The 3 principal components of a dosing pump are:
- The drive mechanism (See Advice n°3)
- The mechanical assembly (See Advice n°4)
- The liquid end

The liquid end

This is the “heart” of the dosing pump, that which is in contact with the pumped fluid.
The component materials must be carefully selected according to the chemical aggressivity of the fluid.
There are three main families of liquid ends:
- The plunger liquid end
- The mechanically driven diaphragm liquid end
- The hydraulically driven diaphragm liquid end
The suction and discharge check valves are integral parts of the liquid end assembly on a dosing pump.

The diaphragm liquid end

The diaphragm liquid end is completely leakproof.

Mechanically driven diaphragm liquid end

A mechanically driven diaphragm liquid end is illustrated in the figure below. The diaphragm is fixed directly and mechanically to the moving coupling or crosshead. Its centre is displaced by the pump stroke and a seal is obtained around the edges.

The diaphragm works under unequal pressures: the pumped fluid pressure on the process side and ambient atmospheric pressure on the other. This characteristic is the source of its other name: the dry diaphragm.

The use of mechanically driven diaphragms is limited to low discharge pressure applications.

The Milton Roy Europe “G” and “LMI” ranges of dosing pumps are fitted with mechanically driven diaphragm liquid ends.
**Hydraulically driven diaphragm liquid end**

Dosing at high pressures, high flow rates or the need for a high pressure with continuous injection of micro flow rates all require the use of hydraulically driven diaphragm liquid ends.

In this type of liquid end the diaphragm acts as a divider between the pump’s hydraulic oil and the process fluid. Therefore it is not subject to pressure and its life is very long. The flow is generated by the diaphragm which itself is hydraulically linked to a piston.

The figure below shows the principal of the hydraulically driven diaphragm pump. Other items necessary for a correct operation not shown are: safety valve on the hydraulic oil circuit, air purge to avoid the build-up of gas at the highest point in the liquid end, hydraulic oil replacement circuit. This replacement circuit can be by simple equilibrium (systematic opening of a by-pass on pumps with an hydraulic lost motion operation) or by a “compensator”. These systems all avoid the need for a pressure contour plate in the liquid end.

Milton Roy Europe “MAXROY®”, “mROY®”, “MILROYAL®”, “PRIMEROYAL®” and “PRIMEROY®” ranges of dosing pumps are all fitted with hydraulically driven diaphragm liquid ends.

**Mechanically activated diaphragm**

The mechanical diaphragms of Milton Roy Europe “LMi” and “G” dosing pumps are formed in PTFE, a material chosen for its chemical inertness. These specially thermo-formed diaphragms allow:

- A rolling action whilst operating (the guarantee of dosing precision).
- A mechanical resistance to external constraints, such as a pressurization during the discharge phase applied to one face only or to the peripheral clamping zone.
- A mechanical resistance to internal constraints linked to the rolling type of action whilst operating.

The figure below shows this type of diaphragm.

Compared to other mechanical diaphragm construction technologies, Milton Roy Europe diaphragms offer an excellent working diameter/stroke length ratio of the order of 5 (other models on the market have a ratio of 10 to 20).

They also give remarkable delivery performances: less than 10% drop in output between operating at atmospheric pressure and at 10 bar. Traditional construction technologies result in drops of 20% or even 40% in certain cases.

**Diaphragm technology**

At the heart of dosing, the diaphragm is the completely leakproof element of the liquid end, whether this is of a mechanical or hydraulic diaphragm type.

The corresponding construction technologies take into account both the necessities of chemical compatibility with the dosed fluid and the mechanical necessities which guarantee dosing precision and the long working life of diaphragms. Because of this, diaphragm construction technologies are the subject of constant research and numerous developments.
Their main characteristics are:
- Process side surface in PTFE, attached to a moulded elastomer support.
- An internally moulded peripheral "O" ring seal.
- A shape designed to give an unconstrained rolling action whilst operating.
- A mechanical resistance to external constraints, such as a pressurization during the discharge phase applied to one face only or to the peripheral clamping zone.
- A mechanical resistance to internal constraints linked to the rolling type of action whilst operating.

The figure below shows this type of diaphragm.

A partial cross section view of a "MAXROY®" pump diaphragm is shown below.

Due to this unique technology, Milton Roy Europe commonly offer working life spans greater than 20,000 hours of continuous operation.

This is principally due to the possibility of reusing the diaphragm after dismantling of the liquid end.

Milton Roy Europe hydraulic diaphragm pumps are available in single or double diaphragm configurations.

Double diaphragm versions may be fitted with detection systems, in case of accidental rupture, based on changes in pressure, resistivity, density, etc.

Double diaphragm with rupture detection: complete security

The working life of hydraulically activated diaphragms is very long (often 20,000 hours or more) and accidental rupture is a rare occurrence. Nevertheless, the rapid development of their applications has led certain users to seek protection against possible ruptures.

This is the case for example:
- If accidental contact between the pumped liquid and the hydraulic oil is prohibited: liquid chlorine, oxygenated water, nitric acid, etc.
- If accidental contamination of the pumped liquid is prohibited (food industry products for example).
- If accidental leakage to the atmosphere is unacceptable: liquids inflammable in air, liquid chlorine, hydrogen sulphide, environmentally dangerous or poisonous liquids, etc.

All Milton Roy Europe rupture detection systems are designed using double diaphragms. If one of the diaphragms bursts, the second ensures safe and leakproof pumping. A diaphragm rupture detection system then activates a visual or electrical alarm.

Several technologies are used:
- The double diaphragm "sandwich" (without intermediary liquid) with a detection by pressure (gauge or controller).
- The double diaphragm with intermediary liquid and a detection by density, resistivity or other parameters.

Milton Roy Europe can help you study special systems adapted to specific cases such as:
- Double diaphragm with nitrogen barrier (combustable liquids).
- A single detection system for multi head pumps.
- Hydraulic impedance detection systems for fluids which diffuse through PTFE.
- Triple diaphragm systems.