HORA Technical Bulletin | Heavy Duty Control Valves

HORA
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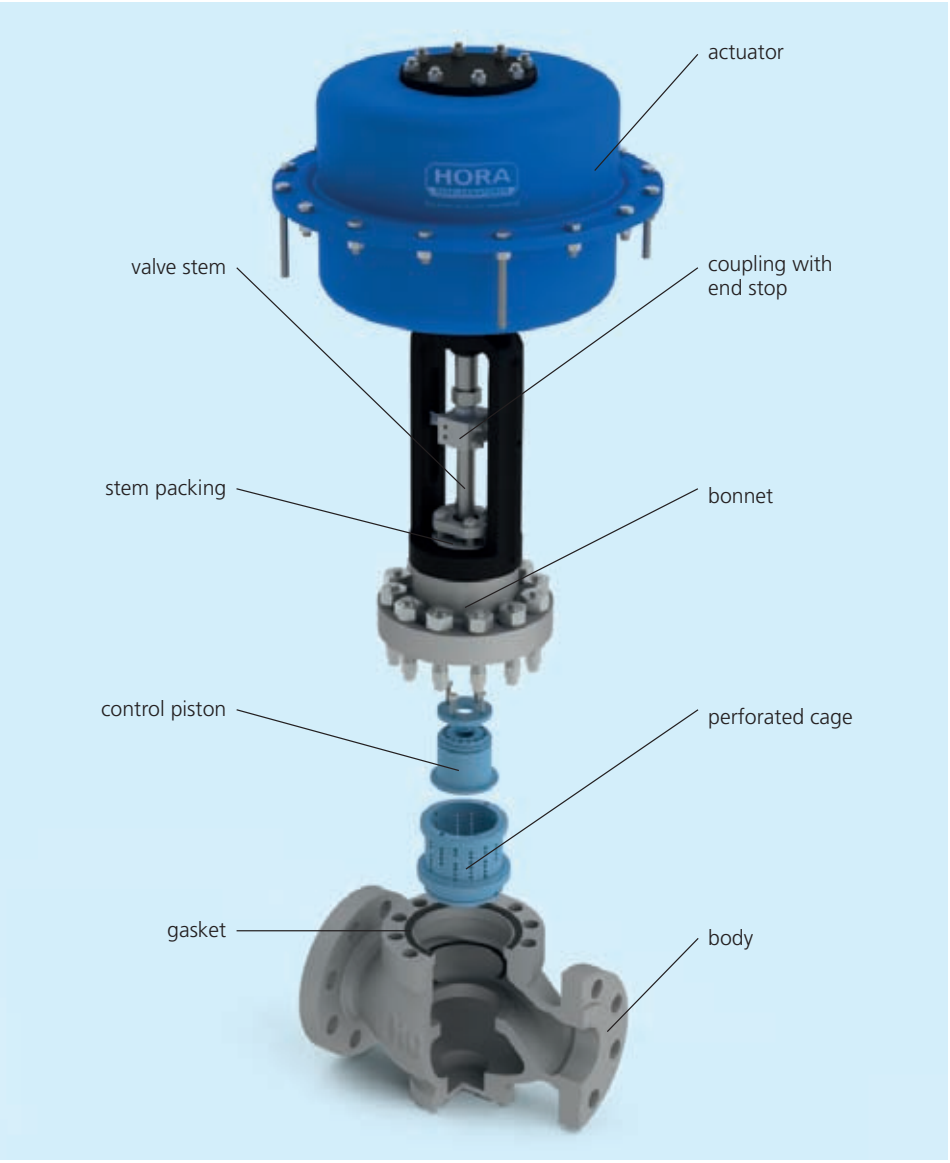
Excellence is our standard

The HORA Heavy Duty Control Valve is a versatile, modular globe valve designed for severe duties. This type of valve can be utilized to regulate and control the flow of gases, steams or liquids in all industrial applications. It is particularly suitable for the water-steam cycle in high pressure/high temperature power plant applications.

Working in close cooperation with end-user facility engineers and technical staff, HORA can identify common problems and our long-standing expertise in valve design enables us to eliminate them. The result is the HORA Heavy Duty Control Valve, which incorporates a number of sophisticated design improvements:

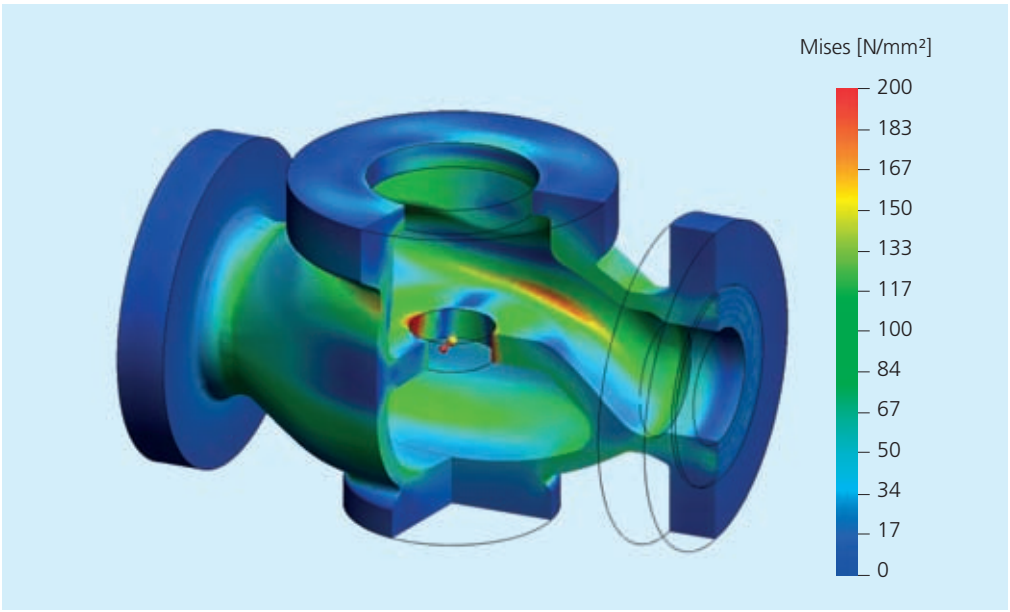


Exploded view drawing

- For optimum flow, the internal geometry of the valve body has been designed and validated using FEM and CFD techniques.
- Operating and maintenance costs are minimized by the use of quick-change trims and highly wear-resistant materials.
- A modular design with an extensive array of standard trims as well as made-to-measure solutions provides optimum performance in flow control.
- An exchange of trims is possible so the valve can be adapted to meet revised process conditions, e.g. plant upgrades.
- A wide range of actuators is available: manual, pneumatic, electric and electro-hydraulic.
- HORA maintains a stock of valve bodies and modules, so product lead times are short, which in turn makes planning for maintenance and plant outages easier.
- The HORA Heavy Duty Control Valve is a premium design providing long service life.

Careful material selection and proven design eliminate common issues associated with control valves such as erosion, corrosion, cavitation, vibration, noise and poor controllability. By combination of optimized design and cost-efficiency, the HORA Heavy Duty Control Valve is a superb choice for severe service operating conditions.

For applications in pressure classes lower than PN 63 or Class 600, please refer to the HORA Standard Duty Control Valves.

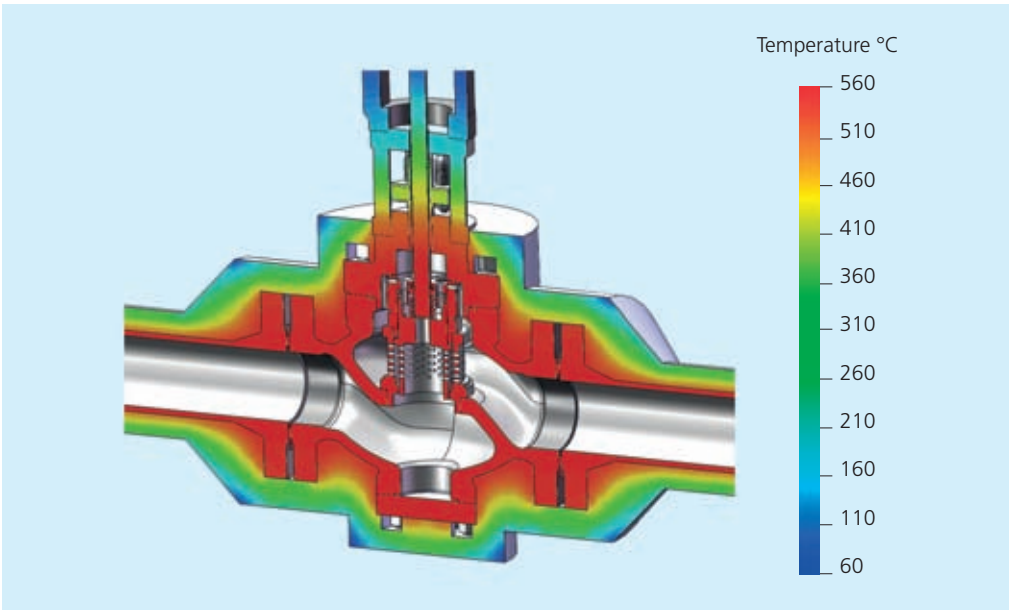


Equivalent stress of a valve body at defined load

The valve body is meticulously designed by means of the Finite Element Method (FEM) and Computational Fluid Dynamics (CFD). This results in high structural integrity. Stress and ensuing damage is reduced to the minimum and the life expectancy of the valve is extended.

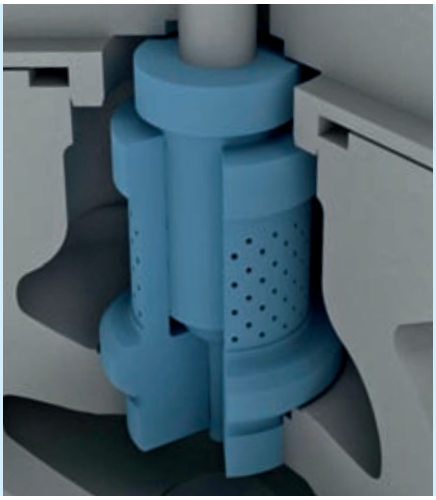
The interiour geometry of the valve has purposely designed large spaces to allow easy access with serviceability in mind. The body can accomodate various trim designs and exhibits high flow coefficient values as well as low turbulence. Depending on pressure class and valve size, end connections are available as socket-weld, butt-weld or flanged. For gas and steam applications involving high pressure drops or high velocities, outlet extensions with integrated perforated discs can be supplied.

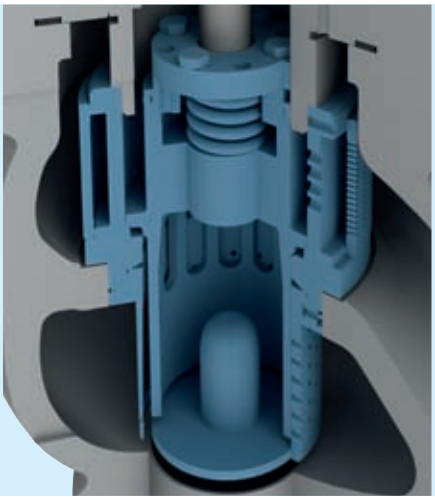
The temperature distribution of insulated valves are analyzed by extensive CFD simulations. At temperatures above 400 °C (752 °F), an intermediate yoke is utilized to protect the actuator and any optional accessories from overheating and resulting damage.

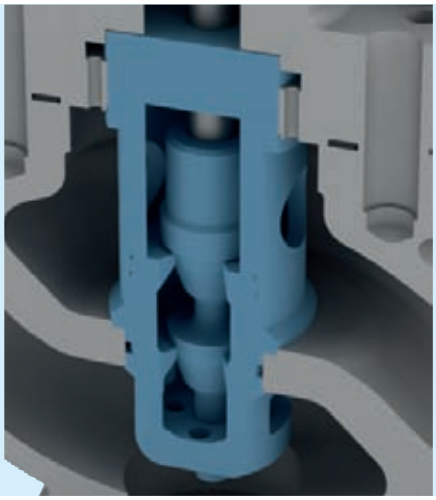


Temperature distribution of an insulated valve

For the HORA Heavy Duty Control Valves, a wide range of different trim designs is available. The trim components can be replaced to adapt the valves to changed process parameters. The same types of trims can also be used in HORA angle valves. Some typical trim setups are presented below.







Low-flow trim

This type of trim features an elegantly simple and advantageously precise construction. It is optimized for perfect control at very low flow rates. The construction, with a guided parabolic plug, is capable of handling high differences in pressure. The low-flow trim is only available in hardened material to ensure low wear between the plug and the seat with perforated cage. Direct armoring is also available. The flow direction for this type of trim is to open. A typical application is the spray water control of desuperheaters and steam conditioning valves.

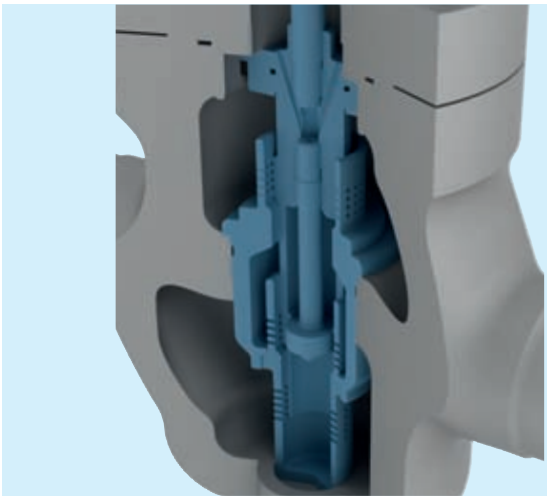
Multi-purpose trim

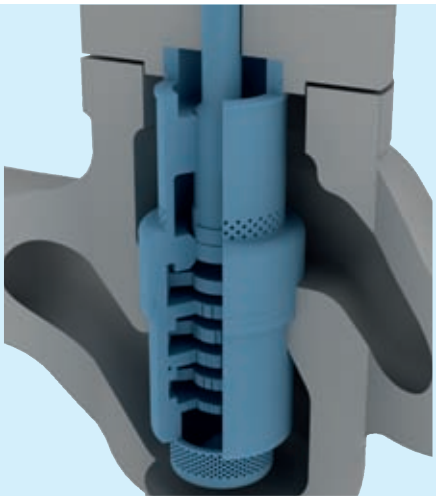
This trim is the best choice for high capacities and large pressure drops. The trim features a multi-stage design for the prevention of cavitation and for the effective attenuation of vibration and noise. The quick-change design reduces maintenance time and no special tools are required. The cage is not screwed or welded – it is held in place by the bonnet. Three different versions are available: unbalanced, balanced and balanced with pilot plug. The modular design ensures maximum flexibility. Independent of the flow direction, a strainer can be utilized.

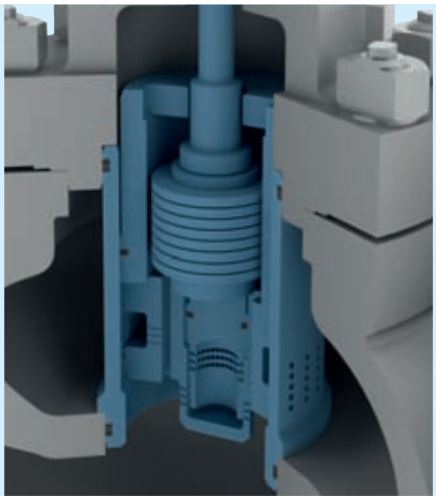
Cascade trim

In applications where pressure drops of up to 150 bar occur within an incompressible fluid, a cascade trim can be used to prevent cavitation. The flow path is shaped by facets on the multi-angled plug, together with the profile of the seat, this leads to a cascading effect which controls the pressure drop. The multi-stage cascade plug with up to 3 + 1 stages is manufactured by tolerance-controlled machining. In applications like pump protection, boiler start up or spray water control, this type of trim has proven to be advantageous.

Welded seats and directly armored seats are available on request. Screwed seats are supplied with a guidance or armored with Stellite 6. A "soft seat" is used for applications where bubble-tight shut off is required. The materials and combinations of all internal parts are selected based on detailed engineering data and in consideration of the specific application the valve is intended for.







Multi-stage convoluted-path trim

If pressure drops of up to 300 bar in an incompressible fluid have to be handled, the multi-stage convoluted-path trim is first choice. The special design of this trim prevents erosion and cavitation and leads to low trim exit velocities. A combination of two seats leads to high reliability and minimizes wear of the main seat. This type of trim is typically used in applications such as pump protection, boiler start up or spray water control.

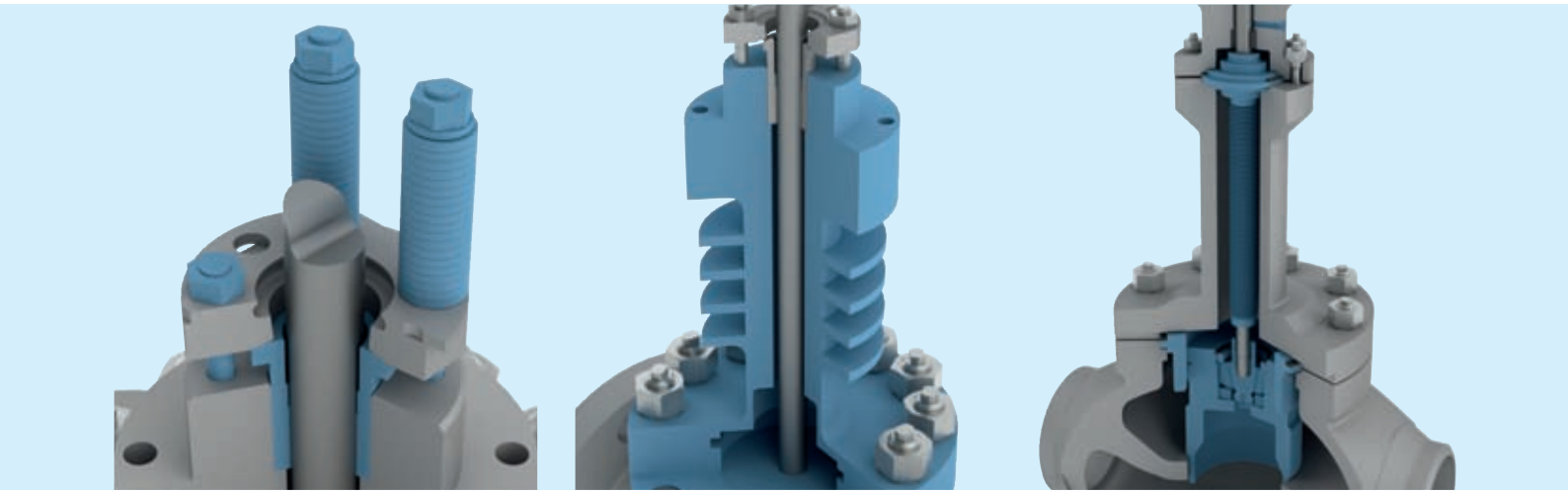
Multi-stage on/off trim

This multi-stage trim with perforated discs is predominantly used in boiler feedwater recirculation and pump protection applications. The design inhibits cavitation effects and features a tight shut off. The seat design allows a worn seat to be turned upside down thus doubling the service life.

Twin trim

The twin trim is a cage-guided trim featuring an integrated pilot plug in addition to the main control plug. It can control high pressure drops at low loads by the low-friction multi-stage design pilot plug and during standard operation, high capacities can be controlled by the main plug. A typical field of application is the control of boiler feedwater. The twin trim eliminates the need for a second valve and for additional by-pass piping.

The sealing system employed is selected based on the process fluid and the conditions of operation. The HORA Heavy Duty Control Valve can be fitted with a selection of special sealing measures to ensure the lowest possible emission and to minimize friction. The configurations can, to some degree, be combined. Some of the available stem sealing options are presented below.



Packing box

On the left side of the above illustration the standard version of the packing box with compression gland is shown. This setup is retightened by the stud screws located on the flange. As shown on the right side of the illustration, by adding a set of disc springs an even pressure of the packing rings on the stem can be achieved. No further modification of the valve is required.

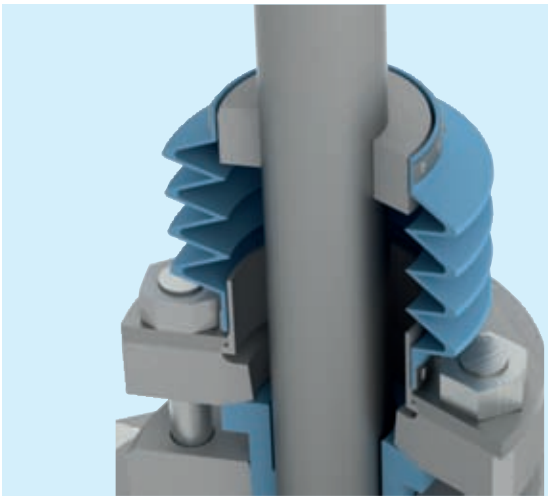
High-temperature setup

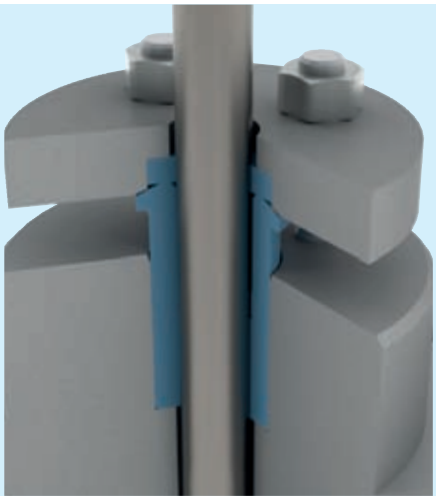
At high operating temperatures, the stem sealing has to be kept below its maximum permissible temperature. This is accomplished by a cooling fin extension in combination with a suitable high-temperature packing material. Adequate CFD simulations yield the cooling fin area required for sufficient heat radiation to protect the packing material from overheating.

Bellows-sealed bonnet

In cases where exceptional leak tightness is demanded, especially if the fluids are corrosive, highly inflammable or harmful to the environment, a bellows-sealed bonnet can be employed. Exposure of the process media to the surrounding atmosphere is completely inhibited by the pressure-tight welding of the bellows to the stem and the bellows bearing. Any leak can be detected via the test port, the monitoring space of which is additionally sealed by a self-adjusting packing box.

When the valves are to be installed outside, the stem sealing and the connection with the actuator has to be weather-resistant and designed to prevent the ingress of foreign matter. To choose a suitable protection, the maximum operating temperature of the packing box has to be observed and all components protruding from the insulation material should be preserved by a high-quality corrosion-resistant coating.





Rubber bellows

For operating temperatures up to 260 °C (500 °F), a rubber bellows may be used as a protective measure for the stem sealing.

Metal bellows

For operating temperatures above 260 °C (500 °F), a bonnet with metal bellows is employed to protect the stem sealing components.

Packing box with wiper

In low-temperature applications where protection against dirt and water is needed, a wiper cleans the stem before it moves through the packing.

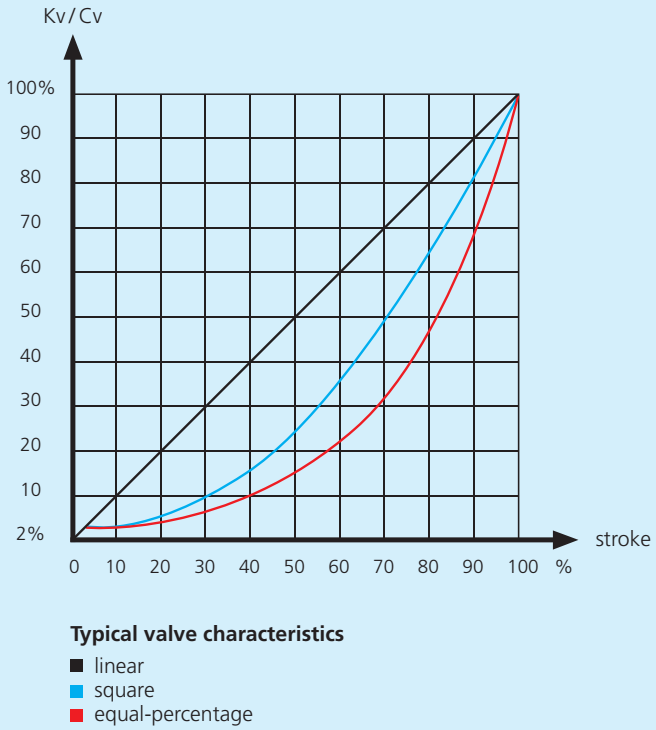
The materials and construction of the stem sealing system are selected based on the respective specifications, e.g. TA Luft construction according to VDI 2440 and DIN EN ISO 15848-1 (Technical instructions on air quality control, administrative regulations issued by the German Government). Additional parameters have to be taken into account, e.g. temperature, pressure, type of medium, stroke velocity, number of strokes, stem diameter and allowed leakage class.

The HORA Heavy Duty Control Valves can be supplied with any valve characteristic. The design of the valve trim affects how the valve capacity changes depending on the valve lift. A trim is chosen to compensate for the non-linear behavior of the system in which the valve is used. Thus, the overall behavior of the system ideally is linearized.

A linear valve characteristic results in a flow proportional to the valve lift for a constant pressure drop. This valve characteristic is predominantly used for flow rate control. With an equal-percentage characteristic each increment of the valve lift results in an equal-percentaged rise in the medium flow rate. This type of characteristic is generally used for pressure control applications. HORA can also supply square and on/off characteristics as well as any modified characteristic for special applications.

The rangeability is the ratio of the maximum to minimum controllable Kv (or Cv) value. HORA Heavy Duty Control Valves are available with exceptionally high rangeabilities to handle wide variations of load and combinations of start-up and maximum load conditions such as those experienced in boiler feedwater control applications.

The flow coefficient Kv is the flow of water (in m^3/h) at a temperature of 5 to 30 °C through a valve with a pressure drop of 1 bar across the valve. The Kv value at maximum valve opening is denoted as Kvs.



Typical valve characteristics

The mathematical expression for the flow coefficient Kv is:

$$K_V = Q \cdot \sqrt{\frac{1\ \text{bar}}{\Delta p} \cdot \frac{\rho}{1000\ \frac{\text{kg}}{\text{m}^3}}}$$

where:

- Q = rate of flow (in m^3/h)
- Δp = pressure drop across the valve (in bar)
- ρ = density of the fluid at load conditions (in kg/m^3)

The formula to convert Kv into Cv is: Cv = 1.156 Kv

The HORA Heavy Duty Control Valves can be combined with all types of actuators. Electric or pneumatic actuators are used by default, however, other types are available on request.

HORA yokes for the conversion of rotary to linear motion can also be used for pneumatic HORA actuators. This is facilitated by the standardized interfaces F10 and F14 for multiturn actuators of all brands. If a multiturn actuator with B1 socket is mounted to a HORA valve, the valve can also be changed over to the above-mentioned pneumatic actuators without the need of a new yoke.

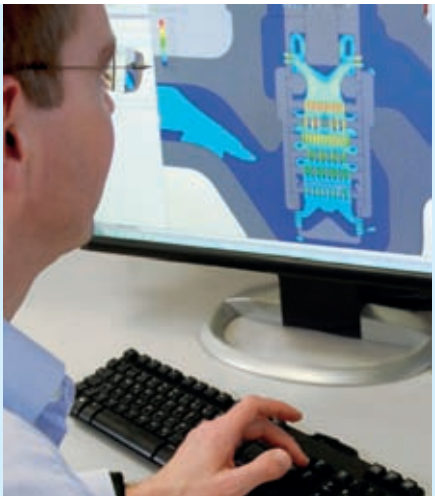
Additional components, such as limit switches and positioners, can be mounted to HORA yokes according to NAMUR guidelines onto the yoke spline or with the help of mounting rails.

Pneumatic actuator with or without additional manual drive

Multiturn actuator, all brands suitable

Manual drive with or without gear box

HORA is a family-owned business focusing on constant process improvement, coupled with continuity and reliability. We are committed to provide fully engineered, tested and proven products for the most severe applications. High emphasis is placed on the compliance with international standards including the PED and ASME. Our engineering experts design, develop and test our products to meet the challenging demands of our customers' process requirements.



To achieve highest quality, HORA valves are carefully designed by state-of-the-art methods.

The new HORA Product Configurator is developed by experienced graduate engineers.

Design, manufacturing and service of HORA valves is carried out by experts only.

To ensure that our valves are manufactured to the highest possible quality while using the most cost-effective techniques, we employ state-of-the-art technologies such as 3D modeling, Finite Element Method (FEM), Computational Fluid Dynamics (CFD), prototyping and Kv (Cv) test facilities. The resulting valves are perfectly suited to fulfill our customers' expectations and will certainly add value to their business.

To make certain that the results of the engineering process are effectively used within our range of products, we have developed a new and unique valve sizing and product configuration software implementing the latest EN and ISA standards.

Our service does not end with product delivery – the HORA Power Technology Service Team is available to support the valves through their full life cycle. You can benefit from our factory-trained specialists through our established global network of partners. For more detailed information on the HORA Power Technology Service, please ask for the booklet "Forget Your Problems!" available from HORA.

In cases where an existing valve of any manufacture has to be replaced, HORA can assist. By way of an engineered retrofit, a completely new valve can be supplied to the same specification and dimensions thereby negating the need for piping modifications.

application	DIN	ASME
valve body size	DN 25 to DN 600	DN 25 to DN 600
valve body rating	PN 63, PN 100, PN 160, PN 250	Class 600, Class 900, Class 1500
fluid temperature	-196 °C to 600 °C	-321 °F to 1112 °F

medium	gases, steam, liquids
connection	flanges (RF, RTJ), socket welded, butt welded, extensions in accordance to international standards
leakage class	metal seat: class IV (0.01 % of Kvs), optional class V; soft seat: class VI
rangeability	50 : 1 (typical) or higher
actuation	manually, pneumatic diaphragm or piston actuator, electric actuator, electro-hydraulic actuator
quality assured manufacturing	DIN ISO 9001:2000, PED 97/23/EC KTA 1401 (accreditation ordinance for suppliers of valves for nuclear power plants)

standards

EN 558	Industrial valves – face-to-face and centre-to-face dimensions of metal valves for use in flanged systems – PN and Class designated valves
EN 1092-1	Flanges and their joints – circular flanges for pipes, valves, fittings and accessories, PN designated – Part 1: steel flanges
EN 1349	Industrial process control valves
EN 60534-4	Industrial process control valves – Part 4: inspection and routine testing
EN 60534-2	Industrial process control valves – Part 2: flow capacity
ASME B16.25	Buttwelding ends
ASME B16.34	Valves – flanged, threaded and welding end
EN 19	Marking of metallic valves
EN 12516	Industrial valves – shell design strength

body materials	material number	standard	temperature range	
GP240GH+N	1.0619+N	EN10213	-10 °C to 450 °C	14 °F to 842 °F
Grade WCB	UNS J03002	ASME SA216	-28 °C to 427 °C	-18 °F to 801 °F
G17CrMo5-5	1.7357	EN10213	-10 °C to 550 °C	14 °F to 1022 °F
Grade WC6	UNS J12072	ASME SA217	-28 °C to 595 °C	-18 °F to 1103 °F
G17CrMo9-10	1.7379	EN10213	-10 °C to 600 °C	14 °F to 1112 °F
Grade WC9	UNS J21890	ASME SA217	-28 °C to 593 °C	-18 °F to 1099 °F
Grade C12A	UNS: J84090	ASME SA217	-28 °C to 593 °C	-18 °F to 1099 °F
GX23CrMoV12-1	1.4931	EN10213	-10 °C to 600 °C	14 °F to 1112 °F
G20Mn5	1.6220	EN10213	-40 °C to 300 °C	-40 °F to 572 °F
Grade LCC	UNS J02505	ASME SA352	-46 °C to 300 °C	-50 °F to 572 °F
GX5CrNiMo19-11-2	1.4408	EN10213	-196 °C to 400 °C	-321 °F to 752 °F
Grade CF8M		ASME SA351	-196 °C to 400 °C	-321 °F to 752 °F

For further information please contact:

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