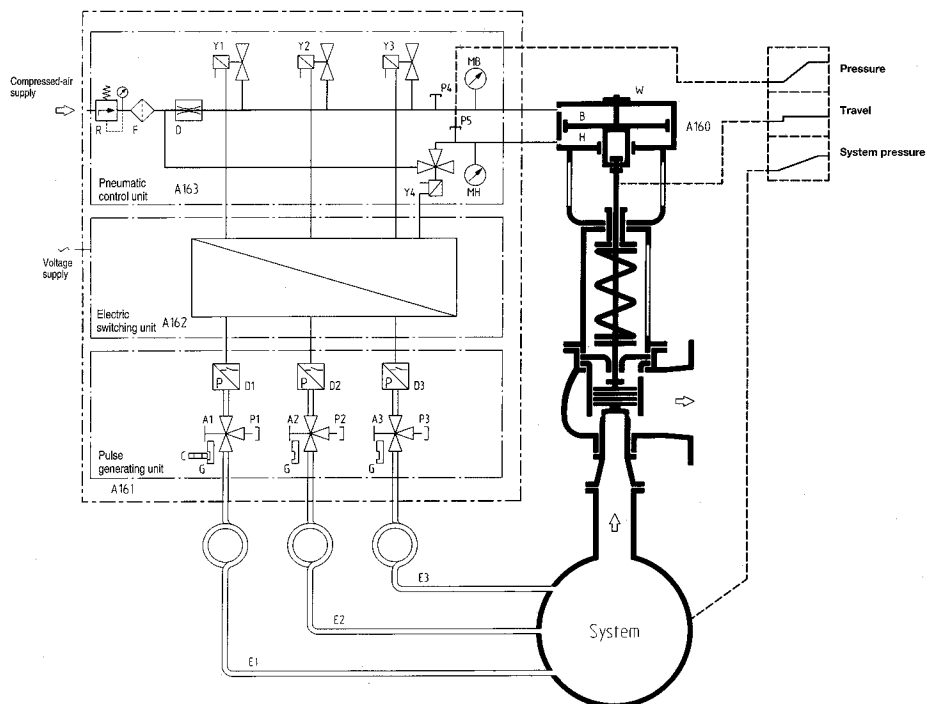


STE 4 Control Device for Safety Valves with Additional Pneumatic Drive

Component Designation TÜV.SV.94-846



E1-E3	Pressure tapping line
A1-A3	Shut-off valve
D1-D3	Pressure switch (force balance system)
C	Key
G	Valve interlock
P1-P5	Test connection
D	Throttle
F	Filter
B	Space for loading
H	Space for lifting
Y1-Y3	Solenoid valve (closed-circuit principle)
MB	Pressure gauge for loading
MH	Pressure gauge for lifting (easing)
R	Pressure control valve
W	Travel measurement
A160	Pneumatic drive

Features and Advantages

- High tightness up to the response pressure due to additional loading
- Low opening and closing pressure differences
- High opening accuracy
- Optimum possibility of pressure measuring element adjustment
- Lifting of the safety valve possible also below the response pressure
- Check of the safety valve adjustment without change of the system pressure
- Testing of the control functions without response of the safety valve
- Individual control constellations possible due to componential design
- Integration of all control air connections even for selection of several safety valves
- Compact
- User-friendly

Application

The electropneumatic control device STE4 serves to control the additional loading for directacting spring-loaded safety valves. Due to the additional loading the pressure-containing system can be operated at a higher working pressure, thereby increasing its efficiency. The margin between the response pressure and working pressure of the system is less than 10% of the response pressure. Since the additional loading normally corresponds to 20% to 30% of the spring force of the self-actuated safety valve an increased tightness at the valve seat is achieved (even at a pressure near the response pressure).

Lifting of the safety valve is also possible below the response pressure.

Design

The STE4 control device consists of the following individual functional components:

Pulse generating unit A 161 according to TO 331.01

Electric switching unit A 162 according to TO 331.01

Pneumatic control unit A 163 according to TO 331.01

Thus a compact control device is created.

The control device operates on the closed-circuit principle, the safety valve on the relief principle.

Closed-circuit principle: On failure of the power supply (electric power and compressed air supply) the additional loading is removed.

Relief principle: For opening of the safety valve the additional loading is removed.

By providing a triple redundancy of the measuring and control elements a high operating reliability is achieved. The user-friendly configuration of the control elements facilitates handling, especially during performance of all possible test.

Mode of Functioning

In the operating state, conditioned compressed is supplied to the loading space B of the pneumatic cylinder and acts as additional closing force (additional loading) on the stem of the safety valve. Solenoid valves Y1-Y3 are energized and in closed position. The 3/2-way solenoid valve Y4 is closed in deenergized condition and shuts off the compressed air supply. At the same time, piston bottom H is connected to the atmosphere. When the system pressure increases above the response pressure adjusted at the pressure switches solenoid valves Y1-Y3 are deenergized and opened. The loading air is discharged to the atmosphere. At the same time voltage is applied to solenoid valve Y4 which opens the connection to space H below the pneumatic piston. Lifting air is admitted. The safety valve opens.

On failure of the lifting air supply, the safety valve operates as spring-loaded self-actuated safety valve. When the pressure drops below the closing pressure of the pressure switches all solenoid valves (Y1-Y3) are switched back. The lifting air pressure is reduced by discharging the air to the atmosphere, and the loading air is again admitted. The safety valve closes.

All switch states and compressed air values are indicated by corresponding signals.

It is also possible to open the safety valve by auxiliary force at a pressure below the response pressure by means of a manual switch on the control unit admitting the lifting air. Actuation from the control room or a load-dependent control can also be provided.

Installation Instructions

The control device is to be fixed so that it will be free from vibrations. The connection between control device and pneumatic drive is to be free from stresses, using flexible compressed-air hoses in each case. To minimize the actuation times the compressed air lines between control device and safety valve should be made as short as possible (10 m max. special feature).

The pressure tapping lines should be laid in such a way that for hot fluids there is a sufficiently large liquid seal (1.5 m min.) to the control device. Outdoor plants should be provided with weather protection by the customer. In addition, the pressure tapping lines are to be protected from freezing in case of danger of frost.

At an ambient temperature greater than 55 °C the electric switching unit is arranged separately, at a place of low ambient temperature. Short-term temperature peaks up to 70 °C are however allowed.

Functional Test and Check of Response

All tests can be performed without affecting plant operation.

For this purpose, a control line can be shut down temporarily. It is ensured by an forced-switching circuit that the two other control lines are in operation and the safety valve remains fully operable. Due to a key-operated interlock (G), only one of the three pressure switches (D1-D3) can be in each case separated from the system by closing the valves (A1-A3) in the pressure tapping lines (E1-E3).

● In the "Test 1" position of the selector switch on the electric switching unit the following functions can be tested:

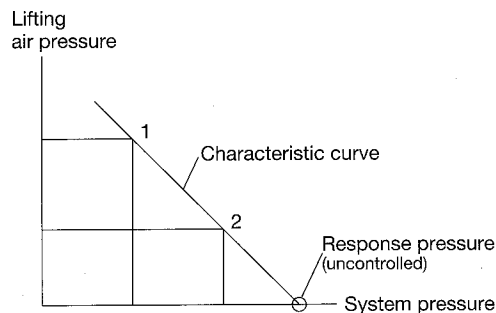
- Function and adjustment of the pressure switches (D1-D3)
- Function of the solenoid valves (Y1-Y3)
- Effectiveness of the relief in space B of the pneumatic cylinder (removal of additional loading)

Pressure is admitted to the pressure switch (D..) to be tested via the associated test connection (P..). On reaching the set response pressure the corresponding solenoid valve (Y..) is opened and the pressure in space (B). Removal of the additional loading is indicated at pressure gauge (MB).

● By selecting switch position "Test 2", functioning of the solenoid valve (Y4) and effectiveness of lifting can be checked. Solenoid valve (Y4) is energized, opens and releases the compressed air into space (H) below the piston of the pneumatic drive (check at pressure gauge [MH]). Since at the same time loading air is in space (B) above the piston the safety valve will not open in the process.

● Check of the response pressure during operation.

The safety valve is opened once, normally during final inspection, by means of the pneumatic drive at two different operating pressures. The operating and lifting air pressure are measured when the safety valve starts to lift, and entered in a diagram. The intersection of the connecting straight lines with the abscissa should correspond to the response pressure without lifting air. During the following recurrent tests, measurement is carried out at an arbitrary operating pressure only. In the process, the safety valve is only minimally opened for a short period of time by means of the pressure control valve by gradually increasing the lifting air pressure. If the measuring point is not on the straight line with sufficient accuracy the spring pretension should be readjusted accordingly.



STE4 AC 230 05

Example of Type Designation

Length of control air hoses 0.5 m → Special unit 1)

Mains voltage 230 V

Alternating current 50 Hz

Type short designation

Standard-design

Standard Design

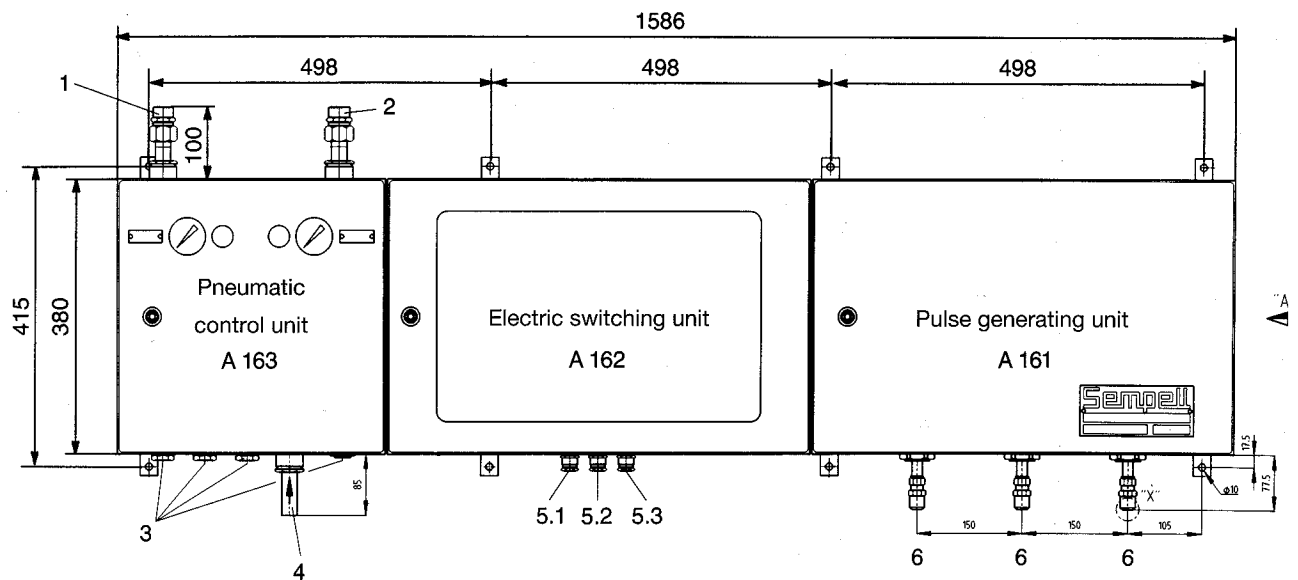
- Control device for controlling a safety valve with one connection for loading and lifting each
- Pressure pulses from a system to be protected
- Length of the control air hoses 3 m

Technical Data

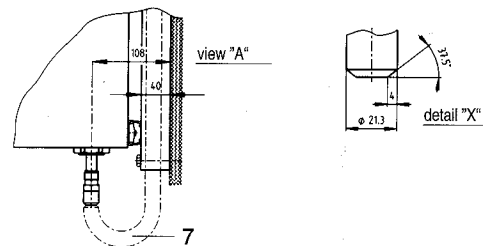
Type of current	50 Hz	
Mains voltage	230 V	2)
Power consumption	60 W	
Mains fuse	6 A	
Connection cross section	4 mm ²	
Type of enclosure	IP 55	
Allowable ambient temperature	- 25 °C to + 55 °C	
Compressed air supply	2 bar min., 8 bar max.	
Air consumption	During actuation : 20 Nm ³ /h During normal operation: Minimal (due to possible leakage)	
Weight	78 kg	
Special Feature		
Control air hose	05	Length of the control air hoses 0,5 m for connection of the control device and the pneumatic drive to the existing piping (pipe 22 x 2 made of corrosion-resistant material)

1) Other special features of the individual components A161, A162, A163 acc. to TO.331.01, TO.331.02, TO.331.03

2) Mains supply 230 V d.c. (direct current) and 24 V as an option.

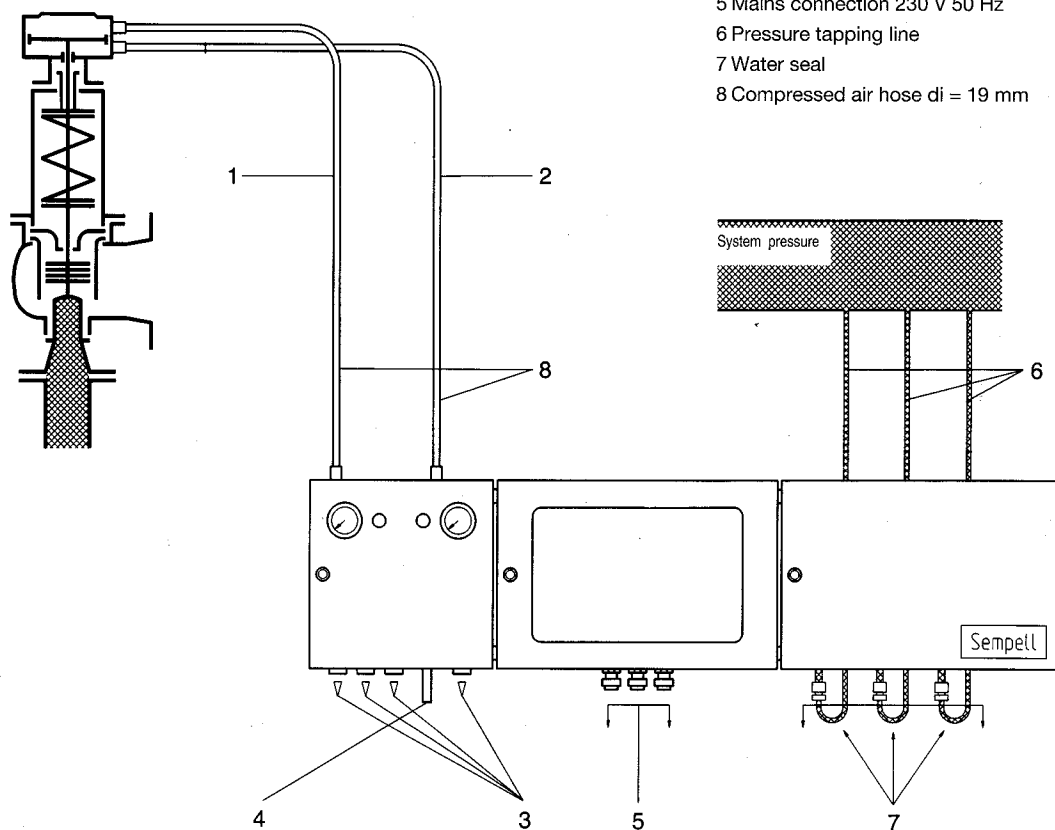


- 1 Compressed air connection loading
- 2 Compressed air connection lifting
- 3 Air outlet
- 4 Compressed air supply 22 diam. x 2.8 bar max.
- 5.1 Mains connection at terminal strip X1L10.N.PE
- 5.2 Control room connection at terminal X2; 1.2.3.4
- 5.3 Free connection
- 6 Connection for the pressure tapping line special steel 316 (equivalent to 1.4401)
- 7 Pressure tapping line with water seal

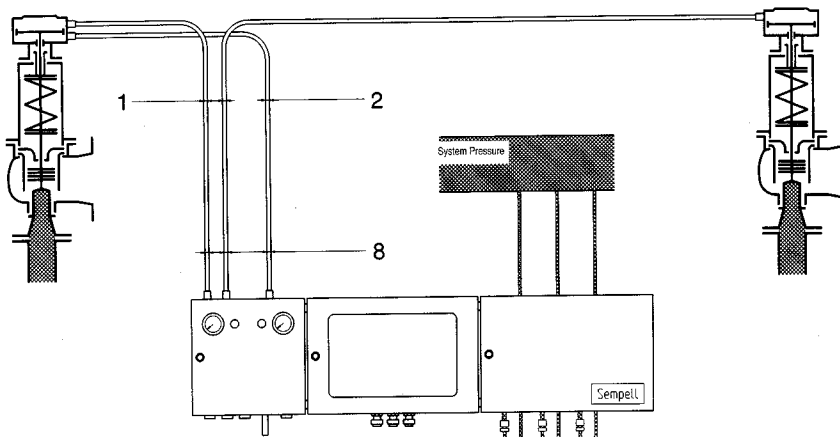


System Circuit Diagram (Standard Design)

- 1 Loading
- 2 Lifting
- 3 Air outlet
- 4 Compressed air supply connection pipe 22 diam. x 2
- 5 Mains connection 230 V 50 Hz
- 6 Pressure tapping line
- 7 Water seal
- 8 Compressed air hose di = 19 mm

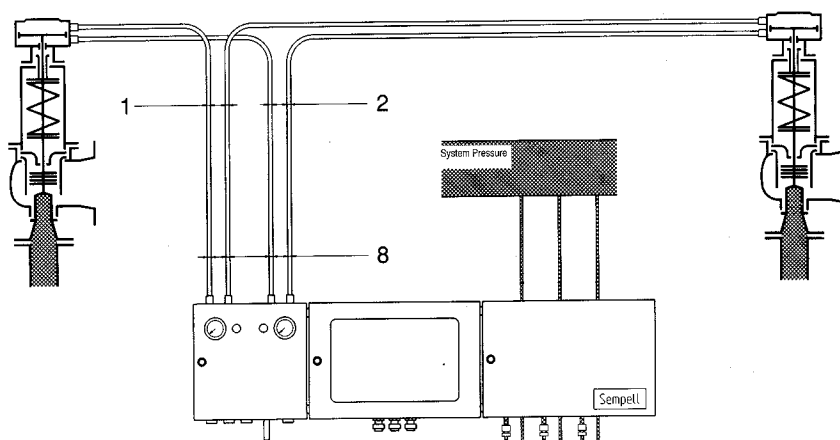


Control of 2 Safety Valves (Special Units according to TO.331.03.XXX)



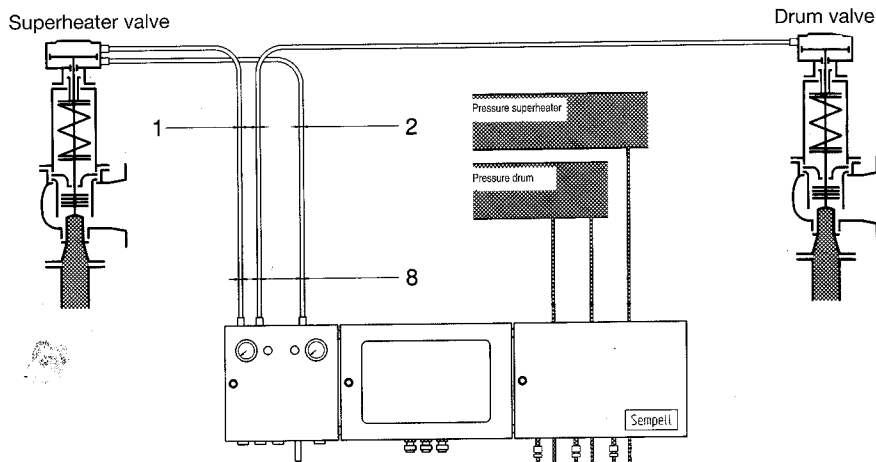
Design A3

- Connection for 2 loading systems and 1 lifting system
- Pressure pulses from one system



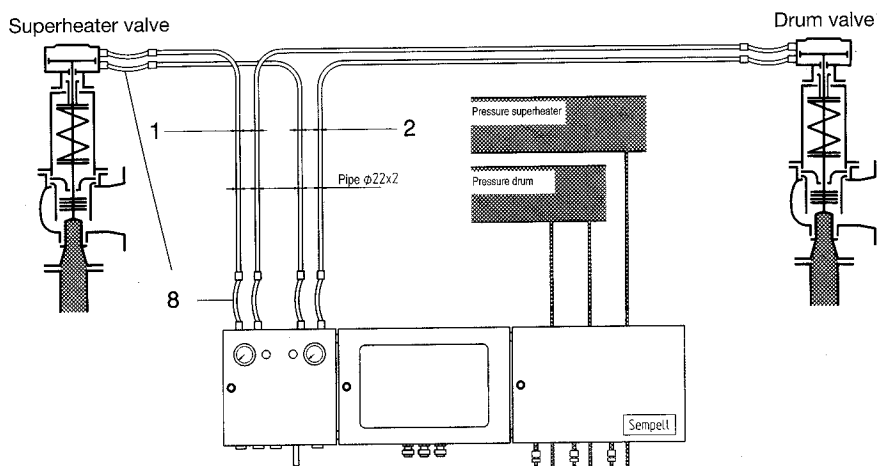
Design A4

- Connection for 2 loading systems and 2 lifting systems
- Pressure pulses from one system



Design B1

- Connection for 2 loading systems and 1 lifting system
 - Pressure pulses from 2 systems e.g. superheater and drum
- | | |
|--------------------|--------------------|
| Superheater valve: | 1 loading system |
| | 1 lifting system |
| Drum valve | : 1 loading system |



Design B2

- Connection for 2 loading systems, 1 lifting system and 1 additional lifting system for manual actuation
 - Pressure pulses from 2 systems e.g. superheater and drum
- | | |
|--------------------|----------------------|
| Superheater valve: | 1 loading system |
| | 1 lifting system |
| Drum valve | : 1 loading system |
| | 1 lifting system |
| | for manual actuation |

For the mobility test, the drum valve can be lifted via the manual actuation mechanism.

Illustration with special unit 05