MANKENBERG

Industriearmaturen
Industrial Valves

Your Specialist and Partner in the Field of Corrosion-resistant Materials

Stainless steels, i. e. corrosion-resistant steels, become resistant to corrosion because a so-called passive layer forms on the surface. Such layer consists of chromium-rich metallic oxide or metallic oxide hydrate preventing the direct contact of the metal with the corroding medium. Even in the event of small lesions, a new layer builds up independently at the relevant area. If this is not the case, for example due to a lack of oxygen, either pitting corrosion (1) or crevice corrosion (2) may occur.
Stainless steels have a percentage by mass of the element chromium of not less than 12 % and of the element carbon that should not exceed 0.12 %. Hence, the percentage of the alloying element chromium is decisive for the corrosion resistance of stainless steel. In case the steel contains further alloying elements such as molybdenum or the like, the material becomes more resistant also to highly aggressive operating conditions.

The suitable valve from the right material for your application:

Our team competently provides comprehensive advice –
Take us at our word!

Used corrosion-resistant materials

Material designation	Material number	Standard	Major alloying elements in mass-%				Pitting resistance equivalent (PREN)
		DIN EN	ASTM	Cr	Ni	Mo	
Stainless Steel	1.4404	X2CrNiMo17-12-2	316L	16.5 - 18.5	10.0 - 13.0	2.0 - 2.5	23.0 - 28.0
	1.4571	X6CrNiMoTi17-12-2	316Ti	16.5 - 18.5	10.5 - 13.5	2.0 - 2.5	25.0
Duplex	1.4462	X2CrNiMoN22-5-3	A182F51	21.0 - 23.0	4.5 - 6.5	2.5 - 3.5	30.0 - 38.0
	1.4539	X2NiCrMoCu25-20-5	N08904	19.0 - 21.0	24.0 - 26.0	4.0 - 5.0	34.0 - 40.0
Super Duplex	1.4410	X2CrNiMo25-7-4	S32750	24.0 - 26.0	6.0 - 8.0	3.0 - 4.5	35.0 - 42.0
Super Duplex	1.4501	X2CrNiMoCuWN25-7-4	S32760	24.0 - 26.0	6.0 - 8.0	3.0 - 4.0	37.0 - 44.0
Cronifer 1925hMo	1.4529	X1NiCrMoCu25-20-7	N08926	19.0 - 21.0	24.0 - 26.0	6.0 - 7.0	41.0 - 48.0
254 SMO®	1.4547	X1CrNiMoCuN20-18-7	S31254	19.5 - 20.5	17.5 - 18.5	6.0 - 7.0	42.0 - 48.0
Hastelloy® C-4	2.4610	NiMo16Cr15Fe6W4	N06455	14.5 - 17.5	66.0	14.0 - 17.0	
Titanium	3.703		R50400				

The higher the PREN, the more resistant to pitting and crevice corrosion | alloys with a PREN of > 33 are classified as sea water resistant | Hastelloy® C-4 and Titanium are classified as being highly resistant to sea water | pitting resistance equivalent (PREN) of stainless steels = % Cr + 3.3*% Mo + 16*% N | a higher PREN is required for an increasing salt content and/or rising temperature

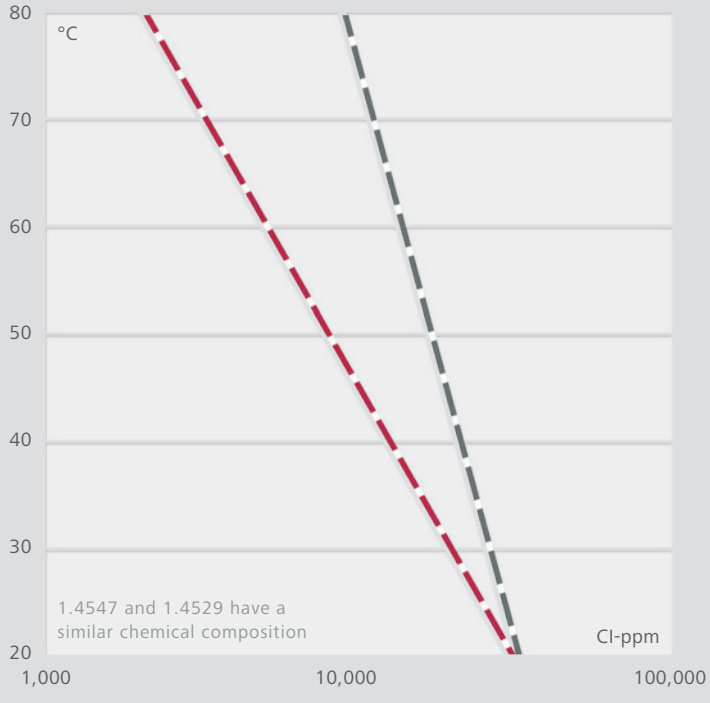
Corrosion-resistant Materials

The right selection of material makes the difference

Stainless steel is needed for numerous applications and industries. This material is used for a huge variety of purposes in essential sectors such as raw material extraction, pharmaceutical and chemical industries, plant construction, oil & gas, offshore applications etc. Mankenberg's product range of flexible standard valves or project-related special valves is correspondingly broad.
The operating conditions at the customer's site sometimes require ultraclean surfaces of the valves whilst other valves must be capable of sustaining the flow of dirty or highly corrosive media. Hence, the optimum solution is selected in close consultation with our engineers, technicians and sales staff. A particular challenge is to select the suitable material for applications in chemical-technical processes, in which caustic and/or corrosive fluids are used.
The same applies to the maritime domain or saline liquids, for which in general sea water-resistant material is needed. It requires special diligence and clarification of all the technical and chemical details in order to properly assess the loading conditions of the material and the interaction between the medium and the environmental conditions.

Behaviour of corrosion-resistant stainless steel 1.4529 / 1.4547

Excellent corrosion resistance owing to an increased percentage of chromium and molybdenum.



1) Pitting Corrosion

Pitting is a particular type of corrosion in media containing chloride ions. In the event that the protective passive layer of the stainless steel is interrupted owing to small lesions, a local corrosion attack occurs. Pits or holes, that are often as small as pinholes, form more readily. As long as the exposure persists, the pits or holes will enlarge.

2) Crevice Corrosion

Crevice corrosion can be found in already existing gaps or fissures which are often generated by the overall design. The passive layer of the stainless steel cannot form there at all and aggressive media such as salt water accelerate the corrosion process. Heavy crevice corrosion may occur in the event that oxygen which is necessary to form the passive layer is not available.

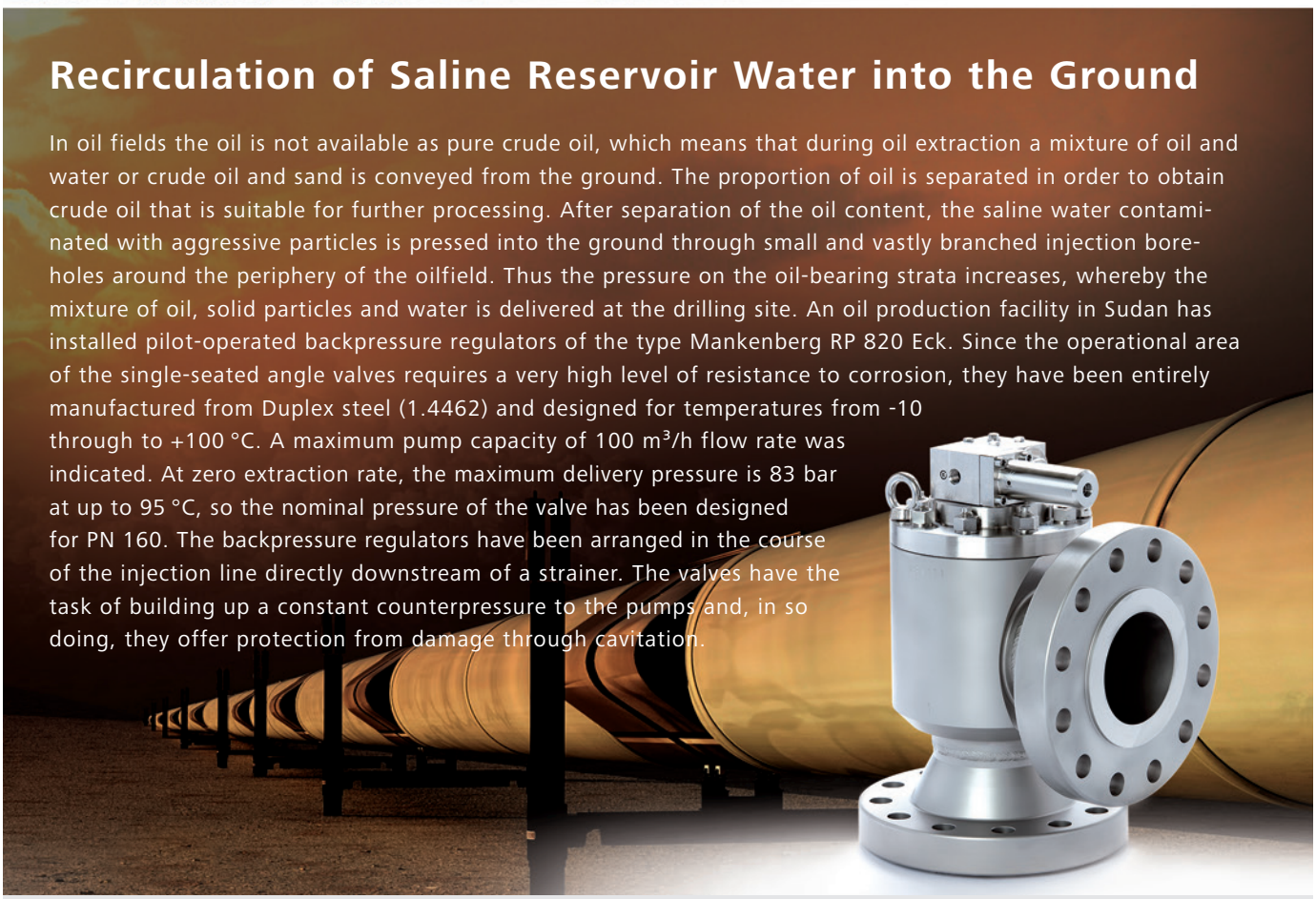
Mankenberg Pressure Regulating Valves in Action

Pressure Reduction of Corrosive Fluids in the Chemical Industry

The production cycles in many chemical industries release caustic waste, often in liquid form, which must be reliably removed from the current process. The discharge of such fluids proves to be rather difficult since many processes take place under excess pressure. By the use of medium-operated pressure reducing valves, the hazardous medium can be brought down to a lower level, thus the handling of caustic or corrosive media turns out to be less dangerous. The diaphragm-controlled pressure regulating valve DM 652 adV used in this case is exposed to severe corrosion depending on the caustic medium and the ambient conditions such as temperature, pressure etc. The design of the DM 652 must take various corrosion types into consideration: surface corrosion may be avoided through properly selected material, the correct combination of materials impedes contact corrosion and elaborate design details counteract crevice corrosion. Hence, the valve's body is manufactured from the solid. The high material costs pay for themselves thanks to the longer operational lifetime with reduced maintenance costs and downtimes.

Recirculation of Saline Reservoir Water into the Ground

In oil fields the oil is not available as pure crude oil, which means that during oil extraction a mixture of oil and water or crude oil and sand is conveyed from the ground. The proportion of oil is separated in order to obtain crude oil that is suitable for further processing. After separation of the oil content, the saline water contaminated with aggressive particles is pressed into the ground through small and vastly branched injection boreholes around the periphery of the oilfield. Thus the pressure on the oil-bearing strata increases, whereby the mixture of oil, solid particles and water is delivered at the drilling site. An oil production facility in Sudan has installed pilot-operated backpressure regulators of the type Mankenberg RP 820 Eck. Since the operational area of the single-seated angle valves requires a very high level of resistance to corrosion, they have been entirely manufactured from Duplex steel (1.4462) and designed for temperatures from -10 through to +100 °C. A maximum pump capacity of 100 m^3/h flow rate was indicated. At zero extraction rate, the maximum delivery pressure is 83 bar at up to 95 °C, so the nominal pressure of the valve has been designed for PN 160. The backpressure regulators have been arranged in the course of the injection line directly downstream of a strainer. The valves have the task of building up a constant counterpressure to the pumps and, in so doing, they offer protection from damage through cavitation.



Pressure Regulating Valve

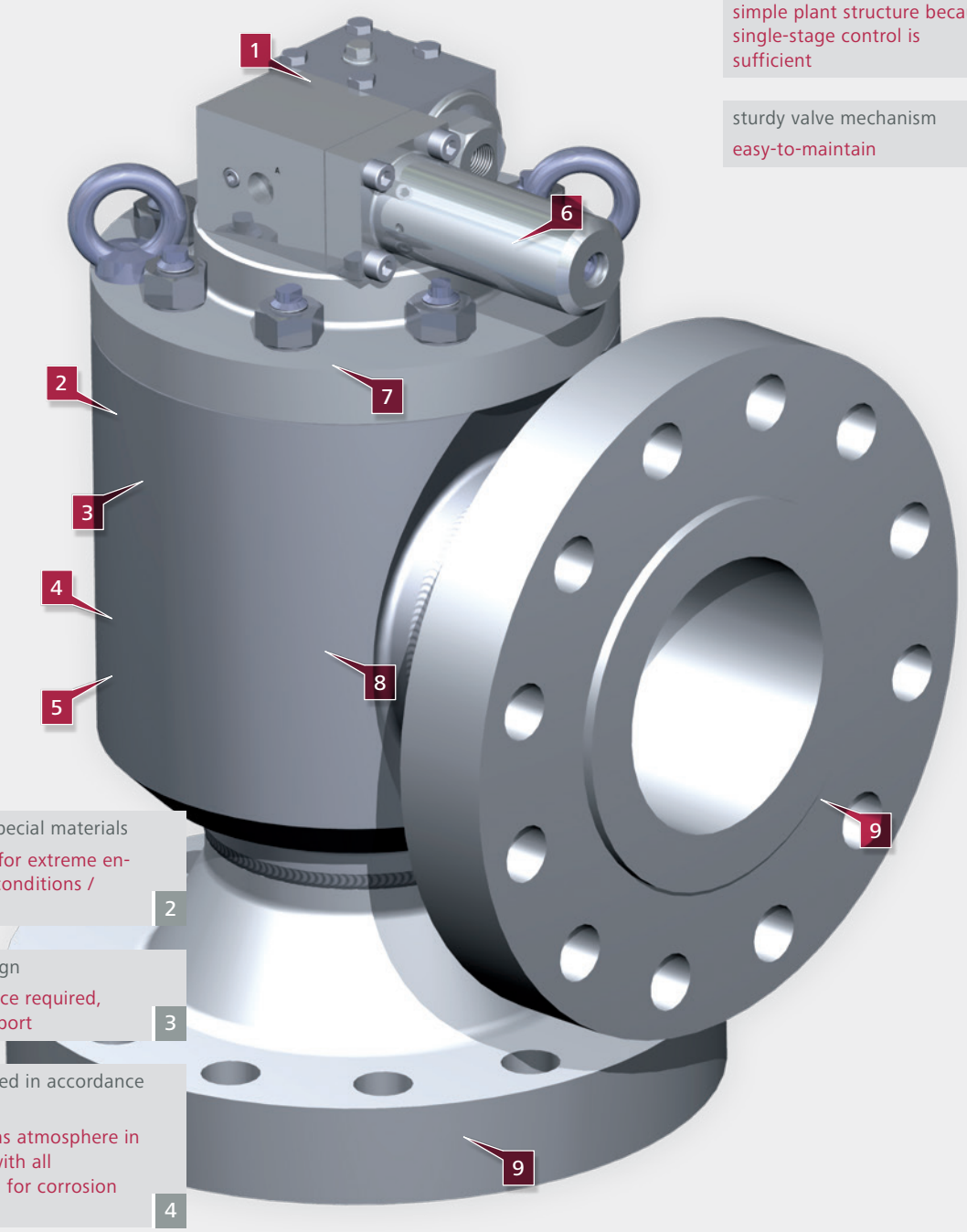
MANKENBERG

exchangeable pilot control
flexible application possibilities 1

precise regulation through pilot valve
highest regulating accuracy without auxiliary energy 6

high pressure drops possible
simple plant structure because single-stage control is sufficient 7

sturdy valve mechanism
easy-to-maintain 8



available in special materials
also suitable for extreme environmental conditions / applications 2

compact design
minimum space required, easy-to-transport 3

can be supplied in accordance with NACE
use in acid gas atmosphere in compliance with all specifications for corrosion resistance 4

optional elastomers
suitable for ozone, adaptation to varying conditions of use 5

various connection possibilities …
no adapters or fitting pieces required 9

Pilot-operated Pressure Regulating Valve RP 820 Eck

Mankenberg Bleeding and Venting Valves in Action

Corrosion Resistance in Clean Steam Systems

The principle of steam drying is used for clean rooms, for example hygienisation in the food and medicinal production and in hospitals. Under this process, the components to be dried are exposed to steam which is generated from distilled water and must be as free as possible from condensate. Using the centrifugal principle, the Mankenberg liquid separator AS 2 self-actingly separates the condensate from the steam under operating pressure. A condensate separating performance of up to 99 % can be achieved. The liquid trap built into the separator body operates instantaneously and its operation is not impaired by backpressure or pressure fluctuations. The collected liquid is safely drained by the float control. No additional energy input is required. The interaction between high temperatures and the highly reactive pure water quickly leads to intergranular corrosion, which is also called intergranular attack. Therefore, low-carbon stainless steel was selected for the AS 2, which ensures a high corrosion resistance in the event that very aggressive media are separated.

Bleeding and Venting of Filters for Thermal Water in a Thermal Bath

The brine for the thermal water in many thermal baths is withdrawn from the ground in many different ways. In unprocessed condition it can seldom be used directly for medical purposes. Thus, various types of brine are treated and, in doing so, they pass through a large number of different filter systems. The latter have to be effectively vented. Using valves in thermal baths places the highest demands on the material to be used. The thermal bath water is tapped at a depth of approximately 770 m. It is heavily mineralised (fluoride-containing sodium chloride thermal water) and, owing to the usually high salt concentration, it is extremely corrosive. In addition, due to the fact that the bleeding / venting valves are installed on top of a pipeline, they come into direct contact alternately with water and atmospheric oxygen, which poses additional requirements on the corrosion resistance of the employed materials. Given the high temperatures and high mineralisation of the brine, the customer replaced the normally coated bleeding and venting valves with valves from titanium. This material is particularly resistant to external influences because, when getting in contact with oxygen from water or air, the surface of the titanium forms a thin layer of titanium oxide that protects the material. The employed float-controlled bleeding and venting valve EB 1.2 is designed for temperatures up to +80 °C and a flow rate of 12 m^3/h at a differential pressure of 2 bar. The body and internal parts of the valve are made from titanium (3.7025 / 3.7035), the clamp is fabricated from CrNiMo steel (1.4404).

Mankenberg Valves in Action

Extinguishing Water Pressure Regulation and Shut-off on Offshore Installations

Offshore platforms are used for drilling offshore oil and gas wells. The platforms are living and working space for the workforce employed there. All the systems and installations are operated independently from the continent. Since oil, gas and other explosive mixtures are constantly handled on the platform, a highly effective fire protection system is indispensable to protect crew and installations.

The extinguishing water (sea water) in the fire fighting systems of the platforms is led to the single hydrants via closed circular pipelines. To maintain a constant pressure at all hydrants in the different platform levels, the circular pipeline is pressurised at 12 – 16 bar(g). However, the jet pipes only require 6 bar up to a maximum of 8.5 bar(g).

The Mankenberg pressure regulating hydrant valve DM 668E reduces the pressure to the required value in the circular pipeline directly upstream of the hose connection. Normally, the valves are closed by means of a shut-off device. However, no additional shut-off valve needs to be installed because the shut-off function has been integrated into the pressure regulating hydrant valve. In the event of a fire alarm, the shut-off will be released directly at the valve.

All the medium contact parts of the DM 668E are made of titanium Grade 2. This material ensures the best possible protection for the fire fighting system which is operated with highly corrosive sea water and sometimes has long down-times. Thanks to the high quality material and with the O-ring placed below the thread, the breakaway torque of the handwheel is reduced to a minimum. Consequently, there will be no undue delay in the event of a fire.

The novel technology of deep-drawing of titanium offers utmost flexibility also with regards to the delivery time, because – unlike cast valves – the DM 668E is available at short notice. Thanks to the spring pack arranged in parallel the valve has a compact overall height and – compared to common fire fighting valves – it requires less space for installation.

Vacuum Breaker for the Cooling Water System of a semi-submersible Oil Production Platform

The semi-submersible offshore platform is located 150 km off the Brazilian coast and is considered to be one of the world's biggest platforms. It processes 180,000 barrels of oil and 6,000,000 m^3 of gas per day. The mega-platform is employed for the deep-sea exploitation of an oil reservoir deposited beneath a salt layer having several kilometres of thickness off the South American coast (pre-sál-layer).

The cooling water system of the offshore platform requires pipelines and valves that are suitable for the extreme marine atmosphere of a deepwater oil rig.

A vacuum breaker is commonly installed in the cooling water system to protect the under-pressure range by means of an adjustable element. The body and cone of the Mankenberg VV 34 vacuum breaker are made from Super Duplex 1.4501, whilst the spring cap is made from 1.4571 and the spring from CrNiMo steel (AISI 316). The VV 34 has been designed for a temperature range of -10 °C through to +60 °C. Its outdoor installation required a protective cage to avoid unintended intrusion of foreign particles or sea birds when air is sucked in.

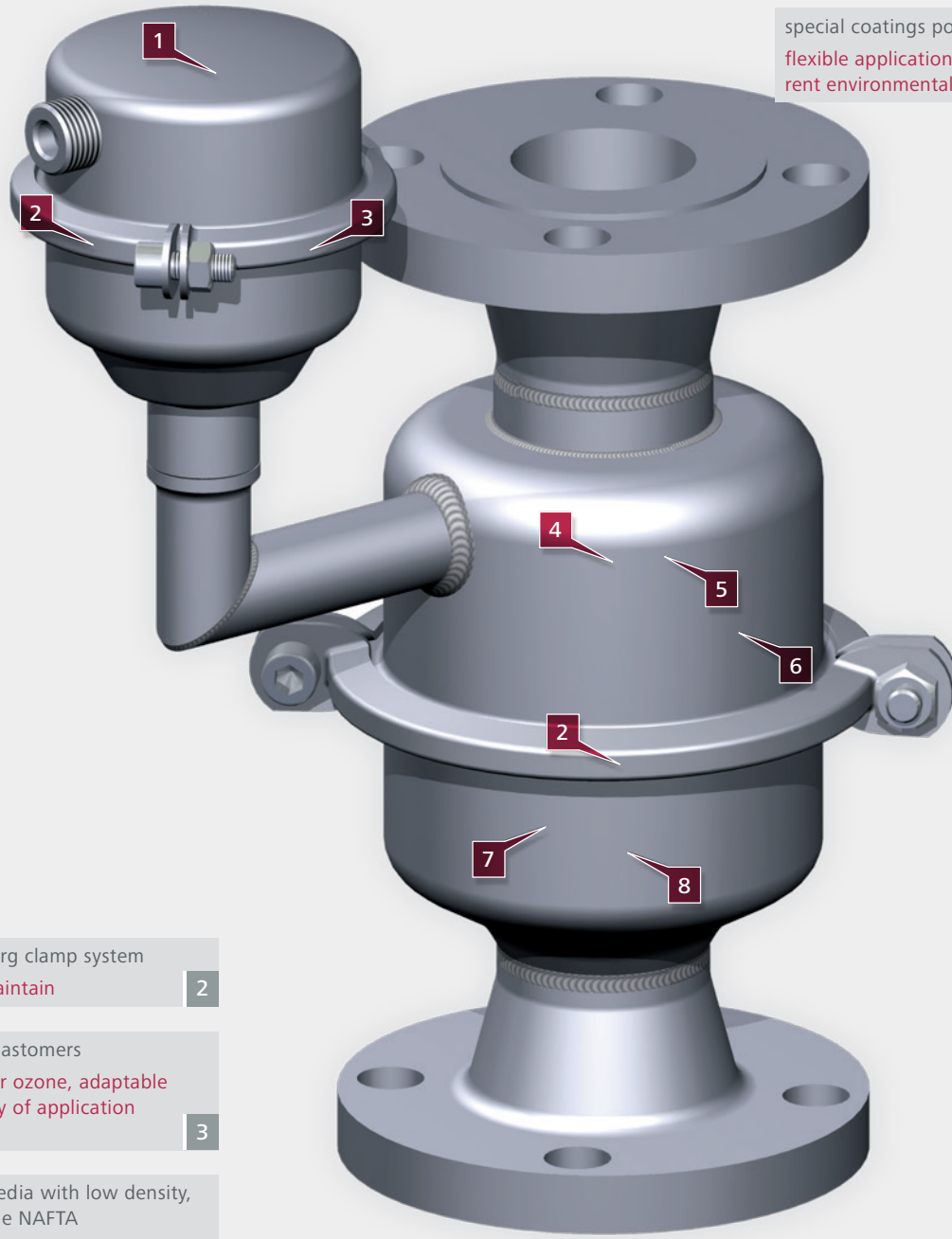
Bleeding and Venting Valve

available in special materials
also suitable for extreme demands 1

compact design
minimum space required, easy transport 6

deep-drawn version possible
good price-performance ratio 7

special coatings possible
flexible applications in different environmental conditions 8



Mankenberg clamp system
easy-to-maintain 2

optional elastomers
suitable for ozone, adaptable to a variety of application conditions 3

also for media with low density, for example NAFTA
may be used in the petrochemical industry 4

sturdy valve mechanism
low maintenance 5

Bleeding and Venting Valve for highest Flow Rates EB 6.54

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Careful Material Selection for the Use of Valves in Acid Gas Environment

If left untreated, natural gas or biogas contains hydrogen sulphide (H_2S) and water vapour. When the H_2S percentage in the natural gas exceeds 1 %, it is commonly referred to as acid gas.
The gas humidity, i. e. the water vapour percentage, brings about hydrate formation and corrosion. To feed the gas once again into the transport network, limit values for the content of water and other fluid constituents are specified. Therefore, withdrawn gas must be dried. The drying process comprises mechanical and thermodynamic process steps. During the final drying process stage the gas is conducted through adsorption towers, in which the residual humidity is collected with the help of highly hygroscopic substances such as glycols.
Similarly to the extraction of natural gas, every field station of a natural gas reservoir is equipped with a drying plant for the withdrawn gas. The gas drying process takes place in three stages: mechanical separation of free water, then pressure reduction and lastly the use of glycol.
In many cases medium-operated high pressure reducers of the type DM 621 according to NACE are employed. All the valves in the process plant are required to comply with the NACE standards as described in MR0175, for example. In accordance with NACE International (National Association of Corrosion Engineers), the material for natural gas valves has to be carefully selected, which means that steels with significantly reduced hardness are taken into consideration. Otherwise there will be the danger of excessive embrittlement of the steel.
For the above mentioned application, the question of corrosion resistance and, consequently, the question of material selection became more vital inasmuch as the gas terminal was built in close proximity to salt water, that is to say sea water atmosphere.

Please send us your enquiry and allow us to advise you.

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