| PW.5.12<br>DW.5.12 | | 424 | 372 | | | | | | | 374 | | 293 | | | |
| PW.5.13<br>DW.5.13 | | 464 | 412 | | | | | | | 394 | | 313 | | | |

* Dimension „q” is given with reference to shaft frontal plane.
Flanges sizes according to PN-ISO7005-1:1996

Pc - working liquid connections
Pm - manometer connection
Ps - drain outlet



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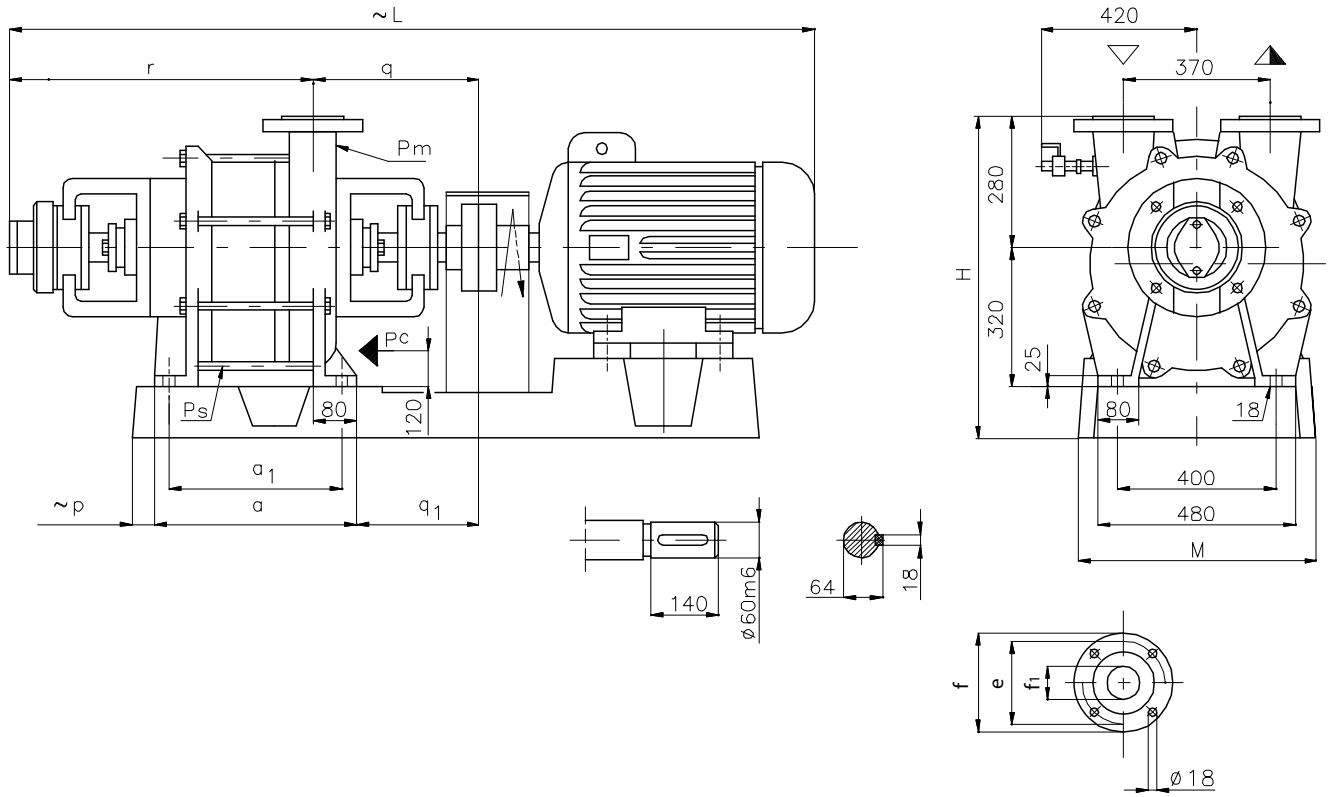
## Dimensions and the choice of units

| Delivery completeness | 1 | 2 | 3 | 5 | | Motor | | Foundation plate | | Liquid container | | Unit dimension | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pump mass | | | | | | | | | | | | | | |
| type size of vacuum pump | with a free shaft end | with a coupling | with a coupling and plate | with a coupling motor and plate | coupling | mechanical size | Power | plate | block | to be set | open standing | P | H | M | L |
| | kg | | | | type | | kW | part no. | | name | | mm | | | |
| PW.5.12 | 119 | 122,0 | 167,0 | 229,0 | EZ3 | 132S4 | 5,5 | 60.77.01.1 | 68.40.14.1 | ZBN | ZBP | 90 | 608 | 415 | 1072 |
| | | | | 240,0 | | 132M4 | 7,5 | | | | | | | | 1112 |
| | | 123,0 | 168,0 | 273,0 | | 160M4 | 11,0 | | 68.40.08.1 | | | | | | 1190 |
| PW.5.13 | | 130,0 | 175,0 | 280,0 | | 160M4 | 11,0 | | | | | 50 | | | 1230 |
| | | | | 300,0 | | 160L4 | 15,0 | | | | | | | | 1277 |
| PW.5.14 | 135 | 139,0 | 184,0 | 289,0 | | 160M4 | 11,0 | | | | | 10 | | | 1270 |
| | | | | 309,0 | | 160L4 | 15,0 | | | | | | | | 1317 |
| | | 142,0 | 187,0 | 352,0 | EZ7 | 180M4 | 18,5 | | 68.40.09.1 | | | | | | 1357 |
| PW.5.21 | 137 | 140,0 | 185,0 | 256,0 | EZ3 | 132S4 | 5,5 | | 68.40.14.1 | | | 40 | 563 | | 1122 |
| | | | | 259,0 | | 132M4 | 7,5 | | | | | | | | 1162 |
| | | 141,0 | 198,0 | 303,0 | | 160M4 | 11,0 | | 68.40.08.1 | | | | | | 1240 |
| PW.5.22 | 145 | 148,0 | 193,0 | 266,0 | | 132M4 | 7,5 | | 68.40.14.1 | | | 5 | | | 1202 |
| | | 149,0 | 194,0 | 299,0 | | 160M4 | 11,0 | | 68.40.08.1 | | | | | | 1280 |
| | | | | 319,0 | | 160L4 | 15,0 | | | | | | | | 1327 |
| PW.5.23 | | 160,0 | 210,0 | 315,0 | | 160M4 | 11,0 | 60.78.01.1 | | | | 120 | | 396 | 1340 |
| | | | | 344,5 | | 160L4 | 15,0 | | | | | | | | 1387 |
| PW.5.24 | 168 | 172,0 | 222,0 | 326,5 | | 160M4 | 11,0 | | | | | 60 | | | 1400 |
| | | | | 347,0 | | 160L4 | 15,0 | | | | | | | | 1447 |
| | | 175,0 | 225,0 | 395,5 | EZ7 | 180M4 | 18,5 | | 68.40.09.1 | | | | | | 1487 |

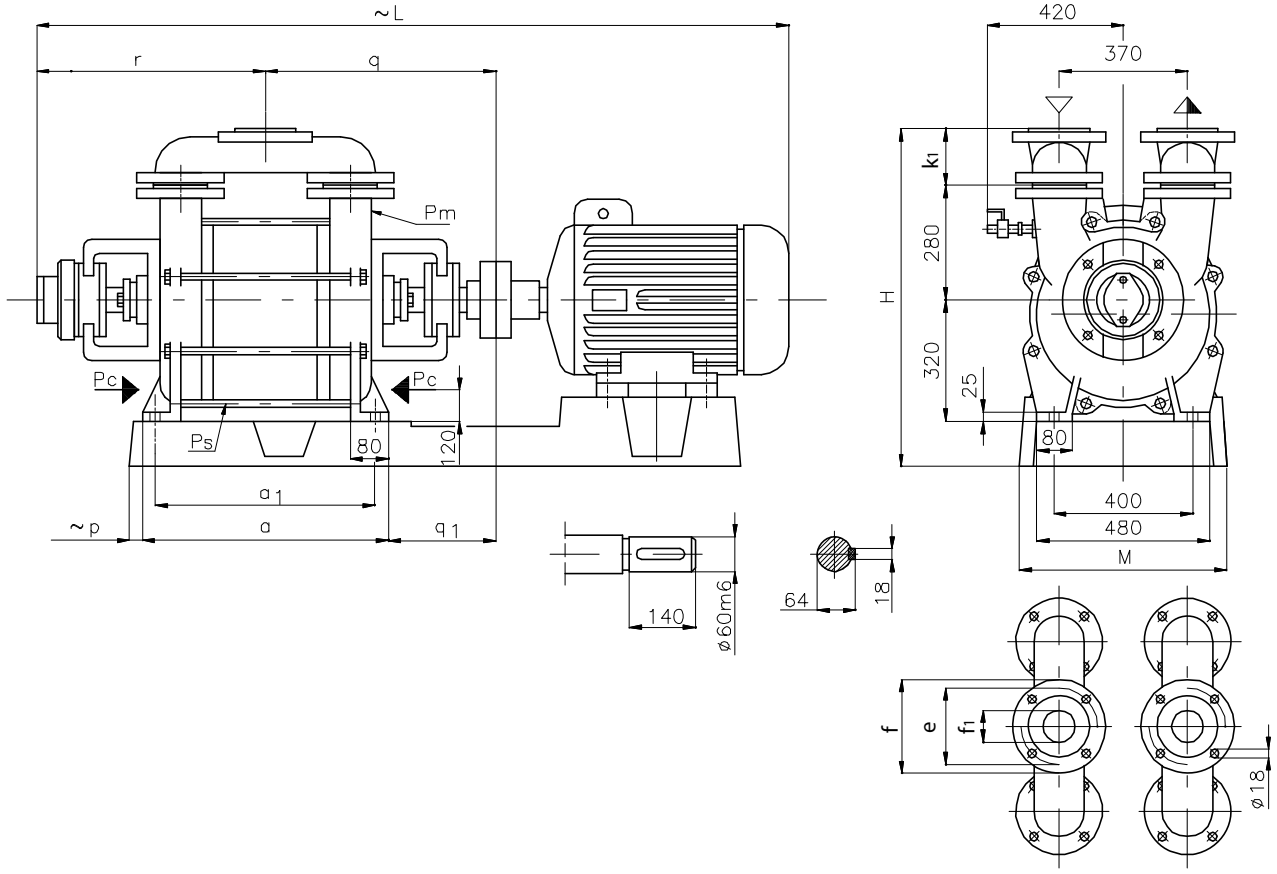
| Delivery completeness | 1 | 2 | 3 | 5 | | Motor | | Foundation plate | | Liquid container | Unit dimension | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pump mass | | | | | | | | | | | | | |
| type size of vacuum pump | with a free shaft end | with a coupling | with a coupling and plate | with a coupling motor and plate | coupling | mechanical size | Power | plate | block | closed standing | P | H | M | L |
| | kg | | | | type | | kW | part no. | | name | mm | | | |
| DW.5.12 | 119 | 130,5 | 175,5 | 280,5 | EZ3 | 160M4 | 11,0 | 60.77.01.1 | 68.40.08.1 | ZBP | 90 | 608 | 415 | 1190 |
| | | | | 300,5 | | 160L4 | 15,0 | | | | | | | 1237 |
| DW.5.13 | 126 | 137,5 | 182,5 | 307,0 | | 160L4 | 15,0 | | | | 50 | | | 1277 |
| | | 144,0 | 189,0 | 354,0 | EZ7 | 180M4 | 18,5 | | 68.40.09.1 | | | | | 1317 |
| | | | | 364,0 | | 180L4 | 22,0 | | | | | | | 1347 |
| DW.5.14 | 135 | 146,5 | 191,5 | 316,5 | EZ3 | 160L4 | 15,0 | | 68.40.08.1 | | 40 | | | 1317 |
| | | 153,0 | 198,0 | 363,0 | EZ7 | 180M4 | 18,5 | | 68.40.09.1 | | | | | 1357 |
| | | | | 373,0 | | 180L4 | 22,0 | | | | | | | 1387 |
| | | 163,0 | 208,0 | 523,0 | | 200L4 | 30,0 | | - | | | | 450 | 1522 |

Motors for pumps and blowers should be selected taking into account 15% power reserve

## Dimensions and the choice of units




**Dimensions of units and pumps PW.7.11-12 and blowers DW.7.11-12**




**Dimensions of units and pumps PW.7.13-14 and blowers DW.7.13-14**



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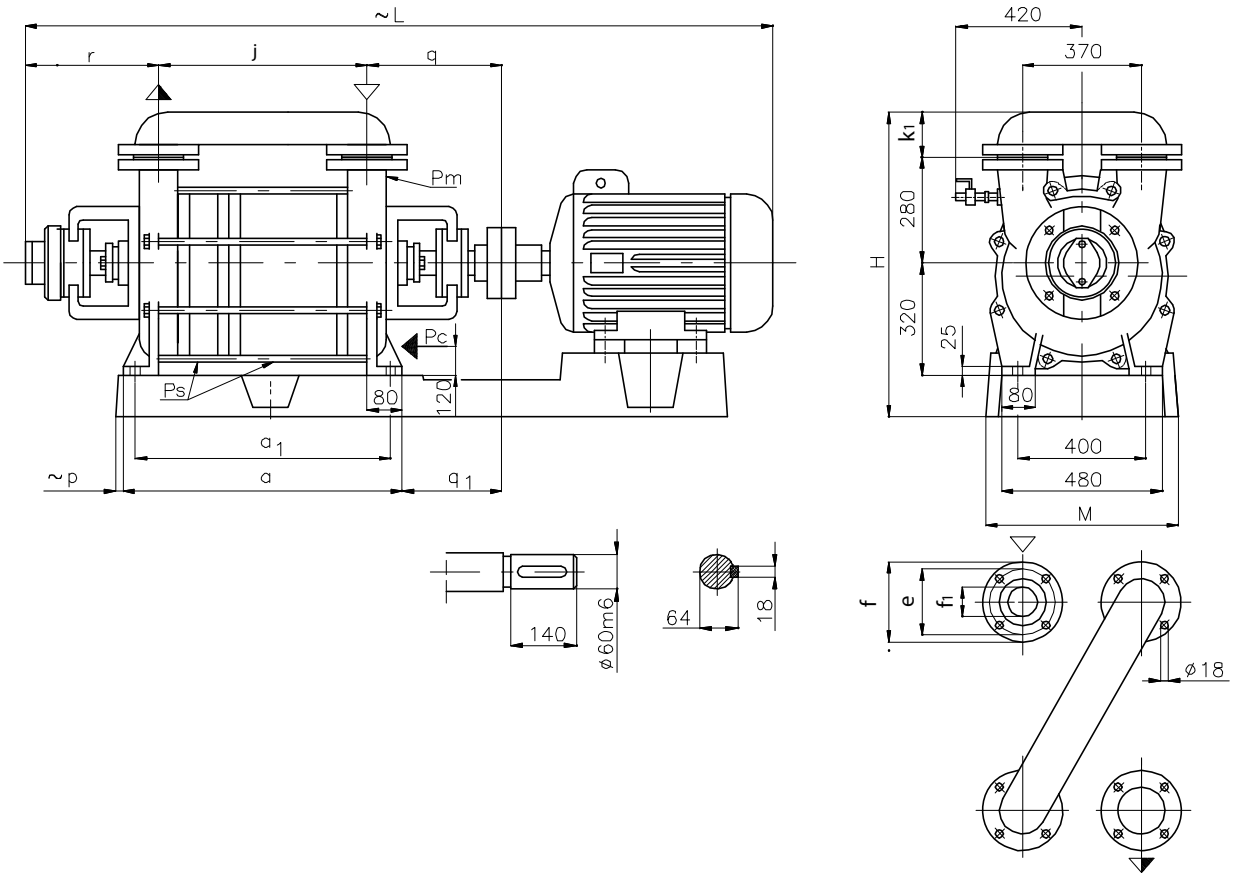
## Dimensions and the choice of units




## Wymiary zespołów oraz pomp PW.7.21-24

| Type dimension | constructional execution $e_1e_1$ | a | $a_1$ | e | f | $f_1$ | j | $k_1$ | q* | $q_1$ | r | $P_C$ | $P_m$ | $P_s$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PW.7.21 | 01 | 620 | 550 | 170 | 210 | 100 | 491 | 220 | 435 | 370 | 363 | R 1,5" | M14x1,5 | M14x1,5 |
| | 10 | | | | | | | | 352 | 287 | 280 | | | |
| PW.7.22 | 01 | 670 | 600 | | | | 541 | | 435 | 370 | 363 | | | |
| | 10 | | | | | | | | 352 | 287 | 280 | | | |
| PW.7.23 | 01 | 820 | 750 | | | | 691 | | 435 | 370 | 363 | | | |
| | 10 | | | | | | | | 352 | 287 | 280 | | | |
| PW.7.24 | 01 | 920 | 850 | | | | 791 | | 435 | 370 | 363 | | | |
| | 10 | | | | | | | | 352 | 287 | 280 | | | |
| PW.7.11 DW.7.11 | 01 | 425 | 355 | | | | - | - | 435 | 370 | 730 | | | |
| | 10 | | | | | | | | 352 | 287 | 647 | | | |
| PW.7.12 DW.7.12 | 01 | 475 | 405 | | | | | | 435 | 370 | 780 | | | |
| | 10 | | | | | | | | 352 | 287 | 697 | | | |
| PW.7.13 DW.7.13 | 01 | 620 | 550 | 200 | 235 | 125 | | 215 | 680 | 370 | 608 | | | |
| | 10 | | | | | | | | 597 | 287 | 525 | | | |
| PW.7.14 DW.7.14 | 01 | 720 | 650 | | | | | | 730 | 370 | 650 | | | |
| | 10 | | | | | | | | 647 | 287 | 575 | | | |

* Dimension „q" is given with reference to shaft frontal plane.
Flanges sizes according to PN-ISO7005-1:1996

Pc - working liquid connections
Pm - manometer connections
Ps - drain outlet

## Dimensions and the choice of units

| Delivery completeness | 1 | 2 | 3 | 5 | | Motor | | Foundation plate | | Liquid container** | | Unit dimension | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pump mass | | | | | | | | | | | | | | |
| type size of vacuum pump | with a free shaft end | with a coupling | with a coupling and plate | with a coupling motor and plate | coupling | mechanical size | Power | plate | block | to be set | open standing | P* | H | M | L* |
| | kg | | | | type | | kW | part no. | | name | | mm | | | |
| PW.7.11 | 320 | 332 | 542 | 777 | EZ7 | 200L6A | 18,5 | - | 68.40.11.1 | ZBN.8 | ZBP.7 | 215 | 735 | 640 | 1925 |
| PW.7.12 | 350 | 362 | 572 | 820 | | 200L6B | 22 | | 68.40.11.1 | | | 165 | | | 1975 |
| | | 366 | 576 | 886 | EZ9 | 225M6 | 30 | | 68.40.12.1 | | | | | 665 | 2060 |
| PW.7.13 | 530 | 546 | 756 | 1171 | | 250M6 | 37 | | 68.40.13.1 | | | 20 | 948 | 700 | 2210 |
| PW.7.14 | 570 | 590 | 815 | 1305 | EZ10 | 280S6 | 45 | 60.75.01.1 | - | | | 120 | | 750 | 2390 |
| | | | 800 | 1290 | | 280S6 | 45 | 60.74.01.1 | | | | 20 | | | |
| PW.7.21 | 500 | 516 | 741 | 1056 | EZ9 | 225M6 | 30 | 60.75.01.1 | 68.40.12.1 | - | | 70 | 903 | 640 | 2040 |
| | | | 726 | 1036 | | 225M6 | 30 | 60.74.01.1 | | | | | | | |
| PW.7.22 | 530 | 546 | 771 | 1081 | | 225M6 | 30 | 60.75.01.1 | | | | 20 | | 665 | 2185 |
| | | | 756 | 1066 | | 225M6 | 30 | 60.74.01.1 | | | | | | | |
| PW.7.23 | 600 | 616 | 916 | 1331 | | 250M6 | 37 | 60.76.01.1 | 68.40.13.1 | | | 120 | | 700 | 2410 |
| | | | 841 | 1256 | | 250M6 | 37 | 60.75.01.1 | | | | 20 | | | |
| PW.7.24 | 670 | 693 | 990 | 1480 | EZ10 | 280S6 | 45 | 60.76.01.1 | - | | | 120 | | 750 | 2590 |

| Delivery completeness | 1 | 2 | 3 | 5 | | Motor | | Foundation plate | | Liquid container ** | Unit dimension | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pump mass | | | | | | | | | | | | | |
| type size of vacuum pump | with a free shaft end | with a coupling | with a coupling and plate | with a coupling motor and plate | coupling | mechanical size | Power | plate | block | closed standing | P | H | M | L |
| | kg | | | | type | | kW | part no. | | nazwa | mm | | | |
| DW.7.11 | 320 | 332 | 558 | 792 | EZ7 | 200L6B | 22 | 60.74.01.1 | 68.40.11.1 | ZBP.7 | 215 | 735 | 640 | 1925 |
| | | 336 | 546 | 856 | EZ9 | 225M6 | 30 | | 68.40.12.1 | | | | 665 | 2010 |
| | | | | 961 | | 250M6 | 37 | | 68.40.13.1 | | | | 700 | 2085 |
| DW.7.12 | 350 | 366 | 576 | 886 | | 225M6 | 30 | | 68.40.12.1 | | 165 | | 665 | 2060 |
| | | | | 991 | | 250M6 | 37 | | 68.40.13.1 | | | | 700 | 2135 |
| | | 370 | 580 | 1070 | EZ10 | 280S6 | 45 | | - | | 20 | 948 | 750 | 2215 |
| DW.7.13 | 520 | 540 | 650 | 1000 | | 280S6 | 45 | | | | | | | 2290 |
| | | | | 1170 | | 280M6 | 55 | | | | | | | 2340 |
| | | 544 | 750 | 1350 | | 280M6Z | 75 | | | | | | | |
| | | | | 1380 | | 280M4 | 90 | | | | | | | 2290 |
| | | | | 1470 | | 280M4Z | 100 | | | | | | | 2390 |
| DW.7.14 | 570 | 590 | 815 | 1395 | | 280M6 | 55 | 60.75.01.1 | | | 120 | | | 2440 |
| | | | 800 | 1360 | | 280M6 | 55 | 60.74.01.1 | | | 20 | | | |
| | | 594 | 819 | 1519 | | 280M6Z | 75 | 60.75.01.1 | | | 120 | | | |
| | | | 804 | 1504 | | 280M6Z | 75 | 60.74.01.1 | | | 20 | | | |

* Dimension P is 87mm bigger, dimension L is 166mm smaller and mass is 20 kg lighter for units with vacuum pumps and blowers of constructional execution 1100.

** Motors for pumps and blowers should be selected taking into account 10% power reserve.



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## Protection and control devices of UZS type

**They are used to protect operation of three-phase asynchronous electric motors of pump units.**

Protection and control devices (Polish abbrev. - UZS) - are used to protect operation of three-phase asynchronous electric motors of pump units and switch them on/off directly.

## Application

This device protects against the results of:

- short circuit
- overload
- phase decay
- power supply asymmetry
- voltage drop
- "dry" operation
- excessive number of switching on
- exceeding the motor winding temperature
- moisture in the motor chamber
- electric shock - RCD relay

**Protection and control devices of UZS type**

## Cooperation with frequency converter

Electric motors that drive vacuum pumps and blowers could be fed by frequency converter and soft-start.
However the following recommendations should be taken into consideration:

- minimum frequency of operation – 30 Hz
- maximum frequency of operation – 60 Hz and the shaft rotational speed – 3000 rpm – can not be exceeded
- a bit bigger motor should be selected in order to have bigger power reserve and due to this fact, smaller thermal load
- frequency converter should be selected acc. to rated current value of el. motor
- frequency converter should be equipped with protection of motor against:
  - current overload,
  - excessive drop of voltage,
  - phase decay,
- feeding of frequency converter should fulfill all requirements of converter's producer especially regarding required section of cables and not exceeding required distance of converter from motor,
- it is recommended to use **ΔU/Δt** filters on the converter's outlet.

**CAUTION!**
Remember about dependence of operation parameters from rotational speed of compressor's shaft

$$Q_x = Q_n \times \frac{n_x^2}{n_n} \qquad P_x = P_n \times \left(\frac{n_x}{n_n}\right)^2$$

## Operation conditions

Protection and control devices (UZS) are adjusted to operate in temperate climate in the surrounding temperature -10°C - +40°C, relative humidity 80% at temperature 20°C, in surrounding free of water, dust, flammable or chemically active explosive gases and vapours. The place of device instalment should not be higher than 1000m above the sea level.

| Protection type | Max. motor power [kW] | Setting range of overload relay [A] |
|---|---|---|
| UZS.4 | 0,55 do 9,0 | 1,2 do 20,0 |
| UZS.5 | 2,2 do 185,0 | 1,2 do 400,0 |
| UZS 7 protection and controlling operation of 2 pumps units | 0,75 do 11,0 | 1,8 do 25,0 |
| UZS 8 protection and controlling operation of 2 or 3 pumps units | 0,75 do 11,0 | 1,8 do 25,0 |

Application of controller enables to switch on and off the motor of pumping unit, to carry out the start-up of the motor in the star-delta configuration, record the operation time and emergency state of motor operation. Usage of protection and control unit type UZS enables additionaly to remote control through connection with computer (output RS 232).

## Technical data and supplementary calculations helpful while selecting vacuum pumps

### 1. 1. Conversion table of pressure and vacuum units of measure.

1. Table

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vacuum | % | 0 | 25 | 50 | 60 | 70 | 80 | 85 | 90 | 92 | 95 | 96 | 100 |
| | mm Hg | 0 | 190 | 380 | 456 | 532 | 608 | 646 | 684 | 699 | 722 | 730 | 760 |
| | m $H_20$ | 0 | 2,58 | 5,16 | 6,20 | 7,23 | 8,26 | 8,78 | 9,30 | 9,50 | 9,81 | 9,92 | 10,33 |
| Absolute pressure $p_s$ | Torr | 760 | 570 | 380 | 304 | 228 | 152 | 114 | 76 | 61 | 38 | 30 | 0 |
| | $\frac{kp}{cm^2}$ | 1,033 | 0,775 | 0,516 | 0,413 | 0,310 | 0,207 | 0,155 | 0,103 | 0,083 | 0,0516 | 0,0413 | 0 |
| | mbar | 1013 | 760 | 506,6 | 405,3 | 304 | 202,7 | 152 | 101,3 | 81,1 | 50,7 | 40,5 | 0 |
| | hPa | 1013 | 760 | 506,6 | 405,3 | 304 | 202,7 | 152 | 101,3 | 81,1 | 50,7 | 40,5 | 0 |

Atmospheric pressure equals 1013 [hPa] measured at sea level at temperature of 20 [°C].

### 2. 2. Table of pressure units conversing from metrical system into English/American one.

2. Table

| | $kp/cm^2$ | m $H_20$ | 1Torr | lb/sq * ft | lb/sq * in | in * of merc |
|---|---|---|---|---|---|---|
| $1kp/cm^3$ (atm) | 1 | 10 | 735,7 | 2048 | 14,225 | 28,965 |
| 1m $H_20$ | 0,1 | 1 | 73,57 | 204,8 | 1,4225 | 2,8965 |
| 1Torr | $1,3595 * 10^{-3}$ | $1,3595 * 10^{-2}$ | 1 | 2,7837 | 0,0193 | 0,03937 |
| 1lb/sq * ft | $4,883 * 10^{-4}$ | $4,883 * 10^{-3}$ | 0,3590 | 1 | $6,944 * 10^{-3}$ | 0,01414 |
| 1lb/sq * in | 0,07031 | 0,07031 | 51,813 | 144 | 1 | 2,03988 |
| 1in * of merc | 0,03452 | 0,03452 | 25,4 | 70,7214 | 0,49022 | 1 |

Calculation of the vacuum pump capacity .

$$Qr = Q \frac{pb}{p_s} * \frac{1}{kv} [\frac{m^3}{h}] \qquad [1]$$

pb - atmospheric pressure 1013 [hPa]
ps - absolute pressure in the suction stub [hPa]
Q - required volume of gas flow of atmospheric pressure
Qr - required volume of rarefied gas flow to the absolute pressure - required pressure
kv - coefficient correcting the vacuum pump capacity

If the temperature measured on the pump outlet is different from 15°C, you should read kv value from the chart presented in page 52.



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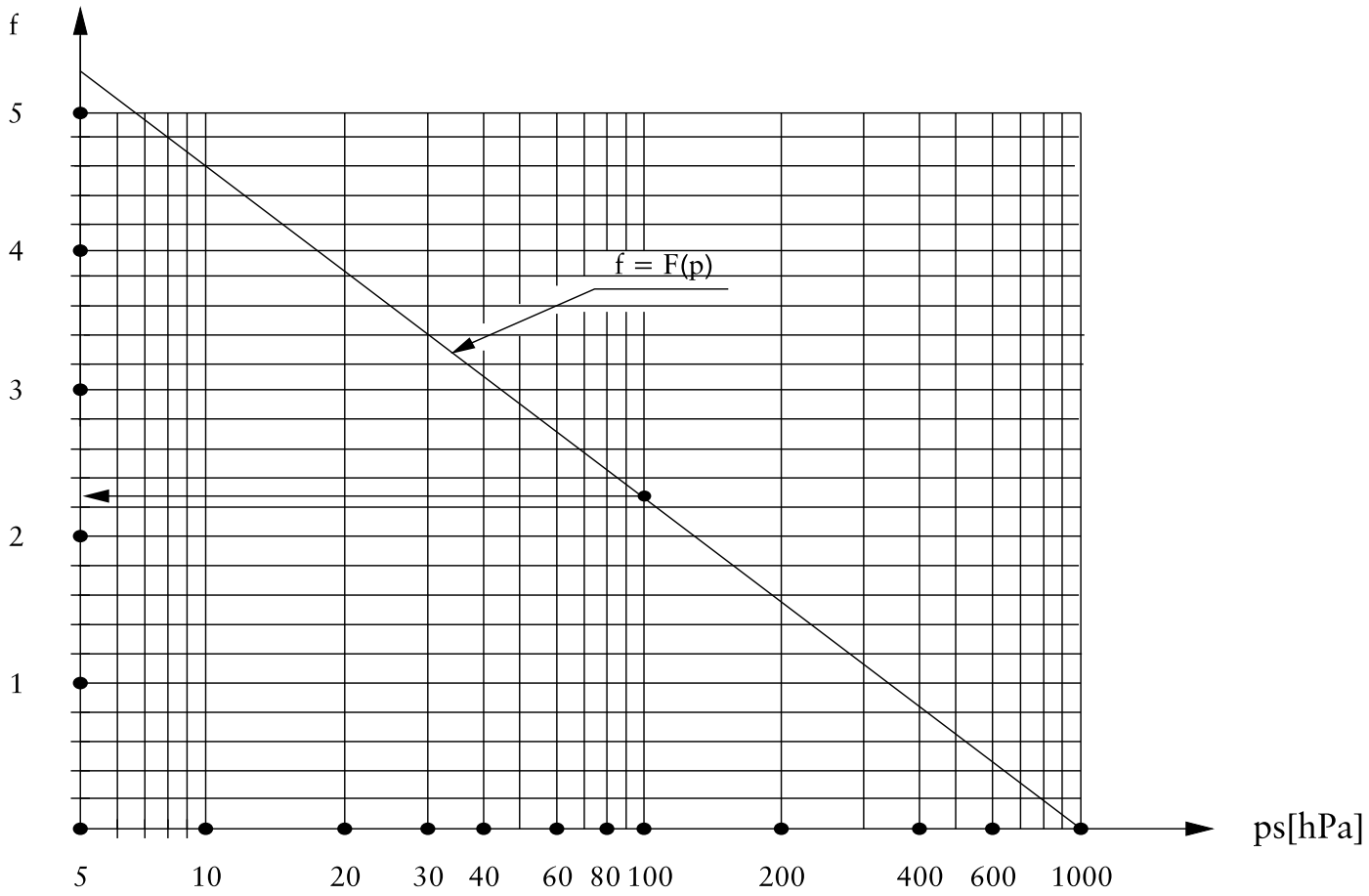
**3. Calculation of the vacuum pump capacity for the set capacity of the closed container and time of emptying.**

$$Qr = \frac{V}{t} * 60 * \ln * \frac{pb}{p_s} \quad [\frac{m^3}{h}] \qquad [2]$$

V - capacity of the whole vacuum system at the suction side of the pump (of container and lines) [m3]
t - required pumping time [min.]
ln - required final pressure in the container [hPa]
ps - absolute pressure in the suction stub [hPa]
pb - catmospheric pressure 1013 hPa

$$Qr = \frac{V}{t} * 60 * f \qquad f = \ln \frac{pb}{p_s} \qquad [3]$$

Chart 1.



## Technical data and supplementary calculations helpful while selecting vacuum pumps

Example 1.

Calculate required capacity of the pump Qr and select the appropriate one for operation with an autoclave, out of which air must be pumped till you gain absolute pressure p=100 [hPa] in time t = 15 [min.]. The capacity of free closed air area equals V = 16 [$m^3$]

so: $$Qr = \frac{V}{t} * 60 * f \quad [\frac{m^3}{h}]$$

from the chart 1 we read f = 2,3 for p=100 [hPa]

$$Qr = \frac{16}{15} * 60 * 2,3 = 147,2 \quad [\frac{m^3}{h}]$$

I select the vacuum pump PW.4.23 as the closest to this capacity and which will pump with capacity Qr = 160 [$m^3$] of the rarefied air at the pressure 100 [hPa].

Example 2.

Calculate during gas pumping and while knowing the following data:
- pump capacity $Q_R$ [$m^3/h$]
- container capacity V- [$m^3$]
- final absolute pressure p [hPa]

After transforming the equation [3] we obtain:

$$t = \frac{V}{Qr} * 60 * f \quad [min.]$$

Example 3.

Calculate required capacity of the container while knowing the following data:
- pump capacity - Qr [$m^3$]
- set pumping time - t [min.]
- set absolute final pressure - p [hPa]

After transforming the equation [3] we obtain:

$$V = \frac{Qr * t}{60 * f} * 60 * f \quad [m^3]$$



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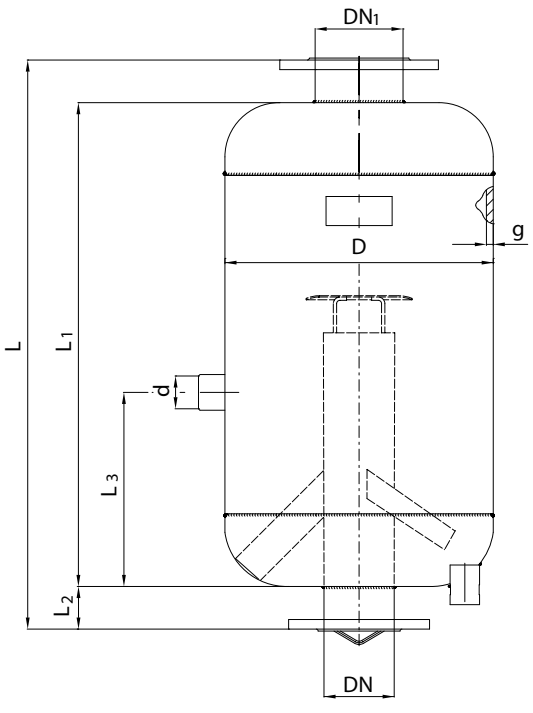
| Typa ol conta-iner | ZBP - dimensions | | | | | | | | ZBP - dimensions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dz | DN | $DN_1$ | $DN_2$ | H | $H_Z$ | $h_2$ | $h_1$ | $l_1$ | $l_2$ | $l_3$ | $l_4$ | $l_5$ | $l_6$ | b | $d_1$ | g |
| ZBP.1 | 276 | 40 | 50 | 15 | 870 | 740 | 180 | 110 | 110 | 240 | 200 | 230 | 200 | 200 | 100 | G1/2 | 2,5 |
| ZBP.4 | 310 | 50 | 80 | 25 | 1026 | 897 | 190 | 65 | 130 | 340 | 200 | 310 | 215 | 215 | 105 | G1 | 2,5 |
| ZBP.7 | 550 | 125 | 150 | 50 | 1145 | 940 | 317 | 130 | 200 | 535 | 400 | 175 | 350 | 350 | 200 | G1 1/2 | 2,5 |

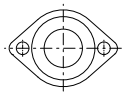
| Typa ol conta-iner | Typa of pump | constructional execution | ZBN - dimensions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | DN | $DN_1$ | D | L | $L_1$ | $L_2$ | $L_3$ | d | g |
| ZBN.1 | PW.1 | 10 | 32 | 40 | 150 | 360 | 240 | 65 | 85 | 28 | 2 |
| ZBN.3 | PW.4.11-12 i PW.4.21-24 | 11 | 40 | 50 | 204 | 580 | 460 | 65 | 160 | 28 | 2 |
| | PW.4.13-14 | 12 | 50 | 50 | 204 | 580 | 460 | 65 | 160 | 28 | 2 |
| ZBN.8 | PW.7.11-12 i PW.7.21-24 | 15 | 100 | 125 | 406 | 980 | 840 | 95 | 280 | 54 | 2 |
| | PW.7.13-14 | 16 | 125 | 125 | 406 | 980 | 840 | 95 | 280 | 54 | 2 |

| Symbol | Application | DN/d |
|---|---|---|
| K1 | water air inlet | DN |
| K2 | air inlet | $DN_1$ |
| K3 | water for blower | $d_1$ |
| K4 | water llow | $DN_2$ |
| K5 | outlet | G |
| K6 | water Indicator | G |
| K7 | air release | M14*1,5 |
| K8 | manometer | M14*1,0 |




ZBN to be set

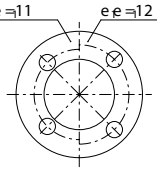
Flange ZBN.1



Flanges ZBN.3

constructional execution e.e =11

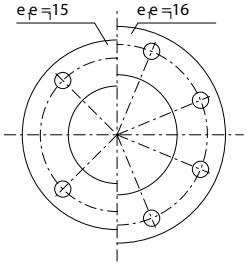
constructional execution e.e =12

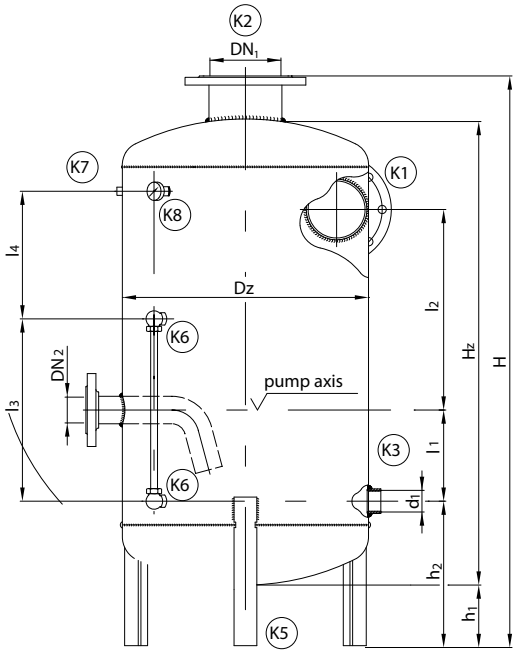


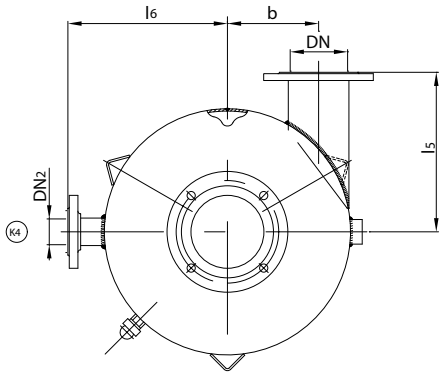
Flanges ZBN.8

constructional execution e.e =15

constructional execution e.e =16






ZBP freely standing

## How to install

The whole compression device consists of:
- compression unit
- pipelines
- valves and equipment

Suction and discharge lines must be precisely made and set in order to avoid forces and moments having an influence on compressor flanges. This condition is fulfilled if there are prepared appropriate compensatory thermal extensions or bellows for lines. Remove any rust and dirt after welding out of pipelines before assembly. No foreign body can enter the compressor as it can damage the rotating system. Arrows placed on suction and discharge bodies indicate the direction of gas flow throughout the compressor. Pipeline holes on the side of suction, discharge and liquid water supply cannot be smaller than connection holes. Washers cannot conceal pipe holes. Discharge line can be led vertically not higher than one metre away from the compressor stub. Keep as small unit hydraulic losses in pipelines as possible. Device is installed in one of three ways depending on the type of operation:

- Install non-return valve on the suction line; on the discharge line for vacuum pumpsand for blowers in order to prevent the working liquid from flowing into installation.

**I type of operation**

- open system, compressor directly supplied with fresh water as a working liquid. This kind of operation is used when the water consumption is of no importance. If there are pressure fluctuations of water supplied above 25%, the vacuum pump should independently take in water from container, to which the flow of fresh water from waterworks is regulated by means of valve controlled with a float or overflow hole in the container. The level of water in the container should be kept at the level of pump shaft. If it is not necessary to separate water piped away and gas on the discharge side during the vacuum pump operation, you can resign from the container of working water "separator". Discharge line should be led to the sewage system.

**II type of operation**

- with working liquid in a closed (circulation) system. This kind of operation is recommended for pumping gases which are caustic and harmful for environment. The booster pump should be taken into account if there is too big resistance during flow through the heat exchanger "w" in circulation pipelines "h". One can resign from the heat exchanger for intermittent running, when the pump works only for a few minutes and there is enough time before the next switching on in order to have the temperature of circulation liquid lowered to the set value.

**III type of operation**

- with working liquid supplied in a combined system. This kind of operation is recommended for typical exploitation conditions. The volume of fresh liquid is smaller than in the first type of operation. You can use separator set on the pump discharge stub in order to have the compact construction of the whole device. This refers to the first and third type of operation.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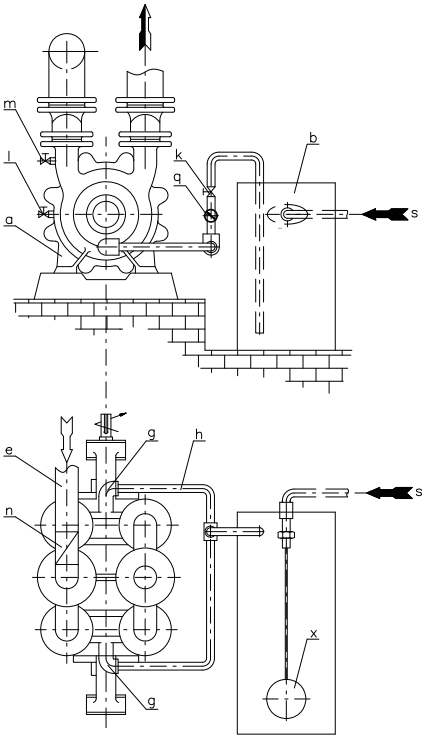
## Examples of installation

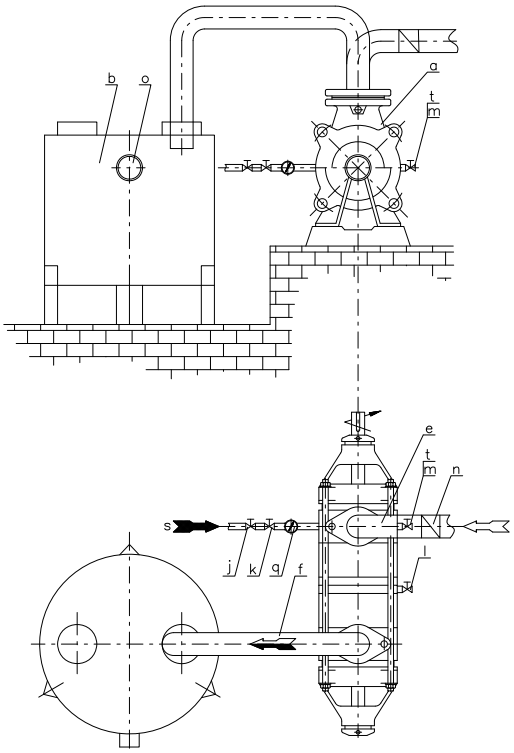
I type of operation PW / DW.04




Installation scheme of vacuum pump
PW.4.11-14, PW.5.12-14, PW.7.11-14.

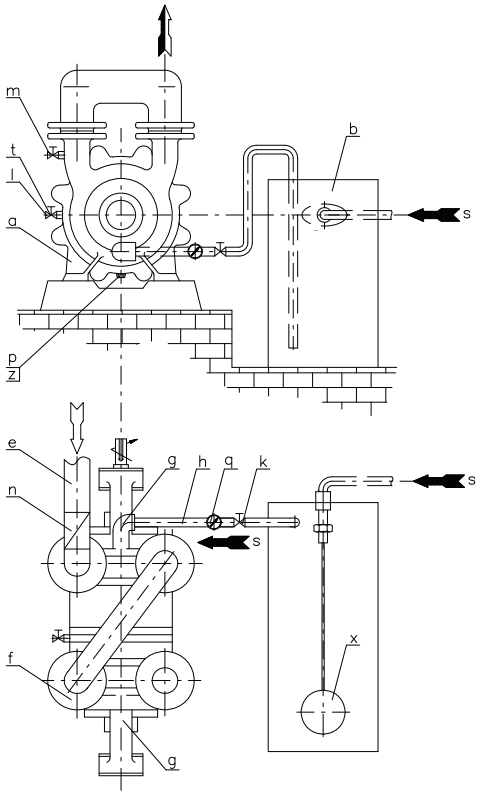
Suction pipeline of working liquid "h" and connection "g" are installed only from the coupling side in vacuum pumps PW.4.11-12, PW.7.11-12.

I type of operation PW / DW.03




Installation scheme of vacuum pump PW.l.

I type of operation PW / DW.05



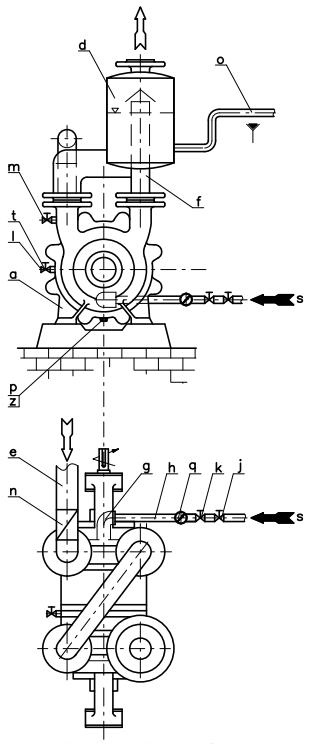

Installation scheme of vacuum pump
PW.4.21-24, PW.5.21-24, PW.7.21-24.

**Symbol explanations**

| | |
|---|---|
| a | vacuum pump |
| c | free standing tank |
| d | attached tank |
| e | suction pipeline |
| f | discharge pipeline |
| g | working liquid connection |
| h | working liquid suction pipeline |
| k | control valve |
| j | cut-off valve |
| l | ventilation valve |
| m | start up valve |
| n | check vavle |
| o | overflow valve |
| p | drain hole |
| q | flowmeter |
| s | fresh working liquid feeding in |
| t | control valve |
| u | working liquid level gauge |
| w | heat exchanger |
| z | stopper |

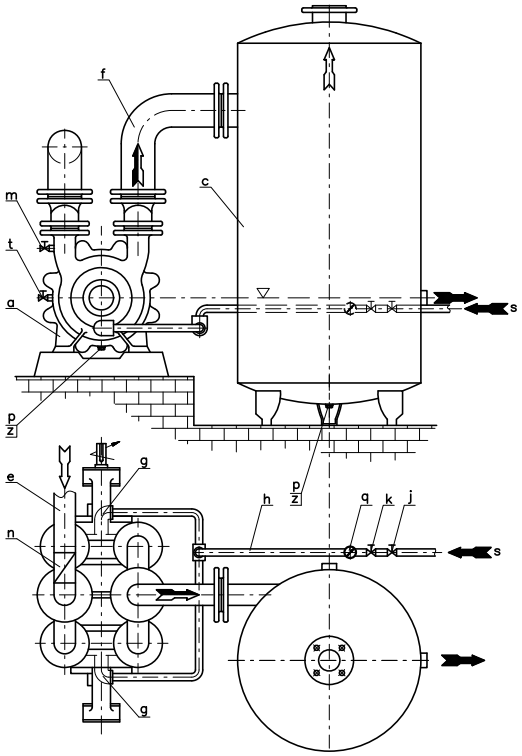
## Examples of installation

I type of operation PW / DW.06




Installation scheme of vacuum pump
PW.4.21-24, PW.5.21-24, PW.7.21-24.

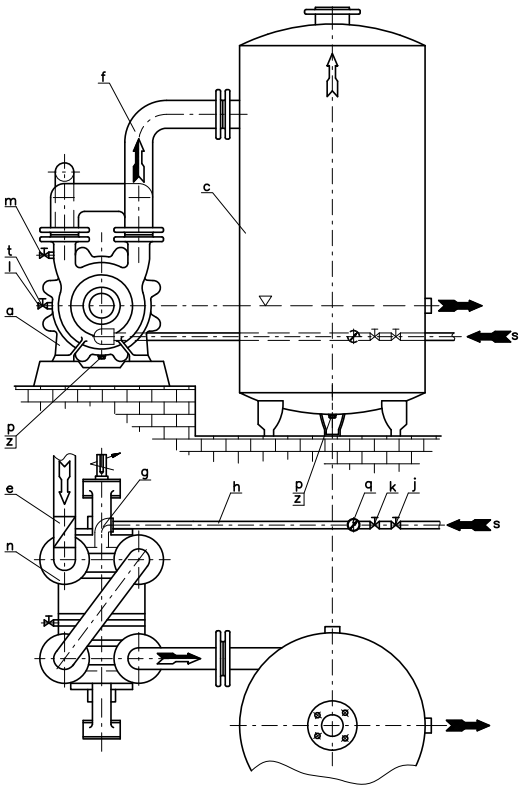
I type of operation PW / DW.07




Installation scheme of vacuum pump
PW.4.11-14, PW.5.12-14, PW.7.11-14.

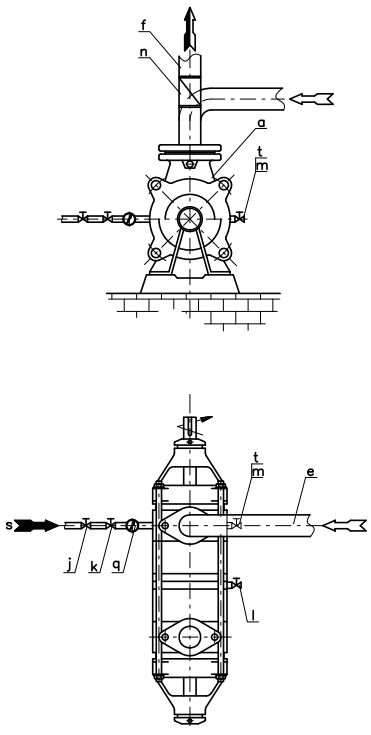
Suction pipeline of working liquid "h" and connection "g" are installed only from the coupling side in vacuum pumps PW.4.11-12, PW.7.11-12.

I type of operation PW / DW.08




Installation scheme of vacuum pump
PW.4.21-24, PW.5.21-24, PW.7.21-24.

I type of operation PW / DW.09




Installation scheme of vacuum pump DW.1



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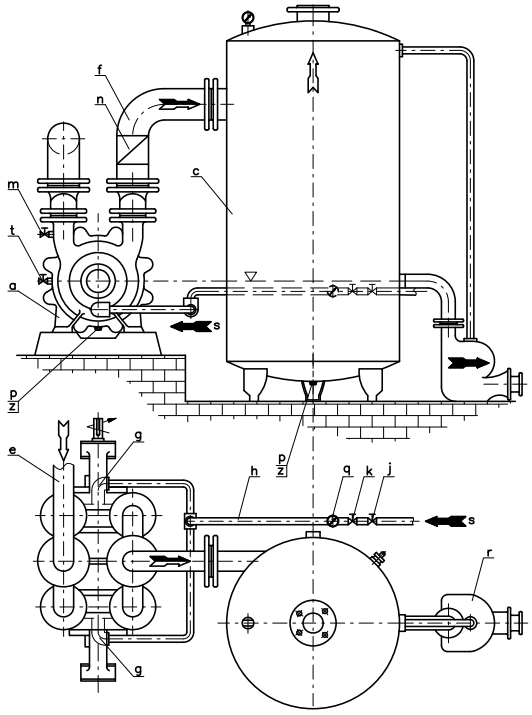
## Examples of installation

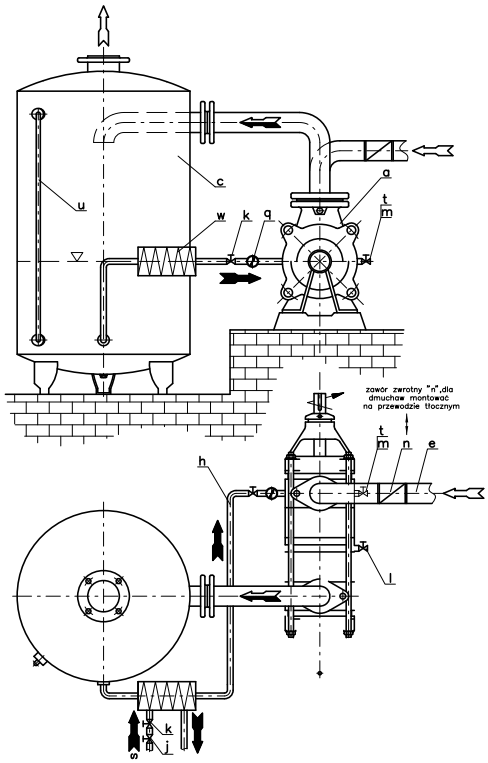
I type of operation PW / DW.10



Installation scheme of blower
DW.4.11-14, DW.5.12-14, DW.7.11-14.

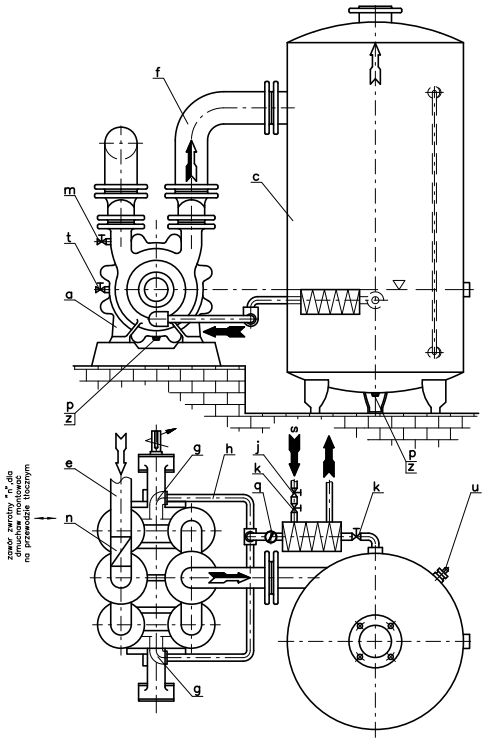
Suction pipeline of working liquid “h” and connection “g” are installed only from the coupling side in blowers DW.4.11-12, DW.7.11-12.

II type of operation PW / DW.11




Installation scheme of blower DW.1
or vacuum pump PW.1

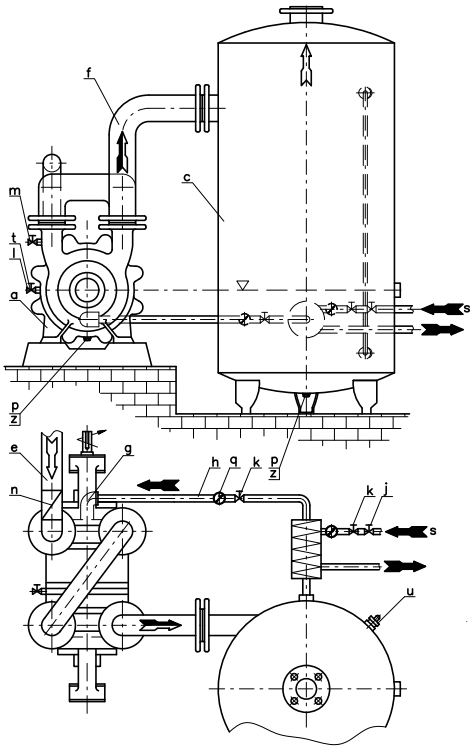
II type of operation PW / DW.12




Installation scheme of vacuum pump PW.4.11-14, PW.5.12-14, PW.7.11-14,
or blowers DW.4.11-14, DW.5.12-14, DW.7.11-14

Suction pipeline of working liquid “h” and connection “g” are installed only from the coupling side in vacuum pumps PW.4.11-12, DW.7.11-12 or blowers DW.4.11-12, DW.7.11-12.

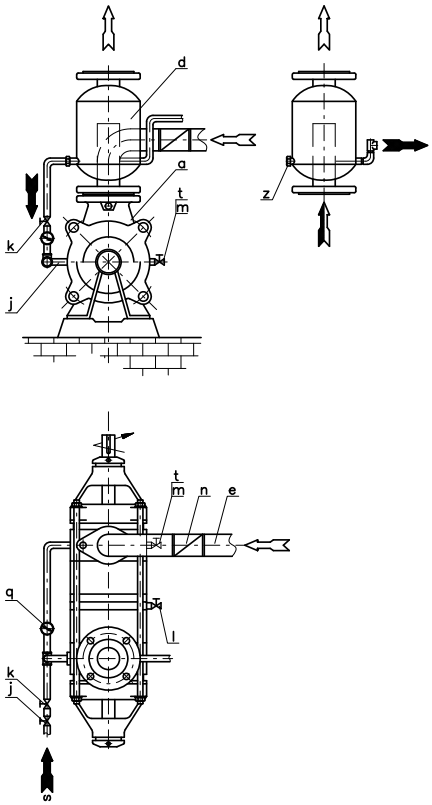
II type of operation PW / DW.13



Installation scheme of vacuum pump
PW.4.21-24, PW.5.21-24, PW.7.21-24

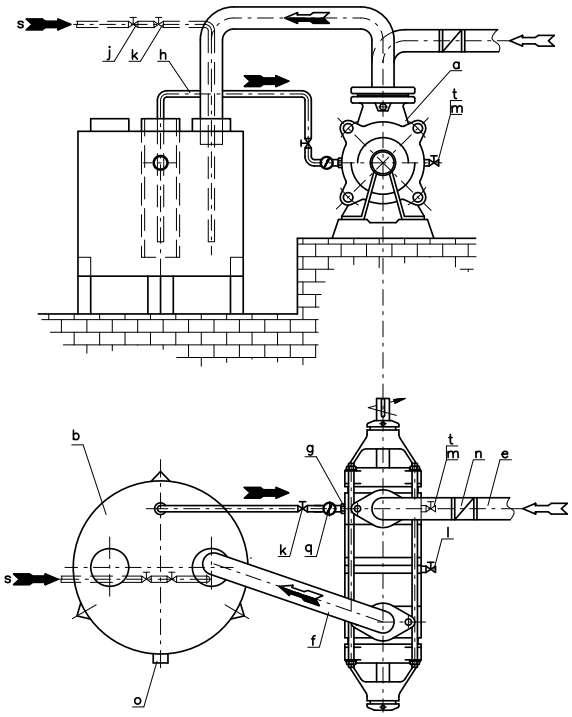
## Examples of installation

III type of operation PW / DW.14



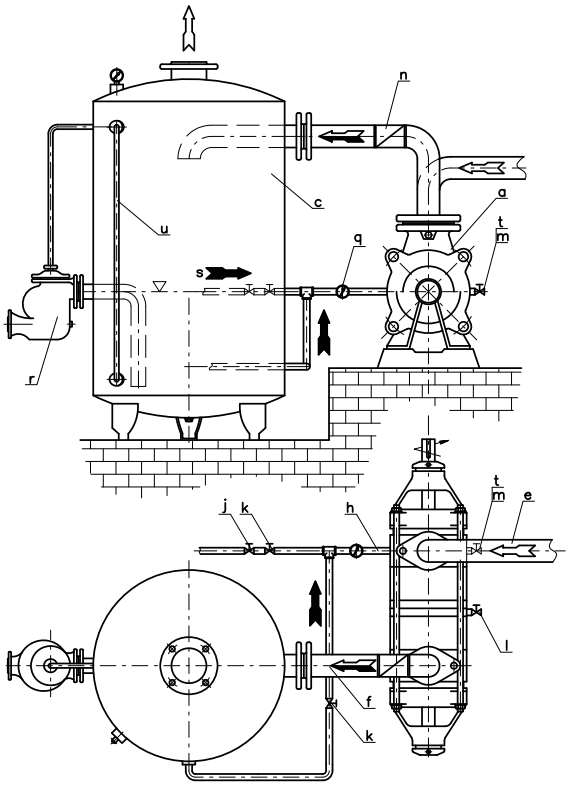

Installation scheme of vacuum pump PW.1

III type of operation PW / DW.15



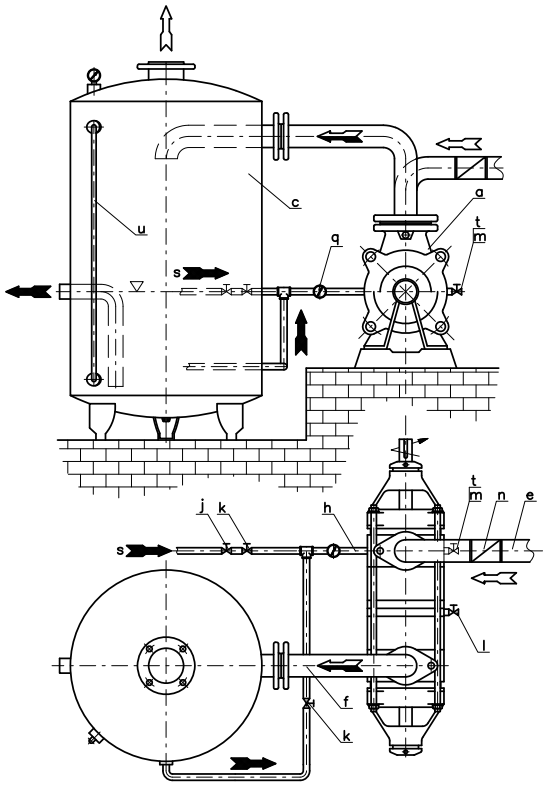

Installation scheme of vacuum pump PW.1

III type of operation PW / DW.16




Installation scheme of blower DW.1

III type of operation PW / DW.17




Installation scheme of vacuum pump PW.1



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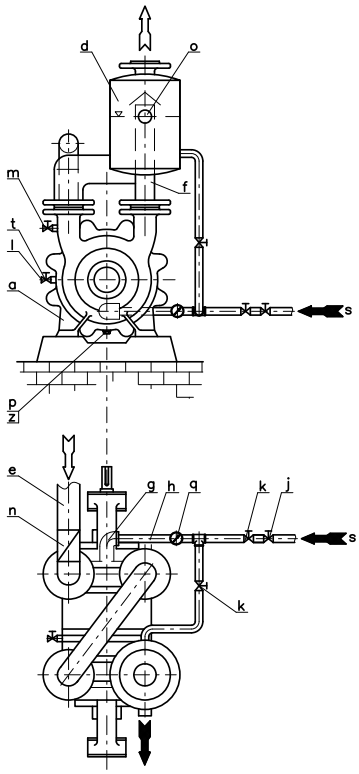
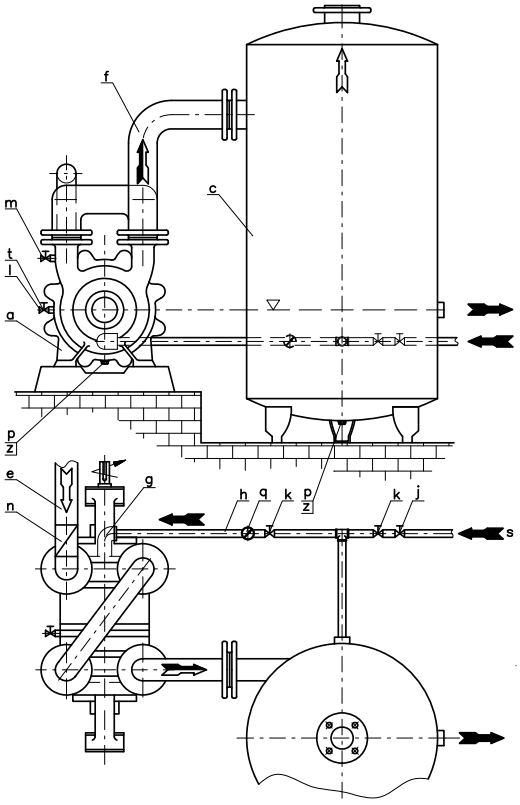
## Examples of installation

III type of operation PW / DW.18



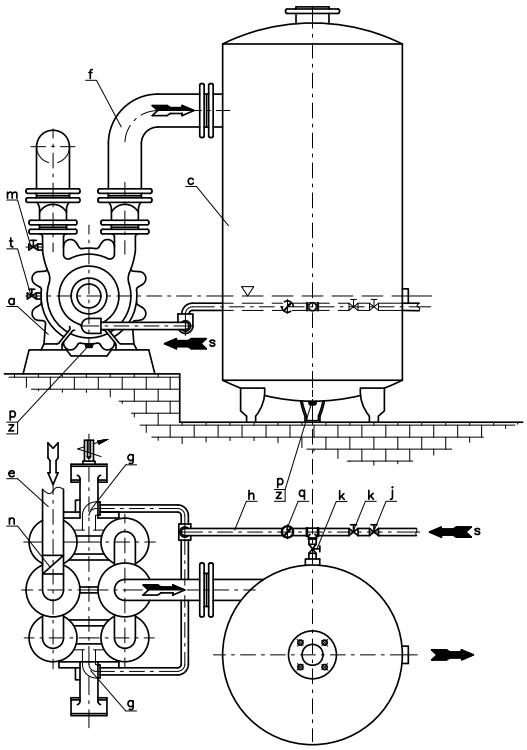

Installation scheme of vacuum pump
PW.4.21-24, PW.5.21-24, PW.7.21-24.

III type of operation PW / DW.19




Installation scheme of vacuum pump
PW.4.21-24, PW.5.21-24, PW.7.21-24.

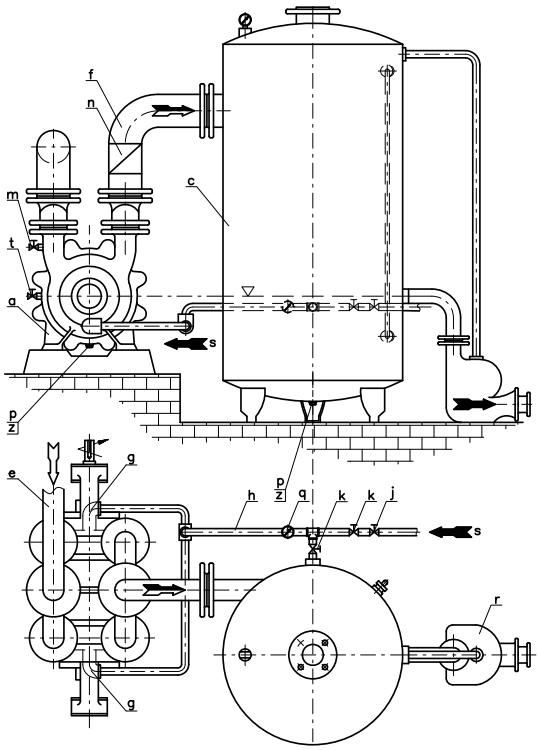
III type of operation PW / DW.19a




Installation scheme of vacuum pump PW.4.11-14, PW.5.12-14, PW.7.11-14,

Suction pipeline of working liquid “h” and connection “g” are installed only from the coupling side in vacuum pumps PW.4.11-12, PW.7.11-12.

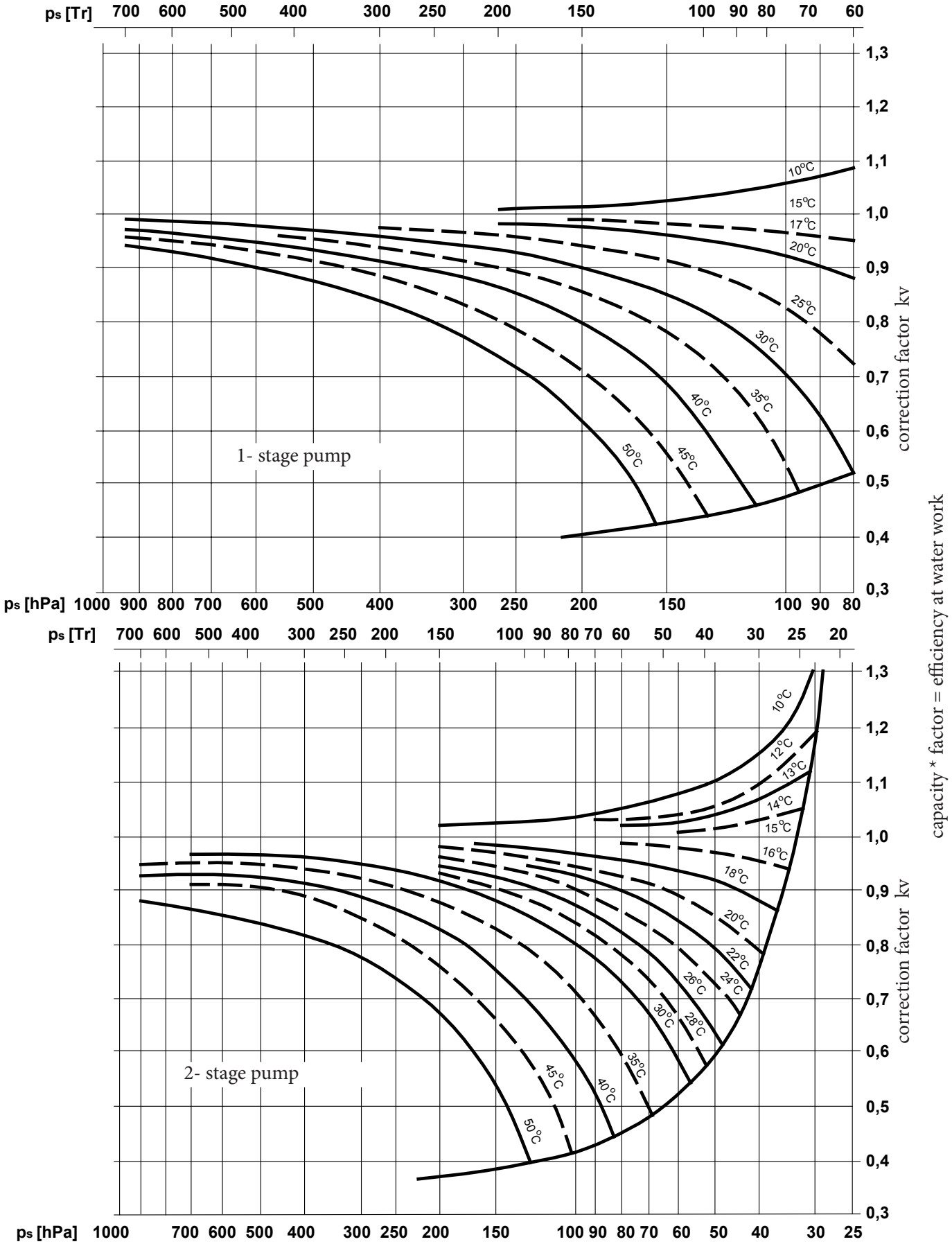
III type of operation PW / DW.20




Installation scheme of blower DW.4.11-14, DW.5.12-14, DW.7.11-14,

suction pipeline of working liquid “h” and connection “g” are installed only from the coupling side in blowers DW.4.11-14, DW.7.11-14.

## The influence of working water temperature on the suction pressure and vacuum pump capacity



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