

Comet Guide

DIAPHRAGM PUMPS

OPERATION AND WORKING PRINCIPLES





SINCE
1959

Established in Reggio Emilia, in the heart of the Italian *pump Valley*, in 1959, **over a period of 60 years**, Comet has managed to skilfully integrate **experience and innovation**. A unique combination which has made the company a major representative of the Italian manufacturing industry.

more than
 **130**
Countries

The **outstanding quality** of our products has made Comet a premium brand known and respected in over **130 countries of the world**.

 **+750**
World **employees**

Our group consists of **people** who share a **single goal**: to produce **added value** for our customers.

made in
 **Italy**

Today, Comet is **world leader in the spraying and weeding sector** and contributes to Italian excellence worldwide. All the pumps of the Agriculture division are proudly **Made in Italy**.

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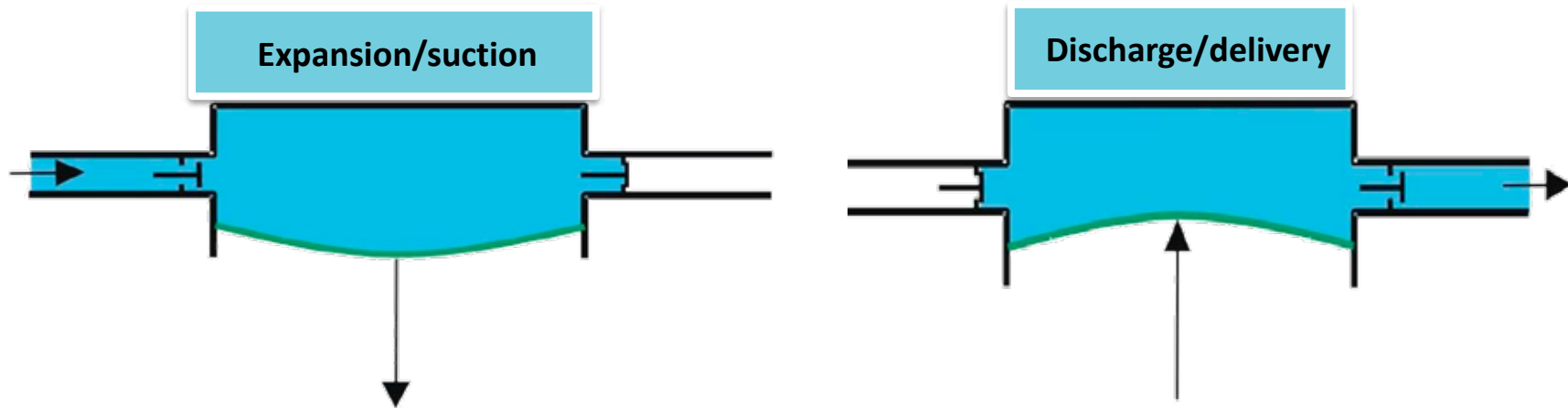
01 - WHAT IS A DIAPHRAGM PUMP: DEFINITION AND PRINCIPLES

Diaphragm pumps are positive displacement pumps which use contracting and expanding cavities to generate pressure imbalances between the pumping chamber and the adjacent spaces.

By trying to compensate such imbalances, the fluid moves naturally **from the area with a higher pressure to the area with a lower pressure, resulting in a pumping action.**

During the **expansion** stroke there is a loss of pressure inside the chamber, producing suction, and the fluid enters into the chamber (this phase is known as **suction** or expansion).

During the **discharge** stroke, there is an increase of pressure and the fluid exits from the chamber (**delivery** or discharge phase).



In diaphragm pumps, expansion and contraction are generated by alternative oscillation of an elastic element called, in fact, diaphragm.

A typical example of a diaphragm pump is the liquid soap dispenser.

The combination of the two strokes of suction and delivery creates a complete pumping cycle.

Given that the pumping chamber has a maximum defined and invariable volume, the pumped volume of every cycle is always constant, regardless of pressure.

$$V = k$$

For this reason, positive displacement pumps are known as **volumetric pumps or constant flow pumps**.

To modify the flow rate it is necessary to change the number of cycles, namely pump speed (RPM)

FLOW RATE (or volume) is directly proportional to SPEED.

On the contrary, pressure changes do not affect the pumped volume.

BPS 260

RPM	0 bar - 0 p.s.i.				5 bar - 72 p.s.i.				10 bar - 145 p.s.i.				15 bar - 217 p.s.i.				20 bar - 290 p.s.i.				kg	lb
	l/min	U.S.g.p.m.	HP	KW	l/min	U.S.g.p.m.	HP	KW	l/min	U.S.g.p.m.	HP	KW	l/min	U.S.g.p.m.	HP	KW	l/min	U.S.g.p.m.	HP	KW		
400	187	49,4	1,3	0,9	185	48,9	2,8	2,1	185	48,9	5,0	3,7	183	48,4	7,2	5,3	181	47,9	9,1	6,7	44,0	97,0
450	208	55,0	1,5	1,1	206	54,5	3,4	2,5	206	54,5	5,8	4,2	206	54,5	8,2	6,1	204	53,9	10,4	7,6		
500	229	60,5	1,6	1,2	229	60,5	4,0	2,9	227	59,9	6,4	4,7	224	59,2	9,1	6,7	224	59,2	11,4	8,4		
550	249	65,9	1,9	1,4	249	65,9	4,6	3,4	249	65,9	7,2	5,3	247	65,2	10,0	7,0	247	65,2	12,9	9,5		

The performance chart of Comet pump BPS 260 confirms that the **pumped volume is constant at a given speed (550 RPM) * (~248 lt/min)** regardless of pressure changes, while **it varies with speed changes (RPM column).**

* Marginal volume reductions are due to efficiency losses typical of any mechanical equipment

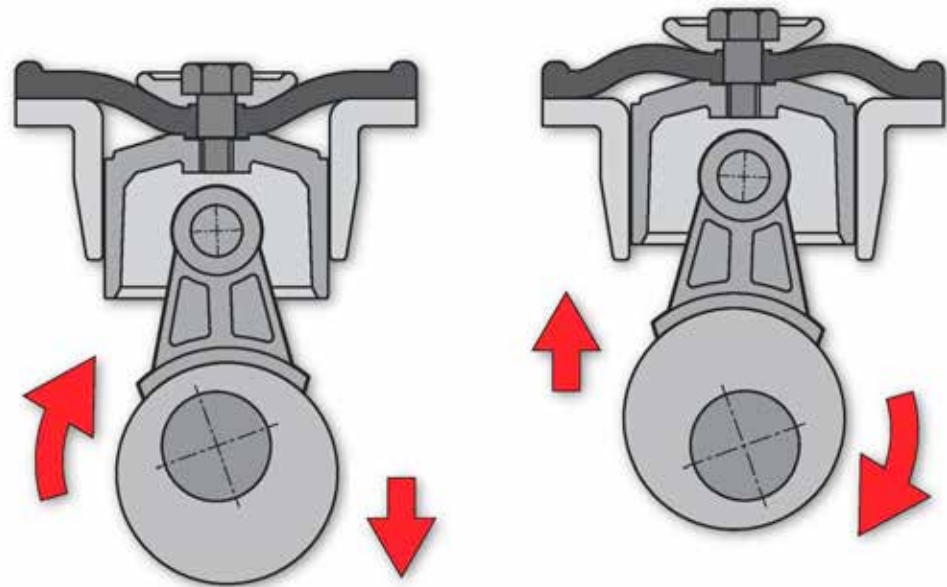
The **achievable pressure** of a positive displacement pump **has no theoretical limits**, as it is only limited by the structural resistance of its components and by its constructive engineering.

Thanks to the **oscillatory movement of the diaphragm** (up and down), this kind of pump is known as an **alternative pump**, same as piston pumps, to distinguish them from rotational pumps, characterized by rotating elements.

Alternative pumps are always **actuated by an external power source** (electric motor, hydraulic or endothermic) that provides the movement via a rotational crankshaft connected to the motor.

A transmission system, as we'll see later in detail, converts the rotary movement of the crankshaft (curved arrows) into an **oscillatory movement** of the diaphragm (straight arrows).

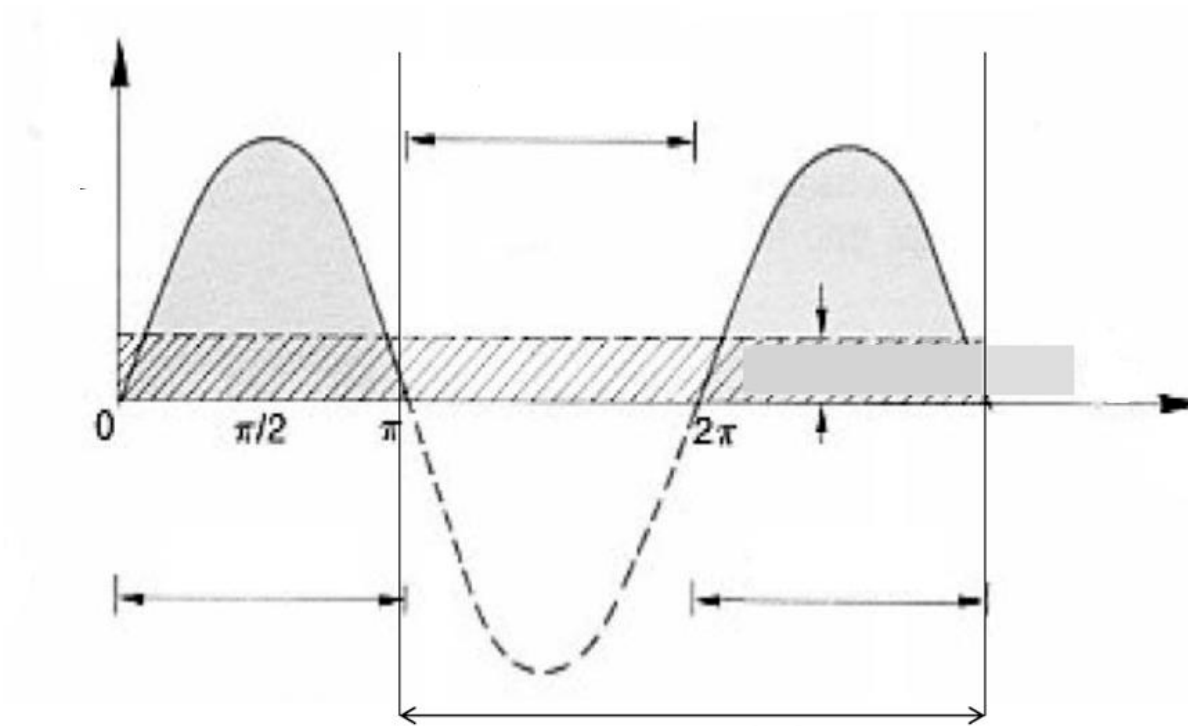
This means that a **complete rotational cycle of the crankshaft coincides with a complete cycle of suction and delivery**.



1 rotational cycle = 1 suction + 1 delivery

The diaphragm pump is part of the **single-acting** alternative pump family, as the delivery phase, that is the pumping of the fluid outside the chamber, only occurs once per cycle, or **every two strokes of the diaphragm**.

On the contrary, when there is a delivery phase for every stroke, the pump is defined as double-acting.



Summary chart:

- 1) The pumped volume is constant for every cycle (grey areas are equal): concept of **volumetric pump**.
- 2) A complete pumping cycle consists of two strokes, suction and delivery: **concept of alternative pump**.
- 3) The positive displacement (delivery out of the pump) is generated during the second stroke only (delivery = grey zone). Concept of **single-acting pump**.
- 4) **One rotational cycle** of the crankshaft coincides with a **complete pumping cycle** (suction + delivery).

The volume displaced in a pumping chamber during a complete cycle is called **displacement** and is obtained by **multiplying the diaphragm stroke for its area**.

The stroke is the distance between the standstills of the diaphragm:

- lower standstill of the suction phase
- upper standstill of the delivery phase

C = stroke

D = diameter

$$V = \pi \cdot (D/2)^2 \cdot C$$

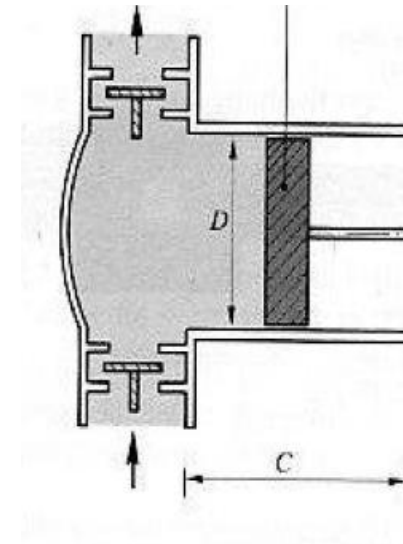
Normally, pumps are equipped with more than one diaphragm, so to obtain the total displacement of a pump, it is enough to multiply the single displacement by the number of diaphragms.

i = number of diaphragms

$$V_{tot} = V \cdot i$$

Lastly, to know the flow rate of a pump in l/min or GPM, it is sufficient to multiply the resulting value by the crankshaft revolutions per minute (RPM).

$$V/min = V_{tot} \cdot RPM$$



02 - COMPOSITION AND FUNCTIONING

Diaphragm pumps **convert the mechanical energy of a motor into dynamic pressure of the pumped fluid.**

Therefore, they are composed of two basic parts:

- **transmission:** elements which transfer the mechanical energy from the motor to the pump.
- **pumping unit:** elements which transform the mechanical energy into fluid pressure.

2.1 - Transmission

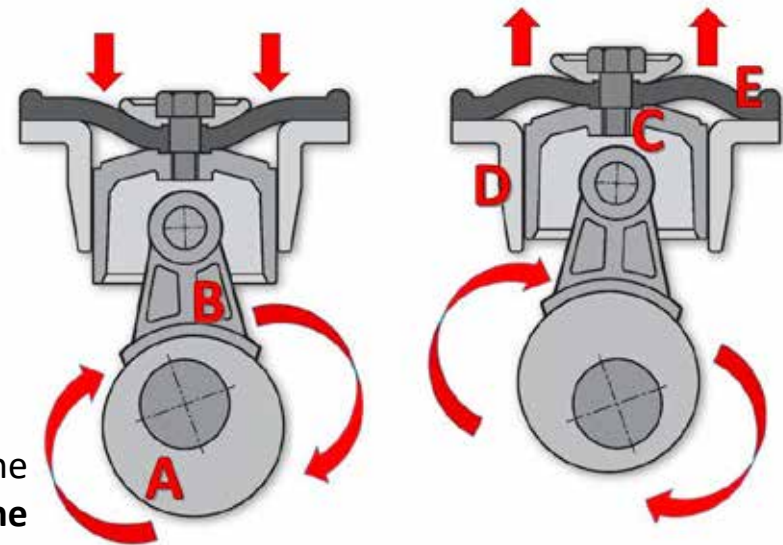
The rotational drive shaft (A) receives energy from the engine which can be electric, hydraulic or endothermic.

The **conversion of the rotational movement** (curved arrows) into oscillatory motion (straight arrows) is produced via a **rod-crank system** (B), which connects the shaft to the piston (C) which runs inside a cylinder or sleeve (D).

The piston is screwed to the central part of the diaphragm (E), which causes its oscillation and **the periodic movement of suction and discharge.**

All the mechanical components are contained in a crankcase in an oil bath with a specific lubricant (normally a 10W40, with the exception of some pump models).

The transmission system is **very similar to a two-stroke combustion engine**, with the difference that in the engine the power is transmitted from the piston to the shaft, while in the pump, power is transmitted from the shaft to the piston and to the diaphragm.



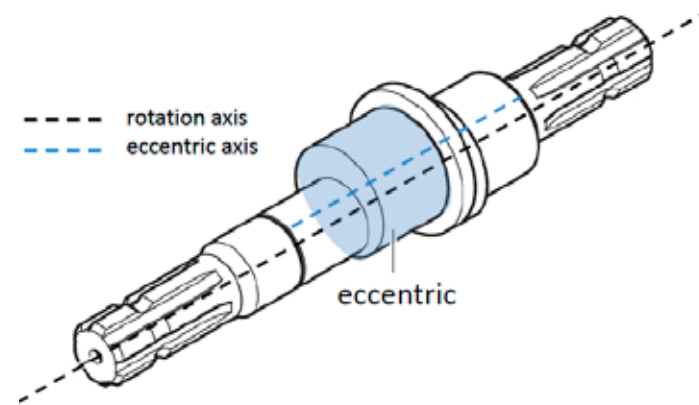
The shaft realizes the conversion from rotational to oscillating movement, by way of an **eccentric** linked to the connecting rod. An eccentric is a circular-shaped element with a rotation axis external (eccentric) to the rotation axis of the shaft.

As a matter of fact, the main application of the diaphragm pump is agricultural spraying and for this reason it has traditionally been given the same rotational speed as a tractor's PTOs : 550 RPM.*

Rotational speed: 550 rpm

Being the fundamental element of transmission, the shaft is subjected to very high forces. That's why it is made with the best steel and submitted to hardening heating treatments. Obviously, it is equipped with top-quality bearings.

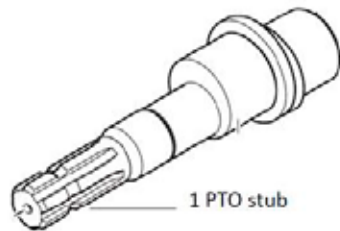
* IMPORTANT: 800 rpm pumps are currently also available, such as **Comet BP - HS**, that can meet the requirements of modern tractors.



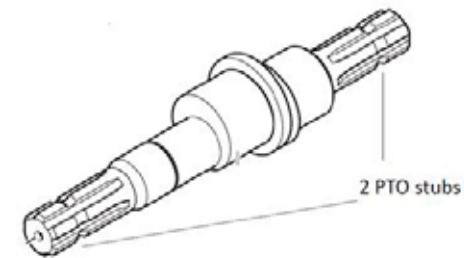
The shaft can receive power from **various types of motors and in various ways**. It is also used as a transmission element for actuating extra-gears. Therefore, configurations of its power-take-offs are multiple.

Here we have the possibilities Comet offers:

- **Single male shaft**, with a single p.t.o. (usually on the delivery side)



- **Through shaft**, with double p.t.o. The second stub is used to transmit power to extra-gears.



In turn, every stub can be:

- **splined 1" 3/8 (male or female)**



- **cylindrical (male or female)**



- **6-hole shaft (male or female)**



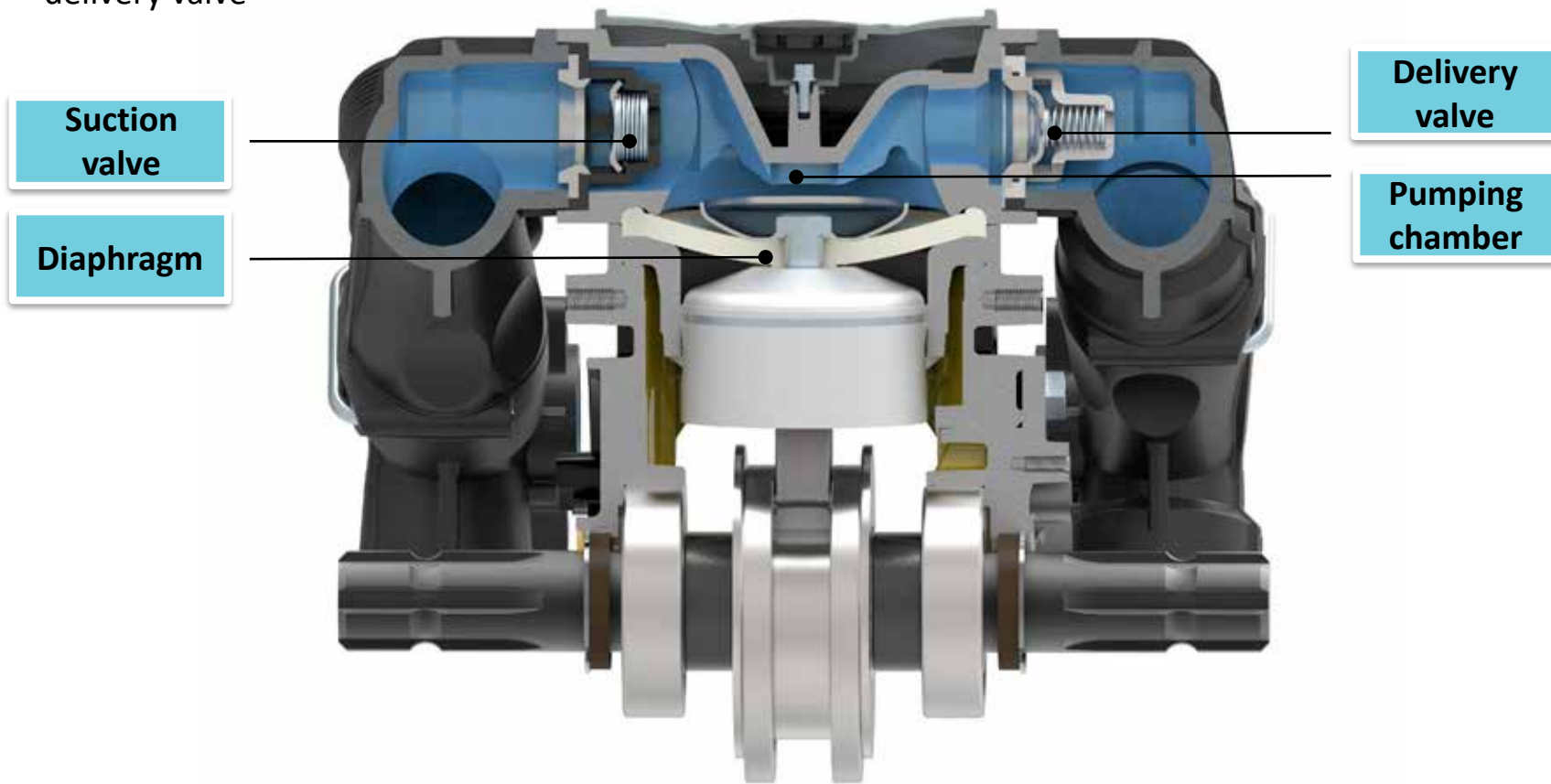
- **conical (male only)**



2.2 - Pumping unit

The main elements of a pumping unit are:

- diaphragm
- suction valve
- pumping chamber
- delivery valve

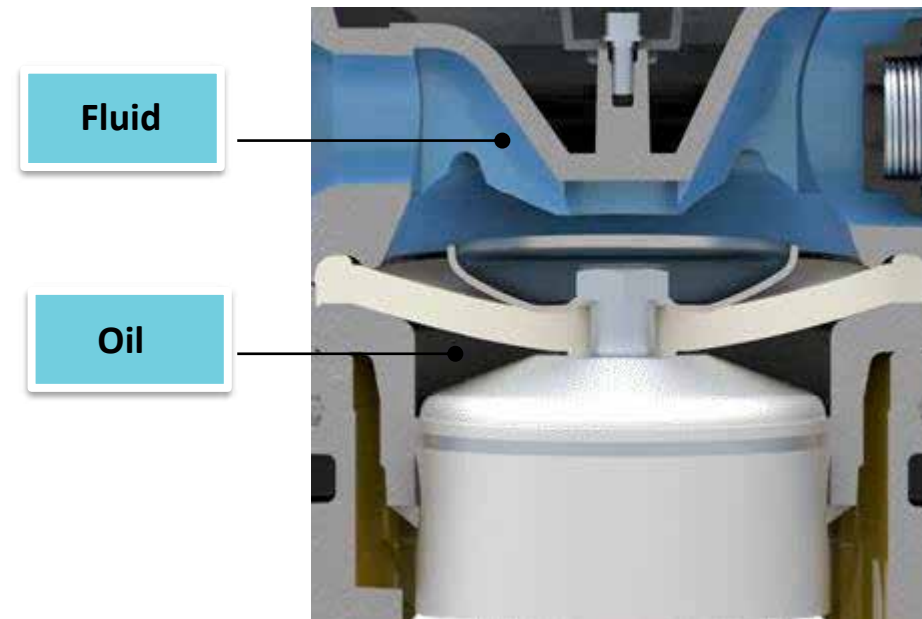


A - Diaphragm

The diaphragm is a **rubber disc** screwed on the top of the piston with a bolt and a fixing disk, that keep it aligned during its strokes. The diaphragm is **the main element of the pump**, since it has two crucial functions:

1 - it **alternately expands and collapses the volume of the pumping chamber**, this way enabling the pumping action.

2 - it **separates the pumping chamber from the transmission system**, preventing the fluid from coming into contact with mechanical parts and oil which would lead to serious damage risks for the pump.



Two distinct features define a diaphragm:

1) Strength: numerical value that measures the plastic deformation and is defined as the resistance to permanent deformation. It is an important element to define a diaphragm, since its variation during use may indicate the presence of incorrect conditions (such as a chemical attack).

2) Materials: Materials (and their levels of elasticity and hardness) affect diaphragm life, stiffness (durometer) and resistance to chemical or environmental corrosion.

Basically diaphragms are available in three different materials:



NBR - Nitrile buna rubber

Features: excellent elasticity and mechanical resistance to solid and abrasive particles, together with good chemical resistance. For this reason, it is the most popular diaphragm in the **air blast** sector (citrus, olive crops and fruit trees in general).



Desmopan® - Thermoplastic elastomer polyurethane supplied by Bayer

Features: excellent chemical resistance and hardness. High resistance to compression, flexion and abrasion. Good resistance to wear, hydrolysis, oxygen, solvents and alcohols or basics. It is the most recommended type of diaphragm for **boom sprayers** (cereals).



Viton® - Fluoroelastomer DuPont™

Features: offers proven resistance to chemical products and extreme temperatures. Unfortunately it's very expensive and is only affordable for **special chemical applications**.



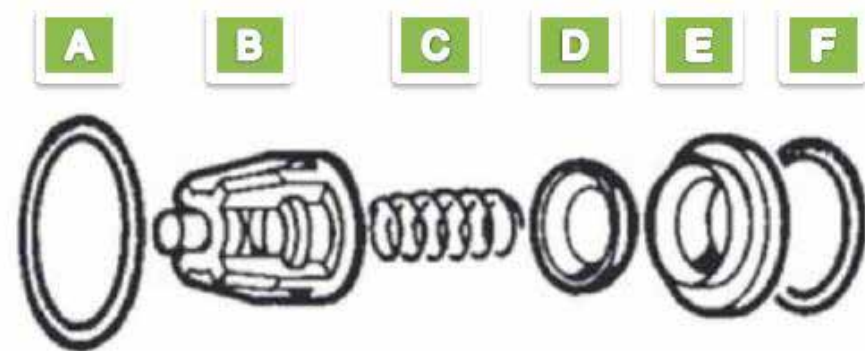
B & C - Suction and delivery valves

Each pumping unit is equipped with **two check valves**: one for **suction** and one for **delivery**.

Check valves are also classified as **non-return valves**, as their purpose is to allow flow in one direction and block flow in the opposite direction.

The elements of a non-return valve are:

- **o-rings (a - f)**
- **housing (b)**
- **spring (c)**
- **sealing disc (d)**
- **seat (e)**



The function of the **o-rings (a - f)** is to create a watertight sealing between the valve and the pump head.

The **housing (b)** consists of a techno-polymer cage, with the function of maintaining disc and spring aligned during their strokes. The slots on the cage allow the correct flow through the valve. Housing is a vital element and requires advanced technology, which combines high wear resistance together with proper flow-rate.

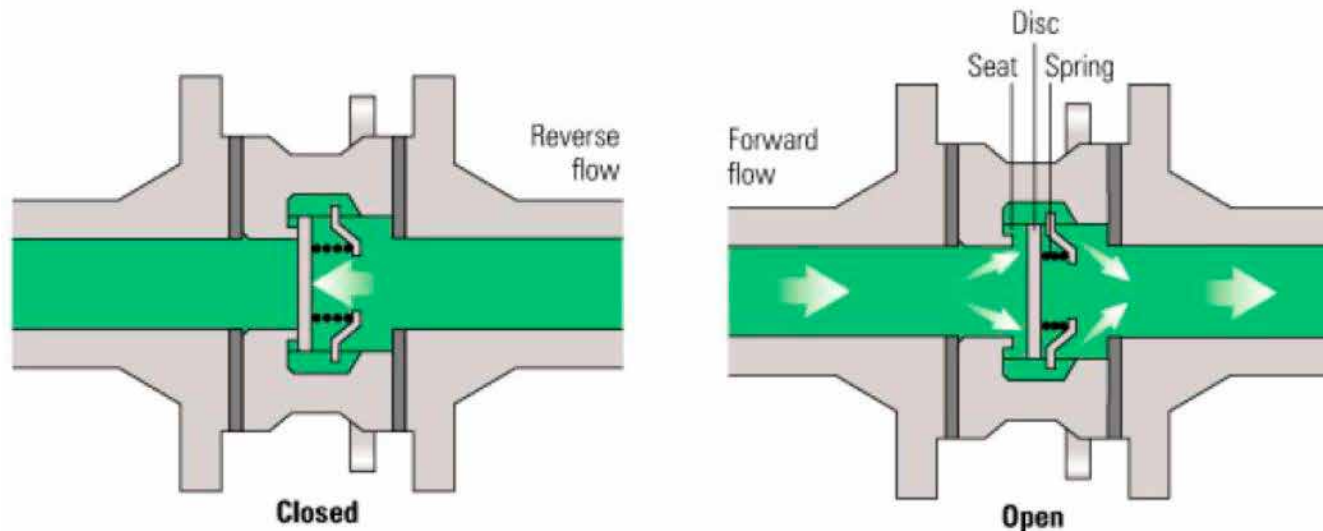
The **spring (c)** has the function of helping the valve shut-off, by exerting a load on the disc. It is manufactured in stainless steel and its load (opening pressure – cracking pressure) must be perfectly calculated during the design studies, so to allow maximum speed in opening and closing.

The **sealing disc (d)** is an oscillating element, which moves in sync with the diaphragm. Its function is to open and close the valve. It consists of a stainless steel disc, with a trapezoidal or semi-spherical shape, thus improving sealing and sliding.

The **seat (e)** is a fixed element and consists of a stainless steel ring, its shape being complementary to that of the disc.

FUNCTIONING: During **the shut-off phase** spring tension keeps the disc attached to the sealing disc (**valve closed**).

During **the opening phase**, the water pressure (also called cracking pressure) overcomes the spring load, allowing detachment of the disc from the seat, thus giving free passage to the fluid (**valve open**).

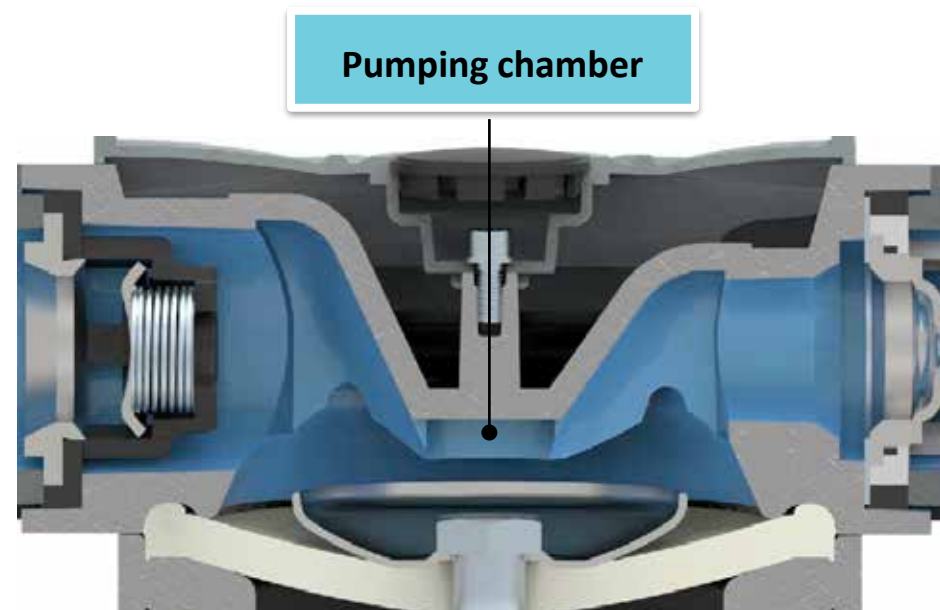


The two check valves (**suction and delivery**) are **positioned in-line and work in an alternative and opposite way**. See the section “Functioning of a pumping unit” for further details.

D - Pumping chamber (or displacement cavity)

The displacement cavity is where the diaphragm stroke generates alternative volume contractions and expansions. In practice **it is the space between the head's hollow and the upper face of the diaphragm.**

The **internal shape of the pump head** has a fundamental effect on performance. For this reason, its internal design has a “dome” concave shape, that allows pumps to reach higher levels of pressure, vacuum, priming as well as improving overall efficiency.



As this part is subject to a heavy pressure and wearing process, it is normally made in heavy-duty materials like **brass, anodized aluminum, plastic coated aluminum or high tech techno polymers.**

FUNCTIONING OF THE PUMPING UNIT

- Suction stroke

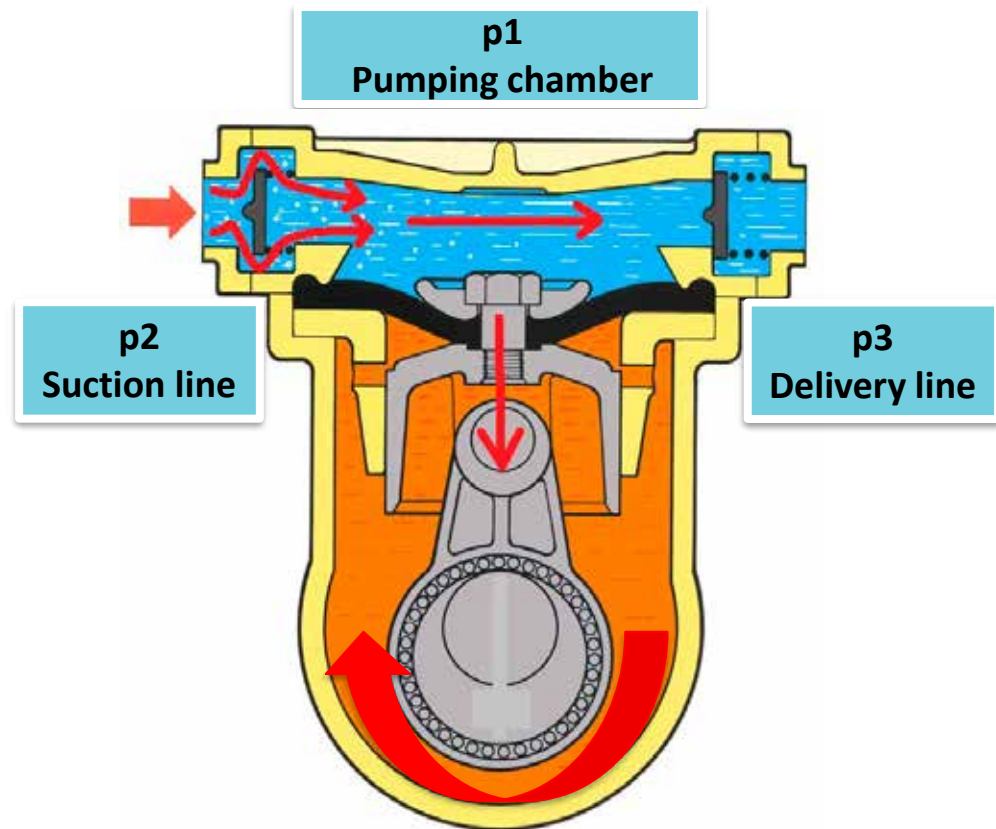
The diaphragm moves downwards. The volume of the chamber expands and creates a pressure (**p1**) lower than the suction (**p2**) and discharge (**p3**) lines.

$$p2 > p1 < p3$$

The **pressure drop** draws the liquid into the chamber through the **inlet valve** which is in the “**open**” position: the vacuum inside the chamber overcomes the spring load, detaching the disc and allowing the liquid to flow inside.

The **outlet valve** works in the opposite way and is in the “**closed**” position, so that the liquid cannot flow out. Vacuum keeps the disc on the sealing ring and prevents any discharge of liquid.

This allows **the pumping chamber to fill up**.



- Delivery phase

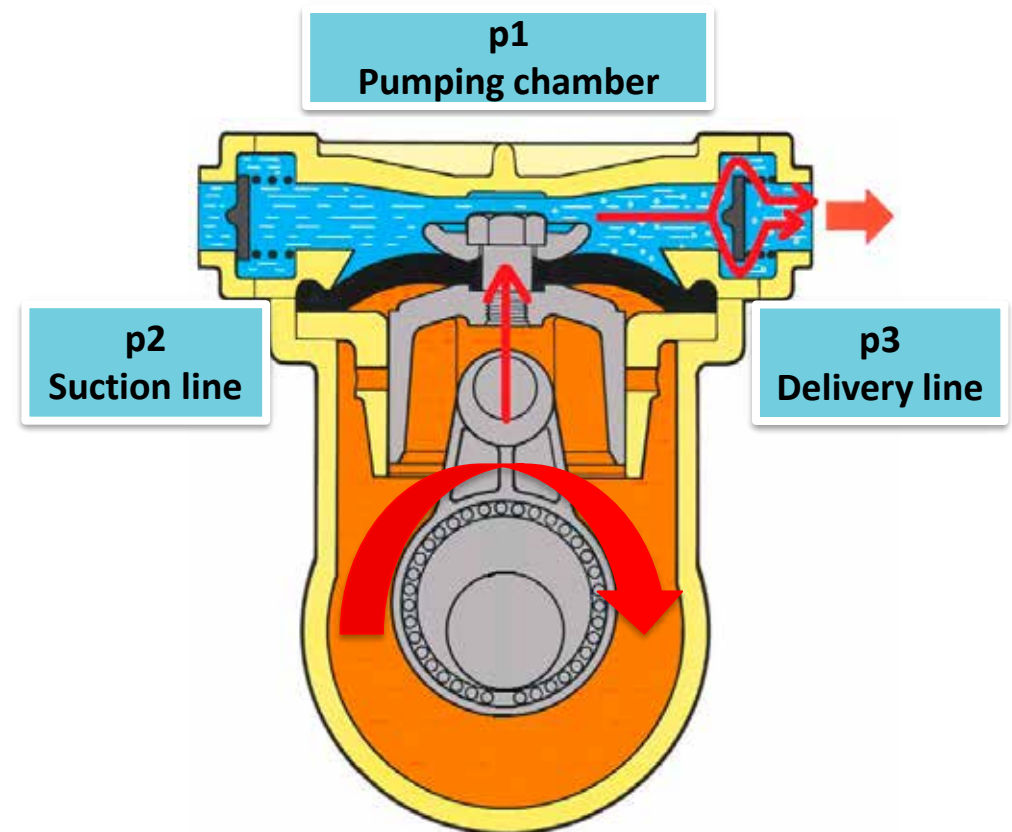
The membrane rises upwards, compressing the volume and increasing the pressure inside the chamber, which is now higher than the pressure on the suction and discharge lines.

$$p_2 < p_1 > p_3$$

The pressure rise causes **the inlet valve to close**, as the positive pressure in the pumping chamber keeps the disc attached to the closing ring and prevents liquid back-flows.

On the contrary, **the delivery valve opens**, as the positive pressure overcomes the resistance of the spring and opens the disc allowing the liquid to come out.

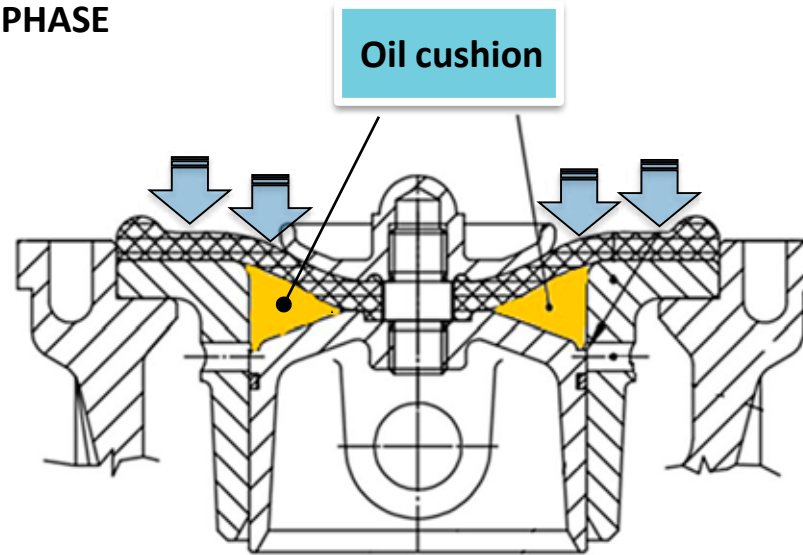
This way, **the liquid is pumped outside** through the delivery line.



THE IMPORTANCE OF OIL DURING THE DELIVERY PHASE

Lubricating oil, between the head of the piston, the bottom part of the diaphragm and the cylinders, plays a fundamental role during the delivery stroke because the diaphragms cannot withstand the pressure of the fluid by themselves.

For this reason the bottom part of the diaphragm must be hydraulically supported by an “oil cushion” in order to counterbalance and overcome fluid pressure.



2.3 - Engineering of a diaphragm pump

As we have seen, a diaphragm pump consists of more pumping units connected to each other so that pumps with different flow rates can be provided while the majority of components is the same.

For example, all BPS pumps share the same 50 l/min pumping unit. What changes is the number of units. This way, 150l/min (3 units), 200 l/min (4 units); 250 l/min (5 units) and 300 l/min (6 units) pumps have been realized.

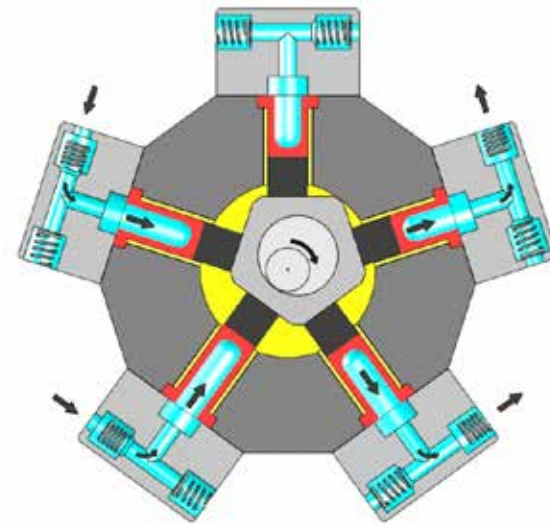


The radial (or stellar) design is the most typical pump architecture. More pumping units are radially connected to a single driving shaft.

The pump uses a single crankcase, equipped with multiple cylinders, within which pistons and diaphragms slide. All the pistons are activated by the same eccentric.

When certain flow-rates are exceeded, radial design is no longer suitable in terms of compactness.

Comet designed a **patented V-shaped longitudinal pump**, the **BPV 500**, for very high flow rates. In this case, the pump is equipped with a multi-elbow crankcase with multiple eccentrics.



2.4 - Other components

2.4.1 - Manifolds

Manifolds are pipes that **gather together the multiple flow lines**, so that the pump has a single suction line and a single delivery line, in order to simplify the circuit.

The **suction manifold** recalls the fluid from a single suction line to several pumping chambers. It has no special strength requirements, as the pressure on the suction line is negative.

The **delivery manifold** gathers the fluid from several pumping chambers into a single pressure line. Its internal pressure can be very high and cause significant damages. For this reason, it must be equipped with a **safety valve**.

Manifolds can be **internal** or **external**, inside or outside the pump crankcase. Internal manifolds have a more compact design together with a competitive price (fewer components). External manifolds ensure higher resistance together with a lower risk of damages should the pump break.

Internal manifolds

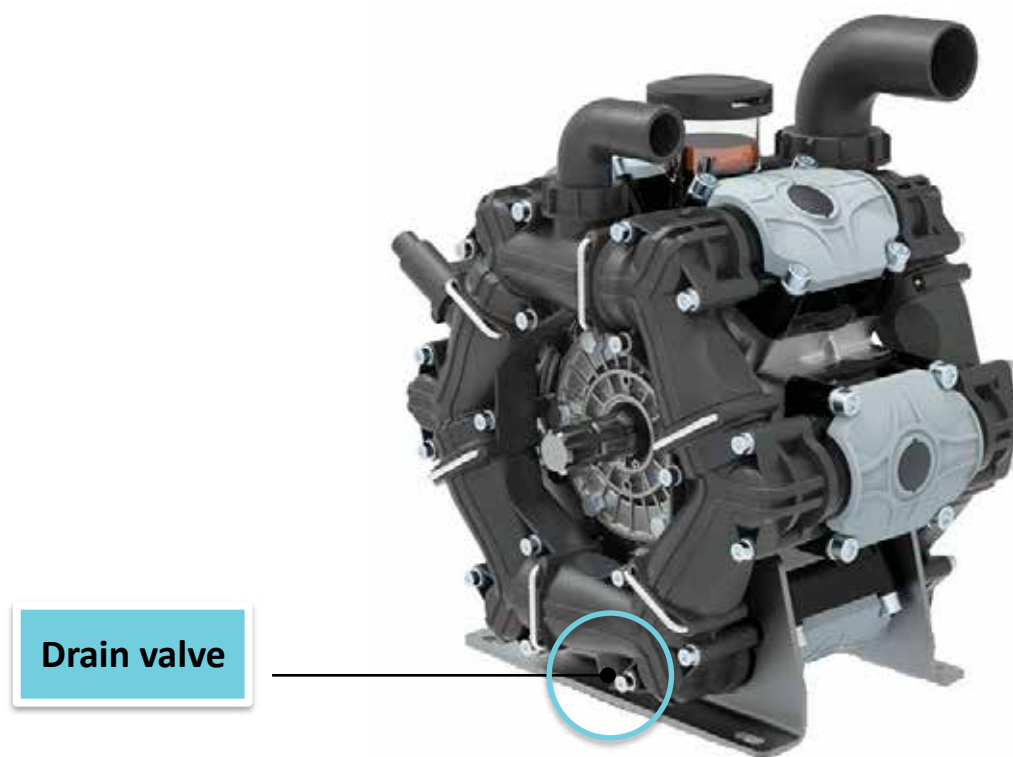


External manifolds



Materials are another important variable, as they affect pressure and chemical/mechanical resistance. **Brass, aluminum** (anodized or plastic coated) and **techno-polymers** are the most commonly used materials.

Last generation manifolds are equipped with a **water discharge valve**, so that they can be emptied before work stops in the winter, avoiding frost damage.



2.4.2 - Fittings

Both manifolds are equipped with a **hose tail** (or hose barb), which can be straight or curved and connects the pump to the machine circuit.

The hose tail on the suction manifold is called **suction or inlet fitting (A)** and is normally made of nylon or polypropylene as there is no pressure issue on the suction line.

The hose tail on the delivery manifold (**B**) and, if present, the delivery taps (**C**) are called **delivery or outlet fittings**. They are made of nylon or propylene on low pressure pumps (up to 20 bar) and of brass on high pressure pumps (up to 50 bar).



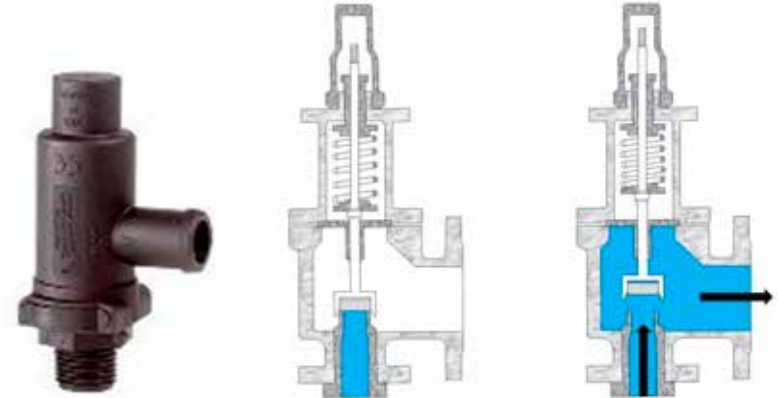
Correct dimensioning of hose tails is extremely important to avoid damage. For this reason **Comet recommendations** about the sizes of suction and delivery fittings **should be strictly complied with**.

PUMP	RACCORDO ASPIRAZIONE Suction tail		RACCORDO MANDATA Delivery tail	
	Dritto / Straight Ø e mm (in)	Curvo / Elbow Ø e mm (in)	Dritto / Straight Ø e mm (in)	Curvo / Elbow Ø e mm (in)
MP 20	23 (0,90)	-	-	16 (0,62)
MP 30	23 (0,90)	-	-	16 (0,62)
P 48	26 (1,02)	-	-	16 (0,62)
P 48 AP	-	26 (1,02)	-	16 (0,62)

2.4.3 - Safety valve

The purpose of a safety (or relief) valve is to reduce the consequences of overpressures on the delivery line.

Safety valves are equipped with a bypass spring-loaded outlet, that opens whenever pressure exceeds the required limit, thus avoiding overpressure that would damage the pump and the other components.



2.4.4 - PTO guards

Farm safety research has shown that a high percentage of farming accidents are PTO-related.

PTO guards provide protection from the PTO plug and front joint of the drive shaft, when connected to the tractor, which represent extreme danger to safety. On this point always remember that it is essential to approach the pump only when the machine has completely stopped.

PTO guards can be mounted and removed very quickly, allowing easy maintenance.



2.4.5 - Oil compensator (oil glass)

The oil glass is a transparent receptacle which contains lubricating oil and is connected to the oil inside the crankcase.

The oil compensator is used to check the correct oil level, and refill it if necessary, so that:

- **mechanical parts are always lubricated**
- **diaphragms can be oil-loaded during the delivery stroke.**

That's why the oil compensator is **always placed on top of the pump**, as the oil level **must always be above the line of the highest diaphragm**.

The other vital function of the oil compensator is to act as a **diaphragm failure warning**.

In case of a diaphragm failure, oil and water mix together thus creating an emulsion inside the crankcase, recognizable by its typical milky color inside the oil compensator.

If this happens, it is necessary to intervene immediately and replace damaged diaphragms to avoid further problems.

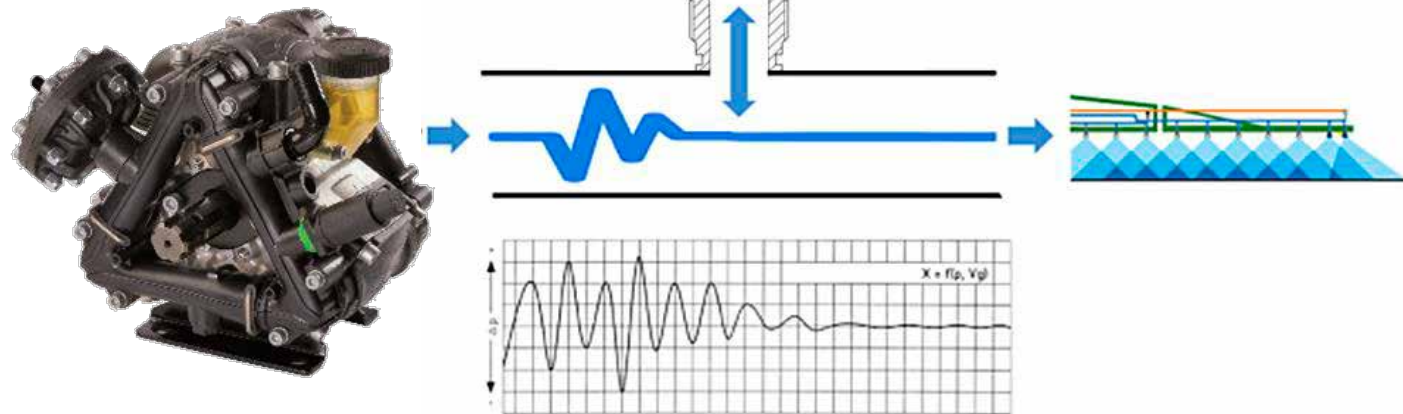


2.4.6 - Pressure accumulator (or pulsation dampener)

A typical pressure accumulator is based on a diaphragm chamber with a pre-set air charge, absorbing system shocks by minimizing pulsation in the system.

The fluid inside a pumping unit is subjected to **alternate accelerations and decelerations**, which are the primary causes of **fluid pulsations or pressure spikes** that cause vibration and noise inside the circuit and can reduce the life of diaphragms and valves.

The pulsation dampener is installed on the delivery manifold (or remotely on the delivery line) and, **thanks to the compressed air-charge, it absorbs the vibrations** generated by the oscillating movement of the diaphragms.



Most of the vibrations are harmonized by synchronizing the stroke of pistons (phasing). For this reason, pumps with 5 or more diaphragms have an excellent stroke-balance and provide a very linear flow rate, thus not requiring a pulsation dampener.

On the contrary, pumps with 4 diaphragms or less normally require a pressure accumulator to reduce pulsations.

2 - 3 - 4 diaphragms



Accumulator REQUIRED

5 - 6 diaphragms



Accumulator NOT REQUIRED

Air-pressure charge inside the accumulator must be set according to pump working pressure.

To recharge, air must be pumped into the accumulator through its recharge valve. See the table below for the correct combination.

PUMP WORKING PRESSURE		ACCUMULATOR AIR CHARGE	
bar	psi	bar	psi
2 - 5	29 - 73	2	29
5 - 10	73 - 145	2 - 5	29 - 73
10 - 20	145 - 290	5 - 7	73 - 102
20 - 50	290 - 725	7	102



Summarizing, the function of a pulsation dampener is to:

- **minimize or eliminate pulsations**
- **prevent potential pipe hammering**
- **reduce the load on the pump itself**
- **reduce noise**

In this way, pumps will have **decreased wear** and a **longer life**.

03 - ADVANTAGES

Diaphragm pumps have several significant benefits:

3.1 - Capacity to create a good vacuum on the suction line

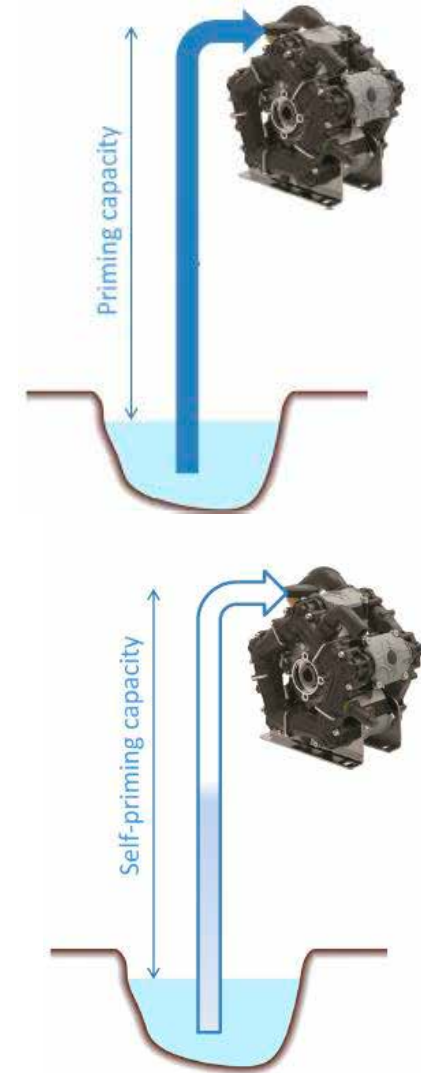
Thanks to this quality, diaphragm pumps have excellent priming and self-priming capacities.

Priming is the ability to **lift fluids from levels below the pump**. Even if they can reach maximum heights of 5-6 meters, lifting between 3 and 3.8 meters (10.5 feet 9.8 y) is the most common for a diaphragm pump.

Advantage: the pump can **suck up liquids from canals or reservoirs** far below it, which represents a huge benefit during tank filling operations.

Self-priming is the ability to suck up the air contained in the suction line during the starting phase, eliminating it through the delivery line. After clearing the air, the pump can prime and operates normally.

Advantage: the pump can be activated without the need to fill the suction hose (unlike centrifugal pumps).



3.1.1 - Precautions linked to vacuum conditions

Apart from its excellent capacity to create and resist vacuum conditions on the suction line, it's important to remember that

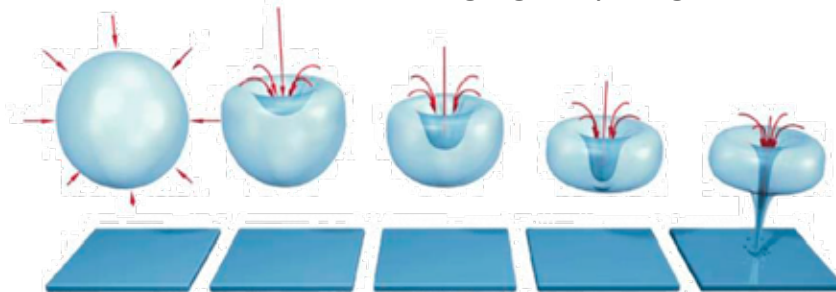
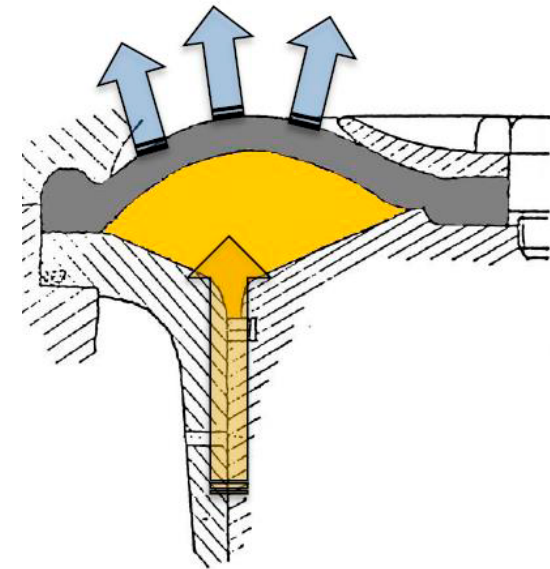
the correct pressure on the suction line is ideally atmospheric

Therefore:

- operations under vacuum conditions must be limited to the **time required to fill the tank**.
- during the priming mode, the **max height difference** between pump inlet and water source is 4 meters (13 feet).

This is because stable and heavy vacuum conditions (up to -0.5 bar/ -7psi) generate an **excess of oil under the diaphragm**, which can damage it in the long term.

Extreme vacuum conditions can also generate **cavitation**: the **formation of vapor pockets**. These vapor bubbles **return to the liquid state** once they reach the discharge line where pressure is positive. The sudden pressure change generates their **implosion** and a severe shock wave, thus damaging diaphragms, valves and heads.



Because of the above mentioned reasons, once the tank has been loaded, the liquid must flow down to the pump naturally, with the simple help of gravity. It is therefore recommended to

place the pump under the tank



A **restriction on the suction line** is another cause of cavitation and it generates a pulsating noise, that increases and decreases in synchronization with variations in pump speed.

Restrictions can be caused by: **clogged suction filters, bended - or undersized hoses, wrong circuit layout such as a contorted maze of suction lines.**

For this reason, it is very important to:

- Clean filters after every working day
- Avoid (when possible) reductions or 90° fittings



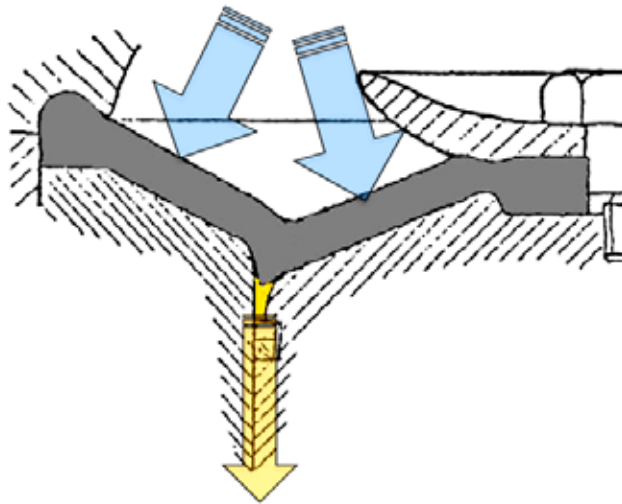
 RECOMMENDED	 NOT RECOMMENDED
	
	
	

Finally cavitation can be a symptom of more serious problems such as a " **drowning** " of the diaphragms.

Cavitation may also occur when the **pump works at less than 10%** of its point of max efficiency.

While the diaphragm pump tolerates a certain vacuum, it absolutely **does not tolerate any positive pressure on the suction line**, since it compresses the diaphragm downwards , which wedges into the gap between piston and cylinder, causing premature failures. This is the reason why diaphragm pumps

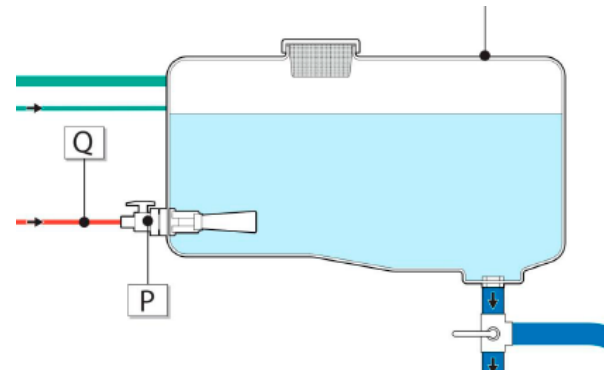
can't be powered by external pumps or waterlines, such as public aqueducts



3.2 - Pressure

Diaphragm pumps can achieve quite significant pressures (up to 50 bar – 725 psi), unlike centrifugal pumps (maximum 10 bar - 145 psi)

This means that diaphragm pumps are the **only suitable ones for atomizers when creating an agitation line at differentiated pressure (Q -P)**.



3.3 – Good dry running capacity

Thanks to the lubrication of the mechanical parts , diaphragm pumps can withstand reasonable periods of dry running (for example, when working in the self-priming mode or if the suction line ruptures) without negative consequences, such as overheating or seizures. This is not possible with centrifugal or piston pumps.

3.4 – Resistance to abrasion and chemical products

Having no mechanical parts in direct contact with the liquid, diaphragm pumps **can manage the majority of water-based phytosanitary substances**, even when mixed with acids, solvents, abrasive particles, sediment or sludge, with a relatively high amount of granules and solid particles.

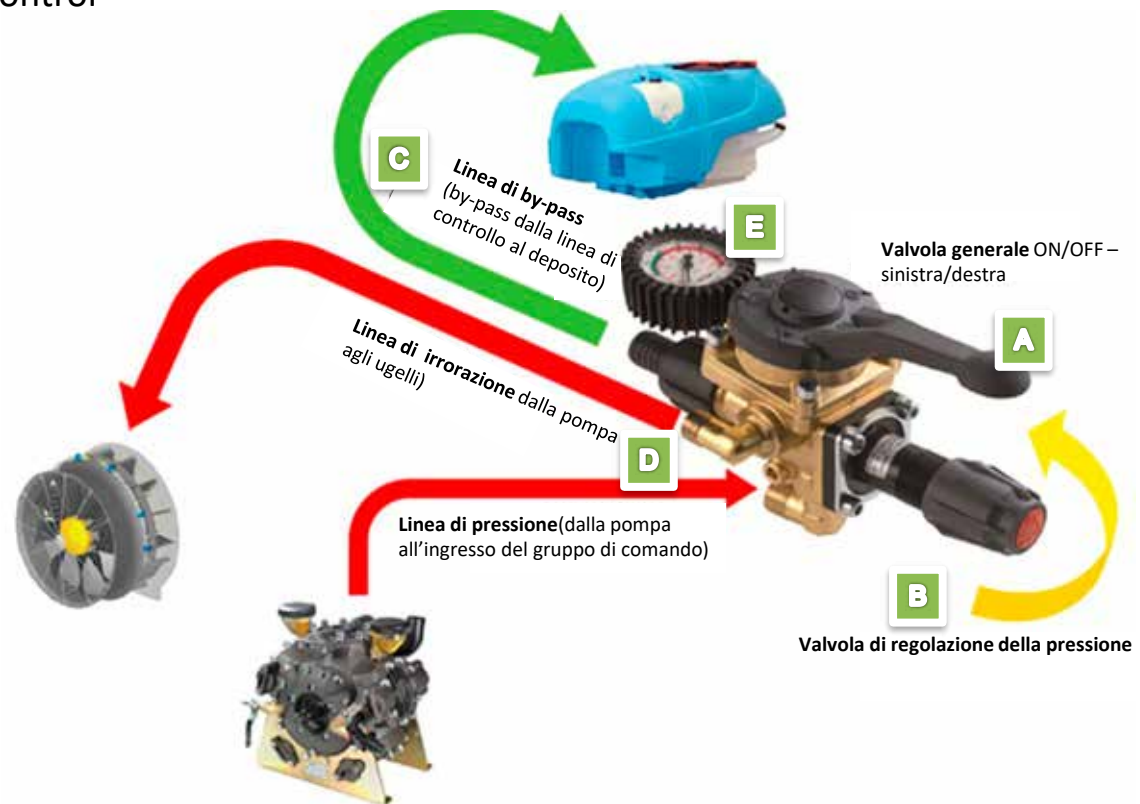
04 – PRESSURE REGULATOR

A diaphragm pump, as any other positive displacement pump, must include a pressure regulator equipped with by-pass on the discharge line , which has a double function:

- **pressure regulation**
- **avoids the risk of over-pressure**

Basically, a pressure regulator (or control unit) is equipped with:

- A – master valve** with a general shut-off function
- B – pressure regulation valve** (optional on some units)
- C - by-pass:** returns the overflow to the tank
- D – section valves:** distributes the flow to the spraying lines
- E – pressure gauge.**

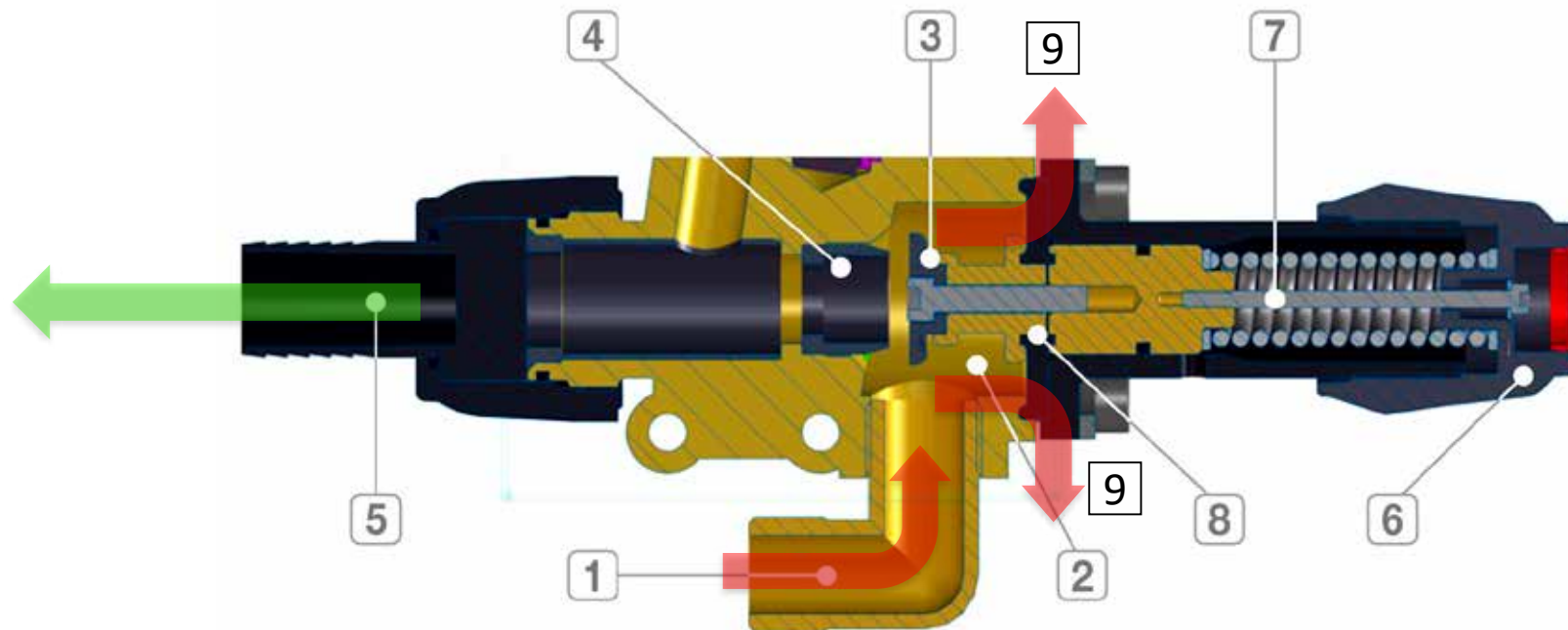


In the typical configuration of a control unit, the pumped liquid flows through an inlet **(1)** and reaches the inner chamber **(3)**, connected directly to the outputs **(9)** (spraying lines).

The pressure regulation system is based on a valve **(3)** and its seat **(4)**. The liquid can be discharged through the seat, towards the by-pass line **(5)**.

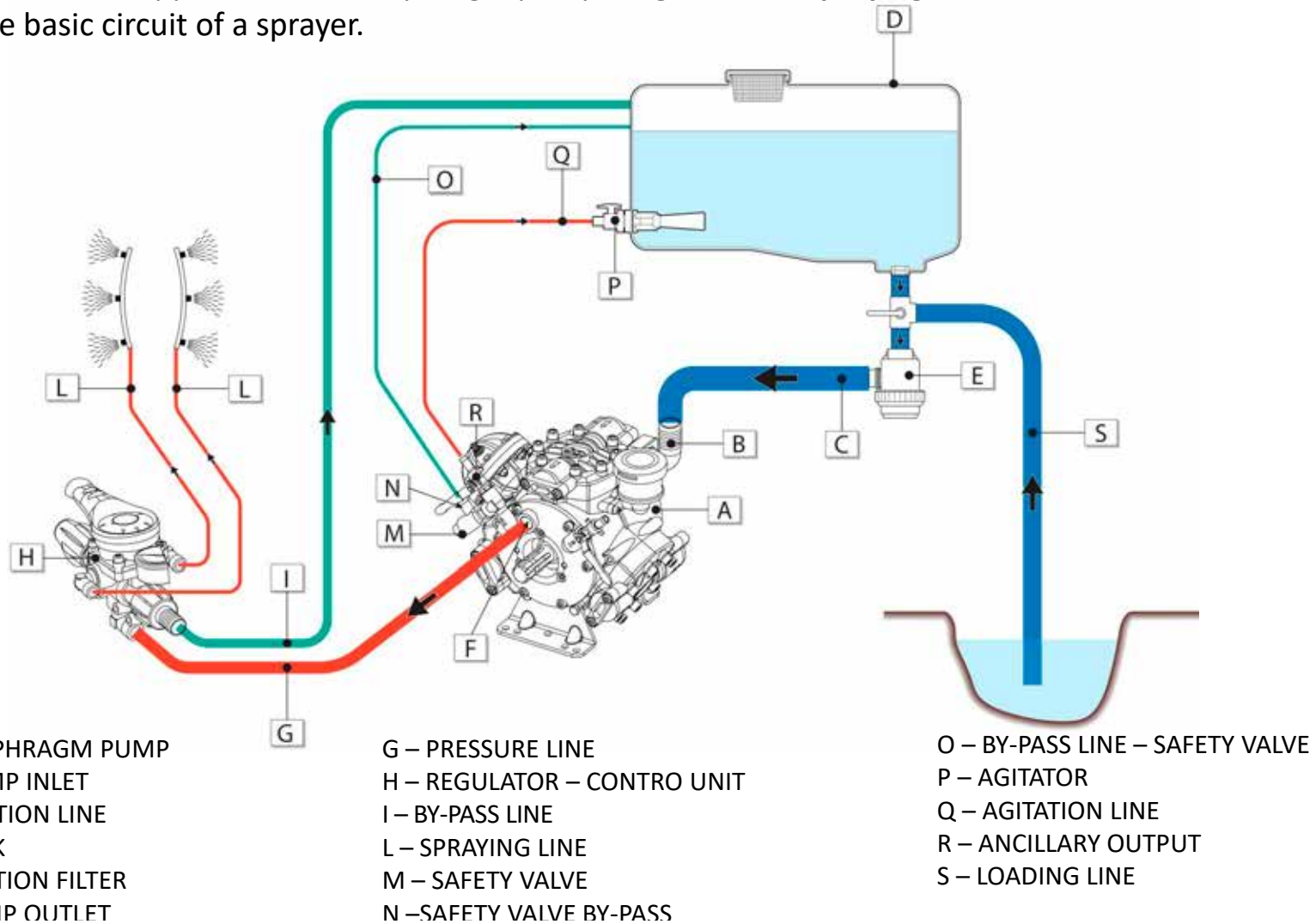
Pressure is adjusted by operating the knob **(6)** that acts on the spring **(7)** connected to the valve.

The diaphragm **(8)** separates the liquid from the system spring - knob.



05 – PLUMBING DIAGRAM

The most common application of a diaphragm pump is **agricultural spraying**. Below, the basic circuit of a sprayer.

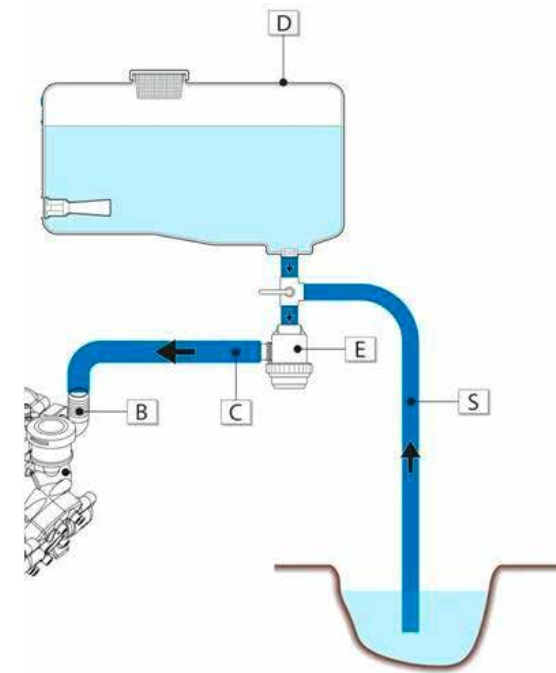


5.1 – Suction line (blue)

A pump can suck fluid from different sources , i.e.:

- **main tank (D)**: when the sprayer operates in the following modes: spraying/agitation/by-pass
- **external water sources**: canals, basins, water deposits, through the loading line **(S)**: sprayer operating in the **loading mode**.
- **clean water tank** to rinse the tank, the pump and the circuit: sprayer operating in the **flush mode** (not shown in the diagram) .

Tank output must be placed at the very bottom, to ensure complete drainage.



A **suction filter (E)** with flow-rate and mesh adequate to pump capacity, is highly recommended.

Suction and loading lines consist of **reinforced plastic hoses**, sufficiently rigid to counteract vacuum, and prevent walls from sticking due to suction, thus throttling the inlet.

The inside diameter of the hose must be equal to the outside diameter of the pump (B) inlet.

A 3 or 4-way **ball valve** is positioned at the entrance of the suction filter (E), to switch from loading to spraying, or rinsing mode.

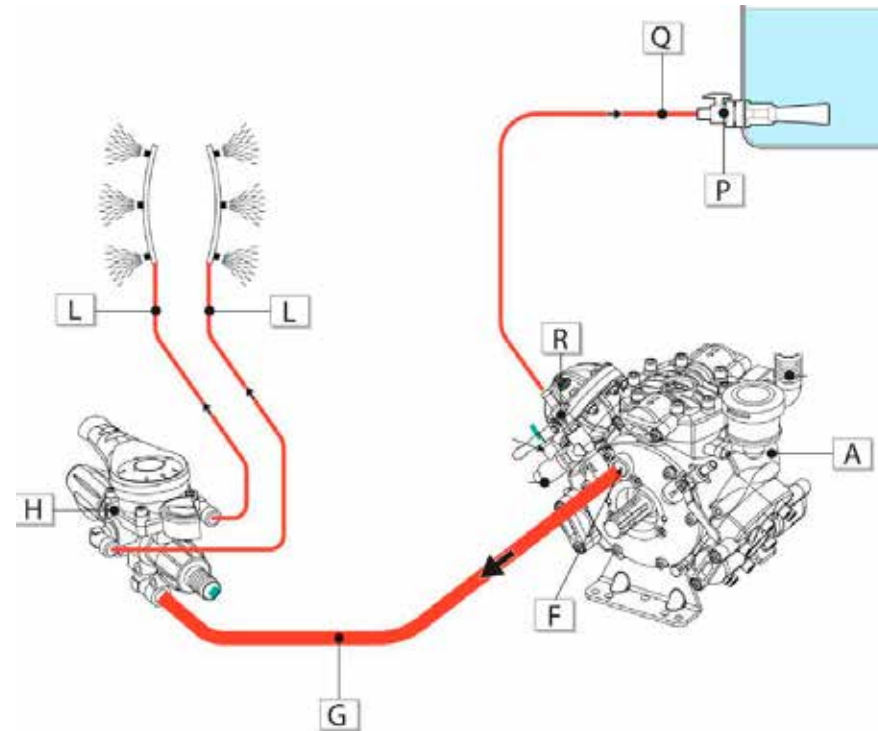
5.2 – Pressure/delivery lines (red)

Pressure lines are normally two:

- **spraying line:** its purpose is to supply the nozzles. The pressure line (G) connects the pump (F) to the control unit (H) and consequently to the spraying lines (L).

- **agitation line:** the **agitator (P)** must be placed at the bottom of the tank (D) with the function of **stirring the liquid**, thus avoiding sediments of chemical substances. The agitator is powered by an **auxiliary output (R)**.

In the figure, the output is located on the pump, but a line of agitation can also be realized by mounting a 3-way valve on the pressure line.



A pressure/delivery line is basically constituted by a **rubber hose with adequate characteristics in terms of size and resistance to pressure**, so as to comply with the specifications of the treatment.

5.3 - By-pass lines (green)

The by-pass lines are required for returning the liquid to the tank .

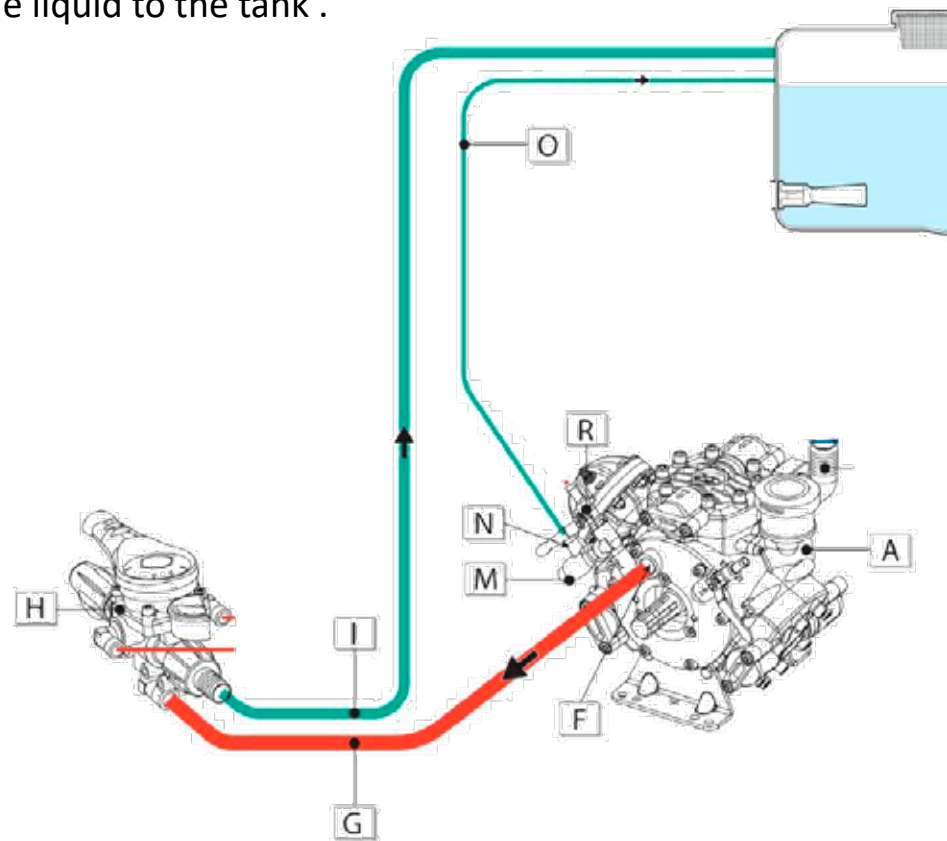
They consist of:

- **Main by-pass line (I):** returns the excess flow from the regulator to the tank.

- **Safety valve by-pass (M)**

in the event of pressure peaks it returns the excess flow to the tank, through the line (O), avoiding failures and environmental contamination.

The discharge holes of the by-pass must be **placed in the upper part of the tank** because in the lower part the water inside the tank would create a strong counter-pressure, thus obstructing normal return with loss of performance and premature failure of the pump .



Pressure (G) and agitation (Q) are full pressure lines , while by-pass lines (I-O) are lower pressure.

06 - COMET RANGE

As mentioned, Comet is the world leader in the field of diaphragm pumps for spraying and stands for an exclusive brand in terms of quality, technology and reliability.

As evidence of the Comet technology, some of the major OEM's such as Amazone, Berthoud, Krukowiak Kuhn, Maschio, Silvan and Tecnomat are equipping their machines with Comet pumps.



6.1 - BP / BPS /BPV Series – Low pressure diaphragm pumps

General features:

- Configuration: 2 to 6 membranes
- Pressure : up to 20 bar (290 psi)
- Capacity: up to 530 l / min (140 US gpm)
- Parts in contact with the liquid: anodized aluminum, coated aluminum, polyamide
- Manifolds: external (except BP 20/15)

Applications:

Boom sprayers for broadcast plant protection and liquid fertilizing.

Low volume orchard sprayers.



The **BP** line – which stands for “*Bassa Pressione*”, low pressure in Italian - is one of Comet’s most reputed lines and has been representing a benchmark for quality and reliability for decades in the field of crop sprayers.

The BP line is undergoing thorough a continuous renovation with the aim of creating a line of low pressure pumps for highly aggressive chemicals.

This innovative new line, which started with pumps **BP 110, BP 115, BP 130 and BP 135**, is equipped with **heads and manifolds in techno-polymer**, for maximum chemical resistance, while mechanical elements are the same used in the BP pumps, to ensure **maximum interchangeability of the parts**.



The **BPS** line “*Bassa Pressione Speciale*” (Special Low Pressure in Italian), represents the evolution of the glorious BP line.

This line is designed to meet the needs of customers and offers a state-of-the-art technology together with superior performance. In particular, the BPS project is focused on optimizing the bore/stroke ratio, thanks to the use of wider diaphragms.

This has reduced the stroke meaning it is possible to have an **extremely compact pump with a longer life of the diaphragms**. All BPS pumps are equipped with a water drain valve.

Pumps are coupable in “tandem” to expand flow rate capacity or multi-purpose applications (spraying/agitation/rinsing/constant recirculation).



The **BPV** line "Low Pressure V" is Comet's most innovative project aimed to meet the very stringent requirements of the **self-propelled** industry, demanding a pump that combines **maximum compactness, high flow, priming capacity and ease of maintenance.**

Since the radial form would not allow the necessary compactness, Comet has engineered a "V" pump (patented technology) , which offers important benefits such as:

- **extreme accessibility** to diaphragms and valves
- **lowered PTO**
- **possibility of separate lines** for spraying and agitation.



6.2 - APS Series – High pressure diaphragm pumps

General features:

- Configuration: 3 to 5 membranes
- Pressure: up to 50 bar (725 psi)
- Capacity: up to 169 l / min (44.6 USgpm)
- Parts in contact with the liquid: anodized aluminum
- Manifold: internal

Applications:

- Medium -large sized orchard sprayers



The **APS series** (*“Alta Pressione Speciale”* – Special High Pressure) is the **global benchmark for high pressure atomizers**.

This exceptional result was achieved after years of improvements in technology and large investments to meet the needs of customers looking for a pump that is simple to use, withstands heavy-duty applications, is super reliable and able to work in extreme conditions, as can be the case in vineyards and orchards (dusty, tropical temperatures, rough tracks, etc.).

To meet these needs, Comet has created APS, which is far superior to what competition offers in terms of **robustness and high quality**. As regards to the components, the APS series is equipped with **oversized bearings, forged reinforced shafts and plenty of raw material**.

It’s a fact that the APS pumps are much heavier than competitors’ with an equal flow rate, and this translates into **much greater resistance** in difficult operating conditions. The bore/stroke ratio is perfectly calibrated to reduce the stress of the diaphragm, ensuring **low maintenance** and **maximum compactness**, as the available space in atomizers represents a very critical point



6.3 IDS Series – High Pressure Diaphragm Pumps

General features:

- Configuration: 3 to 6 membranes
- Pressure : up to 50 bar (725 psi)
- Capacity: up to 259 l/min (68.4 USgpm)
- Parts in contact with the liquid: Brass
- Manifolds: external

Applications

- medium-large sized orchard sprayers



The **IDS** series (acronym for “*Idro-Stella*” - Hydro - Star) is " the jewel on the crown" of the Comet range.

Like the APS series in the aluminum pump range, it is believed that the **IDS series is unrivalled in the field of brass pumps.**

Once again all components have been engineered to adapt to the harshest working conditions that arise in orchards, vineyard and olive groves, and therefore boasts oversized parts, foresee an abundant use of raw materials, has a compact design and an optimal bore/stroke ratio. In addition, all parts in contact with the liquid are made of brass to ensure **maximum abrasion resistance**. The manifolds are external in order to **facilitate maintenance**.

Simply put , the IDS line is the perfect choice for customers who need an indestructible pump.



6.4 - Other product lines

6.4.1 - MC Series – Low pressure pumps

General features:

- Configuration: 2 diaphragms
- Pressure: up to 25 bar (362 psi)
- Capacity : up to 23 l/min (6.1 USgpm)
- Parts in contact with the liquid : anodized aluminum, plastic , polyamide and polypropylene depending on the model selected.
- Manifolds: internal

Applications: gardening, spot spraying, greenhouses, lawns, turfs, distribution of detergents and water-soluble paints.



6.4.2 – P Series - Low-Medium pressure diaphragm pumps

General features:

- Configuration: 2 or 3 membranes
- Pressure: up to 30 bar (435 psi)
- Capacity: up to 64.2 l/min (17 USgpm)



- Parts in contact with the liquid: plastic-coated aluminum, polyamide, polypropylene (depending on the model selected).
- Manifolds: external

Applications: crop protection of average size surfaces.



6.4.3 – MP Series – Medium pressure diaphragm pumps

General features:

- Configuration: 2 diaphragms
- Pressure: up to 30 bar (435 psi)
- Capacity: up to 32 l/min (8.5 USgpm)
- Parts in contact with liquid: anodized aluminum
- Manifolds: internal

Applications : small-sized atomizers.



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