RICHTER
Process Pumps & Valves

CERTIFIED CHEMICAL SAFETY VALVES

KSE 3.0

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SAFETY FOR CORROSIVE AND ULTRA-PURE MEDIA

Only one part certification number for vapours, gases and liquids. Your advantage: Improved flexibility, no mixing up of individual parts, reduced warehousing of parts

RANGE OF APPLICATION

_ Protection of pressure vessels and plants against excessive pressure, gage overpressures of 0.2 to 13 bar
_ Operating temperature up to 180 °C
_ Corrosive media where metallic materials cannot deliver a satisfactory service life or special metals result in high costs
_ Chlorine electrolysis
_ Pure and ultra-pure media
_ Metal-reactive media, e.g. H_2O_2, electronic chemicals
_ Thermal expansion

DESIGN

_ Direct-acting, spring-loaded, bellows safety valve with angle-type valve body
_ Normal safety valve, design and performance according to AD 2000 Data Sheet A2
_ Opening characteristic similar to full lift, streamlined flow parts result in high discharge coefficients
_ Almost proportional performance at low gage overpressures < 1

FOUR VARIANTS

_ Standard design
_ Antistatic design
_ Special design for highly permeating media
_ Special design for food (FDA-conform)

TYPE CODE

PFA lining	KSE/F ...
Antistatic lining	KSE/F-L ...
DN inlet/outlet	... _/_

BELLOWS MADE OF MODIFIED PTFE

_ Hermetic seal to valve bonnet and protection of spindle against corrosion
_ Significantly better resistance to permeation compared to standard PTFE
_ Spring rate and back pressure compensation of the bellows optimised using FEM analysis. Back pressure on outlet side does not influence the set pressure, thus also suitable for use with variable back pressures
_ Just one type of bellows with semi-circular pleats needed for each nominal width at all pressure levels
_ More durable due to arrangement in the flow-protected area and minimization of pressure load
_ Axial needle roller cage integrated into top spring plate: no twisting of the bellows when adjusting the straining screw

LIFTING CAP AND SPRING BONNET

_ Sealed, gas-tight
_ Lifting cap with flange connection and locking screw

SEAL ON VALVE BONNET

_ Proven labyrinth seal of KN/F ball valve, creates a durably tight seal even without subsequent tightening, no maintenance required during operation

PRESSURE-BEARING BODY

_ Flow-optimized design using computational fluid dynamics, pressure load on the PTFE bellows reduced by 50% in comparison to KSE 2.0
_ Cast steel 1.0619+N (GP240GH) and ASTM A216, Grade WCB

SEAT AND PLUG

_ Individually replaceable
_ Pressure-resistant PTFE/carbon compound (no glass, no ceramics)

EXTERNAL CORROSION PROTECTION

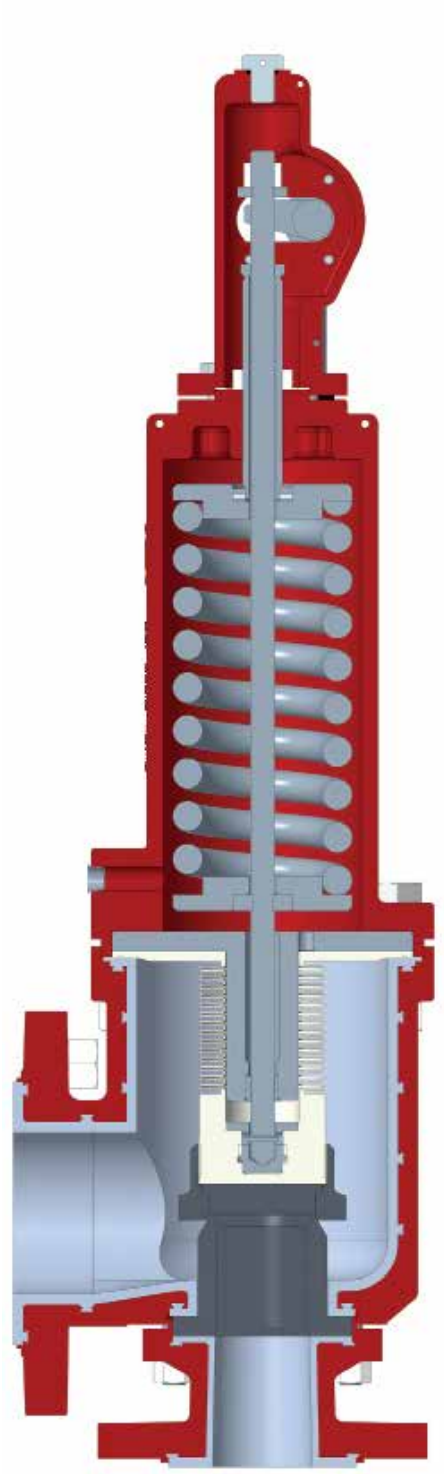
_ Epoxy coating, screws and nuts made of stainless steel A4-70

THICK-WALLED PFA LINING OF THE ENTIRE VALVE BODY

_ Universal corrosion resistance
_ Vacuum-proof
_ Higher diffusion resistance
_ Antistatic lining optional

STANDARDISATION AND REDUCED NUMBER OF DIFFERENT PARTS

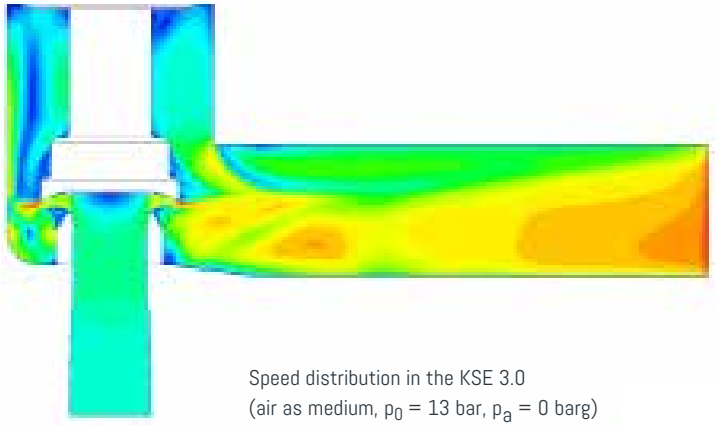
_ Fewer parts, improved warehousing
_ Quick & easy installation, maintenance and repair



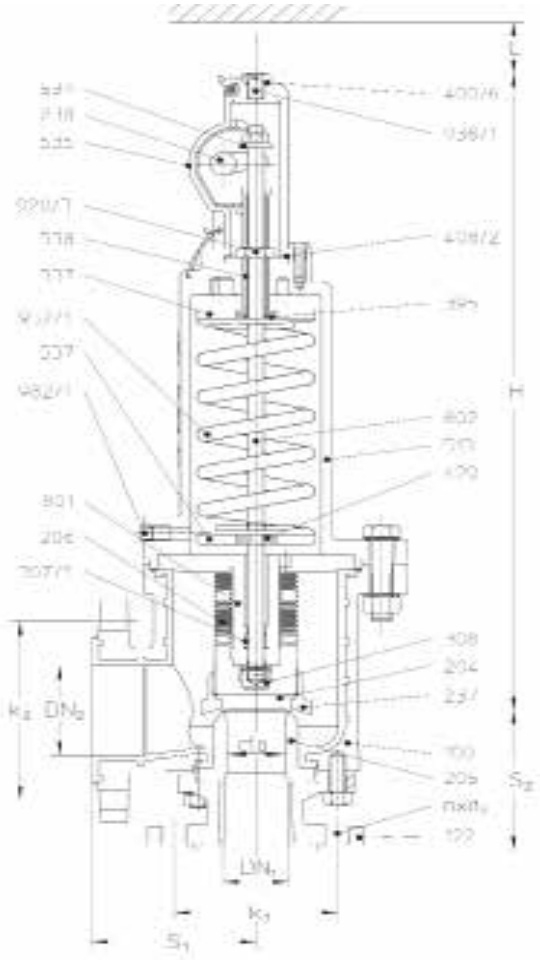
VALVE OPTIMIZED USING COMPUTATIONAL FLUID DYNAMICS

The flow characteristics of the KSE/F 3.0 valve series have been optimized using simulations on the industry-leading CFD software ANSYS CFX.

ADVANTAGES:
Improved discharge coefficients combined with precise and stable functionality.



Speed distribution in the KSE 3.0
(air as medium, p_0 = 13 bar, p_a = 0 barg)



SELECTION TABLE FOR MATERIALS AND CONFIGURATIONS

POS.	DESIGNATION	STANDARD DESIGN	SPECIAL DESIGN conductive	SPECIAL DESIGN for highly permeating media	SPECIAL DESIGN for food (FDA-conform)
100	Valve body	Cast steel 1.0619+N (GP240GH) / PFA (ASTM A216, Grade WCB / PFA)	Cast steel 1.0619+N (GP240GH) / PFA Antistatic (ASTM A216, Grade WCB / PFA-L)	Cast steel 1.0619+N (GP240GH) / PFA (ASTM A216, Grade WCB / PFA)	Cast steel 1.0619+N (GP240GH) / PFA (ASTM A216, Grade WCB / PFA)
122	Inlet nozzles	Cast steel 1.0619+N (GP240GH) / PFA (ASTM A216, Grade WCB / PFA)	Cast steel 1.0619+N (GP240GH) / PFA Antistatic (ASTM A216, Grade WCB / PFA-L)	Cast steel 1.0619+N (GP240GH) / PFA (ASTM A216, Grade WCB / PFA)	Cast steel 1.0619+N (GP240GH) / PFA (ASTM A216, Grade WCB / PFA)
204	Plug	PTFE / carbon compound	PTFE / carbon compound	Modified PTFE / PTFE for $p_a \geq 1.0$ bar or PTFE / PTFE for $p_a < 1.0$ bar	Modified PTFE / PTFE for $p_a \geq 1.0$ bar or PTFE / PTFE for $p_a < 1.0$ bar
205	Seat				
206	Bellows	Modified PTFE	Modified PTFE	Modified PTFE	Modified PTFE
237	Lifting aid	PTFE / carbon compound	PTFE / carbon compound	PTFE	PTFE
238	Lifting lever	without lever (standard) or 14308 (stainless steel)	without lever (standard) or 14308 (stainless steel)	without lever (standard) or 14308 (stainless steel)	without lever (standard) or 14308 (stainless steel)
306	Guide	14308 (stainless steel)	14308 (stainless steel)	Hastelloy® C	14301 (stainless steel)
307/1	Guide bush	PTFE / carbon compound	PTFE / carbon compound	PTFE / carbon compound	PTFE / carbon compound
308	Insert sleeve	14301 (stainless steel)	14301 (stainless steel)	Hastelloy® C	14301 (stainless steel)
395	Axial needle roller cage	Roller bearing steel	Roller bearing steel	Roller bearing steel	Roller bearing steel
396	Axial washer	Roller bearing steel	Roller bearing steel	Roller bearing steel	Roller bearing steel
397	Shaft washer	Roller bearing steel	Roller bearing steel	Roller bearing steel	Roller bearing steel
400/6	O-ring	FKM (Viton® or equivalent)	FKM (Viton® or equivalent)	FKM (Viton® or equivalent)	FKM (Viton® or equivalent)
408/2	Flat seal	Aramid	Aramid	Aramid	Aramid
420	Thrust ring, 2-piece	14301 (stainless steel)	14301 (stainless steel)	Hastelloy® C	14301 (stainless steel)
513	Spring bonnet	Cast steel 1.0619+N (GP240GH)	Cast steel 1.0619+N (GP240GH)	Cast steel 1.0619+N (GP240GH)	Cast steel 1.0619+N (GP240GH)
534	Spindle nut	1.0570 (RSt 52)	1.0570 (RSt 52)	1.0570 (RSt 52)	1.0570 (RSt 52)
535	Lifting cap	Cast steel 1.0619+N (GP240GH)	Cast steel 1.0619+N (GP240GH)	Cast steel 1.0619+N (GP240GH)	Cast steel 1.0619+N (GP240GH)
537	Spring plate	14301 (stainless steel)	14301 (stainless steel)	14301 (stainless steel)	14301 (stainless steel)
538	Adjusting screw	14301 (stainless steel)	14301 (stainless steel)	Hastelloy® C	14301 (stainless steel)
539	Locking plate (Fig. at top)	14301 (stainless steel)	14301 (stainless steel)	14301 (stainless steel)	14301 (stainless steel)
802	Spindle	14301 (stainless steel)	14301 (stainless steel)	Hastelloy® C	14301 (stainless steel)
920/3	Hexagonal nut, flat	A4-70	A4-70	A4-70	A4-70
938/1	Screw plug	A4-70	A4-70	A4-70	A4-70
952/1	Pressure spring	EN 102701SH, galvanized	EN 102701SH, galvanized	EN 102701SH, epoxy-coated	EN 102701SH, galvanized
982/1	Sealing plugs	PE	PE	PE	PE

BIGGER RANGE OF APPLICATIONS: 0.2–13 bar, -60 TO +180 °C

FLANGES
PN 16 according to DIN EN 1092-2 type B, drilled according to ASME B 16.5 on request

PROTECTION AGAINST CORROSIVE ATMOSPHERE
Body with external epoxy coating, screws and nuts made of stainless steel A4-70

MARKING
AD 2000 Data Sheet A4, DIN EN 19

BACK PRESSURE p_{a0} IN VALVE OUTLET
max. of 30% of gage overpressure for vapours/gases, max. of 50% of gage overpressure for liquids, but subject to the following: $p_{a0,\ max}$ = 3 bar

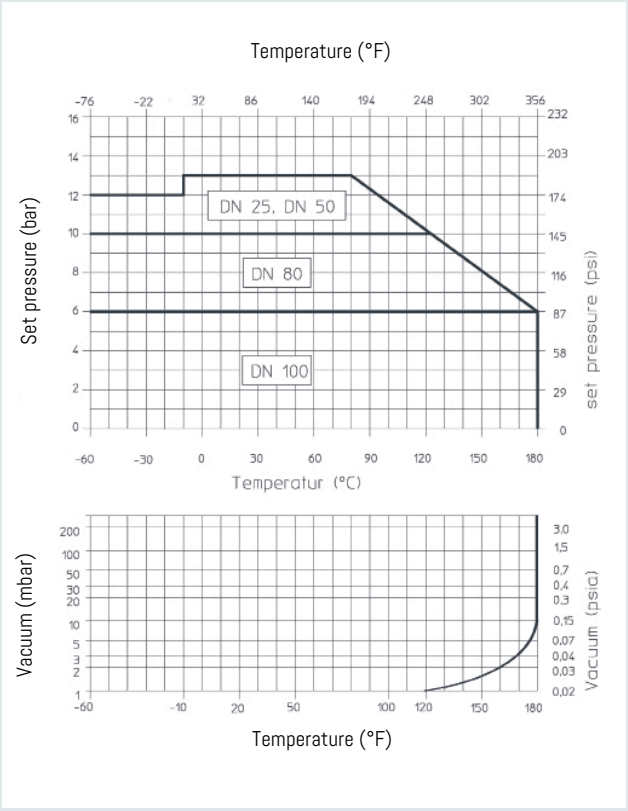
REPLACEABILITY
The valve performance and fitting dimensions mean that KSE 2.0 valves can be replaced with KSE 3.0 valves.

GAGE OVERPRESSURE/TYPE TESTING
The stated gage overpressure range is distributed over various springs, within which all intermediate values can be set.

ONE COMMON PART CERTIFICATION NUMBER
for vapours, gases and liquids

VALVE SIZE [DN]	GAGE OVERPRESSURE [bar]	PART CERTIFICATION NUMBER
KSE DN 25/50	0.2 – 13	TÜV. SV. 24- 1212 .. D/G/F
KSE DN 50/80	0.2 – 13	
KSE DN 80/100	0.2 – 10	
KSE DN 100/150	0.2 – 6	
KSE-C DN 80/100	0.2 - 1	
KSE-C DN 100/150		

PRESSURE AND TEMPERATURE RANGE



OPERATING TEMPERATURE
-60 °C to +180 °C depending on the set pressure. Body material 1.0619 WCB (GP240GH) from -60 °C according to AD 2000 Data Sheets W5 and W10 and within scope of ASME from -29 °C (-20 °F)

GAGE OVERPRESSURE
0.2 to 13 bar depending on the operating temperature and nominal width of the valve

VACUUM RESISTANCE
refer to diagram

CONNECTION AND INSTALLATION DIMENSIONS ACCORDING TO DIN, WEIGHTS

VALVE SIZE [DN]	INLET FLANGE [mm]			OUTLET FLANGE [mm]			SEAT AND OVERALL DIMENSIONS [mm]					APPROX. WEIGHTS [kg]
	DN_1	k_1	n x d_1	DN_2	k_2	n x d_2	d_0	S_1	S_1	H_1	L	
25/50	25	85	4 x 14	50	125	4 x 18	23	100	100	467	120	19
50/80	50	125	4 x 18	80	160	8 x 18	45	125	125	573	120	37
80/100	80	160	8 x 18	100	180	8 x 18	60	155	155	678	170	65
100/150	100	180	8 x 18	150	240	8 x 22	90	200	220	785	170	111

Fitting dimensions for ASME (ANSI) drilled flanges available on request

VERSION KSE 3.0 FOR PRESSURES FROM 0.2 TO 13 bar

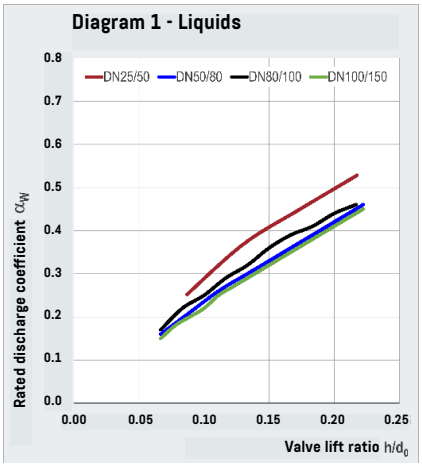
ADVANTAGE: The KSE safety valves can be adapted to the discharge mass flow rate by means of a lift reduction in the event of possible oversizing.

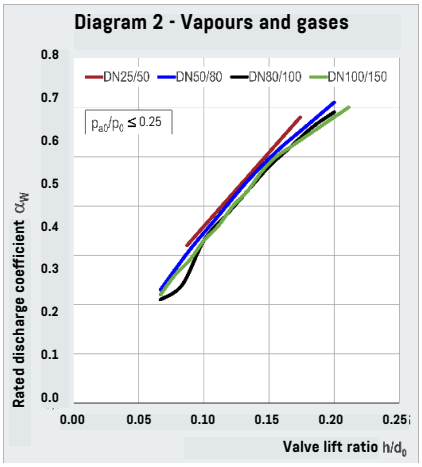
VAPOURS AND GASES: For pressure conditions $p_{a0}/p_0 > 0.25$, take the discharge coefficient α_w from diagram (3) and apply it.

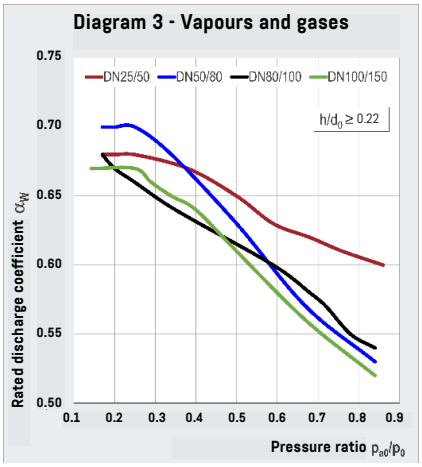
For safety valves adapted to the discharge mass flow rate by means of a lift reduction, take the discharge coefficients α_w from diagram (2), although for pressure conditions $p_{a0}/p_0 > 0.25$ a corresponding deduction should be carried out based on diagram (3). This deduction is the difference between the rated discharge coefficient α_w (see Table) and the value taken from diagram (3) for the relevant pressure condition p_{a0}/p_0.

LIQUIDS: For safety valves adapted to the mass flow by means of a lift reduction, refer to the diagram for the discharge coefficients (1).

KSE 3.0: RATED DISCHARGE COEFFICIENTS FOR LIQUIDS, VAPOURS AND GASES







KSE 3.0: RATED DISCHARGE COEFFICIENTS α_w AS FUNCTION OF h/d_0 AND p_{a0}/p_0

VALVE SIZE [DN]	NARROWEST FLOW CROSS-SECTION A_0 [mm²]	VAPOURS/GASES α_w FOR $h/d_0 \geq 0.22$ AND $p_{a0}/p_0 \leq 0.25$	LIQUIDS α_w FOR $h/d_0 \geq 0.22$
KSE DN 25/50	415	0.67	0.53
KSE DN 50/80	1590	0.70	046
KSE DN 80/100	2827	0.64	046
KSE DN 100/150	6362	0.67	045

KSE 3.0: PERFORMANCE TABLE FOR AIR (20 °C AND 1013 mbar) AND WATER (20 °C) AT 0 bar BACK PRESSURE

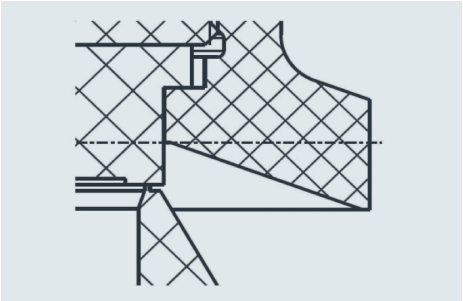
GAGE OVERPRESSURE [bar]	KSE DN 25/50		KSE DN 50/80		KSE DN 80/100		KSE DN 100/150	
	AIR [m_n^3/h]	WATER [kg/h]	AIR [m_n^3/h]	WATER [kg/h]	AIR [m_n^3/h]	WATER [kg/h]	AIR [m_n^3/h]	WATER [kg/h]
0.2	186	6134	644	20396	1145	36264	2529	79737
1	373	11745	1406	39056	2421	69441	5449	152877
2	585	16610	2309	55234	3808	98205	8838	216200
3	786	20343	3148	67647	5117	120276	12056	264790
4	988	23490	3953	78112	6427	138883	15140	305753
5	1189	26263	4759	87332	7736	155276	18225	341842
6	1390	28770	5564	95668	9045	170096	21309	374469
7	1591	31075	6369	103333	10354	183725		
8	1792	33220	7175	110648	11663	196410		
9	1994	35235	7980	117168	12972	208324		
10	2195	37141	8785	123506	14204	219593		
11	2396	38954	9591	129535				
12	2597	40686	10396	135295				
13	2798	42248	11201	140719				

VERSION KSE-C 3.0 FOR LOW PRESSURES, E.G. IN CHLORINE ELECTROLYSIS

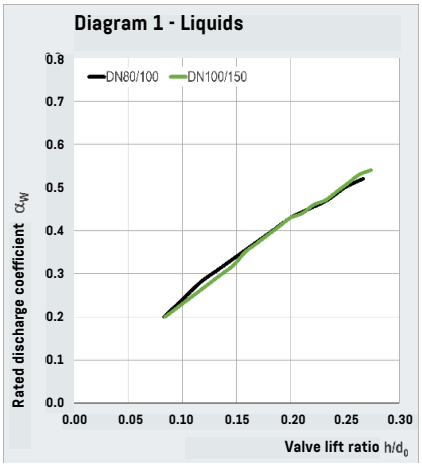
ADVANTAGE: Also leak-tight at gage overpressures in the 250 mbar range and working pressure differences in range < 50 mbar

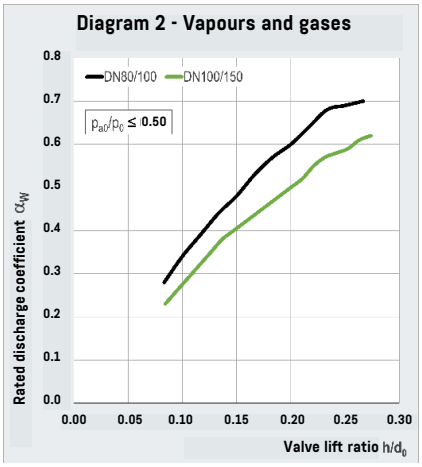
_ Adjustable pressure range 0.2–1.0 bar
_ Gas-tight
_ Improved leak tightness due to three times higher surface pressure
_ Overlapped sealing surfaces
_ Seat Ø: DN 80/100 = 60 mm, DN 100/150 = 95 mm
_ Other replaceable components are identical to those for the standard version of KSE 3.0
_ DN 80/100 and DN 100/150 available with type testing

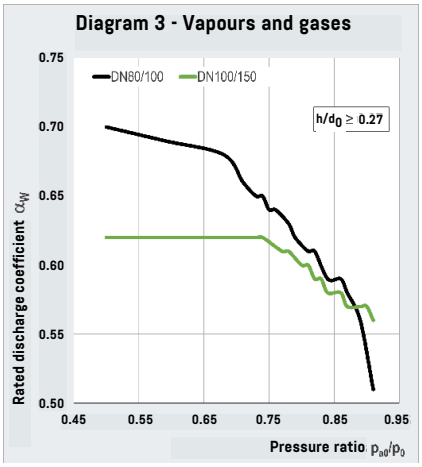
DETAIL:
KSE-C 3.0 seat and plug for low set pressures



KSE-C 3.0: RATED DISCHARGE COEFFICIENTS FOR LIQUIDS, VAPOURS AND GASES







KSE-C 3.0: RATED DISCHARGE COEFFICIENTS α_w AS FUNCTION OF h/d_0 AND p_{a0}/p_0

VALVE SIZE [DN]	NARROWEST FLOW CROSS-SECTION A_0 [mm^2]	VAPOURS/GASES α_w FOR $h/d_0 \geq 0.27$ AND $p_{a0}/p_0 \leq 0.5$	LIQUIDS α_w FOR $h/d_0 \geq 0.27$
KSE-C DN 80/100	2827	0.7	0.52
KSE-C DN 100/150	7088	0.62	0.54

KSE-C 3.0: PERFORMANCE TABLE FOR AIR (20 °C AND 1013 mbar) AND WATER (20 °C) AT 0 bar BACK PRESSURE

GAGE OVERPRESSURE [bar]	KSE-C DN 80/100		KSE-C DN 100/150	
	AIR [m_n^3/h]	WATER [kg/h]	AIR [m_n^3/h]	WATER [kg/h]
0.2	1350	39256	3276	102196
0.3	1620	45841	3875	119340
0.4	1901	51592	4346	134312
0.5	2115	56763	4765	147776
0.6	2284	61502	5145	160111
0.7	2439	65900	5495	171562
0.8	2584	70023	5821	182294
0.9	2722	73916	6131	192429
1.0	2901	77614	6442	202057

VALVE SIZING, FORMULA NOTATION, SPECIFICATIONS

FORMULAS FOR VALVE SIZING

(according to AD 2000 Data Sheet A 2 and DIN 3320)

_ for vapours and gases

$$A_0 = 0.1791 \cdot \frac{q_m}{\psi \cdot \alpha_w \cdot p_d} \cdot \sqrt{\frac{T \cdot Z}{M}}$$

_ for liquids

$$A_0 = 0.6211 \cdot \frac{q_m}{\alpha_w \cdot \sqrt{\Delta p \cdot \rho}}$$

OTHER DOCUMENTATION

_ VdTÜV Data Sheet 871
_ Richter data sheets with discharge coefficients α_w as function of h/d_0 and p_0-p_{a0}

PLEASE STATE THE FOLLOWING IN ENQUIRIES/ORDERS:

_ Valve type, DN, PN
_ Discharge mass flow rate [kg/h]
_ Gage overpressure [bar]
_ Back pressure [bar]
_ Operating pressure of secured system [bar]
_ Medium [gas, vapour, liquid]
_ Temperature of medium [°C]

ADDITIONAL INFORMATION REQUIRED FOR VAPOURS AND GASES

_ Molecular mass [kg/kmol]
_ Isentropic exponent k of the medium in the pressure chamber
_ Compressibility factor Z of the medium in the pressure chamber

ADDITIONAL INFORMATION REQUIRED FOR LIQUIDS

_ Density [kg/m³]
_ Solids, specify if relevant

FORMULA SYMBOLS

$A_0 = \frac{\pi \cdot d_0^2}{4}$ = Narrowest cross-section [mm²]

q_m = Discharge mass flow rate [kg/h]

α_w = Rated discharge coefficient

p_0 = Absolute pressure in the pressure chamber [bar abs]

p_e = Gage overpressure [bar]

p_{a0} = Back pressure in outlet connections [bar]

Δp = p_0-p_{a0} Differential pressure [bar]

ψ = Flow coefficient

T = Absolute temperature of medium in pressure chamber [K]

Z = Compressibility factor of medium in pressure chamber

M = Molecular mass [kg/kmol]

ρ = Density [kg/m³]

d_0 = Narrowest flow diameter [mm] of the safety valve

h = Lift [mm]

RICHTER Process Pumps & Valves

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