

Mondi Štětí a.s.

STANDARD
ST 10.02.01
CENTRIFUGAL PUMPS

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STANDARD

ST 10.02.01

CENTRIFUGAL PUMPS

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in her own hand

Signed by: Ing.Bc. Petr Bubla,
in his own hand

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The objective of this standard is a pump dimensioning and selection and their peripheral equipment.

1 Implemantary regulations

1.1 General

- a) In general, pumps must meet industrial standards. In case the used material is deviating from the standard, it must be visibly stated on the extra written form.
- b) Pump and motor must be mounted on the common stable assembly frame (exceptions only after approval). Base plate must be executed in such way that it is suitable for the possibly biggest motor with the use of the possibly biggest impeller wheel.
- c) Pump dimensioning must be executed in such way that it is the 20 % output increase is possible with the use of the bigger impeller wheel .
- d) Motor rotations should be on principle 1500 rpm, if it is not possible, 3000 rpm are also allowed.
- e) Impeller wheel exchange, coupling, or schaft sealing must be possible without motor and piping disassembly.
- f) All free-standing parts, moving parts (shaft ends, couplings, etc.) must be equiped with the safety cover. Coupling protection must be made of steel - plate, color RAL 1016 or stainless- steel plate with yellow-black stickers.
- g) Base frames assembly with mounted pumps and motors is done with heavy-load anchors and threaded bars (bolts) from the raw concrete. Construction of the base frames is minimally with welding.
- h) Grount must allow leaked liquids draining away (without puddle formations - see the principle sketch incl. inbuild parts)
- i) Removing or adjusting of the coupling must be done only after hardened grount, as well as piping assembly. There must be a record taken about coupling alignment (see attached example).
- j) Painting of the all pump parts (also foundation frame) must be done according to the painting Mondi Štětí standard. Stainless parts do not require any paintcoat.

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- k) If MC pumps or pumps which transferring pulp (pulp over 4%) and where vibrations are, necessary is between pump and outlet pipe placed compensator.

1.2 Material selection recommendations

On the grounds of the used media ,pipe materials and costs (stock lot, etc.), there are pump types determined for pulp and paper industry.

Following materials were selected on the basis of the media used in the operation and their pH values as a minimum requirement for the pump material. They can not be considered general, as the medium with the chemical properties and characteristics must be taken to account.

The manufacturer may recommend some technologically preferable materials.

pH value: 6 - 14 (for example. water, alkali, etc.)

Casing:	GG 25 (gray cast iron = graues Gusseisen)
Impeller wheel + wearing insertions:	1.4460
Shaft:	1.4439 or 1.4460
Bearing housing:	GG 25

pH value: 2 - 6 (acid) (for example diluted lixivium, etc.)

Casing:	1.4460
Impeller wheel + wearing insertions:	1.4460
Shaft:	1.4439 or 1.4460
Bearing housing:	GG 25

pH value : < 2 (strong acid) (for example. used condensate, etc.)

Casing:	1.4571 or equal
Impeller wheel + wearing insertions:	1.4571 or equal
Shaft:	1.4439 or 1.4460
Bearing housing:	GG 25

1.3 Impeller wheel recommendations

Substance density < 0,5 %	closed impeller wheel
Substance density 0,5 - 4 %	open impeller wheel
Substance density 4 - 7 %	open impeller wheel, screew wheel

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Substance density > 8 %

MC pump

1.4 Shaft sealing specifications

Wherever it is possible and meaningful, single seals with sliding rings must be taken into account.

Material combination: Silicon carbides/carbon preferred , depending on use.

- single (single acting) media seals, water dilutable;
- double (double acting) media seals, no diluting, under no conditions there must be allowed transported medium blowing or various pressure conditions which allow opening of the sliding ring.

When the stuffing box packings is applied, pump shafts must be equipped with exchangeable shaft sleeves (application only after the agreement with Mondi Štětí). Standard stuffing box packings string must be used.

All pumps must be constructed in such way, that it is possible to convert from sliding rings to packing strings and vice versa.

Special sealings after agreement, or as an alternative.

1.5 Lubrication

All fat lubricating places must be equipped with flat lubricating heads in accordance with DIN 3404.

Exceptions are only places of use, construction or insufficiency reasons require to use conic lubrication heads in accordance with DIN 71412.

1.6 Coupling

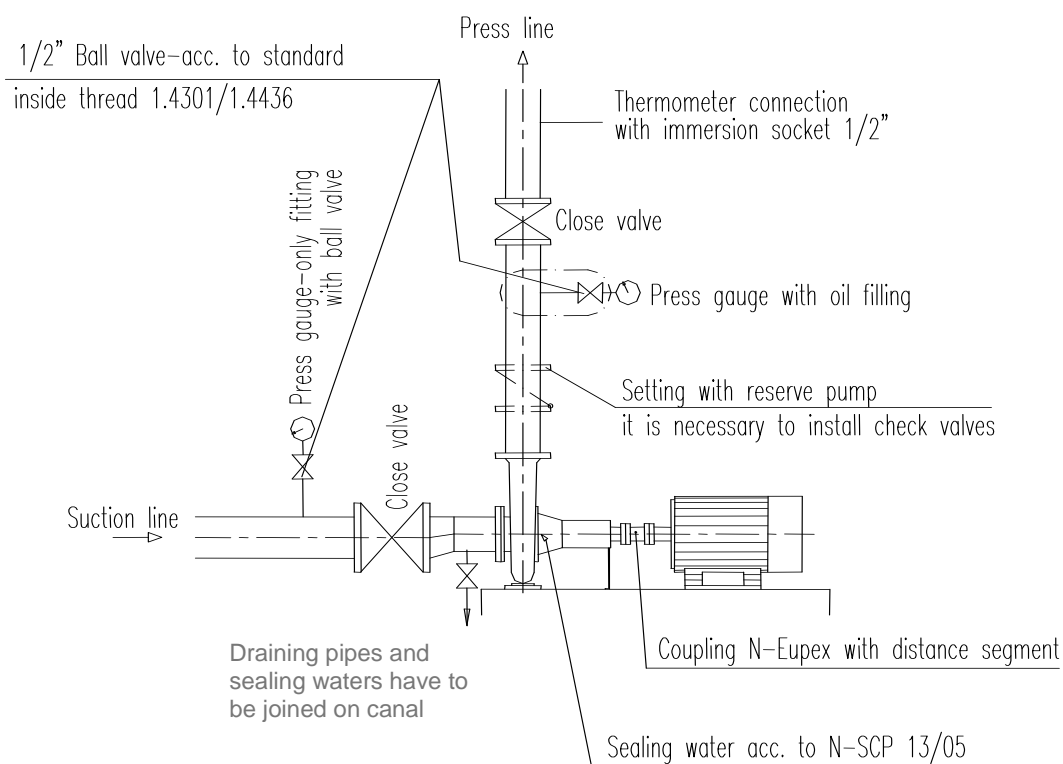
Couplings must be type N-Eupex or Samiflex with the assembly insert part.

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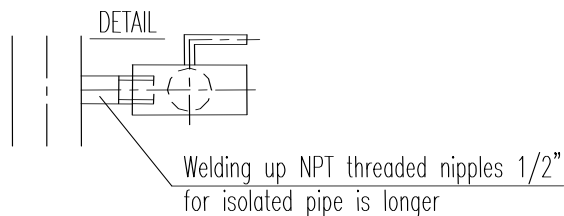
2 Peripheral equipment of the pump

2.1 Standard facilities

Obligatory assembly of the double seals with sliding rings and stuffing box packings



Required built-in for sliding double seal and stuffing



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In case any equipment, instrument or a machine is separated by armature from the piping system, it is necessary to mind that equipment, instrument or a machine are separable without cutting and system emptying.

- Body on flanges, or

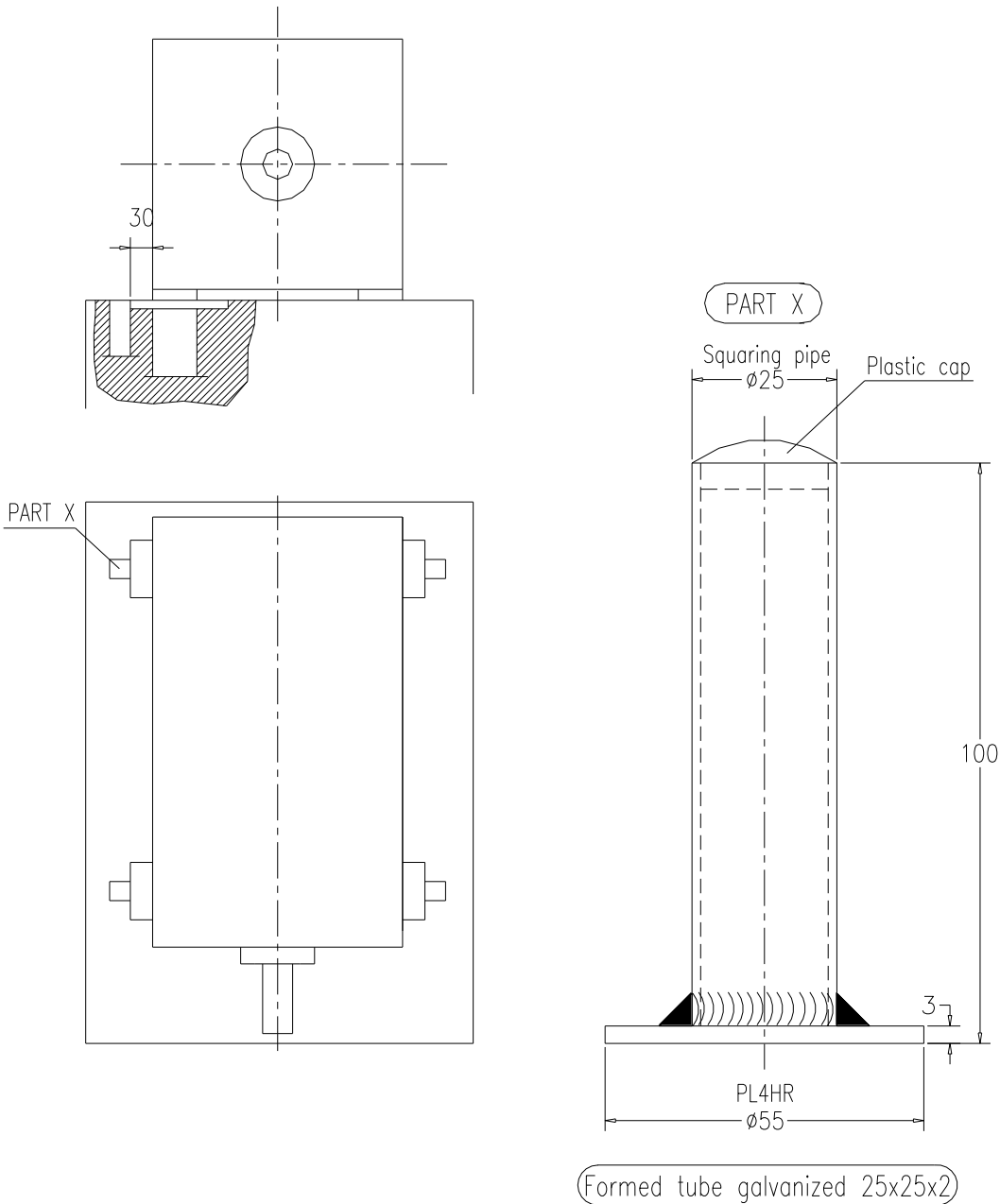
- Separating place according to the armature (flange/screwing)

In case of inseparable bodies, exchangeability of the ball-valves must be done by screwing.

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2.2 Adjusting instrument for coupling alignment

Description: Into section pipe, square irons with adjustable screws are inserted, which allows to move the motor.



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3 Pump specification

Identification	Normal.	Min.	Max.
Running no../ position n.			
Pieces			
Kind of Pump			
Pump type			
Operational conditions			
Transported material			
Temperature [°C]			
Operational pressure [bar]			
Abrasive – corroding components, medium [pH]			
Consistency / Density [%] / [kg/m ³]			
Dynamic viscosity [mPa*s]			
Transported quantity [m ³ /hod]			
Transport height [m FS]			
NPSH equipment [m]			
NPSH of a required pump [m]			
Nominal number of the pump rotation [1/min]			
Grade of pump efficiency [%]			
Power consumption [kW]			
Motor power consumption [kW]			
Construction			
Suction nozzle: DN / PN [mm] / [bar]			
Force nozzle: DN / PN [mm] / [bar]			
Position form (horizont./vert.); (dry; wet)			
Form of the impeller			
Diameter of the impeller [mm]			

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Max. diameter of of the impeller [mm]			
Justification of tension with			
Steps number			
Coupling- type/product			
Bearing / lubrication			
Construction lenght vert. [mm]			
Schaft sealing			
Closing liquid (Quench medium)			
Baseanchor type / size			
Base (Sole)plate dimensions			
Motor			
Construction size of the motor / Construction form (construction)			
Power / rpm [kW]/[1/min]			
Voltage / nominal current [V] / [A]			
Frequency / IP [Hz]			
Frequeny convertor			
Material			
Scroll case/ inter -wheel			
Impeller wheel / distributing wheel			
Sealing packings			
Shaft / shaft sleeve			
Base(Sole) plate			
Coupling			
Protection of couplings			
Packing material			
Seats with sliding rings			
Price			
Motor-free pump			
Assembly coupling + housing			
Plate for pump and motor			
Base anchors			
Threaded bars(bolts)			
Motor assembly			
Motor			

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Counter flanges			
Pump assembly / pcs			
Unit price			
Totla price			
Rabat			
Time of supply			
Price assesment			
Weight without/ with motor			
Supply weight			

4 List of the preferred suppliers

4. Preferred manufacturers for standard parts

Application	Producer
Pums for middle consistency pulp	SULZER METSO PAPER KVARNER PULPING
Pums for low consistency pulp	ANDRITZ SULZER
Chemical pumps	KSB SULZER VOGEL
Water pumps	KSB SULZER SIGMA META VOGEL
Deionized water, condensate	KSB (trust-proof casing, deep-pulled) SULZER

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Acids, liquors	KSB - Asyndetic pumps SULZER
Kaoline, lime	CHESTERTON NETZSCH SEEPEX
Pulper rejects	CHESTERTON SULZER
Vacuum pumps	NASH BINGHAM SIHI SIEMENS
Noncondensable gases (NCG)	HERMETIC Pumpen

5 Supplement to the calculation for transport high – only for information

**Dimensioning of the transport height
For centrifugal pumps
(for information only)**

Using the special logarithmic meter

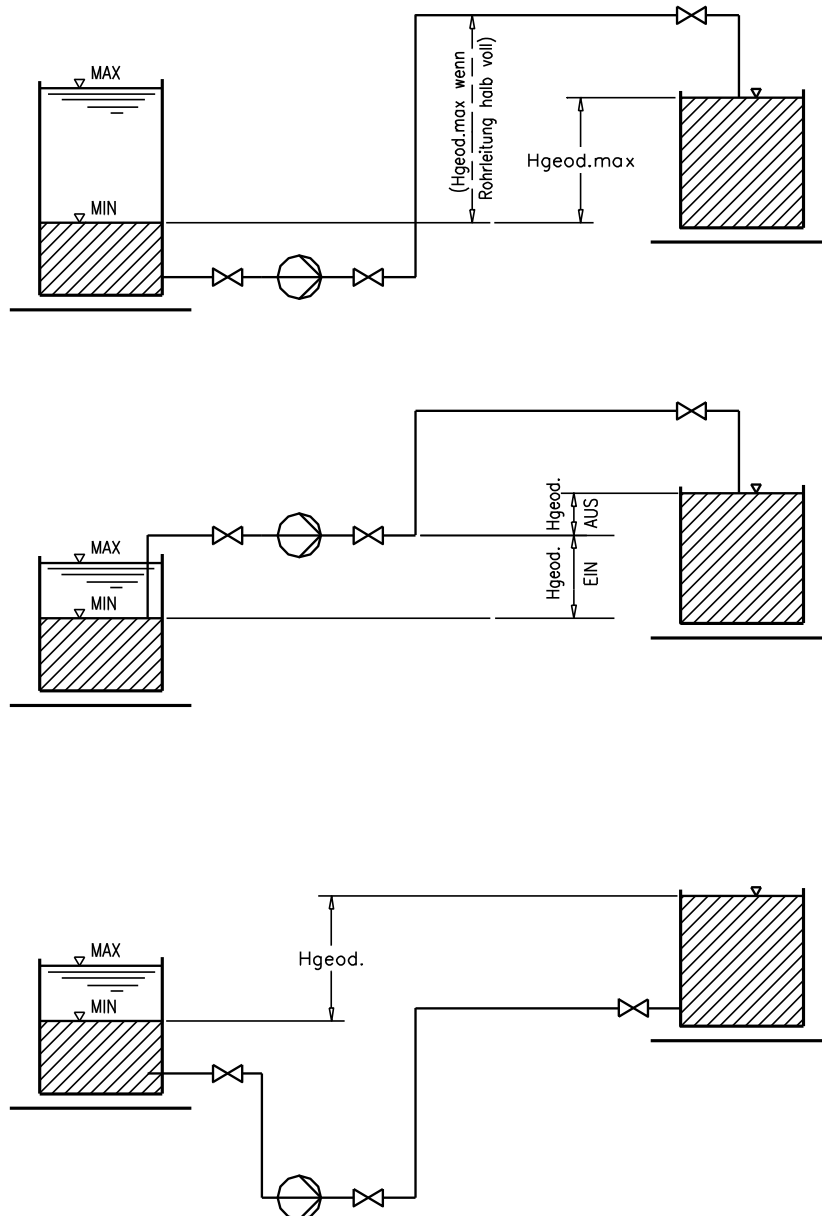
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5.1 Notes

Transport height

Generally, transport height consists of geodetic transport height (= height between liquid levels - input/output, which has to be eclipsed) and of loss heights specific for equipment (= resistance in piping, bends, valves, etc.)

Principle – figures



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5.2 Executing of the necessary details

Necessary for calculations:

- Transport quantity required Q (m³/s)
- transported medium
- Stuff density SD (%)
- Stuff temperature T (°C)
- Transported medium density (kg/m³)
- Kinematic viscosity ν (m²/s)
- internal pressure, when the tank is under pressure /vacuum (bar)
- exact equipment information:
 - pump location
 - pipeline
- isometric sketch
- Kv value of the control armatures
- Number of the diverse inbuilt units:
 - Gate & check valves, T- pieces, etc.

5.3 List of pulp suspensions

1. For simplification there is a following calculation page (5.4)
2. Fill in all existing (relevant) nominal internal pipe areas
3. Calculate flow velocity "v" (m/s)

$$v = \frac{Q}{A} = \frac{\text{transported quantity}}{\text{pipe cross section area}} = \frac{\text{m}^3/\text{s}}{\text{m}^2}$$

4. Fill in individual pipe lengths for the nominal internal pipe areas in (m).

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5. With attached calculating meter (Andritz) appropriate

„pressure loss“ (m)

will be calculated for the nominal internal pipe area.

- a) determine substance density in (%) to corresponding flow velocity "v" (m/s)
- b) nominal internal pipe area (right bottom panel) subtract corresponding pressure loss Dv (m) and divide 100.

ATTENTION : Subtracted value is valid for 100 m of the pipe length !

6. This pressure loss Dv is multiplied by correction factor "Korr" and pipe length L (m) corresponding to the nominal internal pipe area.

$$H_v = L * Korr * D_v \quad (m)$$

Korr... correction factors for substance sort and piping material (see list 5.7)

Hv ... loss height corresponding to the nominal internal pipe area depending on medium and piping characteristics.

7. Difference of the pressure heights ... Hdruck, when is tank under pressure

$$H_{druck} = \frac{\text{full pressure of the tank} - \text{suction pressure}}{\text{density} * \text{grav. acceleration} \quad (9,81 \text{ m/s}^2)} = \frac{\text{bar} * 100.000}{\text{kg/m}^3 * \text{m/s}^2}$$

8. At the end it adds up :

$$H = H_v + H_z + H_{geod} + H_{druck} \quad (m)$$

5.4 Calculating list

			unit	DN1	DN2	DN3	DN4	DN5
Multipl y	1. Transported quantity per sec		m³/s					
	2. Nominal dia	DN	m					
	3. Flow velocity	v	m/s					
	4. Substance density absolut dry	SD	%					
	5. Piping length	L	m					
	6. Correction factors	Korr						

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	7. Mediated. Pressure loss from the calculation meter (Andritz)	Dv	0,01m					
Sumarize	8. Loss height = $L * Korr * Dv$ (result from 5 * 6 * 7)	Hv	m					
	9. Resistances for inbuilt: Bends, armatures, T pieces (see table 5.8)	Hz	m					
	10. Conrtol armatures resistances	Hz	m					
	11. Other resistances	Hz	m					
	12. Geodetic height	Hgeod	m					
	13. Pressure height at the tank closure	Hdruc k	m	plus minus				
	14. Required Pump transport height (sum of 8,9, 10, 11 + 12 + 13)	H	m					
	15. Value NPSH Equipment		m					O.K. ?
	16. Value NPSH Pump		m					O.K. ?
	17. Zero transport height equipment		m					O.K. ?
	18. Zero transport height pump		m					O.K. ?

5.5 Equipment calculation - NPSH – value

Value NPSH

It is useful for safety verification of the pump cavitation. To follow the definition following must be observed:

$$NPSH_{\text{equip.}} > NPSH_{\text{pump}} + 0,5$$

NPSH - equipment

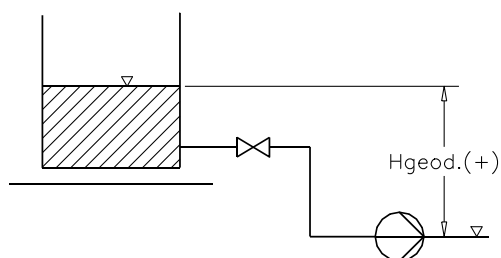
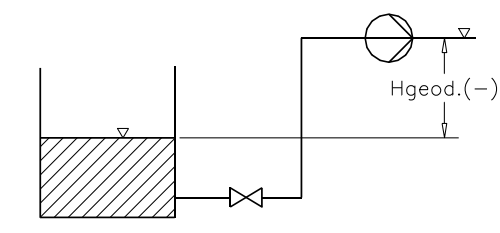
According to the definition, NPSH of the equipment is existing absolute pressure on the entrance section of the pump minus steam pressure at this state, in absolute mWS (m of the spout).

Value NPSH pump see manufacturer's pump data

a) in the suction mode

b) with inflow height

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Calculation model		Unit	Value to be written here
Internal pressure, tank closed	PE	bar relat.	
Atmospheric air pressure	PB	bar	1,00
Steam pressure of a liquid	PD	bar	
Density of a liquid	Density	kg/m ³	
Acceleration of the gravity	g	m/s ²	9,81
Calculated outflow velocity	ve	m/s	
Calculated suction loss height ¹⁾	Hvs	m	
Hgeod (+), or (-)	Hgeod	m	

$$\text{NPSH equipm.} = \frac{(P_E + P_B - P_D) * 100.000}{\text{Density} * g} + \frac{v_e^2}{2g} - H_{VS} + / - H_{geod}$$

1) see the calculation technique

Simplified formula:

$$\text{NPSH equipment} = \frac{(P_E + P_B - P_D) * 10.000}{\text{Density}} - H_{VS} + / - H_{geod}$$

Simplified way for water and substance up to 50 °C, density < 4 %, open tanks:

$$\text{NPSH equipment} = 8 - H_{VS} + / - H_{geod}$$

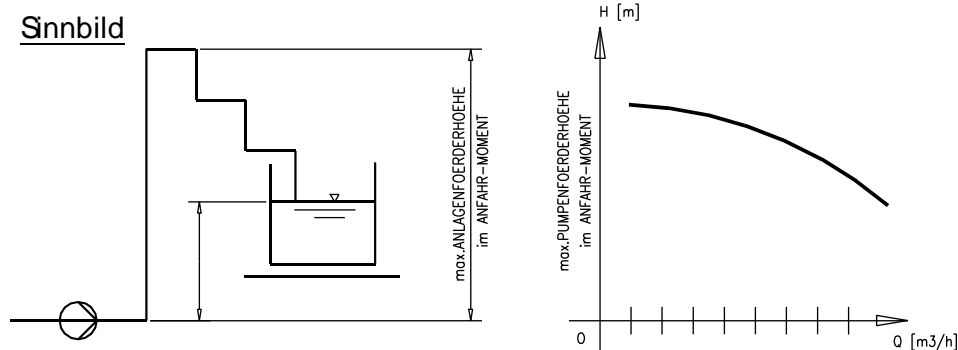
Calculated value of NPSH equipment		m	
value of NPSH pump		m	

5.6 Verifying calculation for the zero transport height

A great amount of equipment has a mean effective transport height smaller than an actual height, which has to be overcome by the pump at the start.

For example: rising pipe line following with descend.

Therefore, it is necessary to compare minimum necessary transport height of the equipment and the maximum transport height of the pump at the moment of start (transport quantity is practical zero).



Application method

1. Zero transport height - equipment

Transport height to the maximum height of equipment must be calculated analogically to a check list and calculation list for transport heights (see calculation modus).

2. Zero transport height – pump

Using the pump characteristics, maximum transport height must be deducted if the transport quantity equals or is larger than zero.

Transport height of the pump must be higher than a transport height of the equipment.

The larger Q/H value must be selected acc. to diagram (quantity/ transport height) if the pump has too small power at the start up.

Foreign pipe line filling is useful in case the deviations are too large eventually for too large nominal pipe internal areas (> 300 mm).

5.7 Correction factors: Parts resistance built into piping

Correction factors

Lambda For different types of substances

K Friction resistance of the pipe 0,7 ... for common pipes
 Stainless steel
 (1.4436, 1.4301, 1.4571)
 (17352, 17240, 17348)

$"KORR" = \text{Lambda} * K$

Valid for:

"KORR" ... Ungrinded sulphit bleached	0,525
"KORR" ... Grinded sulphit bleached	0,490
"KORR" ... Ungrinded salt bleached	0,560
"KORR" ... Grinded salt bleached	0,525
"KORR" ... waste	0,500

Resistances Zeta-values

(Loss heights ... m) for armatures and shaped pieces

ZETA resistance digit of the tube part , armature or shaped pieces

$$H_z = \text{Sum ZETA} * \frac{v^2}{2 * g}$$

H_z ... loss height in armature (m) or shaped pieces

v ... flow velocity (m/s)

g ... acceleration of gravity ... 9,81 m/s²

"Sum ZETA" ... Zeta-values of all armatures and shaped pieces must add up.
This is necessary for the same nominal internal areas of pipe.

ZETA-values ... see table

See a following standardized form

5.8 Standardized form for zeta - values

		DN1	DN2	DN3	DN4	DN5	DN6
Nominal internal areas of pipe DN							
Flow velocity v							
Pcs	List Elbow s, T-pieces, armatures, inbuilt parts						

Summary making on nominal internal area all pieces							
$\frac{v^2}{2g}$ for nominal internal area							
$Hz = \text{"sum ZETA"} * \frac{v^2}{2g}$							

Back to the calculation modus

6 Cartidge seal for centrifugal pumps

6.1.Principles

As long it is possible from the point of economy or technology, the pumps with hydro mechanical seals are used.

6.2 Seals with seal face rings for centrifugal pumps

6.2.1 Usage criteria

Mechanical seals of renowned suppliers, JohnCrane, Metso, Chesterson choice according to the application on the basis of the recommendations of the manufacturer.

For the correct function of the mechanical seal must be cooling water in the required quality and quantity. Functionality of cooling water recommended install under control system.

For production pumps we prefer SULZER products equipped with mechanical seals JohnCrane.

Mechanical Sealing Systems for Industry

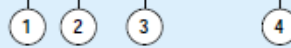


With SAFEBOX seals you can standardize your seal inventory and reduce the amount of capital.

Safebox Seal Identification Codes

Example:

SB2-50-QRMN-302197
XXX-XX-X₁-X₂-X₃-X₄-XXXXXX



1 Type of Seal SB1: single seal
 SBW: single seal with water quench
 SB2: double seal

2 Shaft Diameter (mm, in)

3 Material Codes

X ₁	X ₂	X ₃	X ₄
Q -SiC/SiC	R -AISI 316/329	M -PTFE	N -TC/carbon
G -SiC/carbon	T -Titanium	E -EPDM	G -SiC/carbon
T -TC/TC	U -UHB 904 L	V -Viton®	V -V-Ring (Quench)
			O -Single Seal

4 Drawing Number

Safematic has a comprehensive network of highly trained representatives, distributors, and installation and maintenance personnel. Contact your local Safematic distributor or the Safematic sales office for more information.

The John Crane Safematic® European office is located in Muurame, Finland — tel: 358-14-600611, fax: 358-14-600600. Its North American office is located in Norcross, GA — tel: 1-770-416-9401, fax: 1-770-416-9079.



John Crane

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 Tel: 1-847-967-2400
 Fax: 1-847-967-3915
1-800-SEALING

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 Fax: 44-1753-224224

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Global Specialized Engineering

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ISO Certified

B-Safebox

SAFESEAL SB1 IS A VERSATILE SEAL FOR CLEAN FLUIDS AND LUBRICANTS

Typical Applications

SafeSeal SB1 is a single cartridge seal for use with clean fluids and lubricants: e.g., water, oil, solvents, and pulp (consistency < 2%). Generally it is used in pumps in the Pulp & Paper industry as well as in power plants. The SB1 cartridge seal fits in various pumps as well as in other processing equipment.

The SB1 seal is versatile, easy to install and maintain. Although the design of the seal is simple, it contains advanced technical features like patented seal face holders and an elastic thrust ring.

Features

The balanced cartridge design makes the SB1 seal applicable for a wide range of demanding conditions.

1. Balanced Construction

Sudden changes in pressure do not affect seal function

2. Springs are Located in the Stationary Part of the Seal

Shaft misalignment will not vibrate the springs or wear out the O-rings

3. SiC/Carbon Faces are Standard

Ideal for the high speeds found in condensate and high pressure pumps

4. Cartridge Design

Easy to install, reducing possibilities of human error. No measurements necessary for installation

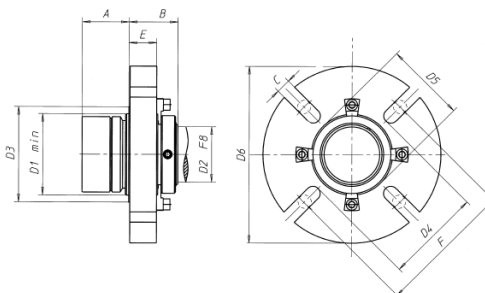
No face cracking during start-up

5. No Drive Pins in Contact with Faces

No face cracking during start-up

6. Available in Different Materials

Selection covers all single seal applications



Technical Specifications

Stuffing Box Pressure max. 15 bar (215 psi)

Speed max. 20 m/s (65 ft/s)

Temperature max. 120 °C (250 °F)

Materials

Seal Faces SiC/Carbon

SiC/SiC

O-Rings PTFE

EPDM

Viton®

Metals AISI 329 Standard,

Titanium, Hastelloy®, UHB

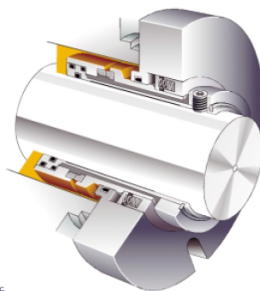
Springs Nimonic Steel

Standard Seal

SB1-0D2-GREO

Viton is a registered trademark of DuPont.

Hastelloy is a registered trademark of Haynes International, Inc.



SB1 Dimensions (mm)

Seal/D2	A	B	C	E	D1	D3	D4	F min.	D5	D6
105	54	51	17	30	135	160	175	134	220	
100	54	51	17	30	129	159	145	175	131	220
95	54	51	17	30	124	149	140	165	126	210
90	54	51	17	30	119	139	132	165	117	210
85	54	51	17	30	114	149	134	165	116	210
80	54	51	17	30	109	139	123	155	111	210
75	54	51	17	30	104	139	117	155	106	210
70	47	51	17	30	96	139	112	155	99	210
68	47	51	17	30	95	139	112	127	95	210
65	47	51	17	30	90	116	102	127	92	160
63	47	51	17	30	90	116	102	127	92	160
60	42	44	13	25	85	111	98	123	87	160
58	42	44	13	25	83	99	94	111	85	160
55	42	44	13	25	75	99	90	111	80	160
53	42	44	13	25	75	99	90	111	80	160
50	42	44	13	25	70	86	86	111	73	160
48	42	44	13	25	68	84	83	105	73	140
45	42	44	13	25	65	81	81	105	68	140
43	42	44	13	25	65	93	60	101	70	140
40	42	44	13	25	60	86	75	98	66	130
38	42	44	13	25	58	84	73	98	65	130
35	42	44	13	25	51	67	67	91	55	130

SAFESEAL SBW IS A RELIABLE QUENCH SEAL

Typical Applications

SafeSeal SBW is a single seal cartridge used in the quench (unpressurized) wash. The SBW seal can be used in many industrial process pumps. The design ensures reliable performance and longevity under demanding conditions. Typical applications include pulp pump pumps in the

Pulp & Paper industry and in high temperature condensate pumps. The SBW cartridge seal fits other processing equipment in addition to pumps.

Features

Balanced cartridge design makes the SBW seal ideal for a wide range of applications under demanding conditions.

1. Balanced Design

Sudden changes in pressure do not affect seal function

2. Springs are Located in the Stationary Part of the Seal, in the Seal Water

Shaft misalignment will not vibrate the springs or wear out the O-rings. The seal water washes the springs

3. Cartridge Design

No measurements necessary for installation. Easy to install, reducing possibilities of human error

4. No Drive Pins in Contact with Faces

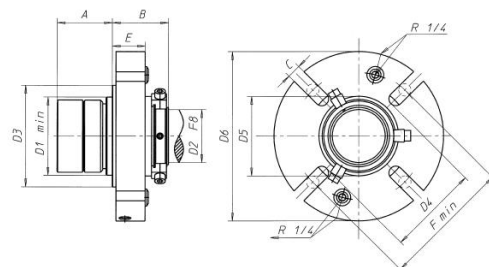
No face cracking during start-up

5. Available in Different Materials

Selection covers all single applications

6. Unpressurized Water Quench

At high temperatures, the seal is cooled with an unpressurized (quench) wash. A v-ring prevents quench water leakage



Technical Specifications

Stuffing Box Pressure max. 15 bar (215 psi)

Seal Water Pressure max. 0.5 bar (7 psi)

Speed max. 20 m/s (65 ft/s)

Temperature max. 150 °C (300 °F)

Materials

Faces SiC/Carbon

SiC/SiC

O-Rings PTFE

EPDM

Viton

Metals AISI 329 Standard,

Titanium, Hastelloy®, UHB

Springs Nimonic Steel

Standard Seal

SBW-0D2-QREV



SBW Dimensions (mm)

Seal/D2	A	B	C	E	D1	D3	D4	F	D5	D6
105	62	65	17	35	135	169	150	175	135	230
100	62	65	17	35	129	159	145	175	131	210
95	62	65	17	35	124	149	140	165	126	210
90	62	65	17	35	119	149	135	165	121	210
85	62	65	17	35	114	149	134	165	116	210
80	62	65	17	35	109	139	123	155	111	210
75	62	65	17	35	104	139	117	155	106	210
70	54	60	17	35	95	139	112	155	99	210
68	54	60	17	35	95	139	112	127	95	210
65	54	60	17	35	90	116	102	127	92	160
63	54	60	17	35	90	116	102	127	92	160
60	52	53	13	31	85	111	98	123	87	160
58	52	53	13	31	83	99	94	111	85	160
55	52	53	13	31	75	99	90	111	80	160
53	52	53	13	31	75	99	90	111	80	160
50	52	53	13	31	70	86	86	111	73	160
48	52	53	13	31	68	84	83	105	73	140
45	52	53	13	31	65	81	81	105	68	140
43	52	53	13	31	65	93	60	101	70	140
40	52	53	13	31	60	86	75	98	66	130
38	52	53	13	31	58	84	73	98	65	130
35	52	49	13	30	55	79	70	91	61	130

SAFESEAL SB2 IS A DOUBLE-BALANCED CARTRIDGE SEAL DESIGNED FOR THE TOUGHEST CONDITIONS

Typical Applications

SafeSeal SB2 is a dual cartridge seal. Its double-balanced design ensures the reliability and longevity of the seal in the most demanding conditions. The SB2 seal is ideal for use with environmentally hazardous and abrasive fluids, most often used in pumps in pulp mill area for cooking, evaporation, and causticizing. The SB2 seal is also compatible with other kinds of pumps and process equipment, including agitators.

Features

1. A Patented Thermal Method is Used to Fasten the Seal Faces, Ensuring Correct, Distortion-Free Face Alignment at all recommended temperatures.

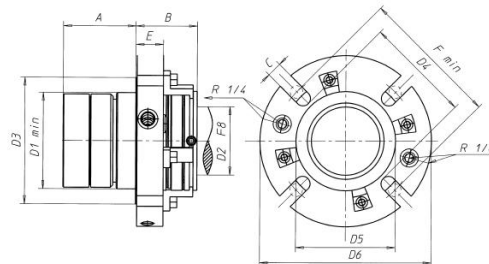
2. The Springs are Located in the Stationary Body of the Seal, in the Seal Water.
The seal water washes the springs, preventing process chemical corrosion. Reduced chance of the springs getting blocked or jammed. Shaft misalignment does not vibrate or wear out the o-rings.

3. The Piston Design Permits Free Axial Movement.
It allows a 2mm axial movement. Impeller adjustments do not affect face stress or spring strength.

4. PTFE Slot Rings
PTFE slot rings replace the traditional o-rings in places where they are exposed to the product, preventing sticking.

5. Protected Faces
The seal face carriers are driven by machined fits. Prevents metal stress from distorting the face.

6. Patented Double-Balanced Design
Allows the use of both pressurized and unpressurized water. Prevents face overload.



SB2 Dimensions (mm)

Seal/D2	A	B	C	E	D1	D3	D4	F	D5	D6
140	84	86	17	36	178	106	192	222	187	280
135	84	86	17	36	172	106	185	215	179	280
130	84	86	17	36	166	106	180	210	174	280
125	76	76	17	34	160	99	175	194	170	270
120	76	76	17	34	157	99	170	194	158	245
115	76	76	17	34	150	99	160	185	150	230
110	76	76	17	34	140	99	149	175	139	230
105	76	76	17	34	135	99	144	175	134	220
100	76	76	17	34	129	99	138	175	131	220
95	76	70	17	30	123	99	134	165	125	200
90	76	70	17	30	119	99	128	165	120	200, 220*
85	76	70	17	30	114	99	123	165	111	200, 220*
80	74	65	17	29	109	99	118	155	111	200, 220*
75	72	60	17	25	95	99	105	155	98	170, 220*
68	72	60	17	25	95	111	104	127	95	170
65	72	60	17	25	93	111	102	127	92	160, 170*
63	72	60	17	25	90	111	99	127	90	160
60	64	53	13, 17	24	85	111	95	123/127	87	150, 170*
58	64	53	13	24	83	99	93	111	84	150
55	64	53	13, 17	24	79	99	89	111/115	82	150, 170*
53	60	53	13	24	76	99	86	111	80	140, 170*
50	60	53	13, 17	23	74	99	84	111/115	77	140, 170*
48	60	53	13	23	72	93	82	105	75	140, 150*
45	59	52	13	23	69	93	79	105	75	130, 150*
43	59	52	13	23	67	89	77	101	70	130, 150*
40	59	52	13	23	62	86	72	98	66	130
38	59	52	13	23	62	86	72	98	66	130
35	57	49	13	20	58	79	68	91	62	130

This seal is the most technically advanced seal on the market.
Combined with the SAFEUNIT control and monitoring systems, it guarantees long and trouble-free use.

*Standard and extra large range sizes

Technical Specifications

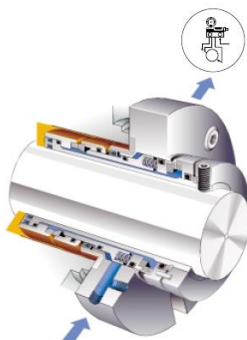
Stuffing Box Pressure max. 15 bar (215 psi)
Seal Pressure max. 15 bar (215 psi)
Velocity max. 20 m/s (65 ft/s)
Temperature max. 180 °C (350 °F)

Materials

Faces SiC/Carbon
SiC/SiC
O-Rings PTFE
EPDM
Viton
Metals AISI 320 Standard,
Titanium, Hastelloy, UHB
Springs Nimonic Steel

Standard Seal

SB2-0D2-QRMG



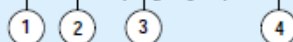
Mechanical Sealing Systems for Industry



SE Seal Identification Codes

Example:

SE2-P1-QRMG-301169
XXX-XX-X₁-X₂-X₃-X₄-XXXXXX



1 Type of Seal SE1; single seal
SEW; single seal with water quench
SE2; double seal

2 Shaft Diameter (mm, in)

3 Material Codes

X ₁	X ₂	X ₃	X ₄
Q -SiC/SiC	R -AlSi 316/329	M -PTFE	N -TC/carbon
G -SiC/carbon	T -Titanium	E -EPDM	G -SiC/carbon
T -TC/TC	U -UHB 904 L	V -Viton®	V -V-Ring (quench)
			O -Single Seal

4 Design Number

P1= tailor made for APP-pumps with four bolts

Safematic has a comprehensive network of highly trained representatives, distributors, and installation and maintenance personnel. Contact your local Safematic distributor or the Safematic sales office for more information.

The John Crane Safematic® European office is located in Muurame, Finland — tel: 358-14-600611, fax: 358-14-600600. Its North American office is located in Norcross, GA — tel: 1-770-416-9401, fax: 1-770-416-9079.



John Crane

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Tel: 1-847-967-2400
Fax: 1-847-967-3915
1-800-SEALING

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Fax: 44-1753-224224

Latin America
Sao Paulo, Brazil
Tel: 55-11-820-4146
Fax: 55-11-829-8270

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Singapore
Tel: 65-222-9161
Fax: 65-223-5035

TI Group
Global Specialist Engineering

For your nearest John Crane facility, please contact one of the locations above.

If the products featured will be used in a potentially dangerous and/or hazardous process, your John Crane representative should be consulted prior to their selection and use. In the interest of continuous development, John Crane Companies reserve the right to alter designs and specifications without prior notice. It is dangerous to smoke while handling products made from PTFE. Old and new PTFE products must not be incinerated.

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ISO Certified

B-SESeals

SE1 SEAL • SIMPLE DESIGN, GOOD TECHNICAL SOLUTIONS

Typical Applications

Safesol SE1 is a special seal designed for clean and lubricating fluids such as water, different types of oils, solvents, and stock (consistency < 2%). It is typically used in pumps in paper and board mills as well as in power plants. The SE1 seal is designed especially for the Ahlstrom APP and APT pump series.

The SE1 seal is easy to install and maintain. In spite of its simple design, SE1 is very advanced in its technical capabilities, including, for example, a patented thermal method for seal face holding and an elastic thrust ring.



Features

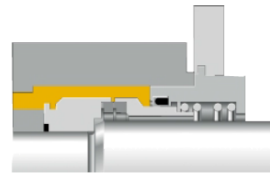
- Balanced Design**
Undisturbed operation even with sudden pressure shocks.
- Spring Located in the Stationary Body of the Seal**
Shaft misalignment does not pump up the spring or wear out the o-ring.
- SiC/Carbon a Standard Option for Seal Faces**
SiC/Carbon holds up well under high speeds found in, for example, condensate pumps and other high temperature pumps.
- Installation Against the Shaft Shoulder**
Easy installation reduces risk of human error. No measurements required for installation.
- No Drive Pins at Seals**
Seal face does not crack at start-up.
- Available in Different Materials**
Selection covers all possible single seal applications.

Technical Specifications

Stuffing Box Pressure	max. 15 bar (215 psi)
Speed	max. 20 m/s (65 ft/s)
Temperature	max. 120 °C (250 °F)

Materials

Seal Faces	SiC/Carbon SiC/SiC
O-Rings	EPDM PTFE Viton®
Metal Parts	Standard material AISI 329 (Titanium, UHB)
Springs	Nimonic steel



SEW SEAL • A RELIABLE, LONG-LASTING SEAL FOR DEMANDING CONDITIONS

Typical Applications

SEW is a seal operating on a non-pressurized water rinsing (quench) principle, and it is designed for the most demanding applications in the pulp industry where reliable and long-lasting operation is required from a seal.

Typical applications include stock pumps at pulp mill washing and screening facilities, as well as high temperature condensate pumps. The SEW seal is especially designed for the Ahlstrom APP and APT pump series.



Features

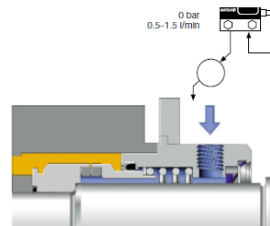
- Balanced Design**
Undisturbed operation even with sudden pressure shocks.
- Spring Located in a Stationary Body**
Shaft misalignment does not pump up the spring or wear out the o-ring.
- Installation Against the Shaft Shoulder**
Easy installation reduces risk of human error. No measurements required for installation.
- No Drive Pins at Seals**
Seal face does not crack at start-up.
- Available in Different Materials**
Selection covers all possible single seal applications.
- Non-Pressurized Seal Water Rinsing (Quench)**
Possible to cool seal with non-pressurized seal water at high temperatures. V-ring prevents water leakage from the seal.

Technical Specifications

Stuffing Box Pressure	max. 15 bar (215 psi)
Speed	max. 20 m/s (65 ft/s)
Temperature	max. 150 °C (300 °F)

Materials

Seal Faces	SiC/Carbon SiC/SiC
O-Rings	EPDM PTFE Viton
Metal Parts	Standard material AISI 329 (Titanium, UHB)
Springs	Nimonic steel



SE2 SEAL • DOUBLE-BALANCED DESIGN, ULTIMATE RELIABILITY

Typical Applications

The double-balanced design of Safesol SE2 ensures reliable and long-lasting operation under the most demanding conditions.

This seal is typically used in pumps for abrasive and environmentally hazardous liquids in cooking, evaporation, and causticizing facilities in pulp mills. The SE2 seal is especially designed for the Ahlstrom APP and APT pump series.



Special Features

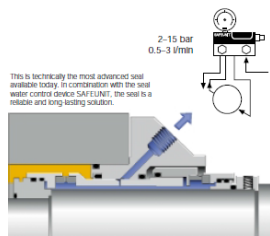
- Seal faces are fastened by a patented thermal heat shrink method, ensuring correct face alignment at all temperatures recommended for this seal.
- The springs are located in the stationary body of the seal in the seal water. This allows the seal water to rise the springs continuously, preventing corrosion by process chemicals. In addition, spring jams decrease. Shaft misalignment does not pump up springs or wear out o-rings.
- The piston-type design of the seal enables free axial movement, therefore axial movement does not have any impact on seal face loading.
- Even in standard models, PTFE slot rings in positions where they are exposed to the product have replaced traditional o-rings. The PTFE seal advantage is that it does not jam even in process conditions involving a lot of solid material.
- Milled slots prevent rolling of the body ring that protects the seal face. This eliminates tension peaks that would distort the seal face.
- The special double-balanced design allows the use of both pressurized and non-pressurized seal water.

Technical Specifications

Stuffing Box Pressure	max. 20 bar (290 psi)
Seal Water Pressure	max. 15 bar (215 psi)
Speed	max. 30 m/s (98 ft/s)
Temperature	max. 180 °C (350 °F)

Materials

Seal Faces	SiC/SiC (product side) SiC/Carbon (atmosphere side)
O-Rings	PTFE (product side) Alternatives: EPDM, Viton, etc.
Metal Parts	Standard material AISI 329 (Titanium, UHB)
Springs	Nimonic steel



Viton is a registered trademark of DuPont.

7 Annex

Loss height H_v in armatures and shaped piecess

$$H_v = \xi * \frac{v^2}{2g} \quad \text{in meters, where} \quad \begin{array}{l} v = \text{middle flow velocity in base section} \\ \text{in m/s} \\ \xi = \text{resistance digit of the contact parts of} \\ \text{the pipe} \end{array}$$

or

$$H_v = \sum \xi * \frac{v^2}{2g} \quad \text{in metres,}$$

ξ - values of all armatures and shaped piecess are added up first .The same nominal internal area DN must be observed. In the following setting resistance digits are sytated for the most common armatures and shaped piecess. With the known values v and ξ loss height can be simply stated H_v using the table 15, page 144.

Armatures

Base section: Section is calculated from the nominal internal area DN.

Flow valves (completely opened valve)

Directly seated valve (stem vertically)	Casted valves, DN 25 up to 200	$\xi = 2,5$
	Wrought valves, DN 25 up to 50	$\xi = 6,5$

Aslope seated valve, direct valve (with aslope stem)

DN	25	32	40	50	65	80	100	125 až 200
ξ	1,7	1,4	1,2	1,0	0,9	0,8	0,7	0,6

Corner valves (valve completely open) DN 25 up to 200: $\xi = 2,0$

Reverse valve

Directly seated valve, DN 25 up to 200	$\xi = 3,5$
Aslope seated valve, DN 50 up to 200	$\xi = 2,0$

Foots valves with a suction basket (to DN 350 included)

DN		50 up to 80	100 up to 350
ξ when	$v = 1 \text{ m/s}$	4,1	3
	$v = 2 \text{ m/s}$	3,0	2,25

Foots valves in a group set-up (from DN 400)

DN	400	500	600	700	800	1000	1200
ξ	7,0	6,1	5,45	4,95	4,55	4,05	3,9

Sealing chek-valves (closing check-valves), ring sealing check-valves(check-valve-completely open)

DN		400	600	800	1000	1200	1500
ξ pri	PN 2,5			0,08	0,06	0,05	0,13
	PN 4		0,16	0,12	0,11	0,20	0,17
	PN 6			0,16	0,30	0,25	0,22
	PN 10	0,48	0,33	0,50	0,45	0,41	0,37
	PN 16	1,20	0,85	0,73	0,63		

Return Check- valves, without lever and weight

DN		50	200	300	500	600	700	800	1000	1200
ξ with	v=1m/s	3,05	2,95	2,90	2,85	2,70	2,55	2,40	2,30	2,25
	v=2m/s	1,35	1,30	1,20	1,15	1,05	0,95	0,85	0,80	0,75
	v=3m/s	0,86	0,76	0,71	0,66	0,61	0,54	0,46	0,41	0,36

If the check –valves are provided with lever and weight, resistance digits can represent multiplied nominal value according to the weight setting. Gross approximate values can be gained for $v \times 2,5$ m/s multiplying factor 2,5.

Turning check valves (knife check valves), with lever and weight/load (axis of rotation of shutter is situated in the upper semicircular area)

v	1 m/s	1,5 m/s	2 m/s	2,5 m/s
ξ	8	3	1,3	0,7

Shutter closures (drainage check valves, High water shutters)

Resistance digits of the shutter closures depend on the flow velocity, construction and flap weight, so that binding values can be stated only by manufacturer.

It can be considered for the aproximate calculations: $\xi = 1,0$ upto 1,5

With stop from reverse flow HYDRO-STOP

	DN	50	100	150	200	250	300	400
ζ pri	v=2m/s	5	6	8	7,5	6,5	6	7
	v=3m/s	1,8	4	4,5	4	4	1,8	3,4
	v=4m/s	0,9	3	3	2,5	2,5	1,2	2,2

With flat gate valve (slide completely open)

DN	100	200	300	400	500	600 až 800	900 až 1200
ζ	0,18	0,16	0,14	0,13	0,11	0,10	0,09

With oval gate valve and cylinder valve (slide completely open)

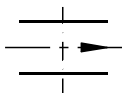
DN	100	200	300	400	500	600 až 800	900 až 1200
ζ	0,22	0,18	0,16	0,15	0,13	0,12	0,11

Round gate valve (slide completely open)

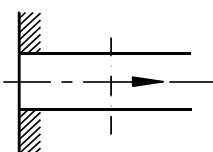
	Referring to the narrowest section
ζ	0,5 up to 0,8

Shaped piece

Relative section for flow velocity \underline{v} is always marked



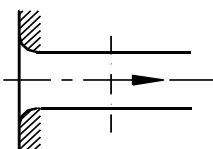
Square inlet



Very sharp
normally round
Rough phase

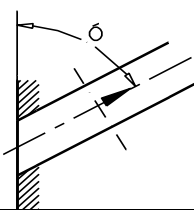
$\zeta = 0,5$
 $\zeta = 0,25$
 $\zeta = 0,2$

Round inlet



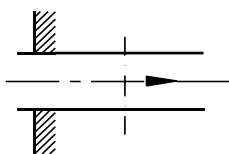
according to the smoothness $\zeta = 0,06$ till
005
normal $\zeta = 0,05$

square inlet
angle α



α	45°	60°	75°
ζ	0,8	0,7	0,6

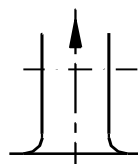
Far overhung
square feed



very sharp $\zeta = 3$
normally rounded $\zeta = 0,6$

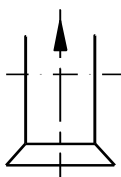
Feeder bodies

Pipe-form feed



$\zeta = 0,05$

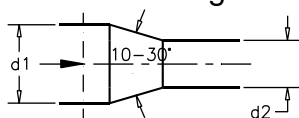
With sloped form feed



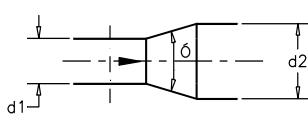
$\zeta = 0,20$

Outlet (outlet loss) $\zeta = 1$
(flow velocity is determining in the outlet inter-section)

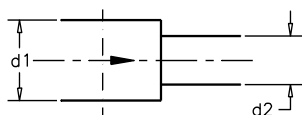
Intersection changes



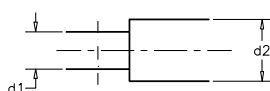
d_1/d_2	0,5	0,6	0,7	0,8	0,9
ζ	0,56	0,46	0,24	0,13	0,04



d_1/d_2		0,5	0,6	0,7	0,8	0,9
ζ pri	$\alpha = 8^\circ$	0,12	0,09	0,07	0,04	0,02
	$\alpha = 16^\circ$	0,19	0,14	0,09	0,05	0,02
	$\alpha = 25^\circ$	0,33	0,25	0,16	0,08	0,03

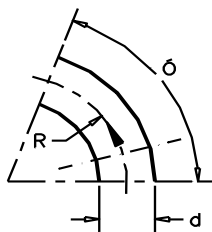


d_1/d_2	1,2	1,4	1,6	1,8	2,0
ζ	0,10	0,22	0,29	0,33	0,35



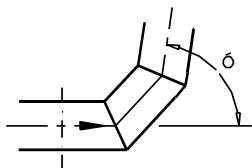
d_1/d_2	1,2	1,4	1,6	1,8	2,0
ζ	0,02	0,05	0,10	0,17	0,26

Bends



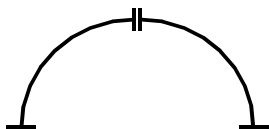
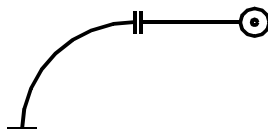
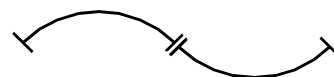
α		45°		60°		90°	
		Surface Smooth Rough		Surface Smooth Rough		Surface Smooth Rough	
ζ for	$R = d$	0,14	0,34	0,19	0,46	0,21	0,51
	$R = 2d$	0,09	0,19	0,12	0,26	0,14	0,30
	$R \geq 5d$	0,08	0,16	0,10	0,20	0,10	0,20

Segment welded

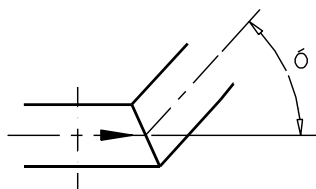


α		45°	60°	90°
Number of the round welds		2	3	3
ζ		0,15	0,2	0,25

In -line bends - 90°

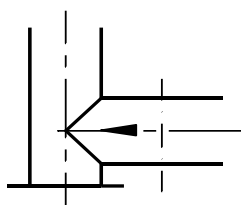
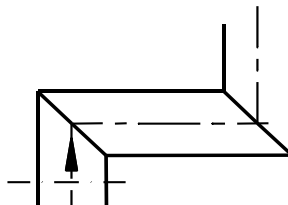
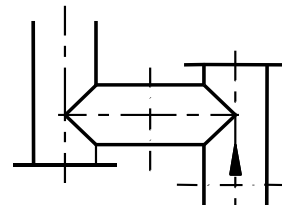
 $2 \times \zeta_{90^\circ}$  $3 \times \zeta_{90^\circ}$  $4 \times \zeta_{90^\circ}$

Elbows



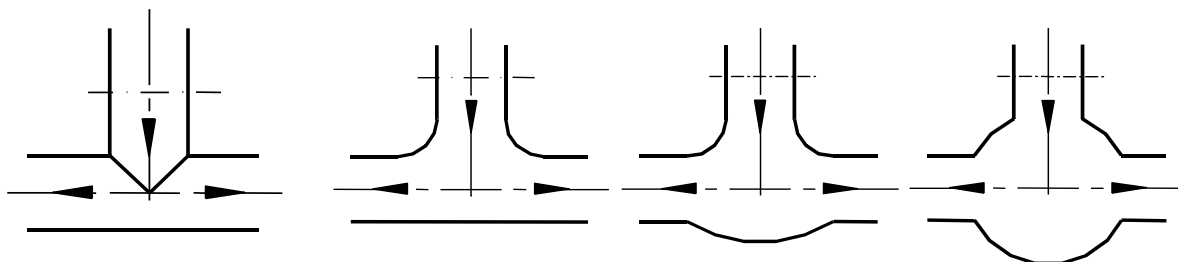
α	45°		60°		90°	
	Surface Smooth	Surface Rough	Surface Smooth	Surface Rough	Surface Smooth	Surface Rough
ζ	0,25	0,35	0,50	0,70	1,15	1,30

Combination with 90° elbows

 $\zeta = 2,5$  $\zeta = 3$  $\zeta = 5$

Compensator

- Wave tube – compensator with/without guide pipe $\zeta = 0,3/2,0$
- Compensator - lyre (with smooth pipe) $\zeta = 0,7$
- Compensator - lyre – Bellows tube $\zeta = 1,4$

T – pieces (flow division)

With sharp edge

$\zeta = 1,3$

round
With flat bottom

$\zeta = 0,7$

Ball-shaped
with rounded neck
inside

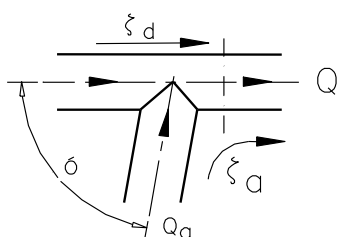
$\zeta = 0,9$

Ball-shaped

$\zeta = 2,5 - 4,9$

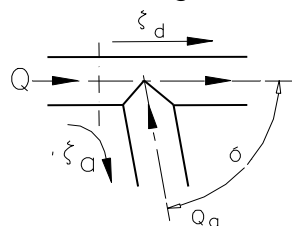
Branch pipes (main piping and branch pipe with the same internal area)

Linking of flow



	$Q_a = 0$	$Q_a = 0,5Q$	$Q_a = 0,8Q$	$Q_a = Q$
$\alpha = 90^\circ$ $\zeta_d =$	0,04	0,35	0,5	-
$\zeta_a =$	-	0,3	0,7	0,9
$\alpha = 45^\circ$ $\zeta_d =$	0,04	0,1	0	-
$\zeta_a =$	-	0,1	0,35	0,4

Flow sharing



	$Q_a = 0$	$Q_a = 0,5Q$	$Q_a = 0,8 Q$	$Q_a = Q$
$\alpha = 90^\circ$ $\zeta_d =$	0,04	0,01	0,2	-
$\zeta_a =$	-	0,9	1,1	1,3
$\alpha = 45^\circ$ $\zeta_d =$	0,04	0,2	0,2	-
$\zeta_a =$	-	0,4	0,35	0,5

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