Reineke

Ein Unternehmen mit Tradition und Zukunft
A company with tradition and a future

Stellventile mit Hydraulikzylinder
Control valves with hydraulic cylinder

ISO 9001 Qualität

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Meß- und Regeltechnik GmbH

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Technische Daten

Armaturen

Hochwertige Stellarmaturen für die Kraftwerkstechnik und die Prozesswärmeerzeugung:

- Druckregelventile
- Sicherheits-Überströmventile
- Sicherheits-Schnellschlussregelventile
- Mengenregelventile
- Dampfumformventile
- Anfahr-Umleitstationen
- Umleitstationen für alle Druckbereiche
- Flaschen-Ablaufregelventile

Ergänzt mit Komponenten wie:

- Treibdampfkühlern
- Venturikühlern
- Einspritzregelventilen
- Schalldämpfern

Die Gehäusekörper bestehen aus geschmiedeten oder gegossenen Werkstoffen entsprechend der relevanten Regelwerke. Die Armaturen können in Durchgangsform, Eckform, Z-Form und T-Form ausgeführt und mit vielfältigen Anschlussgrößen und -formen kombiniert werden.

Zur Betätigung werden elektrische, pneumatische oder hydraulische Reineke –Stellantriebe, jeweils auf den Anwendungsfall zugeschnitten, eingesetzt.

Für Ausführungen mit überlagerter Sicherheitsfunktion gemäß TRD 421 Regelwerk kommen bauteilgeprüfte Reineke-Systeme zum Einsatz.

Technical Data

Control Valves

High quality control valves for applications in electric power and steam plants:

- Pressure Reduction Valves
- Safety Overflow Valves
- Steam Conditioning Valves
- Flow Control Valves
- Start-up Bypass Systems
- HP-, IP- and LP-Turbine Bypass Valves
- Boiler Feedwater Control Valves
- Boiler Blowdown Valves

Completed with accessories:

- Steam Atomizer
- Venturi Cooler
- Spraywater Valves
- Silencers

The valve bodies are made of forged or casted steel material. The valves are designed in globe or angle body configuration, arranged in Z- or T-pattern and can be combinated in several types of connection ends.

The control valves are equipped with electric, pneumatic and Reineke electro-hydraulic actuators.

Control valve systems with safety functions in acc. TRD 421 (German Boiler Regulations) are equipped with Reineke electro-hydraulic actuator systems and Reineke triple pressure protection device.

Gehäuseform **Body Design**	**Nennweiten** **Nom. Diameter**	**Druckstufen** **Pressure Rating**	**Temperatur** **Temperature**	**Gehäusewerkstoff** **Body Material**	**Anschlüsse** **Connections**
Durchgangs-,Eck-, Z– und T-Form	DN 50 bis 700	PN 10 bis 400	-10 bis + 550° C	Schmiede-, Guss- und Blechmaterial, legiert und unlegiert, nach DIN und internationalen Regelwerken	DIN oder ANSI Flansche Schweißenden
Globe/Angle body, in Z- or T- pattern	2" up to 28"	ANSI CLASS 150 to 4500	15 up to 1050° F	forged, casted and fabricated Materials high and low alloys in acc. to DIN and International standards	DIN or ANSI flanges butt weld ends

Reineke
Meß- und Regeltechnik GmbH

VALVES

Content

REINEKE MESS - UND REGELTECHNIK GMBH
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1 Reineke Valve Performance

The control valves are used when pressure and temperature must be precisely controlled. For this function, we produce high quality control valves for power plant engineering and cyclical heat production applications as nentioned below:

- Fossil fired conventional Power Plants
- Supercritical Power Plants
- Combined Cycle Power Plants
- Waste Incineration Plants
- Desalinization Plants
- Steam Processing Plants
- Applications in Pulp- and Paper Industry

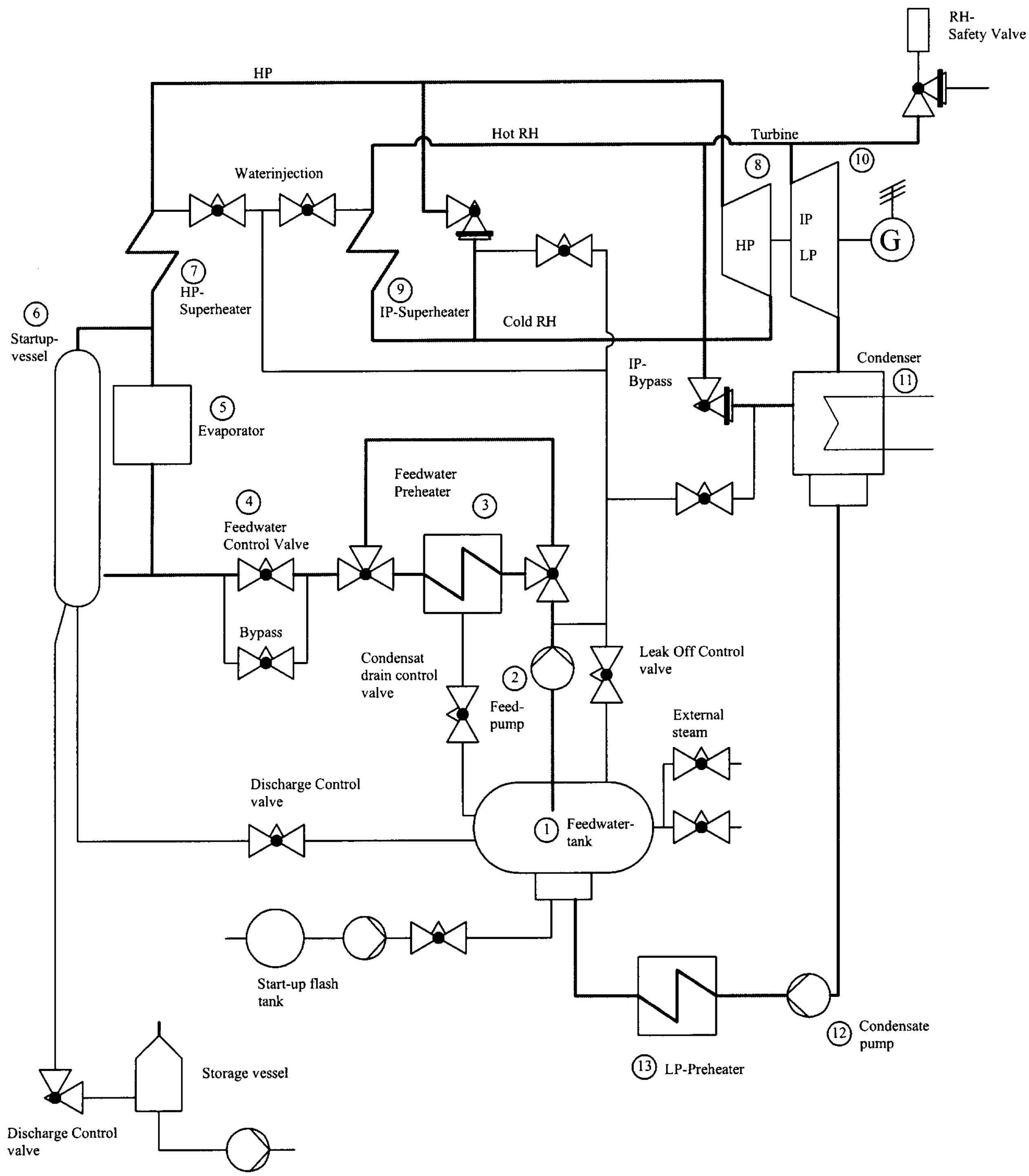
1.1 Water-steam-circuit of a conventional power plant

The fig. 1.1.1 shows a simple diagram of the water steam circuit in a conventional power plant, which is described as follows.

The boiler feed water, which is necessary for the water steam circuit, is taken from the feed water tank (1). The boiler feed pump (2) supplies the water through the high pressure feed water heater (3) and the feed water control valve (4) into the evaporator (5) of the boiler. Here the water evaporates due to the added heat to saturated steam. The steam flows through the start up vessel (6) into the high pressure super heater (7) where it is overheated to the desired final temperature. The furthest distance leads directly into the high pressure parts of the turbine (8), in which the steam energy is generated to electricity by turning the turbine blades.

The low temperature steam leaves the turbine, to be reheated to the operation intermediate and low pressure part of the turbine (10). In most power plants, the rest of the thermal energy can not be used to generate further electricity. This energy is taken from the steam in the condenser (11) so that the steam condenses back to water. The condensate is transported by the condensate pump (12) over the low pressure preheater (13) back into the feed water tank, so that the circuit is completed.

Fig: 1.1.1 Water-Steam-Circuit of a conventional Power Plant



1.2 Features of the Reineke-Valves

A great variety of control valves are needed in every power plant. The plant must be started up and shut down several times. Furthermore the power plant should be operated in a wide load range. The Reineke control valves are designed for precise control operation of pressure combinated with high temperature media. A high reliability and maximum availability in addition with noise-reduced execution (to prevent increasing noise in the beginning and not by isolation) are typical characteristics.

Our goal are the main control and safety valves for any kind of power plant applications, where customized design is necessarry to meet the individual plants operation philosophy.

Our valves:

- HP-, IP- and LP Bypass Valves
- Reheater Valves
- Safety Stop & Control valves
- Discharge Control Valves
- Steam Conditioning & Control Valves
- Spray Water Control Valves
- Drain valves

Our additional components:

- Motive Steam Cooler
- Injection Control Valves

Valve body configuration

The bodies are made of forged or casted materials to design control valves in globe or angle body configuration, Z- and T- forms combinable with almost all connecting sizes. The globe shaped body with even wall thicknesses prevents high extreme stress due to temperature changes. The materials used are suitable for the highest pressures and temperatures of the design and operational conditions. The prepared weld-ends are made of materials which may be easily welded to the piping system materials.

Control and steam conditioning valves are made preferably of forged steel. This design has the advantage of tolerating / absorbing stress and vibration from the pipework in the valve boby. Furthermore the orientation of the in- and outlet is variable.

To enlarge the duration period of our valves especially under critical conditions we use welded seat rings. With a special prewelding underneath the seal welding we reduce the expenditure like heat treatment after a replacement of the seat ring.

All valves in the HP (high pressure) and RH (reheat) line are equiped with self sealing bonnets.

The control valves are fitted with electric, pneumatic and Reineke hydraulic drives. For superimposed safety functions, we recommend the proven component parts of **Reineke** hydraulic units.

Only in certain instances the above mentioned control valves may be applied in a formal standard manufactured length. Style, dimensions and material of our control valves are usually designed to suit a specific system. The system's internal sets of valves need to be individually thermodynamically adjusted to achieve optimal fit and performance. Therefore, our here shown delivery program is limited to the base data of each valve type.

Design Materials

Our selection of materials is based on a combination of code requirements, which are the chemical characteristics of the fluid, **Reineke's** past experience, and the economics of the construction. Typical construction materials are listed in the chart below. Alternative materials may be substituted for the charted materials to accommodate special needs.

For the choise of materials Reineke meets the requirements of the European "Pressurized Equipment Directive" PED 97/23. Preferable DIN materials are used if allowed by the design code. In addition to the DIN materials, materials in accordance with ASME and the associated parameters and tolerances can be used.

Materials (example)

Denomination	Material	DIN	ASME	Remarks
Forged body	X10CrMoVNb9 1	1.4903	A 182 F91	
	10CrMo910	1.7380	A 182 F22	
	13CrMo44	1.7336	A 182 F12	
	15Mo3	1.5415	A 182 F1	
	C22.8	1.0460	A 105	
Casted body	GS-17CrMo5 5	1.7357	A 217 WC6	
	GS-22 Mo4	1.5419	A 217 WC1	
	GS-C 25	1.0619	A 216 WCB	
Valve Stem	X20CrMoV12 1	1.4922		

1.3 Type Code Reineke-Valves

Please take note of the following type codes:

Type code for Valve

□□□□ - □

D	straight design
E	angular design
K	combination design
M	proportioning valve
S	valve with safety function
V	preheater bypass and protection valve
Z	Z - design

1	perforated plug
2	parabolic plug
3	parabolic - perforated plug
4	perforated plug, multi stage
5	shut off plug
6	plug for combination valve
7	circular gate
8	plug for double seat

0	general
1	balanced pressure
2	multi stage system
3	multi stage relief system and balanced pressure

0	general
1	steam desuperheater
2	nozzle
3	spray attemperator

1	actuator: hydraulic
2	actuator: electric
3	actuator: pneumatic
4	actuator: hand wheel

1.4 Characteristics

Your individual operational needs warrant an individual solution. **Reineke** provides flow characteristics that address your specific problem. You no longer have to resign yourself to working around someone else's standard, "off the shelf" solution.

For your special applications we have special answers. We can offer you a variety of solutions to achieve optimum performance.

1.4.1 Linear Characteristic

Linear characteristics are recommended when you experience continuous pressure drops in the operating modes or even when operating in high modes is required.

1.4.2 Equal Percentage Characteristic

Equal percentage characteristics are mainly used to control substances that need to be compressed. It is almost never used when pressure differences are small and quantities large, or when pressure differences are large and quantities small. This application should not be used in lower operating modes.

1.4.3 Square Characteristic

The **square characteristic** is used to control large quantities of various media

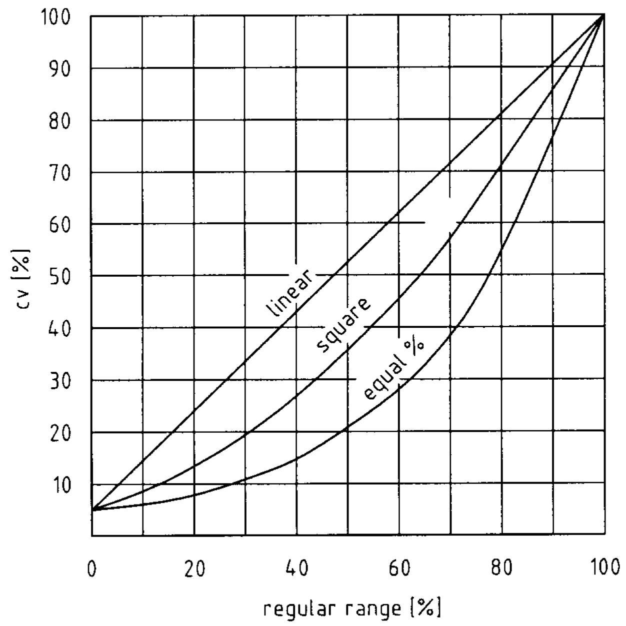


figure 1.4.4: Characteristics

1.5 Valve Plug Configuration

Reineke control valves use two basic valve plug configurations to best suit the applications as outlined below.

1.5.1 Unbalanced Plug

Unbalanced plugs are used when high availability is required. The solid construction principal with welded stem plug connection garanties it´s function without any influence of vibration out of the process. The double guiding sections secure a smooth operation even by high forces and thighness of the seat.

Furthermore when unbalanced forces are small (due to the valve plug area and pressure drop across), or in special circumstances, where a balance plug seal material is incompatible with the process fluid.

Due to typically large unbalanced forces in high pressure drop solutions (forces that must be controlled by the actuator), these valves are limited to small plug sizes (3“or less). ANSI class V or class VI (with soft seat).

1.5.2 Balanced Plug

Balanced plugs are commonly used to reduce the actuator forces (see figure 1.5.3, next page). Axial holes connect the top and bottom ends of the plug and equalize the pressure on both sides. Balancing this pressure significantly reduces the work load of the actuator.

Soft sealing rings were used up to 250°C (482°F) and piston rings for a high temperature range to realize the most possible thighness for this type of plug configuration.

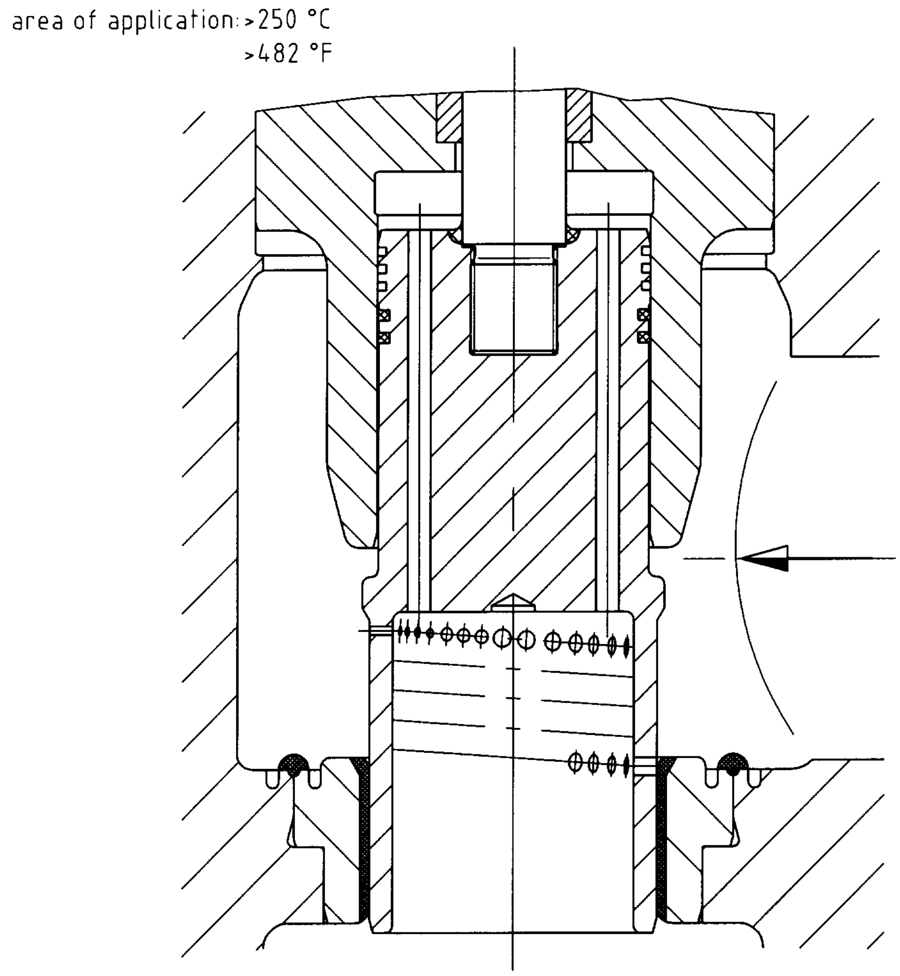


figure 1.5.3: balanced plug with piston rings

1.6 Accessories matched to performance requirements

Right accessory hardware is a critical element to proper valve performance. Positioners, position transmitters, limit switches etc. provide the quality and performance necessary for severe service applications.

Our CAD system allows Reineke engineers to decide on quality accessories to assure that stroking speeds, failure modes and other performance criteria such as resolution and linearity will be achieved not only during our internal testing, but also at your facilities.

Actuators

Reineke's standard actuator is a high performance, double acting, electro hydraulic actuator. Reineke offers it with or without manual override and with or without accumulator or springs. We also supply manual, electro-mechanical, or pneumatic actuators.

2 Applications

Following, we list **Reineke's** focal point for comprehensive solutions:

- Steam Turbine Bypass Applications
  (HP steam to cold reheat, HP steam to condenser, hot reheat steam to condenser)
- Feedwater-System Applications
- Boiler Applications

2.1 Turbine Bypass System

A Turbine Bypass System is the most critical factor in increasing plant efficiency.

Reineke turbine-bypass systems are recognized around the world as some of the best for faster startup and energy loss prevention. They offer a worry-free extended plant life with increased performance and dependability. This smart solution is based on our know how and experience about:

- Control system & Process Know-how
- Valve & Actuator Technology

2.1.1 Sizing of the Reineke Turbine-Bypass System

During sizing of our turbine-bypass system, all plant operating conditions such as the number of warm starts, hot starts and requirements for house load operation must be taken into account. Later in plant life, even combined cycle operation may become common. When sizing our low pressure turbine-bypass valves the desired reheater pressure for the turbine start as well as condenser capacity must also be considered.

Reineke turbine-bypass systems are designed to meet precisely the operating requirements of our customer's individual installations. Capacity can range up to 100 percent of the maximum continuous rating (MCR) boiler steam flow for the HP-bypass as well as for the LP-bypass.

Reineke's Operational Beliefs:

=> "Quick start-up of turbine during cold, warm or hot conditions."

2.1.2 Duty of a Turbine-Bypass System

The primary function of any turbine-bypass system is steam conditioning – high pressure throttling together with desuperheating. Bypass valves must perform these functions and achieve the targeted pressures and temperatures without excessive noise and vibration and without destroying the valve-trim wear. It is essential that bypass valves are engineered and designed to perform under severely temperature cycles.

If required, dependent on the plant design, bypass systems must also perform additional functions like safe HP-bypass opening and LP-bypass closing to protect the condenser during transient operating periods.

We are proud to state that **Reineke's** advanced valve technology meets these stringent service requirements. With its distinctive body design, **Reineke** is well known for developing one of the most durable and lasting turbine bypass valve technologies in the power industry, today.

It is a known fact that excessive vibration in a turbine bypass valve can break pipe hangers and shake off accessories on actuators. Consequently, the result would be high maintenance costs and unscheduled downtime highly undesirable circumstances for any operator.

Reineke's Operational Beliefs:

=> "Improve Plant Efficiency – Eliminate Lost Steam"

Any leakage occurring during normal operation of a turbine bypass valve translates immediately into loss of revenue.

- Any steam that does not pass through the turbine will generate neither electricity nor revenue for the plant.
- Money spent on generating steam is lost revenue.
- Steam leaking past a valve seat could erode the seat, causing an increase in the leakage rate and downtime for maintenance.
- Steam leaking past a valve to condenser could reduce the efficiency of the condenser by deteriorating the vacuum and raising the temperature of the condenser.

Valve applications in typical combined cycle power plants are faced with various conditions, so that the main points listed below have to be matched.

Faster Start-Up and Minimized Thermal Stress

An efficient turbine-bypass system reduces start-up time under cold, warm and hot conditions. Our turbine-bypass system provides continuous flow through the superheater and the reheater and allows for higher firing rates, which result in quicker boiler warm-up. It also controls superheater and reheater pressure during the entire start-up, keeping thermal transients in the boiler to a minimum. Operating experience demonstrates that power plants equiped with **Reineke** valves and turbine-bypass systems will exhibit reduced start-up times and significantly less solid particle erosion of the turbine blades. This, of course, translates into a diminished need for expensive repair and replacement.

Temperature Matching

Our **Reineke** turbine-bypass system allows optimum steam-to-metal temperature matching for all start-up modes. The boiler load can be selected to reach the desired superheater and reheater conditions for turbine start. The result confirms reduced start-up time and extended life for the main turbine components.

In typical fossil fired supercritical plants these mentioned points are very important.

Avoid Boiler Trip after Load Rejections

Our fast-acting **Reineke** turbine-bypass system allows operation of the boiler to continue at an optimal standby load and re-establishes the demand for turbine load after a load rejection. The turbine will cover house load requirements as well as pressure and temperature transients usually associated with boiler trip and restart will be avoided.

Eliminate HP-Safety Valves

When equiped with the necessary safe opening devices, our **Reineke** turbine-bypass valve, sized for 100 % capacity, can serve as an HP-safety valve, thus eliminating the need for separate spring-loaded HP-safety valves, associated piping, and silencers. Again, this will save you much money on equipment and maintenance costs for the plant operator. Our experienced engineers are competent to review applicable codes and system designs.

Preventing Energy and Feedwater Loss

Even when regulations require spring-loaded safety valves, a large capacity **Reineke** turbine-bypass system with fast acting actuators can avoid the lifting of the safety valves and the corresponding energy and water losses during virtually all disrupting circumstances.

2.1.3 LP-Bypass

Our Reineke LP-bypass delivers superior pressure reduction and temperature control, low noise, vibration and fast response in a compact complete steam-conditioning control valve.

The Compact Comprehensive Solution

Our **Reineke** LP-bypass is one of the leading low pressure turbine bypass valves for combined cycle and process steam plants. Our LP-bypass is designed in both angle and globe body configurations and fits easily into most existing piping arrangements. Our LP-bypass may be installed in any orientation without the concern of additional support for the upper structure. Equiped with an integrated spring-loaded spraywater nozzle desuperheating manifold at the valve outlet, our LP-bypass diminishes the downstream desuperheating distance and makes it extremely compact for all types of low pressure steam conditioning applications, including advanced turbine bypass-to-condenser applications with short pipe runs.

Reineke offers greatly reliable, fast, accurate hydraulic and pneumatic actuators that provide superior sytem control.

Accurate Control

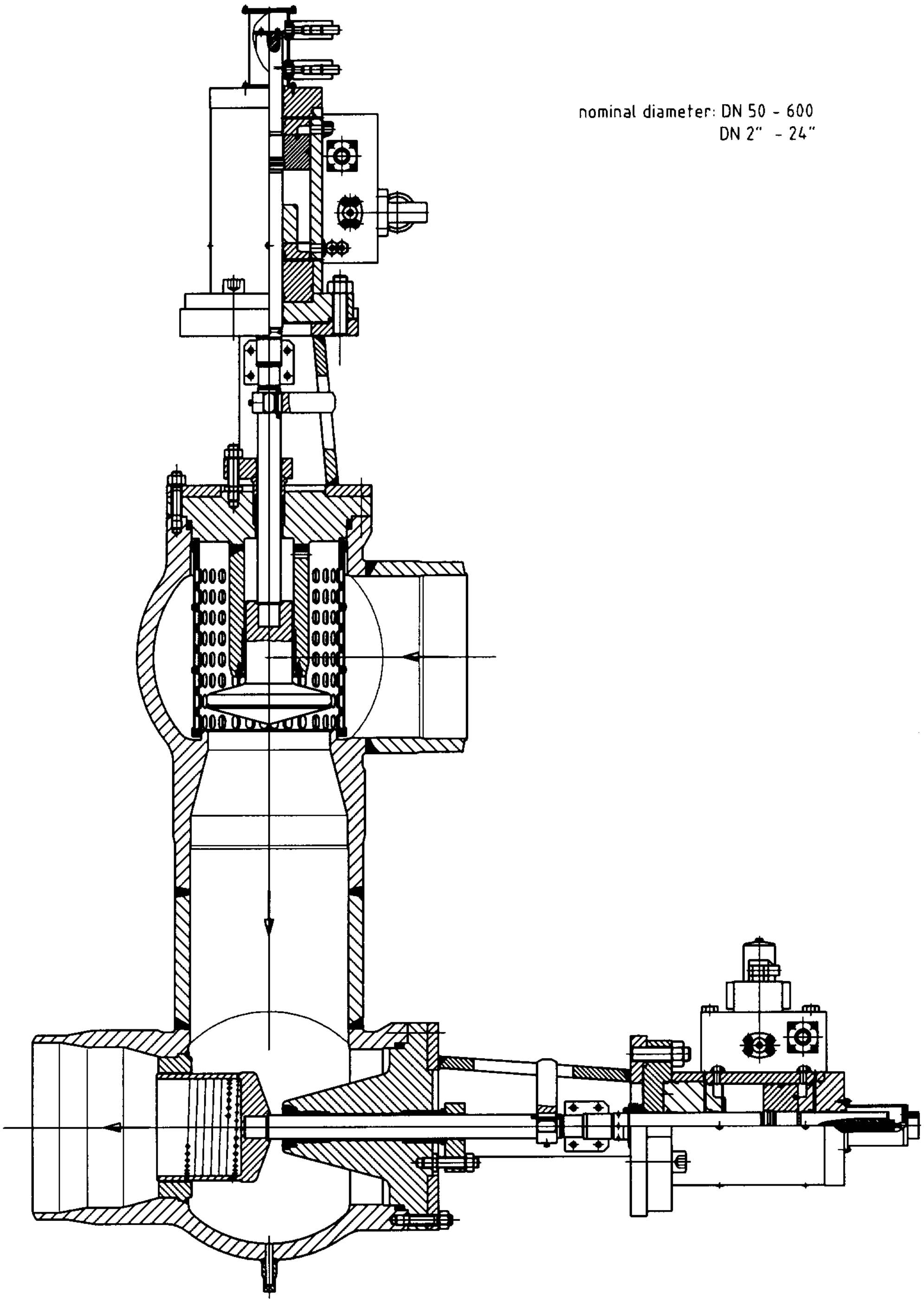
Reineke can document a long history of developing advanced technology for valves and actuation systems for severe service and safety-related applications and can lay claim to having designed one of the most reliable actuation systems in the market today. **Reineke** has been supplying hydraulic actuation systems for over 30 years and we pride ourselves in possessing an extensive list of installations around the globe.

The selection of pneumatic or hydraulic actuation depends primarily on the function of valve design for the particular application as well as on customer preference. A comparison of the factors influencing actuator selection is demonstrated in table 1.

Table 1: Factors Influencing Actuator Selection

Performance Attribute	Pneumatic Actuator	Reineke Hydraulic Actuator
Stroke Speed	fast, less than 1 second for trip mode less than 10 seconds for modulation	very fast, less than 0,5 seconds
Resolution	good, less than 1 %	very good, less than 0,1 %
Thrust	meets thrust requirements for pressurized seat valves	meets thrust requirements for unbalanced valves
Reliability	very reliable and robust	very reliable and robust
Procurement Cost	inexpensive	higher costs
Installation Cost	inexpensive	higher costs
Maintenance	easy, with medium skills	requires higher skills for maintenance
Components	low pressure, reliable accessories	high pressure, special accessories

2.1.3.1 LP-Bypass Valve (K 600-1)

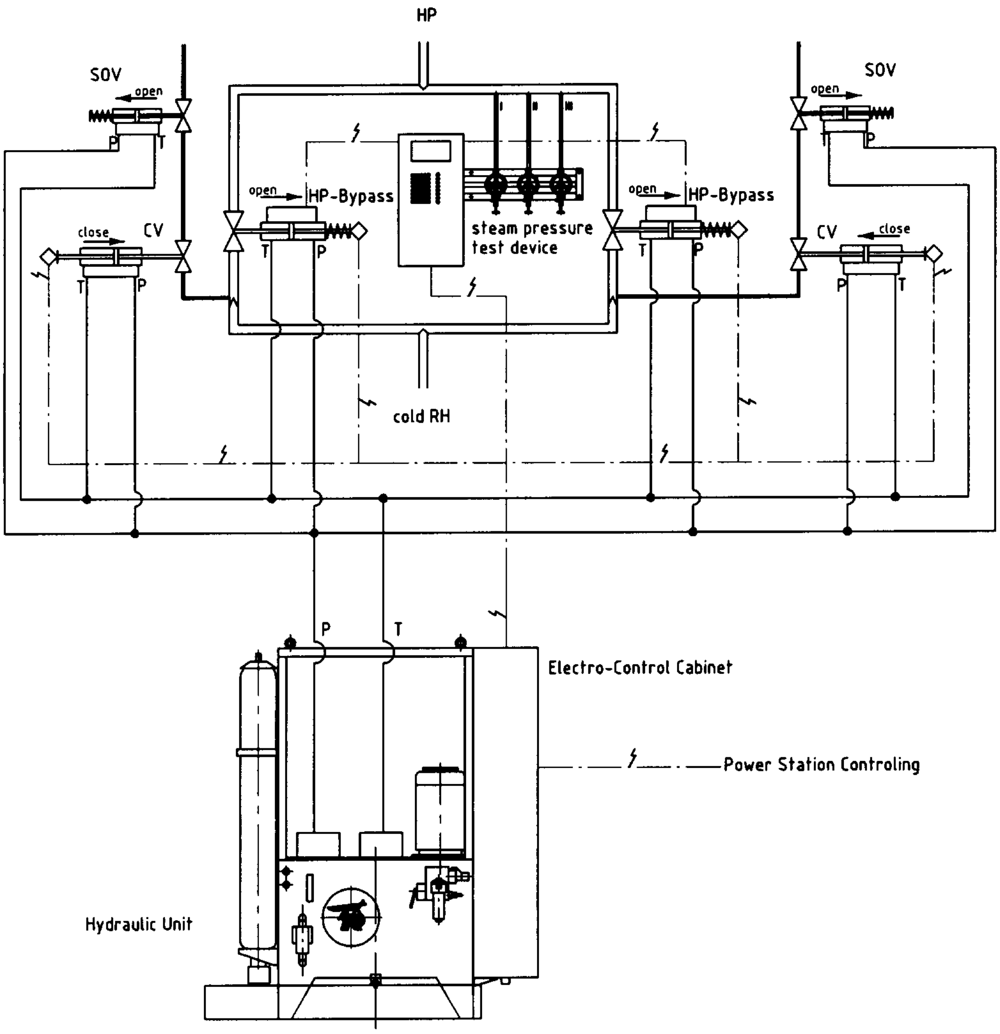


2.1.4 IP- / HP- Bypass

The HP steam bypass valve shall permit the following:

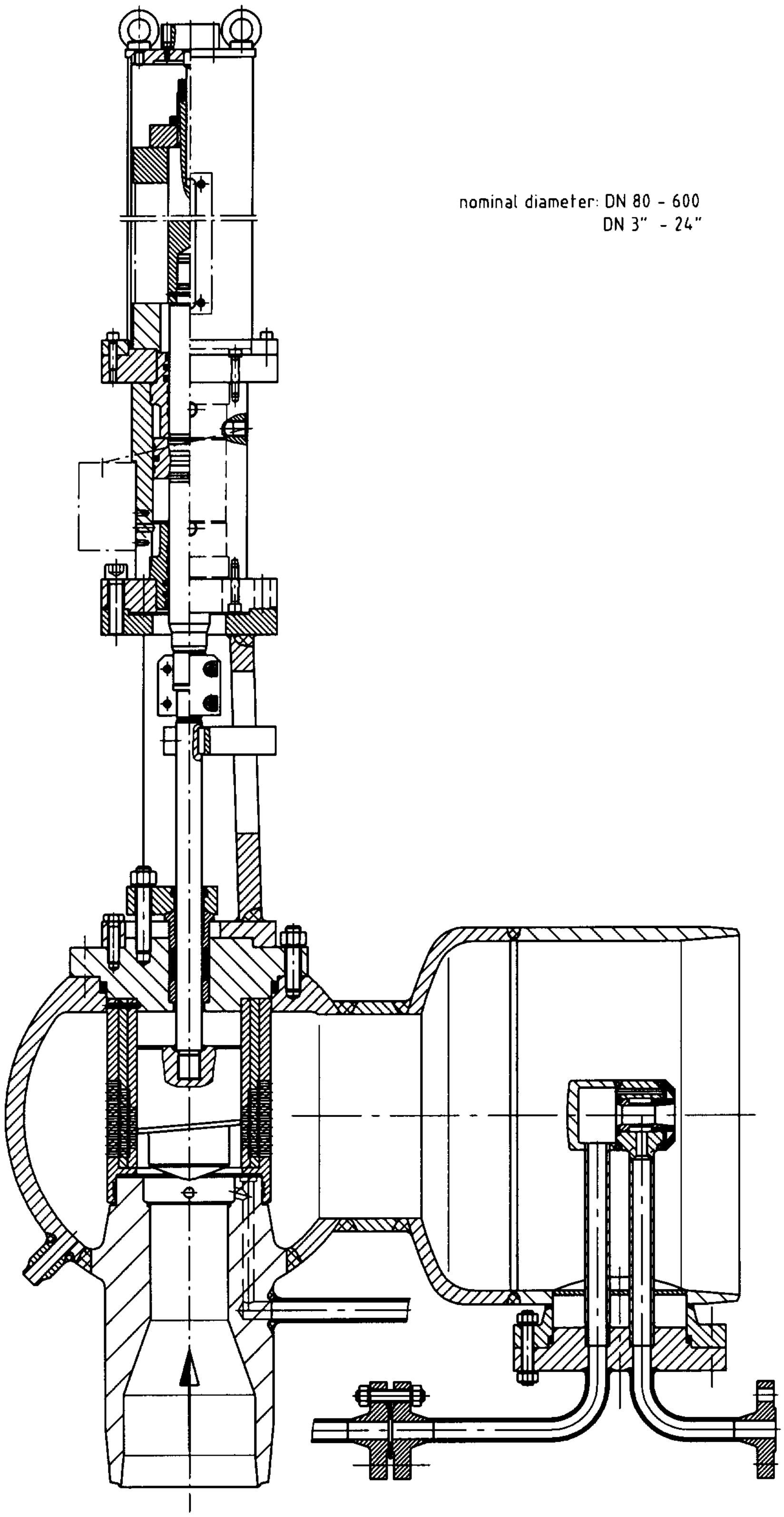
- Safe and orderly start up, shut down and operation of the power plant system within the scope of a defined load program.
- Control of faults and reliable transition to the various operating conditions, taking the effects of all components into account.

In the event of sudden load reduction or a load rejection, the Reineke IP / HP steam bypass valves accommodate the released steam volume and divert it, following cooldown, to the boiler reheat system or the condenser without causing pressure transients which would trigger opening of the safety valves.



sheme: HP-bypass station with safety function

2.1.4.1 IP-Bypass Valve / HP-Bypass Valve (Type E 222-1)



nominal diameter: DN 80 - 600
DN 3" - 24"

2.1.5 Spray Water Valves

Our spray water valves are used in the exhaust stage of the superheater and the combined pressure reducing and desuperheating valves. They control the temperature through the rationing of the needed cooling water. All of these valves are subject to wear these extreme pressure changes, which must be throttled. Depending on the pressure drop, a number of throttle cones are installed. The parabol cone is used up to 20 bar (290 PSI). The two stage parabol-perforated plug is used up to 70 bar (1015 PSI). For higher pressure drops, a three or multistage perforated plug is used.

Our spray water valve is equipped with an easily removable seat ring for effortless maintenance. Our valve is designed for easy and quick replacement of the sealing ring and cone therefore, the seat ring is positioned loosely. The seal is pure graphite. Using the unitized construction principle of our injection valves, the replacement of the seats and cone spindles is possible within one frame size. A one-stage valve may be transformed into a two-stage valve or vice versa, on site and without remachining. All known control drives on the market today can be used to operate our injection valves.

For accurate control of cooling water injection the typical Reineke spray water valve solution is shwon on the next page unter point 2.1.5.1.

Example:

2.1.5.1 Spray Water Valve (Type E 300-1)

2.1.6 Drain Valves

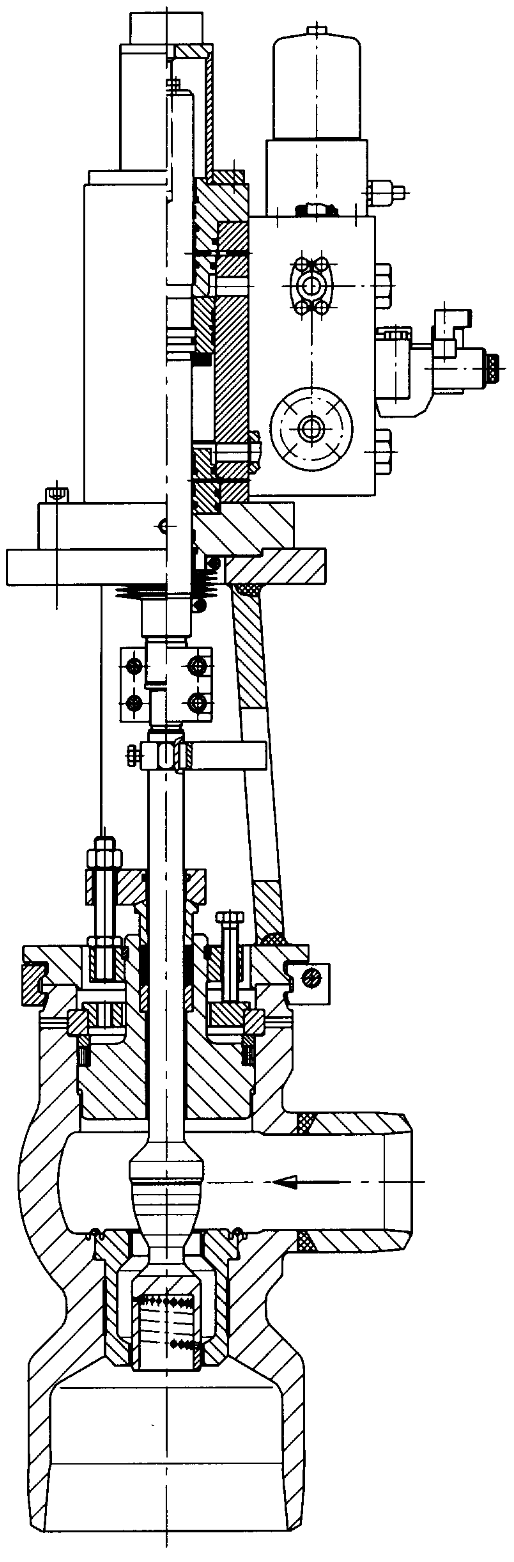
The Reineke drain valves are used in the substructual piping systems of the steam turbines. Even when vents and drains are routed to a common header their upstream pressure ratings have to be the same. For that reason the drain valves are design with a one or multistage plug. Main features are listed below:

- compact design
- high thigtness
- high restistants against soiling
- high availability
- high reliability

Example:

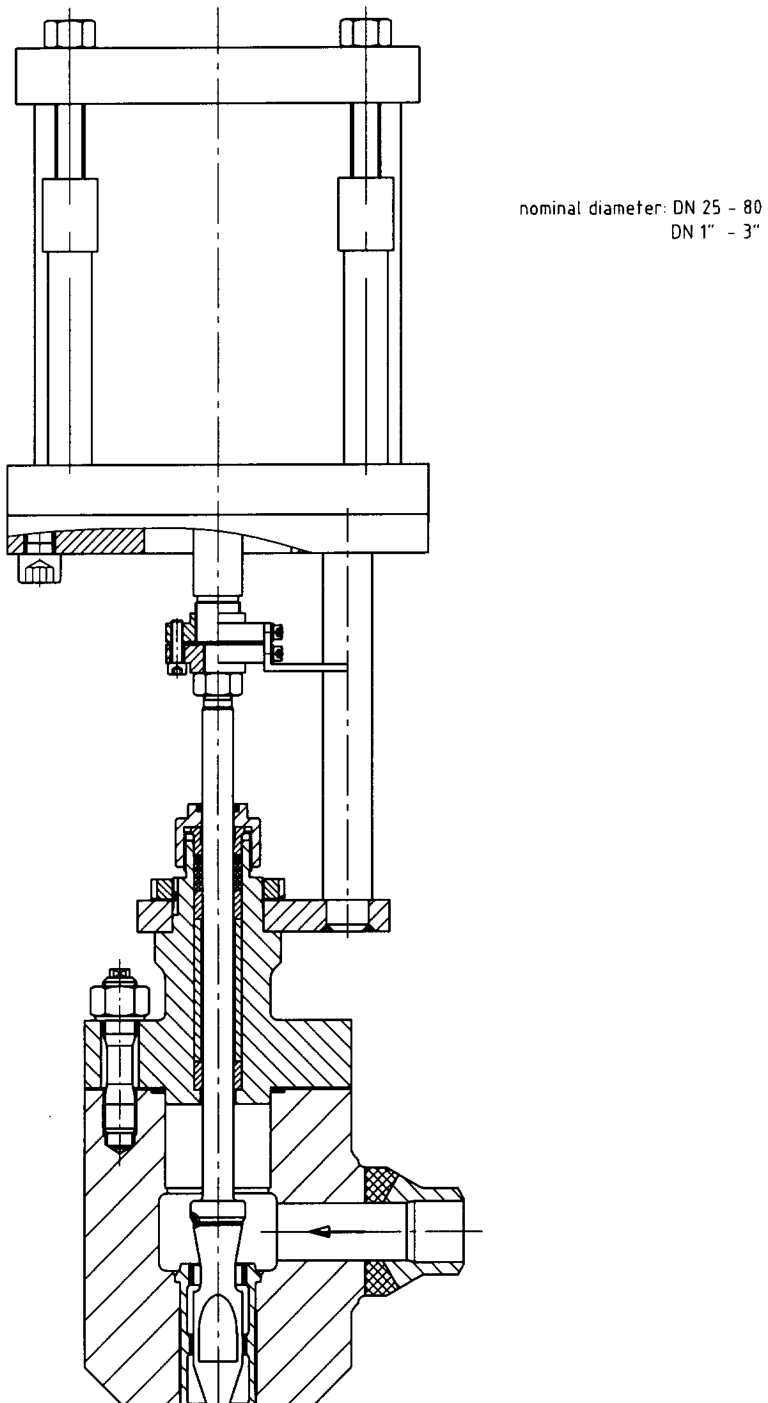
2.1.6.1 Drain Valve (Type E 920-3)

2.1.5.1 Spray Water Valve (Type E 300-1)



nominal diameter: DN 80 - 500
DN 3" - 20"
body design: angle- and z- design

2.1.6.1 Drain Valve (Type E 920-3)



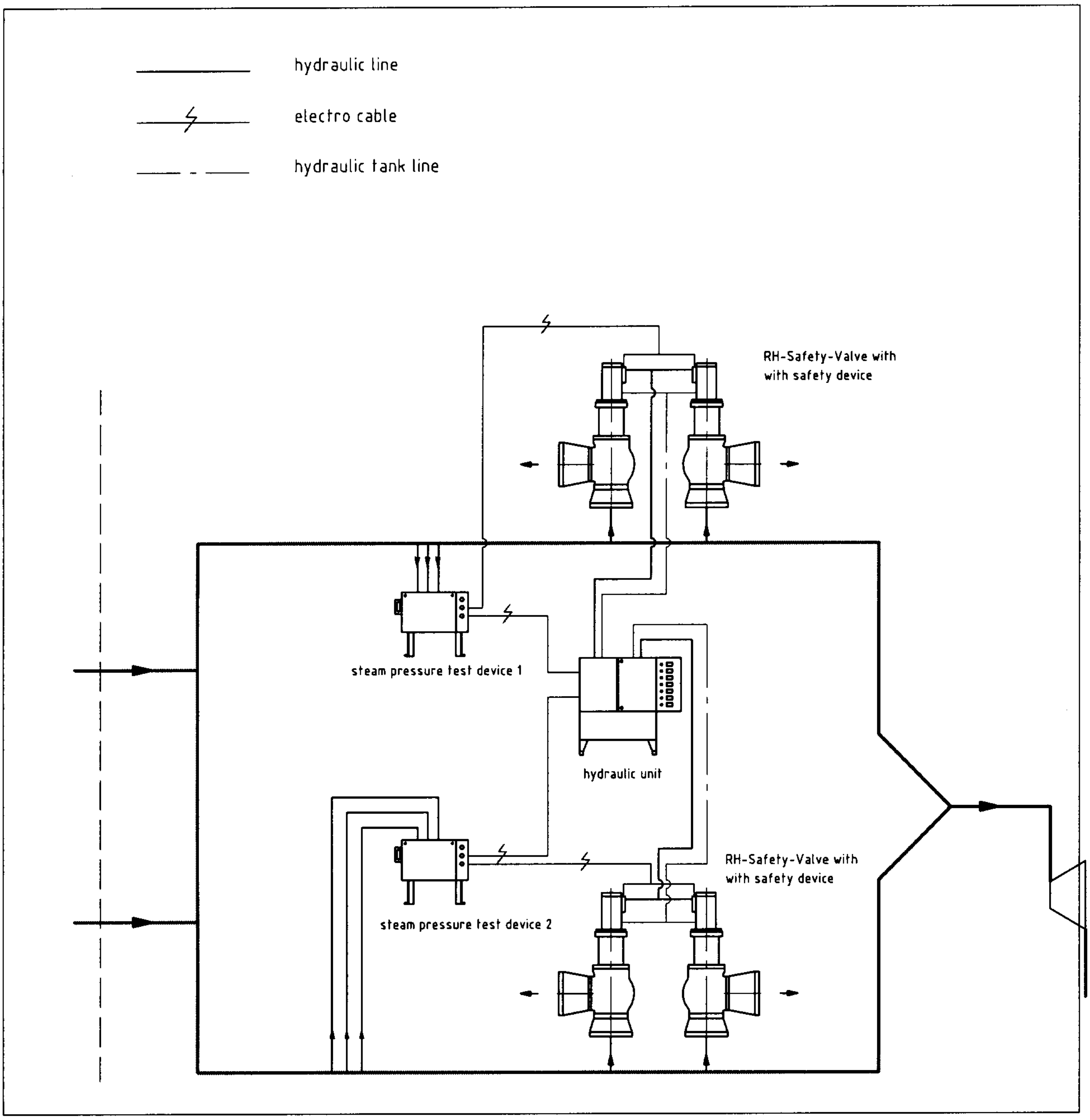
Please use this checklist to evaluate the benefits of the Reineke-Bypass design!

	Benefits	Reineke-Bypass	Competition
1.	High-performance, reliable, fast stroking pneumatic or hydraulic actuation with many years of documented service. Accurate control and resolution to less than half second stroke time with hydraulics.	✓	
2.	Light weight, compact and flexible in design. Fits easily into most existing piping arrangements in both globe and angle configurations.	✓	
3.	Can be installed in any orientation without additional support for the upper structure.	✓	
4.	Small-drilled-hole cage design reduces noise levels to below **85 dB A**.	✓	
5.	Range of up to 50:1 for system control and turbine temperature matching for greater turbine durability.	✓	
6.	Spraywater manifold system allows for multiple attemperation injection points while requiring only one water supply connection.	✓	
7.	Excellent spraywater atomization for advanced turbine bypass-to-condenser applications with short piping runs.	✓	
8.	Extended trim life through the reduction of flow velocity and use of properly selected materials.	✓	
9.	Low maintenance costs with quick change trim. No trim parts are welded or screwed into the valve body.	✓	
10.	Optional preheater connection to minimize thermal stress.	✓	
11.	Optional condensate drain connection available if required.	✓	

1. Special needs can be accommodated. Please consult with the factory.

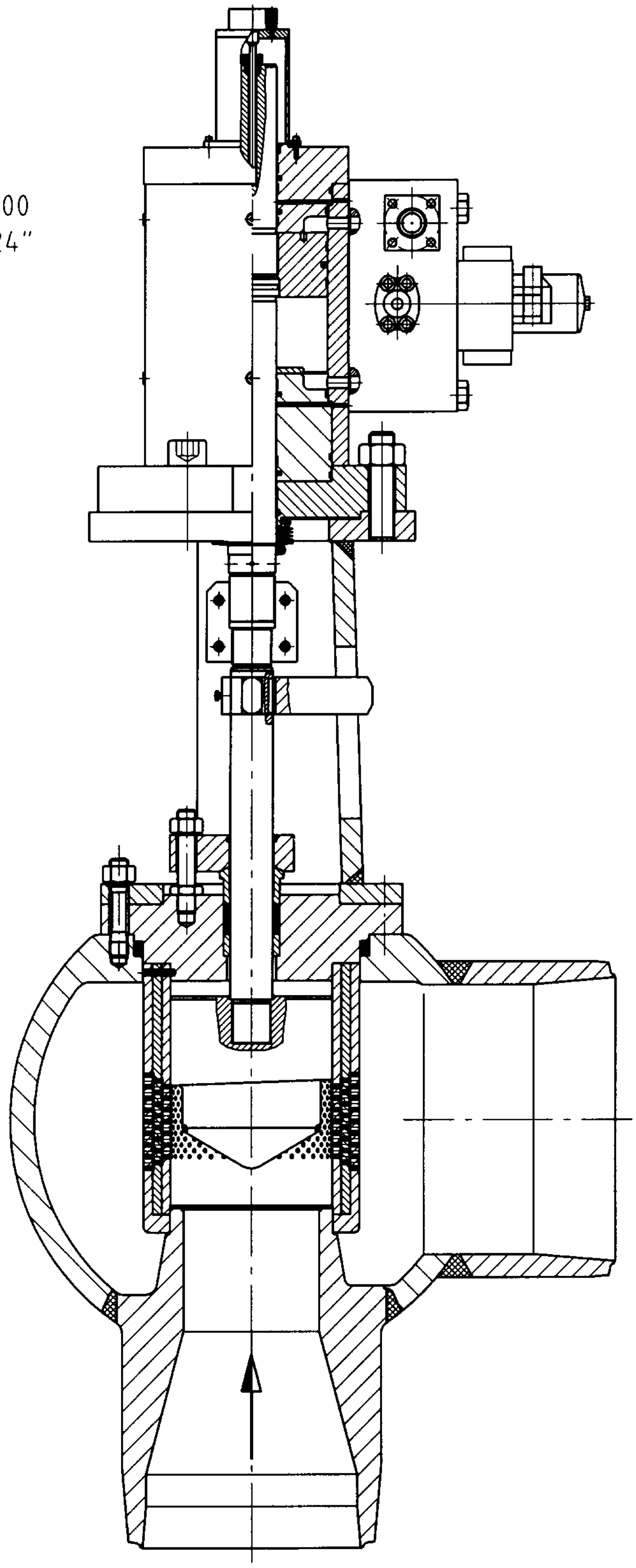
2.1.7 Reheater Safety Valve

The function of the valves is to work as combined pressure reducing and desuperheating valves, and at the same time, acting as safety valves. The sheme below shows the typical arrangement of RH-Safety valve application.



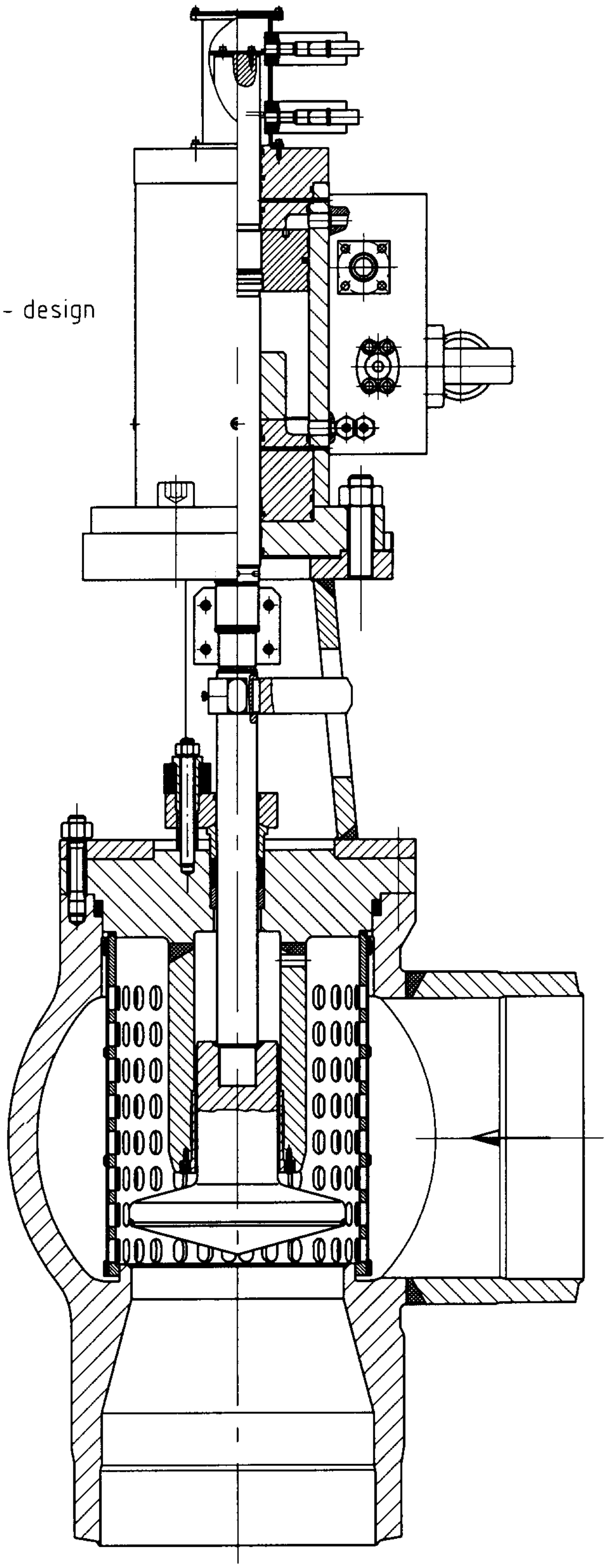
2.1.7.1 Reheater Safety Valve (Type S 220-1)

nominal diameter: DN 80 - 600
DN 3" - 24"



2.1.7.2 Reheater Shut-Off Safety Valve (Type S 500-1)

nominal diameter: DN 50 - 600
DN 2" - 24"
body design: angle- and Z- design



2.1.8 Steam Conditioning Station

Steam conditioning stations reduce the pressure of the steam and simultaneously cool it by injecting water. For instance, there is a difference between steam conditioning valves with integrated injection in the seat, and those with injections in the valve outlet. We are able to delivery two varieties - one uses the pressure atomizer principle as a cooling water injection - the other a motive steam cooler.

The most important consideration of valves used for steam conditioning is tied into the control. The evaporation of the water and the consequent cooling of the steam must operate as required, within this correlation. This is dependent on many variations and parameters. Therefore, we are only listing some general ones:

Type	Control correlation
Injection in the seat	better 1:25
Injection cooler in the outlet	better 1:10
Motive steam cooler in the outlet	up to 1:25

Steam conditioning valves may be equiped with any kind of drive.

Combined Pressure Heating and Desuperheating Valves with Injection Coolers

These valves with injection coolers are a combination of pressure reducing valves and subsequently arranged coolers with the cooler built into the outlet of the valve.

Combined Pressure Heating and Desuperheating Valves with Motive Steam Coolers

Transformer valves with arranged pressure and temperature reducing properties are easily produced to include low noise levels.

The pressure reduction takes place in the perforated cylinders, which are placed one above the other. Each cylinder has several rows of holes which are arranged from cylinder to cylinder slightly offset to each other, which forms a labyrinth where the steam is flash-evaporated (see figure 2.1.8).

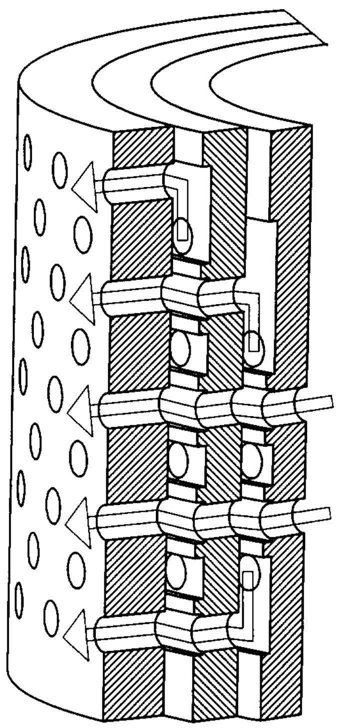
This arrangement of the throttle system in the proper dimensions reduces the noise level to below 85 dB (A). The motive steam cooler is arranged in sequence to this system. The motivated steam used to atomize the cooling water is taken from behind the throttle stage and led to the cooler. The extraction of the steam takes place behind the throttle stage, so the valve stays shut and prevents any motive steam from flowing. This process ultimately eliminates the need for a special stop valve. A controlled adding of cool water necessitates the installation of a water injection control valve to supply the cooler with water.

To cool the temperature of saturated steam, a cooling process with a steam atomizer that uses the superheated steam is installed to drive the cool water atomization. Using steam atomizing, the injection water is more finely sprayed than in the pressure atomization so that the cool water evaporates in the cooling system, quickly and completely.

All parts of the valve exposed to high amounts of strain are hard-faced or made of suitable materials. This type of valve is made for use in the high pressure area of the bypass or start-up operation, because the thermoshock strain of the noise reduced system is high, it is suggested that the valve type should not be used for constant operations.

Reineke do not use steam conditioning valves with direct injection for the superheated steam which flows through the cone and cooling water is mixed with the steam through many injection holes. In this way, the heat transfer of steam/water happens quickly. The evaporation of the water, as well as the cooling of the superheated steam, takes place directly in the seat area. This basic principle is no good for good evaporation of cooling water even in low load operating mode.

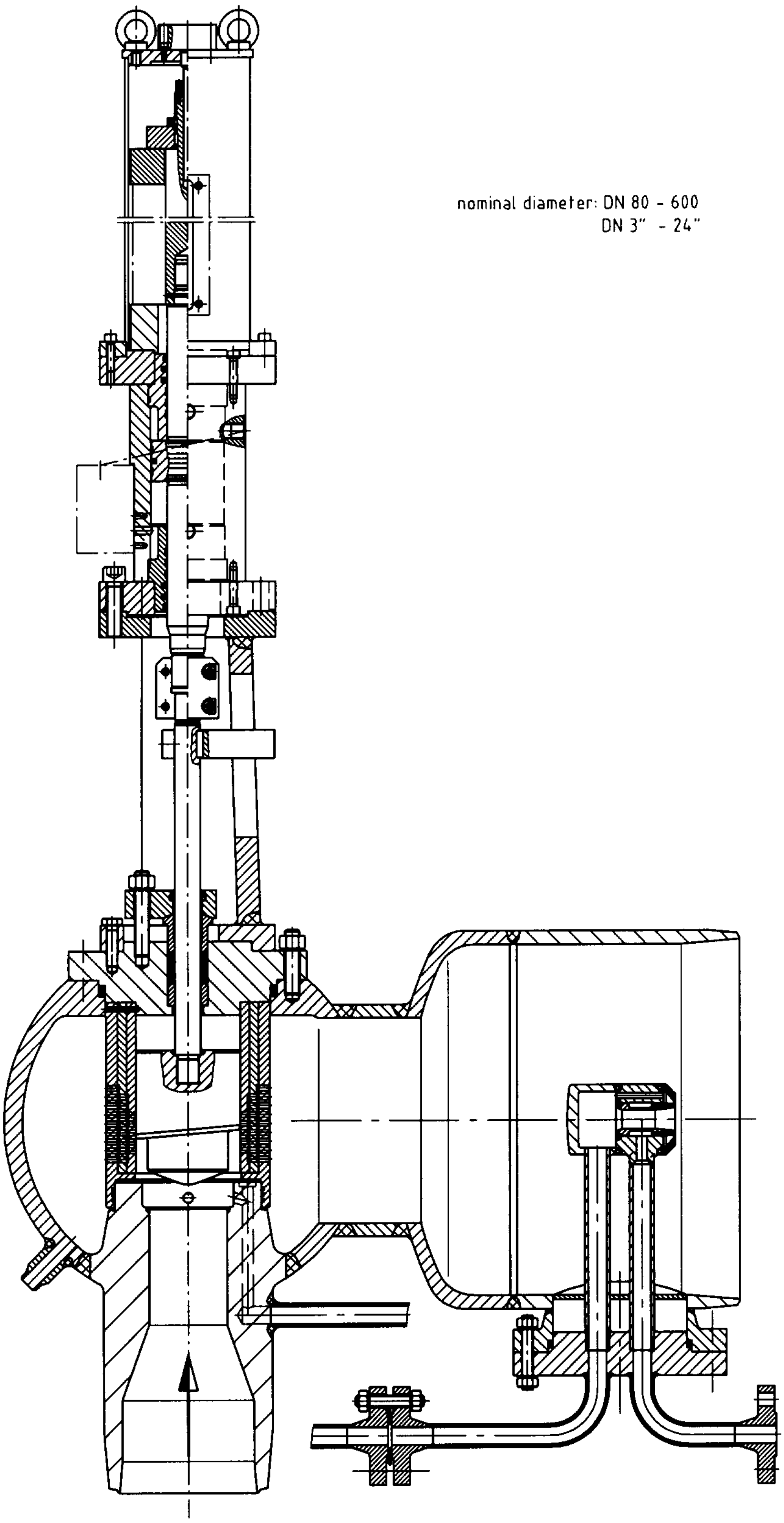
The motive steam, which must be a minimum of 2 bar over the pressure of the steam to be cooled, flows into the steam atomizing nozzle. It is divided into two partial flows of 1:5. The lower steam volume flows through the internal Laval nozzle. Here, in the smallest area, the steam flow is increased to high speed and surges through the steam belt, where the exact amount of cooling water is added. The high speed of the steam divides the cooling water into fine drops and flows as a steam-water mixture to the nozzle outlet. The second steam volume flows through the steam belt to the nozzle mouth and is tangently blown into the steam-water mixture. Here, the steam-water mixture is kept away from the nozzle mouth, which consequently results in further atomization of the cool water.



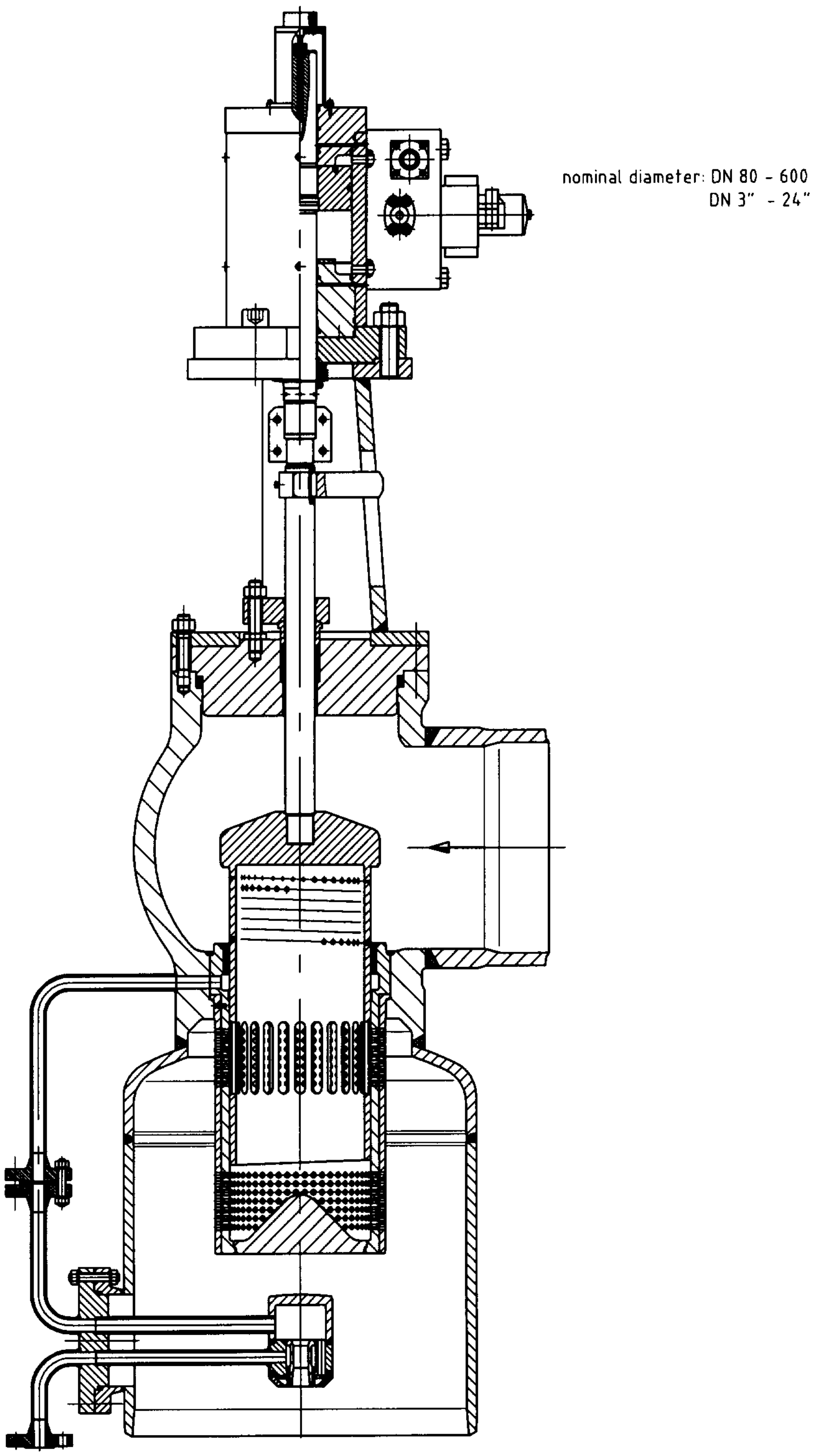
(figure 2.1.8: pressure reducing system)

An insignificant amount of motive steam, about 20% of the total maximum injection water cannot be evaporated within the nozzle. However, the drops are extremely fine with large surface areas and are easily evaporated right behind the nozzle mouth. As a result, there is no danger of any moisture reaching the pipewall.

2.2.8.1 High pressure bypass valve (Type E 222-1) => pressure under plug!

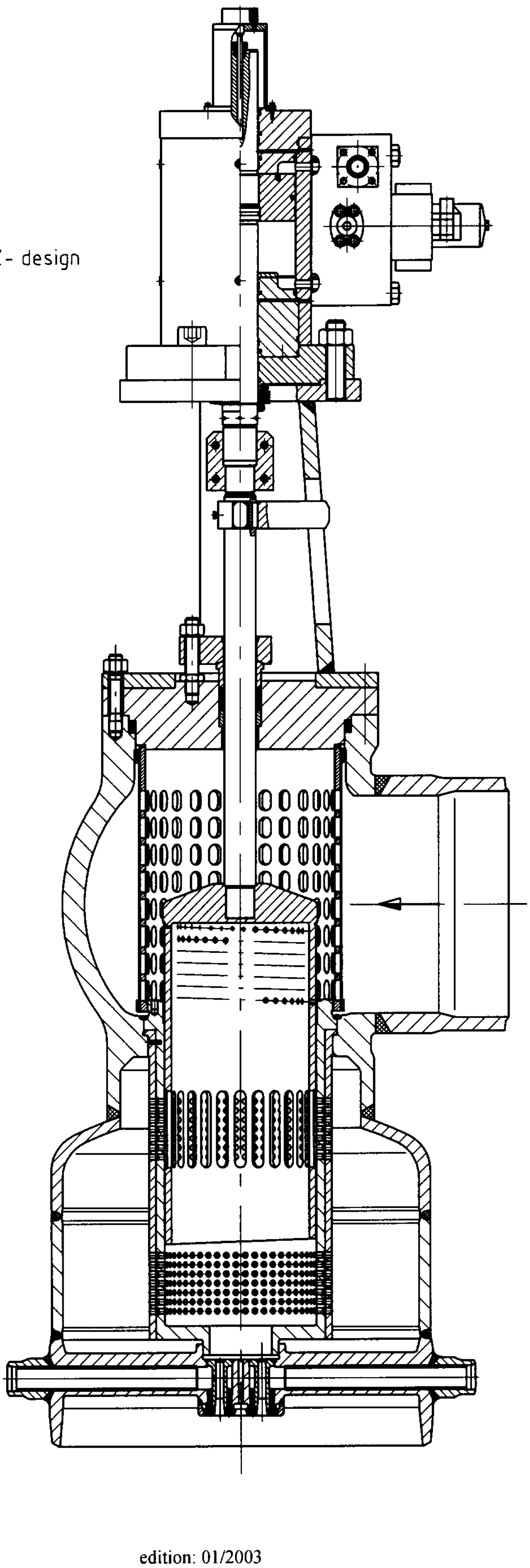


2.2.8.2 High pressure bypass valve (Type E 222-1) => pressure over plug



2.2.8.3 Steam conditioning valve with steam atomizing attemperator (Type E 121-1)

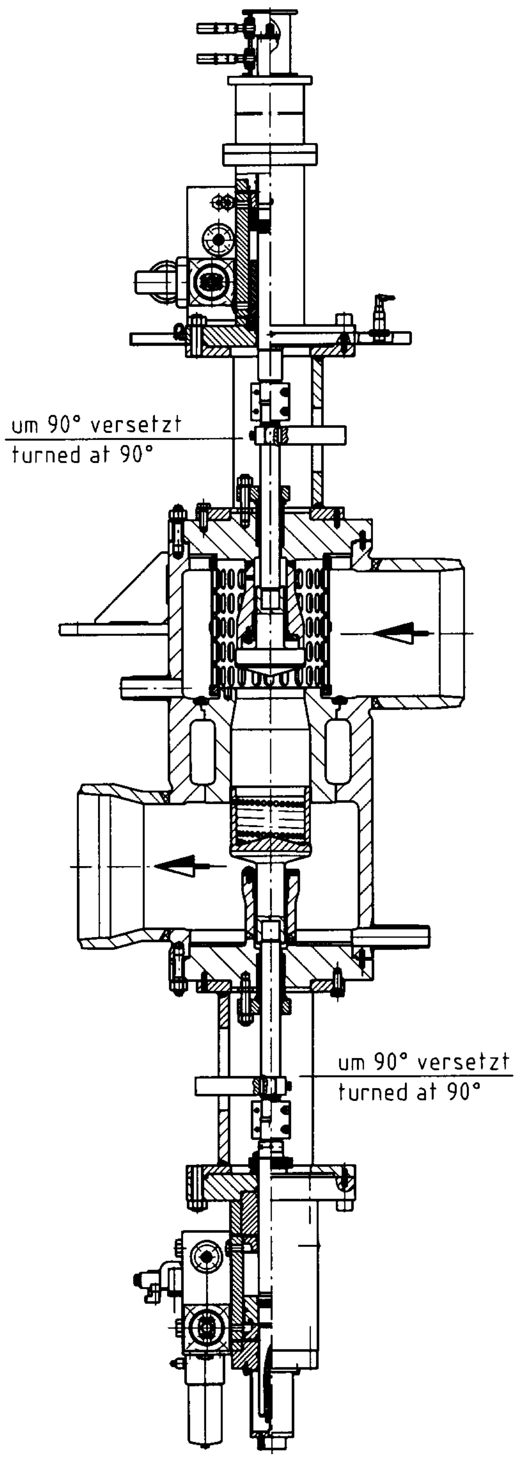
nominal diameter: DN 80 - 600
DN 3" - 24"
body design: angle- and Z- design



2.2.9 Combination Valve

The combination valve unites valve functions. These components are introduced individually in our brochure. The controlled system can be fitted to a specific use. Combination valves may be equiped with all drive types.

2.2.9.1 Combination Valve (Type K 600-1)



2.1.10 Steam Attemperator

The attemperatuor function in a Reineke turbine-bypass must perform a homogenious mixing of steam and spray water as well as manage quick evaporation of the injected water without creating thermal stress, which can result in system damage.

Reineke has developed many different technologies for desuperheating. The primary job for any type of desuperheater is the complete evaporation of the injected water. This must be accomplished without any water droplets hitting against the pressure boundary walls of the valve or the downstream piping. Key factors affecting desuperheater performance are firstly, the degree of atomization of the injected water and the mixing with the stream, and secondly, quick evaporation with proper location and direction of the spray water jet. Complete evaporation must be attained before the first pipe bend to prevent high-speed droplets from contacting the pipe walls, which can cause erosion.

The degree of spraywater atomization attained is determined by the speed of the steam flow relative to the speed of the injection water flow. Full atomization is the result of high water injection speed and injection of the desuperheating water into a zone of turbulent, high speed steam flow. In addition, factors such as accuracy of controls, flow range and piping arrangement can affect the quality of atomization. Finally, good atomization can only be achieved when the proper spraywater valve is selected.

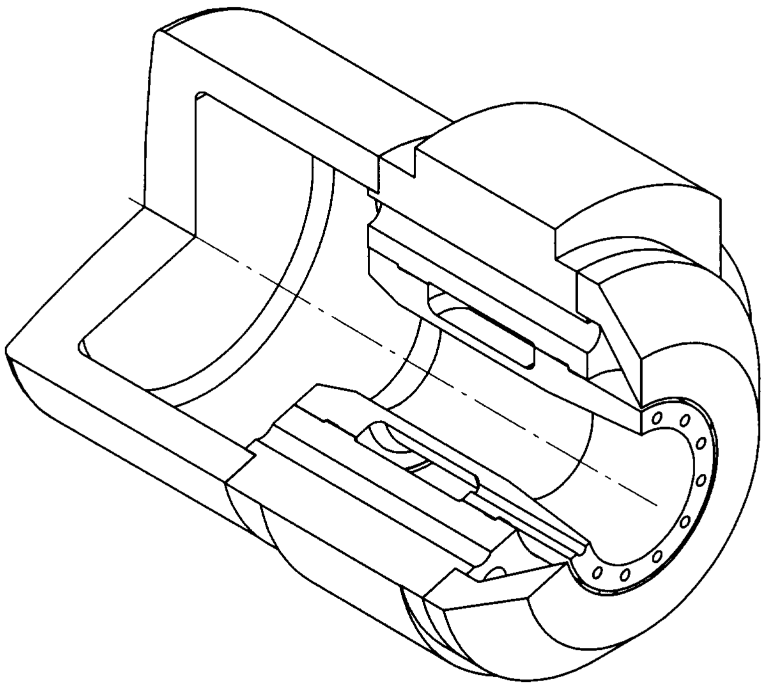


figure: 2.1.10 Nozzle System

2.2 Feedwater System

One of the major valve applications in the feedwater system is the preheater protection. Reineke offers suitable valve configurations to meet the individual plant requirements.

If feedwater control valves are located between an economizer section and the drum the valves and the pipng downstream of the control valve and the control valve are designed for flashing service. Even HP- and IP-feedwater bypass valves are created to be suitable for repeated system filling capable of accomodating high pressure drop. The valve plug and stem is a rigid joint construction.

2.2.1 Preheater Protection Valve

The preheaters are built so that feed water is led through a piping system and turbine steam is brought as heating steam into the casing of this pipe system. To protect the feed heater casing and the turbine against the backflow of feed water, it is necessary to stop the water-side and, at the same time, to lead the feed water from the pump into the boiler using a bypass line. Depending on the extent of the preheater damage, the backflow of feed water can reach the extraction point of the turbine.

Function

The protection of the preheater is shown in the arrangement drawing. A three-way- transfer-valve at the inlet, depending on the position of the linear cone, can stop preheater inlet or the bypass line. The outlet-side stop is controlled by a stop valve.

The control of both valves is achieved from an electro-hydraulic Reineke unit.

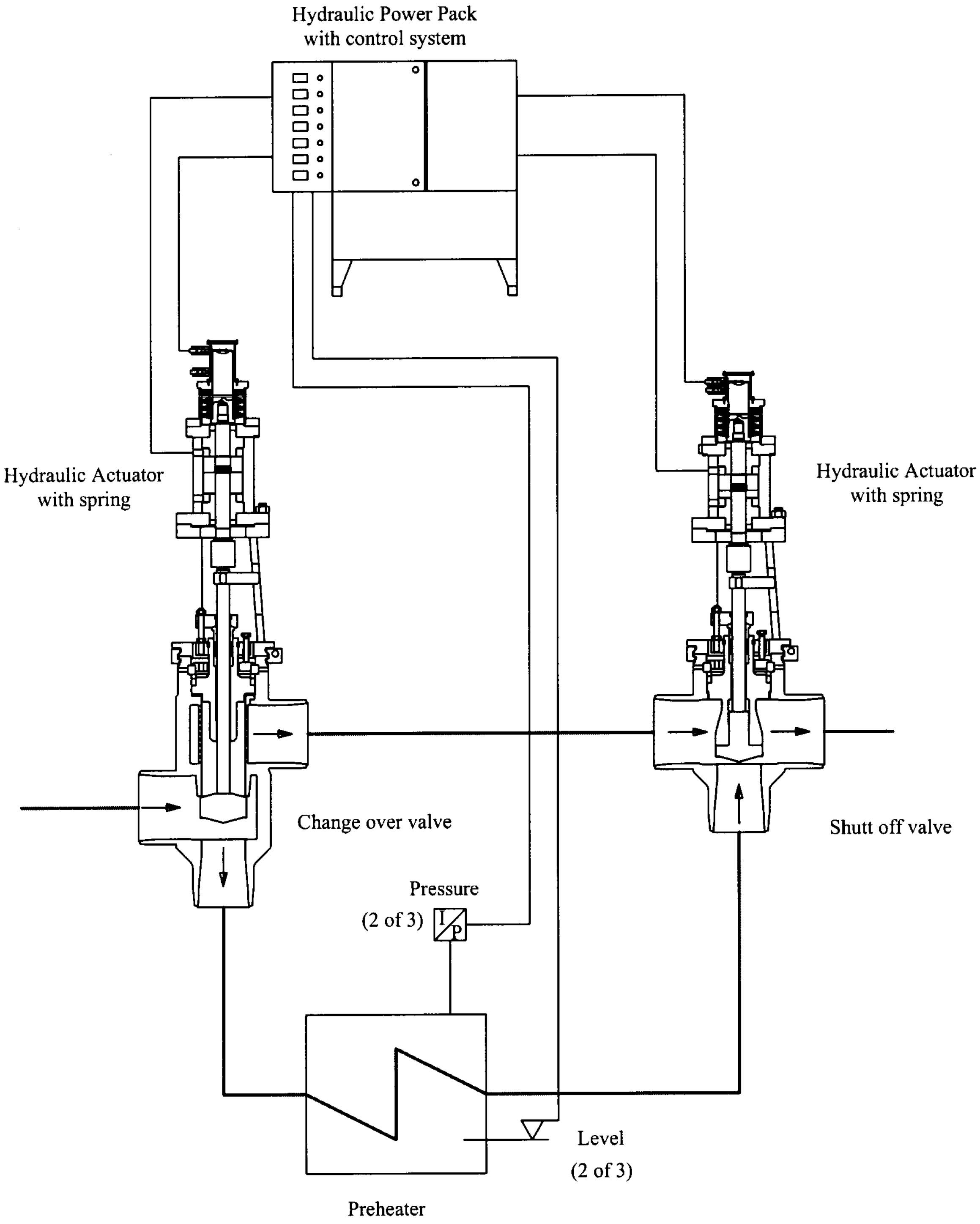
Examples:

2.2.1.1 Valve system for preheater protection

2.2.1.2 Change-over valve (Type V 800-1)

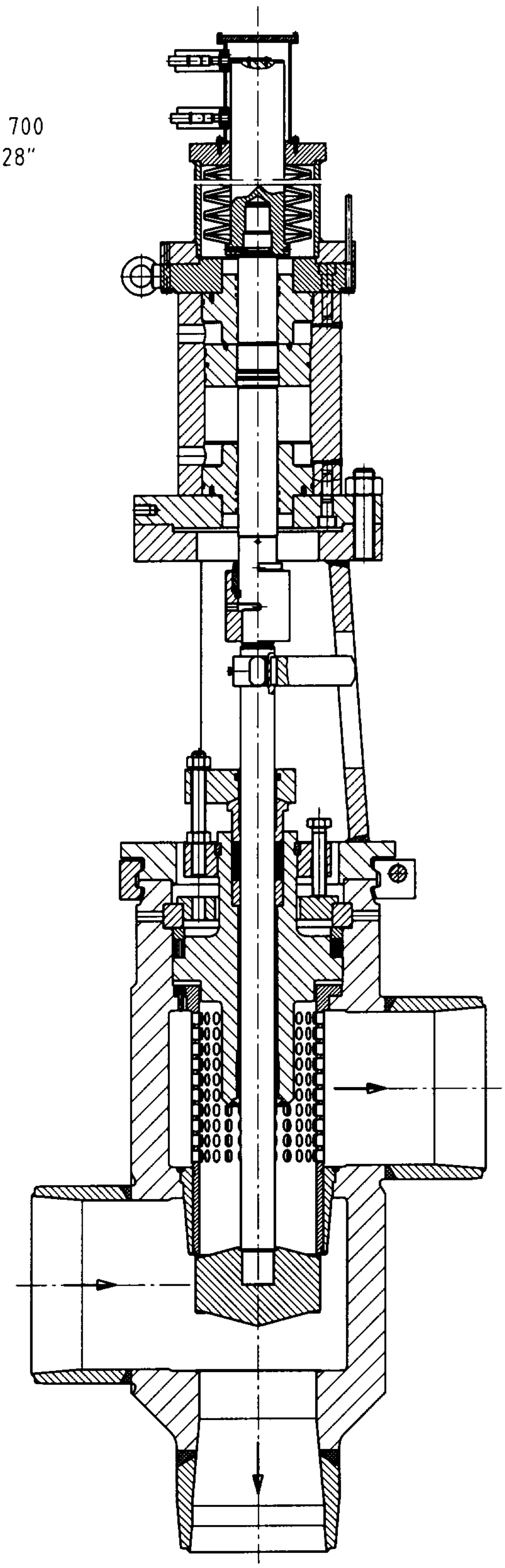
2.2.1.3 Shut-off valve (Type V 500-1)

2.2.1.1 Valve system for preheater protection

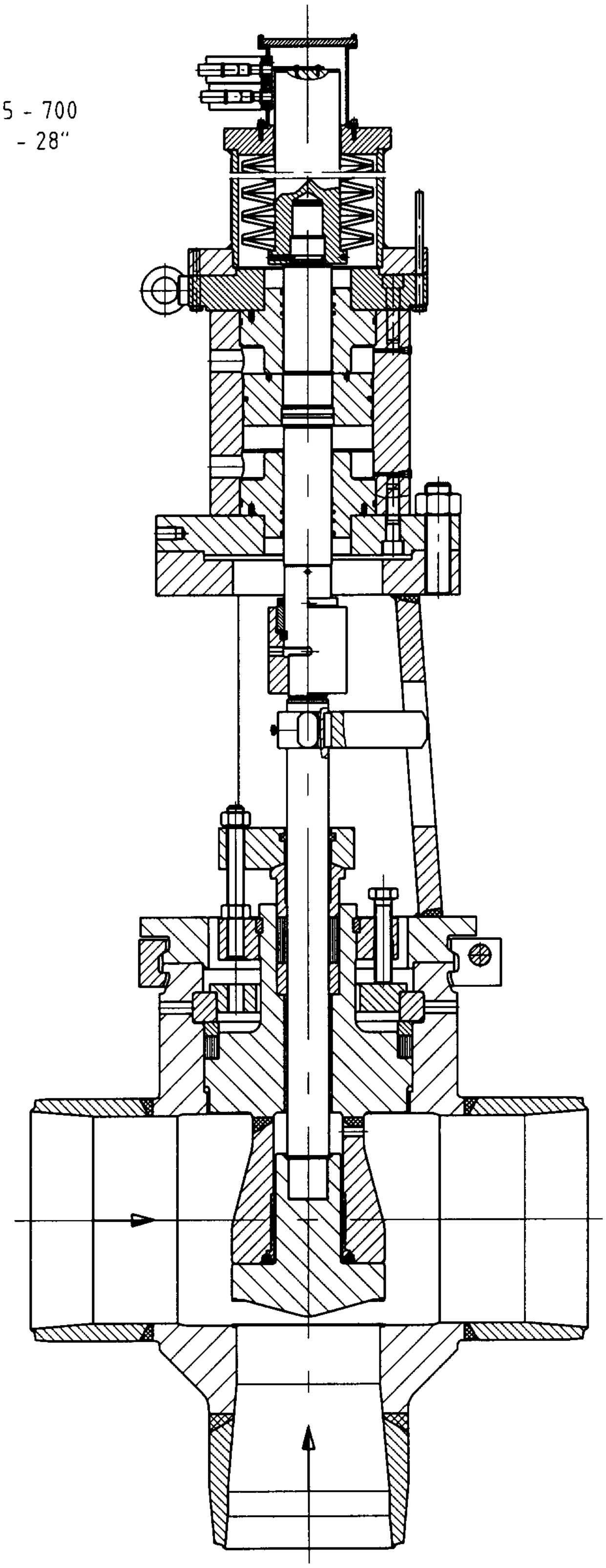


2.2.1.2 Change-over valve (Type V 800-1)

nominal diameter: DN 125 - 700
DN 5" - 28"



2.2.1.3 Shut-off valve (Type V 500-1)



2.2.2 Feed Water Control Valve

The control task is mainly taken on by two control valves:

In the full load operation, the smallest pressure loss is expected with the greatest mass flow rate to optimize the efficiency of the whole system.

The full load operation control valve controls middle to low pressure fluctuations. This function is performed effectively by angle and z-body valves made of forged steel and equiped with perforated plugs. Depending on the design pressure, a flanged joint or a self-sealing closure is used as a casing closure.

The control valve is developed in a way to allow easy maintenance:

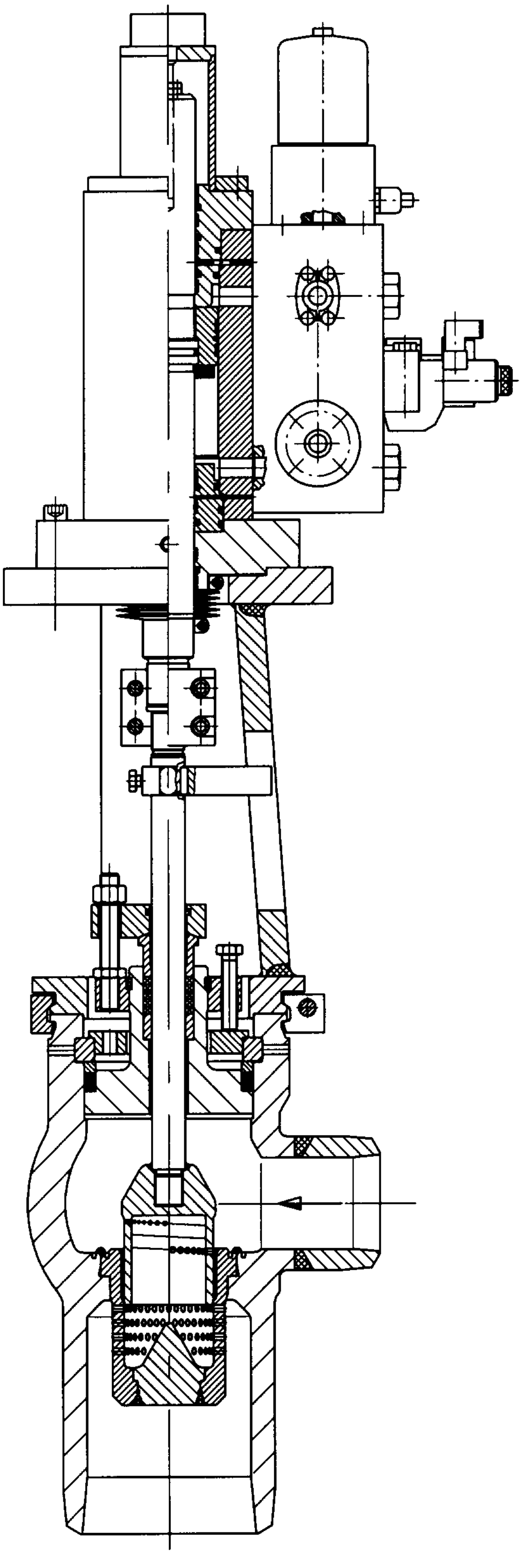
In the start-up operation of the boiler system, there are large pressure fluctuations occuring at a low mass flow rate which need to be reduced. As a rule, it is a multistage version, a 30% start-up valve (bypass). The pressure drop is divided in such a way that the parabol cone, which is the first step of the pressure reduction, is minimally effected, guaranteeing a long service life of the seat fibers. The second stage is a ported cone, the advantages there of have already been mentioned. All known drive types are applicable.

Examples:

2.2.2.1 Feed Water Control Valve (Type E 100-1)

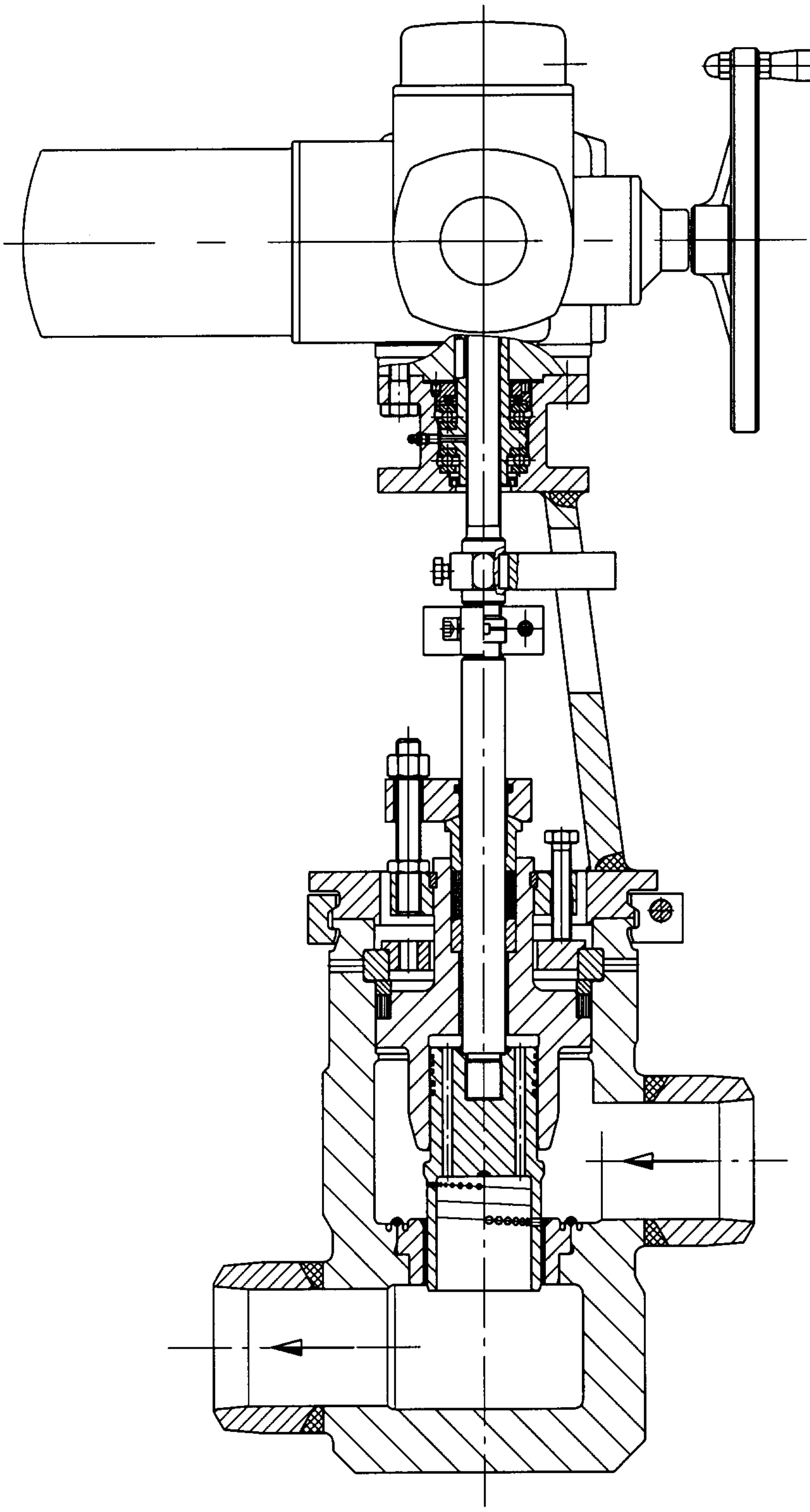
2.2.2.2 Feed Water Control Valve (Type Z 110-2)

2.2.2.1 Feed Water Control Valve (Type E 100-1)



nominal diameter: DN 80 - 500
DN 3" - 20"
body design: angle- and Z- design

2.2.2.2 Feed Water Control Valve (Type Z 110-2)



nominal diameter: DN 80 - 500
DN 3" - 20"
body design: angle- and Z- design

2.3 Boiler Applications

One of the main tasks of the Boiler system is to avoid boiler trip after load rejections. Our fast-acting **Reineke** bypass system allows operation of the boiler to continue at an optimal standby load and re-establishes the demand for turbine load after a load rejection. The turbine will cover house load requirements as well as pressure and temperature transients usually associated with boiler trip and restart will be avoided.

2.3.1 Boiler Blow Down Valve

The boiler blow down / discharge valves drain away the developed boiling water in the start-up bottle. A partial evaporation of the water is inevitable when boiling water is subject to reduction of pressure. For this reason, the increased volume is calculated into the dimentions of the seat. The high differential pressure causes extreme erosion. Therefore, the seat surface and the area behind the set are hard-faced.

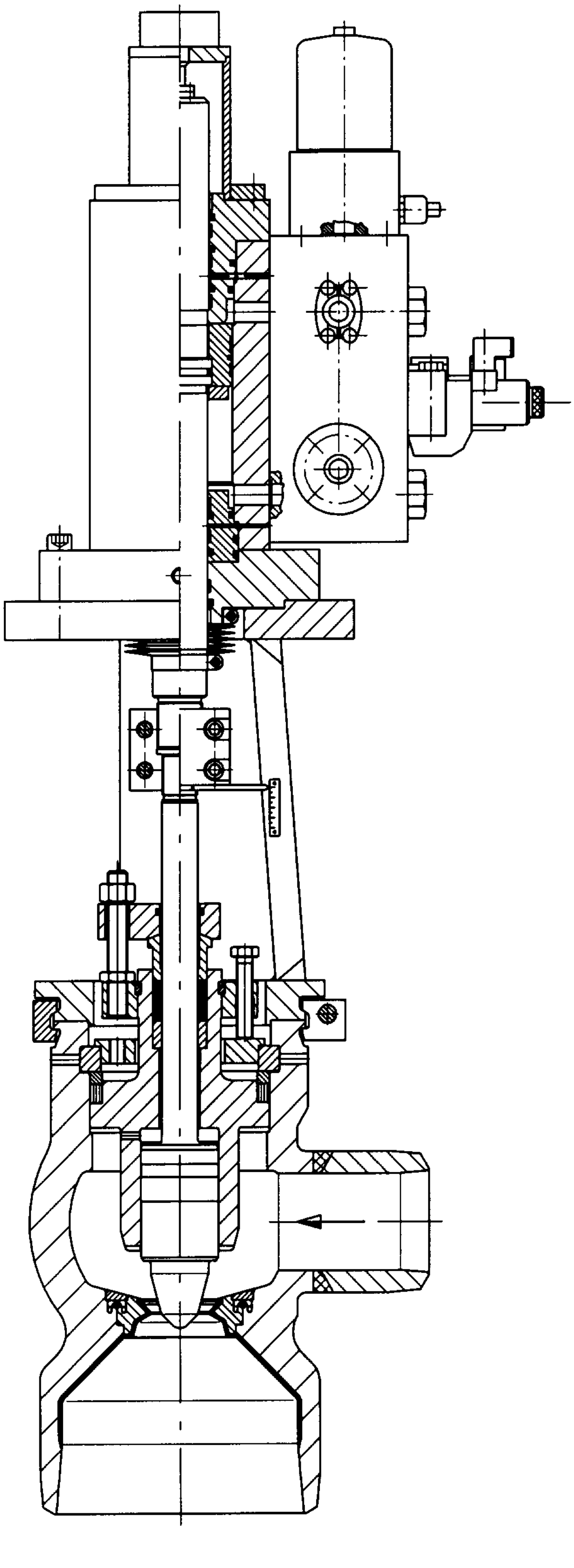
Examples:

2.3.1.1 Discharge Valve (Type E 200-1)

2.3.1.2 Control Valve (Type D 100-1)

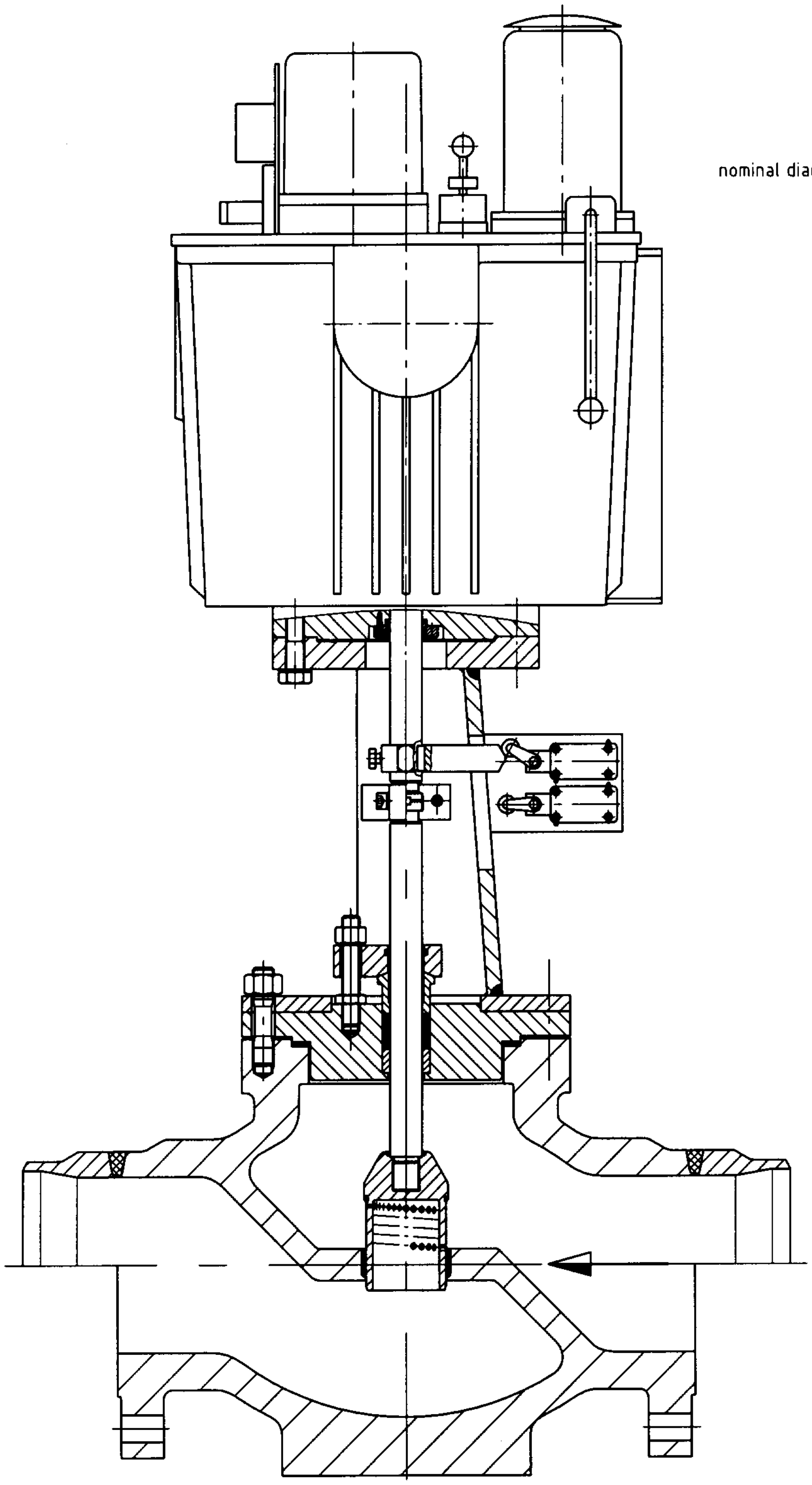
2.3.1.3 Control Valve (Type E 100-1)

2.3.1.1 Discharge Valve (Type E 200-1)

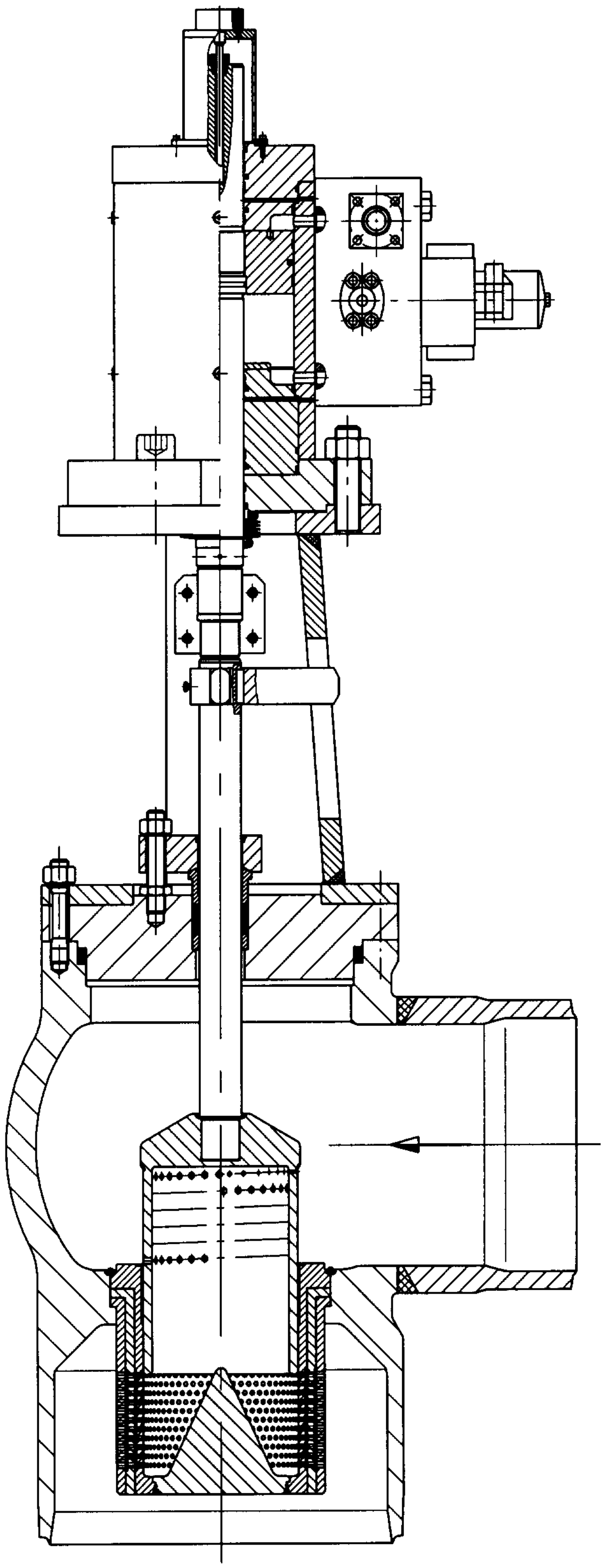


nominal diameter: DN 80 - 300
DN 3" - 12"

2.3.1.2 Control Valve (Type D 100-1)



2.3.1.3 Control Valve (Type E 120-1)



nominal diameter: DN 80 - 500
DN 3" - 20"
body design: angle- and Z- design

2.4 Generel Applications

For several other possible applications please take notice of some examples listet in this chapter.

2.4.1 Safety / Shut Off Valves

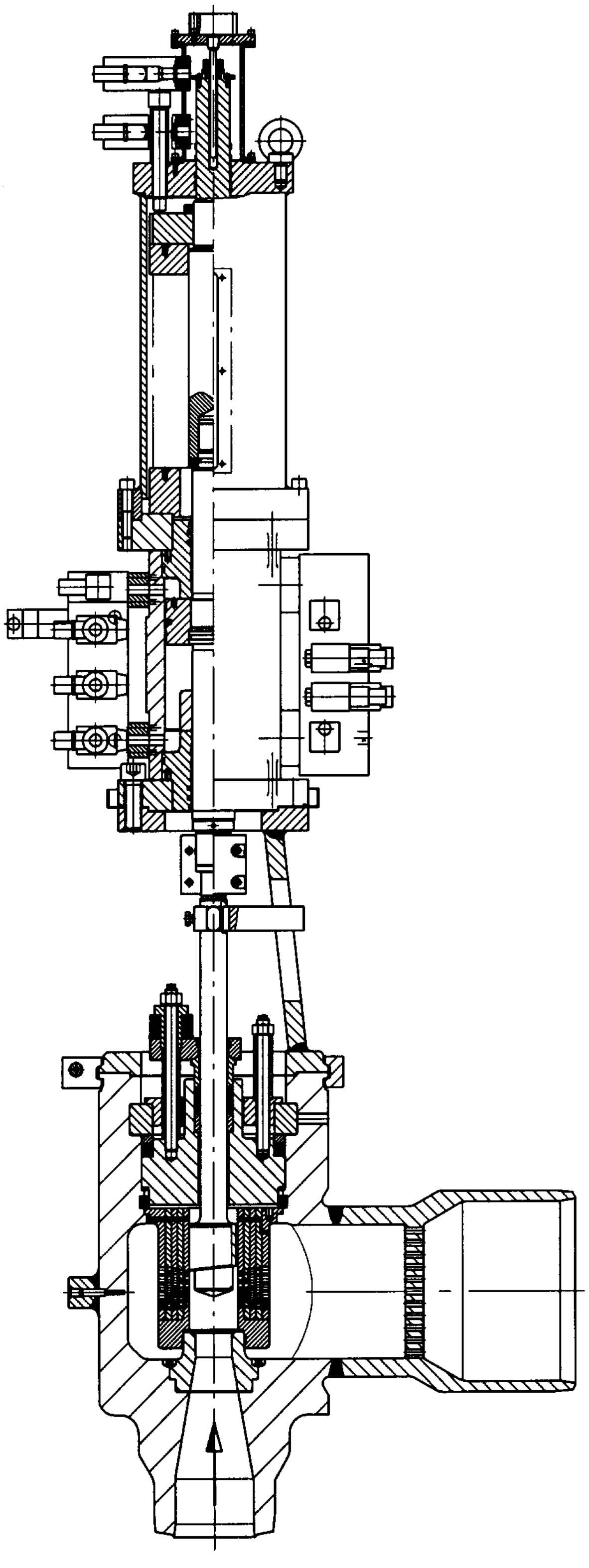
The safety shut-off valves unite the function of a control valve and a stop valve in one valve casing.

The realization of the safety functions is similar to the reheater safety valves by a suited hydraulic system. The closing process is improved by short control times. In this way, the power system behind the valve is protected from gage pressure.

Example:

2.4.1.1 Safety Shut Off Valve (Type S 500-1) => also refer to RH safety valve

2.4.1.1 Safety Shut Off Valve (Type S 500-1)



nominal diameter: DN 80 - 500
DN 3" - 20"

2.4.2 Control Valve

Control Valve, Globe Valve Form

Our control valves can be applied universally and are reliable and dependable under the most difficult operating conditions.

Developed according to flow engineering aspects, with extremely small zeta values and large expansion rooms over and below the seat, our control valves combined with one or multistage control valves allow a high control capability and control conditions. The control sets are made with single seats for lower residual leakage.

Multistage sets are replaceable without taking the valves out of the pipelines when greater pressure differences are present. Ported and parabol cones, standard values, individually arranged multistage control sets and robust drives are used with the valve for middle to higher control tasks in systems and control engineering.

Our control valves are equipped with electric pneumatic or hydraulic drives in accordance with our customer specifications.

Control Valves, (angle body)

Through pressure reduction, the volume of condensation (flashing of water) and steam is increased. For this reason, the casing is equiped with a large volume capacity.

Steam Reduction Valves

The steam reduction valves in the outlet, depending on the extent of the pressure reduction, are to prevent unduly high steam speed. For sound absorption, the casing outlet is equiped with perforated discs.

Examples (as shown before):

2.4.2.1 Control Valve (Type D 100-1)

2.4.2.2 Control Valve (Type E 100-1)

2.4.2.3 Steam Reduction Valve (Type E 120-1)

3 Valve Data Sheet

ARMATUREN DATENBLATT CONTROL VALVE DATA SHEET			Reineke Meß- und Regeltechnik GmbH		
1	Kunde / *Customer*		2	Angebot / *Offer*	
3	Anfrage/ *Inquiry*		4	KKS / *Tag No*	
5	Projekt / *Project*		6	Stückzahl / *Qnt*	1
7	Einsatz / *Application*	LP-Bypass Kombiventil	8	Medium / *Fluid*	Dampf / Steam
9		Isolating valve SSV	10		

PROZESS DATEN / *PROCESS DATA*

			Norm	Max	
11	Menge / *Capacity*	kg/s	66,9	87	
12	Druck Eintritt / *Pressure Inlet*	bara	23,8	54	
13	Druck Austritt / *Pressure Outlet*	bara	22,8	52	
14	Temperatur Eintritt / *Temperature Inlet*	°C	540	540	
15	Temperatur Austritt / *Temperature Outlet*	°C	539	539	
16	Auslegungsdruck / *Pressure Design*	bar	25	25	
17	Auslegungstemperatur / *Temperature Design*	°C	550	550	
18					
19					
20	Schallpegel (1 m Abstand) mit Isolierung Noise Level (1 Mtr distance) with Insulation	dB(A)	99		

ARMATUREN DATEN / *VALVE DATA*

21	Armaturen Typ / *Valve Type*	K600-1	22	Ausführung / *Arrangement*	
23	Druckstufe / *Pressure Rating*				
24	Gehäuse Werkstoff / *Body Material*				
25	Eintritt / *Inlet* DN	400	26	Anschluß Ein / *Conn. Inlet* äØ Flansch Ein / *Flange Inlet*	Z-Design
27	Austritt / *Outlet* DN	600	28	Anschluß Aus / *Conn. Oulet* äØ Flansch Aus / *Flange Outlet*	
29	Stopfbuchse / *Stuffing Gland*	graphite	30	Deckelabdichtung / *Gasket*	
31	*Geschwindigkeit Eintritt* / Velocity Inet *m/s*	82,9	32	*Geschwindigkeit Austritt* / Velocity Outlet *m/s*	87,8
37	Innengarnitur / *Trim*	1.4922			
38	Hub / *Stroke* in mm Absperrv. Regelv.	70 155	39	Kegel Typ / *Plug Type*	Absperrkegel Lochkegel
40	Sitzdurchmesser / *Seat diameter* mm	300 /285	41	Sitzmaterial / *Seat Material*	1.4903/Stellite
42			43	Cv Gewählt / *Selected* *US Gallonen / min.*	
44	Kennlinie / *Characteristic*	linear	45	Stellverhältnis / *Range of Control*	1 : 25

Reineke
Meß- und Regeltechnik GmbH

ARMATUREN DATENBLATT **CONTROL VALVE DATA SHEET**				Reineke Meß- und Regeltechnik GmbH	
1	Kunde / Customer		2	Angebot / Offer	
3	Anfrage/ Inquiry		4	KKS / Tag No	
5	Projekt / Project		6	Stückzahl / Qnt	1
7	Einsatz / Application	LP-Bypass Kombiventil	8	Medium / Fluid	Dampf / Steam
9		Isolating valve SSV	10		

PROZESS DATEN / PROCESS DATA

			Norm	Max	
11	Menge / Capacity	kg/s	66,9	87	
12	Druck Eintritt / Pressure Inlet	bara	23,8	54	
13	Druck Austritt / Pressure Outlet	bara	22,8	52	
14	Temperatur Eintritt / Temperature Inlet	°C	540	540	
15	Temperatur Austritt / Temperature Outlet	°C	539	539	
16	Auslegungsdruck / Pressure Design	bar	25	25	
17	Auslegungstemperatur / Temperature Design	°C	550	550	
18					
19					
20	Schallpegel (1 m Abstand) mit Isolierung Noise Level (1 Mtr distance) with Insulation	dB(A)	99		

ANTRIEBS DATEN / ACTUATOR DATA

46	Antriebstyp / Actuator Type	Stop Valve Control Valve		47	Endschalter / Limit Switsches Stop Valve Control Valve	yes no
48	Antriebshersteller / Actuator Mf.		Reineke	49	Stellungsgeber / Positioner Stop Valve Control Valve	no yes
50	Antriebsprinzip / Actuatorprincip		hydraulic	51		
52	supply fail position	Stop Valve Control Valve	close close	53		
54	Eingangssignal / Inputsignal	Stop Valve Control Valve	24 VDC 4-20mA	55		
58	closing time	Stop Valve Control Valve	< 0,6 sec < 0,6 sec	59		
60	opening time	Stop Valve Control Valve	10-15 sec 5 sec	61		

ABNAHME UND DOKUMENTATION / INSPECTION AND DOCUMENTATION

62	Inspektion / Inspection		63	WAZ / Material certificat.	3.1B 10204
64	Betriebsanleitung Operational Manual	English	65		
66	Masszeichn. / Dimens. Drawing Schnittzeichn. / Section. Drwg. Teileliste / Parts List		67		
68	Bemerkung / Remark				

4 Our Customers

4.1 Power Plants
4.1.1 HP/LP turbine bypass systems
4.1.2 feed water control valves
4.1.3 gland steam control at the turbine
4.1.4 turbine inlet valves
4.1.5 minimum flow control valve
4.1.6 bottle drain valve
4.1.7 condensate control valve
4.1.8 measurement & control of gas turbines (Wobbe index & heating value measurement)
4.1.9 gas stop valves and control valves

4.2 Steel and Iron Works
4.2.1 blast furnace gas control valve
4.2.2 coke plant gas control valves
4.2.3 hot wind tunnel control valves
4.2.4 continuous casting control valves
4.2.5 cooling water control valves
4.2.6 Wobbe index and heating value measurments of gases in blast furnaces & coke plants

4.3 Process Engineering
4.3.1 torch blow-off valve
4.3.2 compressor minimum flow rate control valve
4.3.3 control drive for HP valves
4.3.4 control drive for steam valves
4.3.5 control drive for gas valves
4.3.6 Wobbe index and caloric measurements from various produced gases

4.4 Glass Ceramic & Concrete Factories
4.4.1 measuring and controlling of furnace temperature using lower heating & Wobbe index

4.5 Gas, Oil & Refinery Products, Long Distance Transport Pipes
4.5.1 torch blow-off valve
4.5.2 compression minimum flow control valves
4.5.3 control valves in pump stations
4.5.4 control and rotary drives for check and ball valves

4.6 Environment Engineering
4.6.1 drives for high pressure valves in incineration plants
4.6.2 measuring and controlling of gases using Wobbe index and lower heating value in clarifying, depositing and biological gas plants