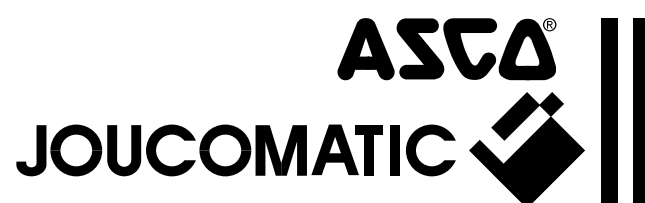


# **Pneumatic components for industrial automation**



# Ordering equipment

On your order please specify :

## PNEUMATIC ACTUATORS

Examples :

### • ROD CYLINDERS :

- Code number \_\_\_\_\_ 453 50 038 0100
- and/or reference number \_\_\_\_\_ PES 80 P A 100-DM
- Code number of option \_\_\_\_\_ . . . . .
- Quantity and code number(s) of mounting(s) \_\_\_\_\_ 434 00 167
- Quantity and code number(s) of magnetic position detector(s) \_\_\_\_\_ 881 00 733
- Quantity and code of detector/cylinder mounting kit(s) (optional) \_\_\_\_\_ 881 00 . . .
- Note : For other stroke lengths,  
please specify exact reference number (eg. : stroke length 115) \_\_\_\_\_ PES 80 P A 115-DM  
(take into account max. stroke lengths)

### • RODLESS CYLINDERS, MAGNETIC COUPLING (STN/STG) / BANDS (STB) :

- Base code number + stroke length (in mm) \_\_\_\_\_ 448 50 009 1000  
(take into account max. stroke lengths)
- and/or reference number (stroke length included, in mm) \_\_\_\_\_ STB 25 A-0 1000-DM
- Quantity and code number(s) of mounting(s) or accessory(ies) \_\_\_\_\_ 434 00 494
- Quantity and code number(s) of magnetic position detector(s) \_\_\_\_\_ 881 44 815

### • BALL BEARING GUIDE ACTUATORS :

- Code number of actuator, series 447 \_\_\_\_\_ 447 00 022
- and/or reference number \_\_\_\_\_ CIB 32 A 160-DM
- Code number(s) of mounting(s) or accessory(ies) \_\_\_\_\_ 439 00 237
- Quantity and code number(s) of magnetic position detector(s) \_\_\_\_\_ 881 00 142
- Quantity and code of detector/cylinder mounting kit(s) \_\_\_\_\_ 881 00 167

### • CYLINDER + BEARING GUIDE UNIT "U" or "H"

- Code of cylinder PES \_\_\_\_\_ 450 00 741
- and/or reference number \_\_\_\_\_ PES 63 T A 400 R-DM
- Optional code number of guiding unit ("H" ball bearing unit) (corresponding to Ø and stroke length) \_\_\_\_\_ 010 683
- Quantity and code number(s) of magnetic position detector(s) \_\_\_\_\_ 881 00 144
- Quantity and code of FRONT mounting kit(s) (for detectors and PES cylinders with tie rods) \_\_\_\_\_ 881 00 180
- Quantity and code of REAR mounting kit(s) (for detectors and PES cylinders with tie rods) \_\_\_\_\_ 881 00 151

### • ROTATABLE CYLINDERS :

- Code of cylinder, series 429 \_\_\_\_\_ 429 00 046
- and/or reference number \_\_\_\_\_ R 20 D 90-M
- Quantity and code number(s) of magnetic position detector(s) \_\_\_\_\_ 881 00 146
- Quantity and code of detector/cylinder mounting kit(s) \_\_\_\_\_ 881 00 275

## SOLENOID VALVES

### • WITH STANDARD CONNECTOR :

- Code number WITH standard connector \_\_\_\_\_ 189 00 001 - 230 V - 50 Hz
- Voltage and frequency of the current \_\_\_\_\_
- Code number of subbase (optional) \_\_\_\_\_ 353 00 069

### • WITHOUT CONNECTOR OR WITH OTHER CONNECTOR :

- Code number WITHOUT connector \_\_\_\_\_ 189 00 002 - 230 V - 50 Hz
- Voltage and frequency of the current \_\_\_\_\_
- Code number of connector with built-in  
visual indicator and protection \_\_\_\_\_ 881 22 410
- or another type of connector : with TRANSIL protection, with flying leads, etc. \_\_\_\_\_ . . . . .
- Code number of subbase (optional) \_\_\_\_\_ 353 00 069

### • SOLENOID HEADS FOR EXPLOSIVE ATMOSPHERES :

- Code number of solenoid valve designed to be equipped with a solenoid head EEx... \_\_\_\_\_ DU 192 00 002
- Prefix for EEx solenoid head \_\_\_\_\_
- Voltage and frequency of the current \_\_\_\_\_ 230 V - 50 Hz

# Ordering equipment

On your order please specify :

## AIR OPERATED VALVES

*Exemples :*

- Code number \_\_\_\_\_ 541 00 857
- Code number of subbase \_\_\_\_\_ 355 00 165
- Code number of one set of 2 endplates for joinable subbases \_\_\_\_\_ 355 00 166
- Quantity and code number(s) of accessory(ies) (optional) \_\_\_\_\_ 881 35 517

## SOLENOID OPERATED VALVES

- Code number of the solenoid valve designed to be equipped with pilots \_\_\_\_\_ 541 90 022
- Quantity and code number(s) of pilot solenoid valve(s) with connector  
(see opposite ordering information for solenoid valves) \_\_\_\_\_ . . . . .
- Code number of subbase \_\_\_\_\_ 355 00 382
- Quantity and code number(s) of accessory(ies) \_\_\_\_\_ 346 00 173

## SOLENOID OPERATED VALVES WITH BUILT-IN PILOT

### • WITH STANDARD CONNECTOR :

- Code number of valve WITH standard connector \_\_\_\_\_ 551 02 009 - 230 V - 50 Hz
- Electrical supply : voltage-frequency \_\_\_\_\_
- Code number of subbase (optional) \_\_\_\_\_ . . . . .

### • WITH OTHER CONNECTORS :

- Code number WITHOUT connector \_\_\_\_\_ 551 02 010 - 230 V - 50 Hz
- Electrical supply : voltage-frequency \_\_\_\_\_
- Quantity and code number of connector with built-in visual indicator and protection \_\_\_\_\_ 881 22 407
- or quantity and another type of connector : with TRANSIL protection, with flying leads, etc. \_\_\_\_\_ . . . . .

## AIR SERVICE EQUIPMENT :

- Code number \_\_\_\_\_ 342 03 291 + 662 535
- Code number of option \_\_\_\_\_
- Quantity and code number of accessory(ies) \_\_\_\_\_ 343 03 003

## OTHERS :

- Code number of the unit \_\_\_\_\_ 309 . . . . .
- Code number of option or accessory (optional) \_\_\_\_\_ . . . . .

1

# Practical information

## PNEUMATIC ACTUATORS

Pneumatic cylinders convert pressure to a linear or rotative movement.

Factors in a choice of a cylinder are :

- Single or double acting
- Standard dimensions or not
- Efforts developed, Ø bore, stroke
- Pressure of the pilot fluid
- Cushioned or not cushioned, mounting
- High or low working cycle
- Ambient temperature
- Aggressiveness surrounding medium
- Equipped or not for magnetic position detectors

Table of cylinder loads and cylinders, see chapter 2

## SOLENOID VALVES, CONTROL VALVES

Solenoid valves and control valves 3 ports, 2 positions (3/2) are available in the following versions :

- Normally Closed at rest (symbol : NC)
- Normally Open at rest (symbol : NO)
- Universal (Symbol : U) : depending on connections, they can be used for the 4 following functions :
  - 3/2 NC - 3/2 NO - Distribution (1 inlet - 2 outlets) - Mixing (2 inlets - 1 outlet)

Factors in choice between spool valves and poppets valves are :

- Size : spool valves from ØM5, G 1/8 to G 1 ; poppet valves from G 1/8 to G 1 1/2
- Pilot : spool valves can be two position positive (bistable-memory) ; poppet valves are always spring return (monostable).
- Functions : poppet valves 3/2 NC : NO-4/2  
spool valves 3/2 NC-NO-U ; 5/2 ; 5/3
- Flow : spool valves have the same KV or flow coefficients from supply and to exhaust. However some poppet valves have a greater KV or flow coefficients to exhaust.
- Response time : in high speed movement, the response time can be important  
Spool valves have a faster response time than poppet valves

Poppet valves and spool valves do not compete, they are complementary. For each application, the correct valve should be selected bearing in mind the precise requirements.

## CONNECTIONS TO VALVES

SUBBASE mounting body = Connection by means of a single or joinable subbases

TAPPED body = Connections directly to the body

Tapped bodies of pneumatic components comply with both standards : ISO 228 : (G) and ISO 7 : (Rp)

## AIR SERVICE EQUIPMENT

Filters, regulators, lubricators and drip leg drain allow smooth operation of compressed air circuit. For the lubrication, it is recommended to use a non-detergent oil without aggressive additives, **VG 32**, group 2 (ISO 3448)

- Viscosity 29 to 35 cSt (mm<sup>2</sup>/s) at 40°C

Oil types of several makes :

- LABO : Prima 32
- ESSO : Spinesso 32
- SHELL : Tellus 22
- ELF : Spinelf 22
- MOBIL : DTE 22

Products conform with the pressure equipment directive 97/23/EC in accordance with article 3.3














## DEGREES OF PROTECTION PROVIDED BY ELECTRICAL ENCLOSURES (IP Code)

(following standards EN 60529 and IEC 529)

The code letters IP (International Protection) followed by 2 characteristic numeral : e.g. IP65

The first characteristic numeral indicates the degree of protection of the energized parts and internal moving parts against ingress of solid foreign objects.

The second characteristic numeral indicates the degree of protection against ingress of water with harmful effects.

1st NUMERAL		Test	2nd NUMERAL		Test
	Abridged definition			Abridged définition	
0	Non-protected		0	Non-protected	
1	Protected against solid foreign objects Ø 50 mm (eg accidental contact with the hand)		1	Protected against vertically falling water drops (condensation)	
2	Protected against solid foreign objects Ø 12,5 mm (eg finger)		2	Protected against vertically falling water drops when enclosure tilted up to 15°	
3	Protected against solid foreign objects Ø 2,5 mm (eg tools, wires)		3	Protected against spraying water up to 60° on either side of the vertical	
4	Protected against solid bodies Ø 1 mm (eg fine tools and small wires)		4	Protected against splashing water from any direction	
5	Dust-protected (no harmful deposit)		5	Protected against water jets from any direction	
6	Dust-tight		6	Protected against powerful water jets from any direction	
			7	Protected against the effects of temporary immersion in water	

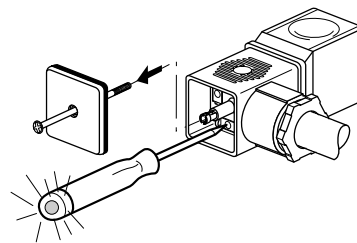
The degree of protection of each product is indicated in its appropriate leaflet, usually IP 65.

# Practical information

## EASY CONNECTIONS

The pilot valves series 190/192 and solenoid operated valves equipped with these pilots, are delivered with a connector size 30, rotatable x 90°, complying with standard ISO 4400. **Top cover removable** so that one can check that the coil is energized without unplugging the connector and hence **without interrupting operation** of the solenoid valve.

These valves can be equipped with cable outlets, 2 m long, or with built-in visual indicator (LED) and electrical protection, or with **transil** protection.



## SAFETY EQUIPMENT FOR EXPLOSIVE ATMOSPHERES

Most of our solenoid valves, spool and poppet valves can be equipped with EEx solenoid heads complying with ATEX 94/9/CE directive for use in explosive atmospheres :

- **Zone 22** "Dust"(solenoid valve series 189, 190 and 192)
- Protection "d" (solenoid valve series 192)
- Protection "m" (solenoid valve series 189)
- Protection "ia" intrinsically safe equipment (solenoid valves series 630, 302 and 195)  
(See end of chapter 5)



## PRESSURES

- **Maximum allowable pressure (MAP)** : The maximum allowable pressure (MAP) in pipework is the maximum effective pressure (in bar or in Pa) which can be applied to the pipework in the relevant installation (1 bar = 10<sup>2</sup> kPa)
- **Inlet pressure** : fluid pressure at the entrance to the pneumatic component
- **Outlet pressure** : fluid pressure at the exit from the pneumatic component
- **Differential pressure Δ P** : difference in pressure between the inlet pressure and the outlet pressure.

## FLOW COEFFICIENTS

- **KV** (following standard NF E 29312) :  
The flow rating of a valve is expressed as the KV - a French coefficient established experimentally for each valve. It corresponds to the flow of water in litres per minute with a pressure differential ΔP of 1 bar with the orifice fully open.
- **CV** : The CV indicated in the tables is an equivalent KV flow coefficient but expressed in US gallons per minute with ΔP = 1 psi.  
CV and KV can be transferred as follows : **KV = 14,3 CV** and **CV = 0,07 KV**
- **C** and **b** (following standard ISO 6358) :  
Coefficients C (sonic conductance) and b (critical pressure ratio) following standard ISO 6358 allow flow calculation in sonic state (See spool valves 541 - 543 - chapters 4 and 5).

## CALCULATION OF FLOW (for air and gas)

- **Defining flow at 6 bar** :  
Corresponding leaflets give for each product its mean flow in litres per minute at 6 bar in Normal Atmosphere Pressure (ANR) following standards ISO 8778 (**with Δ P = 1 bar**)
- **Calculation of flow** :

$$\Delta P < P_{\text{inlet}} / 2$$

$$Q = 28,16 \times KV \times \sqrt{\Delta P \times P_{\text{in}}}$$

including correction for temperature and density

$$Q = 475 \times KV \times \sqrt{\frac{(\Delta P \times P_{\text{in}})}{(T_a \times d)}}$$

Q = Flow in l/min  
ΔP = Differential pressure, in bar

$$\Delta P \geq P_{\text{inlet}} / 2$$

(Maximum allowable flow)

$$Q = 14 \times KV \times P_{\text{ou}}$$

including correction for temperature and density

$$Q = 238,33 \times KV \times P_{\text{ou}} \times \frac{1}{\sqrt{(T_a \times d)}}$$

P<sub>in</sub> = Absolute inlet pressure, in bar  
P<sub>ou</sub> = Absolute outlet pressure, in bar  
T<sub>a</sub> = Absolute temperature, in Celsius degrees  
d = Density compared with air

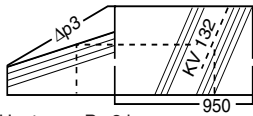
- **Flow graphs** : (see opposite).

# Flow graphs

## HOW TO USE THE GRAPHS

Depending on the supply of pressure use the appropriate graph either 0 - 2 bar or 0 - 40 bar.

Graph shows the relationship between the flow and the pressure drop, depending upon the upstream pressure and the co-efficient of the valve (KV in litres per minute).



Upstream P : 8 bar

Example : a valve Ø 25 mm KV = 132, one needs to know the flow under the following conditions :

– upstream gauge pressure : 8 bar

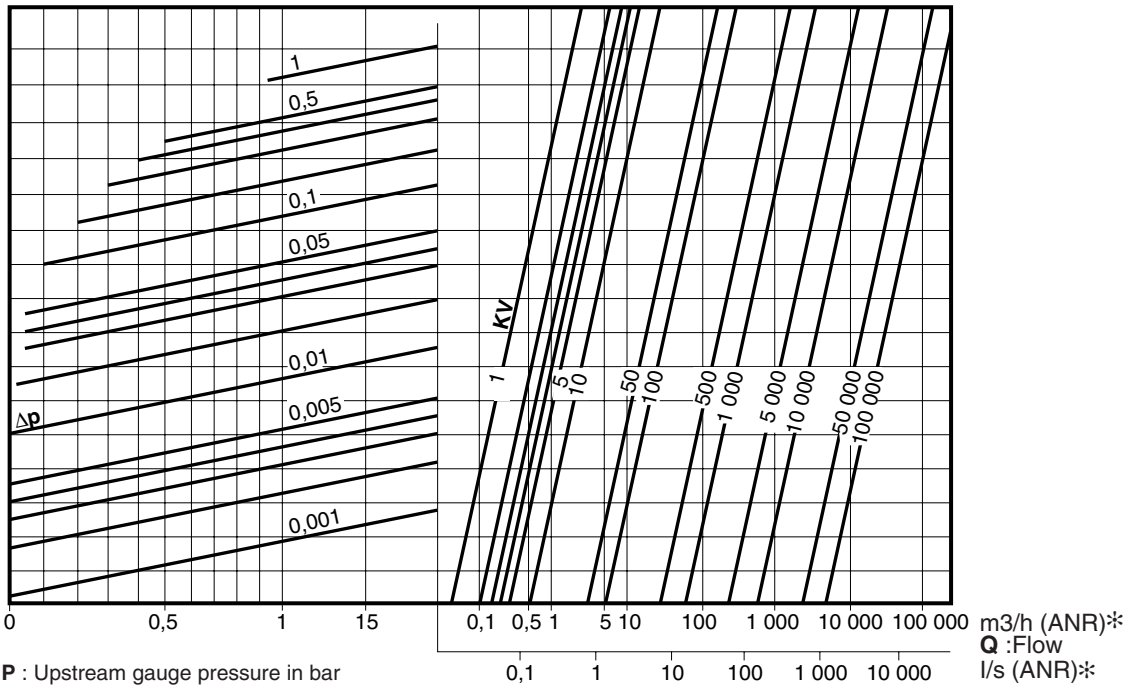
– pressure drop  $\Delta p = 3$  bar

Proceed as shown on the table, one finds flow = 950 m<sup>3</sup>/h.

If the pressure drop is superior to the value shown in the graph, the flow is identical to that with "critical pressure drop", so that :

$$\Delta p = \text{absolute downstream pressure} = \frac{\text{absolute upstream pressure}}{2}$$

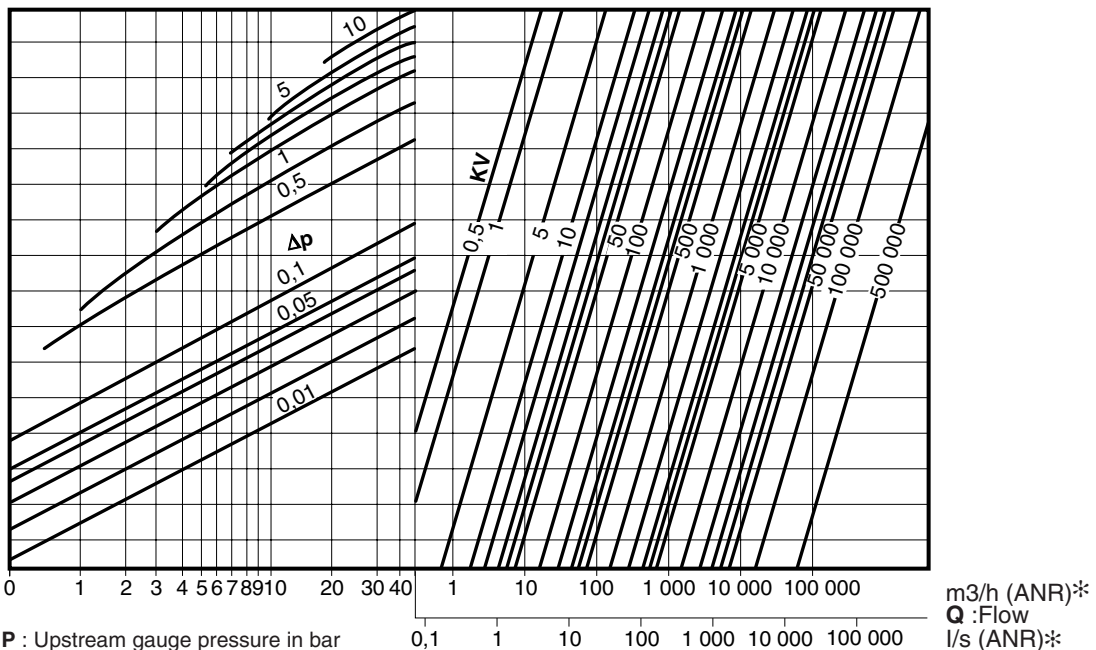
## PRESSURE OF AIR 0 to 2 bar



P : Upstream gauge pressure in bar

\* ANR : Normal reference atmosphere

## PRESSURE OF AIR 0 to 40 bar



P : Upstream gauge pressure in bar

\* ANR : Normal reference atmosphere

# Pneumatic symbols

Complies with standard ISO 1219-1 (1991)

## PNEUMATIC ACTUATORS

Single-acting cylinder rod returned at rest (SER)		Double-acting cylinder Non cushioned		Doubled-ended piston rod cylinder	
Single-acting cylinder rod out at rest (SES)		Double-acting cylinder with adjustable pneumatic cushioning		Double-acting rotatable cylinder	

## SOLENOID VALVES, CONTROL VALVES, PILOT VALVES

- The function of a valve is indicated by two figures. The first figure indicates the number of ports, the second one the number of valve positions (pilot ports excluded).

E.g. : 3/2\* 3 ports / 2 positions  
5/2 5 ports / 2 positions

\* An additional symbol defines the function of valves 2/2 and 3/2 :

NC : Normally closed at rest (de-energized, unpressurized)

NO : Normally open at rest (de-energized, unpressurized)

U : Function universal ; inlet may be fitted to any port

- The valve symbol for pneumatic valves includes as many boxes as valve positions.

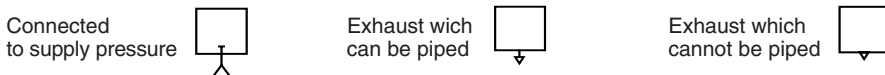


- 2 positions pneumatic valves : the right hand box stands for the rest position
- 3 positions pneumatic valves : the middle box stands for the rest position

- The arrows in the boxes show the direction of the flow :

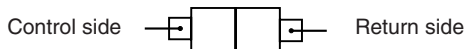
- Connections to ports must reach the box standing for the rest position.

- Symbols of connections to ports are as follows :



- Complete with the additional symbol of :

- control function (on the left)
- return function (on the right)



- Examples of symbols in this catalogue are as follows :

Air operated	Solenoid pilot operated	Direct solenoid valve	Solenoid pneumatic differential	Spring return	Air operated and spring return (5/3)	Solenoid air operated and spring return (5/3)	Double pulse coil (bistable function)
+	+	+	+			+	+
Manual override on control valve (or position tester)	Auxiliary manual override on solenoid valve	Manual override	Auxiliary manual override on solenoid valve	Symbol for manual override		Auxiliary manual override on solenoid valve	Manual override

- Type of pneumatic supply for control and return function :



- Ports numbers comply with standard ISO 5599 as follows :

• Main ports :

2/2 - 3/2 1 - 2 - 3	4/2 - 5/2 - 5/3 1 - 2 - 3 - 4 - 5
1 : Supply pressure (NC) 2 : Outlet 3 : Exhaust	1 : Supply pressure 2 - 4 : Outlets 3 - 5 : Exhausts

In solenoid valves 3/2 NO, pressure is usually in port 3, exhaust in port 1.

- A functional symbol of two figures describes pilot ports (12 - 14 or 10). It indicates which ports are activated by signal :
  - signal 12 : activates ports 1 and 2
  - signal 14 : activates ports 1 and 4
  - signal 10 : deactivates ports 1 and 2 (2/2 and 3/2 valves)

# Pneumatic symbols

Examples of symbols in this catalogue are as follows

Ports/ Positions	Function	Air operated			Solenoid operated <sup>(1)</sup>			
		Symbols	Control	Return	Symbols	Control	Return	
3/2	Direct operated	NC	-	-		solenoid	spring	
		NO	-	-		solenoid	spring	
	Pilot operated	NC		air	spring		solenoid / air	spring
		NC		air	air		solenoid / air	solenoid / air
		NO		air	spring		solenoid / air	spring
4/2		air	spring		solenoid / air	spring		
5/2		air	spring		solenoid / air	spring		
		air	differential		solenoid / air	air differential		
		air	air		solenoid / air	air		
	-	-	-		solenoid / air	solenoid / air differential		
	-	-	-		solenoid / air	solenoid / air		
5/3	W1		closed position (W1) air operated			closed position (W1) solenoid operated		
	W2		open position to pressure (W2) air operated			open position to pressure (W2) solenoid operated		
	W3		open position to exhaust (W3) air operated			open position to exhaust (W3) solenoid operated		

(1) With manual override on solenoid pilots.

## MANUAL AND MECHANICAL OPERATED SOLENOID VALVES

Ports/ Positions	Function	Manual control			Mechanical control		
		Symbols	Control	Return	Symbols	Control	Return
3/2	NC		pedal	spring		roller	spring
	NO		manual	spring		plunger	spring
5/2 - 5/3	-		lever	spring		plunger	spring

## AIR SERVICE EQUIPMENT

Filter		Regulator		Lubricator		FRL unit (simplified diagram)	
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## PNEUMATIC ACCESSORIES

One way adjustable restrictor valve		Silencer		Non-return valve		Adjustable pressure switch	
adjustable restrictor valve bi-directional		Quick exhaust valve		Shuttle valve		Indicator	

## PNEUMATIC LOGIC (following standard ISO 5784)

OR element (sum)		YES element (identity)		Program sequencer module		Timer	
AND element (product)		NOT element (negation)		Memory relay		Single pulse generator	