

DR-SPECIAL

**Valveless piston metering pump,
the problem solver
for metering highly viscous
substances and substances
containing suspended solids**

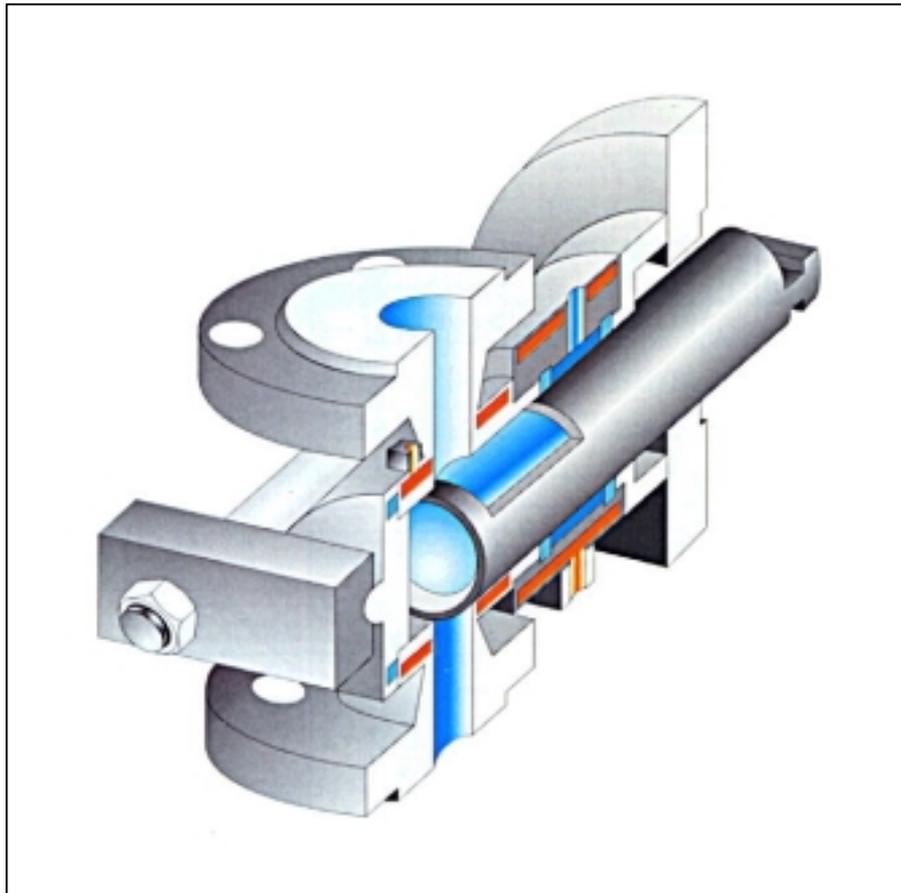


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Introduction

In practically all branches of industry, including the chemical industry, oil and gas production and the food and drinks industry, ever-more precise dosing of a great variety of substances is becoming increasingly important. Process stability and product quality

depend substantially upon the reliable operation of the “heart” of the system - the metering pump.

Stroke-adjustable piston and diaphragm pumps are used for most dosing applications.

Orlita[®] company profile

ORLITA[®] Dosiertechnik GmbH is a member of the ProMinent[®] group. ORLITA[®]'s DR piston metering pump is specially designed for non-standard applications and for use in filling and packaging systems.

It has a capacity ranging from a few millilitres/hour to several cubic meters/hour. The flexible combination

options of the modular components allow you to select the most efficient and economical solution (including multi-head versions) for practically any metering problem. ORLITA[®]'s company philosophy is flexibility and tailored customer solutions based on the company-specific expertise.

Problems faced when dosing highly viscous substances

While the oscillating positive displacement pump is now firmly established as a process metering pump, reliable metering of highly viscous and sticky substances and substances with a high suspended solids content still presents many problems for this pump technology.

Many systems incorporate relatively costly constructions with guided valves or the more economical rotary positive displacement pumps. There are, however, disadvantages to using rotary positive displacement pumps, e.g. limited control range, dependency on

the feed rate pressure and the resulting limited reproducibility of metering.

However, there is no need to be limited by these constraints. For 25 years ORLITA[®] has been producing a pump system which combines the advantages of both pump systems.

- 1. Optimum reproducibility of metering over the whole pump control range**
- 2. Feed rate unaffected by pressure**
- 3. Highly viscous fluids with suspended solids, including large chunky components.**

Application examples

The application examples are many and varied. The following examples give an indication of the areas in which the ORLITA[®] has been used successfully.

These applications all share the fact that they place extreme demands on the pump unit. The piston metering pump has met these demands, however, and proved itself a reliable system component.

Taking samples from a crude oil pipeline

Crude oil is often transported from the shipping harbour by pipeline to the refinery. The quality of the crude oil varies from shipload to shipload. It is important to know the quality of the oil being delivered at any one time. For this reason, samples are taken from the pipeline according to a statistical procedure.

Crude oil is, however, highly viscous, possibly contaminated with suspended and even abrasive solids. It can also contain a significant proportion of relatively high vapour pressure which increases the risk of cavitation.

The DR 15/7 type valveless piston metering pump provides a feed rate of 2 l/h at pressures of 400 bar.

Oil supply

In order to extract more yield from old oil fields, fluid is forced in, e.g. viscous mixture of water and liquid polymers, typical operating pressures can reach over 100 bar.

German operators have been very successful in this area using the DR valveless piston metering pump in German oil fields. The DR 150/36 used in the operation has achieved a capacity of 205 l/h at 150 bar.

Abrasive salt crystals dealt with reliably

A DR 15/7 has been running for more than 40,000 operating hours in the production process of a major European polymer manufacturer. It is being used to meter a honey-like

viscous and abrasive salt crystal substance at approx. 90 ml/h at a pressure of 55 bar. During the 40,000 operating hours the piston was only replaced twice.

Hardness test with abrasive suspensions

A petrol sludge rust-particle mixture was pumped over a 4 week continuous trial which took place in a steel tank whose inside walls had rusted over a long period.

The ceramic version DR with technical ceramic pistons and packing rings,

forced this abrasive, non-lubricating suspension at 12 - 15 bar through filters - at a rate of up to 200 l/h. After 4 weeks the piston cylinder play was unaltered and the ceramic parts showed no signs of wear.

Reproducible metering of viscous products

1. In the manufacture of sealant material, silicon rubber is mixed with additives. A double headed valveless piston metering pump, the D2R 150/70-50, pumps 800 l/h silicon rubber base and 400 l/h abrasive and viscous additive at 20 bar into a mixer. The hard coating on the pistons and cylinders ensures good wear-resistance and guarantees an extremely high pump operating life.
2. In one medical application silicon oil is metered with abrasive fillers. A DR 15/36 piston metering pump meters the product in precise volumes at approx. 10 bar. The viscosity is between approx. 300,000 and 1,000,000 mPas. The fillers have a particle size of between 40 and 100 μm .
3. Body worlds - the revolutionary preparation of body parts, even of complete bodies. So-called plastination is a process whereby modified silicon rubber is compressed into a woven base, sometimes under high pressure. Due to the high level of viscosity on the one hand and the high operating pressure required on the other this task is ideally suited to the capabilities of the DR piston metering pump.

Abrasive challenges in polyamide manufacture

A DR 150/70 has been metering a suspension of 80 – 90% caprolactam and 10 – 20% of an organic salt; this being the suspended solid portion in the production process, for over 7

years. The pump head is heated during the process to approx. 80 °C. 24h continuous operation is guaranteed in that one pump operates while the other one is in standby mode.

Confectionery industry

Confectionery manufacture often involves difficult-to-meter substances, i.e. highly viscous substances or substances containing suspended solids.

A DR 150/90 pump has been successfully in use for over a year now, metering glucose syrup in the production of sweets. This highly viscous, sticky syrup must be precisely

dosed to comply with recipe and cost requirements.

Another example is the production of liquorice confectionery. A multi-headed valveless piston metering pump, type D4R 150/70-15/36-25-12 is used here to meter the various additives: from fruit acid solutions to highly viscous yoghurt substances. The stroke length can even be adjusted while the system is in operation.

Whole fruits

A DR 150/70 piston metering pump pumps fruit preparations containing fruit from which whole cherries emerge intact. This ability to meter large pieces in substances is another advantage of the valveless DR piston metering pump.

Although the fruit preparation itself appears harmless, it exerts a high load on the system parts in contact with the substance, as this kind of preparation sometimes contains highly abrasive substances. In addition, the aggressive cleaning agents used in the CIP

cleaning must not affect the surfaces at high temperatures.

A specially tough ceramic is used for the pistons and packing rings in order to minimise the risk of cracking.

The DR 150/70 valveless piston metering pump is designed for back pressures of up to 39 bar because the viscosity of the substance will cause blockages even over 20 bar. Despite this performance data, the pump head can be dismantled easily and quickly for cleaning purposes.

Metering highly viscous mayonnaise preparation containing vegetable pieces

A mayonnaise preparation with vegetable pieces (< 10 mm) is to be metered into approx. 400 ml tubs. Required reproducibility is better than 1 % and the pump is to be cleaned via CIP system.

In a trial, a DR 150/140 was used to feed the substance via a hose (DN 80 mm) from above using no pressure (gravity). On the discharge side the substance was compressed using a filling tube (Ø 20 mm). The pump operates at 70 strokes/min (speed changer-controlled). The metering

reproducibility (gravimetric) is significantly better than 1 %. By matching the form of the filling tube and the reverse suction setting (by tilting the head) it should be possible to achieve 0.5 %. The vegetable content is not visibly damaged. The pump operates effortlessly (3.0 kW motor).

On the basis of this trial a 2-headed pump unit was constructed for integration into a filling system. It is used to transfer 800 ml of preparation into bags.

Film production

A DR 150 has been metering a viscous chemical (45000 cP) at 100 °C (heated head) at 200 bar for 8 years, 24 hours a day in a system producing ultra thin films. The chemical metered is used to

ensure the required surface quality. The high demands on the availability of these kinds of film production systems are effectively met by the piston metering pump.

The following pages give further application examples from different branches of industry.

Metering, feeding and filling using the DR in the food and beverage industry

Requirement	Applications
<ul style="list-style-type: none"> ◆ Highly viscous /viscous 	<ul style="list-style-type: none"> ◆ Groundnut paste in oil DR 150/50. ◆ Fat-based glaze in a packaging machine DR 150/70. ◆ Gelling agent in confectionery production D2R 15/36-12. ◆ Glucose components (highly viscous) to raw substance in sweets production DR 150/70 and DR 150/90. ◆ Yoghurt in a dairy. DR 150/90. ◆ Lactose syrup, 1500 l/h. DR 150/140. ◆ Liquorice paste in sweets production. DR 15/36. ◆ Lecithin in the confectionery industry, 410 l/h at 2 bar. DR 150/70. ◆ Lecithin, semi-liquid. DR 15/18. ◆ Mayonnaise, 150 ml per stroke. DR 150/120. ◆ Milk cream in confectionery production. DR 15/50. ◆ Rape-lecithin mixture at 5 bar and 70 l/h. DR 15/36. ◆ Chocolate paste for filling pastry waffles. DR 15/50. ◆ Confectioner's cream in trial laboratory. DR 15/36. ◆ Tomato paste in a filling machine. D2R 150/90-90. ◆ Separating agents, wax-based. DR 15/18.
<ul style="list-style-type: none"> ◆ Suspended solids 	<ul style="list-style-type: none"> ◆ Delicatessen preparation with cucumber pieces and peppercorns. DR 150/120. ◆ Fish oil with suspended solid content (70 bar) DR 150/25. ◆ Fruit, chocolate or cheese pieces. DR 15/50. ◆ Fruit syrup mixture (dairy operation). DR 15/50. ◆ Vegetable substances with large pieces of vegetable. DR 150/70. ◆ Spice mixtures, free-flowing. DR 15/25. ◆ Liquid cheese with ham pieces. DR 15/50. ◆ Caramel syrup, beetroot juice and alfalfa suspension. D3R 150/25-25-25. ◆ Chocolate fat-based paste with raisins. Requirement: 98 % of the raisins to remain intact. DR 15/90.
<ul style="list-style-type: none"> ◆ Abrasive 	<ul style="list-style-type: none"> ◆ Alcohol solution with icing sugar content, confectionery production. DR 15/12. ◆ Confectionery essences. DR 15/12. ◆ Fruit puree at approx. 25 bar and 1000 l/h. D2R 150/90-90. ◆ Condensed milk with lactose (dairy). DR 15/25.
<ul style="list-style-type: none"> ◆ High temperature 	<ul style="list-style-type: none"> ◆ Pea soup at 90 °C. DR 15/50. ◆ Cocoa butter, melted. DR 15/70. ◆ Citric acid at 8 bar and 80 °C. DR 15/50.
<ul style="list-style-type: none"> ◆ Highly viscous/abrasive ◆ Suspended solids / abrasive 	<ul style="list-style-type: none"> ◆ Sugar substance, highly viscous and abrasive. D3R 150/140-50-36. ◆ Gelatine solutions containing crystals. DR 150/36.

Metering and feeding using the DR in the chemical industry

Requirement	Applications
◆ Suspended solids	<ul style="list-style-type: none"> ◆ Carbamide suspensions in PU foam production. DR 15/12. ◆ Organic solutions at 120 bar. DR 150/25. ◆ Terephthalic acid suspension at 100 bar in the chemical raw materials industry. DR 15/7.
◆ High temperature	<ul style="list-style-type: none"> ◆ Sticky mixtures containing xylene in fine chemistry. DR15/12. ◆ Chemical caprolactam production. 40 bar at 160 °C. DR 150/70. ◆ Diesel with polyethylene at up to 200 °C and 20 bar. Use in a technical lab. DR 15/7. ◆ Liquid wax at 100 °C and 20 bar in the production of a chemical pre-product. D3R 150/50-50-50. ◆ Magnesium dichloride at max. 40 °C in the chemical raw materials industry. DR 15/18. ◆ Mineral oil at 120 bar and 150 °C. DR 15/12. ◆ Suspensions/solvents at 200 °C. DR 15/36. ◆ Tar and pitch in a technical lab. system at 100 bar and ca. 400 °C. DR 150/25.
◆ Suspended solid / abrasive	◆ Solvents for plastic production. D3R 15/5-5-5.
◆ Suspended solids / high temperature	◆ Organic solutions with suspended solids at 86 bar and 120 °C. DR 150/36.
◆ Abrasive / high temperature	<ul style="list-style-type: none"> ◆ Abrasive nickel catalyser at 30 bar and 100 ° for the chemical raw materials industry. DR 150/36. ◆ Suspensions with cooking salt crystals at 240 °C. DR 150/70.
◆ Highly viscous / high pressures	<ul style="list-style-type: none"> ◆ Viscous production, metering of chemicals at high pressures (460 bar). D2R 15/25-25. ◆ Highly viscous products, fine metering of small quantities at 300 bar and 0.1 l/h. DR 15/7. ◆ Plant protection agents at 40 bar. DR 150/50.
◆ Highly viscous / high temperature	<ul style="list-style-type: none"> ◆ Distillery residues, viscous with abrasive solids, 0.1-2.5 l/h at max. 250 °C. DR 15/7. ◆ Resin at 200 °C in a chemical process technology system. DR 15/25. ◆ Resin, pump, decelerators and hardeners, in parallel with a 4-headed pump. D4R 150/140-15/50-25-12. The largest head meters 3000 l/h, the smallest head meters approx. 9 l/h. ◆ Organic residual products, bituminous, from a vacuum vaporiser at 200 °C during operation. DR 15/70. ◆ Polymer substance in fine chemistry at 250 °C. DR 150/70.

Metering and feeding using the DR in the petrochemical industry

Requirement	Applications
◆ Highly viscous	<ul style="list-style-type: none">◆ Highly viscous material mixture with aromatics. DR 15/7.◆ Cerobite at 8 bar. DR 150/18.◆ Silicon oil in small doses (2.5 l/h) (refinery systems). DR 15/7.◆ Wax / oil catalyser at 64 bar. DR 15/7.
◆ Temperature	<ul style="list-style-type: none">◆ Wax catalyser at 72 bar. DR 150/18.◆ Bitumen at 250 °C and 10 bar. DR 15/7.

Metering and feeding using the DR in the pharmaceutical industry

Requirement	Applications
◆ Highly viscous	<ul style="list-style-type: none"> ◆ Stomach gel, viscous, in flat bags on 4-conveyor packaging line. D4R 15/50-50-50-50. ◆ Pharmaceutical products, gel-type, in 10 g flat bags. DR 15/50. ◆ Concentrated sugar solutions in bio-technical processes for the production of active agents. Pharmaceutical active agents. D3R 15/50-12-12.
◆ Highly viscous / temperature	<ul style="list-style-type: none"> ◆ N-butanol at max. 120 bar and 100 °C. DR 150/18. ◆ Raw acetate, 700 l/h at 100 °C. DR 150/50. ◆ Viscous concentrate containing suspended solids at 100 °C. DR 15/50. ◆ Viscous product containing solid particles, approx. 50 µm at 305 bar and 200 °C. DR 150/25.
◆ Suspended solids	<ul style="list-style-type: none"> ◆ Alcohol with caustic soda granules. DR 150/36. ◆ Enzyme solutions. DR 15/12.
◆ Suspended solids / high pressure / high temperature	<ul style="list-style-type: none"> ◆ Substances with suspended solids at 305 bar and 200 °C. DR 150/25.
◆ Fine metering at high pressure	<ul style="list-style-type: none"> ◆ Extremely small quantities of widely varied liquids against max. 500 bar. Control range from 1ml/h to 680 ml/h. Different material versions available. Reproducibility of metering 0.1 %. Temperature range -10 °C to +110 °C. Viscosity range 0.01 mpa to 250 mpa.

Non-standard applications using the DR

Requirement	Applications
<ul style="list-style-type: none"> ◆ Highly viscous /viscous 	<ul style="list-style-type: none"> ◆ Additives, viscous, in the production of adhesives. DR 15/50. ◆ Dyes in the production of moulded parts from liquid resin. DR 150/70. ◆ Gel with acrylic resin in electrode production for EKG devices in the medical industry. D2R 15/70-70. ◆ Liquid resin for casting moulded parts in electrode production. DR 15/25. ◆ Hardeners in the construction industry, 1.200 l/h at 1 bar. D2R 150/90. ◆ Adhesives, 127 l/h at 9.17 bar, D2R 15/50-50. ◆ Adhesive, viscous in film manufacture, to achieve film adhesive characteristics, 200 bar. DR 150/12. ◆ Polymer mixture, viscous, in a water flow. This flow is pumped in the underground crude oil store in order to recover residual crude oil. DR 15/25 and DR 150/36. ◆ Lubricating grease, warehouse components in car-construction. DR 15/50. ◆ Silicon oil, automatic filling of shock absorbers. DR15/30. ◆ Silicon oil, minute quantities (drops), for moistening preservatives. DR 15/12. ◆ Viscous materials in cement production. DR 15/50. ◆ Pre-product in the manufacture of carpet binders. DR 150/50.
<ul style="list-style-type: none"> ◆ Suspended solids 	<ul style="list-style-type: none"> ◆ Aqueous dispersion for Plexiglas production. DR 150/50 and DR 150/140.
<ul style="list-style-type: none"> ◆ Abrasive 	<ul style="list-style-type: none"> ◆ Used oil with sludge in environmental technology systems. DR 15/12. ◆ Colour paste with abrasive components (TiO₂). D2R 15/12-12. ◆ Methyl / silicon salt solution, aqueous, in the manufacture of high quality building boards. D2R 15/90-90. ◆ NaOH (27%) in dye/paint manufacture.. DR 15/12.
<ul style="list-style-type: none"> ◆ High temperature 	<ul style="list-style-type: none"> ◆ Carbon and oil suspension in technical systems for petrol recovery. 190 bar at 90 °C. DR 15/7. ◆ Oil and sludge mix in environmental technology systems at 150 °C. DR15/7.
<ul style="list-style-type: none"> ◆ Highly viscous / high temperature 	<ul style="list-style-type: none"> ◆ Pitch, liquid, for sealing contact surfaces on graphite electrodes. D2R 15/25-25. ◆ Pitch, liquid, at temperatures of over 100 °C. DR 15/7. ◆ Silicon gel for pouring into moulds, 70 bar at 150 °C. DR 15/18. ◆ Beer grains, shredded at 200 bar. DR 150/36.
<ul style="list-style-type: none"> ◆ High temperature / high pressure 	<ul style="list-style-type: none"> ◆ Crude oil product with synthetic pieces in a recycling system for recovery of mineral oil, 250 bar at 200 °C. DR15/7. ◆ Carbon and oil suspension in a technical system for the production of petrol. Paste-type substance with suspended solids. The pump, made of hard metal, was operated at temperatures of max. 150 °C. DR 15/12.
<ul style="list-style-type: none"> ◆ Suspended solids / high temperature 	<ul style="list-style-type: none"> ◆ Crude oil product with synthetic pieces in a recycling system for recovery of mineral oil, 250 bar at 200 °C. DR15/7. ◆ Carbon and oil suspension in a technical system for the production of petrol. Paste-type substance with suspended solids. The pump, made of hard metal, was operated at temperatures of max. 150 °C. DR 15/12.

The function principle of the valveless piston metering pump

The basis of the function and the performance features of the piston metering pump is the combination of two functions into a single pump.

The pump piston is the only **positive displacement element**. Its form and action cause the inlet and outlet to open alternately.

The metering piston actuates two overlapping actions (see fig. 1):

1. Oscillating action (inherent positive displacement action)

2. Rotary action (controlled opening / closure of suction and discharge side)

The harmonious oscillation of the displacement action in conjunction with the size of the cross-section creates almost constant priming/discharge flow speeds, whichever connection is open at the time. This makes it possible to meter highly viscous liquids, and liquids containing suspended particles. The pump process produces minimum product shear and the feed action is consequently relatively gentle.

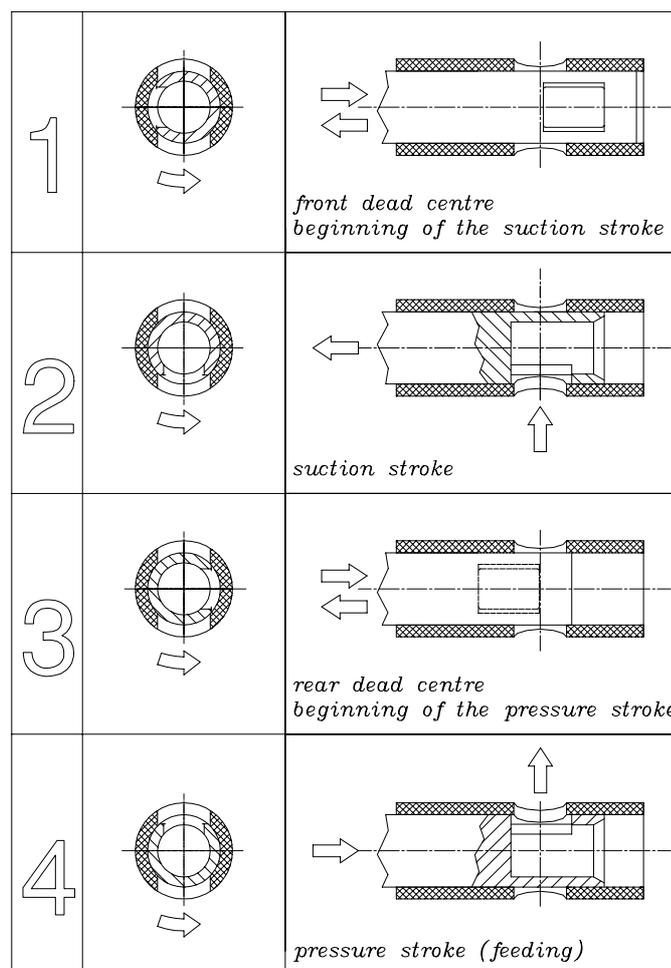
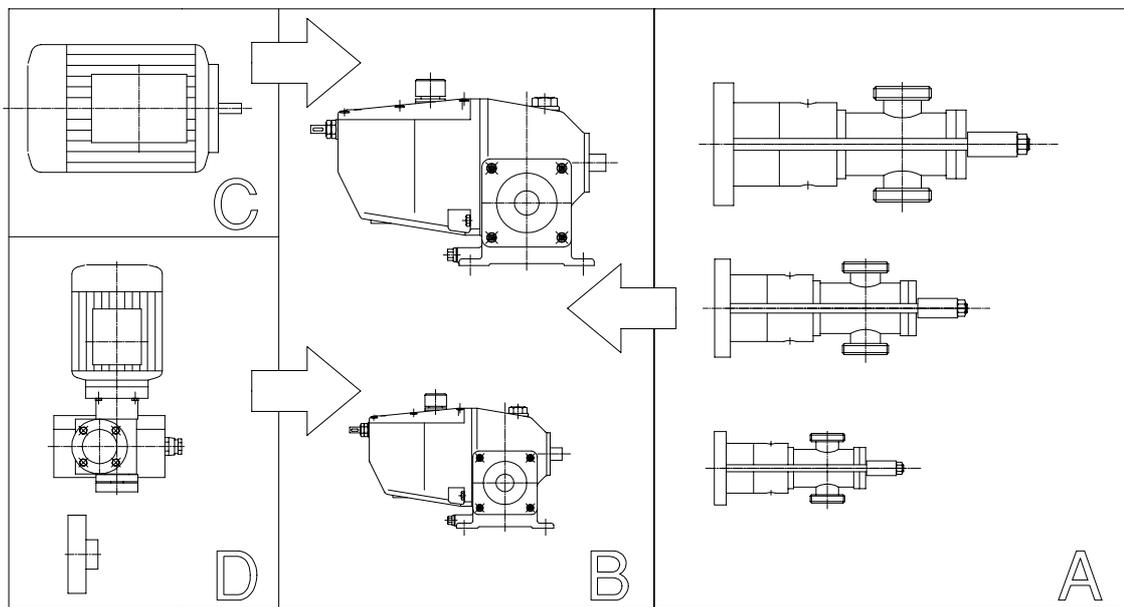


Figure 1: The function principle of the DR metering pump

The structure of the valveless piston metering pump

Backing up the DR piston metering pump is a complete modular system which is designed and constructed to provide commercially effective metering solutions. The basic pump components are shown in Figs. 1 and 2. The modular principle makes it

simple to combine different pump sizes to create a multi-headed unit. As a result it is possible to vary the capacity range (feed rate) accordingly or to meter different products at the same time in any quantity.



	<i>designation</i>	<i>types</i>
A	<i>pump head</i>	<i>different sizes, connections, materials, heatable design</i>
B	<i>crank drive</i>	<i>Rb15, Rb150 – dependent on power, any combinable (multi-head)</i>
C	<i>drive</i>	<i>motors of all types (normal design, ex-design, ...)</i>
D	<i>stroke adjustment</i>	<i>manual, electrical, pneumatical, with/without controller</i>

Figure 2: The modular principle underlying the DR piston metering pump enables optimum adaptation of the unit to practically any metering application.

The pump drive mechanism

The characteristic positive displacement action is produced by Rb stroke-adjustable drive mechanisms. These mechanisms are tried and tested robust components of the pump unit and are available in two capacity classes:

1. Drive mechanism type Rb 15, max. piston force 1,800 N, 15 mm stroke length
2. Drive mechanism type Rb 150 max. piston force 15,000 N, 32 mm stroke length

The drive mechanisms are such that power and movement are transferred,

with no jarring and therefore low-wear. An integrated worm gear translates the motor speed into the required stroking rate for the pump. The drive mechanism stroke adjustment, which is displayed via a meter, allows precise adjustment of each metering quantity thereby enabling integration into measurement and control systems. Fig. 3 shows the kinematic principle of the Rb drive mechanism.

The drive mechanism stroke can be adjusted manually or by electrical means. An optional controller ([0]..4-20mA) allows simple incorporation of the pump into process systems.

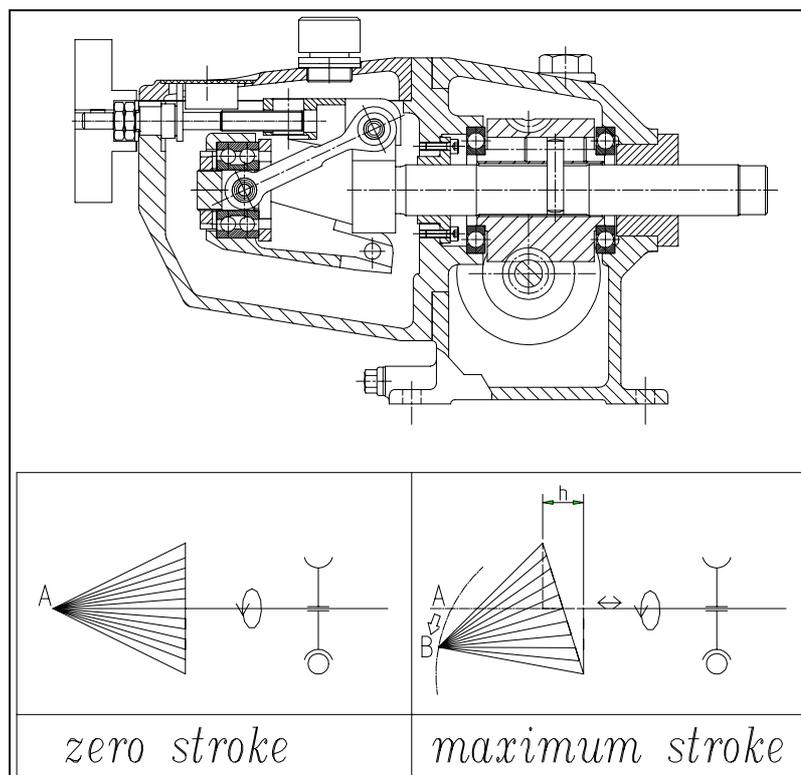


Figure 3: The Rb type drive mechanism produces the necessary positive displacement kinematics of the metering piston

The liquid end in the valveless piston metering pump

The piston metering pump liquid end is characterised by operating reliability due to its simple, robust construction. It is easy to dismantle and the liquid

end is therefore easy to clean and maintain. There are three basic designs:

1. Rotary control piston head type DK (with lip seals, see Fig. 4)

The metering piston liquid end comprises a surface treated, ground metering piston, the metering cylinder (also surface treated) with welded connectors and flushing lanterns, sealed at each side. The liquid end is optionally supplied with a heating jacket.

The flushing valve makes it possible to flush material away from the piston or to introduce a sealing medium at this point. The surface treatment is a highly wear, moisture and corrosion-resistant thermally sprayed metal Eutalloy®-coating. The entire construction is tensioned via a tensioning flange with two bolts. The liquid end can be simply dismantled by undoing the two nuts.

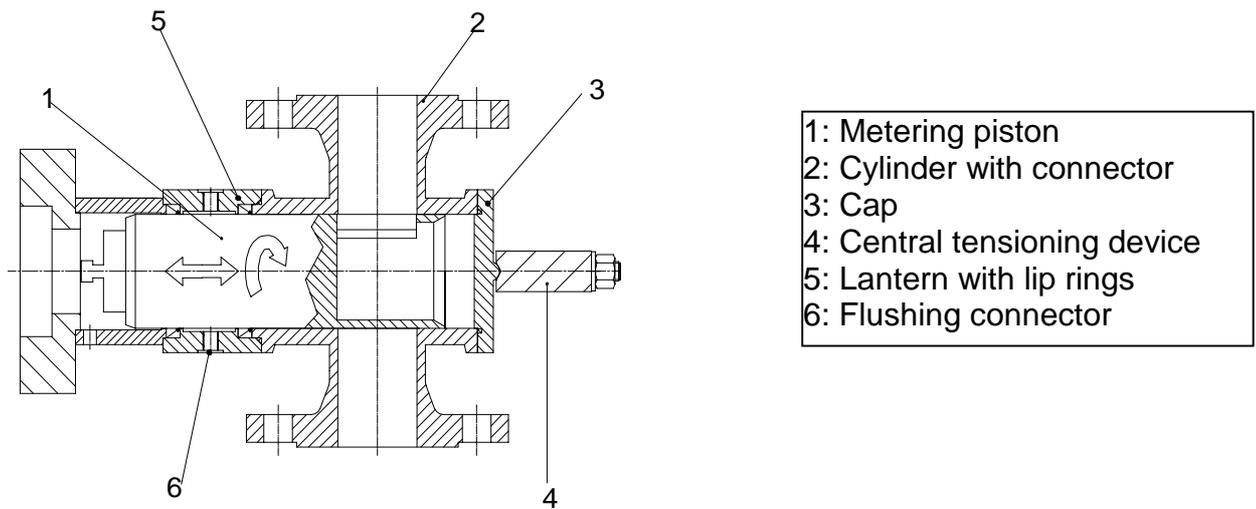
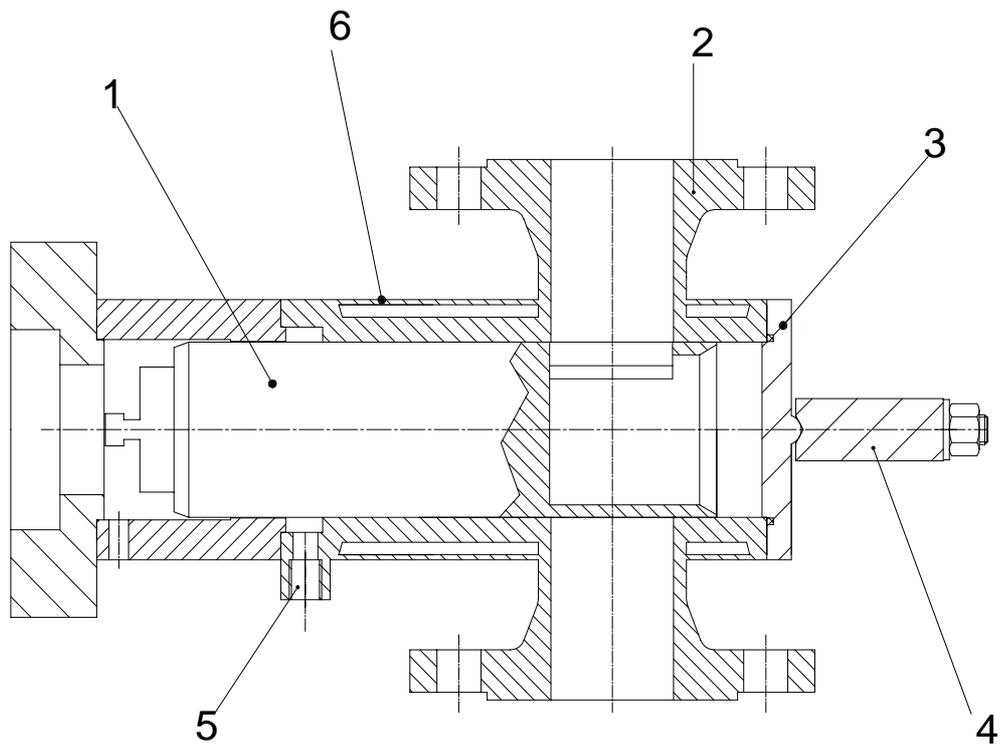


Figure 4: Cross section of the DK metering piston liquid end (lip version) with lantern. The entire liquid end can be simply dismantled by undoing the central tensioning device.

2. Rotary control piston head type DKm (metal seal version, see Fig. 5)
 The essential difference between this and the first version is the omission of the sealed lantern and a longer piston

sealing surface. Leakage can be drained off via the flushing connector. The omission of the seals allows the pump to operate at up to 400 °C.

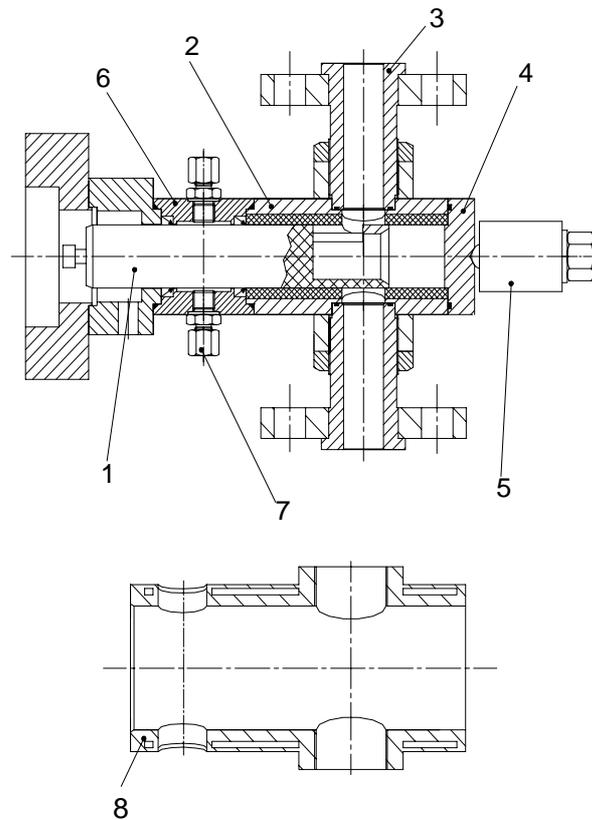


- | |
|--|
| 1: Metering piston
2: Cylinder with connector
3: Cap
4: Central tensing device
5: Flushing connector
6: Heating jacket (optional) |
|--|

Figure 5: Cross section of the DKm type metering piston liquid end. The seal is formed by the gap defined between the metering piston and the cylinder. This version is particularly suited for high temperature use.

3. Rotary control piston head type DKb (design incorporates cylinder liner with easily interchangeable piston/cylinder pairing, see Fig. 6)
 This liquid end was designed to withstand highly abrasive substances. It is chiefly characterised by its easily interchangeable ceramic or metal cylinder liner. This design offers good

mechanical resistance properties and parts which are relatively easy to replace since, in contrast to conventional designs, they are not connected to the heating jacket or to the connectors. The heating jacket can be optionally retrofitted at any time.



- | |
|---|
| 1: Metering piston
2: Cylinder liner
3: Separate connector
4: Cap
5: Central tensioning device
6: Lantern with lip rings
7: Flushing connector
8: Heating jacket (retrofit option) |
|---|

Figure 6: Cross section of the DKb type piston metering pump with retrofittable heating jacket and easily replaceable cylinder liner.

Seals

In all three versions the sealing function is carried out by the piston fitted into the cylinder. A defined clearance is selected for the corresponding pump head size, depending upon the temperature and

viscosity of the metering substance. The leakage volume is then determined. In the case of highly viscous substances, however, and depending upon the pressure, this is generally negligible.

Heating

All three liquid ends can be supplied as heated or non-heated versions. The liquid end is isolated from the drive mechanism for use in high

temperatures (>150 °C to 400 °C) via an additional subassembly (temperature lock) which protects the liquid end from overheating.

Application range

The liquid end can be supplied with nearly all commercially available connectors (flanges, externally/internally male/female threaded connectors). The material and choice

of seals depends on the intended application. Different liquid end sizes can cover a capacity range of 0.15 l/h to 3 m³/h. The DR can operate at pressures up to 630 bar.

Use of the valveless piston metering pump

The construction of the piston metering pump means that it can be adapted to a wide range of metering applications. Along with horizontal and vertical feed options, metering can be reversed at any point. By tilting the liquid end it is possible to achieve a smooth reverse suction action (see Fig. 7). Twisting the connector sleeve to stop the flow

reverses the priming and discharge phases. The pump, depending upon the angle of the liquid end, then sucks a predetermined volume of liquid back out of the discharge tubing. This feature is particularly significant when a clean break of the flow into a filling station is required.

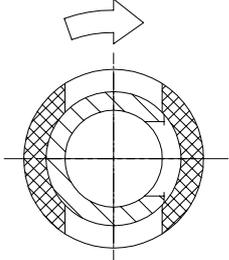
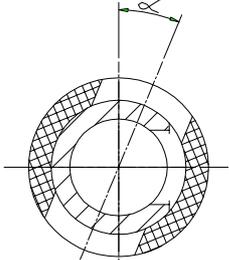
<p>1</p> 	<p>no resuction:</p> <p><i>For a short moment the suction- and pressure sockets in the dead centres of the pump are closed momentary for the same time.</i></p> <p><i>The suction stroke starts with the backward movement of the piston.</i></p> <p>-> <i>resuction = 0</i></p>
<p>2</p> 	<p>resuction</p> <p><i>The pressure socket is partial open at the start of the suction stroke (backward movement of the piston).</i></p> <p><i>A part of the stroke volume (dV) is sucked back from the pressure line.</i></p> <p>-> <i>resuction dV = f (α)</i></p>

Figure 7: Setting a defined reverse suction action by tilting the pump cylinder of the DR type piston metering pump

The characteristic pressure-independent curve for oscillating positive displacement pumps applies equally to the piston metering pump (Figure 8). It is therefore possible to

achieve optimum reproducibility of pre-set feed rates even at the highest flow volumes and pressure variations. The control range of the pump is at least 1:50 allowing precise metering of

widely differing volumes at any one time. At constant operating conditions,

feed fluctuation is less than <0.5% of the overall flow.

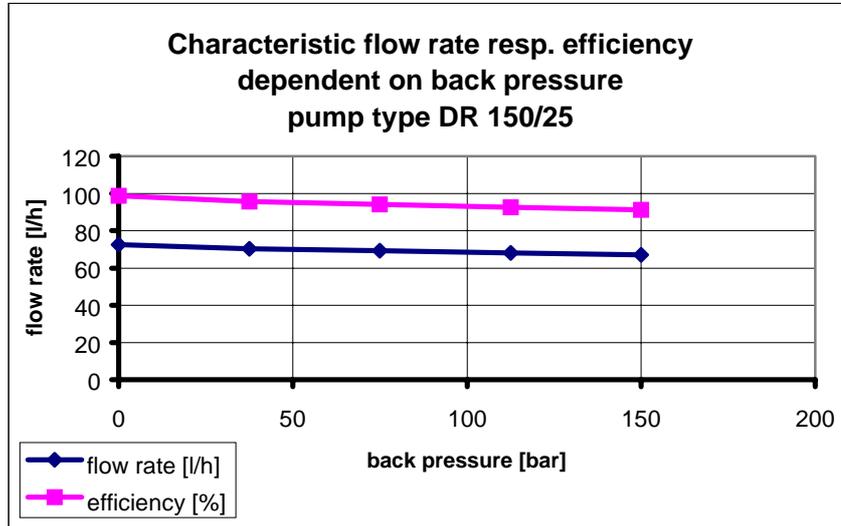


Figure 8

Linearity and the digital feed profile, already familiar features of the conventional metering pumps (piston and diaphragm metering pumps), offer

users considerable advantages when metering “difficult” substances (Figure 9). These features also greatly facilitate integration into a control cycle.

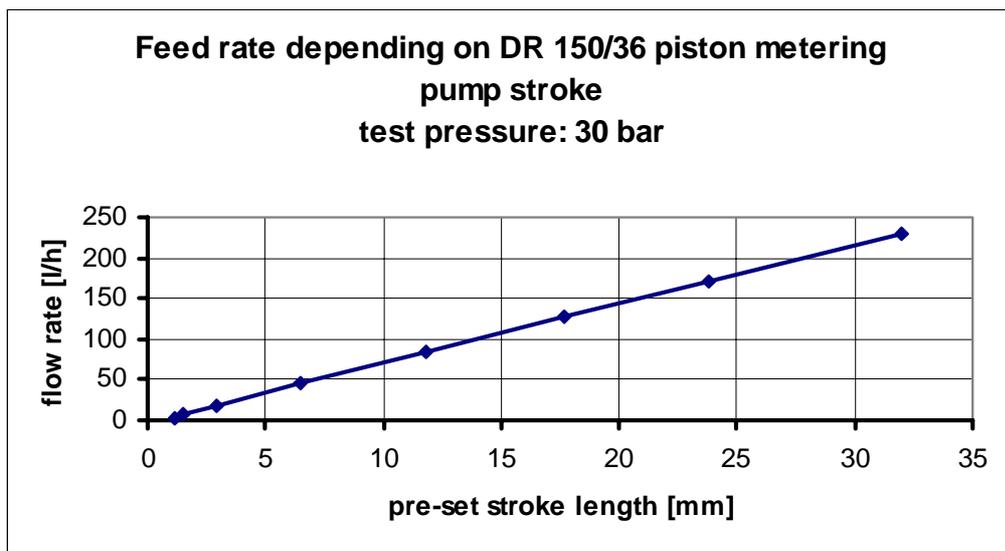


Figure 9

Technical details

Figure 10 gives the performance data of typical rotary positive displacement pumps used in the metering of highly viscous substances, as compared with

the ORLITA®-DR piston metering pump.

Pump type	Used as	Pressure up to [bar]	Feed rate [m ³ /h]	Viscosity range [mm ² /s]	Metered substances
Gear pump	Feed pump	25	max. 100	10 - 4.000	Good and poor lubrication
	Hydraulic pump	300	max. 10	10 - 1.500	Good lubrication
Screw pump	Feed pump	75	max. 1.100	1 - 100.000	Good to no lubrication
Rotary piston pump	Feed pump	20	Max. 500	1 - 100.000	Good to no lubrication, occasionally suspended particles
Worm gear pump	Feed pump	35	Max. 600	1 - 500.000	Good to no lubrication, occasionally suspended particles
Vane pump	Feed pump	25	max. 25	16 - 800	Good to no lubrication
	Hydraulic pump	200	max. 25	16 - 800	Hydraulic oils
Peristaltic pump	Feed pump	15	0.001 – 85	1 - 100,000	Good to no lubrication
DR piston metering pump	Feed and metering pump	630	Max. 3	1 – 1,000,000	Good to no lubrication, with suspended particles and containing pieces

Figure 10: Performance data of typical rotary positive displacement pumps as compared with the DR piston metering pump

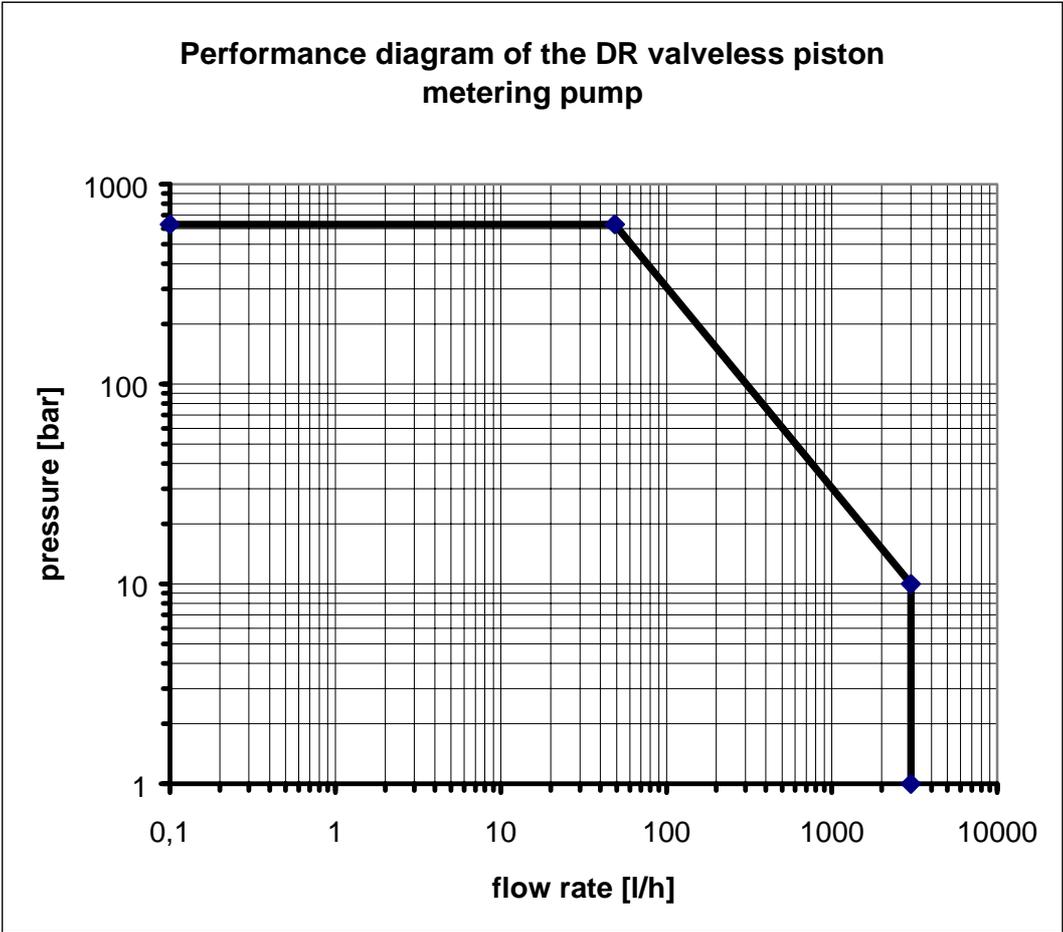


Figure 11: Performance range of a single cylinder version DR at 112 min^{-1} ; $Q \text{ max. } 3300$