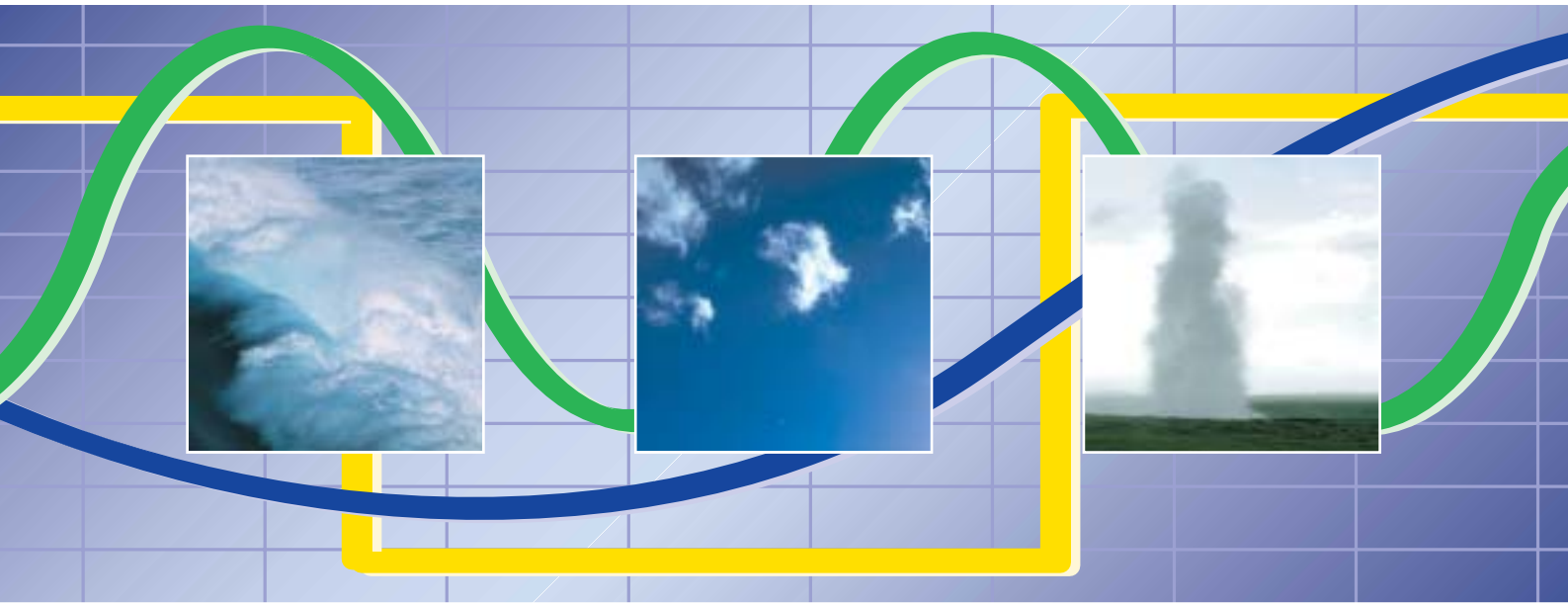
PROPORTIONAL TECHNOLOGY

PRECISE CONTROL OF PRESSURE AND FLOW



ASCO®
JOUCOMATIC

IMPROVED
QUALITY AND PERFORMANCE

The ever-increasing demand for quality, precision, productivity, easy handling, user friendliness, service etc. calls for high standards from operating and manufacturing equipment and machines. High standards can only be achieved if physical variables (e.g. temperature, pressure, force, velocity, torque etc.) are precisely adjusted to the respective operating conditions, i.e. a continuous adjustment of these variables is the important factor.

In this kind of control, generally called proportional technology, solenoid valves with control solenoids (pneumatics, hydraulics, fluid technology) play a significant role.

Proportional valves allow to control a fluid in proportion to an electronic input value. The combination of these valves with control electronics improves their level of precision and expands their range of applications.

PROPORTIONAL TECHNOLOGY

CONTENTS

FOR INCREASED QUALITY, PROCESS SECURITY AND ECONOMY

Proportional valves maximise production processes in all automated production sequences in engineering, food processing, textile industry, industrial plant engineering, medical technology, pharmaceutical and automobile industries. They are used in run-off control systems, remote control systems and in programmable loop control systems.

Distances, speed and forces need to be controlled in all processes in which cycles of operation are repeated. As a rule, proportional valves are a reliable mean of controlling these parameters in an easy, flexible and economic manner. Their performance is above average and retooling can be done easily and quickly. The pressure sensor monitors the proportional valves allowing them to permanently control their functions.

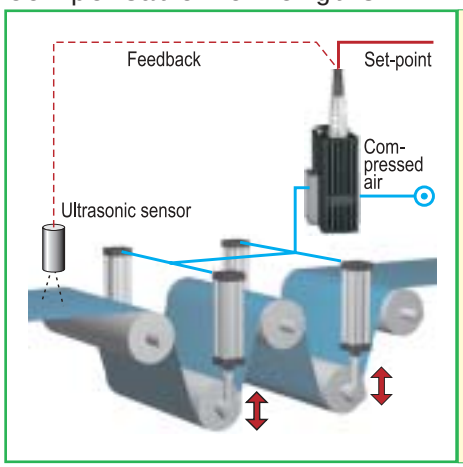
Control systems over large distances using hydraulic or pneumatic lines can often only be realised to a limited extent (e.g. in large plants or in case of risk for an operator). If so, it is preferable to use proportional valves that can be controlled with power lines of any length. The transmission of the signals can be adapted to the user's needs, it is inertia-free and not influenced by either pressure or temperature.

Proportional valves play a major part in programmable control systems. The combination of intelligent electronics and powerful pneumatics is constantly creating new, innovative solutions for the most varied kinds of applications.

ASCO/JOUCOMATIC's engineers advise and support you in all questions relating to designing and optimising your production process. Our qualified product specialists for individual sectors of the market can draw on a wealth of knowledge and experience. Besides standard solutions, we have been developing customised components and adaptations to specific requirements for many years.

PRESSURE CONTROL

Compensation of lengths in winding

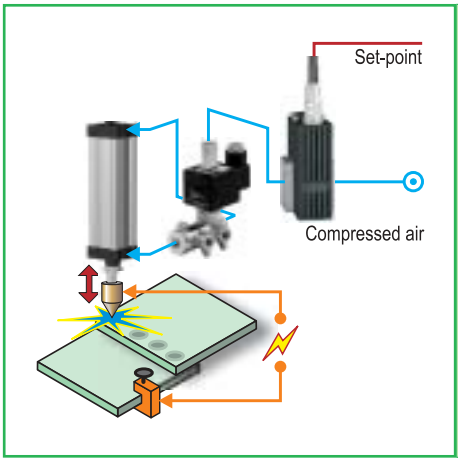


Different lengths of winding material are offset with cylinders piloted by proportional pressure regulators. The tensile stress is controlled at the same time.

APPLICATIONS

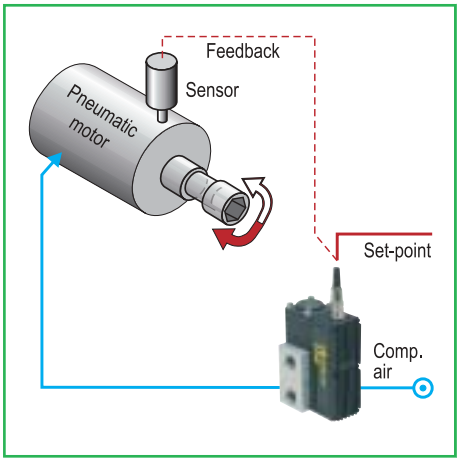
PRESSURE CONTROL

Spot welding



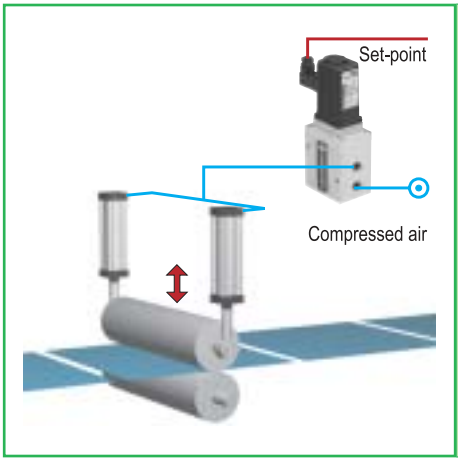
The proportional pressure regulator controls the pinching force of the welding head depending on the material to be welded and its thickness.

Control of speed and torque



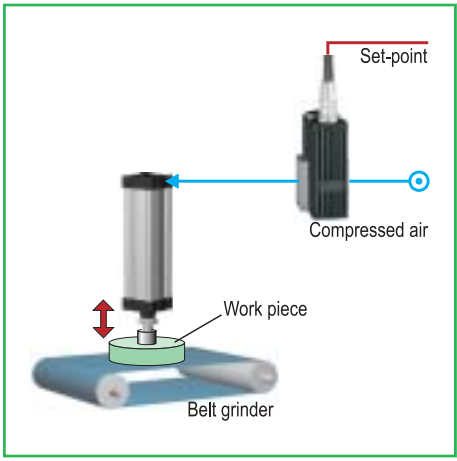
Speed and torque are controlled by changing the pilot pressure.

Thickness compensation



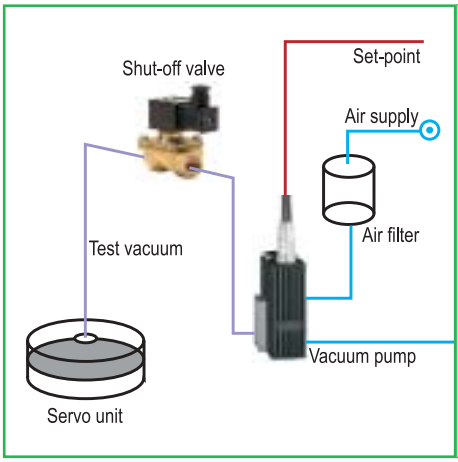
The pressure acting against the roller is controlled with a proportional pressure regulator. Different thickness in the materials is offset.

Force



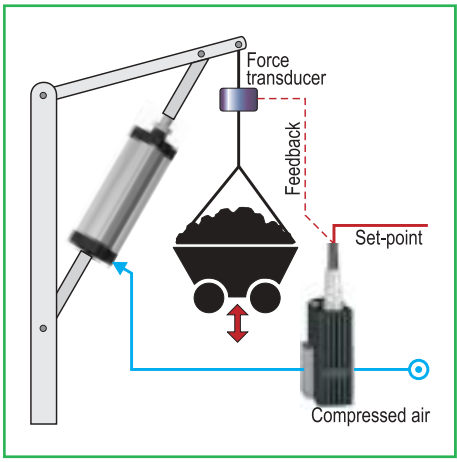
The proportional valve controls the force acting against work pieces on grinding belts, pneumatic presses etc.

Servo unit for brakes



The proportional pressure regulator is incorporated in the bypass of a vacuum pump. The brake booster is checked against the set-point.

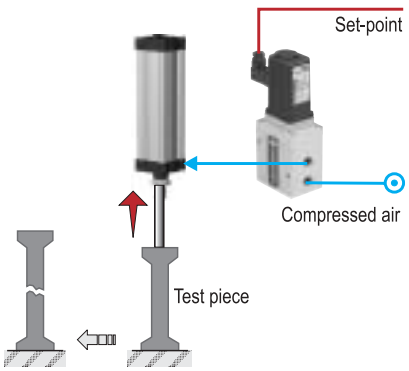
Balancer



The proportional valve pneumatically balances the weight over the cylinder pressure. Heavy loads can easily be lifted and lowered by hand.

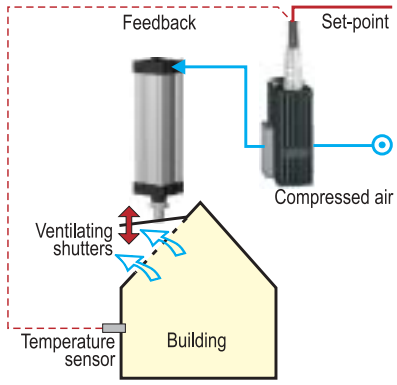
PRESSURE CONTROL

Material testing



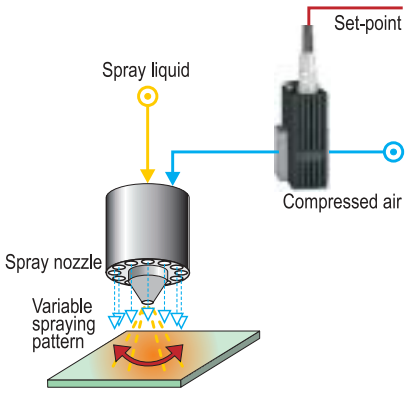
The force acting against the test piece is continuously increased until the test piece is destroyed.

Temperature control



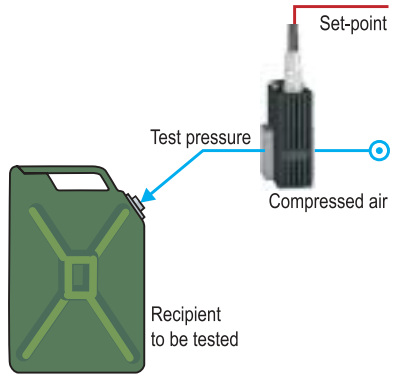
The room temperature is held at a constant level by opening or closing ventilating shutters.

Fluid coating



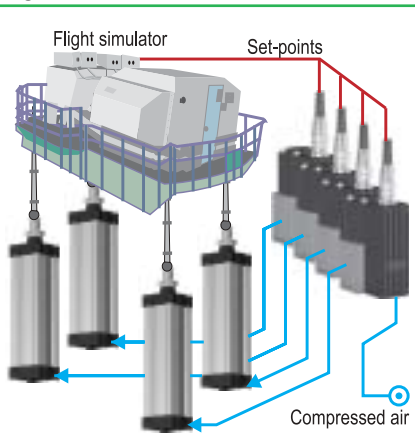
The spray pattern, i.e. the coating width, is adjusted by controlling the air supply through fan adjusting nozzles.

Leak test



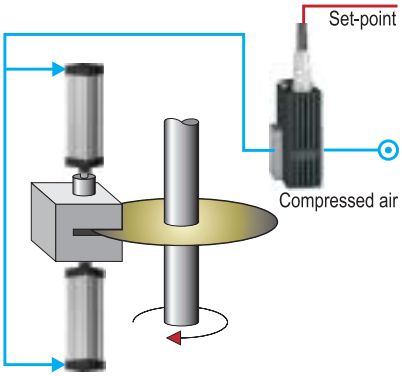
The proportional pressure regulator precisely adjusts the test pressure to the different test pieces for leak test purposes.

Flight simulator



The movements of an aircraft are simulated by applying different pilot pressures to the cylinders.

Brake pressure

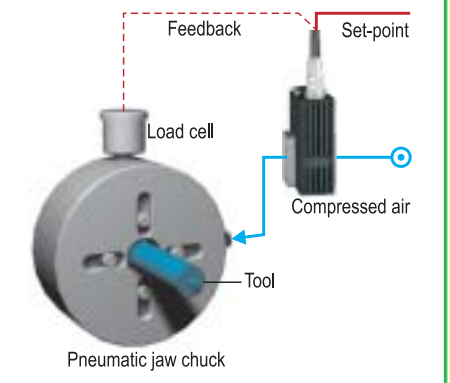


A set-point signal is used to gradually brake and slow down a rotating mass in accordance with the controller's speed profile.

APPLICATIONS

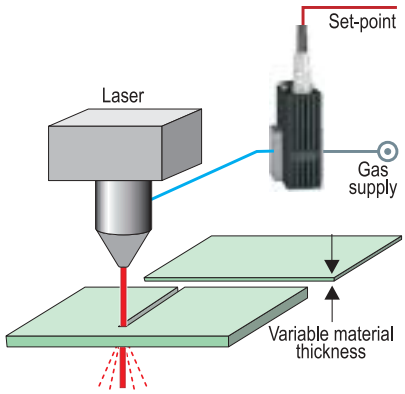
PRESSURE CONTROL

Clamping pressure control



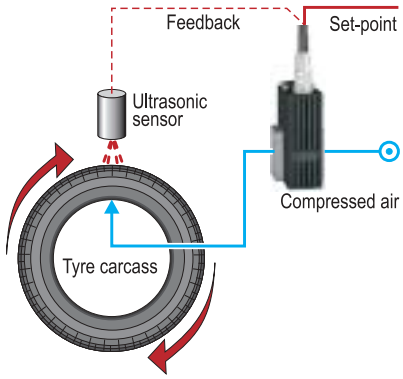
The clamping pressure of machine tools is adjusted in accordance with the materials being used (steel, synthetic material, etc.).

Laser cutting



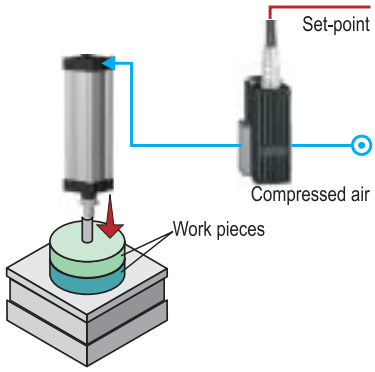
The gas pressure is adjusted in accordance with the material and its thickness.

Tyre making



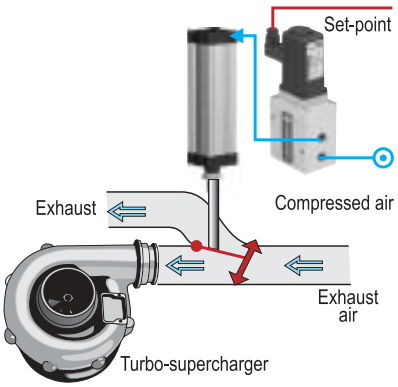
Controlled by the proportional pressure regulator in dependence on the tyre's diameter, the individual plies of the tyre are built up and a constant tyre quality is ensured.

Ultrasonic welding



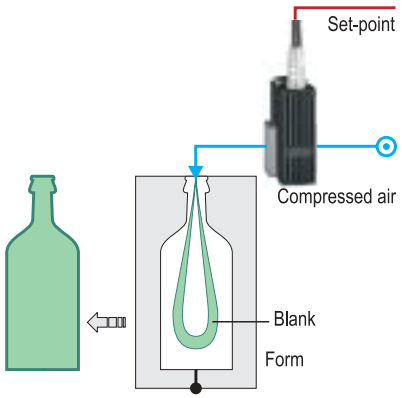
The proportional pressure regulator adjusts the frictional pressure of ultrasonic welding machines.

Turbo-supercharger



Exhaust gas flow is adjusted to the turbo-supercharger depending on the engine speed to maintain the charging pressure at a constant level.

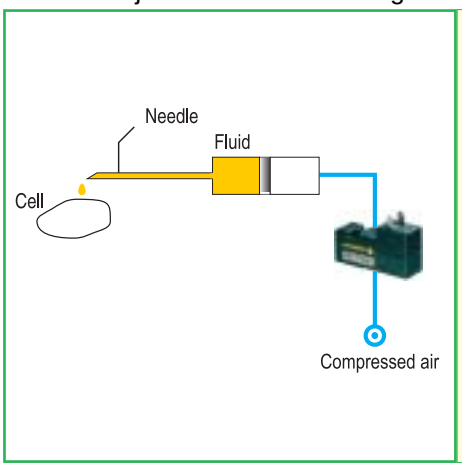
Bottle moulding



The blank is inflated to its optimal form via a proportional valve.

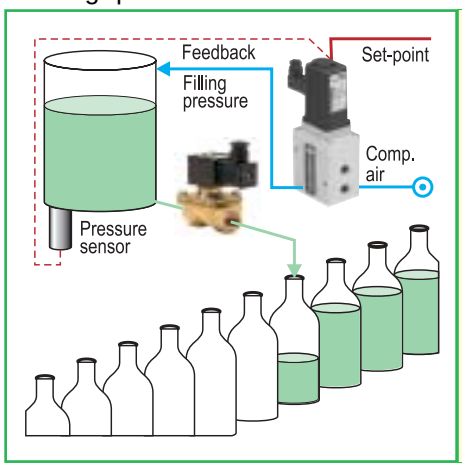
PRESSURE CONTROL

Micro-injection into living cells



A miniature proportional valve adjusts the air pressure injected into a syringe to control the injection pressure needed to transfer aqueous solutions into living cells.

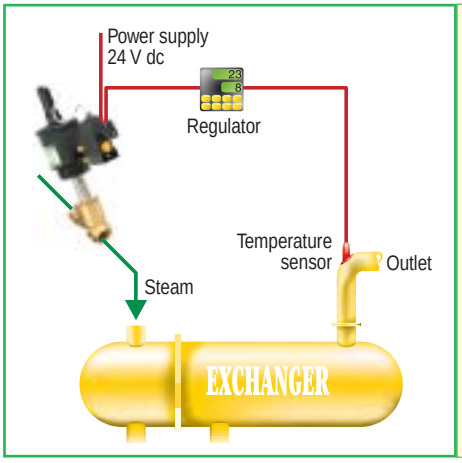
Filling pressure



The liquid flows to the valve at a constant pressure irrespective of the fluid level in the storage tank. The filling volume remains constant.

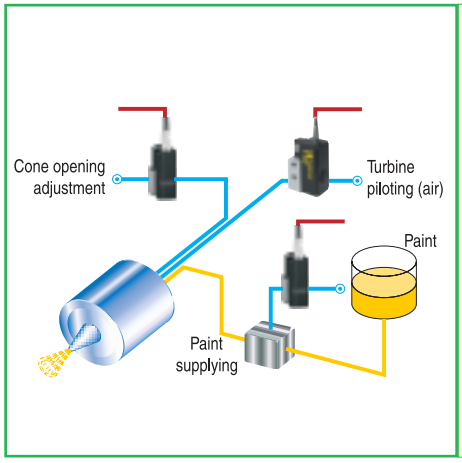
FLOW CONTROL

Heat exchanger



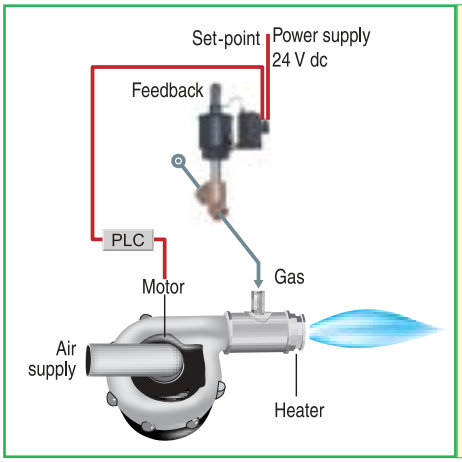
A proportional valve adjusts the flow of steam until the desired temperature at the exchanger outlet is reached.

Paint spray gun



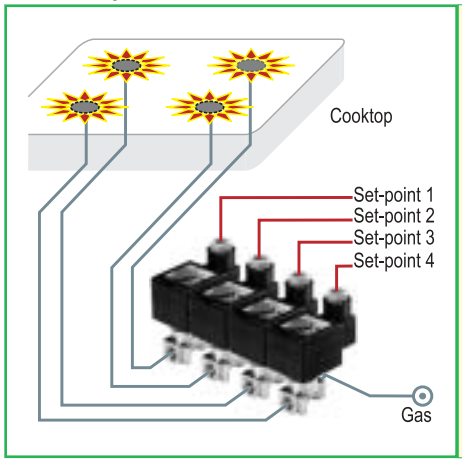
Spray gun control: Control of paint flow and spray density, and of the surface of the part being painted.

Oven burner



A proportional valve adjusts the flow of gas to the burner until you have the desired flame (heat) at the output.

Gas adjustment

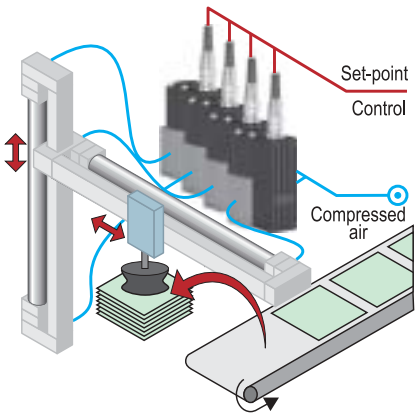


The control unit uses four proportional valves to regulate the gas supply to the four burners.

APPLICATIONS

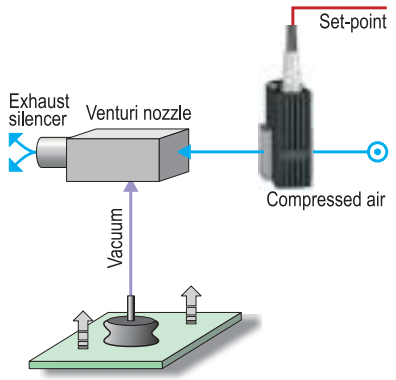
FLOW CONTROL

Positioning



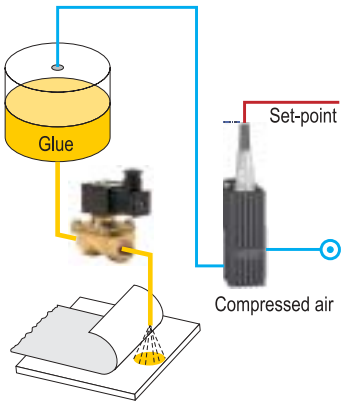
Servovalves control the positions on palletising installations with distance sensors (linear potentiometers) mounted to rodless cylinders.

Vacuum generation



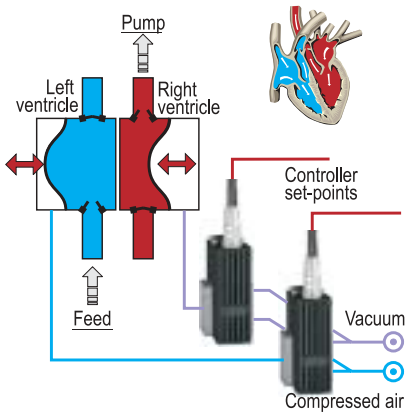
A modification of the inlet pressure at the vacuum generator via the proportional valve changes the vacuum generated.

Glue proportioning



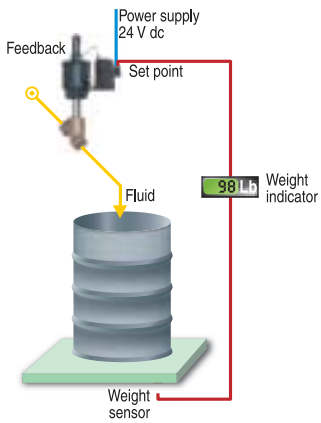
The proportional pressure regulator controls the pressure in dependence on the set-point. The volume of glue dispensed is dosed accordingly.

Artificial heart



Blood is pumped through an artificial heart by alternately applying pressure or vacuum.

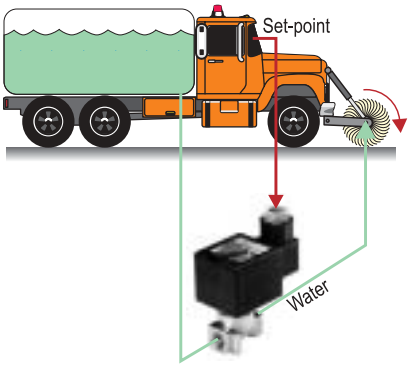
Filling system



A proportional valve regulates the filling rate of the barrel until the barrel's desired weight is reached.

The system allows for quick filling times and achieves an optimum balance between precision and weight.

Volume control



A proportional volume valve continually regulates the water supply to the brush of a road sweeper.

	Connection	Pilot pressure	Operating pressure	Flow	Air Filtration	Hysteresis	Max. power	Technology	Fail-safe behaviour
new SENTRONIC D	G1/8 1/4 3/8	-	0 to 10 bar	-	50 µm	< 1%	21 to 40 W	Poppet valve	Pressure released
SENTRONIC	G1/8 1/4 1/2 1	-	Vacuum to 50 bar	-	50 µm	< 1%	15 to 44 W	Poppet valve	Pressure released
PULSTRONIC	M5 G1/8 1/4 1/2	-	0 to 10 bar	7 to 4000 l/min (NAR)	50 µm	< 1%	3.6 W	Pilot + booster	Pressure held
SERVOTRONIC	G1/4	-	0 to 16 bar	0 to 1400 l/min (NAR)	5 µm	< 0,5%	30 W	Spool-sleeve assembly	Pressure held or pressure released
PIEZOTRONIC	M5 G1/8	-	0 to 8 bar	0.086 to 0.12 l/min (Kv)	5 µm	10 to 15%	0.007 W	Multi-layer construc-tion	Pressure held or pressure released
POSIFLOW	M5 G1/8 1/4 3/8 1/2	-	Vacuum to 16 bar	0.3 to 35 l/min (Kv)	-	< 5%	3 to 11 W	Core and plugnut	Immediate tight-closure
290/390 VALVES POSIMATIC	G1/2 to G2½ Flange, clamp, butt welding versions	4 to 10 bar	0 to 16 bar	77 to 1233 l/min (Kv)	50 µm	< 1%	3.6 W	Profiled disc (2/2) or standard flat disc (3/2)	Pressure released
290/390 VALVES COMPACT POSITIONER		4 to 6 bar					7.2 W		Pressure held or pressure released

CHOICE OF EQUIPMENT

	CONTROL		FLUID				PRECISION		PILOT CONTROL						
	Pressure	Flow	Vacuum	Air/neutral gas	Liquids	Steam	Open loop	Closed loop	Electric	Electro-pneumatic	Static	Dynamic	Step-by-step	Special characteristics
new SENTRONIC D Pages 10-11	●			●				●	●		■	▲	⌐	**Digital** with or without display (pressure- and manual adjustment LEDs) Parameter control
SENTRONIC Pages 12-13	●		●	●			●	●	●		■	▲	⌐	**Analog** **Wide range of applications** **High-frequency set-point** **Very short response times** **High level of accuracy**
PULSTRONIC Pages 14-15	●			●				●	●		■		⌐	Low-cost pressure regulation M5 version with booster control
SERVOTRONIC Pages 16-17	●	●		●					●		■	▲	⌐	Very short response times
PIEZOTRONIC Pages 18-19		●		●			●		●		■		⌐	Very low power consumption Unlimited service life > 1 billion cycles Multi-voltage valve
POSIFLOW Pages 20-21		●	●	●	●		●		●		■		⌐	High resistance to pressure peaks Exceptional service life
290/390 VALVES POSIMATIC Pages 22-23		●	●	●	●	●		●		●	■	▲	⌐	**Digital** **Programmable** **Flow control** **Parameters**
290/390 VALVES COMPACT POSITIONER Pages 22-23		●	●	●	●	●		●		●	■	▲	⌐	**Analog** Compact design Factory-set adjustments

■ **Static :** *Application with few changes of the set-point.*

▲ **Dynamic :** *Application with changes of the set-point at high frequency.*

⌐ **Step-by-step :** *Application with changes of the set-point at low frequency .*

PRESSURE CONTROL

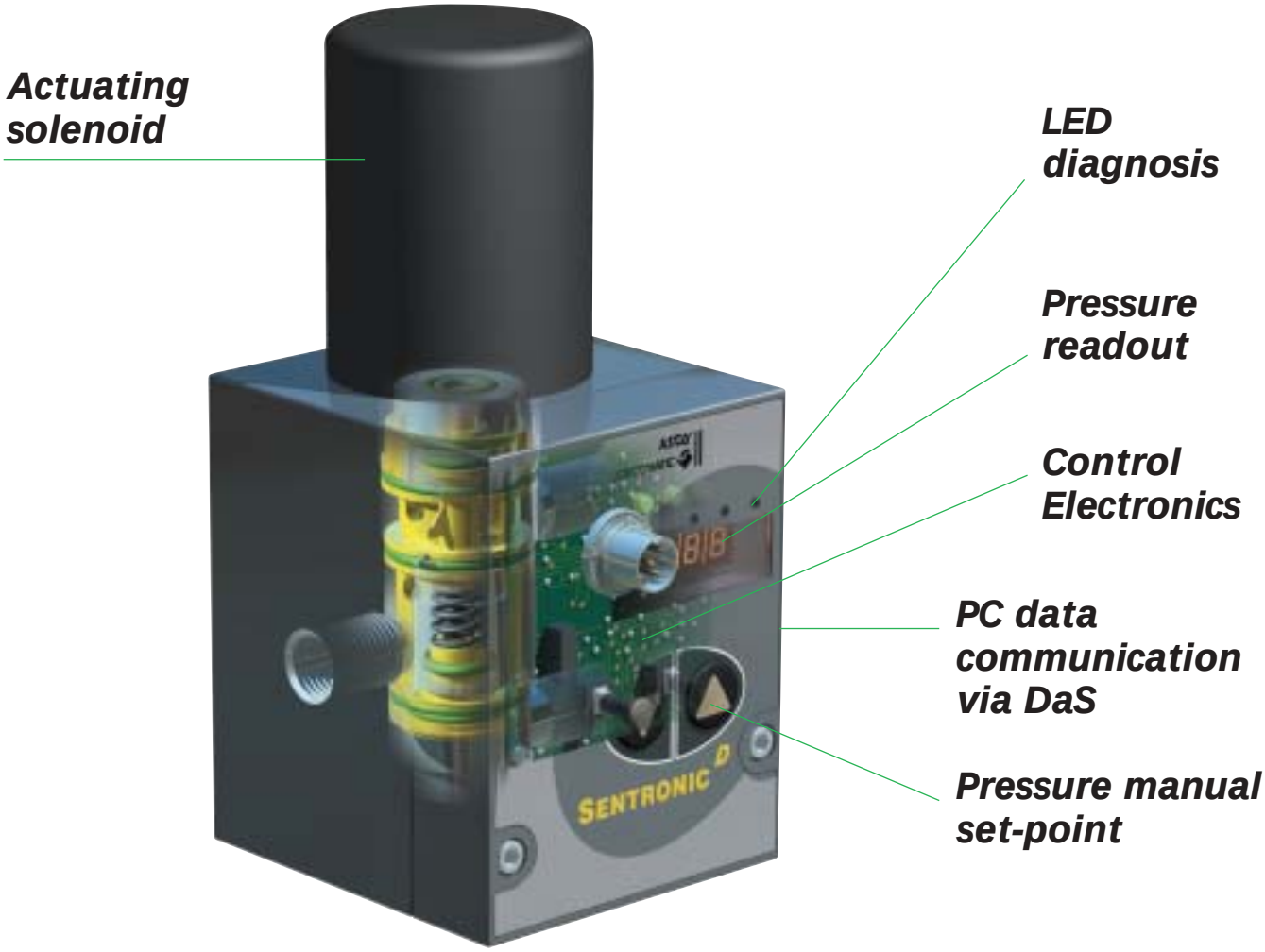
SENTRONIC^{D}: A new generation of DIGITAL electronic pressure regulators:

DIRECT OPERATED: precise control and quick response times

DYNAMIC: short stabilising periods and low oscillation frequency

Gives you full control over the parameters used inside the valve:

- Manual control: the incorporated DISPLAY and the two push-buttons enable pressure readout, pressure manual set-point and LED diagnosis
- Computer control:
  - Parameters features: this flexibility allows you to adapt the valve to your application and optimise its response time, accuracy and pressure control
  - Valve diagnosis: read valve information such as serial number and valve temperature, and watch the operation time using the operation counter. Read valve status and perform test functions for installation and service.
- Storage of parameters: once the optimal parameters are determined, you can store them in a project file for your personal use, or you may forward the file to our Product Support Department for future serial production.



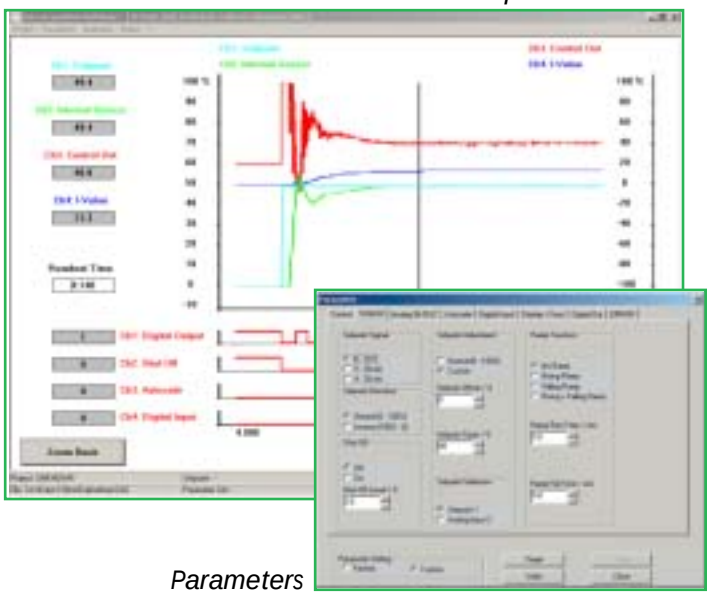
SENTRONIC^{D}

With the **D**ata **a**cquisition **S**oftware and RS 232 interface, it's now possible to adapt the controller to the control loop in an optimal way.
Adjusted valve status can be read out. The adaptation of the PID parameters to the loop control is adjustable with ***DaS*** and the result can be seen immediately with the scope function. The transients are logged by the scope function and can be read out immediately.

FULL CONTROL WITH THE *DaS* SOFTWARE

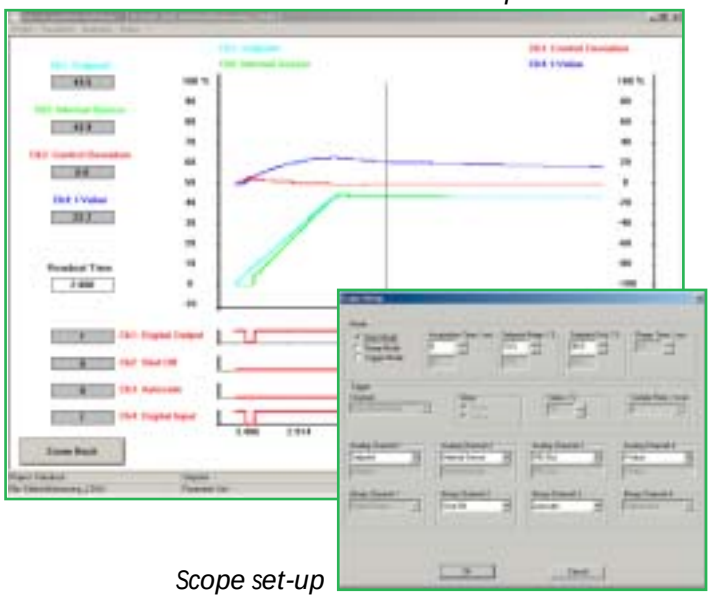
Signal generator and scope function

Step test function



Parameters

Ramp test function



Scope set-up

TECHNICAL CHARACTERISTICS

Fluids:	Air and gases
Pressure ranges:	0-3 bar, 0-6 bar, 0-10 bar
Ports:	G 1/8, G 1/4 , G 3/8, various pad mounting versions
Construction:	Poppet valve
Actuation:	Proportional solenoid
Set-point:	0 - 10 V, 0 - 20 mA, 4 - 20 mA

DaS program features:

- *SENTRONIC^{D} parameters set-up: factory-set or customised*
- *Generate steps and create ramps*
- *Scope function: view of the set-point, outlet pressure, internal signals from the PID control*

Advantages:

- Minimum hysteresis
- Extremely short response times
- Extremely low sensitivity
- All ports in accordance with the corresponding nominal diameters
- Standard filtration at 50 µm
- No constant air consumption
- Analog feedback output
- Easy change of control parameters
- Digital control
- Incorporated display (depending on model)
- Dynamic behaviour (high speed)
- Communication with a PC

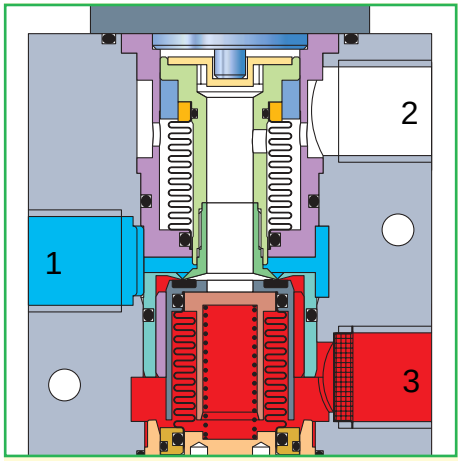
PRESSURE CONTROL

The SENTRONIC valve with its internal control loop combines innovative pneumatic technology with the integrated analog electronics. This valve series allows for accurate adjustment of pressure, flow, force, speed, and linear or angular positions. All orifices have the same diameter for short response times when applying or exhausting pressure. The combined effect of all components assures a control behaviour at an extremely low hysteresis.

SENTRONIC

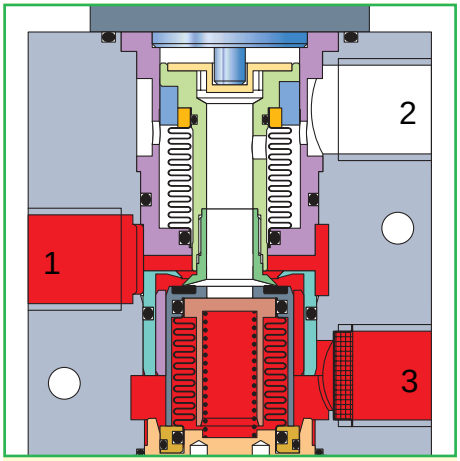
All SENTRONIC valves undergo automatic testing before leaving our manufacturing facilities. Each valve is provided with a test certificate showing all the test results.

OPERATING PRINCIPLE



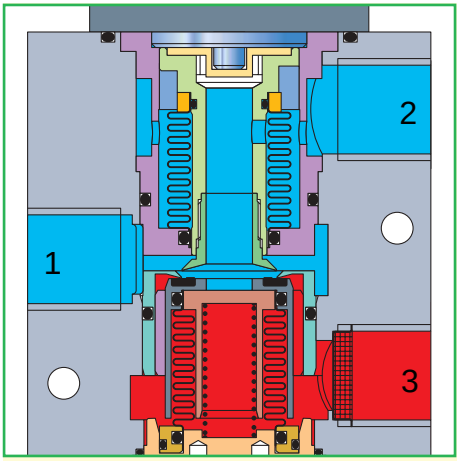
Applying pressure

The pressurisation piston is operated and the flow from port 1 to port 2 is released.



Maintaining pressure

The exhaust piston is in its central position: the flow between port 2 and port 1 or port 3 is blocked.



Exhausting pressure

The exhaust piston is lifted and the flow from port 3 to port 2 is released.

TECHNICAL CHARACTERISTICS

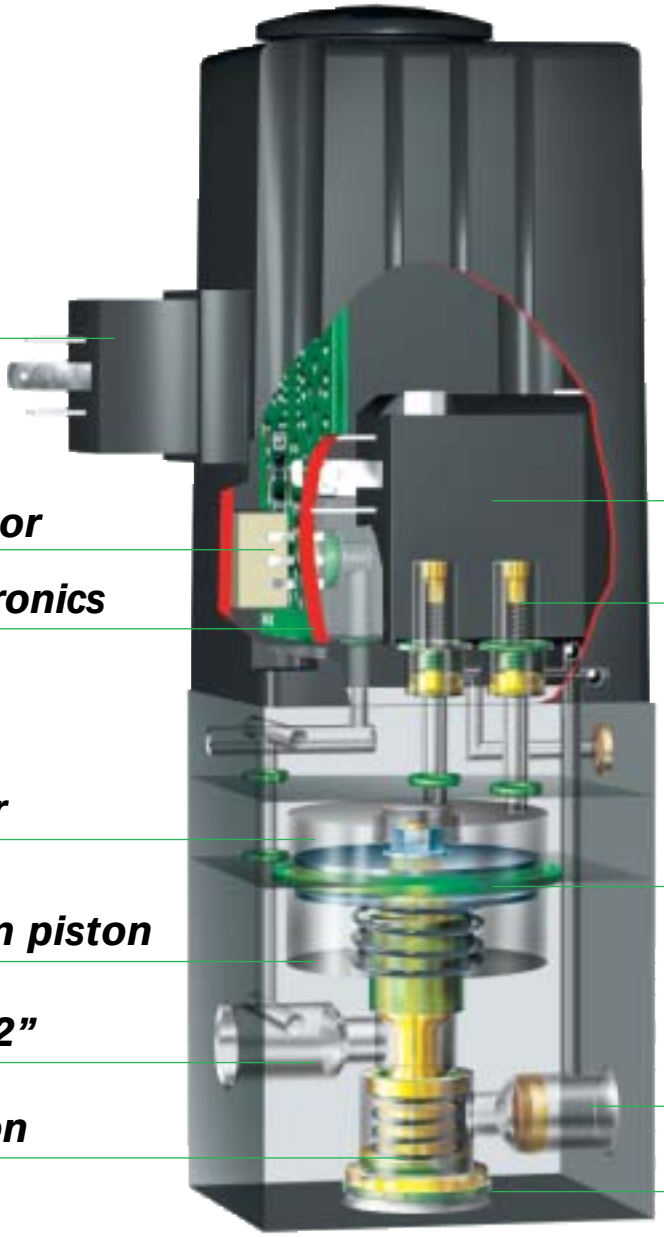
Fluids:	**Air and gases**
Pressure range:	**Vacuum to 50 bar**
Ports:	**G 1/8, G 1/4 , G 1/2, G 1, ISO, various pad mounting versions**
Construction:	**Poppet valve**
Actuation:	**Proportional solenoid**
Set-point:	**0 - 10 V, 0 - 20 mA, 4 - 20 mA, digital**
Options:	**Field bus control**
	Fuzzy control
	Fail safe version (pressure maintained at loss of voltage)
	Integrated pressure switch
	Feedback output

Advantages:

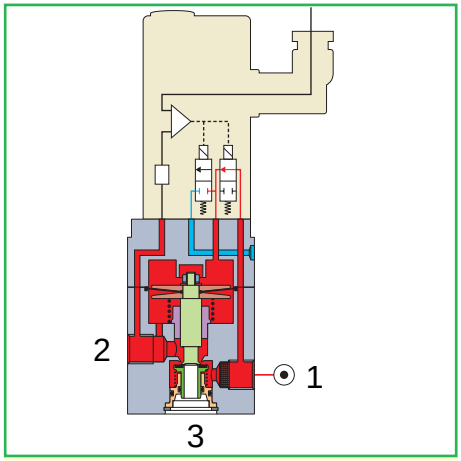
- **Minimum hysteresis**
- **Extremely short response times**
- **Extremely low sensitivity**
- **All ports in accordance with the corresponding nominal diameters**
- **Standard filtration at 50 µm**
- **No constant air consumption**
- **Analog or digital (8 bit) set-point**
- **Analog feedback output**
- **Multipin connector**

PRESSURE CONTROL

Unlike SENTRONIC valves, PULSTRONIC valves operate with pulsed pilot valves which change the pressure in a control chamber. A pressure booster converts the pilot pressure into an outlet pressure with increased flow. The outlet pressure is measured with a pressure sensor and fed into the internal control loop. The set-point is established over the electrical plug-in connector as a standard signal [0 to 10 V, 0(4) to 20 mA].
The PULSTRONIC is particularly suited for pressure control applications with a constant flow, e.g. flow control over nozzles, turbine speed control, glue and lacquer dosing, pressure control of welding equipment.

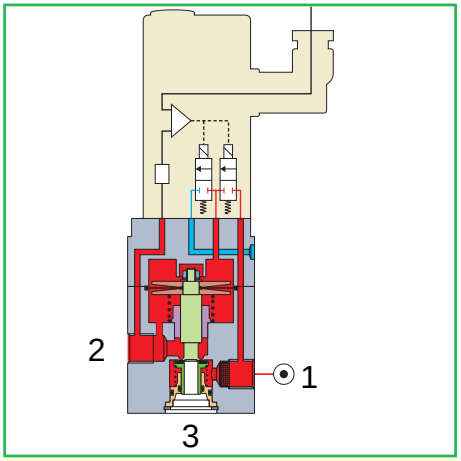


OPERATING PRINCIPLE



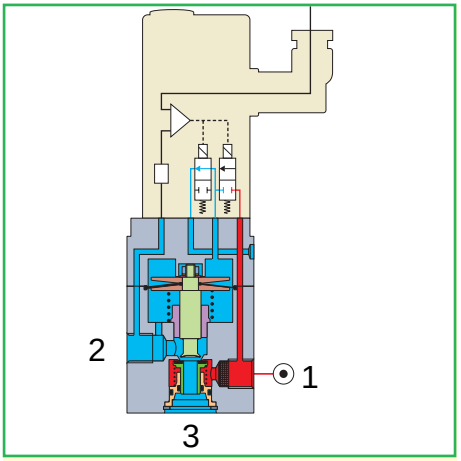
Applying pressure

The pressurisation piston is operated and the flow from port 1 to port 2 is released.



Maintaining pressure

The exhaust piston is in its central position: the flow between port 2 and port 1 or port 3 is blocked.



Exhausting pressure

The exhaust piston is lifted and the flow from port 3 to port 2 is released.

TECHNICAL CHARACTERISTICS

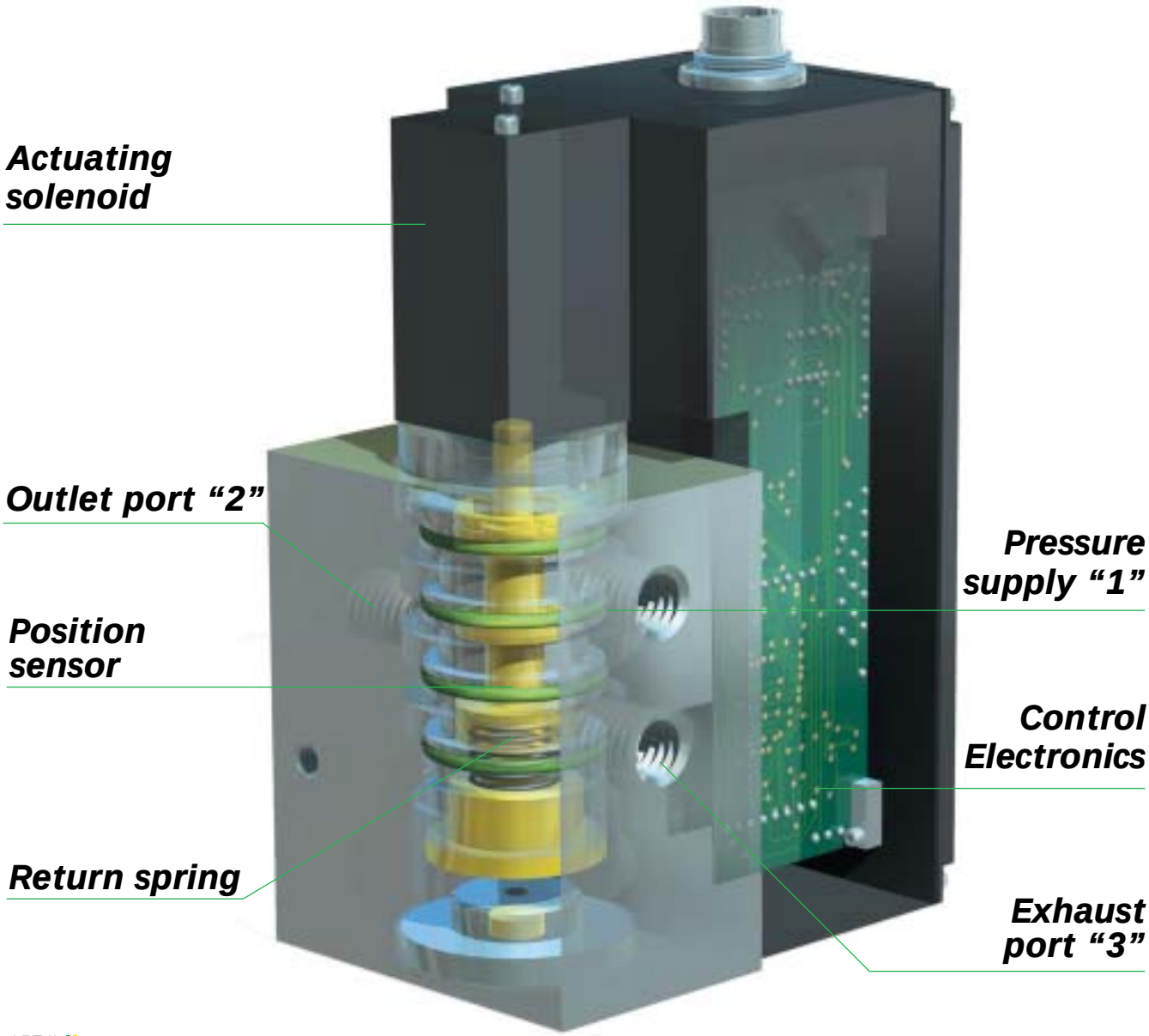
Fluids:	**Air and gases**
Pressure range:	**0 to 10 bar**
Ports:	**M 5 (directly operated)** **G 1/8, G 1/4, G 1/2 ,** **various pad mounting versions**
Construction:	**Poppet valve**
Actuation:	**Pulsed 2/2-way valves**
Set-point:	**0 - 10 V, 0 - 20 mA,** **4 - 20 mA**
Options:	**Internal pressure switch** **Feedback output from 0 to 10 V**

Advantages:

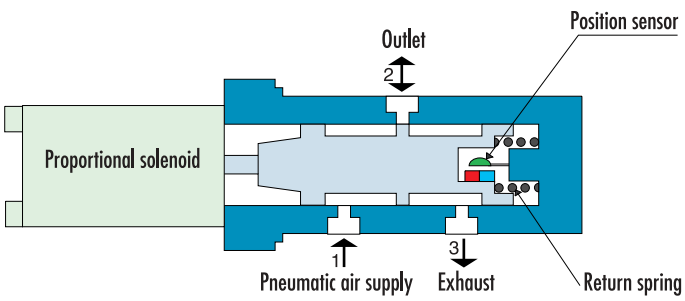
- **Two options available in case of loss of voltage:**
  - **Maintenance of pressure**
  - **Exhaust of outlet**
- **Minimum hysteresis**
- **Quick pressure changes, low overshoot**
- **Standard filtration at 50 µm**
- **No constant air consumption**
- **Stable pressure control at continuous flow**

PRESSURE CONTROL / FLOW CONTROL

Greater versatility in automated production processes: due to electronics, the new generation of SERVOTRONIC products increases the range of application and performance of pneumatic components. The two SERVOTRONIC versions directly respond to all pressure and flow control needs and indirectly meet the performance in the control of physical variables, such as position, velocity, acceleration, force, mass etc.
The combination of innovative pneumatic technology, high-precision mechanics and modern electronics allows for quick control of flow or pressure in a pneumatic actuating system in relation to a signal received from the controlling electronics. The SERVOTRONIC valve is used for flow control (proportional flow) and is provided with a precision-lapped spool and sleeve with hardened and tempered surface allowing for very high pulse frequencies at extremely short response times. The SERVOTRONIC valve has a constant air consumption.

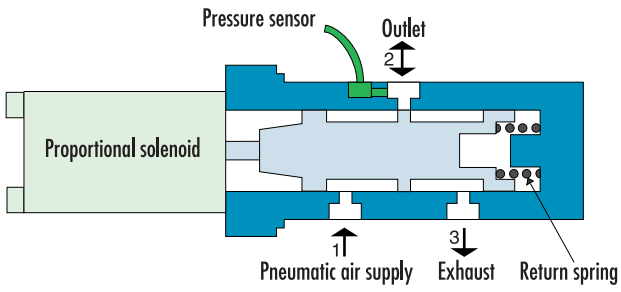


OPERATING PRINCIPLE



Flow control

The SERVOTRONIC flow control version consists of a spool and sleeve servo-valve with three ports, a position sensor and control electronics to define the spool position in proportion to a given set-point. If the loss of pressure at the SERVOTRONIC valve is greater than half of the supply pressure, the flow is proportional to the set-point.



Pressure control

The SERVOTRONIC pressure control version consists of a spool and sleeve servo-valve with three ports and control electronics to define the pressure in proportion to a given set-point.
The spool position can be changed continually to maintain a constant outlet pressure in relation to a given set-point signal.

TECHNICAL CHARACTERISTICS

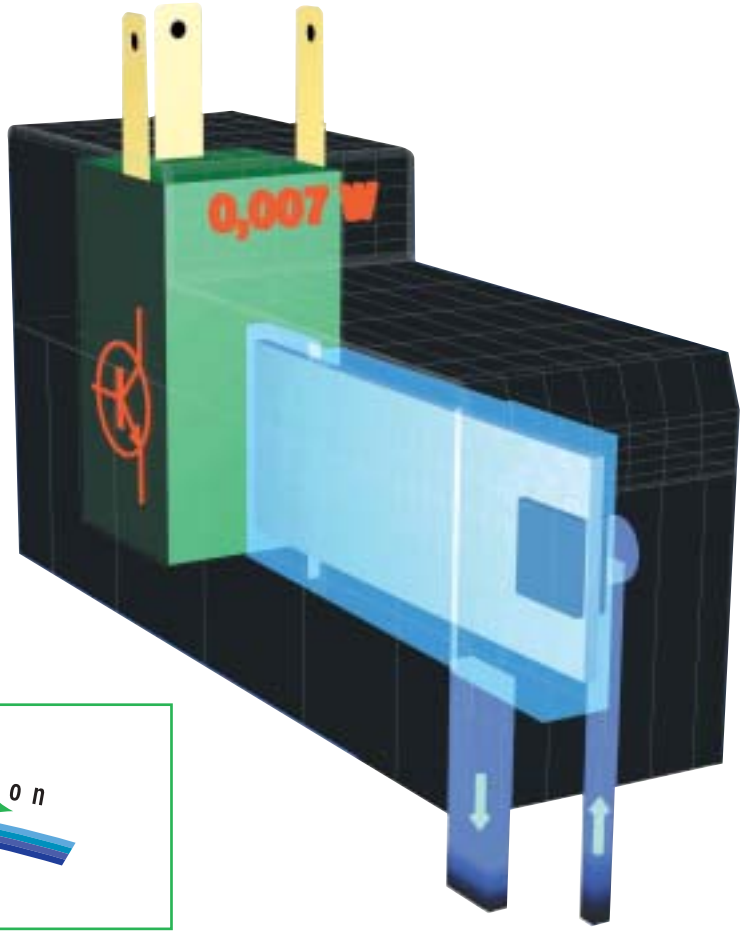
Fluids:	**Air and neutral gases**
Pressure range:	**0 to 10 bar**
Ports:	**G 1/4**
Flow:	**0 to 1400 l/min.**
Construction:	**Spool and sleeve valve**
Actuation:	**Proportional solenoid**
Set-point:	**0 - 10 V, 0 - 20 mA, 4 - 20 mA**
Cut-off frequency:	**150 Hz**

Advantages:

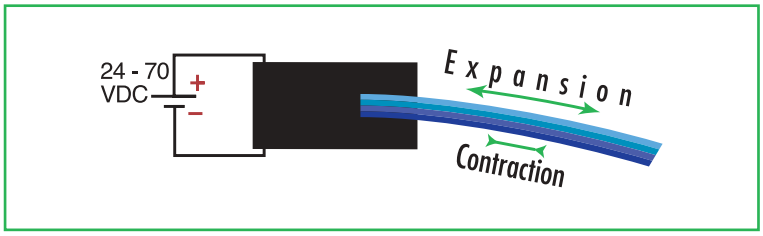
- **Minimal hysteresis**
- **Extremely short response times**
- **Excellent flow characteristics**
- **Compact monobloc construction with integrated electronics and sensor**
- **High reliability and long service life due to precision mechanics combined with simple control technology**
- **Different set-point signals (voltage and current) for the pressure control version**
- **Electrical connection with plug-in connector**
- **Two versions: one for flow and one for pressure control**

FLOW CONTROL

The PIEZOTRONIC valve with proportional control is a high-tech solution designed in particular for those applications with an extremely low power consumption. It is suited for use with battery-operated equipment or in potentially explosive areas. Due to its long service life of 1 billion cycles it is also integrated in measuring systems such as medical equipment and gas analysers. It can even be powered by solar cells. Moreover, the PIEZOTRONIC valve is particularly suited for portable equipment because of its low weight.

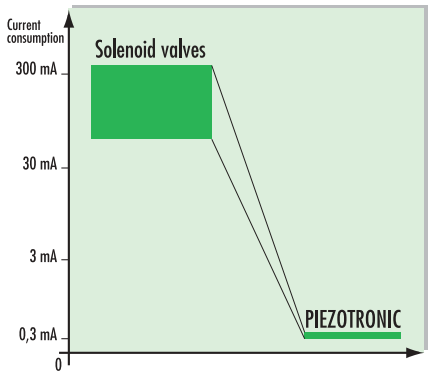


Piezoelectric effect



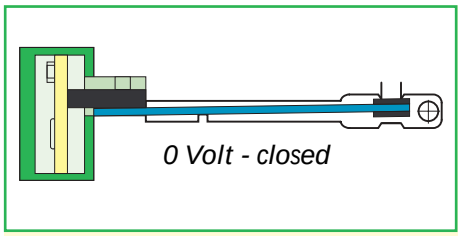
The piezoelectric element consists of at least two layers. When energised, one layer contracts and the other expands resulting in a bending effect (also known from thermo-bimetals).
A mechanical deformation occurs under an electrical charge. The multi-layer piezoelectric element is the essential part of a piezoelectric valve. It consists of elementary dipoles which are polarised during manufacture. The length of the material changes as soon as the piezo ceramics are exposed to an electrical field.
With ASCO/JOUCOMATIC's multi-layer technology, the control voltage has been reduced to only 20 to 40 volts. Larger strokes can be obtained than normally available with two-layer actuators.

Low current consumption

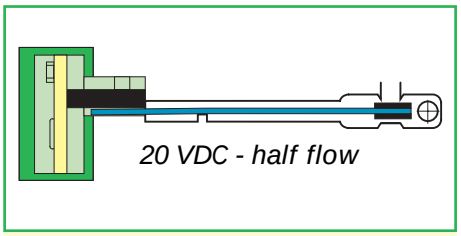


PIEZOTRONIC

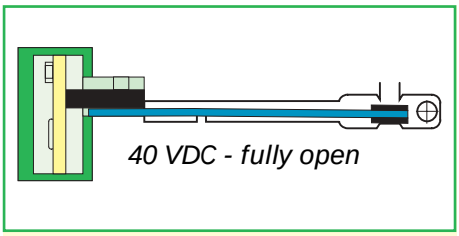
OPERATING PRINCIPLE



closed



half length stroke



open

TECHNICAL CHARACTERISTICS

Fluids:	Air and neutral gases
Pressure range:	0 to 8 bar
Connection:	Pad mounting M 5
Flow:	0 to 6 l/min.
Construction:	Poppet valve
Actuation:	Piezoelectric element
Piloting voltage:	0 - 40 V

Advantages:

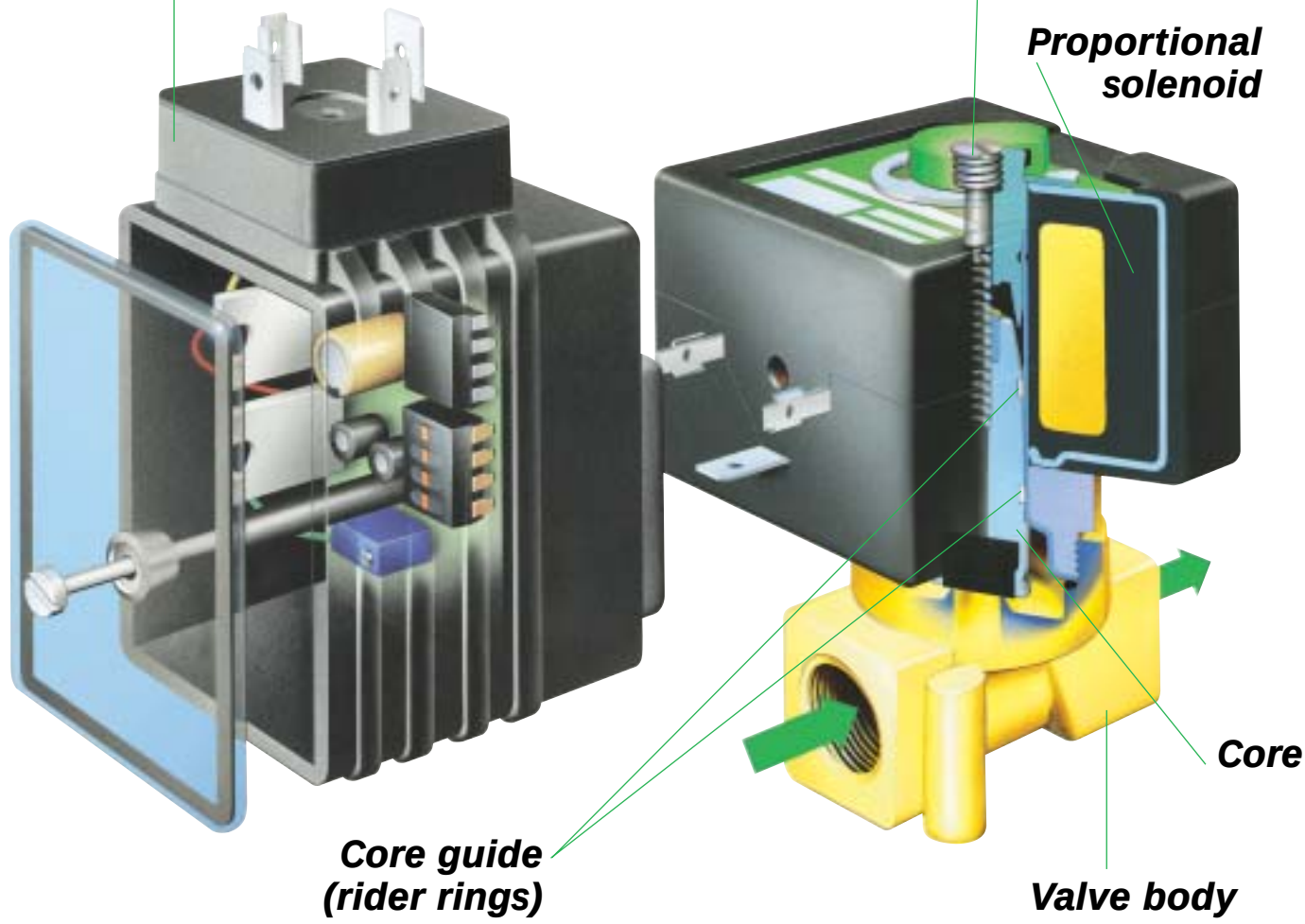
- Low power consumption
- Large electric control range
- Practically unlimited service life, no wearing parts
- No induction peaks, therefore no voltage peak suppression
- Pad mounting to industrial standard
- No overheating

FLOW CONTROL

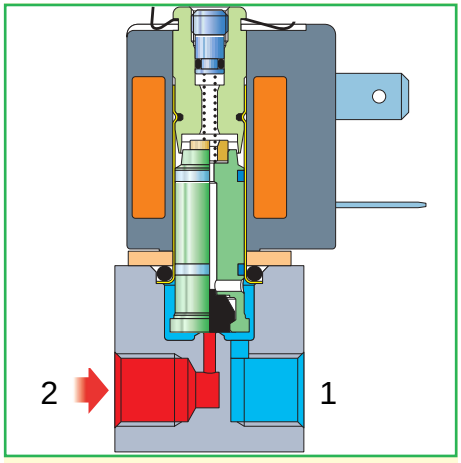
POSIFLOW proportional valves can be used in practically all applications in which the flow of a liquid or gas needs to be controlled. Since a single proportional valve replaces two or three conventional valves connected in parallel (NO / NC) to obtain low, medium or high flow rates, it is extremely cost and space saving. The core is guided by two rider rings so that the valve has low friction and high dynamic properties. An electronic control unit which is directly fitted onto the POSIFLOW increases its range of application even further.
The integrated potentiometer is used to adjust minimum current, maximum current and frequency. A current ramp which can be altered by a potentiometer can also be connected. Thus slow changes in flow can be obtained in spite of sudden changes in the set-point. In case of set-points < 200 mV (<0.4 / 4.4 mA), the piloting current is completely switched off, so that the valve is without current (tightly closed function).

Electronic control unit

The electronic control unit converts a standard signal [0 to 10 V, 0 (4) to 20 mA] into an output current (0 to 1.0 A). The output current, which is pulse width modulated, allows for control with a low hysteresis independent of ambient temperatures.

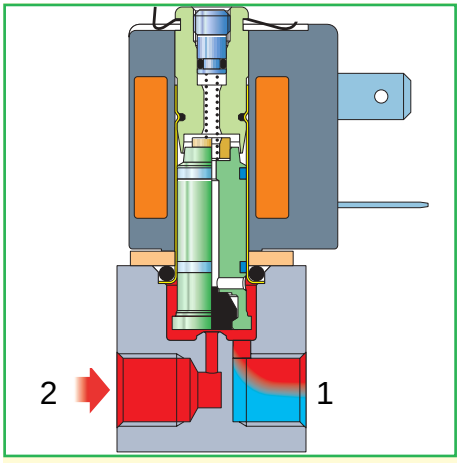


OPERATING PRINCIPLE



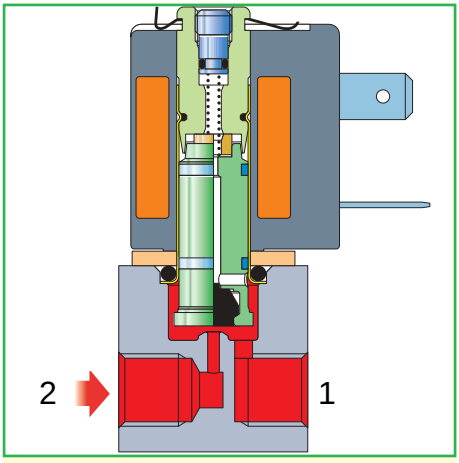
Closed

The core is guided down by two rider rings and the flow from port 2 to port 1 is released.



Half length

The core is guided up by two rider rings and the flow from port 2 to port 1 is released.



Open

The core is maintained in its central position: the flow between port 2 and port 1 is blocked, proportionaly to the command

TECHNICAL CHARACTERISTICS

Fluids:	Air, gases, liquids
Pressure range:	Vacuum to 8 bar
Connection:	M5, G 1/8, G 1/4, G 3/8, G 1/2
Flow:	0 to 31 l/min. H_2O
Construction:	Poppet valve
Actuation:	Proportional solenoid
Piloting:	With electronic control unit
	0 - 10 V, 0 - 20 mA, 4 - 20 mA
Options:	Stainless steel housing
	Special seals
	Explosion-proof version
	Bellows sealing

Advantages:

- Space and cost saving
- Precise regulation:
  - Hysteresis < 5%,
  - Repeatability <3%
  - Sensitivity < 2%
- Integrated temperature compensation
- Ramp function for smooth reaction to sudden changes in the input signal
- Optimal flow without waterhammer
- Switch-off function (tightly closed)
- Remote control / long cable

FLOW CONTROL

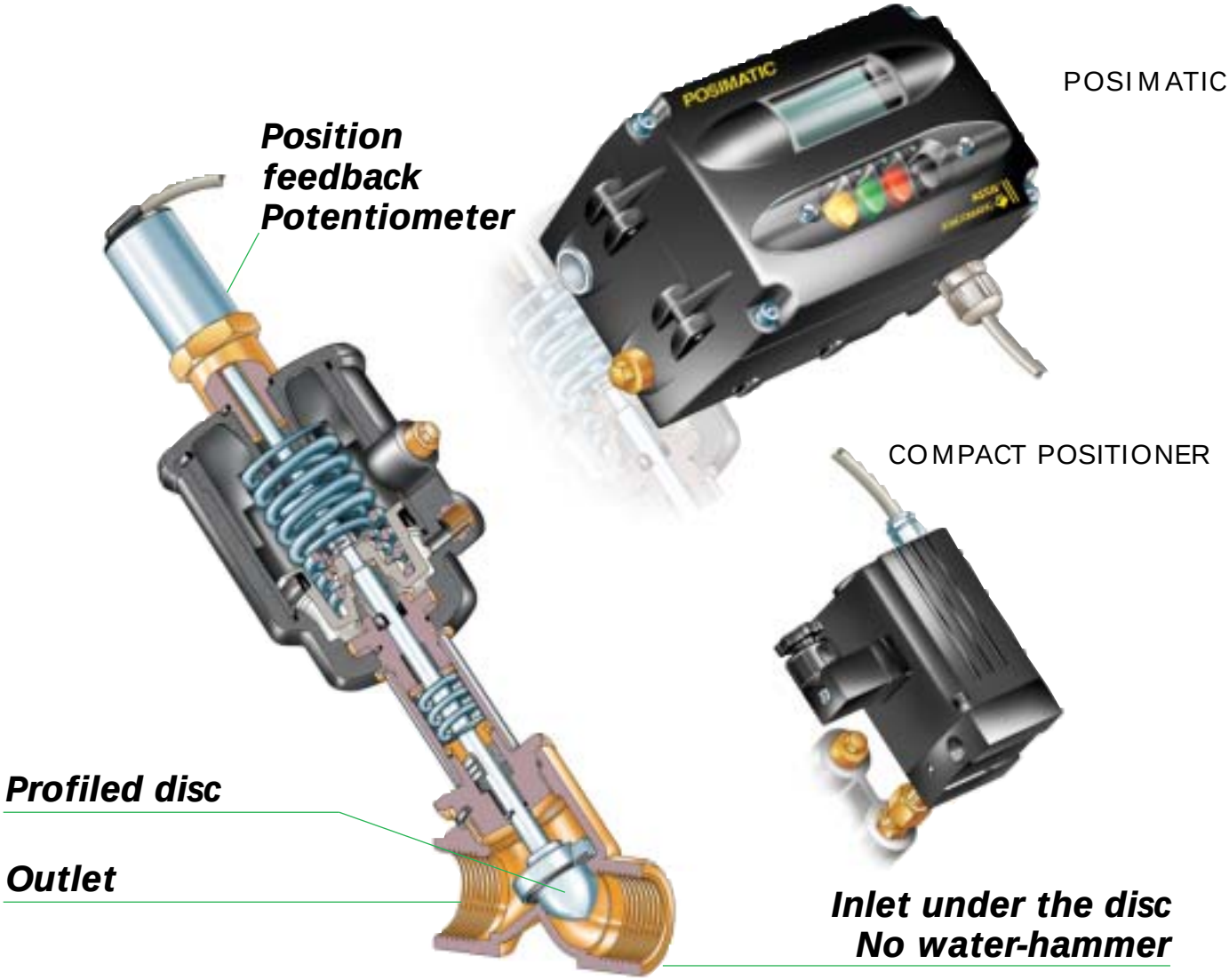
Pressure operated 2 or 3-way proportional valves equipped with **Posimatic** or **Compact Positioner** offer a compact solution and are simple to install and easy to adjust.

These valves can be used in many processes: sequential control systems, regulation in open and closed loop, flow or pressure control by servo-adjustment of the disc stroke.

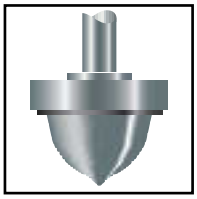
In installations where it is necessary to adapt process parameters directly on site, the **Posimatic positioner** mounted on a series 290 - 390, 2 or 3-way valve allows for a large range of flow characteristics. The system is easily programmable by 4 data entry keys, a pop up menu and an alphanumeric LCD screen.

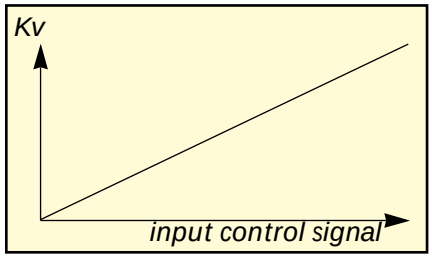
For machinery where space is at a premium, the **Compact positioner**, mounted directly on the valve, represents a simple and economic solution.

Each valve equipped with a positioner is accompanied by a test certificate showing its calibration curve, guaranteeing the linearity of the characteristic “set-point/opening”.



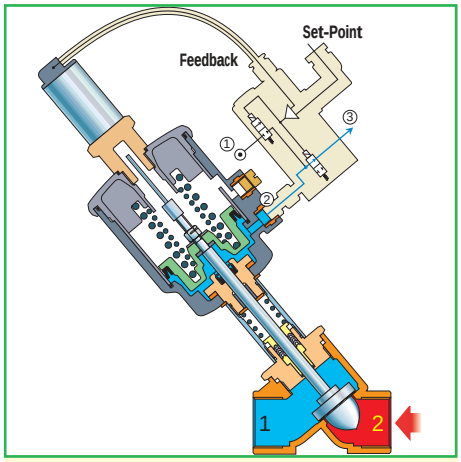
POSIMATIC COMPACT POSITIONER





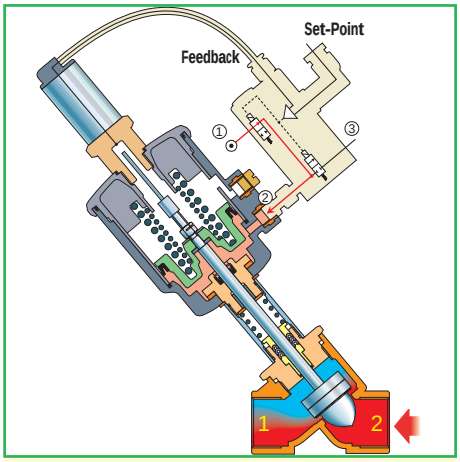
The 2-way 290 PD valves are equipped with a profiled disc. Its parabolic design allows the Kv to be directly proportional to the disc raising.

OPERATING PRINCIPLE



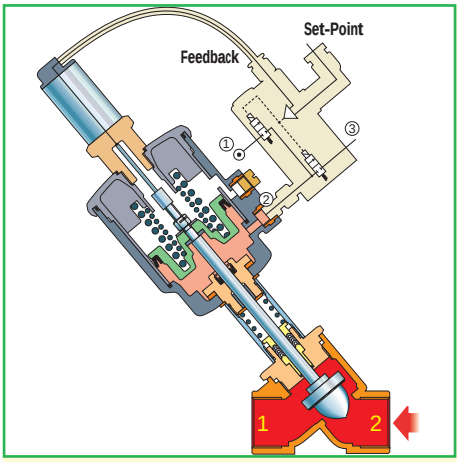
Closed

The profiled disc is bended down and the flow from port 2 to port 1 is released



Half length stroke

The parabolic design of the profiled disc allows the Kv flow to be proportional to the disc raising.



Open

The position of the profiled disc is actuated by two solenoid valves which give or remove air.
The profiled disc is lifted and the flow from port 2 to port 1 is operated.

TECHNICAL CHARACTERISTICS

Fluids:	**Air, gases, liquids and steam**
Pressure range:	**0 to 10 bar**
Ports:	**G 1/8 (Compact Positionner)** **G 1/4 (Posimatic)** **various pad mounting versions**
Flow:	**77 to 1233 l/min**
Construction:	**(Parabolic piston - 2/2 version only)**
Actuation:	**Pulsed 2/2 or 3/2-way valves**
Set-point:	**0 - 10 V, 0 - 20 mA,** **4 - 20 mA**

Valves range:

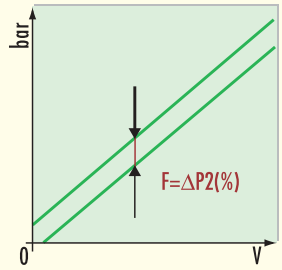
Type: 2/2, 3/2 NC
Nominal diameter: 15 to 65 mm
Differential pressure: 0 - 16 bar
Pipe connections: threaded, butt welding, clamp, flange, bronze, stainless steel body.

Advantages:

- **Two options available in case of loss of voltage (Compact Positioner):**
  - **Maintenance of pressure**
  - **Exhaust of outlet**
- **Minimum hysteresis**
- **Compacity, simplicity (Compact Positioner)**
- **Standard filtration at 50 µm**
- **Manual piloting of the valve (Posimatic)**
- **Easily programmable (Posimatic): (4 data entry keys, menu, LCD screen)**
- **Single or double acting (Posimatic)**

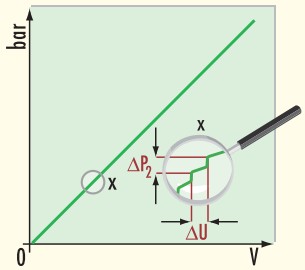
SYMBOLS AND TERMINOLOGY

HYSTERESIS



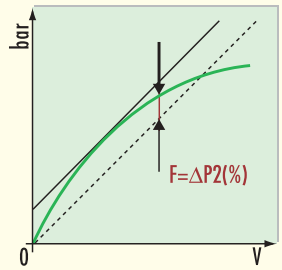
Hysteresis, or turnover voltage, arises from friction and an acute strain on elastic components. This results in different outlet pressures at a predetermined set-point depending on whether the previous value was larger or smaller.

SENSITIVITY



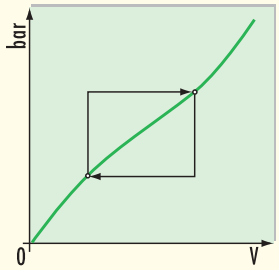
The minimum change in a set-point which leads to a change in the outlet pressure is called sensitivity. Expressed as a percentage of the maximum outlet pressure, this value is merely 0.5 % for ASCO/JOUCOMATIC's Sentronic valve, thus allowing for extremely sensitive adjustments of the outlet pressure.

LINEARITY



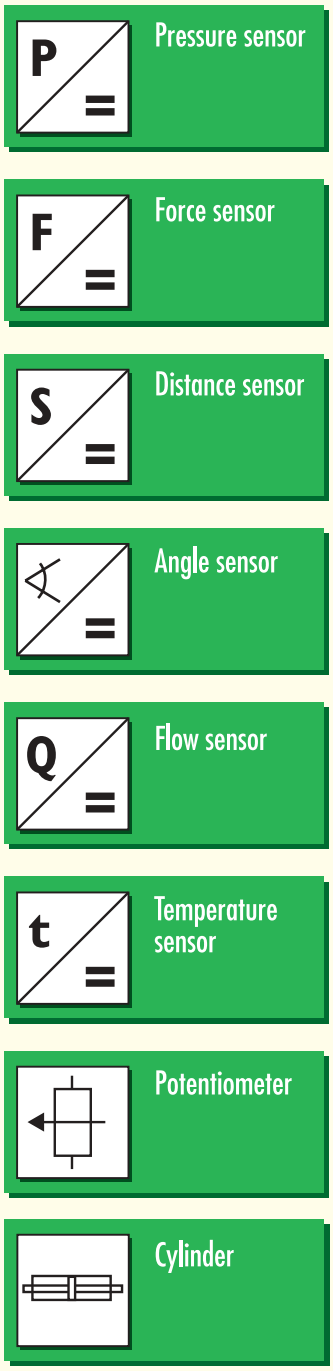
An outlet pressure shown in dependence on a set-point should result in an almost straight (linear) characteristic curve (dotted line) so that the pressure to be expected at a given set-point can be predicted as precisely as possible. The divergence is calculated from the maximum deviation from the ideal characteristic curve as related to the maximum outlet pressure.

REPEATIBILITY



Control components are more precise in repeating a previously determined value than in adjusting to absolute values. The reason is that – under this aspect – the divergence from the linearity is of no importance. Moreover, the repeatability is positively influenced by a low hysteresis.

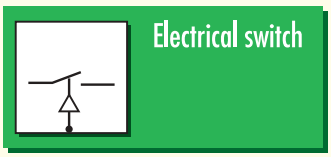
SYMBOLS

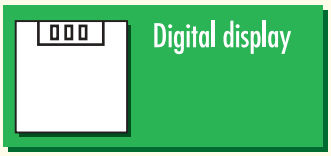


INTRODUCTION TO CONTROL TECHNOLOGY

SYMBOLS

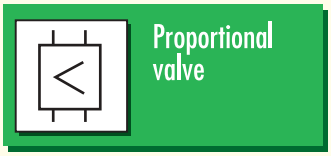

Trimming potentiometer

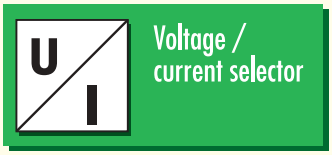

Electrical switch


Digital display


Analogue display

Tachometer generator

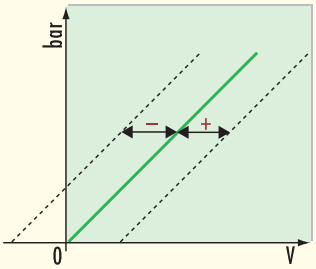

Proportional valve



Voltage / current selector

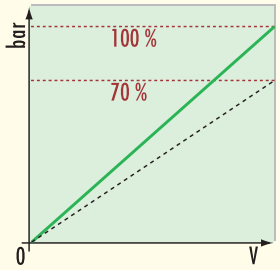
Digital-to-analogue converter

ZERO ADJUSTMENT



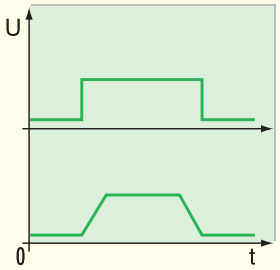
By way of zero adjustment, the proportional valve can be assigned to a predetermined starting point, and/or a definite pressure or flow can correspond to a previously established set-point.

SPAN ADJUSTMENT



If the user's operative range is only a part of the valve's total adjustment range, span adjustment can be used to assign the set-point range (0 - 10 V) to the user's operative range. This provides for the highest-possible resolution.

RAMP FUNCTION



The ramp function transforms a set-point step into an internal gradual increase of the set-point signal. This allows for slow opening and closing of proportional valves.

RIPPLE FREQUENCY

Modulation voltage to minimise friction (slip-stick) in a valve.

FEEDBACK VALUE

Actual electrical value of a physical variable.
(Pressure, force, temperature, flow etc.).

SET-POINT VALUE

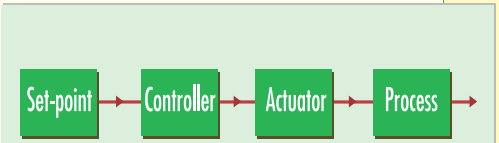
Predetermined (desired) electrical value of the controlled variable which must effectively be reached and maintained.

CONTROL SYSTEMS

In many machines and plants, physical variables (temperature, pressure, force, displacement etc.) must reach a predetermined (desired) value (e.g. the position of a carrier on a machine-tool) independent of parasitic influence from outside. To this intent, two interconnected operations must be assured: comparison and adjustment. The required cycle of operation takes place in a so-called control loop whereby a difference is made between an open loop and a closed loop.

OPEN-LOOP CONTROL

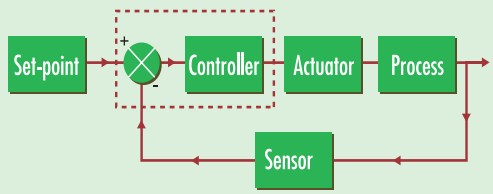
An example for an open control loop is a heating radiator in which the supply of warm water and, thus, the temperature is "controlled" or – more precisely – adjusted with a valve. As soon as the room temperature rises, the valve must be closed by hand. As soon as the room temperature drops, the valve must be opened by hand, i.e. the rise and fall of the temperature are not controlled automatically. It is an open-loop control system with no feedback, i.e. there is no control loop connecting the output of the system to the input of the system.
The use of special methods and equipment to influence cycles of operation and processes is what is generally understood by control. A control system is in place when a process is influenced in relation to a desired (requested) state without consideration of the observed (measured) state. A particular characteristic for controlling is the open sequence of actions via the individual transfer element or the control.



Open-loop control

CLOSED-LOOP CONTROL

In a closed-loop, the predetermined (desired) value is constantly compared to the actual value. DIN standard 19226 defines the terms "Control and Adjustment" as follows: "Control and adjustment is an operation in which a physical variable (e.g. temperature, pressure etc.) is continuously measured and compared to a previously specified value of the variable with the aim of matching the two. The resulting closed sequence of actions occurs in a closed loop, the closed-control loop."
At the example of temperature regulation in a heating radiator, the actual temperature is measured with a temperature sensor and compared to the predetermined (desired) value. As soon as there is a difference between the desired value and the measured value, a signal is transmitted to the valve to open (if the temperature has fallen below the specified value) or to close (if the temperature has risen above the specified value). This means that the temperature is held at the predetermined (desired) value (i.e. it is fully stabilised) irrespective of any outside conditions (parasitic influence).



Closed-loop control

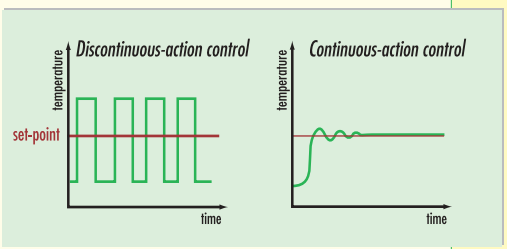
INTRODUCTION TO CONTROL TECHNOLOGY

CONTROL METHODS

Control methods are distinguished according to the manner in which the controller behaves as soon as a deviation is detected in the process. For applications in production, it is important to know how the actuating variable is influenced in terms of time. Controllers have either a continuous or a discontinuous behaviour. A difference is therefore made between discontinuous-action control (two or multipoint control) and continuous-action control (proportional control).

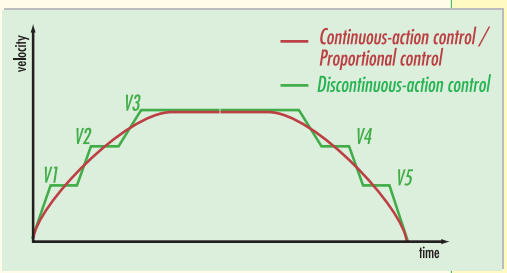
DISCONTINUOUS-ACTION CONTROL

A process which takes place step-by-step is called discontinuous. A discontinuous-action controller influences the process with short switching actions at a constant level of energy. Discontinuous-action controllers are therefore also called switching controllers.
Discontinuous-action controllers assure the actuating function by triggering a sequence of energy pulses. These pulses have influencing times at fixed energy levels but limited influencing periods. On-off controllers which are normally found in household appliances and heating technology just have two actuating constants: “ON” and “OFF”. A disadvantage of this is that a shock-like (impulsive) operation is triggered when the controller is switched on. Moreover, variations of the feedback value around the set-point cannot be avoided. The interval level at which the controlled variable constantly swings between the on and the off state is called the range of fluctuation. This range is the characteristic feature of discontinuous action. Three-point or multipoint controllers have at least one intermediate stage besides the on and off state (e.g.: air conditioning - heating - neutral - cooling).



CONTINUOUS-ACTION CONTROL

Continuous-action controllers assure the actuating function by having a continuous influence on the process. Controlling takes place permanently. The controlled variable can have any value within the defined control range. Non-intermittent, random control signals between 0 and 100 % are triggered.
Example: A heavy load is to be smoothly accelerated and decelerated. In the case of a discontinuous-action controller, the load must first be set into motion at velocity V1 and then at velocity V2. The load is transported at a constant speed V3 which is subsequently decelerated at velocity V4 and V5 (see illustration opposite). The velocity is accelerated and decelerated step by step. The sharp edges of the individual velocity steps are slightly levelled out by the volume flow and the inertia of the cylinder. It is difficult to reduce fluctuations (i.e. to obtain smaller, smoother steps). One way to obtain a considerable reduction of the fluctuation is to use a proportional valve which can continuously control the process – i.e. the speed of cylinders and motors. Sudden switching impacts are avoided. Moreover, cylinder and motor speeds can be defined in advance.



TYPES OF CONTROLLERS

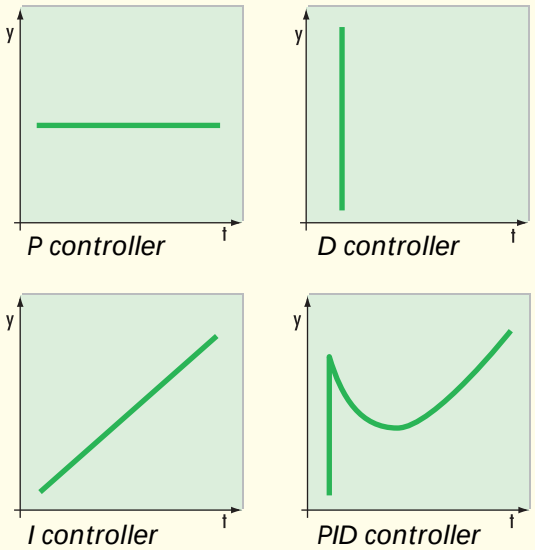
A controller is a transfer element which compares the feedback value received from a transducer (sensor) to a predetermined value (i.e. set-point) and processes it in such a way that a control signal is transmitted in the form of an appropriate variable to the actuating element (proportional valve). The controller should control this transmission over time in such a way that the dynamic qualities of the process to be controlled are well balanced. The set-point must be reached as quickly as possible whilst the feedback value should fluctuate as little as possible around the set-point.

CONTINUOUS-ACTION CONTROLLERS

The output of a continuous-action controller is provided with a continuous signal (voltage or current) which can continuously take all intermediate values between an initial and a final value.

A basic controller is the P controller. A I or a D controller alone are less suitable in practice. Combinations of P, D and I controllers such as PI controllers, PD controllers or PID controllers have proven to be best suited.

The combinations are chosen in relation to the type of application. The advantage of a PID controller is its dynamic performance, its controlling accuracy and its stability. The individual setting of control parameters allows for an optimal adaptation of the proportional valves to specific applications.



Application	Types of controllers		
	P	PI	PID
Pressure	low profile	suitable	suitable
Flow	unsuitable	suitable	less suitable
Temperature	low profile	suitable	suitable
Level	suitable	unsuitable	unsuitable
Speed	suitable	suitable	suitable

INTRODUCTION TO CONTROL TECHNOLOGY

SWITCHING CONTROLLERS

As opposed to a continuous-action controller, this type of controller does not have a continuous output signal. The output signal can only be switched on or off. But this can also be used for controlling purposes.

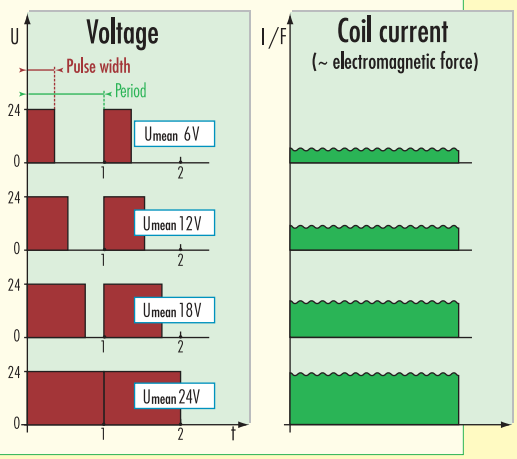
Types of modulation:
- Pulse width modulation
- Pulse amplitude modulation
- Pulse frequency modulation

ASCO/JOUCOMATIC uses pulse width modulation in its electronic control units.

Pulse width modulation
In pulse width modulation, the 24 V DC supply voltage is transformed into rectangular pulses with different widths. The output signal is no longer a constant signal but a sequence of pulses which is repeated at a certain time interval, or period. During each period, the pulse is in the on state for a certain time (24 V) after which it is set to the off state (0 V). The percentage of time at which the pulse is in the on state is called the pulse width.

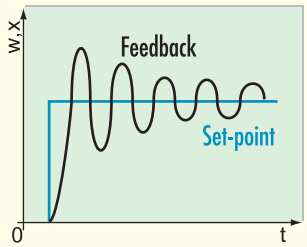
With the pulse width modulation method, the pulse width can be changed from 0 % to 100 % of the period. Changing the pulse width from 0 % to 100 % of the period results in a proportional change of the average coil current.

Pulse width modulation

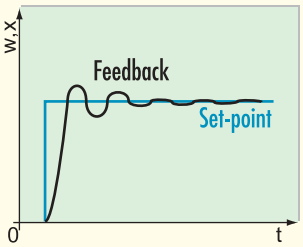


SELF-OPTIMISING CONTROLLERS (FUZZY LOGIC) / SENTRONIC FUZZY

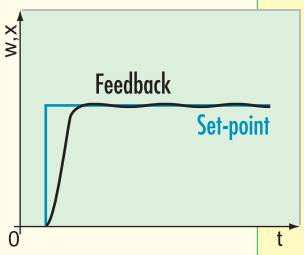
Besides our SENTRONIC valve with standard PID controller, we have a proportional valve with fuzzy logic for applications in which it is difficult to set the control parameters. Unlike YES/NO or 0/1 logic, fuzzy logic uses continuous transitions and automatically defines the optimal control parameters. The proportional valve carries out 10 set-point steps. The electronics evaluate the feedback and the control parameters are improved with fuzzy logic after each step. The parameters are saved to memory after 10 optimisation steps. The proportional valve then operates at these optimised parameters.



Feedback with unmatched control



After the 3rd adaptation



After the 10th adaptation

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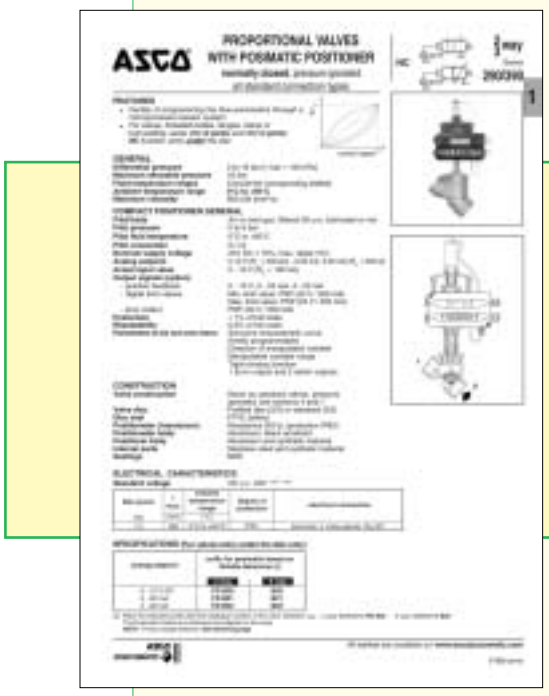

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CATALOGUES

ASCO/JOUCOMATIC develops and commercializes a complete range of products meeting most of your requirements for **fluid control** and **automation.**

ASCO/JOUCOMATIC offers more than 5,000 different types of standard valves and solenoid valves as well as a large variety of pneumatic components.

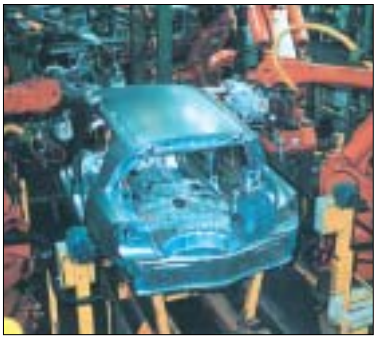
A global presence

Our worldwide manufacturing facilities, engineering specialists and authorized distributors at more than 1,000 locations guarantee comprehensive answers to all your automated system applications and quick service whatever sectors of activity you work in.

To meet your quality assurance requirements, we follow strict development, production and commercialization procedures and the performance of each of our products is tested and verified before they are used. Our ISO 9001 or 9002 certifications are proof of our success.











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