



Control Valves with ZK Radial Stage Nozzle

For Power-Station and Plant Engineering



Engineering steam performance

ZK Control Valves for Power-Station and Plant Engineering

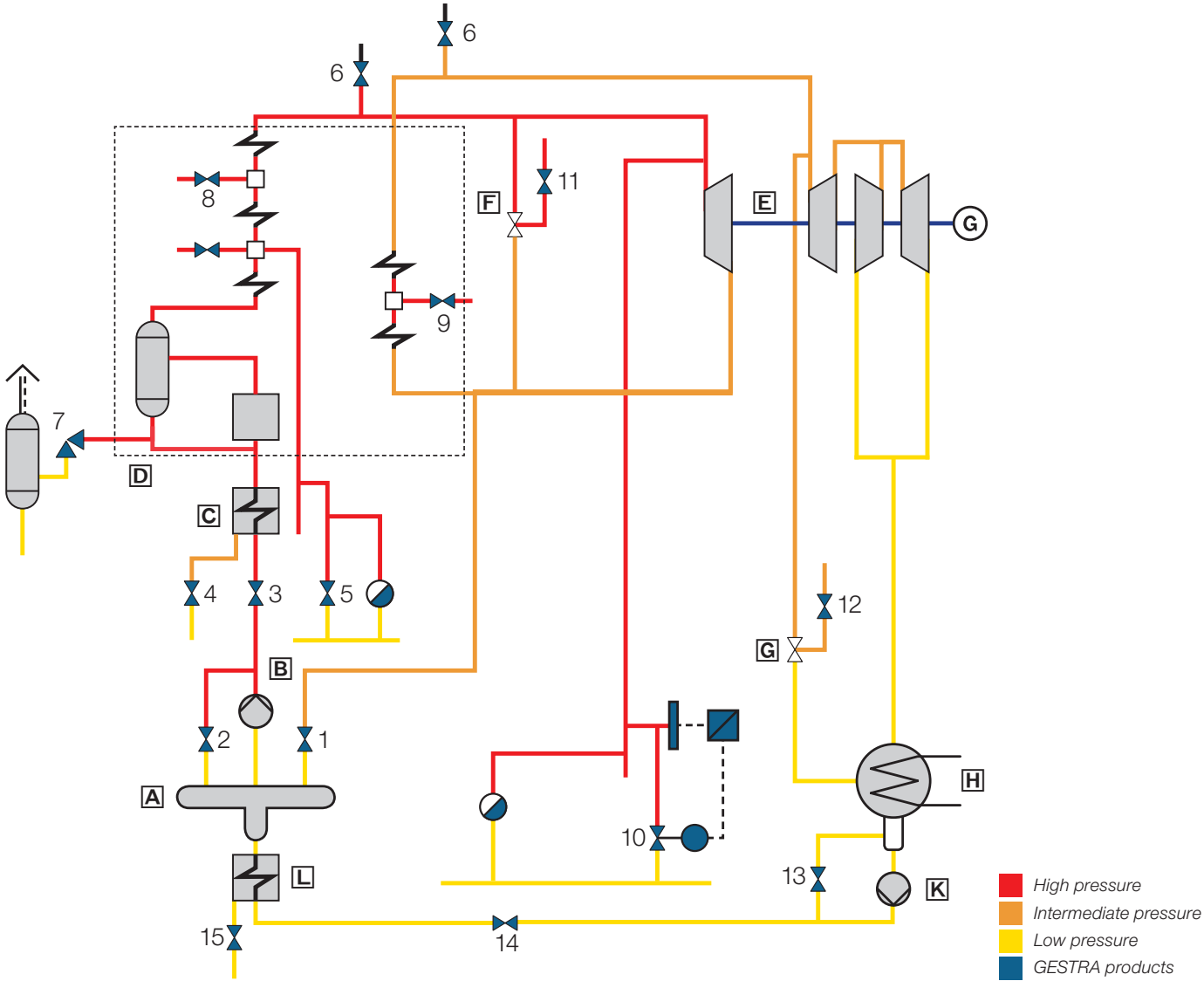
Overview

For many years now, GESTRA control valves of the type ZK have demonstrated their reliability under extreme operating conditions. Long experience and know-how form the sound basis for a generation of efficient and tight-closing control valves for applications in power stations. Thanks to the easy maintenance and repair of the valves as well as the extremely high wear resistance afforded by the design, reliable operation is achieved together with a long service life.

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Application	p [bar]	t [°C]	ZK valve type
A Feedwater tank 1 Heating steam valve	~ 60	~ 400	29, 610
B Main feedwater pump 2 Feedwater leak-off valve 3 Feedwater control valve	up to 560 up to 560	~ 220 ~ 220	313, 213 610, 613
C H.P. preheater 4 Condensate drain control valve	20-60	~ 300	29, 210, 610
D Boiler plant 5 Boiler drain valve Soot-blower warm-up valve Soot-blower steam valve Boiler circulation control valve 6 Boiler vent valve 7 Start-up pot drain valve 8 H.P. spray attemperator valve 9 I.P. spray attemperator valve	up to 330 ~ 50 up to 330 180-330 up to 330 180-330 ~ 280 ~ 50	~ 620 300-350 550 ~ 250 ~ 620 ~ 450 ~ 220 ~ 220	313, 213 29, 210 313 313, 613 313, 613 613 313 29, 210
E Turbine plant 10 Live steam drainage I.P. drainage L.P. drainage	up to 330 ~ 60 < 20	~ 620 ~ 620 ~ 460	313, 213 29, 210, 313 29
F H.P. bypass station 11 Spray injection valve	up to 350	~ 220	313, 213
G I.P. bypass station 12 Spray injection valve	up to 250	~ 220	29, 210
H Condenser			
K Condensate pump 13 Condensate leak-off valve 14 Condensate control valve	10-25 10-25	~ 30 ~ 30	29, 610 29, 610
L L.P. preheater 15 Condensate drain valve	~ 0.4-5	~ 30	29, 610



Applications of the ZK Control Valves

ZK control valves are suited for various fundamental applications in industry and power stations:

- Leak-off control (recirculation)
- Drainage and warm-up
- Level control
- Injection cooling
- Steam control

GESTRA offers:

- Complete solutions
- Subsystems with definite interfaces

The ZK control valve consists of a valve body and the ZK Radial Stage Nozzle with valve plug integrated into the body to act as the control unit.

The ZK Radial Stage Nozzle ensures rapid and reliable adaptation to the prevailing operating conditions.

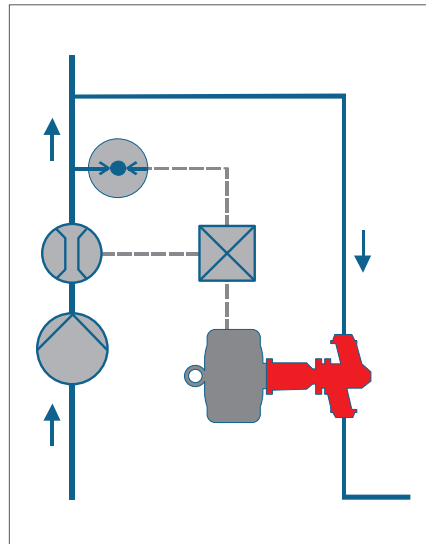
If the operating conditions in the plant change, the control valve can be adapted to the new situation by repositioning or changing the radial stage nozzle. There is no need to remove the valve from the line for this purpose!

A large number of references testifies to the high standard of GESTRA power station equipment.

1. Leak-Off Control (recirculation)

GESTRA leak-off controls for feedwater and condensate pumps represent complete systems for on/off or modulating control.

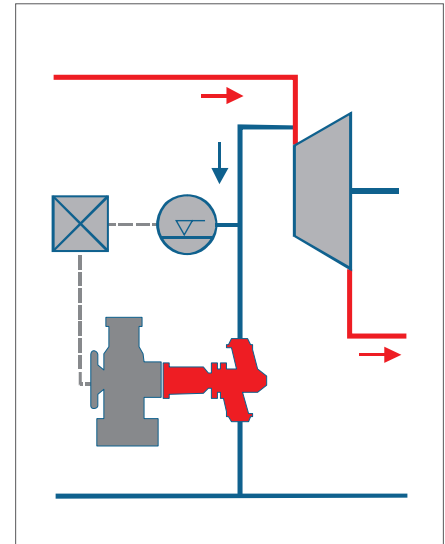
The control valve with ZK Radial Stage Nozzle, the actuator with quick-opening function, and the control unit are optimally adapted to the operating conditions in each case.



2. Drainage and Warm-Up

The control valve with ZK Radial Stage Nozzle, actuator, level electrode and control unit together constitute a complete system which can be perfectly adapted to the operating conditions.

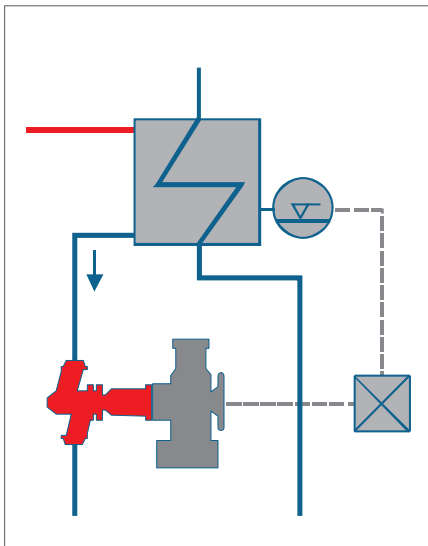
Even condensate flowrates with extreme fluctuations are discharged by this system without any problems. Specific warming-up of certain parts of the plant can be achieved with the aid of a temperature measuring system.



3. Level Control

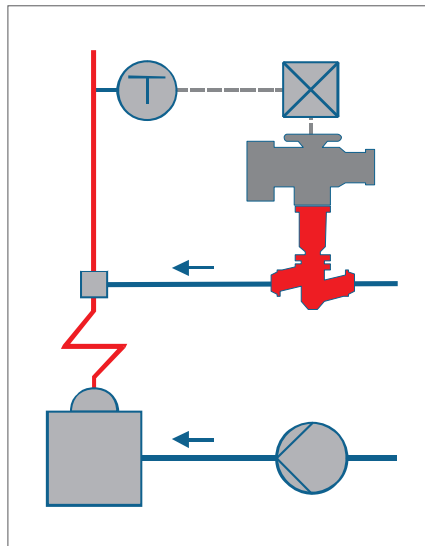
With the aid of the ZK control valve, level control systems can be realized under difficult technical conditions. The GESTRA level control system consists of a control valve with ZK Radial Stage Nozzle, an actuator, a level electrode and a control unit.

The high-pressure probes NRG 211 and NRG 111 offer new possibilities for extreme temperatures and pressure ratings. Reliable operation of the system is ensured by the long life of the radial stage nozzle.

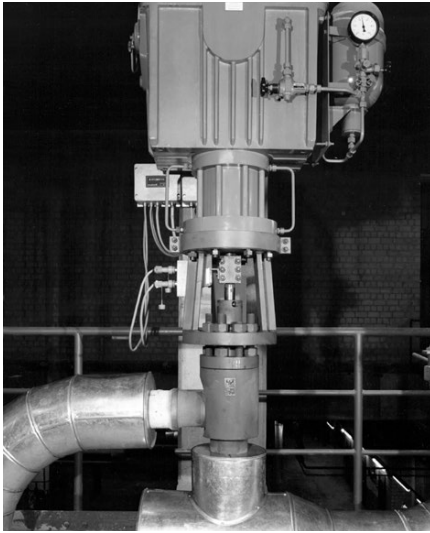


4. Injection Cooling

GESTRA injection cooling systems are offered as complete systems consisting of an injection-cooling valve with radial stage nozzle, an actuator, a temperature measuring system, and the control unit. Injection-cooling valves have to cope with high differential pressures, whilst ensuring extreme wear resistance and good regulating characteristics. The radial stage nozzle meets these high requirements and provides a perfect adaptation of the valve characteristic to the desired regulating characteristic. Thanks to the absolutely tight closure, thermal shock damage is prevented in injection coolers and combined steam pressure reducing and desuperheating valves.



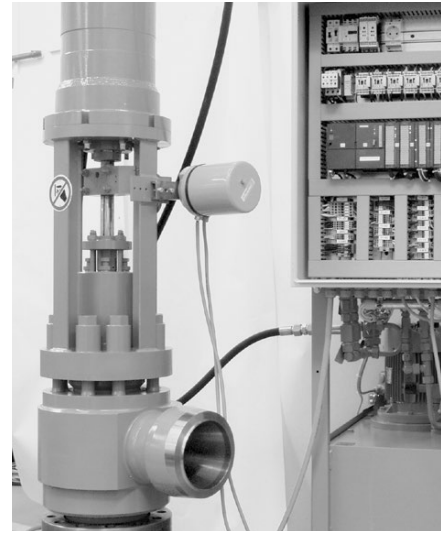
Application Examples of the ZK Control Valves



Leak-off valve ZK 213 with compact electro-hydraulic actuator

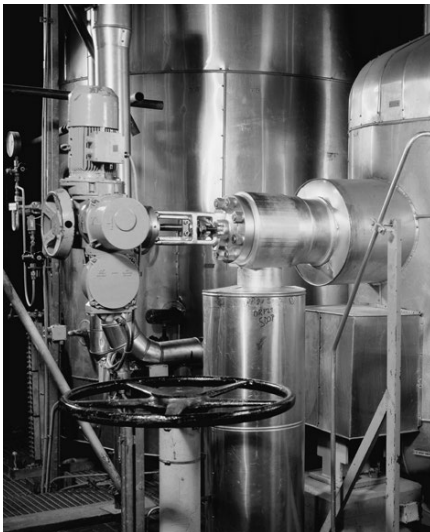


Drain control station using ZK 29 valves with electric actuator

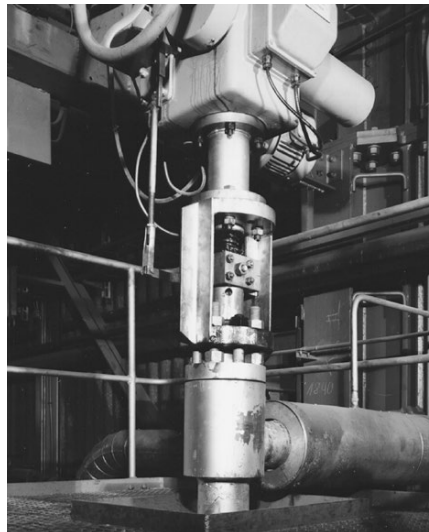


Leak-off control consisting of:

- ZK 213-E4/40 DN 200 with 6-stage nozzle and tandem seat
- Hydraulic actuator with opening spring
- Control cabinet with SIEMENS S7 PLC
- GESTRA software with stored characteristic for leak-off valves



H.P. preheater in a nuclear power station equipped with a condensate drain control valve type ZK 29



ZK 213 as spray injection valve in a high-pressure bypass station

The ZK Radial Stage Nozzle

Operating Principle

Patented both in Germany and abroad, the ZK Radial Stage Nozzle consists of several sleeves with a large number of radial orifices. The orifices are arranged in parallel, but are shifted from sleeve to sleeve so that they partly overlap, forming nozzles mounted in series with intermediate flash chambers.

The flow through the radial stage nozzle is determined by the valve plug. Depending on its position, the individual stage nozzles are either partially or completely open. The valve plug and the seat together form the shut-off unit of the radial stage nozzle. Due to the successive expansion in the flash chambers, the pressure differential across the cross-sectional flow area of the valve is reduced to a minimum.

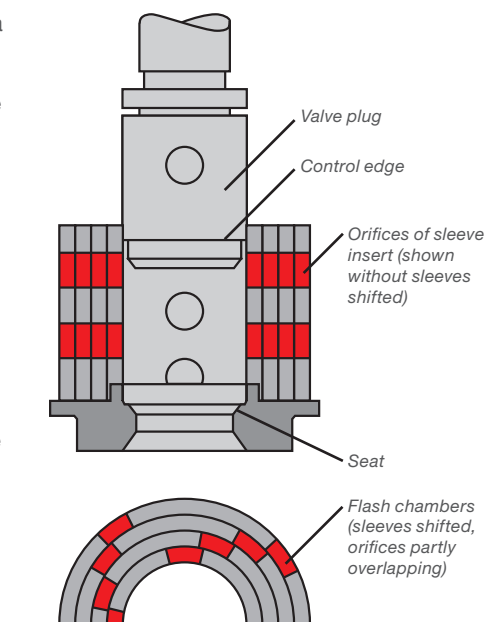
Various stage nozzles and valve plugs are available to cater for the pressure drop in a particular application. For extremely high-pressure gradients, control valves with tandem shut-off are used.

Due to the special design of the ZK Radial Stage Nozzle, the noise level is reduced to a minimum. As a result of the expansion through a multitude of individual nozzles, the sound pressure is normally below 85 dB(A) across the entire control range of the valve.

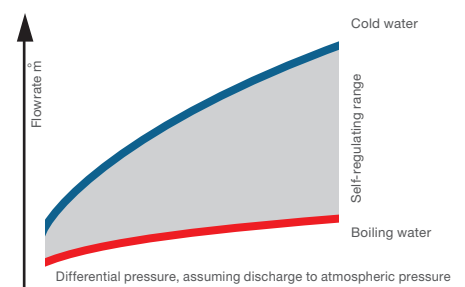
Automatic Control

For drainage purposes, the valve can alternatively be used as a hand control valve. In this case, the radial stage nozzle not only acts as a throttling unit, but also fulfills the function of thermodynamic control.

For this purpose, the control valve is adjusted manually once to the working point. From this time on, the condensate flowrate is determined by the thermal state of the condensate in the nozzle system (cold condensate / hot condensate) without any further modification of the cross-sectional area. The valve is therefore also suitable for varying operational conditions.



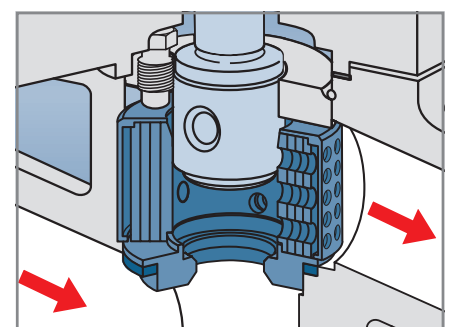
Sectional drawing of ZK 29 radial stage nozzle



Regulating characteristic of the ZK Radial Stage Nozzle



ZK 29 radial stage nozzle with special valve plug



Valve plug of ZK 29 in control position

The ZK Radial Stage Nozzle

Technical Properties

ZK control valves are designed to meet the highest operational requirements. They offer a number of special features in comparison with conventional control valves

■ Extreme wear resistance

The successive expansion of the fluid in the throttling sleeves of the radial stage nozzle produces a considerable reduction in pressure drop across the cross-sectional flow area. Special design details at the seating surfaces ensure safe and reliable valve operation. In addition, the mass flow is split up into many partial flows.

■ Leakage rates

FCI 70-2-2006, class VI (test procedure C) and EN 12266-1, leakage rate A

■ Variable valve characteristics

For the ZK control valves, stage nozzles are available with linear or equal-percentage characteristics. A subsequent change is possible by repositioning throttling sleeves (orifices) or by changing the complete nozzle insert.

■ Easy installation and inspection

The entire nozzle insert, including seat, can be completely dismantled without the need for any specialist work and without removing the valve body from the line.

■ Tandem shut-off

Control valves for an extremely high-pressure gradient are provided with a tandem shut-off (dual seat). In this way, the ZK control valve combines the functions of a conventional shut-off valve and a control valve, even for very high pressures.

■ Low noise level

The continuous reduction of the flow velocity in the radial stage nozzle ensures a low sound level, normally no more than 85 dB(A) across the valve's control range. For differential pressures up to Δp_{\max} 100 bar, the sound level is even below 80 dB(A).

■ Different capacity ranges

The K_{vs} values can be adapted to the operating conditions by repositioning or changing the radial stage nozzle. Intermediate lift positions of the valve plug can thus be avoided.

The complete ZK product range offers K_{vs} values from 0.5 m³/h to 969 m³/h. By changing the internals, it is possible to adjust ZK control valves to cater for changes in differential pressure.

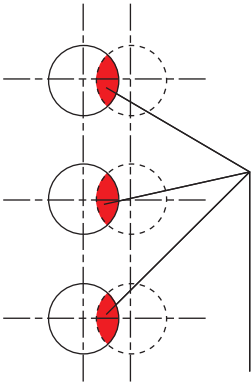
■ Actuators

ZK control valves can be used with most types of actuators available on the market.

Changing the valve characteristics using the ZK 29 as an example



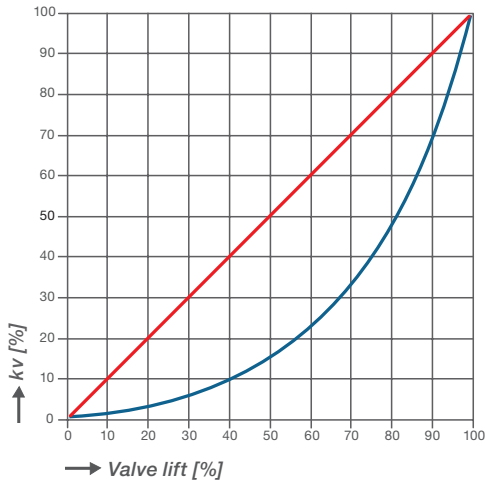
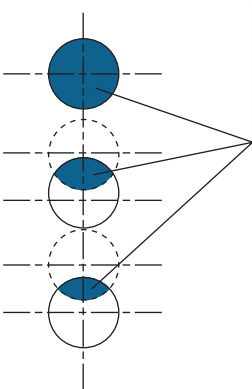
Position of the sleeves for linear characteristic



Cross-sectional flow area

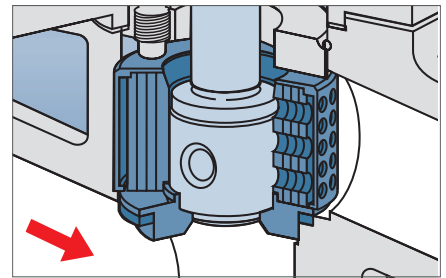
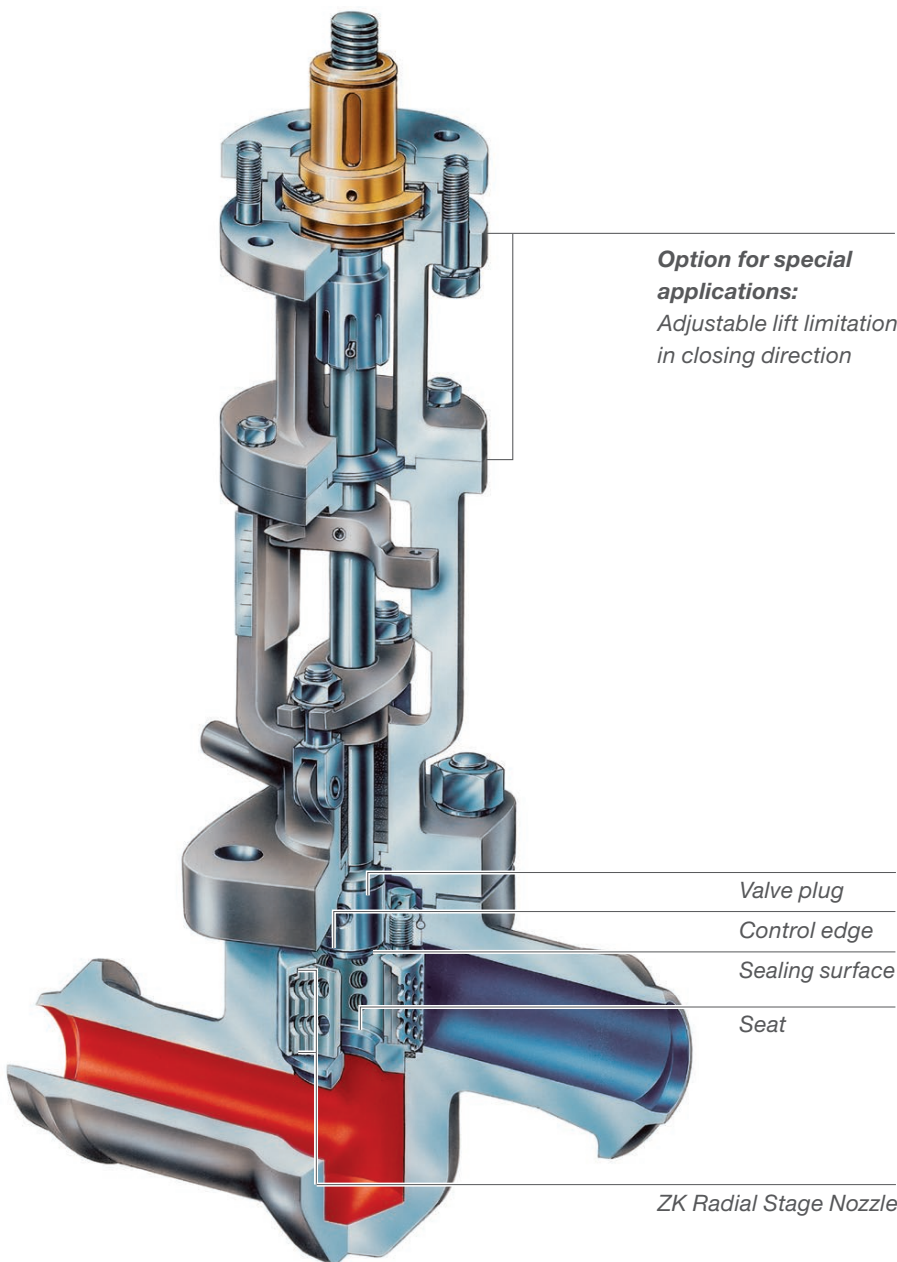


Position of the sleeves for equal-percentage characteristic

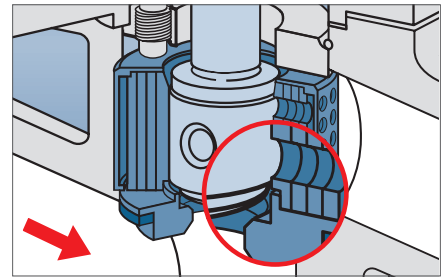


■ Linear characteristic
 ■ Equal-percentage characteristic

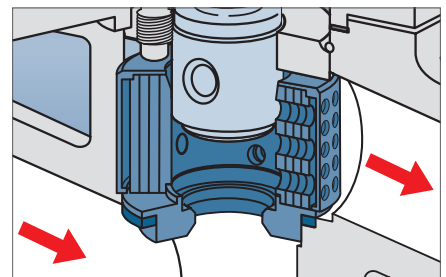
Control Valve ZK 29, Valve Plug in Open Position



ZK 29: Valve plug in closed position



ZK 29: Valve plug no longer in closed position; control edge does not yet open up any orifices



ZK 29: Valve plug in control position

Control Valve ZK 29

PN 160 and class 900
 Δp_{\max} 100 bar (1450 psi)
 K_{vs} 0.7 – 130 m³/h

With its permissible differential pressure of 100 bar, the ZK 29 control valve covers a large range of K_{vs} values.

The valve plug and control valve seat are as a rule subjected to very high flow velocities during opening and closing. To reduce this effect, the valve plug of the ZK control valve has a special control edge above the seating surface.

At the beginning of the opening process, the plug lifts off the seat, yet the flow admitted is very low. Only once a certain lift has been reached, and hence a larger annular channel has been opened between the seat of the valve and the sealing surface of the plug, are the annular rings of the radial stage nozzle opened one after the other by the control edge.

During the closing process, the flow is first considerably reduced by the control edge and then the sealing surface of the plug reaches the seat to close the valve completely.

The ZK 29 offers the possibility of adjusting for various K_{vs} values and characteristics at a later time, by rotating the stage nozzle.

This series of valves is available in overall lengths according to EN and to ISA.

Connections	Butt-weld ends, socket-weld ends, flanged ends (EN, ASME)
Actuators	Electric (rotary, linear or lever actuator), pneumatic, handwheel
Body material	DN 25-50: 13 CrMo 4 4 (1.7335), A182 F12
	DN 80-150: GS-17 CrMo 5 5 (1.7357), A217 WC6
	<i>Other butt-weld ends and body materials on request</i>

Control Valve ZK 210

PN 250
 Δp_{\max} 100 bar (1450 psi)
 K_{vs} 0.7 – 28 m³/h
 Δp_{\max} 180 bar (2610 psi)
 K_{vs} 0.5 – 5 m³/h

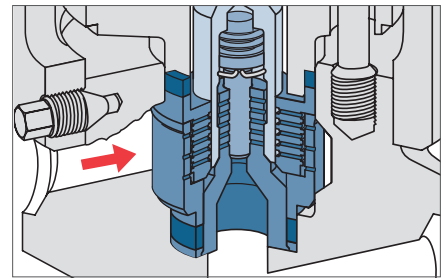
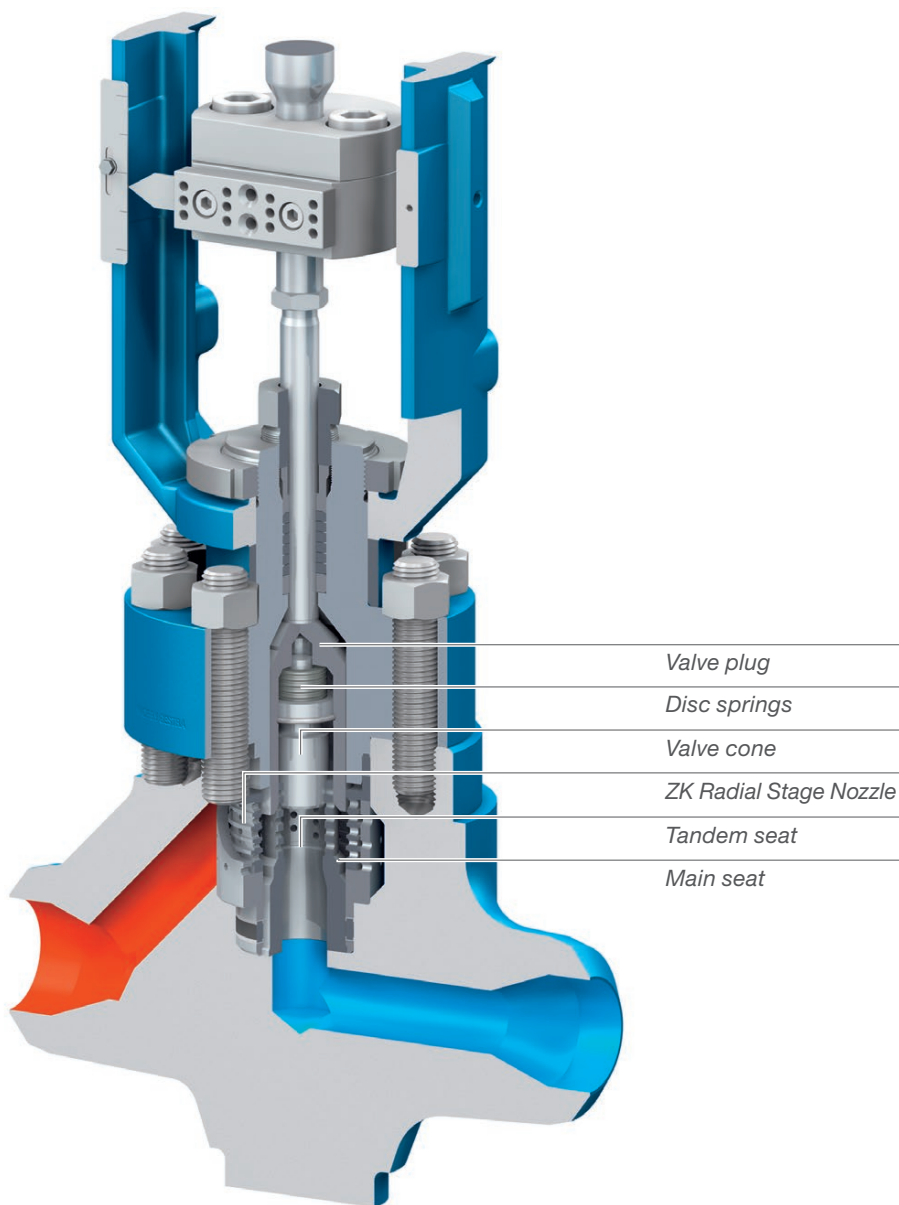
The control valve ZK 210 supplements the valve type ZK 29 primarily by extending the pressure rating to PN 250.

An additional radial stage nozzle arranged downstream makes it possible to overcome pressure differentials of up to Δp_{\max} 180 bar, thus closing the gap to the existing high-pressure types. In comparison to the ZK 29, the required actuator forces are lower.

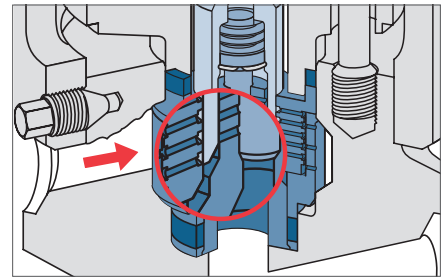
By changing the internals, pressure differentials of Δp_{\max} 100 bar or Δp_{\max} = 180 bar can be achieved. The ZK 210 offers the possibility of adjusting for various K_{vs} values and characteristics at a later time, by rotating the stage nozzle.

Connections	Butt-weld ends, socket-weld ends, flanged ends (EN, ASME)
Actuators	Electric (rotary or linear actuator), pneumatic, handwheel
Body material	13 CrMo 4 4 (1.7335)
	<i>Other butt-weld ends and body materials on request</i>

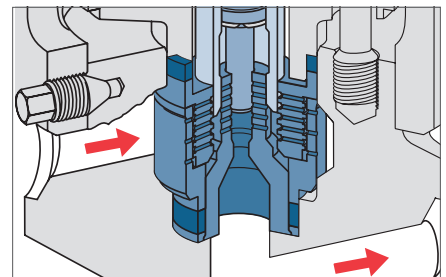
Control Valve ZK 313 with Tandem Shut-Off



ZK 313: Valve plug in closed position



ZK 313: Valve plug no longer in closed position; valve cone still in closed position, control edge does not yet open any orifices



ZK 313: Valve plug in control position

Control Valve ZK 313

PN 630 & Class 2500

Δp_{max} 40 bar (580 psi)

K_{vs} 20 – 46 m³/h

Δp_{max} 300 bar (4350 psi)

K_{vs} 1 – 17 m³/h

Δp_{max} 370 bar (5365 psi)

K_{vs} 4.5 – 9.5 m³/h

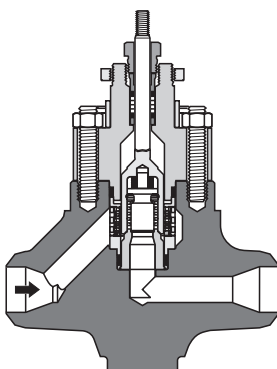
The control valve ZK 313 is also available as an ASME version as per ASME B 16.34. Due to the tandem shut-off, it combines the function of a conventional isolating valve and control valve, and offers long service lifetimes. The leakage rates are in accordance with the highest EN and FCI classifications.

At the beginning of the opening process, first the valve plug is lifted off the main seat, but the valve cone follows only after a certain lift. At the moment of closing and at the beginning of opening, the flow velocity at the valve seat is therefore zero, which means that wire

drawing is prevented. Through the use of the steel type 1.4903 / A 182 F91 and special seat materials, the ZK 313 permits a maximum temperature of 620°C. The ZK 313 valve with additional nozzle can be used for differential pressures up to Δp_{max} 370 bar.

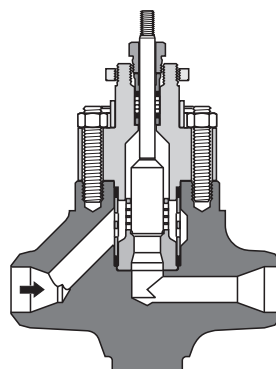
Connections	Butt-weld ends, socket-weld ends (EN, ASME)
Actuators	Electric (rotary, linear or lever actuator), hydraulic, pneumatic, handwheel
Body material	C 22.8 (1.0460), A 105 16 Mo 3 (1.5415) 10 CrMo 9 10 (1.7383), A 182 F 22 X10 CrMoVNb 9 1 (1.4903), A 182 F 91

Nozzle Versions for ZK 313



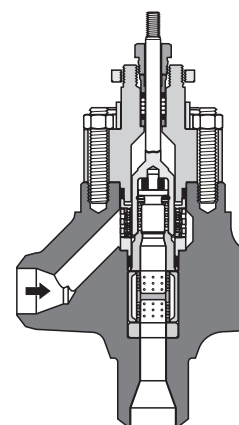
Standard nozzle

Δp_{max} 300 bar / 4350 psi



Special nozzle

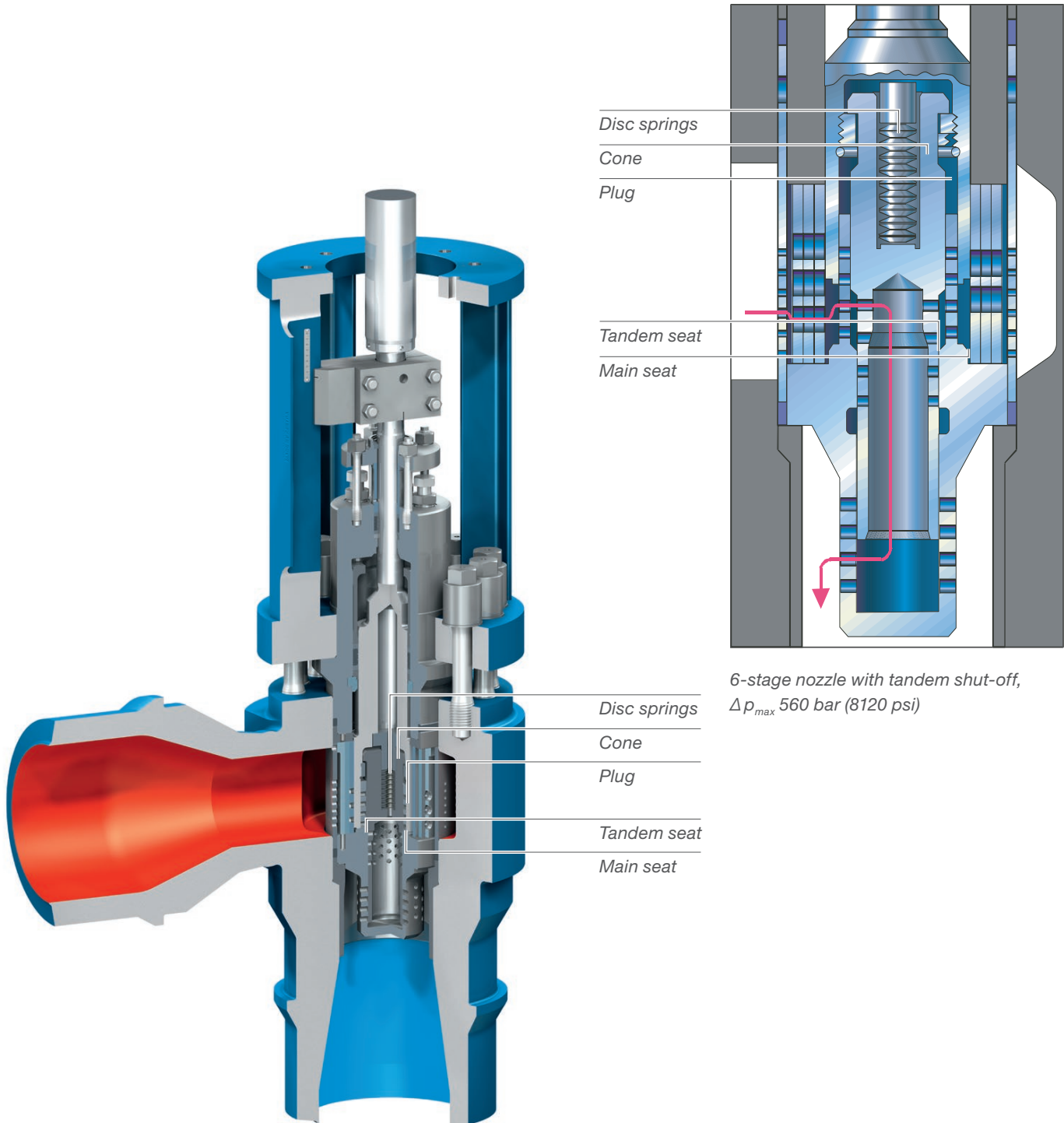
Δp_{max} 40 bar / 580 psi
(without tandem seat)



Special nozzle

Δp_{max} 370 bar / 5365 psi
(also in straight-through design)

Control Valve ZK 213 with Tandem Shut-Off



Control Valve ZK 213

Δp_{\max} 300 bar (4350 psi)

K_{vs} 10 – 90 m³/h

Δp_{\max} 560 bar (8120 psi)

K_{vs} 10 – 70 m³/h

The tandem shut-off of control valve type ZK 213 ensures stable and low-wear operation as a control and shut-off valve for a pressure drop of Δp_{\max} 300 bar or Δp_{\max} 560 bar.

With this control valve, there is a choice of maximum differential pressures of Δp_{\max} 300 bar or Δp_{\max} 560 bar depend on the design. A subsequent change is possible by changing the internals.

The two additional throttling elements fitted downstream in the high-pressure version provide effective protection against wear. Due to the tandem shut-off, it combines the functions of a conventional isolating valve and control valve, and offers long service lifetimes. The leakage rates are in accordance with the highest EN and FCI classifications.

Connections	Butt-weld ends (EN, ASME)
Actuators	Electric (rotary, linear or lever actuator), hydraulic
Body material	16 Mo 3 (1.5415)
	15 NiCuMoNb 5 (1.6368, WB 36)
	<i>Other body materials on request</i>

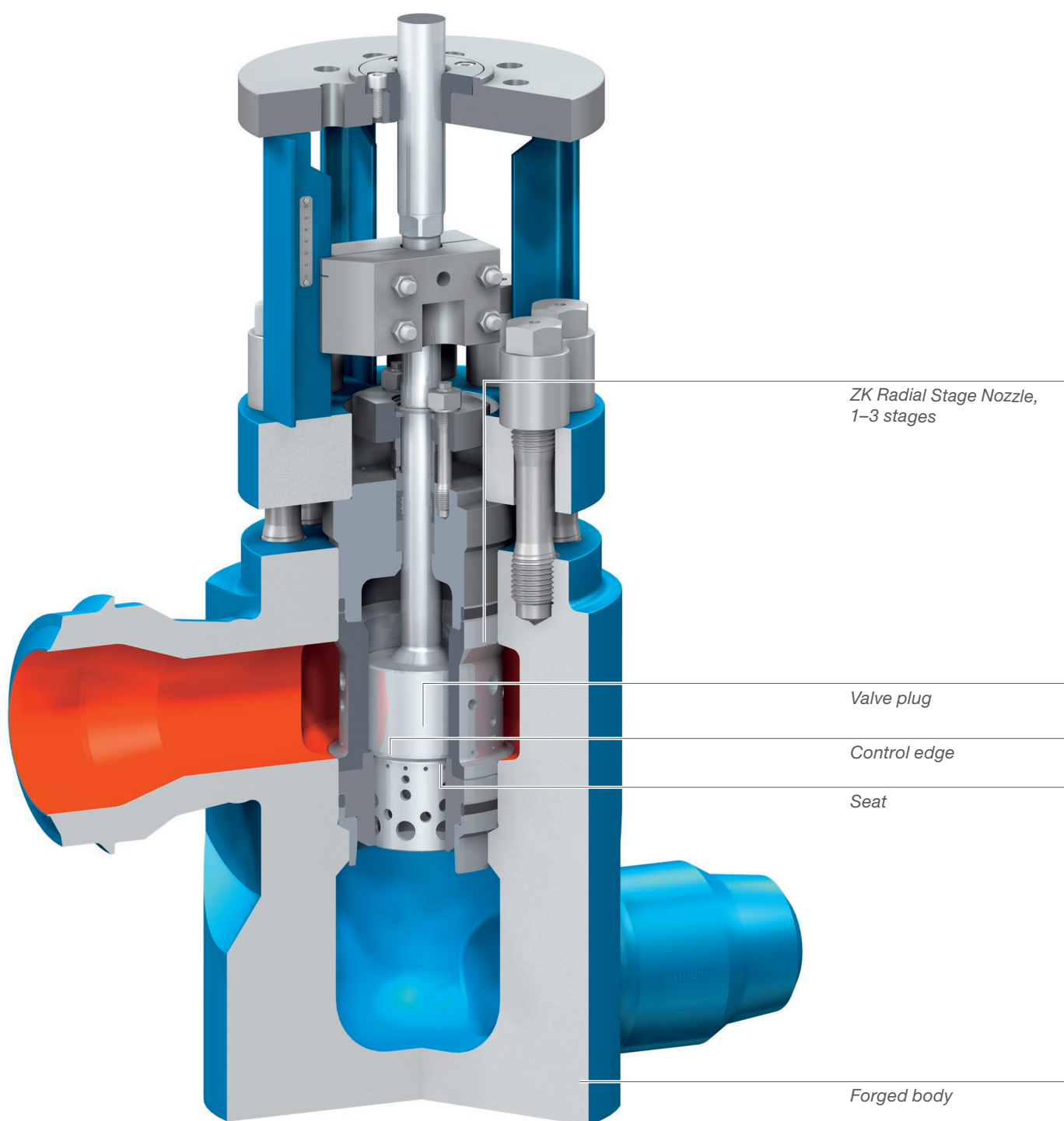


ZK 213 internals when new



Internals of a leak-off valve ZK 213,
DN 100, after 13 years of operation
 $p_1 = 374$ bar (5420 psi), $p_2 = 11$ bar (159.5 psi),
 $t = 172^\circ\text{C}$, $\dot{m} = 35$ kg/s

Control Valve ZK 610 and ZK 613



Control Valve ZK 610, ZK 613

ZK610, PN 250
ZK613, PN 630

Δp_{\max} 40 bar – Δp_{\max} 120 bar (1740 psi)
 K_{vs} 28 – 969 m³/h

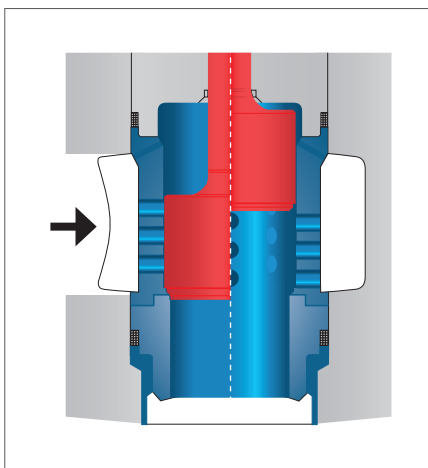
The control valve types ZK 610 and ZK 613 round off the ZK valve range with large K_{vs} values. Thanks to the modular design, it is possible to optimize the number of throttling units to suit the operating conditions. In addition, leakage-free pressure balancing can be used to reduce the actuating forces.

As with the ZK 29, the seating surfaces are protected against high flow velocities by means of a control edge at the valve plug. This design feature achieves the highest leakage-rate classifications according to EN and FCI with long service lifetimes. The entire ZK Radial Stage Nozzle including seat is easy to change, ensuring the highest level of availability.

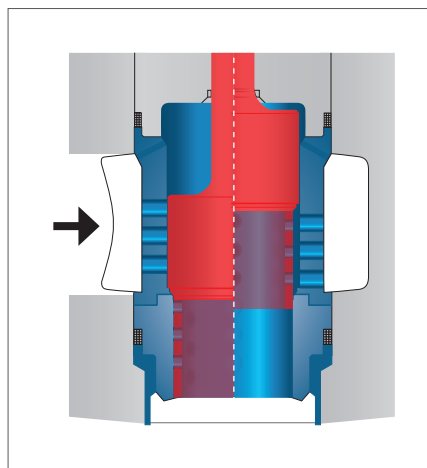
Connections	Butt-weld ends (EN, ASME)
Actuators	Electric (rotary or linear actuator), hydraulic, pneumatic
Body material	C22.8 (1.0460) 16 Mo 3 (1.5415) 10 CrMo 9 10 (1.7383) <i>Other body materials on request</i>

Modular System of the ZK Radial Stage Nozzle for ZK 610, ZK 613

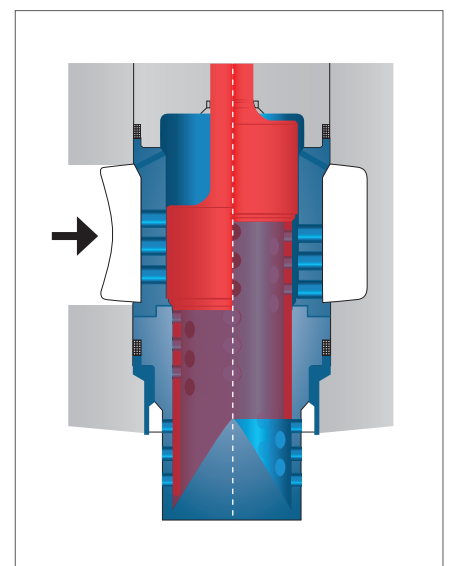
The multi-stage pressure drop is adapted precisely to suit the operating conditions.



1-stage expansion

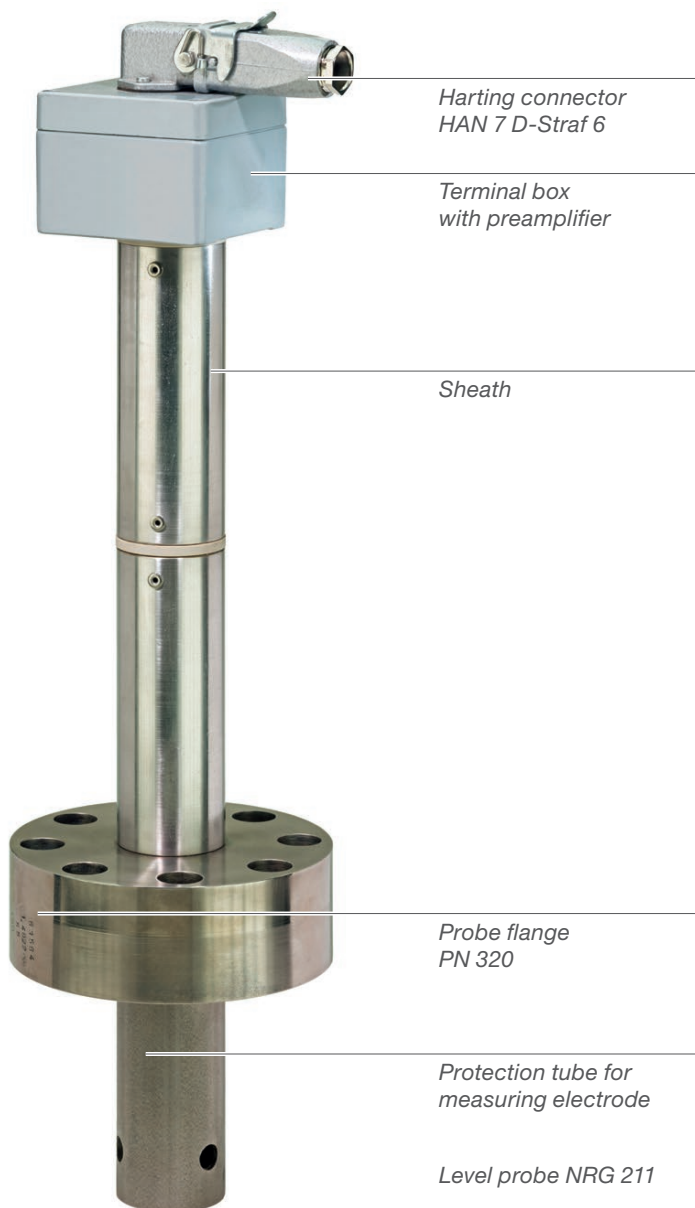


2-stage expansion



3-stage expansion

Controlled Drainage using Probes



Drainage of Turbines and Steam Lines

Controlled drainage is ensured with the aid of the self-monitoring level probes NRG 211 and the corresponding level switches NRS 2-4. Regardless of the conductivity, the NRG 211 supplies precise signals about any condensate which may be present.

The level switches NRS 2-4 connected to the NRG 211 detect whether the probe is immersed or exposed and whether any malfunction/alarm messages are being sent by the probe. In addition, the electrode's supply cable is monitored and, if applicable, any fault is reported.

The signals evaluated by NRS 2-4 units in a redundant configuration are passed on to the local control or the main control system, which handles the actuation of the ZK valves.

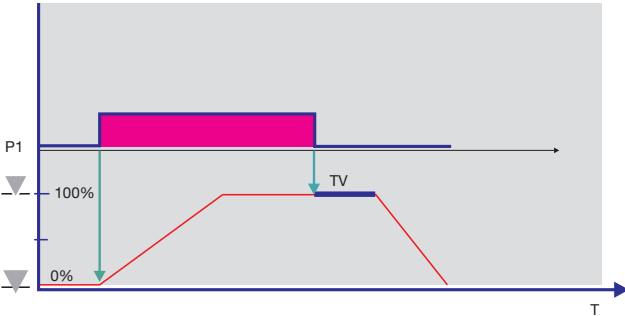
For this control and actuation, a distinction is made between one-stage and two-stage arrangements.

Level probe NRG 211:

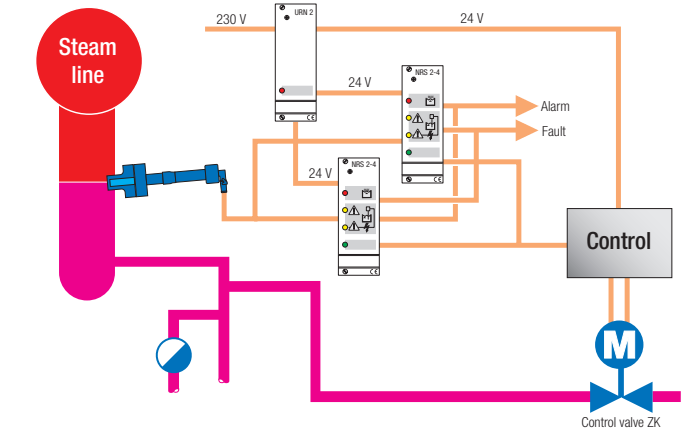
- PN 320, up to 550°C
- Capacitive measurement system, works regardless of the conductivity ($< 0.5 \mu\text{S/cm}$)
- No moving control elements
- Ceramic insulation resistant to thermal shock
- Self-monitoring for short-circuits
- Cable lengths up to 500 m

Timing diagram for drainage using one probe

As long as probe P1 is immersed, the ZK valve opens. After the probe is exposed, there is a time delay TV before the valve closes again. In the case of low condensate flowrates, an optional steam trap can be used for continuous drainage.



Timing diagram for drainage using one probe

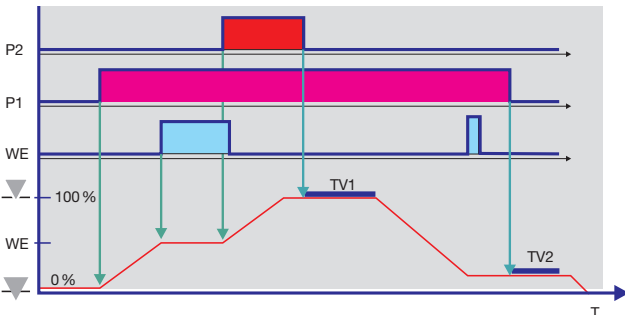


Controlled drainage using one probe and an optional steam trap

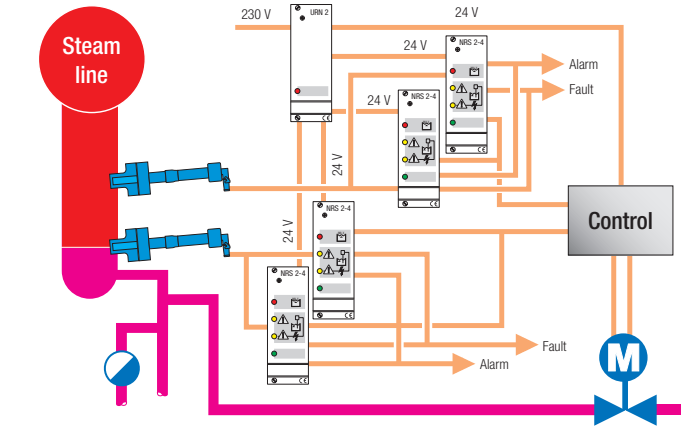
Timing diagram for drainage using two probes

If the lower probe P1 is immersed, the ZK valve opens to a defined intermediate position. When the level drops, the probe signals “exposed” and the ZK valve closes again. If the second probe P2 also becomes immersed as a result of large condensate flowrates, the ZK valve opens to the 100% open position. After P2

is exposed again, the ZK valve first goes to a defined intermediate position after a certain time delay. After the lower probe P1 is exposed, there is a time delay TV before the valve closes again. In the case of low condensate flowrates, an optional steam trap can be used for continuous drainage.



Timing diagram for drainage using two probes



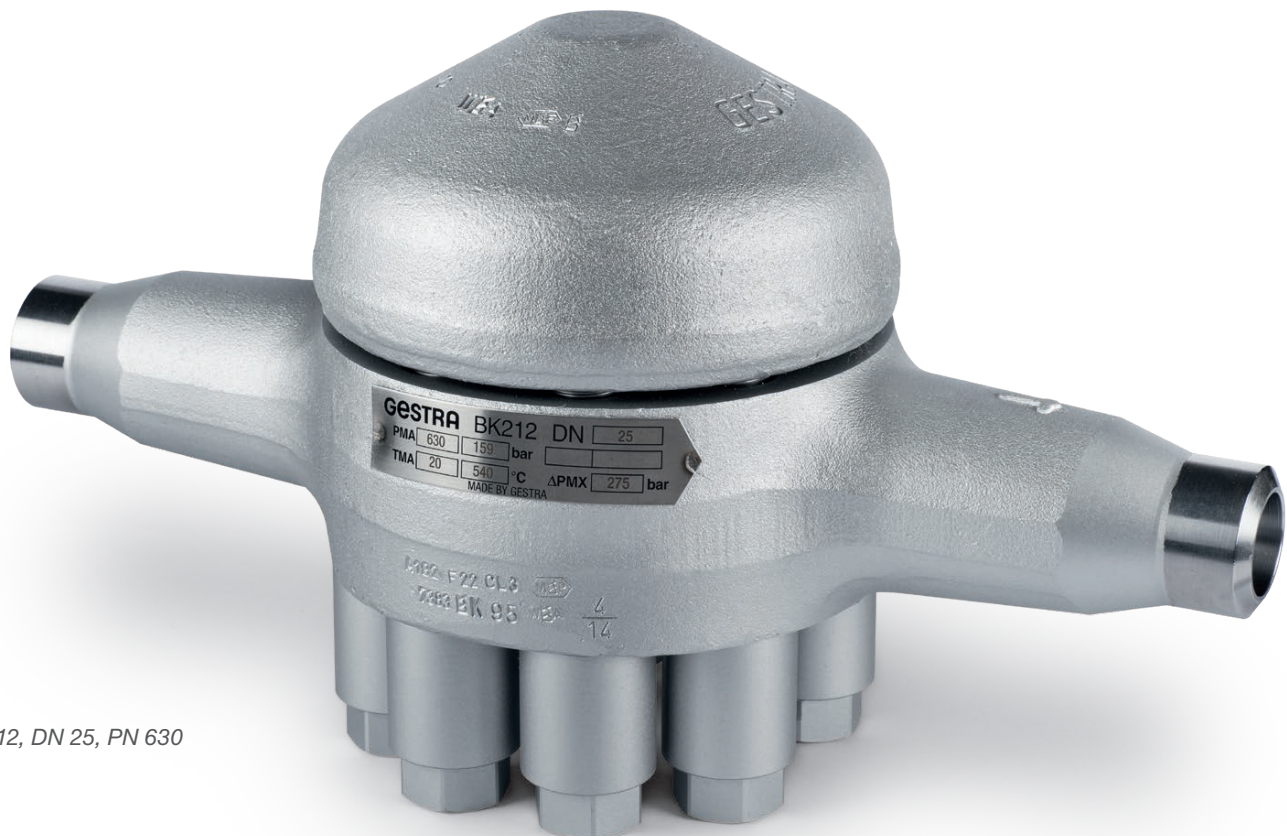
Controlled drainage using two probes and an optional steam trap

Steam Traps for High-Pressure Applications

Thermostatic Steam Trap BK with Thermovit Regulator up to PN 630 and Cl. 2500

Features of the BK Series

- Robust regulators for the toughest operating conditions (unaffected by water hammer and freezing)
- Suitable for superheated steam
- Automatic air-venting (the steam trap can also be used as a thermostatic air vent for steam systems)
- Can be mounted in any position (installation in horizontal or vertical pipes)
- Stage nozzle acts as a non-return valve
- Internals made of corrosion-resistant stainless steels
- Easy in-line maintenance (without removing the body from the pipe)
- Seal between body and regulating element achieved by a metallic base bushing
- Complete series available up to differential pressures of 275 bar

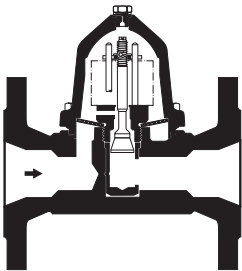


BK 212, DN 25, PN 630

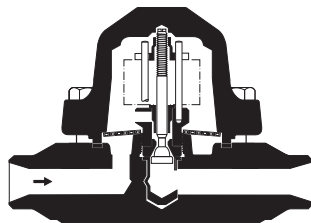
Thermostatic Steam Trap BK from PN 63

Type	PN / Class	Δ PMX [bar]	Materials		Connections
			EN	ASTM	
BK 37	PN 63/100	45	1.5415	A182-F1 ¹⁾	Flanged, socket-weld ends, butt-weld ends
BK 27N DN 40, 50	PN 63	45	1.5415	A182-F1 ¹⁾	Flanged, socket-weld ends, butt-weld ends
BK 28	PN 100	85	1.5415	A182-F1 ¹⁾	Flanged, socket-weld ends, butt-weld ends
BK 29	PN 160	110	1.7335	A182-F12	Flanged, socket-weld ends, butt-weld ends
BK 212	PN 630	275	1.7383	A182-F22	Flanged, socket-weld ends, butt-weld ends
BK 212-F91	–	275	1.4903	A182-91	Flanged, socket-weld ends, butt-weld ends
BK 37-ASME	Class 400/600	45	–	A182-F12	Flanged, socket-weld ends, butt-weld ends
BK 28-ASME	Class 600	85	–	A182-F12	Flanged, socket-weld ends, butt-weld ends
BK 29-ASME	Class 900	110	–	A182-F12	Flanged, socket-weld ends, butt-weld ends
BK 212-ASME	Class 2500	275	–	A182-F22	Flanged, socket-weld ends, butt-weld ends

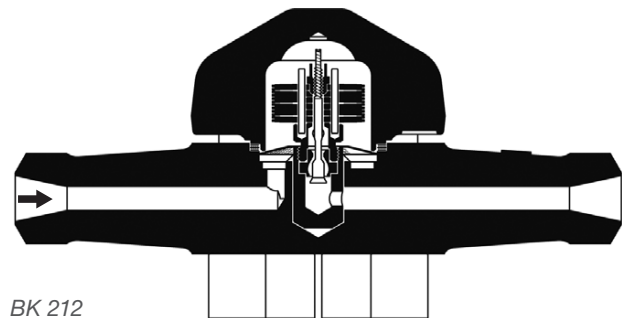
¹⁾ ASTM material comparable to EN material



BK 27N
DN 40, 50
1½", 2"



BK 37, BK 28, BK 29
BK 37-ASME, BK 28-ASME,
BK 29-ASME
DN 15, 20, 25
½", ¾", 1"



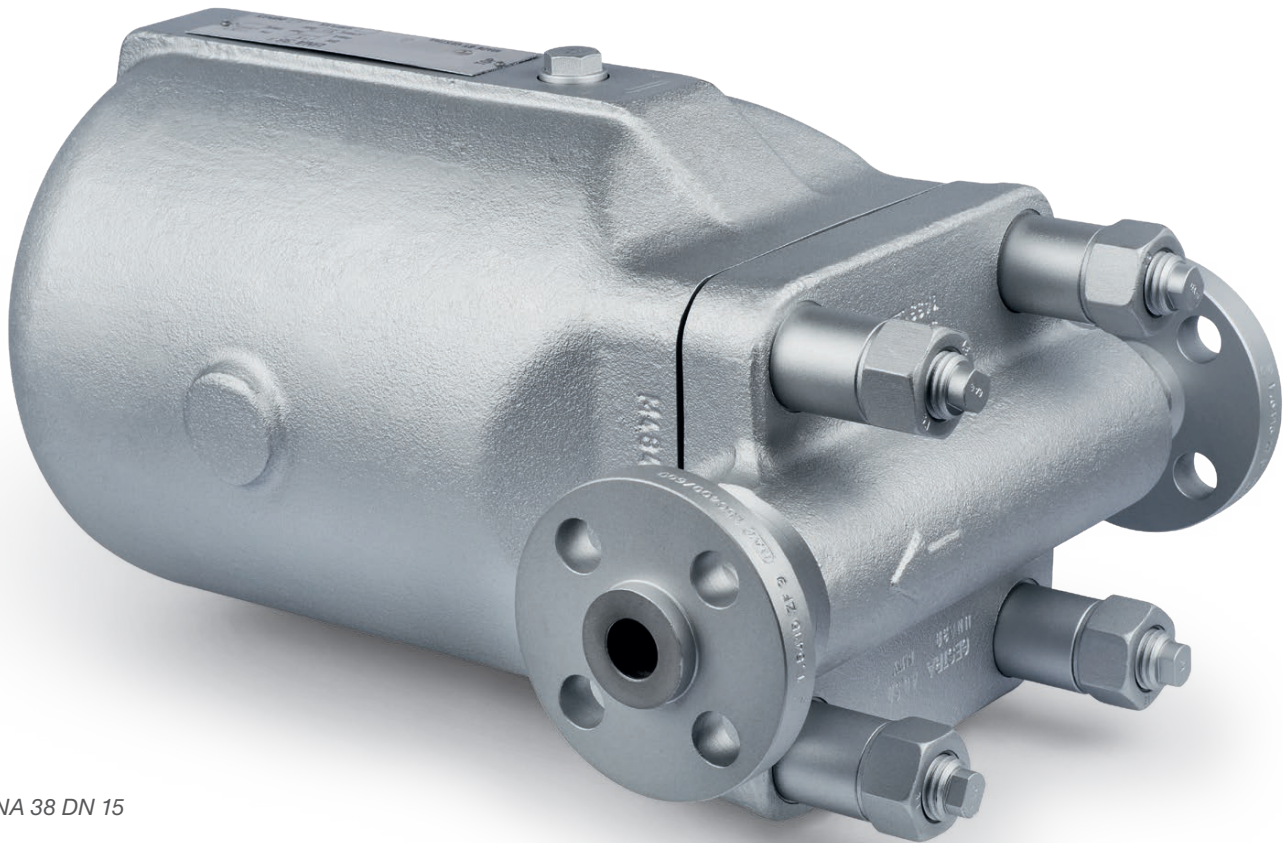
BK 212
BK 212-ASME
DN 15, 20, 25
½", ¾", 1"

Steam Traps for High-Pressure Applications

Steam Trap UNA with Ball Float up to PN 160

Features of the UNA Series

- Function independent of back pressure and condensate temperature
- Operation free of steam loss, thanks to formation of a water pocket
- Drainage without any banking-up, even with fluctuations in pressure and flowrate
- Unaffected by dirt
- Automatic air-venting by thermostat (Duplex control)
- Easy in-line maintenance (without removing the body from the pipe)
- Internals made of corrosion-resistant stainless steels



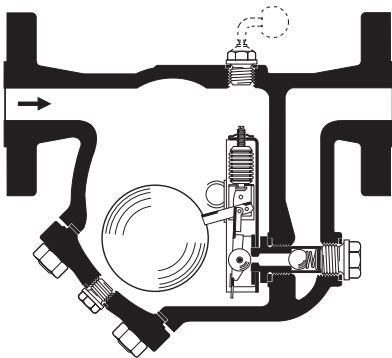
UNA 38 DN 15

Steam Trap Type UNA from PN 63

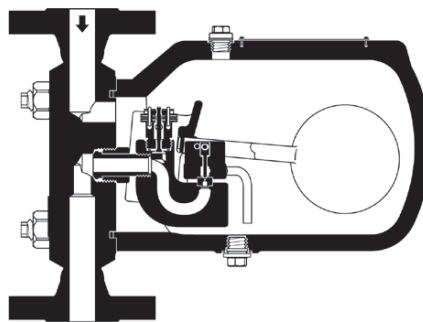
Type	PN	Δ PMX [bar]	Materials		Connections
			EN	ASTM	
UNA 27h ¹⁾	PN 63	45	1.5419	A217-WC1 ²⁾	Flanged, socket-weld ends, butt-weld ends
UNA 38	PN 100	80	1.5415/ 1.7357	A182-F1 ²⁾ / A217-WC6	Flanged, socket-weld ends, butt-weld ends
UNA 38 High-temperature	PN 100	80	1.7335/ 1.7357	A182-F12/ A217-WC6	Flanged, socket-weld ends, butt-weld ends
UNA 39	PN 160	140	1.7335	A182-F12	Flanged, socket-weld ends, butt-weld ends
UNA Special	PN 63	45	1.5419	A217-WC1 ²⁾	Flanged, socket-weld ends, butt-weld ends

¹⁾ Only available for installation in horizontal pipes

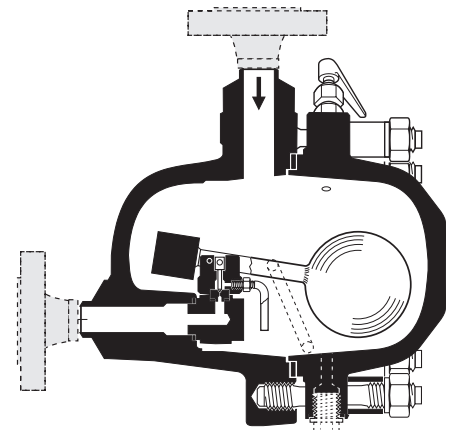
²⁾ ASTM material comparable to EN material



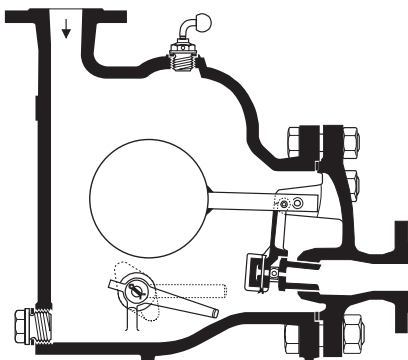
UNA 27h
DN 25, 40, 50
1", 1½", 2"



UNA 38
DN 15, 25, 40, 50
½", 1", 1½", 2"



UNA 39
DN 15, 25, 50
½", 1", 2"



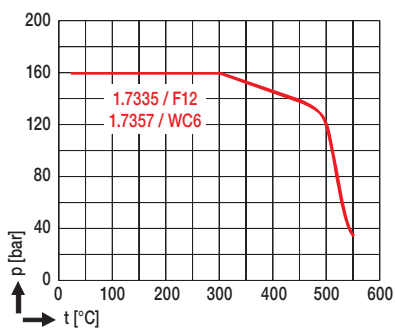
UNA Special
DN 65, 80, 100
2½", 3", 4"

Overview of the Product Range

K_{vs} values [m³/h] (Linear Characteristics, Design, Pressure/Temperature Ratings)

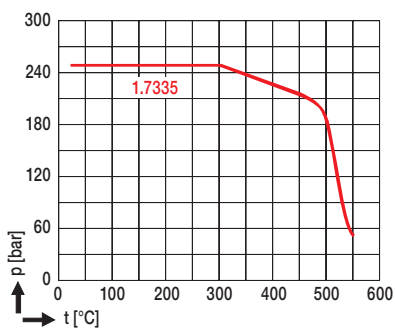
ZK 29			
DN	Δp 100 bar		
25	0.7	1.4	2.1
50	3	6	9
65			
80	14	21	28
100	20	33	46
125			
150	70	100	130
200			
250			
300			
350			
400			

Straight-through / angle



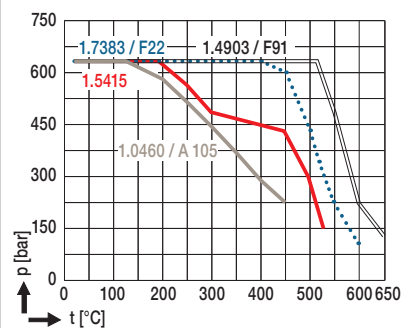
ZK 210			
DN	Δp 100 bar		Δp 180 bar
25	0.8	1.5	2.3
50	3.3	6.5	10
65			
80	9.5	18	28
100			
125			
150			
200			
250			
300			
350			
400			

Straight-through / angle



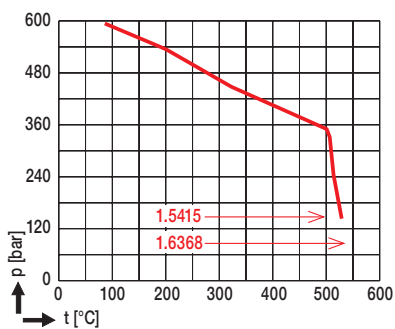
ZK 313							
DN	Δp 300 bar						Δp 370 bar
25	1	1.5	2.3	3.6	5.5		4.5
50	1	1.5	2.3	3.6	5.5	8	11
65	1	1.5	2.3	3.6	5.5	8	11
80	1	1.5	2.3	3.6	5.5	8	11
100						11	14.5
125						11	14.5
150						11	14.5
200							
250							
300							
350							
400							

Straight-through / angle



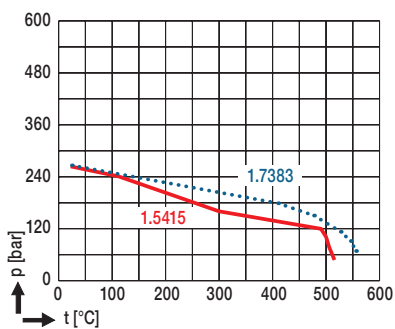
ZK 213, sizes 1-5											
DN	Δp 300 bar					Δp 560 bar					
	Bg.	1	2	3	4	5	1	2	3	4	5
50											
65											
80	20					12					
100	20	40				12	30				
125	20	40	50			12	30	40			
150		40	50	65			30	40	46		
200			50	65	90			40	46	70	
250				65	90				46	70	
300					90					70	
350											
400											

Angle / Z-pattern

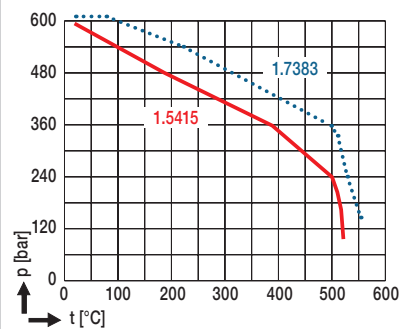


ZK 610 and ZK 613			
DN	Δp 40 bar	Δp 80 bar	Δp 120 bar
25			
50			
65			
80			
100	44 - 98	38 - 54	33 - 47
125	71 - 154	61 - 85	51 - 74
150	112 - 243	95 - 134	81 - 117
200	177 - 385	150 - 212	128 - 185
250	281 - 611	238 - 336	216 - 294
300*	446 - 969	378 - 533	322 - 465
350			
400			

ZK 610 Angle / Z-pattern



ZK 613 Angle / Z-pattern



Adaptation of nominal sizes is possible

*ZK 610 only



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