PS953 Pneumatic Signal Selection Relays

In different areas of process control, there are problems which can easily be solved with special pneumatic limit signal, time or computing relays. For instance, signal monitoring, signal selection, signal adaptation, safety control, etc.

SIGNAL SELECTOR RELAYS

- Signal selector Relay with mechanical or pneumatic setpoint adjustment for pressure and pressure difference

RELAYS FOR CONTROL APPLICATIONS

- Lock-in Relay
- Limiting Relay
- Changeover Relay

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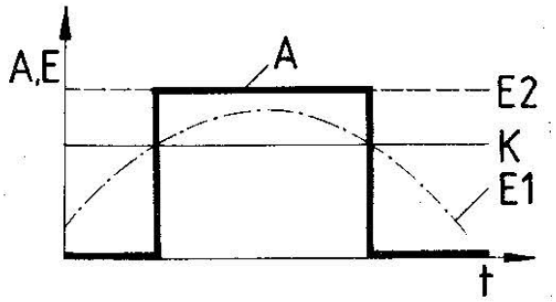
1 PS953-100 & PS953-101 LIMIT SIGNAL RELAY

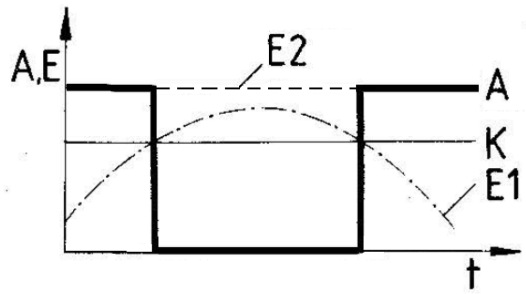
2.1 General

The pressure limit signal relays are designed for use in pneumatic control systems where the application requires the activation or deactivation of the pressure according to a fluctuant pilot pressure.

The limit signal relay actuates an on-off valve when controller signal increases or decreases to setpoint. One typical application is to close an on-off valve in a gas line when line pressure drops below a setpoint. When gas line pressure drops below set point, trip occurs, and valve operator is vented to atmosphere.



Function diagram for PS953-100



Function diagram for PS953-101

2.2 Technical data

Designation	Limit signal relay, change-over if setpoint is exceeded	Limit signal relay, change-over if pilot pressure drops below setpoint
Ordering number:	PS953-100	PS953-101
Pilot pressure E1	0,2 to 1 bar / 3 to 15 psi	
Input E2	0 to max. 10 bar / 0 to max. 150 psi	
Output A	According to switch position, E2 or zero	
Supply air	1,4 ±0,1 bar to max. 6 bar / 20 ±1,4 psi to max. 90 psi	
Limit value K setting equivalent to	0,2 to 1 bar / 3 to 15 psi	
Switching differential	<2 % of final value	
Air consumption	0; 100 Nl/h	
Max. air throughput at Δp = 1 bar	1500Nl/h	

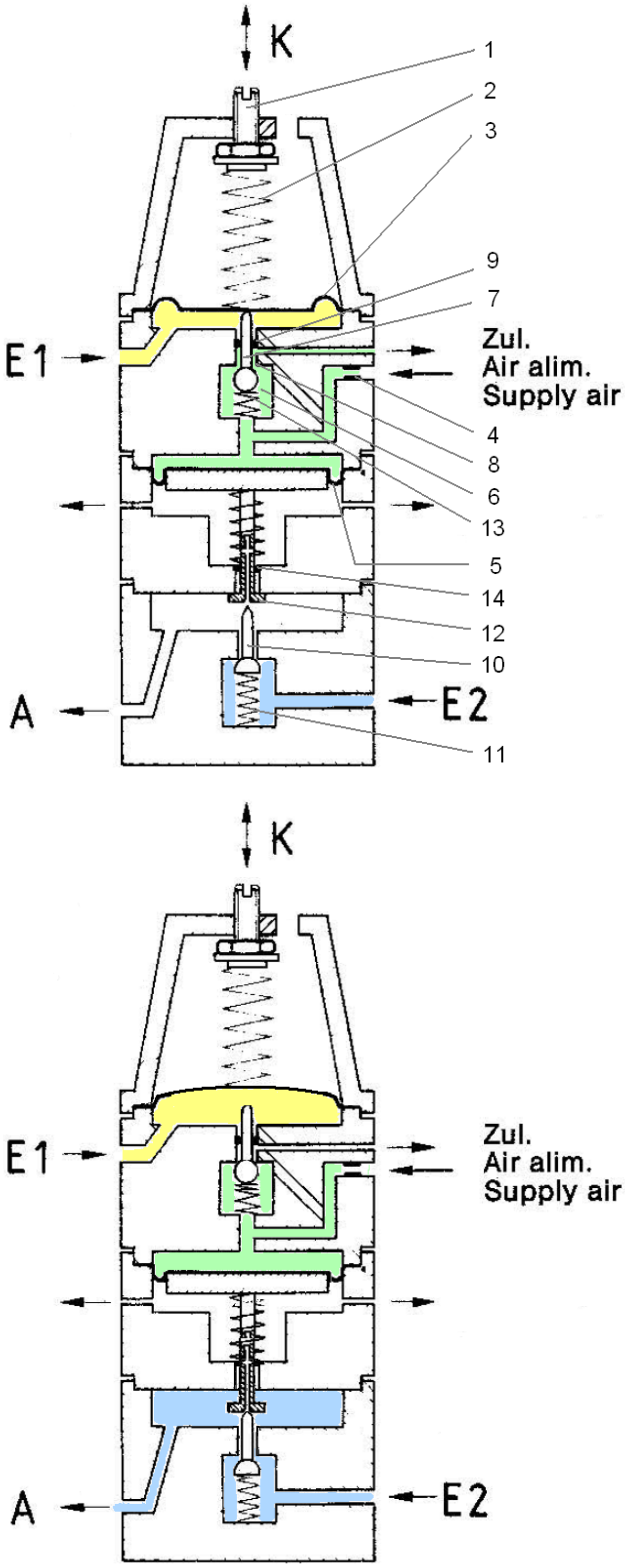
2.3 Operation

Via an adjusting screw (1) spring pressure (2) is balanced against the force of the pilot pressure E1 to be locked by means of a diaphragm (3). The air supply pressure is admitted to a switching amplifier. Via a restriction (4) the reduced volume of air reaches diaphragm (5) of the locking valve, but also reaches the pilot valve (6). This pilot valve follows the diaphragm (3) and is controlled by possible movements of this diaphragm.

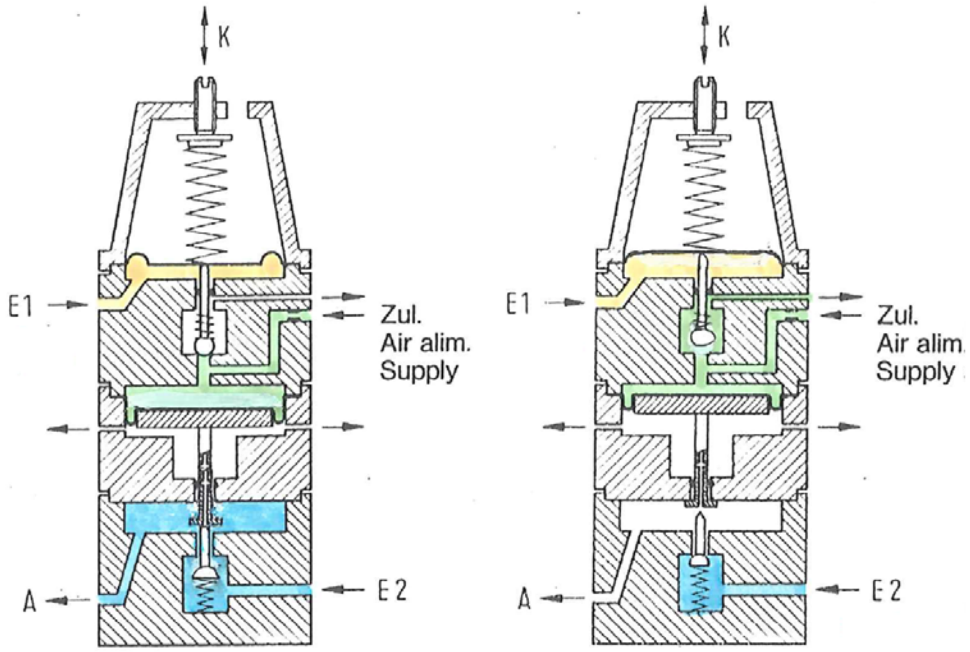
The adjustable pressure K of the measuring spring (2) balances a given, fluctuant pilot pressure E1. If this pressure is below the set limit, it will be overcome by the spring pressure, moving the diaphragm towards the pilot valve (6). The pilot (7) of this valve extends beyond a lower stop. The position of the diaphragm raises the pilot from its ball seat (8). The compressed air present in the space after the restriction escapes via the open ball seat and the exhaust channel. Although a certain amount of air continues to flow through the restriction, pressure cannot build up above the diaphragm (5), since the venting system is so dimensioned that all the air still coming through the restriction can escape. A sealing ring (9) on the stem of the pilot seals off the different pressure chambers one from the other. A vent opening below the diaphragm (5) ensures that no pressure can build up in this space under the diaphragm.

The limit valve is provided with a built-on switch valve with large diameter bores. A valve plug (10) is forced on to a valve seat by a compressed spring (11). Under pressure an effective seal results against the wall of a beveled bore and thus blocks the communication between the inlet E2 and the outlet A of the valve. The space above the valve plug (10) communicates with the venting exhaust thanks to the drilled guide (12), so that the output pressure A is equal to zero.

If the pressure E1 overcomes the spring pressure K, the diaphragm (3) will give way in the direction of the measuring spring and comes up against a stop. The pilot (7) moves to its ball seat (8) and is locked by a small counter-spring (13). The compressed air cannot escape anymore through the exhaust and as a result the pressure builds up in the space above the diaphragm (5), which can rise to the full extent of the pressure to be locked. The diaphragm's movement pushes the guide (12) away from its seat and opens the valve plug against the force of spring (11), thus establishing open communication between inlet E2 and outlet A. The exhaust from the drilled guide (12) is now blocked by a sealing ring (14) on the stem.



Operation for PS953-100
(change-over when setpoint is exceeded)



Operation for PS953-101 (change-over if pilot pressure drops below setpoint)

2.4 Mounting

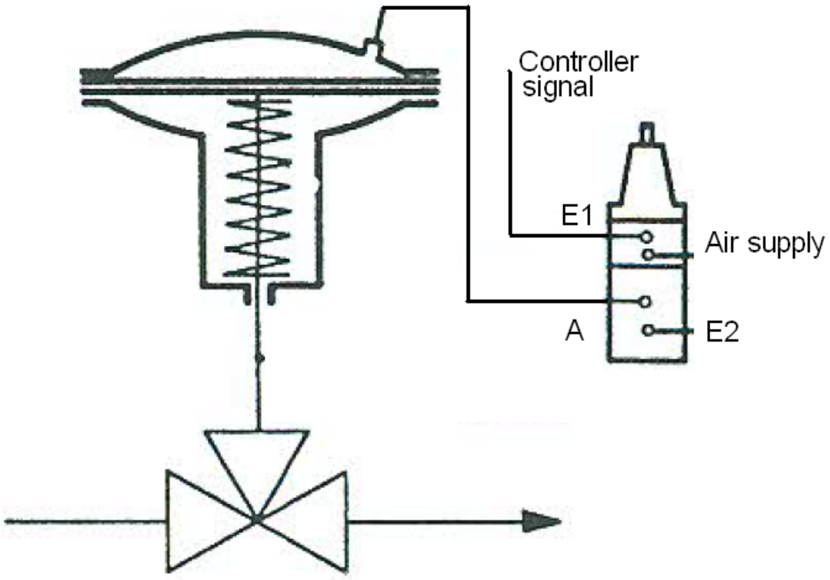
To ensure proper functioning of the limit signal relay together with the pneumatic actuation of an on-off valve, it is important to check that the input pressure E2 is higher than the minimum working pressure necessary for the actuator under the given working conditions

In view of the low weight of the relay it is quite permissible not to apply separate mounting on the actuator, if all connections are made in copper tubing.

Adjustment of pressure limit

It is immaterial whether the pressure limit is adjusted before or after mounting on the pneumatic on-off valve. The air supply is connected to the limit signal relay. The pilot signal E1 is connected to a pressure reducer with dial pressure gauge for the reduced pressure and the pressure adjusted to the required limit value. By turning the adjusting screw (1) with a screwdriver in clockwise direction the spring (2) is compressed until the relay can be heard to trip. For exact adjustment it is recommended to connect an arbitrary air pressure to the inlet E2. The tripping process is then completed when air escapes from the corresponding connection A.

The setting of the adjusting screw (1) must now be carefully readjusted, the limiting pressure being approached "from above" with the pressure reducer. Whilst making due allowance for the switching hysteresis the exact operating point is thus adjusted. It is recommended to lock the screw (1) after adjustment to prevent its setting being disturbed.



Example of arrangement for pneumatic limit signal relay with on-off valve

2.5 Maintenance

Like any other safety relay, the limit signal relay must be tested for proper functioning at regular intervals. It is recommended to cause the relay to trip by increasing the pilot pressure above the pressure limit once every three or six months.

If despite the exceeded setpoint, the limit signal relay should still block the passage of operating air to the actuator, the restriction should be removed and cleaned. Before being put back, the O-ring should be lightly greased with acid-free grease.

If leakages occur when the limit signal relay is in the rest position, the switch valve must be cleaned. An effective measure would be to replace the valve plug (10).

2 PS953-200 & PS953-210 LOCK-UP RELAY

2.1 General

Pneumatic lock-up relays serve to lock pneumatic valve actuators in the event of air supply failure.

Single-acting actuators are invariably operated by the supply air of the controller or the valve positioner from a safe position against spring pressure and against the force of the positioning element. In case of air supply failure the controller vents the pressure chamber of the actuator, causing the actuator to be forced back into its safe position.

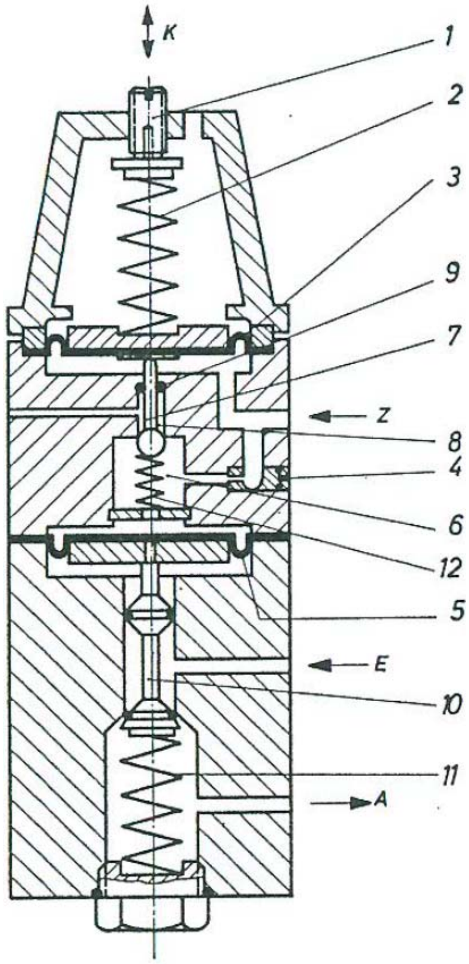
Double-acting actuators have no safe position. Thus, in case of air supply failure the position is determined by the direction of the counter-force of the positioning element.

When a pneumatic lock-up relay is connected between the controller or the valve positioner and the actuator, the position of the actuator will be maintained in the case of air supply failure, if the counter-force of the positioning element remains constant and the pressure chamber of the actuator is not leaking.

2.2 Technical data

Designation	Single-acting Lock-up relay	Double-acting Lock-up relay
Ordering number:	PS953-200	PS953-210
Locking pressure range	1 ... 6 kg/sq.cm	
Switching hysteresis	< 3 % of the set tripping pressure	
Air consumption:		
Pressure to be locked above the limit value	< 30 Nl/h	
Pressure to be locked below the limit value	100 Nl/h	
Max. air passage at connection to the valve actuator	Corresponds to air passage of 10 mm dia. x 1 mm tubing	

2.3 Operation



Pneumatic lock-up relays are constructed as pneumatic limit switches. Via an adjusting screw (1) spring pressure (2) is balanced against the force of the air pressure to be locked by means of a diaphragm (3). This air pressure is at the same time admitted to and serves as air supply for a switching amplifier. Via a restriction (4) the reduced volume of air reaches diaphragm (5) of the locking valve, but also reaches the pilot valve (6). This pilot valve is opposed to diaphragm (3) and controlled by possible movements of this diaphragm.

The pressure of the measuring spring (2) balances a given, adjustable pressure. If this pressure overcomes the spring pressure, the diaphragm will give way in the direction of the measuring spring and comes up against a stop. If the pressure drops below the set limit, it will be overcome by the spring pressure, moving the diaphragm towards the pilot valve (6). The pilot (7) of this valve extends beyond a lower stop. The movement of the diaphragm raises the pilot from its ball seat (8). The compressed air present in the space after the restriction can now escape via the open ball seat. Although a certain amount of air continues to flow through the restriction, pressure cannot build up above the diaphragm (5), since the venting system is so dimensioned that all the air still coming through the restriction can escape. A sealing ring (9) on the stem of the pilot seals off the different pressure chambers one from the other.

Depending on the type, this limit valve is provided with one or two built-on locking valves with large diameter bores. A valve plug (10) is forced on to a valve seat by a compressed spring (11). Under pressure an effective seal results against the wall of a beveled bore and thus blocks the communication between the inlet and the outlet of the valve.

Above the inlet opening the valve plug has a guide, which by means of a sealing ring at the same time enables the space under the diaphragm (5) to be sealed off. A vent opening below the diaphragm ensures that no pressure can build up in this space. Via a diaphragm plate, the diaphragm lies loosely on the valve plug. The compressed spring (11) blocks the connection between inlet and outlet in the event that no pressure prevails above the diaphragm, i.e, when the air pressure to be locked lies below the pressure limit set mechanically by means of the adjusting screw and the pilot (7) of the pilot valve (6) is open. If the pressure to be locked rises above the pressure limit the pilot is locked on to its ball seat by a small counter-spring (12), as a result of which pressure builds up in the space above the diaphragm, which can rise to the full extent of the pressure to be locked. Via the large diaphragm area this pressure opens the valve plug against the force of spring (11), thus establishing open communication between inlet and outlet.

To increase the positive closing action the pressure chamber to be blocked (e.g. the cap of a diaphragm actuator of a control valve) must always be connected to connection A (outlet) in order that in the event of air supply failure the contained pressure supports the closing force of the spring (11).

2.4 Mounting

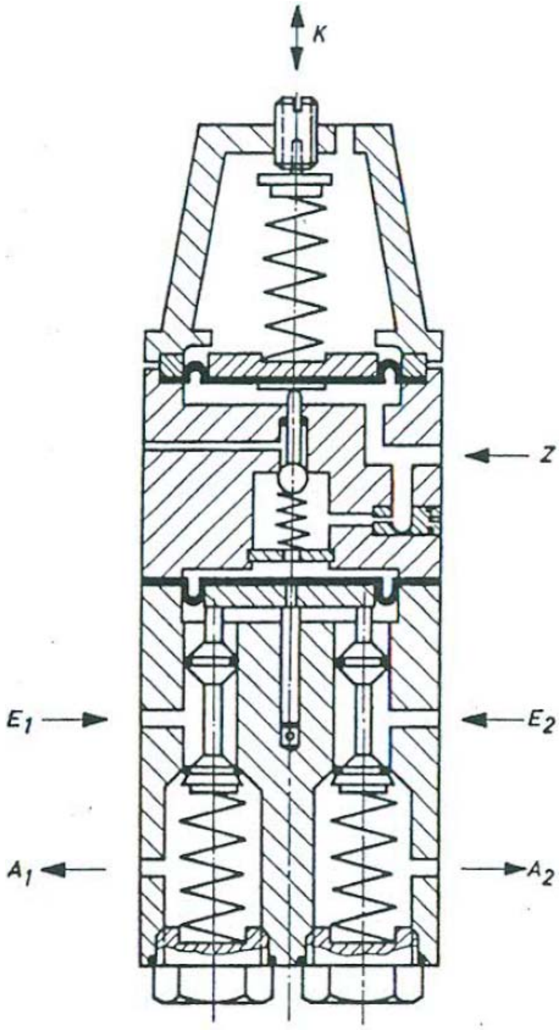
As the lock-up relay is a pneumatic safety switch inside a positioning device, mounting of the relay should actually take place in the workshop.

To ensure proper functioning of the lock-up relay together with the pneumatic control of the actuator, it is important that the lock-up relay should be mounted immediately before the pressure chamber of the actuator, but in any case after the pressure transmitter acting on the actuator (e.g. valve positioner, manually operated pressure transmitter). The proper functioning of the Lock-up relay is only ensured when it is known for certain that the actuator to be blocked is pressure-tight.

In the case of double-acting actuators, it is essential that the two actuator chambers should also be pressure-tight with respect to each other. If it is not known whether the actuator is suitable for building on a lock-up relay, the whole of the pressure chamber must be tested for tightness in the workshop.

The setting of the limit value is determined by the minimum working pressure necessary for the actuator under the given working conditions. If the lock-up relay is mounted after a valve positioner, allowance must be made for the fact that a valve positioner does not pass on the full air supply pressure to the actuator (in the case of Foxboro Eckardt valve positioners about 90% of the air supply pressure). Depending on the make of the positioner, the limit value must be set higher than would be required at the arithmetically determined working pressure.

In view of the low weight of the relay it is quite permissible not to apply separate mounting on the actuator, if all connections are made in copper tubing.

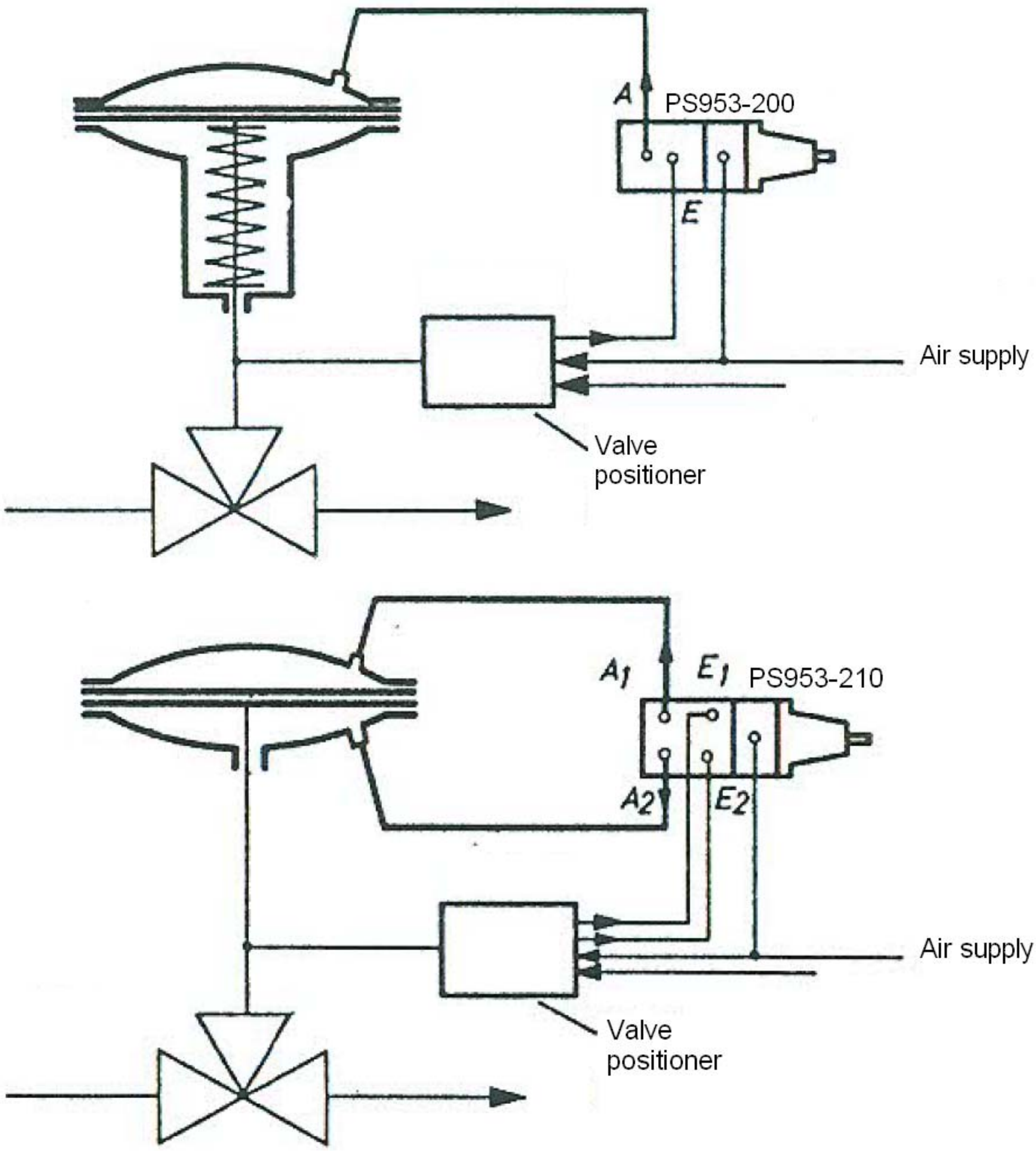


After mounting, all the lines originating from the connections A of the lock-up relay must be tested for tightness, since the blocking of the pressure chamber of the actuator can only be effective if all the parts concerned are pressure-tight.

Adjustment of pressure limit

It is immaterial whether the pressure limit is adjusted before or after mounting on the actuator. Connection Z of the lock-up relay is connected to a pressure reducer with dial pressure gauge for the reduced pressure and the pressure adjusted to the required limit value. By turning the adjusting screw (1) with a screwdriver in clockwise direction the spring (2) is compressed until the relay can be heard to trip. For exact adjustment it is recommended to connect an arbitrary air pressure to the outlet. The tripping process is then completed when air escapes from the corresponding connection E.

The setting of the adjusting screw (1) must now be carefully readjusted, the limiting pressure being approached "from above” with the pressure reducer. Whilst making due allowance for the switching hysteresis the exact operating point is thus adjusted. It is recommended to lock the screw (1) after adjustment to prevent its setting being disturbed.



Example of arrangements for pneumatic lock-up relay with control valves.

The lines and pressure chambers drawn in heavy print must be tested for tightness after installation of the lock-up relay.

2.5 Maintenance

Like any other safety relay the lock-up relay must be tested for proper functioning at regular intervals. It is recommended to cause the relay to trip by lowering the pressure below the pressure limit once every three or six months. Insofar as the process permits this the testing can take place as follows:

The air supply to the valve positioner is shut off before the branch-off to connection Z of the lock-up relay. The regular air consumption of the positioner will cause the air line to be vented quickly and the relay to be tripped without the condition of the actuator being changed, since the blocking effect will cause the actuator to be held in the position it happens to be in at that moment. After the air supply has been opened up again allowance must be made for a surge on the actuator in the case of control ranges with quick changes, since in the meantime the valve positioner has already built up a different working pressure on the actuator without the stroke being able to follow. If despite the normal air supply pressure the lock-up relay should block the passage of operating air to the actuator, the restriction should be removed and cleaned. Before being put back, the O-ring should be lightly greased with acid-free grease.

If leakages occur when the lock-up relay is in the safe position, the locking valve must be cleaned. An effective measure would be to replace the valve plug (10).

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