Series
STE 4 Control device for safety valves with pneumatic actuator.

1 DANGER AND WARNING INDICATIONS

The construction of the Sempell safety valves and control devices corresponds to the standard technology and the valid safety regulations. Nevertheless, improper use or improper installation may cause risks for personnel or can lead to restrictions in regard of the operational safety. Therefore Sempell GmbH recommends the operator of the valves to take appropriate measures and make sure that the present operating instruction is read and understood by the assigned personnel.

Please observe the following points besides the notes given in the text:

• Danger of burning when in contact with safety valves and connecting pipes while operating at increased temperature.
• Disassembly of the safety valve only in case of pressureless system and after cooling down. Wait for official permission. Disconnect electrical supply.
• Protection against risks caused by evaporation also in case of pressureless system; for information please contact the responsible safety inspector.
• After assembly check all sealing points in regard of tightness.
• Carry ear protection during adjustment, if necessary.
• Danger of burning by discharge of small amounts of possibly hot medium in case of safety valves with open spring bonnet (type SO..., VSE 1, VSR 1, VSE 8).
• Danger of injury while discharging in case of open discharge line.
• Extreme vibrations (chatter) can lead to an inadmissible increase of operating pressure with possibly destruction of the safety valve or to destruction of the balanced bellows with unintentional escape of medium.

Exclusion of liability
Sempell GmbH cannot be held liable in case of improper maintenance and adjustment of a Sempell valve, use of inadmissible spare parts or utilities and in case of temporary or permanent connection of equipment with the safety valve which is not approved by us.

Application limits
It is only allowed to use the safety valves and the control device according to the details of this operating instruction and/or according to the parameters and application data agreed in the delivery contract (see nameplate). The application of the valve has to take place adequate to the medium tolerances of the used materials.

Warnings for the operating and maintenance personnel
Before commissioning and maintenance works familiarise yourself with the legal accident prevention regulations, the local safety instructions and this operating instruction and observe them. Use safety valve, control device and their individual parts and accessories only for the purpose intended by us. Work on the electrical systems or equipment must only be carried out by an electrician or instructed personnel under control and supervision of an electrician according to the electrotechnical regulations.
SEMPELL SERIES STE 4 CONTROL DEVICE FOR SAFETY VALVES
OPERATING INSTRUCTIONS

2 DESCRIPTION OF COMPONENTS

For the following sections the connection diagram section 9.2 is valid unless otherwise provided.

2.1 Description of the function

The type-tested control device STE 4 pilots the on- and off-switch of the loading air or lifting air of the spring-loaded safety valve with pneumatic actuator.

Under power the 2/2 way solenoid valves (Y1, Y2, Y3) are closed and the 3/2 way solenoid valve (Y4) connects de-energized the pressure space (H) of the pneumatic actuator for lifting air with the atmosphere.

Via pressure regulator (R1), filter (F) and throttle (D), the loading air is on the loading cavity (B) of the pneumatic actuator. It causes an additional closing force to the spindle of the spring-loaded safety valve with pneumatic actuator.

The pressure gauge MB in the control unit shows the loading pressure, the control lamps (Y1, Y2, Y3, B) shine.

Opening

The pressure switches (D1, D2, D3) inserted into the impulse unit are adjusted to the desired set pressure. In case of exceeding set pressure, the solenoid valves (Y1, Y2, Y3) installed into the control unit become de-energized. These solenoid valves (Y1, Y2, Y3) switch by means of the contacts of the relay and are assigned to the corresponding pressure switch.

Additionally, each of the three solenoid valves become simultaneous de-energized by means of a relay contact released by each of the three pressure switches (D1, D2, D3). The solenoid valve (Y4) is energized.

The loading air is relieved through the solenoid valves (Y1, Y2, Y3). The lifting air is built up by the solenoid valve (Y4). The controlled safety valve opens.

The relief of the loading air also occurs if only one of the three solenoid valves (Y1, Y2, Y3) opens.

If the lifting air is not switched on, the controlled safety valve opens after the reduction of the loading air like a spring-loaded safety valve.

Closing

If the system pressure drops below the reseat pressure of the pressure switches (D1, D2, D3), the solenoid valves (Y1, Y2, Y3, Y4) switch back. The supply of lifting air stops. The pressure space (H) of the pneumatic actuator relieves to atmosphere and the loading air in the loading cavity (B) builds up again. The controlled safety valve closes.

Sliding pressure operation

Open the safety valve below the set pressure by an electrical impulse from the control

room. In case of higher control air pressures (lifting air) a second pressure regulator R2 will be used to reduce the loading air pressure (accessory, see system circuit diagram with pressure regulator R2).

2.2 Description of the construction

According to the specification, there are three separated control lines in the control device STE 4, that means three pulse generators (pressure switches) and three control units (solenoid valves) with each an independent pressure sense connection.

For testing and/or repair purpose it is possible to temporarily put one of the three control lines out of operation by means of the valve interlock (G).

The control device STE 4 consists of the functional groups:

impulse unit A161, electric switch unit A162 and pneumatic control unit a163.

The impulse unit is composed of the connections for the pressure sense lines (E1, E2, E3), the shut-off valves with interlock (A1, A2, A3) and the pressure switches (D1, D2, D3).

The test connections (P1, P2, P3) are located between the shut-off valves and the pressure switches. The pressure switches contain two micro switches so that opening and closing pressure can be set independent from each other (P-min, P-max).

ATTENTION!
The components of the impulse unit A161 are under system pressure!
The electric switch unit includes the equipment for signal treatment and control. At the bottom side is the connection for the power supply. Protected by an inspection window, control lamps and manual switches for working and testing are on the front panel. Pressing the switch “Lamp Test” energizes all control lamps.

The pneumatic control unit contains the connections for the compressed-air supply of the pneumatic section through pressure regulator (R1) and air filter (F) to three closed-circuit 2/2 way solenoid valves (Y1, Y2, Y3); one open-circuit 3/2 way solenoid valve (Y4) and the pressure gauges for loading and lifting air (MB, MH).

At the upper side are the connections of the control lines to the pneumatic actuator.
3 TECHNICAL DATA SAFETY VALVE CONTROL

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Sempell GmbH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Control Device</td>
</tr>
<tr>
<td>Series</td>
<td>STE 4</td>
</tr>
<tr>
<td>Compressed-air supply</td>
<td>Max. 8 bar, 12 bar as option</td>
</tr>
<tr>
<td>Operating pressure for the pneumatic actuator</td>
<td>Max. 8 bar</td>
</tr>
<tr>
<td></td>
<td>Max. 12 bar for lifting air (accessory with pressure regulator R2)</td>
</tr>
<tr>
<td>Air consumption at opening</td>
<td>About 26 Nm³ at 5 bar</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>Max. 60 °C</td>
</tr>
<tr>
<td>Protection class</td>
<td>IP 55</td>
</tr>
<tr>
<td>Weight</td>
<td>About 78 kg</td>
</tr>
<tr>
<td>Type tested approval mark no.</td>
<td>TÜV.SV. ...-846</td>
</tr>
</tbody>
</table>

Electric connections:
- Control device: Input voltage 230 V, 50 Hz - 24 V DC or 48 V DC as option
- Solenoid valve coils: Connecting voltage 230 V, 50 Hz - 24 V DC or 48 V DC as option

4 OPERATING INSTRUCTIONS

Switch on the control device STE 4 by the key operated switch at the electric switch unit. The white control lamp “Operation” shows the operating state. The pointer of the measuring instrument in the “Test” field is in the black area “Operation”.

ATTENTION!
A change of the lead sealed pressure switch adjustment must take place in the presence of the independent TÜV inspector [TRD 601, sheet 2, section 4.2.1].

4.1 Adjustment after installation
Before delivery the pressure switches are pre-set to the desired set pressure and closing pressure (see section 2.1). After the installation of the system a resetting of the pressure switches (D1, D2, D3) may be necessary under operating conditions (e.g. because of temperature changes or after maintenance works).
Therefore connect a spindle pump with calibrated pressure gauge [accessory] at one of the test connections (P1, P2, P3). Apply the desired set pressure to the pressure switch. Because of the closed pertaining shut-off valve (a1, a2, a3) the system pressure has no influence. In doing so, temporarily prevent the response of the safety valve by the pneumatic actuator.

Procedures
- Open the front door of the electric switch unit. Set test switch in the "Test" field into position "Test 1". Indicator: yellow control lamp in the "Test" field blinks.

The lifting air to the pneumatic actuator is temporarily switched off. The safety valve remains fully operational.

Unlock and close the corresponding shut-off valve [A1, A2 or A3] by means of interlock key. Connect spindle pump with pressure gauge at the test connection (P1 or P2 or P3) of the previously closed shut-off valve [connections see section 4.7.1].

4.2 Pre-setting
In case of a new adjustment or of great deviations pre-set both micro switches of the pressure switch (D1, D2, D3) approximately at their set value first. The precision pressure switches Manocomb-Sem-2K have calibrated nominal value scales for P-max and P-min with an accuracy of ≤ 1%. By means of the corresponding knurled-head screws pre-set the switch points quite precise.

4.3 Set pressure control
Increase pressure with the spindle pump connected to the test connection until the control lamp P-max [red] flashes up. This is the switch point. Register pressure reading on the test gauge. To change the switch point, turn the higher knurled-head screw. Turn the adjusting screw only a little when you are close to the switch point. Lower excess pressure up to about 0 bar and then increase again until the pressure switch actuates. Register pressure indicator of the gauge again and correct switch point if necessary.

Repeat procedures until the desired switch pressure is reached.
In case of pressure decrease, the switching band of the pressure switch with micro switches can be determined. This is the pressure difference between switch-on point [flash up of the control lamp P-max] and switch-back point (darken of the control lamp P-max).
**4.4 Reseat pressure**

Increase pressure with the spindle pump connected at the test connection beyond the desired closing pressure until the control lamp P-min (yellow) shines. Slowly decrease pressure until the control lamp P-min (yellow) goes out. This is the switch point. Register pressure reading of the gauge.

To change the switch point, turn the corresponding adjusting screw. Turn adjusting screw a little when approaching the switch point. Lower excess pressure up to about 0 bar and then increase again beyond the closing pressure (control lamp P-min (yellow) shines). Slowly decrease pressure until the pressure switch actuates. Register pressure reading of the gauge again and correct switch point if necessary.

Repeat procedures until the desired switch point is reached.

In case of pressure decrease the switching band of the pressure switch with micro switch can be determined. This is the pressure difference between switch-on point (lighting up of the control lamp P-min) and back switch point (darken of the control lamp P-min).

After adjustment open the corresponding shut-off valve again and lock it by means of the interlock key. Put the cover on the pressure switch and lead seal. Close front door again.

**4.5 Monitoring**

Check daily the actual status of the control device by visual check.

The actual function will be shown as follows:
- The safety valve is closed and loading air is applied:
  - Electric switch unit:
    - white control lamp “Operation” shines. Gauge reading is in the black area “Operation”.
    - Green lamps Y1, Y2, Y3 and B shine.
  - Pneumatic control unit:
    - gauge reading present at “Load” (MB).
    - Inspection window “Load” is green.

- The safety valve is opened and lifting air is applied:
  - Electric switch unit:
    - white control lamp “Operation” shines. Gauge reading is in the black area “Lifting”. Yellow lamps Y4 and H shine. Red and yellow lamps (P-min/P-max) 1 and/or 2 and/or 3 shine.
  - Pneumatic control unit:
    - gauge reading present at “Lifting” (MH).
    - Inspection window “Lifting” is green.

**4.7 Testing**

**4.7.1 Check of pressure switch and operation of the solenoid valves**

For testing, one of the three pressure switches [D1, D2, D3] can be separated from the system by closing the unlocked shut-off valve [A1, A2, A3] in the pressure sense line [E1, E2, E3] by means of the valve interlock (G).

With a spindle pump with test gauge [Minimess fa. Hydrotechnik] after removing the knurled protective cap.

The control lamps P-min or P-max show the gain of set and closing pressure (also see sections 4.3, 3.4).

If the safety valve shall not open during the tests, set the test switch at field “Test” of the control device in position “Test 1” to prevent the opening of the 3/2 way solenoid valve [Y4] and so the charge of the lifting air. At the same time this switch position leads to the opening of only the solenoid valve [Y1, Y2, Y3] assigned to the specific pressure switch.

Have the set and closing pressure adjustment checked once a year by an inspector.

**ATTENTION!**

A change of the lead sealed pressure switch adjustment must take place in the presence of the independent TÜV inspector [TRD 601, sheet 2, section 4.2.1].

**4.6 TROUBLE SHOOTING**

<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Cause</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loading air is prematurely dropped</td>
<td>Pressure switch adjustment changed</td>
<td>Pressure switch adjustment see chapter 4</td>
</tr>
<tr>
<td>Control line “Load” leaky</td>
<td>Eliminate leaking point in the control line</td>
<td></td>
</tr>
<tr>
<td>Tube fittings leaky</td>
<td>Retighten tube fittings</td>
<td></td>
</tr>
<tr>
<td>Electric supply deactivated</td>
<td>Check electric connections</td>
<td></td>
</tr>
</tbody>
</table>
• Check of the control legs 1 to 3
  - Adjustment of the control air pressure to 2 bar.
  - Check of the pressure gauge "Load"
  - Test switch into position "Test 1"
  - Signal lamp (orange) lights up.

• Check of control leg 1 (pressure switch D1, solenoid valve Y1)
  - Unlock and close shut-off valve a1.
  - Slowly apply pressure to test connection P1 up to the response of the pressure switch.
  - Read corresponding pressure P-max at the test gauge. Solenoid valve Y1 powerless. Drop of the loading air; indicator at the pressure gauge "Load" < 0.2 bar; no lifting air. Indicator pressure gauge "Lifting" 0 bar, ampere meter in position "Test 1".
  - Slowly drop pressure until the pressure switch switches back.
  - Read corresponding pressure P-min at the test gauge. Solenoid valve Y1 is energized and closes. Loading air will be charged. Indicator pressure gauge "Load" 2 bar.
  - Open and lock shut-off valve a1.

• Check of control leg 2 (pressure switch D2, solenoid valve Y2)
  - Unlock and close shut-off valve a2.
  - Slowly apply pressure to test connection P2 up to the response of the pressure switch.
  - Read corresponding pressure P-max at the test gauge. Solenoid valve Y2 powerless. Drop of the loading air; indicator at the pressure gauge "Load" < 0.2 bar; no lifting air. Indicator pressure gauge "Lifting" 0 bar, ampere meter in position "Test 1".
  - Slowly drop pressure until the pressure switch switches back.
  - Read corresponding pressure P-min at the test gauge. Solenoid valve Y2 is energized and closes. Loading air will be charged. Indicator pressure gauge "Load" 2 bar.
  - Open and lock shut-off valve a2.

• Check of control leg 3 (pressure switch D3, solenoid valve Y3)
  - Unlock and close shut-off valve a3.
  - Slowly apply pressure to test connection P3 up to the response of the pressure switch.
  - Read corresponding pressure P-max at the test gauge. Solenoid valve Y3 powerless. Drop of the loading air; indicator at the pressure gauge "Load" < 0.2 bar; no lifting air. Indicator pressure gauge "Lifting" 0 bar, ampere meter in position "Test 1".
  - Slowly drop pressure until the pressure switch switches back.
  - Read corresponding pressure P-min at the test gauge. Solenoid valve Y3 is energized and closes. Loading air will be charged. Indicator pressure gauge "Load" 2 bar.
  - Open and lock shut-off valve a3.

• Set back to working conditions
  - Turn test switch into position "Operation".
  - Set control air pressure at normal operating pressure.
  - Signal lamp (orange) goes out. Control at the pressure gauge "Load".

4.7.2 Check of the displacement force reserve of solenoid valves Y1, Y2 and Y3
The solenoid valves (Y1, Y2, Y3) consist of an electric actuated pilot valve and a pneumatic actuated control valve.
At the electric actuated pilot valve, pressing the respective push-button in the electric switch unit lowers the operating tension up to a value where a faultless solenoid has to switch. A pressure drop of the loading air at the pressure gauge [MB] shows the switching. The lifting air is not actuated.
As the extent of the loading air pressure counteracts the switch safety of the solenoid valve check with the highest possible control pressure.
By means of the magnetic actuated pilot valve the pilot pressure is released. In case of the pneumatic actuated control valve the height of the air pressure brings about the switch safety. To prove the displacement force reserve on the control valve check with the lowest possible control pressure [operation test according to section 4.7.1].
Control the displacement force reserve at the solenoid valves by pressing the switches at a highest possible air pressure. Afterwards control according to section 4.7.1 at lowered air pressure.
The loading air pressure has to drop to \( p < 0.2 \text{ bar} \) for all tests.
Once a year an inspector has to test the displacement force reserves with the same pressures.
Sempell Series STE 4 Control Device for Safety Valves
Operating Instructions

• Test course
Ampere meter into position “Operation”, Test switch in position “Operation”.
- Open the front door and the cover plate of the electric switch unit.

• Check of the displacement force reserve of solenoid valve Y1
- Adjust the control air pressure to about 5 bar.
  Control at the pressure gauge “Load”.
- Turn potentiometer clockwise to the highest value.
- Press and hold push-button for displacement force reserve of solenoid valve Y1.
- Slowly turn down the potentiometer anti-clockwise until the solenoid valve Y1 actuate (power will be reduced).
Solenoid valve Y1 opens. The load will be relieved. The loading air pressure has to drop to < 0.2 bar: indicator pressure gauge “Load”, ampere meter in position “Test 1”, register the reading of the potentiometer adjustment.
- Loosen push-button.
Solenoid valve Y1 closes (nominal voltage at Y1). Load will be charged.

• Check of the displacement force reserve of solenoid valve Y2
Check of the control air pressure. Indicator at the pressure gauge “Load”.
- Turn potentiometer clockwise to the highest value.
- Press and hold push-button for displacement force reserve of solenoid valve Y2.
- Slowly turn the potentiometer anti-clockwise until the solenoid valve Y2 actuate (power will be reduced).
Solenoid valve Y2 opens. The load will be relieved. The loading air pressure has to drop to < 0.2 bar: indicator pressure gauge “Load”, ampere meter in position “Test 1”, register the reading of the potentiometer adjustment.
- Loosen push-button.
Solenoid valve Y2 closes (nominal tension at Y2). Load will be charged.

• Check of the displacement force reserve of solenoid valve Y3
Control of the control air pressure. Indicator pressure gauge “Load”.
- Turn potentiometer clockwise to the highest value.
- Press and hold push-button for displacement force reserve of solenoid valve Y3.
- Slowly turn the potentiometer anti-clockwise until the solenoid valve Y3 actuate (power will be reduced).
Solenoid valve Y3 opens. The load will be relieved. The loading air pressure has to drop to < 0.2 bar: indicator pressure gauge “Load”, ampere meter in position “Test 1”, register the reading of the potentiometer adjustment.
- Loosen push-button.

Solenoid valve Y3 closes (nominal voltage at Y3). Load will be charged.

• Adjustment of the working state
- Adjust control air pressure on normal working pressure.
Control at the gauge “Load”.

4.7.3 Lifting air charge
By putting the test switch into position “Test 2” the 3/2 way solenoid valve (Y4) is energized and so builds up the lifting air in the pressure space (H) of the pneumatic actuator.
Indicator: yellow control lamp in the field “Test” signals, control lamps Y4 and H shine, pressure indicator gauge MH, pointer in the gauge is in the black field “Test 2”.
As the loading air simultaneously is applied in the pressure space (B) of the pneumatic actuator, the safety valve does not open. For the special design with pressure regulator R2 adjust the control pressure at the pressure regulator R1 to pressure level of pressure regulator R2.

4.7.4 Safety valve operation (pneumatic)
With the help of the lifting air the safety valve can be opened fully to test the movability. In doing so, for a short time the loading air will be reduced and the lifting air will be built up. It is possible to execute this test out of the control room by remote operation and/or locally at the control device by the push-button “Hand Actuation”. At least one possibility has to be there according to specification TRD 421 and AD-A2.
If a pressure lock valve is in the pneumatic control unit to raise the lifting air (e.g. at drum safety valves) it has to be actuated additionally.
Check the movability of the safety valve by an inspector once a year.

Adjustment of the working state
- Adjust control air pressure on normal working pressure.
Control at the gauge “Load”.

4.7.3 Lifting air charge
By putting the test switch into position “Test 2” the 3/2 way solenoid valve (Y4) is energized and so builds up the lifting air in the pressure space (H) of the pneumatic actuator.
Indicator: yellow control lamp in the field “Test” signals, control lamps Y4 and H shine, pressure indicator gauge MH, pointer in the gauge is in the black field “Test 2”.
As the loading air simultaneously is applied in the pressure space (B) of the pneumatic actuator, the safety valve does not open. For the special design with pressure regulator R2 adjust the control pressure at the pressure regulator R1 to pressure level of pressure regulator R2.

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It is possible to execute this test out of the control room by remote operation and/or locally at the control device by the push-button “Hand Actuation”. At least one possibility has to be there according to specification TRD 421 and AD-A2.
If a pressure lock valve is in the pneumatic control unit to raise the lifting air (e.g. at drum safety valves) it has to be actuated additionally.
Check the movability of the safety valve by an inspector once a year.
4.7.5 Safety valve adjustment (system pressure)

In case of checking the spring setting of the safety valve only by the system pressure, block the air supply to the control device STE 4 for a short time.

Procedures

- Open front door of the electric switch unit.
- Disconnect power supply by means of a key operated switch.
- Indicator: white control lamp "Operation" is out.
- Open front door of the pneumatic control unit.
- Register the pressure shown at the gauge of the pressure regulator R1. Shutoff air supply at pressure regulator R1 by moving up and turning left the handle of the regulator.
- Indicator: pressure shown at the pressure gauge lowers to \( p = 0 \) bar.

The safety valve adjustment can now be checked by increasing the system pressure without influence of the pneumatic actuator. After finishing the test, restore the control pressure and the power supply.

Procedures

- Adjust control pressure at the pressure regulator R1 to the previously registered value again by moving up and turning right the regulator handle. Read the pressure at the gauge. Moving down the regulator handle secures the adjustment.
- Close front door of the pneumatic control unit.
- Switch on the power supply by means of the key operated switch. Close front door of the electric switch unit.
- Indicator: white control lamp "Operation" shines.

4.7.6 Safety valve adjustment (pneumatic)

To execute the adjustment of the safety valve at any system pressure and without considerable disturbance of the actual working procedures, the following test method is proposed:

For each safety valve determine once the angle of inclination (perhaps already at the inspection) (see diagram) by measuring at two different system pressures. Slowly add the lifting air to the respective system pressure by means of pressure regulator valve R1. Record the measuring points (lifting air pressure, system pressure) in the diagram while the opening of the safety valve starts.

Measure and register system pressure, lifting air pressure (PS) and lift of the safety valve.

The intersection of the straight line with the abscissa \( \text{lifting air pressure} = 0 \) barg corresponds with the set pressure of the safety valve without lifting air.

For the following tests only one observation is done at a random system pressure.

If the measured point is not at the straight line correct the spring compression of the safety valve.

Remark: the gradient of the measured characteristic curve (straight line) is due to the construction (relation between the effective pneumatic piston surface and the effective seat surface). After a modification of the spring compression the characteristic curve has been shifted parallel.

For recorded measurement the following equipment is necessary:

- 2 pieces electric pressure transmitters
- 1 piece electric travel pickup
- 1 piece 4-channel test amplifier
- 1 piece 4-channel recorder

(This equipment can be obtained by Sempell GmbH)

Procedures

- Open the front door of the pneumatic control unit. Register the shown pressure at the gauge of the pressure regulator R1. Stop the compressed-air supply at the pressure regulator R1 by moving up and turning the regulator handle anti-clockwise.
- Press and hold the hand actuation until the solenoid valves Y1-Y4 have relieved the piston space B.
- Indicator: shown pressure at the gauge lowers to \( p = 0 \) bar.

ATTENTION!

Disconnect compressed-air supply at the control device STE 4 so that the cavities of the pneumatic actuator are not under pressure!
The pneumatic actuator is temporarily switched off; the safety valve remains fully operational.

- In case of a cup spring safety valve (type VSE8, SOT) unscrew the cap of the pneumatic actuator and attach test cap with displacement pickup to the safety valve.
- For a safety valve (VSE/VSR 1/5, SO, SB) with mounted pneumatic actuator A160 assemble the displacement pickup sideways to the coupling.
- Connect pressure transmitter to lifting air (P5 in the pneumatic control unit). Also connect a pressure transmitter to the system pressure.
- Press and hold fast hand actuation. Slowly turn up handwheel of the pressure regulator R1 (clockwise rotation). The pressure gauge "Lifting" indicates the increasing lifting air pressure. Increase pressure until the safety valve opens. Measure and register pressure and lift with the help of the measuring devices.
- After finishing the opening loosen hand actuation. The lifting air will be reduced and the loading air will be built up again.
- The safety valve closes.
- At a pneumatic control unit equipped with an additional pressure block valve for the lifting air (e.g. for drum valves), it shall be actuated additionally to the switch "Hand Lifting".

After finishing the test restore the original control pressure again.

**Procedures**

- Re-adjust control pressure at the pressure regulator R1 to the previously registered value by moving up and turning clockwise the regulator handle. Read the pressure at the pressure gauge. Moving down the regulator handle secures the adjustment.

**Notice!** In case of two or several safety valves controlled by one control unit, all safety valves open at the procedure described above. If only the tested safety valve shall open, it is possible to block the second safety valve mechanically under consideration of special precautions.

*After finishing the test, remove this safety valve blocking in any case!!!*

It is also possible to remove and shut the control air hoses at the second safety valve.

**5 TASKS OF THE INDEPENDENT INSPECTOR**

These tasks are executed according to VdTÜV Merkblatt Sv ...-846.

**5.1 At inspection test before commissioning**

1. Check correspondence of approved type test identification number with the mark on the control unit.

2. Check reliability of the main valve in connection with the control device.

3. Check correspondence of functional diagram with the design.

4. Check each control leg according to section 4.7.1-3.

In doing so, especially check the adjustment of the pressure switch, the displacement force reserve and the reduction of the air. The time to reduce air shall be about the same for each control leg. Therefore register the pressure in- and decrease of lifting and loading air against time. The dead time of the control device must correspond to the pressure change rate of the protected system.

**During operation of the system**

1. Shut off air. Check the adjustment of the main valve without loading and lifting air. Register lift of the main valve and the system pressure against time. When the main valve only opens to some extent due to operation, check by extrapolation of the lift course if the required lift is reached at least at 10% above the admissible design pressure. If the safety valve has capacity reserves, the maximum possible lift for discharging the required discharge amounts must not be reached. This test is not necessary for type-tested safety valves.

2. Fully open the main valve with the lifting air. Check movability. This can also be executed by hand through the manual switch at operational pressure. Register system pressure, air lifting pressure and lift of the main valve against time.

3. The admissible ambient temperature of 60 °C must not be exceeded at the position of the electric components of the control device.

**5.2 At periodic inspections**

1. Check external state.

2. Yearly check control device according to section 5.1, point 4.

3. Yearly check the adjustment of the main valve without loading and lifting air (see section 4.7.6).

4. Yearly check operation of the main valve. To evaluate the lifting course against time execute the test with system pressure and capacity comparable to the first test.

5. Check sliding faces at spindle, pistons, guides and so on in contact with medium in regard of defects. Examine welding seams and greater wall interface thickness in regard of cracks.
6 PREVENTIVE MAINTENANCE

Observe safety instruction in section 1.

Before each operation ensure that
- the planned measures will not cause any faults of the system or injury to persons
- control device and system part are properly disconnected. Check that all circuits are disconnected

At the control device
- disconnect all poles, prevent accidental reconnection
- confirm that the equipment is not live, is earthed and short-circuited
- fit barriers or covers to neighbouring live components

6.1 Control and maintenance

Generally the pressure switches (D1, D2, D3) in the impulse unit of the control are rarely actuated. Check their functional readiness once a year. Except the yearly control (see section 4.7.1 to 4.7.6) and occasional readjustments (see section 4.1) there is no further maintenance necessary.

The pressure regulator R1 in the control unit of the compressed-air supply is a simple acting membrane regulator with automatic release of the secondary pressure.

By moving up and turning of the regulator handle adjust the pressure and read it at the pressure gauge. Moving down the regulator handle secures the adjustment.

7 REPAIR INSTRUCTION AND INSTALLATION

Observe safety instruction in section 1.

Before each operation ensure that
- the planned measures will not cause any faults of the system or injury to persons
- control device and system part are properly disconnected

At the control device
- disconnect all poles, prevent accidental reconnection
- confirm that the equipment is not live, is earthed and short-circuited
- fit barriers or covers to neighbouring live components

7.1 Storage

At delivery of the control device all connection inlets are closed with corresponding caps. Connection hoses and a key are attached to the outside.

In this state the control device can be stored without difficulties in closed, dust-free and dry rooms lying on the fixing frame (inspection window to the upper side).

A weather-protected outdoors storage is not admissible.

Technical data
Primary pressure max.: 18 bar g
Secondary pressure: 0 - 10 bar g
                (0 - 12 bar g option)
Flow rate: 0 - 2500 l/min
Water separating: 95 %

The mechanical acting filter F in the maintenance unit of the compressed-air supply is provided with a sight glass.

At the bottom side is the manual water trap.

By turning the plastic nut by hand for about 1.5 turns, drain the filter. Afterwards tighten the nut.

The plastic nut of the water separator is at the bottom side of the control unit behind the compressed-air supply.

Control the filter at least yearly and if necessary, clean and drain the filter (see section 7.8).

Technical data
Primary pressure max.: 18 bar g
Area of flow rate: 0 - 2500 l/min
Water separating: 95 %
Filter element: 25 µm
Tank volume: 45 ml (cm³)
7.2 Assembly
The delivery of the control device STE 4 takes place assembled on a frame tightened by eight screws.
At delivery the key of the front doors is placed at the connection for the compressed-air supply of the control unit. Further keys are behind the front door of the electric switch unit.
It is only allowed to operate the control device STE 4 by an air pressure of max. 8 bar. For the special design with pressure regulator R2 the lifting air can be up to max. 12 bar.
The control device has to be easy accessible to facilitate adjusting and inspection. Protect the location of the installation against wet and dirt.
Do not mount control device too close to the safety valve (distance at least 3 m). For remote location consider the delay times (see VdTÜV-regulation ...-846).

ATTENTION!
Take care that no vibrations of the structure are transferred to the control device as they can fraudulently alter the measured value [switch point]. If necessary, install vibration dampers, e.g. rubber buffers.

7.3 Pressure sense line
To connect the pressure sense line the control device has three pressure connections (E1, E2, E3). The pertaining tube fittings (attached to delivery) have a welding connection DA Ø 21.3 x 4 out of 316SS (similar to 1.4401).
It is possible to weld adequate pipe profiles on these connections. The tube fittings have to be assembled according to the instructions (see section 9.3).
If desired special connections and materials are deliverable [request].
The inner diameter of the pressure tapping line must be at least 15 mm.
The pressure connection has to take place above an flexible laid line. In case of fixed line bracings between pressure sense line and welding connection of the control device it may cause switch inaccuracy of the pressure switches.
Guarantee by suitable measures that no vibration can be transferred to the control device. Dampen vibrations or pressure peaks out of the medium by switch on throttles.

Connection of the sense line in the system:
For preventing too great pressure deviations observe following instructions:
• If possible, connect not directly at the safety valve inlet
• Connection of the system part to be secured on a point with as great volume as possible and as little as possible pressure fluctuations.

In case of pressure sense lines coming from different systems (e.g. drum, superheater), take care of the correct connection at the impulse unit (different pressure setting of pressure switches).
Prevent undue heating up of the control device in case of connecting the control device at pressure tapping lines with hot medium. The temperature at the impulse unit inlet may not exceed 60°C.
For steam as medium, connect via syphons or water locks before the control device. Therefore lay pressure sense line so that condensate can be formed. The pressure sense line close to the control unit may not be insulated.
Protect lines and control device from freezing.
If the impulse unit A161 is provided with a heating [accessory H1, H2], observe the following points:
At danger of freezing assure that the control unit is always energized.

ATTENTION!
Also when the control unit is switched off by the main switch (lockable switch), the heating remains energized.

The power supply of the heater can be disconnected by an additional switch.
For outdoor installation additionally protect the system from direct exposure of sunlight.
After commissioning check the pressure sense lines up to the pressure switch on tightness.
Upstream each pressure switch [D1, D2, D3] there is a corresponding shut-off valve [A1, A2, A3] in the impulse unit of the control device. With these it is possible to close one pressure tapping line for adjustment works.
The shut-off valves are secured by the valve interlock (G) in such a way that only one pressure switch can be put out of operation. The other pressure switches remain in service [see connection diagram section 9.2].
The test connections [P1, P2, P3] allow the connection of a spindle pump with pressure gauge to adjust and control the switch points [see section 4.7.1].

Pressure test in the system
The components in the impulse unit A161 are connected to system pressure through the pressure sense lines. The pressure switches [D1, D2, D3] may be loaded with a test pressure up to 1.5× the end of scale value.
7.4 Compressed-air connection

To connect the compressed-air supply the control unit has a compressed-air connection (pipe OD Ø 22).

The connections of the lifting and loading air lines are on top of the pneumatic control unit. According to the design of the control unit there are several connections available for lifting and loading air. The pertaining (enclosed with the delivery) air hoses enable the stress free connection to the pneumatic actuator of the controlled safety valve. The air hoses for control unit and pneumatic actuator have the same tube fittings ferrule with which a pipe OD Ø 22 x 2 mm can be fastened.

NOTE
- Clean the lifting and loading air lines by blowing out with compressed air before connecting.
- Take care that the control air lines are assigned correctly:
  - Loading air line at the upper connection of the pneumatic actuator
  - Lifting air line at the bottom connection of the pneumatic actuator
- If safety valves are applied with lifting air through a block valve in the pneumatic control unit take care of the correct connection of the lifting air lines.

7.5 Power-supply line

To connect the power supply the electric switch unit has cable glands at the bottom side through which the cable is lead into the control device. Open the front door and the cover plate of the electric switch unit to connect the cable at the connecting strip. The connection of the cable at the connecting strip takes place according enclosed wiring diagram.

The pertaining electric diagrams are at the inner side of the front door of the impulse unit. The power-supply line of the electric switch unit is 230 V, 50 Hz; the mains supply voltage 24 V DC or 48 V DC as option. To connect the line for remote operation from the control room and the conduit of foreign impulses, there is a further cable gland at the bottom side of the control device.

ATTENTION!
- Observe the valid electrical regulations in any case.
- Work on the electrical systems or equipment must only be carried out by an electrician or instructed personnel under control and supervision of an electrician according to the electrical regulations.

7.6 Change of pressure switches D1, D2, D3

Procedures
- Open the front door of the electric switch unit A162. Disconnect the power supply by the key operated switch. Indicator: white control lamp “Operation” goes out.
- Open front door of the pneumatic control unit A163. Register the shown pressure at the gauge of the pressure regulator R1. Shutoff compressed-air supply at the handwheel of the pressure regulator R1. Indicator: shown pressure at the gauge lowers to p = 0 bar. The pneumatic actuator is temporarily switched off; the safety valve remains fully operational.

ATTENTION!
- While working prevent a response of the safety valve through the pneumatic actuator in any case.

Disassembly
To change the pressure switches D1, D2, D3 under operating conditions, separate the pressure switch from the system by shutoff the respective shut-off valve (a1, a2, a3).

If the specification prescribes a double closing of the pressure line, replace the pressure switch at pressureless state of the system to secure.

The pressure switches (D1, D2, D3) are in the impulse unit.
- Open front door of the impulse unit.
- Unlock by interlock key and close by turning clockwise the corresponding shut-off valve (a1, a2 or a3).
- Loosen the pertaining electric cable of the pressure switch at the connecting strip in the electric switch unit (see documentation electric switch unit).

ATTENTION!
- Check if the respective shut-off valve (A1, A2 or A3) is closed.

Loosen pipe joint (21) below the pressure switch by means of two 19 mm picklocks. Remove pressure switch including cable.

ATTENTION!
- The components in the impulse unit A161 are under high pressure!
- In case of improper maintenance works, danger occurs of damage through spraying liquid and/or discharge of poisonous/inflammable gases under high pressure.

Installation
To install the pressure switch, observe the assembly instruction of the producer of the tube fitting (product Parker) (see section 9.3).
- Join electric cable at the connecting strip (see documentation electric switch unit).
- Adjust pressure switch with spindle pump to the required pressure (see section 4.1 - 4.4 and 4.7.1)
- Open and lock the corresponding shut-off valve [A1, A2, A3] After finishing the works, restore control pressure and power supply.

Procedures
- Set air control pressure by the handwheel of the pressure regulator R1 to the previously registered value. Close front door of the control unit.
- Switch on power supply by the key operated switch. Close front door of the electric switch unit.
- Indicator: white control lamp “Operation” shines.
7.7 Replacing (or cleaning) of the filter F
During these works close the air supply of the control unit.

Procedures
- Disconnect power supply by means of the key operated switch. Shut off pressure regulator R1 by turning the handwheel anti-clockwise.

The lifting and loading air of the pneumatic actuator is temporarily switched off; the safety valve remains fully operational.

Disassembly
The maintenance unit including filter F is installed into the pneumatic control unit A163.
- Loosen threaded pipe elbow at the pressure regulator R1 from the inlet line (SW 32, SW 36).
- Detach four allen bolts size 4 mm at the pressure regulator R1 and remove the whole maintenance unit (pressure regulator R1 and filter F). In doing so, do not loosen gasket ring.
- Loosen the 4 cross-slotted bolts at the maintenance unit and at the same action block the hexagonal nuts. Remove bottom cover.
- After loosen the hexagonal screw size 10 mm with plate it is possible to remove the filter.

Clean or replace filter if necessary (see also section 6.1).

Installation
The installation takes place in reverse order. Observe the flow direction arrows at the upper and bottom part while assembling. After assembly restore control pressure and power supply.

Procedures
- Adjust control pressure at the pressure regulator R1 to the previously registered value by moving up and turning clockwise the regulator handle. Read the pressure at the gauge. Moving down the regulator handle secures the adjustment.
- Close front door of the pneumatic control unit.
- Restore power supply with key operated switch. Close the front door of the electric switch unit.
- Indicator: white control lamp “Operation” shines.

7.8 Ordering of spare and reserve parts
For spare parts storage or spare parts ordering see spare part list section 9.1.

For an order following details are necessary:
- Job and position number of the manufacturer (see section 3)
- Type (see section 3)
- Part-no., quantity, part name and so on (see section 9.1)

7.9 Instructions for transport
The control device STE 4 will be delivered mounted on a frame and with closed connection inlets.

The transport of the control device shall be:
- lying on a pallet with the fixing frame (inspection window at the top side) with a vehicle or
- hanging in a crane fastened with hoisting bands fixed to the frame at the outside (inspection window at the top side).
8 Declaration to EC-Directive

For valves with CE-approval mark applies the following declaration:

**Declaration to EC-Directive:**

**Conformity Declaration**

According to Pressure Equipment Directive 97/23/EG

---

1. **Manufacturer:** Sempell GmbH  
   Werner von Siemens Straße  
   41352 Korschenbroich

2. **Pressure Device**

3. **Conformity Valuation Procedure**

4. **Designated Agency**  
   TÜV-CERT-Certification agency for QM-Systems  
   of TÜV Rheinland Industrie Service GmbH  
   Am Grauen Stein, 51101 Köln  
   registration number 0035

5. **Applied documents**  
   Type test VdTÜV SV 846

6. **Designated Agency Supervising Quality Assurance**  
   TÜV-CERT-Certification agency for QM-Systeme  
   of TÜV Rheinland Industrie Service GmbH  
   Am Grauen Stein, 51101 Köln

7. **Applied co-ordinated standards**  
   Valid EN material standards

8. **Applied Standards and Specification**  
   TRD 421, AD2000-Merkblatt A2, TRD 110,  
   VdTÜV-Merkblatt SV 100,  
   DIN EN ISO 4126-5

9. **Other Applied EC-Directives**  
   None

10. **Authorized representative of the manufacturer in EC**

11. **Signature:**  
    J.Ott  
    Dr. H.D.Perko

12. **Date:**  

13. **Name:**  
    J.Ott  
    Dr. H.D.Perko

14. **Function:**  
    responsible for product  
    authorized representative for PED
9 TECHNICAL DOCUMENTS

9.1 Spare parts list

**SPARE PART LIST IMPULSE UNIT A161**

<table>
<thead>
<tr>
<th>Part no.</th>
<th>Number of units</th>
<th>Name of part</th>
<th>Order no. / Dim.</th>
<th>Manufacturer</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1-D3</td>
<td>3</td>
<td>Pressure switch</td>
<td>Manocomb-Sem-2K A116</td>
<td>Pinter</td>
<td>Div.</td>
</tr>
<tr>
<td>P1-P3</td>
<td>3</td>
<td>Vice coupling</td>
<td>2103-01-44.00</td>
<td>Hydrotechnik</td>
<td>Div.</td>
</tr>
</tbody>
</table>

**SPARE PART LIST ELECTRICAL SWITCH UNIT A162**

(see documentation electric switch unit)

**SPARE PART LIST PNEUMATIC SWITCH UNIT A163**

<table>
<thead>
<tr>
<th>Part no.</th>
<th>Name of part</th>
<th>Order no. / Dim.</th>
<th>Manufacturer</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>MH, MB</td>
<td>Pressure gauge</td>
<td>1 827 231 035</td>
<td>Bosch Div.</td>
<td>Div.</td>
</tr>
</tbody>
</table>

9.2 Drawings

**CONTROL UNIT**

Air connection for loading

Air connection for lifting

Sense line connection

Stainless steel 316
Sempell Series STE 4 Control Device for Safety Valves
Operating Instructions

System Circuit Diagram
Design with pressure regulator R2 for increased lifting air pressure

System Circuit Diagram

NOTES
E1 - E3 Pressure sense line
A1 - A3 Shut-off valve
D1 - D3 Pressure switch
C Key
G Valve interlock
P1 - P5 Test connection
D Throttle
F Filter
B Cavity for loading
H Cavitye for lifting
Y1 - Y3 Solenoid valve (closed-circuit principle)
Y4 Solenoid valve (open-circuit principle)
MB Pressure gauge for loading
MH Pressure gauge for lifting (easing)
R1, R2 Pressure control valve
A160 Pneumatic actuator
S Safety valve
SYSTEM CIRCUIT DIAGRAM WITH TWO SAFETY VALVES

DIAGRAM FOR THE ADJUSTMENT CONTROL OF THE SAFETY VALVE
9.3 Installation instructions A-Lok tube fittings

A-Lok tube fittings are supplied completely assembled.

General remarks
1. The end of the tube must be cut square; any burrs may be removed without causing undue chamfering of the tube end.
2. Insert the tube into the fitting. Ensure that the tube is firmly butted home into the body of the fitting. Finger tight the nut.
3. With the body firmly held, mark the nut in the finger tightened position, and tighten the nut 1¼ turns from the marked position. The connection is then correctly completed.
4. For tube fittings up to ⅜" and 4 mm OD, only ¾ turn is necessary.

High pressure applications, high safety factor systems
To allow for possible variations in tube hardness when the application demands the maximum pressure sealing capabilities of the fitting, it is recommended that the nuts are tightened until the tube cannot be rotated by hand. From this point the nut should then be tightened 1½ turns.

Retightening and disassembly
With A-Lok tube fittings the connection can be disconnected and re-tightened many times and the same reliable, safe, leak-proof connection obtained. Simply insert the tube into the body and butt home firmly.

Holding the body with a spanner, the nut is tightened to the original position and then given a slight extra effort to retain positive sealing.