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QVF

member of De Dietrich PROCESS SYSTEMS

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Your partner for solutions for high-corrosive processes

De Dietrich PROCESS SYSTEMS

De Dietrich | ROSENMUND | QVF

Competence Center Glass-lined equipment	Competence Center Filter/Dryer	Competence Center Glass equipment
		and Process/Engineered Systems

Turnover (approx.):	200 mio €
Employees (approx.):	1500
Sites:	20

DDPS, leading supplier of glass-lined equipment, acquired the leading company for filter/dryer, **Rosenmund**, in 1999 and the major supplier of Borosilicate glass components and systems, **QVF**, in 2000, to become the leading supplier of equipment and systems for high-corrosive processes.

De Dietrich PROCESS SYSTEMS

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DDPS Global Network

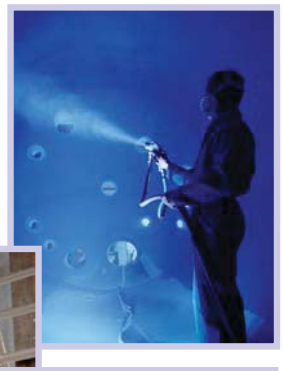
De Dietrich Process Systems is a customer-focused, performance driven, value based, global leader of process solutions for the chemical, pharmaceutical and allied industries.

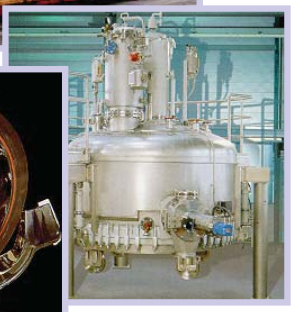
Our mission is to be your preferred provider of solutions, equipment, expertise and services to improve your processes in a mutual and trustworthy manner and to remain your first choice in our technologies.

Our Tech Centre in your neighbourhood:

- Africa (South)	→	Dunswart
- Belgium	→	Heverlee-Leuven
- Brazil	→	São Paulo
- China	→	Shanghai
- France	→	Zinswiller, Semur en Auxois
- Germany	→	Mainz
- Great Britain	→	Stafford
- India	→	Mumbai
- Ireland	→	Shannon
- Russia	→	Moscow
- Singapore	→	Singapore
- Spain	→	Barcelona
- Switzerland	→	Liestal
- United States	→	Union ,NJ

DDPS Equipment





De Dietrich Process Systems is proud to have expertise on design and manufacturing of a wide range of key process equipment to provide optimised solutions for your high-corrosive processes.
Together with our worldwide network of service, maintenance and process support we want to be "a solution ahead".

Borosilicate glass 3.3
Comprehensive glass system up to DN 1000 with standardised solutions for most unit operations.

Glass-lined steel
Reactors, vessels, piping and accessories up to DN 4100 and 310 m³.

Filter/Dryer
High value filtration and drying systems.

All products meet the current regulations and standards as the European PED (pressure equipment directive), ATEX 95 and regarding different locations the national standards as ANSI. Due to our in-house development and manufacturing we are able to meet your requirements on the highest level.

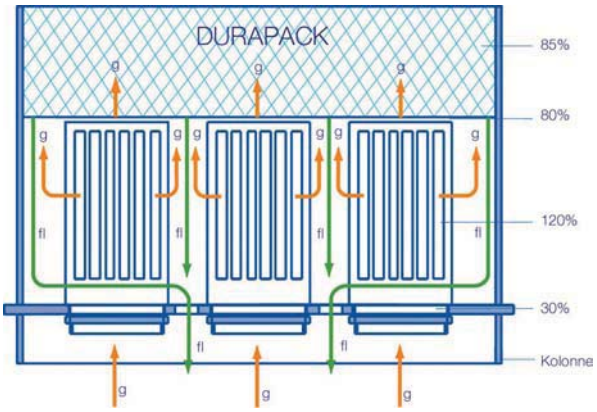
Optimised process equipment

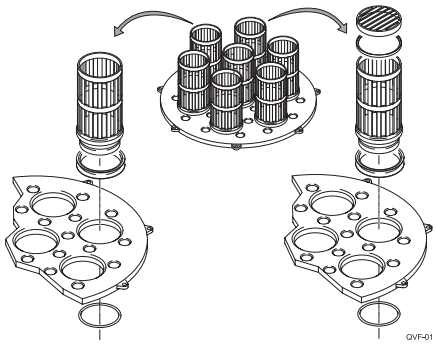
Regarding the special needs of high-corrosive processes DDPS developed equipment to fit these requirements.

Especially the combination of the various competence inside DDPS leads to unique solutions.

DURAPACK®
Structured glass packing

CORE-Tray ®
Non-metal support tray with 120% free cross area

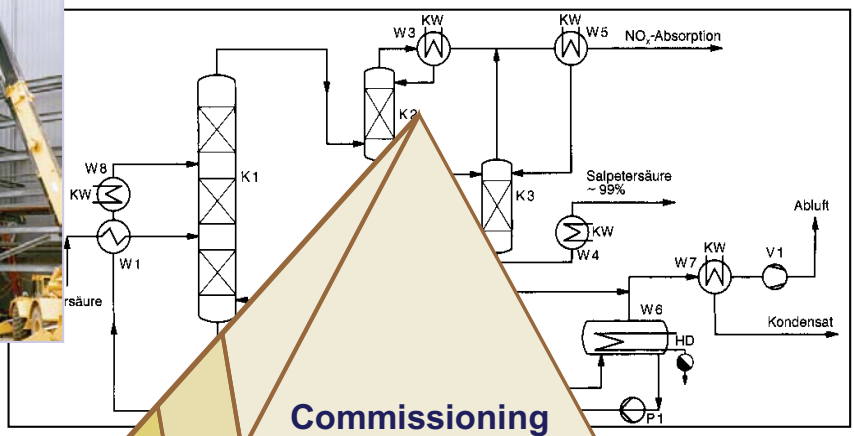




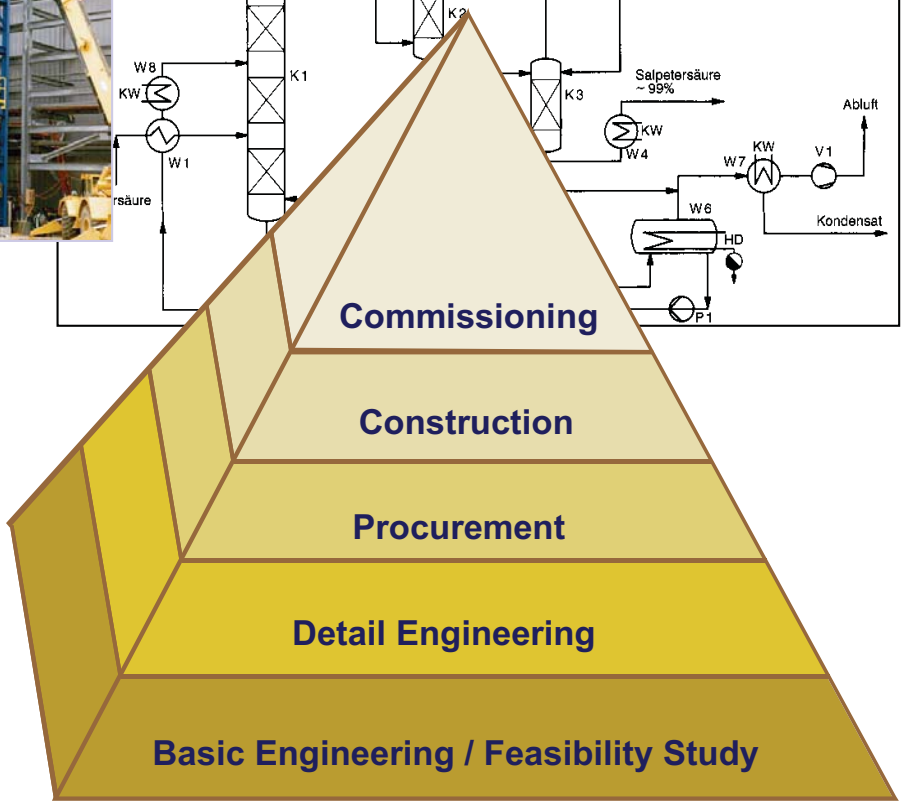
Process systems

More than parts

Experienced Engineering Teams



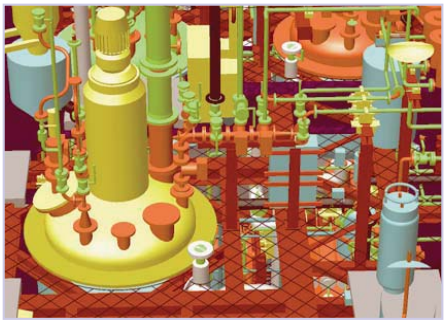
Own test facilities



DDPS wants to become "a solution ahead" provider with specialised and experienced engineering teams, capable to develop conceptual studies and solutions to meet customer requirements.

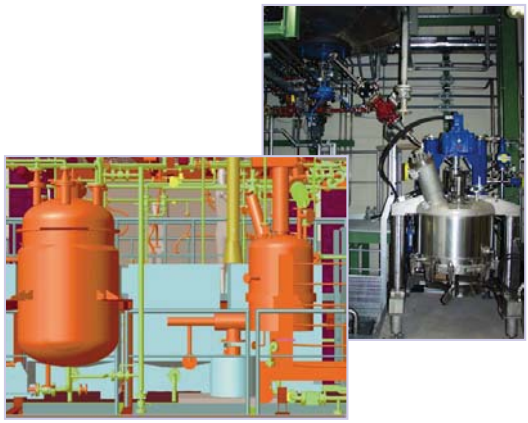
We can deliver feasibility studies and process guarantees through in-house process technology and test facilities.

Your Engineering Partner



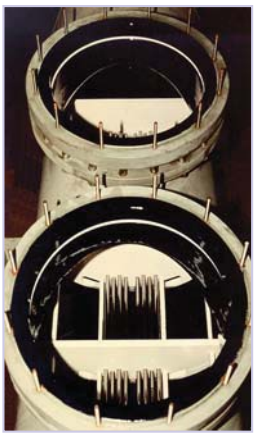
Our technical expertise on the design and manufacture of key process equipment provides you with the optimum solution for specialy processes.

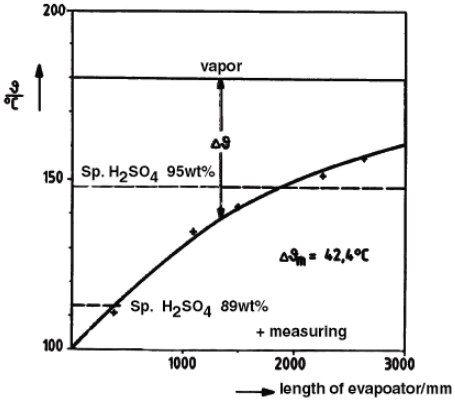
Our engineering capability starts from key equipment to complete sub-systems up to full-scope systems.



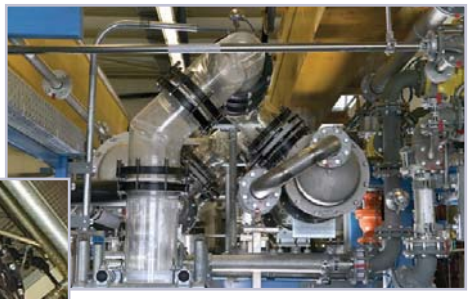
DDPS is provided with a wide range of experience from studies in our test facility and from hundreds of installations.

The highly efficient horizontal boiler is the key equipment for sulphuric acid concentration units made from glass-lined steel and Tantalum bayonets.





Own process technology in various fields



Acid production and recycling plant
- denitration
- H_2SO_4 concentration and cleaning
- HNO_3 concentration
- HCl concentration
- bromine recovery

Aqueous effluent processing
- evaporation
- stripping
- extraction (phenol, pyridine, acetic acid)
- iodine recovery

Waste air cleaning
- hydrogen chloride (HCl)
- bromine chloride (HBr)
- chlorine (Cl_2)
- sulphur dioxide (SO_2)
- hydrogen chloride (HCl/SO_2)
- oxides of nitrogen (NOx)
- volatile hydrocarbons
- ethylene oxide

Few of our key customers

Dynamit Nobel

Bayer | Lonza | Sanofi

Pfizer | Syngenta | BASF | Roche Diagnostics | Merck+Cie

Schering Plough | SNPE | Wacker | Novartis

Many major chemical and pharmaceutical companies have trusted in us for various projects.

We strive for your satisfaction.

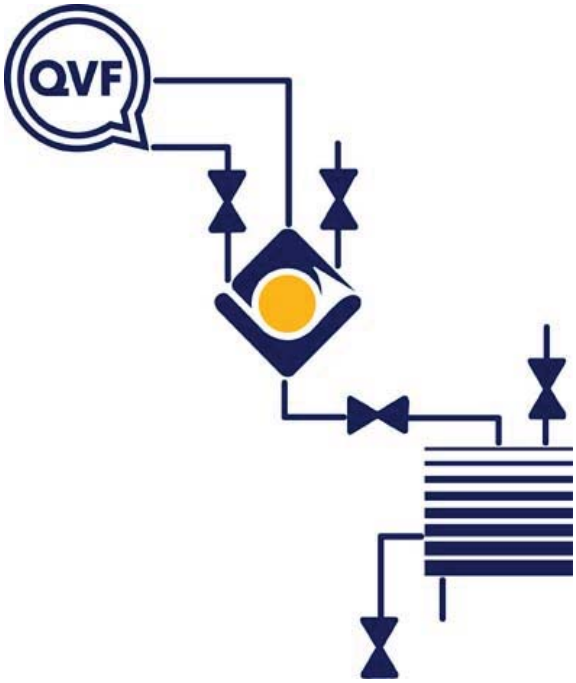
Clariant | Merck Germany | Aventis | Amersham | Degussa

Astra Zeneca | Synthelabo | Monsanto

Rhodia

DDPS - „A Solution Ahead“

- Specialised and experienced process engineering teams capable of developing conceptual studies and solutions to meet customer requirements
- Feasibility studies and process guarantees through in-house process technology and test facilities
- Technical expertise on the design and manufacture of key process equipment provides the optimum solution for specialy processes
- World wide service, maintenance and process support



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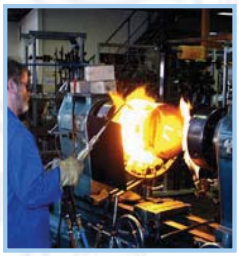

The Material Advantage

DDPS Competence Center for Borosilicate glass and Process Systems

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Internet: www.qvf.com

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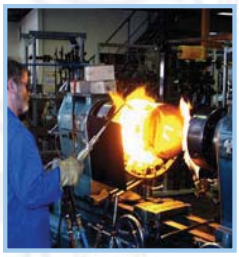


History

1955
QVF Glastechnik GmbH formed in West Germany as a subsidiary of QVF Limited

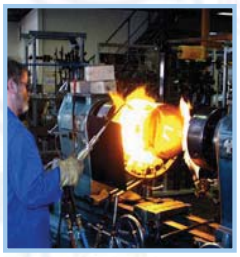
1973
QVF LTD. becomes a wholly-owned subsidiary of Corning Glass Works New York

1993
QVF Group purchased from Corning and established as an independent group

1997
QVF takes over NORMAG GmbH and intensifies Miniplant Technik

1998
QVF Glastechnik and Schott Engineering merge to QVF ENGINEERING GMBH

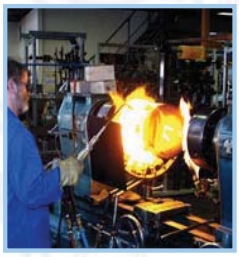
2000
De Dietrich Process Systems takes over QVF ENGINEERING GMBH



QVF today

- Employees approx. 250 in Germany
- Production in Mainz
  Stafford

QVF is certified according DIN-ISO 9001, Pressure Equipment Directive (PED, module H1). For sure do we work according environmental regulations.





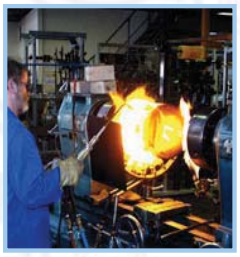

Product Range

- Complete product range of borosilicate glass equipment and allied materials

- Pre-engineered Systems
  - SiC heat exchangers
  - SiC evaporators
  - Rotary evaporators
  - Systems for liquid-liquid extraction

- Customerized Systems
  - Reaction units
  - distillation overheads

- Process Systems
  - In-house knowledge for various processes
  - Full scope of supply, from basic engineering to commissioning

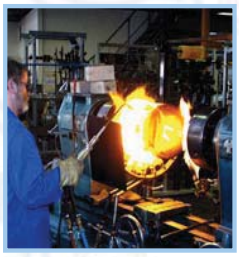


Test Facility of QVF

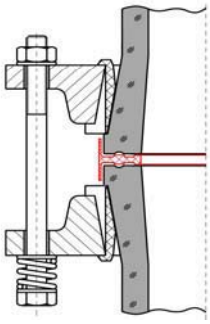
We can deliver feasibility studies and process guarantees through in-house process technology and test facilities.

The following equipment is currently available:

- Thin film evaporator
- Reactor vessel
- Horizontal evaporator (SAC)
- Extraction column DN 100 (PSE, RZE)
- Distillation column (structured packing) DN 100
- Individual equipment and plants due to customer`s requirements can be assembled

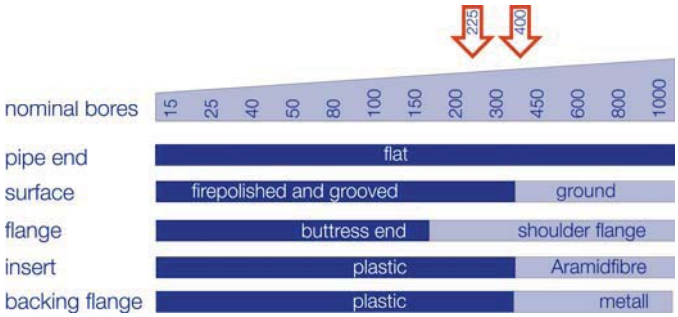


World Product Range 2002



The component system from QVF
Full range of components made from borosilicate glass with safety flat buttress end, mostly compatible to the former product ranges of Schott and QVF
A comprehensive system which tooks into consideration the need of GMP requirements, produced according Pressure Equipment Directive (CE mark)
(see WPR 2002 catalogue)

Safety flat buttres end - just once in the world

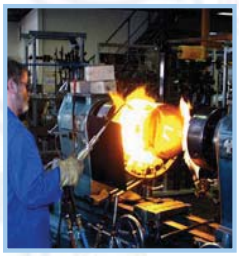


Guidelines for the development

Technically high-quality technology
The most important priority is the requirement for the best product to guarantee the safety and operation of the equipment and plant.

Compatibility
The long life of glass installations makes it a requirement to maintain compatibility with the existing Schott and QVF systems as far as possible. With every decision that was made, its effect on the existing systems was explicitly examined.

Stockholding
A plant built from modular components depends on the availability of items from stock for continuity of operation. The WPR guarantees maximum „on line“ time with the minimum stockholding.



The KF-Pipeline System

The "KF pipeline system" is a supplement to the QVF catalogue "Process Plant Components", also known as "WPR 2002".

Pipelines, apparatus and systems made of borosilicate glass 3.3 which carry the CE mark, are manufactured and quality monitored in compliance with the Pressure Equipment Directive (97/23/EC). At the same time, the chemical/physical material characteristics of borosilicate glass 3.3 and the design of glass components are subject to national and international standards.
The type of flange for glass parts is not standardised, but is determined according to the user's technical demands. Whilst, for instance, a flat safety flange is excellently suited to GMP system engineering due to its construction with little dead space, a ball and socket system is highly valued for its flexibility.
For this reason, QVF has included the ball and socket pipeline system from the former Schott catalogue 6076, in this supplement, to the WPR catalogue, as the "KF pipeline system" and is manufacturing it with state-of-the-art technology and in line with the aforementioned standards and directives as an alternative coupling system for glass system engineering.
The KF pipeline system has therefore not only been given the CE mark, but certification for compliance with the Clean Air Act has also been provided for the valves and couplings. Accuracy of manufacturing, storage and quality control all correspond to WPR 2002.

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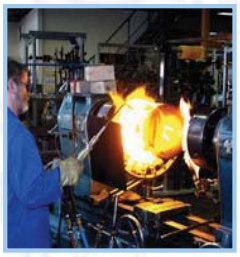


Miniplant Product Range 2005

Advantages of miniplant technology

- Simulation of process steps to obtain samples and process data
- Scale-up ability from the miniplant to the production plant
- Short development times through simultaneous development of different process steps
- Training facilities for universities and training

Components

All components have been developed for scale-up. Thermal insulation through silvered and evacuated insulation jackets make the process parameters attained especially valuable to you. Details such as bottom outlet valves or triple-wall reactors of up to 25-liter volumes round off the program.
Online-Catalogue

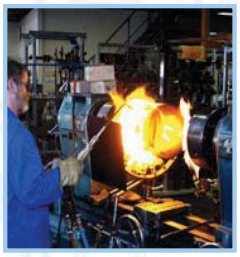
Miniplant Systems

All miniplant systems are delivered with technical documentation. The assembly in our company and the integration of the necessary accessory aggregates by us ensures a quick setup time in your company.

Glass components
\+ Accessories
\+ Engineering
\+ Documentation
\+ Construction

= Miniplant - Unit

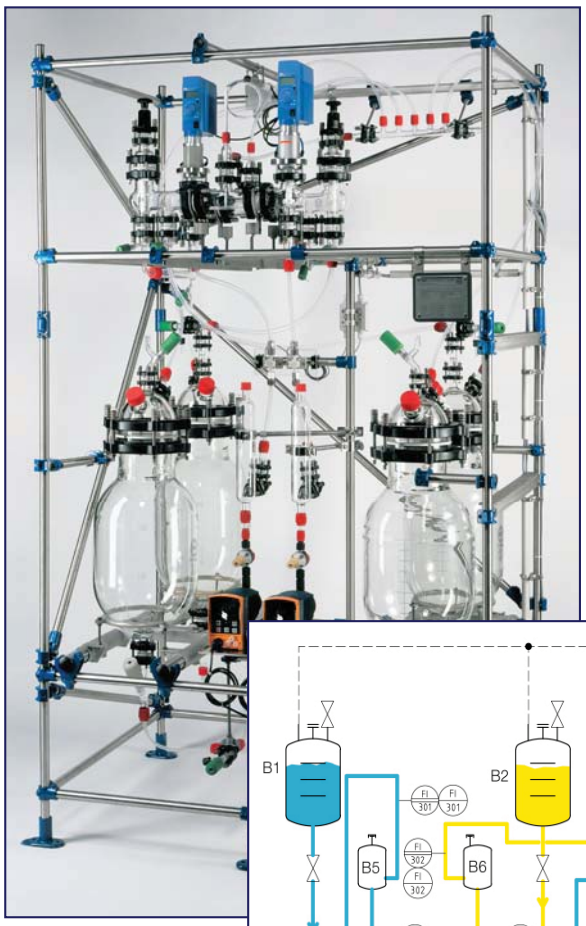
home



Miniplant Product Range 2005

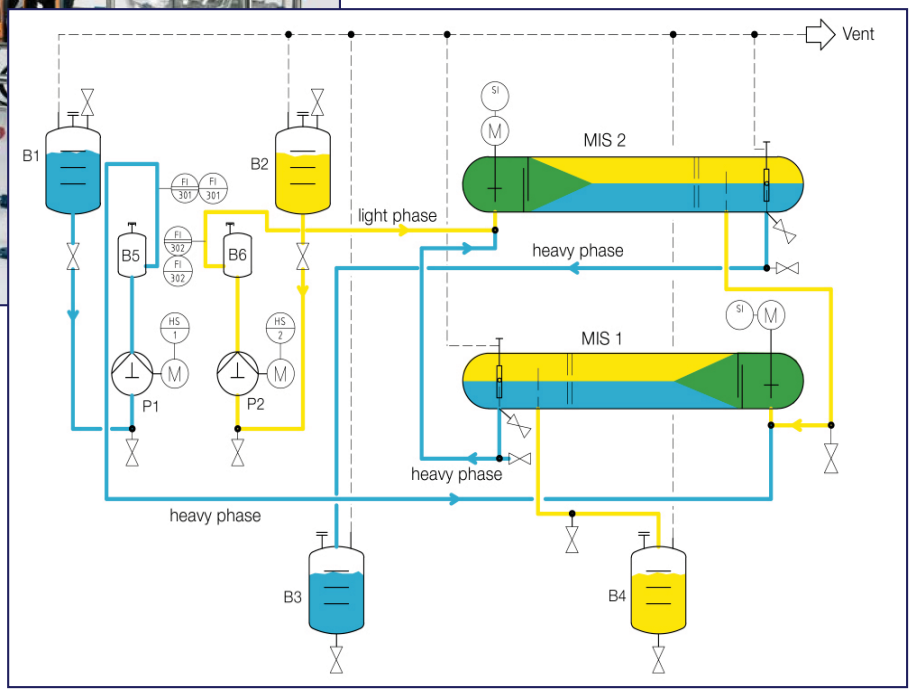
Miniplant Standard Units

- Reaction
- Liquid/Liquid Extraction / Mixer Settler DN 50
- Liquid/Liquid Extraction / Pulsed Column
- Solid/Liquid Extraction
- Destillation
- Absorption
- Adsorption
- Crystallisation



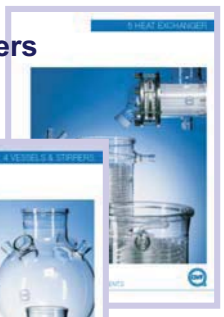
Teaching Units

Standard apparatuses can also be used for training and further education. Manuals are available to instructors for teaching units.



World Product Range 2002 - The Catalogue

5 Heat Exchangers



4 Vessels&Stirrers

3 Valves&Filters

6 Column Components

2 Pipeline Components

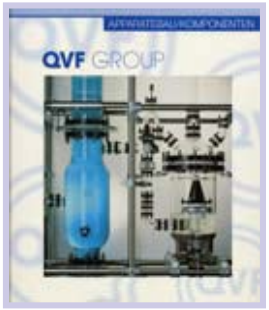
1 Technical Information

8 Measurement &Control

9 Couplings

10 Structures& Support

WPR 2002



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QVF

PROCESS PLANT COMPONENTS

PROCESS PLANT IN BOROSILICATE GLASS 3.3

QVF process plant and pipeline components manufactured from borosilicate glass 3.3 are widely used as the basis for the construction of complete process systems throughout the chemical and pharmaceutical industries, as well as many related areas such as food and drink production, dye works and the electroplating industry. One reason for this widespread use is the special properties of borosilicate glass 3.3 (see below), complemented by the use of other highly corrosion resistant materials such as PTFE and ceramics. Secondly, borosilicate glass is an approved and proven material in the construction of pressure equipment.

Another point which should be mentioned in this context is the great reliability of the positive and high performance connection of all components. This is achieved by the use of flat buttress ends, properly designed and optimised throughout the range of nominal sizes to comply with the special requirements of the material, and a reliable flange system.

The full range of standard components and associated equipment available is described in the following sections of this catalogue.

Chemical composition of borosilicate glass 3.3

The special properties – especially its high chemical resistance, its resistance to temperature and its low coefficient of linear expansion – of the borosilicate glass 3.3 exclusively used by QVF for the construction of glass plant and pipeline are achieved by strict adherence to its chemical composition, which is as follows:

Table 1

Component	% by weight
SiO_2	80.6
B_2O_3	12.5
Na_2O	4.2
Al_2O_3	2.2
Trace elements	0.5

Properties of borosilicate glass 3.3

The very wide use of this material throughout the world in the chemical and pharmaceutical industries as well as many other allied areas, is mainly due to its chemical and thermal properties (see also ISO 3585) together with a great number of other benefits that distinguish borosilicate glass 3.3 from other materials of construction. These include special properties such as

- smooth, non-porous surface
- no catalytic effect
- no adverse physiological properties
- neutral smell and taste
- non-flammability
- transparency

Chemical resistance

Borosilicate glass 3.3 is resistant to chemical attack by almost all products, which makes its resistance much more comprehensive than that of other well-known materials. It is highly resistant to water, saline solutions, organic substances, halogens such as chlorine and bromine and also many acids. There are only a few chemicals which can cause noticeable corrosion of the glass surface namely hydrofluoric acid, concentrated phosphoric acid and strong caustic solutions at elevated temperatures. However, at ambient temperatures caustic solutions up to 30% concentration can be handled by borosilicate glass without difficulty.

Borosilicate glass 3.3 can be classified in accordance with the relevant test methods as follows (see also ISO 3585 and EN 1595):

Table 2

Hydrolytic resistance at 98 °C	Hydrolytic resistance grain class ISO 719-HGB 1
Hydrolytic resistance at 121 °C	Hydrolytic resistance grain class ISO 720-HGA 1
Acid resistance	Deposit of Na2O < 100 mg/dm² to ISO 1776
Alkali resistance	Alkali resistance class ISO 695-A2

Further information about acid and alkali attack can be obtained from the following figures.

The corrosion curves in fig.1 show a maximum for different acids in the concentration range between 4 and 7 N (HCl for example at the azeotrope with 20.2 wt %). Above that the reaction speed decreases markedly so that the eroded layer amounts to only a few thousandths of millimetre after some years. There is, therefore, justification for referring to borosilicate glass 3.3 as an acid-resistant material.

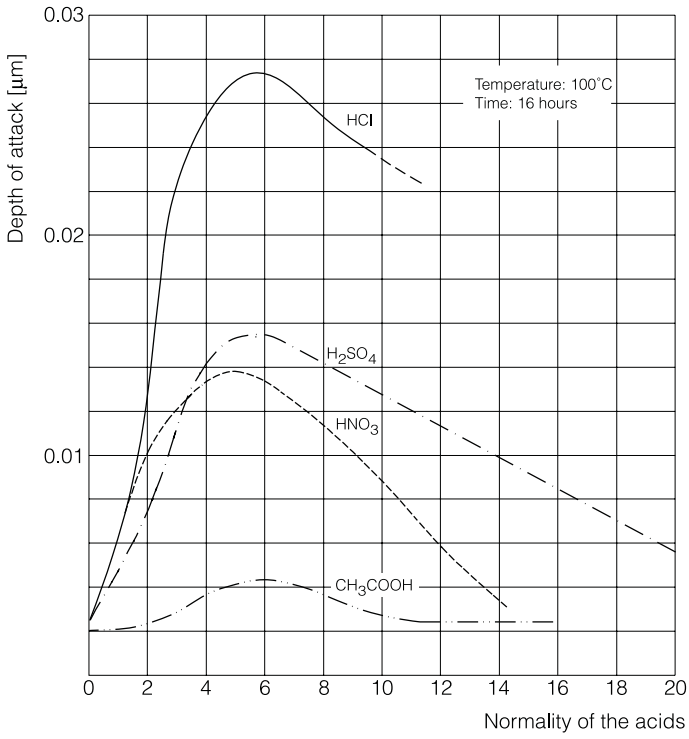


Fig.1
Acid attack on borosilicate glass 3.3 as a function of concentration

It can be seen from the corrosion curves in fig. 2 that the attack on the glass surface initially increases as the concentration of the caustic solution increases but after exceeding a maximum it assumes a virtually constant value. Rising temperatures increase the corrosion, while at low temperatures the reaction speed is so low that reduction of the wall thickness is hardly detectable over a number of years.

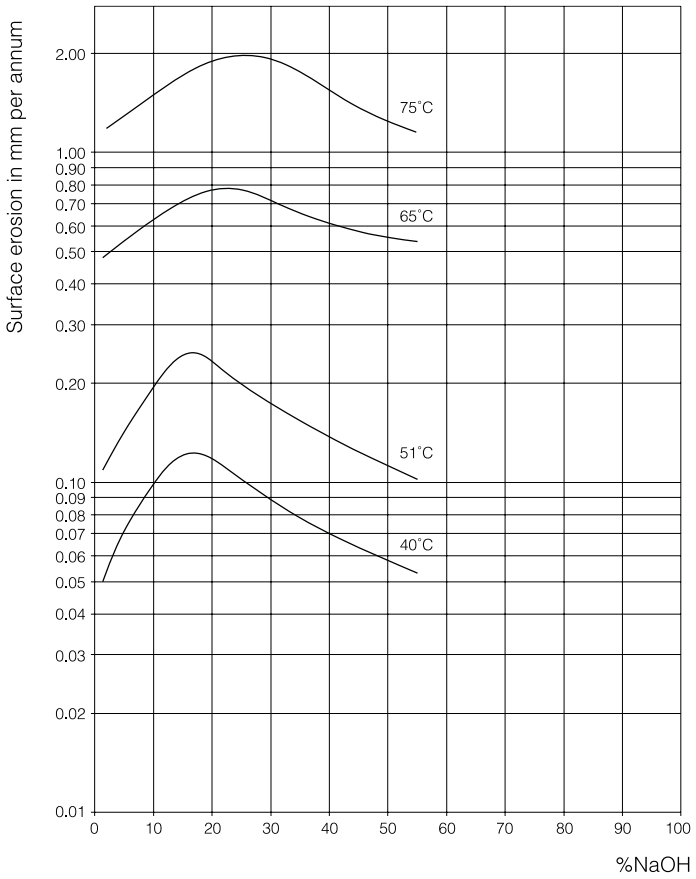


Fig. 2
Alkali attack on borosilicate glass 3.3 as a function of temperature

Physical properties

Borosilicate glass 3.3 differs from other materials of construction used for process plant not only because of its virtually universal resistance to corrosion (see above) but also because of its very low thermal expansion coefficient. There is, therefore, no need for expensive measures to compensate for thermal expansion resulting from changes in temperature. This becomes of particular significance in the layout of long runs of glass pipeline.

The most important physical properties for the construction of plant are listed below (see also ISO 3585 and EN 1595).

Table 3

Mean linear thermal expansion coefficient	$\alpha_{20/300} = (3.3 \pm 0.1) \times 10^{-6}\ K^{-1}$
Mean thermal conductivity between 20 and 200°C	$\lambda_{20/200} = 1.2\ W\ m^{-1}\ K^{-1}$
Mean specific heat capacity between 20 and 100°C	$C_{p\ 20/100} = 0.8\ kJ\ kg^{-1}\ K^{-1}$
Mean specific heat capacity between 20 and 200°C	$C_{p\ 20/200} = 0.9\ kJ\ kg^{-1}\ K^{-1}$
Density at 20°C	$\rho = 2.23\ kg\ dm^{-3}$

Optical properties

Borosilicate glass 3.3 shows no appreciable light absorption in the visible area of the spectrum, and consequently it is clear and colourless.

With borosilicate glass 3.3, the transmission of UV light, which is of great importance for photo-chemical reactions, is somewhat greater in the middle spectrum than with normal window glass. The chlorine molecule absorbs in the 280 to 400 nm range, and thus from the levels of transmission shown in fig. 3, it can be seen that plant made from this material is, therefore, ideal for chlorination and sulphochlorination processes.

If photosensitive substances are being processed, it is recommended that brown coated borosilicate glass 3.3 be used. This special coating reduces the UV light transmission to a minimum, since the absorption limit, as can also be seen from the figure below, is changed to approximately 500 nm.

Sectrans coated glass components, which have an absorption limit of approximately 380 nm, are also ideal for these applications.

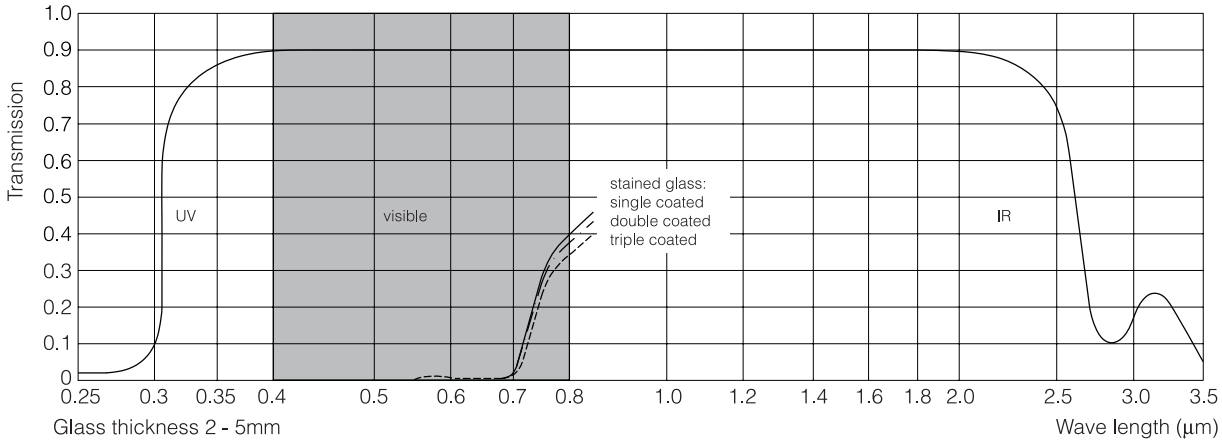


Fig. 3
Transmission curves for borosilicate glass 3.3

Mechanical properties

The permissible tensile strength of borosilicate glass 3.3 (see table 4) includes a safety factor which takes into account practical experience on the behaviour of glass and, in particular, the fact that it is a non-ductile material. Unlike other materials of construction used for similar purposes, it is not able to equalise stresses occurring at local irregularities or flaws, as happens in the case of ductile materials such as metals. The safety factor also takes into account additional processing which components may have undergone (ground sealing surfaces), handling of the glass (minute surface damage) and permissible pressures and temperatures to which it may be subjected in use.

The design figures indicated in the table below and specified in EN 1595 therefore apply to the permissible tensile, bending and compressive stress to which glass components may be subjected taking into account the likely surface condition of the glass in service.

Table 4

Strength parameters	Tensile and bending strength	K/S = 7 N mm^{-2}
	Compressive strength	K/S = 100 N mm^{-2}
Modulus of elasticity		E = 64 kN mm^{-2}
Poisson's ratio (transverse contraction figure)		ν = 0.2

Permissible operating conditions

The permissible values for operating temperature and pressure must always be seen in combination. The reason for this is the thermal stresses that result from temperature differences between the inner and outer surfaces of the glass component. These stresses are superimposed on the stresses resulting from the working pressure. Higher thermal stresses therefore result in a reduction of the permissible working pressure. Thermal insulation reduces the thermal stresses and can, therefore, become a requirement of an installation.

Jacketed glass components are dealt with on page 1.10.

Permissible operating temperature

Borosilicate glass only deforms at temperatures which approach its transformation temperature (approximately 525 °C) and up to this point it retains its mechanical strength. The permissible operating temperature is, however, considerably lower – normally around 200 °C – for glass components, provided that there is no sudden temperature shock and that the components are not specially marked (see page 1.8). In exceptional cases, which call for special precautions, temperatures up to 300°C are also possible.

At sub-zero temperatures tensile strength tends to increase. Borosilicate glass 3.3 can, therefore, be used safely at temperatures as low as -80 °C.

These temperature limits should be regarded only as a guideline and must always be modified in accordance with the actual operating conditions of a given application. The individual operating conditions of some components in this catalogue must also be considered. Where such operating limits apply, they are detailed in the individual catalogue sections and component descriptions

Thermal shock

Rapid changes in temperature across the walls of glass components should be avoided during operation both indoors and outside. They result in increased thermal stress in the glass which, as described above, has an adverse effect on the permissible operating pressure of the plant components. Although it is not possible to give a definite figure applicable to all the operating conditions likely to be encountered in practice, a maximum permissible thermal shock of 120 K can be taken as a general guide.

Permissible operating pressure

Glass components in all nominal sizes that are basically cylindrical, domed and spherical can be used with full vacuum (-1 bar g), provided they are not specially marked otherwise.

Likewise the maximum permissible operating pressures (p_s) shown in tables 5 to 8 apply to these glass components as a function of their principal nominal size DN or diameter D (in the case of spherical vessels) and the internal (product side) and external (ambient) temperature difference ($\Delta\Theta$). Further details with regard to the sizing of borosilicate glass 3.3 components can be found in the next section.

The internal areas of heat exchangers are dealt with separately in Section 5 under the particular product description. In cases where glass equipment is operated with a gas pressure, appropriate safety precautions are required and our sales engineers will be happy to discuss these with you.

Depending on the shape and the particular working conditions, glass components can be used under certain circumstances at higher internal pressures. In these cases, the glass component is specially marked on in accordance with EN 1595.

General operating data

Operating temperature $T_B = 200$ °C
Temperature differences $\Delta\Theta \leq 180$ K
Heat transfer coefficient inside $\alpha_i = 1200$ Wm^{-2}K^{-1}, outside $\alpha_a = 11.6$ Wm^{-2}K^{-1}
All components are suitable for full vacuum $p_s = -1$ bar g

Table 5: **Glass components excluding spherical vessels**

		Main nominal size DN												
		15	25	40	50	80	100	150	200	300	450	600	800	1 000
Glass component	p_s (bar g)	4	4	4	4	3	2	2	1	1	0.6	0.6	0.6	0.6

Table 6: **Spherical vessels**

		Nominal capacity (l) / Diameter D (mm)					
		10/280	20/350	50/490	100/610	200/750	500/1005
Spherical vessel	p_s (bar g)	1	1	0.6	0.6	0.6	0.3

Table 7: **Bellows type valves**

		Connection DN					
Valve		15	25	40	50	80	100
PVD, PED, PVA, DPVD, DPED, PVF, PVS, PVM, PES, PEM	p_s (bar g)	3	3	3	2	1.5	-
PRV, PRS, PRM, OF, BAS, BAL, BASP, PVW, PEV, PEVV	p_s (bar g)	3	3	3	2	1.5	-
SVF	p_s (bar g)	-	2	-	2	-	2

Table 8: **Non-return valves, ball-valves, dirt traps**

		Connection DN						
Valve		15	25	40	50	80	100	150
PFC	p_s (bar g)	-	3	3	2	-	1	-
NRV, RK, RKP, MV, KH, KHP, KHK, KHPP	p_s (bar g)	4	4	4	4	3	2	2

Design of glass components

The following parameters form the starting basis for calculating the strength of all the borosilicate glass 3.3 components listed in this catalogue:

- The permissible pressure.

  This ranges from -1 bar g (vacuum) up to a pressure of 4 bar g (DN 15 to DN 50) and 0.6 bar g (DN 1000) or 1 bar g (10l and 20l flasks) and 0.3 bar g (500l flasks).

- The permissible temperature difference ($\Delta\Theta$) between the outside area (ambient) and interior (product area).

  For standard glass components this has been fixed at 180 K which corresponds to the difference between the permissible operating temperature of 200 °C and the ambient temperature of 20 °C. At higher temperature differences the permissible pressure range will be reduced.

- The heat transfer coefficient (α_a) at the surface of the glass.

  This depends on the location of the installation and has a significant influence on the temperature difference $\Delta T = u\Delta\Theta s/\lambda$ between inner and outer surfaces of the glass wall of the component. Increasing values of the wall temperature difference results in a decrease in the permissible operating pressure or vacuum because of increased thermal stresses. The heat transfer values indicated in the table below have been selected on the basis of calculations and practical experience.

Table 9

Location of installation	**Heat transfer coefficient ($Wm^{-2} K^{-1}$)**	**Used for tables**
Inside building, exposed to draughts	11.6	5 and 6
Outside, protected from wind	11.6	5 and 6

- The heat transfer coefficient (α_i) to be expected on the inner wall. This also influences the temperature difference (ΔT) between the outside and inside surfaces of the glass component. A value of 1200 $Wm^{-2} K^{-1}$ has been used for calculation purposes which covers cases generally occurring in practice.

The strength calculation itself is carried out on the basis of EN 1595 and the German AD-Regulations for pressure vessels.

Marking of glass components

The basis for the marking of borosilicate glass 3.3 components is the Pressure Equipment Directive 97/23/EC and European Standard EN 1595 ("Glass Pressure Vessels"). Information additional to this included on the component is provided for quality assurance purposes (traceability, correct use by the customer, etc) and has been approved by the Notified Body responsible for monitoring our compliance with the directive.

The different marking possibilities listed in fig. 4 to 6 are used as follows:

Table 10

Fig. 4	Standard parts as catalogue
Fig. 5	Special parts with catalogue operating conditions
Fig. 6	Special parts whose permissible operating pressure and/or temperatures differ from the details in this catalogue

Contrary to table 10 components for DN 15 and DN 25 are supplied with no CE mark (see article 3, paragraph 3 of directive 97/23/EC on this point).

The following information can be obtained in detail from the marking:

Table 11

Part of mark	Meaning	Remarks
QVF-logo	Manufacturer of component	
CE 0035	CE mark with Notified Body's identification number	
Boro 3.3	Material borosilicate glass 3.3	
M, S, P	Place of manufacture	M=Mainz (D), S=Stafford (GB) P=Paris (F)
7	Strength parameter to EN 1595	
02	Catalogue issue	02=2002
123456	Batch serial number	Sequential number
PS150/1500	Catalogue item reference	For standard component
SK4712	Drawing number or special item reference	For special item with permissible operating pressure as the catalogue
p=-1/+5 bar	Permissible operating pressure	Deviating from the catalogue
$\Delta\Theta \leq 180$ K	Permissible temperature difference	Information relates to the permissible operating pressure, can possibly also deviate from the catalogue

Fig. 4

Fig. 5

Fig. 6

Safety flat buttress ends

In practice the buttress end areas of borosilicate glass components have to withstand not only the tensile and compressive stresses resulting from being operated under pressure or vacuum, and the thermal stresses caused by the operating temperature, but also the stresses set up by the bolting forces in the coupling. Engineering a safe buttress end therefore involves ensuring that the sum of these stresses is minimised. The design of the flange coupling and the fire polished sealing surface both make significant contributions to this end.

The major dimensions of the safety flat buttress ends can be found in the table below, in conjunction with the illustrations alongside.

Table 12

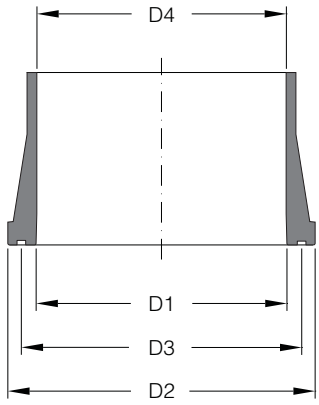
DN	D1	D2	D3	D4	Type
15	16.8	28.6	23	15.5 – 17.5	**A**
25	26.5	42.2	34	25 – 27	**A**
40	38.5	57.4	48	36.5 – 39.75	**A**
50	50.5	70	60.5	48 – 52	**A**
80	76	99.2	88	72 – 78	**A**
100	104.5	132.6	120.5	97.6 – 110	**A**
150	154	185	172	150 – 156	**A**
200	203	235	220	197 – 205	**B**
300	300	340	321	299 – 303	**B**
450	457	528	-	444 – 456	**C**
600	614	686.5	-	592 – 599	**C**
800	838 – 816	920	-	799 – 805	**C**
1000	1052 – 988	1093	-	976 – 983	**C**

Glass components with safety flat buttress end can be connected direct to spherical ended components by means of the glass or PTFE adaptors described in Section 2 "Pipeline Components".

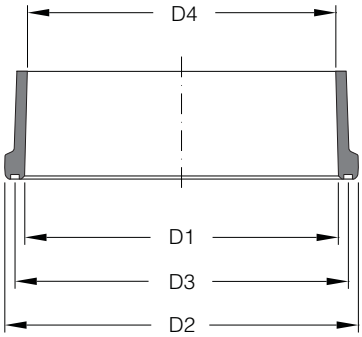
All components with safety flat buttress ends produce positive and high performance connections ensuring safety in operation when used in conjunction with the couplings described in Section 9 "Couplings". The following significant details are especially noteworthy in this context:

- Grooves in the fire-polished sealing surface in the DN 15 to DN 300 nominal size range securely locate the O-ring gasket in place and prevent it being pushed out by the internal pressure.
- Flexible gaskets (see Section 9 "Couplings") facilitate deflections of up to 3° so that even complicated systems can be laid out simply and securely.

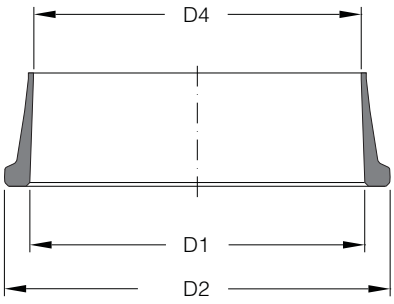
A



B



C



Jacketed glass components

These borosilicate glass 3.3 components provide a solution that meets requirements encountered in practice. They have proved their worth to excellent effect throughout the chemical and pharmaceutical industries as well as many related areas such as food and drink production, dye works and the electroplating industry. They are used not only to avoid heat loss for the purpose of saving energy but also where the product temperature has to be maintained to prevent crystallising or undesirable reactions. This is achieved without losing the benefit of being able to monitor the process visually.

Jacketed versions of all the major glass components of our modular system are available. The range therefore includes not only pipeline components but also valves and vessels as well as a wide variety of column components.

Jacketed components can be found in the appropriate section of this catalogue.

In the case of shorter pipe sections, fittings and spherical vessels up to 50 l nominal capacity, the jacket is one-piece and welded at both ends. In all other cases, the different linear expansion of the basic component and the jacket has to be compensated for by other means. On longer pipe sections the jacket is welded at both ends but it has a flexibly sealed expansion joint in the middle. On vessels it is welded only at the upper end and at the bottom it has a flexible seal.

The connections on the jacket are standard safety flat buttress ends. Further details on connection options can be found in the respective product description.

Permissible operating conditions

The permissible operating pressures for the inner part of jacketed components are identical to those for their non-jacketed counterparts (see page 1.7). However, deviations will arise in the permissible operating temperatures for the inner part and the permissible operating conditions in the jacket itself. These are caused by the permanently flexible seal, which absorbs the different expansion levels of the inner component and the jacket, but does not have the high temperature resistance and strength of borosilicate glass.

Permissible operating temperature:
Taking into account a sufficiently high safety factor, the permissible operating temperature for the inner component is -80 °C to +200 °C and for the jacket it is -50 °C to +180 °C. The maximum permissible temperature difference ($\Delta\Theta$) between the inner and outer areas is 180 K for heat transfer coefficients up to $\infty_i = 1000\,W/m^2K$ (inner component) and $\infty_a = 120\,W/m^2K$ (Jacket).

Permissible operating pressure:
The maximum permissible operating pressure in the jacket is +0.5 bar g up to an overall heat transfer coefficient of $u = 70\,Wm^{-2}K^{-1}$. This average value can be expected during a heating process with thermal oil in the jacket and stirred liquid inside the vessel.

GMP-compliant installations

Special care is required in the selection of components and equipment for the construction of installations complying with GMP guidelines as regards their design and the materials of construction used. Because of its special properties, which are highly valued in the pharmaceutical industry, and when used in conjunction with materials on the FDA-approved list such as glass lined steel (vessels, valves) and PTFE (bellows, linings, cladding) borosilicate glass 3.3 guarantees that the build-up of deposits is avoided in areas in contact with the product. Minimum dead space to ensure complete draining and a capability for simple and effective cleaning are achieved by the design of the components, their layout and the selection of suitable valves. Stainless steel coupling and support material is available (see Section 9 "Couplings" and Section 10 "Structures & Supports") for the design of complete units complying with clean room conditions from the external aspect.

We would be happy to advise you on the basis of the regulatory requirements applicable in each particular case and the guidelines drawn up by ourselves for the design of GMP-compliant plant.

Protection against mechanical damage

Borosilicate glass 3.3 components can be GRP wrapped or Sectrans coated to protect the glass surface against external damage such as scratching or impact. Both versions can be applied to almost all glass components irrespective of their shape. Both have excellent resistance to chemicals and weathering. They present no health risk and heating them does not give rise to any unpleasant odours or gases.

Coating or wrapping glass components does not increase their permissible operating pressure in any way.

External protection of borosilicate glass 3.3 pressure vessels against mechanical damage in working areas and areas subject to traffic can be provided by safety screens. The use of these is to be recommended and in some areas it is a legal requirement (e.g. to comply with Point 9 of the TRB 801 Technical Regulations for Pressure Vessels in Germany).

Coated and wrapped glass components

Sectrans is a highly transparent polyurethane-based coating that is applied to the glass component by spraying to a defined thickness. The permissible long-term operating temperature for this material is 140 °C, but it can also go up to 180 °C for short periods. Above 140 °C the coating can turn yellow, but this has no adverse effect on its protection function and transparency.

In the event of the glass being broken, the Sectrans coating provides protection against splintering. If no pressure is involved, limited protection against the product escaping is provided. However if the glass component is being used at the permissible operating pressure the contents can escape.

The coating incorporates UV protection so that it can be used for handling photosensitive substances.

GRP wrapping is semi-transparent, but its visual properties are not as good as Sectrans coating. The maximum permissible operating temperature for GRP wrapped glass components however is approximately 150 °C.

In the event of the glass being broken, the GRP wrapping also provides protection against splintering and if no pressure is involved it prevents liquid escaping. Where low pressure is involved, there is limited protection against the product escaping which provides an emergency evacuation capability in the event of breakdown.

When ordering Sectrans coated components the suffix "L" should be added to the catalogue reference given in this catalogue, e.g. "PS100/500L". For GRP wrapped components the suffix "C" should be added , e.g. "PS100/500C".

If Sectrans coated or GRP wrapped borosilicate glass 3.3 components are to be used in category 1 or 2 areas (formerly zone 0 or 1), they should have a conductive layer. Our sales engineers will be happy to advise you on this.

Safety screens

Simple versions, such as wire mesh or expanded metal in box-section frames are of course a low cost solution, but not user-friendly. This applies especially when the plant needs protection on all sides. There is no doubt that it is better to use transparent plastic safety screens with frames that are self-supporting or fixed to the support structure and which can be equipped with covered service openings.

The best solution is to use safety screens consisting of medium flexibility transparent PVC which has a high resistance to abrasion. To ensure good lateral stability, these have galvanised metal strips bolted on at the top and bottom. Hooks are also fitted to the top edge to enable the safety screen to be suspended from the structure. Swivelling versions and covered service openings guarantee optimum ease of use. The screens can be individually adapted to local conditions as they are subdivided into overlapping sections.

For installations where electrostatic charges can be expected the screens can be supplied with an antistatic coating. This reduces the conductor resistance to less than $10^{8}\Omega$. The temperature of use of this material is between -40 and +40 °C. It has limited resistance to organic substances and adequate resistance to inorganic substances.

Electrostatic Earthing

Where glass plant is operated in areas where there is a risk of flammable atmospheres occurring, then precautions must be taken against spark generation by the discharge of electrostatic charges. The extent of the precautions required is related to the likelihood of an explosive atmosphere occurring. EC Directive 94/9/EC lays down different categories (formerly zones) according to the risk of explosion. Details about the occurrence, assessment and avoidance of ignition risks resulting from electrostatic charges can be found in the German Chemical Association's Guideline ZH1/200 "Static Electricity".

Precautions are of special importance with glass plant due to the joint couplings, each of which can include a combination of conductive and non-conductive materials. If the area in which the glass plant is installed is classed as Category 1 (formerly Zone 0), or with chemicals of Explosion group IIC as Category 2 (formerly Zone 1), then conductive parts of the plant must be earthed if their charge capacity exceeds 3 pF.

Plastic flanges however, do not need to be earthed. Therefore, in the smaller nominal size range of glassware the earthing requirements can be significantly reduced, or even eliminated in some circumstances, by using plastic instead of metal flanges.

If it is necessary to earth metal parts this should be done by connecting them to an electric protective conductor (drives etc) or by fitting conductive earthed points to the components to be earthed. In the glass plant it is advisable not to earth all parts of the plant individually but to interconnect them in a continuous circuit. This can done by means of a main conductor located parallel to the column, pipeline etc to which the components requiring earthing can be connected. By "earthing" it is to be understood in this context that the conductor resistance,(i.e. the electrical resistance of the earthing between an electrode set up on one side and earth) is not greater than $10^{6}\Omega$.

All the mechanical connections used for an earthing must be so resistant that they match the demands occurring in operation. Only welds, soldered joints or protected bolted couplings may be used. They should not be interrupted at any point by nonconductive intermediate items. Also they may not be disconnected for repair work while the glass plant is in operation.

If Sectrans-coated or GRP-wrapped borosilicate glass 3.3 components are to be used in category 1 or 2 flameproof areas (formerly zone 0 or 1), they should have a conductive layer. Our sales engineers will be happy to advise you on this.

Marking of electrical equipment

With the introduction of EC directive 94/9/EC (ATEX 100a) additional marking of equipment for use in explosive atmospheres is required. This indicates the area in which the equipment can be used, i.e. new EC test certificates (replacing the conformity certificates to directive 76/117/EEC) do not now contain any special indication with regard to permissible use in a specific flameproof zone.

In process engineering installations, the relevant markings are "II 1G" and "II 2G" for measurement and control instruments and "II 2G" for motors, where "II" means the appliance group (allowing the appliance to be used in any area except mining), "1" or "2" the category (formerly zone) and "G" (standing for gases and vapours) the type of explosive atmosphere.

As the marking prescribed by CENELEC, e.g. "EEx e II T4" or "EEx ia IIC T6" has been retained and the information called for in ATEX 100a must be added, the full new marking for this equipment is "II 2G EEx e II T4" or "II 2G EEx ia IIC T6".

Risk analysis / residual risks

All the components and apparatus in the 2002 edition of the QVF catalogue have been subjected to a risk analysis in accordance with Directive 97/23/EC and the corresponding countermeasures are documented by QVF. To exclude risks above and beyond these resulting from improper use (Directive 97/23/EC, Appendix I, Section 1-3) the following points should be observed:

- Although borosilicate glass 3.3 is a material resistant to virtually all chemical attack, alkaline solutions, hydrofluoric acid and concentrated phosphoric acid can cause some erosion. If there is any concern that there may be a reduction in wall thickness, the required minimum wall thickness should be checked at regular intervals.
- Unstable fluids, substances that can decompose, call for special safety precautions in the use of glass plant.
- The permissible operating conditions in accordance with section 1 the catalogue, page 1.6, should be observed and compliance ensured if necessary by means of additional measures such as pressure relief valves, bursting disks, over-fill preventi on or temperature limiters.

  - Permissible operating pressures:
    The permissible operating pressure should be observed in every case, including when commissioning, checking for leaks and filling the plant.
  - Permissible operating temperature:
    The maximum operating temperature for glass components is 200°C and this should be observed and where necessary, e.g. with electrical heating or exothermic reaction, ensured by the use of suitable measuring equipment.
  - Permissible thermal shock:
    Borosilicate glass can withstand thermal shocks up to 120 K. For plants operating at temperatures in excess of 120 °C, and which are not protected by insulation, the thermal shock limit could be exceeded by cold water sprayed onto the equipment by a sprinkler system. To avoid this, sprinkler heads should not be mounted in the vicinity of unprotected glass process plant. In the event of a fire high temperatures may arise which could also result in breakage of the glass.
- Extra loads, such as reaction forces on side branches, are not permissible. Bellows should be included in interconnecting pipework to ensure a stress-free connection to the glass plant.
- **Mechanical damage / protective measures:**
  The tubular structure supporting the equipment or plant also provides protection against damage from external sources and prevents other items coming into contact with it.

  Parts of the plant which are located outside the structure must be protected against mechanical damage.

Parts of the plant, which can reach a surface temperature higher than 60° C in operation and which are located outside the support structure, must be provided with protection against contact.

Additional safety devices are available in the form of safety screens, spray guards, coated and wrapped glass components (see section 1 of the catalogue, pages 1.11 and 1.12).

- **Damage to heat exchangers:**
  Should damage occur to the coil batteries in coil type heat exchangers or the heat exchange tubes in shell and tube heat exchangers, the service fluid and product can become mixed.

  Media, wich could react resulting in the generation of pressure and temperature (exothermic processes), should therefore be kept separate.

QVF

PROCESS PLANT COMPONENTS

Introduction

QVF borosilicate glass 3.3 pipeline is widely used in the chemical, pharmaceutical and allied industries together with other applications such as food and drink production, dye works and electroplating. This is because of the special properties of borosilicate glass 3.3 and PTFE (gaskets) plus the fact that borosilicate glass 3.3 is an approved and proven material of construction for pressure vessels.

Reference should also be made in this context to the extreme reliability of the improved, strong and high-duty coupling system used for all components. This is achieved throughout the whole range of nominal sizes by the use of the safety buttress end which has been designed specifically by taking into account the properties of the material combined with a reliable flange system.

The complete range of standard pipeline components is described on the following pages. Non-standard components can also be supplied to special order.

A detailed listing of all catalogue components by »Description« and »Reference« can be found in the »Index«.

Many of the components listed in this section are not only used in pipelines but also used in the design of process plant. For example pipe sections are used in columns, feed pipes are fitted in reducing tee pieces and reducers are also used as the top or bottom component in columns.

Detailed information on a number of the topics referred to in the following pages can be found in Section 1 »Technical Information«.

A deviation of up to 3° can be achieved by using the flexible gaskets described in Section 9 »Couplings« which considerably simplifies the design and installation of complicated pipeline systems.

Details of the design of the different types of optimised buttress ends are illustrated alongside.

DN15 - DN150

DN200 - DN300

DN450 - DN1000

Metric grid modular system

The pipeline components in the DN 15 to DN 150 nominal size range (pipe sections also up to DN 1000) described in this section comply with EN 12585 "Pipeline and Fittings, Compatibility and Interchangeability" and are conceived as a modular system. The only exception to this is the side branch on some reducing tee pieces. The basic unit of measurement is 25 mm and all component dimensions are a multiple of this basic length. The resultant metric grid system facilitates trouble-free design and installation of systems with these components.

In addition, all fittings and valves (please see Section 3 »Valves & Filters«) in the same nominal size always have the same limb length, so that bends can be interchanged with tee pieces or tee pieces with valves etc. This means that any modifications which may be required to existing pipelines can be carried out quickly and easily.

GMP compliant installations

The layout of pipelines when designing plant and equipment complying with GMP regulations calls for special care in both the planning and selection of the components, together with the materials of construction used for them. Borosilicate glass 3.3 has a number of special properties that are highly valued in the pharmaceutical industry and these, in conjunction with PTFE materials (gaskets) approved in accordance with the FDA catalogue, ensure that any build-up of unwanted deposits is avoided in areas which come in contact with the product. A design without any dead space, which ensures that components drain fully and can be cleaned easily and effectively, is achieved by the shape of the components and the way they are installed. Where the external surfaces of the pipeline have to comply with clean room requirements, appropriate stainless steel coupling and support material can be supplied (please see Section 9 "Couplings" and Section 10 »Structures and Supports«).

We would be happy to advise you on the basis of the regulatory requirements applicable to a particular case and the guidelines drawn up by ourselves for the design of GMP compliant plant.

Horizontally installed pipeline

Whereas vertical pipelines only have to support their own weight, bow can also occur in horizontal lines as a result of the additional weight of the liquids they contain. To reduce the resultant stress to a permissible level, supports should be provided at adequate intervals. The maximum spacing of these is indicated in Section 10 »Structures and Supports« as a function of the density ρ of the product being conveyed.

Coated pipeline components

Damage to borosilicate glass 3.3 components resulting from accidental external causes cannot be entirely excluded, especially in the smaller nominal sizes. This is primarily due to the relatively rigorous conditions prevalent in production plants and applies especially where no additional protection is provided in the form of insulation.

Our answer to this problem is to provide borosilicate glass 3.3 pipeline components with a Sectrans transparent coating. This can be applied irrespective of the shape of the component and it provides additional protection without having any adverse effect on visual monitoring of the process.

A glass fibre reinforced polyester coating providing a higher level of protection can also be supplied on request. This does have a slightly adverse effect on the transparency of the glass, making it translucent and not transparent.

Permissible operating conditions

While the maximum permissible operating temperature for all borosilicate glass 3.3 pipeline components is generally 200 °C ($\Delta\Theta \leq 180$ K), the maximum permissible operating pressure is governed by the main nominal size of the component but not by its shape. Detailed information on this and the operation of jacketed components can be found in Section 1 »Technical Information«.

The permissible operating conditions for components in other materials can be found in the respective product description.

Components suitable for higher permissible operating conditions can be supplied on request.

The drainline piping system

For drainage, venting and dye lines, we recommend our beaded end borosilicate glass 3.3 drainline piping as an especially economical solution. All components can be used up to a maximum permissible operating pressure of 0.5 bar g.

Detailed information on this and the complete product range can be found in a separate brochure.

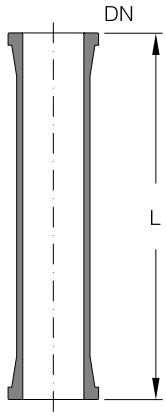
PIPE SECTIONS

Pipe sections are used not only in pipeline systems but also in the design of columns.

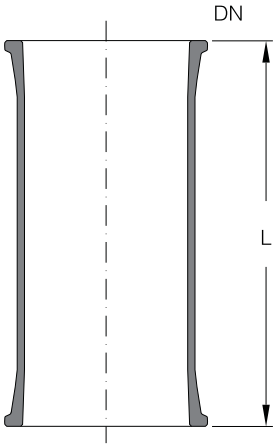
For example, pipe sections with »LBE..« type packing supports (please see Section 6 »Column Components«) clamped between the ends provide a larger free cross-section than the combination of column section and built-in packing support. Increased packed heights can be achieved by installing a pipe section on top of a column section.

Precision bore pipe sections with tight tolerances for chromatography columns and special column internals are listed in Section 6 »Column Components«.

The end form, which depends on the nominal size, is shown in the diagram on page 2.2. Further information can be found in Section 1 »Technical Information«.



DN15 - DN300



DN450 - DN1000

	Reference	Reference	Reference	Reference
L	DN15	DN25	DN 40	DN50
75	PS15/75	PS25/75	-	-
100	PS15/100	PS25/100	PS40/100	PS50/100
125	PS15/125	PS25/125	PS40/125	PS50/125
150	PS15/150	PS25/150	PS40/150	PS50/150
175	PS15/175	PS25/175	PS40/175	PS50/175
200	PS15/200	PS25/200	PS40/200	PS50/200
300	PS15/300	PS25/300	PS40/300	PS50/300
400	PS15/400	PS25/400	PS40/400	PS50/400
500	PS15/500	PS25/500	PS40/500	PS50/500
700	PS15/700	PS25/700	PS40/700	PS50/700
1000	PS15/1000	PS25/1000	PS40/1000	PS50/1000
1500	PS15/1500	PS25/1500	PS40/1500	PS50/1500
2000	PS15/2000	PS25/2000	PS40/2000	PS50/2000
3000	-	PS25/3000	PS40/3000	PS50/3000

	Reference	Reference	Reference
L	DN80	DN100	DN150
125	PS80/125	-	-
150	PS80/150	PS100/150	PS150/150
175	PS80/175	PS100/175	PS150/175
200	PS80/200	PS100/200	PS150/200
300	PS80/300	PS100/300	PS150/300
400	PS80/400	PS100/400	PS150/400
500	PS80/500	PS100/500	PS150/500
700	PS80/700	PS100/700	PS150/700
1000	PS80/1000	PS100/1000	PS150/1000
1500	PS80/1500	PS100/1500	PS150/1500
2000	PS80/2000	PS100/2000	PS150/2000
3000	PS80/3000	PS100/3000	PS150/3000

	Reference	Reference	Reference
L	DN200	DN300	DN450
300	PS200/300	PS300/300	-
500	PS200/500	PS300/500	PSN450/500
1000	PS200/1000	PS300/1000	PSN450/1000
1500	PS200/1500	PS300/1500	PSN450/1500
2000	PS200/2000	PS300/2000	PSN450/2000

	Reference	Reference	Reference
L	DN600	DN800	DN1000
500	PSN600/500	-	-
1000	PSN600/1000	PS800/1000	PS1000/1000
1500	PSN600/1500	PS800/1500	PS1000/1500

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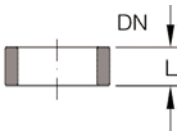
SPACERS

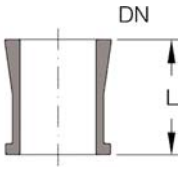
Variations in length can be accommodated by having pipe sections specially made to the appropriate length. A simple alternative is, however, to use spacers. These are fitted between the ends of the adjacent components using an additional gasket and bolts of the appropriate length.

A



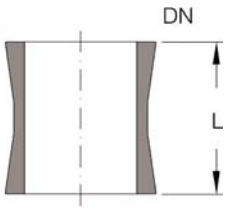
L	Type	Reference DN15	Reference DN25	Reference DN40	Reference DN50
10	A	SS15/10	SS25/10	SS40/10	SS50/10
15	A	SS15/15	SS25/15	SS40/15	SS50/15
20	A	SS15/20	SS25/20	SS40/20	SS50/20
25	A	SS15/25	SS25/25	SS40/25	SS50/25
50	C	PSS15/50	-	-	-
50	B	-	PSS25/50	PSS40/50	PSS50/50
75	B	-	-	PSS40/75	PSS50/75

B



L	Type	Reference DN80	Reference DN100	Reference DN150
10	A	SS80/10	SS100/10	SS150/10
15	A	SS80/15	SS100/15	SS150/15
20	A	SS80/20	SS100/20	SS150/20
25	A	SS80/25	SS100/25	SS150/25
50	B	PSS80/50	PSS100/50	PSS150/50
75	B	PSS80/75	PSS100/75	PSS150/75
100	C	PSS80/100	-	-
100	B	-	PSS100/100	PSS150/100
125	C	-	PSS100/125	PSS150/125

C

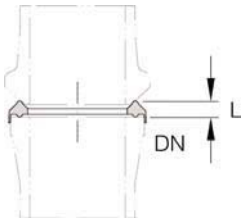


ADAPTORS-PTFE

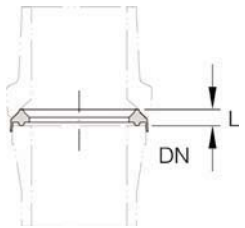
These components can be used up to a maximum operating temperature of 130 °C. They carry out parallel duties: they provide a trouble-free method of connecting components with safety buttress ends to the KF system and they also act as gaskets. Adaptors should always be installed with the location collar on the safety buttress end.

The KF buttress end requires a different type of coupling. For further information please contact our Sales Department.

The borosilicate glass 3.3 adaptors described on page 2.6 supplement these PTFE adaptors for larger nominal sizes and higher operating temperature.



DN	L	Reference
15	6	KRT15
25	7	KRT25
40	8	KRT40
50	8	KRT50
80	10	KRT80



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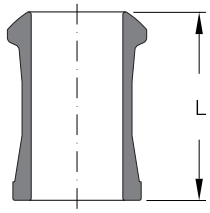
ADAPTORS-GLASS

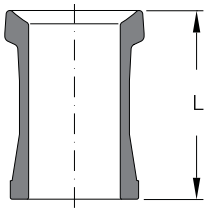
In the larger nominal sizes and at higher operating temperatures, when the »KRT..« adaptors described on page 2.5 cannot be used, »AMS..« or »AFS..« adaptors made of borosilicate glass 3.3 should be used.

Couplings for the safety buttress end of the adaptors can be found in Section 9 »Couplings«. The KF buttress end requires a different type of coupling. For further information please contact our Sales Department.

A



B



		Reference	Reference
DN	L	Type A	Type B
15	75	AMS15	AFS15
25	75	AMS25	AFS25
40	100	AMS40	AFS40
50	100	AMS50	AFS50
80	125	AMS80	AFS80
100	150	AMS100	AFS100
150	150	AMS150	AFS150
200	150	AMS200	AFS200
300	200	AMS300	AFS300

REDUCERS

There are both concentric and eccentric versions of these components available to comply with the varying requirements encountered in practice. In DN 150 nominal size and above the basic form of these components is hemispherical.

The concentric version should always be used for preference in vertical installations.

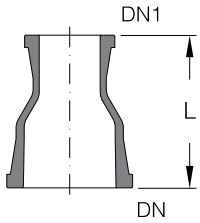
Eccentric reducers are very frequently used in horizontal pipelines where there is a change of bore to enable them to drain completely. There can also be a requirement for this version for design reasons, e.g. where there is a change of lateral alignment.

The end form, which depends on the nominal size, is shown in the diagram on page 2.2. Further information can be found in Section 1 »Technical Information«.

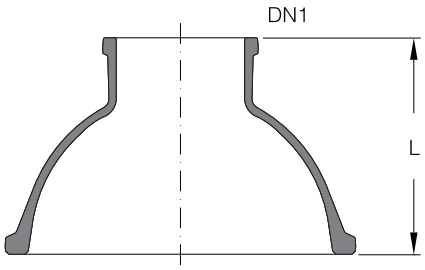
REDUCERS

Concentric Reducers

DN	DN1	L	Reference
25	15	100	PR25/15
40	15	100	PR40/15
40	25	100	PR40/25
50	15	100	PR50/15
50	25	100	PR50/25
50	40	100	PR50/40
80	25	125	PR80/25
80	40	125	PR80/40
80	50	125	PR80/50
100	25	150	PR100/25
100	40	150	PR100/40
100	50	150	PR100/50
100	80	150	PR100/80
150	25	200	PR150/25
150	40	200	PR150/40
150	50	200	PR150/50
150	80	200	PR150/80
150	100	200	PR150/100
200	25	175	PR200/25
200	40	175	PR200/40
200	50	175	PR200/50
200	80	200	PR200/80
200	100	200	PR200/100
200	150	200	PR200/150
300	25	225	PR300/25
300	40	225	PR300/40
300	50	225	PR300/50
300	80	250	PR300/80
300	100	250	PR300/100
300	150	275	PR300/150
300	200	250	PR300/200
450	50	325	PR450/50
450	80	325	PR450/80
450	100	350	PR450/100
450	150	350	PR450/150
450	200	325	PR450/200
450	300	325	PR450/300
600	50	375	PR600/50
600	80	375	PR600/80
600	100	400	PR600/100
600	150	425	PR600/150
600	200	400	PR600/200
600	300	400	PR600/300
800	80	550	PR800/80
800	100	550	PR800/100
800	150	575	PR800/150
800	200	550	PR800/200
800	300	550	PR800/300
1000	300	650	PR1000/300
1000	450	650	PRN1000/450
1000	600	650	PRN1000/600



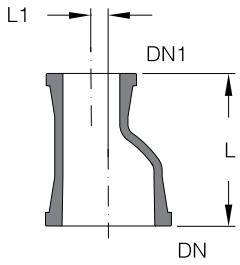
DN25 - DN150



DN200 - DN1000

REDUCERS

Eccentric Reducers

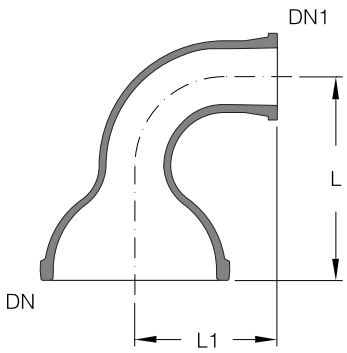


DN	DN1	L	L1	Reference
25	15	100	5	PRE25/15
40	25	100	6	PRE40/25
50	25	100	12	PRE50/25
50	40	100	6	PRE50/40
80	25	125	24	PRE80/25
80	40	125	18	PRE80/40
80	50	125	12	PRE80/50
100	25	150	39	PRE100/25
100	40	150	33	PRE100/40
100	50	150	27	PRE100/50
100	80	150	15	PRE100/80
150	50	200	52	PRE150/50
150	80	200	40	PRE150/80
150	100	200	25	PRE150/100

90° BEND REDUCERS

These items are an alternative to using a reducer plus a 90° bend. This saves one gasket and coupling and also reduces the overall length required.

The end form, which depends on the nominal size, is shown in the diagram on page 2.2. Further information can be found in Section 1 »Technical Information«.



DN	DN1	L	L1	Reference
40	25	125	100	PBR40/25
50	40	150	150	PBR50/40
80	50	150	150	PBR80/50
100	50	200	150	PBR100/50
100	80	200	175	PBR100/80
150	50	200	150	PBR150/50
150	80	250	175	PBR150/80
200	80	250	175	PBR200/80
300	80	300	175	PBR300/80
300	150	350	250	PBR300/150

BENDS

Bends are available in a variety of angles to suit different applications. This applies, for example, to 10° and 80° bends whose uses include connections to reflux dividers (please see Section 6 »Column Components«) and thin film evaporators.

Bends up to and including DN 150 nominal size are supplied as "swept bends", and in the larger nominal sizes "mitred bends".

In addition to the standard range specified below, bends of other angles and in larger nominal sizes can also be supplied on request.

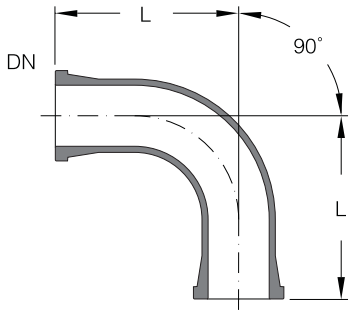
Bends with thermometer branch can be found on page 2.11.

The end form, which depends on the nominal size, is shown in the diagram on page 2.2. Further information can be found in Section 1 »Technical Information«.

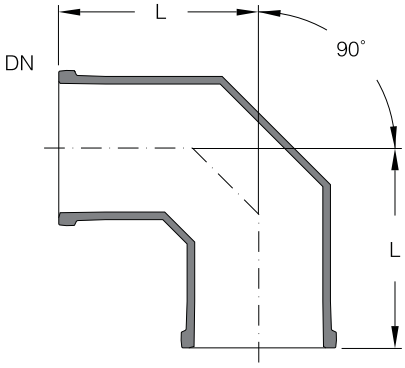
BENDS

90° Bends

DN	L	Reference
15	50	**PB90/15**
25	100	**PB90/25**
40	150	**PB90/40**
50	150	**PB90/50**
80	200	**PB90/80**
100	250	**PB90/100**
150	250	**PB90/150**
200	300	**PB90/200**
300	400	**PB90/300**



DN15 - DN150



DN200 - DN300

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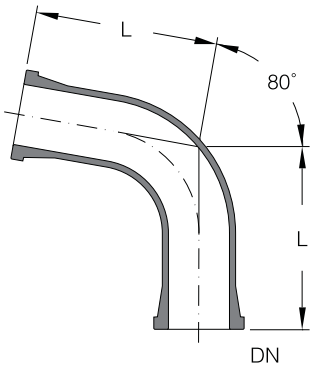
BENDS

80° Bends

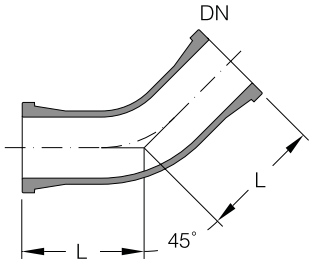
DN	L	Reference
25	100	PB80/25
40	150	PB80/40
50	150	PB80/50
80	200	PB80/80
100	250	PB80/100
150	250	PB80/150



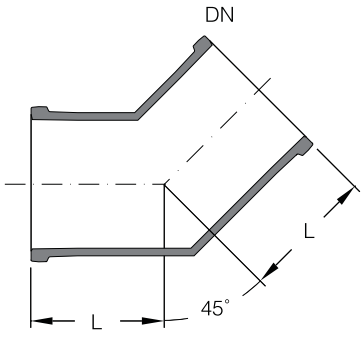
BENDS

45° Bends

DN	L	Reference
15	50	PB45/15
25	75	PB45/25
40	100	PB45/40
50	100	PB45/50
80	125	PB45/80
100	175	PB45/100
150	200	PB45/150
200	200	PB45/200
300	200	PB45/300



DN15 - DN150



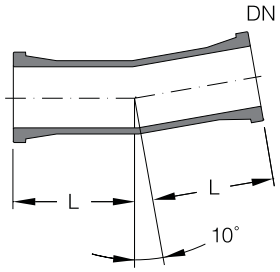
DN200 - DN300

home

BENDS

10° Bends

DN	L	Reference
25	50	PB10/25
40	75	PB10/40
50	100	PB10/50
80	125	PB10/80
100	150	PB10/100

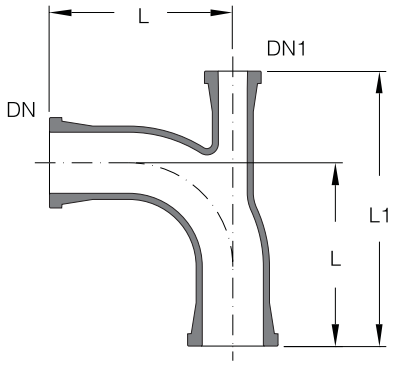


90° BENDS WITH THERMOMETER BRANCH

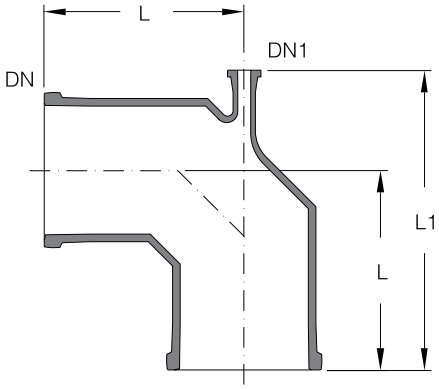
This is a version of the 90° bend that allows a thermometer or measuring probe to be inserted axially into a line (please see Section 8 »Measurement & Control«).

The end form, which depends on the nominal size, is shown in the diagram on page 2.2. Further information can be found in Section 1 »Technical Information«.

DN	DN1	L	L1	Reference
50	25	150	225	PBT50
80	25	200	280	PBT80
100	25	250	330	PBT100
150	25	250	340	PBT150
200	25	300	450	PBT200
300	25	400	525	PBT300



DN50 - DN150

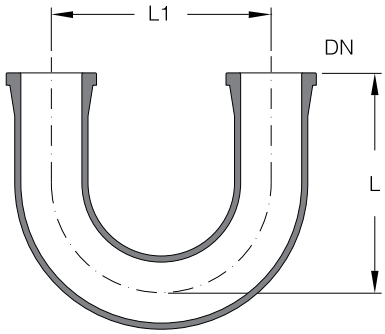


DN200 - DN300

U BENDS

These components are used to turn a pipeline through 180° without the need for any other horizontal or vertical components.

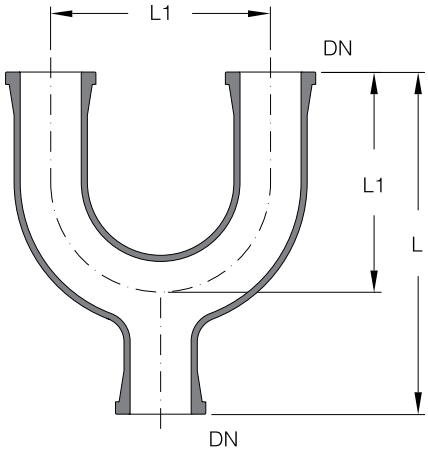
DN	L	L1	Reference
15	75	75	PU15
25	140	140	PU25
40	180	180	PU40
50	180	180	PU50
80	200	230	PU80



U BENDS WITH BOTTOM OUTLET

Typical applications for U bends with bottom outlet include merging two different flow streams in a pipeline system, provision of a vented overflow on columns and liquid seals with drain.

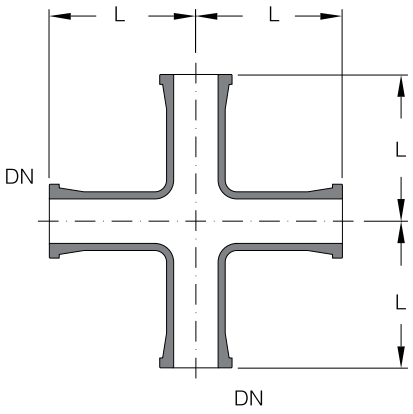
DN	L	L1	Reference
15	125	75	PUO15
25	210	140	PUO25
40	270	180	PUO40
50	280	180	PUO50



CROSS PIECES

Cross pieces are important components in complex systems of interconnecting pipeline.

DN	L	Reference
15	50	**PX15**
25	100	**PX25**
40	150	**PX40**
50	150	**PX50**
80	200	**PX80**
100	250	**PX100**
150	250	**PX150**

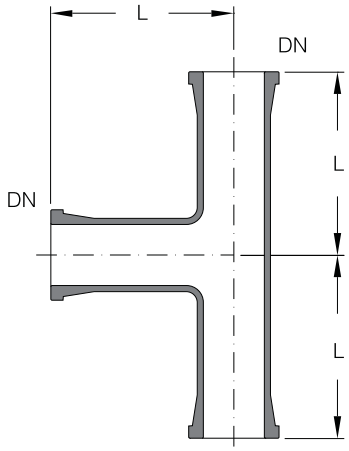


EQUAL TEE PIECES

Equal tee pieces are used for junctions in pipelines of the same nominal size. They have the same limb length as 90° bends.

The end form, which depends on the nominal size, is shown in the diagram on page 2.2. Further information can be found in Section 1 »Technical Information«.

DN	L	Reference
15	50	**PT15**
25	100	**PT25**
40	150	**PT40**
50	150	**PT50**
80	200	**PT80**
100	250	**PT100**
150	250	**PT150**
200	300	**PT200**
300	400	**PT300**

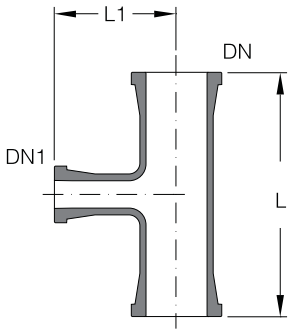


UNEQUAL TEE PIECES

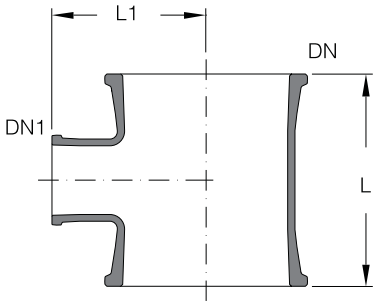
Unequal tee pieces are mainly used in the design of columns and at junctions between pipelines of different nominal sizes.

In addition to the standard range specified below, unequal tee pieces can also be supplied with other nominal size side branches on request.

The end form, which depends on the nominal size, is shown in the diagram on page 2.2. Further information can be found in Section 1 »Technical Information«.



DN25 - DN300



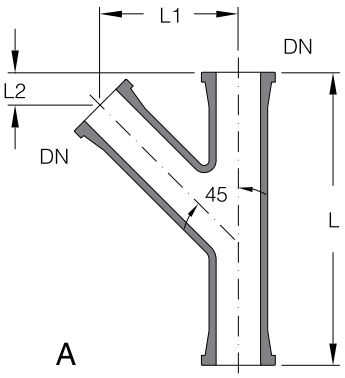
DN450 - DN1000

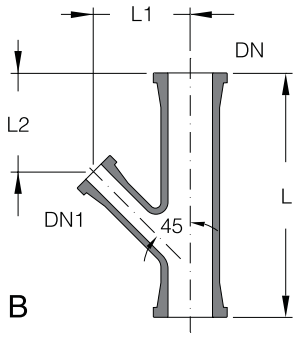
DN	DN1	L	L1	Reference
25	15	150	75	**PTU25/15**
40	25	200	75	**PTU40/25**
50	25	200	80	**PTU50/25**
50	40	200	100	**PTU50/40**
80	25	250	100	**PTU80/25**
80	40	250	100	**PTU80/40**
80	50	250	115	**PTU80/50**
100	25	250	110	**PTU100/25**
100	40	250	125	**PTU100/40**
100	50	250	125	**PTU100/50**
100	80	300	150	**PTU100/80**
150	25	250	150	**PTU150/25**
150	40	250	150	**PTU150/40**
150	50	250	150	**PTU150/50**
150	80	300	175	**PTU150/80**
150	100	300	200	**PTU150/100**
200	40	250	175	**PTU200/40**
200	50	250	175	**PTU200/50**
200	80	300	200	**PTU200/80**
200	100	300	225	**PTU200/100**
200	150	400	250	**PTU200/150**
300	40	400	225	**PTU300/40**
300	50	400	225	**PTU300/50**
300	80	400	240	**PTU300/80**
300	100	400	275	**PTU300/100**
300	150	500	300	**PTU300/150**
300	200	600	275	**PTU300/200**
450	80	400	325	**PTU450/80**
450	150	500	375	**PTU450/150**
600	150	600	450	**PTU600/150**
600	300	800	500	**PTU600/300**
800	150	700	575	**PTU800/150**
800	300	1000	650	**PTU800/300**
1000	150	700	675	**PTU1000/150**
1000	300	1000	750	**PTU1000/300**

Y PIECES

These components are used in a similar way to U bends with a bottom outlet for merging two different flow streams in a pipeline system and also for incorporating measuring probes in vertical pipelines.

DN	DN1	L	L1	L2	Type	Reference
15	-	125	70	5	**A**	**PY15**
25	-	200	106	19	**A**	**PY25**
40	25	225	92	83	**B**	**PY40/25**
40	-	250	124	26	**A**	**PY40**
50	25	250	99	101	**B**	**PY50/25**
50	-	300	141	33	**A**	**PY50**
80	-	350	177	23	**A**	**PY80**
100	-	450	247	52	**A**	**PY100**



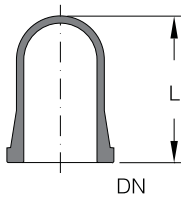


CLOSURES

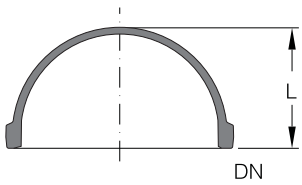
Where branches have to be closed off, closures should be used together with a standard coupling. If frequent access to a branch is required, a quick release coupling should be used instead (please see Section 9 »Couplings«).

In nominal size DN 200 and above, closures are supplied in the hemispherical end version.

The end form, which depends on the nominal size, is shown in the diagram on page 2.2. Further information can be found in Section 1 »Technical Information«.



DN15 - DN150



DN200 - DN300

DN	L	Reference
15	40	**PBE15**
25	75	**PBE25**
40	75	**PBE40**
50	100	**PBE50**
80	95	**PBE80**
100	145	**PBE100**
150	125	**PBE150**
200	120	**PBE200**
300	170	**PBE300**

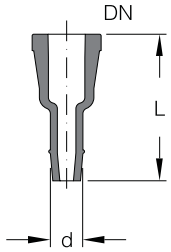
HOSE CONNECTORS

Hose connectors are used to connect flexible lines (hoses) for such purposes as to drain a unit, to carry cooling water to and from heat exchangers or for heating jacketed components. The internal diameter of the hoses should be as indicated in the table below to avoid fixing and leakage problems.

In the case of long and/or heavy hoses, 90º hose connectors should be used to reduce the bending moment on the connecting branches.

HOSE CONNECTORS

Straight Hose Connectors

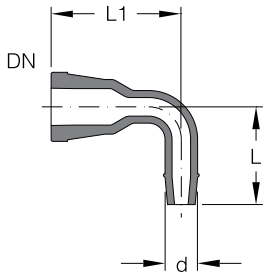


DN	hose-iØ d	L	Reference
15	10	70	**PHC15/10**
15	13	70	**PHC15/13**
15	16	110	**PHC15/16**
15	18	70	**PHC15/18**
15	20	70	**PHC15/20**
25	20	90	**PHC25/20**
25	26	110	**PHC25/26**
40	26	100	**PHC40/26**
40	42	110	**PHC40/42**

HOSE CONNECTORS

90° Hose Connectors

DN	hose-iØ d	L	L1	Reference
15	16	60	60	**PHC90/15/16**
15	18	60	60	**PHC90/15/18**
15	20	60	60	**PHC90/15/20**
25	20	60	80	**PHC90/25/20**
25	26	70	80	**PHC90/25/26**

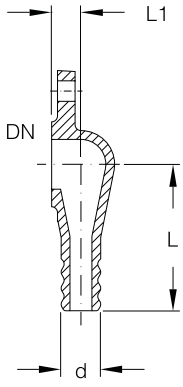


METAL HOSE CONNECTORS

The use of these hose connectors, manufactured from stainless steel, is recommended where there is a requirement for connecting flexible hoses containing heat transfer fluids at elevated temperatures to jacketed components, or long and/or heavy hoses containing coolant to heat exchangers.

Metal hose connectors are supplied complete with the flange, insert, gasket and fastenings necessary to connect to the glass branch in question.

DN	hose-iØ d	L	L1	Reference
15	13	50	10	**PMC15/13**
25	20	70	15	**PMC25/20**
50	42	90	40	**PMC50/42**



JACKETED COMPONENTS

Jacketed components provide a means of heating and cooling pipeline systems. Jacketed versions of pipe sections, bends and tee pieces are available as standard components up to DN 80 inclusive. In the case of fittings and shorter pipe sections (up to L = 500 mm) the jacket is one-piece and welded at both ends. On longer pipe sections, because of differences in linear expansion between the inner component and the jacket, we incorporate a split design with a flexible seal.

In addition to the standard components listed below, pipe sections of other lengths and larger nominal sizes (up to DN 300) together with fittings up to DN 150 are also available.

The permissible operating conditions for the jacket and inner component can be found in Section1 "Technical Information".

The branches on the jacket are of the QVF safety buttress end type. If they are aligned horizontally with long or heavy hoses connected to them, we recommend 90° hose connectors to reduce the bending moment on the branches.

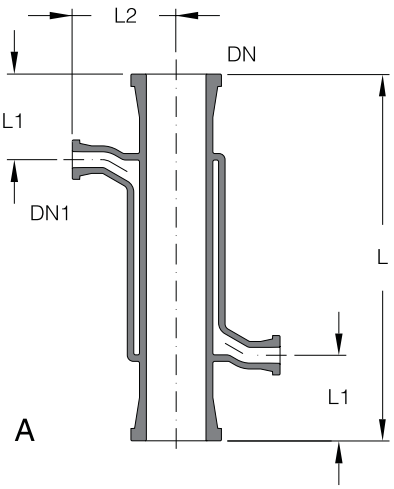
Borosilicate glass 3.3 and metal hose connectors can be found on pages 2.16 and 2.17 and hoses in Section 9 »Couplings«.

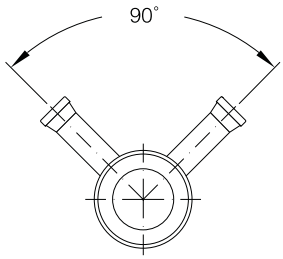
Components can also be supplied on request with jackets extending up to the buttress end. Further details of these can be found in Section 1 »Technical Information«.

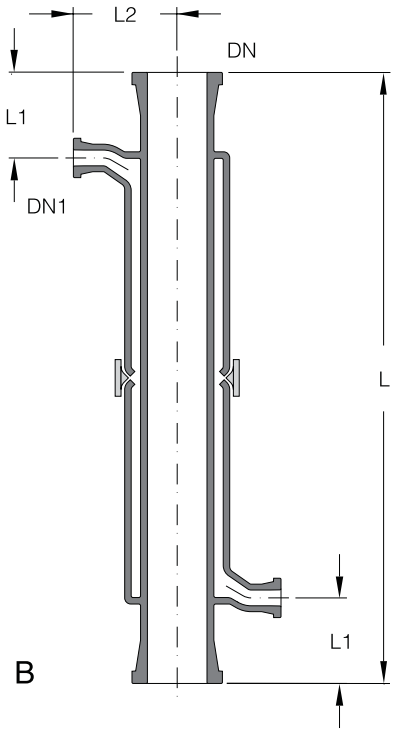
JACKETED COMPONENTS

Pipe Sections

DN	DN1	L	L1	L2	Type	Reference
15	15	200	50	65	A	DPS15/200
15	15	300	50	65	A	DPS15/300
15	15	400	50	65	A	DPS15/400
15	15	500	50	65	A	DPS15/500
15	15	700	50	65	B	DPS15/700
15	15	1000	50	65	B	DPS15/1000
15	15	1500	50	65	B	DPS15/1500
15	15	2000	50	65	B	DPS15/2000
25	15	200	65	75	A	DPS25/200
25	15	300	65	75	A	DPS25/300
25	15	400	65	75	A	DPS25/400
25	15	500	65	75	A	DPS25/500
25	15	700	65	75	B	DPS25/700
25	15	1000	65	75	B	DPS25/1000
25	15	1500	65	75	B	DPS25/1500
25	15	2000	65	75	B	DPS25/2000
40	15	300	65	80	A	DPS40/300
40	15	400	65	80	A	DPS40/400
40	15	500	65	80	A	DPS40/500
40	15	700	65	80	B	DPS40/700
40	15	1000	65	80	B	DPS40/1000
40	15	1500	65	80	B	DPS40/1500
40	15	2000	65	80	B	DPS40/2000
50	15	300	70	85	A	DPS50/300
50	15	400	70	85	A	DPS50/400
50	15	500	70	85	A	DPS50/500
50	15	700	70	85	B	DPS50/700
50	15	1000	70	85	B	DPS50/1000
50	15	1500	70	85	B	DPS50/1500
50	15	2000	70	85	B	DPS50/2000
80	15	300	90	100	A	DPS80/300
80	15	400	90	100	A	DPS80/400
80	15	500	90	100	A	DPS80/500
80	15	700	90	100	B	DPS80/700
80	15	1000	90	100	B	DPS80/1000
80	15	1500	90	100	B	DPS80/1500
80	15	2000	90	100	B	DPS80/2000



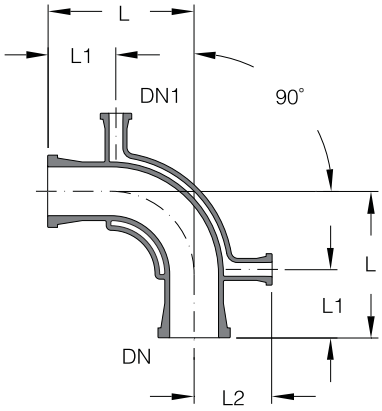




JACKETED COMPONENTS

90° Bends

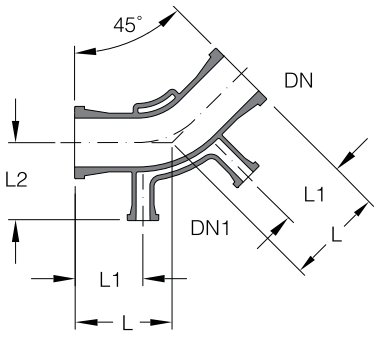
DN	DN1	L	L1	L2	Reference
15	15	75	50	60	DPB90/15
25	15	100	65	70	DPB90/25
40	15	150	65	75	DPB90/40
50	15	150	70	80	DPB90/50
80	15	200	90	95	DPB90/80



JACKETED COMPONENTS

45° Bends

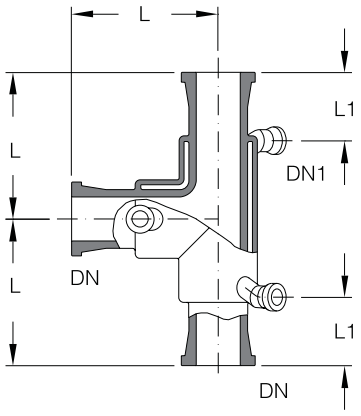
DN	DN1	L	L1	L2	Reference
15	15	75	50	60	DPB45/15
25	15	100	65	70	DPB45/25
40	15	100	65	75	DPB45/40
50	15	100	70	80	DPB45/50
80	15	125	90	95	DPB45/80

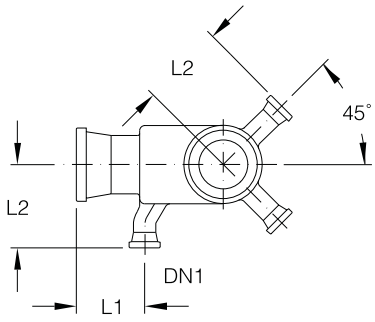


JACKETED COMPONENTS

Tee Pieces

DN	DN1	L	L1	L2	Reference
25	15	100	65	75	DPT25
40	15	150	65	80	DPT40
50	15	150	70	85	DPT50
80	15	200	90	100	DPT80

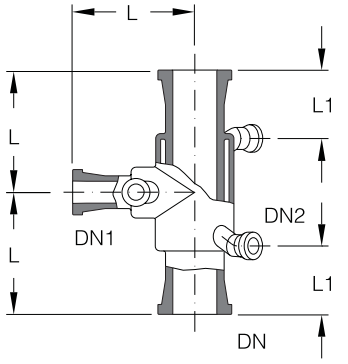


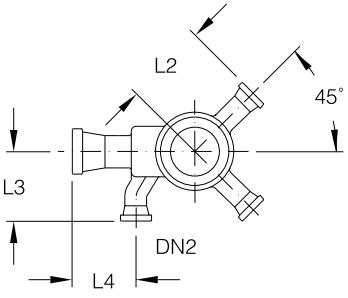


JACKETED COMPONENTS

Unequal Tee Pieces

DN	DN1	DN2	L	L1	L2	L3	L4	Reference
25	15	15	100	65	75	65	50	DPTU25/15
40	25	15	100	65	80	75	65	DPTU40/25
50	25	15	125	70	85	75	65	DPTU50/25
50	40	15	125	70	85	75	65	DPTU50/40
80	25	15	150	90	100	75	65	DPTU80/25
80	40	15	150	90	100	80	65	DPTU80/40
80	50	15	150	90	100	85	70	DPTU80/50





QVF

PROCESS PLANT COMPONENTS

home

Introduction

QVF valves can be relied upon to require minimum maintenance and to provide maximum reliability in service. They are widely used in the chemical, pharmaceutical and allied industries together with other applications such as food and drink production, dye works and electroplating. This is because of the special properties of borosilicate glass 3.3, PTFE, PFA, ceramic and tantalum plus the fact that borosilicate glass 3.3 is an approved and proven material of construction for pressure vessels.

Reference should also be made in this context to the extreme reliability of the improved, strong and high-duty coupling system used for all components. This is achieved throughout the whole range of nominal sizes by the use of the safety buttress end which has been designed specifically by taking into account the properties of the material combined with a reliable flange system.

The complete range of standard valves is described on the following pages. Non-standard versions can also be supplied to special order where indicated in the product description.

A detailed listing of all valves by »Description« and »Catalogue Reference« can be found in the »Index«.

Detailed information on a number of the topics referred to in the following pages can be found in Section 1 »Technical Information«.

Metric grid modular system

The valves described in this section comply with EN 12585 "Pipeline and Fittings, Compatibility and Interchangeability" and are conceived as a modular system. The only exceptions to this are »RKP..« non-return valves and »FVT..« butterfly valves. The basic unit of measurement is 25 mm and all component dimensions are a multiple of this basic length. The resultant metric grid system facilitates trouble-free design and installation of systems with these components.

In addition valves and fittings (please see Section 2 »Pipeline Components«) in the same nominal size always have the same limb length, therefore the valves can be interchanged with bends, tee pieces etc. This means that any modifications which may be required to existing pipelines can be carried out quickly and easily.

TA Luft compliant double seal

The German national clean air regulations known as "TA Luft" came into force in 1986. They indicate the maximum permissible limits for dust, vapour or gaseous emissions from processing, transporting or transferring materials in powder, liquid or gaseous form. They also include regulations relating to the sealing of valves and require a secondary seal in types incorporating bellows seals

A comparable ordinance containing additional information on procedures and instrumentation for the checking of emissions was published four years later by the United States Environmental Protection Agency (EPA).

All hand operated borosilicate glass 3.3/PTFE valves are, therefore, fitted with a secondary seal in addition to the basic bellows seal. Pneumatically actuated on/off valves and control valves alone are available in two alternative versions. Butterfly valves and ball valves are fitted with a secondary seal.

GMP compliant installations

The use of valves and the layout of interconnecting pipeline incorporating valves when designing plant and equipment complying with GMP regulations, calls for special care in both the planning and selection of the components, together with the materials of construction used for them. Borosilicate glass 3.3 has a number of special properties that are highly valued in the pharmaceutical industry, and these, in conjunction with PTFE materials (bellows, linings) approved in accordance with the FDA catalogue, ensure that any build-up of unwanted deposits is avoided in areas which come in contact with the product. A design without any dead space, which ensures that components drain fully and can be cleaned easily and effectively, is achieved in many valves by their shape and the way they are installed. Where the external surfaces of these components have to comply with clean room requirements, appropriate stainless steel coupling and support material can be supplied (please see Section 9 »Couplings« and Section 10 »Structures and Supports«).

We would be happy to advise you on the basis of the regulatory requirements applicable to a particular case, and the guidelines drawn up by us, for the design of GMP compliant plant.

Coated valves

Damage to borosilicate glass 3.3 valves resulting from accidental external causes cannot be entirely excluded, especially in the smaller nominal sizes. This is primarily due to the relatively rigorous conditions prevalent in production plants and applies especially where no additional protection is provided in the form of insulation.

Our answer to this problem is to provide borosilicate glass 3.3 valve bodies with a Sectrans transparent coating. This can be applied irrespective of the shape of the component and it provides additional protection without having any adverse effect on visual monitoring of the process.

A glass fibre reinforced polyester coating providing a higher level of protection can also be supplied on request. This does have a slightly adverse effect on the transparency of the glass, making it translucent and not transparent.

Permissible operating conditions

While the maximum permissible operating temperature for borosilicate glass 3.3 valve bodies is generally 200 °C ($\Delta\Theta \leq 180$ K) and their maximum permissible operating pressure is the same as for pipeline components of the same nominal size, the incorporation of bellows imposes certain restrictions and the maximum permissible operating pressure for the complete valve is somewhat lower. When the valves are used in plant applications this is unlikely to be a problem since the maximum permissible operating pressure of the plant as a whole is governed by the components with the largest nominal size. Detailed information on this and the operation of jacketed valves can be found in Section 1 »Technical Information«.

Valves with PTFE bellows suitable for higher permissible operating pressures can also be supplied on request.

Where different operating conditions apply to individual valves, the relevant details are provided in the respective product description.

ON/OFF VALVES WITH REGULATING PLUG

The design (bellows plug and seat shape) of the manually operated valves described below is such that they can be used both as on/off valves and for the coarse regulation of liquid flow, for example in pump delivery lines. If required, on/off valves can also be supplied in the DN100 and DN150 nominal sizes but without regulating cone.

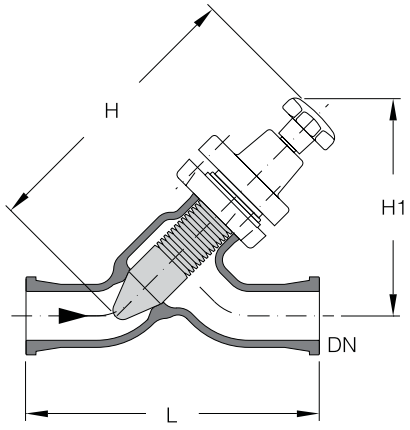
Manually operated control valves can be found on page 3.13 and on/off and control valves with pneumatic actuators are described from page 3.10 and 3.14.

These valves only act as regulating valves when the direction of flow is towards the cone.

ON/OFF VALVES WITH REGULATING PLUG

Straight Through Valves

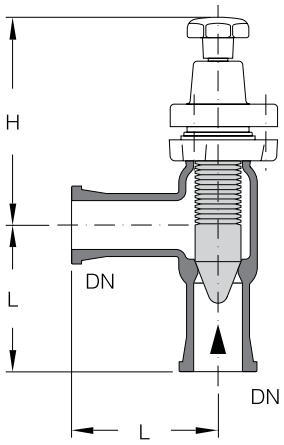
DN	L	H	H1	Reference
15	125	120	90	**PVD15**
25	175	220	170	**PVD25**
40	225	285	215	**PVD40**
50	300	295	225	**PVD50**
80	375	430	320	**PVD80**



ON/OFF VALVES WITH REGULATING PLUG

Angle Valves

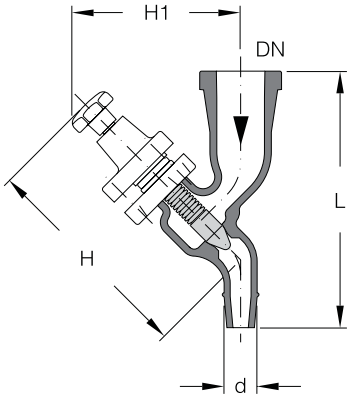
DN	L	H	Reference
15	50	85	PED15
25	100	170	PED25
40	150	215	PED40
50	150	210	PED50
80	200	290	PED80



DRAIN VALVES

These valves have a hose connector at the outlet so that a hose can be connected to them easily and securely. The internal diameter of the hoses should be as indicated in the table below to avoid fixing and leakage problems.

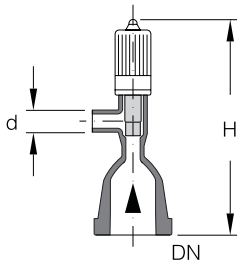
DN	hose Ø d	L	H	H1	Reference
25	16	140	120	92	PVA25/16
40	16	150	120	92	PVA40/16
40	26	200	223	170	PVA40/26



VENT VALVES

These valves are ideal for venting plant operating under vacuum, at atmospheric pressure or at low positive pressure (up to 0.5 bar g). In all other cases we recommend the use of the drain valves as described on page 3.5.

DN	d	H	Reference
15	10	132	**PVL15**
25	10	140	**PVL25**
40	10	145	**PVL40**



JACKETED ON/OFF VALVES

In addition to pipe sections and pipeline fittings (see Section 2 »Pipeline Components«) jacketed valves with regulating plug can also be supplied for pipeline systems involving temperature control. Further versions of the valves described here are also available on request.

These jackets are one-piece and sealed at both ends. They are designed to ensure that the critical area in particular, i.e. the valve seat, can be maintained at a given temperature. The less critical pipe ends can be heated separately by a suitable method.

Details of the permissible operating conditions for the inner and outer area can be found in Section 1 »Technical Information«.

The branches on the jacket are of the safety buttress end type. If they are aligned horizontally and if long hoses or heavy hoses are connected to them, we recommend 90° hose connectors to reduce the bending moment on the branches.

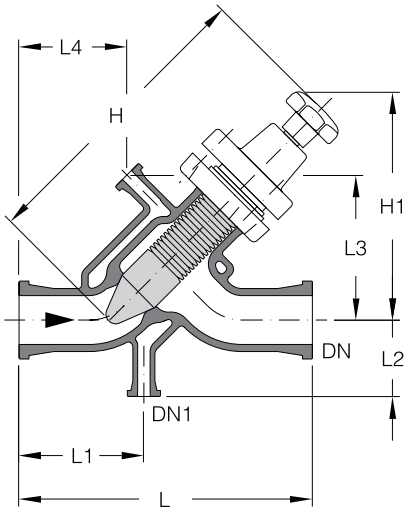
In the case of the DN 15 angle valves the branches on the jacket are positioned turned through 90° to the front (DN 1) and back (DN 3) respectively.

Borosilicate glass 3.3 and metal hose connectors can be found in Section 2 »Pipeline Components« and hoses in Section 9 »Couplings«.

JACKETED ON/OFF VALVES

Straight Through Valves

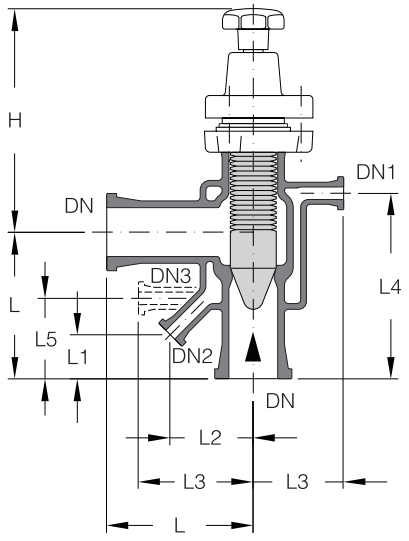
DN	DN1	L	L1	L2	L3	L4	H	H1	Reference
15	15	125	65	45	71	22	128	98	**DPVD15**
25	15	175	90	60	95	49	235	179	**DPVD25**
40	15	225	115	65	129	64	285	217	**DPVD40**
50	15	300	150	75	145	107	310	231	**DPVD50**



JACKETED ON/OFF VALVES

Angle Valves

DN	DN1	DN2	DN3	L	L1	L2	L3	L4	L5	H	Reference
15	15	-	15	50	-	-	65	57	37	97	**DPED15**
25	15	15	-	100	20	85	70	118	-	185	**DPED25**
40	15	15	-	150	25	85	90	177	-	215	**DPED40**
50	15	15	-	150	55	85	95	185	-	226	**DPED50**



LOADING VALVES

These valves are used to maintain a constant pressure and are recommended for use after dosing pumps. They may, however, also be used on occasions with centrifugal pumps (in this application it is more usual to use an orifice plate).

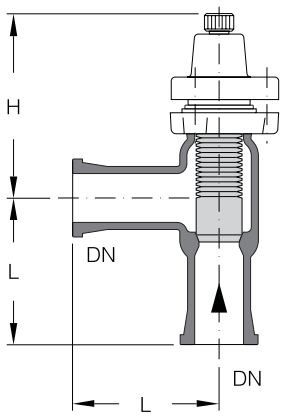
They can thus be used to deliver liquids safely, into or out of a vacuum, for example. Their use as by-pass valves in conjunction with dosing pumps prevents the build-up of an unacceptably high pressure in the event of the pressure-side pipeline being inadvertently closed off.

Unlike manually operated types, this valve has a spring the tension of which can be changed by means of a screwdriver. It can be adjusted to any setting between 0.2 bar g and the maximum permissible operating pressure of the valve.

If no pressure setting is specified on the order, valves are supplied set to approx. 0.2 bar g.

Care should be taken when operating these valves to ensure that the sum of the setting pressure and the pressure drop in the valve does not exceed the maximum permissible operating pressure of the pipeline.

Loading valves should not be used as pressure relief valves as they do not have the necessary approval for such applications.



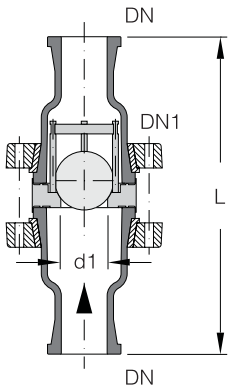
DN	L	H	Reference
15	50	80	**PVF15**
25	100	155	**PVF25**
40	150	170	**PVF40**
50	150	170	**PVF50**

BALL-TYPE NON-RETURN VALVES

The function of these valves is to ensure that flow in vertical pipelines can only be in one direction. The PTFE seat, ball and retaining plate provide excellent corrosion resistance.

Where there is an increased requirement for freedom from leakage these valves can be supplied on request with an O-ring gasket.

Ball-type non-return valves are not suitable for use as a long-term shut-off function.



DN	DN1	d1	L	Reference
15	50	23	225	**NRV15**
25	50	23	225	**NRV25**
40	80	48	325	**NRV40**
50	80	48	325	**NRV50**
80	80	48	325	**NRV80**

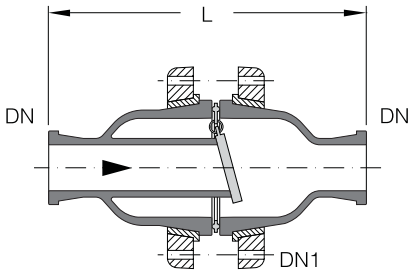
TYPE RK NON-RETURN VALVES

Unlike PTFE flap type non-return valves (please see below), this version provides a large free cross-section even in small nominal sizes and consequently ensures low pressure drop. It is suitable for liquids and installation in horizontal and vertical pipelines.

The PTFE flaps are mounted on tantalum hinges which must be located at the top when installed in horizontal lines.

If required we can supply a version with drain branch and an eccentric design which is used with a »PRE..« (please see Section 2 »Pipeline Components«).

Flap-type non-return valves are not suitable for use to provide a long-term shut-off function.



DN	DN1	L	Reference
25	50	225	**RK25**
40	80	275	**RK40**
50	100	325	**RK50**

TYPE RKP NON-RETURN VALVES

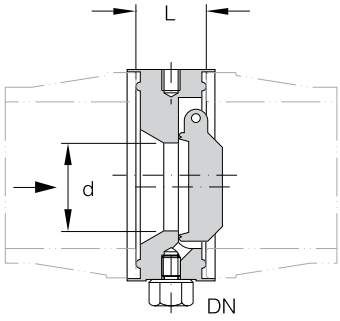
These PTFE flap-type non-return valves are only available in larger nominal sizes (please see also type »RK..« non-return valves above). They can be fitted in horizontal or vertical pipelines using longer coupling bolts. No additional gaskets are required.

The PTFE flaps are mounted on tantalum hinges which must be located at the top when installed in horizontal lines.

The maximum permissible operating temperature for these flap-type non-return valves is 130 °C. The permissible operating pressure is the same as for pipeline components of the same nominal size.

The valve body is manufactured from carbon filled PTFE.

Flap-type non-return valves are not suitable for use to provide a long-term shut-off function.



DN	d	L	Reference
50	30	24	**RKP50**
80	55	24	**RKP80**
100	82	24	**RKP100**
150	125	25	**RKP150**

PNEUMATICALLY ACTUATED ON/OFF VALVES

These valves consist of the valve body and bellows plug used in our manually operated straight through and angle valves combined with either a Kämmer or Samson pneumatic diaphragm actuator. If required, pneumatically actuated on/off valves can also be supplied in the DN 100 and DN 150 nominal sizes.

All the types specified below are available in two versions, the only difference being the type of seal to atmosphere provided. Thus catalogue reference »PVS25 /..« for example describes a valve with single seal (between the valve body and the diaphragm actuator), while catalogue reference »PVS25S /..« applies to a valve with a double seal in accordance with TA-Luft (an additional spindle seal in the intermediate flange below the yoke rods as a precaution in case the bellows ruptures. Please see also page 3.2). In this case the Kämmer actuator must also be fitted with intermediate flange and yoke rods.

To provide a means of supporting the valves a »KK50-5« structure fitting (please see Section 10 »Structures & Supports«) is provided on one of the yoke rods to facilitate attachment to the support structure. In the case of valves without yoke rods (Kämmer actuator with single seal) a special support is part of the supply.

The required supply pressure is 2.5 bar g for all actuators and this should not be exceeded by more than 10%.

When ordering please add »1« to the catalogue reference for »spring to open« and »2« for »spring to close«.

If required Samson actuators can be supplied with the following additional built-on features:

- Limit switch with built-in inductive proximity switches in accordance with EN 50227/IEC 61934 hazardous area, type EEx ia IIC T6 to indicate if the valve is open or closed.
- 3/2 way solenoid valve, hazardous area type EEx ia IIC T6 (24 V DC).

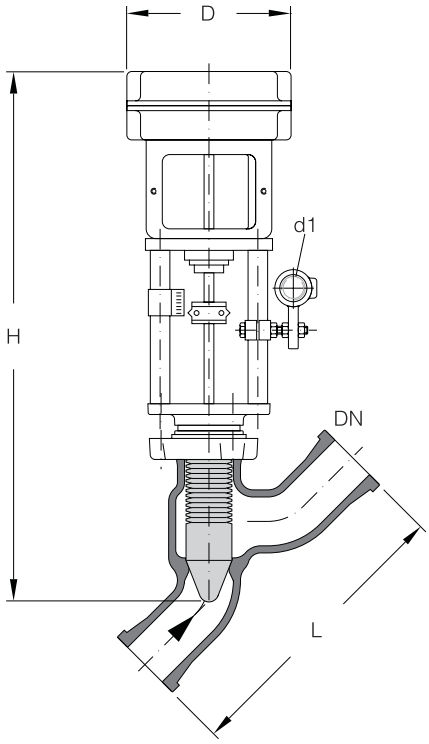
Kämmer actuators can be supplied with the following additional built-on features on request:

- Inductive proximity switches in accordance with EN 50227/IEC 61934 hazardous area type EEx ia IIC T6, to indicate if the valve is open or closed. This is fitted into a housing mounted on top of the actuator (Dimension H increases by 70 mm).
- 3/2 way solenoid valve hazardous area type EEx me IIC T6 (24 V DC)

PNEUMATICALLY ACTUATED ON/OFF VALVES

Straight Through Valves with Samson Actuator

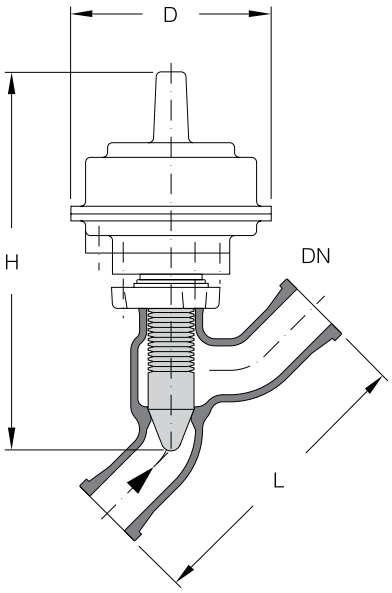
DN	D	d1	L	H	Reference
25	168	27	175	419	PVS25/...
25	168	27	175	465	PVS25S/...
40	168	27	225	481	PVS40/...
40	168	27	225	518	PVS40S/...
50	168	27	300	489	PVS50/...
50	168	27	300	525	PVS50S/...
80	280	27	375	629	PVS80/...
80	280	27	375	710	PVS80S/...



PNEUMATICALLY ACTUATED ON/OFF VALVES

Straight Through Valves with Kämmer Actuator

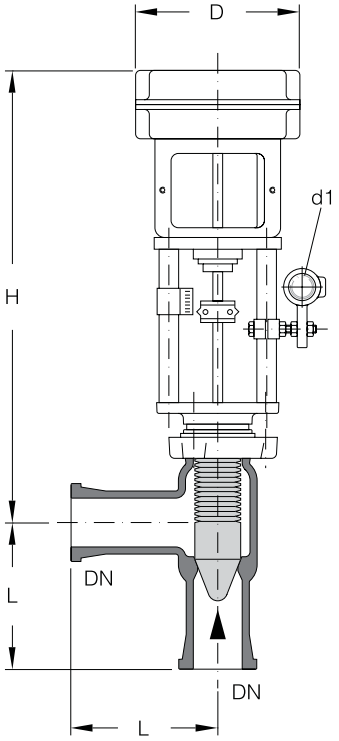
DN	D	L	H	Reference
25	150	175	265	PVM25/...
25	150	175	380	PVM25S/...
40	205	225	398	PVM40/...
40	205	225	563	PVM40S/...
50	205	300	387	PVM50/...
50	205	300	570	PVM50S/...
80	300	375	526	PVM80/...
80	300	375	707	PVM80S/...



PNEUMATICALLY ACTUATED ON/OFF VALVES

Angle Valves with Samson Actuator

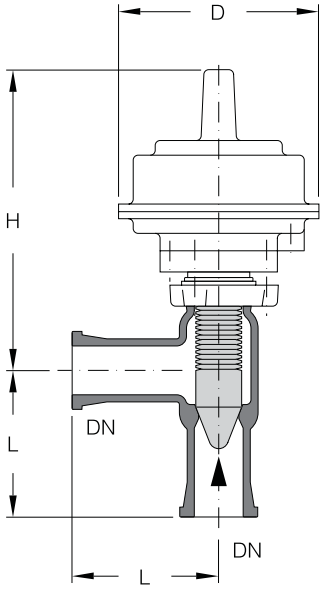
DN	D	d1	L	H	Reference
25	168	27	100	368	PES25/...
25	168	27	100	415	PES25S/...
40	168	27	150	411	PES40/...
40	168	27	150	448	PES40S/...
50	168	27	150	409	PES50/...
50	168	27	150	442	PES50S/...
80	280	27	200	512	PES80/...
80	280	27	200	593	PES80S/...



PNEUMATICALLY ACTUATED ON/OFF VALVES

Angle Valves with Kämmer Actuator

DN	D	L	H	Reference
25	150	100	215	PEM25/...
25	150	100	330	PEM25S/...
40	205	150	328	PEM40/...
40	205	150	493	PEM40S/...
50	205	150	308	PEM50/...
50	205	150	491	PEM50S/...
80	300	200	409	PEM80/...
80	300	200	590	PEM80S/...



CONTROL VALVES

Like the pneumatically actuated control valves specified on pages 3.14 and 3.15, the manually operated control valves listed below are supplied exclusively as angle type. They can be retrofitted for pneumatic operation.

All the k_{VS} values indicated for valves of a given nominal size (please see table) can be achieved by changing the PTFE plug/seat combination. A choice of linear or equal percentage characteristic curves are available.

The control ratio to VDI / VDE 2173 is 25 : 1 in all cases. The valve stroke is 10 mm for DN 25 nominal size valves and 15 mm for all other sizes.

When ordering please add the code number for the required k_{VS} value and the type of the characteristic curve required, (please see table below) to the catalogue reference.

Available k_{VS}-values

The »k_{VS} value« is a typical figure indicating the flow of water in m^3/h at 20 °C with a pressure drop of Δp=1 bar through the fully opened valve.

			k_{VS} value m^3/h													
DN		Operating characteristic	0,1	0,16	0,25	0,4	0,63	1	1,6	2,5	4	6,3	10	16	25	40
25	**Code for operating charcteristic and k_{VS} value**	Equal Percent.	01	03	05	07	09	11	13	15	17	19				
		Linear	02	04	06	08	10	12	14	16	18	20				
40		Equal Percent.										01	03	05		
		Linear										02	04	06		
50		Equal Percent.												01	03	05
		Linear												02	04	06

Catalogue reference key

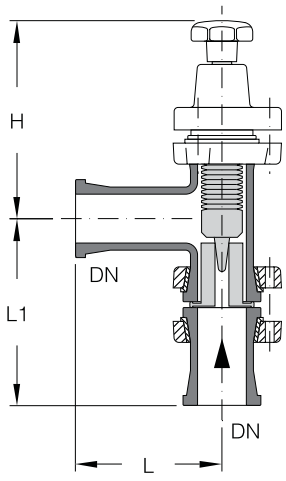
PRV25 05

- 05 — Code for operating characteristic and k_{VS} value (see table above)
- PRV25 — Control valve type

CONTROL VALVES

Hand Control Valves

DN	L	L1	H	Reference
25	100	167	170	**PRV25/...**
40	150	182	195	**PRV40/...**
50	150	192	205	**PRV50/...**



PNEUMATICALLY ACTUATED CONTROL VALVES

These valves consist of the valve body and bellows plug used in our manually operated control valves combined with either a Kämmer or Samson diaphragm actuator. Both are fitted as standard with an an attached electro-pneumatic I/P positioner of hazardous area type EEx ia IIC T6.

All the types specified below are available in two versions, the only difference being the type of seal to atmosphere provided. Thus catalogue reference »PRS25 /..«, for example, describes a valve with single seal (between the valve body and the diaphragm actuator), while catalogue reference »PRS25S /..« applies to a valve with a double seal in accordance with TA-Luft (additional spindle seal in the intermediate flange below the yoke rods as a precaution in case the bellows ruptures, please see also page 3.2).

To provide a means of supporting the valves a »KK50-5« structure fitting (please see Section 10 »Structures & Supports«) is provided on one of the yoke rods to facilitate attachment to the support structure.

Samson diaphragm actuators can also be supplied with HART or PROFIBUS positioners.

The required supply pressure is 2.5 bar g for all actuators and this should not be exceeded by more than 10 %.

When ordering please add the suffixes to the catalogue reference as indicated in the catalogue reference key. Suffixes for the required kVS value and the type of characteristic curve required can be found on page 3.13.

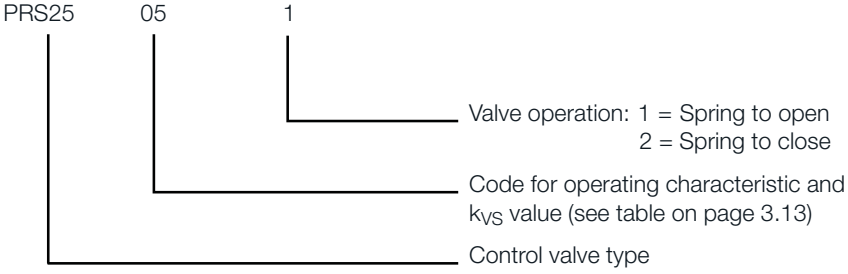
If required the positioners fitted to Samson actuators can be supplied with the following additional features:

- Built-in 3 / 2 way solenoid valve, hazardous area type EEx ia IIC T6 (24 V DC).
- Built-in inductive proximity switches in accordance with EN 50227/IEC 61934, hazardous area type EEx ia IIC T6 to indicate if the valve is open or closed.
- Built-in analogue position transmitter, hazardous area type EEx ia IIC T6 (4-20 mA). Please note that this can only be supplied in place of the proximity switches detailed above.
- Built-on pressure regulator.

Kämmer actuators can be supplied with the following additional built-on features on request:

- Inductive proximity switches in accordance with EN 50227/IEC 61934, hazardous area type EEx ia IIC T6, to indicate if the valve is open or closed. These are fitted into a housing mounted on top of the actuator (Dimension H increases by 70 mm).
- 3 / 2 way solenoid valve hazardous area type EEx me IIC T6 (24 V DC)

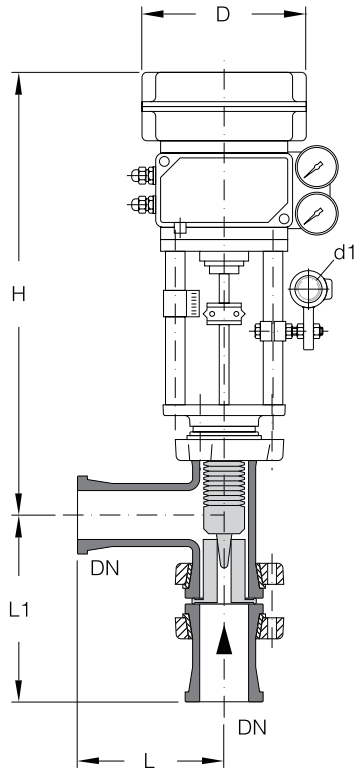
Catalogue Reference Key



PNEUMATICALLY ACTUATED CONTROL VALVES

Control Valves with Samson Actuator

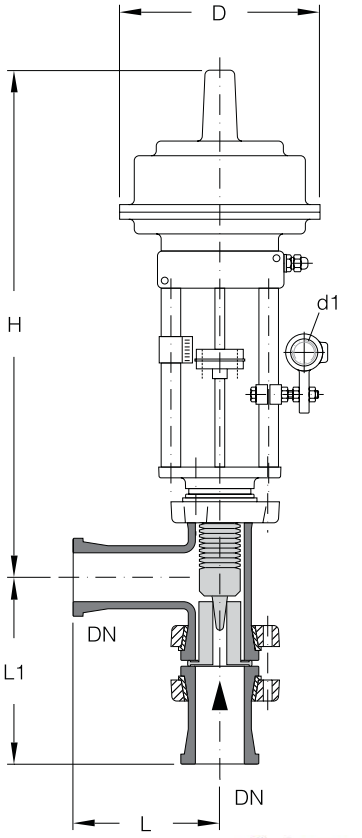
DN	D	d1	L	L1	H	Reference
25	168	27	100	164	378	**PRS25/...**
25	168	27	100	164	415	**PRS25S/...**
40	168	27	150	180	408	**PRS40/...**
40	168	27	150	180	443	**PRS40S/...**
50	168	27	150	190	418	**PRS50/...**
50	168	27	150	190	453	**PRS50S/...**



PNEUMATICALLY ACTUATED CONTROL VALVES

Control Valves with Kämmer Actuator

DN	D	d1	L	L1	H	Reference
25	150	27	100	164	445	**PRM25/...**
25	150	27	100	164	445	**PRM25S/...**
40	205	27	150	180	584	**PRM40/...**
40	205	27	150	180	586	**PRM40S/...**
50	205	27	150	190	594	**PRM50/...**
50	205	27	150	190	596	**PRM50S/...**



PRESSURE RELIEF VALVES

These valves are officially tested and approved for gases and vapours. They are direct operating and spring-loaded proportional (normal) pressure relief valves with a proven glass/PTFE seat/plug combination and are used to protect plant and equipment against exceeding the stated and/or approved operating pressure in accordance with the actual guidelines for pressure equipment. They can, however, also be used with pipeline and plant not subject to these regulations (where lower operating pressures or vacuum apply).

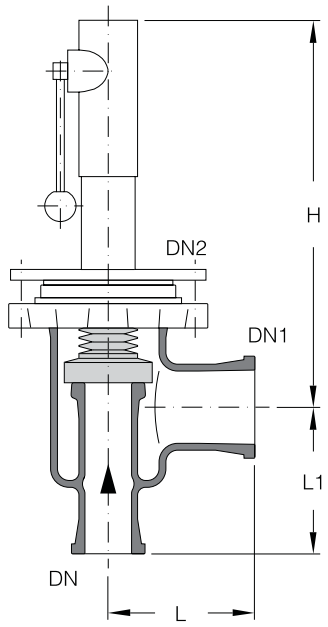
Before delivery, each valve is durably marked with the component reference »TÜV·SV...-590·d_o·D/G·α_w·p« issued by the TÜV test institute. In this reference: ...indicates the year of the applicable test report, 590 the test number, d_o the smallest flow diameter in mm, D/G the approval for gases and vapours, α_w the discharge coefficient and p the setting pressure in bar.g.

For lower duties, we can also supply a DN 50 ball valve for a blow-off pressure of 20 mbar.

When ordering, please indicate the catalogue reference and the required blow-off pressure in bar g.

The setting pressure can only be changed by specialist personnel (e.g. by QVF). The valve must then be resealed and the model label altered.

To ensure that they function properly, pressure relief valves must always be installed vertically. Support fittings are available for this purpose.



DN	DN1	DN2	L	L1	H	Reference
25	50	80	150	125	325	**SVF25/50**
50	80	100	150	150	395	**SVF50/80**
100	150	150	200	225	480	**SVF100/150**

Technical Data

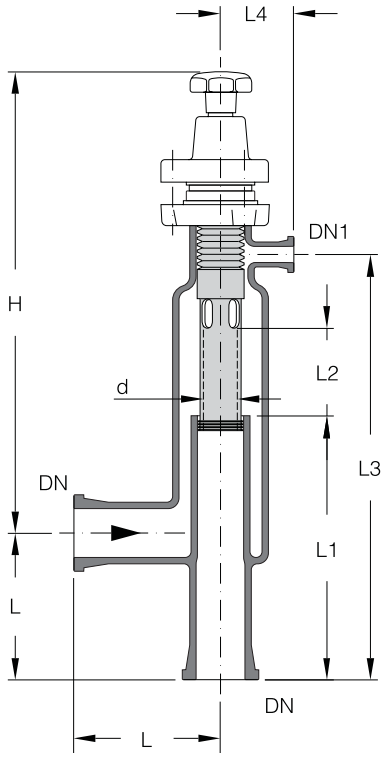
DN	Minimum flow diameter d_o	Minimum flow cross section A_o (mm²)	Discharge coefficient α_w	Set pressure range (bar g)
25	25	490	0,44	0,26-1,51
50	50	1960	0,10	0,11-0,25
50	50	1960	0,19	0,18-1,39
100	100	7850	0,17	0,07-1,18

ADJUSTABLE OVERFLOW VALVES

These valves are recommended for adjusting the interface in separators (e.g. in liquid-liquid extraction) azeotropic column heads or similar units. Level adjustment is infinitely variable and is by means of a PTFE tube fitted with sealing lips that can be moved up and down inside a precision bore glass tube.

Maximum possible throughputs (based on water and measured without any head in the input) are indicated in the table below.

Horizontal separators with sealed-in adjustable overflow valve can be found in Section 4 »Vessels & Stirrers«.



DN	DN1	d	L	L1	L2	L3	L4	H	Reference
25	15	25	100	165	50	255	78	340	**OF25**
40	15	25	150	265	90	435	78	470	**OF40**
50	15	35	150	270	90	435	75	470	**OF50**
80	15	60	200	330	120	555	100	580	**OF80**

Technical Data

DN	Maximum flow rate (l/h)
25	600
40	900
50	1600
80	3200

BOTTOM OUTLET VALVES

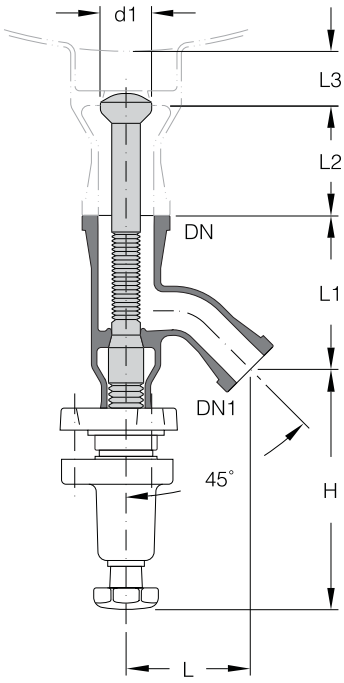
These valves close from below against an integral sealed-in glass seat eliminating dead space i.e. falling stem valves, which is important in such applications as stirred vessels and reaction vessels. The sealed-in glass seat can be incorporated in spherical and cylindrical vessels (please see Section 4 »Vessels & Stirrers«).

For pneumatically actuated bottom outlet valves, please see page 3.18.

Versions which seal from above can also be supplied on request i.e. rising stem. With these valves a special inverted valve seat is required which must be specified when ordering the vessel. The plug is fitted from inside the vessel after the valve is attached to the bottom outlet.

The »BAS40« is a short form valve, designed for use in spherical and cylindrical vessels which have short bottom outlets.

In the case of spherical and cylindrical vessels which have longer bottom outlets, because they are jacketed or are for use in oil baths, the »BAL40« long version should be used.



DN	DN1	d1	L	L1	L2	L3	H	Reference
40	25	35	85	105	75	35	165	**BAS40**
40	25	35	85	105	155	35	165	**BAL40**

PNEUMATICALLY ACTUATED BOTTOM OUTLET VALVE

This valve combines the valve body and bellows plug of the »BAS 40« manually operated bottom-outlet valve with a Samson pneumatic diaphragm actuator. The length of travel of the sealing plug below the seat is 15 mm and this therefore leaves the entire flow cross-section free. The valve can be set to close or to open as required in the event of a breakdown of the compressed air supply (please see below).

These valves are designed specifically for use with spherical or cylindrical vessels (see Section 4 »Vessels & Stirrers«) or immersion heat exchangers (see Section 5 »Heat Exchangers«) which have an integral glass-seat sealed into the bottom outlet. In the case of spherical and cylindrical vessels this feature can be incorporated on request.

To provide a means of supporting the valves a »KK50-5« structure fitting (please see Section 10 »Structures & Supports«) is provided on one of the yoke rods to facilitate attachment to the support structure.

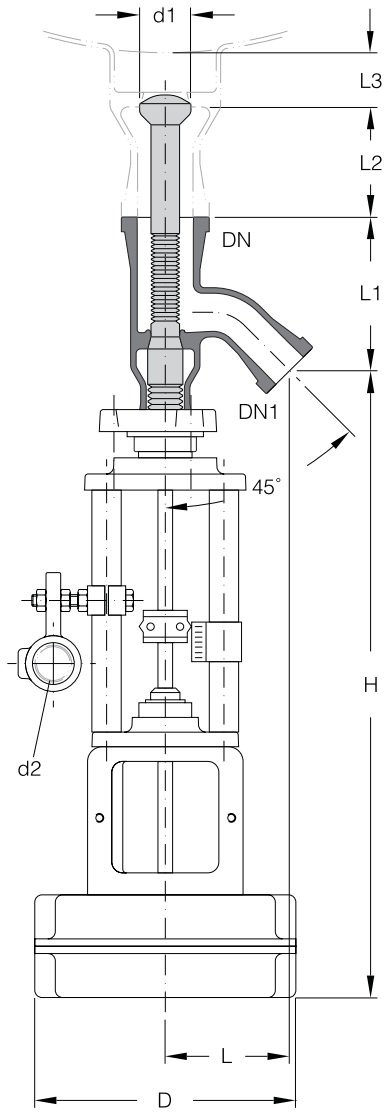
Pneumatic actuators from other manufacturers, a long version based on the »BAL 40« and versions sealing from above can also be supplied on request. In the latter case the bellows plug has to be fitted from inside the vessel.

The supply pressure required is 2.5 bar g and this should not be exceeded by more than 10 %.

When ordering please add a »1« to the catalogue reference if the »spring-to-open« fail-safe version is required or a »2« for »spring-to-close«.

If required the actuators can be supplied with the following additional built-on features:

- Limit switch with built-in inductive proximity switches in accordance with EN 50227/IEC 61934, hazardous area type EEx ia IIC T6, to indicate if the valve is open or closed.
- 3/2 way solenoid valve, hazardous area type EEx ia IIC T6 (24 V DC)..



DN	DN1	D	d1	d2	L	L1	L2	L3	H	Reference
40	25	168	35	27	85	105	75	35	378	**BASP40/...**

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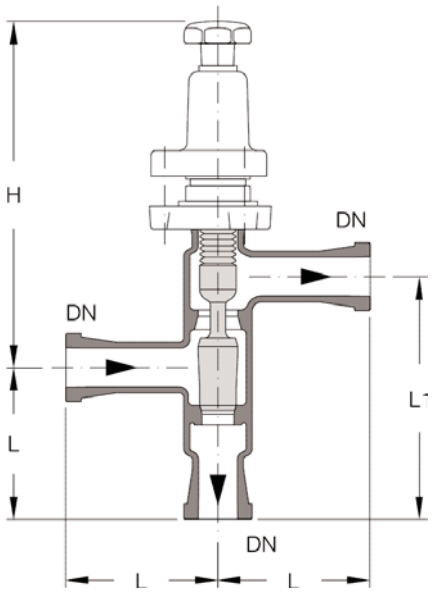
THREE WAY FLOW CHANGE VALVES

With normal three way valves it is possible to close both outlets at the same time by mistake which can result in the build-up of excess pressure in the line and also in the plant itself. The valve described here provides a safe solution to this problem since the design ensures that free flow through the valve is never impeded.

The use of a three way flow change valve is recommended when a plant is operated batchwise, under vacuum, and needs to be vented at regular intervals. In such circumstances one outlet is connected to the vacuum pump and the other (in reverse direction of flow) is used for venting purposes.

As in the case of on-off and control valves (please see page 3.10 and 3.14) three way flow change valves can be supplied with pneumatic actuators.

DN	L	L1	H	Reference
25	100	160	232	**PVW25**
40	150	220	270	**PVW40**



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GAS MIXING VALVES

These valves are used to feed gas into bubble columns without internals and reaction vessels. The gas enters through holes drilled radially at the narrowest cross-section of the PTFE jet and the flow of liquid causes it to shear off into very fine bubbles. This also ensures uniform distribution in the liquid even when used with large reaction vessels or similar equipment.

The liquid and gas throughput ratio can be selected within wide limits with the valve fully opened. This is achieved by appropriate adjustment of the gas feed pressure, selection of an appropriate diameter for the gas inlet holes or changing the liquid flow rate. It is also possible to vary the ratio of the two flow rates to each other by adjusting the setting of the control cone.

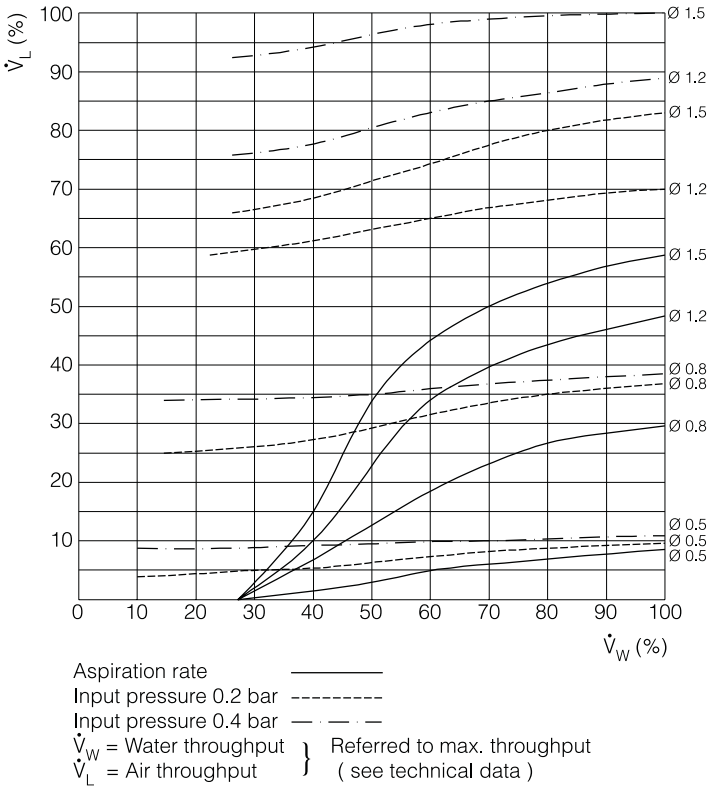
A wide range of measurements have been carried out for the water/air system and graphs recording the results of these are available on request. A summary of these curves can be seen in the diagram below.

The diameter of the gas inlet holes can be freely selected between 0.5 and 1.5 mm in 1/10 mm increments.

When ordering, the required gas inlet hole diameter (please see below) should be added to the catalogue reference.

The specification of the centrifugal pump is determined by the liquid throughput on the one hand and the pressure drop in the valve and back pressure resulting from the column of liquid behind the valve on the other hand.

These valves should not be used as cut-off valves due to the risk of distortion of the gas inlet holes.



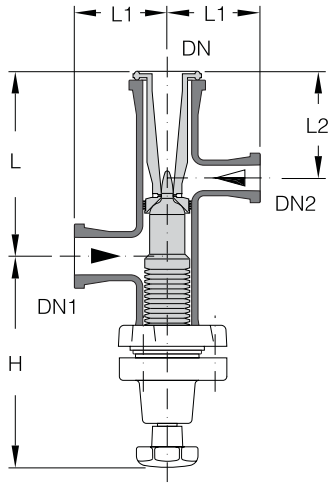
Gas throughput (air, 20 °C) versus liquid throughput (water, 20 °C)

GAS MIXING VALVES

Technical Data

The throughputs for water and gas refer to a pressure drop of 2 bar in the valve and were measured with an input pressure (air) of 0.4 bar g and a hole diameter of 1.5 mm.

Valve size		DN	25	40	50
Permissible operating pressure at 120 °C		bar.g	3,5	3,5	3,0
Throughput	Water	l/h	1000	2000	4000
	Air	Nm³/h	2,3	8,0	13,0



DN	DN1 Liquid	DN2 Gas	L	L1	L2	H	Reference
25	15	15	120	50	80	186	**RM25/...**
40	25	25	155	75	95	207	**RM40/...**
50	40	25	190	95	110	220	**RM50/...**

SAMPLING VALVES

These valves are void of dead space and are designed for installation in horizontal pipelines. They are used to take samples from plant and other equipment. There are two different versions (please see below and page 3.23) which should be selected according to whether they are to operate under positive or atmospheric pressure or alternatively, under vacuum.

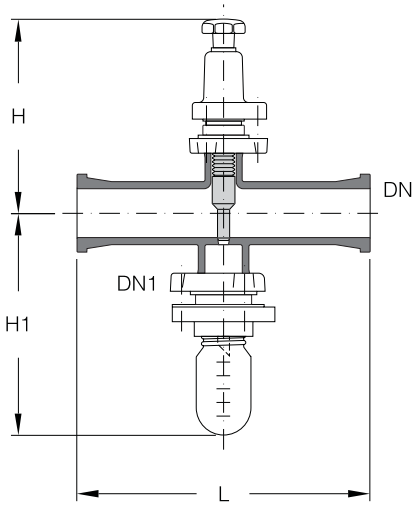
The two-part sampling flange below the outlet neck has a PPH feed pipe fitted inside it and has a GL 45 screw thread (usual with laboratory glass ware). It will, therefore, accept a laboratory bottle (which is included in the supply), for example. It can also be vented via a hole provided in the flange. To evacuate the bottle when taking samples from a vacuum, this hole is fitted with a three-way valve (G 1/4 connection).

When taking samples from a vacuum, the vessels used (e.g. laboratory bottles) must be suitable for use under vacuum.

SAMPLING VALVES

Sampling Valves for Atmospheric and Positive Pressure

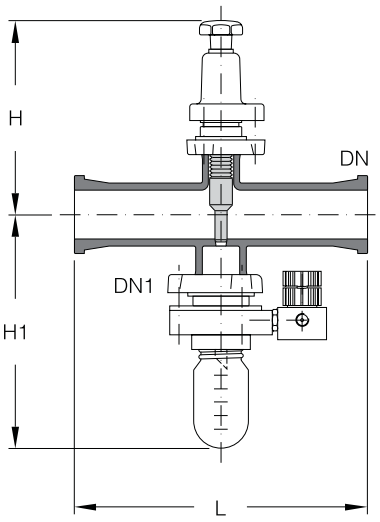
DN	DN1	L	H	H1	Reference
25	40	200	202	207	**PEV25**
40	40	300	202	215	**PEV40**
50	40	300	202	220	**PEV50**



SAMPLING VALVES

Sampling Valves for Vacuum

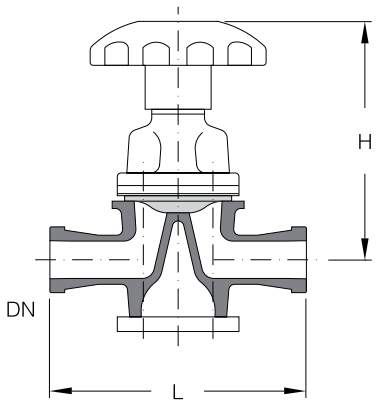
DN	DN1	L	H	H1	Reference
25	40	200	202	215	**PEVV25**
40	40	300	202	223	**PEVV40**
50	40	300	202	228	**PEVV50**



DIAPHRAGM VALVES

The design of these valves differs from that of our normal valves and provides great benefits where GMP requirements have to be met. The PTFE diaphragm seals on a fire-polished glass weir and, when installed vertically, the valve can be emptied fully via the pipeline it is connected to.

DN	L	H	Reference
25	175	170	**MV25**
40	200	175	**MV40**



BALL VALVES

As a result of the careful selection of materials which ensures that they meet the corrosion resistance standards expected of our products, these ball valves, which close with a gas-tight seal, represent an excellent complement to the rest of our range of glass valves. They are used in every type of application where full bore flow, i.e. low pressure drop, is an important requirement. In addition, they offer the benefit of short operating travel.

All the various versions have the common features of ceramic ball (Al_2O_3), PFA-sheathed stainless steel operating spindle and PTFE sealing ring (various designs). Body materials, mating ends (with or without coupling components) and the sealing arrangements for the operating spindle vary.

All bodies (except »KH..«), coupling flanges and hand levers are epoxy resin coated.

Support fittings are available which consider the installation options for these components..

The maximum permissible operating temperature for all versions is 180 °C. The maximum permissible operating pressure is the same in each case as for the corresponding size borosilicate glass 3.3 pipeline.

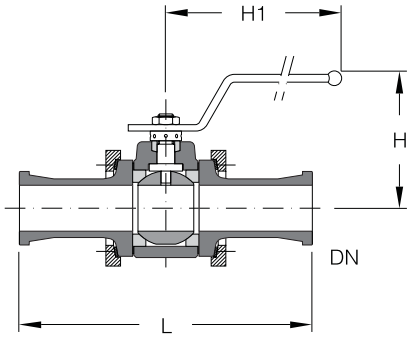
BALL VALVES

Ball Valves with Borosilicate Glass 3.3 Body

This version has a borosilicate glass 3.3 body and connecting ends (please see above for data on materials of construction applicable to all versions). This design is particularly suitable for liquids containing solids.

The operating spindle is sealed by means of a PTFE-sheathed O-ring and requires no maintenance.

DN	L	H	H1	Reference
25	175	115	150	**KH25**
40	225	155	225	**KH40**
50	300	160	225	**KH50**

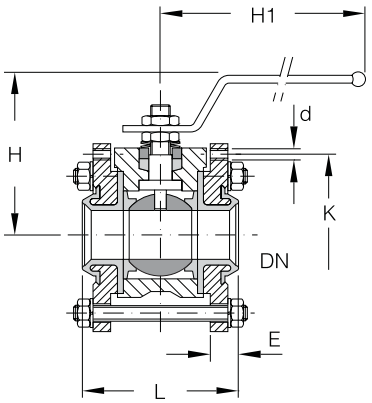


BALL VALVES

Compact Ball Valves with Spheroidal Graphite Cast Iron/PFA Body

A feature of these compact ball valves with body and connecting flanges made of spheroidal graphite cast iron/PFA (please see on page 3.24 for data on materials of construction applicable to all versions) is their short overall length They are ideal for direct installation in borosilicate glass 3.3 between components with safety buttress ends. Appropriately drilled type »CRSSE..« adaptor flanges (please see section 9 »Couplings«), inserts, bolts etc. should be ordered separately.

The operating spindle is sealed by means of a self-adjusting, maintenance-free stuffing box.



DN	L	H	H1	E	K x n x d	Reference
25	80	115	150	15	85 x 4 x M8	**KHK25**
40	100	155	225	16	110 x 4 x M8	**KHK40**
50	125	160	225	23	125 x 4 x M8	**KHK50**

PNEUMATICALLY ACTUATED BALL VALVES

All the manually operated ball valves described above can be supplied with NORBRO single-action actuators. Their spring return action can be set at will as a safety feature to either »spring to open« or »spring to close«.

Technical data and installation dimensions of these ball valves are the same as for the manually operated version.

The actuators themselves and the fitting kits used conform to ISO standards. Support fittings are available which consider the installation options for these components.

If required, we can also supply actuators with a lower number of springs for lower air supply pressures, double-action NORBRO actuators or actuators by other manufacturers.

Compressed air is required at 5.5 bar g for single-action actuators with the full number of springs.

To avoid the sudden build-up of high surface pressure between the ball and operating spindle at the start of the opening or shutting action, we recommend the incorporation of air flow controls in the supply line to the actuator.

When ordering please add a »1« to the catalogue reference if the »spring-to-open« fail-safe version is required or a »2« for »spring-to-close«.

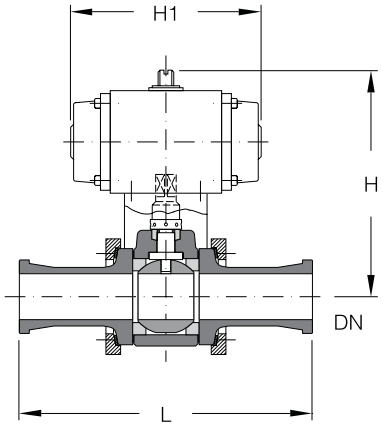
The »spring to open« setting can be changed to »spring to close« and vice-versa by changing the position of the operating spindle in the actuator by 90°.

If required, two inductive proximity detectors of hazardous area type EEx ia IIC T6 to indicate on/off can be supplied for the actuators.

PNEUMATICALLY ACTUATED BALL VALVES

Ball Valves with Borosilicate Glass 3.3 Body

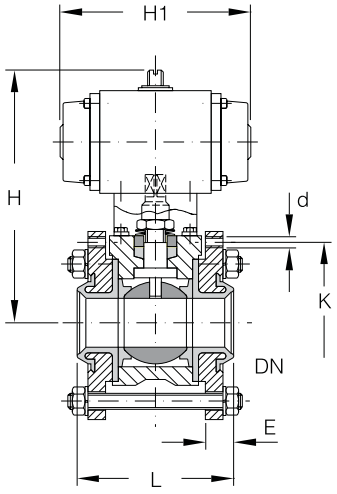
DN	L	H	H1	Reference
25	175	182	155	KHP25/...
40	225	240	195	KHP40/...
50	300	244	195	KHP50/...



PNEUMATICALLY ACTUATED BALL VALVES

Compact Ball Valves with Spheroidal Graphite Cast Iron/PFA Body

DN	L	H	H1	E	K x n x d	Reference
25	80	208	155	15	85 x 4 x M8	KHKP25/...
40	100	255	195	16	110 x 4 x M8	KHKP40/...
50	125	259	195	23	125 x 4 x M8	KHKP50/...



BUTTERFLY VALVES

These valves, which close with a gas-tight seal, complement our ball valve range (please see pages 3.24 to 3.26) in the larger bores. The combination of materials of construction selected ensures that they also meet the corrosion resistance standards expected of our products. They are used not only where there is a requirement for full bore flow, i.e. low pressure drop, and short operating travel, but also absence of dead space and short overall length.

In reaction units they can be used to separate the distillation overhead gear and reaction vessel when it is intended to operate the latter for periods at higher pressure.

These butterfly valves comprise essentially a PFA-sheathed stainless steel disk/ operating spindle unit, a two-part PFA / spheroidal graphite cast iron body, a maintenance-free, self-adjusting operating spindle seal together with a hand lever and an integral earthing strap for static electricity discharge purposes. The body and hand lever are epoxy resin coated.

As a result of their virtually equal percentage characteristic curve in the 20° to 80° opening angle range, flap valves can also be used as control valves. The seal between the disk and body lining is concentric and it makes a soft seal.

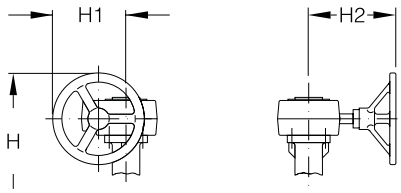
Support fittings are available which consider the installation options for these components.

Butterfly valves nominal size DN 50 are supplied as standard with a hand lever with fixed intermediate settings. Larger valves are supplied with a geared handwheel. All sizes can, however, be supplied with pneumatic actuators if required.

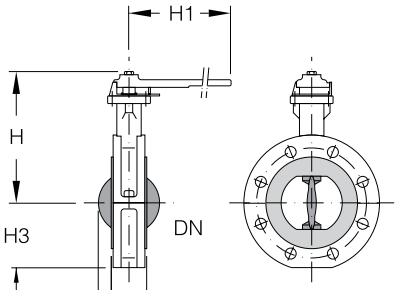
These butterfly valves can also be used for connections to glassed steel branches. The corresponding sets of adaptors have to be ordered separately (see Section 9 »Couplings«).

The maximum permissible operating temperature is 190 °C at -0,5/+4 bar g and 120 °C at -1/+4 bar g.

If required, butterfly valves can be supplied with an additional secondary seal (stuffing box), alarm connection and proximity switch (»valve closed« indicator).



DN80 - DN200



DN50

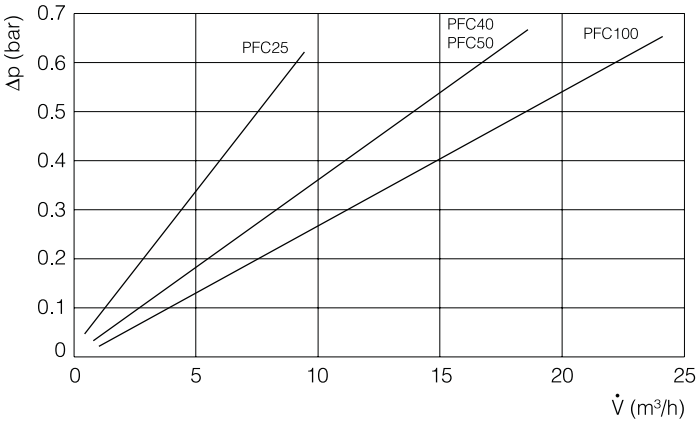
DN	L	L1	H	H1	H2	H3	Reference
50	43	4	175	300	-	66	**FVT50**
80	46	18	262	120	181	93	**FVT80**
100	52	25	277	120	181	106	**FVT100**
150	56	48	314	120	181	135	**FVT150**
200	60	71	334	120	181	165	**FVT200**

PIPELINE FILTERS

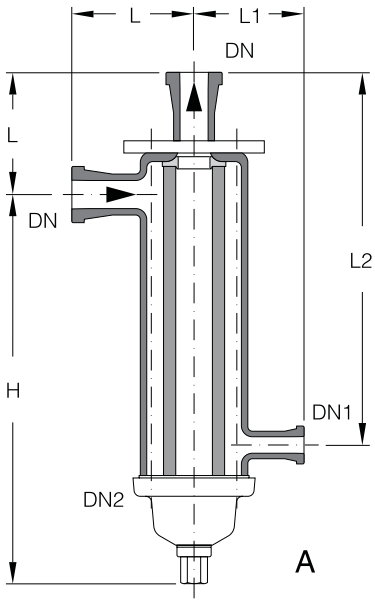
Our proven pipeline filters with ceramic elements (please see also »Dirt Traps« on page 3.29) are recommended for the removal of very fine impurities from liquid or gas streams in glass pipeline systems. They are supplied as standard in grain size 30 with an average pore diameter of 40 µm. Other grain sizes and materials are also available upon request.

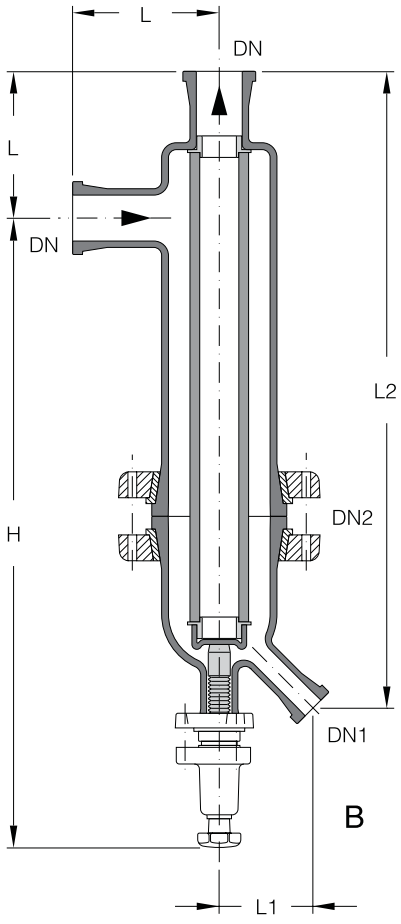
The degree of contamination can be observed clearly at all times through the borosilicate glass 3.3 body provided the product permits it. The assembly is designed for ease of cleaning or replacement of the filter element.

The graphs below provide pressure drop data (based on water) for the various sizes. They refer to clean filter elements.



Pressure drop versus throughput (water, 20 °C) with grain size 30





DN	DN1	DN2	L	L1	L2	H	Type	Reference
25	15	80	100	90	305	320	**A**	**PFC25**
40	25	100	150	96	654	650	**B**	**PFC40**
50	25	100	150	96	654	650	**B**	**PFC50**
100	25	200	250	128	715	626	**B**	**PFC100**

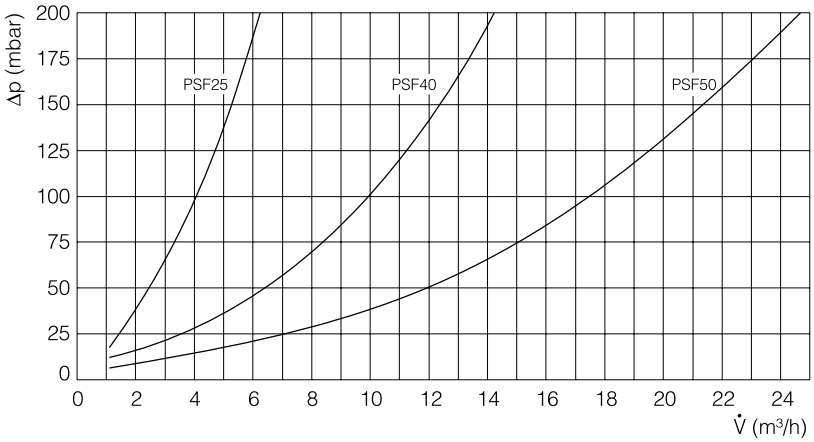
DIRT TRAPS

These angled seat filters with PTFE insert are designed for use in pipeline systems. They are used to protect equipment, e.g. pumps with magnetic coupling, against damage by abrasive contents or other impurities (please see also »Pipeline Filters« on page 3.28).

Dirt traps can be supplied as coarse filters, i.e. with 2 mm diameter holes in the PTFE cylinder, or as fine filters. In the latter case a PTFE filter sleeve with a mesh size of 100, 300 or 500 µm is fitted over the support cylinder. The graphs below provide pressure drop data (based on water) for the various sizes. They refer to clean filter inserts.

The degree of contamination can be observed clearly through the borosilicate glass 3.3 body provided the product permits it.

When ordering fine filters, the mesh size (please see above) should be added to the catalogue reference. The mentioned pressure drop is related to a maximum temperature of 180 °C.



Pressure drop versus throughput (water, 20 ºC)

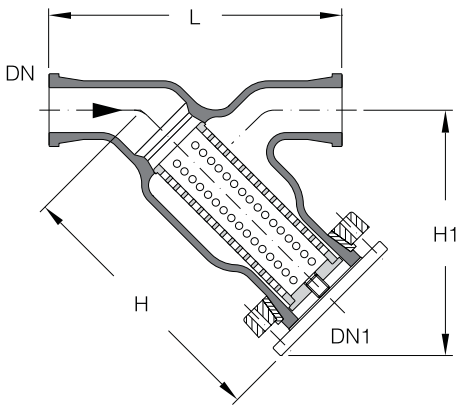
DIRT TRAPS

Coarse filters

DN	DN1	L	H	H1	Pmax. (bar)	Reference
25	40	175	180	163	3	**PSF25**
40	50	225	190	173	3	**PSF40**
50	80	300	280	252	2	**PSF50**

Fine filters

DN	DN1	L	H	H1	Pmax. (bar)	Reference
25	40	175	180	163	3	**PSF25/...**
40	50	225	190	173	3	**PSF40/...**
50	80	300	280	252	2	**PSF50/...**



QVF

PROCESS PLANT COMPONENTS

Introduction

QVF vessels and stirrers provide the optimum solution for every requirement encountered in practice because of the wide range of types available. Vessels in either basic or jacketed form are essential components of many units and plants, both large and small. They can be combined with various components such as vessel covers, stirrers, stirrer drives and heat exchangers to construct a widely varying range of stirred units and reaction units. The range is supplemented by complete assemblies such as mobile vessels, horizontal separators and cyclones.

These components are widely used in the chemical, pharmaceutical and allied industries together with other applications such as food and drink production, dye works and electroplating. This is because of the special properties of borosilicate glass 3.3, glass-lined steel and PTFE (gaskets) plus the fact that borosilicate glass 3.3 is an approved and proven material of construction for pressure vessels.

Reference should also be made in this context to the extreme reliability of the strong and high-duty coupling system used for all components. This is achieved throughout the whole range of nominal sizes by the use of the safety buttress end which has been designed specifically by taking into account the properties of the material coupled with a reliable flange system.

The complete range of standard components and assemblies is described on the following pages. Non-standard components that can be supplied to special order are referred to in the respective product description.

A detailed listing of all components by »Description« and »Catalogue Reference« can be found in the »Index«.

Detailed information on a number of the topics referred to in the following pages can be found in Section 1 »Technical Information«.

Details of the design of the different types of optimised buttress ends are illustrated alongside.

Immersion heat exchangers for spherical and cylindrical vessels can be found in Section 5 »Heat Exchangers«.

DN15 - DN150

DN200 - DN300

DN450 - DN1000

GMP compliant installations

The use of vessels, stirrers and stirrer drives and the layout of interconnecting pipeline incorporating valves, when designing plant and equipment complying with GMP regulations, calls for special care in both the planning and selection of the components used together with the materials of construction used for them. Borosilicate glass 3.3 has a number of special properties that are highly valued in the pharmaceutical industry and these in conjunction with materials approved in accordance with the FDA catalogue, such as glass-lined steel (vessels, valves) and-PTFE (bellows, lining, coating), ensure that any build-up of unwanted deposits is avoided in areas which come in contact with the product. A design without any dead space, which ensures that components drain fully and can be cleaned easily and effectively, is achieved by the shape of the components, the way they are installed and the selection of suitable valves. Where the external surfaces of complete assemblies have to comply with clean room requirements, appropriate stainless steel coupling and support material can be supplied (please see Section 9 »Couplings« and Section 10 »Structures and Supports«).

We would be happy to advise you on the basis of the regulatory requirements applicable to a particular case and the guidelines drawn up by us, for the design of GMP compliant plant.

Coated vessels

Damage to borosilicate glass 3.3 vessels and vessel covers resulting from accidental external causes cannot be entirely excluded, especially in the smaller nominal sizes. This is primarily due to the relatively rigorous conditions prevalent in production plants and applies especially where no additional protection is provided in the form of insulation.

Our answer to this problem is to provide borosilicate glass 3.3 vessels with a Sectrans transparent coating. This can be applied irrespective of the shape of the component and it provides additional protection without having any adverse effect on visual monitoring of the process.

A glass fibre reinforced polyester coating providing a higher level of protection can also be supplied on request. This does have a slightly adverse effect on the transparency of the glass , making it translucent and not transparent.

Permissible operating conditions

While the maximum permissible operating temperature for borosilicate glass 3.3 vessels, vessel covers and fittings is generally 200 °C ($\Delta\Theta \leq 180$ K), the maximum permissible operating pressure is governed by the main nominal size or the maximum diameter (spherical vessels only) of the component but not by its shape. Detailed information on this and the operation of jacketed components can be found in Section 1 »Technical Information«.

The permissible operating conditions for components in other materials can be found in the respective product description.

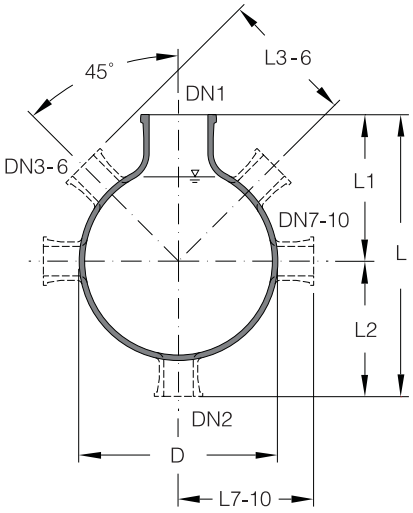
Glass components suitable for higher permissible operating conditions can be supplied on request.

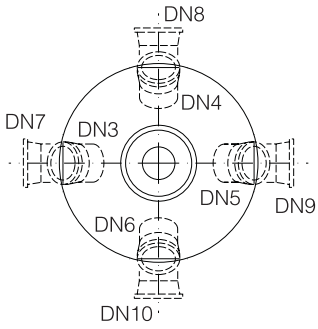
SPHERICAL VESSELS

Spherical vessels are commonly used not only as simple receivers and feed vessels but also for stirred and reaction vessels as well as circulatory evaporators. Cylindrical vessels (please see page 4.9 to 4.12) can be used as a possible alternative as can jacketed glass-lined steel vessels as specified on pages 4.23 and 4.24.

Various items for use with spherical vessels can be found as follows: vessel covers and connection flanges for stirrer drives on pages 4.18 to 4.20 and 4.42 glass and metal immersion heat exchangers in Section 5 »Heat Exchangers«, heating mantles and heating baths on pages 4.31 to 4.33 and stirrers on page 4.35 onwards.

To cater for their wide variety of possible uses, spherical vessels are required with various bottom and side branches (the top branch cannot be varied for manufacturing reasons). The illustration alongside shows the variations that occur most frequently and the table below gives information about the range of possible side branch diameters.





Nominal capacity (l)	D	DN1	DN2	DN3 : DN6	DN7 : DN10	L	L1	L2	L3 : L6	L7 : L10
10	280	100	15	15	15	430	250	180	180	180
			25	25	25	450		200	200	200
			40	40	40	455		205	205	205
			50	50	50	465		215	215	215
			80	80	80	475		225	225	225
			100	80	80	500		250	225	225
			150	80	80	535		285	225	225
20	350	100	15	15	15	540	325	215	215	215
			25	25	25	560		235	235	235
			40	40	40	565		240	240	240
			50	50	50	575		250	250	250
			80	80	80	585		260	260	260
			100	80	100	610		285	260	285
			150	80	100	645		320	260	285
50	490	200	25	25	25	705	400	305	305	305
			40	40	40	710		310	310	310
			50	50	50	720		320	320	320
			80	80	80	730		330	330	330
			100	100	100	755		355	355	355
			150	100	150	790		390	355	390
			200	100	200	775		375	355	375
100	610	200	25	25	25	815	450	365	365	365
			40	40	40	825		375	370	370
			50	50	50	830		380	380	380
			80	80	80	840		390	390	390
			100	100	100	865		415	415	415
			150	150	150	900		450	450	450
			200	150	200	875		425	450	425
200	750	300	25	25	25	985	550	435	435	435
			40	40	40	990		440	440	440
			50	50	50	1000		450	450	450
			80	80	80	1010		460	460	460
			100	100	100	1035		485	485	485
			150	150	150	1070		520	500	520
			200	150	200	1050		500	500	500
			300	150	200	1100		550	500	500
500	1005	450	50	-	-	-		-	-	-

SPHERICAL VESSELS

The versions described on pages 4.6 and 4.7 are available as standard. Details and dimensions, common to the various versions of vessels, can be found in the appropriate illustrations and tables.

All spherical vessels can be supplied with graduations on request.

When spherical vessels require a valve seat in order to fit a »BAS40« bottom outlet valve (please see Section 3 »Valves & Filters«) please add »BAS« to the catalogue reference. For example »VSM..BAS«. (dimension L increases in accordance with the table below).

Nominal capacity (l)	DN2	L for VS...BAS	L for VS...BAL	L for VS...E
10	40	500	580	580
20	40	610	690	690
50	40	755	835	835
100	40	865	945	945
200	40	1035	1115	1115
500	40	1315	-	-

For spherical vessels without a sealed in seat for a bottom outlet valve and which are to be fitted in heating baths please add »E« to the catalogue √reference to indicate the extended bottom outlet required. For example »VSM..E«. (dimension L increases in accordance with the table above).

For spherical vessels to be fitted in a heating baths and which also require a valve seat in order to fit a »BAL40« bottom outlet valve (please see Section 3 »Valves & Filters«) please add »BAL« to the catalogue reference. For example »VSM..BAL«. (dimension L increases in accordance with the table above).

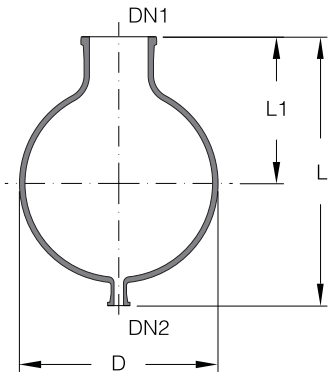
Brackets, support rings and vessel holders for spherical vessels can be found in the Section10 »Structures & Supports«.

The end form, which depends on the nominal size, is shown in the diagram on page 4.2. Further information can be found in Section 1 »Technical Information«.

SPHERICAL VESSELS

Receivers

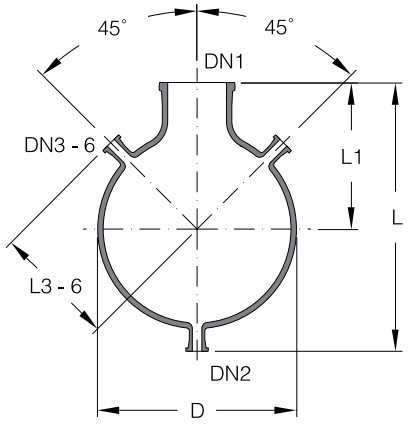
Nominal capacity (l)	D	DN1	DN2	L	L1	Reference
10	280	100	40	455	250	**VSC10**
20	350	100	40	565	325	**VSC20**
50	490	200	40	710	400	**VSC50**
100	610	200	40	825	450	**VSC100**
200	750	300	50	1000	550	**VSC200**
500	1005	450	50	1300	700	**VSC500**

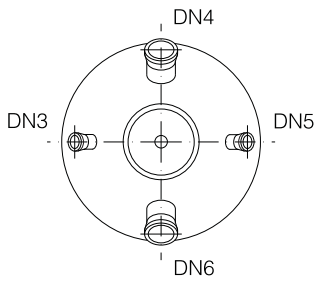


SPHERICAL VESSELS

Reaction Vessels

Nominal capacity (l)	D	DN1	DN2 DN3 DN5	DN4	DN6	L	L1	L3 L5	L4	L6	Reference
10	280	100	40	80	80	455	250	205	225	225	**VSM10**
20	350	100	40	80	80	565	325	240	260	260	**VSM20**
50	490	200	40	80	80	710	400	310	330	330	**VSM50**
100	610	200	40	100	100	825	450	370	415	415	**VSM100**
200	750	300	50	100	150	1000	550	450	485	500	**VSM200**

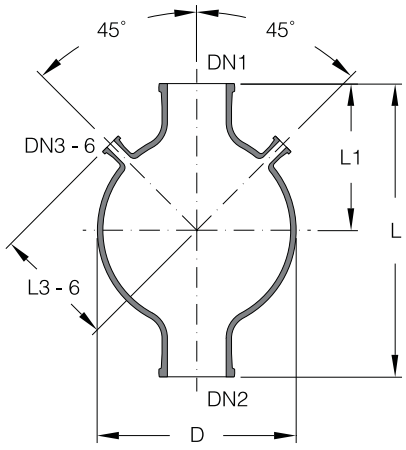


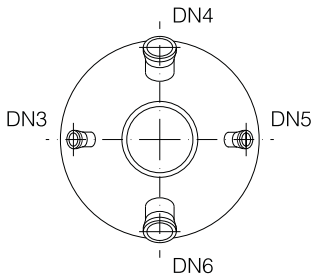


SPHERICAL VESSELS

Reaction Vessels for Immersion Heaters

Nominal capacity (l)	D	DN1	DN2	DN3 DN5	DN4	DN6	L	L1	L3 L5	L4	L6	Reference
10	280	100	150	40	80	80	535	250	205	225	225	**VSH10**
20	350	100	150	40	80	80	645	325	240	260	260	**VSH20**
50	490	200	200	40	80	80	775	400	310	330	330	**VSH50**
100	610	200	200	40	100	100	875	450	370	415	415	**VSH100**
200	750	300	300	50	100	150	1100	550	450	485	500	**VSH200**





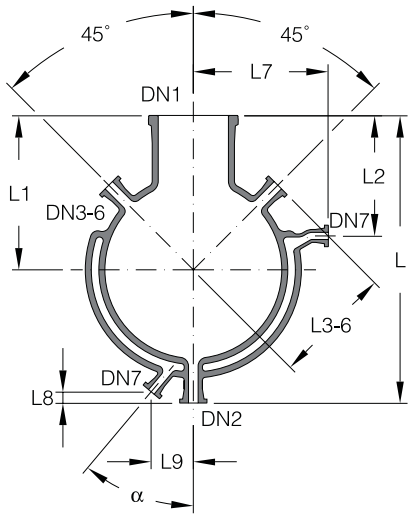
JACKETED SPHERICAL VESSELS

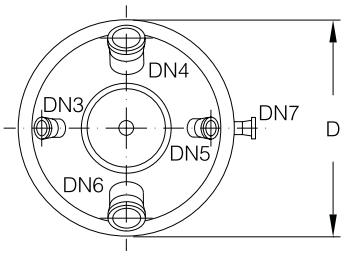
As an alternative to heating the contents of spherical vessels in heating mantles (please see page 4.31) or heating baths (please see pages 4.32 and 4.33) they can also be supplied up to a nominal capacity of 50 litre with a borosilicate glass 3.3 jacket. This is welded to the vessel at both ends.

Due to their design, jacketed spherical vessels must be supported at the top branch flange using tubular support frames (see Section 10 »Structures & Supports«). Further information can be obtained from our sales department.

If jacketed spherical vessels require a valve seat in order to fit a »BAL40« bottom outlet valve (please see Section 3 »Valves & Filters«) please add »BAL« to the catalogue reference. For example »DVSM..BAL« (dimensions will vary as indicated in the table below).

Nominal capacity (l)	Dimensions for DVS...BAL		
	DN2	L	L8
10	40	575	120
20	40	700	145
50	40	850	115





The permissible operating conditions for the jacket and inner component can be found in Section1 »Technical Information«.

Water or heat transfer fluids, can be used for heat transfer purposes. Our engineers will be pleased to advise on this subject.

The branches on the jacket are the safety buttress end type. If they are aligned horizontally and if long or heavy hoses are connected to them, we recommend 90° hose connectors to reduce the bending moment on the branches.

Borosilicate glass 3.3 and metal hose connectors can be found in Section 2 »Pipeline Components« and hoses in Section 9 »Couplings«.

The end form, which depends on the nominal size, is shown in the diagram on page 4.2. Further information can be found in Section 1 »Technical Information«.

Nominal capacity (l)	D	DN1	DN2	DN3 DN5	DN4 DN6	DN7	L	L1	L2	L3 L5	L4 L6	L7	L8	L9	α (°)	Reference
10	368	100	40	-	-	25	550	250	210	-	-	255	95	125	40	**DVSC10**
20	415	100	40	-	-	25	635	325	300	-	-	275	80	120	40	**DVSC20**
50	610	200	40	-	-	25	800	400	325	-	-	370	65	140	40	**DVSC50**
10	368	100	40	40	80	25	550	250	210	205	225	255	95	125	40	**DVSM10**
20	415	100	40	40	80	25	635	325	300	240	260	275	80	120	40	**DVSM20**
50	610	200	40	40	80	25	800	400	325	380	400	370	65	140	40	**DVSM50**

CYLINDRICAL VESSELS

The version with full bore top neck can be used for a wide variety of purposes such as reaction vessels, separating vessels, receivers and feed vessels.

Cylindrical vessels with a reduced diameter top neck provide an economical alternative in some cases since they require a smaller vessel cover. These vessels are mainly used as receivers.

Vessel covers for use with these cylindrical vessels can be found on pages 4.18 to 4.20.

Graduated and jacketed (up to DN 300 nominal size) versions can be supplied as standard. Further information on these can be found on pages 4.11 to 4.15.

When cylindrical vessels require a valve seat in order to fit a »BAS40« bottom outlet valve (please see Section 3 »Valves & Filters«) please add »BAS« to the catalogue reference. For example »VZ..BAS«. (dimension L increases in accordance with the table below).

Reference	Nominal capacity (l)	L
VZ5/150BAS	5	510
VZ10/200BAS	10	600
VZ20/300BAS	20	550
VZ30/300BAS	30	695
VZ50/300BAS	50	945
VZN100/450BAS	100	935
VZN150/450BAS	150	1240
VZN200/450BAS	200	1545
VZN400/600BAS	400	1735
VZN500/800BAS	500	1240
VZ750/1000BAS	750	1300
VZ20/150BAS	20	700
VZ30/150BAS	30	845
VZ50/150BAS	50	1045
VZ100/200BAS	100	1145
VZ150/200BAS	150	1445
VZ200/200BAS	200	1670
VZ300/200BAS	300	1535

Cylindrical vessels with a full bore top neck and nominal capacities of 5 to 50 litre can be suspended from the upper backing flange. All other vessels should be supported by the appropriate holder as described in Section 10 »Structures & Supports«.

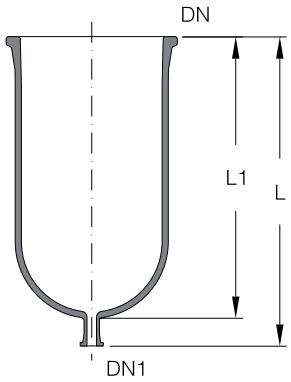
All cylindrical vessels with reduced diameter top neck should be supported by a vessel holder (please see Section 10 »Structures & Supports«).

The end form, which depends on the nominal size, is shown in the diagram on page 4.2. Further information can be found in Section 1 »Technical Information«.

CYLINDRICAL VESSELS

Universal Cylindrical Vessels

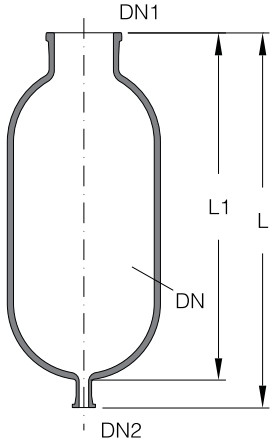
Nominal capacity (l)	DN	DN 1	L	L1	Reference
5	150	25	460	400	**VZ5/150**
10	200	25	550	490	**VZ10/200**
20	300	25	500	440	**VZ20/300**
30	300	40	650	585	**VZ30/300**
50	300	40	900	835	**VZ50/300**
100	450	40	890	825	**VZN100/450**
150	450	40	1195	1130	**VZN150/450**
200	450	40	1500	1435	**VZN200/450**
400	600	50	1700	1625	**VZN400/600**
500	800	80	1250	1130	**VZN500/800**
750	1000	80	1300	1190	**VZ750/1000**



CYLINDRICAL VESSELS

Cylindrical Receivers

Nominal capacity (l)	DN	DN 1	DN2	L	L1	Reference
20	300	150	25	650	590	**VZ20/150**
30	300	150	40	800	735	**VZ30/150**
50	300	150	40	1000	935	**VZ50/150**
100	450	200	40	1100	1035	**VZ100/200**
150	450	200	40	1400	1335	**VZ150/200**
200	450	200	40	1625	1560	**VZ200/200**
300	600	200	50	1500	1425	**VZ300/200**



GRADUATED CYLINDRICAL VESSELS

The specification for the standard graduations for each size of vessel are given in the tables. Universal cylindrical vessels and cylindrical receivers can also be supplied with graduations to meet your particular requirements.

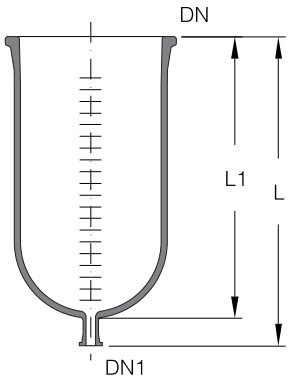
Cylindrical vessels calibrated in more precise increments, also including the volume of the outlet valve, can be supplied upon request.

The end form, which depends on the nominal size, is shown in the diagram on page 4.2. Further information can be found in Section 1 »Technical Informaton«.

GRADUATED CYLINDRICAL VESSELS

Universal Cylindrical Vessels

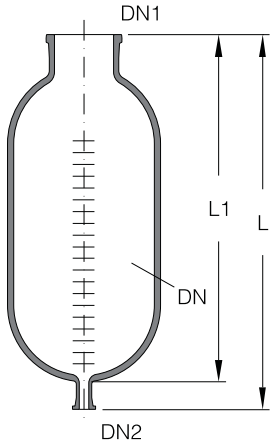
Nominal capacity (l)	DN	DN 1	L	L1	Graduations (l)	Reference
5	150	25	460	400	0,25	**VZG5/150**
10	200	25	550	490	0,5	**VZG10/200**
20	300	25	500	440	2	**VZG20/300**
30	300	40	650	585	2	**VZG30/300**
50	300	40	900	835	2	**VZG50/300**
100	450	40	890	825	5	**VZGN100/450**
150	450	40	1195	1130	5	**VZGN150/450**
200	450	40	1500	1435	5	**VZGN200/450**
400	600	50	1700	1625	5	**VZGN400/600**
500	800	80	1250	1130	10	**VZGN500/800**
750	1000	80	1300	1190	20	**VZG750/1000**



GRADUATED CYLINDRICAL VESSELS

Cylindrical Receivers

Nominal capacity (l)	DN	DN1	DN2	L	L1	Graduations (l)	Reference
20	300	150	25	650	590	2	VZG20/150
30	300	150	40	800	735	2	VZG30/150
50	300	150	40	1000	935	2	VZG50/150
100	450	200	40	1100	1035	5	VZG100/200
150	450	200	40	1400	1335	5	VZG150/200
200	450	200	40	1625	1560	5	VZG200/200
300	600	200	50	1500	1425	5	VZG300/200



JACKETED CYLINDRICAL VESSELS

Up to a nominal capacity of 100 litres, cylindrical vessels with full bore or reduced diameter top branch can also be supplied with a borosilicate glass 3.3 jacket. In the case of the smaller sizes (up to 30 litres capacity) this is welded to the vessel at both ends. In the larger sizes it is only welded to the vessel at its upper end and a flexible seal is used on the bottom outlet branch.

Due to their design, jacketed cylindrical vessels should be supported on the top neck flange using tubular support frames (see Section 10 »Structures & Supports«). Further information can be obtained from our sales department.

If jacketed cylindrical vessels require a valve seat in order to fit a »BAL40« bottom outlet valve (please see Section 3 »Valves & Filters«) please add »BAL« to the catalogue reference. For example »DVZ..BAL«. (dimensions will vary as indicated in the table below).

Reference	DN1	DN2	L	L3	L4	α (°)
DVZ5/150BAL	40	-	640	150	115	40
DVZ10/200BAL	40	-	680	145	120	40
DVZ20/150BAL	-	40	815	135	120	40
DVZ20/300BAL	40	-	660	135	120	40
DVZ30/150BAL	-	40	960	135	120	40
DVZ30/300BAL	40	-	805	135	120	40
DVZ50/150BAL	-	40	1240	150	145	40
DVZ50/300BAL	40	-	1090	150	145	40
DVZ100/450BAL	40	-	1030	140	145	40

The permissible operating conditions for the jacket and inner component can be found in Section 1 »Technical Information«.

Water or heat transfer fluids can be used for heat transfer purposes. Our engineers will be pleased to advise on this subject.

The branches on the jacket are of the safety buttress end type. If they are aligned horizontally and if long or heavy hoses are connected to them, we recommend 90° hose connectors to reduce the bending moment on the branches.

Borosilicate glass 3.3 and metal hose connectors can be found in Section 2 »Pipeline Components« and hoses in Section 9 »Couplings«.

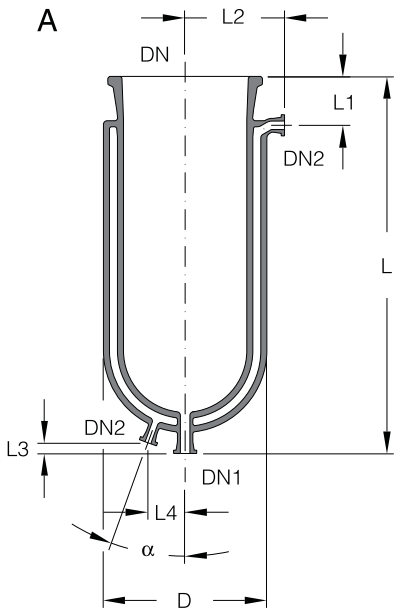
The end form, which depends on the nominal size, is shown in the diagram on page 4.2. Further information can be found in Section 1 »Technical Information«.

JACKETED CYLINDRICAL VESSELS

Universal Cylindrical Vessels

Nominal capacity (l)	DN	DN1	DN2	D	L	L1	L2	L3	L4	α (°)	Type	Reference
5	150	25	25	215	535	135	180	35	100	40	A	DVZ5/150
10	200	25	25	270	580	100	205	30	100	40	A	DVZ10/200
20	300	25	25	368	555	125	255	28	110	40	A	DVZ20/300
30	300	40	25	368	705	125	255	33	110	40	A	DVZ30/300
50	300	40	25	368	1050	125	255	100	130	40	B	DVZ50/300
100	450	40	25	520	990	150	330	100	140	40	B	DVZ100/450

A



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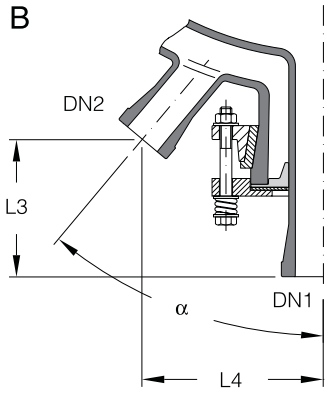
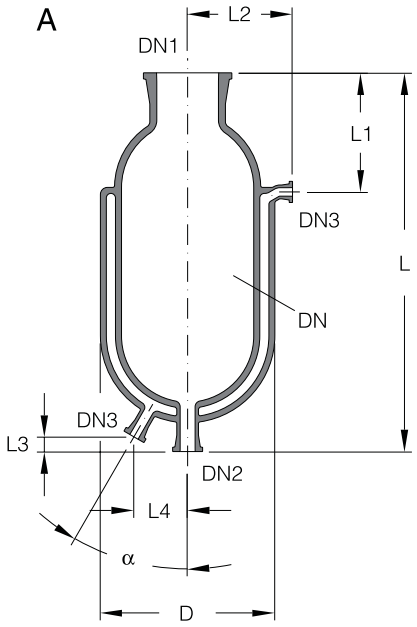


JACKETED CYLINDRICAL VESSELS

Cylindrical Receivers

Nominal capacity (l)	D	DN	DN1	DN2	DN3	L	L1	L2	L3	L4	α (°)	Type	Reference
20	368	300	150	25	25	710	280	255	28	110	40	A	DVZ20/150
30	368	300	150	40	25	860	280	255	33	110	40	A	DVZ30/150
50	368	300	150	40	25	1200	280	255	100	130	40	B	DVZ50/150

A



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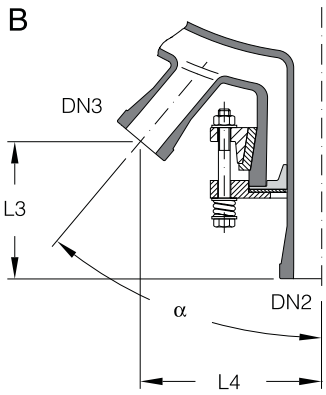
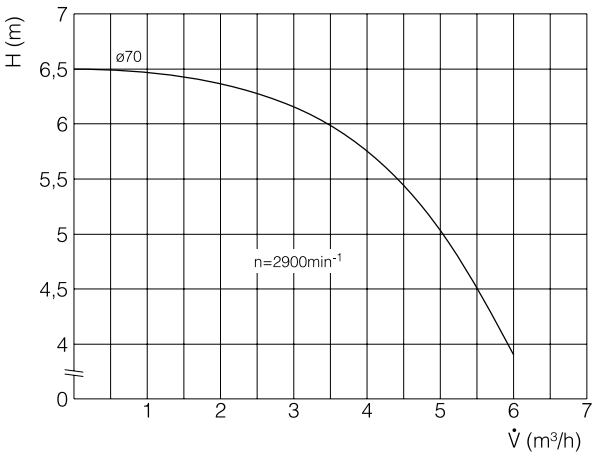


MOBILE VESSELS

Mobile vessels comprise of a mobile support structure with five steerable, antistatic castors (two fitted with brakes) with a cylindrical or spherical vessel fixed within it.

Mobile vessels can also be supplied with a centrifugal pump with single mechanical seal and borosilicate glass 3.3 body. Technical details can be found below.

Motor (kW)	0.25
Motor speed (min^{-1})	2900
Voltage (V), 50 Hz	230/400
Protection Type	EEx e II T3



Pump head versus delivery (water, 20 °C)

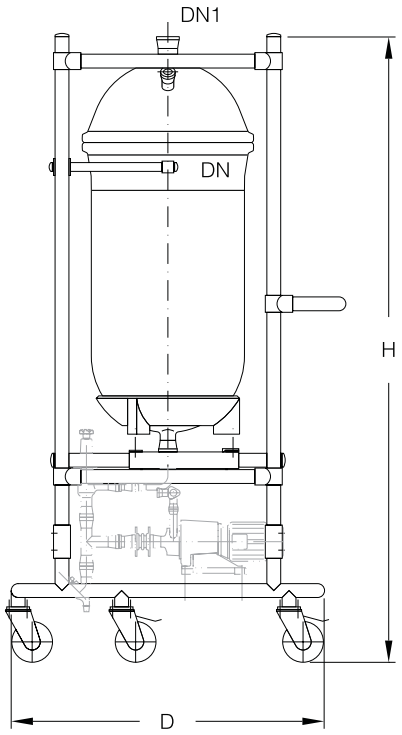
These vessels are ideal for pilot plant and production use to transport and store products.

Cylindrical mobile vessels can be supplied from 30 to 200 litre and spherical vessels from 50 to 200 litre. If required, they can also be graduated (please see page 4.11 as an example). The version without pump is fitted with a DN 40 drain valve and the version with pump incorporates a DN 25 drain valve plus a DN 25 and DN 15 angle valve on either side of the pump.

MOBILE VESSELS

Mobile Cylindrical Vessels

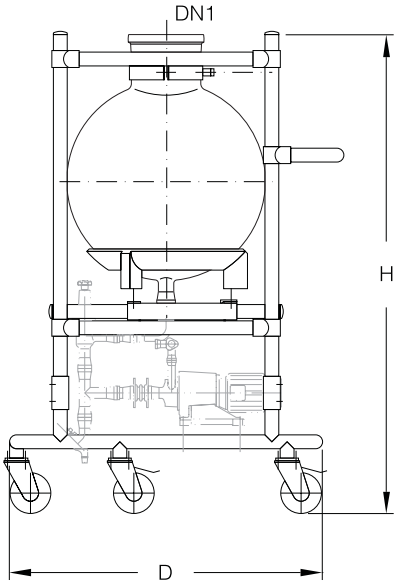
Nominal capacity (l)	DN	DN 1	D	H	Reference without pump	Reference with pump
30	300	50	821	1545	VGFN30	VGPN30
50	300	50	821	1795	VGFN50	VGPN50
100	450	50	962	1945	VGFN100	VGPN100
150	450	50	962	2245	VGFN150	VGPN150
200	450	50	962	2545	VGFN200	VGPN200



MOBILE VESSELS

Mobile Spherical Vessels

Nominal capacity (l)	DN1	D	H	Reference without pump	Reference with pump
50	200	962	1370	VFN50	VFPN50
100	200	962	1470	VFN100	VFPN100
200	300	1245	1700	VFN200	VFPN200



VESSEL COVERS

These components provide the optimum, vacuum-tight closure for vessels They facilitate observation of the process even after fitting or adding dip pipes (please see pages 4.21and 4.22), stirrers (please see pages 4.35 to 4.40), or measuring instruments (please see section 8 »Measurement & Control«) etc..

Vessel covers with alternative branch sizes and configurations can also be supplied to meet your special requirements.

If the unit is to be operated under vacuum or at atmospheric pressure, charge branches can be fitted with a quick release coupling (please see Section 9 »Couplings«).

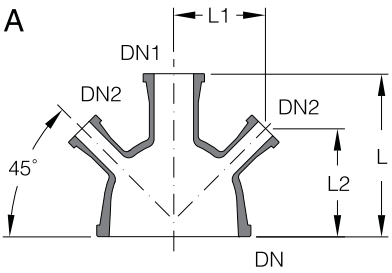
The end form, which depends on the nominal size, is shown in the diagram on page 4.2. Further information can be found in Section 1 »Technical Information«.

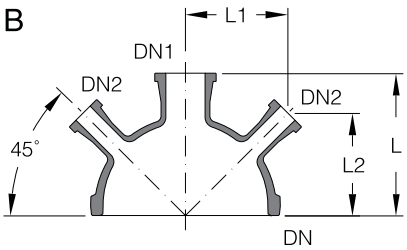
VESSEL COVERS

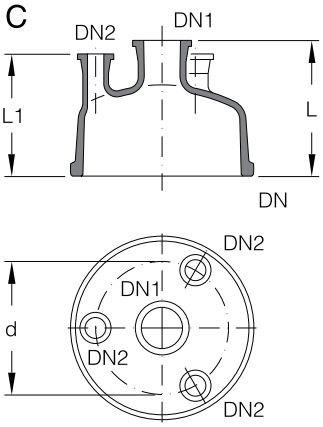
Covers for Receivers and Spherical Vessels

These covers are intended for use with spherical and cylindrical vessels used as receivers. They can, however, also be used with stirrer assemblies.

DN	DN1	DN2	d	L	L1	L2	Type	Reference
100	50	2 x 15	-	175	79	106	A	VZC100/50
150	50	2 x 25	-	200	113	133	A	VZC150/50
200	50	2 x 25	-	175	126	126	B	VZC200/50
200	-	3 x 40	150	-	175	-	C	VZA200
300	50	2 x 25	-	225	161	161	B	VZC300/50
300	80	3 x 40	245	250	225	-	C	VZA300/80
450	50	2 x 40	-	325	221	221	B	VZC450/50
600	50	2 x 40	-	375	264	264	B	VZC600/50
800	80	2 x 80	-	550	389	389	B	VZC800/80
1000	80	2 x 80	-	650	488	413	B	VZC1000/80





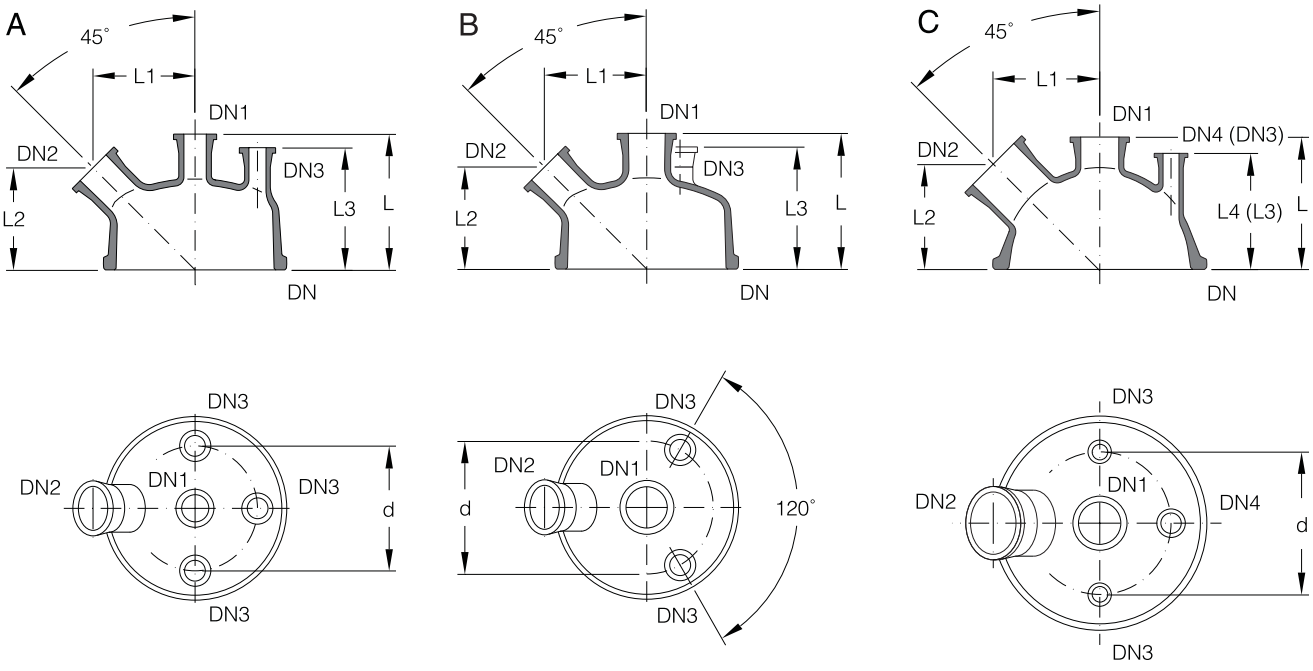


VESSEL COVERS

Covers with Central Stirrer Branch

These vessel covers have a centre branch for use in conjunction with a stirrer. We recommend the incorporation of a baffle to promote turbulence when used with propeller and turbine stirrers.

DN	DN1	DN2	DN3	DN4	d	L	L1	L2	L3	L4	Type	Reference
300	50	80	3 x 40	-	245	250	188	188	225	-	A	VZMC300/50
	80	80	2 x 40	-	245	250	188	188	225	-	B	VZMC300/80
450	50	150	2 x 40	50	350	325	262	259	285	285	C	VZMC450/50
	80	150	2 x 40	50	350	325	262	259	285	285	C	VZMC450/80
	100	150	2 x 40	50	350	350	262	259	285	285	C	VZMC450/100
600	50	150	2 x 40	50	400	375	291	290	335	335	C	VZMC600/50
	80	150	2 x 40	50	400	375	291	290	335	335	C	VZMC600/80
	100	150	2 x 40	50	400	400	291	290	335	335	C	VZMC600/100
800	80	150	3 x 80	-	450	550	386	386	525	-	C	VZMC800/80
	100	150	3 x 80	-	450	550	386	386	525	-	C	VZMC800/100
	150	150	3 x 80	-	450	575	386	386	525	-	C	VZMC800/150
1000	80	150	3 x 80	-	500	650	487	412	600	-	C	VZMC1000/80
	100	150	3 x 80	-	500	650	487	412	600	-	C	VZMC1000/100
	150	150	3 x 80	-	500	650	487	412	600	-	C	VZMC1000/150

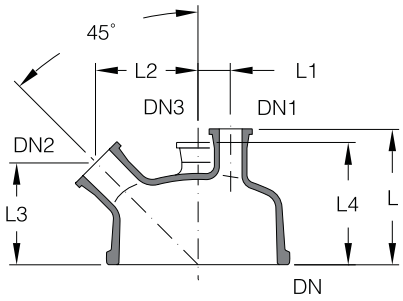


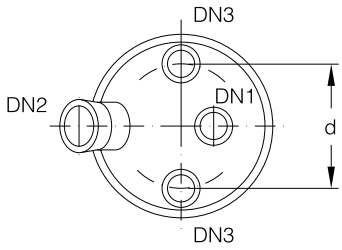
VESSEL COVERS

Covers with Eccentric Stirrer Branch

As the branch provided on these covers for fitting a stirrer is located off-centre, the possibility of a vortex being set up is avoided to a large extent even when propeller and turbine stirrers are used.

DN	DN1	DN2	DN3	d	L	L1	L2	L3	L4	Reference
200	50	50	-	-	200	40	139	139	-	VZME200/50
300	50	80	40	245	250	60	188	188	225	VZME300/50



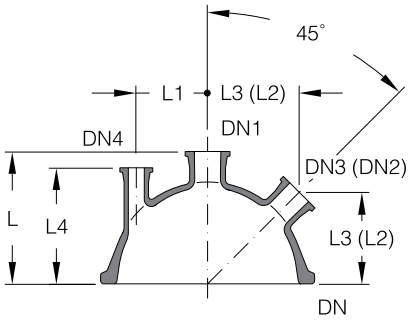


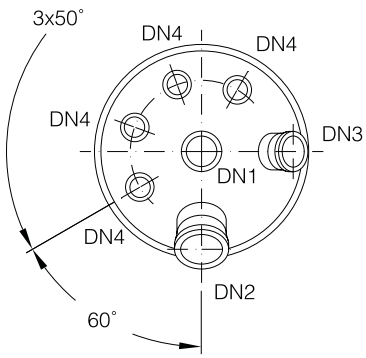
VESSEL COVERS

Covers for Reaction Vessels

These covers complement the range described above. They have a centre branch for use in conjunction with a stirrer, two extra large branches for overhead gear and charge port plus various other connections.

DN	DN1	DN2	DN3	DN4	L	L1	L2	L3	L4	Reference
450	80	100	80	50	325	175	247	232	285	VZR450/80
600	100	100	80	50	400	200	288	291	335	VZR600/100





DIP PIPES

The design of the dip pipe depends on the arrangement of the branches on the vessel cover used with spherical or cylindrical vessels.

Type »DP../100« can be used as a standard dip pipe irrespective of the branch arrangement.

Dip pipes with other lengths can be supplied on request.

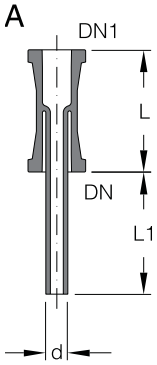
DIP PIPES

Straight Dip Pipes

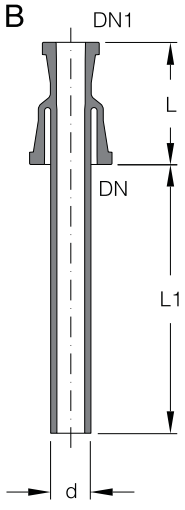
These can only be used in conjunction with vertically aligned branches on vessel covers.

DN	DN1	d	L	L1	Type	Reference
25	25	18	100	100	**A**	**DP25/100**
40	25	28	100	100	**B**	**DP40/100**
40	25	28	100	300	**B**	**DP40/300**
40	25	28	100	500	**B**	**DP40/500**
40	25	28	100	650	**B**	**DP40/650**
40	25	28	100	850	**B**	**DP40/850**
50	25	28	100	100	**B**	**DP50/100**
50	25	28	100	300	**B**	**DP50/300**
50	25	28	100	525	**B**	**DP50/525**
50	25	28	100	650	**B**	**DP50/650**
50	25	28	100	875	**B**	**DP50/875**

A



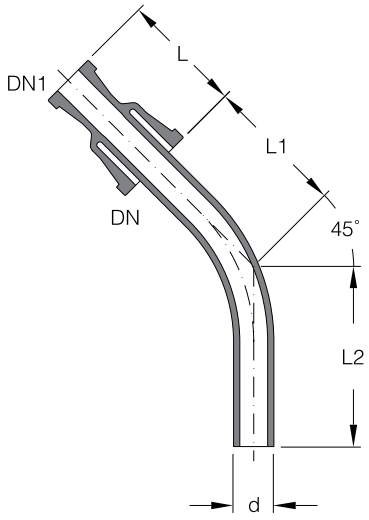
B



DIP PIPES

Angled Dip Pipes

This version should be selected for use with branches aligned at 45° for type »VZC..« vessel covers on spherical and cylindrical vessels which are generally used as feed vessels or receivers.



DN	DN1	d	L	L1	L2	Reference
25	15	13	100	95	115	**DP45/25/115**
25	15	13	100	115	150	**DP45/25/150**
40	25	28	100	115	115	**DP45/40/115**
40	25	28	100	135	165	**DP45/40/165**
40	25	28	100	150	260	**DP45/40/260**
40	25	28	100	150	345	**DP45/40/345**
50	25	33	100	150	150	**DP45/50/150**
50	25	33	100	150	245	**DP45/50/245**
50	25	33	100	150	335	**DP45/50/335**
50	25	33	100	150	435	**DP45/50/435**
80	50	59	125	200	265	**DP45/80/265**
80	50	59	125	200	365	**DP45/80/365**
80	50	59	125	275	525	**DP45/80/525**

GLASS-LINED REACTION VESSELS

In addition to jacketed glass vessels (see pages 4.8 and 4.13 to 4.15), these glass-lined vessels are also suitable for the carrying out reactions with simultaneous heating or cooling. Additionally, due to their unique design, they form the basis for our standard series of GMP reaction units.

They are supplied as standard with a main body flange of the same diameter as the reactor body, and are thus suitable for the use of both anchor and impeller-type agitators. The jacket extends all the way up to the main flange, and is equipped with turbulence enhancing nozzles to maximise heat transfer performance. Either steam or thermal oil can therefore be used as the heating medium.

The vessels are designed for use with glass covers (see page 4.10), to permit constant visual monitoring of the entire reaction process. The glass bottom outlet valve seats onto the integral block flange at the base of the reactor, with minimum dead volume.

The glass foam insulation (in the VERI.. version) is sheathed in stainless steel, which is welded top and bottom directly onto the reactor, to totally seal the insulation. The jacket sheath can also be supplied in a polished version on request. Non-insulated reaction vessels are fitted with angle plates to which the support brackets are attached. For insulated vessels, the support brackets are welded directly onto the insulation sheathing, thus providing a thermal barrier between the reactor and its supports.

Together with the agitator drives and agitators described on pages 4.35 to 4.45, these reaction vessels form the basis of our Universal Reaction System. Standard fractionation columns, or overheads designed to meet your specific requirements, can also be supplied.

On request, we also supply these reaction vessels in other materials such as stainless steel or hastelloy. If required, the vessel can also be fabricated to a very high standard of internal finish, with ground welded seams and/or electrolytically polished surfaces.

The internal pressure and temperature ratings are -1 to 1 bar g, and -60 to 200 °C. The maximum working pressure of a complete reaction unit is dictated by the pressure rating of the glass components selected for the overhead equipment. The vessels are capable of withstanding full vacuum.

The maximum operating pressure in the jacket is 10 bar g, with a temperature range of -60 to 200 °C. Higher pressures are available upon request.

The bottom outlet valve and the attachment bolts for the glass cover are included in the scope of supply.

GLASS-LINED REACTION VESSELS

Reaction Vessels

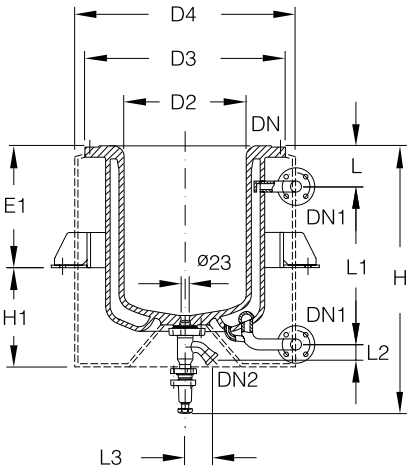
Nominal capacity (l)	DN	DN1	DN2	D2	D3	D4	n x d	d1	K	K1	Type	Reference
25	450	25	40	380	615	-	16 x 10	18	585	625	A	VER25
25	450	25	40	380	615	664	16 x M8	18	585	740	B	VERI25
40	450	25	40	380	615	-	16 x 10	18	585	625	A	VER40
40	450	25	40	380	615	664	16 x M8	18	585	740	B	VERI40
63	450	25	40	430	615	-	16 x 10	18	585	680	A	VER63
63	450	25	40	430	615	762	16 x M8	18	585	850	B	VERI63
100	600	25	40	580	755	-	20 x M12	18	710	880	B	VER100
100	600	25	40	580	755	910	20 x M12	18	710	1000	B	VERI100

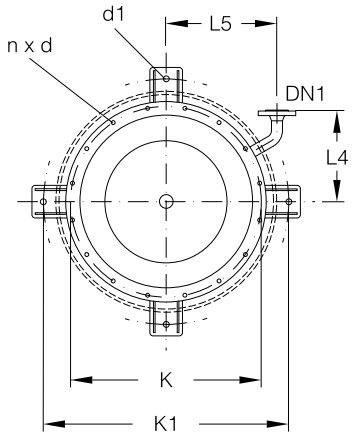
Nominal capacit (l)	L	L1	L2	L3	L4	L5	H	H1	E1	Type	Reference
25	125	355	73	92	280	340	718	-	320	A	VER25
25	125	355	73	92	280	340	718	210	320	B	VERI25
40	125	485	73	92	280	340	848	-	400	A	VER40
40	125	485	73	92	280	340	848	260	400	B	VERI40
63	125	575	23	92	300	360	888	-	350	A	VER63
63	125	575	23	92	300	360	888	380	350	B	VERI63
100	125	525	33	92	350	460	848	-	350	B	VER100
100	125	525	33	92	350	460	848	340	350	B	VERI100

Technical Data

Reference	Nominal capacity (l)	Max. Volume (l)	Heat transfer area Nominal (m^2)	Heat transfer area max. (m^2)	stirred Volume (l)
VER25, VERI25	25	43	0,37	0,52	5,7
VER40, VERI40	40	60	0,53	0,68	5,7
VER63, VERI63	63	80	0,75	0,87	8,3
VER100, VERI100	100	128	0,90	1,04	12,6

A





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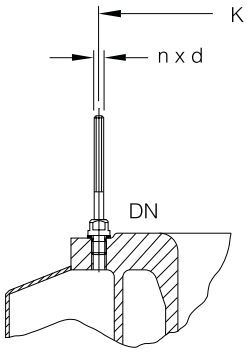


HORIZONTAL SEPARATORS

The continuous separation of immiscible liquids with different densities requires low flow rates and the largest possible phase-interface between the light and heavy phase. Horizontal separators satisfy these requirements perfectly.

The separation layer is controlled by means of an adjustable overflow valve that can be installed either outside the separator (please see »OF..«, Section 3 »Valves & Filters«) or sealed into it (»AOF..«). The internals of the two types of overflow valve are identical for the same nominal size.

The table below indicates typical figures for maximum possible throughputs in these separators. These are based on water at 20° C and are measured without any head in the input and can only be achieved up to the minimum density difference stated and for built-in overflow valves. We would be pleased to provide an exact layout for you. Non-standard and intermediate sizes (up to DN 1000 and of different lengths), especially for smaller density differences, can also be supplied upon request.

DN	Maximum flow rate $\dot{V}$ at low to medium Interfacial tension Σ heavy (H.P.) and light phase (L.P.) (l/h)	Maximum flow rate heavy phase (H.P.) for overflow valve (l/h)	Minimum difference $\Delta\rho$ at flow rat $\dot{V}$ (kg/m³)
100	200	400	100
150	400	600	100
200	800	900	100
300	1700	1600	100
450	4000	3200	100
600	7000	5000	100
800	12000	7000	100

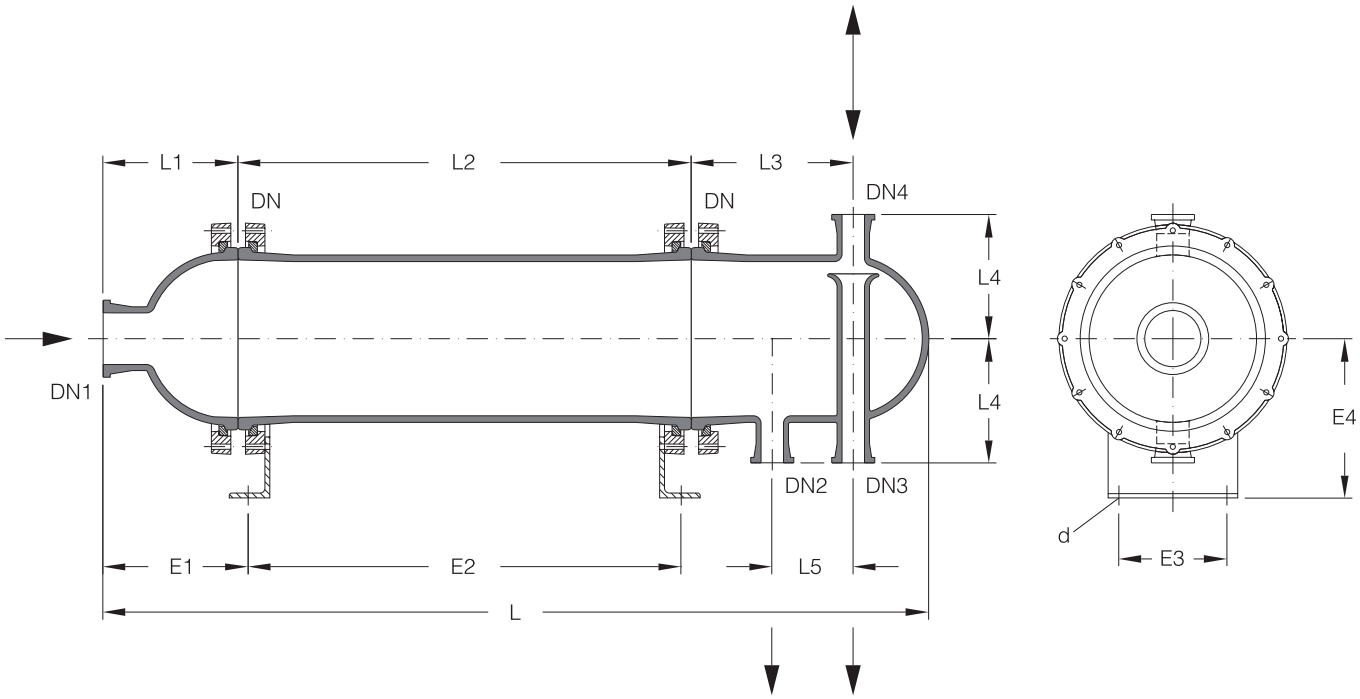
The borosilicate glass 3.3 coalescer illustrated on page 4.28 is a special feature and it conforms to GMP requirements. It is available in nominal sizes up to DN 300 and can be incorporated into all horizontal separators and mixer-settlers. It is used to speed up coalescence which would otherwise be very slow with fine dispersion (please request special leaflet).

The end form, which depends on the nominal size, is shown in the diagram on page 4.2. Further information can be found in Section 1 »Technical Information«.

HORIZONTAL SEPARATORS

Horizontal Separators without Overflow Valve

Two supporting brackets for fixing the horizontal separator in the structure are included within the scope of supply. (Please see dimensions in the table below and section 10 »Structures & Supports«)



DN	DN1	DN2 (H.P.) DN3 (L.P.) DN4 (vent)	L	L1	L2	L3	L4	L5	Reference
100	25	15	950	150	500	200	120	100	**A100**
150	40	25	1000	200	500	200	140	100	**A150**
200	80	40	1580	200	1000	245	175	120	**A200**
300	100	50	2190	250	1500	300	230	150	**A300**
450	150	80	2950	350	2000	355	330	175	**AN450**

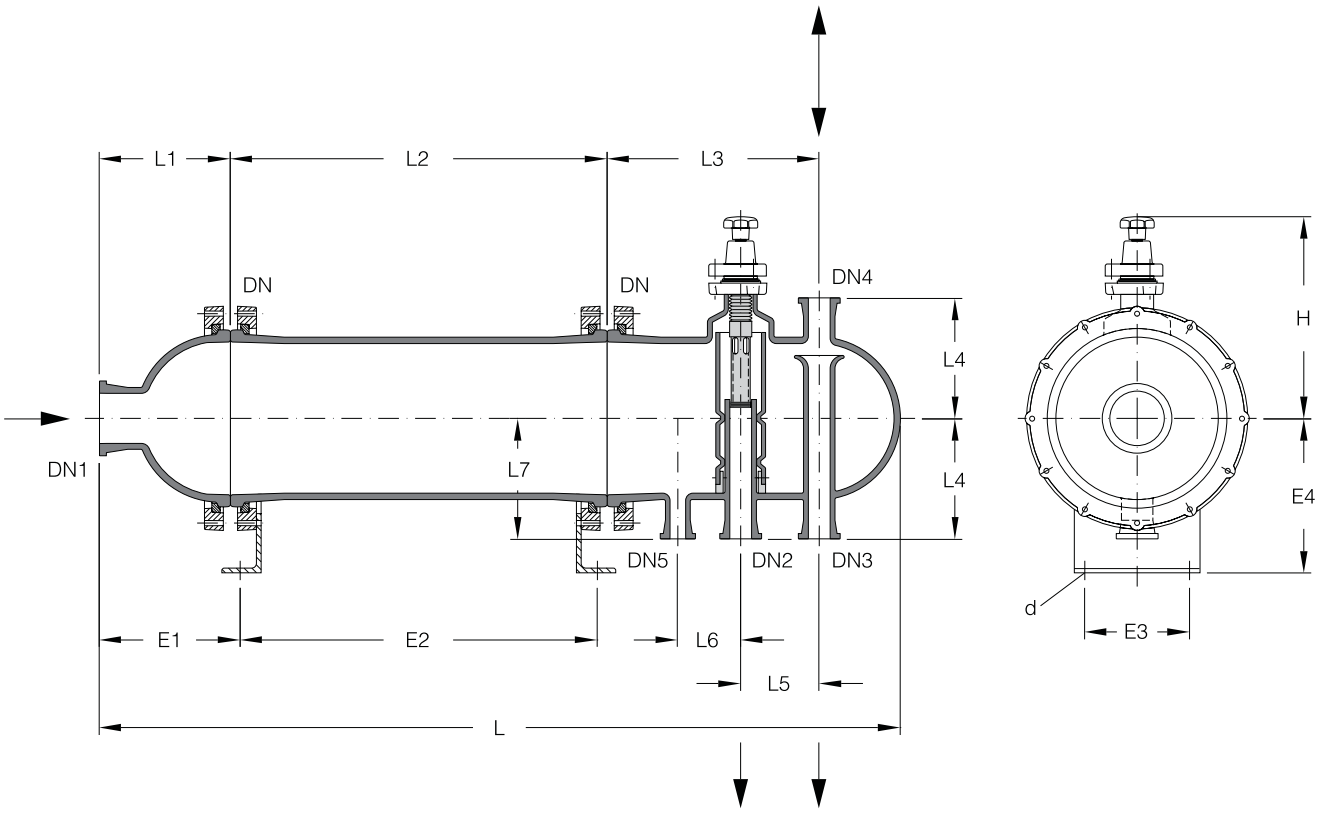
Dimensions

DN	E1	E2	E3	E4	d
100	174	452	110	165	13
150	216	468	200	208	14
200	218	964	200	243	14
300	269	1463	200	295	14
450	650	1400	300	280	18

HORIZONTAL SEPARATORS

Horizontal Separators with Built-In Overflow Valve

Two supporting brackets for fixing the horizontal separator in the structure are included within the scope of supply. (Please see dimensions in the table below and section 10 »Structures & Supports«).



DN	DN1	DN2 (H.P.) DN3 (L.P.) DN4 (vent)	DN5	L	L1	L2	L3	L4	L5	L6	L7	H	Reference
100	25	15	15	950	150	500	220	110	70	70	110	252	**AOF100/15**
150	40	25	25	1100	200	500	300	140	100	100	140	274	**AOF150/25**
200	80	40	25	1680	200	1000	345	175	120	100	175	349	**AOF200/40**
300	100	50	40	2310	250	1500	405	230	150	120	230	386	**AOF300/50**
450	150	80	40	3075	350	2000	475	330	175	150	305	500	**AOF450/80**
600	150	100	40	2750	425	1500	575	420	225	175	380	640	**AOF600/100**
800	150	100	40	3140	575	1500	600	535	225	175	495	775	**AOF800/100**

Dimensions

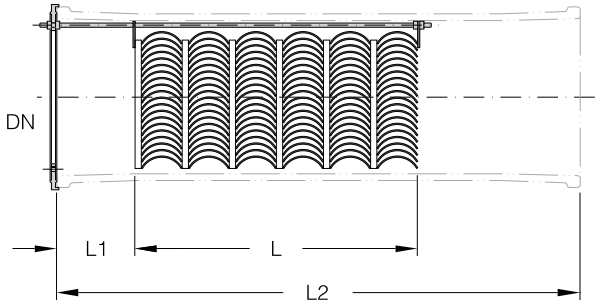
DN	E1	E2	E3	E4	d
100	174	452	110	165	13
150	216	468	200	208	14
200	218	964	200	243	14
300	269	1463	200	295	14
450	650	1400	300	280	14
600	725	900	400	362	14
800	925	800	630	475	14

HORIZONTAL SEPARATORS

Coalescers

Special features of these items are resistance to fouling, their ability to break down foam and their high efficiency with a limiting drop size of ≥ 20 µm and a maximum flow volume, based on the empty pipe, of 25 m^3/m^2 h (please see pages 4.26 and 4.27).

If the number of individual elements required differs from the figure shown in the table below, please specify the number required when ordering.



DN	L	L1	L2	Number of elements	Capacity (l/h)	Reference
100	360	100	500	4	200	COSA100
150	360	100	500	4	400	COSA150
200	540	150	1000	6	800	COSA200
300	540	150	1000	6	1700	COSA300

MIXER-SETTLERS

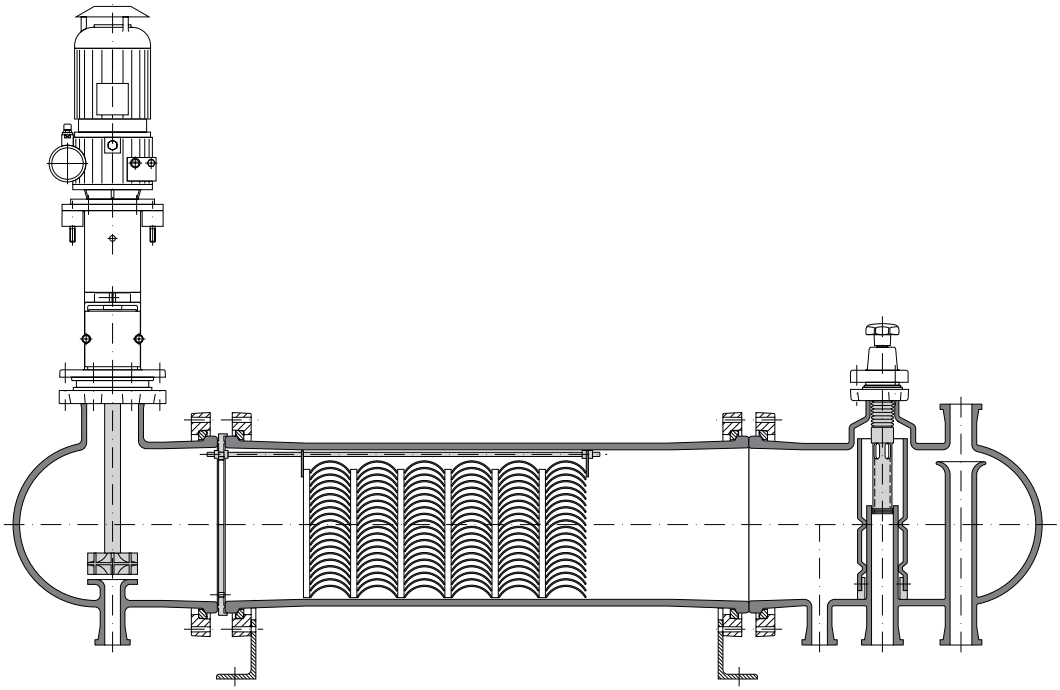
Mixer-settlers are used for extraction processes wherever there are great demands in flexibility on the operation of the plant. Frequently changing products, alterations to the number of stages required or wide variations in throughput can be decisive factors in this decision process. A precondition for their use is, however, that only a restricted number of theoretical stages is required.

Scaling-up presents no problem since back-mixing effects can be excluded completely by the clear separation of the light and heavy phases in each stage. When properly sized, each practical stage also corresponds approximately to a theoretical stage.

Each mixer-settler stage consists of a mixing chamber with a self-priming, variable speed stirrer as shown in the diagram below and a horizontal separator without a reducer on the inlet end (please see »AOF..«, page 4.27), i.e. the two phases are mixed in each stage then allowed to settle and separate from each other. The assemblies indicated, i.e. mixer and settler zone, are physically separated by a weir fitted within the flange coupling.

By connecting several mixer-settler stages in series and arranging for the phases to flow countercurrent to each other, the plant can be adapted to handle the particular separation problem in hand.

Further information can be found in our special leaflet entitled "Extraction Units & Mixer-Settlers", which is available upon request.



CYCLONES

The cyclones described here are designed for the separation not only of droplets from gases and vapours but also of particulate solids from gases. The overall degree of separation can be as high as 99%, but this figure is governed to a very large extent by the following parameters:

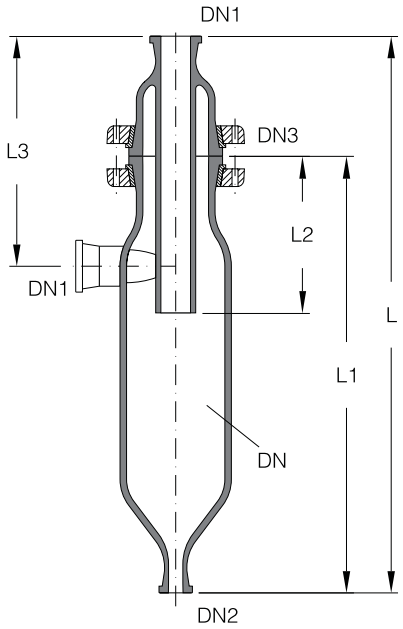
- Liquid loading of the gas or vapour or the solids loading of the gas

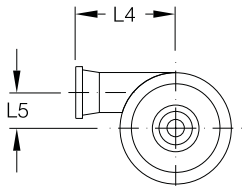
- Droplet or particle size range

- Droplet or particle size distribution

For the standard air/water system at ambient temperature and with a gas velocity of 15 m/s in the dip tube, limiting droplet diameters are approx. 2.5 µm for the DN 100 and DN 150 nominal sizes and approx. 3.5 µm for nominal sizes DN 200 and DN 300. The pressure drop in these cases is in the region of 25 to 30 mbar.

We would be pleased to provide an exact design for the cyclone you require.





DN	DN1	DN2	DN3	L	L1	L2	L3	L4	L5	Reference
100	40	25	80	714	560	180	284	125	35	**CY100**
150	50	25	100	839	655	235	349	150	55	**CY150**
200	80	25	150	1119	915	320	429	200	75	**CY200**
300	100	25	150	1425	1225	405	485	275	100	**CY300**

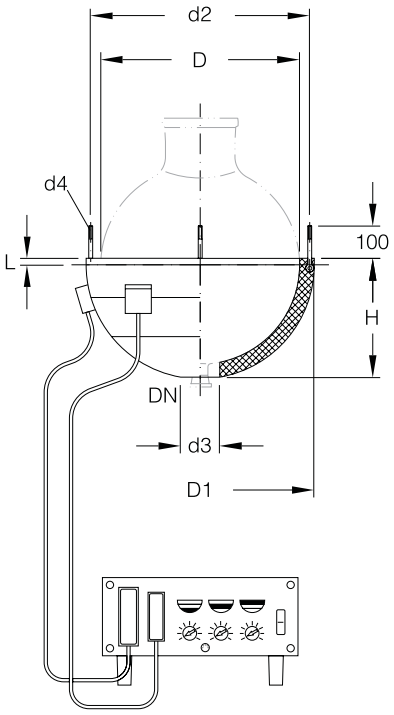
HEATING MANTLES FOR SPHERICAL VESSELS

As an alternative to heating baths (please see pages 4.32 and 4.33) electric heating mantles can also be supplied for spherical vessels. Their heating power varies according to the nominal capacity of the vessel involved.

These heating mantles are subdivided into several heating zones each of which is equipped with a temperature probe so that the surface temperature of the vessel can be monitored. These work in conjunction with the control unit included in the supply to prevent local hot spots occurring. The control unit also includes energy regulators which can be used to control the heat input separately for each heating zone depending on the liquid level.

A contact thermometer (please see Section 8 »Measurement & Control«) and/or an electronic double point controller coupled with a resistance thermometer can be used to control the product temperature.

The number of heating zones and supply voltage of the heating mantles are indicated in the table below.



Nominal capacity of spherical vessel (l)	power (kW)	Voltage(V), 50 Hz	Number of heating zones
10	1,4	230	3
20	2,0	230	3
50	4,0	230/400, 3ph	3
100	6,0	230/400, 3ph	4
200	9,0	230/400, 3ph	5

Heating mantles are fixed in the support structure using »KK50-..« or »KKO50-..« structure fittings or »RRM..« type support mount (see Section 10 »Structures & Supports«). The weight of the spherical vessels and other components used in conjunction with them must be supported on separate fixed points.

Heating mantles can also be supplied for cylindrical vessels on request.

If the heating mantle is to be used for a spherical vessel without a bottom outlet or with a non-standard bottom outlet, the catalogue reference becomes »HHK.., but for spherical vessel without bottom outlet« or »HHK.., but for DN .. bottom outlet« respectively. The maximum nominal size for the outlet is DN100.

In view of the heat involved, a metal coupling must be used on the vessel's bottom outlet (please see Section 9 »Couplings«).

Hazardous area electric heating mantles can be supplied to special order.

Nominal capacity of spherical vessel (l)	DN	D	D1	d2	d3	d4	L	H	Reference
10	40	280	370	313	120	4 x M12	10	185	**HHK10**
20	40	350	440	388	120	4 x M12	15	230	**HHK20**
50	40	490	580	555	120	4 x M12	20	300	**HHK50**
100	40	610	700	676	120	4 x M12	20	380	**HHK100**
200	50	750	840	821	140	4 x M12	20	445	**HHK200**

HEATING BATHS FOR SPHERICAL VESSELS

Heating baths can be used to advantage in applications where the materials being handled would tend to block or stick to the coils of immersion heat exchangers or where the use of heating mantles is not recommended. Options are available for heating either electrically or with steam.

The spherical vessel sits on a support ring and a restraint prevents it from floating up. A stuffing box seals the bottom outlet to prevent leakage from the bath. The design also avoids imposing any stresses on the spherical vessel.

The baths are made of steel. The external surface is primed and painted.

The heat transfer fluid in the bath can be, for example, water of boiler feed water quality or a synthetic oil. The bath temperature must always be a sufficient amount below the boiling temperature of the fluid. To ensure that this condition is met, the heating baths can be fitted with suitable temperature control equipment if required.

Complete stainless steel heating baths and heating baths for cylindrical vessels can be supplied to special order.

Where it is necessary to ensure that the liquid in the bottom outlet is heated it is recommended to use spherical vessels with »BAL40« bottom outlet valve (please see Section 3 »Valves & Filters«).

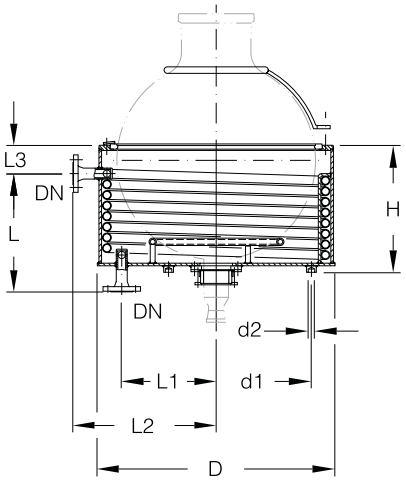
HEATING BATHS FOR SPHERICAL VESSELS

Heating Baths, Steam Heated

The »BHKD..BAL« version is suitable for spherical vessels with sealed in seat for a »BAL40« bottom outlet valve, the »BHKD..E« version for spherical vessels with extended bottom outlet (please see page 4.5).

The maximum permissible steam pressure in the heating coils is 10 bar g.

If required, a steam control valve, flexible hose and condensate separator can be supplied with these heating baths.



Nominal capacity of spherical vessel (l)	DN	D	d1	d2	L	L1	L2	L3	H	Reference with VS...E	Reference with VS...BAL
20	15	490	295	3 x 20	255	215	310	65	270	**BHKD20E**	**BHKD20BAL**
50	15	625	395	3 x 20	305	280	380	85	340	**BHKD50E**	**BHKD50BAL**
100	25	730	585	3 x 20	365	290	440	85	390	**BHKD100E**	**BHKD100BAL**
200	25	910	585	3 x 20	450	400	530	90	480	**BHKD200E**	**BHKD200BAL**

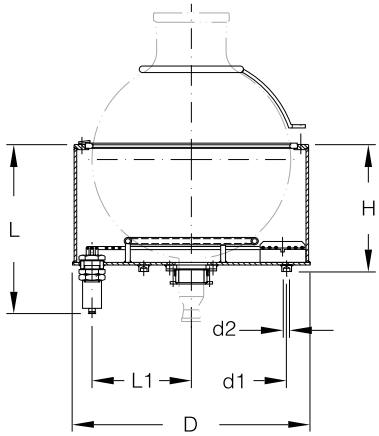
HEATING BATHS FOR SPHERICAL VESSELS

Heating Baths, Electrically Heated

As a standard these baths are supplied with either non hazardous or hazardous area immersion heating elements. As a consequence of the lower permissible surface temperature of the latter their heat output is lower. The supply voltage is 230/400 V, 3ph, 50 Hz in both cases.

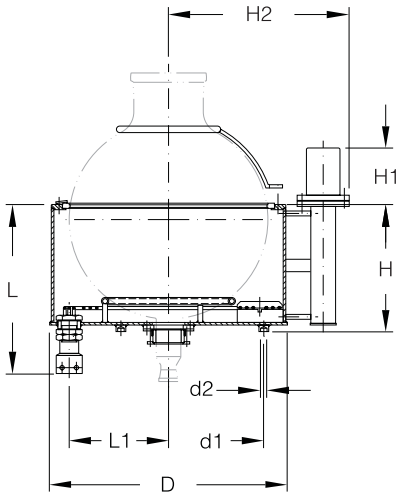
Heating baths with hazardous area immersion heating elements are fitted with a level control.

The »BHKE..BAL« and »BHKX..BAL« versions are suitable for spherical vessels with sealed in seat for a »BAL40« bottom outlet valve, the »BHKE..E« and »BHKX..E« versions for spherical vessels with extended bottom outlet (please see page 4.5).



Non hazardous area immersion heating elements

Nominal capacity of spherical vessel (l)	D	d1	d2	L	L1	H	Power (kW)	Reference with VS...E	Reference with VS...BAL
20	490	295	3 x 20	400	183	270	3,6	**BHKE20E**	**BHKE20BAL**
50	625	395	3 x 20	470	250	340	6,0	**BHKE50E**	**BHKE50BAL**
100	730	585	3 x 20	520	305	390	9,0	**BHKE100E**	**BHKE100BAL**
200	910	585	3 x 20	610	395	480	11,0	**BHKE200E**	**BHKE200BAL**



EEx de IIC T3 protection type immersion heating elements

Nominal capacity of spherical vessel (l)	D	d1	d2	L	L1	H	H1	H2	Power (kW)	Reference with VS...E	Reference with VS...BAL
20	490	295	3 x 20	530	170	270	155	435	3,8	**BHKX20E**	**BHKX20BAL**
50	625	395	3 x 20	600	237	340	155	505	6,0	**BHKX50E**	**BHKX50BAL**
100	730	585	3 x 20	650	290	390	155	555	9,0	**BHKX100E**	**BHKX100BAL**
200	910	585	3 x 20	740	380	480	155	645	11,4	**BHKX200E**	**BHKX200BAL**

STIRRER DRIVES

We can supply a range of drive assemblies for mixing, homogenising etc. using corrosion resistant stirrers (please see pages 4.43 to 4.45). They comprise various types of drive unit and stirrers of the appropriate shaft diameter in PTFE-sheathed or glass coated steel and borosilicate glass 3.3 (or stainless steel on request). The actual stirrer selected depends on the intended duty.

A selection of possible combinations of vessel, covers or adaptor flanges, stirrers and drives can be found in the tables below. The selection of a suitable combination of stirrer and drive power relates to materials of low to medium viscosities.

Stirrer Drives for Glass Vessels

Spherical Vessel with Reducer

Nom. cap. (l)	Vessel and Reducer	Stirrer	Stirrer Drive
10	VSM10 and PR100/50	SPG90/620	RAK50/034 or FAK50/037
20	VSM20 and PR100/50	SPG90/700	RAK50/034 or FAK50/037
50	VSM50 and PR200/50	SPG140/820	RAK50/034 or FAK50/037

Spherical Vessel with Cover Plate

Nom. cap. (l)	Vessel and Plate	Stirrer	Stirrer Drive
50	VSM50 and TFR200/80	STT140/700 or SPT145/690	RAL80/035 or FAL80/035
100	VSM100 and TFR200/80	STT140/800 or SPT145/790	RAL80/055 or FAL80/055
100	VSM100 and TFR200/100	STT140/800 or SPT145/790	RAL100/075 or FAL100/075

Cylindrical Vessel with Cover

Nom. cap. (l)	Vessel and Cover	Stirrer	Stirrer Drive
10	VZ10/200 and VZC200/50	SPG90/700	RAK50/034 or FAK50/037
20	VZ20/300 and VZME300/50	SPG140/700	RAK50/034 or FAK50/037
	VZ20/300 and VZC300/50		
	VZ20/300 and VZMC300/50		
30	VZ30/300 and VZME300/50	SPG140/820	RAK50/034 or FAK50/037
	VZ30/300 and VZC300/50		
	VZ30/300 and VZMC300/50		
50	VZ50/300 and VZME300/50	SPG140/1000	RAK50/034 or FAK50/037
	VZ50/300 and VZC300/50		
	VZ50/300 and VZMC300/50		
50	VZ50/300 and VZA300/80	STT140/1080 or SPT 145/1070	RAL80/035 or FAL80/035
	VZ50/300 and VZC300/80		
	VZ50/300 and VZMC300/80		
100	VZN100/450 and VZMC450/80	STT140/1080 or SPT145/1070	RAL80/055 or FAL80/055
	VZN100/450 and VZMC450/100	STT140/1080 or SPT145/1070	RAL100/075 or FAL100/075
150	VZN150/450 and VZMC450/100	STT140/1380 or SPT190/1370	RAL100/075 or FAL100/075

STIRRER DRIVES

Stirrer Drives for Glass-Lined Reaction Vessels

Nom. cap. (l)	Reaction Vessel	Stirrer	Stirrer Drive
25	VER25 or VERI25	SIE230/820	RAL80/055 or FAL80/055
40	VER40 or VERI40	SIE230/950	RAL80/055 or FAL80/055
63	VER63 or VERI63	SIE230/985	RAL80/055 or FAL80/055
100	VER100 or VERI100	SIE230/1020	RAL100/075 or FAL100/075
25	VER25 or VERI25	SAE335/820	RALA80/075 or FALA80/075
40	VER40 or VERI40	SAE335/950	RALA80/075 or FALA80/075
63	VER63 or VERI63	SAE385/985	RALA80/075 or FALA80/075
100	VER100 or VERI100	SAE500/1020	RALA100/110 or FALA100/110

In addition to the electrically operated drives shown, we are also able to supply pneumatically operated stirrer drives on request.

The stirrer drives except types »RAK..« and »FAK..« are fitted with anti-vibration mountings to avoid transmission of vibration from the motor to the structure and from there to the glass plant. They are fitted to the bearing housing (up to a power rating of 0.75 kW) or between the stirrer drive and the base plate.

The gasket, backing flange and fixings are included in the supply.

STIRRER DRIVES

Variable Speed Drive Assemblies with Bearing Assembly

These assemblies incorporate a flange-mounted bearing assembly. This is fitted below a variable speed drive motor and facilitates direct mounting of the complete drive unit onto a glass vessel cover. The drive spindle and stirrer shaft are connected inside the housing by means of a clamp type coupling for smaller drives or muff type for larger drives. The easily interchangeable, single acting PTFE/ceramic mechanical seal is also located within this housing.

A hand-wheel is provided so that the drive speed can be varied within a wide range to suit the requirements of the particular application. The minimum setting for types »RAL..« and »FAL..”« is 185 rpm and for types »RALA..« and »FALA..« 0 rpm. The setting can be changed with the drive stopped or in operation. Before switching on the drive motor it should be set to its lowest speed.

To facilitate supporting the drive unit in the structure, structure fittings and tubular structures can be used (please see Section 10 »Structures & Supports«). They are not included in the supply.

These stirrer drive units are designed for use with PTFE, glass coated steel and stainless steel (on request only) stirrers with a shaft diameter of 44.5 mm and 70 mm (type »RAL (or FAL) 100/150« and »RAL (or FAL) 100/220« only). A selection can be found on pages 4.43 and 4.44.

Electric motors are supplied as standard in protection type EEx e II T4 or EEx de IIC T4 and for a 230/400 V, 3 phase, 50 Hz supply. Other voltages and frequencies can also be catered for.

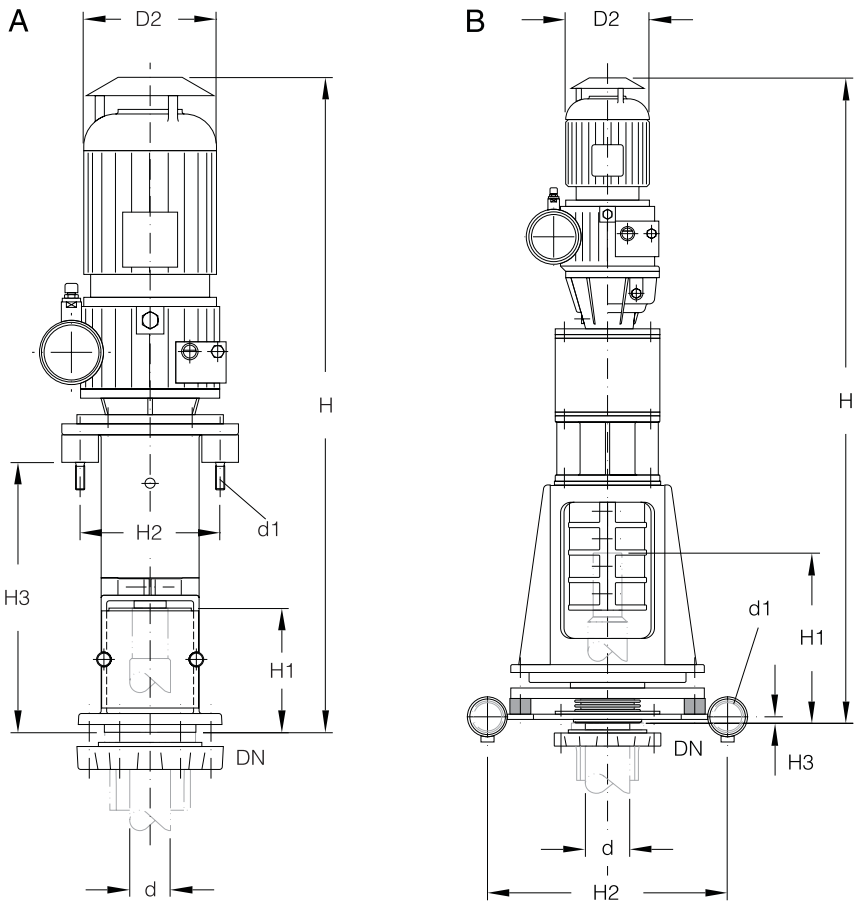
The maximum allowable operating temperature for the single acting mechanical seal is 120 °C.

These drives can also be supplied on request with a double mechanical seal (please see page 4.40).

STIRRER DRIVES

Protection type EEx e II T4

DN	d	d1	D2	H	H1	H2	H3	Power (kW)	Speed (min-1)	Type	Reference
80	44,5	2 x M10	145	720	140	153	298	0,35	185-800	A	RAL80/035
80	44,5	2 x M10	160	770	140	153	298	0,55	185-600	A	RAL80/055
100	44,5	2 x M10	160	770	138	153	298	0,75	185-600	A	RAL100/075
80	44,5	2 x M10	162	922	140	153	298	0,75	0-200	A	RALA80/075
100	44,5	2 x M10	181	978	138	153	298	1,1	0-200	A	RALA100/110
100	70	2 x Ø60	206	1278	325	460	-	1,5	115-660	B	RAL100/150
100	70	2 x Ø60	222	1341	325	460	-	2,2	115-660	B	RAL100/220



Protection type EEx de IIC T4

DN	d	d1	D2	H	H1	H2	H3	Power (kW)	Speed (min-1)	Type	Reference
80	44,5	2 x M10	145	720	140	153	298	0,35	185-800	A	FAL80/035
80	44,5	2 x M10	160	770	140	153	298	0,55	185-600	A	FAL80/055
100	44,5	2 x M10	160	770	138	153	298	0,75	185-600	A	FAL100/075
80	44,5	2 x M10	156	960	140	153	298	0,75	0-200	A	FALA80/075
100	44,5	2 x M10	156	958	138	153	298	1,1	0-200	A	FALA100/110
100	70	2 x Ø60	194	1127	325	460	-	1,5	115-660	B	FAL100/150
100	70	2 x Ø60	218	1135	325	460	-	2,2	115-660	B	FAL100/220

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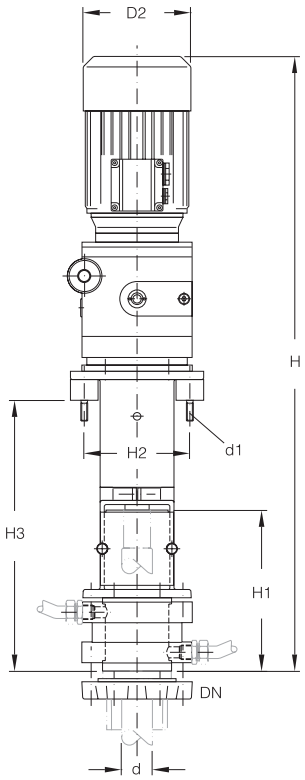
STIRRER DRIVES

Stirrer Drives, ATEX-version

Protection type II 2 G c 108°C EEx e II T4

Within the European Union, devices that have a potential source of ignition that are to be used in areas in danger of explosion must be certified according to the European Directive 94/9/EC (ATEX). The stirring/drive combinations considered here are designed for zone 1 usage, and are therefore certified according to category 2G.

The integrated double mechanical seal must be attached by the operator to a suitable cooling/greasing circuit (see errata page 4.41). The motor has the protection level "increased safety".



DN	d	d1	D2	H	H1	H2	H3	Power (kW)	Speed (min $^{-1}$)	Reference
80	44,5	2 x M10	138	816	234	153	393	0,50	0-800	**RAL80/035/AT**
80	44,5	2 x M10	156	886	234	153	393	0,55	0-600	**RAL80/055/AT**
100	44,5	2 x M10	156	886	227	153	386	0,65	0-600	**RAL100/075/AT**
80	44,5	2 x M10	156	1034	234	153	393	0,65	0-240	**RALA80/075/AT**
100	44,5	2 x M10	176	1078	227	153	386	1,3	0-240	**RALA100/110/AT**

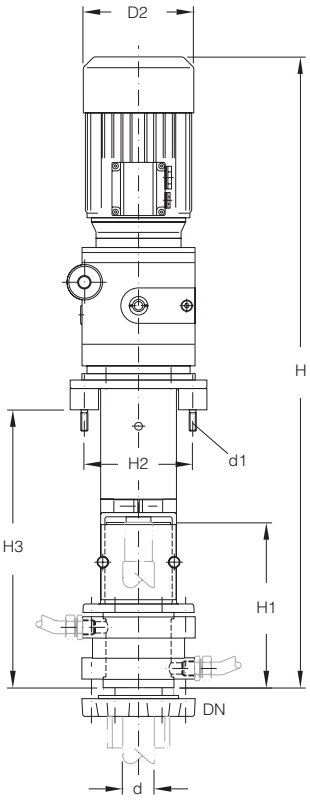
STIRRER DRIVES

Stirrer Drive, ATEX-version

Protection type II 2 G c 108°C EEx de II T4

Within the European Union, devices that have a potential source of ignition that are to be used in areas in danger of explosion must be certified according to the European Directive 94/9/EC (ATEX). The stirring/drive combinations considered here are designed for zone 1 usage, and are therefore certified according to category 2G.

The integrated double mechanical seal must be attached by the operator to a suitable cooling/greasing circuit (see errata page 4.41). The motor has the protection level "pressure-proof encapsulated".



DN	d	d1	D2	H	H1	H2	H3	Power (kW)	Speed (min $^{-1}$)	Reference
80	44,5	2 x M10	138	862	234	153	393	0,55	0-800	**FAL80/035/AT**
80	44,5	2 x M10	156	933	234	153	393	0,55	0-600	**FAL80/055/AT**
100	44,5	2 x M10	156	926	227	153	386	0,75	0-600	**FAL100/075/AT**
80	44,5	2 x M10	156	1081	234	153	393	0,75	0-240	**FALA80/075/AT**
100	44,5	2 x M10	176	1114	227	153	386	1,5	0-240	**FALA100/110/AT**

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STIRRER DRIVES

Drives for Frequency Inverter

This type of drive can be used wherever variations in speed are achieved by means of a frequency inverter. The flameproof electric motor is fitted with thermistors required for this combination as standard. These drives can also be used to drive stirrers at a fixed speed (750 rpm), this can however cause problems on start-up. Such a solution should, therefore, only be adopted in exceptional cases.

To facilitate supporting the drive unit in the structure, structure fittings and tubular structures can be used (please see Section 10 »Structures & Supports«). They are not included in the supply.

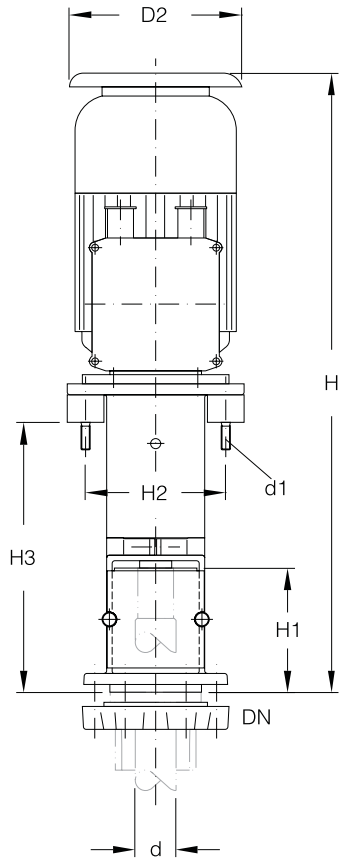
These stirrer drive units are designed for use with PTFE, enamelled steel and stainless steel (on request only) stirrers with a 44.5 mm shaft diameter. Details of these can be found on pages 4.43 and 4.44.

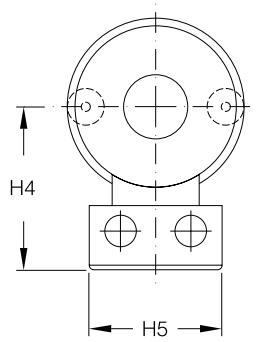
The electric motors, which have a minimum speed of 75 rpm, are supplied in protection type EEx de IIC T4 and for a 230/400 V, 3 phase, 50 Hz supply. Other voltages and frequencies can also be catered for.

The frequency inverter must be located in a non-hazardous area or built into a suitable enclosure.

The maximum allowable operating temperature for the single acting mechanical seal is 120 °C.

These drives can also be supplied on request with a double mechanical seal (please see page 4.40).





DN	d	d1	D2	H	H1	H2	H3	H4	H5	Power (kW)	Speed with Freq. Inverter (min-1)	Reference
80	44,5	2 x M10	176	673	138	153	298	178	145	0,37	75-750	RAE80/037
80	44,5	2 x M10	176	673	138	153	298	178	145	0,55	75-750	RAE80/055
80	44,5	2 x M10	194	725	138	153	298	198	145	0,75	75-750	RAE80/075
100	44,5	2 x M10	176	673	138	153	298	178	145	0,37	75-750	RAE100/037
100	44,5	2 x M10	176	673	138	153	298	178	145	0,55	75-750	RAE100/055
100	44,5	2 x M10	194	725	138	153	298	198	145	0,75	75-750	RAE100/075
100	44,5	2 x M10	194	725	138	153	298	198	145	1,10	75-750	RAE100/110

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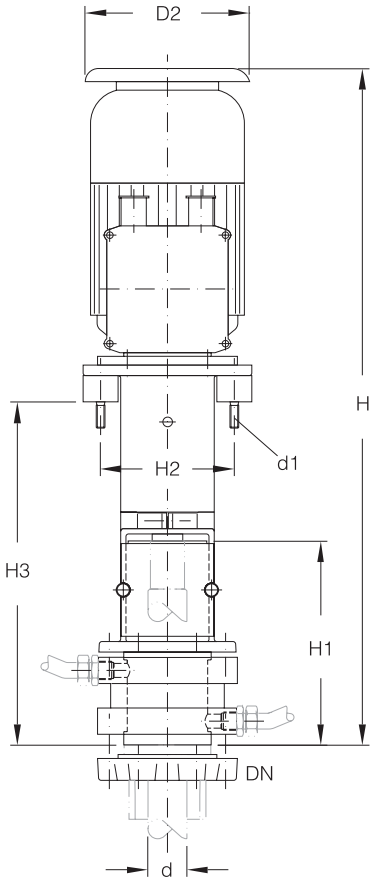
STIRRER DRIVES

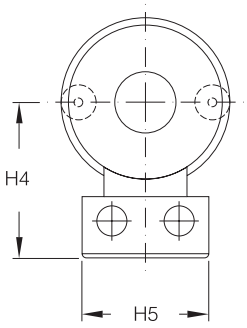
Drives for Frequency Inverter, ATEX-version

Protection type II 2 G c 108°C EEx de II T4

IWithin the European Union, devices that have a potential source of ignition that are to be used in areas in danger of explosion must be certified according to the European Directive 94/9/EC (ATEX). The stirring/drive combinations considered here are designed for zone 1 usage, and are therefore certified according to category 2G.

The integrated double mechanical seal must be attached by the operator to a suitable cooling/greasing circuit (see errata page 4.41). The version RAE... is designed for operation with a frequency inverter, and has no manually adjustable transmission.





DN	d	d1	D2	H	H1	H2	H3	H4	H5	Power (kW)	Speed with Frequenz Inverter (min $^{-1}$)	Reference
80	44,5	2 x M10	188	774	234	153	393	178	145	0,37	75-750	**RAE80/037/AT**
80	44,5	2 x M10	188	774	234	153	393	178	145	0,55	75-750	**RAE80/055/AT**
80	44,5	2 x M10	194	819	234	153	393	198	145	0,75	75-750	**RAE80/075/AT**
100	44,5	2 x M10	188	767	227	153	386	178	145	0,37	75-750	**RAE100/037/AT**
100	44,5	2 x M10	188	767	227	153	386	178	145	0,55	75-750	**RAE100/055/AT**
100	44,5	2 x M10	206	813	227	153	386	198	145	0,75	75-750	**RAE100/075/AT**
100	44,5	2 x M10	206	813	227	153	386	198	145	1,10	75-750	**RAE100/110/AT**

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STIRRER DRIVES

Compact Variable Speed Drives

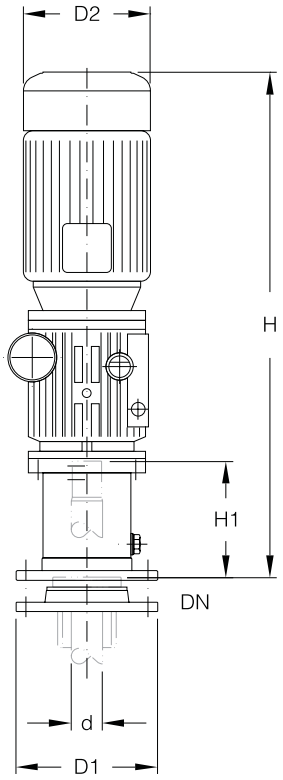
These assemblies incorporate a variable speed drive motor and a closed housing suitable for mounting directly onto a vessel cover. The motor spindle and stirrer shaft are connected together with grub screws. The single acting mechanical seal is located in the housing. These are both easily accessible after removing the drive motor. An opening is provided on the housing so that the rotating part of the mechanical seal can be locked in position on the stirrer shaft.

On vessel covers, compact drives suitable for coupling to a DN 50 nominal size branch are used.

These stirrer drive units are designed for use with borosilicate glass 3.3 stirrers with a 32 mm shaft diameter and a maximum length of 1000 mm (please see page 4.45). Their use is therefore restricted to a maximum stirred volume of 50 litres.

Electric motors are supplied as standard in protection type EEx e II T4 or EEx de IIC T4 and for a 230/400 V, 3 phase, 50 Hz supply. Other voltages and frequencies can also be catered for.

The maximum allowable operating temperature for the single acting mechanical seal is 120 °C.



Protection type EEx e II T4

DN	d	D1	D2	H	H1	Power (kW)	Speed (min^{-1})	Reference
50	32	145	145	517	119	0,34	0-550	**RAK50/034**

Protection type EEx de IIC T4

DN	d	D1	D2	H	H1	Power (kW)	Speed (min^{-1})	Reference
50	32	145	150	543	119	0,37	0-550	**FAK50/037**

STIRRER DRIVES

Drives with Double Mechanical Seal

For stirring duties which place increased demands on the mechanical seal's freedom from leaks, for example when handling toxic or highly corrosive substances, the stirrer drives, with the exception of types »RAK..« and »FAK..«, can be supplied with a double mechanical seal. When ordering please add »GRD« to the catalogue reference for the stirrer drive in question.

Length L of the stirrer used and the overall height H of the stirrer drive selected are increased by 90 mm in each case.

The maximum allowable operating temperature for the double mechanical seal is 125 °C. With suitable cooling of the thermosiphon fluid, temperatures of up to 200 °C in the reaction vessel are allowed.

The thermosiphon barrier pressure units required for operating double mechanical seals are described on page 4.41.

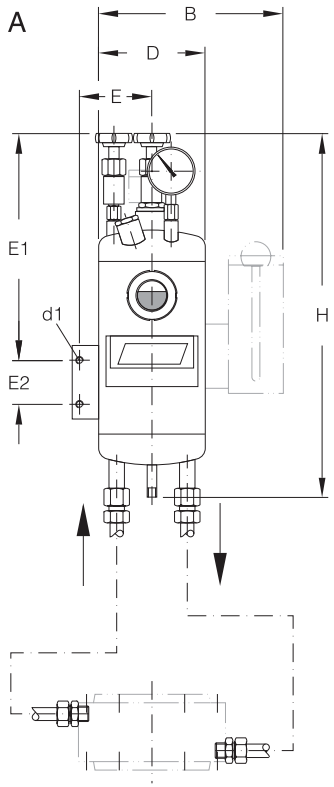
THERMOSIPHON UNITS

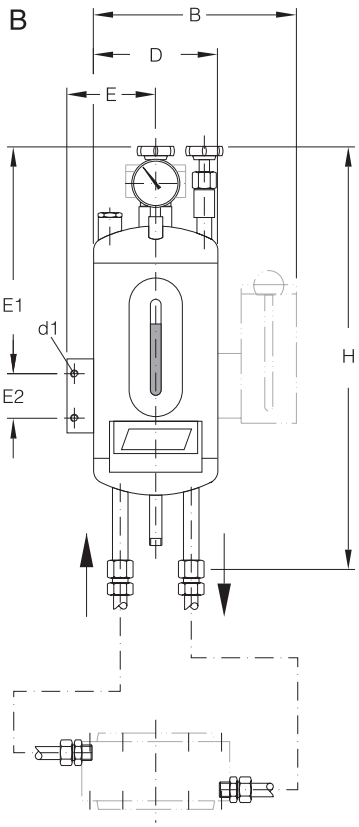
These units work on the thermosiphon principle. We always recommend using them in conjunction with double mechanical seals whenever handling substances that are toxic or highly corrosive, that contain abrasive components or that have a tendency to crystallise. The barrier fluid, which should be chosen on the basis of its compatibility with the product, carries out three functions necessary for trouble-free operation: it acts as a barrier, provides lubrication and keeps the unit cool. It is covered by a gas buffer, pressurised to suit the operating pressure in the reaction vessel.

Thermosiphon units are supplied with or without a top-up unit to maintain the barrier fluid level during operation. This cannot be retrofitted.

Type »THAO..« (without top-up unit) comprises a vessel with internally fitted cooling coil in stainless steel, pressure gauge and sight glass together with the fittings necessary for connection to the mechanical seal including 6 metres of stainless steel tubing. Type »THAP..« (with top-up unit) comprises the same items plus an additional vessel and a built-on hand-pump. The parts in contact with the product are also made of stainless steel.

If stirring drives are used with siphon systems in areas with danger of explosion within the European Union ATEX, the siphon vessel must be monitored for a minimum fill level using a fill-level probe in accordance with EU directive 94/9/EC (ATEX). If you select the order number ending AT, then you will receive the siphon vessel with an integrated fill-level probe.





Technical data

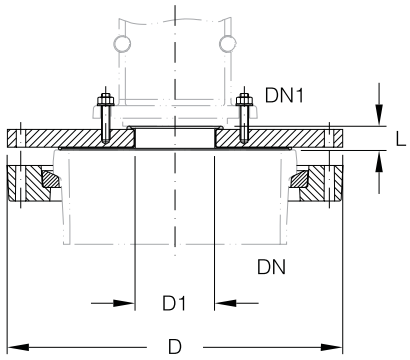
Reference		THAO3 THAO/AT	THAO6 THAO6/AT	THAP3 THAP3/AT	THAP6 THAP6/AT
Tank Capacity	l	3	6	3	6
Nominal Capacity	l	2,5	4	2,5	4
Heat Transfer Area of the Cooling Coil	m^2	0,1	0,14	0,1	0,14

Tank Capacity (l)	D	d1	B	H	E	E1	E2	Type	Reference without ATEX	Reference with ATEX
3	140	M10	-	455	115	305	30	A	THAO3	THAO3/AT
6	170	M10	-	504	105	170	30	B	THAO6	THAO6/AT
3	140	M10	230	455	115	305	30	A	THAP3	THAP3/AT
6	170	M10	260	504	105	170	30	B	THAP6	THAP6/AT

CONNECTING FLANGES FOR STIRRERS

Where space is limited or, if for other reasons, there is no need to fit a vessel cover (please see pages 4.18 to 4.20) with its various branches, the stirrer drives described above, with the exception of types »RAK..« and »FAK..«, can also be mounted directly onto spherical vessels (please see pages 4.5 to 4.8) by means of these connecting flanges. They are stainless steel rings which are PTFE-sheathed in the area in contact with the product and are available as standard for DN 200 and DN 300 branches. No additional gaskets are required.

The adaptor flange, insert and fixings are included in the supply.



DN	DN1	D	D1	L	Reference
200	80	321	76	19	**TFR200/80**
200	100	321	104	19	**TFR200/100**
300	80	428	76	19	**TFR300/80**
300	100	428	104	19	**TFR300/100**

PTFE STIRRERS

The different shapes of vessel (spherical or cylindrical vessels) on the one hand and the duties to be carried out on the other (suspension, homogenisation, with or without simultaneous heat transfer etc.) determine the type of stirrer to be used. Their design (propeller or turbine) is another factor influencing the need or otherwise for a baffle to create turbulence. Further information can be found with the individual types of stirrer.

These two-piece stirrers consist of a PTFE-sheathed shaft and a PTFE stirrer element with steel core that is attached to the shaft to prevent twisting. A perfect seal is maintained between the two parts over the whole permissible temperature range (-50 to +150 °C).

The PTFE used in the manufacture of these stirrers is carbon filled.

For construction reasons the maximum possible stirrer length is limited to 1800 mm.

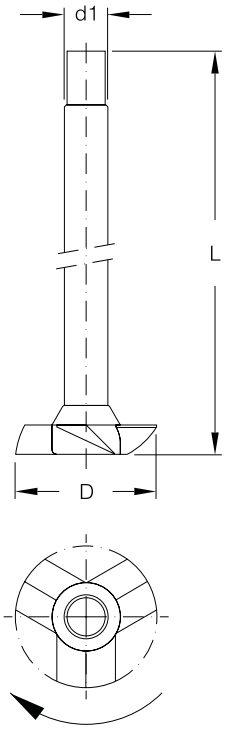
PTFE STIRRERS

Propeller Stirrers

These stirrers produce axial primary flow with a radial component and are particularly suitable for homogenisation and suspension. They are also suitable for general stirring duties with simultaneous heat transfer (heating or cooling) between the liquid being stirred and the vessel wall. They can also be used for dispersion (including from gases) and emulsification.

Propeller stirrers are mainly used with borosilicate glass 3.3 spherical and cylindrical vessels. In the latter case it is recommended that they be installed on an eccentric stirrer branch to avoid setting up a vortex.

L	D	d1	Reference
690	145	44,5	SPT145/690
790	145	44,5	SPT145/790
1070	145	44,5	SPT145/1070
1370	190	44,5	SPT190/1370
1670	270	70	SPT270/1670



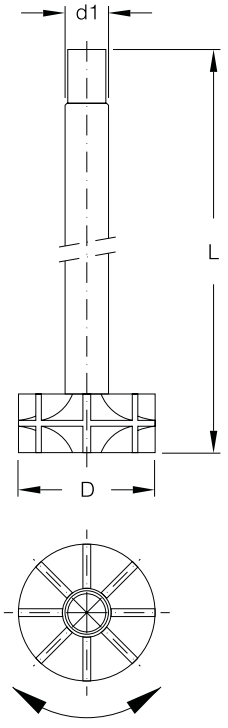
PTFE STIRRERS

Turbine Stirrers

These stirrers produce a radial primary flow and are recommended for homogenisation, dispersion (including from gases) and emulsification. They can also be used when heat transfer between the liquid being stirred and the vessel wall is required.

Turbine stirrers are mainly used with borosilicate glass 3.3 spherical vessels and cylindrical vessels. In the latter case it is recommended that they be installed on an eccentric stirrer branch to avoid setting up a vortex.

L	D	d1	Reference
700	140	44,5	STT140/700
800	140	44,5	STT140/800
1080	140	44,5	STT140/1080
1380	140	44,5	STT140/1380



GLASS COATED STEEL STIRRERS

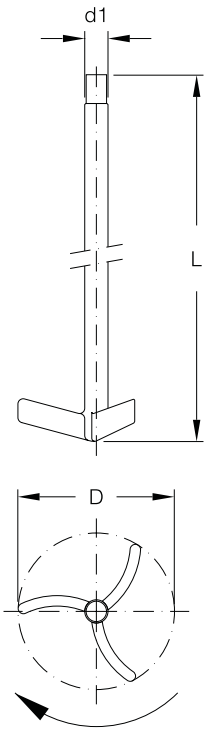
We supply one-piece impeller and anchor type glass coated steel stirrers with a 44.5 mm shaft diameter for use with the glass lined steel reaction vessels described on pages 4.23 and 4.24.

When these stirrers are used the drive power required needs to be assessed. We would be happy to do this for you.

Impeller Stirrers

These stirrers generate a radial primary flow and are used mainly for homogenising high viscosity liquids. They are also ideally suited for applications where good heat transfer is required between the liquid being stirred and the vessel wall. Impeller stirrers are used with types »RAL..«, »FAL..« and »RAE..« stirrer drive units (please see pages 4.38 and 4.39).

L	D	d1	Reference
820	230	44.5	SIE230/820
950	230	44.5	SIE230/950
985	230	44.5	SIE230/985
1020	230	44.5	SIE230/1020

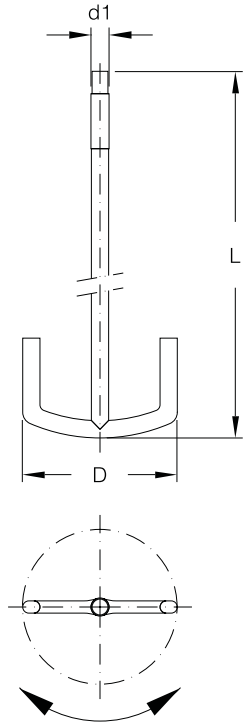


GLASS COATED STEEL STIRRERS

Anchor Stirrers

These are used for applications involving relatively low speeds at the circumference and where higher viscosities may be encountered. They are particularly suitable for homogenisation with simultaneous heat transfer between the liquid being stirred and the vessel wall. Anchor stirrers are used with types »RALA..« and »FALA..« stirrer drive units (please see page 4.38).

L	D	d1	Reference
820	335	44,5	SAE335/820
950	335	44,5	SAE335/950
985	385	44,5	SAE385/985
1020	500	44,5	SAE500/1020



GLASS STIRRERS

It is possible to produce both propeller and vortex type stirrers in borosilicate glass 3.3 with its virtually universal resistance to corrosion. Only the former are, however, of real practical importance since they are extremely versatile in application. Vortex stirrers are, therefore, only supplied to special order.

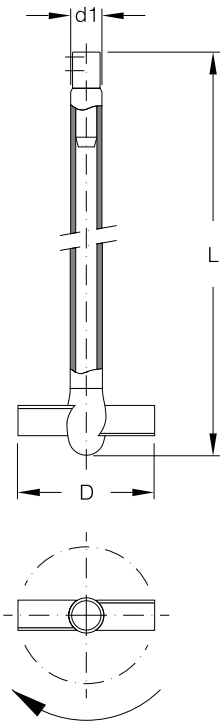
All glass stirrers have a 32 mm shaft diameter and can be used with the »RAK..« and »FAK..« type stirrer drives described on the page 4.40.

GLASS STIRRERS

Propeller Stirrers

As a result of the axial primary flow these stirrers produce, there is a very wide range of applications for them. They are used for homogenisation, dispersion (also from gases) and emulsification and they can also be used on a restricted basis for suspensions. Another application for them is for stirring with simultaneous heat transfer (heating or cooling) between the liquid being stirred and the vessel wall.

L	D	d1	Reference
620	90	32	**SPG90/620**
700	90	32	**SPG90/700**
700	140	32	**SPG140/700**
820	140	32	**SPG140/820**
1000	140	32	**SPG140/1000**



5 HEAT EXCHANGER

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QVF

PROCESS PLANT COMPONENTS

home

Introduction

QVF heat exchangers provide the optimum solution for every requirement encountered in practice because of the wide range of types available. This applies not only to coil type heat exchangers, which are available as condensers, boilers and immersion heat exchangers, but also to shell and tube heat exchangers, which are designed for use with tubes in the widest possible range of corrosion resistant materials.

These items are widely used in the chemical, pharmaceutical and allied industries together with other applications such as food and drink production, dye works and electroplating. This is because of the special properties of borosilicate glass 3.3 and all the other materials used plus the fact that borosilicate glass 3.3 is an approved and proven material of construction for pressure vessels.

Reference should also be made in this context to the extreme reliability of the strong and high-duty coupling system used for all components. This is achieved throughout the whole range of nominal sizes by the use of the safety buttress end which has been designed specifically by taking into account the properties of the material coupled with a reliable flange system.

The complete range of standard heat exchanger components is described on the following pages. Non-standard components that can be supplied to special order are referred to in the respective product description.

A detailed listing of all heat exchangers by »Description« and »Catalogue Reference« can be found in the »Index«.

Detailed information on a number of the topics referred to in the following pages can be found in Section 1 »Technical Information«.

Details of the design of the different types of optimised buttress ends are illustrated alongside.

DN15 - DN150

DN200 - DN300

DN450 - DN1000

GMP compliant installations

The use of heat exchangers and the layout of interconnecting pipeline incorporating valves when designing plant and equipment complying with GMP regulations, calls for special care in both the planning and selection of the components used together with the materials of construction used for them. Borosilicate glass 3.3 has a number of special properties that are highly valued in the pharmaceutical industry and these in conjunction with materials approved in accordance with the FDA catalogue, such as PTFE (bellows, lining, coating), glass-lined steel (heat exchanger shells) and special materials (silicon carbide etc.) ensure that any build-up of unwanted deposits is avoided in areas which come in contact with the product. A design without any dead space, which ensures that components drain fully and can be cleaned easily and effectively, is achieved by the shape of the components (e.g. coil and circular ring type heat exchangers) and the way they are installed. Where the external surfaces of these components have to comply with clean room requirements, appropriate stainless steel coupling and support material can be supplied (please see Section 9 »Couplings« and Section 10 »Structures and Supports«).

We would be happy to advise you on the basis of the regulatory requirements applicable to a particular case and the guidelines drawn up by us for the design of GMP compliant plant.

Coated heat exchangers

Damage to borosilicate glass 3.3 assemblies resulting from accidental external causes cannot be entirely excluded, especially in the smaller nominal sizes. This is primarily due to the relatively rigorous conditions prevalent in production plants and applies especially where no additional protection is provided in the form of insulation.

Our answer to this problem is to provide borosilicate glass 3.3 heat exchangers with a Sectrans transparent coating. This can be applied irrespective of the shape of the component and it provides additional protection without having any adverse effect on visual monitoring of the process.

A glass fibre reinforced polyester coating providing a higher level of protection can also be supplied on request. This does have a slightly adverse effect on the transparency of the glass, making it translucent and not transparent.

Permissible operating conditions

While the maximum permissible operating temperature for borosilicate glass 3.3 heat exchanger bodies is generally 200 °C ($\Delta\Theta \leq 180$ K), the maximum permissible operating pressure is governed by the main nominal size of the component but not by its shape. Detailed information on this can be found in Section 1 »Technical Informaton«.

The maximum permissible figures for pressure and temperature gradient across the heat exchange surfaces and PTFE tube plates (between the media) and the permissible operating conditions for components in other materials can be found in the respective product description.

Glass components suitable for higher permissible operating conditions can also be supplied on request.

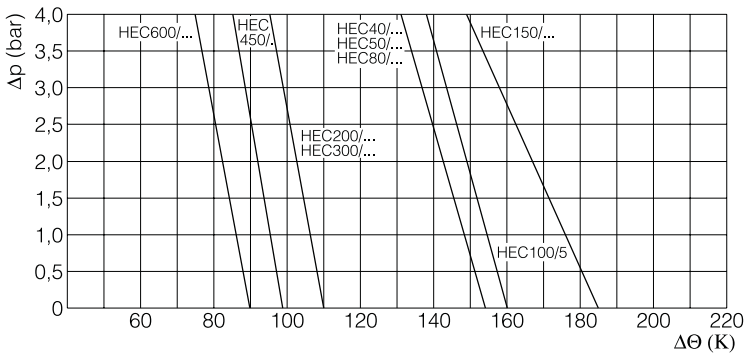
COIL TYPE HEAT EXCHANGERS

Unlike the shell and tube heat exchangers described on pages 5.15 to 5.22 these items have the coil battery welded to the jacket. This is of importance for plant which has to conform to GMP requirements since it ensures that the product and the coolant cannot come into contact with each other.

Coil type heat exchangers are mainly used as condensers or coolers. They can, however, be used for heat transfer between liquids and gases in general. Turbulent flow is ensured even in the larger nominal bores since the coil layers are offset and fill the flow cross-section to a great extent.

Information on pressure drop in the coils together with performance data which can be used to estimate the heat transfer surface required can be found on pages 5.6 and 5.7. We would be happy to carry out detailed design work for you.

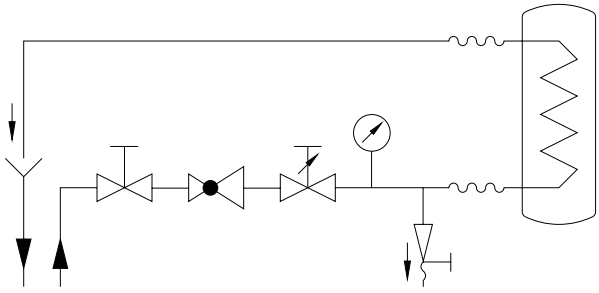
The permissible pressure difference across the wall of the coils as a function of the temperature difference at that point is indicated in the diagram below. The specified $\Delta\Theta$ is the difference between the temperature of the shell side medium and the medium inside the coils. The permissible pressure difference is valid up to an overall heat transfer coefficient of U=290 $Wm^{-2}\,K^{-1}$ wich covers most practical applications.

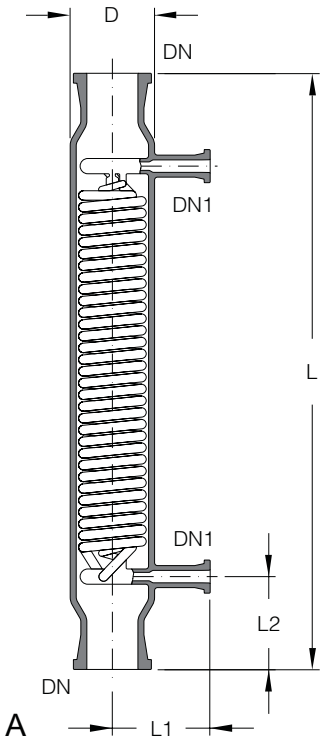


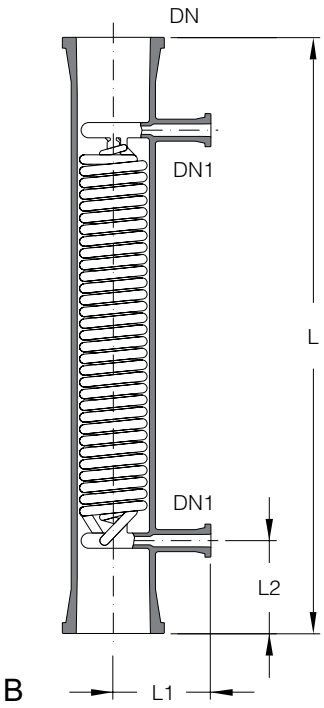
Permissible pressure difference between coil and jacket as a function of the temperature difference between the products in the two areas.

The inlet and outlet connections are of the safety buttress end type. If they are aligned horizontally and if long or heavy hoses are connected to them, we recommend 90° hose connectors to reduce the bending moment on the branches.

When installing coil-type heat exchangers appropriate precautions should be taken. Details of these can be found in the installation and operating instructions enclosed with each item. The main points to be taken into account when planning to use these items as coolers are (see also flow chart below):







COIL TYPE HEAT EXCHANGERS

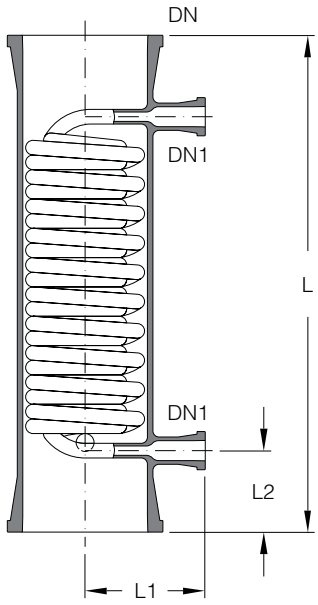
- The use of hoses or bellows on the cooling water connections to avoid imposing stresses.
- Fitting a pressure reducing valve (if necessary), control valve, non-return valve (not when used under re-cool conditions) and pressure gauge immediately before the heat exchanger.
- Free drainage of the cooling water from the coils, if it is not possible to provide other means of ensuring that the permissible operating pressure (see page 5.4) is not exceeded.
- Ball valves or other rapid opening valves must not be used in the inlet lines to coil type heat exchangers to avoid any water hammer in the coil.

Up to DN 150 nominal bore coil type heat exchangers can also be installed horizontally (with a slight fall).

The end form, which depends on the nominal size, is shown in the diagram on page 5.2. Further information can be found in Section 1 »Technical Information«.

Area (m²)	DN	DN1	D	L	L1	L2	Type	Reference
0,2	40	15	60	610	75	95	A	HEC40/2
0,3	50	15	85	610	100	95	A	HEC50/3
0,3	80	15	-	610	100	95	B	HEC80/3
0,5	100	15	-	610	125	80	B	HEC100/5
0,7	150	25	-	610	150	100	C	HEC150/7
1,0	150	25	-	840	150	100	C	HEC150/10
1,0	200	25	-	500	175	95	D	HEC200/10
1,5	200	25	-	725	175	95	D	HEC200/15
2,5	300	25	-	600	275	100	E	HEC300/25
4,0	300	25	-	825	275	100	E	HEC300/40
6,0	450	25	-	850	350	125	E	HEC450/60
8,0	450	25	-	900	350	125	E	HEC450/80
12,0	600	50	-	1100	450	150	E	HEC600/120
15,0	600	50	-	1250	450	150	E	HEC600/150

C



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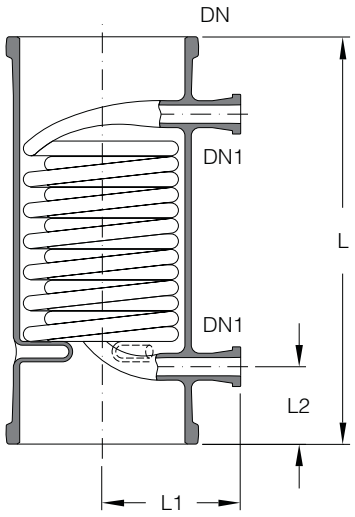

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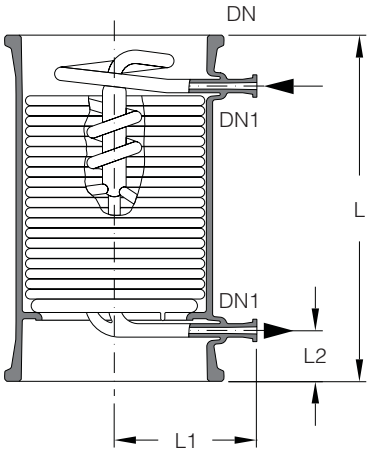


COIL TYPE HEAT EXCHANGERS

Technical data

Reference	Area	Free cross sec. area shell	Capacity	
			Coil	Jacket
	(m^2)	(cm^2)	(l)	(l)
HEC40/2	0,2	4,5	0,16	0,9
HEC50/3	0,3	5,5	0,35	1,7
HEC80/3	0,3	5,5	0,35	2,1
HEC100/5	0,5	18	0,7	3,8
HEC150/7	0,7	70	1,9	8,3
HEC150/10	1,0	70	2,7	11
HEC200/10	1,0	90	2	12
HEC200/15	1,5	90	4	16
HEC300/25	2,5	250	6	32
HEC300/40	4,0	250	10	40
HEC450/60	6,0	450	26	91
HEC450/80	8,0	450	28	95
HEC600/120	12,0	700	65	215
HEC600/150	15,0	700	69	263

Performance data

An approximate calculation of heat transfer surface areas can be based on the following guide figures for heat transfer coefficients.

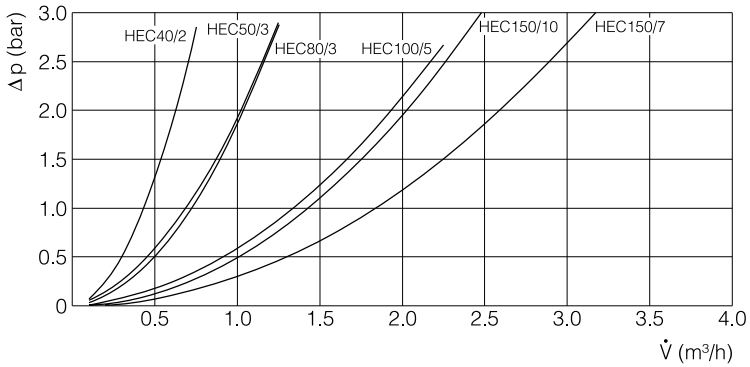
Jacket side Medium	Vapour to be condensed	Liquid	Gas
Coil side medium	Cooling water	Cooling water	Cooling water
Heat transf. coeff. $Wm^{-2}\,K^{-1}$)	290	175	50

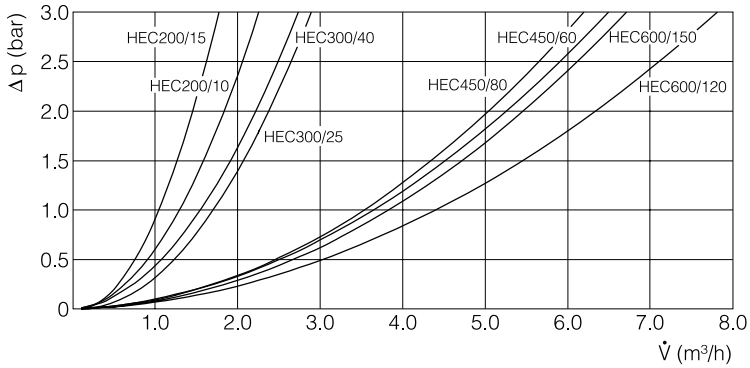
The table below shows figures calculated on this basis for the condensation of steam at atmospheric pressure and a cooling water throughput for a maximum pressure drop of 2,5 bar in the coils (inlet temperature 20 °C):

Reference	Area	Coolant throughput	Steam condensed
	(m^2)	(l/h)	kg/h)
HEC40/2	0,2	700	7
HEC50/3	0,3	1200	12
HEC80/3	0,3	1200	12
HEC100/5	0,5	2200	18
HEC150/7	0,7	3000	45
HEC150/10	1,0	2300	60
HEC200/10	1,0	2150	45
HEC200/15	1,5	1650	60
HEC300/25	2,5	2750	85
HEC300/40	4,0	2600	125
HEC450/60	6,0	6100	230
HEC450/80	8,0	5800	280
HEC600/120	12,0	7300	330
HEC600/150	15,0	6300	370

COIL TYPE HEAT EXCHANGERS

Pressure drop diagram





Pressure drop in the coil as a function of throughput (water, 20 ºC).

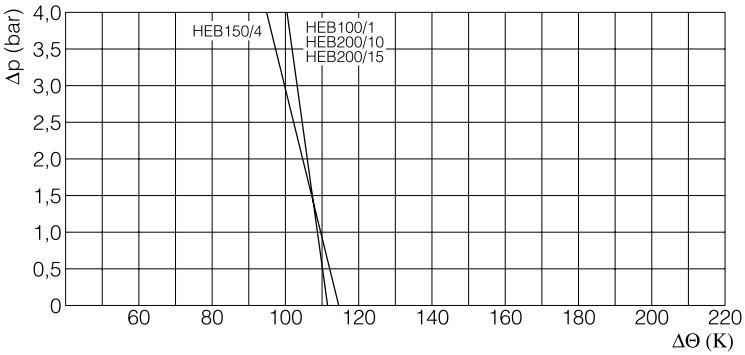
COIL TYPE BOILERS

This type of heat exchanger is predominantly used in circulatory evaporators.

Performance data which can be used to estimate the heat transfer surface required can be found on page 5.9. We would be happy to carry out detailed design work for you.

Coil type heat exchangers suitable for heat transfer between liquids and gases in general are described on pages 5.4 to 5.7.

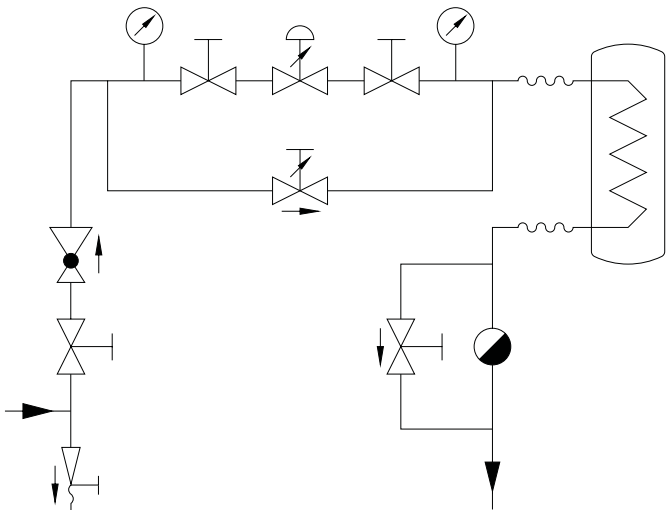
The permissible pressure difference across the wall of the coils as a function of the temperature difference at that point is indicated in the diagram below. The specified $\Delta\Theta$ is the difference between the temperature of the shell side medium and the medium inside the coils. The permissible pressure difference is valid up to an overall heat transfer coefficient of U=290 Wm^{-2} K^{-1} wich covers most practical applications.



Permissible pressure difference between coil and jacket as a function of the temperature difference between the products in the two areas.

The inlet and outlet connections are of the safety buttress end type.
If they are aligned horizontally and if long or heavy hoses are connected to them, we recommend 90° hose connectors to reduce the bending moment on the branches.

When installing boiler type heat exchangers appropriate precautions should be taken. Details of these can be found in the installation and operating instructions enclosed with each item. The main points to be taken into account when planning to use these items are (see also flow chart below):



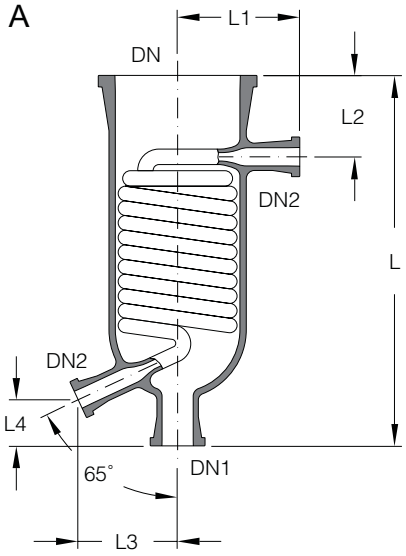
COIL TYPE BOILERS

- The use of hoses or bellows on the steam and condensate connections to avoid imposing stresses.
- Provision for sufficient fall on the steam inlet and condensate outlet lines.
- Fitting a pressure reducing valve (if necessary), control valve and pressure gauge immediately before the boiler and a reliable system to clear condensate with a by-pass valve (for use during start-up) immediately after the boiler.
- Ball valves or other rapid opening valves must not be used in the inlet lines to coil type boilers to avoid any pressure hammer in the coil.

Coil type boilers should not be fitted at the bottom of columns or vessels, since adequate circulation cannot be guaranteed in such locations. Delay in boiling can occur which in turn may result in breakage of the coil.

The pipe end form, which depends on the nominal size, is shown in the diagram on page 5.2. Further information can be found in Section 1 »Technical Information«

A



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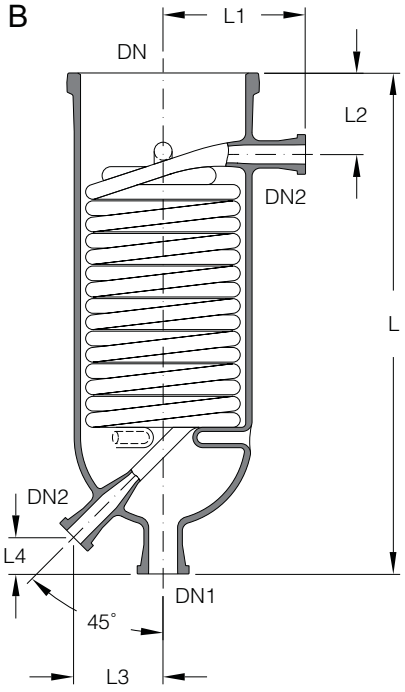


Area (m²)	DN	DN1	DN2	L	L1	L2	L3	L4	Type	Reference
0,1	100	25	25	380	125	100	103	46	A	HEB100/1
0,4	150	40	25	455	150	100	122	57	A	HEB150/4
1,0	200	40	25	615	175	100	110	45	B	HEB200/10
1,5	200	40	25	775	175	100	110	45	B	HEB200/15

Technical data

Reference	Area	Capacity	
	(m²)	Coil (l)	Jacket (l)
HEB100/1	0,1	0,25	2,3
HEB150/4	0,4	1,0	4,7
HEB200/10	1,0	2,1	14
HEB200/15	1,5	3,2	15

Performance data

For approximate calculation of evaporation performance the heat transferred in all sizes can be considered on average as 400 $Wm^{-2}K^{-1}$ with a steam pressure in the coils of 3.0 bar g. This figure declines marginally at lower pressures.

The table below shows figures calculated on this basis for the evaporation of water with an inlet temperature of 100 °C and at atmospheric pressure (if the feed is cold, the performance of the boiler will be only about 80% of the figures quoted):

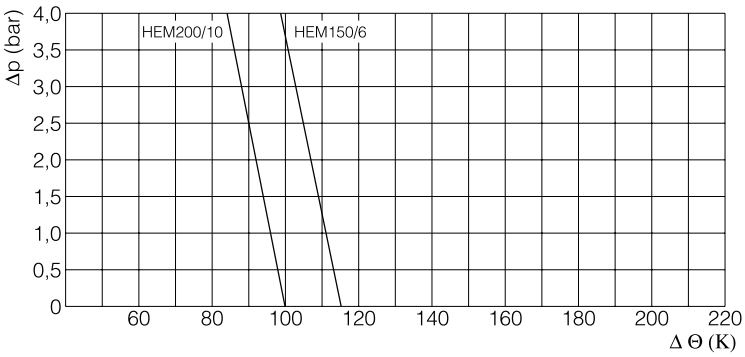
Reference	Area	Steam pressure	Water evaporated
	(m²)	(bar g)	(kg/h)
HEB100/1	0,1	2	2,7
		3	3,3
HEB150/4	0,4	2	12,5
		3	16,5
HEB200/10	1,0	2	20
		3	24
HEB200/15	1,5	2	29
		3	37

IMMERSION HEAT EXCHANGERS

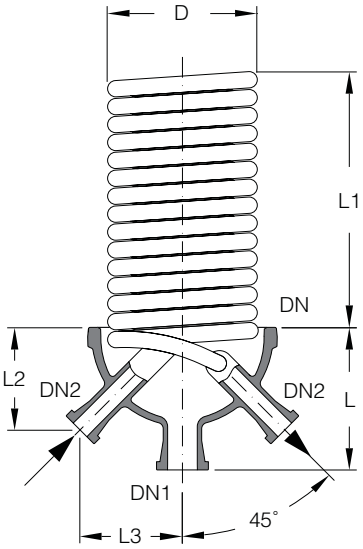
This type of heat exchanger is predominantly used in vessels to heat or cool products in conjunction with stirring duties. Suitable vessels are spherical vessels with large bottom outlet (similar to type »VSH..«) or cylindrical vessels with a bottom outlet of appropriate nominal size which can also be supplied on request.

Performance data which can be used to estimate the heat transfer surface required can be found at the end of this section. We would be happy to carry out detailed design work for you.

The permissible pressure difference across the wall of the coils as a function of the temperature difference at that point is indicated in the diagram below. The specified $\Delta\Theta$ is the difference between the temperature of the shell side medium and the medium inside the coils. The permissible pressure difference is valid up to an overall heat transfer coefficient of U=290 Wm^{-2} K^{-1} wich covers most practical applications.



Permissible pressure difference between coil and jacket as a function of the temperature difference between the products in the two areas.



DN200

The inlet and outlet branches are of the safety buttress end type. Borosilicate glass 3.3 and metal hose connectors can be found in section 2 »Pipeline Components« and steam hoses, which can also be used on the condensate side, in section 9 »Couplings«.

When installing immersion heat exchangers appropriate precautions should be taken. Details of these precautions can be found in the installation and operating instructions supplied with each item. The main points to be taken into account when planning to use these items as coolers or boilers can be found on pages 5.4 and 5.5 under »Coil-Type Heat Exchangers« or alternatively on pages 5.8 and 5.9 under »Coil-Type Boilers«.

The pipe end form, which depends on the nominal size, is shown in the diagram on page 5.2. Further information can be found in Section 1 »Technical Information«.

Area (m^2)	DN	DN1	DN2	D	L	L1	L2	L3	Capacity (l)	Reference
0.6	150	40	25	128	185	290	133	113	1.1	**HEM150/6**
1.0	200	40	25	184	175	355	126	126	2.9	**HEM200/10**

IMMERSION HEAT EXCHANGERS

Performance data

For approximate calculation of evaporation performance the heat transferred in all sizes can be considered on average as 400 W/m^{2}K with a steam pressure in the coils of 3.0 bar g. This figure declines marginally at lower pressures.

The table below shows figures calculated on this basis for the evaporation of water with an inlet temperature of 100 °C and at atmospheric pressure (if the feed is cold, the performance of the boiler will be only about 80% of the figures quoted):

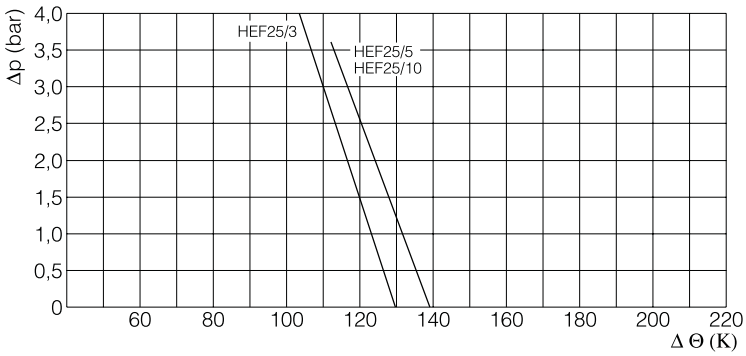
Reference	Area (m^2)	Steam pressure (bar g)	Water evaporated (kg/h)
HEM150/6	0,6	2	13,5
		3	17,5
HEM200/10	1,0	2	20
		3	28

LIQUID COOLERS

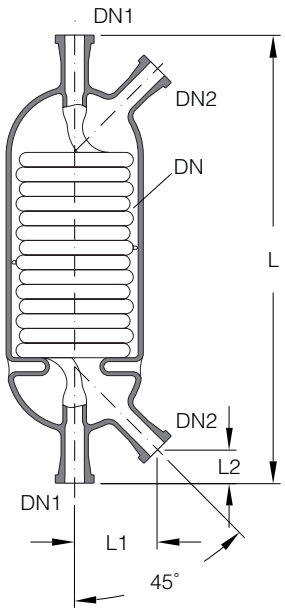
These liquid coolers are used typically for the cooling of products from distillation columns and can be connected directly to the reflux head in a column.

As the product flows through the coil battery, the pressure drop indicated in the diagram below should be taken into account. It must exist as a static feed height before the cooler.

The permissible pressure difference across the wall of the coils as a function of the temperature difference at that point is indicated in the diagram below. The specified ΔΘ is the difference between the temperature of the shell side medium and the medium inside the coils. The permissible pressure difference is valid up to an overall heat transfer coefficient of U=290 Wm^{-2} K^{-1} wich covers most practical applications.



Permissible pressure difference between coil and jacket as a function of the temperature difference between the products in the two areas.



The inlet and outlet connections are of the safety buttress end type. If they are aligned horizontally and if long or heavy hoses are connected to them, we recommend 90° hose connectors to reduce the bending moment on the branches.

Borosilicate glass 3.3 and metal hose connectors can be found in Section 2 »Pipeline Components« and hoses are in section 9 »Couplings«.

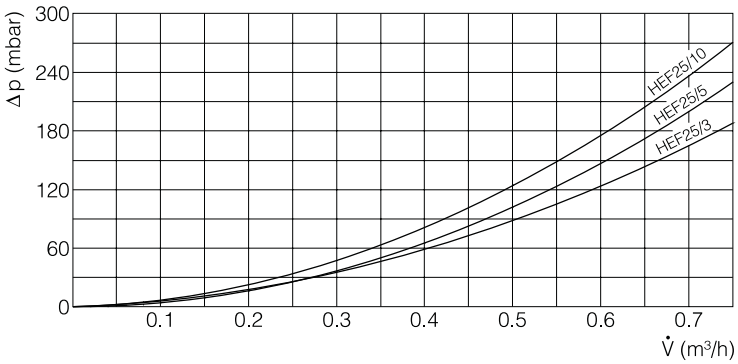
Area (m^2)	DN	DN1	DN2	L	L1	L2	Reference
0,3	100	25	25	550	85	38	**HEF25/3**
0,5	150	25	25	550	104	43	**HEF25/5**
1,0	150	25	25	750	104	43	**HEF25/10**

Technical data

Reference	Area	Capacity	
	(m^2)	Coil (l)	Jacket (l)
HEF25/3	0.3	0.6	2.5
HEF25/5	0.5	1.2	5.2
HEF25/10	1.0	2.1	7.3

LIQUID COOLERS

Pressure drop diagram

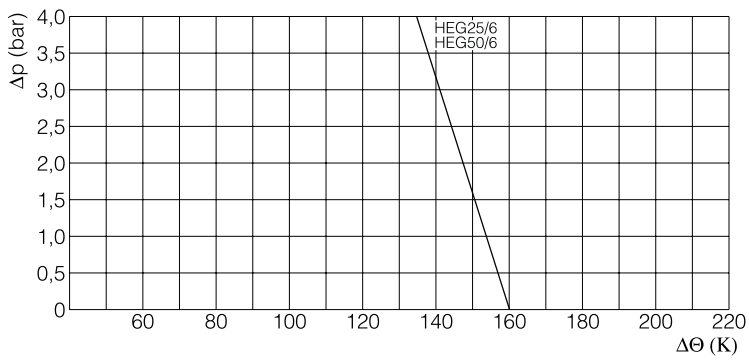


Pressure drop in the coil based on water at 20 °C

VENT CONDENSERS

These items are installed before vacuum pumps or in vent gas lines to remove any components in vapour form still remaining in the gas stream after the main condenser. Their compact design makes them ideal for fitting directly in pipework without the need for any reduction.

The permissible pressure difference across the wall of the coils as a function of the temperature difference at that point is indicated in the diagram below. The specified ΔΘ is the difference between the temperature of the shell side medium and the medium inside the coils. The permissible pressure difference is valid up to an overall heat transfer coefficient of U=290 Wm^{-2} K^{-1} wich covers most practical applications.



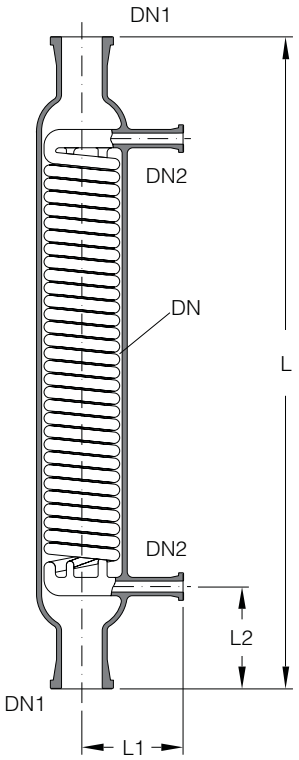
Permissible pressure difference between coil and jacket as a function of the temperature difference between the products in the two areas.

VENT CONDENSERS

The inlet and outlet connections are of the safety buttress end type. If they are aligned horizontally and if long or heavy hoses are connected to them, we recommend 90° hose connectors to reduce the bending moment on the branches.

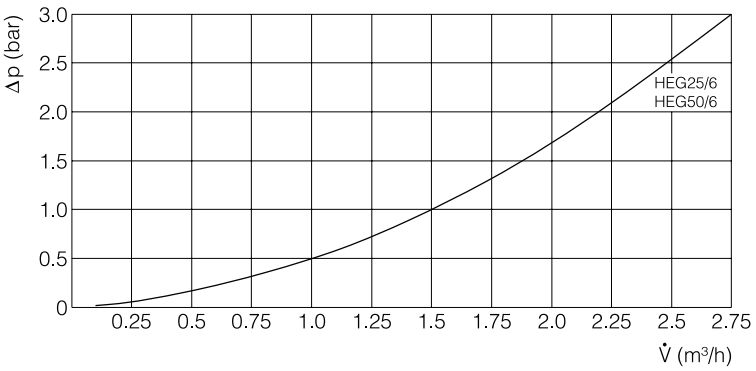
Borosilicate glass 3.3 and metal hose connectors can be found in Section 2 »Pipeline Components« and hoses are in section 9 »Couplings«.

Area (m^2)	DN	DN1	DN2	L	L1	L2	Reference
0,6	100	25	15	800	100	125	**HEG25/6**
0,6	100	50	15	800	100	125	**HEG50/6**



Technical data

Reference	Area (m^2)	Capacity Coil (l)	Capacity Jacket (l)
HEG25/6	0.6	0.9	3.4
HEG50/6	0.6	0.9	3.6



Pressure drop in the coil based on water at 20 °C

SHELL AND TUBE HEAT EXCHANGERS

Shell and tube heat exchangers provide a versatile alternative to the coil-type heat exchangers described on previous pages. They were conceived as condensers, but they are equally suitable for heat transfer between two liquids or gases.

These shell and tube heat exchangers are of modular construction. They comprise the following individual elements: tubular shell, headers, tube plates, heat exchange tubes and baffles. Sealing of the individual tubes in the tube plate is of particular importance. The threaded PTFE bushes and PTFE sealing rings provide a seal of the highest integrity between the different materials.

Four basic versions of shell and tube heat exchanger, with PTFE tube plates and borosilicate glass 3.3 or silicon carbide heat transfer tubes, are available as standard. They are listed on pages 5.16 to 5.19.

Performance data which can be used to estimate the heat transfer surface required is given on page 5.21. We would be happy to carry out accurate calculations for you using special programs.

The maximum permissible operating conditions in borosilicate glass 3.3 heat exchangers are detailed in the table below. If duties in excess of these figures are called for, we recommend the use of the special versions described on page 5.22.

DN	Area	Max. Temperature difference for Glass Heat Exchanger Tubes	Permissible operating temperature	Permissible operating pressure (bar g)			Permissible differential pressure for tube plate (bar)	
				Shell	Tube side			
	(m^2)	(K)	(°C)		../..S..G	../..G..G	../..S..G	../..G..G
150	2,5-5	130	-50/+150	-1/+2	3	3	4	4
200	5-10	130	-50/+150	-1/+1	3	2	4	3
300	12,5-25	130	-50/+150	-1/+1	3	2	4	3

The standard branch positions are as indicated in the appropriate diagrams. Alternative positions are available on request.

When making connections to the service necks on the heat exchangers, bellows should be used to avoid imposing any stresses.

When installing shell and tube heat exchangers appropriate precautions should be taken. Details of these can be found in the installation and operating instructions supplied with each item.

The standard version of these heat exchangers is designed to be installed horizontally. If required, however, drain and venting facilities can be provided on the tube plates together with changes to the support arrangements on the units to permit vertical installation (please see page 5.20).

The end form, which depends on the nominal size, is shown in the diagram on page 5.2. Further information can be found in Section 1 »Technical Information«.

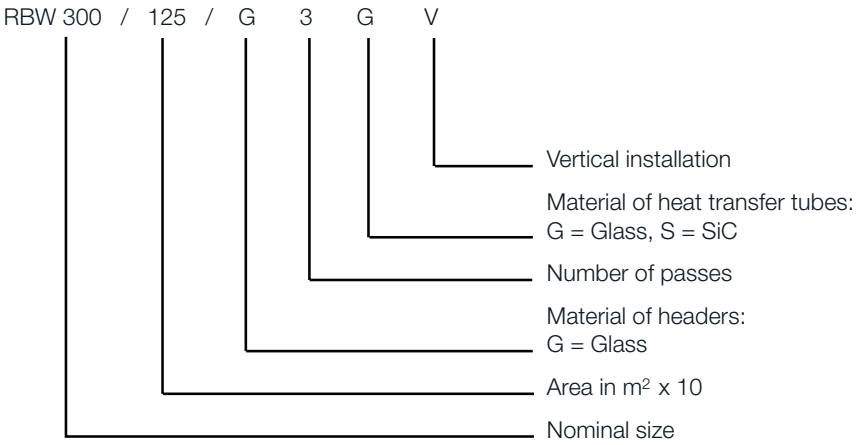
SHELL AND TUBE HEAT EXCHANGERS

Shell and Tube Heat Exchangers, both sides corrosion resistant

There are two versions of this type of heat exchanger, single pass (version A) and triple pass (version B). Both versions combine borosilicate glass 3.3 (shell, heat exchange tubes and headers) and PTFE (tube plates, bushes and baffles). Included in the supply are two support brackets which provide the basis for fixing to the support structure (see assembly dimensions).

If silicon carbide heat exchange tubes are required, please replace the applicable »G« in the catalogue reference with »S« (see Key to catalogue references). In these cases a prior check on the heat transfer area should be carried out.

Key to catalogue references



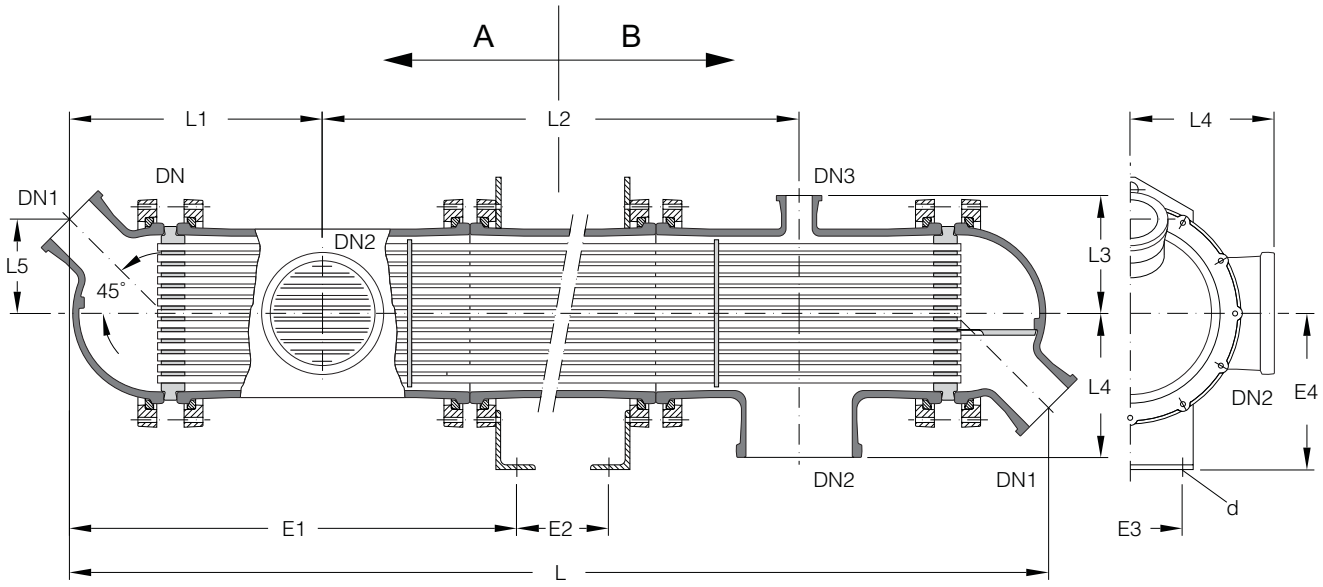
Dimensions

Reference	DN	Area (m^2)	E1	E2	E3	E4	d
RBW150/25G..G	150	2.5	574	620	200	208	14
RBW150/32G..G	150	3,2	574	1120	200	208	14
RBW150/40G..G	150	4,0	574	1620	200	208	14
RBW150/50G..G	150	5,0	574	2120	200	208	14
RBW200/50G..G	200	5,0	677	917	200	243	14
RBW200/63G..G	200	6,3	677	1417	200	243	14
RBW200/80G..G	200	8,0	677	1917	200	243	14
RBW200/100G..G	200	10,0	677	2417	200	243	14
RBW300/125G..G	300	12,5	897	521	200	295	14
RBW300/160G..G	300	16,0	897	1021	200	295	14
RBW300/200G..G	300	20,0	897	1521	200	295	14
RBW300/250G..G	300	25,0	897	2021	200	295	14

SHELL AND TUBE HEAT EXCHANGERS

Shell and Tube Heat Exchangers, both sides corrosion resistant

DN	Area (m^2)	DN1	DN2	DN3	L	L1	L2	L3	L4	L5	Type	Reference
150	2.5	50	100	50	1774	332	1110	160	200	108	A	RBW150/25G1G
150	2.5	50	100	50	1774	332	1110	160	200	108	B	RBW150/25G3G
150	3,2	50	100	50	2274	332	1610	160	200	108	A	RBW150/32G1G
150	3,2	50	100	50	2274	332	1610	160	200	108	B	RBW150/32G3G
150	4,0	50	100	50	2774	332	2110	160	200	108	A	RBW150/40G1G
150	4,0	50	100	50	2774	332	2110	160	200	108	B	RBW150/40G3G
150	5,0	50	100	50	3274	332	2610	160	200	108	A	RBW150/50G1G
150	5,0	50	100	50	3274	332	2610	160	200	108	B	RBW150/50G3G
200	5,0	80	150	50	2282	386	1510	175	250	138	A	RBW200/50G1G
200	5,0	80	150	50	2282	386	1510	175	250	138	B	RBW200/50G3G
200	6,3	80	150	50	2782	386	2010	175	250	138	A	RBW200/63G1G
200	6,3	80	150	50	2782	386	2010	175	250	138	B	RBW200/63G3G
200	8,0	80	150	50	3282	386	2510	175	250	138	A	RBW200/80G1G
200	8,0	80	150	50	3282	386	2510	175	250	138	B	RBW200/80G3G
200	10,0	80	150	50	3782	386	3010	175	250	138	A	RBW200/100G1G
200	10,0	80	150	50	3782	386	3010	175	250	138	B	RBW200/100G3G
300	12,5	100	200	50	2318	504	1310	235	275	180	A	RBW300/125G1G
300	12,5	100	200	50	2318	504	1310	235	275	180	B	RBW300/125G3G
300	16,0	100	200	50	2818	504	1810	235	275	180	A	RBW300/160G1G
300	16,0	100	200	50	2818	504	1810	235	275	180	B	RBW300/160G3G
300	20,0	100	200	50	3318	504	2310	235	275	180	A	RBW300/200G1G
300	20,0	100	200	50	3318	504	2310	235	275	180	B	RBW300/200G3G
300	25,0	100	200	50	3818	504	2810	235	275	180	A	RBW300/250G1G
300	25,0	100	200	50	3818	504	2810	235	275	180	B	RBW300/250G3G



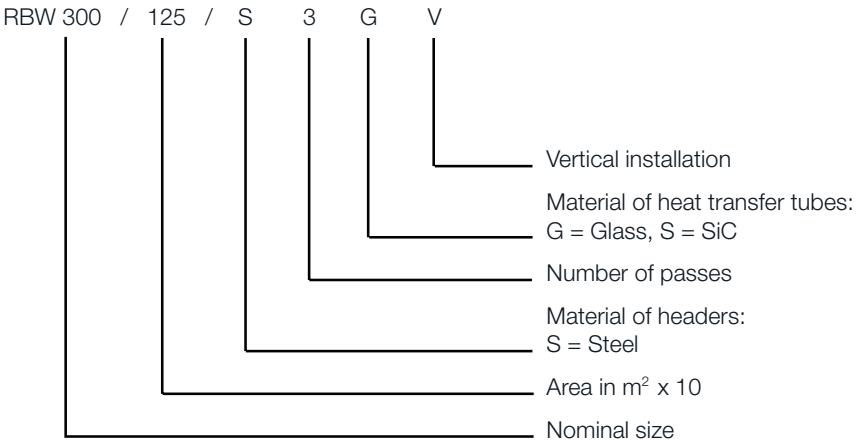
SHELL AND TUBE HEAT EXCHANGERS

Shell and Tube Heat Exchangers, shell side corrosion resistant

There are also two versions of this type of heat exchanger, single pass (version A) and triple pass (version B). Both versions use borosilicate glass 3.3 (shell and heat exchange tubes) and PTFE (tube plates, bushes and baffles) in combination with stainless steel headers. Included in the supply are two support brackets which provide the basis for fixing to the support structure (see assembly dimensions).

If silicon carbide heat exchange tubes are required, please replace the applicable »G« in the catalogue reference with »S« (see Key to catalogue references). In these cases a prior check on the heat transfer area should be carried out.

Key to catalogue references



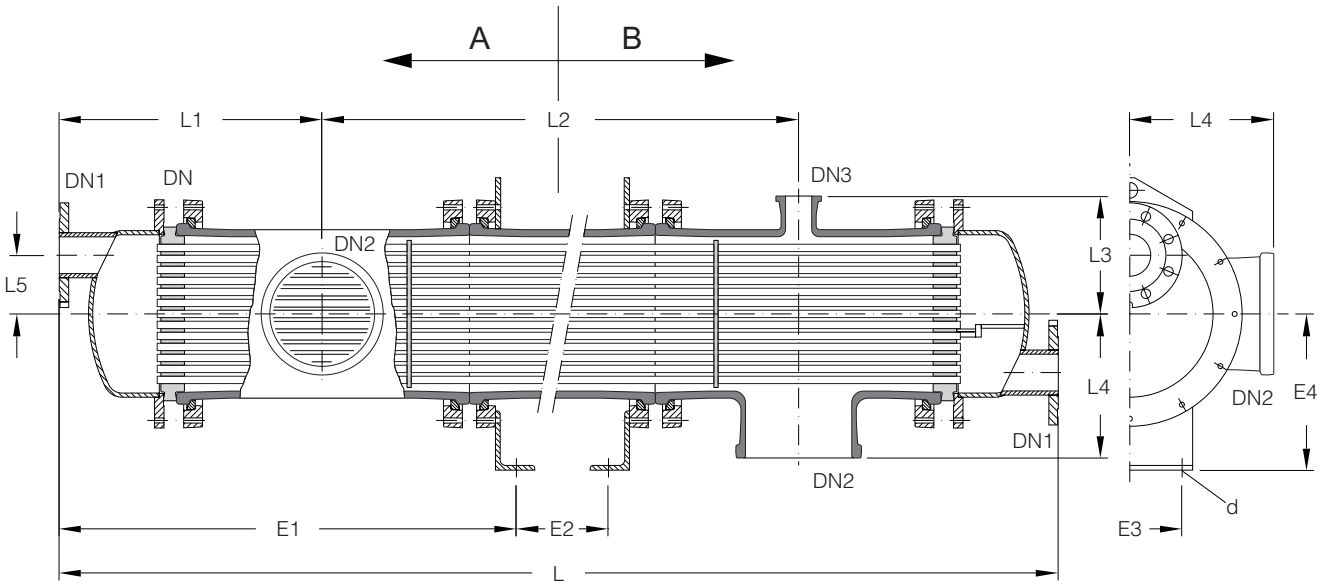
Dimensions

Reference	DN	Area (m^2)	E1	E2	E3	E4	d
RBW150/25S..G	150	2.5	565	620	200	208	14
RBW150/32S..G	150	3,2	565	1120	200	208	14
RBW150/40S..G	150	4,0	565	1620	200	208	14
RBW150/50S..G	150	5,0	565	2120	200	208	14
RBW200/50S..G	200	5,0	691	917	200	243	14
RBW200/63S..G	200	6,3	691	1417	200	243	14
RBW200/80S..G	200	8,0	691	1917	200	243	14
RBW200/100S..G	200	10,0	691	2417	200	243	14
RBW300/125S..G	300	12,5	916	521	200	295	14
RBW300/160S..G	300	16,0	916	1021	200	295	14
RBW300/200S..G	300	20,0	916	1521	200	295	14
RBW300/250S..G	300	25,0	916	2021	200	295	14

SHELL AND TUBE HEAT EXCHANGERS

Shell and Tube Heat Exchangers, shell side corrosion resistant

DN	Area (m^2)	DN1	DN2	DN3	L	L1	L2	L3	L4	L5	Type	Reference
150	2.5	40	100	50	1750	320	1110	160	200	55	A	RBW150/25S1G
150	2.5	40	100	50	1750	320	1110	160	200	55	B	RBW150/25S3G
150	3,2	40	100	50	2250	320	1610	160	200	55	A	RBW150/32S1G
150	3,2	40	100	50	2250	320	1610	160	200	55	B	RBW150/32S3G
150	4,0	40	100	50	2750	320	2110	160	200	55	A	RBW150/40S1G
150	4,0	40	100	50	2750	320	2110	160	200	55	B	RBW150/40S3G
150	5,0	40	100	50	3250	320	2610	160	200	55	A	RBW150/50S1G
150	5,0	40	100	50	3250	320	2610	160	200	55	B	RBW150/50S3G
200	5,0	50	150	50	2300	395	1510	175	250	77	A	RBW200/50S1G
200	5,0	50	150	50	2300	395	1510	175	250	77	B	RBW200/50S3G
200	6,3	50	150	50	2800	395	2010	175	250	77	A	RBW200/63S1G
200	6,3	50	150	50	2800	395	2010	175	250	77	B	RBW200/63S3G
200	8,0	50	150	50	3300	395	2510	175	250	77	A	RBW200/80S1G
200	8,0	50	150	50	3300	395	2510	175	250	77	B	RBW200/80S3G
200	10,0	50	150	50	3800	395	3010	175	250	77	A	RBW200/100S1G
200	10,0	50	150	50	3800	395	3010	175	250	77	B	RBW200/100S3G
300	12,5	80	200	50	2350	520	1310	235	275	112	A	RBW300/125S1G
300	12,5	80	200	50	2350	520	1310	235	275	112	B	RBW300/125S3G
300	16,0	80	200	50	2850	520	1810	235	275	112	A	RBW300/160S1G
300	16,0	80	200	50	2850	520	1810	235	275	112	B	RBW300/160S3G
300	20,0	80	200	50	3350	520	2310	235	275	112	A	RBW300/200S1G
300	20,0	80	200	50	3350	520	2310	235	275	112	B	RBW300/200S3G
300	25,0	80	200	50	3850	520	2810	235	275	112	A	RBW300/250S1G
300	25,0	80	200	50	3850	520	2810	235	275	112	B	RBW300/250S3G

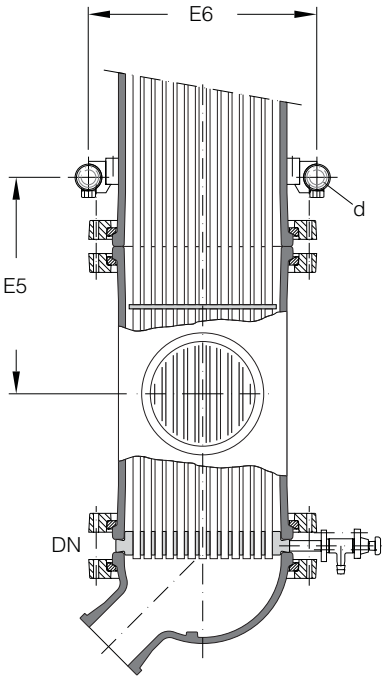


SHELL AND TUBE HEAT EXCHANGERS

Shell and Tube Heat Exchangers for vertical installation

All the heat exchangers described on pages 5.16 to 5.19 can also be supplied for vertical installation. The tube plates are then fitted with suitable venting and draining arrangements. Included in the supply is also a support frame which provide the basis for fixing to the support structure (see assembly dimensions).

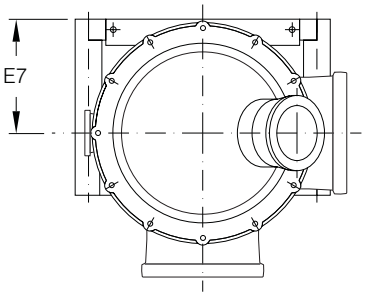
In such cases a »V« should be added to the catalogue reference (see Key to catalogue references) for the particular heat exchanger (see pages 5.17 to 5.19).



Key to catalogue references

RBW 300 / 125 / S 3 G V

- V — Vertical installation
- G — Material of heat transfer tubes: G = Glass, S = SiC
- 3 — Number of passes
- S — Material of headers: S = Steel, G = Glass
- 125 — Area in m^2 x 10
- 300 — Nominal size



Dimensions

Reference	DN	Area (m^2)	E5	E6	E7	d
RBW150/25..GV	150	2.5	300	300	148	42
RBW150/32..GV	150	3,2	300	300	148	42
RBW150/40..GV	150	4,0	300	300	148	42
RBW150/50..GV	150	5,0	300	300	148	42
RBW200/50..GV	200	5,0	375	305	168	42
RBW200/63..GV	200	6,3	375	305	168	42
RBW200/80..GV	200	8,0	375	305	168	42
RBW200/100..GV	200	10,0	375	305	168	42
RBW300/125..GV	300	12,5	425	436	218	42
RBW300/160..GV	300	16,0	425	436	218	42
RBW300/200..GV	300	20,0	425	436	218	42
RBW300/250..GV	300	25,0	425	436	218	42

SHELL AND TUBE HEAT EXCHANGERS

Performance data

An approximate calculation of heat transfer surface areas can be based on the following guide figures for heat exchange values.

Type of heat transfer	Fluid	Heat transf. coeff. ($Wm^{-2}K^{-1}$) for tubes made of	
		Glass	SiC
Liquid-liquid	Water-water	330-560	650-1800
	Water-organic solvent	300-500	500-1400
	Water-heat transfer oil	220-400	400-800
Liquid-gas	Water-air	15-90	15-90
Condensation	Water-water	520-640	1400-3100
	Water-organic solvent	400-580	900-2100

Technical data

Reference	Area	Number of Tubes (Ø14 x 1,5)	Free cross sectional area		Capacity	
			Tubes	Shell	Tubes and headers	Shell
	(m^2)	-	(cm^2)	(cm^2)	(l)	(l)
RBW150/25..1..	2,5	37	35	120	9,0	18
RBW150/32..1..	3,2	37	35	120	10,0	24
RBW150/40..1..	4,0	37	35	120	12,5	30
RBW150/50..1..	5,0	37	35	120	14,0	36
RBW200/50..1..	5,0	61	58	220	19,0	47
RBW200/63..1..	6,3	61	58	220	22,0	58
RBW200/80..1..	8,0	61	58	220	25,0	69
RBW200/100..1..	10,0	61	58	220	28,0	80
RBW300/125..1..	12,5	163	155	456	53,5	94
RBW300/160..1..	16,0	163	155	456	61,0	117
RBW300/200..1..	20,0	163	155	456	69,0	140
RBW300/250..1..	25,0	163	155	456	75,5	163
RBW150/25..3..	2,5	37	11,7	120	9,0	18
RBW150/32..3..	3,2	37	11,7	120	10,0	24
RBW150/40..3..	4,0	37	11,7	120	12,5	30
RBW150/50..3..	5,0	37	11,7	120	14,0	36
RBW200/50..3..	5,0	61	19,3	220	19,0	47
RBW200/63..3..	6,3	61	19,3	220	22,0	58
RBW200/80..3..	8,0	61	19,3	220	25,0	69
RBW200/100..3..	10,0	61	19,3	220	28,0	80
RBW300/125..3..	12,5	163	51,6	456	53,5	94
RBW300/160..3..	16,0	163	51,6	456	61,0	117
RBW300/200..3..	20,0	163	51,6	456	69,0	140
RBW300/250..3..	25,0	163	51,6	456	75,5	163

SHELL AND TUBE HEAT EXCHANGERS

Shell and Tube Heat Exchangers, special versions

Because of the modular design of the standard heat exchangers (see page 5.15), a wide variety of alternative materials can also be supplied and this facilitates adaptation of the heat exchangers to the particular requirements of each case. Details can be found in the table below and our special brochure which is available on request.

Nominal size		DN	50 - 450
Heat exchange area		m^2	up to 60
Outside diameter of internal tubes		mm	14 or larger
Number of tube side passes		-	1 - 4
Permissible operating conditions	Pressure	bar g	max. 5
	Temperature	°C	max. 180
	Differential pressure (tube/shell)	bar	max. 6
Materials	Shell	-	Borosilicate glass 3.3 Stainless steel Steel, glass lined or coated Special materials
	Headers	-	Borosilicate glass 3.3 Stainless steel Steel, glass lined or coated
	Tube plates	-	PTFE, solid Steel/PTFE-coated
	Bushes and gaskets	-	PTFE
	Baffles	-	PTFE
	Heat exchange tubes	-	Borosilicate glass 3.3 Silicon carbide Stainless steel Special materials

If metal tube plates are used, larger shell diameters and higher permissible operating conditions are possible.

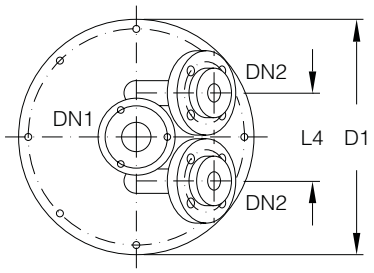
Additional features which can be supplied on request are:

- Turbulence devices for fitting in the heat exchange tubes. These increase heat transfer in the tubes by up to three times the normally attainable value.
- Double tube plates that ensure trouble-free separation of the shell-side and tube-side pressure area. Risks caused by leakage, for example the contamination of the product by the heating or cooling fluid, are thus avoided. This is of importance above all else for plant which has to conform to GMP requirements.

METAL - IMMERSION HEAT EXCHANGERS

Our range of metal immersion heat exchangers are used specifically in applications where higher steam pressures and/or larger heat transfer surfaces are required.

The properties of the product should be taken into account when selecting the material of construction (coil and circular ring immersion heat exchangers for example are supplied as standard in stainless steel).

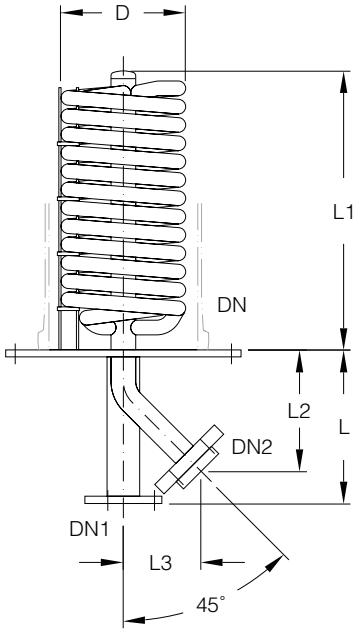


Coil-Type - Immersion Heat Exchangers

This versatile heat exchanger is used for the heating of spherical and cylindrical vessels (please see section 4 »Vessels & Stirrers«) and at the bottom of columns (please see section 5 »Column Components«). The heating coil is welded to a bottom plate which incorporates a branch with flange drilled to suit QVF PCD hole size and number. Hoses can be supplied for the steam and condensate connections (see section 9 »Couplings«).

Coil-type immersion heat exchangers are supplied as standard in stainless steel. They are also available, however, in hastelloy on request.

The maximum permissible operating pressure for these coil-type immersion heat exchangers is 20 bar g and the maximum operating temperature is 300 °C (PN 40 steam and condensate connection, EN 1092).



Area (m^2)	DN	DN1	DN2	D	D1	L	L1	L2	L3	L4	Capacity (l)	Reference
0,15	150	25	2 x 25	145	274	200	235	156	106	120	1,0	**EH150/1.5**
0,25	150	25	2 x 25	145	274	200	375	156	106	120	1,6	**EH150/2.5**
0,25	200	40	2 x 25	170	321	200	255	156	106	120	1,8	**EH200/2.5**
0,5	200	40	2 x 25	170	321	200	380	156	106	120	2,7	**EH200/5**
0,8	200	40	2 x 25	170	321	200	555	156	106	120	3,9	**EH200/8**
1,0	200	40	2 x 25	170	321	200	655	156	106	120	4,6	**EH200/10**
1,5	200	40	2 x 25	170	321	200	930	156	106	120	6,6	**EH200/15**
1,5	300	40	2 x 25	250	420	200	555	156	106	170	6,5	**EH300/15**
2,0	300	40	2 x 25	250	420	200	705	156	106	170	8,0	**EH300/20**
3,0	300	40	2 x 25	250	420	200	1005	156	106	170	10,0	**EH300/30**

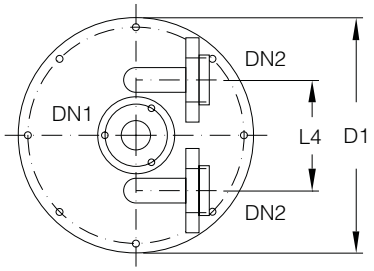
METAL - IMMERSION HEAT EXCHANGERS

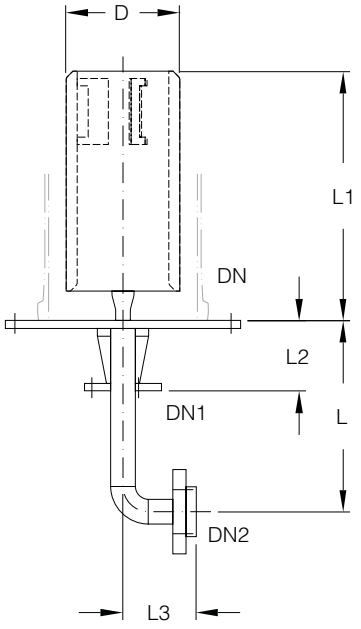
Circular Ring Type - Immersion Heat Exchangers

These items are recommended for use in spherical vessels as they yield high heat transfer and evaporation performance in conjunction with a turbine stirrer fitted centrally. The forced circulation across the heat transfer surface results in evaporation down to a very low residual volume. Other advantages are the smooth surface, the baffle fitted inside to create turbulence and the integral branch with QVF taper for a »BAS40« borosilicate glass 3.3 bottom outlet valve (see section 3 »Valves«). Hoses can be supplied for the steam and condensate connections (see chapter 9 » Couplings«).

Circular ring immersion heat exchangers are supplied as standard in stainless steel. They are also available, however, in titanium, tantalum or hastelloy on request.

The maximum permissible operating pressure for circular ring immersion heat exchangers is 6 bar g and the maximum operating temperature is 200 °C (PN 40 steam and condensate connection, EN 1092).





Area (m²)	DN	DN1	DN2	D	D1	L	L1	L2	L3	L4	Capacity (l)	Reference
0,15	200	40	2 x 25	155	321	250	225	85	100	151	0,75	**KRH200/1.5**
0,2	200	40	2 x 25	155	321	250	285	85	100	151	1,0	**KRH200/2**
0,25	200	40	2 x 25	155	321	250	340	85	100	151	1,25	**KRH200/2.5**
0,3	300	40	2 x 25	235	420	250	295	85	100	210	3,0	**KRH300/3**
0,35	300	40	2 x 25	235	420	250	330	85	100	210	3,5	**KRH300/3.5**
0,4	300	40	2 x 25	235	420	250	370	85	100	210	4,0	**KRH300/4**
0,45	300	40	2 x 25	235	420	250	405	85	100	210	4,5	**KRH300/4.5**
0,5	300	40	2 x 25	235	420	250	445	85	100	210	5,0	**KRH300/5**

METAL - IMMERSION HEAT EXCHANGERS

Bayonet Type - Immersion Heat Exchangers

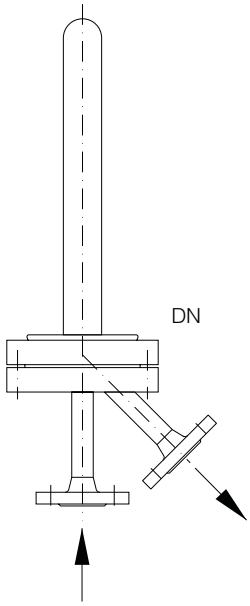
There is a very wide range of applications for this type of heat exchanger, particularly where a high level of corrosion resistance is required. Typical applications include use as boilers in circulatory evaporators and for heating columns. The design incorporating multiple bayonets ensures good heat transfer even when larger heat transfer surfaces are involved.

Bayonet immersion heat exchangers can be supplied in nominal sizes DN 80 to DN 600 with heat transfer areas from 0.05 to 8.5 m^2.

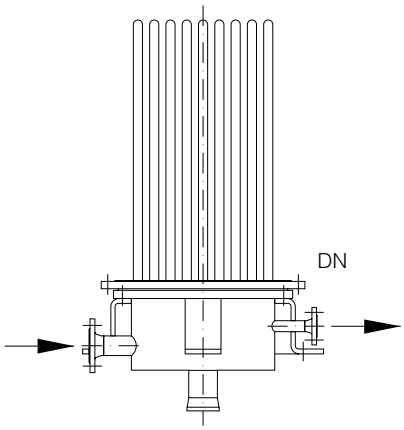
The base of these boilers is designed to act as a vapour distributor and condensate collector. A branch drilled to suit QVF PCD hole size and number welded through the base serves as a product connection. Hoses can be supplied for the steam and condensate connections (please see chapter 9 »Couplings«).

Bayonet immersion heat exchangers are supplied in tantalum as standard. Other materials are, however, also available.

The maximum permissible operating pressure for bayonet immersion heat exchangers is 10 bar g and the maximum operating temperature is 210 °C (PN 40 steam and condensate connection, EN 1092).



DN80 - DN100
0,05m^2 - 0,4m^2



DN150 - DN600
0,1m^2 - 8,5m^2

QVF

PROCESS PLANT COMPONENTS

Introduction

QVF column components provide the optimum solution for every requirement encountered in practice for operations such as distillation, rectification, absorption, reaction and extraction because of the wide range of different components available. This applies not only to the various types of column and pipe sections available (plain and jacketed and with or without internals) but also to the wide selection of internals and random and structured packing that can be supplied.

These components are widely used in the chemical, pharmaceutical and allied industries together with other applications such as food and drink production, dye works and electroplating. This is because of the special properties of borosilicate glass 3.3 and PTFE together with the special materials that are used in some instances for internals, plus the fact that borosilicate glass 3.3 is an approved and proven material of construction for pressure vessels.

Reference should also be made in this context to the extreme reliability of the strong and high-duty coupling system used for all components. This is achieved throughout the whole range of nominal sizes by the use of the safety buttress end which has been designed specifically taking into account the properties of the material, coupled with a reliable flange system.

The complete range of standard column components is described on the following pages. Non-standard components can also be supplied to special order. Column sections and fittings in other materials (glass-lined steel etc.) can also be supplied on request.

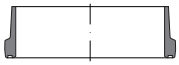
A detailed listing of all column components by »Description« and »Catalogue Reference« can be found in the »Index«.

Detailed information on a number of the topics referred to in the following pages can be found in Section 1 »Technical Information«.

Further information on complete columns can be found in our special leaflets dealing with individual unit operations.

Details of the design of the different types of optimised buttress ends are illustrated alongside.

DN15 - DN150



DN200 - DN300

DN450 - DN1000

GMP compliant installations

The use of columns and the layout of interconnecting pipeline incorporating valves when designing plant and equipment complying with GMP regulations, calls for special care in both the planning and selection of the components together with the materials of construction used for them. Borosilicate glass 3.3 has a number of special properties that are highly valued in the pharmaceutical industry and these in conjunction with materials approved in accordance with the FDA catalogue such as glass-lined steel (special versions of large bore column bottom sections), PTFE (redistributors and packing retainers) and special materials (e.g. internals) ensure that any build-up of unwanted deposits is avoided in areas which come in contact with the product. A design without any dead space, which ensures that components drain fully and can be cleaned easily and effectively, is achieved by the shape of the components, the way they are installed and the selection of suitable valves. Where the external surfaces of complete assemblies have to comply with clean room requirements, appropriate stainless steel coupling and support material can be supplied (please see Section 9 »Couplings« and Section 10 »Structures and Supports«).

We would be happy to advise you on the basis of the regulatory requirements applicable to a particular case and the guidelines drawn up by us for the design of GMP compliant plant.

Coated column components

Damage to borosilicate glass 3.3 plant resulting from accidental external causes cannot be entirely excluded. This is primarily due to the relatively rigorous conditions prevalent in production plants and applies especially where no additional protection is provided in the form of insulation.

Our answer to this problem is to provide borosilicate glass 3.3 column components with a Sectrans transparent coating. This can be applied irrespective of the shape of the component and it provides additional protection without having any adverse effect on visual monitoring of the process.

A glass fibre reinforced polyester coating providing a higher level of protection can also be supplied on request. This does have a slightly adverse effect on the transparency of the glass, making it translucent and not transparent.

Permissible operating conditions

While the maximum permissible operating temperature for all borosilicate glass 3.3 column components is generally 200 °C ($\Delta\Theta \leq 180$ K), the maximum permissible operating pressure is governed by the main nominal size of the component but not by its shape. Detailed information on this and the operation of jacketed components can be found in Section 1 »Technical Information«.

The permissible operating conditions for components in other materials can be found in the respective product description.

Glass components suitable for higher permissible operating conditions can be supplied on request.

COLUMN SECTIONS

Depending on the nominal size, column sections are supplied in 1000 and/or 1500 mm lengths, and also with or without a thermometer branch. They have an integral shelf on which the packing support rests. A PTFE ring is fitted between the support shelf and packing support to prevent direct contact between the two parts.

Column sections can be filled with random packing or alternatively structured packing if the free cross sectional area of the packing support is large enough (please see page 6.5), For structured packing higher free cross sectional areas can be achieved by the use of »CSDU..« type column sections (please see page 6.12).

Larger free cross-sections can be achieved in the DN 80 to DN 300 nominal size range by combining pipe sections (please see section 2 »Pipeline Components«) with »LBE..« type packing supports (please see page 6.8). By using pipe sections and special types of support plates this is possible across the whole range of nominal sizes. The column sections for structured packing, such as DURAPACK® high performance borosilicate glass 3.3 packing, described on page 6.12 is an example of this type of application.

Pipe sections can also be used to extend the length of column sections i.e. to increase the packed height, provided the permissible load-bearing capacity of the packing support is not exceeded.

Column sections suitable for installing distribution plates as well as packing retainers are described on pages 6.6 and 6.10. Precision bore pipe sections with and without buttress ends for special internals or chromatography columns can be found on page 6.32.

Jacketed column sections can also be supplied on request.

All column sections are supplied complete with a packing support. Random packing (please see page 6.9) and structured packing (please see page 6.10 and 6.11), should be ordered separately.

Details of free cross-sections (including packing support), the load-bearing capacity of the support rings in conjunction with the supplied packing supports and the recommended packing can be found in the table on the following page. The free cross-section of individual components used to construct columns and the load-bearing capacity of the packing supports is indicated in the description of the product in question.

The minimum size of random packed or stacked raschig rings can also be found in the table on the following page. Where raschig rings of smaller sizes are used a layer of high performance DURAPACK® should be installed first.

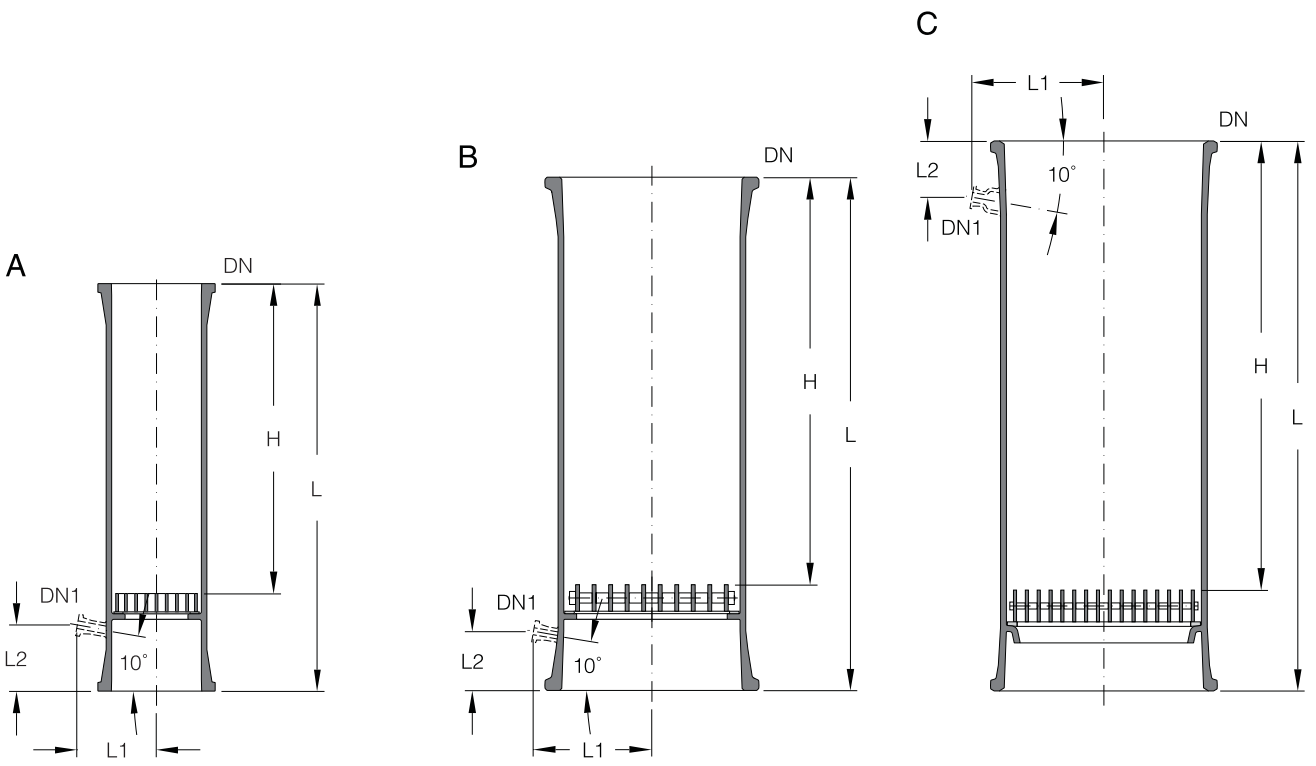
In the table below »DN« refers to the nominal size of the column.

For manufacturing reasons on column sections in DN 800 and DN 1000 nominal sizes in which the support shelf also acts as a redistributor the thermometer branch can only be located below the upper buttress end.

The end form, which depends on the nominal size is shown in the diagram on page 6.2. Further information can be found in section 1 »Technical Information«.

COLUMN SECTIONS

DN	DN1	L	L1	L2	H	Free cross-section (%)	Type	Load bearing capacity (N)	Minimum size of packing (FC) random packed, stacked		Cat. Reference without thermo-meter branch	Cat.Reference with thermo-meter branch
80	25	1000	108	91	835	32	A	230	FC8	-	CS80/1000	CST80/1000
100	25	1000	122	96	840	36	A	350	FC10	-	CS100/1000	CST100/1000
150	25	1000	147	111	830	34	A	700	FC15	FC20	CS150/1000	CST150/1000
200	25	1000	171	111	830	45	B	900	FC20	FC20	CS200/1000	CST200/1000
200	25	1500	171	111	1330	45	B	900	FC20	FC20	CS200/1500	CST200/1500
300	25	1000	221	111	825	56	B	1000	FC25	FC30	CS300/1000	CST300/1000
300	25	1500	221	111	1325	56	B	1000	FC25	FC30	CS300/1500	CST300/1500
450	25	1500	299	151	1234	44	B	3050	FC50	FC50	CSN450/1500	CSTN450/1500
600	25	1500	377	151	1209	53	B	3950	FC50	FC50	CSN600/1500	CSTN600/1500
800	40	1500	562	248	1105	55	C	10500	FC50	FC50	CSN800/1500	CSTN800/1500
1000	40	1500	650	250	1081	56	C	12500	FC50	FC50	CSN1000/1500	CSTN1000/1500



COLUMN SECTIONS FOR LIQUID DISTRIBUTION TRAYS

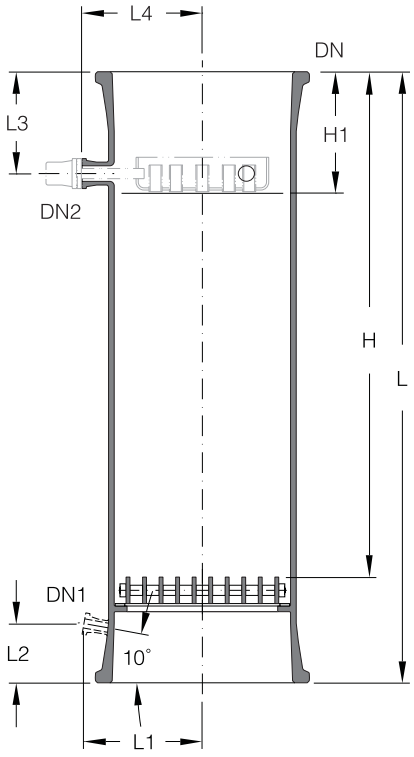
Irrespective of the nominal size these column sections are supplied in one length only so that they still provide sufficient height for random or structured packing. They have three extra side branches offset at 120° from each other so that a nozzle type distributor can be fitted to redistribute the liquid. These are located at an appropriate height so that a PTFE redistributor (please see page 6.16) can be installed in the coupling above the distribution plate.

These column sections can be supplied with or without thermometer branch.

All column sections are supplied complete with packing support. Distribution trays, random packing (please see page 6.9) and structured packing (please see page 6.11) should be ordered separately.

Further technical information and dimensions can be found on page 6.5, where »CS..« and »CST..« type column sections are described.

The end form , which depends on the nominal size, is shown in the diagram on page 6.2. Further information can be found in section 1 »Technical Information«.



DN	DN1	DN2	L	H	H1	L1	L2	L3	L4	Reference without thermo-meter branch	Reference with thermo-meter branch
200	25	25	1500	1330	150	171	111	110	165	**CSV200/1500**	**CSVT200/1500**
300	25	25	1500	1325	165	221	111	125	218	**CSV300/1500**	**CSVT300/1500**
450	25	40	1500	1234	205	299	151	135	300	**CSVN450/1500**	**CSVTN450/1500**
600	25	40	1500	1209	255	377	151	175	380	**CSVN600/1500**	**CSVTN600/1500**

PACKING SUPPORTS FOR RANDOM PACKED COLUMN SECTIONS

For nominal sizes up to DN 300 we supply »LB..« borosilicate glass 3.3 packing supports for the column sections described on pages 6.5 and 6.6. For larger diameters we provide type »HD..« packing supports for which a combination of glass and PTFE is used.

As packing supports are always supplied as part of the column section assembly, they are normally only ordered separately when required as replacements. The PTFE ring on which they are seated is supplied complete with the support.

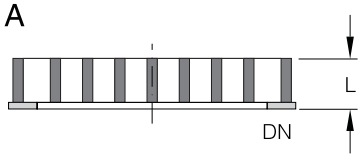
Details concerning free cross-sections of the supports and their load-bearing capacities when loaded evenly and on the minimum size of packing to be used are given on page 6.5.

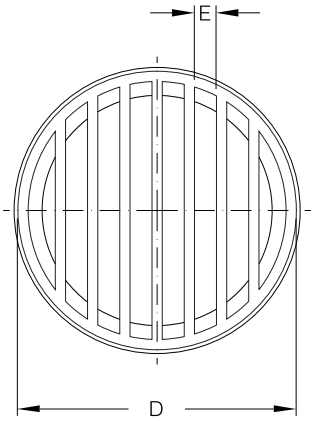
Packing supports for structured packing can be found on page 6.16.

In the table below »DN« refers to the nominal size of the column.

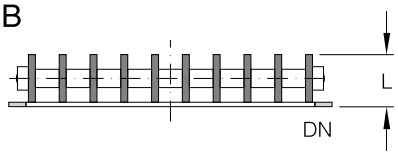
DN	L	D	E	Type	Reference
80	21	70	7	**A**	**LB80**
100	21	95	7	**A**	**LB100**
150	31	140	13	**A**	**LB150**
200	31	190	17	**A**	**LB200**
300	31	270	22	**A**	**LB300**
450	66	440	33	**B**	**HD450**
600	91	590	33	**B**	**HD600**
800	133	790	39	**B**	**HD800**
1000	153	968	39	**B**	**HD1000**

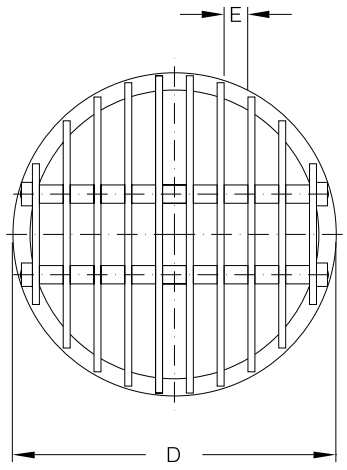
A





B





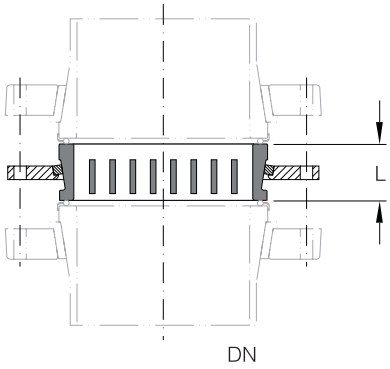
PACKING SUPPORTS FOR RANDOM PACKED PIPE SECTIONS

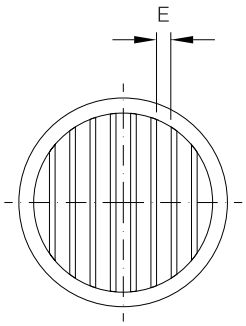
These items are used with pipe sections (please see section 2 »Pipeline Components«). This alternative provides larger free cross-sections than the combination of column sections with packing supports. In addition to the glass support plate the supply also includes the special backing flange with special insert, screwed rods, nuts and compression springs.

Details concerning free cross-sections of the supports and their load-bearing capacities when loaded evenly can be found in the table below.

DN	L	Free cross-section (%)	E	Load bearing capacity (N)	Minimum size of packing (FC)		Type	Reference
					random packed	stacked		
80	25	56	7	700	FC 8	-	A	LBE80
100	25	72	7	900	FC10	-	A	LBE100
150	50	77	13	1000	FC15	FC20	A	LBE150
200	50	81	18	1100	FC20	FC20	B	LBE200
300	50	81	21	1200	FC25	FC30	B	LBE300

A





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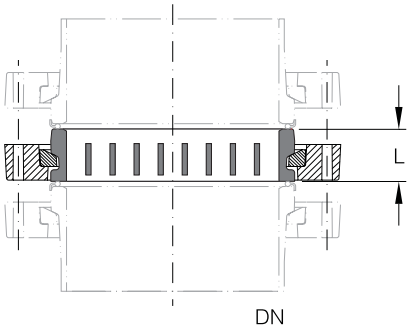
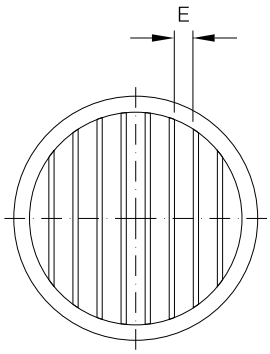




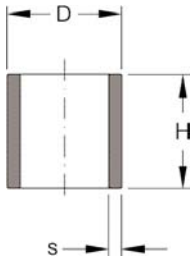
COLUMN PACKING

In addition to the borosilicate glass 3.3 raschig rings shown here, we can also supply other column packing in materials and geometries to suit the individual application. We would be happy to assist you in the selection of suitable packing and the design of the columns.

Borosilicate glass 3.3 structured packing (DURAPACK®) can be found on pages 6.11.

Column sections with bubble-cap plates are shown on page 6.30 onwards.

The permissible height of the packing is restricted by the load-bearing capacity of the packing support fitted in the column section (please see page 6.5).



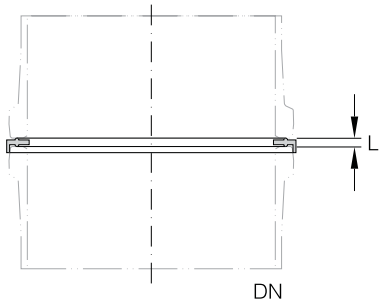
D x H	s	Bulk density random (kg/m³)		Surface random (m²/m³)		Free volume random (%)		Reference
		packed	stacked	packed	stacked	packed	stacked	
8 x 8	1,0	660	-	633	-	69	-	**FC8**
10 x 10	1,0	520	-	487	-	75	-	**FC10**
15 x 15	1,2	435	-	331	-	79	-	**FC15**
20 x 20	1,2	345	-	259	-	83	-	**FC20**
25 x 25	1,4	290	-	186	-	86	-	**FC25**
30 x 30	1,4	275	325	173	205	86	84	**FC30**
38 x 38	2,0	300	360	135	162	85	83	**FC40**
50 x 50	2,5	260	335	93	120	87	84	**FC50**

PACKING RETAINERS

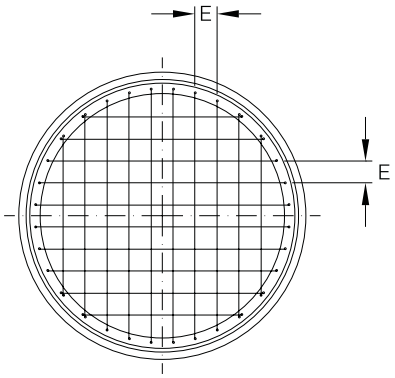
These components are installed above packed column sections to prevent damage to reflux separators or condensers by the carry-over of column packing. They are in the form of a PTFE ring of selected quality with a tantalum wire mesh.

Packing retainers are installed in the same way as gaskets between two buttress ends and therefore no additional gasket is required.

Packing retainers should not be used in place of packing supports (please see page 6.7).



DN	L	E	Free cross-section (%)	Reference
80	5	10	66	CPC80
100	5	10	92	CPC100
150	6	10	96	CPC150
200	6	18	82	CPC200
300	4	20	85	CPC300
450	4	20	90	CPCN450
600	5	30	95	CPCN600
800	7	30	96	CPC800
1000	7	37	92	CPC1000



STRUCTURED PACKING

Mass transfer in absorption, desorption, rectification and extraction columns can be improved by the use of structured packing in various materials. They provide high throughput coupled with low pressure drop and at the same time ensure good separation efficiency.

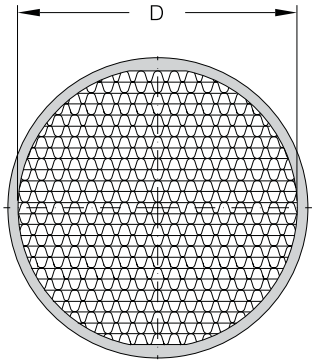
The DURAPACK® borosilicate glass 3.3 mass transfer packing referred to here combines these benefits with the ability to handle very corrosive and/or high purity products. Further information such as areas of application, pressure drop, separation efficiency and flooding point can be found in our special brochure "DURAPACK® Borosilicate Glass 3.3 Structured Mass Transfer Packing".

Complete couplings with longer bolts are required for column sections with structured packing installed, this is because of the support rings and packing restraints clamped between the flat buttress ends. These can be found in the section 9 »Couplings«.

We would be happy to provide advice on process engineering design aspects and the selection of suitable components for your particular application.

STRUCTURED PACKING

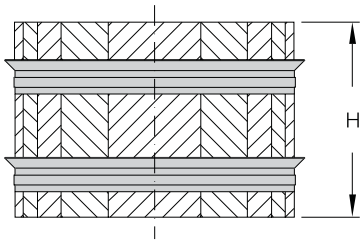
DURAPACK®-Elements



The individual corrugated glass plates are homogeneously fused together to form flow channels inclined at an angle of 45° to each other. The specific surface area is 300 m^2/m^3. Further information about pressure drop, separation efficiency and flooding throughput can be found in our special brochure (please see page 6.10).

In the DN 100 to DN 450 range of nominal sizes, the packing elements are one-piece. In the larger sizes they are segmented. They can be used in column sections and pipe sections (please see section 2 »Pipeline Components«) and they are installed using special edge seals which are included in the supply.

The one-piece packing is supported on a PTFE support ring (steel reinforced in DN 450 and above) and the segmented type is supported on a combination of support ring and packing support (please see pages 6.13 and 6.16). The support rings are clamped between the buttress ends and also serve as gaskets.



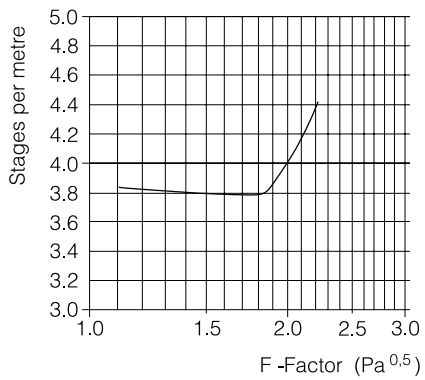
On request we can also supply DURAPACK® elements in different sizes or for larger diameters (e.g. glass-lined columns) as well as structured packing in other materials of construction.

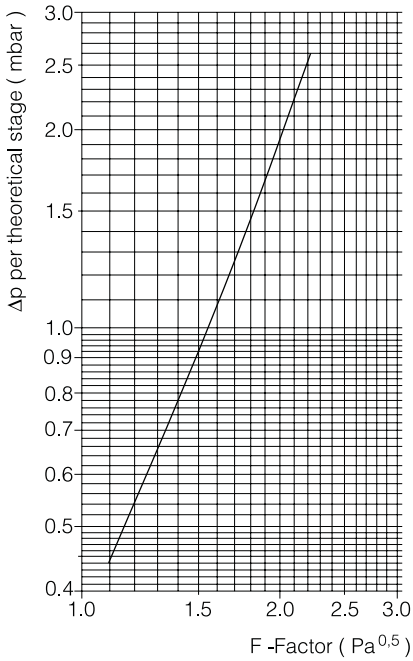
The installation of DURAPACK® mass transfer packing calls for considerable experience and requires a certain amount of fitting work (make-up rings, retainers, drilling of holes for measurement probes). Any elements supplied including accessories should, therefore, only be installed by our trained installation personnel on the actual site. The maximum packing height should not exceed 3 metres.

Where the packing elements are not intended for use in glass pipes, please consult us because of the possibility of varying diameters and the possible need for adaptation of the edge seal.

In the tables below »DN« refers to the nominal size of the pipe in which the packing is installed.

DN	D	H	Weight of one layer (kg)	Number of segments in a layer	Reference
100	90	200	0,5	1	**DUPA100/300**
150	140	200	1,3	1	**DUPA150/300**
200	190	200	2,3	1	**DUPA200/300**
300	285	200	5,2	1	**DUPA300/300**
450	435	200	12,1	1	**DUPA450/300**
600	585	200	22,4	4	**DUPA600/300**
800	798	200	40,2	4	**DUPA800/300**
1000	973	200	60,0	7	**DUPA1000/300**





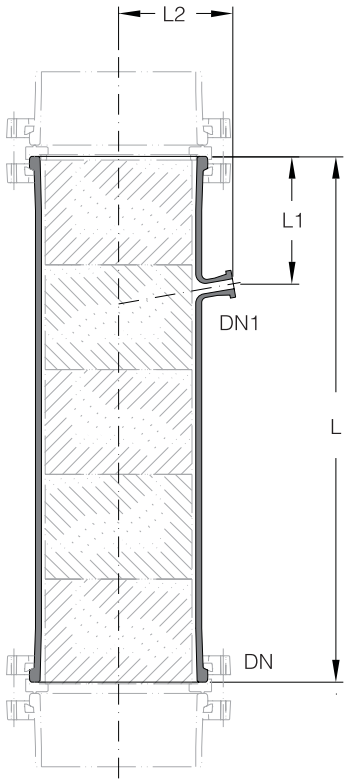
COLUMN SECTIONS FOR STRUCTURED PACKING

In the DN 100 to DN 1000 nominal bore range special column sections with thermometer branch can be supplied for structured packing such as the high efficiency DURAPACK® packing described on page 6.11. Compared with the »CS..« type (see page 6.5) they provide a significantly larger free cross sectional area and are, therefore, more suitable for internals of the type mentioned.

To ensure that the structured packing is installed properly in these column sections we supply not only special support grids and rings (see page 6.16 and 6.13) but also other required elements such as restrainers and spacer rings (see page 6.15)..

To connect column sections containing structured packing to each other and to other glass components »CPDU..« or »CCSFDU..« couplings (see section 9 »Couplings«) with longer bolts are required because of the additional items such as support rings and restrainers clamped between the buttress ends.

The end form, which depends on the nominal size is shown in the diagram on page 6.2. Further information can be found in section 1 »Technical Information«.



DN	DN1	L	L1	L2	Reference
100	25	1000	295	122	**CSDU100**
150	25	1000	295	147	**CSDU150**
200	25	1000	295	171	**CSDU200**
300	25	1000	290	221	**CSDU300**
450	25	1000	230	299	**CSDU450**
600	25	1000	230	377	**CSDU600**
800	40	1000	215	562	**CSDU800**
1000	40	1000	215	650	**CSDU1000**

SUPPORT RINGS FOR STRUCTURED PACKING

Support rings are generally used to support structured packing such as high performance DURAPACK® packing (please see pages 6.10 and 6.11) in pipe sections. Up to DN 300 nominal size they are made of selected quality PTFE. In larger nominal sizes PTFE-sheathed steel rings are used. These also act as a support flange for the column section. In the DN 800 and DN 1000 nominal sizes there is also the alternative possibility to combine the support ring with a fixed-point flange with the latter supported on a steel angle substructure. Further information to this can be found in section 10 »Structures and Supports«.

Support rings are clamped between the buttress end faces using longer bolts in the coupling. The rings have a bead on both faces, so that no additional gasket is required.

The permissible loads for support rings and the packed heights applicable to structured packing indicated in the following tables should not be exceeded.

Above an operating temperature of 150 °C and with packed heights of more than one metre, PTFE-sheathed steel rings (please see page 6.14) must also be used in the DN 100 to DN 300 nominal size range.

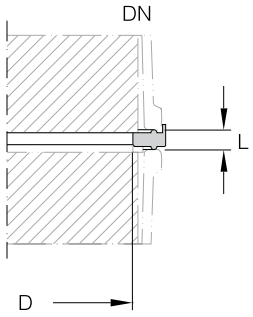
Where segmented packing is used (e.g. with DURAPACK® in the DN 600 to DN 1000 nominal size range) »SPP..« packing supports (please see page 6.16) should also be used in addition to the support rings.

PTFE (DN 100 to DN 300) or steel/PTFE (DN 800 and DN 1000) support rings are also used as packing restrainers (please see page 6.15).

SUPPORT RINGS FOR STRUCTURED PACKING

PTFE Support Rings

DN	D	L	packed height	Load bearing capacity (N)	Free cross-section (%)	Reference
100	80	12	1m DUPA	35	64	**SPS100**
150	130	14	1m DUPA	78	75	**SPS150**
200	180	15	1m DUPA	140	81	**SPS200**
300	275	20	1m DUPA	315	84	**SPS300**



SUPPORT RINGS FOR STRUCTURED PACKING

Steel/PTFE Support Rings

DN	D	K	K1	L	n x d1	n x d2	packed height	Load bearing capacity (N)	Free cross-section (%)	Type	To suit to support frame	Reference
100	80	178	254	18	6 x M8	3 x 11	3m DUPA	105	64	**A**	RRD150 a. 150/1.25	**SPSH100**
150	130	254	295	20	6 x M10	3 x 11	3m DUPA	235	75	**A**	RRD200	**SPSH150**
200	180	295	400	22	8 x M8	3 x 11	3m DUPA	415	81	**A**	RRD300	**SPSH200**
300	275	400	495	22	12 x M8	3 x 14	3m DUPA	935	84	**A**	RRDN400 a. 400/2	**SPSH300**
450	380	585	710	27	16 x M8	3 x M12	3m DUPA	2100	71	**B**	RRDN600 a. 600/2.5	**SPSH450**
600	520	710	850	33	20 x M12	3 x M16	2m DUPA	2490	75	**C**	U-Profile-Frame	**SPSH600**
800	725	950	-	25	24 x 14	-	2m DUPA	4425	82	**D**	-	**SPSH800**
1000	910	1120	-	25	28 x 14	-	2m DUPA	6915	83	**D**	-	**SPSH1000**

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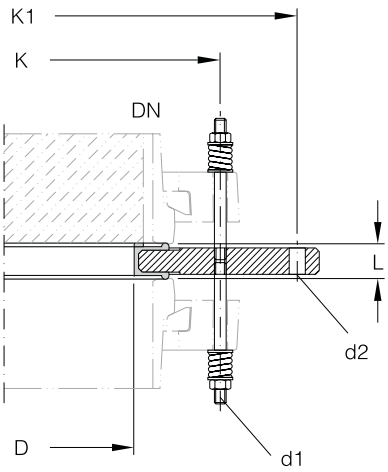

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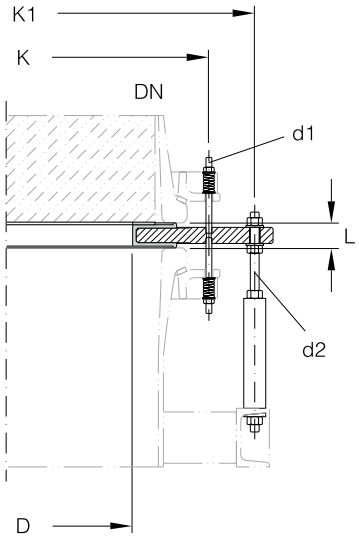

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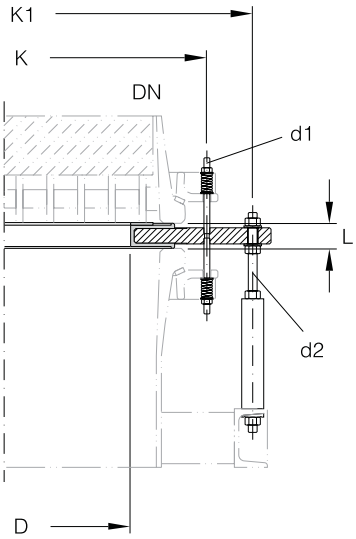

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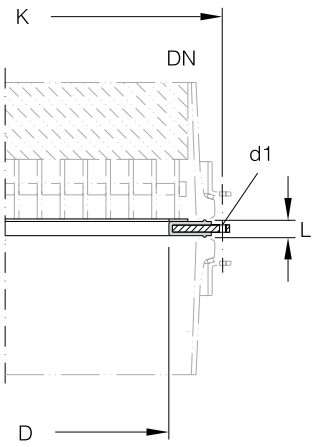
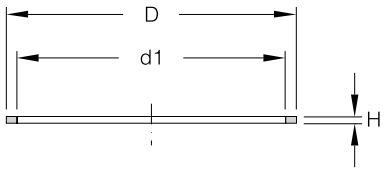


SPACER RINGS FOR STRUCTURED PACKING



Structured packing such as high efficiency DURAPACK® packing (please see page 6.11) must always be very carefully fixed after installation in column sections. Otherwise there is the risk of relative movement between the jacket and the internals should any pressure surges occur which could result in damage to the packing elements with consequent loss of performance or even disruption of operation.

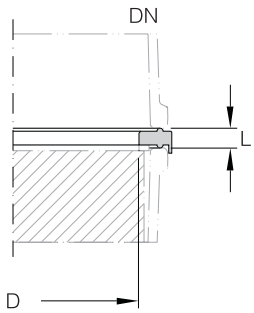
For this reason, one or more spacer rings should be inserted above a section of structured packing to fill any free space between the internals and a restrainer (please see below) clamped between the buttress ends in the upper coupling. These spacer rings are made of selected quality PTFE.

It is advisable to have a variety of rings available in different thicknesses to ensure that the free space can be filled to optimum effect.

In the table below »DN« refers to the nominal size of the column.

DN	D	d1	H	Free cross-section %	Reference
100	96	80	2	64	**SPC100/2**
100	96	80	5	64	**SPC100/5**
150	145	130	2	75	**SPC150/2**
150	145	130	5	75	**SPC150/5**
200	195	180	2	81	**SPC200/2**
200	195	180	5	81	**SPC200/5**
300	291	275	2	84	**SPC300/2**
300	291	275	5	84	**SPC300/5**
450	440	380	2	71	**SPC450/2**
450	440	380	5	71	**SPC450/5**
600	592	520	2	75	**SPC600/2**
600	592	520	5	75	**SPC600/5**
800	798	725	5	82	**SPC800/5**
800	798	725	8	82	**SPC800/8**
1000	973	910	5	83	**SPC1000/5**
1000	973	910	8	83	**SPC1000/8**

RESTRAINERS FOR STRUCTURED PACKING



Structured packing such as high efficiency DURAPACK® packing (please see page 6.11) must always be very carefully fixed after installation in column sections. Otherwise there is the risk of relative movement between the jacket and the internals should any pressure surges occur and this could result in damage to the packing elements with consequent loss of performance or even disruption of operation.

For this reason, after the packing elements have been installed and spacer rings have been carefully fitted to take up any free space, a restrainer should be fitted in the coupling above the structured packing. In DN 100 to DN 300 and DN 800 and DN 1000 column sections the support rings described on page 6.13 and 6.14 also act as restrainers. In the DN 450 and DN 600 nominal bores the components described below, which perform a similar function, should be used. These are made of selected quality PTFE.

DN	D	L	Free cross-section (%)	Reference
450	380	15	71	**SPST450**
600	520	15	75	**SPST600**

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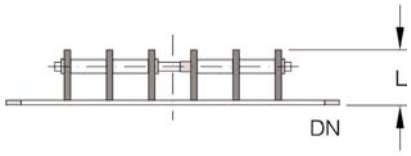
PACKING SUPPORTS FOR STRUCTUREDPACKING

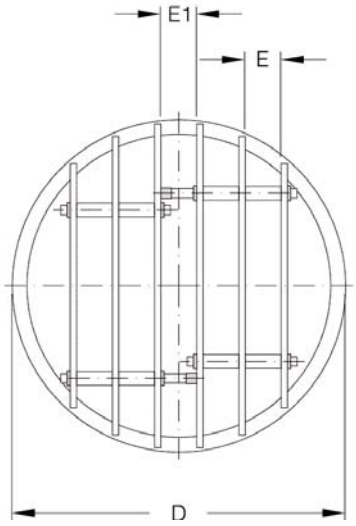
With all segmented, structured packing and thus also with DURAPACK® high-performance packing (please see page 6.11) it is necessary to use extra packing supports on top of the support rings described on page 6.13. These are made in a combination of borosilicate glass 3.3 and PTFE.



Details concerning free cross-sections of the supports (which have been determined in combination with a support ring) and their load-bearing capacities when loaded evenly can be found in the table below.

These packing supports are not suitable for random packing. Supports for this purpose are described on page 6.7.

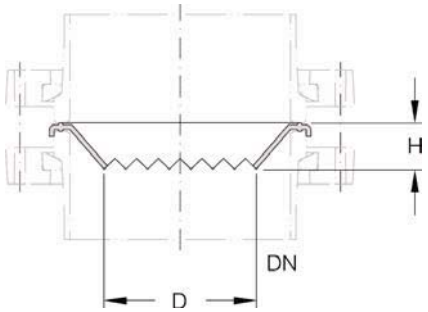
In the table below »DN« refers to the nominal size of the column.



DN	D	L	E	E1	Free cross-section (%)	Load bearing capacity (N)	Reference
600	590	102	140	90	60	3600	SPP600
800	790	125	85	85	64	6000	SPP800
1000	968	125	85	85	63	8000	SPP1000

PTFE REDISTRIBUTORS

These redistributors are made of selected quality PTFE. They are clamped in the coupling of a pipe or column section in the same way as a gasket so that no additional gasket is required.



The redistributors act as simple liquid collectors and direct the liquid away from the column wall. They are, therefore, installed above redistributors and feed distributors. Their inside diameter is designed to match nozzle type distributors (please see pages 6.22 and 6.23).

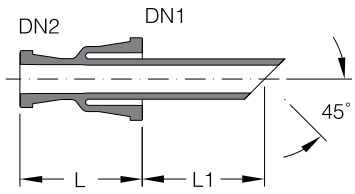
DN 800 and DN 1000 nominal size column sections have an integral redistributor (please see page 6.5).

In the table below »DN« refers to the nominal size of the pipe or column section.

DN	D	H	Free cross-section (%)	Reference
25	18	5,5	52	TL25
40	28	9,2	49	TL40
50	35	11,2	49	TL50
80	55	15,5	47	TL80
100	70	18,8	49	TL100
150	105	32	49	TL150
200	140	40	39	TL200
300	200	55	44	TL300
450	315	40	49	TLN450
600	420	55	49	TLN600

home

COLUMN FEED PIPES



These feed pipes can be used in diameters and types of column where it is acceptable for the liquid feed to be directed in a single stream onto the column packing.

Straight feed pipes are used as well as spray feed pipes in extraction columns to introduce the phase to be dispersed and the continuous phase.

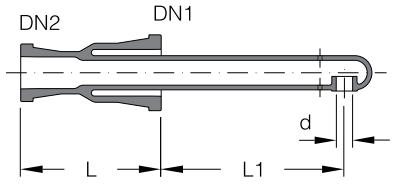
Angled feed pipes can be used in any application where it is acceptable for the liquid feed to be directed in a single stream onto the column packing. They are usually installed via an unequal tee piece (please see section 2 »Pipeline Components«). They should not, however, be used with distribution trays.

Straight Feed Pipes

DN	DN1	DN2	L	L1	Reference
80	40	25	100	100	**FPS80/40**
80	50	25	100	115	**FPS80/50**
100	40	25	100	125	**FPS100/40**
100	50	25	100	125	**FPS100/50**
150	40	25	100	150	**FPS150/40**
150	50	25	100	150	**FPS150/50**
200	40	25	100	175	**FPS200/40**
200	50	25	100	175	**FPS200/50**
300	40	25	100	225	**FPS300/40**
300	50	25	100	225	**FPS300/50**
450	80	40	125	325	**FPS450/80**
600	150	50	200	450	**FPS600/150**

COLUMN FEED PIPES

Angled Feed Pipes



DN	DN1	DN2	L	L1	d	Reference
80	40	25	100	100	13,4	**FP80/40**
80	50	25	100	115	13.4	**FP80/50**
100	40	25	100	125	13,4	**FP100/40**
100	50	25	100	125	13,4	**FP100/50**
150	40	25	100	150	13,4	**FP150/40**
150	50	25	100	150	13,4	**FP150/50**
200	40	25	100	175	13,4	**FP200/40**
200	50	25	100	175	13,4	**FP200/50**
300	40	25	100	225	13,4	**FP300/40**
300	50	25	100	225	13,4	**FP300/50**
450	80	40	125	325	24,0	**FP450/80**
600	150	50	200	450	37,4	**FP600/150**

SPRAY FEED SECTIONS WITH BUILT-IN FEED PIPE

Where there is a requirement for a finer initial distribution of the liquid stream than can be obtained with a column feed pipe (please see page 6.17) a spray feed section with built-in feed pipe can be used in the DN 100 to DN 300 nominal size range. This component delivers the liquid to the column in the form of a ring. Spray feed pipes for DN 450 and DN 600 nominal size columns can be found below.

These one-piece components comprise an unequal tee piece with a fused-in spray type feed pipe. They make it possible to use a spray type feed even in small and medium size columns.

For more specialised requirements tray, tube and nozzle type distributors can be supplied (please see pages 6.19 to 6.23).

DN	DN1	D	L	L1	n x d1	Type	Reference
100	25	45	250	110	20 x 2	A	FR100
150	25	70	250	150	27 x 2	A	FR150
200	25	90	250	175	27 x 2	B	FR200
300	25	100	300	220	30 x 3	B	FR300

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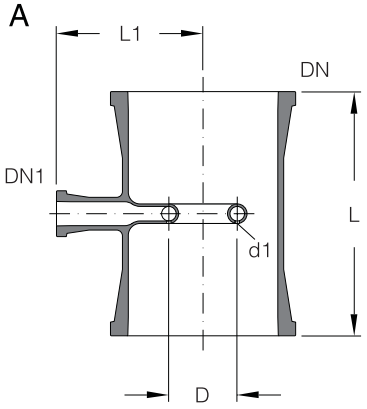

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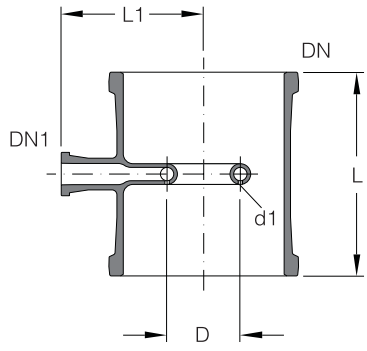


SPRAY FEED PIPES

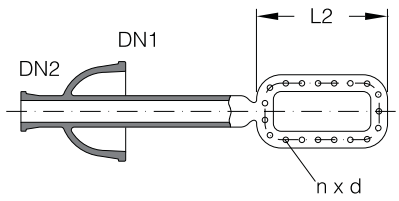
For DN 450 and DN 600 nominal size columns these spray feed pipes are used instead of column feed pipes to provide a finer initial distribution of the liquid stream in the form of a ring. A version suitable for smaller columns can be found above.

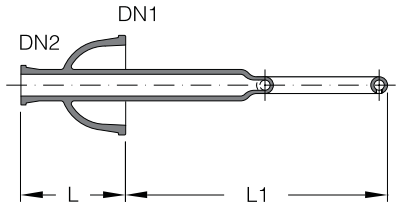
This design, which can only be used with larger column sizes, facilitates the fitting and removal of the spray feed pipe without the need for any extensive dismantling work. This makes adaptation to changes in operating conditions a very simple matter.

For more specialised requirements tray, tube and nozzle type distributors can be supplied (please see pages 6.19 to 6.23).

In the table below »DN« refers to the nominal size of the column.

for use with DN	DN1	DN2	L	L1	L2	n x d	Reference
450	150	50	200	500	250	40 x 3	FD450
600	150	50	200	650	400	60 x 3	FDN600





LIQUID DISTRIBUTORS

To create the conditions required for optimum mass transfer in larger nominal size columns through even distribution, we recommend the use of special components both for the first feed distribution and also redistribution in the column. Depending on the particular duty we can supply borosilicate glass 3.3 column components with sealed-in tube and channel type distributors as well as nozzle type distributors in a combination of borosilicate glass 3.3 and PTFE. The latter are fitted in distributor sections (please see page 6.23) for feed distribution duties or for use as redistributors in special column sections (please see page 6.6).

The following criteria have an important bearing on the selection of the appropriate liquid distributor:

– Process conditions such as pressure, temperature, F factor and irrigation density B_{max}

– Column diameter and type of packing

– System properties where a distinction should be made between clean (C=clean) and slightly soiled (S=soiled) systems

Liquid distributors can be selected from the table below on the basis of the nominal size of the column, irrigation density and system properties. Further data can be found in the individual product descriptions.

Tube type distributors FTD DN	Channel distributors FCD DN	Nozzle distributors FVA,FV DN	System characteristic	B_{max} approx. (m^3/m^2h)
150	-	-	C	21
200	-	-	C	17
300	-	-	C	16
450	-	-	C	17
600	-	-	C	22
-	300	-	C + S	12
-	450	-	C + S	12
-	600	-	C + S	10
-	-	200	C + S	43
-	-	300	C + S	56
-	-	450	C + S	79
-	-	600	C + S	88

All the irrigation densities indicated in this section refer to our standard version. On request, we can also supply distributors for other values.

The end form, which depends on the nominal size is shown in the diagram on page 6.2. Further information can be found in section 1 »Technical Information«.

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LIQUID DISTRIBUTORS

Channel Distributors

Where good distribution of the liquid over the whole cross section of the column is required with low irrigation densities we recommend the use of a channel distributor. The items described here are especially suitable for feed distribution of the liquid with all types of structured packing. On request, we can also supply them with an integral collecting tray for use as redistributors.

Channel distributors are one-piece borosilicate glass 3.3 components which can be fitted in columns without the need for any special adaptation. The liquid flows through drilled holes aligned in a downward direction and also through overflow pipes. The latter start to work from 40% (stage 2) or 75 % (stage 3) respectively of the maximum irrigation density onwards.

In the event of overloading, the liquid backs up along the whole length and runs off over the channel edges ensuring that irrigation of the column cross section is achieved over a large surface. Good drainage of any remaining liquid is ensured by appropriate sizing of the draining holes.

Special versions of these distributors can be supplied on request, i.e. with drop points differing from those indicated in the table below (diameter and number of holes and overflow pipes) and also in nominal sizes DN 800 and DN 1000.

DN	DN1	L	L1	L2	n x d	Type	Reference
300	25	400	175	275	32 x 3	A	**FCD300**
450	25	550	200	350	78 x 3	A	**FCD450**
600	50	600	225	450	128 x 3	A	**FCD600**
800	50	700	350	775	200x3	B	
1000	50	700	350	850	328x3	B	

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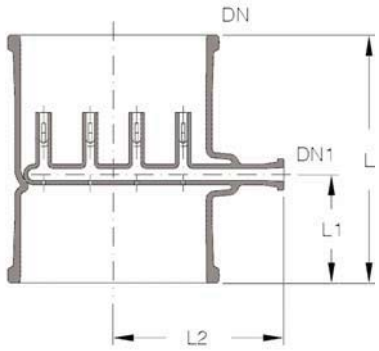

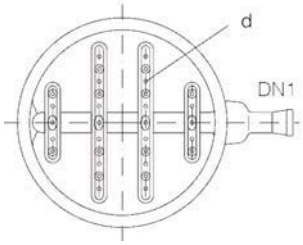

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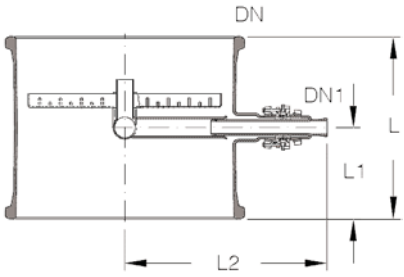

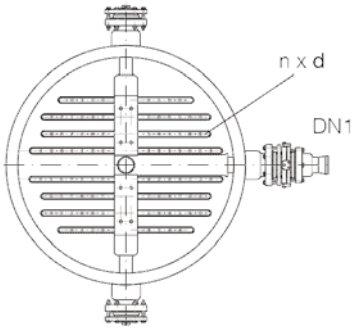

Technical Data

DN	Free cross-section (%)	B (m^3/m^2h)	Number of drop points per m^2
300	63	3,5 – 12	283 – 452
450	66	3 – 12	289 – 490
600	64	2,5 – 10	240 – 452
800	60	0,6 – 7,9	216 – 400
1000	62	0,6 – 8,3	219 – 418

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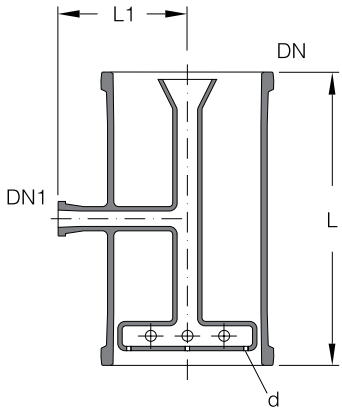
LIQUID DISTRIBUTORS

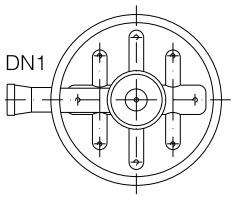
Tube Distributors



This distributor is designed for use with DURAPACK® high performance packing (please see page 6.11). It guarantees a particularly even distribution over the cross section of the column for average irrigation densities by the overflow height in the overflow pipe depending on the particular throughput. It is, therefore, particularly suitable for feed distribution with all types of structured packing. In addition, it can also be used for redistribution, if for example an »RDA..« type reflux separator is fitted above it as a collector.

Tube distributors are one-piece borosilicate glass 3.3 components which can be fitted in columns without the need for any special adaptation. The liquid flows through holes aligned in a downward direction. The horizontal tube is inclined downwards slightly to ensure good drainage.

Special versions of these distributors can be supplied on request, i.e. with drop points differing from those indicated in the table below (diameter and number of holes).



DN	DN1	L	L1	n x d	Reference
150	25	300	150	9 x 2,5	**FTD150**
200	25	400	175	11 x 2,5	**FTD200**
300	50	400	300	17 x 3	**FTD300**
450	80	400	375	41 x 3	**FTD450**
600	80	600	475	75 x 3	**FTD600**

Technical Data

DN	Free cross-section (%)	B (m^3/m^2h)	Number of drop points per m^2
150	64	2,5 – 21	509
200	58	2,5 – 17	350
300	64	2,5 – 16	240
450	59	2,5 – 17	258
600	51	2,5 – 22	265

LIQUID DISTRIBUTORS

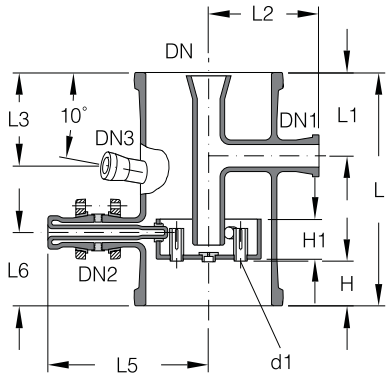
Nozzle distributors for feed distribution

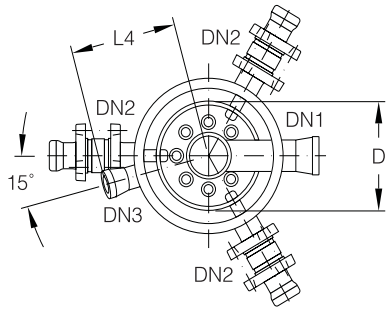
This type of distributor is ideal for high irrigation densities and widely varying throughputs. Good distribution of the liquid over the column cross section is ensured in both cases.

Nozzle distributors for feed distribution are a combination of borosilicate glass 3.3 and PTFE (nozzles only). The nozzles have lateral slits and are inserted separately in a support tray. They can, therefore, be replaced if required. The tray in turn is located on three support fingers positioned at 120° to each other and adjustable by means of a flexible gasket (see section 9 »Couplings«). A PTFE ring is fitted to prevent direct contact between the tray and the support fingers. Holes are designed to ensure good drainage when empty.

When a nozzle distributor is used for redistribution purposes an »RDA..« type reflux separator should be fitted above it with the inlet branch DN1 closed off. As an alternative we can supply the nozzle distributors described on page 6.23 which can be installed in distributor sections or column sections specially designed for the purpose.

The supply includes the support fingers and flexible gaskets plus three flange couplings in addition to the glass jacket and complete tray.





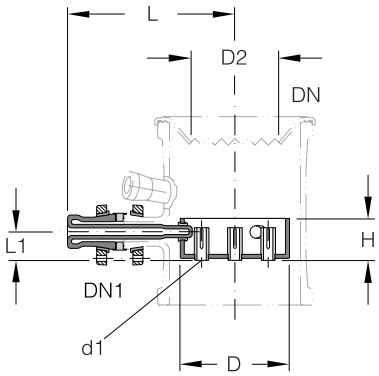
DN	DN1	DN2	DN3	D	L	L1	L2	L3	L4	L5	L6	H	H1	Reference
200	40	25	25	140	350	125	170	140	165	250	110	72	60	**FVA200**
300	50	25	25	231	450	150	230	165	215	300	125	87	60	**FVA300**
450	80	40	25	350	525	200	320	214	295	390	135	69	100	**FVA450**
600	80	40	25	470	600	200	400	215	375	470	175	97	110	**FVA600**

Technical Data

DN	Free cross-section (%)	B (m^3/m^2h)	n x d1	Number of drop points per m^2
200	51	4,5 – 43	6 x 18	764
300	45	5 – 56	18 x 18	1018
450	44	2,5 – 79	18 x 28	453
600	44	2,5 – 88	36 x 28	509

LIQUID DISTRIBUTORS

Nozzle distributors for redistribution



These distributor trays are identical to the version supplied for the nozzle type distributors used for feed distribution described above. They can be installed, for example, in distribution sections with thermometer branch as detailed below. This results in a very compact unit that can be installed on top of standard column sections. They can also, however, be used in conjunction with column sections specially designed for this purpose (please see page 6.6). In both cases, a PTFE redistributor (please see page 6.16) should be fitted above the nozzle distributor.

The supply includes the support fingers and flexible gaskets plus three flange couplings in addition to the complete tray.

In the table below »DN« refers on the nominal size of the column.

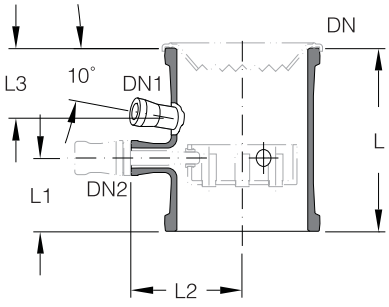
DN	DN1	D	D2	d1	L	L1	H	Reference
200	25	140	140	18	250	38	63	**FV200**
300	25	231	200	18	300	38	63	**FV300**
450	40	350	315	28	390	66	103	**FVN450**
600	40	470	420	28	470	78	113	**FVN600**

Technical Data

DN	Free cross-section (%)	B (m^3/m^2h)	n x d1	Number of drop points per m^2
200	52	4,5 – 43	7 x 18	891
300	45	5 – 56	19 x 18	1075
450	44	2,5 – 79	19 x 28	478
600	45	2,5 – 88	37 x 28	523

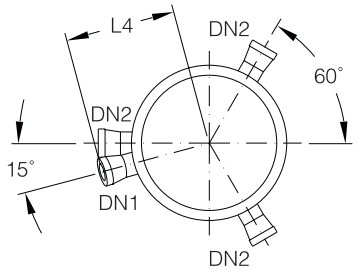
LIQUID DISTRIBUTORS

Distributor sections for nozzle distributors



Fitting the nozzle distributors used for redistribution duties described above in these components with integral thermometer branch results in a very compact unit for use in columns. They have three branches at 120° to each other for the installation of the distributor tray.

DN	DN1	DN2	L	L1	L2	L3	L4	Reference
200	25	25	275	110	165	105	170	**FSD200**
300	25	25	300	125	218	100	220	**FSD300**
450	25	40	375	135	300	165	295	**FSD450**
600	25	40	425	175	380	170	375	**FSD600**



REFLUX SEPARATORS

Reflux separators are used to control the reflux ratio in rectification columns, i.e. to separate the condensate produced into reflux and take-off streams. There are various versions available. In the manually operated version the off-take is adjusted by means of a valve on the outlet connection. The electromagnetically and pneumatically operated versions are automatically controlled in conjunction with a timer (please see section 8 »Measurement & Control«).

The end form, which depends on the nominal size, is shown in the diagram on page 6.2. Further information can be found in section 1 »Technical Information«.

Manually Operated Reflux Separators

In these units the reflux is adjusted by means of a manually operated valve on the distillate outlet connection. When the valve is fully open the divider is set to total off-take, as the return pipe is located higher than the outlet connection. By regulating the valve, the reflux ratio can be continuously adjusted up to total reflux.

If a specific and reproducible reflux ratio is required, the use of an automatically operated reflux divider is recommended.

DN	DN1	L	L1	L2	L3	L4	α (°)	Free cross-section (%)	Type	Reference
80	25	190	104	108	126	97	30	21	A	RDA80
100	25	255	134	120	121	106	25	27	A	RDA100
150	25	255	134	145	145	111	20	21	A	RDA150
200	25	380	139	169	169	111	-	45	B	RDA200
300	25	380	139	220	220	121	-	25	B	RDA300
450	40	610	263	304	304	162	-	42	B	RDAN450
600	40	1000	288	379	379	312	10	45	C	RDAN600

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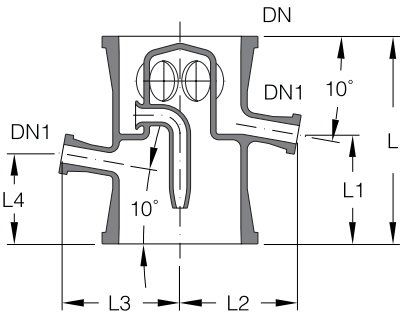

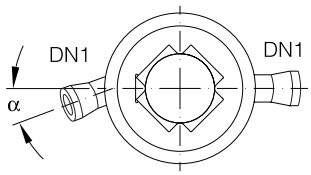

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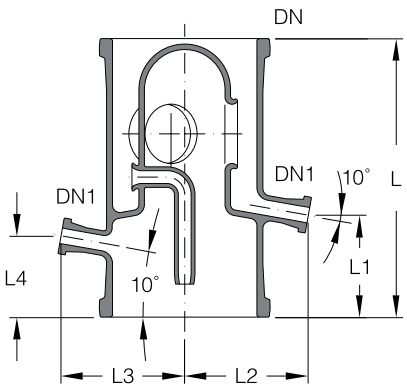

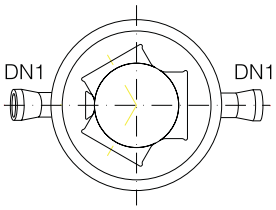

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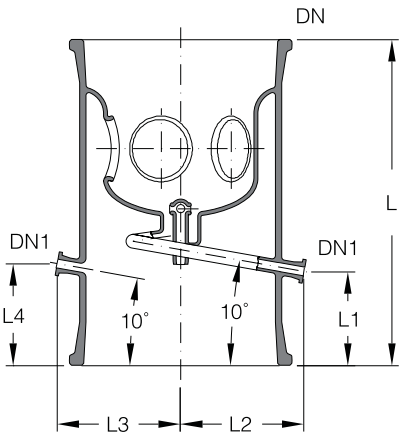
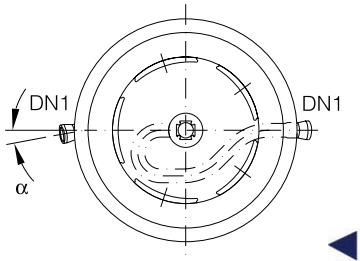




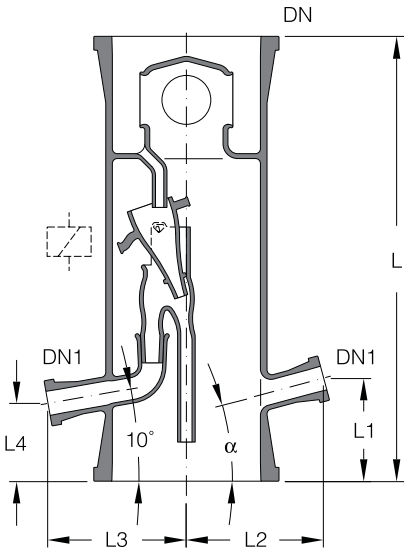
REFLUX SEPARATORS

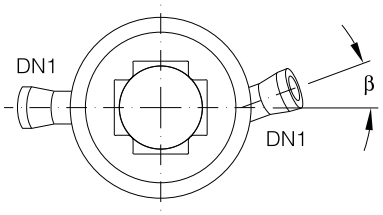
Electromagnetically Operated Reflux Separators - Internal

This type of reflux separator uses a swinging funnel mechanism. The funnel, which has a soft iron core sealed into it, is operated magnetically from outside the column by means of a timer. When the electromagnet is not energised the funnel is at rest and all the condensate is returned to the column. Activation of the electromagnet moves the funnel into the off-take position and the distillate is removed from the column via the off-take branch.

The electromagnet and timer (see section 8 »Measurement & Control«) should be ordered separately.

To prevent vapour entering the distillate line, a liquid seal (please see page 6.28) should always be used on the off-take line.





DN	DN1	L	L1	L2	L3	L4	α (°)	β (°)	Free cross-section (%)	Reference
80	25	380	91	126	106	65	10	30	21	RHM80
100	25	455	101	118	118	80	10	30	27	RHM100
150	25	455	101	146	146	79	10	20	21	RHM150

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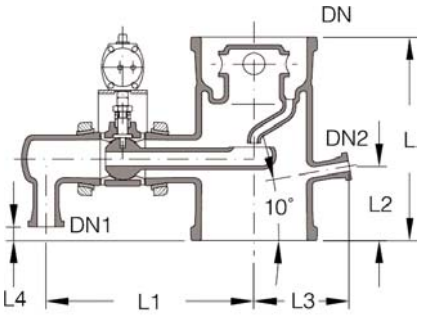
REFLUX SEPARATORS

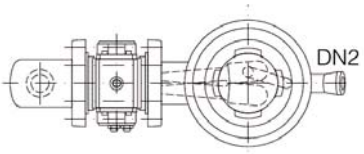
Pneumatically Operated Reflux Separators - Internal

This version is recommended for higher distillate volumes and columns with larger sizes. It has a swivel arm with collecting cup which is moved through a given angle by a pneumatic actuator. In one position all of the condensate is removed from the column as product and in the other position it bypasses the cup and is returned to the column.

All the parts of this version in contact with the product are borosilicate glass 3.3 or PTFE.

The pneumatic actuators used are single-acting, i.e. in the event of power failure a spring returns the unit to the safety position (total reflux). Electric and pneumatic timers are available, the former requiring the use of a solenoid control valve.





If these reflux separators are to be used in conjunction with an electric timer, they should be ordered using the catalogue reference »RSP../1«. The solenoid control valve is then included in the supply.

The timer required has to be ordered separately (please see section 8 »Measurement & Control«).

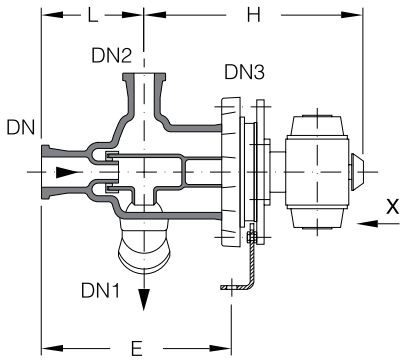
To prevent vapour entering the distillate line, a liquid seal (please see page 6.28) should always be used on the off-take line.

DN	DN1	DN2	L	L1	L2	L3	L4	Free cross-section (%)	Reference
200	40	25	375	399	137	175	25	16	**RSP200**
300	40	25	450	442	137	225	50	16	**RSP300**
450	40	25	550	517	162	298	50	20	**RSP450**
600	40	25	800	592	186	378	150	25	**RSP600**

home

REFLUX SEPARATORS

Pneumatically Operated Reflux Separators - External



This version is often used with a rectification column when a shell and tube heat exchanger is used as a condenser instead of a coil type heat exchanger.

In this reflux separator a rotating arm is rotated by a pneumatic actuator with magnetic clutch horizontally through an angle of 45° to each side. In this way the condensate, which is delivered to the separator through a side branch, can be taken off as product or returned to the column.

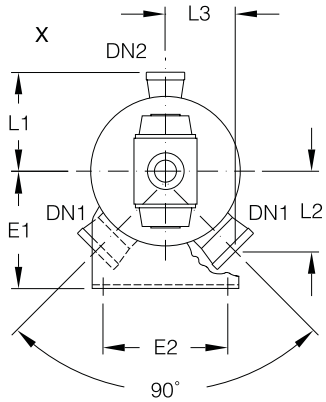
All the parts of this version in contact with the product are borosilicate glass 3.3 or PTFE.

The pneumatic actuators used are single-acting or double-acting. In the event of power failure a spring returns the single-acting unit to the safety position (total reflux). Electric and pneumatic timers are available, the former requiring the use of a solenoid control valve.

If these reflux separators are to be used in conjunction with an electric timer, they should be ordered using the corresponding catalogue reference from the table below. The solenoid control valve is then included in the supply (hazardous area type EEx ia IIC T6).

The timer required has to be ordered separately (please see section 8 »Measurement & Control«).

To prevent vapour entering the distillate line, the off-take line from these reflux separators should be designed to form a liquid seal.



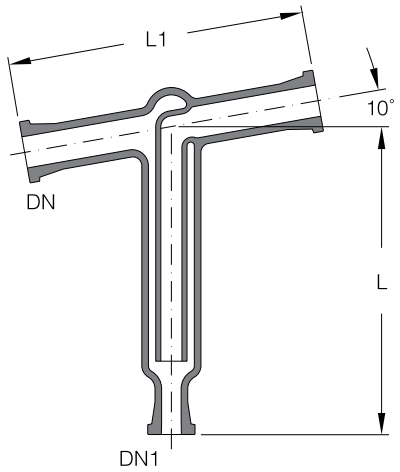
DN	DN1	DN2	DN3	L	L1	L2	L3	E	E1	E2	H	Reference
40	50	25	100	140	135	110	96	260	160	170	300	**FT100/...**

Type of pneumatic actuator	Reference
Single action	**FT100/1**
Single action with 3/2-way solenoid valve 24VDC	**FT100/2**
Double action	**FT100/3**
Double action with 5/2-way solenoid valve 24VDC	**FT100/4**

LIQUID SEALS

Liquid seals are fitted on the off-take branch of automatically operated reflux separators to prevent the passage of vapours into the distillate line. A drain valve can be fitted so that the liquid seal can be fully drained.

If the condensate undergoes after-cooling in an »HEF..« type product cooler (please see section 5 »Heat Exchangers«), a liquid seal should not be used.



DN	DN1	L	L1	Reference
25	25	160	205	**LS25**
40	25	315	305	**LS40**

COLUMN ADAPTORS

These items, which are available in two different versions, are used as the top component in rectification and absorption columns. Depending on the particular duty and availability of space either a round top or flat top column adaptor can be selected.

Flat Top Column Adaptors

Flat top column adaptors have a small side branch as standard. This type is usually selected where the available headroom is restricted.

We can also supply flat top column adaptors with larger side branches, although this results in an increase in overall height.

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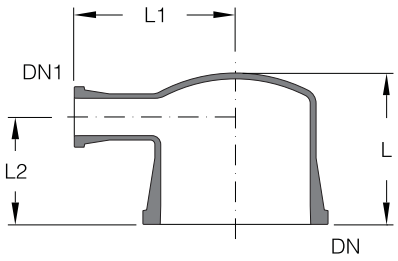

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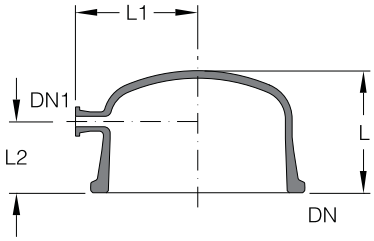


DN	DN1	L	L1	L2	Type	Reference
150	40	155	165	110	**A**	**FH150/40**
200	40	175	175	125	**B**	**FH200/40**
300	40	200	225	125	**B**	**FH300/40**
450	40	275	300	150	**B**	**FH450/40**
600	40	325	375	175	**B**	**FH600/40**

COLUMN ADAPTORS

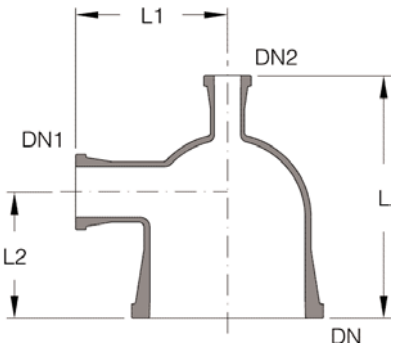
Round Top Column Adaptors

The side branch on this version provides a large free cross-section, as required for example to facilitate connection to an external shell and tube condenser (please see section 5 »Heat Exchangers«) and/or a vacuum pump.

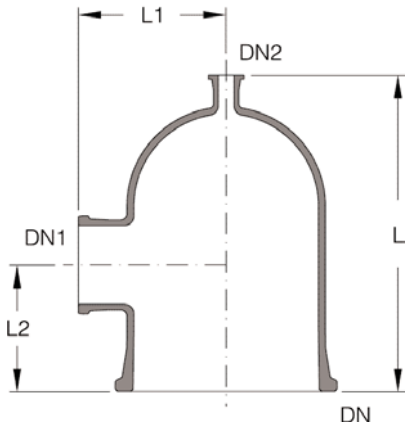
All round top adaptors also have an additional branch that can be used, for example, to insert a measuring probe.

DN	DN1	DN2	L	L1	L2	Type	Reference
80	40	25	180	110	90	A	CA80/40/25
100	50	25	230	125	125	A	CA100/50/25
150	50	25	240	150	125	A	CA150/50/25
150	80	25	255	165	125	A	CA150/80/25
200	50	40	350	175	125	B	CA200/50/40
200	80	40	375	200	150	B	CA200/80/40
200	100	40	425	225	175	B	CA200/100/40
200	150	40	450	250	200	B	CA200/150/40
300	50	40	425	225	150	B	CA300/50/40
300	80	40	475	250	175	B	CA300/80/40
300	100	40	475	275	175	B	CA300/100/40
300	150	40	550	300	225	B	CA300/150/40
450	80	50	575	325	200	B	CA450/80/50
450	150	50	675	375	250	B	CA450/150/50
450	200	50	750	350	300	B	CA450/200/50
600	80	50	750	400	300	B	CA600/80/50
600	150	50	800	450	300	B	CA600/150/50
600	200	100	850	425	300	B	CA600/200/100
600	300	100	850	500	400	B	CA600/300/100
800	200	150	1250	575	500	B	CA800/200/150
800	300	150	1250	650	500	B	CA800/300/150
1000	200	150	1300	675	500	B	CA1000/200/150
1000	300	200	1300	750	500	B	CA1000/300/200

A



B



COLUMN SECTIONS WITH GLASS/PTFE BUBBLE-CAP PLATES

There are two different versions of columns with bubble cap plates available with borosilicate glass 3.3/PTFE/tantalum bubble-caps or with stainless steel bubble-caps (please see page 6.31). The actual column section is borosilicate glass 3.3 in both cases.

Column sections specifically designed for the purpose are used to provide correct support for the plates, to ensure that they are firmly fixed on the underside and to ensure a permanently reliable edge seal. This is achieved by reducing the cross-section of the outer jacket within sufficiently close tolerances at the appropriate points and using a PTFE sealing ring. The glass plates and sealing rings are also braced within the column by means of tantalum hooks as protection against pressure surges.

The standard bubble-caps supplied have a relatively low pressure drop. These bubble-caps can, however, be supplied with risers on, as these are better suited for use as scrubbers which are downstream of batch processes. This ensures that the scrubbing liquid is retained on the plates when vapour flow is halted for short periods.

Glass pipes are used as downcomers, with a cross-section selected for the liquid loading for the particular application. The bottom column section requires a downcomer fitted with a dip pot to provide a liquid seal. Both versions, i.e. with and without dip pot, can be found in the table below

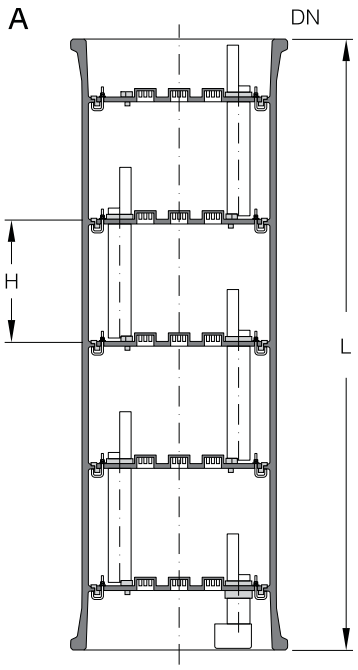
Further information on column sections with bubble-caps such as areas of application, operating range, flooding point and pressure drop can be found in our special brochure "Column Sections with Random and Structured Packing and Internals".

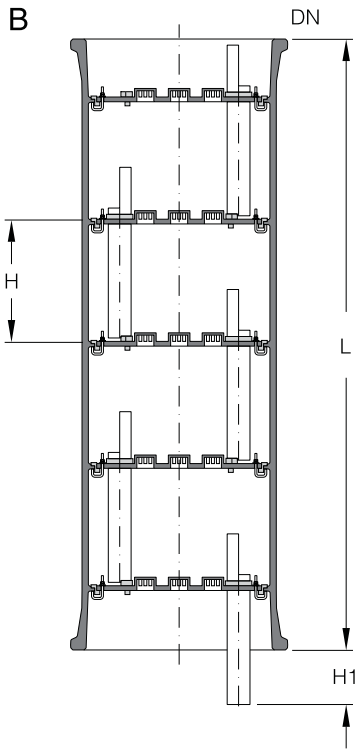
The normal weir height of the downcomers is 30 mm. If other heights are required, please indicate on the order.

If bubble-caps are required with riser, please add »K« to the catalogue reference (for example »BCSAK..«. The relative free cross-section area is reduced to approximately 83 % in this case (please see Technical Data).

Borosilicate glass 3.3 bubble-caps and plates made from other materials can also be supplied on request.

The end form, which depends on the nominal size, is shown in the diagram on page 6.2. Further information can be found in section 1 »Technical Information«.





DN	L	H	H1 approx.	Number of plates	Caps per plate	Down-comers per plate	Reference with dip pot Type A	Reference without dip pot Type B
200	1000	200	91	5	2	1	BCSA200/1000	BCS200/1000
300	1000	250	116	4	5	1	BCSA300/1000	BCS300/1000
450	1500	300	141	5	13	2	BCSA450/1500	BCS450/1500
600	1500	375	179	4	24	2	BCSA600/1500	BCS600/1500

Technical Data

DN	Bubble cap slit H x B	Free cross-section without riser (5%)	Free cross-section with riser (5%)	Weir height downcomer
200	16 x 3	6,4	3,9	30
300	16 x 3	7,1	4,4	30
450	16 x 3	8,2	5,0	30
600	16 x 3	8,5	5,2	30

COLUMN SECTIONS WITH STAINLESS STEEL BUBBLE-CAP PLATES

There are two different versions of columns with bubble cap plates available: with stainless steel bubble-caps or with borosilicate glass 3.3 bubble-caps (please see page 6.30). The actual column section is borosilicate glass 3.3 in both cases.

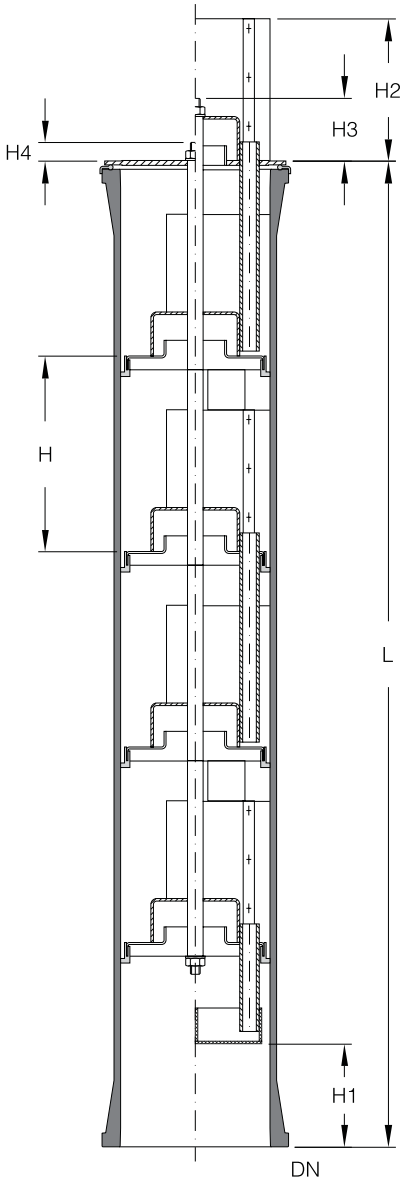
The stainless steel bubble-cap internals are completely preassembled and then integrally fitted into precision bore borosilicate glass 3.3 pipe sections so that their performance can be visually monitored at all times. The seal between the bubble-cap plates and the pipe section is made with specially designed PTFE seals.

The original version of the bubble-cap design was a single bubble-cap sized to provide optimum vapour and liquid cross sectional areas. It has now been modified and adapted to the tube diameters to ensure that the column sections are suitable for high vapour and liquid loading with small tray spacing and ensure a consistently high level of efficiency over a wide operating range.

To achieve these benefits in their entirety, various designs of bubble-cap have been selected. In the DN 80 and DN 100 nominal sizes kidney-shaped bubble-caps are used and circular bubble-caps in DN 150.

Further information on column sections with bubble-caps such as areas of application, operating range, flooding point and pressure drop can be found in our special brochure "Column Sections with Random and Structured Packing and Internals".

Bubble-cap internals and column sections can also be supplied on request in other materials.



DN	L	H	H1	H2	H3	H4	Number of plates	Caps per plate	Reference
80	1009	80	42	-	-	6	11	1	CSG80/1000
100	1007	111	47	-	45	-	9	1	CSG100/1000
150	1010	200	109	145	64	-	5	1	CSG150/1000

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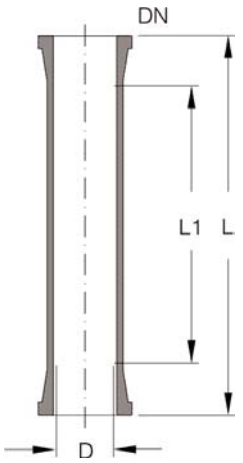
PRECISION BORE PIPE SECTIONS

The special feature of these components is their very closely toleranced internal diameter between the buttress ends. Together with precision bore cylinders (please see below) they provide a technical and cost-effective solution where column sections are required for special internals such as high efficiency packing and bubble-cap plates with edge seal or sieve plates without edge seal.



In addition to the standard sizes listed below we can also supply pipe sections in other lengths and for higher operating pressures.

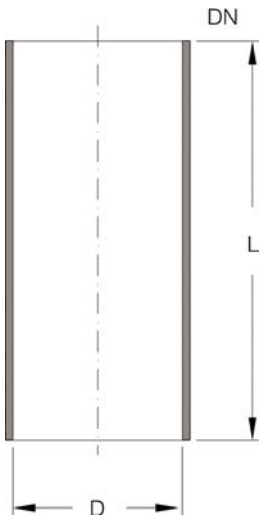
The end form, which depends on the nominal size, is shown in the diagram on page 6.2. Further information can be found in section 1 »Technical Information«.

DN	D	L	L1	Reference
25	25 ± 0,1	1000	860	**CPS25/1000/860**
40	38 ± 0,1	1000	860	**CPS40/1000/860**
50	50 ± 0,2	1000	860	**CPS50/1000/860**
80	75 ± 0,3	1000	860	**CPS80/1000/860**
100	100 ± 0,4	1000	820	**CPS100/1000/820**
150	150 ± 0,4	1000	800	**CPS150/1000/800**
200	200 ± 0,5	1000	800	**CPS200/1000/800**
300	296 ± 0,6	1000	720	**CPS300/1000/720**
450	446 ± 0,7	1000	660	**CPS450/1000/660**

PRECISION BORE CYLINDERS

These pipes have no buttress ends and have a very closely toleranced internal diameter over their whole length. They are normally used for chromatography columns and are clamped between two other components.

We would be happy to advise you on suitable design measures.



In addition to the standard sizes listed below we can also supply cylinders in other lengths and for higher operating pressures.

DN	D	L	Pmax, 20°C (bar)	Reference
300	296 ± 0,5	1000	3	**CCY300/1000**
450	446 ± 0,6	1000	1,5	**CCY450/1000**
600	590 ± 1,5	1000	1	**CCY600/1000**

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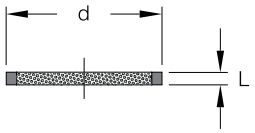
FILTER PLATES



These porous plates are made of sintered glass powder. They have fused edges and can be clamped between standard safety buttress ends. They are used to introduce gases into columns, for example, in bubble columns, or as filter strainers to separate solids from liquids (e.g. in precious metal separation units) operating under vacuum.

These filter plates are available in three different porosity ranges. Further information on this can be found in the table below.

DN	d	L	Porosity	Reference
50	70	20	0-2	**FIL50/...**
80	100	20	0-2	**FILN80/...**
100	130	20	0-2	**FILN100/...**
150	185	16	0-2	**FIL150/...**
200	235	19	0-2	**FIL200/...**

Porosity	0	1	2
	150	90	40
Nominal value of the maximum pore diameter (µm)	to	to	to
	200	150	90

When ordering, please add the code number for the porosity required (please see above) to the catalogue reference.

The permissible pressure difference for all filter plates is 1 bar.

8 MEASUREMENT & CONTROL

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QVF

PROCESS PLANT COMPONENTS

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General

QVF measurement and control equipment complements the component range and ensures that borosilicate glass 3.3 plant and apparatus operates safely. In addition to commercially available equipment, which we always fall back on if it complies with our corrosion resistance requirements, we also offer a range of special items (in particular transducers) developed either by ourselves or in cooperation with well-known companies.

Above all, because of their corrosion resistance, our transducers are widely used in the chemical and pharmaceutical industries and also in a wide range of related areas, as well as food and drinks manufacturing, dyeing and the electroplating industry. The special properties of borosilicate glass 3.3 and tantalum contribute to this plus the fact that borosilicate glass 3.3 is an approved and tried and tested material for the construction of pressure vessels.

The full range of standard equipment is described on the following pages. Reference is made in the particular product description of special versions that can be supplied on request.

In addition to the individual items of equipment we can also supply complete control loops, measurement and control systems and process control systems including the necessary documentation and control panels subject to the relevant regulations in each case (e.g. CENELEC).

GMP Compliant Installations

The use of transducers and, where required, the layout of interconnecting pipework incorporating valves when constructing plant and apparatus complying with GMP guidelines calls for special care in the design and selection of the components used and the materials of construction employed for them. Because of its special properties that are so highly valued in the pharmaceutical industry in conjunction with the PTFE materials (gaskets, special parts, bellows) approved in accordance with the FDA catalog, borosilicate glass 3.3 guarantees that the build-up of deposits is prevented in areas in contact with the product. The design and arrangement of many transducers results in the avoidance of any dead space and ensures that they can be fully drained and easily and effectively cleaned. Appropriate stainless steel coupling and support materials are available (please see section 9 "Couplings" and section 10 "Structures") to ensure that the external design of these assemblies meets clean room requirements.

Permissible Operating Conditions

While the permissible operating temperature for all borosilicate glass 3.3 components is generally 200ºC, the permissible positive operating pressure is dependent on the main nominal size and not on the shape of the component.

Detailed information on this can be found in section 1 "Technical Information".

PRINCIPLES OF EXPLOSION PROTECTION

The installation and operation of electrical equipment in hazardous areas is covered by the "Regulations for electrical installations in potentially explosive atmospheres ElexV".

EC Directive 94/9/EC (ATEX 100a)
This directive regulates the suitability of equipment and protective systems intended for use in potentially explosive atmospheres and lays down fundamental safety requirements.

Fundamental Technical Principles

Classification of zones
Hazardous areas are classified into zones based on the frequency and duration of the occurrence of explosive atmospheres. Information and guidelines on the classification of zones can be found in IEC 60079-10 and national standards.

In Zones 0 and 1 only electrical equipment may be used for which a certificate of conformity or a type examination certificate exists; **in Zone 0,** however, only apparatus specifically certified for this purpose may be installed. The table below provides an overview of the classification of zones and indicates the apparatus applicable to the particular zone.

Gases, vapours, mists	Category	Potentially explosive atmosphere present (in accordance with 94/9/EC)
Zone 0	1 G	Continuously or for long periods or frequently
Zone 1	2 G	Occasionally
Zone 2	3 G	Rarely or for short periods

Dusts are classified in Zones 20, 21 and 22 and correspond to Categories 1D, 2D, 3D (D = Dusts).

Explosion groups
Electrical equipment is differentiated into two groups:

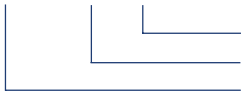
Group I: Electrical equipment for mining.
Group II: Electrical equipment for the chemical industry, petrochemical industry, mills, etc.

Temperature classes
The maximum surface temperature of electrical equipment must always be lower than the ignition temperature of the gas or vapour/air mixture where it is to be used. Equipment that meets a higher temperature class (e.g. T5) can of course also be used in applications requiring a lower temperature class (e.g. T2 or T3).

Permissible surface temperature of the electrical equipment

T1	T2	T3	T4	T5	T6
450 °C	300 °C	200 °C	135 °C	100 °C	85 °C

Certification and marking
Marking in accordance with EN 50014
[E Ex ia] IIC T6



Additional marking in accordance with EC Directive 94/9/EC (ATEX 100a)

EX II (1) G

THERMOMETERS FOR LOCAL DISPLAY

These are supplied as standard with safety flat buttress end and can be fitted in DN 25 nominal size measuring branches. The measuring range is 0 to 200 ºC.

Thermometers for local display are made of 16 III Normalglas. They are mainly used in laboratories and pilot plants and are available in three different versions. The angled versions are mainly used in column adaptors, spherical vessels and columns. Because of the properties of the mechanical sensors severe turbulence should be avoided in the measuring vessel. The thermometers are filled with light oil (petroleum).

As these thermometers are made from 16 III Normalglas (equivalent to N16B thermometer glass) it is not possible to make them in DN 40. It is, therefore, necessary to specify a spherical vessel with a DN 25 side branch when using a THL45/... thermometer.

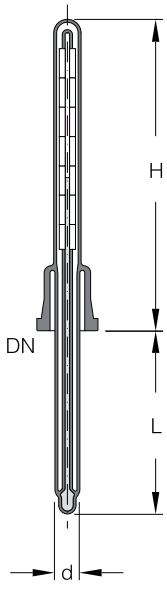
Our 45º and 90º angled thermometers have a scale that can be rotated through 360° for ease of legibility.

Thermometers with limit contact can be found on page 8.7.

THERMOMETERS FOR LOCAL DISPLAY

Straight Thermometers

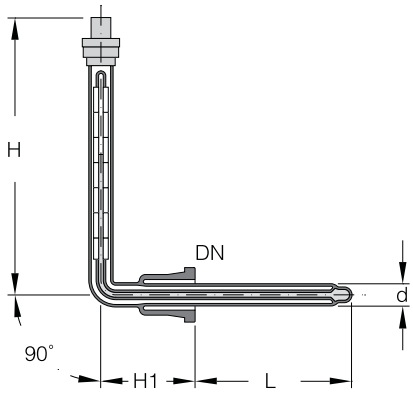
DN	L	H	d	Reference
25	100	265	15	**THL100**
25	150	265	15	**THL150**
25	200	265	15	**THL200**
25	300	265	15	**THL300**



THERMOMETERS FOR LOCAL DISPLAY

90° Angled Thermometers

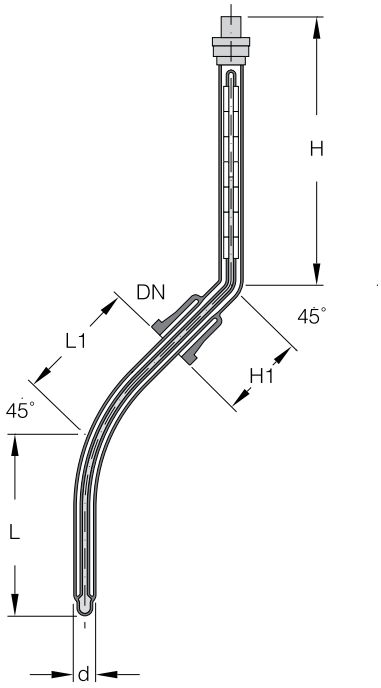
DN	L	H	H1	d	Reference
25	100	265	100	15	**THL90/100**
25	150	265	100	15	**THL90/150**
25	200	265	100	15	**THL90/200**
25	300	265	100	15	**THL90/300**



THERMOMETERS FOR LOCAL DISPLAY

45° Angled Thermometers

DN	L	L1	H	H1	d	for spherical vessel (l)	Reference
25	160	115	255	90	15	10	**THL45/160**
25	210	125	255	90	15	20	**THL45/210**
25	300	150	255	90	15	50	**THL45/300**
25	375	135	255	90	15	100	**THL45/375**
25	475	155	255	90	15	200	**THL45/475**



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REMOTE DIAL THERMOMETERS

These remote-reading dial thermometers are supplied for direct temperature measurement in parts of plant where access is difficult. The display can be mounted in an easily visible place on the support structure by means of a bracket that is included in the scope of supply and suitable for pipe diameters between 20 and 80 mm. The measuring probe is located in a glass protective sheath at the measuring point.

A 3 m long stainless steel flexible capillary is used to connect the display and the sensor. To achieve better heat transfer the tip of the protective sheath is filled with silicone heat transfer paste.

These remote dial thermometers can also be supplied with an inductive max. contact (THLDC..). They then comply with the requirements applicable to Group II electrical equipment for use in category 2G (zone 1) hazardous areas.

Technical data

Display	Diameter	-	100 mm (nominal size)
	Measurement range	-	0-120 °C (2 °C graduations)
	Measurement accuracy	-	Class 1 without glass protective sheat
	Housing temperature	-	-20 to +65 °C
	Measurement principle	-	Gas pressure (inert gas filling)
	Protection type	-	IP 56
Contact device (Type THLDC)	Version	-	inductive
	Type of explosion protection	-	II 2 G, EEx ia IIC T6
	Switching function	-	Max. contact, closing with increasing temperature
	Cable connection	-	Plug with screw connection
Dip tube: Remote line (capillary)	Diameter	-	10 mm
	Diameter x length	-	2 x 3000 mm
Materials	Display	-	Stainless steel
	Dip tube/remote line	-	Stainless steel
	Bracket	-	Steel, galvanised

On request we also supply these remote dial thermometers for other measuring ranges (e.g. 0 – 200 °C) and remote line lengths.

Remote dial thermometers with contact device require the use of an appropriate isolating switching amplifier.

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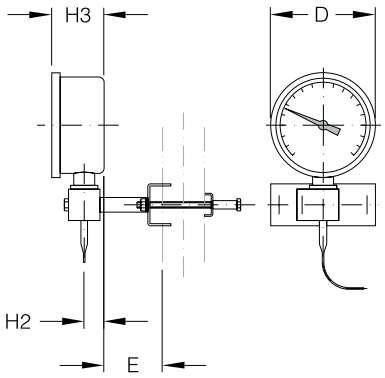
REMOTE DIAL THERMOMETERS

Remote Dial Thermometer without Contact*

DN	L	H	H1	H2	H3	E	D	d1	Type	Reference
25	100	105	430	19	50	85	100	20	A	THLD25/100
25	150	105	430	19	50	85	100	20	A	THLD25/150
25	200	105	430	19	50	85	100	20	A	THLD25/200
25	300	105	430	19	50	85	100	20	A	THLD25/300

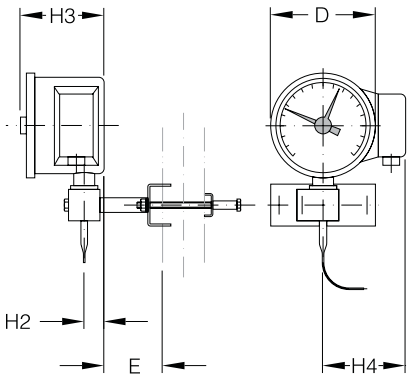
A



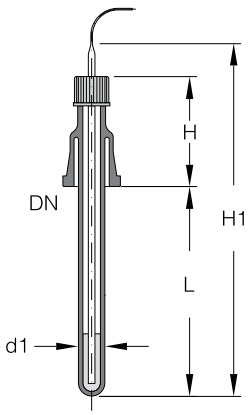
Remote Dial Thermometer with Contact *

DN	L	H	H1	H2	H3	H4	E	D	d1	Type	Reference
25	100	105	430	19	103	84	85	100	20	B	THLDC25/100
25	150	105	430	19	103	84	85	100	20	B	THLDC25/150
25	200	105	430	19	103	84	85	100	20	B	THLDC25/200
25	300	105	430	19	103	84	85	100	20	B	THLDC25/300

B



*for A , B



RESISTANCE THERMOMETERS FOR CATEGORY 2G HAZARDOUS AREAS

If there is a requirement to transfer temperatures to a control room or a process control system, resistance thermometers can be used as transmitters. They comply with the requirements applicable to Group II electrical operating equipment for use in category 2G (zone 1) hazardous areas.

The interchangeable measuring sensor used in these resistance thermometers comprises a stainless steel tube with a Pt 100 built-in four-wire measuring element. This is fitted in a virtually universally corrosion resistant borosilicate glass 3.3 protective sheath with heat transfer paste in the tip. The polyamide head is firmly fixed to the glass part with adhesive.

The "THRT.." version has a transmitter built into its head and this can be retrofitted in the "THR.." version or located in the control room. However, in the case of the "THR.." the transmitter is not part of the scope of supply.

Resistance thermometers can be supplied optionally with straight or angled stems (for spherical vessels) and they can be installed in DN 25 and DN 40 nominal size safety flat buttress ends respectively.

Technical data

Measuring probe	Resistance element	-	1x Pt 100 to IEC 751, Class A, 4-wire
	Permissible product temperature	-	-50 to +200 °C
Head	Version	-	BUKH shape
	Cable connection	-	Screw connection, blue
	Permissible ambient temperature	-	-45 to +85 °C
Transmitter (built-in, Type THRT)	Measuring range (standard)	-	0 to 200 °C
	Output signal	-	4 to 20 mA, 2-wire
	Type of explosion protection	-	II 1G EEx ia IIC T6
Materials	Thermometer	-	Stainless steel
	Protective sheath	-	Borosilicate glass 3.3
	Head	-	Polyamide, black
Type of explosion protection	Measuring probe	-	II 2G EEx ia IIC T6

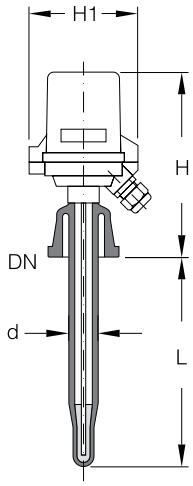
On request we can also supply resistance thermometers with transmitters (Type THRT) for different measurement ranges.

Resistance thermometers for Group II for use in Category 1G (Zone 0) hazardous areas can be found on page 8.10 .

RESISTANCE THERMOMETERS FOR CATEGORY 2G HAZARDOUS AREAS

Straight Thermometers

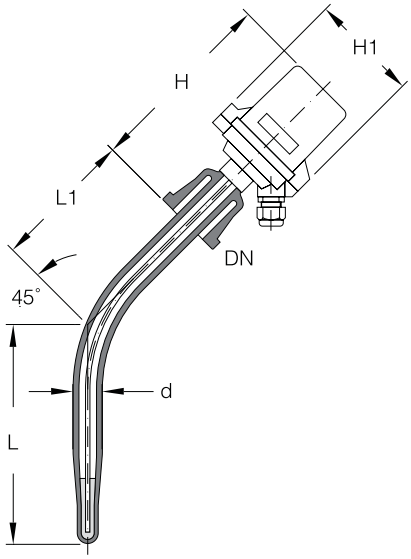
DN	L	H	H1	d1	Reference without transmitter	Reference with transmitter
25	100	183	104	22	THR25/100	THRT25/100
25	150	183	104	22	THR25/150	THRT25/150
25	200	183	104	22	THR25/200	THRT25/200
25	300	183	104	22	THR25/300	THRT25/300
40	200	183	104	22	THR40/200	THRT40/200
40	300	183	104	22	THR40/300	THRT40/300
40	500	183	104	22	THR40/500	THRT40/500



RESISTANCE THERMOMETERS FOR CATEGORY 2G HAZARDOUS AREAS

45° Angled Thermometers

DN	L	L1	H	H1	d	for spherical vessel (l)	Reference without transmitter	Reference with transmitter
40	160	120	183	104	22	10	THR45/40/160	THRT45/40/160
40	210	130	183	104	22	20	THR45/40/210	THRT45/40/210
40	300	157	183	104	22	50	THR45/40/300	THRT45/40/300
40	375	140	183	104	22	100	THR45/40/375	THRT45/40/375
50	475	170	193	104	22	200	THR45/50/475	THRT45/50/475



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RESISTANCE THERMOMETERS FOR CATEGORY 1/2 (1)G HAZARDOUS AREAS

If there is a requirement to transfer temperatures to a control room or a process control system, resistance thermometers can be used as transmitters. The THRX range complies with the requirements applicable to Group II electrical operating equipment for use in category 1G (zone 0) hazardous areas.

These devices consist essentially of a resistance thermometer with stainless steel guard tube, screw-in thread and connection head plus a virtually universally corrosion resistant borosilicate glass 3.3 protective sheath. The two parts are joined together by means of a connecting piece, the contour of which is the same as a safety flat buttress end, and a standard flange coupling.

A four-wire Pt 100 resistor acts as the measuring element. The measuring tip of the resistance thermometer is inserted in a heat transfer paste.

The "THRXT.." version (Category 2 (1) G) has a transmitter built into its head and this can be retrofitted in the "THRX..” version or located in the control room. However, in this case the transmitter is not part of the scope of supply.

Resistance thermometers can be installed in measuring branches with DN 25 and DN 40 nominal size safety flat buttress ends respectively.

Technical data

Measuring probe	Resistance element	-	1x Pt 100 to IEC 751, Class A, 4-wire
	Permissible product temperature	-	-50 to +200 °C
Head	Version	-	BUKH shape
	Cable connection	-	Screw connection, blue
	Permissible ambient temperature	-	-45 to +85 °C
Transmitter (built-in, Type THRXT)	Measuring range (standard)	-	0 to 200
	Output signal	-	4 to 20 mA, 2-wire
	Type of explosion protection	-	II 2 (1) G EEx [ia] ib IIC T6
Materials	Thermometer	-	Stainless steel
	Protective sheath	-	Borosilicate glass 3.3
	Head	-	Polyamide, black
Type of explosion protection	Measuring probe	-	II 1G EEx ia IIC T6

On request we can also supply resistance thermometers with transmitters (Type THRXT) for different measurement ranges.

Thermometers with measurement transducer type THRXT are only permitted for use in category 2 (zone 1) due to the Ex-Protection Level of the measurement transducer (see table). However, they can be used to feed a device in category 1.

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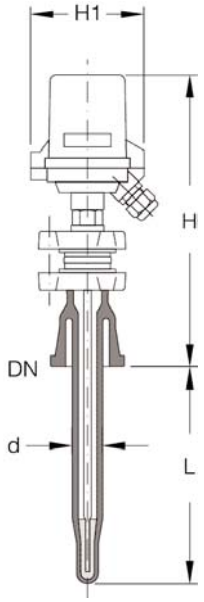
RESISTANCE THERMOMETERS FOR CATEGORY 1/2 (1)G HAZARDOUS AREAS

Resistance Thermometers for Category 1G Hazardous Areas

DN	L	H	H1	d	Reference without transmitter Category 1 G	Reference with transmitter Category 2 (1)G
25	100	275	104	22	THRX25/100	THRXT25/100
25	150	275	104	22	THRX25/150	THRXT25/150
25	200	275	104	22	THRX25/200	THRXT25/200
25	300	275	104	22	THRX25/300	THRXT25/300
40	200	275	104	22	THRX40/200	THRXT40/200
40	300	275	104	22	THRX40/300	THRXT40/300
40	500	275	104	22	THRX40/500	THRXT40/500



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PRESSURE GAUGES

These pressure measurement instruments can be connected to glass branches and with their flush laser-welded tantalum diaphragm they guarantee a corrosion-resistant, dead-space-free and GMP compliant arrangement of measuring points. As the contour of the pressure gauge is the same as a pipe section with safety flat buttress end, it can be connected directly to DN 25 nominal size measuring branches using a standard flange coupling.

The pressure gauges can be supplied for three measuring ranges and optionally with an inductive max. contact as well. With this contact they then comply with the requirements applicable to Group II electrical operating equipment for use in category 2G (zone 1) hazardous zones.

Technical data

Display	Diameter	-	100 mm (nominal size)
	Measurement range	-	see table
	Measurement accuracy	-	Class 1
	Indicator	-	Microadjustable pointer
	Protection type	-	IP 65
Pressure gauge	Filled with	-	Vegetable oil
	Permissible temperature range	-	see instrument data
	Permissible positive pressure	-	1.3 x upper limit of measuring range
Contact device (Type PGLC)	Version	-	inductive
	Type of explosion protection	-	II 2G EEx ia IIC T6
	Switching function	-	Max. contact, closing with increasing pressure
	Cable connection	-	Plug with screw connection
Pressure gauge materials	Basic body	-	Stainless steel
	Diaphragm	-	Tantalum (laser welded)

On request we can also supply these pressure gauges with different measurement ranges.

Pressure gauges with contact device require the use of an appropriate isolating switching amplifier.

Flange contour also suitable for connection to Schott flange with standard Schott coupling.

For use under vacuum in plants complying with GMP guidelines for the –1 to +1.5 bar measuring range a standard 'O' ring gasket (type TR) should be included.

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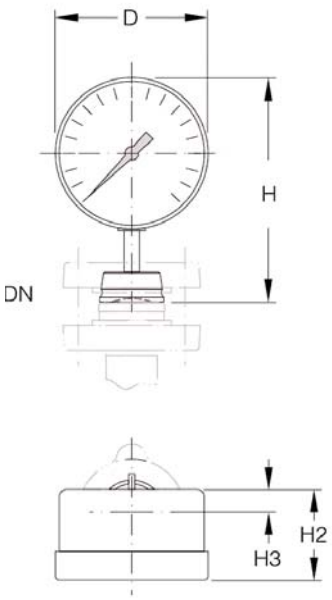
PRESSURE GAUGES

Pressure gauges without Contact Device

DN	Measuring range n. Class 1 (bar)	Permissible temp. n. Glass 1 <1/>1 (bar abs) (°C)	H	H2	H3	D	Type	Reference
25	-1 bis +1,5	-40 bis +160/200	150	60	15	100	A	PGL1.5
25	0 bis +2,5	-40 bis +200/200	150	60	15	100	A	PGL2.5
25	0 bis +6,0	-40 bis +200/200	150	60	15	100	A	PGL6

A

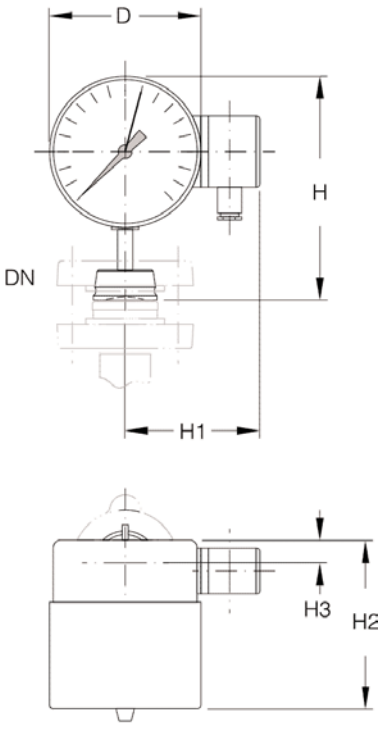


PRESSURE GAUGES

Pressure gauges with Contact Device

DN	Measuring range n. Class 1 (bar)	Permissible temp. n. Glass 1 <1/>1 (bar abs) (°C)	H	H1	H2	H3	D	Type	Reference
25	-1 bis +1,5	-40 bis +160/200	150	89	112	15	100	B	PGLC1.5
25	0 bis +2,5	-40 bis +200/200	150	89	112	15	100	B	PGLC2.5
25	0 bis +6,0	-40 bis +200/200	150	89	112	15	100	B	PGLC6

B



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PRESSURE TRANSMITTERS

If there is a requirement to transfer pressure data to a control room or a process control system, these devices can be used as transducers. The attached pressure gauge with its flush laser-welded tantalum diaphragm guarantees a corrosion-resistant, dead-space-free and GMP compliant arrangement of measuring points. As the contour of the pressure gauge is the same as a pipe section with safety flat buttress end, it can be connected direct to DN 25 nominal size measuring branches using a standard flange coupling.

These pressure transmitters comply with the requirements applicable to Group II electrical operating equipment for use in Category 1G (zone 0) hazardous areas.

Technical data

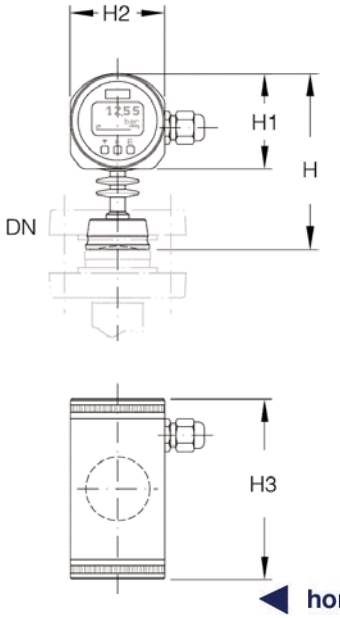
Pressure transmitter	Measurement ranges	-	See table
	Measurement accuracy	-	< ± 0.2% of final value at 20 °C
	Zero point error	-	4.8 mbar/10 K
	Output signal	-	4 to 20 mA, 2-wire, HART optio
	Operated by		Graphic display German/English
	Protection type		IP 65
Pressure gauge	Filled with	-	Vacuumoil
	Permissible temperature range	-	-40 to +200 °C
	Overload limit	-	6/10 bar abs.
Pressure gauge materials	Basic body	-	Stainless steel
	Diaphragm	-	Tantalum (laser welded)
Type of explosion protection		-	II 1/2G EEx ia IIC T6

On request we can also supply these pressure transmitters with different measurement ranges.

For use of plants complying with GMP guidelines under vacuum a standard 'O' ring gasket (type TR) should be included.

Flange contour also suitable for connection to Schott flange with standard Schott coupling.

DN	Measuring range (mbar abs)	H	H1	H2	H3	Reference
25	0 bis 4000	245	63	62	119	PGT4000



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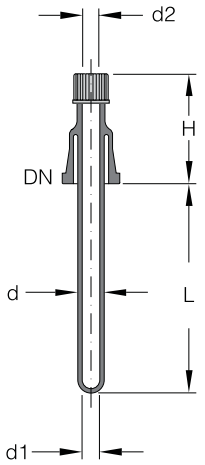
THERMOMETER POCKETS WITH SCREW CAP

These thermometer pockets are designed for use with stem type thermometers or other temperature probes. Improved heat transfer can be achieved by filling the pocket with a contact fluid or heat transfer paste.

DN	L	L1	H	d	d1	d2	d3	Type	Reference
25	100	-	105	20	16	10	-	A	TPG25/100
25	150	-	105	20	16	10	-	A	TPG25/150
25	200	-	105	20	16	10	-	A	TPG25/200
25	300	-	105	20	16	10	-	A	TPG25/300
40	200	150	115	28	16	10	20	B	TPG40/200
40	300	150	115	28	16	10	20	B	TPG40/300
40	500	150	115	28	16	10	20	B	TPG40/500
40	650	150	115	28	16	10	20	B	TPG40/650
40	850	150	115	28	16	10	20	B	TPG40/850

A



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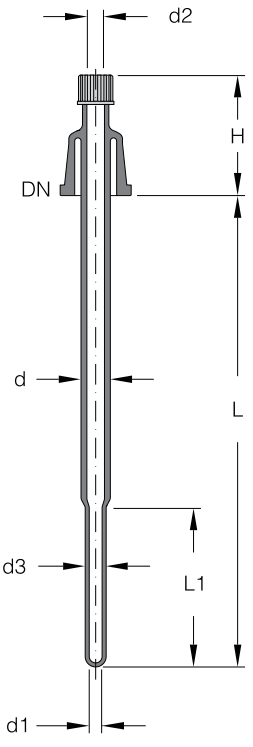


FLOWMETERS

These devices use a float to determine the volume of liquid or gas flowing through. They consist of a calibrated measuring tube made of borosilicate glass 3.3 with an etched scale (graduated in mm), the PTFE float and upper and lower PTFE float traps. Also included in the scope of supply is a calibrated scale clamped to the measuring tube and calibrated to water (at 20 °C).

The measuring tubes have safety flat buttress ends at both ends. Details of the measuring ranges can be found in the table on page 8.17.

To ensure accurate measurement, flowmeters must be fitted in an absolutely vertical position and in DN 80 and above a 5xDN calming zone must be provided before the device. Measurement accuracy conforms to Class 1.6.

As an alternative we can also supply these devices with attached, adjustable, bistable limit switches for maximum signalling. For this version (type FMLC) a PTFE-encapsulated magnetic float is used which results in a changed measuring range.

Other calibrated scales can be supplied if required for special liquids/gases and operating conditions. In such cases the following information should be specified:

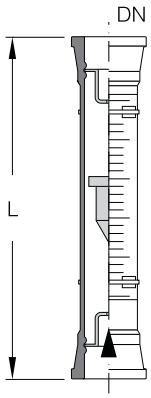
– Liquid/gas
– Measuring range in l/h or Nm^3/h
– Density in kg/l or kg/Nm^3
– Viscosity in mPa·s
– Operating temperature in °C
– Operating pressure in bars
– Nominal size of the pipeline

In the case of repeat orders we need the catalogue reference of the flowmeter and the serial number of the etched scale.

When used in hazardous areas the limit switch (type FMLC only) must be fitted with a type EEx ia/ib IIC T6 contact protection relay or isolating switching amplifier.

FLOWMETERS

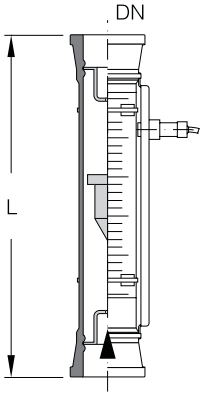
Flowmeter without Contact Device



DN	Water (l/h) 20°C	Air (m³/h) 1bar abs, 20°C	L	Reference
25	0,2 – 4	0,010 – 0,18	350	FML25/4
25	0,5 – 10	0,020 – 0,4	350	FML25/10
25	2 – 40	0,1 – 1,6	350	FML25/40
25	4 – 63	0,2 – 2,4	350	FML25/63
25	15 – 160	0,6 – 6,3	350	FML25/160
25	40 – 400	1,6 – 16	350	FML25/400
40	60 – 630	2,5 – 25	350	FML40/630
40	100 – 1000	4 – 40	350	FML40/1000
50	60 – 630	2,5 – 25	350	FML50/630
50	100 – 1000	4 – 40	350	FML50/1000
80	160 – 1600	6,3 – 63	350	FML80/1600
80	250 – 2500	10 – 100	350	FML80/2500
80	400 – 4000	16 – 160	350	FML80/4000
80	630 – 6300	25 – 250	350	FML80/6300

FLOWMETERS

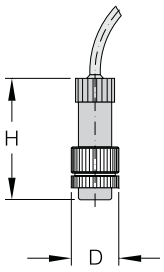
Flowmeter with Contact Device



DN	Water (l/h) 20°C	Air (m³/h) 1bar abs, 20°C	L	Reference
25	20 – 250	0,8 – 8	350	FMLC25/250
25	60 – 630	2 – 20	350	FMLC25/630
40	100 – 1000	3 – 32	350	FMLC40/1000
40	160 – 1600	5 – 52	350	FMLC40/1600
50	100 – 1000	3 – 32	350	FMLC50/1000
50	160 – 1600	5 – 52	350	FMLC50/1600
80	250 – 2500	8 – 80	350	FMLC80/2500
80	400 – 4000	15 – 130	350	FMLC80/4000
80	630 – 6300	20 – 200	350	FMLC80/6300
80	1000 – 10000	30 – 330	350	FMLC80/10000

Limit Switches

As replacements or to provide an extra closing contact we can supply the limit switches listed below include brackets for fixing to the terminal rail.



DN	H	D	Function	Reference
25	51	20	Max. close	FMLC25-1
25	51	20	Min. closer	FMLC25-2

FLOWMETERS WITH ELECTRICAL OUTPUT

These devices use a float to determine the volume of liquid or gas flowing through. They consist of a transducer with local display, an attached calibrated measuring tube made of borosilicate glass 3.3, a PTFE-sheathed float fitted with a magnet, and upper and lower PTFE float traps. The 350 mm long measuring tubes have safety flat buttress ends at both ends. Details of the measuring ranges can be found in the table below.

The position of the float is determined by magnetic sensors and this information is converted into an electrical output signal.

To ensure accurate measurement, flowmeters must be fitted in an absolutely vertical position and in DN 80 and above a 5xDN calming zone must be provided before the device. Measurement accuracy will then conform to Class 2.5.

On request we can supply these devices with up to two inductive limit switches programmable from the scale suitable for II 2G EEx ia IIC T6 hazardous area protection for max. or min. signalling as the case may be. These can also be retrofitted.

The device is also fitted with a LCD display from which the flow rate at the particular time or the cumulative flow quantity (switchable) can be read off digitally.

Technical data

Display	Dimensions	-	Ø161 mm
	Display range	-	l/h and m^3/h respectively
	Digital display	-	8-digit, 7-segment, LCD
	Measurement accuracy	-	Class 2.5
	Display scale	-	Flow units l/h and m^3/h respectively Standard: Water 20 °C
	Protection type	-	IP 67
Measuring tube	Version:	-	Conical glass tube
	Permissible operating temperature	-	-50 to +130 °C
Transducer	Measurement range	-	See table
	Output signal	-	4 to 20 mA, 2-wire
	Type of explosion protection	-	II 2G EEx ia IIC T6
	Ambient temperature	-	-25 to +70 °C
	Cable thread	-	M16 x 1.5
Materials	Measuring tube	-	Borosilicate glass 3.3
	Measuring tube internals	-	PTFE and PTFE-sheathed respectively
	Transducer casing	-	Stainless steel
Type of explosion protection		-	II 2G EEx ia IIC T6

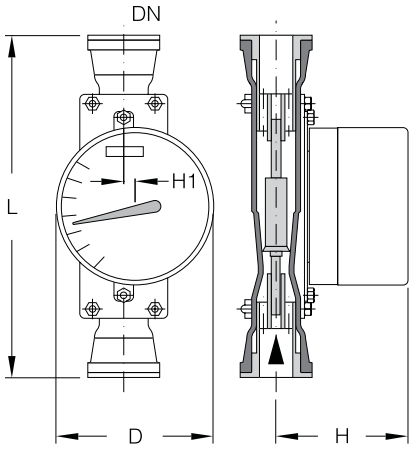
If to be designed for liquids or gases other than water or air the following information should be specified:

– Liquid/gas
– Measuring range in l/h or m^3/h
– Density in kg/l or kg/m^3
– Viscosity in mPa·s
– Operating temperature in °C
– Operating pressure in bars
– Nominal size of the pipeline

In the case of repeat orders or changes to the product data we need the catalogue reference and the serial number of the flowmeter.

FLOWMETERS WITH ELECTRICAL OUTPUT

DN	Water (l/h) 20°C	Air (m³/h) 1bar abs, 20°C	L	D	H	H1	Reference
25	16 – 160	0,5 – 5	350	161	129	11	**FMT25/160**
25	25 – 250	0,85 – 8,5	350	161	129	11	**FMT25/250**
25	40 – 400	1,3 – 13	350	161	129	11	**FMT25/400**
25	63 – 630	2 – 20	350	161	129	11	**FMT25/630**
25	100 – 1000	3,4 – 34	350	161	129	11	**FMT25/1000**
40	160 – 1600	5 – 50	350	161	136	11	**FMT40/1600**
40	250 – 2500	8,5 – 85	350	161	136	11	**FMT40/2500**
50	160 – 1600	5 – 50	350	161	136	11	**FMT50/1600**
50	250 – 2500	8,5 – 85	350	161	136	11	**FMT50/2500**
80	400 – 4000	13 – 130	350	161	151	11	**FMT80/4000**
80	630 – 6300	20 – 200	350	161	151	11	**FMT80/6300**
80	1000 – 10000	35 – 350	350	161	151	11	**FMT80/10000**
80	1600 – 16000	–	350	161	151	11	**FMT80/16000**

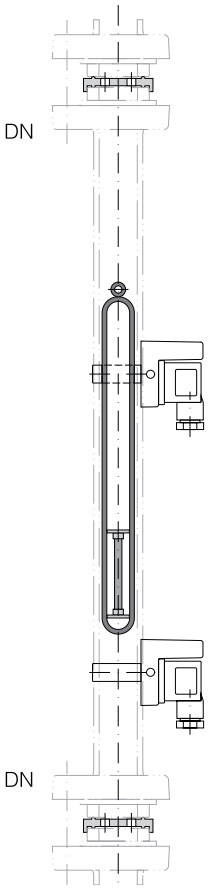


ELECTRIC LEVEL CONTROL

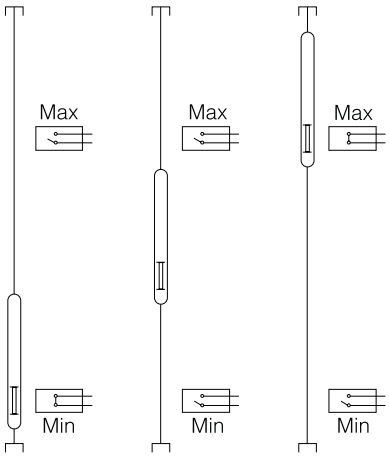
This comprises a DN 25 nominal size bypass tube, in which a glass float with a built-in magnet moves up and down, and an externally fitted bistable max. and min. contact which is set or reset when the float passes it completely.

The standard scope of supply includes the borosilicate glass 3.3 float, two cast limit switches (function: max. and min. closing with reference to the up and down travel of the float) with pipe supports and two PTFE float traps. These limit the movement of the float to the range being monitored. Further limit switches (see below) can be used for extra signalling of alarm situations. A DN 25 bypass tube of the length required should be ordered separately.

The limit switches must be fitted with a contact protection relay or an isolating switching device with a II 2G EEx ia IIC T6 input.



Wiring diagram



DN	Reference
25	LEC25

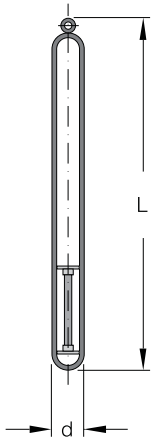
ELECTRIC LEVEL CONTROL

Magnetic Float for Level Control

The magnetic floats used in the type "LEC…" level controls are suitable for use with liquids having a density between 0.8 and 1.2 kg/dm³. On request, however, we can also supply these floats for lower densities.

The "DN" figure in the table below refers in all cases to the nominal size of the bypass tube.

Float traps to suit these floats (see below) should be ordered separately.

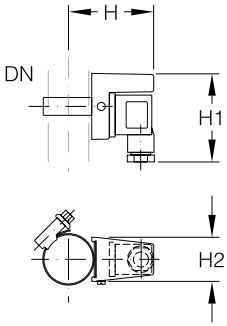


DN	L	d	Reference
25	238	22	LEC25-1

Limit Switches for Level Control

The standard switches used with the type "LEC…" level controls are the closing type. They store the particular switching point and remain closed until the float passes them in the opposite direction.

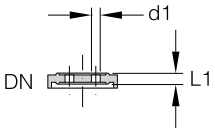
The switches are supplied with the pipe clamps required.



DN	H	H1	H2	Function	Reference
25	60	63	30	Max. close	LEC25-2
25	60	63	30	Min. close	LEC25-3

Float Traps for Level Control

The float traps listed here are used with type "LEC…" level controls. They are fitted above and below the magnetic float in one of the couplings used with the bypass tube. They have a built-in bead on both sides for sealing purposes and, therefore, there is no need for a separate gasket.



DN	L1	n x d1	Reference
25	5,5	3 x 6	LEC25-4

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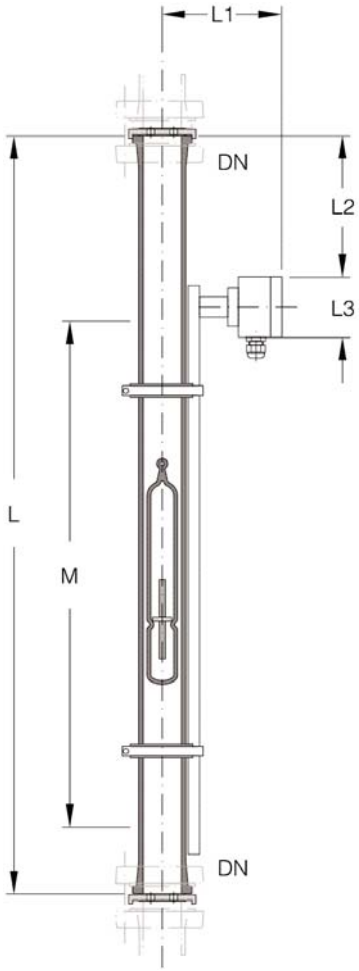
ELECTRICAL LEVEL MEASUREMENT DEVICE

This comprises a DN 50 nominal size bypass tube containing a glass float with built-in magnet. An externally fitted level transmitter contains a chain of resistors with dedicated reed contacts. The change of the resistance is converted by a flow converter in to a 4 to 20 mA signal.

The standard scope of supply includes the measuring tube, the borosilicate glass 3.3 float, the transmitter complete with fixings (pipe supports with support rings), two PTFE float traps and the connecting housing with built-in type II 2G EEx ia IIC T6 transmitter. The 4 to 20 mA output signal is available in a 2-wire version and must be supplied by an appropriate supply device. The measuring device can thus be operated in hazardous areas.

The float traps are built into the upper and lower measuring tube couplings and limit the movement of the float to the range to be measured. They have a built-in bead on both sides for sealing purposes and, therefore, there is no need for a separate gasket.

Floats are available for two density ranges (see below). The depth of immersion in both cases is between 50 and 90 %. The position of the resistor chain is arranged in relation to them in such a way that the magnet switches the first and last reed contact (0 to 100 % of the level) at the maximum and minimum float position respectively. The contact grid selected as a function of the length of the measuring range (distance between the bypass tube connections) guarantees a good resolution. Further details can be found in the table below.



DN	Density (kg/dm³)	L	L1	L2	L3	M Measurement range	Contact grid (mm)	Reference
50	0,7 – 1,25	500	141	198	80	100	5	LET50/1.25/500
50	0,7 – 1,25	700	141	198	80	300	5	LET50/1.25/700
50	0,7 – 1,25	1000	141	198	80	600	10	LET50/1.25/1000
50	0,7 – 1,25	1500	141	198	80	1100	10	LET50/1.25/1500
50	0,7 – 1,25	2000	141	198	80	1600	20	LET50/1.25/2000
50	0,8 – 1,50	500	141	98	80	200	5	LET50/1.50/500
50	0,8 – 1,50	700	141	98	80	400	5	LET50/1.50/700
50	0,8 – 1,50	1000	141	98	80	700	10	LET50/1.50/1000
50	0,8 – 1,50	1500	141	98	80	1200	10	LET50/1.50/1500
50	0,8 – 1,50	2000	141	98	80	1700	20	LET50/1.50/2000

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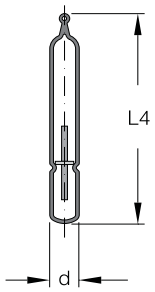
ELECTRICAL LEVEL MEASUREMENT DEVICE

Magnetic Float for Electrical Level Measurement Device

On request we can also supply floats for type "LET…" level measurement devices for other density ranges. Float traps to suit these (see below) should be ordered separately.

The "DN" figure in the table below refers to the nominal size of the bypass tube.

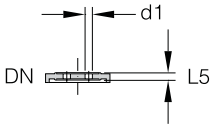


DN	Density (kg/dm³)	L4	d	Reference
50	0,7 – 1,25	400	46	LET50/1.25-2
50	0,8 – 1,50	300	46	LET50/1.50-2

ELECTRICAL LEVEL MEASUREMENT DEVICE

Float Traps for Electrical Level Measurement Device

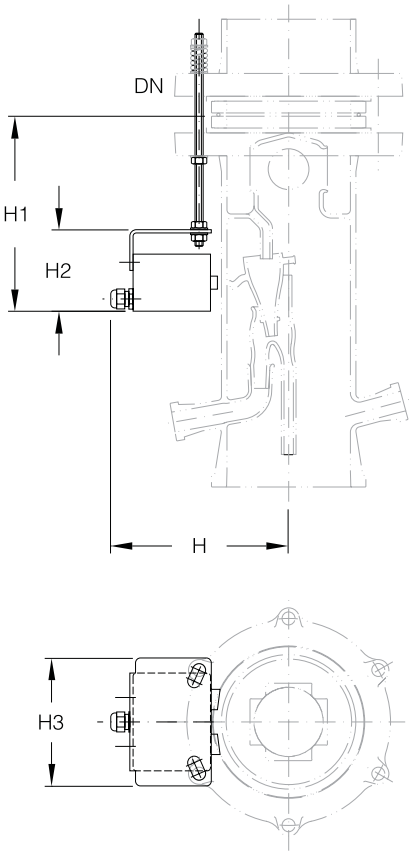
The float traps for the type "LET..." level measurement device are fitted above and below the magnetic float in the measuring tube coupling. They have a built-in bead on both sides for sealing purposes and, therefore, there is no need for a separate gasket.



DN	L5	n x d1	Reference
50	8	3x10	LET50/1.25-3

MAGNET FOR REFLUX SEPARATORS

These 'U' magnets are used with Type RHM reflux separators. Used in conjunction with an electrical timer module a movable funnel with an iron core sealed into the glass located inside the column can be operated from outside.



Technical data

Supply	DC voltage	-	24 VDC +6 / -10 %
	Nominal current	-	0.622 A
	Connecting cable	-	3x1.5 mm², 1.5 m long
	Max. permissible ambient temperature	-	-5 to +40 °C
Materials	Housing	-	Aluminium, varnished
	Moulding	-	Epoxy resin
Protection type	Housing	-	IP 54
	Explosion protection	-	EEx m II T4

DN	H	H1	H2	H3	Reference
80	175	200	90	120	**RSM80**
100	192	234	90	120	**RSM100**
150	218	239	100	157	**RSM150**

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ELECTRIC TIMER

This is an electronic timer used for controlling the reflux ratio in rectification columns with electromagnetically or pneumatically operated reflux separators with magnetic control valves. The reflux and offtake times can be adjusted on the timer from 1 to 99 seconds. The boiling point is monitored with a resistance thermometer (Pt 100) and this intervenes in the control so that when a preset temperature is reached the timer switches to total reflux or offtake and gives a warning that this has happened by sounding an alarm. When a second cut-off value (hysteresis value from 1 to 9 seconds presettable) is reached, the control returns to the preset timing cycle. There are 4 keys on the front panel which are used to enter all the preset values. Additionally there are 3 different programs available:

Program 0: all functions operating,
Program 1: alarm off, fault warning off
Program 2: Pt100 off, output signal off, fault warning off

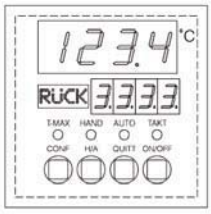
Timer Module for Rack Mounting

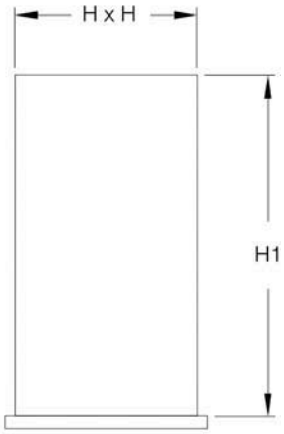
The control unit described above is supplied as timer module type TMM01 for rack mounting.

Timer for hazardous areas, Category 2G

For use in hazardous areas the timer module type TMM01 is built into an EEx de (ia) IIC pressure resistant housing and can thus be used as a type TMX01 Group II, Category 2G hazardous area timer.

A





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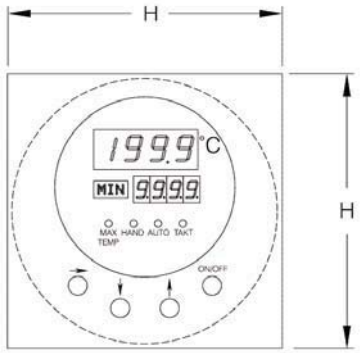
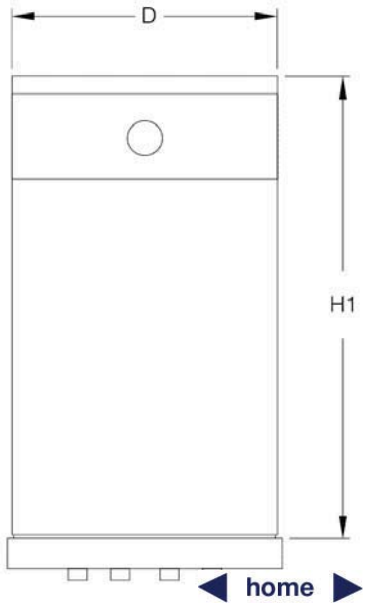


Technical data

Input	Pt 100	-	1x Pt 100, 3 to 4 wire
	Power supply	-	24 VDC, 5A
Output	Analog signal	-	4-20 mA
	Time	-	Transistor 24 VDC max. 3A
	Cut-off value 1	-	Relay max. 40 VDC, 800 mA
	Cut-off value 2	-	Relay max. 40 VDC, 800 mA
Materials	Housing TMM01	-	Makrolon
	Housing TMX01	-	Light metal
Protection type	Housing TMR01	-	IP 50 (Front)
	Housing TMX01	-	IP 65

H	H1	D	Type	Reference
72	135	-	**A**	**TMM01**
145	244	140	**B**	**TMX01**



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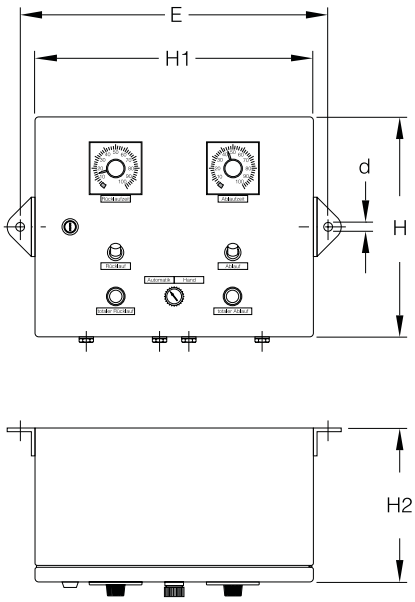
PNEUMATIC TIMER

The TMXP controller is a pneumatic timer used for controlling pneumatic reflux separators. As it operates completely pneumatically, it can be used without restriction in hazardous areas. The reflux and offtake times can be adjusted on the timer from 0.3 to 10 seconds or alternatively from 0.3 to 100 seconds. There are two buttons which can be used, when the timer is set to "Manual", to switch it to total offtake or total reflux. When set to "Automatic" the timer starts the preset reflux ratio. Whether set to "Manual" or "Automatic" the instrument display panel indicates the current position of the reflux separator (reflux or offtake).

H	H1	H2	E	d	Reference
300	380	210	420	12	TMXP



ELECTRODES
FOR PH, REDOX AND CONDUCTIVITY MEASUREMENT

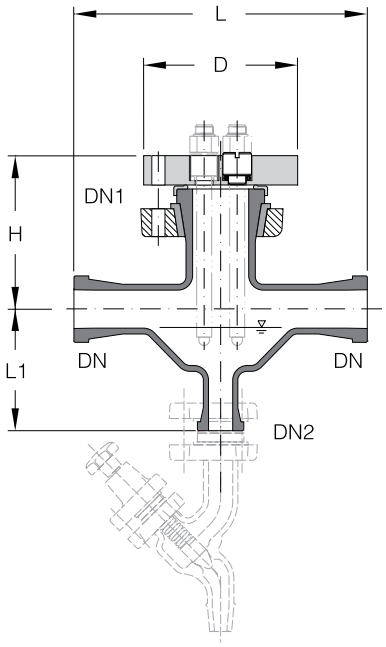
The equipment available for process monitoring and control of pH, Redox and conductivity includes borosilicate glass electrode measuring chambers with PTFE flange. Up to two commercially available electrodes with PG 13.5 thread and 120 mm long can be fitted in the PTFE flange. One screw thread is blanked off as standard. The maximum operating temperature is 120 °C. The choice of a suitable electrode is governed by the process conditions.

If glass electrodes cannot be used for conductivity measurement, we can also supply inductive measuring cells for the measuring chamber.

Straight and angled dip tubes can be supplied in various lengths for use in columns, receivers and spherical vessels.

Electrode Measuring Chambers

DN	DN1	DN2	L	L1	H	D	Reference
25	40	15	200	83	98	105	QIP25



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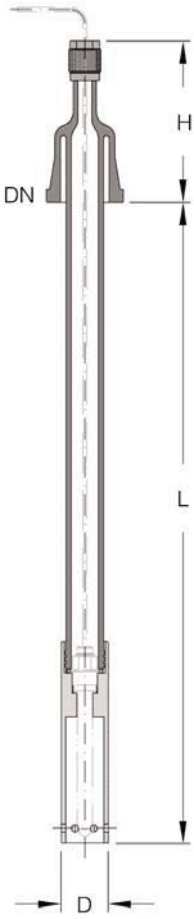
ELECTRODES
FOR PH, REDOX AND CONDUCTIVITY MEASUREMENT

The straight and angled immersion armatures are suited for process monitoring in columns and vessels. The immersion armatures made from borosilicate glass 3.3 contain a PTFE electrode holder to which a regular electrode with a 120-mm long PG 13.5 thread can be attached The gasket between the glass and PTFE electrode holder is made of Viton, especially for the electrode.

The maximum operating temperature for the immersion armature is 120°C.

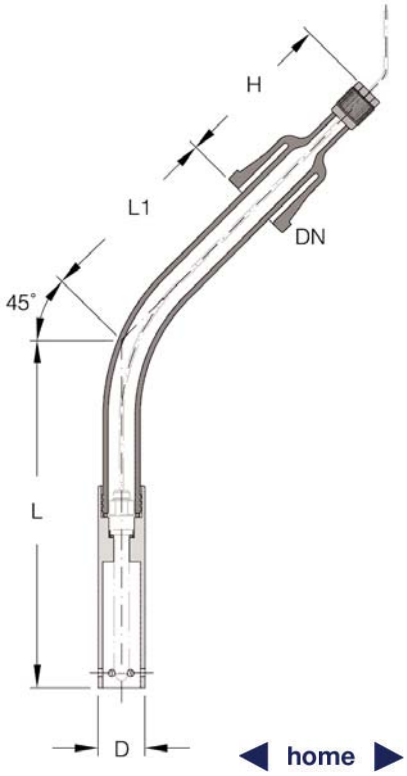


Straight Dip Tubes

DN	L	H	D	Reference
40	500	128	37	QID40/500
40	650	128	37	QID40/650
40	850	128	37	QID40/850

Angled Dip Tubes for Installation in Spherical Vessels

DN	L	L1	H	D	for spherical vessel (l)	Reference
40	275	150	128	37	50	QID45/40/275
40	350	150	128	37	100	QID45/40/350
50	450	150	138	37	200	QID45/50/450



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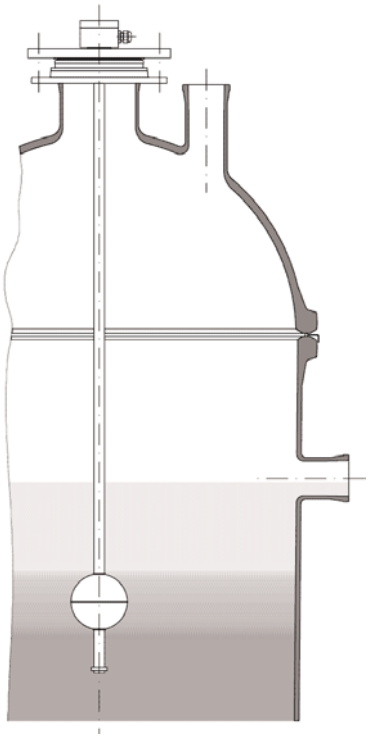
ELECTRICAL INTERFACE MEASUREMENT

Float type measuring instruments are used for interface measurement in extraction columns. The float's magnet system activates a resistor chain in the guide tube which corresponds to a 3-wire potentiometer circuit. A 2-wire measurement transformer in the connection housing converts the resistor chain signal with a 5 mm contact grid to 4-20 mA.

These floats can only be installed from above in a branch with a minimum size of DN 80. The density of the heavy phase must be at least 0.70 kg/dm3.



Technical data

Supply	Control voltage	-	24VDC 2-wire
	Output signal	-	4-20 mA
	Ambient temperature	-	max. 70 °C
Materials	Connection housing	-	Aluminium
	Flange	-	Stainless steel
	Wetted	-	Stainless steel
Protection type	Housing	-	IP 65
	Explosion protection	-	II 2 G EEx ib IIC T6

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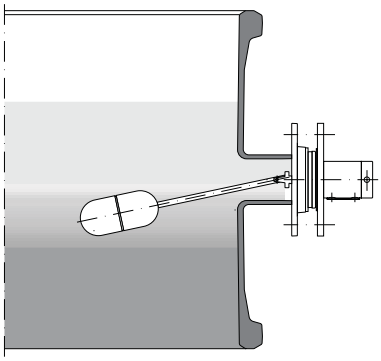
PNEUMATIC INTERFACE MEASUREMENT



Float type measuring instruments are used for measuring the interface between two liquids in horizontal separators and extraction columns. The measurement signal is converted by means of magnetic transmission from a pneumatic proportional controller into a 0.2 to 1 bar output signal. These floats can be installed either from the side or from above in a branch with a minimum size of DN 80. The output signal at the float's midpoint is 0.6 bar. The normal control range is +15 mm/-15 mm and this can be extended by lengthening the stem. The density of the heavy phase must be at least 0.70 kg/dm^3.

If the output signal is not switched directly to a pneumatic control valve, the signal can be converted via a P/I converter (option) to 4-20 mA and processed in an electrical controller.

Technical data

Supply	Instrument air	-	1.4 bar
	Control connection	-	G 1/8
	Ambient temperature	-	0 to +80 °C
Materials	Connection housing	-	Aluminium die casting
	Wetted	-	Stainless steel or PTFE
Protection type	Housing	-	IP 65

QVF

PROCESS PLANT COMPONENTS

Introduction

QVF couplings are a strong and high-duty system providing maximum reliability with the minimum of maintenance. This is achieved throughout the whole range of nominal sizes by the use of the safety buttress end, which has been designed specifically to take into account the properties of the material, coupled with corrosion resistant, easy-to-install gaskets plus the carefully dimensioned individual parts of the actual coupling. The materials are selected to consider both the type of products being handled in the plant and equipment and also the possibility that they may be located in a corrosive atmosphere.

The particular properties of borosilicate glass 3.3 and the fact that it is an approved and proven material of construction for pressure vessels are of prime importance in this connection. This is one of the reasons that borosilicate glass 3.3 is so widely used in the chemical, pharmaceutical and allied industries together with other applications such as food and drink production, dye works and electroplating.

The complete range of standard components available is described on the following pages. Non-standard components can, however, also be supplied to special order.

A detailed listing of all couplings and individual components by »Description« and »Catalogue Reference« can be found in the »Index«.

Detailed information on couplings and a number of other topics referred to in the following pages can be found in Section 1 »Technical Information«.

The use of flexible gaskets (please see page 9.24) makes it possible to achieve a deviation of up to 3° and provides the same degree of movement as a ball and socket system.

The term »DN« always refers in this section to the nominal size of the glass components.

GMP and clean room compliant installations

The design of plant and equipment complying with GMP regulations calls for special care in both the planning and selection of the components together with the materials of construction used for them. Borosilicate glass 3.3 has a number of special properties that are highly valued in the pharmaceutical industry, and these, in conjunction with PTFE materials (gaskets, bellows, lining) approved in accordance with the FDA catalogue ensure that any build-up of unwanted deposits is avoided in areas which come in contact with the product. A design without any dead space, which ensures that components drain fully and can be cleaned easily and effectively, is achieved in the case of many components by their shape and the way they are installed.

All these benefits can, however, only be taken advantage of if the gaskets used meet the same criteria. For that reason we use exclusively gaskets made from PTFE of the highest quality and can also supply a special GMP compliant gasket without any dead space (please see page 9.23) in addition to the other types of gasket available.

Where the external surfaces of the pipeline have to comply with clean room requirements, appropriate stainless steel coupling and support material can be supplied (please see also Section 10 »Structures and Supports«).

We would be happy to advise you on the basis of the regulatory requirements applicable to a particular case and the guidelines drawn up by us for the design of GMP compliant plant and for plant suitable for use under clean room conditions.

Coated glass components

Damage to borosilicate glass 3.3 components resulting from accidental external causes cannot be entirely excluded, especially in the smaller nominal sizes. This is primarily due to the relatively rigorous conditions prevalent in production plants and applies especially where no additional protection is provided in the form of insulation.

Standard couplings and inserts are used to install Sectrans coated borosilicate glass 3.3 components.

In the case of components with a glass fibre reinforced polyester coating, which provides a higher level of protection, and can also be supplied on request, couplings complete with thinner inserts are required for nominal sizes DN 15 to DN 150.

Permissible operating conditions

All couplings are suitable for operating temperatures of up to 200 °C on the product side and for the permissible operating pressure applicable to the particular nominal size. Plastic flanges may, however, only be used up to an operating temperature of 150 °C on the product side when lagged.

In the case of cover plate assemblies, quick release couplings and bellows, the operating conditions indicated in the respective product description apply.

Connection to other materials

The requirement for connecting QVF borosilicate glass 3.3 plant and equipment to other materials of construction such as PTFE lined components, glass-lined branches and exotic materials, to mention but a few, is becoming more and more frequent

In addition to standard couplings for glass components, the following pages also contain solutions for these very different applications. They ensure that the normal bolting forces applicable to glass plant are applied but without being exceeded.

COUPLINGS

Various types of couplings are available to join borosilicate glass 3.3 components together to install operable pipelines and process plants. They are designed to comply not only with the requirements of GMP-compliant installations but also consider the fact that glass plant and pipeline often has to operate in relatively corrosive environments.

The table below provides a summary of the various couplings available:

Coupling	Nominal size												
	15	25	40	50	80	100	150	200	300	450	600	800	1000
For uncoated and Sectrans coated components													
Version 1	Plastic, »CP..« type									Cast iron/Steel, »CCS..« type			
Version 2	Stainless steel, »CSS..« type												
For glass fibre reinforced polyester coated components													
Version 1	Plastic, »CP..C« type							Plastic, »CP..« type		Cast iron/Steel, »CCS..« type			
Version 2	Stainless steel, »CSS..C« type							Stainless steel, »CCS..« type		Stainless steel, »CCS..« type			
For uncoated and Sectrans coated components and flexible gasket													
Version 1	Plastic, »CP..G« type												
Version 2	Stainless steel, »CSS..G« type												
For glass fibre reinforced polyester coated components and flexible gasket													
Version 1	Plastic, »CP..GC« type												
Version 2	Stainless steel, »CSS..GC« type												
For fixed points													
Version 1												Steel, »CCSF..« type	
Version 2												Stainless steel, »CSSF..« type	

COUPLINGS

Complete couplings include two flanges and two inserts in the selected materials and the necessary quantity of stainless steel nuts, set screws, flat washers and springs. A detailed description of all the individual parts can be found on pages 9.12 to 9.20.

Compression springs are used to set and maintain the correct bolt load on the coupling. Further information on this can be found under the Compression Springs heading on page 9.20.

We recommend greasing stainless steel coupling set screws as protection against seizure.

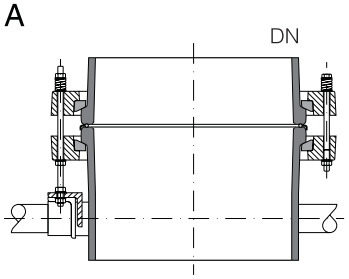
Couplings do not include gaskets which should be ordered separately and should be selected in accordance with the operating requirements of each particular case (please see page 9.22 to 9.24).

Standard inserts can be used with Sectrans coated glass components (suffix »L«) but glass fibre reinforced polyester coated components (suffix »C«) in the DN 15 to DN 150 nominal size range require the use of thinner inserts (please see section 1 »Technical information« and page 9.4).

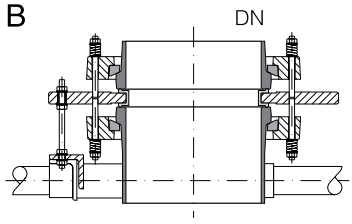
In the DN 15 to DN 600 nominal size range fixed points are created by using a combination of standard couplings and support frames (type A) or support plates and support frames (type B) respectively in the structure. In the DN 800 and DN 1000 nominal size a special fixed point coupling (type C) is required. This includes a fixed point flange which is fixed directly to the heavy duty support stool.

»RRD..« tubular support frames and »UBD..« profile steel support frames can be found in section 10 »Structures & Supports«. Examples are illustrated alongside.

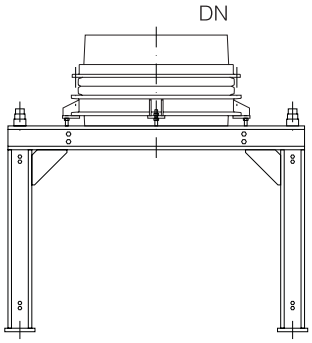
A



B



C



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COUPLINGS

Couplings with Plastic Flanges

The standard version of these couplings incorporates glass fibre reinforced Duroplast flanges with inserts in plastic (up to DN 150 nominal size) or Duroplast (with rubber/glass fibre layer in DN 200 and DN 300) respectively nuts, set screws, flat washers and springs.

These couplings do not require earthing, even if the products being handled are prone to set up an electrostatic charge as all the metal parts (set screws etc.) have a sufficiently low capacitance.

In addition, we supply couplings in the DN 15 to DN 150 nominal size range with thinner inserts as required for use with glass fibre reinforced polyester coated glass components (please see table on page 9.4) or, if applicable, longer set screws for use with flexible gaskets (please see page 9.24). These different versions are identified by adding the appropriate suffix to the catalogue reference.

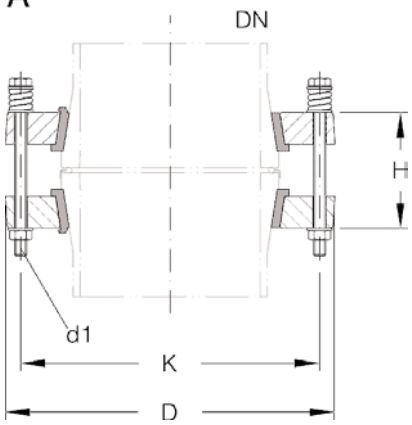
If thinner inserts are required for glass fibre reinforced polyester coated glass components of nominal sizes DN 15 to DN 150, the suffix »C« should be added to the catalogue reference which then becomes, for example, »CP..C«.

In nominal sizes DN 200 and DN 300 the standard couplings can also be used with Sectrans and glass fibre reinforced polyester coated glass components.

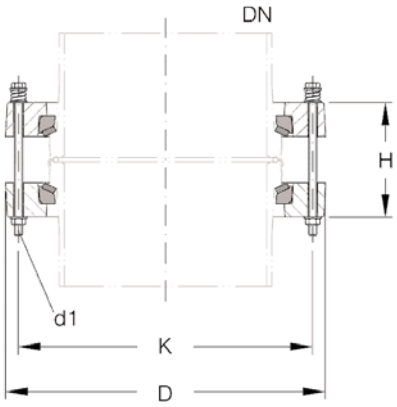
When flexible gaskets are used, longer set screws are necessary and a»G« should be added to the catalogue reference which then becomes, for example, »CP..G«.

Catalogue references with the suffix »GC«, e.g. »CP.. GC«, refer to couplings for use with flexible gaskets in combination with coated glass components.

A



B



DN	D	K	n x d1	H	Type	Reference
15	70	50	3 x M6	39	**A**	**CP15**
25	90	70	3 x M8	61	**A**	**CP25**
40	109	86	3 x M8	66	**A**	**CP40**
50	122	98	3 x M8	73	**A**	**CP50**
80	160	133	6 x M8	87	**A**	**CP80**
100	204	178	6 x M8	98	**A**	**CP100**
150	280	254	6 x M10	100	**A**	**CP150**
200	321	295	8 x M8	112	**B**	**CP200**
300	428	400	12 x M8	113	**B**	**CP300**

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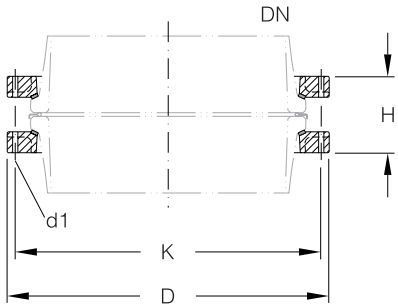
COUPLINGS

Couplings with Cast Iron and Steel Flanges

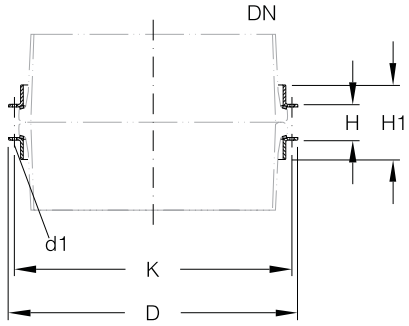
These couplings incorporate epoxy resin painted spheroidal graphite cast iron flanges (DN 450 and DN 600) or welded steel flanges (DN 800 and DN 1000) respectively, bonded rubber/glass fibre inserts plus stainless steel set screws, nuts, flat washers and springs. They can also be used with Sectrans and glass fibre reinforced polyester coated glass components.

DN	D	K	n x d1	H	H1	Type	Reference
450	615	585	16 x M8	146	-	**A**	**CCS450**
600	755	710	20 x M12	173	-	**A**	**CCS600**
800	986	950	24 x M12	121	253	**B**	**CCS800**
1000	1160	1120	28 x M12	123	255	**B**	**CCS1000**

A



B



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COUPLINGS

Couplings with Stainless Steel Flanges

The standard version of these couplings incorporates stainless steel flanges, set screws, nuts, flat washers and springs. The inserts are plastic (up to DN 150 nominal size), Duroplast with rubber/glass fibre layer (in DN 200 and DN 300) or rubber/glass fibre in DN 450 and above respectively.

In addition, we supply couplings in the DN 15 to DN 150 nominal size range with thinner inserts as required for use with glass fibre reinforced polyester coated glass components (please see table on page 9.4) or longer set screws for use with flexible gaskets respectively (please see page 9.24). These different versions are identified by adding the appropriate suffix to the catalogue reference.

If thinner inserts are required for glass fibre reinforced polyester coated glass components of nominal sizes DN 15 to DN 150, the suffix »C« should be added to the catalogue reference which then becomes, for example, »CSS..C«.

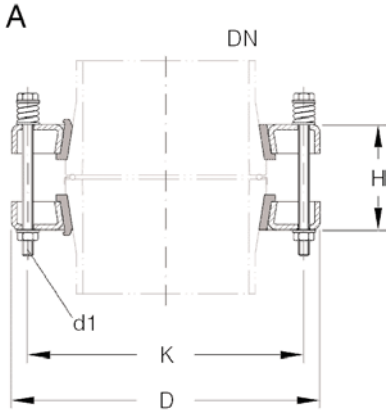
In nominal sizes DN 200 to DN1000 the standard couplings can also be used with Sectrans and glass fibre reinforced polyester coated glass components.

When flexible gaskets are used, longer set screws are necessary and a »G« should be added to the catalogue reference which then becomes, for example, »CSS..G«.

Catalogue references with the suffix »GC«, e.g. »CSS GC«, refer to couplings for use with flexible gaskets in combination with coated glass components.

DN	D	K	n x d1	H	H1	Type	Reference
15	64	50	3 x M6	38	-	A	CSS15
25	85	70	3 x M8	59	-	A	CSS25
40	106	86	3 x M8	66	-	A	CSS40
50	124	98	3 x M8	72	-	A	CSS50
80	155	133	6 x M8	83	-	A	CSS80
100	200	178	6 x M8	95	-	A	CSS100
150	284	254	6 x M10	97	-	A	CSS150
200	325	295	8 x M8	96	-	B	CSS200
300	428	400	12 x M8	97	-	B	CSS300
450	615	585	16 x M8	116	-	C	CSS450
600	755	710	20 x M12	125	-	C	CSS600
800	996	950	24 x M12	121	253	D	CSS800
1000	1170	1120	28 x M12	123	255	D	CSS1000

A



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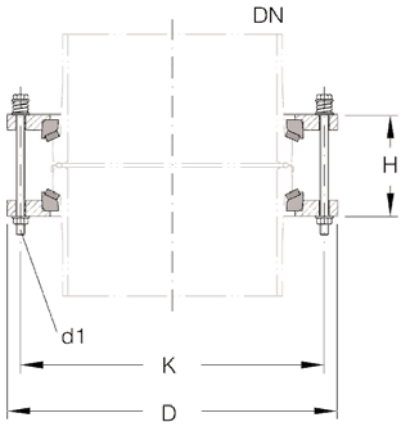
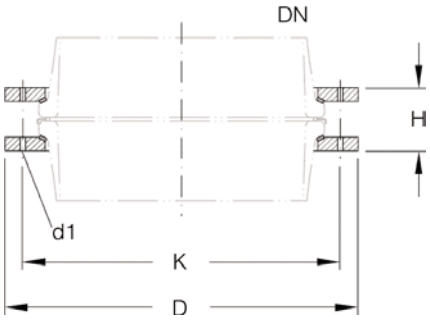


C



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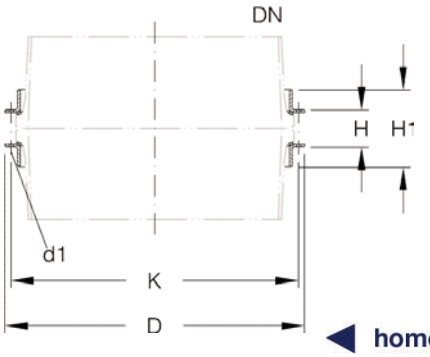

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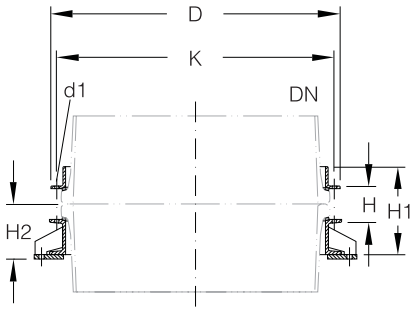
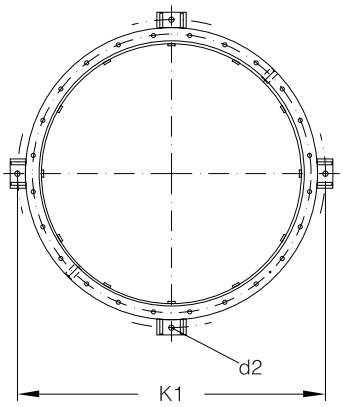
COUPLINGS

Steel and Stainless Steel Fixed Point Couplings

In DN 800 and DN 1000, fixed points are created by using special couplings on a profile steel support frame. They incorporate one standard and one fixed point flange which is fixed directly to the U-profile frame by means of four support lugs set at 90°.

DN	D	K	K1	n x d1	n x d2	H	H1	H2	Reference Steel	Reference Stainless steel
800	996	950	1050	24 x M12	4 x 18	121	298	187	CCSF800	CSSF800
1000	1170	1120	1220	28 x M12	4 x 18	123	300	188	CCSF1000	CSSF1000





COUPLINGS FOR DURAPACK® COLUMNS

As described in section 6 »Column Components«, structured packing and, also DURAPACK® high efficiency packing is supported on a support ring. These are designed to be clamped in a coupling and for this purpose longer set screws are required. The complete couplings described on the following page take this aspect into account.

As regards design and the materials used they are the same as the »CP..« and »CCS..« couplings or alternatively »CCSF..« (fixed point coupling) which are described in detail on pages 9.6, 9.7 and 9.10. For this reason only two (»CPDU..« and »CCSFDU..«) of the versions actually available are shown.

These couplings can also be supplied on request with stainless steel flanges.

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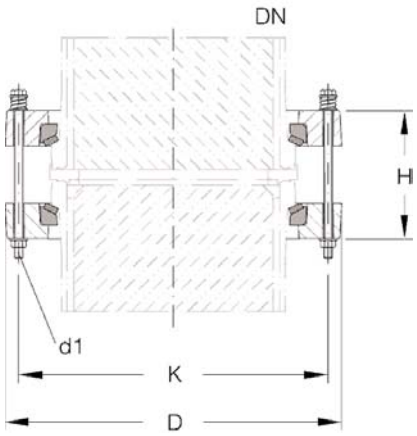
COUPLINGS FOR DURAPACK® COLUMNS

Couplings for Column Sections

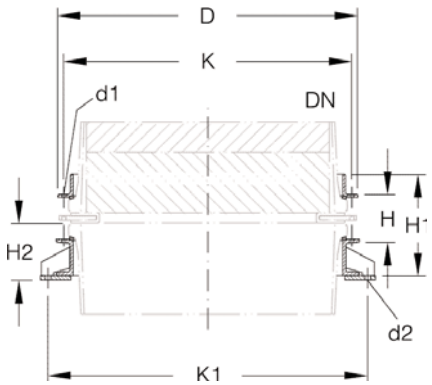
DN	D	n x d1	K	H	Reference
100	204	6 x M8	178	105	**CPDU100**
150	280	6 x M10	254	109	**CPDU150**
200	321	8 x M8	295	122	**CPDU200**
300	428	12x M8	400	128	**CPDU300**
450	615	16 x M8	585	164	**CCSDU450**
600	755	20 x M12	710	191	**CCSDU600**
800	986	24 x M12	950	139	**CCSDU800**
1000	1160	28 x M12	1120	141	**CCSDU1000**



COUPLINGS FOR DURAPACK® COLUMNS

Fixed Point Couplings

DN	D	n x d1	n x d2	K	K1	H	H1	H2	Reference
800	996	24 x M12	4 x M18	950	1050	139	313	183	**CCSFDU800**
1000	1170	28 x M12	4 x M18	1120	1220	141	315	184	**CCSFDU1000**



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QUICK RELEASE COUPLINGS

There is a frequent requirement in process plant applications to open or close couplings as quickly as possible without using tools. Charging materials to reaction or extraction vessels or replacing measurement indicators are typical examples of this. The ideal solution in such instances is our quick release couplings.

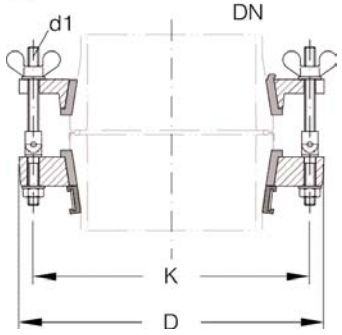
These comprise a stainless steel upper flange with slotted bolt holes, hinged quick release bolts and a lower plastic backing flange which is fixed to prevent it falling down. The support ring and the fastenings are stainless steel. As with all couplings, the gasket is not included and should be ordered separately.

The permissible operating pressure for quick release couplings ranges from -1 to +0.5 bar g as the bolts can only be tightened by hand.

If thinner inserts are required for glass fibre reinforced polyester coated glass components of nominal sizes DN 25 to DN 150 (please see page 9.4), the suffix »C« should be added to the catalogue reference which then becomes »CVS..C«.

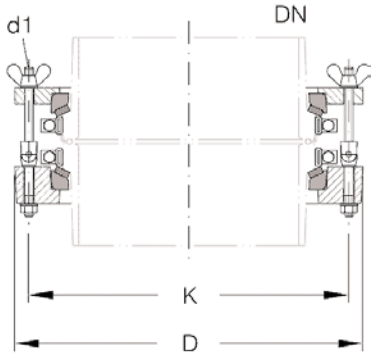
In nominal sizes DN 200 and DN 300 the standard couplings can also be used with Sectrans and glass fibre reinforced polyester coated glass components.

A



DN	D	K	n x d1	Type	Reference
25	90	70	3 x M8	**A**	**CVS25**
40	109	86	3 x M8	**A**	**CVS40**
50	122	98	3 x M8	**A**	**CVS50**
80	160	133	6 x M8	**A**	**CVS80**
100	204	178	6 x M8	**A**	**CVS100**
150	280	254	6 x M10	**A**	**CVS150**
200	321	295	8 x M8	**B**	**CVS200**
300	428	400	12 x M8	**B**	**CVS300**

B



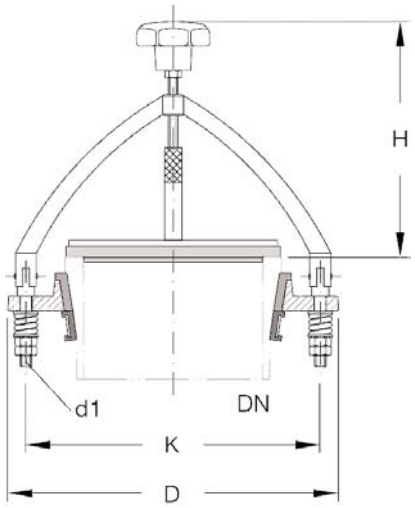
RAPID CLOSURES

These rapid closures provide a more convenient solution for special applications compared to the quick release couplings described previously. They have a swivelling bracket and are closed or released by means of a spindle attached to it via a centrally located hand-wheel.

The flange, cover, bracket and hinged bolts are stainless steel. The cover is faced with a PTFE disc on the product side and the O-ring which is also corrosion resistant, is located in a recessed groove so that it cannot fall out when the closure is opened.

The permissible operating pressure for rapid closures ranges from -1 bis +0,1 bar. The version KMC...A can be used up to pressure of +0,6 bar, if the apparatus is equipped with a local pressure gauges.

If thinner inserts are required for glass fibre reinforced polyester coated glass components, the suffix »C« should be added to the catalogue reference which then becomes »KMC..C«.



DN	D	d1	K	H	Reference -1/+0,1 bar	Reference -1/+0,6 bar
50	132	M8	110	138		
80	155	M8	133	148	**KMC50**	**KMC50A**
100	200	M8	178	178	**KMC80**	**KMC80A**
150	280	M10	254	180	**KMC100**	**KMC100A**
					KMC150	**KMC150A**

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BACKING FLANGES

Flanges can be supplied in a variety of materials to complement the complete couplings described on pages 9.4 to 9.9.These are one-piece units up to and including DN 300 nominal size and two-piece in the larger sizes. The materials used have been selected on the basis of the bolting forces required whilst also taking into account the practical requirements of plant and pipeline in borosilicate glass 3.3.

The diameter and number of bolt holes as well as the PCD (QVF PCD) are identical for all types of the same nominal size. They can, therefore, be easily interchanged. However, the different set screw lengths required for DN 200 and DN 300 should be taken into account.

Inserts for size DN 15 to DN 300 flanges should be ordered separately (please see pages 9.18 and 9.19).

Adaptor flanges connecting borosilicate glass 3.3 components to equipment in other materials can be found on pages 9.16 and 9.17.

BACKING FLANGES

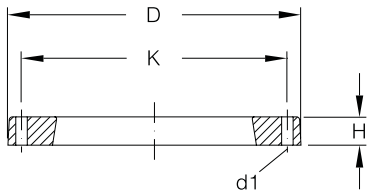
Plastic Backing Flanges

Because of their low weight and relatively good corrosion resistance, glass fibre reinforced Duroplast backing flanges are used in the vast majority of installations. They provide the additional benefit that they do not need earthing even if the products being handled are prone to setting up an electrostatic charge.

Plastic backing flanges can be used up to a maximum operating temperature on the product side of 200ºC. If the coupling is insulated, this temperature should not exceed 150ºC.

DN	D	K	n x d1	H	Type	Reference
15	70	50	3 x 7	11	A	CRP15
25	90	70	3 x 9	16	A	CRP25
40	109	86	3 x 9	19	A	CRP40
50	122	98	3 x 9	22	A	CRP50
80	160	133	6 x 9	27	A	CRP80
100	204	178	6 x 9	28	A	CRP100
150	280	254	6 x 11	28	A	CRP150
200	325	295	8 x 9	34	B	CRP200
300	428	400	12 x 9	36	B	CRP300

A



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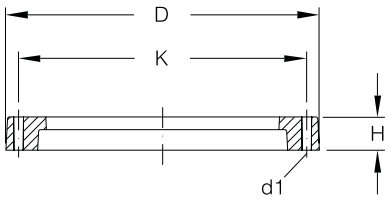


BACKING FLANGES

Cast Iron and Steel Backing Flanges

Because of the bolting forces required, only metal backing flanges are used for the larger nominal sizes. The standard versions are made of spheroidal graphite cast iron (DN 450 and DN 600) or profile steel (DN 800 and DN 1000).

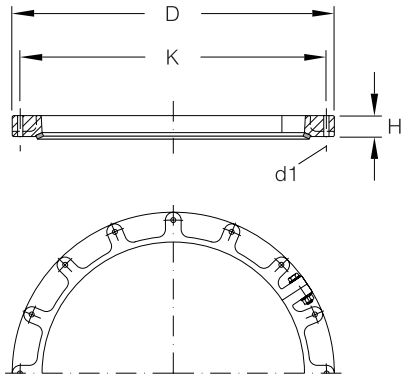
These backing flanges consist of two halves joined together by means of location sleeves and set screws. They are primed and then painted with epoxy resin to provide them with relatively good resistance to corrosion.

They are supplied complete with a bonded segmented rubber/glass fibre insert.

These backing flanges are made up of matching halves which carry appropriate identification. Non-matching halves should not be substituted during installation.

DN	D	K	n x d1	H	Type	Reference
450	615	585	16 x 9	40	**A**	**CRCS450**
600	755	710	20 x 14	50	**A**	**CRCS600**
800	986	950	24 x 14	75	**B**	**CRCS800**
1000	1160	1120	28 x 14	75	**B**	**CRCS1000**

A



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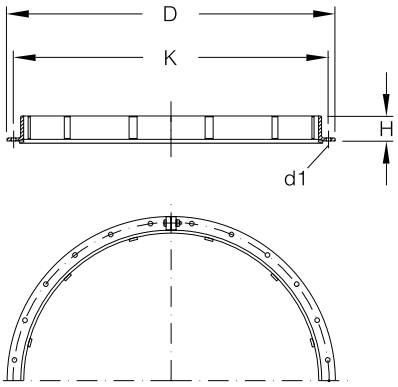


BACKING FLANGES

Stainless Steel Backing Flanges

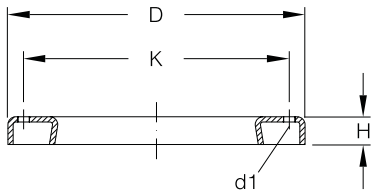
One-piece backing flanges are used in the DN 15 to DN 300 nominal sizes range. These are deep-drawn (up to and including DN 150) or machined stainless steel. Inserts (please see pages 9.18 and 9.19) for these backing flanges should be ordered separately.

For the DN 450 to DN 1000 nominal sizes a welded design has been chosen. These flanges consist of two halves joined together by means of location sleeves and set screws. They are supplied complete with a bonded segmented rubber/glass fibre insert.

Backing flanges of DN 450 to DN 1000 nominal sizes are made up of matching halves which carry appropriate identification. Non-matching halves should not be substituted during installation.

DN	D	K	n x d1	H	Type	Reference
15	64	50	3 x 7	10	**A**	**CRSS15**
25	85	70	3 x 9	16	**A**	**CRSS25**
40	106	86	3 x 9	19	**A**	**CRSS40**
50	124	98	3 x 9	22	**A**	**CRSS50**
80	155	133	6 x 9	25	**A**	**CRSS80**
100	200	178	6 x 9	27	**A**	**CRSS100**
150	284	254	6 x 11	27	**A**	**CRSS150**
200	325	295	8 x 9	15	**B**	**CRSS200**
300	428	400	12 x 9	15	**B**	**CRSS300**
450	615	585	16 x 9	25	**C**	**CRSS450**
600	755	710	20 x 14	25	**C**	**CRSS600**
800	986	950	24 x 14	75	**D**	**CRSS800**
1000	1160	1120	28 x 14	75	**D**	**CRSS1000**

A



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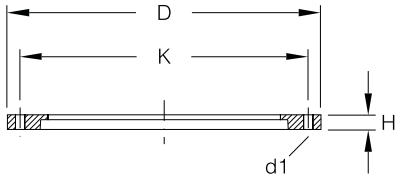

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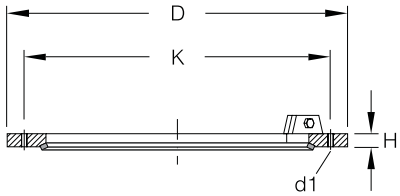

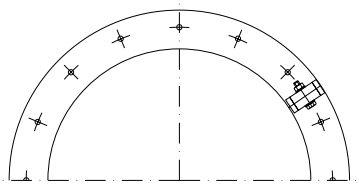

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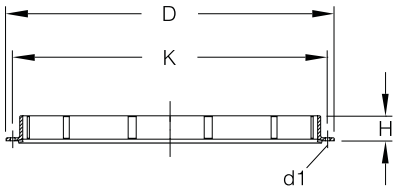
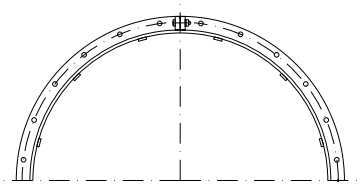




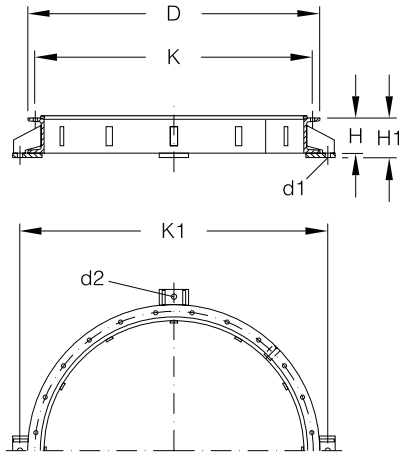
FIXED POINT FLANGES

Steel and Stainless Steel Fixed Point Flanges

In the DN 15 to DN 600 nominal size range, fixed points are created by using a combination of standard couplings with support flanges and vessel holders and support rings with tubular support frames in the structure (please see section 10 »Structures & Supports«). In the DN 800 and DN 1000 nominal sizes, special couplings are used to mount fixed points directly onto a profile steel support frame. For this purpose a special fixed point flange should be used as the lower flange. This is fixed directly to the U-profile frame by means of four support lugs set at 90°.

All fixed point flanges are supplied in epoxy resin painted steel or stainless steel. They consist of two halves joined together by means of location sleeves and set screws.

These backing flanges are made up of matching halves which carry appropriate identification. Non-matching halves should not be substituted during installation.



DN	D	K	K1	n x d1	n x d2	H	H1	Reference Steel	Reference Stainless steel
800	996	950	1050	24 x 14	4 x 18	120	135	CRCSF800	CRSSF800
1000	1170	1120	1220	28 x 14	4 x 18	120	135	CRCSF1000	CRSSF1000

ADAPTOR FLANGES

Where borosilicate glass 3.3 components have to be connected to flanges on equipment in other materials of construction, different PCDs, bolt hole diameters and bolt configurations are generally involved. These adaptor flanges provide a solution to such problems. They have a larger than normal outside diameter and can be supplied either undrilled or drilled to a particular specification.

As the bolting force applicable to couplings for glass components is lower than for metal equipment, we supply adaptor flanges predrilled to your specifications but with bolt hole diameters identical to those in our standard backing flanges. Where the mating flange is drilled to take larger bolts, reducing washers (please see page 9.21) should be used.

Adaptor flanges can be supplied in cast iron (in the DN15 to DN150 nominal sizes) or machined steel (in the DN200 and DN 300 nominal sizes) with an epoxy resin painting or alternatively stainless steel.

If the flanges are required with a hole configuration differing from those indicated below, please provide details when ordering.

ADAPTOR FLANGES

Undrilled Adaptor Flanges

DN	D	H	Type	Reference Cast iron/Steel	Reference Stainless steel
15	95	10	A	CRCSU15	CRSSU15
25	115	16	A	CRCSU25	CRSSU25
40	150	19	A	CRCSU40	CRSSU40
50	165	22	A	CRCSU50	CRSSU50
80	200	25	A	CRCSU80	CRSSU80
100	220	27	A	CRCSU100	CRSSU100
150	285	27	A	CRCSU150	CRSSU150
200	325	15	B	CRCSU200	CRSSU200
300	460	15	B	CRCSU300	CRSSU300

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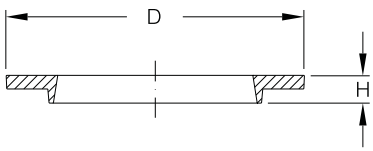

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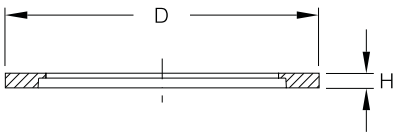
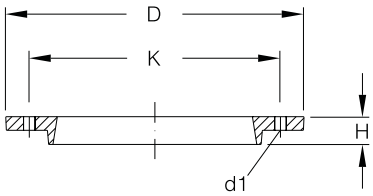


ADAPTOR FLANGES

Adaptor Flanges drilled to EN 1092, PN 10

In nominal sizes DN 200 and DN 300 plastic flanges (type »CRP..«) and stainless steel flanges (type »CRSS..«) are drilled to EN 1092, PN 10 (PCD only) and can also be used as adaptor flanges.



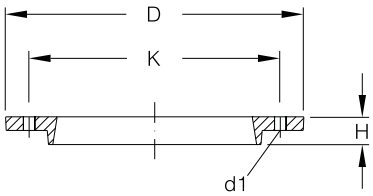
DN	D	K	n x d1	H	Reference Cast iron	Reference Stainless steel
15	95	65	4 x 7	10	CRCSE15	CRSSE15
25	115	85	4 x 9	16	CRCSE25	CRSSE25
40	150	110	4 x 9	19	CRCSE40	CRSSE40
50	165	125	4 x 9	22	CRCSE50	CRSSE50
80	200	160	8 x 9	25	CRCSE80	CRSSE80
100	220	180	8 x 9	27	CRCSE100	CRSSE100
150	285	240	8 x 11	27	CRCSE150	CRSSE150

ADAPTOR FLANGES

Adaptor Flanges drilled to ANSI, Class 150

DN	D	K	n x d1	H	Type	Reference Cast iron/Steel	Reference Stainless steel
15	95	60	4 x 7	10	A	CRCSA15	CRSSA15
25	115	79	4 x 9	16	A	CRCSA25	CRSSA25
40	150	98	4 x 9	19	A	CRCSA40	CRSSA40
50	165	121	4 x 9	22	A	CRCSA50	CRSSA50
80	200	152	4 x 9	25	A	CRCSA80	CRSSA80
100	220	190	8 x 9	27	A	CRCSA100	CRSSA100
150	285	241	8 x 11	27	A	CRCSA150	CRSSA150
200	325	298	8 x 9	15	B	CRCSA200	CRSSA200
300	460	432	12 x 9	15	B	CRCSA300	CRSSA300

A



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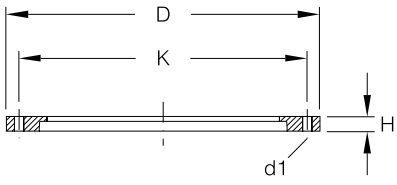


home

INSERTS

Inserts are fitted to avoid direct contact between the flange and glass buttress end and to compensate for any unevenness resulting from manufacturing tolerances. They should always be renewed if a joint is dismantled.

The »DN« figure in the table below refers to the nominal size of the coupling.

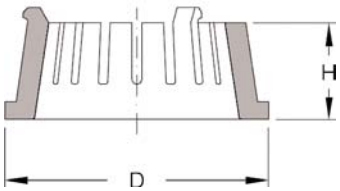
INSERTS

Plastic Inserts

Where small nominal sizes are involved, for example in interconnecting pipework in and between units, the number of joints that has to be made is relatively large and inserts that are especially easy to install can reduce the time and effort involved quite considerably. This requirement can be best catered for by using these one-piece inserts made of specific polyamide in the DN 15 to DN 150 nominal size range and the hinged Duroplast with rubber/glass fibre layer version in the DN 200 and DN 300 nominal sizes.

DN	D	H	Type	Reference
15	37	12	A	CIP15
25	52	19	A	CIP25
40	68	22	A	CIP40
50	82	25	A	CIP50
80	113	29	A	CIP80
100	150	33	A	CIP100
150	202	33	A	CIP150
200	254	18	B	CIP200
300	359	18	B	CIP300

A



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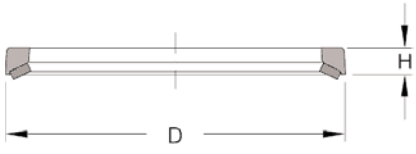


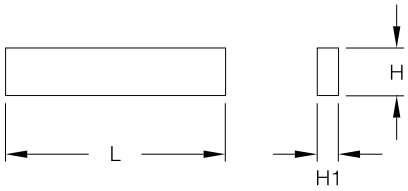
home

INSERTS

Rubber/Glass Fibre Inserts

This segmented version is for the DN 450 to DN 1000 nominal size range. The inserts are bonded to the flange, i.e. they are included in the supply. They only need to be ordered separately when required as spares.

The black side of the insert should be bonded to the flange.



DN	n x L	H	H1	Reference
450	2 x 800	13	6	**CIR450**
600	2 x 1047	13	6	**CIR600**
800	4 x 700	13	6	**CIR800**
1000	4 x 837	13	6	**CIR1000**

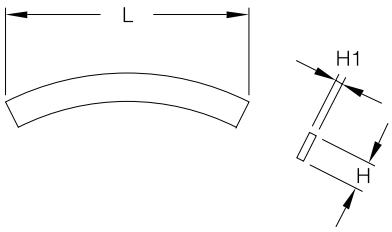
INSERTS

Rubber/Aramide Fibre Inserts

In applications involving glass fibre reinforced polyester coated borosilicate glass 3.3 components, identified by the suffix »C« (please see section 1 »Technical Information«), these thinner rubber/aramide fibre inserts should be used in the DN 15 to DN 150 nominal size range. All the other coupling components are the same as the standard version.

These inserts should never be used with uncoated or Sectrans coated glass components.

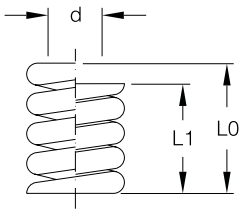
The side of the insert which is marked in blue should be fitted towards the glass flange.



DN	L	H	H1	Reference
15	89	10	2,5	**CIC15**
25	133	16	3,5	**CIC25**
40	180	19	4	**CIC40**
50	220	22	5	**CIC50**
80	308	25	5,5	**CIC80**
100	411	27	6	**CIC100**
150	570	27	6,5	**CIC150**

COMPRESSION SPRINGS

Compression springs are used to set the correct bolt load and to maintain it after the gasket has settled, thus ensuring that the coupling remains leak-free. These springs are supplied exclusively in stainless steel.



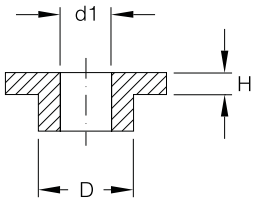
To achieve the required sealing load and to ensure that the coupling bolts are tightened evenly, first make the nuts finger-tight and then finish off with a spanner (from DN 80 upwards alternating between bolts on opposite sides of the coupling). The free length L0 and compressed length L1 are shown in the table below.

In addition, with couplings in the DN 450 to DN 1000 range the compressed length L1 should be checked after the plant is heated for the first time and if necessary the set screws retightened.

In the table below »DN« refers to the nominal size of the coupling.

Suitable for coupling DN	d	L0	L1	Reference
15	6,5	13,5	11	**DFSS6.5**
25	8,5	20	14,5	**DFSS8.5**
40	8,5	20	14,5	**DFSS8.5**
50	8,5	20	14,5	**DFSS8.5**
80	8,5	20	14,5	**DFSS8.5**
100	8,5	20	14,5	**DFSS8.5**
150	10,5	30	24,5	**DFSS10.5**
200	10,5	30	24,5	**DFSS10.5**
300	10,5	30	24,5	**DFSS10.5**
450	10,5	30	24,5	**DFSS10.5**
600	13	39	31	**DFSS13**
800	13	39	31	**DFSS13**
1000	13	39	31	**DFSS13**

REDUCING WASHERS



Whenever borosilicate glass 3.3 components have to be connected to those of other materials of construction, we recommend the use of predrilled adaptor flanges (please see page 9.17). The diameter of the bolt holes in these flanges is identical to the equivalent type of standard flange described on pages 9.12 and 9.14 in order to limit the bolting force to the figure applicable to glass components.

As the mating flange is usually drilled to take larger bolts, reducing washers should be used to locate the smaller bolts centrally in the mating flange hole. These are supplied in stainless steel as standard.

The »DN« figure in the table below refers to the nominal size of the coupling.

Reducing washers can be supplied in other sizes on request.

Reducing Washers for Flanges to EN 1092, PN 10

Suitable for coupling DN	D	d1	H	Reference
15	13	7	3	**RWSS13/7**
25	13	9	3	**RWSS13/9**
40-100	17	9	3	**RWSS17/9**
150	21	11	3	**RWSS21/11**
200-300	21	9	3	**RWSS21/9**

Reducing Washers for Flanges to ANSI, Class 150

Suitable for coupling DN	D	d1	H	Reference
15	15	7	3	**RWSS15/7**
25-40	15	9	3	**RWSS15/9**
50-100	18	9	3	**RWSS18/9**
150	21	11	3	**RWSS21/11**
200	21	9	3	**RWSS21/9**
300	24	9	3	**RWSS24/9**

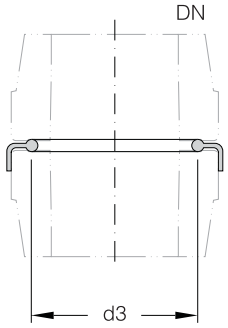
GASKETS

The choice of the correct gasket is of crucial importance for the proper functioning of borosilicate glass 3.3 plant and pipeline as well as for connections to components in other materials of construction. Depending on the particular application, a suitable gasket can be selected from the four basic versions described below.

Special gaskets and gaskets in other materials can also be supplied to special order.

GASKETS

PTFE ‘O’ Ring Gaskets



This simple type is the most widely used gasket. It is self-centring on the periphery of the pipe end and up to and including DN 300 the sealing ‘O’ ring sits in a groove on the buttress end face.

‘O’ ring gaskets are made to the highest standards from pure, high quality PTFE.

‘O’ ring gaskets are also suitable in many cases for connections to components in other materials of construction provided the surface does not exhibit any great unevenness. We would be happy to advise you in cases of doubt.

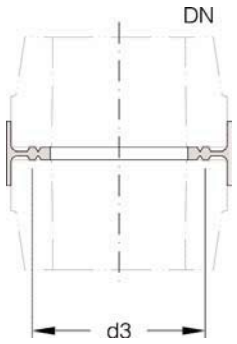
DN	d3	Reference
15	23	**TR15**
25	34	**TR25**
40	48	**TR40**
50	61	**TR50**
80	88	**TR80**
100	121	**TR100**
150	172	**TR150**
200	220	**TR200**
300	321	**TR300**
450	492	**TRN450**
600	646	**TRN600**
800	871	**TR800**
1000	1050	**TR1000**

GASKETS

GMP-Compliant Gaskets

The essential difference between this special type and the version described on page 9.22 is that the seal between the glass components is made on the internal bore. To do this it was necessary to replace the 'O' ring with a flat, slender sealing bead. The same quality material is used as for the »TR..« type.

In addition, these gaskets have a double collar that prevents the product escaping radially in the event of leakage.

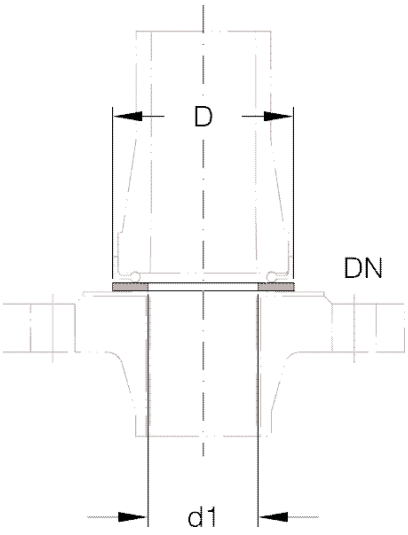


DN	d3	Reference
15	23	TRGMP15
25	34	TRGMP25
40	48	TRGMP40
50	61	TRGMP50
80	88	TRGMP80
100	121	TRGMP100
150	172	TRGMP150
200	220	TRGMP200
300	321	TRGMP300
450	509	TRNGMP450
600	662	TRGMP600

GASKETS

Flat Gaskets

If borosilicate glass 3.3 components have to be connected to PTFE-lined components, we recommend the use of a flat gasket in addition to the 'O' ring gasket. The standard bolting forces applicable to the connection of glass components are then adequate for these applications and the 'O' ring cannot press into the PTFE sealing surface. These flat gaskets are also made from a PTFE material of selected quality.



DN	D	d1	Reference
15	29	17	TP15
25	42	27	TP25
40	57	40	TP40
50	70	51	TP50
80	99	77	TP80
100	133	106	TP100
150	185	156	TP150
200	233	205	TP200
300	338	302	TP300

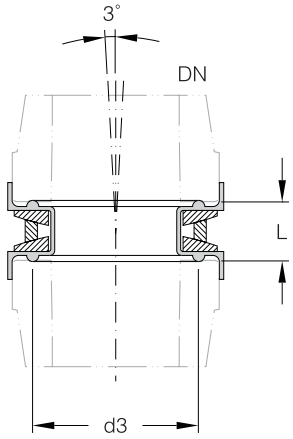
GASKETS

Flexible Gaskets

These flexible gaskets are ideal for applications in which angular deviations resulting from manufacturing tolerances have to be corrected or where a 'fall' has to be created deliberately. The outside of the gasket is made from pure PTFE of selected quality and the ring and washers from stainless steel.

Deflections of up to 3° (equivalent to 52mm/m) are possible. Up to a temperature of 180 °C, the permissible operating pressure is the same as for glass components of the same nominal size.

If earthing straps are required for flexible gaskets to discharge electrostatic charges, they should be ordered separately. They are also suitable for retrofitting.



DN	d3	L	Reference
15	23	11	**KSG15**
25	34	12	**KSG25**
40	48	14	**KSG40**
50	61	16	**KSG50**
80	88	20	**KSG80**
100	121	22	**KSG100**
150	172	28	**KSG150**

BELLOWS

Bellows are important elements in the construction of borosilicate glass 3.3 plant and pipeline. They can be used not only to compensate for expansion and contraction due to changes in temperature but also to avoid stress within plant or to ensure stress-free connection to other components, usually in other materials, which could induce vibration (e.g. service lines, pumps, stirred vessels, etc.). The versions described below take into account these various applications.

Bellow flanges are supplied in either epoxy resin coated, spheroidal graphite, cast iron or stainless steel. Screws, nuts and compression springs are stainless steel in both versions.

The relationship between permissible operating pressure and temperature for the various types of bellows is indicated in the tables below. If used at the maximum permissible operating temperature of 200 °C, they are only suitable for use without any internal pressure. Intermediate figures can be interpolated.

Permissible operating conditions for »FB..« bellows

	Permissible operating pressures (bar g)			
DN	20 °C	100 °C	160 °C	200 °C
15	-1 / +4	-1 / +3	-1 / +1,5	
25	-1 / +4	-1 / +3	-1 / +1,5	
40	-1 / +4	-1 / +3	-1 / +1,5	
50	-1 / +4	-1 / +2	-1 / +1	
80	-1 / +3	-1 / +2	0 / +1	
100	-1 / +2	-1 / +2	0 / +1	
150	-1 / +2	-1 / +1,5	0 / +0,7	
200	-1 / +1	-1 / +1	0 / +0,5	
300	-1 / +1	-1 / +0,7	0 / +0,3	

unpressurised

As this table indicates, »FB..« type bellows of DN 80 and above cannot be used under vacuum at temperatures in excess of 100 °C. In such cases type »VB..« vacuum bellows, which have an internal stiffening tube, should be used.

Permissible operating conditions for »VB..«, bellows

	Permissible operating pressures (bar g)			
DN	20 °C	100 °C	160 °C	200 °C
80	-1 / +3	-1 / +2	-1 / +1	
100	-1 / +2	-1 / +2	-1 / +1	
150	-1 / +2	-1 / +1,5	-1 / +0,7	
200	-1 / +1	-1 / +1	-1 / +0,5	
300	-1 / +1	-1 / +0,7	-1 / +0,3	

unpressurised

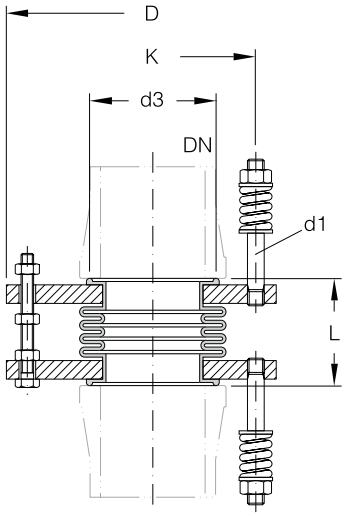
The bellows are set to the correct length with the permitted amount of movement ±ΔL (please see table) using locknuts before leaving the factory. The adjustment of the locknuts at the time of installation and the support and restraint of equipment should be such that the forces resulting from pressure or vacuum in bellows does not result in undue stresses in the pipework. For further information please consult our sales engineers.

We can also supply bellows for higher operating pressures as well as electrically conductive PTFE bellows.

BELLOWS

Bellows for Connecting Glass to Glass

The complete assembly includes the high grade PTFE bellows which is in contact with the product together with two flanges, limiting screws which ensure that the maximum permissible movement is not exceeded and the ancillary items such as studs etc. for the couplings.

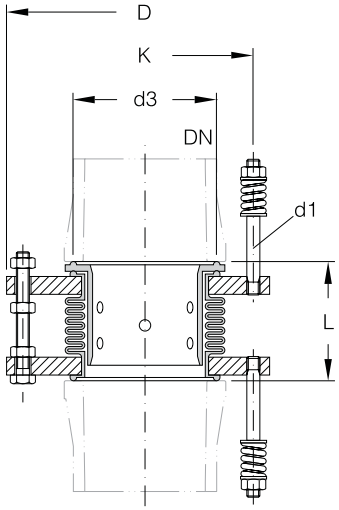


DN	L ±ΔL	D	K	n x d1	d3	Reference Cast iron	Reference Stainless steel
15	35 ± 5	80	50	3 x M6	23	FBCS15	FBSS15
25	43 ± 5	105	70	3 x M8	34	FBCS25	FBSS25
40	52 ± 5	125	86	3 x M8	48	FBCS40	FBSS40
50	50 ± 6	140	98	3 x M8	61	FBCS50	FBSS50
80	68 ± 6	190	133	6 x M8	88	FBCS80	FBSS80
100	70 ± 6	200	178	6 x M8	121	FBCS100	FBSS100
150	73 ± 6	280	254	6 x M10	172	FBCS150	FBSS150
200	73 ± 6	345	295	8 x M8	220	FBCS200	FBSS200
300	73 ± 6	460	400	12 x M8	321	FBCS300	FBSS300

BELLOWS

Vacuum Bellows for Connecting Glass to Glass

The complete assembly includes the high grade PTFE bellows (including stiffening tube) which is in contact with the product together with two flanges, limiting screws, which ensure that the maximum permissible movement is not exceeded, and the ancillary items such as studs etc. for the couplings.



DN	L ±ΔL	D	K	n x d1	d3	Reference Cast iron	Reference Stainless steel
80	73 ± 6	190	133	6 x M8	88	VBCS80	VBSS80
100	76 ± 6	200	178	6 x M8	121	VBCS100	VBSS100
150	79 ± 6	280	254	6 x M10	172	VBCS150	VBSS150
200	79 ± 6	345	295	8 x M8	220	VBCS200	VBSS200
300	79 ± 6	460	400	12 x M8	321	VBCS300	VBSS300

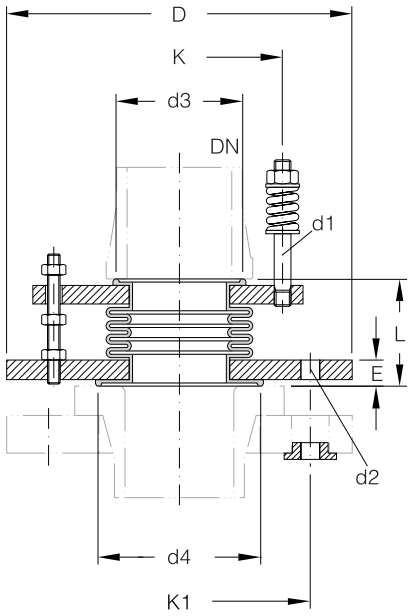
BELLOWS

Bellows for Connecting Glass to other materials

This version comprises the high grade PTFE bellows which is in contact with the product together with two different types of flange, limiting screws, which ensure that the maximum permissible movement is not exceeded, and the ancillary items such as studs etc. for the coupling on the glass side and reducing washers for the other side.

Both flanges supplied with these bellows are sized for the bolting forces and bolt sizes (for hole diameter please see page 9.12) appropriate to glass plant. When connecting to flanges in other materials that usually have larger holes, the reducing washers referred to above (please see also page 9.21) should be used.

We can also supply bellows for coupling to flanges with different hole configurations and sealing faces.



EN 1092, PN 10

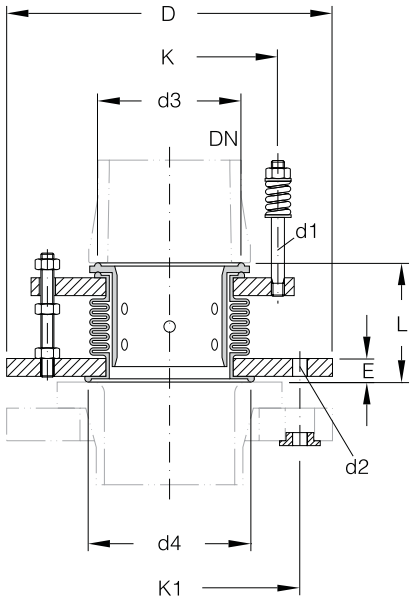
DN	L ±ΔL	D	E	K	K1	n x d1	n x d2	d3	d4	Reference Cast iron	Reference Stainless steel
15	35 ± 5	95	8	50	65	3 x M6	4 x 7	23	28	FBCSE15	FBSSE15
25	43 ± 5	115	12	70	85	3 x M8	4 x 9	34	44	FBCSE25	FBSSE25
40	52 ± 5	150	13	86	110	3 x M8	4 x 9	48	58	FBCSE40	FBSSE40
50	50 ± 6	165	14	98	125	3 x M8	4 x 9	61	71	FBCSE50	FBSSE50
80	68 ± 6	200	17	133	160	6 x M8	8 x 9	88	100	FBCSE80	FBSSE80
100	70 ± 6	220	17	178	180	6 x M8	8 x 9	121	128	FBCSE100	FBSSE100
150	73 ± 6	285	19	254	240	6 x M10	8 x 11	172	178	FBCSE150	FBSSE150
200	73 ± 6	345	19	295	295	8 x M8	8 x M8	220	231	FBCSE200	FBSSE200
300	73 ± 6	460	19	400	400	12 x M8	12 x M8	321	335	FBCSE300	FBSSE300

ANSI, Class 150

DN	L ±ΔL	D	E	K	K1	n x d1	n x d2	d3	d4	Reference Cast iron	Reference Stainless steel
15	35 ± 5	95	8	50	60	3 x M6	4 x 7	23	28	FBCSA15	FBSSA15
25	43 ± 5	115	12	70	79	3 x M8	4 x 9	34	44	FBCSA25	FBSSA25
40	52 ± 5	150	13	86	98	3 x M8	4 x 9	48	58	FBCSA40	FBSSA40
50	50 ± 6	165	14	98	121	3 x M8	4 x 9	61	71	FBCSA50	FBSSA50
80	68 ± 6	200	17	133	152	6 x M8	4 x 9	88	100	FBCSA80	FBSSA80
100	70 ± 6	220	17	178	190	6 x M8	8 x 9	121	128	FBCSA100	FBSSA100
150	73 ± 6	285	19	254	241	6 x M10	8 x 11	172	178	FBCSA150	FBSSA150
200	73 ± 6	345	19	295	298	8 x M8	8 x M8	220	231	FBCSA200	FBSSA200
300	73 ± 6	460	19	400	432	12 x M8	12 x M8	321	335	FBCSA300	FBSSA300

BELLOWS

Vacuum Bellows for Connecting Glass to other materials



This version comprises the high grade PTFE bellows (including stiffening tube) which is in contact with the product together with two different types of flange, limiting screws, which ensure that the maximum permissible movement is not exceeded and the ancillary items such as studs etc. for the coupling on the glass side and reducing washers for the other side.

Both flanges supplied with these bellows are sized for the bolting forces and bolt sizes (for hole diameter please see page 9.12) appropriate to glass plant. When connecting to flanges in other materials that usually have larger holes, the reducing washers referred to above (please see also page 9.21) should be used.

We can also supply bellows for coupling to flanges with different hole configurations and sealing faces.

EN 1092, PN 10

DN	L ±ΔL	D	E	K	K1	n x d1	n x d2	d3	d4	Reference Cast iron	Reference Stainless steel
80	73 ± 6	200	17	133	160	6 x M8	8 x 9	88	100	VBCSE80	VBSSE80
100	76 ± 6	220	17	178	180	6 x M8	8 x 9	121	128	VBCSE100	VBSSE100
150	79 ± 6	285	19	254	240	6 x M10	8 x 11	172	178	VBCSE150	VBSSE150
200	79 ± 6	345	19	295	295	8 x M8	8 x M8	220	231	VBCSE200	VBSSE200
300	79 ± 6	460	19	400	400	12 x M8	12 x M8	321	335	VBCSE300	VBSSE300

ANSI, Class 150

DN	L ±ΔL	D	E	K	K1	n x d1	n x d2	d3	d4	Reference Cast iron	Reference Stainless steel
80	73 ± 6	200	17	133	152	6 x M8	4 x 9	88	100	VBCSA80	VBSSA80
100	76 ± 6	220	17	178	190	6 x M8	8 x 9	121	128	VBCSA100	VBSSA100
150	79 ± 6	285	19	254	241	6 x M10	8 x 11	172	178	VBCSA150	VBSSA150
200	79 ± 6	345	19	295	298	8 x M8	8 x M8	220	231	VBCSA200	VBSSA200
300	79 ± 6	460	19	400	432	12 x M8	12 x M8	321	335	VBCSA300	VBSSA300

METAL/PTFE SPACERS

These components must always be used as interface spacers when connecting borosilicate glass 3.3 to other materials where a direct connection is not possible because either the inside diameters are different or the mating surface has a highly radiused edge, e.g. on a glass lined branch.

The spacers are in the form of a stainless steel disk, with two soft insert rings and a "U" section high grade PTFE sheath.

In nominal sizes DN 40 to DN 1000 the metal/PTFE spacers are suitable for use with flanges drilled to EN 1092, PN 10 and ANSI, Class 150.
In nominal size DN25 the "EMPA25/25" type has to be used with ANSI Class 150 flanges.

The spacers can be clamped in the coupling in the case of components up to and including DN 600.

In the larger nominal sizes (DN 800 and DN 1000), both components are bolted separately to the spacer, its stainless steel ring being drilled to the appropriate PCDs and hole sizes.The stainless steel coupling screws, nuts and compression springs are included in the supply.

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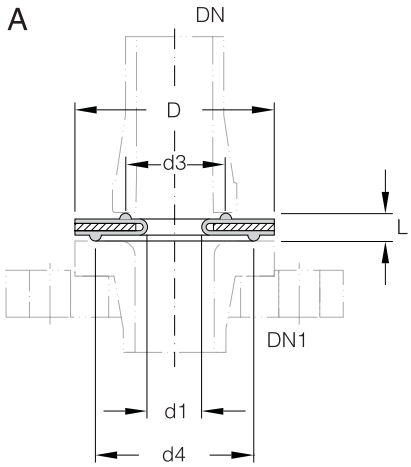

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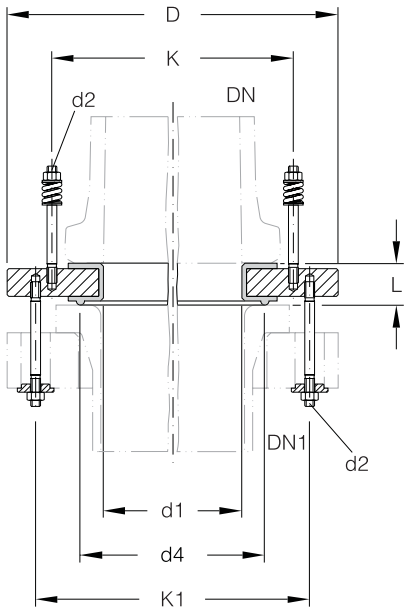


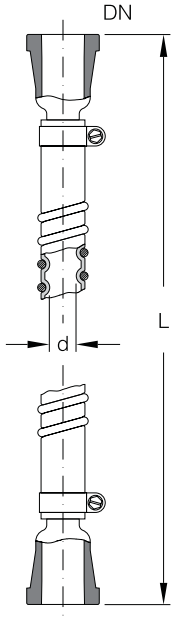
DN	DN1	D	K	K1	d1	n x d2	d3	d4	L	Type	Reference
25	25	68	-	-	18	-	34	54	9	A	EMP25/25
25	25	50	-	-	18	-	34	40	9	A	EMPA25/25
40	32	78	-	-	30	-	48	66	9	A	EMP40/32
40	40	88	-	-	30	-	48	70	9	A	EMP40/40
50	50	102	-	-	42	-	60.5	82	11	A	EMP50/50
50	65	122	-	-	42	-	60.5	110	11	A	EMP50/65
80	65	122	-	-	68	-	88	110	12	A	EMP80/65
80	80	138	-	-	68	-	88	120	12	A	EMP80/80
100	80	138	-	-	100	-	120.5	120	15	A	EMP100/80
100	100	158	-	-	100	-	120.5	142	15	A	EMP100/100
150	150	212	-	-	150	-	172	194	15	A	EMP150/150
150	200	268	-	-	150	-	172	242	16	A	EMP150/200
200	200	268	-	-	200	-	220	242	16	A	EMP200/200
200	250	320	-	-	200	-	220	298	16	A	EMP200/250
300	300	370	-	-	300	-	321	344	16	A	EMP300/300
450	450	544	-	-	450	-	500	492	21	A	EMP450/450
600	600	700	-	-	600	-	640	646	22	A	EMP600/600
800	800	1015	950	950	779	24 x M12	-	840	46	B	EMP800/800
1000	1000	1230	1120	1160	1000	28 x M12	-	1050	46	B	EMP1000/1000

PRODUCT HOSES

These flexible hoses are ideal as product lines in applications calling for frequent modifications, e.g. in pilot plant. They have also proven ideal for complicated piping arrangements where space is limited. Another application for which they provide an ideal solution is to provide a variable height overflow.

The hoses are made of high grade PTFE shrunk onto a borosilicate glass 3.3 hose connector at each end and fixed with a special stainless steel clamp. Longer hoses up to a maximum length of 10 metres can be supplied on request.

All spiral hoses can be used under vacuum to an absolute pressure of 1 mbar at a temperature of 180° C. The permissible operating pressure as a function of temperature is indicated in the table below.



DN	d	L	Minimum bend radius	Permissible operating pressures (bar g) 20 °C	100 °C	120 °C	Reference
15	10	500	35	4	0,5		SP15/500
15	10	1000	35	4	0,5		SP15/1000
15	10	2000	35	4	0,5		SP15/2000
25	17	500	50	4	0,5	unpressurised	SP25/500
25	17	1000	50	4	0,5		SP25/1000
25	17	2000	50	4	0,5		SP25/2000
40	28	500	75	2,5	0,5		SP40/500
40	28	1000	75	2,5	0,5		SP40/1000
40	28	2000	75	2,5	0,5		SP40/2000

HOSES FOR SERVICE CONNECTIONS

These hoses provide a flexible connection for service lines (steam, condensate, heating fluids and coolants) to heat exchangers, boilers and borosilicate glass 3.3 jacketed components or jacketed metal reaction vessels. The corrugated hose, woven sleeve and coupling flange are stainless steel.

Hoses are also available in other lengths on request.

The permissible maximum operating pressure for these hoses is 16 bar g and the permissible operating temperature is -30/+300 °C.

The permissible operating conditions for the components to which they are connected should also be taken into account.

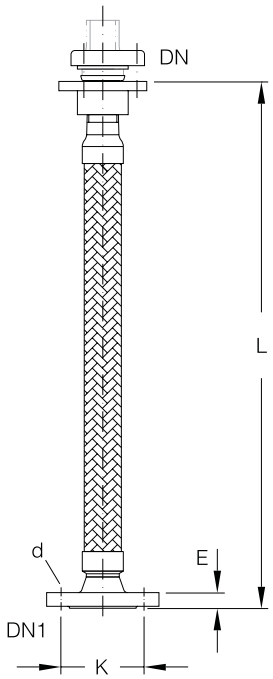
All hoses can also be supplied with woven glass fibre fabric insulation. In such cases the suffix »IN« should be added to the catalogue reference, e.g. »MSCIN25«.

HOSES FOR SERVICE CONNECTIONS

with QVF/EN 1092, PN 16 connections

These are used with heat exchangers and jacketed components with borosilicate glass 3.3 jacket. A complete stainless steel coupling including gasket for connection to the glass side branch is included in the supply.

DN	DN1	L	K	n x d	E	Reference
15	15	1000	65	4 x 14	14	**MSC15**
25	25	1000	85	4 x 14	16	**MSC25**
50	50	1000	125	4 x 18	18	**MSC50**

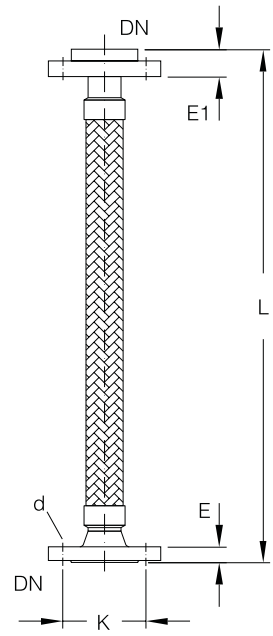


HOSES FOR SERVICE CONNECTIONS

with connections to EN 1092, PN 16

These hoses are used with metal immersion heat exchangers, heating baths and shell and tube heat exchangers with metal headers. One end is fitted with a loose flange for ease of assembly.

DN	L	K	n x d	E	E1	Reference
15	1000	65	4 x 14	14	28	**MSCE15**
25	1000	85	4 x 14	16	32	**MSCE25**
50	1000	125	4 x 18	18	36	**MSCE50**



COMPLETE COUPLINGS FOR BUTTERFLY VALVES

These complete couplings are designed for the installation of butterfly valves (please see section 3 »Valves & Filters«) between borosilicate glass 3.3 buttress ends or between glass and metal flanges.

If the valves are installed between glass fibre reinforced polyester coated glass components (with the suffix »C"« in the catalogue reference), thinner inserts are required for nominal sizes DN 50 to DN 150. In such cases the suffix »C« should also be added to the catalogue reference for the coupling e.g. »FVT../1C«.

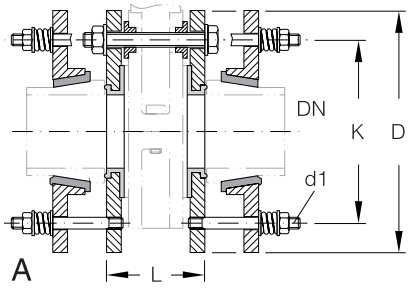
COMPLETE COUPLINGS FOR BUTTERFLY VALVES

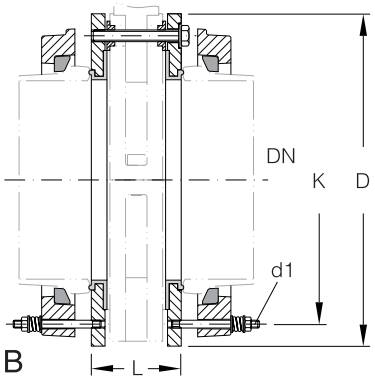
for fitting between glass buttress ends

In this case, the couplings comprise two stainless steel rings with a "U" section high grade PTFE sheath, two spheroidal graphite cast iron flanges (up to DN 150 nominal size) or plastic flanges (DN 200 and 300 nominal size) with inserts and the appropriate quantity of stainless steel reducing washers, set screws, compression springs and nuts.

Stainless steel flanges can also be supplied on request.

DN	L	D	K	n x d1	Type	Reference
50	70	165	125	4 x M8	**A**	**FVT50/1**
80	74	200	160	8 x M8	**A**	**FVT80/1**
100	80	220	180	8 x M8	**A**	**FVT100/1**
150	88	285	240	8 x M10	**A**	**FVT150/1**
200	96	340	295	8 x M8	**B**	**FVT200/1**





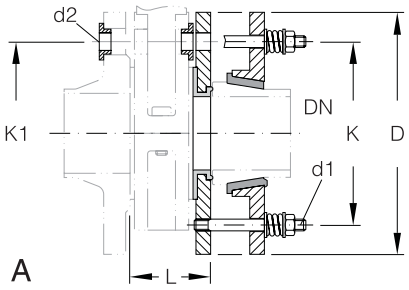
COMPLETE COUPLINGS FOR BUTTERFLY VALVES

for fitting between glass and metal flanges to EN 1092, PN 10

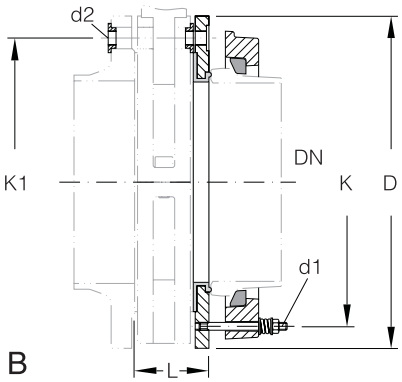
Couplings for this application comprise one stainless steel ring with a "U" section high grade PTFE sheath, one spheroidal graphite cast iron flange (up to DN 150 nominal size) or plastic flange (DN 200 and 300 nominal size) with insert and the appropriate quantity of stainless steel reducing washers, set screws, compression springs and nuts.

Stainless steel flanges can also be supplied on request.

DN	L	D	K	K1	n x d1	n x d2	Type	Reference
50	57	165	125	125	4 x M8	4 x 11	**A**	**FVT50/2**
80	60	200	160	160	8 x M8	8 x 11	**A**	**FVT80/2**
100	66	220	180	180	8 x M8	8 x 11	**A**	**FVT100/2**
150	72	285	240	240	8 x M10	8 x 13	**A**	**FVT150/2**
200	78	340	295	295	8 x M8	8 x 13	**B**	**FVT200/2**



A



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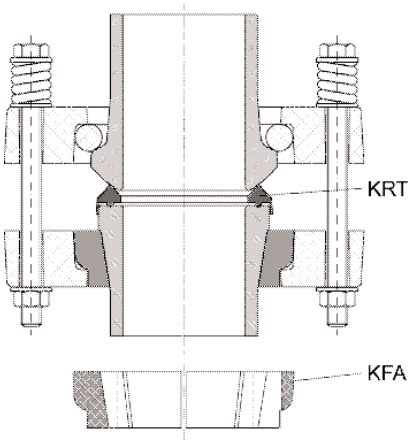
CONNECT SCHOTT TO WPR DN15 - DN150

To connect this diameters a spezial coupling was developed, with the reference no. CPKFA.... and can be used for ball and socket glass-ends. Following pats are in the scope of supply:

2 x SCHD.../K (Schott-backing flanges)
1 x BEIL.../K (Schott-insert)
1 x KFA...(adaptor)
1 x KRT (adaptor PTFE/gasket, Tmax = 130°C)

Especially for the assembling of DN80 and DN100 take care the adaptor gasket KRT is exactly positioned.



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QVF

PROCESS PLANT COMPONENTS

General

QVF structures are designed to support plant and other equipment comprising components exclusively or principally in borosilicate glass 3.3. Because of the special requirements resulting from the use of this material, structures are now available in the form of a proven modular system that not only meets standard requirements but also provides or facilitates solutions for problems of a very special nature.

Basically these structures consist of steel tubing in three different diameters which is connected using the appropriate fittings. As a result, the structures can not only be dismantled and reassembled whenever required but they can also be modified and added to quite easily. The modular system also includes components for establishing fixed points, supporting spherical and cylindrical vessels and horizontal cylindrical components plus a wide range of supports, to mention just the most important items. The result is an extremely flexible system.

The full range of components, which are available as standard in galvanised mild steel and to some extent in stainless steel, is described in this section. Special versions, which are available on request, are referred to under the respective product descriptions.

A detailed listing of all structure components by »Description« and »Catalogue Reference« can be found in the »Index«.

If any supports are required which you cannot find in this section, please contact us. Space does not permit the inclusion of every possible version in this catalogue.

The sizes of structure tubing and other fittings indicated for the various nominal sizes, shapes and configurations of glass components should be adhered to. If this is not possible due to special circumstances, please seek our advice on this and any other problems relating to structures.

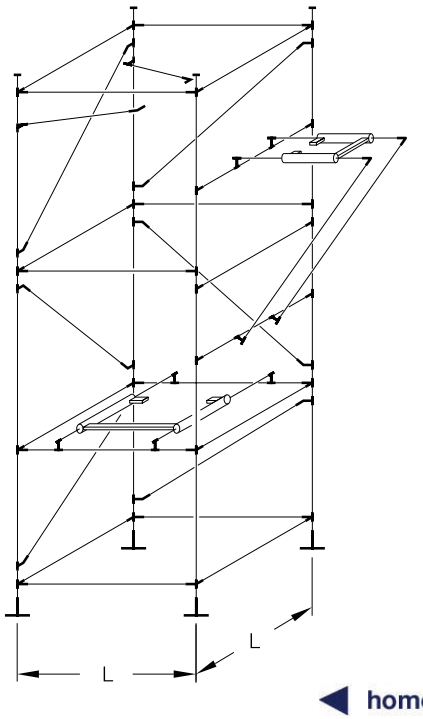
Design of tubular structures

The diameter of structure tubing to be used plus minimum dimensions, i.e. width and depth of tubular structures are determined by the nominal size (cylindrical glass components) or diameter (spherical vessels) and the weight of the components they are designed to support. Details can be found in the table below and the related illustration. If additional equipment or complicated pipework needs to be accommodated in a structure, appropriately larger sizes should be used.

The figures for DN 800 and DN 1000 cylindrical components and 500 litre nominal capacity spherical vessels only apply to installations with a low total weight. In all other cases, we recommend the use of a heavy duty fabricated base structure.

Structure dimensions for

Columns	Cylindrical vessels	Spherical vessels Contents	Structure tube diameter	Structure dimension
DN	DN	l	mm	L
80	-	-	27	400
100	-	-	27	500
150	-	5, 10	42	600
200	-	20	42	700
300	450	50	42	800
450	600	100, 200	42	1000
450	600	100, 200	60	1100
600	-	-	42	1100
600	-	-	60	1400
800	800	-	60	1600/1510
1000	-	-	60	1930/1680



Support structures must be sufficiently rigid to prevent any bending of the individual tubes in excess of the permissible amount and the subsequent transfer of external stress to the glass components. This is achieved by incorporating additional bracing

For rigidity at least two adjacent sides of the structure should be provided with diagonal bracing. In addition, tall structures (e.g. for columns) should be braced back to existing structural steelwork or the walls of the building.

The establishment of fixed points is of particular importance. They are formed by combining a light duty support frame or heavy duty support frame with a coupling, a support plate or a support element (vessel holder, angle bracket, etc.). Fixed points have to carry the entire weight of a unit or column and should therefore, be located at the lowest point (in the case of a vessel holder) or lowest possible point (in the case of a support plate) in the installation.

Assembly of the glass components must always be started from the fixed point.

Glass units and their structures expand at different rates as a result of change in temperature. The unit must, therefore, be able to expand above the fixed point without restraint.

Guides giving lateral support must always be provided for units and columns.

If the overall height of the unit or column is fairly low this can be achieved by using two »KK50-5« or »KK50-7« structure fittings each with one of the set screws of a horizontally positioned coupling passing through them.

Above a certain height this is achieved with a light duty support frame which can also be used to support the weight of glass components during installation and maintenance work.

Guide elements should not be bolted rigidly to the unit or plant during operation.

Where supports are used in a structure for individual components or assemblies, these should be installed in such a way that the glass components are subject in the main to compressive forces. It has to be taken into consideration, that normally an additional fixed point is created at such points.

Glass components must be able to expand freely from a fixed point, therefore a bellows is generally fitted between two fixed points.

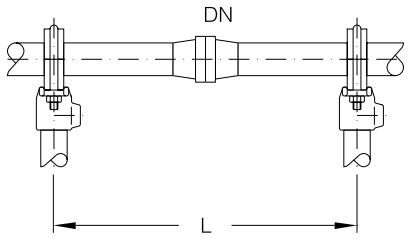
If there is the risk of vibration generated in the vicinity of glass units being transferred to the tubular structure, appropriate preventive measures should be taken.

The structure components described on pages 10.5 to 10.8 can also be used to support platforms and walkways for the use of plant operators and maintenance staff. They are connected directly to the plant support structure which results in a particularly compact design. The decking of these platforms and walkways is in the form of grids or embossed metal sheets.

Supporting Horizontal Pipeline

Both horizontal and vertical pipelines must be supported at certain intervals to avoid subjecting them to additional stress due to bending or lateral movement (e.g. on either side of bellows). The recommended spacing of horizontal pipeline supports as a function of nominal size is indicated in the table below.

	Maximum spacing of supports	L in mm for	
Pipeline DN	Gas	Liquid $\rho = 1$	Liquid $\rho = 1{,}8$
15	1500	1500	1000
25	2000	2000	1500
40	2500	2000	1500
50	2500	2000	1500
80	3000	2000	1500
100	3000	2500	2000
150	3000	2000	2000
200	3000	2000	1500
300	3000	2000	1500



Clean Room Design

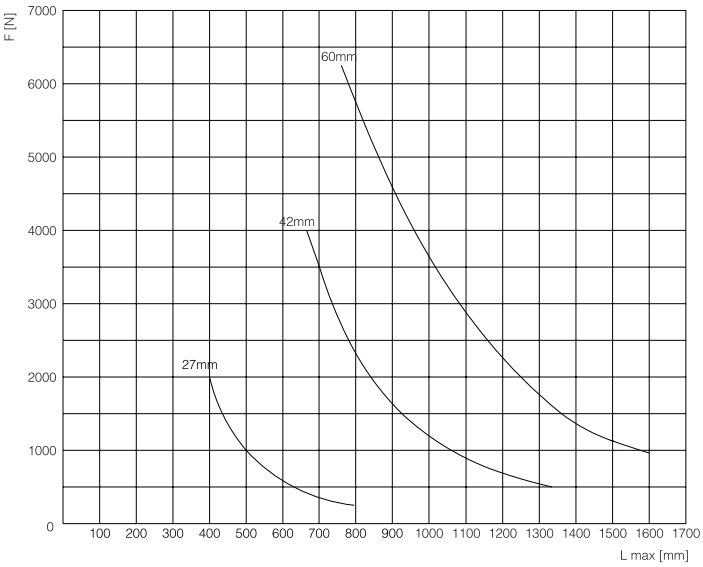
Stainless steel structure, support and coupling components can be supplied for use in applications where clean room conditions apply (see also Section 9 »Couplings«).

We would be happy to advise you on the requirements applicable in each particular case using the guidelines we have drawn up for the design of complete tubular structures for use under clean room conditions.

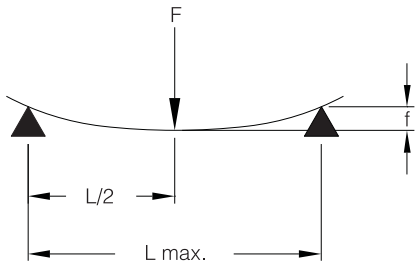
STRUCTURE TUBING

This tubing is used in conjunction with the structure fittings described on pages 10.6 to 10.8 to form the basis of structures to support borosilicate glass 3.3. plant. Structure tubing is available in three sizes and can be supplied in galvanised mild steel or stainless steel. This is to take into account the fact that glass is used in areas where various degrees of corrosive atmosphere are encountered.

As it is important that the structure tubing should not bow by more than 2 mm, the maximum permissible free length of the tubing is dependent on the load it is carrying. This can be calculated, at a fixed point for example, as the sum of the weights of support frames, glass components including couplings and liquid content. The number of support points should also be taken into account. Further information can be found in the illustration alongside and the diagram below.



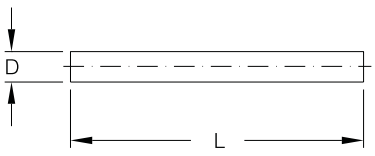
Permissible structure tubing load as a function of unsupported length



If individual lengths of tubing are required cut to a specific length, please add the length (in mm) to the catalogue reference.

For tubular structures that are to be installed in clean rooms, we can also supply stainless steel tubes with a ground finish on request. The catalogue reference is then for example: »M-RO7E/..«.

The structure components described below and on pages 10.6 to 10.8 can also be used to support platforms for the use of plant operators and maintenance staff. They are connected direct to the plant support structure which results in a particularly compact design. The decking of these platforms is in the form of grids or embossed metal sheets.



D	Fitting size	L	Reference Galvanised	Reference Stainless steel	Reference Ground
27	5	variable	RO5/....	RO5E/....	M-RO5E/....
42	7		RO7/....	RO7E/....	M-RO7E/....
60	9		RO9/....	RO9E/....	-
75	10		RO10/....	-	-

STRUCTURE FITTINGS

Closed sided fittings are used principally in conjunction with structure tubing to build complete structures where the design has been fixed prior to installation together with the necessary support frames, brackets, diagonal bracing and supports. In such cases subsequent modifications can only be carried out on a restricted basis.

If it is expected at the time of the original installation that extensive modification may be required or will have to be carried out subsequently, we recommend that the use of open sided structure fittings be considered. They are also ideal for items added to the structure at a later stage (e.g. support frames) or extra fittings (e.g. brackets).

We can supply a comprehensive range of closed and open sided structure fittings to cater for the various applications and the many different requirements encountered in practice. The finishes available are galvanised (catalogue reference »KK..« and »KKO..«), coated blue (catalogue reference »M-KK..« and »M-KKO..«) and to some extent stainless steel (catalogue reference »KK.. E« and »KKO..E«). Further details, including details of the various possible uses of the individual fittings and the necessary accessories, can be found in the tables on pages 10.7 and 10.8.

If type »KKO..« structure fittings are fixed to horizontal tubes, they should always be located on top of the tube, so that a closed assembly is ensured.

The structure components described on pages 10.5 to 10.8 can also be used to support platforms for the use of plant operators and maintenance staff. They are connected directly to the plant support structure which results in a particularly compact design. The decking of these platforms is in the form of grids or embossed metal sheets.

STRUCTURE FITTINGS

Closed Sided Fittings

Purpose	For tube diam.	Reference	Reference coated blue	Reference Stainless steel	
Single tube socket	27 mm	KK10-5	M-KK10-5	-	
	42 mm	KK10-7	M-KK10-7	KK10-7E	
	60 mm	KK10-9	M-KK10-9	-	
Tube coupler (to lengthen tubes)	27 mm	KK14-5	M-KK14-5	-	
	42 mm	KK14-7	M-KK14-7	-	
	60 mm	KK14-9	M-KK14-9	-	
90° Elbow fitting	27 mm	KK15-5	M-KK15-5	-	
	42 mm	KK15-7	M-KK15-7	-	
	60 mm	KK15-9	M-KK15-9	-	
Corner fitting	27 mm	KK21-5	M-KK21-5	-	
	42 mm	KK21-7	M-KK21-7	KK21-7E	
	60 mm	KK21-9	M-KK21-9	-	
Side fitting	27 mm	KK26-5	M-KK26-5	-	
	42 mm	KK26-7	M-KK26-7	KK26-7E	
	60 mm	KK26-9	M-KK26-9	-	
For tee connections	27 mm	KK35-5	M-KK35-5	-	
	42 mm	KK35-7	M-KK35-7	KK35-7E	
	60 mm	KK35-9	M-KK35-9	-	
For cross connections	27 mm	KK40-5	M-KK40-5	-	
	42 mm	KK40-7	M-KK40-7	KK40-7E	
	60 mm	KK40-9	M-KK40-9	-	
For fitting removable tubes	27 mm	KK45-5	M-KK45-5	-	
	42 mm	KK45-7	M-KK45-7	KK45-7E	
	60 mm	KK45-9	M-KK45-9	-	
For diagonals in conjunction with KKO50-7 and KKO50-9 respectively	27 mm	KK49-5	M-KK49-5	KK49-5E	
	42 mm	KK49-7	M-KK49-7	-	
	60 mm	-	-	-	
For supporting flanges in conjunction with KKO45-75 and KKO45-95 respectively (see p. 10.8)	27 mm	KK50-5	M-KK50-5	-	
	42 mm	KK50-7	M-KK50-7	-	
	60 mm	-	-	-	
Structure foot	27 mm	KK62-5	M-KK62-5	-	
	42 mm	KK62-7	M-KK62-7	KK62-7E	
	60 mm	KK62-9	M-KK62-9	-	
Replacement grub screw	27 mm	KK97-5	-	DI916-12x16-A2	
	42 mm	KK97-7	-	DI916-16x16-A2	
	60 mm	KK97-7	-	DI916-16x16-A2	
Replacement Allen key	27 mm	KK99-5	-	6mm	
Steel (inches)	42 mm	KK99-7	-	8mm	
Stainless steel (metric)	60 mm	KK99-7	-	8mm	
Plug for tube ends	27 mm	RP-5	-	-	
	42 mm	RP-7	-	-	
	60 mm	RP-9	-	-	
	75 mm	RP-10	-	-	

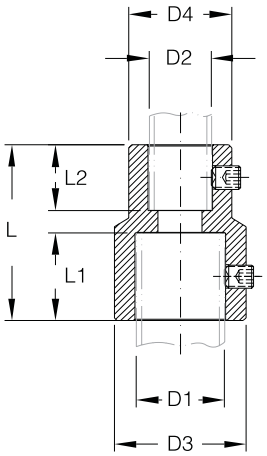
STRUCTURE FITTINGS

Open Sided Fittings

Purpose	For tube diam.	Reference	Reference coated blue	Reference Stainless steel	
For addition of single tubes	27 mm	-	-	-	
	42 mm	KKO10-7	M-KKO10-7	-	
	60 mm	-	-	-	
For fitting removable 75 mm diam.	27 mm				
tubes with support frames	42 mm	KKO17-109	M-KKO17-109	-	
RRDN600//2.5 75 mm diam. tube	60 mm				
Corner socket for addition of extra	27 mm	-	-	-	
tubes	42 mm	KKO21-7	M-KKO21-7	-	
	60 mm	-	-	-	
			-		
Corner socket for addition of extra	27 mm	-		-	
tubes	42 mm	KKO26-7	M-KKO26-7	-	
	60 mm	-	-	-	
Corner socket for addition of extra	27 mm	-	-	-	
tubes	42 mm	KKO35-7	M-KKO35-7	-	
	60 mm	-	-	-	
For addition of removable 27 mm	27 mm	-	-	-	
diam. tubes, support frames	42 mm	KKO45-75	M-KKO45-75	KKO45-75E	
and brackets	60 mm	KKO45-95	M-KKO45-95	-	
For support frames	27 mm	KKO45-5	M-KKO45-5	-	
	42 mm	KKO45-7	M-KKO45-7	-	
	60 mm	KKO45-97	M-KKO45-97	-	
For diagonals in conjunction with	27 mm	KKO50-5	M-KKO50-5	KKO50-5E	
fittings KK49-7 and KK49-5	42 mm	KKO50-7	M-KKO50-7	KKO50-7E	
	60 mm	KKO50-9	M-KKO50-9		
Replacement grub screw (metric)	27 mm	DI916-12x16-ST	-	DI916-12x16-A2	
	42 mm	DI916-16x20-ST	-	DI916-16x20-A2	
	60 mm	DI916-16x20-ST	-	DI916-16x20-A2	
Replacement Allen key	27 mm	6mm	-	6mm	
	42 mm	8mm	-	8mm	
	60 mm	8mm	-	8mm	

REDUCING FITTINGS

If it is necessary for design or technical reasons to reduce the diameter of the tubing used in a support structure, the reducing fittings listed below can be used. In principle, these should be handled in the same way as »KK14.. « sleeve couplings.

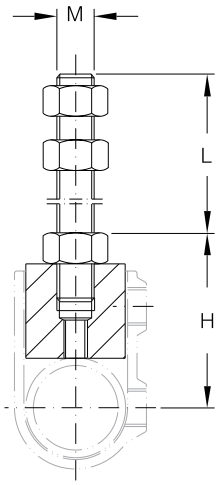


D1	D2	D3	D4	L	L1	L2	Reference-Galvanised	Reference Stainless steel
42	27	70	48	100	51	39	RC75	RC75E
60	42	90	70	125	62	51	RC97	RC97E

STRUCTURE BUSHES

One of the best ways to fix supports in structures is to use screwed rod. This is connected directly to the tubular structure using structure fittings or, where heavy components are involved, using structure bushes as well. In addition, structure bushes are also required to fix support brackets and support saddles (see pages 10.14 and 10.15) in the structure.

In special cases, it is also possible to fix vessel holders and support rings (see pages 10.13 and 10.14) and column support plates (see page 10.12) directly to the tubular structure using structure bushes. There is then no need to use a support frame (see page 10.11).



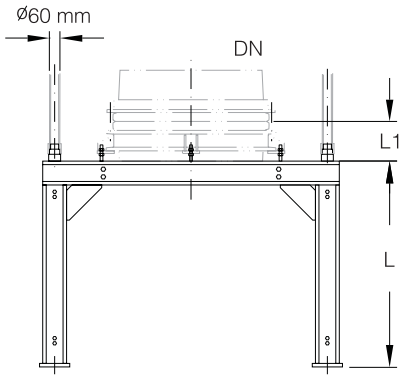
For tube	M	L	H	Reference Stainless steel
27	8	57	50	RRM8-5
27	10	78	52	RRM10-5
42	8	57	68	RRM8-7
42	10	78	69	RRM10-7
42	12	75	71	RRM12-7
42	16	95	74	RRM16-7
60	12	75	95	RRM12-9
60	16	95	98	RRM16-9

SUPPORT STOOLS

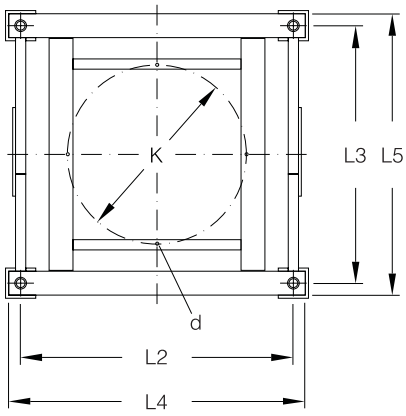
Because of the considerably greater weight to be supported when tall units and columns in the DN 800 and DN 1000 nominal sizes are involved, the design of the fixed point must be more substantial than in the smaller nominal sizes. The ideal solution is a heavy duty support stool which can be combined with a fixed point flange (see section 9 »Couplings«) and on which the 60mm tubular structure required is erected. A typical application is shown in the illustration alongside.

Plant and columns must be able to expand without restriction from a fixed point, therefore a bellows is generally fitted between two fixed points.

We can also supply suitable designs for special sizes and other nominal sizes on request.



To suit DN	L	L1	L2	L3	L4	L5	K	n x d	Reference
800	variable	183	1600	1510	1740	1650	1050	4 x 18	**UBD800/2**
1000	variable	184	1930	1680	2070	1820	1220	4 x 18	**UBD1000/2**



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SUPPORT FRAMES

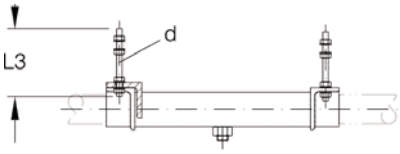
These frames are used in the DN80 to DN600 range of nominal sizes as a base element for a fixed point and are installed horizontally using tubes and fittings on a framework in the structure. Cylindrical components are then fixed directly via a coupling (see pages 9.4 to 9.10) or indirectly via support plates (see page 10.12). Spherical and cylindrical vessels are supported indirectly via vessel holders or support rings (see pages 10.13 and 10.14). These elements are connected to the support frames using screwed rod which, for stability reasons, should be as short as possible. They are also used to align the couplings or structure elements supported on the support frames.

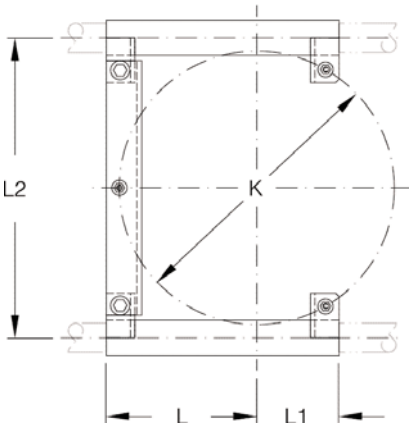
Support frames are supplied in galvanised finish or stainless steel and have a QVF PCD. The material required for fixing the support frames and the screwed rod required (see above) are included in the supply.

Information about using these support frames with couplings, vessel holders, etc. can be found in the respective product description.

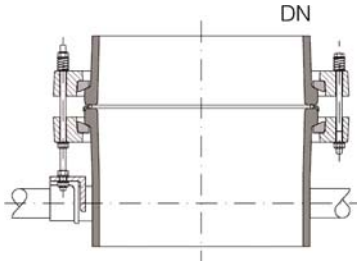
Plant and columns must be able to expand without restriction from a fixed point, therefore a bellows is generally fitted between two fixed points.

Plant and columns must always be provided with lateral support. Above a certain height, support frames should be used for this purpose.



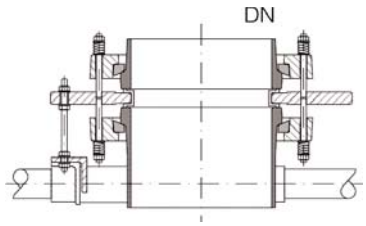


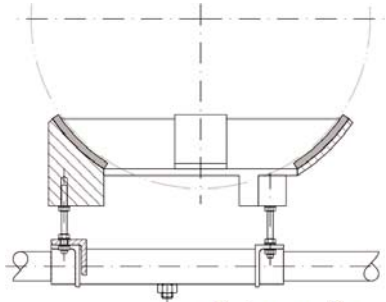
DN	L	L1	L2	L3	K	n x d	Tube diam	Reference Galvanised	Reference Stainless steel
80	92	51	195	150	133	3 x M8	27	RRD80	RRD80E
100	107	63	235	200	178	3 x M8	27	RRD100	RRD100E
150	145	83	300	200	254	3 x M10	27	RRD150	RRD150E
150	147	88	300	200	254	3 x M10	42	RRD150/1.25	RRD150/1.25E
200	168	120	305	200	280-295	3 x M8	42	RRD200	RRD200E
300	218	119	436	210	395-400	3 x M8	42	RRD300	RRD300E
400	273	115	550	270	495	3 x M12	42	RRDN400	RRDN400E
400	273	115	575	340	495	3 x M12	60	RRDN400/2	RRDN400/2E
450	313	133	640	280	585	3 x M12	42	RRDN450	RRDN450E
450	313	133	660	340	585	3 x M12	60	RRDN450/2	RRDN450/2E
600	379	226	700	330	710	3 x M12	42	RRDN600	RRDN600E
600	375	230	755	410	710	3 x M12	75	RRDN600/2.5	RRDN600/2.5E



Typical applications

Reference	Columns DN Fig. A	Support rings	Vessel supports Fig. C	Support plates Fig. B
RRD80	80	-	-	CTF80
RRD100	100	-	-	CTF100
RRD150	150	VRSE5, VRSE10	-	CTF100
RRD150/1.25	150	VRSE5, VRSE10	-	CTF150
RRD200	200	VRSE20,	VHZ300, VHZE300	CTF200
RRD300	300	-	VHS50, VHSE50	
			VHS100, VHSE100	
			VHZ450, VHZE450	CTF300
RRDN400	-	-	-	CTF300
RRDN400/2	-	-	-	-
RRDN450	450	-	-	-
RRDN450/2	450	-	VHS200, VHSE200	CTFN450
RRDN600	600	-	-	CTFN450
RRDN600/2.5	600	-	-	





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SUPPORT PLATES

Indirectly installing cylindrical borosilicate glass 3.3 components on support frames using support plates offers a significant benefit compared to the combination of a coupling and light duty support frame: the glass components above and below can be installed and dismantled independently from each other. As the PCD is different, the support flange remains firmly connected to the support frame or structure during such work.

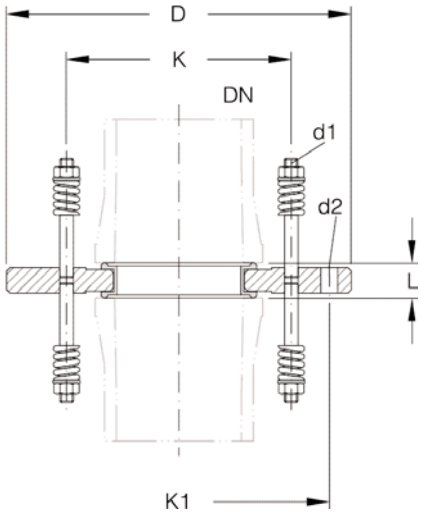
Another benefit of the support plate is that the weight of the glass components supported on it only results in compressive stress therefore as a rule there is no need to compensate for this weight.

Support plates consist of a steel ring, which is primed and protected against corrosion by an epoxy resin paint, and a high grade PTFE sheath. The complete assembly also includes the coupling components for the glass such as bolts, nuts, washers, and compression springs but no flanges. As the support plate incorporates a sealing bead on both sides, no additional PTFE gaskets are required.

The support plate metal rings can also be supplied in stainless steel on request.

DN	D	L	K	K1	n x d1	n x d2	Type	To suit support frame	Reference
80	205	18	133	178	6 x M8	3 x 9	A	RRD100	CTF80
100	290	18	178	254	6 x M8	3 x 11	A	RRD150	CTF100
								RRD150/1.25	
150	350	20	254	295	6 x M10	3 x 11	A	RRD200	CTF150
200	430	22	295	400	8 x M8	3 x 11	A	RRD300	CTF200
300	530	22	400	495	12 x M8	3 x 14	A	RRDN400	CTF300
								RRDN400/2	CTF300
450	760	27	585	710	16 x M8	3 x M12	B	RRDN600	CTFN450
								RRDN600/2.5	
600	900	33	710	850	20 x M12	3 x M16	B	U-section	CTFN600

A



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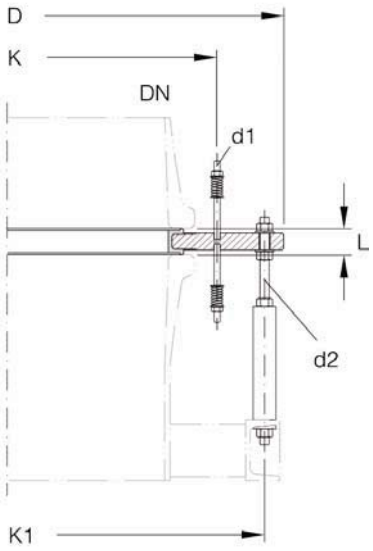


VESSEL HOLDERS

These vessel holders are used to support borosilicate glass 3.3 spherical and cylindrical vessels with a nominal capacity of 50 litres and above. The lining of the holder is specially shaped to fit the outside of the particular vessel. The metal casing of the holder is cast aluminium or steel (»VHS500« only) primed and epoxy resin painted to protect it against corrosion, or stainless steel respectively. All vessel holders have a QVF PCD.

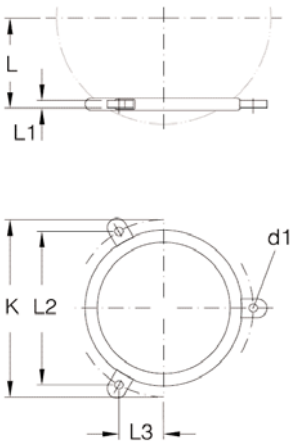
Spherical Vessel Holders

To suit Spherical vessel Capacity (l)	Support frame	D	H	L	L1	L2	L3	K	d1	Type	Reference	Reference Stainless steel
50	RRD300	440	126	270	15	342	99	395	3 x M12	B	VHS50	VHSE50
100	RRD300	500	122	330	15	346	100	400	3 x M12	B	VHS100	VHSE100
200	RRDN450 u. 450/2	620	118	360	15	540	112	585	3 x M12	B	VHS200	VHSE200
500	-	980	267	505	12	566	330	800	4 x 18	C	VHS500	VHSE500

Cylindrical Vessel Holders

To suit: Cylindrical vessel DN	(l)	Support frame	D	H	L	L1	L2	L3	K	d1	Type	Reference	Reference Stainless steel
150	5	RRD150 a. 150/1.25	-	-	68	10	220	64	254	3 x 11	A	-	VRZE150
200	10	RRD150 a. 150/1.25	-	-	88	10	220	64	254	3 x 11	A	-	VRZE200
300	20-50	RRD200	320	125	195	15	198	99	280	3 x M10	B	VHZ300	VHZE300
450	100-200	RRD300	440	125	240	15	342	99	395	3 x M12	B	VHZ450	VHZE450
600	300-400	RRD300	500	122	330	15	346	100	400	3 x M12	B	VHS100	VHSE100
800	500	RRDN600 a. 600/2.5	654	162	455	10	574	209	710	3 x 14	D	VHZ800	VHZE800
1000	750	RRDN600 a. 600/2.5	736	181	550	10	574	209	710	3 x 14	D	VHZ1000	VHZE1000

A



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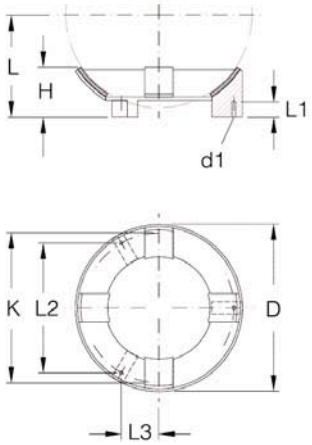

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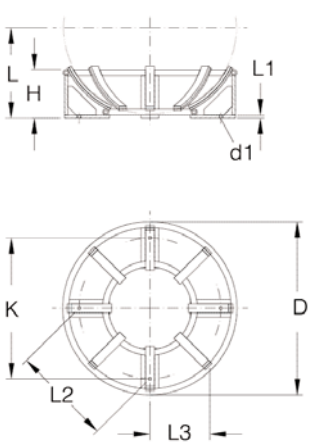

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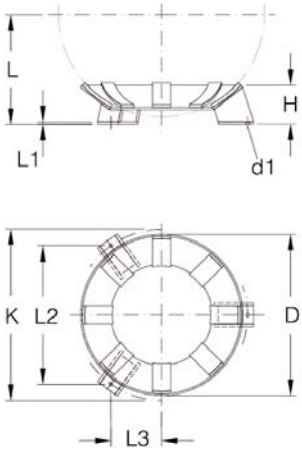
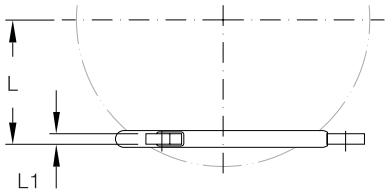
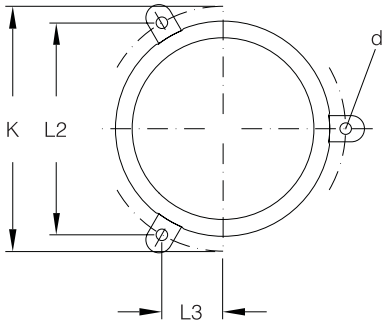


SPHERICAL VESSEL SUPPORT RINGS

This type of ring can be used to support borosilicate glass 3.3 spherical vessels up to a nominal capacity of 20 litres. They are stainless steel and are fitted with a close fitting silicon rubber sleeve. All support rings are drilled to a QVF PCD.

An alternative method of supporting these small spherical vessels in a tubular structure is by means of support brackets (see page 10.15). These are connected to the coupling on the top neck and this then forms the fixed point.



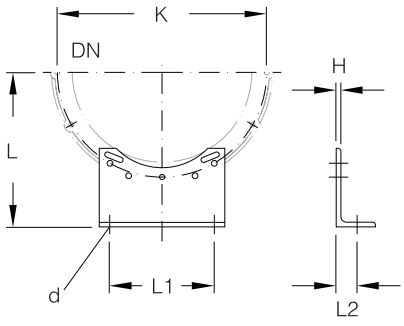


To suit Spherical vessel Capacity (l)	Support frame	L	L1	L2	L3	K	n x d	Reference
5	RRD150 or 150/1.25	78	10	220	64	254	3 x 11	VRSE5
10	RRD150 or 150/1.25	106	10	220	64	254	3 x 11	VRSE10
20	RRD200	138	10	209	104	295	3 x 9	VRSE20

ANGLED SUPPORT BRACKETS

These brackets are used to support horizontal assemblies in the DN150 to DN300 nominal size range such as horizontal separators (see section 4 »Vessels & Stirrers«) or shell and tube heat exchangers (see section 5 »Heat Exchangers«). They are fitted to a coupling using longer set screws or fixed by means of »RRM..« structure bushes and closed or open structure fittings (see pages 10.6 to 10.9) to cross members.

Angled support brackets are supplied with either a galvanised finish or stainless steel as standard. The material required for connection to the tubular structure (see above) should be ordered separately.

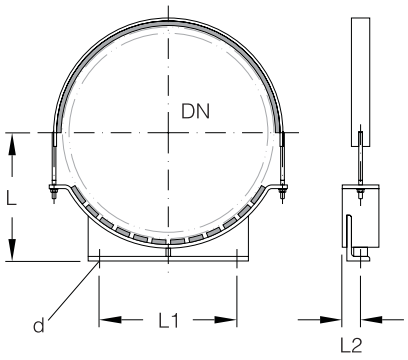


To suit DN	K	H	L	L1	L2	d	Reference Galvanised	Reference Stainless steel
100	178	8	165	110	30	13	SUA100	SUA100E
150	225	9	208	200	40	14	SUA150	SUA150E
150	240	9	215	200	40	14	SUA150	SUA150E
150	254	9	208	200	40	14	SUA150	SUA150E
200	280	9	235	200	40	14	SUA150	SUA150E
200	295	9	243	200	40	14	SUA150	SUA150E
300	395	9	293	200	40	14	SUA150	SUA150E
300	400	9	295	200	40	14	SUA150	SUA150E

SUPPORT SADDLES

These support saddles with bracing strap are designed to support DN450 and DN600 assemblies such as horizontal separators (see Section 4 »Vessels & Stirrers«) in tubular structures. The lower part consists of a steel bar with segmented rubber lining and a profiled steel support frame. It is fixed by means of »RRM..« structure bushes and closed or open structure fittings (see pages10.6 to 10.9) to horizontal structure tubes. The upper part is a rubber lined metal strap braced to the lower part by means of captive screwed rods and nuts.

Support saddles are supplied with either a galvanised finish or stainless steel as standard. The material required for connection to the tubular structure (see above) should be ordered separately.



To suit DN	L	L1	L2	d	Reference Galvanised	Reference Stainless steel
450	280	300	40	18	SUS450	SUS450E
600	362	400	50	18	SUS600	SUS600E
800	475	630	50	18	SUS800	SUS800E

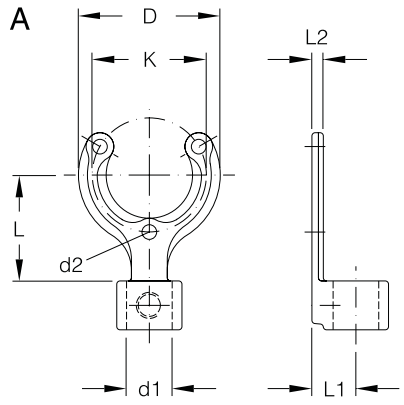
PIPELINE SUPPORT BRACKETS

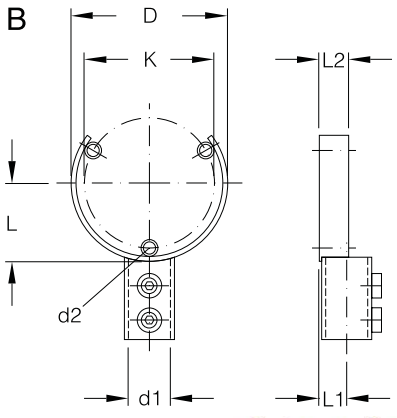
These brackets are used in tubular support structures in conjunction with open sided structure fittings (see page 10.8), which guarantee the flexibility required in installation, and short lengths of structure tubing to provide a versatile support for borosilicate glass 3.3. components. They are supplied in a galvanised finish as standard.

As these brackets have the same PCD as the corresponding flange, they can be connected directly to a coupling. However, the standard set screws should be replaced by longer set screws or screwed rod which is available in all the normal diameters. Both should be at least 50 mm longer than the standard set screws to ensure an adequate setting range.

Fixing pipeline support brackets couplings nearly always creates a fixed point, from which glass components must be able to expand without restriction, therefore a bellows is generally fitted between two fixed points.

If long horizontal tubes are required to connect pipeline support brackets to the structure, these must be braced diagonally.





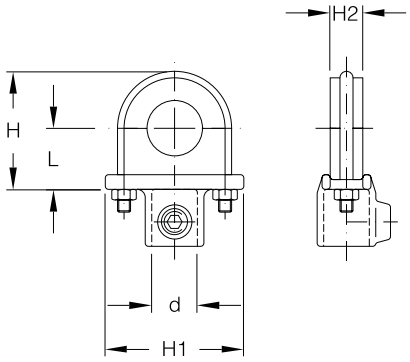
To suit DN	L	L1	L2	K	D	d1	d2	Type	Reference Galvanised	Reference Stainless steel
25	65	27	7,0	70	87	27	9	A	HK25	HK25E
40	65	27	7,0	86	103	27	9	A	HK40	HK40E
50	70	27	7,0	98	115	27	9	A	HK50	HK50E
80	100	30	16	133	156	27	9	A	HK80	HK80E
80	80	31	30	133	160	42	12,5	B	HK80/1.25	HK80/1.25E
100	103	31	30	178	205	42	12,5	B	HK100/1.25	HK100/1.25E
150	140	31	40	254	281	42	12,5	B	HK150/1.25	HK150/1.25E
200	164	31	50	295	328	42	11	B	HK200/1.25	HK200/1.25E
300	220	31	50	400	440	42	11	B	HK300/1.25	HK300/1.25E

PIPELINE SUPPORTS

These supports are used in conjunction with open sided structure fittings (please see page 10.8) which guarantee the flexibility required in installation, or structure feet and short lengths of structure tubing to support borosilicate glass 3.3 pipeline components in tubular structures and from walls. They consist of a two-piece rubber collar which grips the glass pipe firmly and a 'U' bolt fixed to a backplate. The latter has a socket so that it can be connected to the structure.

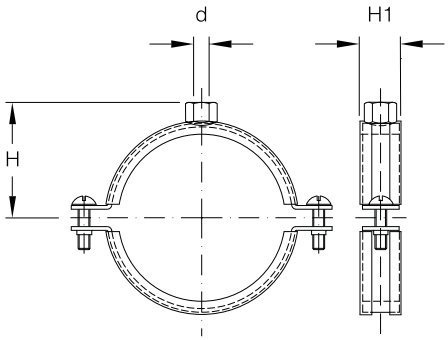
Pipeline supports are supplied with metal parts either in galvanised finish or stainless steel as standard. When correctly installed they do not constitute a fixed point, i.e. the weight of vertical pipelines should be taken up by other means, e.g. using pipeline support brackets.

When these supports are used for horizontal pipelines the recommended spacing indicated on page 10.4 must be adhered to. In the case of vertical pipeline, the distance between two supports should not exceed 5 meters.



To suit DN	L	H	H1	H2	d	Reference Galvanised	Reference Stainless steel
15	38	73	85	20	28	**HR15**	**HR15E**
25	38	73	85	20	28	**HR25**	**HR25E**
40	56	103	110	20	28	**HR40**	**HR40E**
50	56	103	110	20	28	**HR50**	**HR50E**
80	81	155	165	20	28	**HR80**	**HR80E**
100	81	155	165	20	28	**HR100**	**HR100E**
150	127	255	270	40	28	**HR150**	**HR150E**
200	154	299	310	40	44	**HR200**	**HR200E**
300	189	374	390	40	44	**HR300**	**HR300E**

PIPE HANGERS



These hangers can be used to fix borosilicate glass 3.3 pipeline in structures and to walls. They comprise two parts, one having a captive nut welded to it into which M10 or M12 screwed rod can be screwed. A lock nut is also required. When used in tubular structures, the screwed rod is fixed with two nuts in closed sided (»KK50-5« or »KK50-7«) or open sided (»KKO50-5« or »KKO50-7«) structure fittings which guarantee the necessary flexibility in installation. A special type of support can be supplied for wall fixing.

Pipe hangers are supplied in either galvanised finish or stainless steel as standard with rubber to prevent direct contact with the glass components. When correctly installed they do not constitute a fixed point, i.e. the weight of vertical pipelines should be taken up by other means, e.g. using pipeline support brackets.

When these supports are used for horizontal pipelines the recommended spacing indicated on page 10.4 must be adhered to. In the case of vertical pipeline, the distance between two supports should not exceed 5 meters.

Structure fittings type »KK50-5« and »KKO50-5« require drilling out from 11 to13 mm diameter.

To suit DN	H	H1	d	Reference Galvanised	Reference Stainless steel
15	36	23	M10	**HS15**	**HS15E**
25	42	23	M10	**HS25**	**HS25E**
40	48	34	M12	**HS40**	**HS40E**
50	54	34	M12	**HS50**	**HS50E**
80	69	34	M12	**HS80**	**HS80E**
100	83	34	M12	**HS100**	**HS100E**
150	110	46	M12	**HS150**	**HS150E**
200	137	46	M12	**HS200**	**HS200E**
300	183	46	M12	**HS300**	**HS300E**

SAFETY SCREENS

Fitting support structures with safety screens meets two safety requirements at the same time: operating personnel are protected from any hazards that may arise from possible breakages and the units are protected against mechanical damage arising from external sources.

Safety screens consist of sheets of medium flexibility transparent PVC with high resistance to abrasion. To ensure good lateral stability, they have galvanised metal strips bolted on both sides at the top and bottom. Hooks are also fitted to the top edge to enable the safety screen to be suspended from the structure.

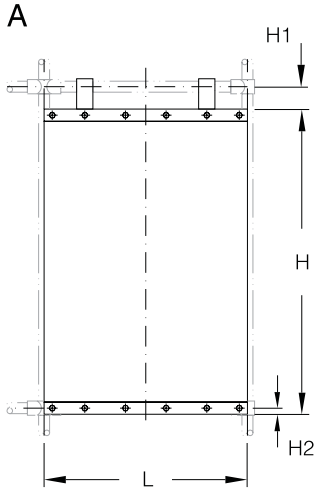
Safety screens are 5 mm thick. Up to a width of 1100 mm they are supplied in one piece as standard. Larger screens are two-piece with an overlap. The maximum possible length is 6 metres.

Safety screens can also be supplied on request in special widths, in articulated form or, where the complete structure requires screening, with sliding panels or with covered hand holes on the operating side.

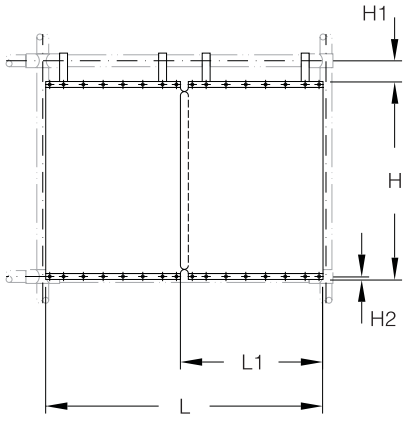
When ordering, the required height in mm should be added to the catalogue reference.

We can also supply rigid PVC safety screens with antistatic coating, i.e. electrically conductive surface, on request. These are suitable for use in areas where electrostatic loading is possible. The surface resistance is 10^6 to $10^7\Omega$.

A



B



Structure dimension L	L1	Type	H	H1	H2	Structure tube diameter	Reference
400	-	**A**		55	15	27	**SVH400/..**
500	-	**A**		55	15	27	**SVH500/..**
600	-	**A**		75	15	42	**SVH600/..**
700	-	**A**		75	15	42	**SVH700/..**
800	-	**A**		75	15	42	**SVH800/..**
900	-	**A**	variable	75	15	42	**SVH900/..**
1000	-	**A**		75	15	42	**SVH1000/..**
1100	-	**A**		75	15	42	**SVH1101/..**
1100	-	**A**		105	15	60	**SVH1102/..**
1400	720	**B**		105	15	60	**SVH1400/..**
1510	775	**B**		105	15	60	**SVH1510/..**
1600	820	**B**		105	15	60	**SVH1600/..**
1680	860	**B**		105	15	60	**SVH1680/..**
1930	985	**B**		105	15	60	**SVH1930/..**

QVF

PROCESS PLANT COMPONENTS

INDEX

GENERAL

Pipelines, apparatus and systems made of borosilicate glass 3.3 which carry the CE mark, are manufactured and quality monitored in compliance with the Pressure Equipment Directive (97/23/EC). At the same time, the chemical/physical material characteristics of borosilicate glass 3.3 and the design of glass components are subject to national and international standards.

The type of flange for glass parts is not standardised, but is determined according to the user's technical demands. Whilst, for instance, a flat safety flange is excellently suited to GMP system engineering due to its construction with little dead space, a ball and socket system is highly valued for its flexibility.

For this reason, QVF has included the ball and socket pipeline system from the former Schott catalogue 6076, in this supplement, to the WPR catalogue, as the "KF pipeline system" and is manufacturing it with state-of-the-art technology and in line with the aforementioned standards and directives as an alternative coupling system for glass system engineering.

The KF pipeline system has therefore not only been given the CE mark, but certification for compliance with the Clean Air Act has also been provided for the valves and couplings. Accuracy of manufacturing, storage and quality control all correspond to WPR 2002.

REFERENCE NUMBERS

The Schott KF system from catalogue 6076 is a common coupling system in the fields of industry and research. The referrence numbers listed in this catalogue supplement therefore correspond to those from catalogue 6076. In those instances in which the technical properties have been changed, an "N" (new) has been added to the reference number.

Whilst the parts made purely of glass are listed identically to listings in catalogue 6076, for hand-operated valves, for instance, the important dimensions for connection compatibility are identical, but internal parts have been given a second seal and a cone as standard to improve regulation. An "N" has been added to the order number for these valves (e.g. VEN 25).

MATERIAL PROPERTIES/OPERATING DATA

The "KF pipeline system" is a supplement to the QVF catalogue "Process Plant Components", also known as "WPR 2002". Thus, the information given in the catalogue on

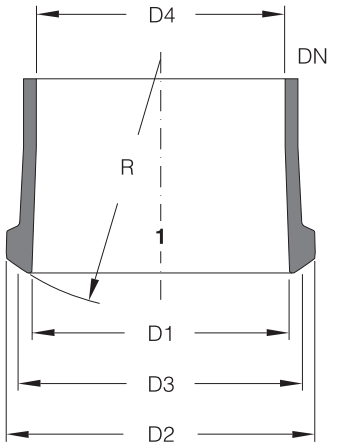
- borosilicate glass 3.3, chemical, physical properties
- permitted operating conditions
- dimensioning of components
- labelling of components
- danger analysis and potential hazards

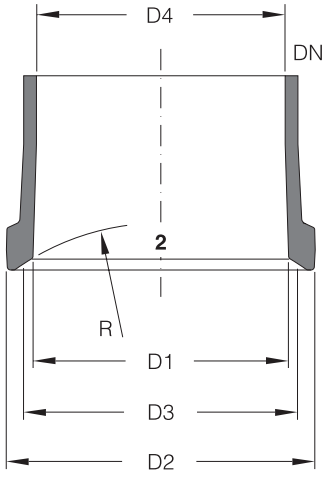
also applies to the "KF pipeline system". You will find the operating data for the valves in the valves section of this supplement. Any variations are listed for each individual article as applicable.

KF PIPE ENDS

The designation KF was derived from Schott's German name for the ball and socket system ("Kugel-Flansch") and comprises spherically ground sealing surfaces and a shoulder flange for force transmission. In this catalogue, ball pipe ends are all labelled with the code digit 1 and socket pipe ends with code digit 2. Possible variants are also shown in the drawings.

You will find the main KF pipe end dimensions in the following table.





DN	D1	D2	D3	D4 [1]	R
15	14-16	30	23	14-16	18
25	23-26	44	34	22,5-25,5	25
40	38-42	62	51	38,5-41,5	40
50	47,5-52,5	76	63	48,5-51,5	50
80	80,5-82,5	110	96	77,5-82,5	80
100	100-102	130	116	102-108	100
150	152,5-154,5	184	169	147-155	150
200	202-204	233	220	196-206	200
300	299-301	338	321	292,5-305,5	300

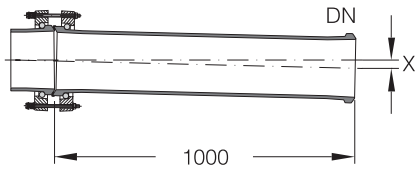
[1] The dimensions provided refer to the internal diameter of straight standard pipes.

The internal diameter of fittings and melting areas may vary.

ALIGNMENT OF KF COUPLINGS

Before the final sealing force is applied, glass parts can be aligned at an angle to each other so that horizontal pipelines can be laid with a gradient α without the need for additional components.

The following table shows the maximum permitted angle of alignment by nominal diameter for a pipe with a length of 1000 mm.



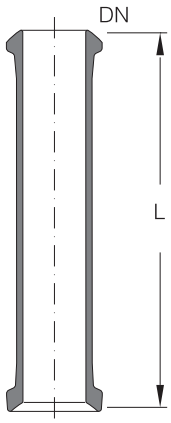
DN	15	25	40	50	80	100	150	200	300
X (mm)	87	52	52	52	52	34	26	17	17
α °	5	3	3	3	3	2	1,5	1	1

CONNECTION TO OTHER MATERIALS AND FLANGE SYSTEMS

Connections can be made to pipelines made of other materials either using bellows, in order to compensate for expansion and forces from external material, or using AMS or AFS glass adapters from WPR 2002. These adapters can also be used to connect to the flat safety flange. This connection can however, be established without the need for an additional glass part, using a CPKFA adaptor coupling.

KF PIPE SECTIONS

	Reference	Reference	Reference
L	DN15	DN25	DN40
100	RO15/0100	RO25/0100	RO40/0100
125	RO15/0125	RO25/0125	RO40/0125
150	RO15/0150	RO25/0150	RO40/0150
175	RO15/0175	RO25/0175	RO40/0175
200	RO15/0200	RO25/0200	RO40/0200
300	RO15/0300	RO25/0300	RO40/0300
400	RO15/0400	RO25/0400	RO40/0400
500	RO15/0500	RO25/0500	RO40/0500
700	RO15/0700	RO25/0700	RO40/0700
1000	RO15/1000	RO25/1000	RO40/1000
1500	RO15/1500	RO25/1500	RO40/1500
2000	RO15/2000	RO25/2000	RO40/2000
3000	-	RO25/3000	RO40/3000



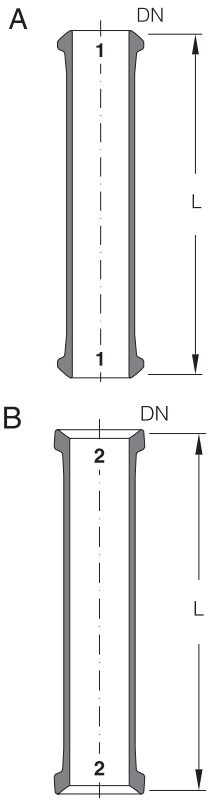
	Reference	Reference	Reference
L	DN50	DN80	DN100
100	RO50/0100	RO80/0100	RO100/0100
125	RO50/0125	RO80/0125	RO100/0125
150	RO50/0150	RO80/0150	RO100/0150
175	RO50/0175	RO80/0175	RO100/0175
200	RO50/0200	RO80/0200	RO100/0200
300	RO50/0300	RO80/0300	RO100/0300
400	RO50/0400	RO80/0400	RO100/0400
500	RO50/0500	RO80/0500	RO100/0500
700	RO50/0700	RO80/0700	RO100/0700
1000	RO50/1000	RO80/1000	RO100/1000
1500	RO50/1500	RO80/1500	RO100/1500
2000	RO50/2000	RO80/2000	RO100/2000
3000	RO50/3000	RO80/3000	RO100/3000

	Reference	Reference	Reference
L	DN150	DN200	DN300
150	RO150/0150	RO200/0150	-
175	RO150/0175	RO200/0175	-
200	RO150/0200	RO200/0200	RO300/0200
300	RO150/0300	RO200/0300	RO300/0300
400	RO150/0400	RO200/0400	RO300/0400
500	RO150/0500	RO200/0500	RO300/0500
700	RO150/0700	RO200/0700	RO300/0700
1000	RO150/1000	RO200/1000	RO300/1000
1500	RO150/1500	RO200/1500	RO300/1500
2000	RO150/2000	RO200/2000	RO300/2000
3000	RO150/3000	-	-

KF PIPE SECTIONS

Short pipes with the required combination of ball and socket are used to adjust to the various different types of flange.

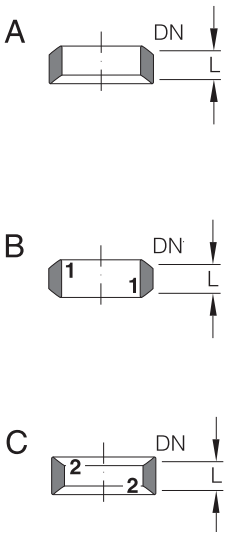
		Reference	Reference
DN	L	Type A	Type B
15	100	RO15/0100/11	RO15/0100/22
25	100	RO25/0100/11	RO25/0100/22
40	100	RO40/0100/11	RO40/0100/22
50	100	RO50/0100/11	RO50/0100/22
80	125	RO80/0125/11	RO80/0125/22
100	125	RO100/0125/11	RO100/0125/22
150	150	RO150/0150/11	RO150/0150/22
200	150	RO200/0150/11	RO200/0150/22
300	200	RO300/0200/11	RO300/0200/22



KF SPACERS

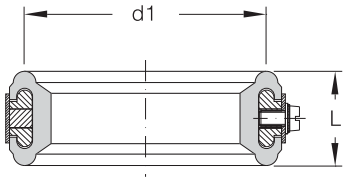
KF spacers are used to adjust lengths and types of flanges. They are fastened in place between couplings using accordingly long screws.

		Reference	Reference	Reference
DN	L	Type A	Type B	Type C
15	25	RO15/0025	RO15/0025/11	RO15/0025/22
15	50	RO15/0050	RO15/0050/11	RO15/0050/22
25	25	RO25/0025	RO25/0025/11	RO25/0025/22
25	50	RO25/0050	RO25/0050/11	RO25/0050/22
40	25	RO40/0025	RO40/0025/11	RO40/0025/22
40	50	RO40/0050	RO40/0050/11	RO40/0050/22
50	25	RO50/0025	RO50/0025/11	RO50/0025/22
50	50	RO50/0050	RO50/0050/11	RO50/0050/22
80	50	RO80/0050	RO80/0050/11	RO80/0050/22
100	50	RO100/0050	RO100/0050/11	RO100/0050/22
150	50	RO150/0050	RO150/0050/11	RO150/0050/22
200	50	RO200/0050	RO200/0050/11	RO200/0050/22



KF UNIVERSAL SPACERS

These spacers can be used for all Schott pipe ends up to a nominal diameter of DN 150. They consist of a PTFE body with an external stainless steel support and can be used at an operating temperature of up to 120°C, up to the nominal pressures of the glass pipelines.

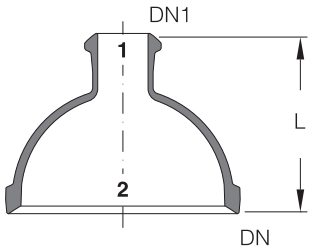


The universal spacer cannot be used in combination with the safety flat buttress end.

DN	L	d1	Reference
15	25	23	RO15/0025/U
25	25	35	RO25/0025/U
40	25	50	RO40/0025/U
50	25	64	RO50/0025/U
80	50	96	RO80/0050/U
100	50	116	RO100/0050/U
150	50	169	RO150/0050/U

KF REDUCERS

Concentric Reducers



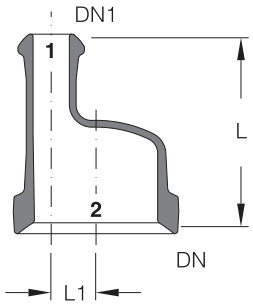
Nominal diameter DN 80 and above with round bottom version (.../R).

DN	DN1	L	Reference
25	15	100	RS25/15/21
40	15	100	RS40/15/21
40	25	100	RS40/25/21
50	15	100	RS50/15/21
50	25	100	RS50/25/21
50	40	100	RS50/40/21
80	25	125	RS80/25/21/R
80	40	125	RS80/40/21/R
80	50	125	RS80/50/21/R
100	25	150	RS100/25/21/R
100	40	150	RS100/40/21/R
100	50	150	RS100/50/21/R
100	80	150	RS100/80/21/R
150	25	200	RS150/25/21/R
150	40	200	RS150/40/21/R
150	50	220	RS150/50/21/R
150	80	200	RS150/80/21/R
150	100	200	RS150/100/21/R
200	25	175	RS200/25/21/R
200	40	175	RS200/40/21/R
200	50	175	RS200/50/21/R
200	80	200	RS200/80/21/R
200	100	200	RS200/100/21/R
200	150	200	RS200/150/21/R
300	25	225	RS300/25/21/R
300	40	225	RS300/40/21/R
300	50	225	RS300/50/21/R
300	80	250	RS300/80/21/R
300	100	250	RS300/100/21/R
300	150	250	RS300/150/21/R
300	200	250	RS300/200/21/R

KF REDUCERS, ECCENTRIC

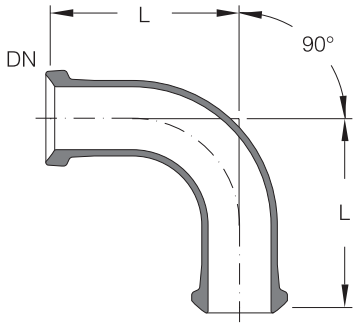
Nominal diameter DN 80 and above with round bottom version (.../R).

DN	DN1	L	L1	Reference
50	25	100	13	**RU50/25/21**
80	25	125	25	**RU80/25/21/R**
100	25	150	35	**RU100/25/21/R**

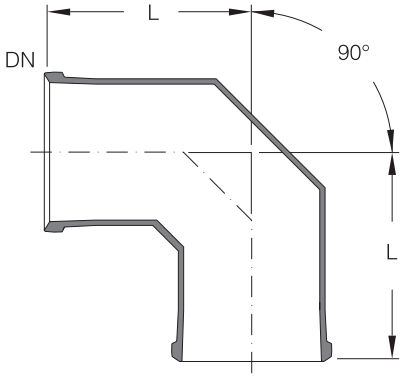


KF BENDS 90°

DN	L	Reference
15	50	**BO15/90**
25	100	**BO25/90**
40	150	**BO40/90**
50	150	**BO50/90**
80	200	**BO80/90**
100	250	**BO100/90**
150	250	**BO150/90**
200	300	**BO200/90**
300	400	**BO300/90**



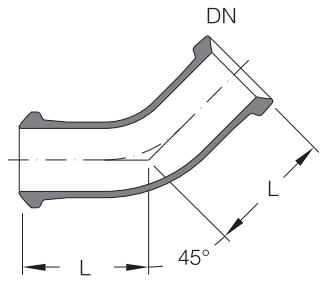
DN15 - DN100



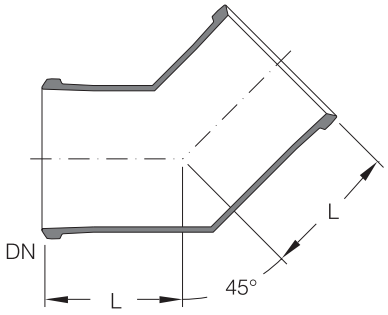
DN150 - DN300

KF BENDS 45°

DN	L	Reference
15	50	BO15/45
25	75	BO25/45
40	100	BO40/45
50	100	BO50/45
80	125	BO80/45
100	175	BO100/45
150	200	BO150/45
200	200	BO200/45
300	200	BO300/45



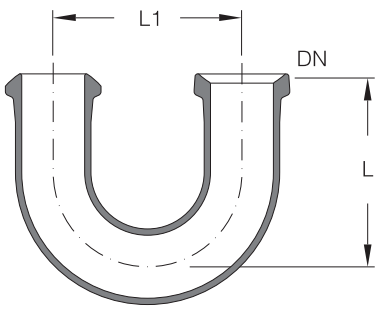
DN15 - DN100



DN150 - DN300

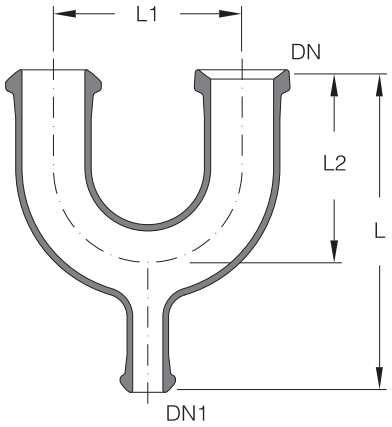
KF U BENDS

DN	L	L1	Reference
15	100	100	UB15
25	150	150	UB25
40	150	150	UB40
50	150	150	UB50
80	200	210	UB80
100	200	230	UB100



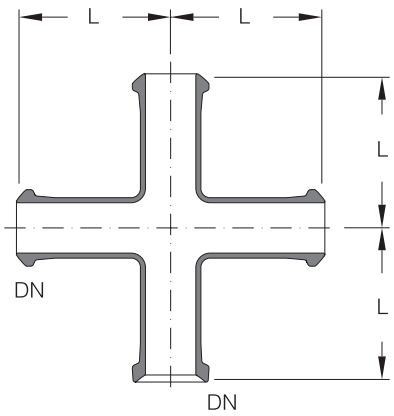
KF U BENDS WITH BOTTOM OUTLET

DN	DN1	L	L1	L2	Reference
15	15	200	100	100	**HO15/15**
25	25	250	150	150	**HO25/25**
40	25	250	150	150	**HO40/25**
50	25	250	150	150	**HO50/25**
80	25	300	210	200	**HO80/25**
100	50	350	230	200	**HO100/50**



KF CROSS PIECES

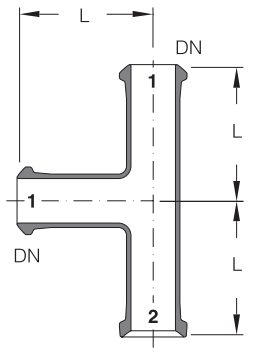
DN	L	Reference
15	50	**KR15**
25	100	**KR25**
40	150	**KR40**
50	150	**KR50**
80	200	**KR80**
100	250	**KR100**
150	250	**KR150**



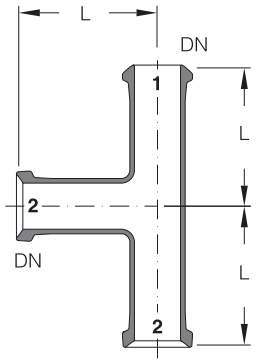
KF EQUAL TEE PIECES

DN	L	Reference Type A	Reference Type B
15	50	TS15/121	TS15/122
25	100	TS25/121	TS25/122
40	150	TS40/121	TS40/122
50	150	TS50/121	TS50/122
80	200	TS80/121	TS80/122
100	250	TS100/121	TS100/122
150	250	TS150/121	TS150/122
200	300	TS200/121	TS200/122
300	400	TS300/121	TS300/122

A

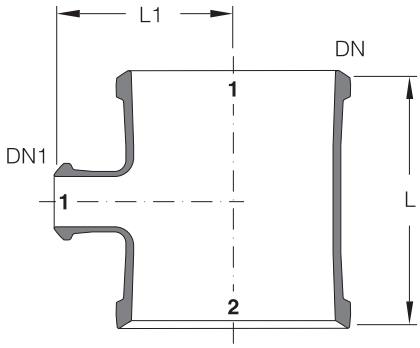


B



KF UNEQUAL TEE PIECES

DN	DN1	L	L1	Reference
25	15	150	75	TS25/15/121
40	25	200	100	TS40/25/121
50	25	200	100	TS50/25/121
50	40	200	100	TS50/40/121
80	25	200	100	TS80/25/121
80	40	250	100	TS80/40/121
80	50	250	100	TS80/50/121
100	25	200	125	TS100/25/121
100	40	250	125	TS100/40/121
100	50	250	125	TS100/50/121
100	80	300	125	TS100/80/121
150	25	200	150	TS150/25/121
150	40	250	150	TS150/40/121
150	50	250	150	TS150/50/121
150	80	300	150	TS150/80/121
150	100	300	150	TS150/100/121
200	25	200	175	TS200/25/121
200	40	250	175	TS200/40/121
200	50	250	175	TS200/50/121
200	80	300	175	TS200/80/121
200	100	300	175	TS200/100/121
200	150	400	225	TS200/150/121
300	25	300	225	TS300/25/121
300	40	400	225	TS300/40/121
300	50	400	225	TS300/50/121
300	80	400	225	TS300/80/121
300	100	400	225	TS300/100/121
300	150	500	275	TS300/150/121
300	200	600	275	TS300/200/121

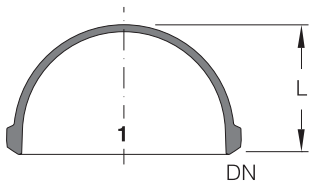


KF CLOSURES

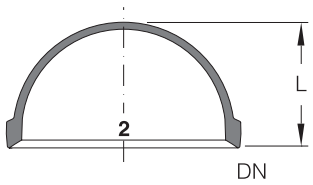
Nominal diameter DN 80 and above with round bottom version (.../R).

		Reference	Reference
DN	**L ca.**	**Type A**	**Type B**
15	70	**BL15/1**	**BL15/2**
25	70	**BL25/1**	**BL25/2**
40	85	**BL40/1**	**BL40/2**
50	100	**BL50/1**	**BL50/2**
80	70	**BL80/1/R**	**BL80/2/R**
100	90	**BL100/1/R**	**BL100/2/R**
150	115	**BL150/1/R**	**BL150/2/R**
200	125	**BL200/1/R**	**BL200/2/R**
300	170	**BL300/1/R**	**BL300/2/R**

A

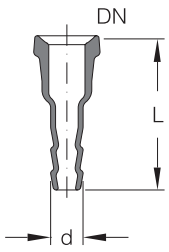


B



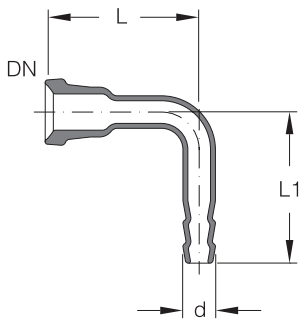
KF STRAIGHT HOSE CONNECTORS

DN	**Schlauch-iØ d**	**L**	**Reference**
15	8	100	**OL15/8**
15	20	100	**OL15/20**
25	8	100	**OL25/8**
25	15	100	**OL25/15**
25	20	100	**OL25/20**
25	30	120	**OL25/30**
40	50	150	**OL40/50**
50	60	150	**OL50/60**



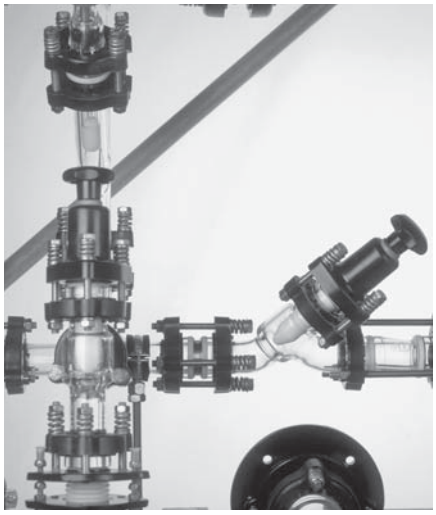
KF HOSE CONNECTORS, 90°

DN	hose-iØ d	L	L1	Reference
15	20	50	70	**OL15/20/W**
25	20	100	100	**OL25/20/W**
25	30	100	100	**OL25/30/W**



General

The valves of the KF system, with the exception of pressure retaining valves, vent valves and drain valves, have the same dimensions for connection as the valves in catalogue 6076 but also feature the usual internal parts as found in WPR. The combination of connecting dimensions from the former Schott range with WPR internal parts ensures that valves in existing pipelines can be easily replaced and guarantees quick availability and state-of-the-art technology. Hand-operated valves are fitted with a second seal on the handwheel as standard.



All valves comply with the conditions of the Clean Air Act.

Permitted operating conditions

The following operating pressure values, related to nominal diameter, apply for a maximum operating temperature of 180°C:

Table 1: **Bellows type valves**

		Connection DN					
Armatur		15	25	40	50	80	100
VEN, VSN, VEN/KP, VEN/SP, VSN/KP, VSN/SP,	p_S (bar g)	3	3	3	2	1,5	-
VEN/RH, VEN/RPK, VEN/RPS, VSN/OL, VEN/LUE, VDN	p_S (bar g)	3	3	3	2	1,5	-
VEN/FS	p_S (bar g)	-	2	-	2	-	2

Table 2: **Return valves, ball-valves**

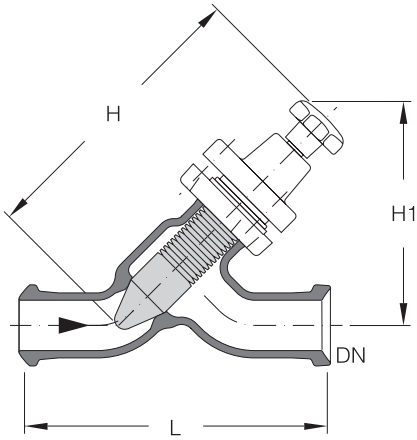
		Connection DN					
Armatur		15	25	40	50	80	100
KH/G, KHPN/G, KHK, KHKP, VKN/H, VKN/V	p_S (bar g)	4	4	4	4	3	-

Because of the shape of the base and cone, bellow valves with a PTFE cone can be used as both shut-off valves or to roughly regulate flow. The throttle function of these valves is only ensured if the flow is against the cone.

KF ON/OFF VALVES WITH REGULATING PLUG

Straight Through Valves

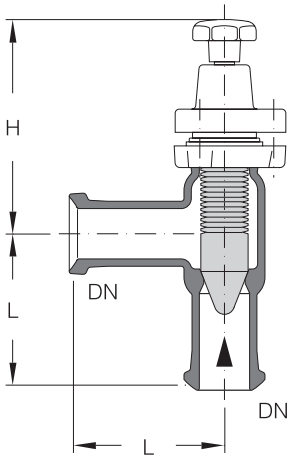
DN	L	H	H1	Reference
15	150	120	90	VSN15
25	200	220	170	VSN25
40	300	285	215	VSN40
50	300	295	225	VSN50
80	400	430	320	VSN80



KF ON/OFF VALVES WITH REGULATING PLUG

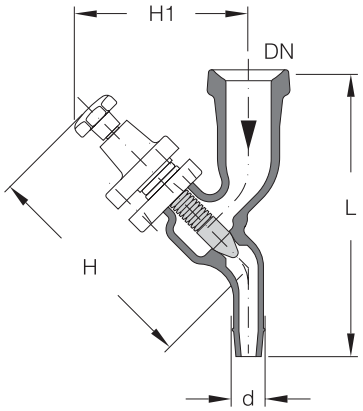
Angle Valves

DN	L	H	Reference
15	50	85	VEN15
25	100	170	VEN25
40	150	215	VEN40
50	150	210	VEN50
80	200	290	VEN80



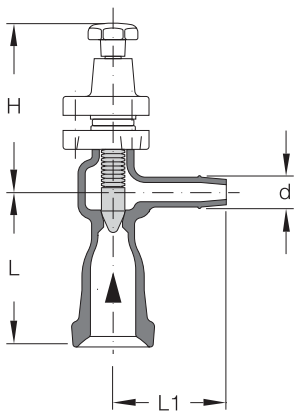
KF DRAIN VALVES

DN	hose-iØ d	L	H	H1	Reference
15	16	130	120	92	**VSN15/OL**
25	16	150	120	92	**VSN25/OL**
50	26	225	223	170	**VSN50/OL**



KF VENT VALVES

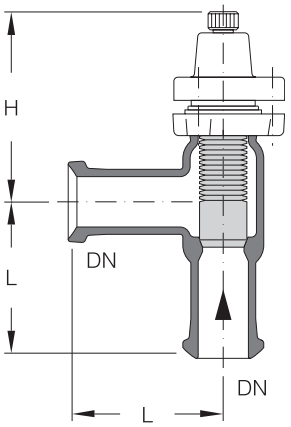
DN	hose-iØ d	L	L1	H	Reference
25	16	80	60	85	**VEN25/LUE**



LOADING VALVES

They are used to provide constant back pressure and are best used behind dosing pumps, but also occasionally behind centrifugal pumps (for which an aperture is generally preferred).

A spring is used in place of the usual manual operation featured with other valves. Its tension setting can be changed using a screwdriver. This makes it possible to set all intermediate values infinitely variably between 0.2 bar g and the permitted operating pressure of the valve, to a tolerance of ± 0,1 bar.



If no other pressure setting is specified when the order is placed, the valve will be delivered with a setting of approximately 0.2 bar.

During operation it is important to make sure that the sum of the pressure setting and pressure loss in the valve is not allowed to exceed the maximum operating pressure for the pipeline.

Loading valves must not be used as safety valves as the necessary approval for this type of usage has not been granted.

DN	L	H	Reference
15	50	80	**VDN15**
25	100	155	**VDN25**
40	150	170	**VDN40**
50	150	170	**VDN50**

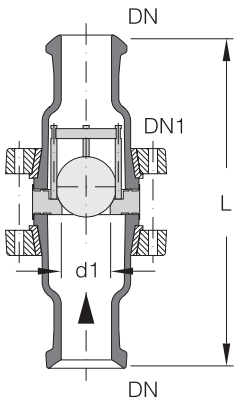
KF BALL TYPE NON-RETURN VALVES

The valve is guaranteed to function properly and ensure the correct direction of flow in pipelines in both a horizontal and vertical installed position.

A solid ball is used in vertical pipelines for gasses, vapours and liquids. A hollow ball is used in horizontal pipelines for gasses and vapours. For liquids in horizontal pipelines, it depends on the liquid whether a solid or a hollow ball is used. The product comes into contact with borosilicate glass and PTFE.

These valves can be supplied on request with an O-ring seal in for more extreme impermeability requirements.

However, it is important to make sure that the ball return valve is not used to provide a lasting shut-off effect. The appropriate valves and ball valves, depending on the individual instance of usage, must be used for this purpose.



DN	DN1	d1	L	Effektive density (kg/dm³)		Reference	Reference
				Hollow ball	Solid ball	Hollow ball	Solid ball
15	50	23	225	0,50	2,2	**VKN15/H**	**VKN15/V**
25	50	23	225	0,50	2,2	**VKN25/H**	**VKN25/V**
40	80	48	325	0,65	2,2	**VKN40/H**	**VKN40/V**
50	80	48	325	0,65	2,2	**VKN50/H**	**VKN50/V**
80	80	48	275	0,65	2,2	**VKN80/H**	**VKN80/V**

KF PNEUMATICALLY ACTUATED ON/OFF VALVES

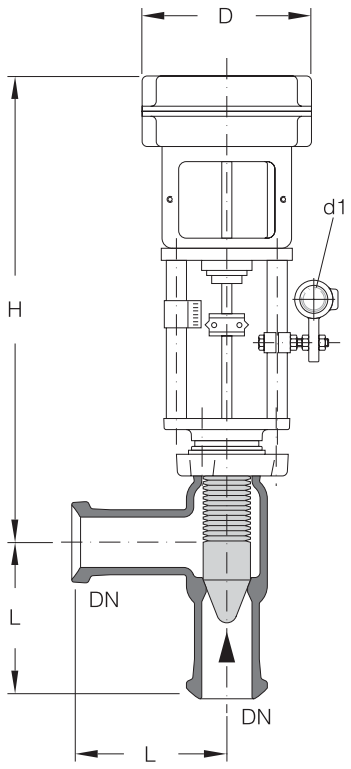
Angle Valves with Samson Actuator

The pneumatic open/close valve with a Samson drive is actuated with a supply air pressure setting of 2.5 bar g which must not be exceeded by more than 10%. The cone on this valve cannot be used for regulation and is used for reasons of compatibility only.

A "1" must be added to the order number for the position "spring opens" and a "2" must be added for the position "spring closes".

On request, the Samson actuating drives can be delivered with the following added accessories:

- Limit signal transmitter with built-in inductive proximity switches with protection type II 2 G EEx ia IIC T6 for signalling the open/close position.
- 3/2-way solenoid valve with protection type II 2 G EEx ia IIC T6 (24 VDC).



DN	D	d1	L	H	Reference
25	168	27	100	368	**VEN25/SP...**
40	168	27	150	411	**VEN40/SP...**
50	168	27	150	409	**VEN50/SP...**
80	280	27	200	512	**VEN80/SP...**

KF PNEUMATICALLY ACTUATED ON/OFF VALVES

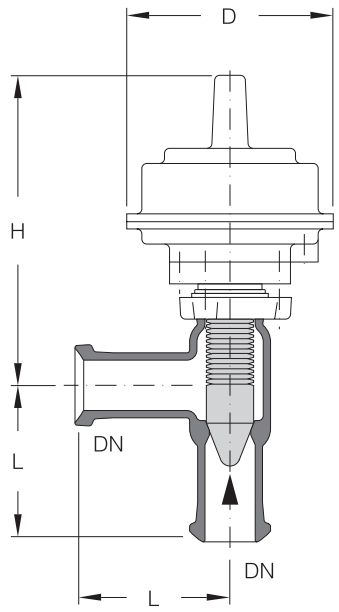
Angle Valves with Flowserve-Kämmer Actuator

The pneumatic open/close valve with a Flowserve-Kämmer drive is actuated with a supply air pressure setting of 2.5 bar g which must not be exceeded by more than 10%. The cone on this valve cannot be used for regulation and is used for reasons of compatibility only.

A "1" must be added to the order number for the position "spring opens" and a "2" must be added for the position "spring closes".

On request, Flowserve-Kämmer actuating drives can supplied with the following added accessories:

- Housing with built-in inductive proximity switches with protection type II 2 G EEx ia IIC T6 for signalling the open/close position. Constructed on the drive (the H dimension increases by 80 mm).
- 3/2-way solenoid valve with protection type II 2 G EEx ia IIC T4 (24 VDC).



DN	D	L	H	Reference
25	150	100	215	**VEN25/KP...**
40	205	150	328	**VEN40/KP...**
50	205	150	308	**VEN50/KP...**
80	300	200	409	**VEN80/KP...**

KF CONTROL VALVES

The regulating performance of the glass control valve is determined by the combination of base and cone. Equal percentage or linear characteristic curves can be selected.

In all cases, the ratio according to VDI / VDE 2173 is 25 : 1.

Three different base diameters are available for nominal diameter DN25.

Valves with a base diameter of 4 or 8 which require a higher level of dosing accuracy, even when exposed to heat, have a cone made of tantalum.

Available k_{VS}-values

The »k_{VS} value« is a typical figure indicating the flow of water in m^3/h at 20 °C with a

DN	Sitz-Ø d		Operating characteristic	k_{VS} value m^3/h													
				0,1	0,16	0,25	0,4	0,63	1,0	1,6	2,5	4,0	6,3	10	16	25	40
25	4	**Code for operating characte-ristic and k_{VS} value**	Equal Perzent.	01	03	05	07										
			Linear	02	04	06	08										
25	8		Equal Perzent.					09	11	13							
			Linear					10	12	14							
25	16		Equal Perzent.								15	17	19				
			Linear								16	18	20				
40	42		Equal Perzent.											21	23	25	
			Linear											22	24	26	
50	42		Equal Perzent.												23	25	27
			Linear												24	26	28

Cataloque reference key

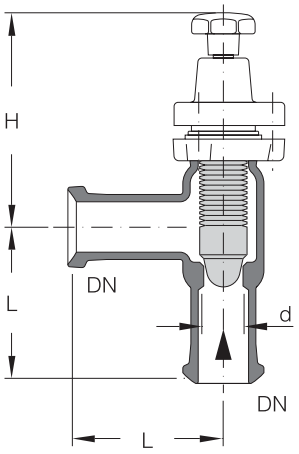
VEN25 ... 05

- 05 — Code for operating characteristic and k_{VS} value (see table above)
- ... — Type of actuation (manual or actuating drive)
- VEN25 — Control valve type

KF CONTROL VALVES

Hand Control Valves

DN	L	H	d	Reference
25	100	164	4 / 8 / 16	**VEN25/RH/...**
40	150	214	42	**VEN40/RH/...**
50	150	214	42	**VEN50/RH/...**



KF PNEUMATICALLY ACTUATED CONTROL VALVES

These valves consist of the valve body and bellows plug used in our manually operated control valves combined with either a Flowserwe-Kämmer or Samson diaphragm actuator. Both are fitted as standard with an an attached electro-pneumatic I/P positioner of hazardous area type II 2 G EEx ia IIC T6.

The required supply pressure is 2.5 bar g for all actuators and this should not be exceeded by more than 10 %.

When ordering please add the suffixes to the catalogue reference as indicated in the catalogue reference key. The code digit for the required valve flow coefficient (kvs value) and the type of characteristic curve required can be found with the manual-control accoutrements.

Cataloque reference key

VEN25/ RSP/ 05/ 1

- 1 — Valve operation: 1 = Spring to open; 2 = Spring to close
- 05/ — Code for operating characteristic and kvs value (see tasble on page 3.6)
- RSP/ — Type of drive and manufacturer
- VEN25/ — Control valve type

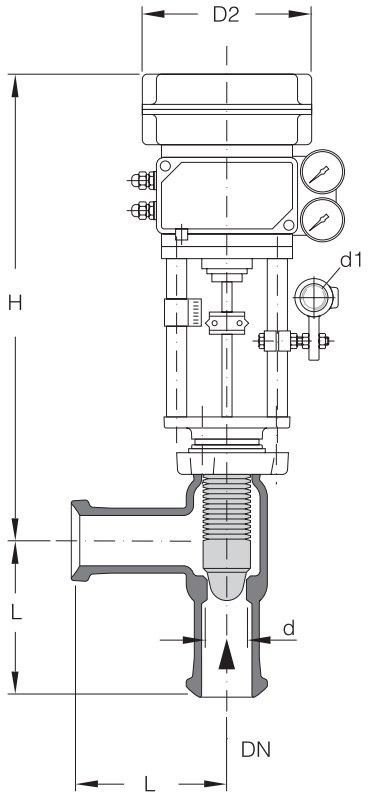
KF CONTROL VALVES

with Samson Actuator

If required the positioners fitted to Samson actuators can be supplied with the following additional features:

- Built-in 3 / 2 way solenoid valve, hazardous area type II 2 G EEx ia IIC T6 (24 VDC)
- Built-in inductive proximity switches in accordance, hazardous area type II 2 G EEx ia IIC T6 to indicate if the valve is open or closed.
- Built-in analogue position transmitter, hazardous area type II 2 G EEx ia IIC T6 (4-20 mA). Please note that this can only be supplied in place of the proximity switches detailed above.
- Built-on pressure regulator.

DN	L	H	D2	d	d1	Reference
25	100	370	168	4 / 8 / 16	27	**VEN25/RSP/...**
40	150	427	168	42	27	**VEN40/RSP/...**
50	150	427	168	42	27	**VEN50/RSP/...**



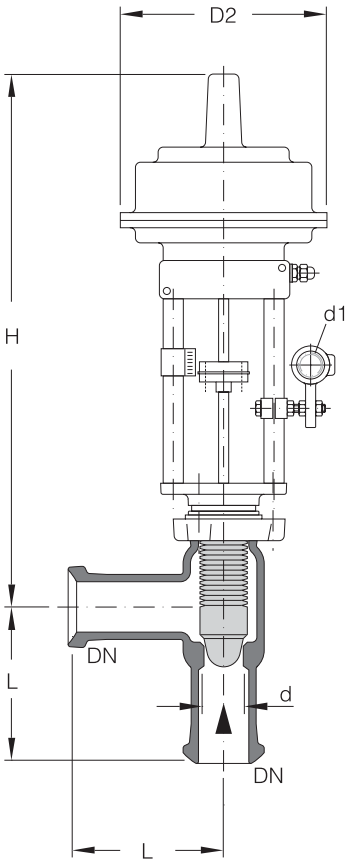
KF CONTROL VALVES

with Flowserve-Kämmer Actuator

Flowserve-Kämmer actuators can be supplied with the following additional built-on features on request:

- Inductive proximity switches in accordance, hazardous area type II 2 G EEx ia IIC T6 to indicate if the valve is open or closed. These are fitted into a housing mounted on top of the actuator (Dimension H increases by 80 mm).
- 3/2-way solenoid valve with protection type II 2 G EEx ia IIC T4 (24 VDC).

DN	L	H	D2	d	d1	Bestell-Nr.
25	100	386	150	4 / 8 / 16	27	**VEN25/RKP/...**
40	150	552	205	42	27	**VEN40/RKP/...**
50	150	552	205	42	27	**VEN50/RKP/...**

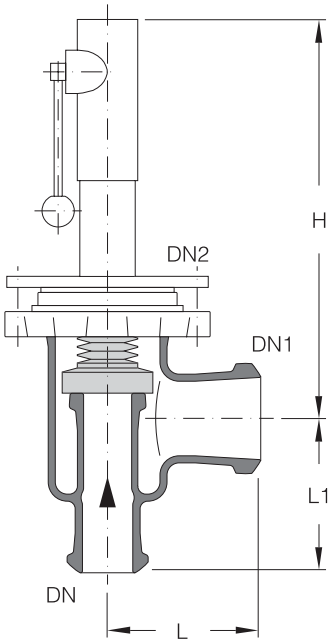


KF PRESSURE RELIEF VALVES

These valves are officially tested and approved for gases and vapours. They are direct operating and spring-loaded proportional (normal) pressure relief valves with a proven glass/PTFE seat/plug combination and are used to protect plant and equipment against exceeding the stated and/or approved operating pressure in accordance with the actual guidelines for pressure equipment.

The connection dimensions correspond to the valves in catalogue 6076. Flange DN2 is produced as a flat safety flange so that the upper parts are identical to the WPR version.

Before delivery, each valve is durably marked with the component reference »TÜV SV...-590 d_O D/G α_W p« issued by the notified body. In this reference: ...indicates the year of the applicable test report, 590 the test number, d_O the smallest flow diameter in mm, D/G the approval for gases and vapours, α_W the discharge coeficient and p the setting pressure in bar g.



When ordering, please indicate the catalogue reference and the required blow-off pressure in bar g.

The overpressure setting can only be changed by a qualified person (e.g. by QVF). The valve must then be re-leaded and the type plate must be changed.

To ensure that they function properly, pressure relief valves must always be installed vertically. Support fittings are available for this purpose.

DN	DN1	DN2	L	L1	H	Reference
25	50	80	150	125	325	**VEN25/50FS**
50	80	100	150	150	395	**VEN50/80FS**
100	150	150	200	225	480	**VEN100/150FS**

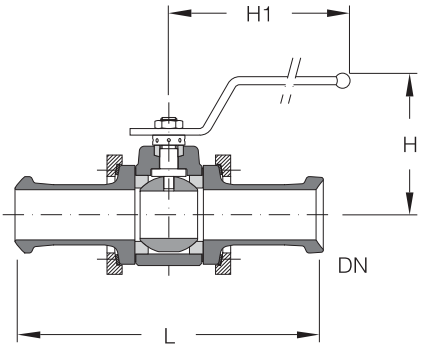
Technical Data

DN	Minimum flow diameter d_o	Minimum flow cross section A_o (mm²)	Discharge coefficient a_W	Set pressure range p (bar g)
25	25	490	0,44	0,26-1,51
50	50	1960	0,10	0,08-0,25
50	50	1960	0,19	0,18-1,39
100	100	7850	0,17	0,07-1,18

KF BALL VALVES

Ball Valves with Borosilicate Glass 3.3 Body

The ball and the shaft is PFA coated. The sealing rings are made of PTFE. The housing and the adapters are made of borosilicate glass 3.3. The selector shaft is sealed by a PTFE coated O-ring and is maintenance-free.



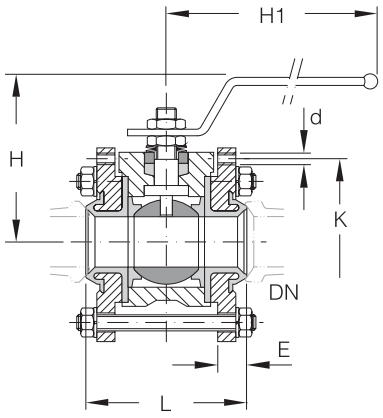
The maximum permissible operating temperature for all versions is 180 °C. The maximum permissible operating pressure is the same in each case as for the corresponding size borosilicate glass 3.3 pipeline.

DN	L	H	H1	Reference
25	200	115	150	**KH/G25**
40	300	155	225	**KH/G40**
50	300	160	225	**KH/G50**

KF BALL VALVES

Compact Ball Valves with GGG/PFA Body

The compact ball valves have a characteristic short installed length and are suitable for direct installation in KF pipeline system pipelines due to their double-sided universal connection. They can be installed using SCHD.../K flange rings. The ball and the shaft is PFA coated. The sealing rings are made of PTFE. The selector shaft is sealed by a self-adjusting, maintenance-free gland made of PTFE.



The maximum permissible operating temperature for all versions is 180 °C. The maximum permissible operating pressure is the same in each case as for the corresponding size borosilicate glass 3.3 pipeline.

DN	L	H	H1	E	K x n x d	Reference
25	80	115	150	15	85 x 4 x M8	**KHK25**
40	100	155	225	16	110 x 4 x M8	**KHK40**
50	125	160	225	23	125 x 4 x M8	**KHK50**

KF PNEUMATICALLY ACTUATED BALL VALVES

The ball valves can be supplied as standard with single-acting Flowserve-NORBRO drives. Their resettable spring means you have the advantage of being able to choose between the safety positions "spring open" and "spring closes".

Technical data and installation dimensions of these ball valves are the same as for the manually operated version.

Compressed air is required at 5.5 bar g for single-action actuators with the full number of springs.

To avoid the sudden build-up of high surface pressure between the ball and operating spindle at the start of the opening or shutting action, we recommend the incorporation of air flow controls in the supply line to the actuator.

When ordering please add a »1« to the catalogue reference if the »spring-to-open« fail-safe version is required or a »2« for »spring-to-close«.

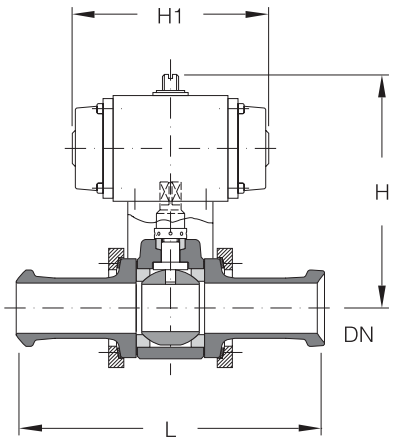
The »spring to open« setting can be changed to »spring to close« and vice-versa by changing the position of the operating spindle in the actuator by 90°.

If required, two inductive proximity detectors of hazardous area type EEx ia IIC T6 to indicate on/off can be supplied for the actuators.

KF PNEUMATICALLY ACTUATED BALL VALVES

Ball Valves with Borosilicate Glass 3.3 Body

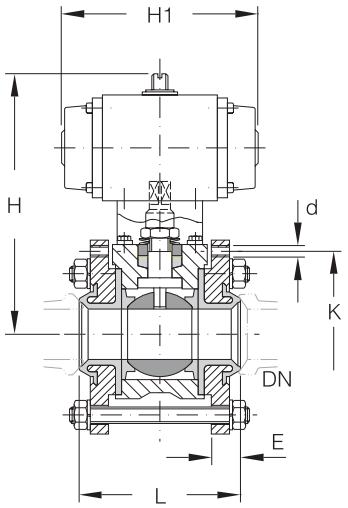
DN	L	H	H1	Reference
25	200	182	155	**KHPN/G25**
40	300	240	195	**KHPN/G40**
50	300	244	195	**KHPN/G50**



KF PNEUMATICALLY ACTUATED BALL VALVES

Compact Ball Valves with GGG/PFA Body

DN	L	H	H1	E	K x n x d	Reference
25	80	208	155	15	85 x 4 x M8	**KHKP25**
40	100	255	195	16	110 x 4 x M8	**KHKP40**
50	125	259	195	23	125 x 4 x M8	**KHKP50**



KF COUPLINGS

General

An important factor for ensuring operational safety and keeping the requirement for maintenance for glass installations as low as possible is the right choice of flange rings and seals.

The scope of delivery for a flange coupling includes two flange rings and two inserts in the selected material as well as screws, nuts, washers and stainless steel springs. The gaskets are not included in the scope of delivery and must be ordered separately.

The use of springs ensures that the screw force is set properly and at the same time makes sure it is maintained once the seal has settled. Take the value for maximum tightening torque from the following table. Stainless steel screws must be greased during installation to prevent the screws from blocking. The values shown below refer to greased screws.

Nominal size DN	Maximum tightening torque for screws (Nm)	Compressed lenght of spring (mm)
15	0,8	11
25	1,2	14,5
40	1,2	14,5
50	1,2	14,5
80	1,2	14,5
100	1,2	14,5
150	2,8	24,5
200	2,8	24,5
300	2,8	24,5

The same couplings can be used for coated glass components. The centring pins on the plastic inserts must only be removed for nominal diameters DN 200 and DN 300.

The listed order numbers correspond to those from catalogue 6076 whereby stainless steel screws are always used with springs.

Couplings with long screws are used to install spacers. The length of the spacer must be added to order number for the coupling, e.g.: SVED25/K/25.

KF COUPLINGS

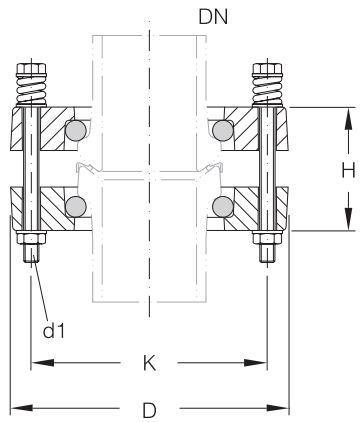
Couplings with Plastic Flanges

These are the couplings which are used most frequently as they are both light-weight and highly resistant to corrosion. No other measures against electrostatic charges are required in areas at risk from explosion. The flange rings and inserts are made of fibreglass reinforced duroplastic. Whereas the inserts are hinged, the flange rings are a one-piece construction. With the exception of nominal diameter DN 15, they all have a pitch circle and number of bores as per EN1092, PN10 but smaller screw diameters.

The plastic flange coupling is suitable for a product operating temperature of 200°C but may only be insulated up to a product operating temperature of 150°C.

DN	D	K	n x d1	H	Type	Reference
15	64	50	3 x M6	44	**A**	**SVER15/K**
25	105	85	4 x M8	51	**A**	**SVED25/K**
40	132	110	4 x M8	65	**A**	**SVED40/K**
50	147	125	4 x M8	69	**A**	**SVED50/K**
80	184	160	8 x M8	92	**A**	**SVED80/K**
100	204	180	8 x M8	93	**A**	**SVED100/K**
150	266	240	8 x M8	98	**A**	**SVED150/K**
200	321	295	8 x M8	112	**B**	**CP200**
300	428	400	12 x M8	113	**B**	**CP300**

A



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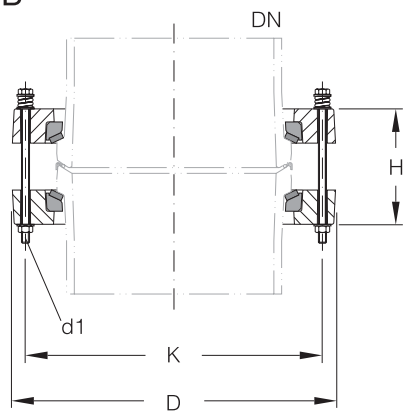


KF COUPLINGS

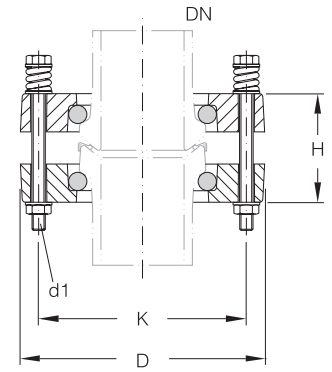
Couplings with Silumin Flanges

Silumin is a metallic material which must be earthed if there is a risk of electrostatic charges in the explosion-risk area, but can resist even higher temperatures. Thus, couplings with silumin clamp rings can be integrated into insulation for a product temperature of up 200°C.

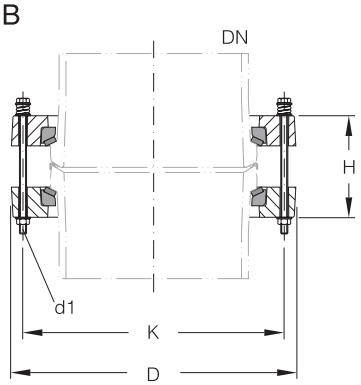
Standard duroplastic inserts with hinges are used for a nominal width of up to DN 100. Divided silumin inserts with a rubber/fibreglass coating are used for a nominal diameter of DN 150 and above.

DN	D	K	n x d1	H	Type	Reference
15	64	50	3 x M6	44	A	SVER15/S
25	92	75	3 x M8	51	A	SVER25/S
40	118	100	3 x M8	65	A	SVER40/S
50	131	110	3 x M8	69	A	SVER50/S
80	172	150	6 x M8	92	A	SVER80/S
100	192	170	6 x M8	93	A	SVER100/S
150	247	225	8 x M8	100	B	SVER150/S
200	307	280	8 x M8	103	B	SVER200/S
300	429	395	12 x M8	107	B	SVER300/S

A



B



KF COUPLINGS

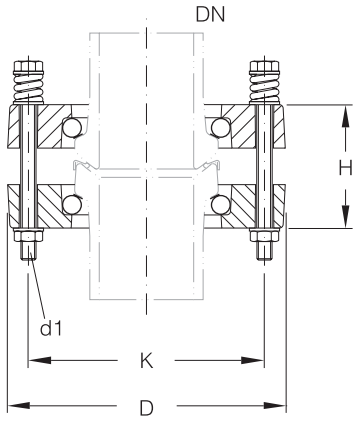
Couplings with silumin flange rings and steel spiral inserts.

When operating acidic products, glass systems may become contaminated by product from outside, e.g. mineral acids. In these cases, the silumin flange is used with stainless steel spiral inserts instead of the duroplast inserts. It is always used in conjunction with an NBR/Aramid base. This coupling can be insulated at up to a temperature of 200°C.

One exception is hydrochloric acid which can corrode stainless steel and silumin, so in this case the standard plastic coupling is preferred as it is resistant to hydrochloric acid. If the flanges of an hydrochloric acid system are to be insulated at higher temperatures, we recommend the use of epoxide resin-coated silumin flange rings with plastic or silumin inserts.

If couplings with epoxide resin-coated flange rings are required, the letter "S" for the material "silumin" must be suffixed with an "E", e.g. SVER25/SE or SVER25/SE/H.

C



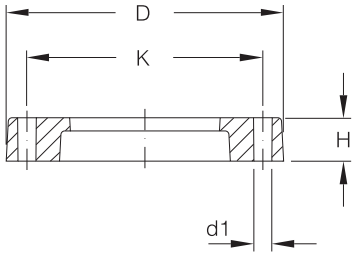
DN	D	K	n x d1	H	Type	Reference
15	64	50	3 x M6	46	C	SVER15/S/H
25	92	75	3 x M8	53	C	SVER25/S/H
40	118	100	3 x M8	67	C	SVER40/S/H
50	131	110	3 x M8	71	C	SVER50/S/H
80	172	150	6 x M8	94	C	SVER80/S/H
100	192	170	6 x M8	95	C	SVER100/S/H
150	For acid systems, use SVER150/S.					
200	For acid systems, use SVER200/S.					
300	For acid systems, use SVER300/S.					

KF BACKING FLANGES

Plastic Backing Flanges

Flange rings made of fibreglass reinforced duroplastic with a pitch circle and number of bores as per EN1092, PN 10, except DN 15.

Screw diameters in glass couplings do not correspond to EN dimensions. To connect EN flanges, reducing washers and the respective springs must be used. The length of the screw is determined by thickness of the EN flange.



DN	D	K	n x d1	H	Reference
15	64	50	3 x 7,0	14	**SCHE15/K**
25	105	85	4 x 9,5	17	**SCHD25/K**
40	132	110	4 x 9,5	20	**SCHD40/K**
50	147	125	4 x 9,5	23	**SCHD50/K**
80	184	160	8 x 9,5	28	**SCHD80/K**
100	204	180	8 x 9,5	28	**SCHD100/K**
150	266	240	8 x 9,5	34	**SCHD150/K**
200	321	295	8 x 9,5	34	**CRP200**
300	428	400	12 x 9,5	36	**CRP300**

KF BACKING FLANGES

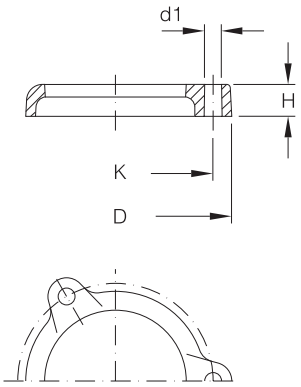
Silumin Backing Flanges

Silumin flange rings are not coated as standard.

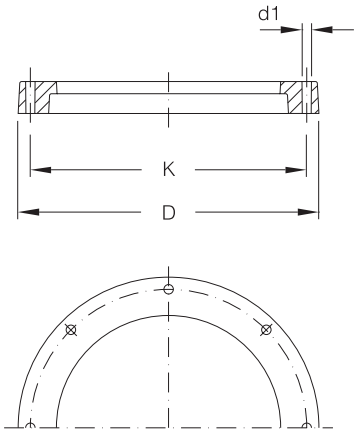
DN	D	K	n x d1	H	Type	Reference
15	64	50	3 x 7,0	12	**A**	**SCHE15/S**
25	92	75	3 x 9,5	14	**A**	**SCHE25/S**
40	118	100	3 x 9,5	18	**A**	**SCHE40/S**
50	131	110	3 x 9,5	18	**A**	**SCHE50/S**
80	172	150	6 x 9,5	24	**A**	**SCHE80/S**
100	192	170	6 x 9,5	24	**A**	**SCHE100/S**
150	247	225	8 x 9,5	24	**B**	**SCHE150/S**
200	307	280	8 x 9,5	26	**B**	**SCHE200/S**
300	429	395	12 x 9,5	26	**B**	**SCHE300/S**

If epoxide resin-coated flange rings are required, the order number needs to be suffixed with an "E", e.g.: SCHE25/SE.

A



B



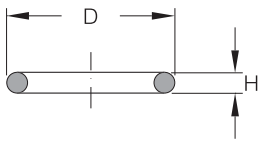
KF INSERTS

Plastic Inserts

These inserts can be used in the plastic flange rings up to DN 150 but can only be used in siluim flange rings for up to DN 100. The inserts are divided and hinged.

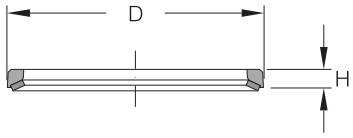
They can also be used for coated components but if doing so, the centring pins have to be removed for nominal diameters DN 200 and DN 300.

A



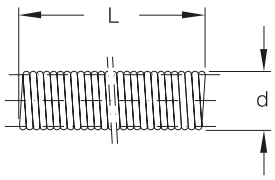
DN	D	H	Type	Reference
15	38	6,5	A	BEIL15/K
25	54	8,0	A	BEIL25/K
40	75	11	A	BEIL40/K
50	89	11	A	BEIL50/K
80	125	14	A	BEIL80/K
100	147	14	A	BEIL100/K
150	200	15	A	BEIL150/K
200	254	18	B	CIP200A
300	359	18	B	CIP300A

B



KF INSERTS

Stainless steel spiral inserts

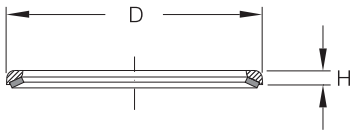


Single-piece stainless steel spiral inserts are used if there is a risk of contamination from mineral acids (other than hydrochloric acid). They are always used together with an NBR/Aramid "UNLA" base in silumin flange rings.

DN	D	L	Reference		Reference
15	6,5	83	BEIL15/S	+	UNLA15
25	8,5	123	BEIL25/S	+	UNLA25
40	11	170	BEIL40/S	+	UNLA40
50	11	215	BEIL50/S	+	UNLA50
80	15,5	305	BEIL80/S	+	UNLA80
100	15,5	373	BEIL100/S	+	UNLA100

KF INSERTS

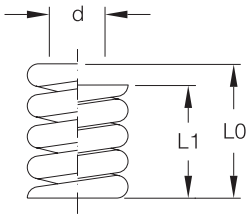
Silumin inserts with rubber/fibreglass layer



This inserts are used with Silumin flange-rings.

DN	D	H	Reference
150	201	14	**BEIL150/AS**
200	253	14	**BEIL200/AS**
300	353	14	**BEIL300/AS**

COMPRESSION SPRINGS



Compression springs are used to set the correct bolt load and to maintain it after the gasket has settled, thus ensuring that the coupling remains leak-free. These springs are supplied exclusively in stainless steel.

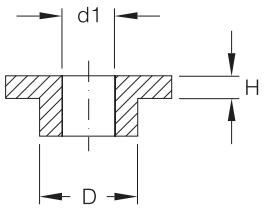
To achieve the required sealing load and to ensure that the coupling bolts are tightened evenly, first make the nuts finger-tight and then finish off with a spanner (from DN 80 upwards alternating between bolts on opposite sides of the coupling). The free length L0 and compressed length L1 are shown in the table on page 9.1. The coupling can also be tightened with a greased screw in line with the torque values already specified.

In the table below »DN« refers to the nominal size of the coupling.

Suitable for coupling DN	d	L0	L1	Reference
15	6,5	13,5	11	**DFSS6.5**
25	8,5	20	14,5	**DFSS8.5**
40	8,5	20	14,5	**DFSS8.5**
50	8,5	20	14,5	**DFSS8.5**
80	8,5	20	14,5	**DFSS8.5**
100	8,5	20	14,5	**DFSS8.5**
150	10,5	30	24,5	**DFSS10.5**
200	10,5	30	24,5	**DFSS10.5**
300	10,5	30	24,5	**DFSS10.5**

REDUCING WASHERS

When switching over from other materials to the KF series, the usual screw diameters have to be reduced to the screw diameters commonly used in glass couplings using stainless steel reducing washers in order to limit force.



Reducing Washers for Flanges to EN 1092, PN10

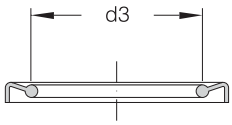
Suitable for KF coupling DN	D	d1	H	Reference
15	13	7	3	**RWSS13/7**
25	13	9	3	**RWSS13/9**
40-100	17	9	3	**RWSS17/9**
150-300	21	9	3	**RWSS21/9**

Reducing Washers for Flanges to ANSI, Class 150

Suitable for KF coupling DN	D	d1	H	Reference
15	15	7	3	**RWSS15/7**
25-40	15	9	3	**RWSS15/9**
50-100	18	9	3	**RWSS18/9**
150-200	21	9	3	**RWSS21/9**
300	24	9	3	**RWSS24/9**

GASKETS

PTFE ‘O’ Ring Gaskets



‘O’ring gaskets are manufactured using a specially selected high-quality virgin PTFE material. If these seals are used, the glass coupling of the KF system is compliant with the requirements of a high-quality coupling as defined by the Clean Air Act.

DN	d3	Reference
15	23	**DICH15/TG**
25	34	**DICH25/TG**
40	51	**DICH40/TG**
50	63	**DICH50/TG**
80	96	**DICH80/TG**
100	116	**DICH100/TG**
150	169	**DICH150/TG**
200	220	**DICH200/TG**
300	321	**DICH300/TG**

KF BELLOWS

Permissible Operating Conditions for FALD.../UF.. Bellows

PTFE bellows are used in order to accommodate temperature related changes in length and to prevent external forces or oscillations from being transferred onto glass systems.

The bellows are delivered with locking screws to limit their length for installation and recoil force. They are set as of the provided use. The connecting elements are not included in the scope of delivery. Therefore, you must use an FVED... adapter to make the connection to the KF pipe end (e.g. FVED50/UF/K).

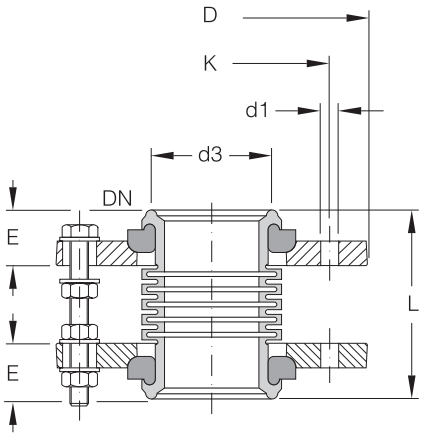
The KF-bellows, except DN 200 and DN 300, cannot be used in combination with the safety flat buttress end.

For the permitted operating conditions of PTFE bellows, see the following table:

DN	Pressure corr. Glass DN	Vacuum	unpressurised
15-150	120°C	150°C	200°C
200-300	120°C	120°C	200°C

KF BELLOWS

Bellows for double-sided connection to glass pipe ends and EN connections as per EN 1902, PN 10



DN	L ± ΔL	D	K	n x d1	d3	E	Reference
15	75 + 4 / -5	95	50	3 x 7,0	23	21	**FALD15/UF**
25	75 + 4 / -5	115	85	4 x 9,5	35	24	**FALD25/UF**
40	100 ± 5	150	110	4 x 9,5	53	28	**FALD40/UF**
50	100 ± 5	165	125	4 x 9,5	64	30	**FALD50/UF**
80	100 ± 5	200	160	8 x 9,5	96	34	**FALD80/UF**
100	100 ± 5	220	180	8 x 9,5	116	34	**FALD100/UF**
150	125 ± 5	340	240	8 x 9,5	169	38	**FALD150/UF**
200	100 + 3 / -5	390	295	8 x 9,5	220	32	**FALD200/UF**
300	100 + 3 / -5	460	400	12 x 9,5	321	32	**FALD300/UF**

When connecting KF pipelines, you require an adapter for each connection, but no additional seals.

When connection EN flanges, reducing washers and the respective springs are used. The length of the screw is determined by thickness of the EN flange.

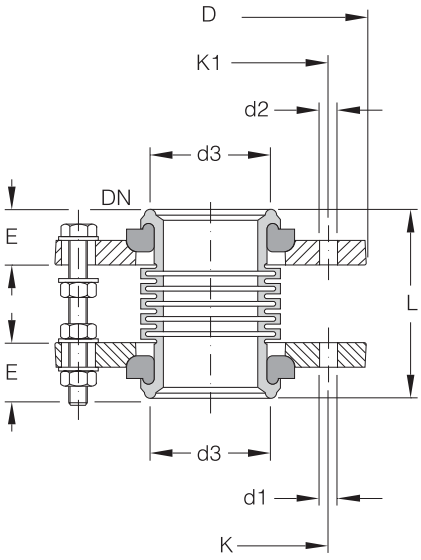
For connecting flanges with another sealing diameter, an additional DICHN.../TE spacer plate is used.

KF BELLOWS

Bellows for Connecting Glass and ANSI, Class 150

The pitch circle and the number of holes is in line with the ANSI standard. Use RWSS... reducing washers and the appropriate screws for the nominal diameter in order to centre the reduced screw diameter. The flange thickness determines the length of the screw.

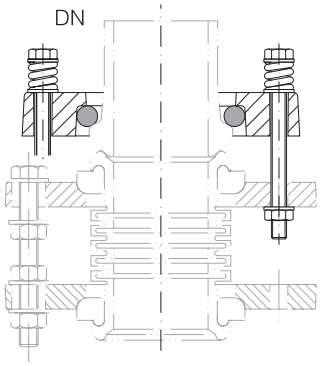
For connecting flanges with another sealing diameter, an additional DICHN.../TE



DN	L ± ΔL	D	K	K1	n x d1	n x d2	d3	E	Reference
15	75 + 4/-5	95	50	60	3 x 7,0	4 x 7,0	23	21	**FALDA15/UF**
25	75 + 4/-5	115	85	79	4 x 9,5	4 x 9,5	35	24	**FALDA25/UF**
40	100 ± 5	150	110	98	4 x 9,5	4 x 9,5	53	28	**FALDA40/UF**
50	100 ± 5	165	125	121	4 x 9,5	4 x 9,5	64	30	**FALDA50/UF**
80	100 ± 5	200	160	152	8 x 9,5	4 x 9,5	96	34	**FALDA80/UF**
100	100 ± 5	220	180	190	8 x 9,5	8 x 9,5	116	34	**FALDA100/UF**
150	125 ± 5	340	240	241	8 x 9,5	8 x 9,5	169	38	**FALDA150/UF**
200	100 + 3/-5	390	295	298	8 x 9,5	8 x 9,5	220	32	**FALDA200/UF**
300	100 + 3/-5	460	400	432	12 x 9,5	12 x 9,5	321	32	**FALDA300/UF**

ADAPTERS FOR CONNECTING GLASS

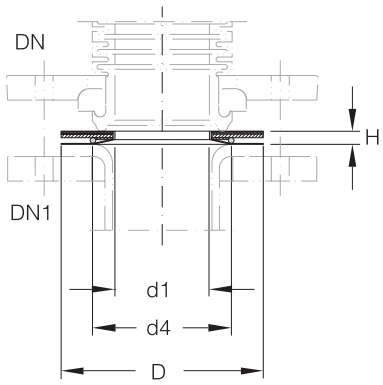
DN	Reference
15	**FVER15/UF/K**
25	**FVED25/UF/K**
40	**FVED40/UF/K**
50	**FVED50/UF/K**
80	**FVED80/UF/K**
100	**FVED100/UF/K**
150	**FVED150/UF/K**
200	**FVED200/UF/K**
300	**FVED300/UF/K**



METAL/PTFE SPACERS

The spacer plate is used if the sealing diameter of the bellows does not come into contact with the sealing surface of the opposite flange. This is the case with enamel connections, for instance.

The spacer plate consists of a PFTE cover and a stainless steel core with an additional soft layer. The spacer of all diameters do have a earthing clip.

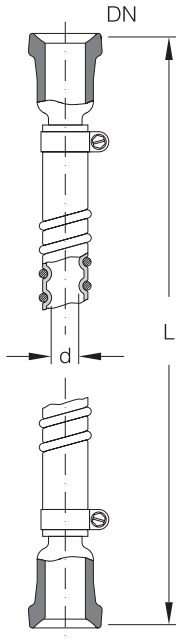


DN	DN1	D	d1	d4	L	Reference
25	25	68	25	51	8	DICHN25/TE
40	32	78	32	63	8	DICHN32/TE
40	40	86	40	67	8	DICHN40/TE
50	50	102	50	86	8	DICHN50/TE
80	65	122	65	95	10	DICHN65/TE
80	80	138	80	111	10	DICHN80/TE
100	100	158	100	140	10	DICHN100/TE
150	150	212	150	194	10	DICHN150/TE
200	200	268	200	246	12	DICHN200/TE
300	300	370	300	345	11	DICHN300/TE

KF PRODUCT HOSES

The PTFE spiral hoses are shrunk onto borosilicate glass 3.3. adapters with a socket flange on both sides and fastened by a stainless steel clamp.

All spiral hoses are vacuum-proof and can be used at pressure of down to 1 mbar, at an operating temperature of 180°C. You can take the permitted temperature-related operating pressure values from the following table.



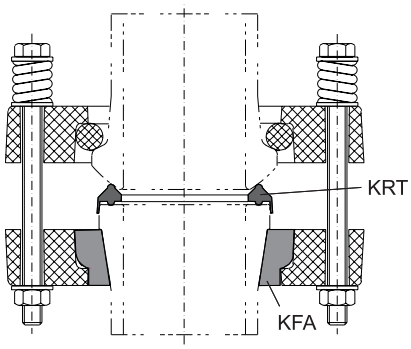
DN	d	L	Minimum bend radius	Permissible operating pressure (bar g)			Reference
				20 °C	100 °C	120 °C	
15	10	500	50	4	0,5	unpressurised	WELN15/500
15	10	1000	50	4	0,5		WELN15/1000
25	17	500	85	4	0,5		WELN25/500
25	17	1000	85	4	0,5		WELN25/1000

ADAPTORS KF TO WPR

To connect to safety flat buttress ends a special coupling was developed, with the reference no. CPKFA.... and can be used for ball and socket glass-ends. Following parts are in the scope of supply:

2 x SCHD.../K (KF-backing flanges)
1 x BEIL.../K (KF-insert)
1 x KFA...(adaptor)
1 x KRT..., or KRTN... (adaptor PTFE/gasket, T_{max} = 130°C)
screws and springs

For the assembling of DN 80 take care the adaptor gasket KRT is exactly positioned.



DN	Reference
15	**CPKFA15**
25	**CPKFA25**
40	**CPKFA40**
50	**CPKFA50**
80	**CPKFA80**
100	**CPKFA100**
150	**CPKFA150**

SUPPORT BRACKETS

Support brackets are provided for fastening components with a nominal diameter of DN 15 to DN 200 in conjunction with open or closed KK fittings.

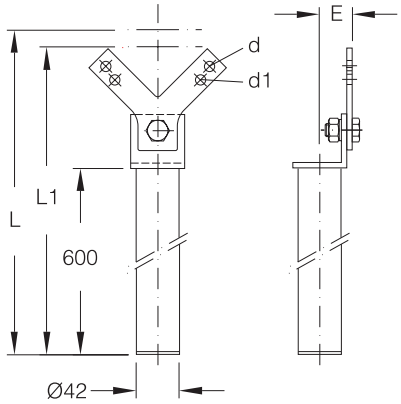
Two screws from each coupling are used for DN 15 to DN 50.

The support brackets listed in the following for these nominal diameters are suitable for fastening both plastic flange rings (as per EN1092) and silumin flange rings.

For DN 100 to DN 200, three M8 threaded rods each are used to install the coupling with the pipe sleeves which are welded on. Different support forks are required for the various pitch circles of the flange rings.

The support brackets can be adjusted to the required length on site. The pipe is then closed using the pipe sealing cap which is included in the scope of delivery.

A

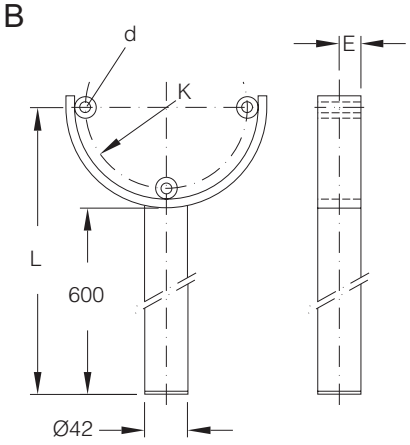


Universal support bracket for EN/ANSI and silumin pitch circles

DN	L [1]	L1 [1]	d	d1	E	Type	Reference Galvanised	Reference Stainless steel
15	-	695	-	7	30	A	GEGAN15/25	GEGAN15/25/E
25	703	703	9,5	-	30	A	GEGAN15/25	GEGAN15/25/E
40	725	717	9,5	9,5	30	A	GEGAN40/50	GEGAN40/50/E
50	738	728	9,5	9,5	30	A	GEGAN40/50	GEGAN40/50/E

[1] When combining EN1092, PN10 flange ring connections, dimension L applies. For other, dimension L1 applies.

B



Support bracket for EN1092, PN10 flange connections

DN	L	K	d	E	Type	Reference Galvanised	Reference Stainless steel
80	695	160	10	22	B	GEGAN80	GEGAN80/E
100	705	180	10	22	B	GEGAN100	GEGAN100/E
150	735	240	10	22	B	GEGAN150	GEGAN150/E
200	Use support bracket HK200... from WPR						

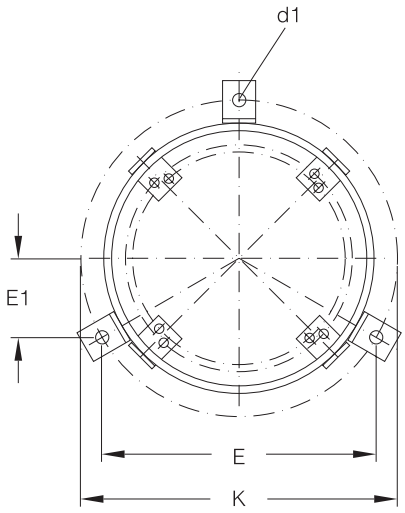
Support bracket for flange connections with silumin flange rings

DN	L	K	d	E	Type	Reference Galvanised	Reference Stainless steel
80	690	150	10	22	B	GEGAS80	GEGAS80/E
100	700	170	10	22	B	GEGAS100	GEGAS100/E
150	728	225	10	22	B	GEGAS150	GEGAS150/E
200	760	280	10	22	B	GEGAS 200	GEGAS200/E

SUPPORT RING

The weight of glass apparatus and vertical pipelines is transferred onto the support construction by support rings. The support rings have two internal pitch circles; thus they can be used for silumin flanges as well as fir plastic flanges. The support rings are fastened to the structure using RRM... pipe frame round nuts on the supporting construction.

For pipelines up to and including DN 100, GEGA… support forks are used in place of support rings.



DN	d1	K	E	E1	Reference Galvanised	Reference Stainless steel
150	14	335	290	84	**GETR150/U**	**GETR150/U/E**
200	14	390	338	98	**GETR200/U**	**GETR200/U/E**
300	18	520	450	130	**GETR300/U**	**GETR300/U/E**

SUPPLIERS OF

Components from Borosilicate glass 3.3 and other corrosion resistant material

- Pipeline Components
- Valves
- Control Instruments
- Heat Exchangers
- Vessels
- Chemical Plant Equipment
- Standard Units

Pumps from high corrosion resistant materials

- Dosing pumps hand controlled
- Microprocessor-controlled dosing pumps
- Steam jet vacuum pumps

Standard units for Laboratory and production made from Borosilicate glass 3.3 and other corrosion resistant materials

- Distillation unit for water purification
- Rotary Film Evaporators
- Thin-Film Evaporators
- Crystallizers
- Chemical Plant Reactors

ENGINEERS FOR

- Feasibility studies
- Process development
- Pilot tests
- Process optimization
- Basic engineering
- Drafting for permission by authorities

PROJECT MANAGEMENT FOR

Engineering, assembling and commissioning of chemical plants made from appropriate material

- Mineral Acid Concentration
- Waste Water Recycling
- Distillation and Rectification with special applications
- Liquid-Liquid-Extraction for recycling of organic substances
- VOC Recovery Units
- Halogenization of organic substances
- Special Processes

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MINIPLANT 2005 - The Catalogue

What's Miniplant?

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COMPONENT DESCRIPTION INDEX

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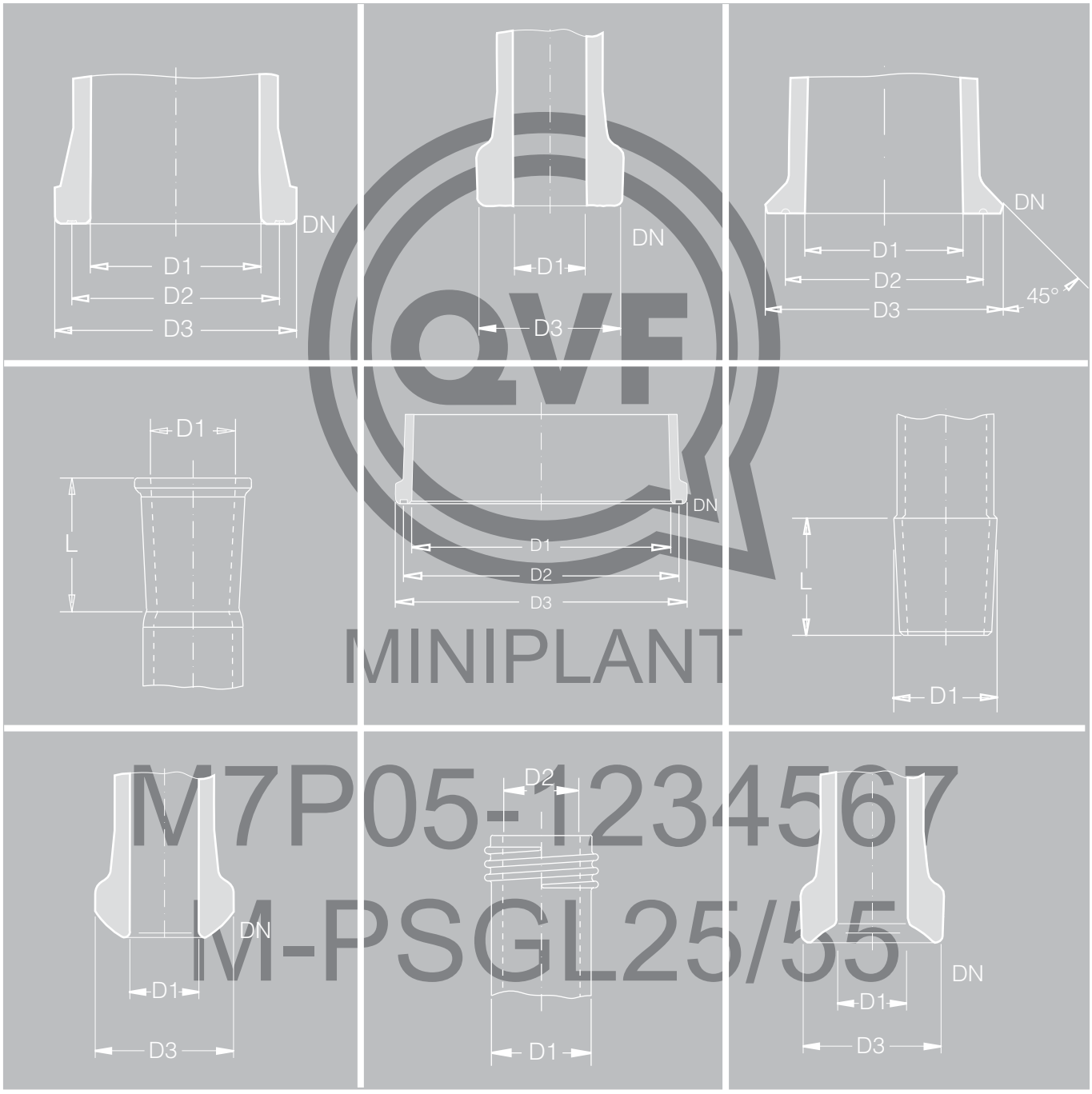


Significance of the Miniplant Technology

Miniplant technology is regularly used today in developing process production facilities. The cost savings this achieves result mainly from bypassing the engineering stage, which, experience shows, requires much time and high costs from the time of initial approval until the plant is operational. In contrast, Miniplant facilities with their low product volumes are normally built up quickly and inexpensively.

The design of the QVF Miniplant components permits simulation of a complete technical process, obtaining of samples, and the development and examination of the process strategy. In particular, the reaction of individual processes to the entire chain can be examined. The study of all processes, taking into account computer-assisted calculations, makes the scale-up of the production units possible under certain conditions. For fluid processes, the available plant components are fully developed and permit scale-up ratios of up to 1:10000. This holds for solid processes as well, with limitations, but here further development is needed.

The Miniplant technology is performed with small quantities on the kilo scale. As a rule, one can assume volumes of 5 to 10 liters for discontinuous processes, and column diameters of around 50 mm for continuous processes. The small quantities and diameter require special measures regarding process data recording, feeding and heat balances.

Only the interplay of the components with the measurement and control technology and the conscientious engineering of the plant ensure the success of the Miniplant technology.

QVF Miniplant System

The Miniplant components developed by QVF supplement the component system for technical glass apparatus construction. But whereas the components of the **World Product Range 2002** are assigned the CE mark as pressure-bearing components in accordance with the Pressure Equipment Directive PED 97/23 EC, Miniplant facilities are operated with a maximum excess operating pressure of 0.5 bar and are therefore not assigned the CE mark (see "Operating Conditions"). Of course, the layout and calculation, production and testing of the Miniplant components fall under the AD-200 regulations, and these components are produced with the same process monitoring in QVF's QA management system.

The Miniplant components are given the QVF product label and the term "Miniplant" for differentiation. All order designations of the Miniplant components program start with M-... and thus show that they belong to these components.

Marking of Glass Components

All glass components from the Miniplant program are marked with the specifications of the corresponding component. The information they contain can be taken from the following table.

MINIPLANT
BORO 3.3
M7P05-1234567
M-PSGL25/55

Table 1

Part of mark	Meaning	Remarks
QVF-logo	Manufacturer of component	
Boro 3.3	Material borosilicat glass 3.3	
M	Place of manufacture	M=Mainz, Germany
7	Strength parameter to EN 1595	
05	Catalogue issue	05 = 2005
1234567	Batch serial number	Sequential number
M-PSGL25/55	Catalogue item reference	For standard component

Borosilicate glass 3.3

The standardized apparatus material borosilicate glass 3.3 is distinguished by an almost universal corrosion resistance and outstanding surface characteristics. As a result, it is the preferred material for Miniplant facilities and permits visual observation of the process and also good cleaning.

The characteristics of borosilicate glass 3.3, which QVF uses exclusively, are described in the WPR 2002 catalogue. Layout and calculation of the Miniplant components are performed according to AD instruction sheets and the current standards.

Permissible Operating Conditions

The permissible operating conditions result from the calculation of the permissible tensions in accordance with EN 1595, taking into account pressure and temperature influences. All glass parts are dimensioned so that the maximum temperature difference between the inside and outside space is 180°C and the permissible excess operating pressure is -1/+0.5 bar. The maximum use temperature for glass components is 200°C.

The same operating conditions apply for jacketed components, double-shell components and components with insulating jacket, but the information on temperature shock must be given special attention. Rapid temperature changes should be avoided with glass components. The temperature gradients must be limited, especially for process-related temperature changes, e.g. changeover from heating to cooling. A temperature shock of 120°C must not be exceeded.

If operating conditions must be reduced through combinations of materials or other requirements, this is noted for the respective components. Components with expanded operating conditions are also possible and are marked as in the WPR 2002 catalogue in accordance with the PED.

Glass ends

Besides the safety flat flange (safety flat buttress end), the Miniplant technology uses many pipe ends, whose measurements are shown in the table below. Connecting elements, gaskets and the universally usable flexible gasket, which allows a deflection in the flat connection of up to 3°, are described in the WPR 2002 catalogue.

Connecting elements for pipelines with threaded pipe ends are described in the "Connections" section. For pipeline components with threaded ends, pipe lengths with the threaded connectors normally result in a 25 mm matrix, which permits interchangeability of the components against other shapes.

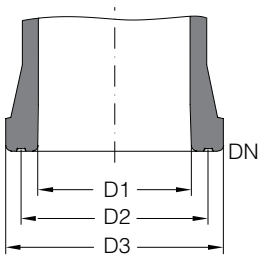
Safety flat buttress ends

This flange taken from the technical construction set offers a fire-polished gasket surface with a groove for the gasket. Besides the very high corrosion resistance, this connection system offers special advantages for construction in accordance with GMP standards. Connecting elements, such as flanges, gaskets and inserts, that correspond to the respective structural shape are available.

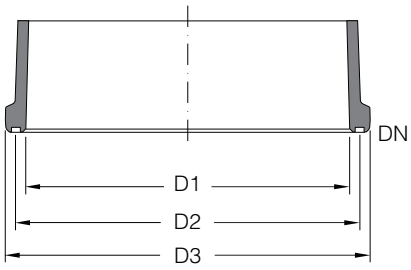
Table 2

DN	D1	D2	D3	Type
15	16,8	23	28,6	**A**
25	26,5	34	42,2	**A**
40	38,5	48	57,4	**A**
50	50,5	60,5	70	**A**
80	76	88	99,2	**A**
100	104,5	120,5	132,6	**A**
150	154	172	185	**A**
200	203	220	235	**B**
300	300	321	340	**B**

A



B



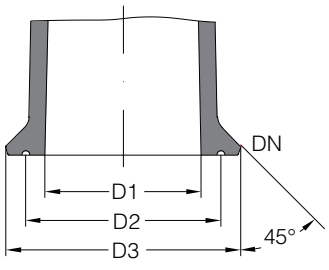
Laboratory flanged pipe ends

Laboratory flanged pipe ends are used for the reactor flange and hood, especially for small reaction vessels. Here, the O-ring seal lies in a polished groove. The laboratory flanged pipe ends are marked with "SLF" in the tables.

Table 3

SLF	D1	D2	D3	Type
100	100	115	138	**C**
150	148	161	184	**C**
200	205	220	242	**C**

C



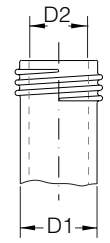
Threaded pipe ends

The standardized glass pipe ends with round threads are frequently used for connecting hoses and measurement transducers. In the tables, connections with threaded pipe ends are shown with the letter code "GL".

Table 4

GL	D1	D2	Type
14	12	8,1	D
18	16	10,5	D
25	22	16,5	D
32	28	21,5	D
45	40	34,5	D

D



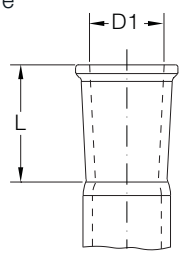
Taper ground connection

The connection with a taper of 1:10, common in laboratory applications, is used to connect laboratory devices to Miniplant facilities. The dimensions correspond to DIN 12 242. Taper ground connections are also called standard ground (Normschliff) connections and identified with NS. Taper ground connections cannot be used with excess pressure.

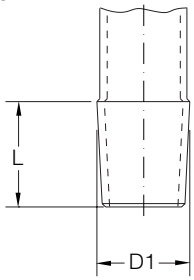
Table 5

NS	D1	L in mm	Type
14/23	14,5	23	E
29/32	29,2	32	E

E Sleeve



Core



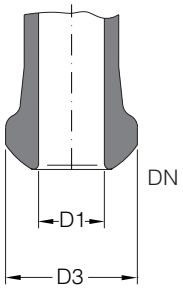
KF couplings

Corresponding to the earlier Schott "6076" connection system, the KF connection (KF = Kugel-Flansch or conical flange) permits an angular deviation of the connection by 3° without additional components. The sealing surfaces are ground. Safety flat flanges and KF pipe ends can be connected with transition gaskets or glass transition pieces.

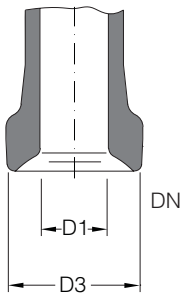
Table 6

DN	D1	D3	Type
15	15	30	F
25	25	25	F
40	40	62	F
50	50	76	F
80	81,5	109,5	F

F Bowl



Socket



Jacketed glass components

Jackets are often used to heat or cool vessels and pipelines. Jackets are normally fused together with the component on both sides so leaks cannot arise. The heat-transfer medium is connected via safety flat flange pipe ends and the appropriate adapter to entry and exit connection pieces.

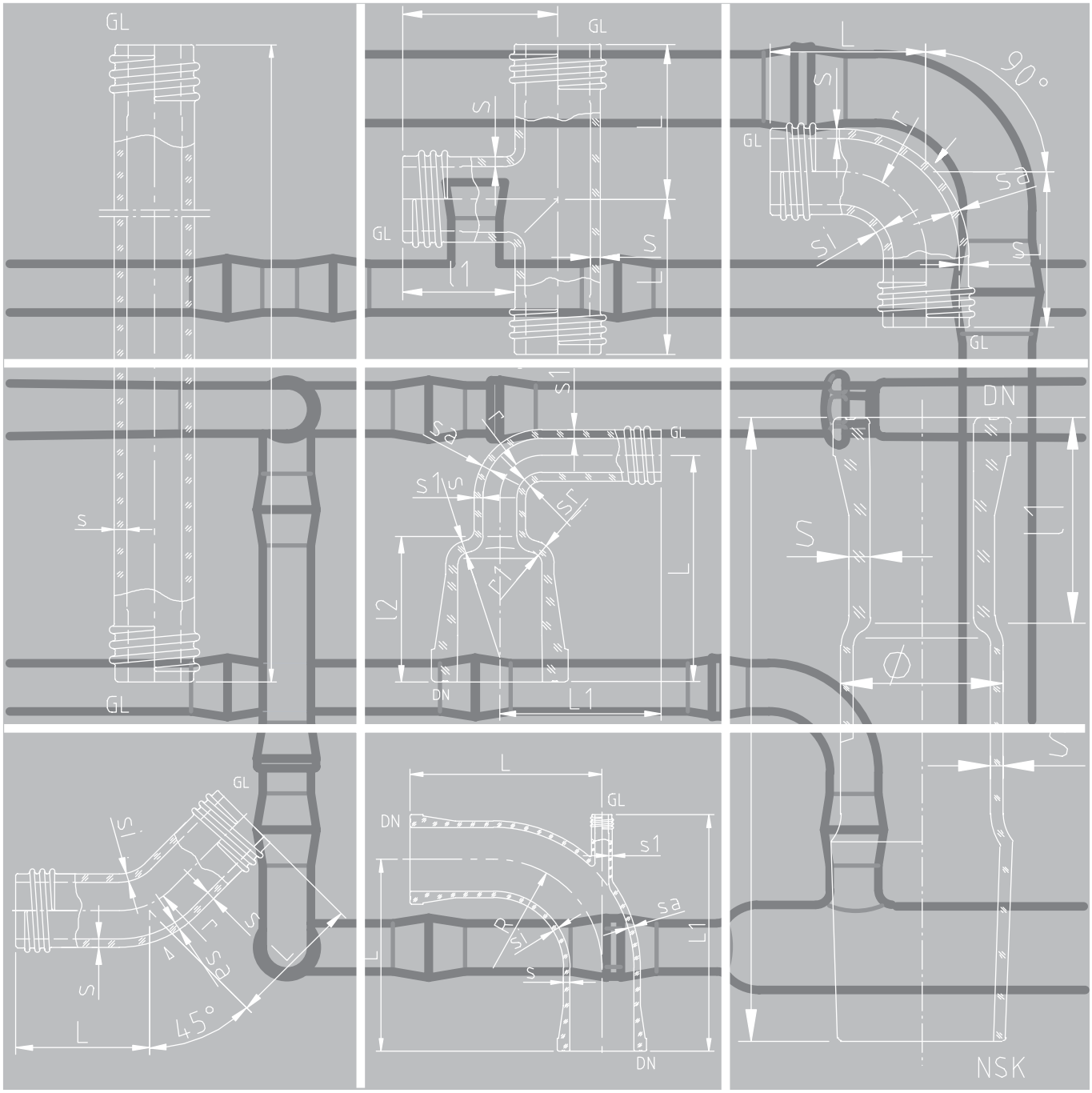
For jackets fused together on both sides, the allowable operating temperature in the jacket space is 200°C. At the same time, it must not be more than 180°C above the ambient temperature nor exceed the product temperature by more than 50°C. Of course, the information on temperature shock must be observed.

The permitted excess operating pressure in the jacket is -1 to 0.5 bar.

Isolating jackets

Various components for the Miniplant technology (e.g. columns) are also offered with special isolating jackets. In these cases, the inside of the jackets made according to fig. 3 are silver-coated and the jackets space itself evacuated. In this way, undesired heat losses are reduced to a minimum.

Both of these measures are combined in the case of the triple-wall reactor "TWR..."; but to permit a better observation of the process, the isolating jacket is not silver-coated. It prevents heat loss and ice formation on the outside for processes below the freezing point.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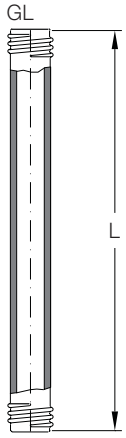
NSK

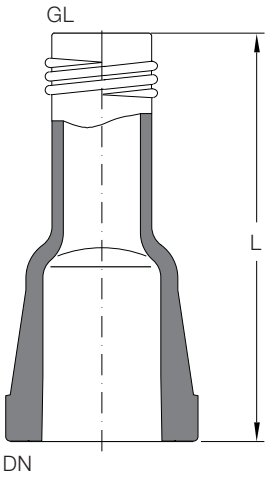
PIPES (GL/GL)

Together with the treaded connections from section “Couplings” each pipe fits into the metric grid modular system.



L	Reference GL14	Reference GL18	Reference GL25
60/55	**M-PSGL14/60**	**M-PSGL18/60**	**M-PSGL25/55**
85/80	**M-PSGL14/85**	**M-PSGL18/85**	**M-PSGL25/80**
110/105	**M-PSGL14/110**	**M-PSGL18/110**	**M-PSGL25/105**
135/130	**M-PSGL14/135**	**M-PSGL18/135**	**M-PSGL25/130**
160/155	**M-PSGL14/160**	**M-PSGL18/160**	**M-PSGL25/155**
185/180	**M-PSGL14/185**	**M-PSGL18/185**	**M-PSGL25/180**
235/230	**M-PSGL14/235**	**M-PSGL18/235**	**M-PSGL25/230**
285/280	**M-PSGL14/285**	**M-PSGL18/285**	**M-PSGL25/280**
385/380	**M-PSGL14/385**	**M-PSGL18/385**	**M-PSGL25/380**
485/480	**M-PSGL14/485**	**M-PSGL18/485**	**M-PSGL25/480**
685/680	**M-PSGL14/685**	**M-PSGL18/685**	**M-PSGL25/680**
985/980	**M-PSGL14/985**	**M-PSGL18/985**	**M-PSGL25/980**

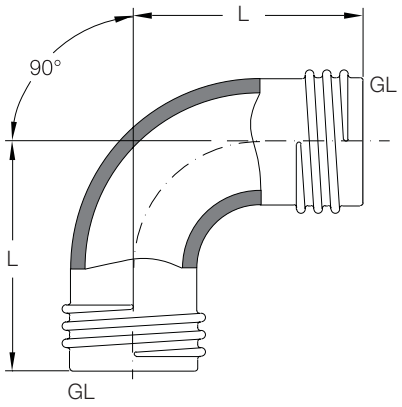
REDUCERS (DN/GL)



DN	GL	L	Reference
15	14	67	**M-PR15/GL14**
15	18	67	**M-PR15/GL18**
15	25	67	**M-PR15/GL25**
25	14	90	**M-PR25/GL14**
25	18	90	**M-PR25/GL18**
25	25	90	**M-PR25/GL25**
40	14	100	**M-PR40/GL14**
40	18	100	**M-PR40/GL18**
40	25	100	**M-PR40/GL25**
50	14	110	**M-PR50/GL14**
50	18	110	**M-PR50/GL18**
50	25	110	**M-PR50/GL25**

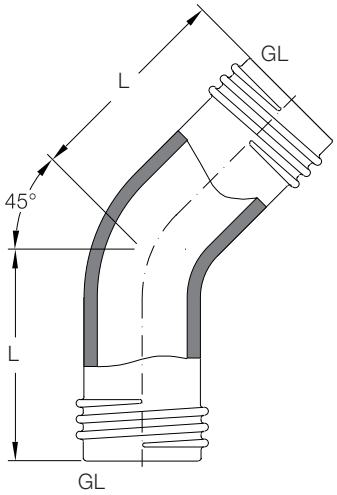
90°-BENDS (GL/GL)

GL	L	Reference
14	32	**M-PB90/GL14**
18	37	**M-PB90/GL18**
25	40	**M-PB90/GL25**



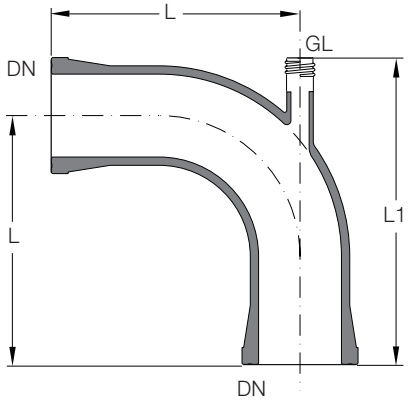
45°-BENDS (GL/GL)

GL	L	Reference
14	32	**M-PB45/GL14**
18	37	**M-PB45/GL18**
25	40	**M-PB45/GL25**



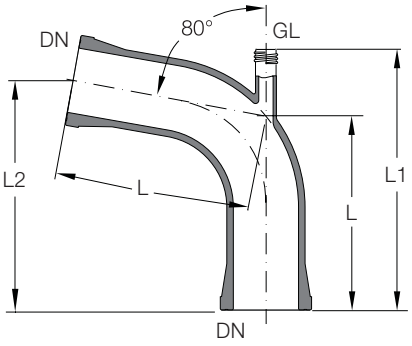
90°-BENDS WITH THERMOMETER BRANCH (DN/DN/GL)

DN	GL	L	L1	Reference
15	25	50	90	**M-PBT90/15/GL25**
25	25	100	130	**M-PBT90/25/GL25**
50	25	150	185	**M-PBT90/50/GL25**
80	25	200	240	**M-PBT90/80/GL25**
100	25	250	290	**M-PBT90/100/GL25**



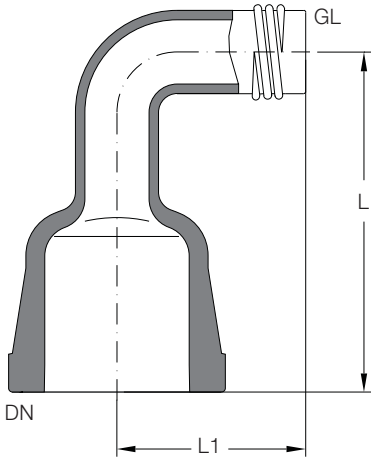
80°-BENDS WITH THERMOMETER BRANCH(DN/DN/GL)

DN	GL	L	L1	L2	Reference
15	25	50	95	59	**M-PBT80/15/GL25**
25	25	100	140	117	**M-PBT80/25/GL25**
50	25	150	200	176	**M-PBT80/50/GL25**
80	25	200	260	235	**M-PBT80/80/GL25**
100	25	250	320	293	**M-PBT80/100/GL25**



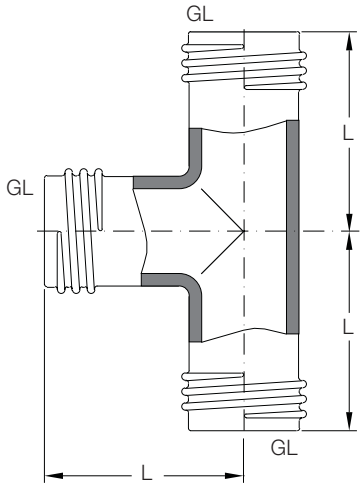
90°- BEND REDUCERS (DN/GL)

DN	GL	L	L1	Reference
15	14	50	50	**M-PBR90/15/GL14**
15	18	50	50	**M-PBR90/15/GL18**
15	25	50	50	**M-PBR90/15/GL25**
25	18	70	50	**M-PBR90/25/GL18**
25	25	70	50	**M-PBR90/25/GL25**
40	18	90	50	**M-PBR90/40/GL18**
40	25	90	50	**M-PBR90/40/GL25**
50	18	90	50	**M-PBR90/50/GL18**
50	25	100	50	**M-PBR90/50/GL25**



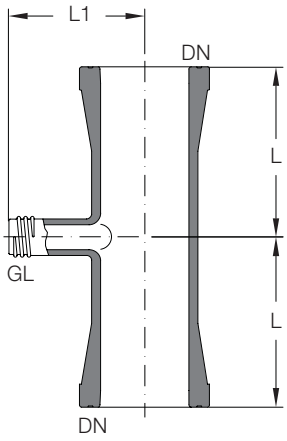
TEE PIECES (GL/GL/GL)

GL	L	Reference
14	32	**M-PTGL14**
18	37	**M-PTGL18**
25	40	**M-PTGL25**



UNEQUAL TEE PIECES (DN/GL)

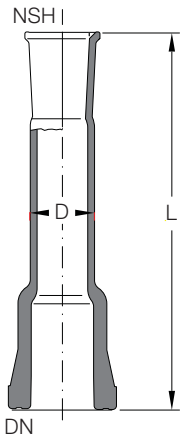
DN	GL	L	L1	Reference
15	14	50	45	**M-PTU15/GL14**
15	18	50	45	**M-PTU15/GL18**
15	25	50	45	**M-PTU15/GL25**
25	18	75	50	**M-PTU25/GL18**
25	25	75	50	**M-PTU25/GL25**
40	18	75	60	**M-PTU40/GL18**
40	25	75	60	**M-PTU40/GL25**
50	18	75	65	**M-PTU50/GL18**
50	25	75	65	**M-PTU50/GL25**



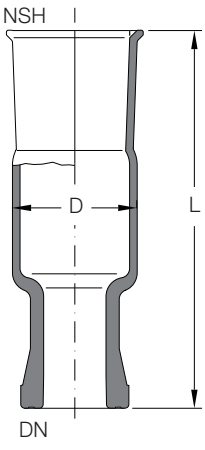
ADAPTORS (DN/NS)

DN	NSH	NSK	L	D	Type	Reference
15	14/23	-	100	17	**A**	**M-AG15/NSH14**
15	-	14/23	100	13	**C**	**M-AG15/NSK14**
15	29/32	-	100	33	**B**	**M-AG15/NSH29**
15	-	29/32	100	26	**D**	**M-AG15/NSK29**
25	29/32	-	100	33	**A**	**M-AG25/NSH29**
25	-	29/32	100	26	**C**	**M-AG25/NSK29**

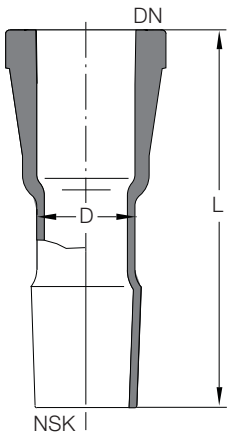
A



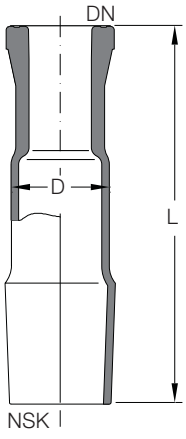
B

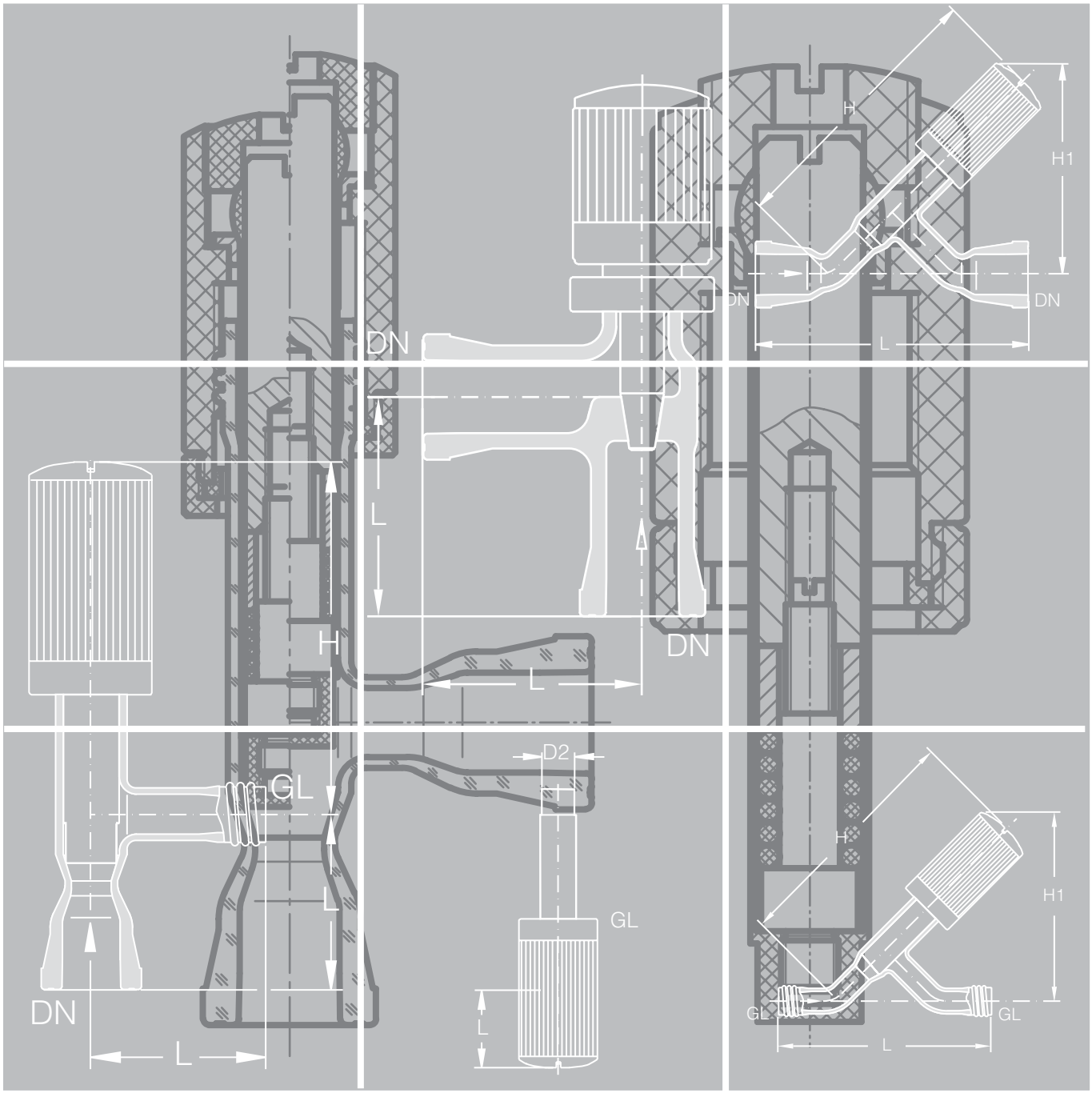


C



D




H
H1
DN
DN
L
DN
L
H
DN
L
D2
GL
L
GL
DN
L
L
H
H1
GL
GL
L

SPINDLE VALVES

With these robust and low-dead-space valves, the product comes into contact only with the extremely corrosion-resistant materials borosilicate glass 3.3 and PTFE. They are therefore suitable for almost universal use in Miniplant technology.

The low leakage rate and impermeability of the spindle insert are special characteristics of this valve design. Impermeability is achieved through O-rings that are pressed onto an adjustable adapter sleeve and guided into a very precisely produced valve sleeve made of borosilicate glass 3.3. The top parts of the spindle valves can be replaced.

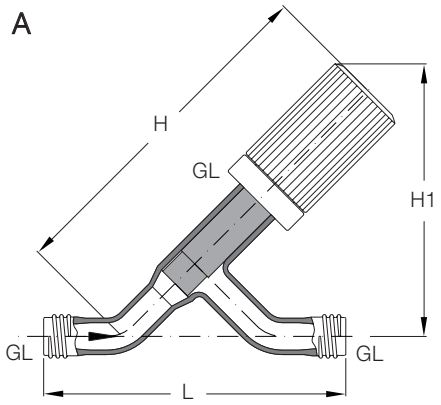
All spindle valves can be equipped with a pneumatic drive. The connection for the pneumatic hose is 6 mm.

Spindle valves with a PTFE stamp are limited to product temperatures of 180°C. Top parts free of nonferrous metal are also available.

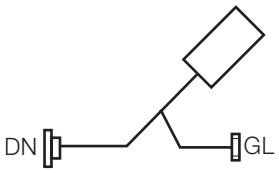
SPINDLE VALVES

DN/GL	L	H	H1	Type	Reference
GL18	125	143	111	A	M-SPVGL18
DN15/GL18	125	143	111	B	M-SPV15/GL18
DN15/GL25	125	143	111	B	M-SPV15/GL25
DN25/GL25	175	177	139	B	M-SPV25/GL25
GL18/DN15	125	143	111	C	M-SPVGL18/15
GL25/DN15	125	143	111	C	M-SPVGL25/15
GL25/DN25	175	177	139	C	M-SPVGL25/25
DN15	125	143	111	D	M-SPV15
DN25	175	177	139	D	M-SPV25

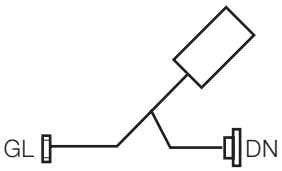
A



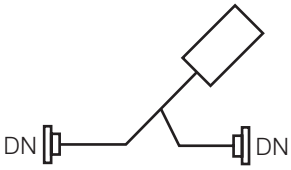
B



C



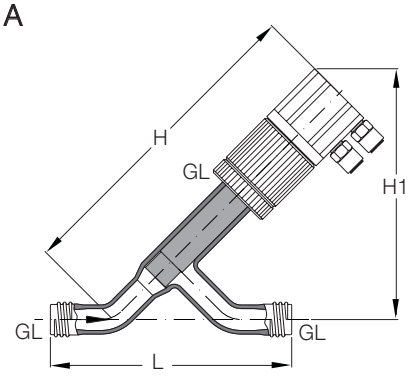
D



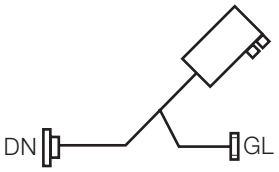
SPINDLE VALVES WITH PNEUMATICAL ACTUATOR

DN/GL	L	H	H1	Type	Reference
GL18	125	163	128	A	M-SPVPGL18
DN15/GL18	125	163	128	B	M-SPVP15/GL18
DN15/GL25	125	163	128	B	M-SPVP15/GL25
DN25/GL25	175	207	160	B	M-SPVP25/GL25
GL18/DN15	125	163	128	C	M-SPVPGL18/15
DN25/GL15	125	163	128	C	M-SPVPGL25/15
GL25/DN25	175	207	160	C	M-SPVPGL25/25
DN15	125	163	128	D	M-SPVP15
DN25	175	207	160	D	M-SPVP25

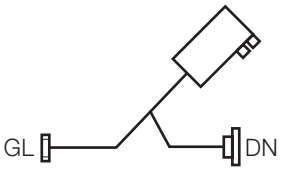
A



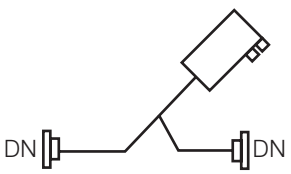
B



C



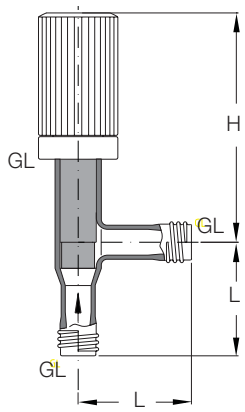
D



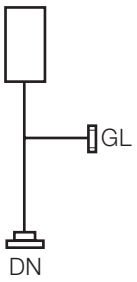
SPINDLE VALVES

DN/GL	L	H	Type	Reference
GL18	50	101	A	M-SPVEGL18
DN15/GL18	50	101	B	M-SPVE15/GL18
DN15/GL25	50	101	B	M-SPVE15/GL25
DN25/GL25	100	121	B	M-SPVE25/GL25
GL18/DN15	50	101	C	M-SPVEGL18/15
GL25/DN15	50	101	C	M-SPVEGL25/15
GL25/DN25	100	121	C	M-SPVEGL25/25
DN15	50	101	D	M-SPVE15
DN25	100	121	D	M-SPVE25

A



B



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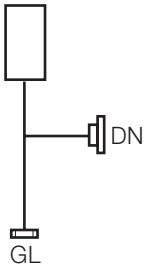
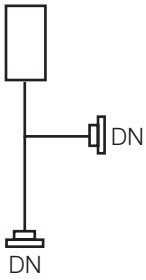


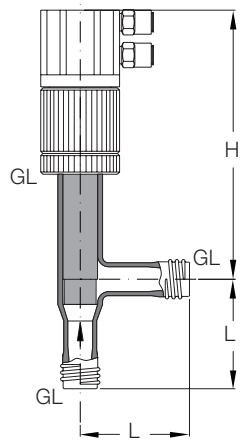
D



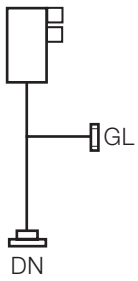
SPINDLE VALVES WITH PNEUMATICAL ACTUATOR

DN/GL	L	H	Type	Reference
GL18	50	121	A	M-SPVEPGL18
DN15/GL18	50	121	B	M-SPVEP15/GL18
DN15/GL25	50	121	B	M-SPVEP15/GL25
DN25/GL25	75	150	B	M-SPVEP25/GL25
GL18/DN15	50	121	C	M-SPVEPGL18/15
GL25/DN15	50	121	C	M-SPVEPGL25/15
GL25/DN25	75	150	C	M-SPVEPGL25/25
DN15	50	121	D	M-SPVEP15
DN25	75	150	D	M-SPVEP25

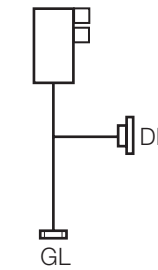
A



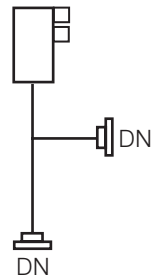
B



C



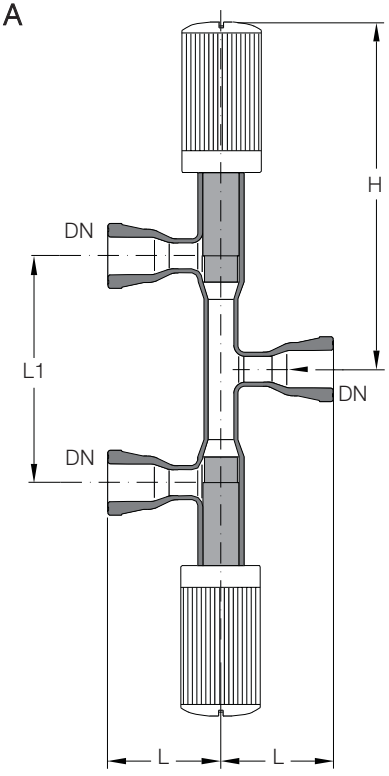
D



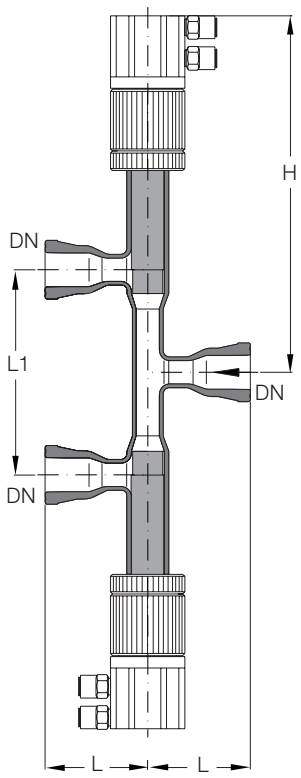
THREE WAY VALVES

DN/GL	L	L1	H	Type	Reference
DN15	50	100	151	**A (manual)**	**M-SPVW15**
DN25	100	125	183	**A (manual)**	**M-SPVW25**
DN15	50	100	171	**B (pneumatical)**	**M-SPVWP15**
DN25	100	125	213	**B (pneumatical)**	**M-SPVWP25**

A



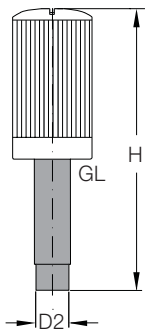
B



SPINDLE VALVE TOP PART

All top parts of the spindle valves are replaceable and assigned to the valve bodies via the connection thread. For special applications, you can obtain designs free of nonferrous metal (...BF).

GL	D2	H	Reference
18	8,6	79	**M-OSPV6**
25	14,5	115	**M-OSPV10**
32	20,5	139	**M-OSPV15**
18	8,6	79	**M-OSPV6BF**
25	14,5	115	**M-OSPV10BF**
32	20,5	139	**M-OSPV15BF**

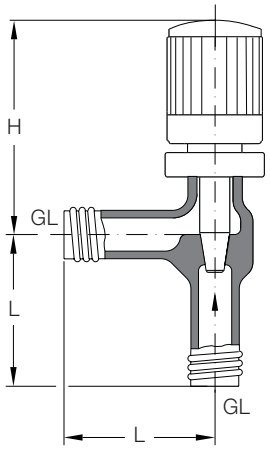


GLASS NEEDLE VALVE

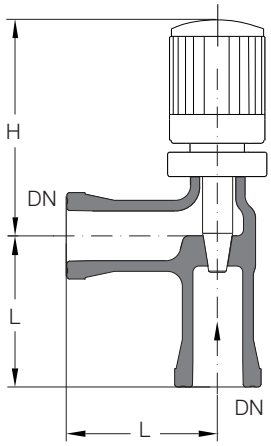
These valves can be used everywhere that high demands are placed on dosage accuracy.

DN/GL	L	H	Type	Reference
GL18	50	70	**A**	**M-GNVGL18**
DN15	50	70	**B**	**M-GNV15**

A



B



BOTTOM OUTLET VALVES WITH BELLOWS

Bottom outlet valves with bellows are used for vessels with volumes of 10 liters or more. The seal is in the vessel bottom and is self-adjusting. As a result, low and changing temperatures are possible. The bottom geometry and bellows together provide a low-dead-space combination that meets the highest purity requirements.

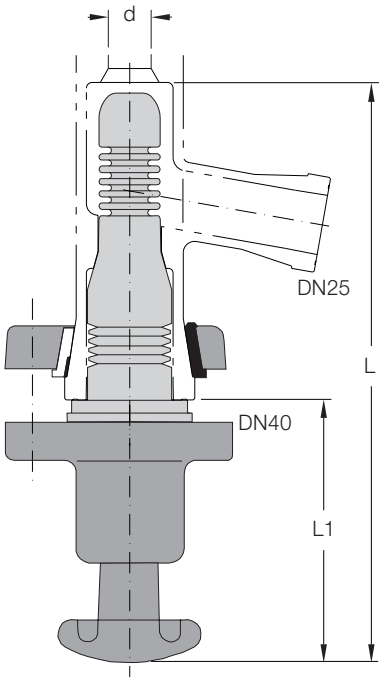
Besides the standard bottom outlet valves (A), versions are also available with an integrated overtwist lock (B). Due to the smooth surface, all glass fittings close with a very low contact pressure. To protect against incorrect operation, the version with overtwist lock can be used.

For vessels <10 l, spindle outlet valves are used (M-OBAS...).

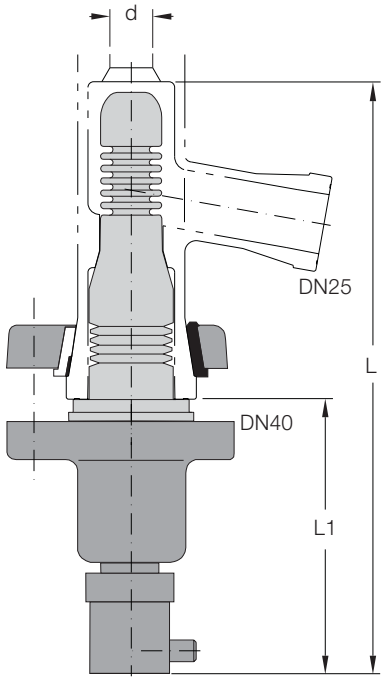
The fittings BAMD25 and BAMDT25 are used for vessels with jacket.

DN	d	L	L1	Type	Reference
25	27	260	115	**A**	**BASD25**
25	27	310	115	**A**	**BAMD25**
25	27	265	120	**B**	**BASDT25**
25	27	315	120	**B**	**BAMDT25**

A



B

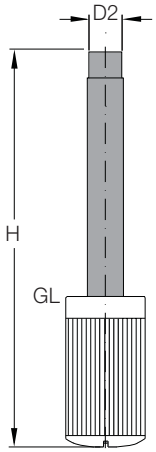


BOTTOM OUTLET VALVE SPINDLE

These robust and replaceable valve top parts combined with the valve bodies melted onto reaction vessels result in low-dead-space, highly vacuum-resistant bottom outlet valves. Almost universal use is ensured since the product only comes into contact with the highly corrosion-resistant materials PTFE and borosilicate glass 3.3.

The low leakage rate is achieved through an additional installed compression spring, which compensates for the shrinking of the valve cone during a cooling-off process.

The bottom outlet valves are assigned to the reaction vessels based on the connection thread. The specified length is measured from the glass thread end.

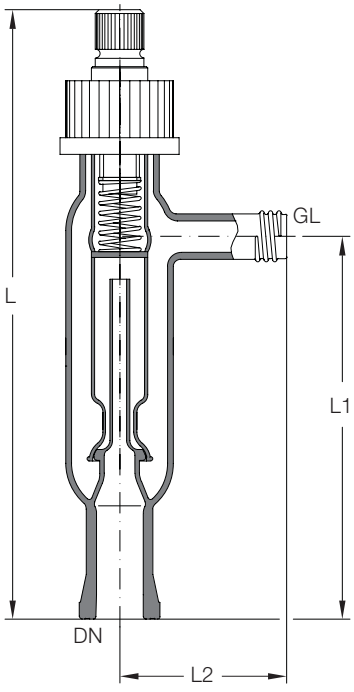


GL	D2	H	Reference
25	12,5	190	**M-OBAS10**
32	16,5	225	**M-OBAS15**

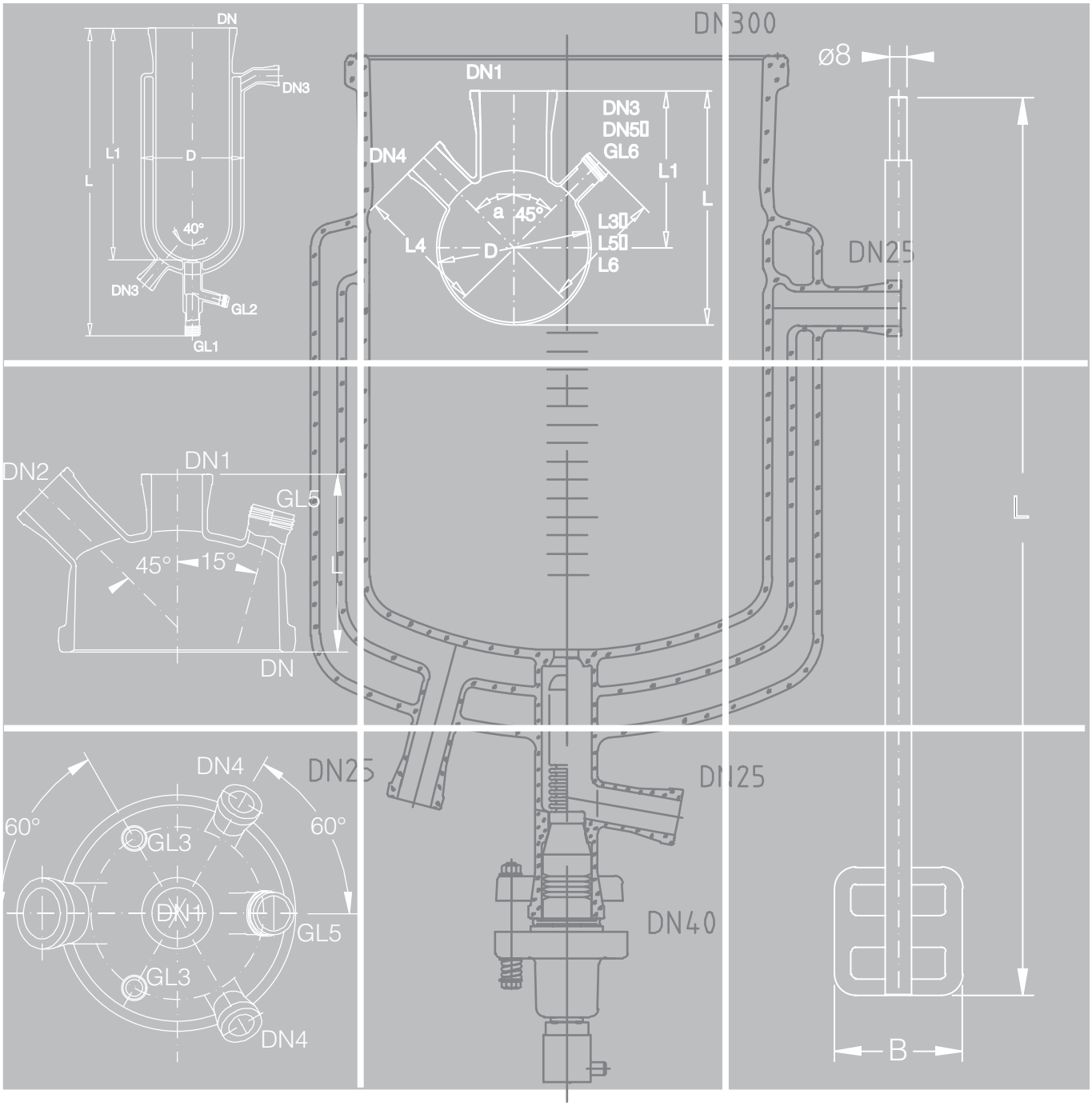
LOADING VALVES

They are used to set a constant pressure or for artificial pressure build-up. All parts in contact with the product are made of the highly corrosion-resistant materials PTFE and borosilicate glass 3.3. They are set at the factory to 0.3 bar and can be set to other pressures if desired.

Pressure holding valves must not be used as safety valves.



DN	GL	L	L1	L2	Reference
15	18	220	135	59	**M-PVF15**


DN
DN3
L1
D
L
40°
DN3
GL2
GL1
DN1
DN4
DN3
DN50
GL6
L1
L
a
45°
L3
L5
L6
L4
D
DN 300
ø8
DN25
DN2
DN1
GL5
45°
15°
L
DN
L
DN4
DN25
60°
60°
GL3
DN1
GL5
GL3
DN4
DN25
DN40
B

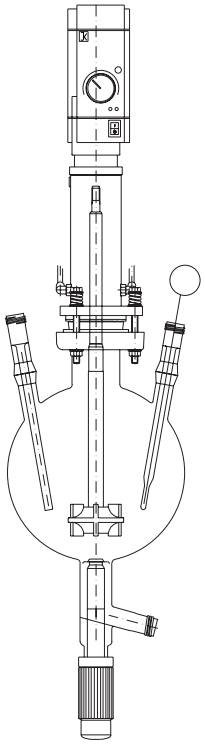
SPHERICAL VESSELS

Spherical vessels are suitable as receivers or as reaction vessels. Through their low height to volume ratio, the equipment can also be adapted to low spaces. Receivers and reaction vessels differ in that reaction vessels have a neck nozzle, through which the stirring device must normally be installed. The adjacent figure shows a typical installation. In addition to the standard vessels of the following pages, the 10° nozzles shown here are also possible.

A vessel can be used with bottom drain nozzles to avoid the dead space in the bottom nozzle. With this design, a valve seals the bottom. A spindle valve or bellows valve is used, depending on the volume of the vessel.

Reaction vessels made of glass can be heated with a jacket that is fused to the vessel perimeter and bottom nozzle and designed for an excess operating pressure of 0.5 bar. To avoid cold bridges, the jacket can be pulled up to the flange and equipped with a deflector so that the flange area is also rinsed with heat transfer medium.

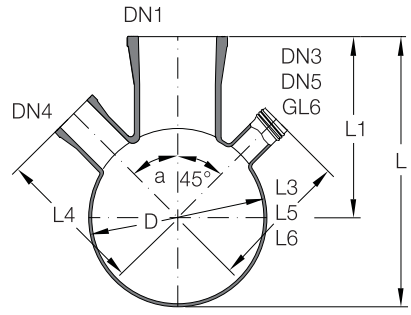
With low temperature reactions, temperatures in the jacket frequently run below the freezing point, so ice can form on the jacket, obstructing vision. Cylindrical triple-wall vessels in which the jacket is surrounded by an additional isolating jacket are suitable for this use. Standardized covers are available for all cylindrical vessels.

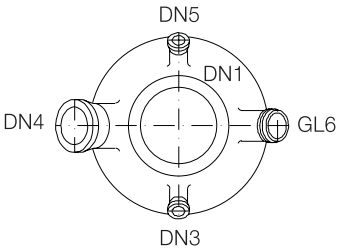


SPHERICAL VESSELS

Vessels without bottom nozzles

Nominal capacity(l)	D	DN1	DN3 DN5	DN4	GL6	L	L1	L3 L5	L4	L6	a	Reference
2	166	50	15	25	45	243	160	125	145	145	45°	**M-VSH2/50**
4	207	50	15	40	45	284	180	145	170	170	45°	**M-VSH4/50**
4	207	80	15	40	45	304	200	145	170	170	45°	**M-VSH4/80**
5	223	50	15	40	45	302	190	150	175	175	45°	**M-VSH5/50**
5	223	80	15	40	45	327	215	150	175	175	45°	**M-VSH5/80**
5	223	100	15	40	45	342	230	150	175	175	50°	**M-VSH5/100**
6	236	50	15	50	45	318	200	160	195	185	45°	**M-VSH6/50**
6	236	80	15	50	45	338	220	160	195	185	45°	**M-VSH6/80**
6	236	100	15	50	45	358	240	160	195	185	50°	**M-VSH6/100**
10	280	100	15	50	45	390	250	180	215	205	45°	**M-VSH10/100**
20	350	100	15	80	45	465	290	215	260	240	45°	**M-VSH20/100**

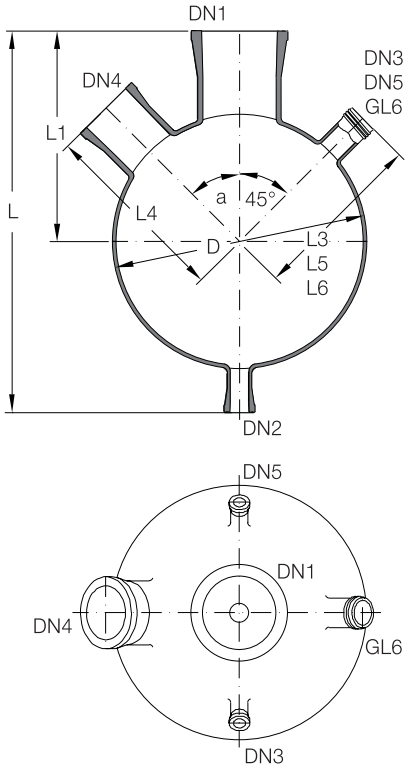




SPHERICAL VESSELS

Vessels with bottom nozzles

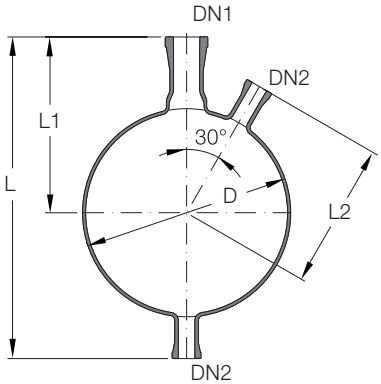
Nominal capacity(l)	D	DN1	DN2	DN3 DN5	DN4	GL6	L	L1	L3 L5	L4	L6	a	Reference
2	166	50	15	15	25	45	280	160	125	145	145	45°	**M-VSM2/50**
4	207	50	15	15	40	45	325	180	145	170	170	45°	**M-VSM4/50**
4	207	80	15	15	40	45	345	200	145	170	170	45°	**M-VSM4/80**
5	223	50	25	15	40	45	360	190	150	175	175	45°	**M-VSM5/50**
5	223	80	25	15	40	45	385	215	150	175	175	45°	**M-VSM5/80**
5	223	100	25	15	40	45	400	230	150	175	175	50°	**M-VSM5/100**
6	236	50	25	15	50	45	380	200	160	195	185	45°	**M-VSM6/50**
6	236	80	25	15	50	45	400	220	160	195	185	45°	**M-VSM6/80**
6	236	100	25	15	50	45	420	240	160	195	185	50°	**M-VSM6/100**
10	280	100	25	15	50	45	450	250	180	215	205	45°	**M-VSM10/100**
20	350	100	25	15	80	45	525	290	215	260	240	45°	**M-VSM20/100**

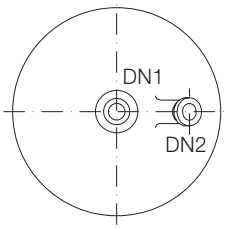


SPHERICAL VESSELS

Receivers with bottom nozzles

Nominal capacity(l)	D	DN1	DN2	L	L1	L2	Reference
2	166	25	15	275	155	125	**M-VSS2**
4	207	25	15	320	175	145	**M-VSS4**
6	236	25	15	350	190	160	**M-VSS6**





SPHERICAL VESSELS

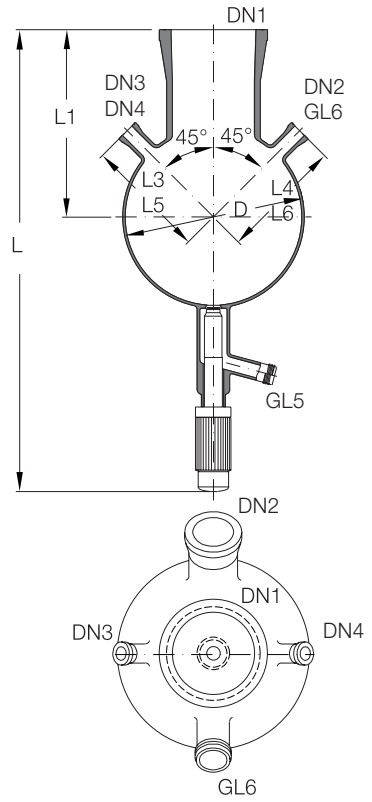
With low-dead-space bottom drain valve

Spherical vessels of type VSM have their own fused seat for a bottom drain valve, which seals the vessel bottom with low-dead-space from below. The M-OBAS bottom drain valve is used for nominal volumes of up to 6 liters; for volumes of 10 and 20 liters, the BASD valve is used, whose structural design is described in the "Fittings" chapter.

If spheres with bottom nozzles or bottom outlet valves are to be used in heating covers or bath heating vessels, the nozzle length must be adjusted.

Nominal capacity(l)	D	DN1	DN2	DN3 DN4	DN5 GL5	GL6	L ca.	L1	L3 L5	L4	L6	Type	Reference
2	166	50	25	15	18	45	430	160	125	145	145	**A**	**M-VSMB2/50**
4	207	50	40	15	18	45	470	180	145	170	170	**A**	**M-VSMB4/50**
4	207	80	40	15	18	45	490	200	145	170	170	**A**	**M-VSMB4/80**
5	223	50	40	15	25	45	525	190	150	175	175	**A**	**M-VSMB5/50**
5	223	80	40	15	25	45	550	215	150	175	175	**A**	**M-VSMB5/80**
5	223	100	40	15	25	45	565	230	150	175	175	**A**	**M-VSMB5/100**
6	236	50	50	15	25	45	545	200	160	195	185	**A**	**M-VSMB6/50**
6	236	80	50	15	25	45	565	220	160	195	185	**A**	**M-VSMB6/80**
6	236	100	50	15	25	45	585	240	160	195	185	**A**	**M-VSMB6/100**
10	280	100	50	15	25	45	660	250	180	215	205	**B**	**M-VSMB10/100**
20	350	100	80	15	25	45	735	290	215	260	240	**B**	**M-VSMB20/100**

A



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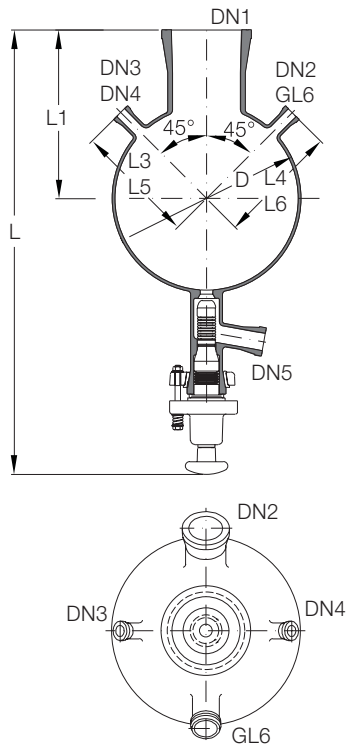
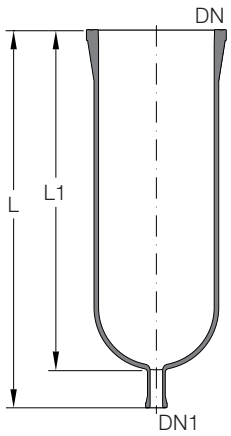


CYLINDRICAL VESSELS

Universal cylindrical vessels

These cylindrical vessels equipped with round bottoms can be used both for stirring tasks and as receivers.



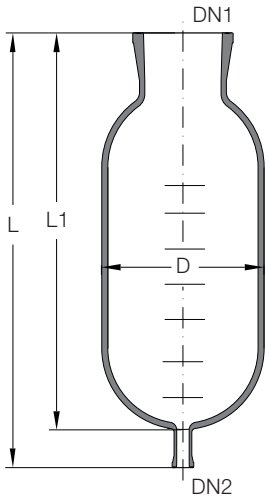
Nominal capacity(l)	DN	DN1	L	L1	Reference	Reference [2] with graduations
2	100	15	400	346	**M-VZ2/100**	**M-VZG2/100**
4	150	15	400	346	**M-VZ4/150**	**M-VZG4/150**
6	150	15	500	446	**M-VZ6/150**	**M-VZG6/150**
10	*200*	*25*	*550*	*490*	***VZ10/200***	***VZG10/200*** [1]
16	300	25	450	387	**M-VZ16/300**	**M-VZG16/300**

[1] Component out of WPR 2002
[2] Graduation for 6 i calibration 0,25 l, 10 l calibration 0,5 l, > 10 l calibration 2 l

CYLINDRICAL VESSELS

Receiver cylinder vessels

The vessels with round bottoms closed at the neck are especially suitable as receivers.



Nominal capacity(l)	DN1	DN2	D	L	L1	Reference	Reference [1] with graduations
6	100	15	165	575	521	**M-VZ6/100**	**M-VZG6/100**
10	100	15	215	575	521	**M-VZ10/100**	**M-VZG10/100**
16	150	15	270	650	596	**M-VZ16/150**	**M-VZG16/150**
25	150	25	315	700	636	**M-VZ25/150**	**M-VZG25/150**

[1] Graduation for 6 i calibration 0,25 l, 10 l calibration 0,5 l, > 10 l calibration 2 l

CYLINDRICAL VESSELS

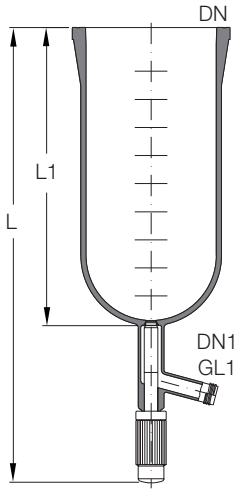
Universal cylindrical vessels with bottom drain valve

Cylindrical vessels of type VZB have their own fused seat for a bottom drain valve, which seals the round bottom with low-dead-space from below. The M-OBAS bottom drain valve is used for nominal volumes of up to 6 liters; for the 10- and 16-liter vessels, the BASD valve is used.

Nominal capacity(l)	DN	DN1 GL1	L	L1	Type	Reference	Reference with gratuations
2	100	18	530	350	A	**M-VZB2/100**	**M-VZBG2/100**
4	150	18	530	350	A	**M-VZB4/150**	**M-VZBG4/150**
6	150	15	660	450	A	**M-VZB6/150**	**M-VZBG6/150**
10	*200*	*25*	*755*	*490*	*B*	***VZ10/200BASD***	***VZG10/200BASD*** [1]
16	300	25	655	390	B	**M-VZB16/300**	**M-VZBG16/300**

[1] Component out of WPR 2002

A



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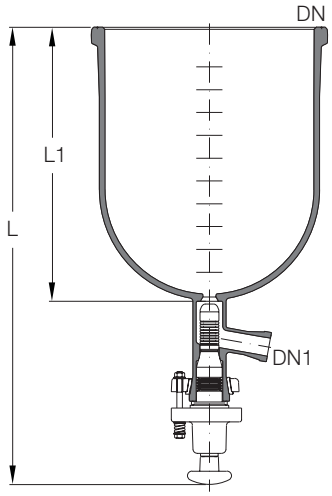
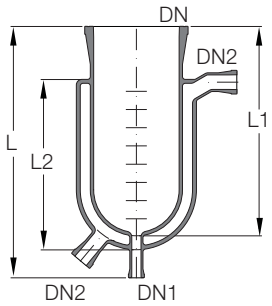


CYLINDRICAL VESSELS

Cylindrical vessels with jacket



IIn the Miniplant technology, jackets are fused at the bottom nozzle and inside vessel so they can be operated with water or thermal oil. The nozzles of the tempering jackets are equipped with a safety flat flange, to which you can make straight or angled connections with appropriate adapters from the "Connections" chapter.

Cylindrical vessels with jacket are supported at the neck.

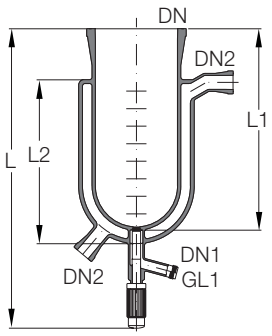
Nominal capacity(l)	DN	DN1	DN2	L	L1	L2	Volume jacket	Reference	Reference [1] with graduations
2	100	15	15	475	400	325	2,3	**M-TVZ2/100**	**M-TVZG2/100**
4	150	15	15	450	375	305	2,9	**M-TVZ4/150**	**M-TVZG4/150**
6	150	15	15	565	490	420	4,0	**M-TVZ6/150**	**M-TVZG6/150**
10	*200*	*25*	*25*	*580*	*490*	*423*	*7,0*	***DVZ10/200***	***DVZG10/200*** [2]
16	300	25	25	500	420	325	6,3	**M-TVZ16/300**	**M-TVZG16/300**

[1] Graduation for 6 i calibration 0,25 l, 10 l calibration 0,5 l, > 10 l calibration 2 l
[2] Component out of WPR 2002

CYLINDRICAL VESSELS

Cylindrical vessels with jacket and bottom drain valve

A



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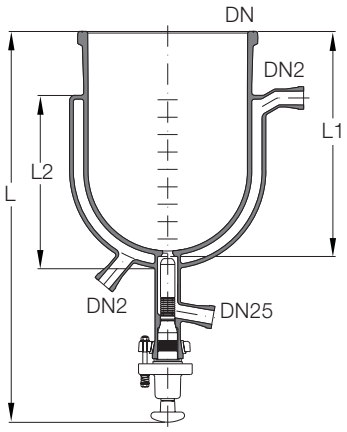


Jacketed cylindrical vessels of type TVZB have their own fused seat for a bottom drain valve, which seals the round bottom with low-dead-space from below. The M-OBAS bottom drain valve is used for nominal volumes of up to 6 liters; for the 10- and 16-liter vessel, the BAMD valve is used, whose structural design is described in the "Fittings" chapter.

Nominal capacity(l)	DN	DN1 GL1	DN2	L	L1	L2	Volume jacket	Type	Reference	Reference[1] with graduations
2	100	18	15	575	400	325	2,3	**A**	**M-TVZB2/100**	**M-TVZBG2/100**
4	150	18	15	550	375	305	2,9	**A**	**M-TVZB4/150**	**M-TVZBG4/150**
6	150	15	15	700	490	420	4,0	**A**	**M-TVZB6/150**	**M-TVZBG6/150**
10	*200*	*25*	*25*	*805*	*490*	*423*	*7,0*	***B***	***DVZ10/200BAMD***	***DVZG10/200BAMD*** [2]
16	300	25	25	735	420	325	6,4	**B**	**M-TVZB16/300**	**M-TVZBG16/300**

[1] Graduation for 6 i calibration 0,25 l, 10 l calibration 0,5 l, > 10 l calibration 2 l
[2] Component out of WPR 2002

REACTION VESSELS

The reaction vessels have a dome end, so the thermodynamic characteristics can be transferred for the scale-up. A number of different stirring devices are available for mixing, whose combinations with vessels and covers are listed in a table in the "Stirrer Drives" section.

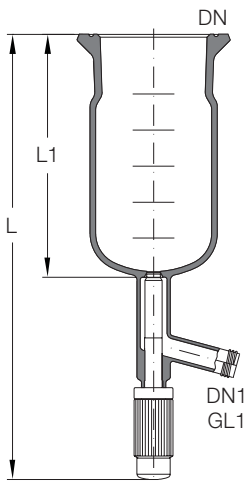
Up to volumes of 4 liters, the main flange is designed as a laboratory flange, for which appropriate covers are available.

Reaction vessels have their own fused seat for a bottom drain valve, which seals the dome end with low-dead-space from below. The M-OBAS bottom drain valve is used for nominal volumes of up to 6 liters; for 10 liters and larger, the BASD valve is used.

The reaction vessels M-TVZB are delivered together with the bottom drain valve.

Nominal capacity(l)	SLF	DN	DN1	GL1	L	L1	Type	Reference
0,5	100	-	-	18	340	160	**A**	**M-VZKB05**
1,0	100	-	-	18	400	220	**A**	**M-VZKB1**
2,0	150	-	15	-	375	195	**A**	**M-VZKB2**
4,0	150	-	25	-	490	310	**A**	**M-VZKB4**
6,0	-	200	15	-	515	390	**C**	**M-VZKB6**
10	-	300	25	-	580	310	**B**	**M-VZKB10**
16	-	300	25	-	630	360	**B**	**M-VZKB16**
25	-	300	25	-	755	485	**B**	**M-VZKB25**

A



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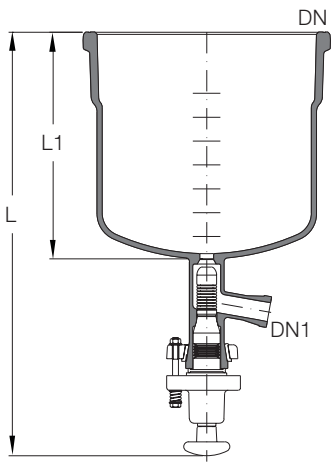

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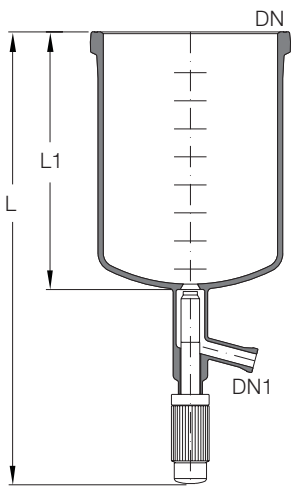


JACKETED REACTION VESSELS

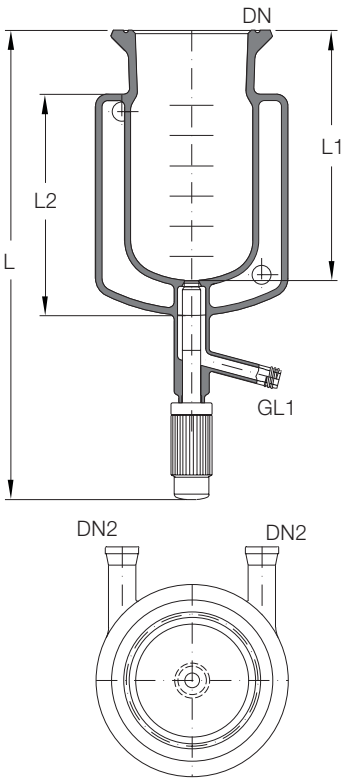
In the Miniplant technology, tempering jackets are fused at the bottom nozzle and inside vessel so they can be operated with water or thermal oil. The nozzles of the tempering jackets are equipped with a safety flat flange, to which you can make straight or angled connections with appropriate adapters from the "Connections" chapter.

Reaction vessels are delivered with their own fused seat for a bottom drain valve, which seals the bumped bottom with low-dead-space from below. The M-OBAS bottom drain valve is used for nominal volumes of up to 6 liters; for 10 liters and larger, the BAMD valve is used.

Cylindrical vessels with jacket are supported at the neck nozzle.

Nominal capacity(l)	DN SLF	DN1 GL1	DN2	L	L1	L2	Area dm²	Volume jacket	Type	Reference
0,5	100	18	15	340	160	130	4,0	1,2	**A**	**M-TVZKB05**
1,0	150	18	15	400	220	190	6,1	1,7	**A**	**M-TVZKB1**
2,0	150	18	15	375	195	165	8,0	2,0	**A**	**M-TVZKB2**
4,0	150	18	15	490	310	280	14,0	3,3	**A**	**M-TVZKB4**
6,0	200	15	15	510	300	235	15,2	4,4	**B**	**M-TVZKB6**
10	300	25	25	670	350	275	23,6	5,2	**C**	**M-TVZKB10**
16	300	25	25	700	380	260	29,7	9,7	**D**	**M-TVZKB16**
25	300	25	25	825	505	385	42,2	13,7	**D**	**M-TVZKB25**

A



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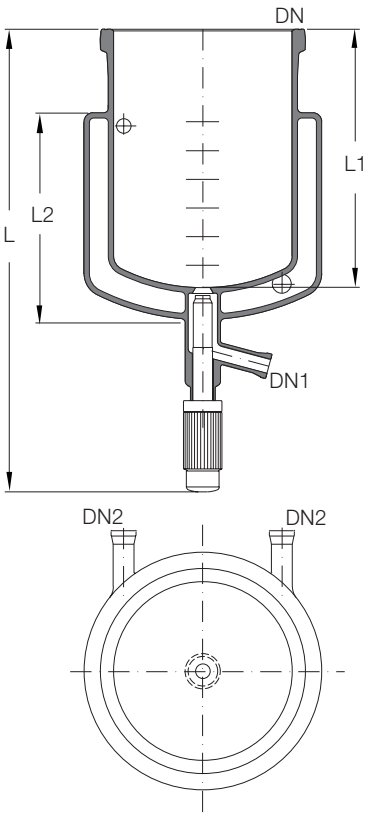

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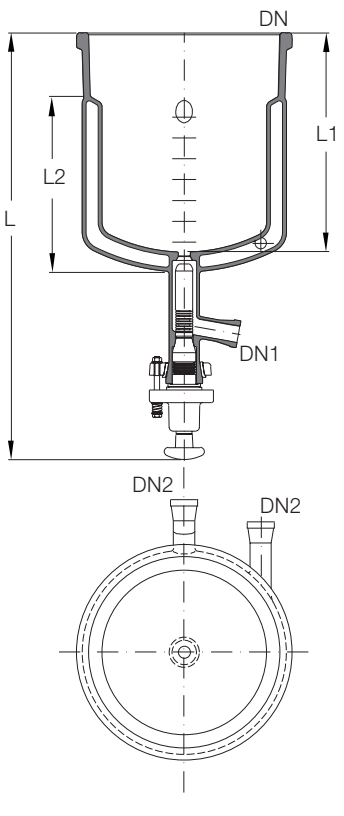

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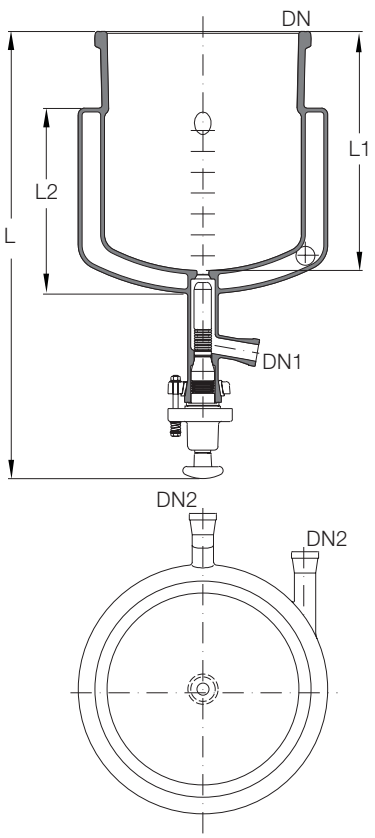


TRIPLE-WALL REACTOR

The triple-wall reactor offers a combination of tempering and isolating jackets. With this, the vessel can be operated in the product and jacket area from -80° up to +140 °C, although the temperature difference between the medium and heat medium should not exceed 50°C.

To avoid thermal stress, the heating or cooling speed must not exceed the value of 1 K/min.

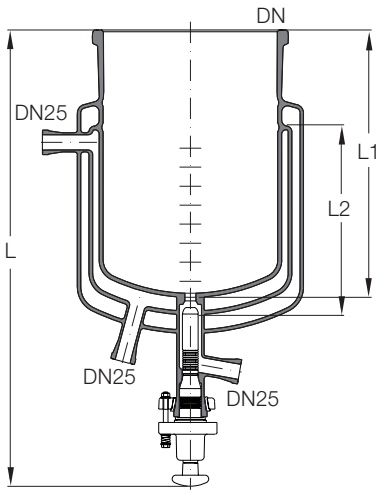
The surrounding isolating jacket is evacuated to 10^{-7} bar and prevents the loss of heat to the environment and ice formation on the outside surface for processes below the freezing point. As the insulation jacket is not silver-coated, the process can be observed well using a light-colored thermal oil.

All triple-wall vessels are equipped with a low-dead-space bottom drain valve with overtwist lock. This valve seals from below in a fused glass flange.

All triple-wall vessels are laminated with Sectrans.

Flow nozzles can be used for better heat exchange in the jacket.

A



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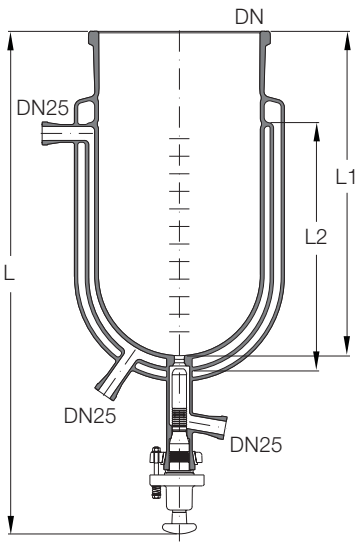
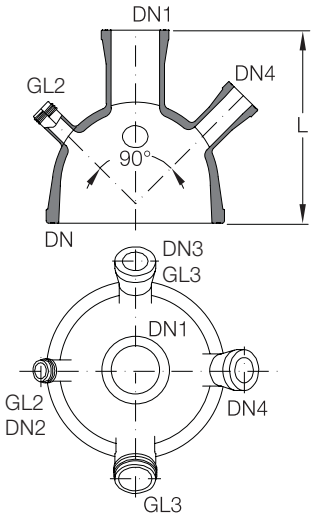


Nominal capacity(l)	DN	L	L1	L2	Area dm²	Volume jacket l	Type	Reference
6,3	200	700	370	255	16,8	9,5	**A**	**M-TWR6.3**
10	200	825	495	380	25,2	11,7	**A**	**M-TWR10**
16	300	790	460	325	31,5	8,2	**A**	**M-TWR16**
25	300	940	610	465	50,2	8,2	**B**	**M-TWR25**

VESSEL COVERS

DN	DN1	GL2 DN2	GL3 DN3	GL4 DN4	GL5 DN5	L	Type	Reference
100	50	15	25	-	-	175	**A**	**M-VZA100/50**
150	50	25	45	25	-	200	**A**	**M-VZA150/50**
200	50	50	25	25	45	175	**B**	**M-VZA200/50**
300	50	80	25	25	40	225	**C**	**M-VZA300/50**

A



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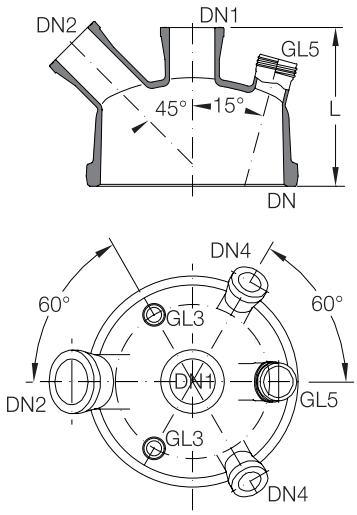

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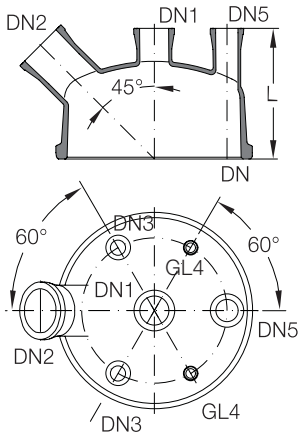
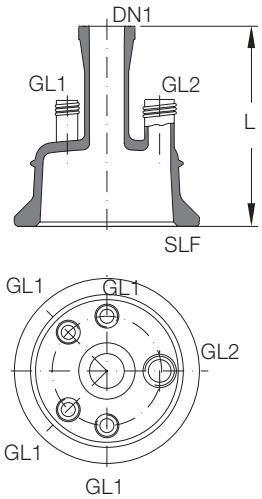


VESSEL COVERS

These vessel covers are suitable for connection to vessels with laboratory flanges.
You will find a corresponding three-way holder in the "Connections" chapter.

SLF	DN1	DN2	GL1	GL2	GL3	GL4	GL5	L	Type	Reference
100	25	-	18	25	-	-	-	150	**A**	**M-VZC100/25**
150	25	25	18	18	25	18	45	130	**B**	**M-VZC150/25**

A



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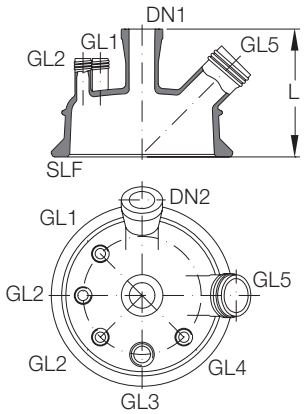
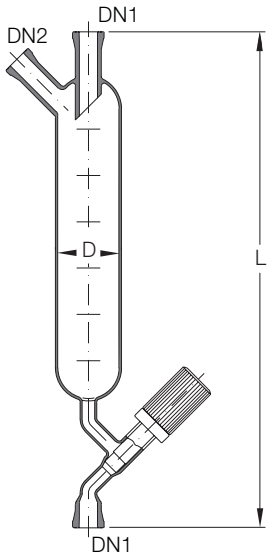


RECEIVERS

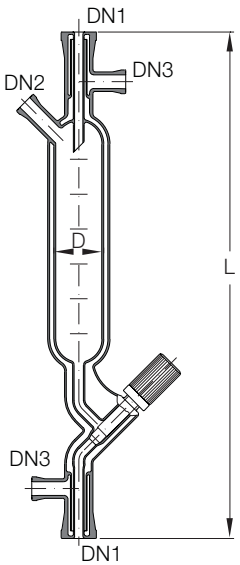
Receivers can be used both for measuring volume in a process and for feeding reaction partners. In the temperature-controlled version, the heat-transfer medium is guided over an integrated baffle plate into the flange area. You will find adapters for heat-transfer hoses in the "Connections" chapter.

Nominal capacity(l)	D	L	DN1	DN2	DN3	Type	Reference
0,5	60	450	15	15	-	**A**	**M-VG05**
1,0	70	530	15	15	-	**A**	**M-VG1**
2,0	85	650	15	15	-	**A**	**M-VG2**
4,0	110	700	15	15	-	**A**	**M-VG4**
0,5	60	610	25/15	15	15	**B**	**M-TVG05**
1,0	70	680	25/15	15	15	**B**	**M-TVG1**
2,0	85	820	25/15	15	15	**B**	**M-TVG2**
4,0	110	860	25/15	15	15	**B**	**M-TVG4**

A



B



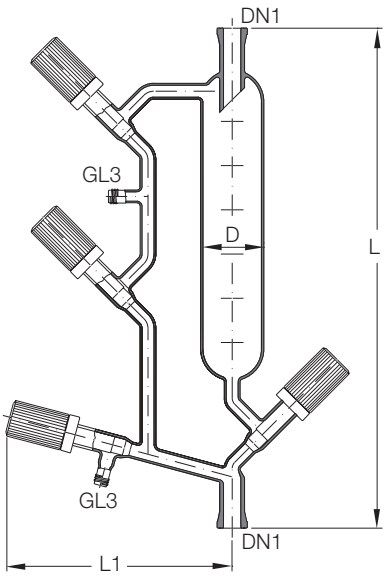
ANSCHÜTZ-THIELE RECEIVERS

This special design of a graduated receiver can be used for distillation volume measurements with vacuum columns. Through the integrated vacuum switching, distillation is not impaired during the measuring process.

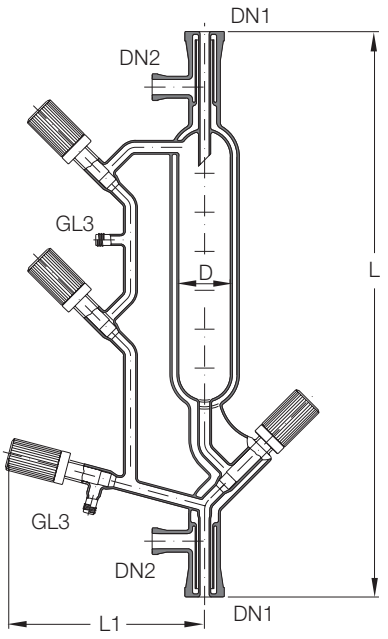
In the temperature-controlled version, the heat-transfer medium is guided over an integrated return into the flange area. You will find adapters for heat-transfer hoses in the "Connections" chapter.

Nominal capacity(l)	D	L	L1	L2	DN1	DN2	GL3	Type	Reference
0,25	48	425	163	125	15	-	GL14	**A**	**M-ATV025**
0,5	60	475	214	145	15	-	GL14	**A**	**M-ATV05**
1,0	70	560	233	160	15	-	GL14	**A**	**M-ATV1**
0,25	48	550	173	125	25/15	15	GL14	**B**	**M-TATV025**
0,5	60	610	234	145	25/15	15	GL14	**B**	**M-TATV05**
1,0	70	885	244	160	25/15	15	GL14	**B**	**M-TATV1**

A



B



HORIZONTAL SEPARATORS

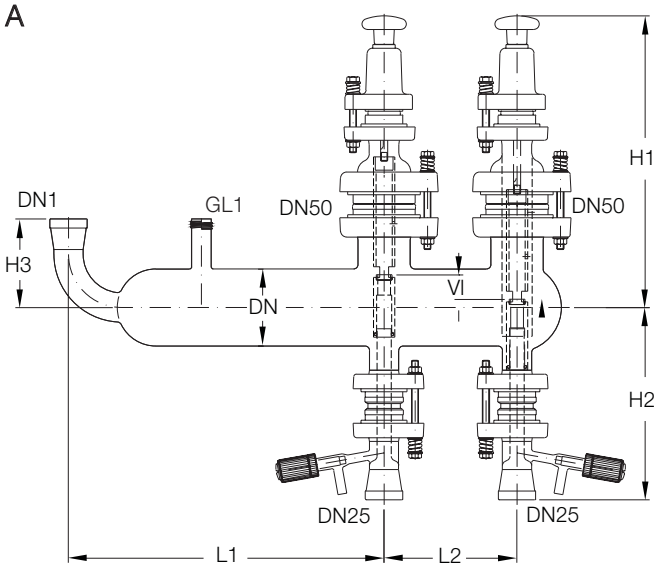
Separators are used for continuous separation of a two-phase mixture. They offer a large phase interface for separating and a low flow speed. The interface is regulated in both versions with an internal overflow valve for the heavy phase. An integrated jacket tube holds the light phase back from the height-adjustable overflow opening.

In version A, the total fill level of the separator can also be set with an overflow valve. Since the two valves can be interchanged with each other, the outlet nozzles for the heavy and light phases can easily be switched. This is an ideal possibility to make the phase switching without additional pipelines and valves.

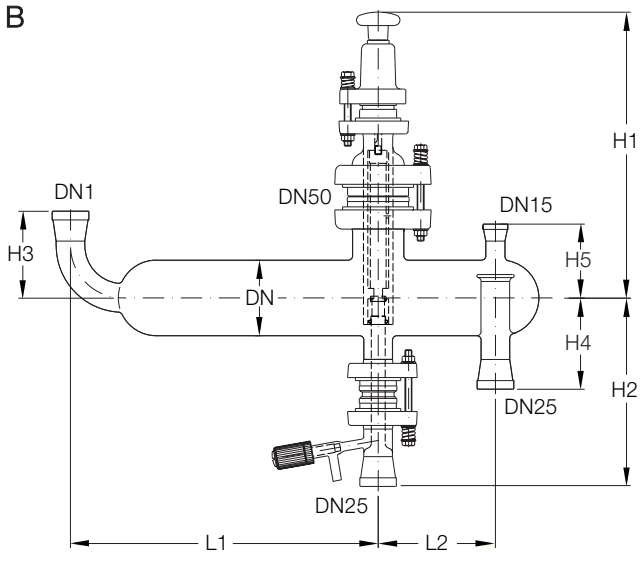
In version B, the drain height of the light phase is set through the fused-in overflow tube.

DN	DN1	GL	L1	L2	L3	H1	H2	H3	H4	H5	Vl	Type	Reference
50	15	18	330	150	130	315	202	70	-	-	20	**A**	**M-AOFA50**
80	25	18	450	150	150	330	217	100	-	-	37	**A**	**M-AOFA80**
100	25	25	450	150	150	340	217	100	-	-	37	**A**	**M-AOFA100**
50	15	-	330	135	-	315	202	70	90	70	-	**B**	**M-AOF50**
80	25	-	450	135	-	330	217	100	105	85	-	**B**	**M-AOF80**
100	25	-	450	135	-	340	217	100	115	100	-	**B**	**M-AOF100**

A



B



STIRRER DRIVES

You will find a selection of various combinations of vessels and covers with stirrer drives and stirrers in the following table. Besides the desired stirring task, decisive for the selection are the possibility to connect the stirrer to the drive and the sealing of the vessel. Besides the metal stirrers, corrosion-resistant stirrers/seal variants are also available.

Vessels	Covers	Stirrer drives M-RAL	Stirrer drives M-RAM	Stirrer drives M-RG	
Cylindrical Vessels		**Diagonal blade stirrers borosilicate glass 3.3**	**Diagonal blade stirrers stainless steel**	**Propeller stirrers steel/PTFE**	**Turbine stirrers steel/PTFE**
M-VZB2/100	M-VZA100/50	M-SSG45/700	M-SSE45/420	-	-
M-VZB4/150	M-VZA150/50	M-SSG60/730	M-SSE60/445	M-SPT70/680	M-STT70/680
M-VZB6/150	M-VZA150/50	M-SSG60/810	M-SSE60/535	M-SPT70/770	M-STT70/770
VZ10/200BASD	M-VZA200/50	-	M-SSE75/555	M-SPT70/790	M-STT70/790
M-VZB16/300	M-VZA300/50	-	-	M-SPT90/725	M-STT90/725
Jacketed Cylindrical Vessels					
M-TVZB2/100	M-VZA100/50	M-SSG45/750	M-SSE45/470	-	-
M-TVZB4/150	M-TVZA150/50	M-SSE60/750	M-SSE60/470	M-SPT70/700	M-STT70/700
M-TVZB6/150	M-VZA150/50	M-SSG60/860	M-SSE60/575	M-SPT70/810	M-STT70/810
DV10/200BAMD	M-VZA200/50	-	M-SSE75/555	M-SPT70/790	M-STT70/790
M-TVZB16/300	M-VZA300/50	-	-	M-SPT90/755	M-STT90/755
Reaction Vessels					
M-VZKB05	M-VZC100/25	M-SSG45/500	M-SSE45/230	-	-
M-VZKB1	M-VZC100/25	M-SSG45/550	M-SSE45/280	-	-
M-VZKB2	M-VZC150/25	M-SSG75/500	M-SSE75/235	-	-
M-VZKB4	M-VZC150/25	M-SSG75/620	M-SSE75/345	-	-
M-VZKB6	M-VZA200/50	M-SSG75/660	M-SSE75/380	M-SPT90/620	M-STT90/620
M-VZKB10	M-VZA300/50	-	-	M-SPT120/670	M-STT120/670
M-VZKB16	M-VZA300/50	-	-	M-SPT120/710	M-STT120/710
M-VZKB25	M-VZA300/50	-	-	M-SPT120/825	M-STT120/825
Jacketed Reaction Vessels					
M-TVZKB05	M-VZC05	M-SSG45/500	M-SSE45/230	-	-
M-TVZKB1	M-VZC100/25	M-SSG45/550	M-SSE45/280	-	-
M-TVZKB2	M-VZC150/25	M-SSG75/500	M-SSE75/235	-	-
M-TVZKB4	M-VZC150/25	M-SSG75/620	M-SSE75/345	-	-
M-TVZKB6	M-VZC200/50	M-SSG75/660	M-SSE75/380	M-SPT90/620	M-STT90/620
M-TVZKB10	M-VZC300/50	-	-	M-SPT90/710	M-STT90/710
M-TVZKB16	M-VZC300/50	-	-	M-SPT120/730	M-STT120/730
M-TVZKB25	M-VZC300/50	-	-	M-SPT120/855	M-STT120/855
Triple-wall Reactors					
M-TWR6.3	M-VZC200/50	-	-	M-SPT90/680	M-STT90/680
M-TWR10	M-VZC200/50	-	-	M-SPT90/805	M-STT90/805
M-TWR16	M-VZC300/50	-	-	M-SPT120/805	M-STT120/805
M-TWR25	M-VZC300/50	-	-	M-SPT90/940	M-STT90/940
Spherical Vessels					
M-VSMB2/50	-	M-SSG45/440	M-SSE45/155	-	-
M-VSMB4/50	-	M-SSG45/480	M-SSE45/195	-	-
M-VSMB4/80	-	-	M-SSE60/215	M-SPT70/450	M-STT70/450
M-VSMB5/50	-	M-SSG75/500	M-SSE45/215	-	-
M-VSMB5/80	-	-	M-SSE60/235	M-SPT70/260	M-SPT70/260
M-VSMB5/100	-	-	M-SSE75/250	M-SPT70/270	M-SPT70/270
M-VSMB6/50	-	M-SSG75/500	M-SSE45/230	-	-
M-VSMB6/80	-	-	M-SSE60/245	M-SPT70/260	M-SPT70/260
M-VSMB6/100	-	-	M-SSE75/265	M-SPT90/285	M-SPT90/285
M-VSMB10/100	-	-	-	M-SPT90/310	M-SPT90/310
M-VSMB20/100	-	-	-	M-SPT90/440	M-SPT90/440

COMPLETE LABORATORY STIRRER DRIVES

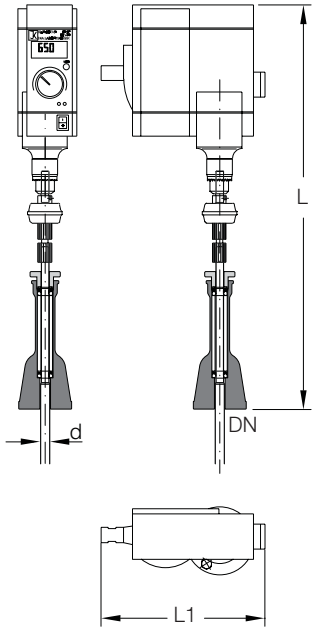
Drive with stirring shaft seal for glass stirrers

The stirrer drives M-RAL and M-RALD are used in combination with the glass diagonal blade stirrers, which have a diameter of 10 mm in the area of the seal. The product is supplied with the drive, seal and flexible coupling. The stirring shaft seal can be flanged to the cover with a standard glass connector (not supplied).

Due to integrated microprocessor-control, these robust, tested-and-proved drives have constant torque. An electronic safety circuit and the soft start-up that prevents spraying are additional advantages. The precision chuck can receive stirrer shafts up to a diameter of 10 mm. The drive of type M-RALD additionally has a digital speed indicator.

Connection voltage is 230V, 50 Hz, the protection rating IP42. The drive is suitable for a maximum ambient temperature of 40°C and maximum relative humidity of 80%.

With the lip seal, the product comes into contact only with the highly corrosion-resistant materials borosilicate glass 3.3 and PTFE. It also guarantees a good guiding of the stirrer shaft (D 10 or 16 mm) and can be adjusted with a thrust screw.

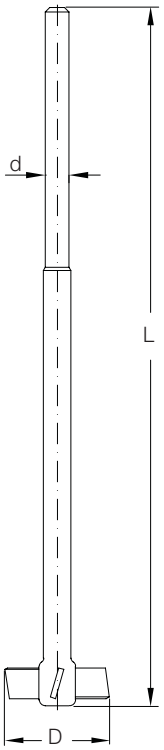


DN	L	L1	d	Power W	Speed 1/min	Reference
25	527	218	10	75	40-1200	**M-RAL25/10**
25	542	218	16	75	40-1200	**M-RAL25/16**
50	538	218	10	75	40-1200	**M-RAL50/10**
50	553	218	16	75	40-1200	**M-RAL50/16**
25	527	218	10	130	50-2000	**M-RALD25/10**
25	542	218	16	130	50-2000	**M-RALD25/16**
50	538	218	10	130	50-2000	**M-RALD50/10**
50	553	218	16	130	50-2000	**M-RALD50/16**

Borosilicate glass diagonal blade stirrers

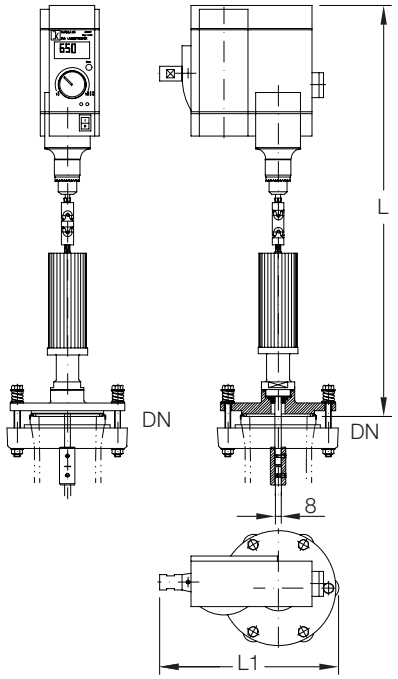
D	L	d	Reference[1)]
45	page 4-15	10	**M-SSG45/[L]**
60	page 4-15	10	**M-SSG60/[L]**
75	page 4-15	10	**M-SSG75/[L]**

[1)] References are completed by total length. For appropriate stirrers for the vessels please see table on page 4-15.



COMPLETE LABORATORY STIRRER DRIVES

Magnetic coupling for metal stirring devices



The M-RAM and M-RAMD stirrer drives are used in combination with the metal, diagonal-blade and lattice stirrers, which are pinned to the drive shaft through an adapter. The product is supplied with the drive, magnetic coupling, stirring shaft adapter for a diameter of 10 mm, the dual cardan joint and the glass connecting elements.

Due to integrated microprocessor control, these robust, tested-and-proved drives have constant torque (max. 60 Ncm) up to the range of high viscosities (50,000 mPas). An electronic safety circuit and the soft start-up that prevents spraying are additional advantages. The drive of type M-RAMD additionally has a digital speed indicator.

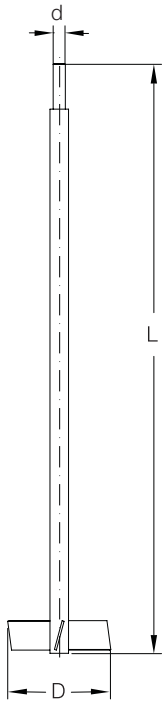
Connection voltage is 230V, 50 Hz, the protection rating IP42. The drive is suitable for a maximum ambient temperature of 40°C and maximum relative humidity of 80%.

The stirring container seals equipped with a permanent magnet system are gasproof and suitable for high vacuums. Their corrosion resistance depends on the material chosen for the flange and shaft end. These parts are made standard in material No. 1.4571.

DN	L	L1	Power W	Speed 1/min	Reference
25	450	187	75	40-1200	**M-RAM25**
50	530	201	75	40-1200	**M-RAM50**
80	650	218	75	40-1200	**M-RAM80**
100	700	242	75	40-1200	**M-RAM100**
25	450	187	130	50-2000	**M-RAMD25**
50	530	201	130	50-2000	**M-RAMD50**
80	650	218	130	50-2000	**M-RAMD80**
100	700	242	130	50-2000	**M-RAMD100**

Metal diagonal blade stirrers

Material 1.4571, matte pickled and passivated

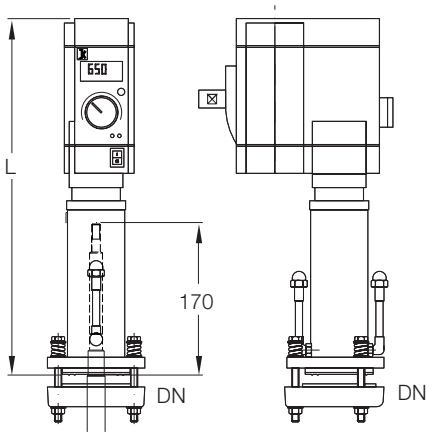


D	L	d	Reference[1)]
45	page 4-15	8	**M-SSE45/[L]**
60	page 4-15	8	**M-SSE60/[L]**
75	page 4-15	8	**M-SSE75/[L]**

[1)] References are completed by total length. For appropriate stirrers for the vessels please see table on page 4-15.

COMPLETE LABORATORY STIRRER DRIVES

Drive with mechanical seal for PTFE stirrers



The M-RGL laboratory stirrer is used when a PTFE diagonal-blade or turbine stirrer is to be used together with a laboratory stirrer drive. The product is supplied with the drive, rotary transmission lead-through for a shaft diameter of 18 mm and the glass connecting elements.

Due to integrated microprocessor control, these robust, tested-and-proved drives have a constant torque of max. 60 Ncm. They can be used up to the range of high viscosities (50,000 mPas). An electronic safety circuit and the soft start-up that prevents spraying are additional advantages. The drive has a digital speed indicator.

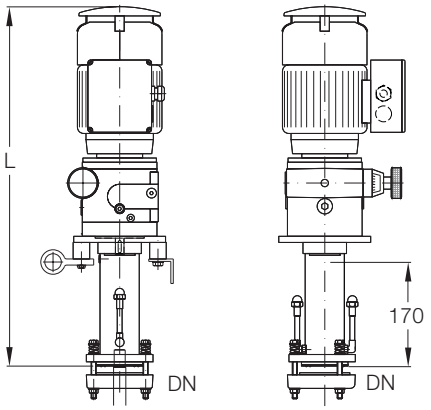
Connection voltage is 230V, 50 Hz, the protection rating IP42. The drive is suitable for a maximum ambient temperature of 40°C and maximum relative humidity of 80%.

A single-acting mechanical seal (sliding-ring SiC, counter ring, hard carbon), which is dependent on the direction of rotation, seals on the product side, while a radial shaft seal ring seals on the atmosphere side. Up to a product temperature of 90°C, the sliding ring chamber is filled with coolant/lubricant and the connections short-circuited. At a product temperature of over 90°C, the mechanical seal is flushed with 2-10 liters of tap water per hour .

DN	L	L1	L2	Reference
50	400	185	217	**M-RGL50/130**

COMPACT STIRRER DRIVE

Gear motor with mechanical seal for PTFE stirrers



Stirrer drive with ATEX certification for zone 1 and temperature class T4

The M-RGD compact stirrer drive is used in combination with the PTFE diagonal blade or turbine stirrers. It consists of a continuously variable, manually adjustable gear motor, rotary transmission lead-through with integrated bearings, and connecting elements. The compact stirrer drive is flanged with its PFA-coated connecting plate to the DN 50 glass nozzle.

A single-acting mechanical seal (sliding-ring SiC, counterring, hard carbon), which is dependent on the direction of rotation, seals on the product side, while a radial shaft seal ring seals on the atmosphere side. Up to a product temperature of 90°C, the sliding ring chamber is filled with coolant/lubricant and the connections short-circuited. At a product temperature of over 90°C, the mechanical seal is flushed with 2-10 liters of tap water per hour .

Standard is a three-phase A.C. motor of currency protection type EEx ell T4, 230/400V, 50 Hz.

DN	D	L	L1	Speed ^{1}/min	Power W	Reference
50	150	590	202	0 - 600	250	**M-RGD50/250**

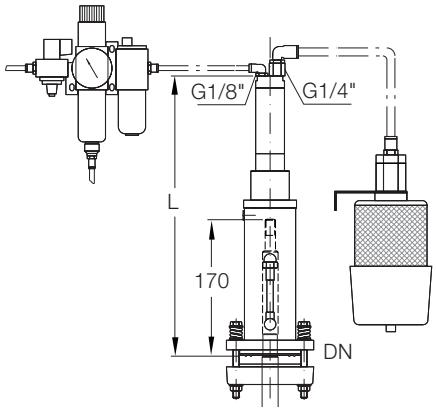
COMPRESSED AIR DRIVES WITH MECHANICAL SEAL

The compressed air drive is combined with the rotary transmission lead-through described in M-RGD and is likewise suitable for PTFE diagonal blade stirrers or turbine stirrers. It consists of the compressed air drive, rotary transmission lead-through with integrated bearings, and the connecting elements. The rotary transmission lead-through is flanged with its PFA-coated connecting plate to the DN 50 glass nozzle.

A single-acting mechanical seal (sliding ring SiC, counter ring, hard carbon), which is dependent on the direction of rotation, seals on the product side, while a radial shaft seal ring seals on the atmosphere side. Up to a product temperature of 90°C, the sliding ring chamber is filled with coolant/lubricant and the connections short-circuited. At a product temperature of over 90°C, the mechanical seal is flushed with 2-10 liters of tap water per hour.

The compressed air drive is operated with an excess pressure of 6.3 bar and has a torque of 4.3 Nm at a nominal speed of 535 rpm and an air throughput of 5.3 l/s.

A pressure reducer and silencer must be used for speed adjustment and noise reduction.

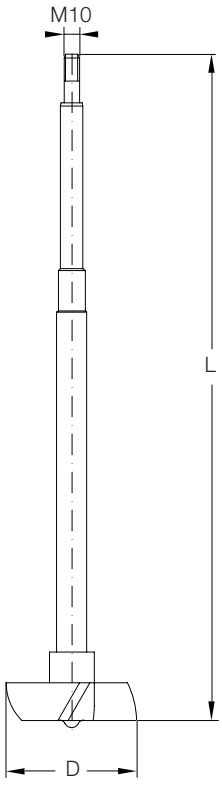


DN	L	L1	Reference
50	350	185	**M-RGP50/240**

PROPELLER STIRRERS, PTFE

The two-part stirrer consists of the PTFE-coated shaft and PTFE stirring device with steel core, which is connected to the shaft in a twist-free manner. A proper seal between the two parts is ensured over the entire permissible temperature range (-50° to +150°C).

The shaft coating and stirring device are made of heat-dissipating PTFE.



D	L	Reference[1)]
70	page 4-15	**M-SPT70/[L]**
90	page 4-15	**M-SPT90/[L]**
120	page 4-15	**M-SPT120/[L]**

[1)] References are completed by total length. For appropriate stirrers for the vessels please see table on page 4-15.

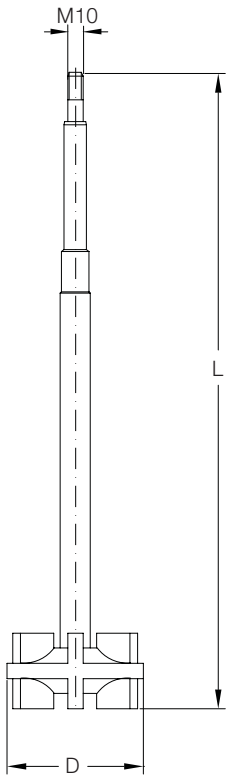
TURBINE STIRRERS, PTFE

The two-part stirrer consists of the PTFE-coated shaft and PTFE stirring device with steel core, which is connected to the shaft in a twist-free manner. A proper seal between the two parts is ensured over the entire permissible temperature range (-50° to +150°C).

The shaft coating and stirring device are made of heat-dissipating PTFE.

D	L	Reference.[1)]
70	page 4-15	**M-STT70/[L]**
90	page 4-15	**M-STT90/[L]**
120	page 4-15	**M-STT120/[L]**

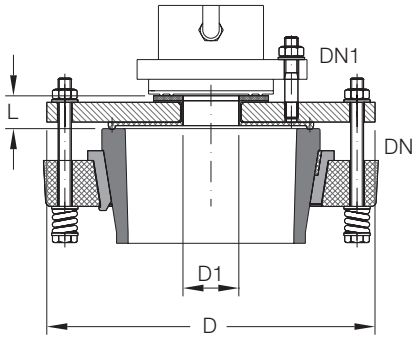
[1)] References are completed by total length. For appropriate stirrers for the vessels please see table on page 4-15.

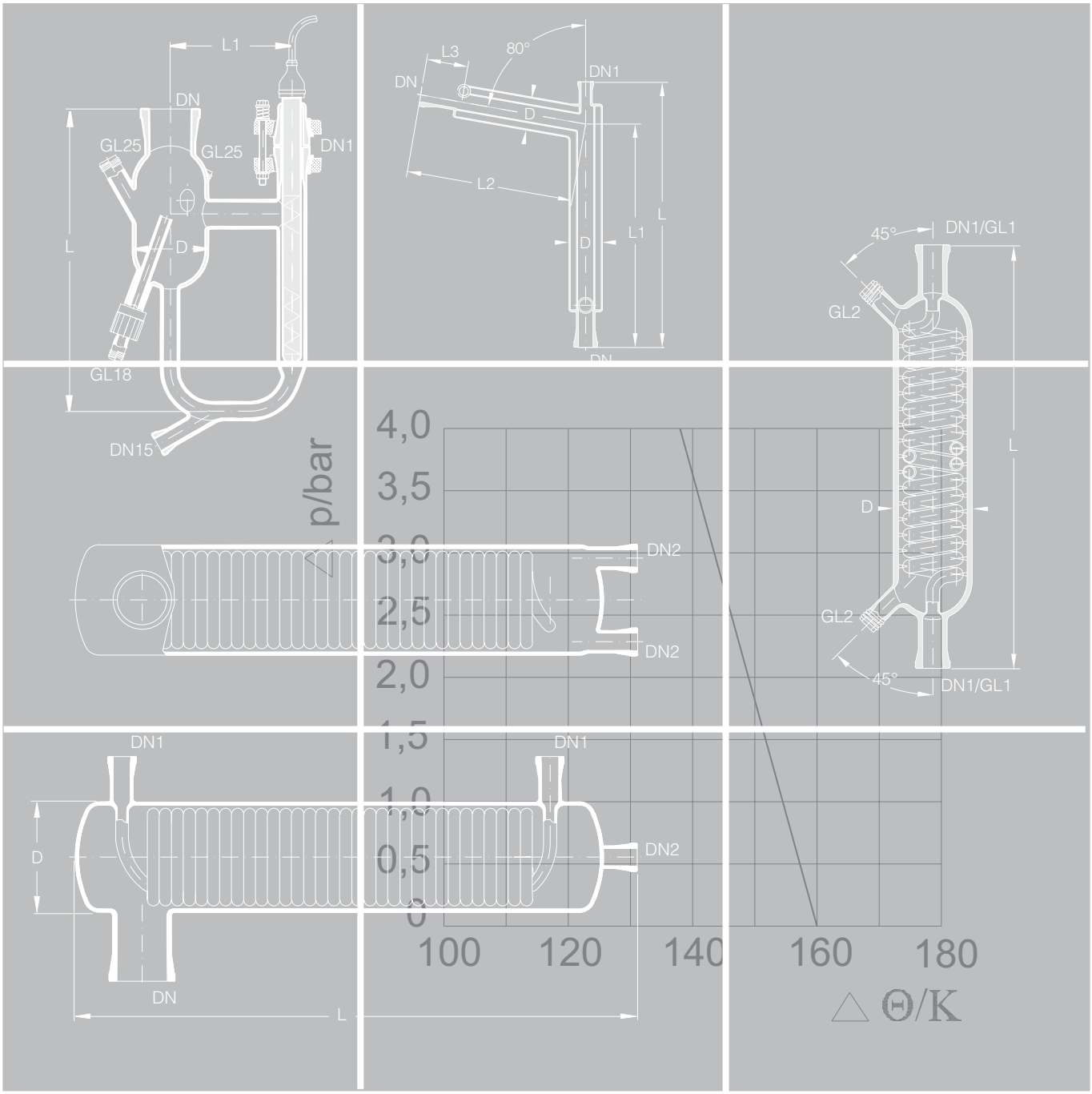


CONNECTING FLANGES FOR STIRRERS

The connecting flange TFR... is used to install stirrers in glass spheres and to reduce stirrer nozzles to the connection dimensions of the stirrer drives.

DN	DN1	D	D1	L	Reference
80	50	160	34	19	**TFR80/50**
100	50	200	34	20	**TFR100/50**




L1
DN
GL25
GL25
DN1
L
D
GL18
DN15
L3
80°
DN1
DN
D
L2
L
L1
D
DN
45°
DN1/GL1
GL2
L
D
GL2
45°
DN1/GL1
p/bar
4,0
3,5
2,5
2,0
1,5
0,5
DN2
DN2
DN1
DN1
DN2
D
DN
L
100
120
140
160
180
△ϑ/K

COIL TYPE HEAT EXCHANGER

These heat exchangers consist of spiral-shaped, rolled glass coils that are fused into a glass shell with two connecting sleeves. The devices, which are mainly used for condensation, are equipped with supports for horizontal installation of the coil packages to suit the compact design of our Miniplant facilities.

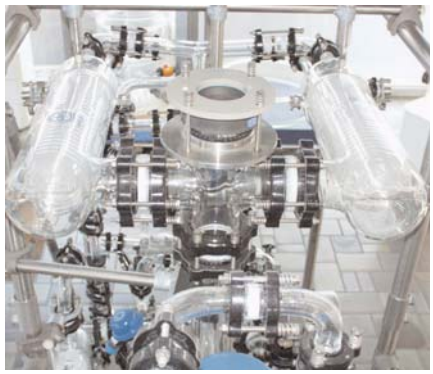
Tempering of liquids and condensing of solvents out of inert gases, for which special components are available, are additional applications for heat exchange. The standardized circulating vaporizers are used together with the components of the "Columns" chapter.

Important notes for operation / operating conditions

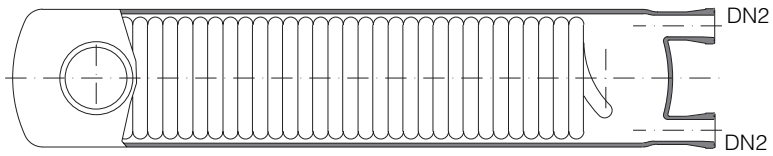
- Coil heat exchangers must be connected on the tube side without tension by means of hoses or bellows and must be prevented from exceeding the permissible excess operating pressure through suitable measures.
- They must not be operated with steam in the coils. Also, a short-term boiling of the refrigerant due to too little flow is not permissible.
- To avoid pressure shocks, valves should always be opened and closed slowly. A free outlet nozzle, which should be as close as possible to the outlet supports, must be planned for the refrigerant.
- A closed brine circulation is possible if measures are taken to prevent pressure shocks.
- The permissible operating pressure for the jacket is 0.5 bar up to a maximum temperature difference between jacket area and ambient temperature of 180°C.
- For cooling water operation (fluid group II) and with a temperature difference of 130°C between the product side and coolant, pressure of 3 bar can be applied to the pipe coil.

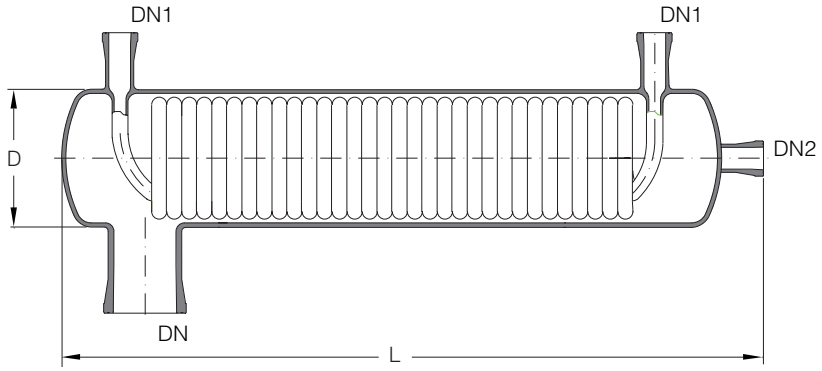
CONDENSERS, HORIZONTAL

The vapor stream enters the condenser from the side and is condensed in the coils. With the device inclined toward the outlet nozzle, the distillate leaves the device through the lower nozzle, while the upper nozzle is used for ventilation, evacuation or flushing. The outlets are placed so that no residue remains in the condenser.



Area A (m²)	D	DN	DN1	DN2	L	Reference
0,3	90	50	15	15	580	**M-HECH50/3**
0,5	120	50	15	15	630	**M-HECH50/5**
0,3	90	80	15	15	580	**M-HECH80/3**
0,5	120	80	15	15	630	**M-HECH80/5**
0,7	165	80	25	25	610	**M-HECH80/7**
1,0	165	80	25	25	840	**M-HECH80/10**
0,7	165	100	25	25	610	**M-HECH100/7**
1,0	165	100	25	25	840	**M-HECH100/10**



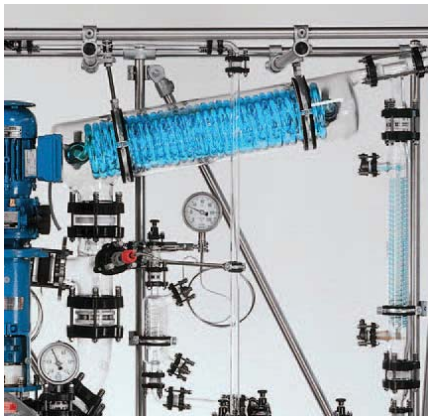


Technical data

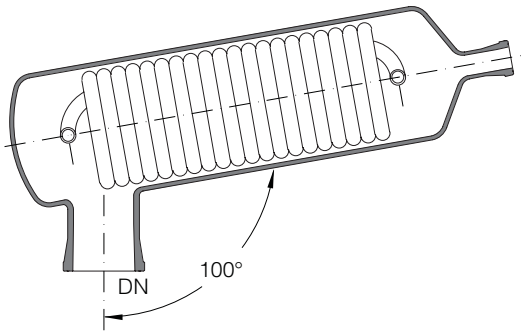
Reference	Area A (m^2)	Capacity	
		Coil (l)	Jacket (l)
M-HECH50/3	0,3	0,3	2,7
M-HECH50/5	0,5	0,7	5,1
M-HECH80/3	0,3	0,3	2,5
M-HECH80/5	0,5	0,7	5,1
M-HECH80/7	0,7	1,9	8,9
M-HECH80/10	1,0	2,7	12,7
M-HECH100/7	0,7	1,9	8,9
M-HECH100/10	1,0	2,7	12,1

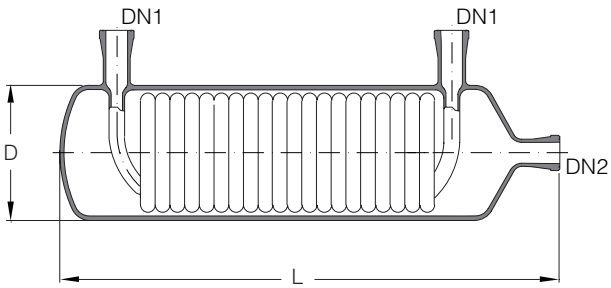
CONDENSERS, 10°

The 10° inclined condenser is placed directly on the column or the vapor tube. The condensate runs back through the vapor nozzle and can be divided in the return separator into outflow and return flow.



Area A (m²)	DN	DN1	DN2	D	L	Reference
0,3	50	15	25	90	565	**M-HECR50/3**
0,3	80	15	25	90	565	**M-HECR80/3**
0,7	80	25	25	165	620	**M-HECR80/7**
1,0	80	25	25	165	850	**M-HECR80/10**
0,7	100	25	25	165	620	**M-HECR100/7**
1,0	100	25	25	165	850	**M-HECR100/10**



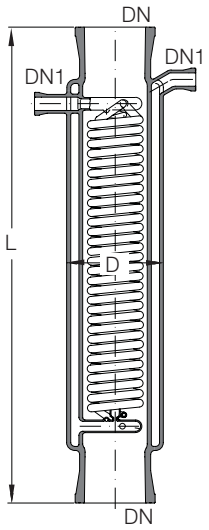


Technical data

Reference	Area A (m^2)	Capacity coil (l)	Capacity Jacket (l)
M-HECR50/3	0,3	0,3	2,5
M-HECR80/3	0,3	0,3	2,5
M-HECR80/7	0,7	1,9	8,0
M-HECR80/10	1,0	2,7	12,1
M-HECR100/7	0,7	1,9	8,0
M-HECR100/10	1,0	2,7	12,1

VENT COOLERS

Vent coolers are used with cooling jackets to intensify the cooling performance and avoid creeping flow on the outer wall. The coolant first flows through the coil and then through the jacket. This design is suitable for vertical installation.



Area A (m²)	DN	DN1	D	L	Reference
0,2	50	15	85	625	**M-THEC50/2**
0,3	50	15	120	625	**M-THEC50/3**
0,3	80	15	120	625	**M-THEC80/3**
0,5	100	15	165	675	**M-THEC100/5**

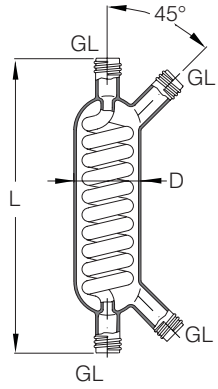
Technical data

Reference	Area	Capacity	
	A (m^2)	Coil (l)	Jacket (l)
M-THEC50/2	0,2	1,0	1,1
M-THEC50/3	0,3	2,0	2,5
M-THEC80/3	0,3	2,0	2,8
M-THEC100/5	0,5	4,3	5,6

LIQUID COOLERS

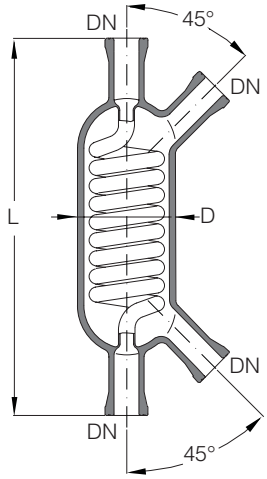
Liquid coolers, in which the fluid to be cooled flows through the coil, offer very diverse possible uses. They can also be installed immediately after a fluid separator, that is, as a distillate aftercooler. For large fluid throughput, sufficient inlet height must be assured.

A



Area A (m²)	DN	GL	D	L	Type	Reference.
0,02	-	18	44	195	**A**	**M-HEFGL18/02**
0,03	15	-	65	250	**B**	**M-HEF15/03**
0,06	15	-	65	350	**B**	**M-HEF15/06**
0,1	15	-	65	500	**B**	**M-HEF15/1**

B

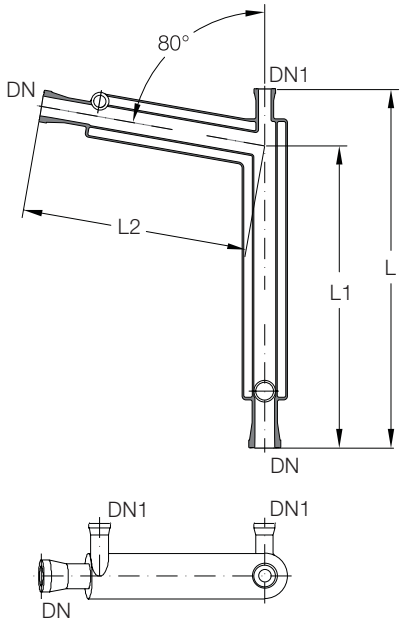


Technical data

Reference	Area A (m²)	Capacity Coil (l)	Capacity Jacket (l)
M-HEFGL18/02	0,02	0,11	0,03
M-HEF15/03	0,03	0,25	0,08
M-HEF15/06	0,06	0,43	0,11
M-HEF15/1	0,1	0,68	0,18

DISTILLATE COOLERS

They are preferably placed directly after the fluid separator to quickly cool the condensate leaving the column to a temperature below its boiling point. An additional nozzle permits connection of a pressure compensating line or the use of a thermometer.

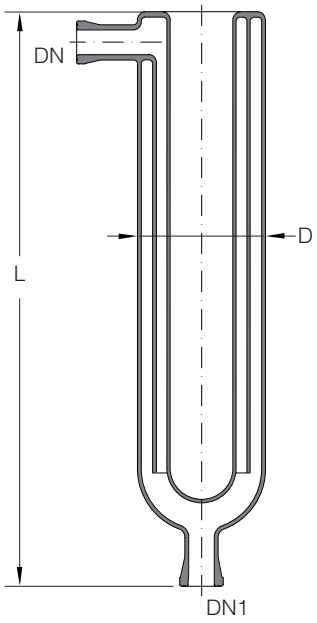


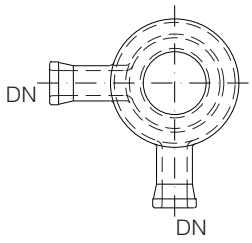
Area A (m²)	DN	DN1	L	L1	L2	Reference
0,045	15	15	460	400	300	**M-DNK15**

CONDENSATION TRAPS

Condensation traps normally serve as safety coolers in a system's ventilation line to lower the partial pressure of solvents in the exhaust air. The cooling vessel can be filled with dry ice and the exhaust air directed along this vessel. Condensed-out solvent can be removed at the bottom drain valve.

Area A (m²)	D	DN	DN1	Capacity (l)	L	Reference
0,04	85	15	15	0,4	360	**M-CT85/04**
0,06	100	25	15	0,9	410	**M-CT100/06**
0,09	140	25	15	1,7	440	**M-CT140/09**





CIRCULATING VAPORIZER

The circulating vaporizer with quartz heater plugs is used for continuous heating of rectification columns and offers the following advantages over simple blown heating:

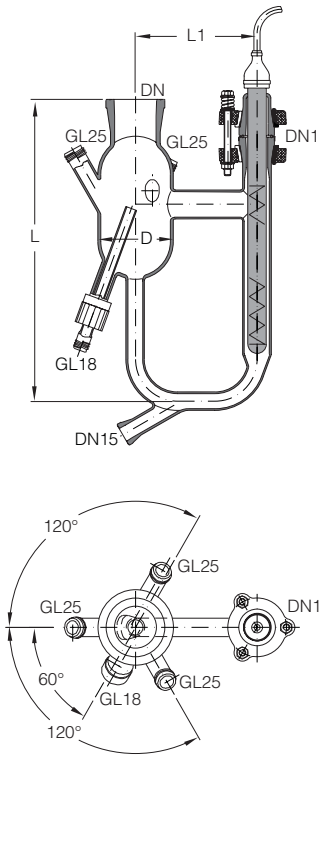
- The sump volume is reduced considerably.
- Large heating performance in proportion to the sump volume can be installed. Operating voltage for heater plugs: 230 V.
- Through thermoconvection, the fluid circulation considerably reduces the staying time in the heating zone of the fluid to be vaporized.
- Sedimentation and delays in boiling are prevented.

With continuously operating rectification, it is necessary that the sump level be maintained largely constant. To achieve this, an overflow tube, with which the fluid level can be set, is inserted into the vaporizer at the height required for the sump level.

The heater plugs are not heated in the unmoistened area.

Capacity (l)	DN	DN1	L	L1	D	Number of quartz heater plugs	Type	Power kW	Reference
1,3	50	25	400	145	90	**1**	A	1	**M-UV50/1**
1,5	50	25	400	145	90	**2**	B	2	**M-UV50/2**
1,85	80	50	495	145	90	**1**	A	1,5	**M-UV80/1**
2,5	80	50	495	145	90	**2**	B	3	**M-UV80/2**

A



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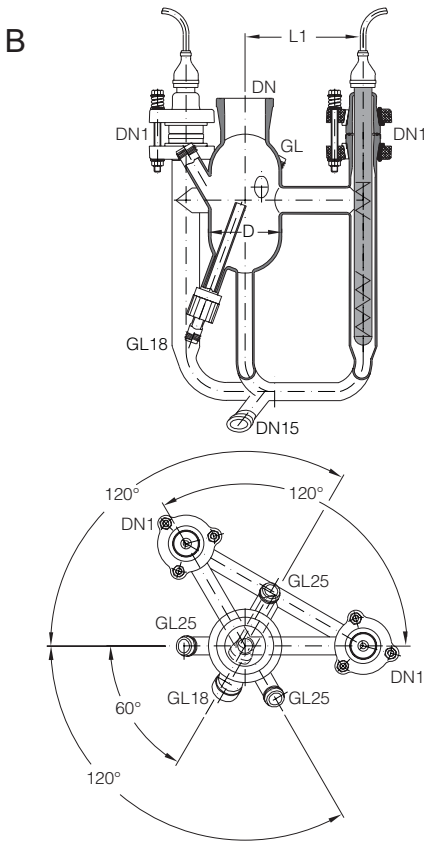

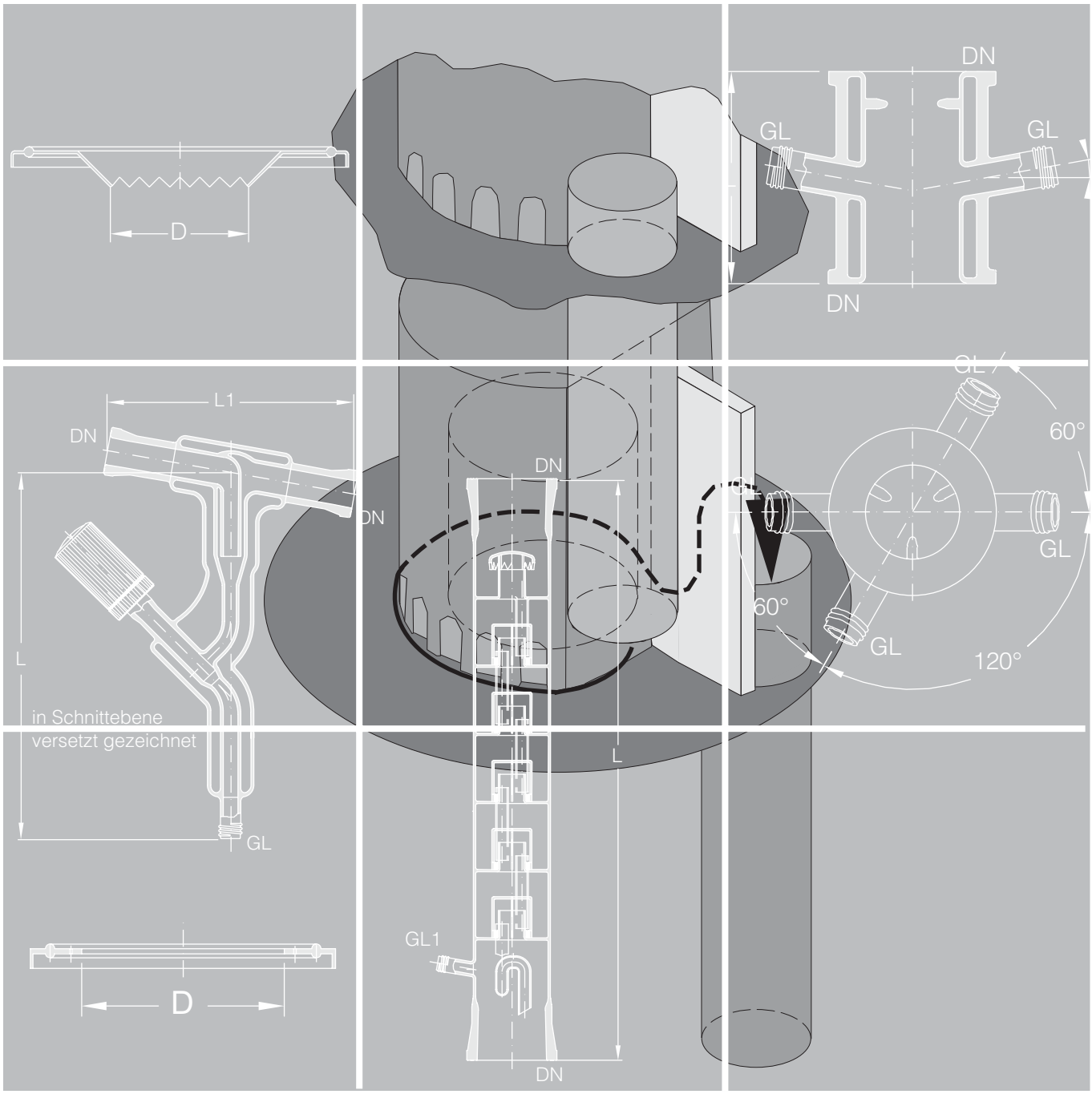
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COLUMNS FOR PACKINGS

To ensure the scale-up-capability of a separating column in the Miniplant scale, it is important to limit the uncontrolled reflux in order to distil in a quasi-adiabatic way.

For this purpose, the columns, up to 150°C, are equipped with an evacuated (10^{-6} millibar) isolating jacket, which is silver-coated on the inside and extends to the flat safety flange. At higher temperatures, an additional isolating or an adiabatic auxiliary heating is useful. If heating, it must be controlled in a way that the jacket temperature and the column temperature differ from each other by less than 0.2°C. To compensate for the different thermal expansions between the inner and outer tubes, these isolating jackets are equipped with one, two or three expansion bellows, depending on their lengths. An inspection slot in the silver-plating allows observation of the processes in the column. There are three different ways of placing the bulk material or packings. If the liquid will be collected between the columns and then redistributed from the central collecting point, the version with assembly baskets is recommended. If the LB assembly frames are used, guide funnels should be used to avoid run-out on the edges. If additional measurement outlets are required between the segments, the universal intermediate bottom with inlaid assembly frame is applied.

The design of funnels and assembly frames requires a minimum size for the packing. If process technology reasons require going below this size, a packing of larger size must first be placed in the column.

In the following table you find further details on this and on the free cross sections of the individual component parts, which are important for the layout of columns. Please note the difference between the nominal diameter DN (nominal mating diameter for the connection) and the inner diameter D1.

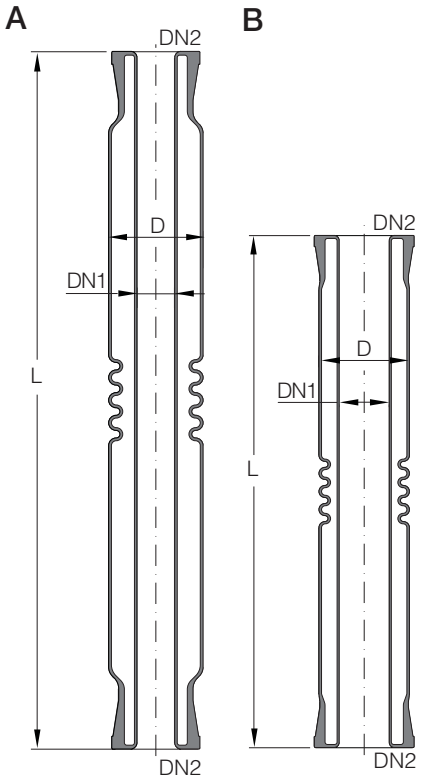
	Free cross section			Packing		
	Packing support M-PF	Packing support LB	LBE	Minimum size of packing M-PF	LB	LBE
DN [1]	%	%	%	mm	mm	mm
30	76	-	-	8	-	-
50	72	84	-	10	10	-
80	60	73	59	15	10	10

[1] Corresponds D1 for jacketed column section

COLUMN WITH ISOLATING JACKET

The columns M-ICS don't have a support bead for the placement of baskets or assembly frames. They are used in conjunction with a universal adapter or for the extension of columns which have a support.

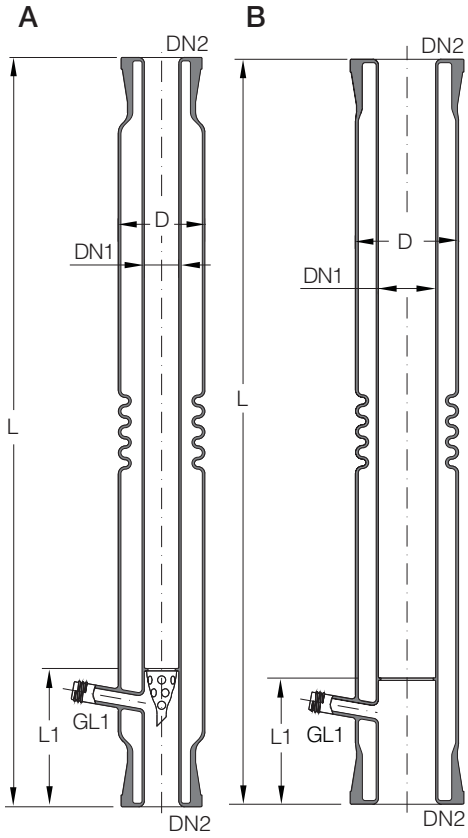
DN	D	DN1	DN2	L	Bellows	Type	Reference
50/30	75	30	50	650	1	A	**M-ICS50/30/500**
50/30	75	30	50	1160	2	A	**M-ICS50/30/1000**
80/50	90	50	80	510	1	B	**M-ICS80/50/500**
80/50	90	50	80	1020	2	B	**M-ICS80/50/1000**
100/80	120	100	100	510	1	B	**M-ICS100/80/500**
100/80	120	100	100	1020	2	B	**M-ICS100/80/1000**



COLUMN WITH ISOLATING JACKET AND SUPPORT RING

Each column is equipped with a measurement outlet underneath the support ring. While the basket is fused in for nominal diameter DN 50 (inner diameter 34 mm), for the larger nominal diameters an LB assembly frame can be used as an alternative. Like the basket, this assembly frame is not included in the scope of delivery. If a packing is to be used, the free cross section of the basket is sufficient. If the guiding funnel behavior of the basket is not desired, the ordered packing can be set directly on the support ring, using an intermediate ring of PTFE.

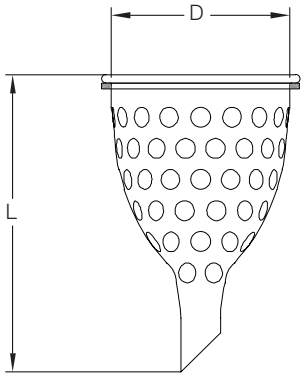
DN	D	DN1	DN2	GL1	L	L2	Bellows	Type	Reference
50/30	75	30	50	18	650	120	1	**A**	**M-ICST50/30/500**
50/30	75	30	50	18	1160	120	2	**A**	**M-ICST50/30/1000**
80/50	90	50	80	18	650	110	1	**B**	**M-ICST80/50/500**
80/50	90	50	80	18	1160	110	2	**B**	**M-ICST80/50/1000**
100/80	120	80	100	18	650	130	1	**B**	**M-ICST100/80/500**
100/80	120	80	100	18	1160	130	2	**B**	**M-ICST100/80/100**



PACKING SUPPORTS

Using these basket supports ensures that the liquid is placed in the center of the subsequent column, as is desired for small column diameters.

Their free cross section was chosen such that it is sufficiently wide for the application of ordered packings as well. The support baskets are placed in the columns, together with an intermediate ring of PTFE, in order to avoid glass-to-glass-contact. The intermediate rings are included in the scope of delivery of each support basket.

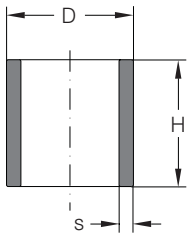


For DN	D	L	Reference
50	26	50	**M-PF30**
80	44	75	**M-PF50**
100	63	105	**M-PF80**

RANDOM PACKING

In addition to the Rasching rings listed here, which are made of 3.3 borosilicate glass, we also provide packings made from other materials, which are adapted to the application and have different geometries. We will be glad to make the right selection and design the column for you.

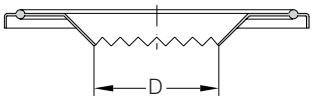
You can find other sizes of Rasching rings made of 3.3 borosilicate glass in the WPR 2002 Catalogue.



D x H	S mm	Bulk density random kg/m³	Surface random kg/m³	Reference
3 x 3	0,6	996	1547	**FC3**
6 x 6	0,5	496	860	**FC6**

GUIDING FUNNELS FOR COLUMNS WITH INSULATION

Guiding funnels are clamped into the standard flange connection, i.e. they simultaneously act as ring seals. During the column filling process, care must be taken to keep the necessary distance between the packing and the bottom edge of the guiding funnel.



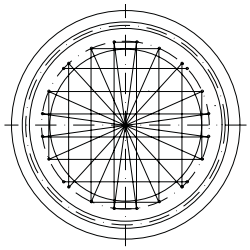
DN	D	A free %	Reference
50/30	20	51	**M-ITL50/30**
80/50	35	49	**M-ITL80/50**
100/80	55	47	**M-ITL100/80**

PACKING RETAINERS

These component parts are used, for example, at the column head to prevent potential damage of reflux heads or condensers possibly arising from torn packings. They cannot be used as packing supports.

The packing retrainers consist of a PTFE ring, which is stringed with a tantalum wire. They are clamped between the glass component parts instead of a PTFE ring seal, using a standard clip connection. Version A is used for component parts without isolating jacket, whereas version B fits the insulated components.

A



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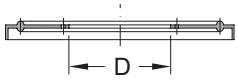
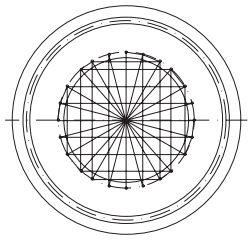
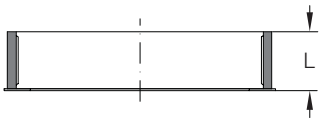


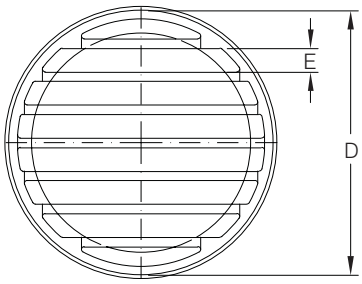


DN	D	A free %	Type	Reference
50	45	81	**A**	**M-CPC50**
80	67	76	**A**	**M-CPC80**
100	98	87	**A**	**M-CPC100**
50/30	25	88	**B**	**M-ICPC50/30**
80/50	45	98	**B**	**M-ICPC80/50**
100/80	67	100	**B**	**M-ICPC100/80**

PACKING SUPPORTS

The packing supports are suitable for columns with support bead and the universal adapter (see below). For technical data, such as free cross section and minimum size of packings, please refer to the introductory section of this chapter. For the nominal diameter DN 50, the distance between the support bars was chosen larger than the reasonable packing size in order to keep the free cross section sufficiently wide.



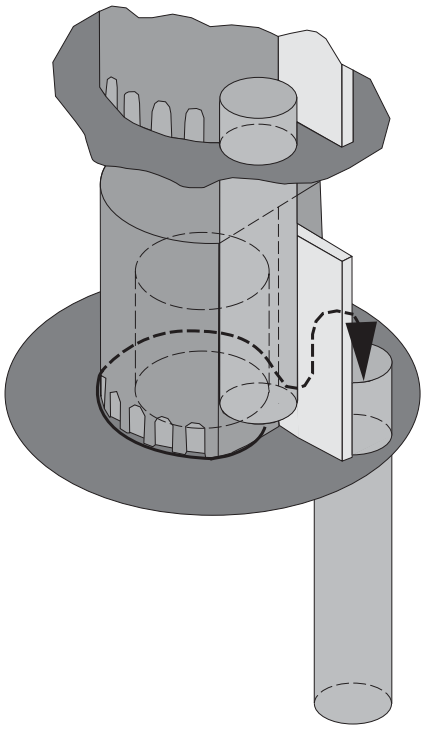


For isolating jacket components, use the next smaller nominal width instead of the nominal connection width.

DN	D	L	E	Reference
50	48	12	8	**LB50**
80	70	20	7	**LB80**
100	95	20	7	**LB100**

BUBBLE CAP COLUMN

Bubble cap columns meet the requirements for high and constant effectiveness over a broad load range. They have good guidance for vapor and liquids and a relatively low pressure loss. The specific advantage of a bubble cap column is that the equilibrium state (concentration profile), once established, is largely conserved, even if the process is interrupted, so that equilibrium is re-established within a short time after a restart.



Measurements have revealed that with the test mixture chlorobenzene / ethyl benzene the effectiveness per bottom range from 0.5 to 0.8 at normal pressure and from 0.7 to 0.9 at 66 millibar. The F-factor range was measured from 1.0 to 0.1 Pa 0.5.

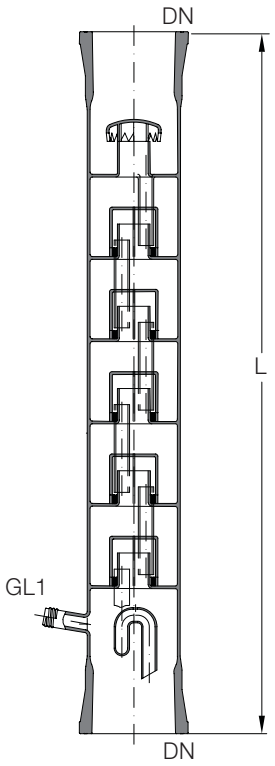
The influx and drain of the bottom are separated by a fused in glass weir, so that the liquid is guided in a circle. Each bottom has a stack. The last liquid drain is equipped with a siphon.

Standard bubble cap columns are available either with a silver-coated, evacuated (10^{-7} millibar) isolating jacket, which extends to the flat safety flange, or without an isolating jacket. An inspection slot in the silver coating allows the observation of the processes in the column. All bubble cap columns are equipped with either 5 or 10 practical fused-in bottoms.

Between the lower bubble cap bottom and the flat safety flange, there is an outlet for insertion of a measurement element. The adjacent picture shows special constructions.

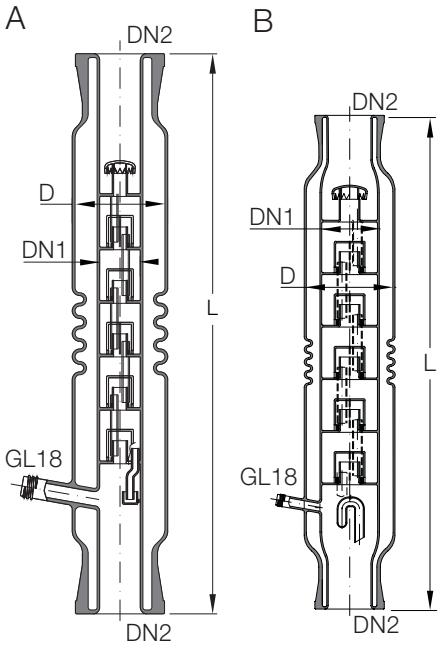
BUBBLE CAP COLUMN

DN	GL1	L	Plates	Reference
50	18	500	5	**M-BCT50/5**
50	18	750	10	**M-BCT50/10**
80	18	640	5	**M-BCT80/5**
80	18	1000	10	**M-BCT80/10**



BUBBLE CAP COLUMN

DN	D	DN1	DN2	GL1	L	Plates	Bellows	Type	Reference
50/30	75	30	50	18	440	5	1	A	**M-IBCT50/30/5**
50/30	75	30	50	18	620	10	1	B	**M-IBCT50/30/10**
50/50	90	50	50	18	540	5	1	B	**M-IBCT50/50/5**
50/50	90	50	50	18	800	10	1	B	**M-IBCT50/50/10**
80/80	130	80	80	18	705	5	1	B	**M-IBCT80/80/5**
80/80	130	80	80	18	1080	10	2	B	**M-IBCT80/80/10**

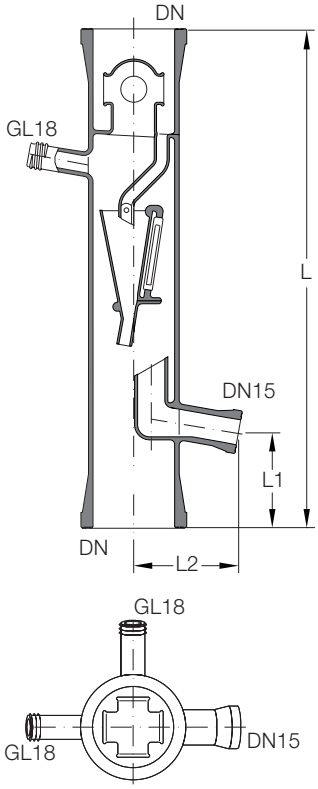


REFLUX SEPARATOR, ELECTROMAGNETICALLY ACTUATED

If it is desired to establish the reflux ratios in a precise and reproducible way, the use of an electromagnetically actuated liquid separator in conjunction with a timer is recommended.

In this version, the movable funnel, which is movably supported and has a fused-in counter-magnet, is attracted (total drain) or repelled (total reflux) by a magnet, which is attached to the outside of the column and can be switched over by means of the timer. In order to ensure a faultless function of the liquid separator, the funnel should stay in one of its end positions for not less than 2 seconds.

For electromagnetically actuated liquid separators, a liquid seal is always necessary to prevent vapor from entering the distillation line. The electromagnet and the timer have to be ordered separately. You can find the nominal diameters DN80 and DN100 in the WPR 2002 catalogue.

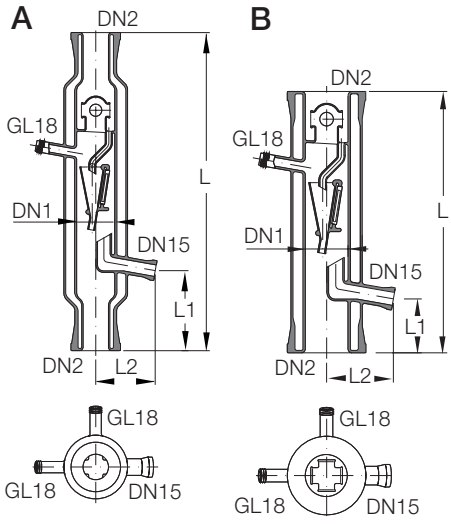


DN	L	L1	L2	Reference
50	330	63	70	**M-RHM50**

REFLUX SEPARATORS WITH ISOLATING JACKET

Optionally, electromagnetically actuated liquid separators are available with silver-coated high-vacuum isolating jackets (10^{-7} millibar).

The electromagnet and timer must be ordered separately.



DN	DN1	DN2	L	L1	L2	Type	Reference
50/50	50	50	450	113	85	A	**M-IRHM50/50**
80/50	50	80	330	68	85	B	**M-IRHM80/50**
100/80	80	100	380	83	100	B	**M-IRHM100/80**

ACCESSORIES

Electromagnet (A)

In conjunction with a timer, it is used for actuating the movably supported funnels of liquid separators. Its operating voltage is 24 Volt DC.

Item	Reference
Electromagnet	**M-IRHM-2**

Connection cable (B)

Cables in five different lengths are available as standard for electrical connection of the above electromagnet. They are appropriate for the listed electromagnets and can be used to connect a timer.

Length (m)	Reference
2	**M-IRHM-3/2**
4	**M-IRHM-3/4**
6	**M-IRHM-3/6**
8	**M-IRHM-3/8**
10	**M-IRHM-3/10**

Suspension device (C)

Like the electromagnet, these suspension devices are used in electromagnetically controlled liquid separators.

These clamps are used to attach the electromagnet to the liquid separator. You can refer to the following table for the size (= reference number).

For reflux separator	Ø	Reference
M-RHM50	60	**M-RHM-50-3**
M-IRHM50/50	90	**M-IRHM-50/50-3**
M-IRHM80/50		**M-IRHM-80/50-3**
M-IRHM100/80	120	**M-IRHM-100/80-3**

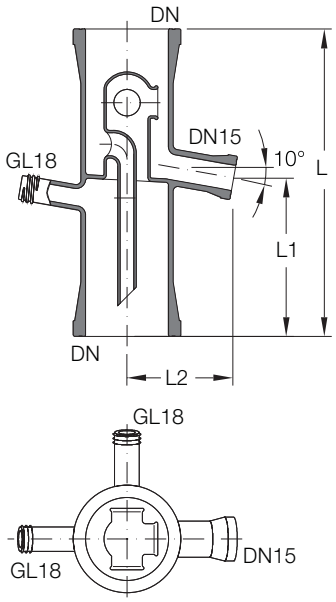
REFLUX SEPARATOR, MANUALLY ACTUATED

The reflux is adjusted by means of a valve to be mounted on the drain outlet. If the valve is completely opened, the head is set to total drainage of the distillate, because the reflux tube is placed higher than the drain outlet. Through proper throttling of the valve, the reflux ratio can be adjusted continuously until a total reflux is reached.

The reflux ratio is not clearly defined.

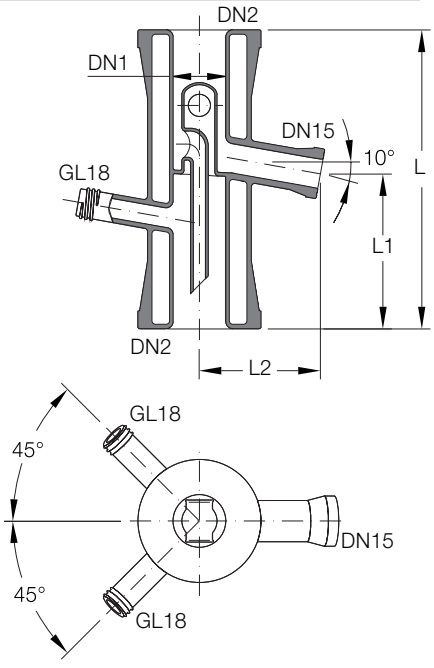
You will find the nominal diameters DN80 and DN100 in the WPR 2002 Catalogue.

DN	L	L1	L2	Reference
50	200	103	69	**M-RDA50**



REFLUX SEPARATOR WITH ISOLATING JACKET, MANUALLY ACTUATED

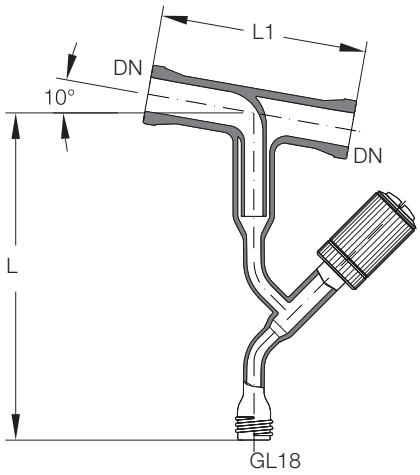
DN	DN1	DN2	L	L1	L2	Reference
50/30	30	50	170	89	69	**M-IRDA50/30**
80/50	50	80	200	105	85	**M-IRDA80/50**
100/80	80	100	220	115	100	**M-IRDA100/80**



LIQUID SEAL

For electromagnetically actuated liquid separators, a liquid seal is necessary to prevent vapor from entering the distillation line.

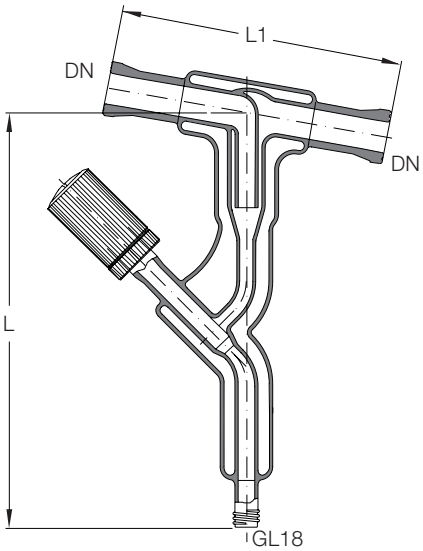
DN	L	L1	Reference
15	158	100	**M-LS15**



LIQUID SEAL WITH ISOLATING JACKET

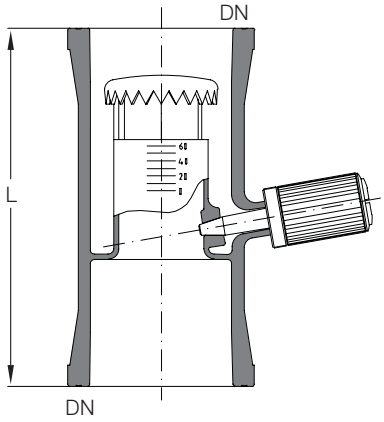
For electromagnetically actuated liquid separators, a liquid seal is necessary to prevent vapor from entering the distillation line.

DN	L	L1	Reference
15	220	150	**M-TLS15**



ADAPTER FOR REFLUX MEASUREMENT

The reflux quantity is determined by damming up the liquid between two check marks (equaling 10 milliliters) and performing a time measurement. This measurement method is only recommended for small column diameters or small liquid quantities.

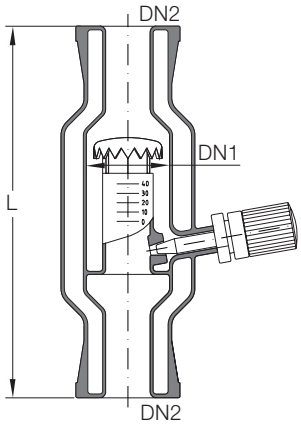


DN	L	Reference
50	175	**M-RM50**
80	190	**M-RM80**

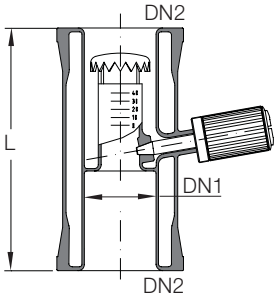
ADAPTER FOR REFLUX MEASUREMENT WITH ISOLATING JACKET

For the reflux measurement adapter with silver-coated isolating jacket, the check mark can be observed through the inspection slot.

A



B



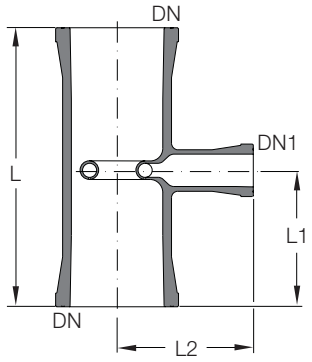
DN	DN1	DN2	L	Type	Reference
50/50	50	50	250	**A**	**M-IRM50/50**
80/50	50	80	190	**B**	**M-IRM80/50**
100/80	80	100	200	**B**	**M-IRM100/80**

COLUMN FEED SECTION WITH RING SPRINKLERS

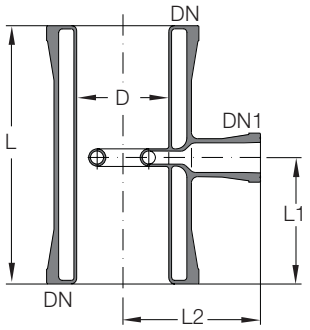
The use of ring sprinklers, from the nominal diameter DN 80 on, allows well distributed fluid placement, as is desired for packings and packing columns.

DN	D	L	L1	L2	Hole Ø	Hole-number	Type	Reference
80	-	225	110	110	1,5	15	**A**	**M-FR80**
100	80	225	110	120	1,5	15	**B**	**M-IFR100/80**

A



B

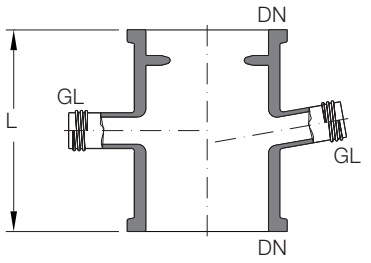


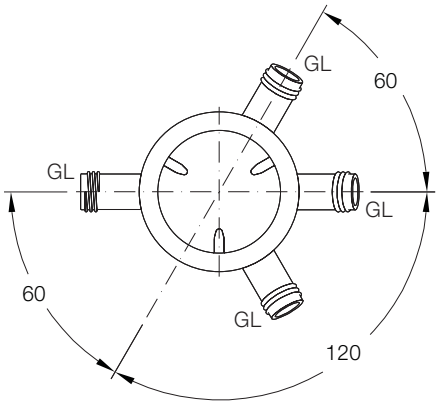
UNIVERSAL ADAPTER

Components of this type can take over various functions. And so they are available with different accessories on request. The universal adapter can be used to feed in the mixture to be separated at the column head or between the column stripper and the concentrating column, for extracting samples from the column, or for measuring process parameters.

When the LB assembly frame is inserted, they carry the packing bulk material, whereas packings can be put directly on the bearing pins.

They are available standard either with a silver-coated high-vacuum jacket (10^{-7} millibar) and inspection slot or without isolating jacket. Both types are clamped between two glass components.

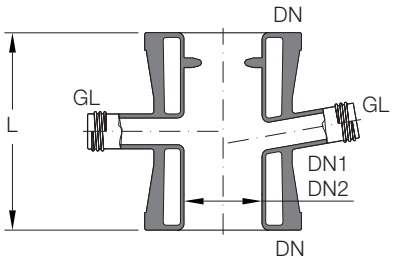


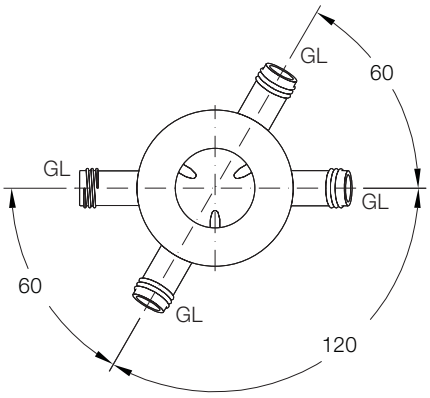


DN	GL	L	Reference
50	18	75	**M-FB50**
80	25	125	**M-FB80**
100	25	125	**M-FB100**

UNIVERSAL ADAPTER WITH ISOLATING JACKET

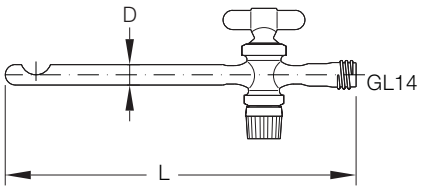
DN	DN1	DN2	GL	L	Reference
50/30	30	50	18	75	**M-IFB50/30**
80/50	50	80	25	125	**M-IFB80/50**
100/80	80	100	25	130	**M-IFB100/80**



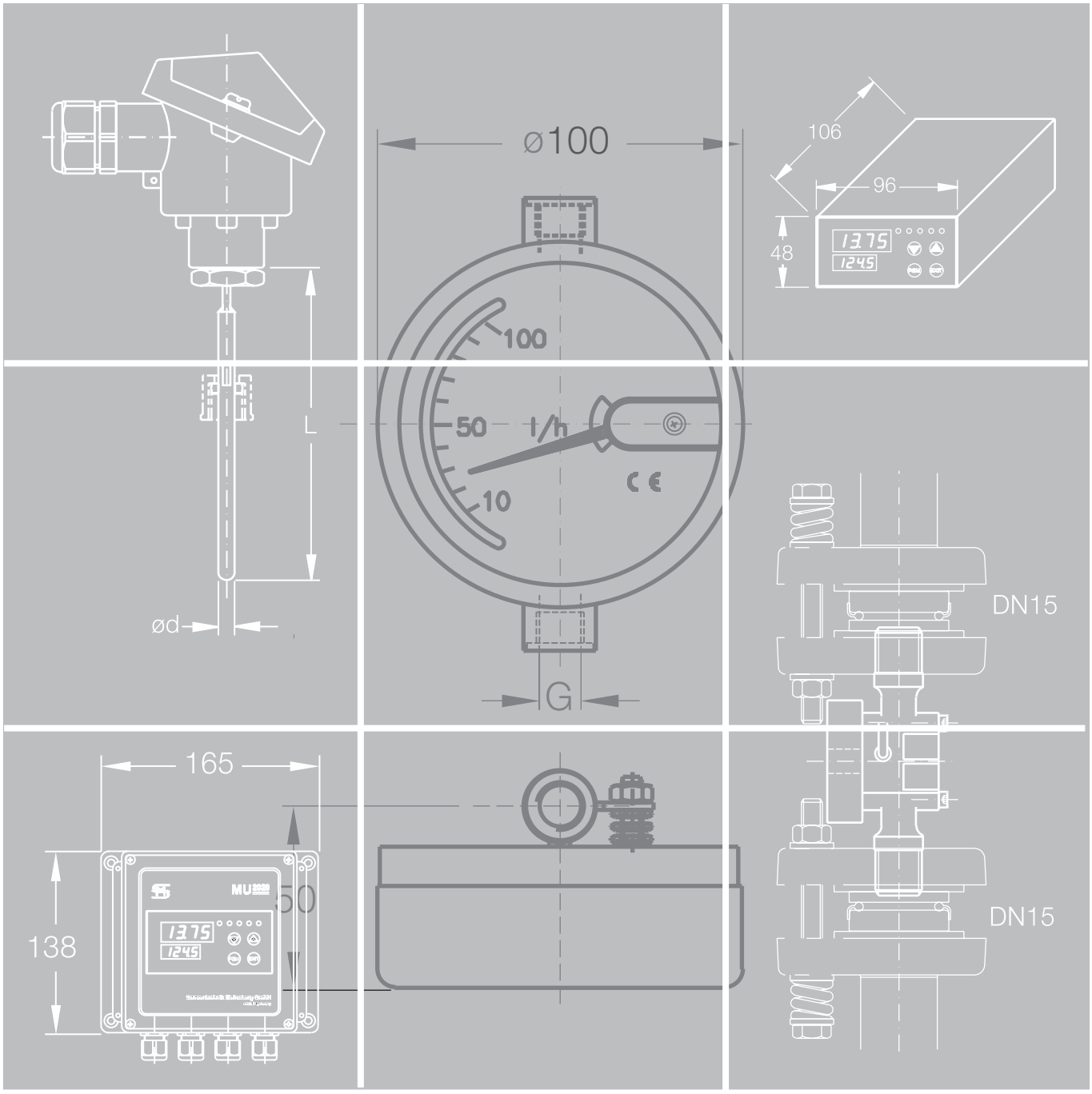


SAMPLE VALVE

The sample valve is used to extract samples from the column, preferably in conjunction with the universal adapter.



DN	L	D	Reference
50	200	10	**M-ISS50-2**

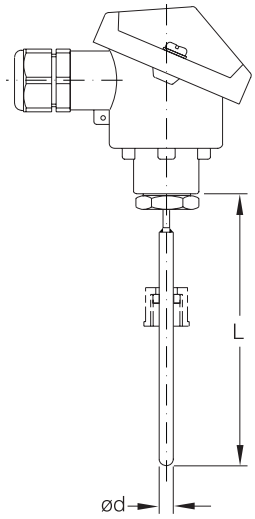

ø100
106
96
48
100
50
10
l/h
L
ød
G
DN15
DN15
165
138
50

RESISTANCE THERMOMETER FOR EX AREAS

Certificate: ATEX II 1 GD EEx ia IIC

These devices consist of a resistance thermometer with stainless steel protective tube (M-THRX3...) and, for the M-THRX6..., an additional protective sleeve made of borosilicate glass 3.3. The glass protective tube is filled with heat conducting paste for better heat exchange.

The resistance thermometers can be installed with GL threaded fittings.



Technical data

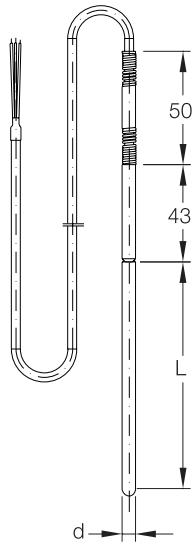
Measuring insert	Measurement resistance-		1x Pt 100 as per IEC 751,
	Class A, 4-conductor		
Permitted product	temperature	-	50 to +200 °C
Connecting head	Design	-	TA20A Alu
	Cable socket	-	M20 x 1.5 blue
Measuring transducer	Measuring range	-	50 up to +200 °C(only for
type: THRXT)	Ex protection	-	II 1G EEx ia IIC
Output signal		-	4 to 20 mA, 2-conductor
Ex protection	Measuring insert	-	II 1G EEx ia IIC

d	L	Type	Reference
3	120	**A**	**M-THRX3/120**
3	120	**B**	**M-THRXT3/120**
6	120	**A**	**M-THRX6/120**
6	120	**B**	**M-THRXT6/120**

Type A: without measuring transducer
Type B: with measuring transducer

RESISTANCE THERMOMETER

These devices consist of a resistance thermometer with stainless steel protective tube (M-THR3/100) and, for the M-THR6/100, an additional protective sleeve made of borosilicate glass. The probe tip is used with heat conducting paste for better heat exchange.



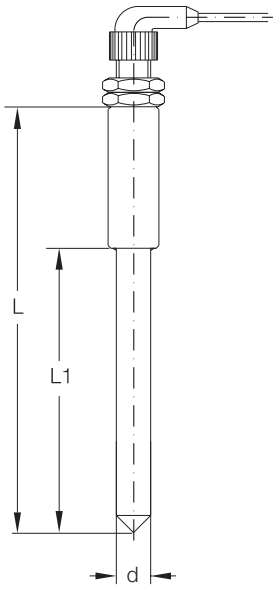
Technical data

Measuring insert	Measurement resistance	1x Pt 100 as per IEC 751, Class A, 4-conductor
	Permitted product temperature	- -50 to +200 °C
Connecting cable	Design	- 8 m silicon with free ends

d	L	Reference
3	100	**M-THR3/100**
6	100	**M-THR6/100**

LEVEL SWITCH

This is an opto-electronic sensor that sends timed infrared light into the glass rod. The contact is actuated when the glass rod is dipped into a liquid.



Technical data

Sensor	Supply voltage	- 20 - 28 V DC
	No-load current input	- < 60 mA
	Output type	- Transistor
	Max. switching current PNP	- 100 mA
	Protection type	- IP 67
	Temperature range sensor	- -20 to +200 °C

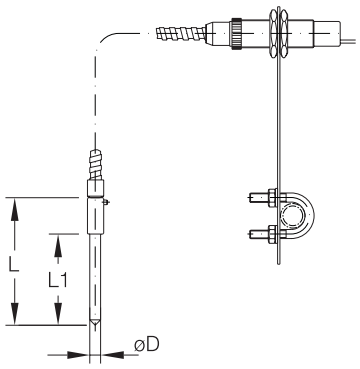
These sensors are not suitable for safety applications.
M-LLSC12... When the glass rod is dipped in, the contact is closed (min.).
M-LLSO12... When the glass rod is dipped in, the contact is opened (max.).

L	L1	d	Type	Reference
150	100	12	**opener**	**M-LLSO12/100**
200	150	12	**opener**	**M-LLSO12/150**
250	200	12	**opener**	**M-LLSO12/200**
350	300	12	**opener**	**M-LLSO12/300**
450	400	12	**opener**	**M-LLSO12/400**
150	100	12	**shutter**	**M-LLSC12/100**
200	150	12	**shutter**	**M-LLSC12/150**
250	200	12	**shutter**	**M-LLSC12/200**
350	300	12	**shutter**	**M-LLSC12/300**
450	400	12	**shutter**	**M-LLSC12/400**

LEVEL SWITCH FOR THE CATAGORY 2G EX AREA

IRD-10P EEx d IIC T6 ATEX

The opto-electronic sensor sends timed infrared light into the glass rod through an optical fiber. The contact is opened when the glass rod is dipped into a liquid.



Technical data

Sensor	Supply voltage	-	20 - 28 V DC
	No-load current input	-	< 60 mA
	Output type	-	Transistor
	Max. switching current PNP	-	100 mA
	Protection type	-	IP 67
	Temperature range sensor	-	-20 to +200 °C
Accessories	Lenght of optical fiber	-	500 mm
Ex protection	Protection type	-	EEx d IIC T6
	ATEX identification code	-	DMT 99 ATEX E 056/N1

L	L1	øD	Reference
140	100	12	**M-LLSX12/100**
190	150	12	**M-LLSX12/150**
240	200	12	**M-LLSX12/200**
340	300	12	**M-LLSX12/300**
440	400	12	**M-LLSX12/400**

PH/REDOX MEASUREMENT

For wall set-up or cabinet installation, including sensor connecting cable

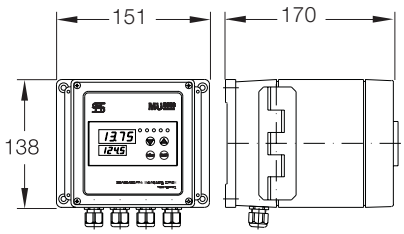
Technical data

Measurement ranges	-	pH -1 ... 14; -1999 ... 1999mV; -50 ... 250 °C
Measurement resolution	-	0,01 pH; 1 mV; 0,1 °C
Temperature compensation	-	automatic or manuel
Control outputs	-	voltage-free relay outputs; max. 3 A, 250 V AC; 1 binary exit
Analogue outputs	-	0 (4) ... 20 mA or 0 (2) ... 10 V
Display	-	2 x 4 position LED display, 13 / 8 mm
Power supply	-	53 V AC/DC, approx. 8 VA
Ambient temperature	-	-10 ... 55 °C
Wall set-up housing	-	Plastic housing for wall set-up with connecting space; protection rating IP65
Dimensions	-	151 x 138 x 170 mm (WxHxD)
Housing for control cabinet installation	-	Switchboard installation housing front protection rating IP 65
Dimensions	-	96 x 48 x 106 (WxHxD)
EMC	-	EN 61326
Electrodes	-	Single-rod measuring cells, separated measuring cells;temperature probe Pt 100 or Pt 1000
Cable	-	SMEK plug-in head connector, length 8 m.

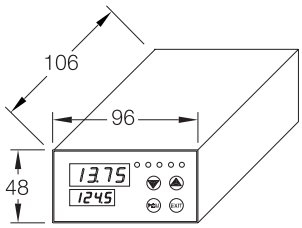
Measurement	Type	Reference
PH/Redox	**A**	**M-MU2000-W**
PH/Redox	**B**	**M-MU2000-P**

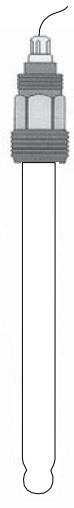
Type A: for field mounting
Type B: for integration into control cabinet

A wall assembling



B control rack





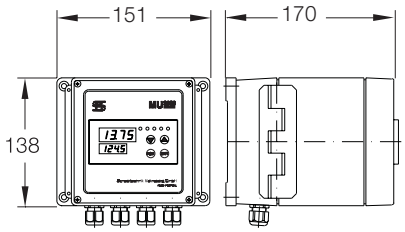
CONDUCTIVITY-MEASUREMENT

For wall set-up or cabinet installation, including sensor connecting cable

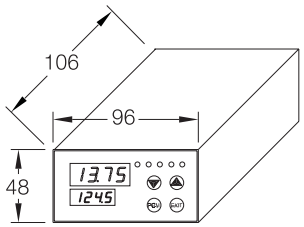
Technical data

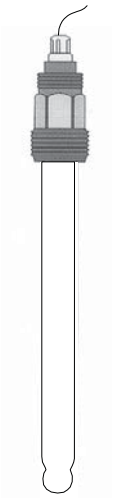
easurement ranges	-	0 ... 0.5 mS/cm up to 0 ... 200 mS/cm; -50 ... 250 °C
Measurement resolution	-	0,01 pH; 1 mV; 0,1 °C
Adjustable cell constants	-	0.01; 0.1; 1.0; 3.0; 10.0 cm
Temperature probe	-	Pt 100 or Pt 1000
Temperature compensation	-	automatic or manuel
Control outputs	-	2 voltage-free relay outputs; max. 3 A, 250 V AC; 1 binary exit
Analogue outputs	-	0 (4) ... 20 mA or 0 (2) ... 10 V
Display	-	2 x 4 position LED display, 13 / 8 mm
Power supply	-	53 V AC/DC, approx. 8 VA
Ambient temperature	-	-10 ... 55 °C
Wall set-up housing	-	Plastic housing for wall set-up with connecting space; protection rating IP65
Dimensions	-	151 x 138 x 170 mm (WxHxD)
Housing for control cabinet installation	-	Switchboard installation housing front protection rating IP 65
Dimensions	-	96 x 48 x 106 (WxHxD)
EMC	-	EN 61326
Electrodes	-	Single-rod measuring cells, separated measuring cells;temperature probe Pt 100 or Pt 1000
Cable	-	SMEK plug-in head connector, length 8 m.

A wall assembling



B control rack





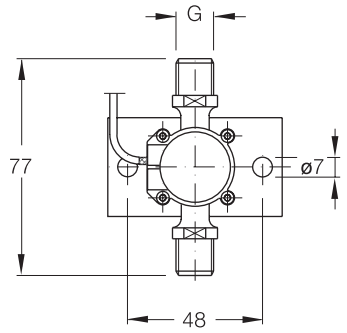
Measurement	Type	Reference
Conductivity	**A**	**M-MU2020-W**
Conductivity	**B**	**M-MU2020-P**

Type A: for field mounting
Type B: for integration into control cabinet

IMPELLER FLOW SENSOR

The compact flow sensor works according to the paddlewheel principle and is especially suitable for use in solid-free and aggressive fluids.

The sensor is supplied with a G 1/4" male thread for the process connection and a 3-lead cable for the electrical connection.



Technical data

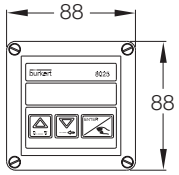
Measurement recorder	Operating pressure	-	5 bar, 22 °C
	Protection type	-	IP 65
	Viscosity of the media	-	1 ... 10 cst
	Measuring range	-	10 ... 150 l/h
	Accuracy	-	2 % (meas. range limit value)
	Operating voltage	-	12 ... 24 V DC
Materials	Housing	-	ECTFE (Halar)
	Vane wheel	-	ECTFE (Halar)
	Axle and bearing	-	Sapphire
	Magnets	-	ECTFE (Halar) encapsulated
	O-ring	-	FFKM

The measuring transducer is included in the scope of supply.

G	Type	Reference
1/4"	wall assembling	**M-LFS15-W**
1/4"	control rack	**M-LFS15-P**

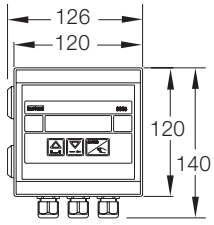
Measuring transducer for control cabinet (M-LFS15-P)

The electrical connection is made through terminals. The output signal is an impressed standard signal 4...20mA. The measuring transducer requires a power supply of 13...30 VDC for operation.



Measuring transducer for field mounting (M-LFS15-W)

The flow transmitter is integrated into a splash-proof plastic housing, protection rating IP 65.



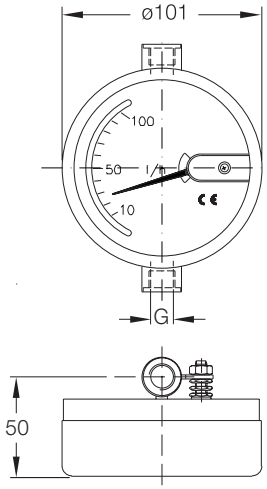
FLOWMETER, SUSPENDED BODY

with threaded connetion

A suspended body is carried concentrically by a specially shaped conical tube, and the position of the suspended body is magnetically transmitted to a display.

The devices are used for measuring small flows of liquids and gases.

The flowmeters are to be mounted vertically in a pipeline so that the material to be measured can flow upward through the device.



Technical data

Measurement recorder	Measurable forms	-	Fluids or gases
	Measuring ranges	-	10 - 100 l/h
	Measuring range ratio	-	10 : 1
	Accuracy	-	Class 4 as per VDI/VDE 3513
	Display scale	-	Calibrated for water (standard)
Process connection		-	Inside thread G 1/4
	Material	-	All medium-contacting parts are stainless steel (1.4571).
Measuring transducer	Power supply	-	13.5 - 30 V DC
	Output signal	-	4 - 20 mA
Ex protection	Design	-	II 2 G EEx ia IIC T5...T6

G	Measure L	Reference
1/4"	125	**M-FMT100**

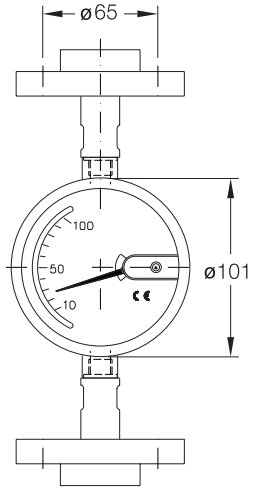
FLOWMETER, SUSPENDED BODY

with connecting flange

A suspended body is carried concentrically by a specially shaped conical tube. The position of the suspended body is magnetically transmitted to a display.

The devices are used for measuring small flows of liquids and gases.

The flowmeters are to be mounted vertically in a pipeline so that the material to be measured can flow upward through the device.



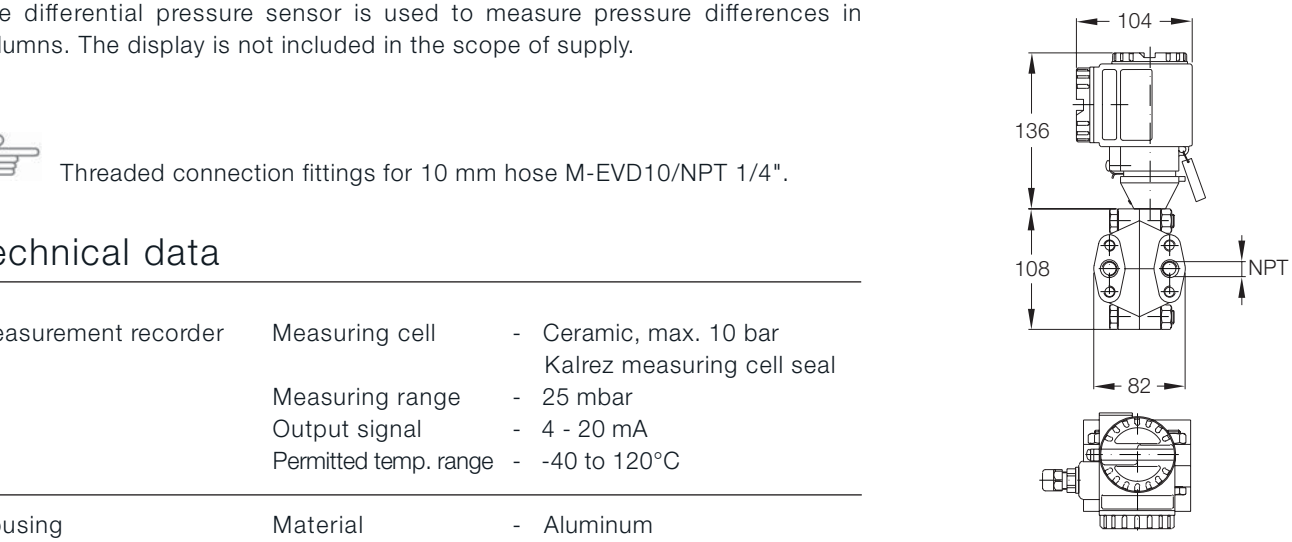
Technical data

Measurement recorder	Measurable forms	- Fluids or gases
	Measuring ranges	- 10 - 100 l/h
	Measuring range ratio	- 10 : 1
	Accuracy	- Class 4 as per VDI/VDE 3513
	Display scale	- Calibrated for water (standard)
Process connection		- Inside thread G 1/4
	Material	- All medium-contacting parts are stainless steel (1.4571).
Measuring transducer	Power supply	- 13.5 - 30 V DC
	Output signal	- 4 - 20 mA
Ex protection	Design	- II 2 G EEx ia IIC T5...T6

Measure L	Reference
250	**M-FMTF100**

DIFFERENTIAL PRESSURE TRANSDUCER

The differential pressure sensor is used to measure pressure differences in columns. The display is not included in the scope of supply.

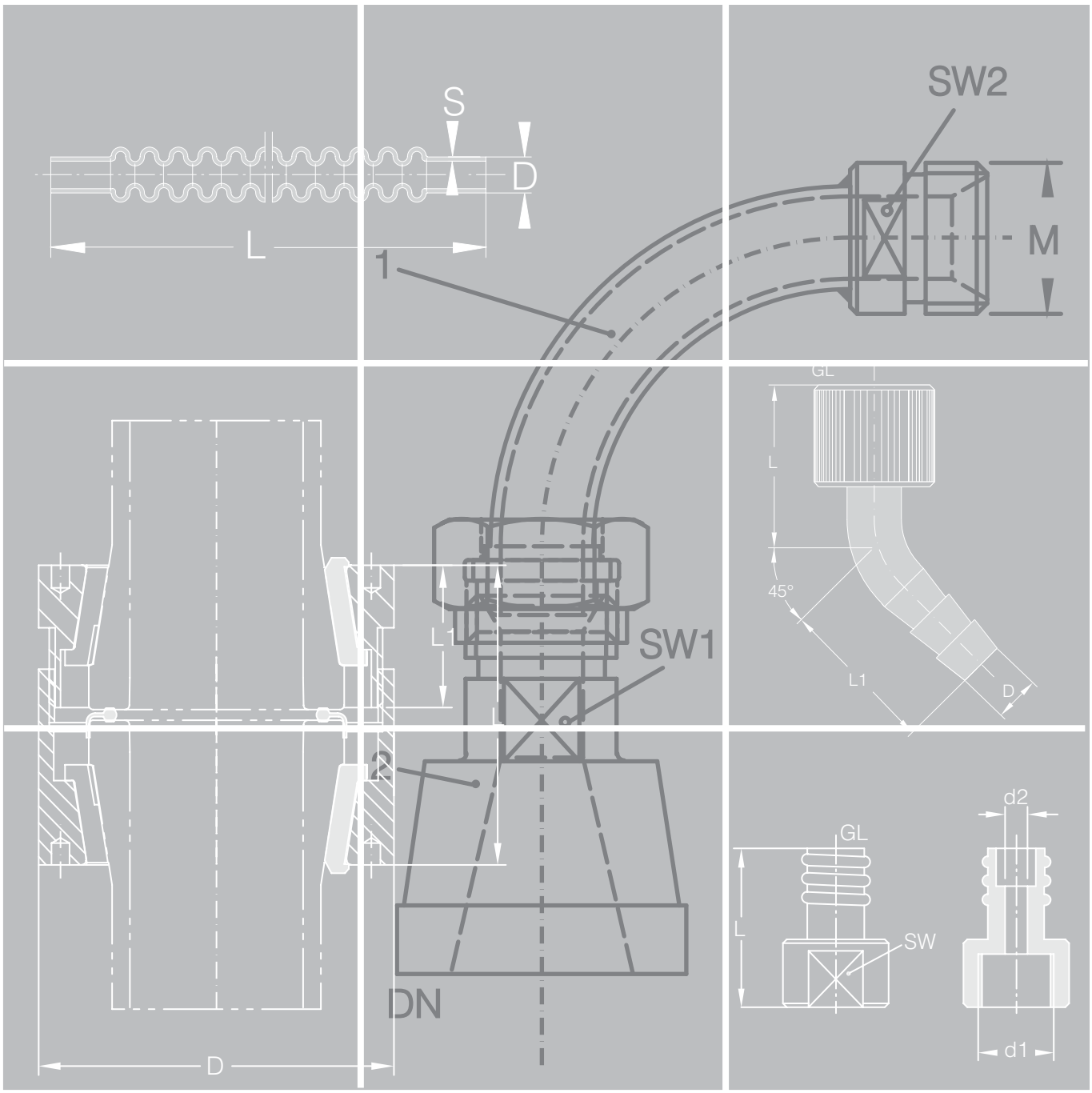


Threaded connection fittings for 10 mm hose M-EVD10/NPT 1/4".

Technical data

Measurement recorder	Measuring cell	-	Ceramic, max. 10 bar Kalrez measuring cell seal
	Measuring range	-	25 mbar
	Output signal	-	4 - 20 mA
	Permitted temp. range	-	-40 to 120°C
Housing	Material	-	Aluminum
	Process connection	-	1/4" NPT

NPT	Reference
1/4"	**M-DPGT25**


S
D
L
1
SW2
M
L1
SW1
2
DN
D
GL
L
45°
L1
D
GL
L
SW
d2
d1

COUPLINGS

Miniplant technology uses the most varied of flange ends.

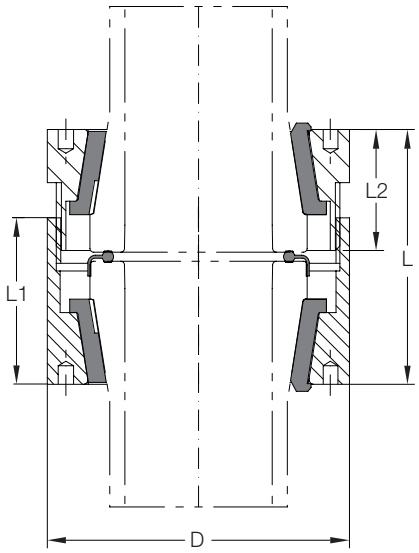
The available kinds are shown in chapter 1 with the corresponding main measurements. For every flange shape, the corresponding flange and gasket are used, which differ not only in the shape but also in the material used for the flange. To avoid duplication, we refer to the WPR 2002 Catalogue for the standard couplings and in the following describe only the connecting elements not contained in it.

Screw connectors are frequently used for measurement recorders and hose connections. They are described in the following as they fit the GL threads.

QUICK-RELEASE COUPLING

The quick-release coupling is used to connect safety flat flange pipe ends under narrow space conditions. The connection consists of two halves, including plastic inserts, that are pushed over the pipe ends. Since the connection does not have spring elements, it must be tightened when the temperature changes. The coupling can be tighten by hand or a special key is used for stretching: It as well as the gasket must be procured separately.

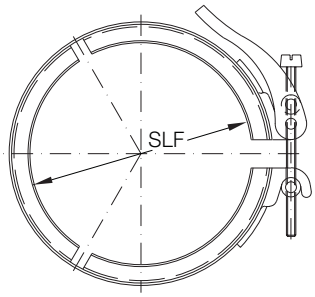
Alternatively, the couplings shown in the WPR 2002 Catalogue can be used.



DN	D	L	L1	L2	M	Special key	Reference
15	46	38	30	18.5	M42x1.5	**M-SK15-3**	**M-SK15**
25	60	60	40	29	M56x1.5	**M-SK25-3**	**M-SK25**
40	80	67	44	32	M75x1.5	**M-SK40-3**	**M-SK40**

QUICK-RELEASE FASTENER

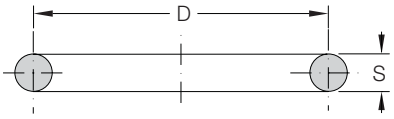
The quick-release fastener connects two laboratory flanges (SFL) and consists of three stainless steel retaining segments. A suitable O-ring, which is not included, is used as a sealing element.



SLF	Reference
100	**M-SCHN100**
150	**M-SCHN150**

O-RING FOR LABORATORY FLANGE COUPLING

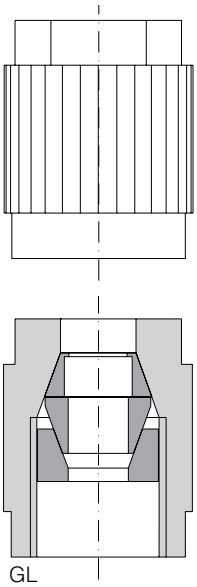
Material: FEP-jacket



SLF	D	s	Reference
100	110	4	**GO110X4-FEP**
150	150	5	**GO150X5-FEP**

LABORATORY THREADED CONNECTIONS

The medium flowing through the coupling comes into contact only with PTFE. The laboratory threaded connections are used especially to connect glass tubes with PFA hoses and tubes made of plastic, glass and metal. These couplings are also used to lock feeler gauges (also stainless steel), probes, laboratory stop-cocks, immersion tubes, thermometers and cable feeds.

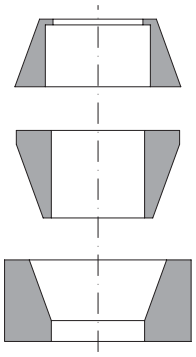


GL

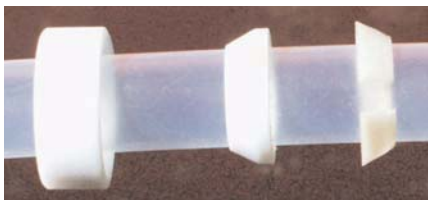
For hose Ø outside mm	Reference GL14	Reference GL18	Reference GL25	Reference GL32
3	M-SGGL14/3-HT	M-SGGL18/3-HT	M-SGGL25/3-HT	-
6	M-SGGL14/6-HT	M-SGGL18/6-HT	M-SGGL25/6-HT	-
8	M-SGGL14/8-HT	M-SGGL18/8-HT	M-SGGL25/8-HT	-
10	-	M-SGGL18/10-HT	M-SGGL25/10-HT	M-SGGL32/10-HT
12	-	-	M-SGGL25/12-HT	M-SGGL32/12-HT
14	-	-	M-SGGL25/14-HT	M-SGGL32/14-HT
16	-	-	-	M-SGGL32/16-HT

REPLACEMENT INSIDE PARTS

Clamping ring made of PPS reinforced with glass fibers, sealing plate and sealing wedge made of PTFE.

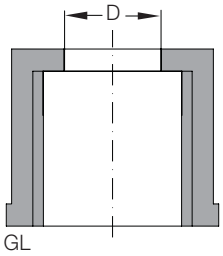


For hose Ø outside mm	Reference GL14	Reference GL18	Reference GL25	Reference GL32
3	M-SGEGL14/3-HT	M-SGEGL18/3-HT	M-SGEGL25/3-HT	-
6	M-SGEGL14/6-HT	M-SGEGL18/6-HT	M-SGEGL25/6-HT	-
8	M-SGEGL14/8-HT	M-SGEGL18/8-HT	M-SGEGL25/8-HT	-
10	-	M-SGEGL18/10-HT	M-SGEGL25/10-HT	M-SGEGL32/10-HT
12	-	-	M-SGEGL25/12-HT	M-SGEGL32/12-HT
14	-	-	M-SGEGL25/14-HT	M-SGEGL32/14-HT
16	-	-	-	M-SGEGL32/16-HT



THREADED CAPS

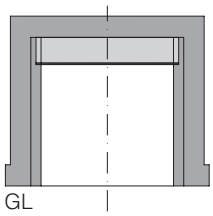
Very high mechanical durability. The knurls, which are extremely easy to grip, permit secure closing and easy opening of the threaded caps.



GL	D Ø mm	Reference
GL 14	9,2	**M-SBGL14/9-HT**
GL 18	11	**M-SBGL18/11-HT**
GL 25	15	**M-SBGL25/15-HT**
GL 32	20	**M-SBGL32/20-HT**

THREADED CAPS

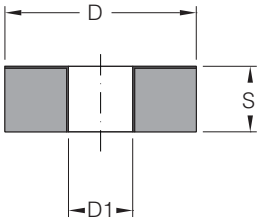
The caps with PTFE/silicon seal are especially mechanically durable. The knurls, which are extremely easy to grip, permit secure closing and easy opening of the threaded caps. The seal consists of a PTFE/silicon seal, whereby the medium in the vessel comes into contact only with PTFE, and the silicon compensates for minor unevenness at the neck of the vessel.



GL	Reference
GL 14	**M-SVGL14-HT**
GL 18	**M-SVGL18-HT**
GL 25	**M-SVGL25-HT**
GL 32	**M-SVGL32-HT**
GL 45	**M-SVGL45-HT**

SILICON GASKETS (VMQ)

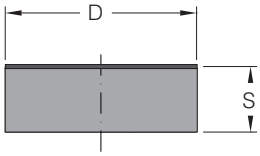
Material VMQ, with PTFE cuff vulcanized on (for threaded caps).



For thread	D mm	D1 mm	S mm	Reference
GL 14	12	6	4	**M-DICHGL14/6**
GL 18	16	6	5	**M-DICHGL18/6**
GL 18	16	8	5	**M-DICHGL18/8**
GL 18	16	10	5	**M-DICHGL18/10**
GL 25	22	8	6	**M-DICHGL25/8**
GL 25	22	10	6	**M-DICHGL25/10**
GL 25	22	12	6	**M-DICHGL25/12**
GL 32	29	10	8	**M-DICHGL32/10**
GL 32	29	12	8	**M-DICHGL32/12**
GL 32	29	14	8	**M-DICHGL32/14**
GL 32	29	16	8	**M-DICHGL32/16**
GL 32	29	18	8	**M-DICHGL32/18**
GL 45	42	26	8	**M-DICHGL45/26**

SILICON GASKETS (SEPTA)

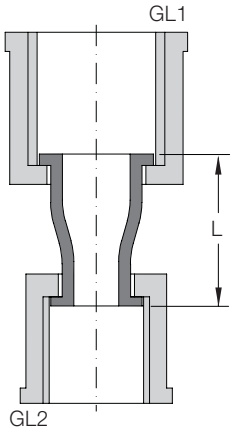
Material VMQ, for threaded caps.



For thread	D mm	S mm	Reference
GL 14	12	2,0	**M-SVDICH14**
GL 18	16	2,0	**M-SVDICH18**
GL 25	22	2,0	**M-SVDICH25**
GL 32	29	2,0	**M-SVDICH32**
GL 45	42	3,0	**M-SVDICH45**

THREADED COUPLING REDUCERS

Made of fluoroplastic, with threaded cap reinforced with PPS glass fiber. For flexible coupling of two glass threads with integrated PTFE/FPM seal. The medium comes into contact only with PTFE.

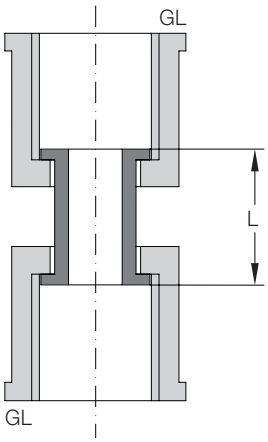


GL 1	GL 2	L mm	Reference
GL 18	GL 14	20	**M-SKGL18/14**
GL 25	GL 14	27	**M-SKGL25/14**
GL 25	GL 18	28	**M-SKGL25/18**
GL 32	GL 18	32	**M-SKGL32/18**
GL 32	GL 25	28	**M-SKGL32/25**

THREADED COUPLINGS

Made of fluoroplastic, with integrated PTFE/FPM seal for flexible coupling of two glass threads. The medium comes into contact only with PTFE.

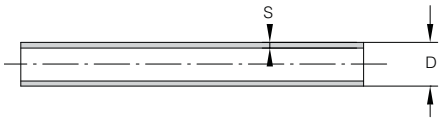
Material: PTFE/PPS



For thread	L mm	Reference
GL 14	20	**M-SKGL14**
GL 18	27	**M-SKGL18**
GL 25	28	**M-SKGL25**
GL 32	32	**M-SKGL32**

PFA-HOSES

PFA-hoses are distinguished by their transparency and non-porous surface. The low slope to the material connection results from their smooth surface and anti-adhesive behavior. PFA-hoses are almost universally chemically resistant. They are physiologically safe and bio-compatible. Hoses made of PFA are gas-proof, flexible, and have very good dielectric attributes.

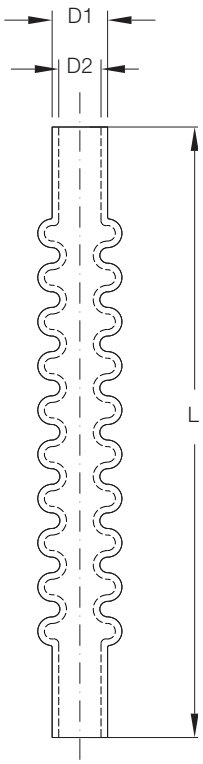


Material: PFA.

D mm	S mm	Reference
6	1	SCHL6X1-PFA
8	1	SCHL8X1-PFA
10	1	SCHL10X1-PFA
12	1	SCHL12X1-PFA
14	1	SCHL14X1-PFA

FLEX-HOSES

Made of fluoroplastic, flex-hoses are ideal for couplings subject to vibration, for bends in narrow spaces, and to compensate for thermal elongation. The 40-mm-long, cylindrical end pieces permit direct connection to fittings or olives, for example. Flex-hoses are extremely flexible, pore-free, translucent, and without thermal load.



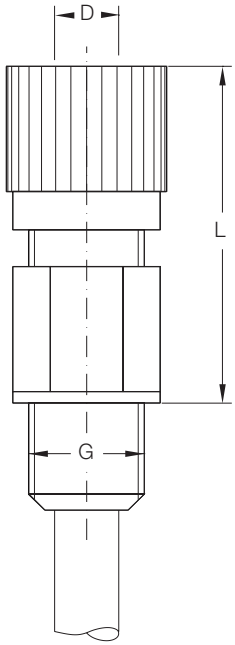
Material: PFA.

Temperature range: -270°C/+260°C.

D1 mm	D2 mm	Bend radius mm	Reference 0,5 m	Reference 1,0 m
8	6	15	SCHLFLEX8/500	SCHLFLEX8/1000
10	8	18	SCHLFLEX10/500	SCHLFLEX10/1000
12	10	23	SCHLFLEX13/500	SCHLFLEX13/1000

SCREW-IN THREADED FITTING

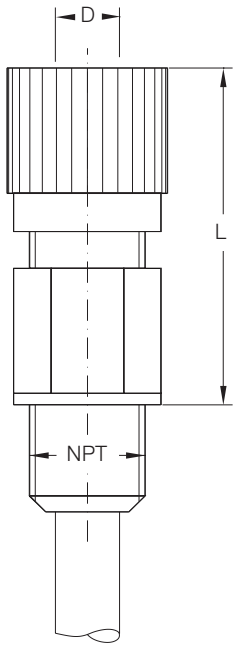
The tube is led through the threaded fitting, such as with immersion tubes and probes. The PFA screw-in threaded fitting has a series 2D G male thread.



D mm	G “	L mm	Reference
6	1/4	35	**M-EVD6D/G1/4**
6	3/8	36	**M-EVD6D/G3/8**
8	1/4	35	**M-EVD8D/G1/4**
10	3/8	40	**M-EVD10D/G3/8**
12	1/2	45	**M-EVD12D/G1/2**

STRAIGHT SCREW-IN THREADED FITTING

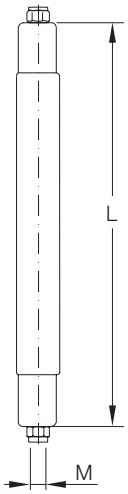
The tube is led through the threaded fitting, such as with immersion tubes and probes. The PFA screw-in threaded fitting has a series 2D NPT male thread.



Tube-Ø mm	Connection thread “	L mm	Reference
6	NPT 1/4	33	**M-EVD6D/NPT1/4**
8	NPT 1/4	33	**M-EVD8D/NPT1/4**
10	NPT 1/4	40	**M-EVD10D/NPT1/4**

THERMOSTAT CONNECTING HOSE

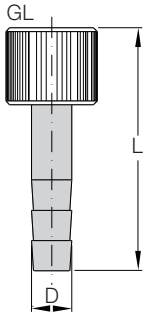
Together with the straight or curved thermostat adapter, the thermostat connecting hose connects the heating unit with the tempering jacket or heat exchanger. The stainless steel corrugated hose (1.4541) is surrounded by triple insulation, which, at a 300°C inside temperature, ensures a contact temperature of 60°C. Fastening is made with a union nut.

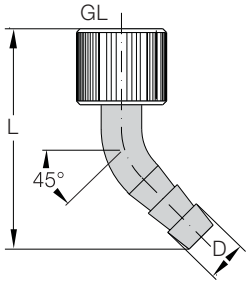


M	L mm	Reference
M16x1	500	**M-HS10/500**
M16x1	1000	**M-HS10/1000**
M16x1	2000	**M-HS10/2000**
M22x1.5	500	**M-HS15/500**
M22x1.5	1000	**M-HS15/1000**
M22x1.5	2000	**M-HS15/2000**

OLIVES

The olives are made of fluoroplastic, straight design and bent; threaded caps are made of PPS reinforced with glass fiber; olives are made of PFA, with elastic PFA sealing lip and FPM o-ring. The medium comes into contact only with PFA.





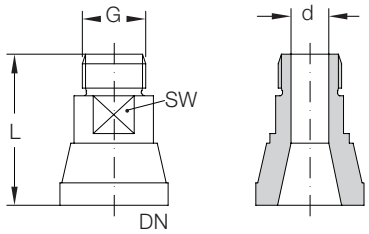
Thread	D mm	Ø Inside mm	L mm	Reference straight	Reference 45°
GL14	8,7	6	Ca. 45	**M-OLGL14/9**	-
GL14	8,7	6	Ca. 49	-	**M-OLWGL14/9**
GL18	10,5	7	Ca. 51	**M-OLGL18/11**	-
GL18	10,5	7	Ca. 65	-	**M-OLWGL18/11**
GL25	16,0	10	Ca. 68	**M-OLGL25/16**	-

ADAPTER

Flat flange - G male thread junction

These adapters can be used for connecting pipelines with the safety flange system to solenoid valves.

Material: PTFE

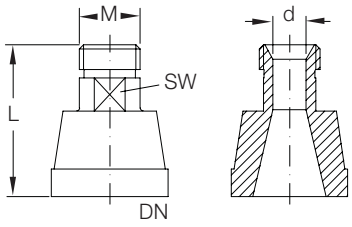


DN	d	G	L	SW	Reference
15	10	3/8"	40	18	**M-AK1/.4**
25	14	1/2"	55	19	**M-AK2/.6**

ADAPTER

Flat flange - M male thread junction

Material: stainless steel



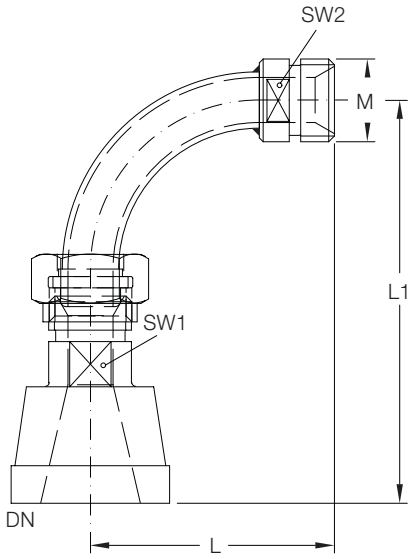
DN	d	M	L	SW	Reference
15	10	M16x1	40	14	**M-AM15/16**
25	10	M16x1	55	14	**M-AM25/16**
15	10	M22x1.5	40	19	**M-AM15/22**
25	10	M22x1.5	55	19	**M-AM25/22**

ADAPTER 90°

Flat flange - M male thread junction

Material: stainless steel

DN	M	L	L1	SW1	SW2	Reference
15	M16x1	60	88	14	13	**M-AM90/15/16**
25	M16x1	60	103	14	13	**M-AM90/25/16**
15	M22x1.5	65	92	19	19	**M-AM90/15/22**
25	M22x1.5	65	107	19	19	**M-AM90/25/22**



ADAPTER

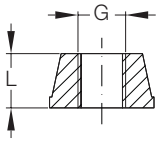
Flat flange - G male thread junction

When manometers with rotating closing adapters 1/2" are used, a thread adapter reference AD-T1/2 (GT50943) must be used in addition to the adapter. The seal is made through two flat seals.

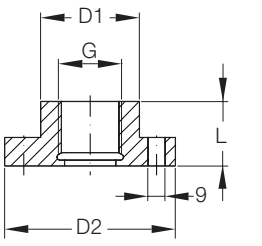
Material: Stainless steel

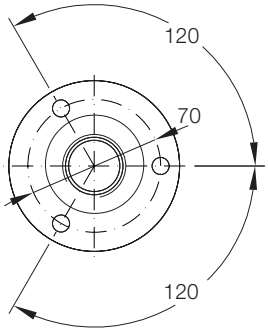
DN	G	L	Type	Reference
15	1/8	15	A	**AD15-1/8**
15	1/4	15	A	**AD15-1/4**
15	3/8	20	A	**AD15-3/8**
25	1/8	25	A	**AD25-1/8**
25	1/4	25	A	**AD25-1/4**
25	3/8	25	A	**AD25-3/8**
25	1/2	25	A	**AD25-1/2**
25	3/4	25	A	**AD25-3/4**
25	1	34	B	**AD25-1**
40	1/8	25	A	**AD40-1/8**
40	1/4	25	A	**AD40-1/4**
40	3/8	25	A	**AD40-3/8**
40	1/2	25	A	**AD40-1/2**
40	3/4	25	A	**AD40-3/4**
40	1	25	A	**AD40-1**
50	1/8	30	A	**AD50-1/8**
50	1/4	30	A	**AD50-1/4**
50	3/8	30	A	**AD50-3/8**
50	1/2	30	A	**AD50-1/2**
50	3/4	30	A	**AD50-3/4**
50	1	30	A	**AD50-1**

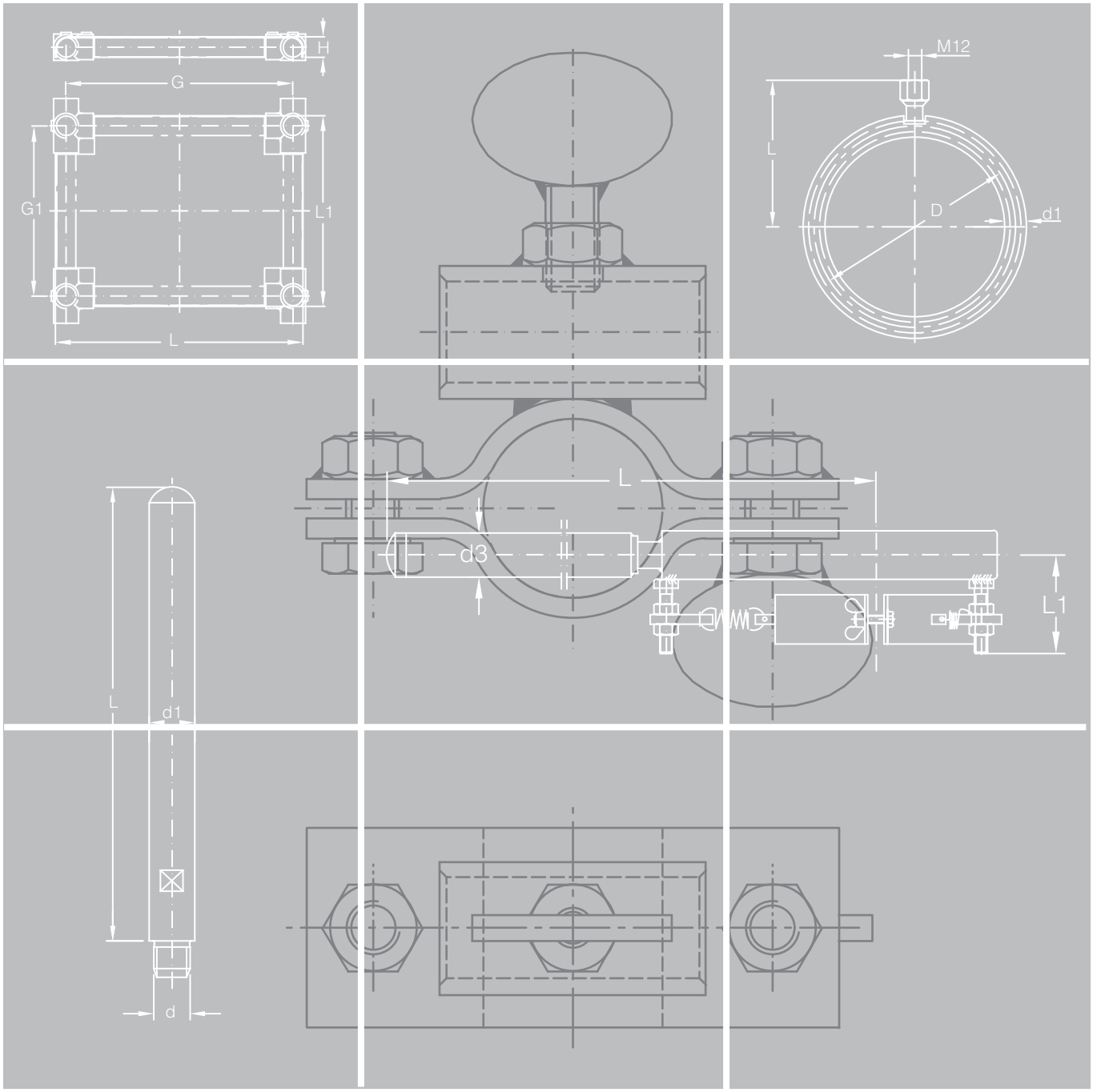
A



B

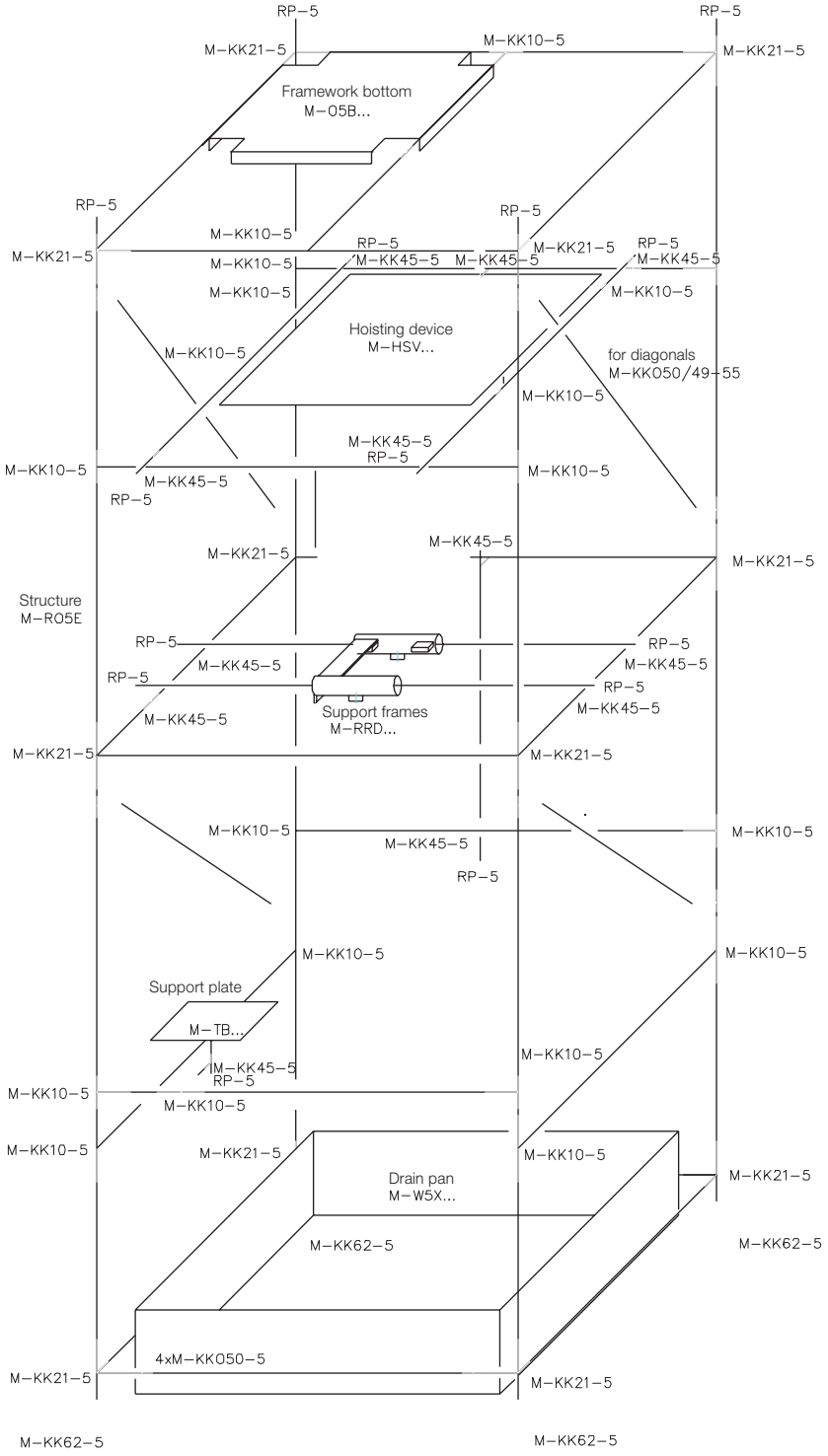





H
G
G1
L1
L
M12
L
D
d1
L
d3
L1
L
d1
d

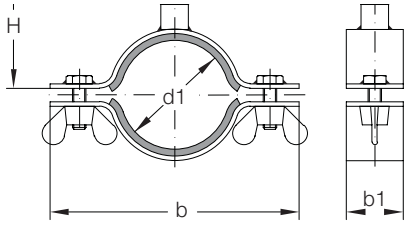
STRUCTURES

Glass installations are supported in a tension-free manner. The Miniplant technology uses polished tubes of stainless steel with coated framework connectors. The example below shows the different framework elements. You can find the tubes and connectors in the WPR 2002 Catalogue. On the following pages, you will see all special supports for the Miniplant technology. Of course, protective walls and housings are available as well.



PIPELINE SUPPORT

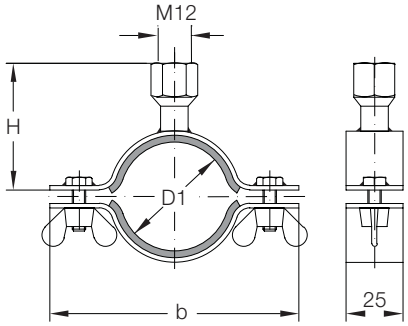
This pipeline support made of stainless steel with a ceramic tape inlay is used to guide columns and support pipelines. Use the corresponding round rod for clamping it to the framework.



DN	d1	H	b	b1	Reference
15	22	45	79	25	**M-RH15**
25	33	50	90	25	**M-RH25**
40	47	57	104	25	**M-RH40**
50	59	63	116	25	**M-RH50**
80	87	77	144	25	**M-RH80**
100	115	92	174	30	**M-RH100**
150	165	117	254	30	**M-RH150**
200	215	142	314	35	**M-RH200**

SUPPORT

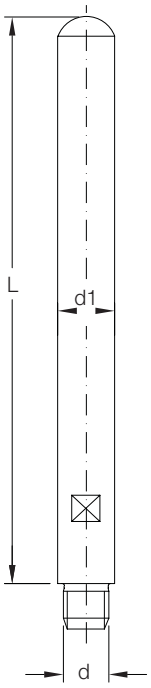
This pipeline support made of stainless steel with a ceramic tape inlay is used to guide columns and support pipelines. Use the corresponding round rod for clamping it to the framework.



D1	H	b	Reference
70	60,5	130	**M-VH70**
75	68,5	136	**M-VH75**
85	76	146	**M-VH85**
100	83,5	162	**M-VH100**
110	88,5	172	**M-VH110**
130	98,5	195	**M-VH130**

ROUND ROD

Accessory for the pipeline support M-RH... and M-VH...

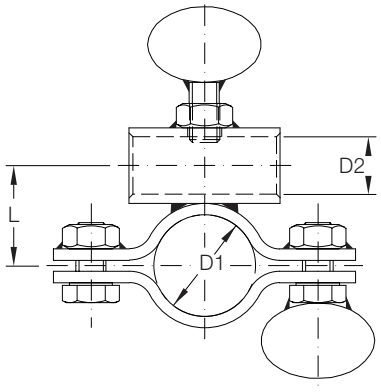


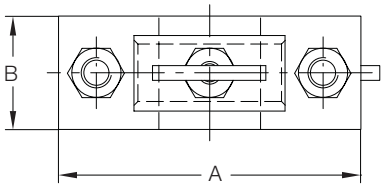
L	d	d1	Reference
150	M12	15	**M-RST150**
200	M12	15	**M-RST200**
250	M12	15	**M-RST250**
300	M12	15	**M-RST300**
350	M12	15	**M-RST350**
400	M12	15	**M-RST400**
450	M12	15	**M-RST450**

PIPE HANGERS

This pipe clamp is used for attaching round rods and framework tubes to fixed points and pipeline supports.

It is made of stainless steel.



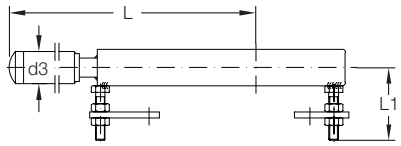


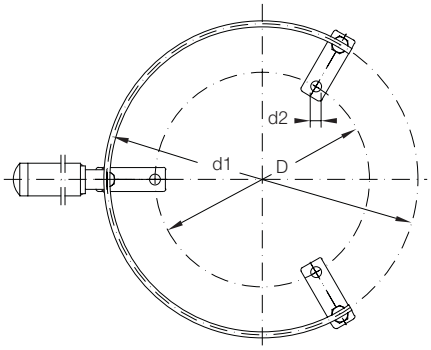
D1	D2	L	A	B	Reference
26,9	15,2	26	80	30	**M-RS5/15**
26,9	27,3	33	80	30	**M-RS5**
42,4	15,2	35	105	30	**M-RS7/15**
42,4	27,3	41	105	30	**M-RS7/5**

COLUMN SUPPORT - FIXED POINT

All gravity forces should be directed to the column support at the lower column connection. This fixed point is attached to the framework.

It is made of stainless steel.

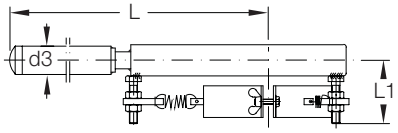


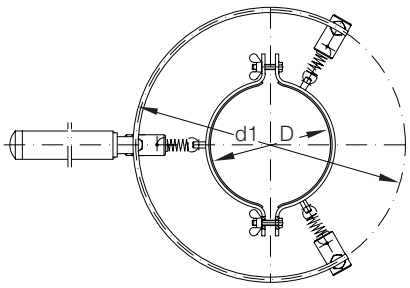


DN	D	d1	d2	d3	L	L1	Reference
50	98	178	9	26,9	419	54	**M-FKH50**
80	133	213	9	26,9	436	60	**M-FKH80**
100	178	258	11	26,9	458	60	**M-FKH100**

COLUMN SUPPORT - PLUMMETING POINT

Columns mounted on a fixed point support must be guided in their upper area. The plummeting point support allows for longitudinal expansions caused by temperature increases, while guiding the column safely.

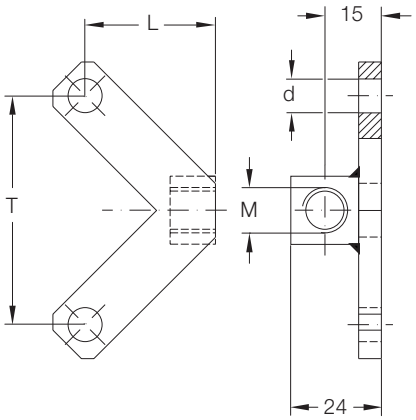




DN	D	d1	d3	L	L1	Reference
50	59	178	26,9	419	54	**M-LKH50**
80	87	213	26,9	436	60	**M-LKH80**
100	115	258	26,9	458	60	**M-LKH100**
150	165	305	26,9	482	66	**M-LKH150**

SUPPORT BRACKETS

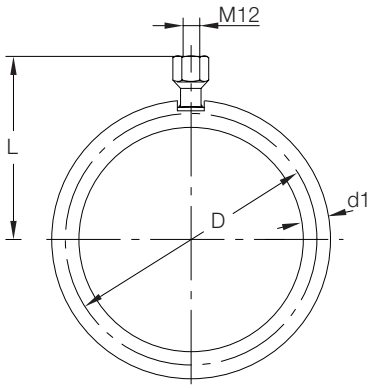
This support yoke made of stainless steel can be used for supporting glass component parts at their connection. The support yokes fit together with the standard glass connectors. For ring clamps with DIN hole circles, use the type M-GHE... .



DN	d	T	L	M	Reference
15	7	43.3	25	M12	**M-GH15**
25	9	60.6	34	M12	**M-GH25**
40	9	74.5	38	M12	**M-GH40**
15	7	46	27	12	**M-GHE15**
25	9	60,1	34	12	**M-GHE25**
40	9	78	40	12	**M-GHE40**

SPHERICAL VESSEL SUPPORT RINGS

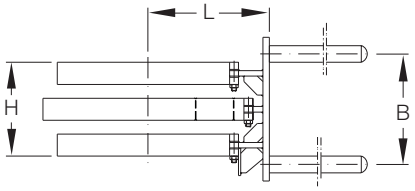
Spherical vessels are mounted on support rings, which are attached to the framework by means of an M-RST round rod and the M-RS pipe clamp. The ring of stainless steel is coated with silicone. You will find support rings for other spheres in the WPR 2002 Catalogue.

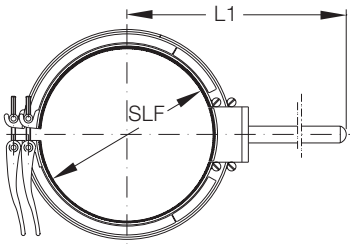


D	d1	L	For spherical vessels liter	Reference
148	16	108	2	**M-VRS2**
183	16	125	4	**M-VRS4**

TRIPLE SUPPORT

Reaction vessels, including caps with laboratory flanges, are sealed and simultaneously supported in the framework by means of the M-DFH triple support. The support rings can be opened individually. The seal is not included in the scope of delivery. The support rod diameter is 15 millimeters.



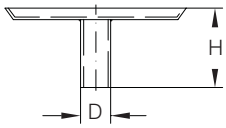


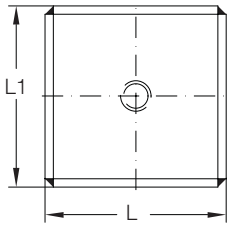
SLF	L	L1	H	B	Reference
100	92	236	47	100	**M-DFH100**
150	110	254	85	100	**M-DFH150**

SUPPORT PLATE

Pumps are placed on support plates, which are integrated into the framework.

Material: stainless steel

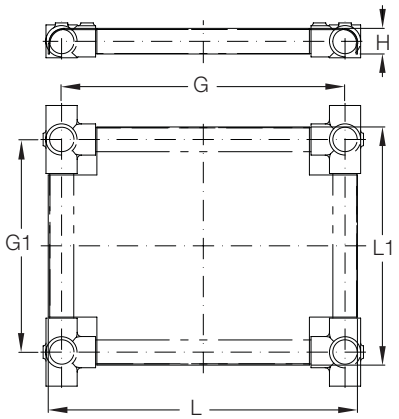




L	L1	H	D	Reference
160	160	70	26,9	**M-TB1**
235	305	70	26,9	**M-TB2**

FRAMEWORK BOTTOM

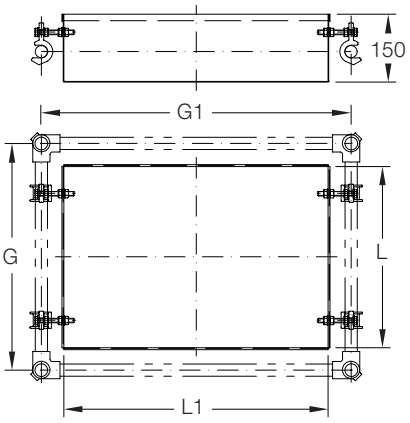
The stainless-steel framework bottom can be used to integrate measurement instruments and other equipment into the framework.



L	L1	G	G1	H	For frame pipeline “	Reference
280	405	250	375	30	3/4	**M-05B2.5X3.75**
530	405	500	375	30	3/4	**M-05B5X3.75**
530	530	500	500	30	3/4	**M-05B5X5**
530	780	500	750	30	3/4	**M-05B5X7.5**
295	420	250	375	45	1 1/4	**M-07B2.5X3.75**
545	420	500	375	45	1 1/4	**M-07B5X3.75**
545	545	500	500	45	1 1/4	**M-07B5X5**
545	795	500	750	45	1 1/4	**M-07B5X7.5**

DRAIN PAN

Material: stainless steel



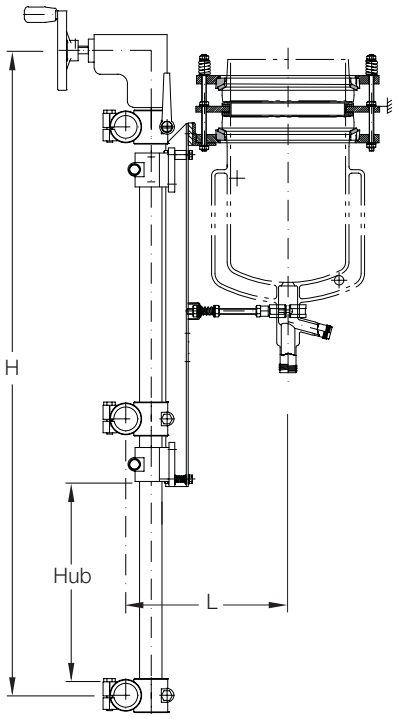
L	L1	G	G1	Volume	Reference
400	400	500	500	17	**M-W5X5**
400	650	500	750	28	**M-W5X7.5**
400	900	500	1000	39	**M-W5X10**
650	650	750	750	46	**M-W7.5X7.5**
650	900	750	1000	64	**M-W7.5X10**
1400	650	1500	750	100	**M-W7.5X15**

HOISTING AND SWIVELING FACILITY

The hoisting and swiveling facility should be used where reaction vessels are mechanically cleaned or replaced.

Once the lower nuts are released, the vessel can be lowered and swiveled to the side, while the cap and the stirrer rest on the fixed point plate.

The hoisting and swiveling facility is designed for a total weight of the reaction vessel of 100 kg. It can be used with vessels of DN 200 and DN 300. The support plate has a PTFE coating where product contact can occur.

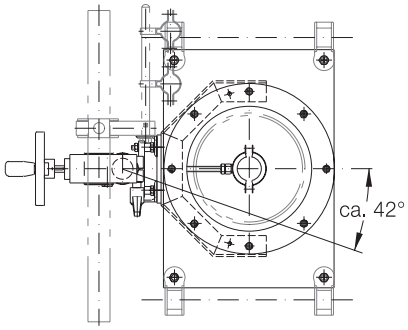


Hoisting Rod

Overall length (mm)	Hoisting (mm)	Reference
1200	325	**M-HSV325**
1600	550	**M-HSV550**

Support

Vessel Ø	L	Reference
DN 200	286	**M-HSV200**
DN 300	339	**M-HSV300**



QVF

member of De Dietrich PROCESS SYSTEMS

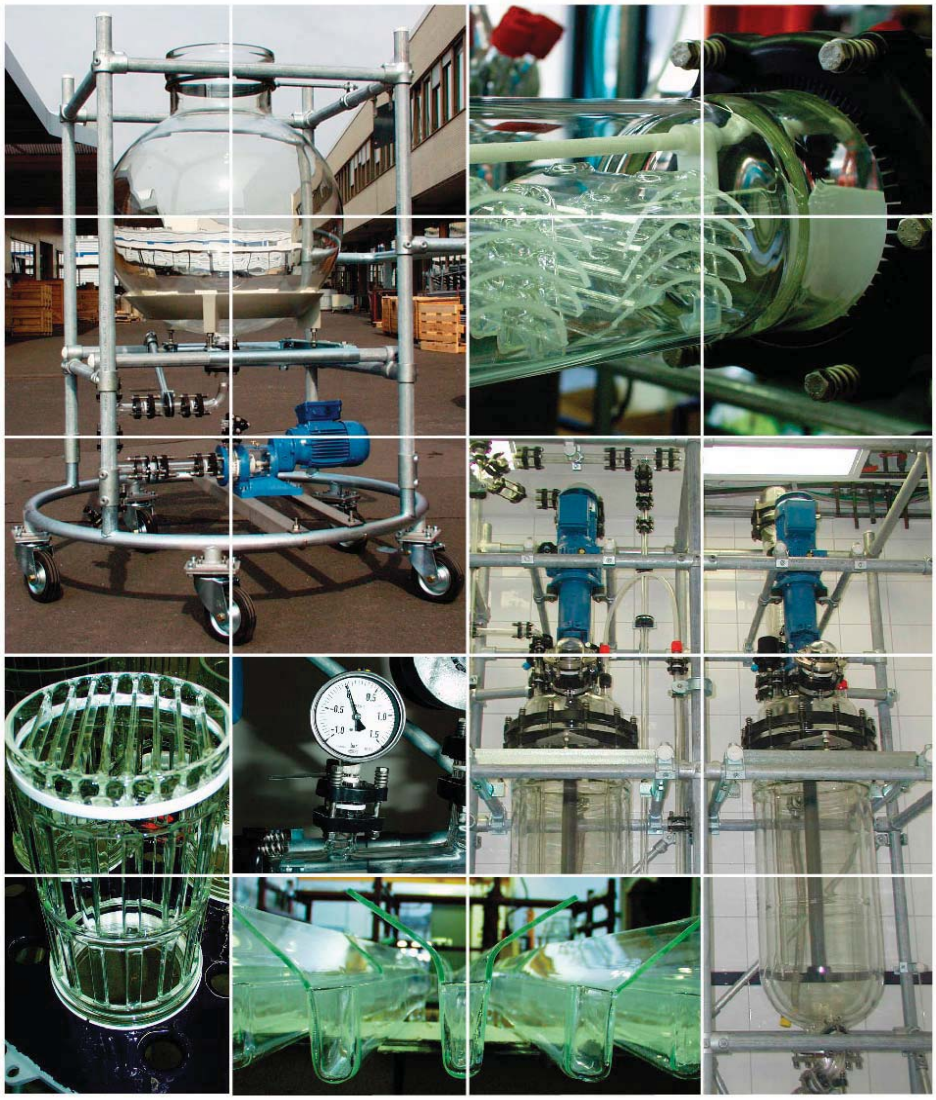
Production

QVF

member of De Dietrich PROCESS SYSTEMS

Production

Equipment



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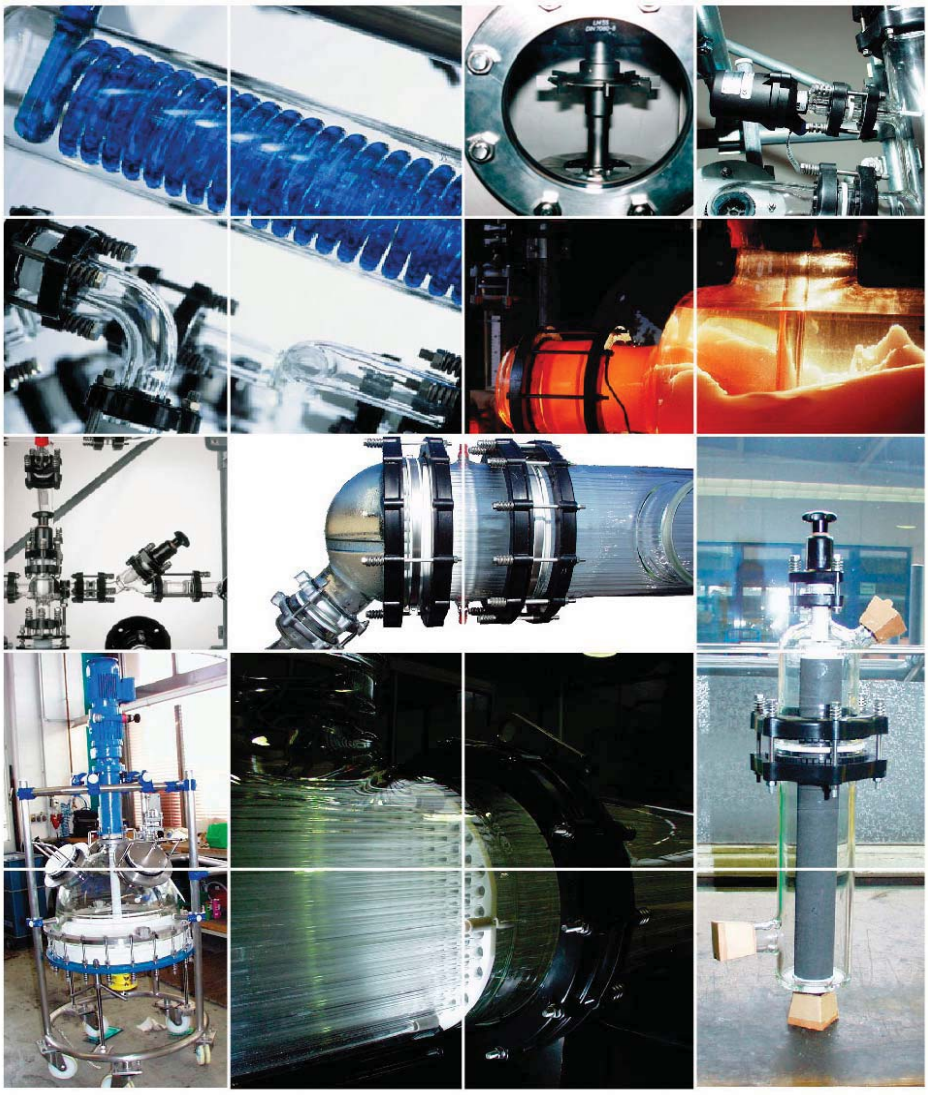
Equipment



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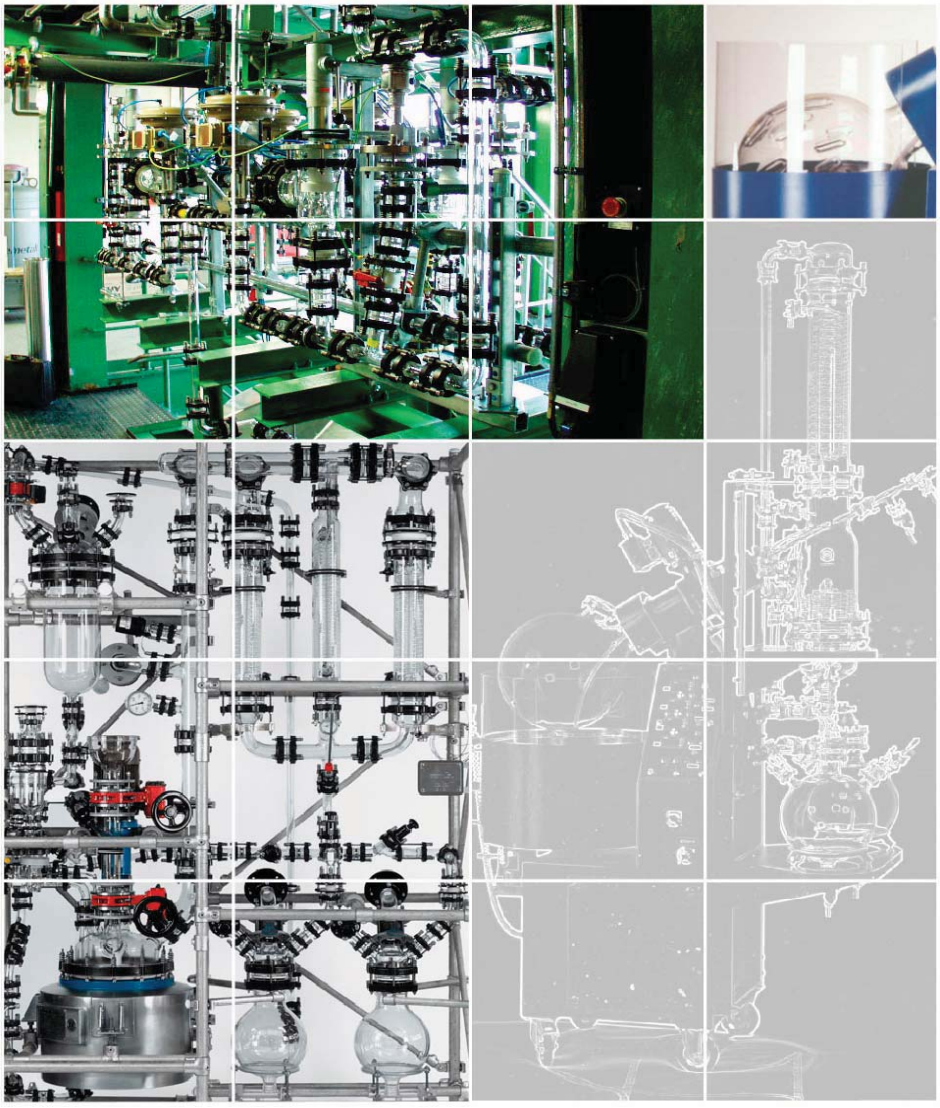
Systems



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Systems

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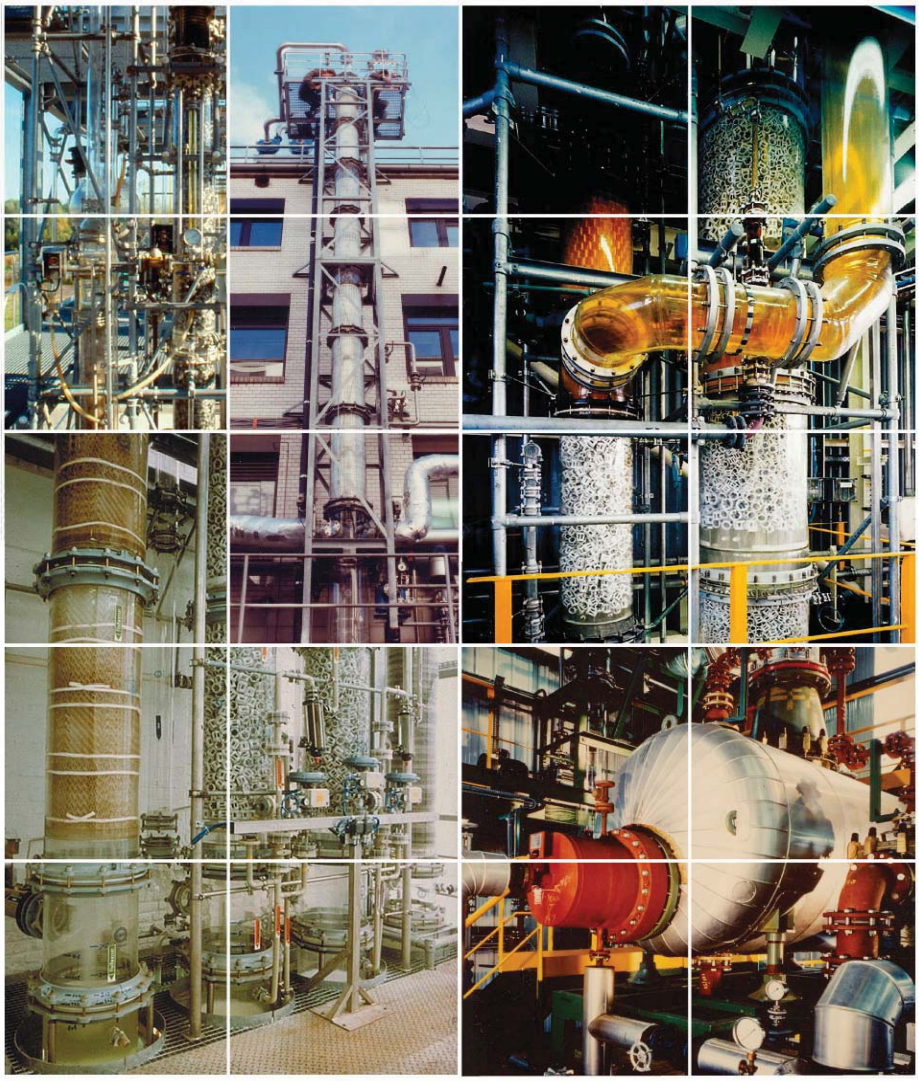
Process Systems



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Process Systems

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Miniplants

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Miniplants

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Literature

A Solution Ahead

Explosion protection for glass plants

Borosilicate glass 3.3
A modular kit with a system

Recovery of high boiling solvents from waste water

World Product Range 2002

CORE-TRAY
Column internals from DDPS

CORE-THERM
QVF-High pressure heat exchanger

QVF PHARMA REACTOR

Miniplant-Unit
for research and development

A Solution Ahead

Degreaser reconditioning case study

Recovery of acetic acid
by means of
liquid-liquid extraction

Bottom outlet valves
designed for use in dead storage space

DURAPACK®
Structured borosilicat glass packings for mass transfer

Nitrogen Savings
with pressure siphon

Miniplant Standard-Unit
Mixer Settler DN50

Rotary Evaporator
Rotadest R20/R50/R100

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QVF WORLD PRODUCT RANGE

P124E.1

THE CHALLENGE OF THE MARKET

The internationalisation of the chemical and pharmaceutical industry requires plant suppliers to have a world-wide presence and world-wide services as well as a product range available in every continent. The fast-moving nature of chemical and pharmaceutical products makes the rapid adaptation of production plant to new circumstances without any compatibility problems a necessity. Many companies wish to produce locally for local markets and, at the same time, guarantee the high standard of their products. This calls for production plants of a constantly high quality.

Internationalisation requires the development and preparation of a uniform World Product Range (WPR) as a world-wide and universally usable modular system for glass process plant. The WPR is, therefore, not something new in principle, but rather the integration of the two leading ranges from Schott and QVF into a new standard that will be applicable world-wide.

GUIDELINES FOR THE DEVELOPMENT

Technically high-quality technology

The most important priority is the requirement for the best product to guarantee the safety and operation of the equipment and plant.

Compatibility

The long life of glass installations makes it a requirement to maintain compatibility with the existing Schott and QVF systems as far as possible. With every decision that was made, its effect on the existing systems was explicitly examined.

Stockholding

A plant built from modular components depends on the availability of items from stock for continuity of operation. The WPR guarantees maximum „on line“ time with the minimum stockholding.

BASIC DECISIONS

Glass units are no longer large-scale laboratory apparatus. Nowadays they are items of plant that are fully incorporated in the production process and that have to comply not only with the appropriate technical regulations but also users' increased safety requirements. Whereas formerly priority was given to the need for supposed flexibility when plants were modified at short notice, nowadays modifications are not permissible without prior planning and documentation and, as a result, reliability and ease of

Safety flat buttres end from QVF

technical design have come to the fore.

Wherever pipeline is involved, the flat buttress end is predominantly used along with the bolted coupling. The WPR accordingly only contains glass components with flat buttress ends which in addition reduces the number of components required to a minimum; you only have to think of the many possible different versions of a cross-piece that are reduced to just one single item with the flat buttress end system.

Alongside these basic benefits of the flat buttress end, the safety flat buttress end developed by QVF has two other special features that make it ideal for modern pipeline design. All nominal sizes of pipeline components (up to DN 300) have fire-polished sealing surfaces and a groove. The groove stabilises and locates the PTFE gasket seated on the sealing surface which is now extremely smooth.

Long-term tests with caustic soda solution, which, as is well known, attacks glass when highly concentrated and at high temperatures, have shown that the well-known "efflorescence" on the couplings does not occur with the safety flat buttress end.

Alongside increased safety, the cleaning aspect, particularly with reference to GMP-compliant plant, is particular importance to users. Together with the specially developed GMP gasket, which effects a seal on the internal bore by being centred in the groove and on the shoulder, the safety flat buttress end provides connection without any

RANGE OF BORES / CE MARKING

dead space in pipeline which incorporates a fall of at least 5°. Further developments and special features can be found in our three-stage GMP-compliant plant design concept.

RANGE OF SIZES

Since the WPR is based on the long tradition of the existing QVF and Schott glass plant and pipeline systems and as one of the guidelines was the compatibility aspect (as explained below) together the continued use of existing components, the couplings have been adapted to the existing designs. Up to nominal size DN 150 the conical type with shoulder is used, from DN 200 the pure shoulder type is used.

In the case of DN 200/225 and DN 400/450 a decision had to be taken on which nominal size to use as standard. To provide a better connection with non-glass plant the decision was made in favour of the DN 200 nominal size. The DN 400 nominal size has been omitted from the WPR to provide a more logical size progression from DN 300 to DN 600. As a result the WPR is available with a logically stepped range of nominal sizes from DN 15 to DN 1000.

In response to increasing requirements for utmost cleanliness on the external surfaces of plant as well, QVF can also supply stainless steel structures and stainless steel flanges if required. Up to DN 300 plastic flanges with stainless steel coupling elements are supplied as standard. Consequently it is not normally necessary to earth the couplings to comply with current regulations relative to the possibility of electrostatic loading.

Drilled adaptor flanges can be supplied for connection to EN1092, PN10 or ANSI, class 150 flanges.

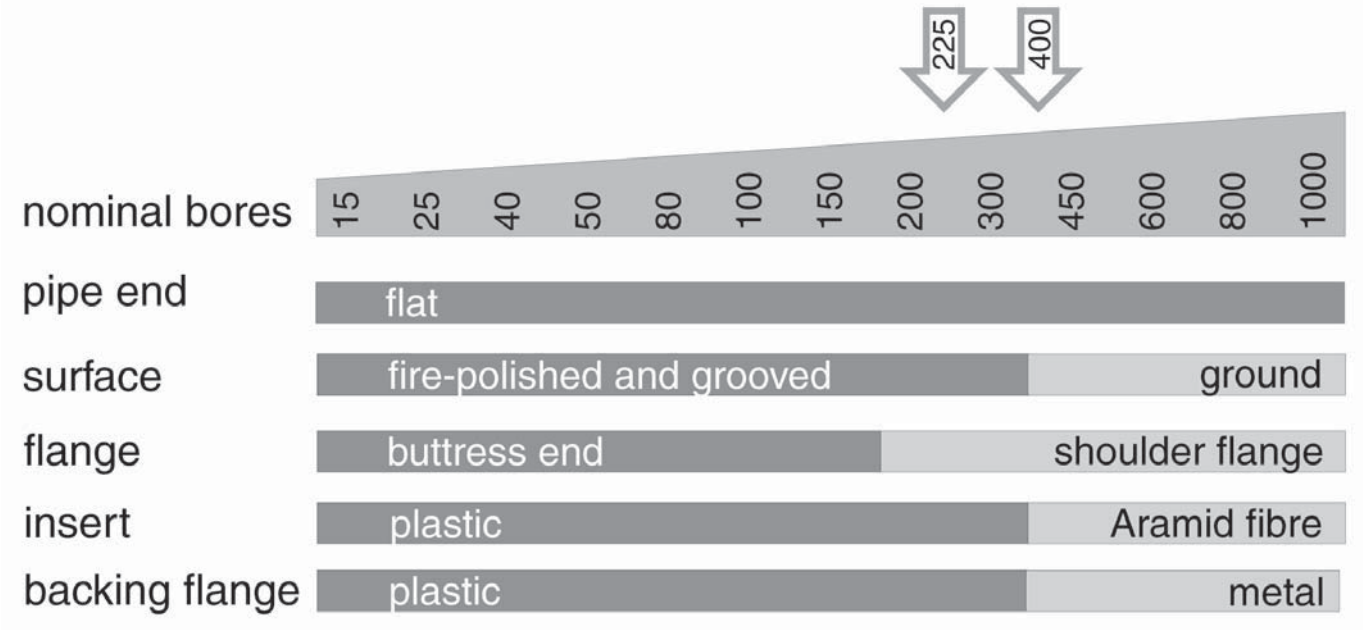
flat buttrres end with groove, fire-polished (DN 15-DN 150)

shoulder type with groove, fire-polished (DN 200+DN 300)

shoulder type without groove, ground (DN 450-DN 1000)

CE MARKING

The previous basis for the design and layout of glass plant was the German pressure vessel regulations and the corresponding sections of the AD data sheets, specifically AD-N4. In the course of harmonisation within the EU, the pressure vessel regulations have been converted into European Pressure Vessel Guideline 97/23/EG. This stipulates that all glass plant must be designed to comply with this new European standard by 2002 at the latest. From this date there is a requirement throughout Europe as a whole for all glass components from



COMPATIBILITY

nominal size above DN 25 and from a permissible pressure of 0.5 bar g to carry the CE mark.

The WPR anticipates this development. All components conform to the new standard and carry the CE mark and the accreditation number of the relevant notified body.

This means that with immediate effect you are getting the only glass plant and pipeline system that already complies with the requirements of the future.

COMPATIBILITY

The virtually universal corrosion resistance of borosilicate glass 3.3 and the use of the modular component principle result in glass plant and glass components having a very much longer lifespan than other equipment in the chemical industry. This fact, which in itself is a positive one, does on the other hand make it absolutely necessary to ensure with the introduction of the WPR that there is compatibility with the previous systems that have been in existence for over 45 years.

While this aspect is not relevant in the case of new, complete installations, connecting new plant to existing equipment and the spare parts situation have to be taken into account. In all cases where the various types of connection described below do not permit the use of a WPR component to replace an existing component, QVF can of course supply spare parts equivalent to the former systems. This also applies to the DN 225 and DN 400 nominal sizes.

In the pipeline range up to DN 150 the components of the flange system are identical with the former QVF system so that it is only necessary to describe here connection to former Schott components.

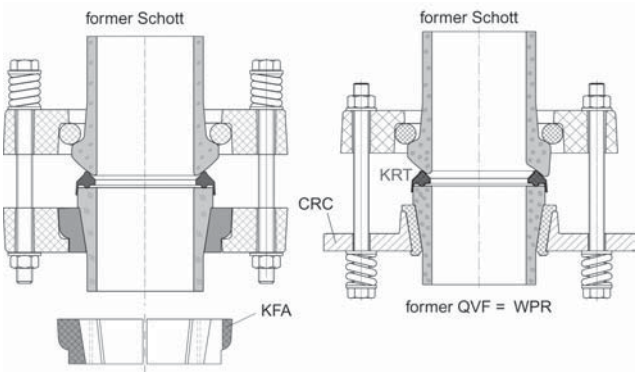
DN 15-DN 100: Connecting Schott to WPR

Using the KRT adaptor gasket all WPR nominal sizes in this range can be connected to the KF spherical end system. Two types of backing flange are available. In addition to the CRC drilled adaptor flange for the WPR side, the former Schott backing flanges can also be used on the WPR side with the aid of the special KFA insert. This economically priced component provides a simple way to make any existing Schott backing flanges WPR-compatible. To connect to Schott flat buttress ends use the WPR gasket.

DN 150-300: Connecting Schott spherical ends to WPR

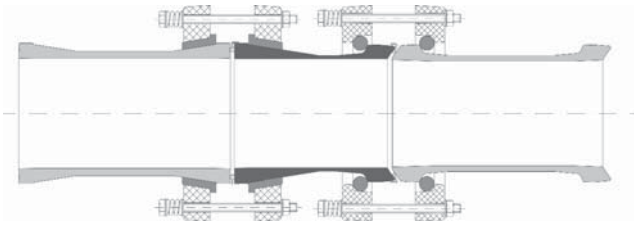
In this nominal size range, using a large KRT gasket would restrict the permissible operating conditions of the glass components. QVF, therefore, recommends the use of AMF or AMS glass adaptors for connections to the KF spherical end system in these nominal sizes.

DN 200-300: Schott flat buttress end to WPR

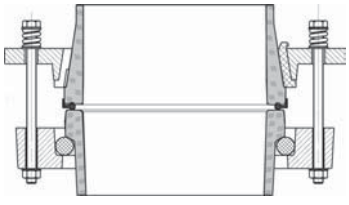


Former Schott components with flat buttress end have a ground sealing surface on which the WPR gasket is located. As the PCD and bolt diameters are also identical here with the WPR, these buttress ends can be connected without any problem using the WPR gasket.

DN 450-1000: Schott / QVF to WPR



The geometry of the buttress ends from DN 450 upwards corresponds to the former Schott version. The existing Schott coupling components can be used for the WPR without restriction. In the case of former QVF components, use the appropriate QVF flanges with a specially drilled PCD and either a WPR or former QVF gasket according to preference.



Connecting the former system to the WPR looks

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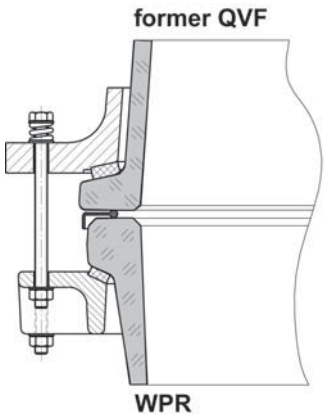
SPECIAL AND/OR NEW ITEMS

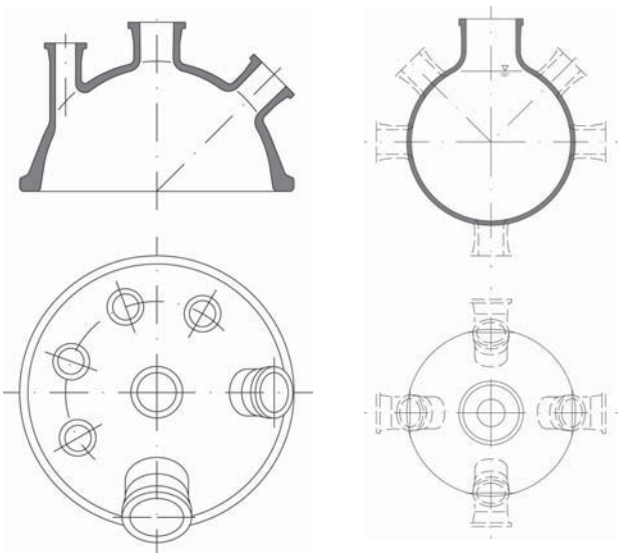
complicated at first sight, but complications will rarely occur in practice except in the case of plant components from DN 200 upwards. This can, however, be dealt with easily in the case of connecting Schott to WPR and QVF to WPR, as all items have flat buttress ends. This makes it possible for you to change over to the new WPR, even when purchasing spare parts in this range of nominal sizes.



Spherical vessels and vessel covers

While the main dimensions have remained same for many components and only the neck geometry has been optimised, these too have changed in some cases on spherical vessels and vessel covers. If you cannot find a vessel cover in the WPR range to replace one you use for a feed vessel or reaction vessel, we will make one for you to special order as in the past. In the case of new installations or major modifications, we would, however, recommend the use of coversfrom the new range since, as a result of the extensive use of hemispherical ends, these components have a greater stability with lower wall thicknesses, which has a positive effect on weight and thermal stress.

In the case of spherical vessels, QVF provides the maximum possible variation in neck positions and neck sizes, although there is a change of overall diameter from the former QVF flasks due to a change in raw material sourcing. Where a replacement is supplied the pipe connections will need modification to match the combination of spherical vessel and vessel support. Our sales engineers will be happy to advise you on this point

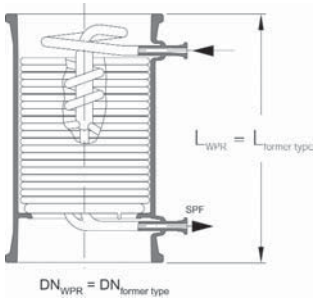


Heat exchangers and plant components

If heat exchangers are connected to the rest of the plant by piping or if their principal dimensions are the same as the WPR, they can be replaced by WPR heat exchangers. It is of course also possible to manufacture heat exchangers with different dimensions to replace existing items. As necks for connections to services generally have safety flat buttress ends in the WPR, it may be necessary to use the form of connection described previously in certain cases.

Plant components such as column sections, distributors and separators have retained their main dimensions but in some cases have been modified for technical reasons. They can, therefore, also be used in existing systems without restriction.

SPECIAL AND/OR NEW ITEMS



The work on the new WPR component range has not only drawn on experience gained with the former ranges. The opportunity has also been used, as a by-product as it were, to progress a number of new developments which will benefit you with the WPR. These include developments in stirrer drives with a wider range of stirrers and SiC shell and tube heat exchangers developed for high pressures and GMP applications. For standard glass users the following are crucial:

Stirrer drives with extensive stirrer range

To comply with demand, electronically controllable drives and slow-running drives have been added to the range of variable speed stirrer drives. The range of available stirrer types and materials covers high purity glass stirrers via highly versatile PTFE stirrers to glass coated anchor and impeller stirrers for heavy duty use.

Conductive coating

To enable the use of coated glass components in Zone 1

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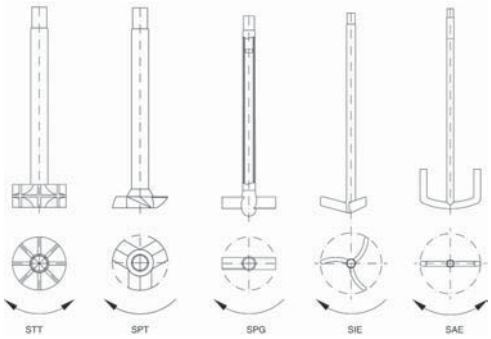
BENEFITING FROM DDPS

hazardous areas without additional measures and restrictions, QVF can supply conductive versions of its Sectrans and GFP (glass fibre-polyester) coatings.

This involves applying an additional transparent layer of polymer which results in a slight blue tint. This additional coating is wear resistant and withstands the temperatures normally encountered in glass plant.

Its surface resistance is 10^7 Ω so that it provides a non-char-



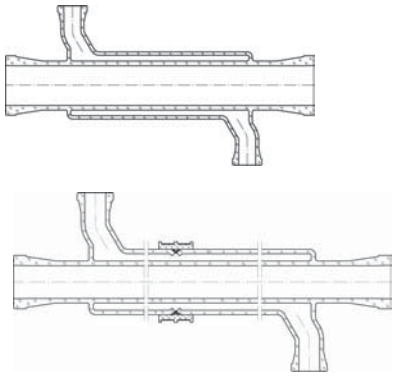
geable surface which can be used to drain off any charge which occurs and as a result of which it can be used in Zone 1 without any precautionary measures. This only applies to plant in which the process inside it does not set up an electrostatic charge. Suitable solutions can also be supplied for such applications.

Jacketed components

Components, which previously had jackets sealed onto them with silicone rubber, are now available with integrally sealed jackets resulting in higher permissible operating pressures. These include not only pipe sections but also fittings, valves and vessels. In the case of pipe sections up to DN 80 and a length of 500 mm and spherical vessels up to 50 litre capacity the jacket is completely welded in. In the case of longer lengths of pipe and the bottom outlet on larger vessels, heavy duty seals have been developed. Any sealants deemed unreliable are no longer supplied.

Standard glass-lined steel components

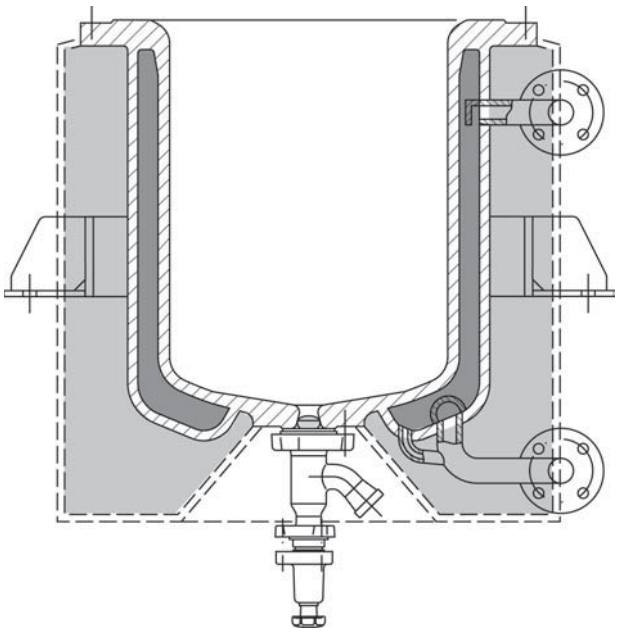
One of the most widely used types of glass plant is the reaction unit. Benefiting from its membership of the De Dietrich Process Systems Group QVF has developed an glass-lined steel reaction vessel that is unique for GMP plant. These vessels, which are designed for use with glass vessel covers and have no reduction of the bore in the flange area, are available from stock in sizes from 25 to 100 litres. With its block flange, a bottom outlet valve with minimum dead space and its optional welded-on stainless steel heating/cooling jacket, this vessel is the basic component in our standard range of GMP



reaction units. Matching anchor or impeller type glass coated stirrers have also been included in the range.

DURAPACK

DURAPACK is a structured glass column packing which was part of the former Schott range in its welded form. It has, however, undergone further development to provide increased efficiency. The plate geometry has been changed so that performances, which could only be achieved previously by treating the surface with glass material to roughen it, can now be achieved with a surface which is generally smooth so that the packing is easier to clean. An improved edge seal eliminates the need to use special column sections for this packing.



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QVF - FOCUS ON YOUR NEEDS

STOCKING POLICY / AVAILABILITY

As a supplier with the self-imposed obligation to provide its customers who have former Schott and QVF systems and also WPR customers with the delivery service they are accustomed to, QVF has had to adapt its stocking policy accordingly. All of the QVF Group's three production units and four warehouse locations jointly guarantee the availability of components. The production of product ranges is controlled on the basis of stock turnover and stock levels are carefully maintained to ensure that QVF can continue to provide the short delivery times to which its customers are accustomed.

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CORE-TRAY
COLUMN INTERNALS FROM DDPS

P129e.3

APPLICATION

Whenever a distillation process has to be carried out in columns containing no metal because corrosion can occur or there can be an adverse effect on the product from metal ions, column packings are available such as DURAPACK, a structured glass packing with outstanding separation properties. Columns containing no metal and able to withstand high temperatures and high vacuum, are available in Borosilicate glass 3.3 and glass-lined steel.

NEW

- ☞ 120 % free cross section
- ☞ corrosion resistant, metal-free
- ☞ up to 1,8 m diameter

The CORE-TRAY support (patent applied) can also be supplied in a version acting as a liquid collector and distributor, and now also provides a solution for the problem of metal-free support trays with a large free cross-section. Whereas previously available versions made of enamel or graphite created a bottleneck in the column, CORE-TRAY provides a free cross-section of approx. 120%. Using only glass-lined steel for

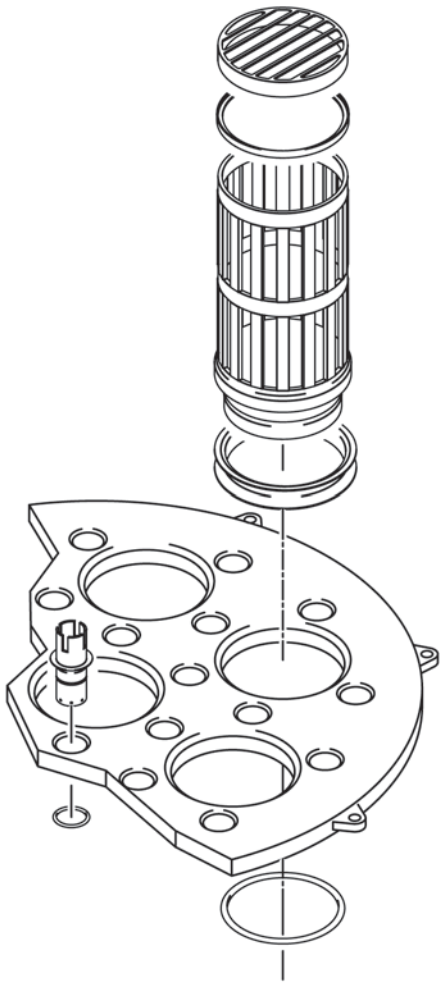

Fig. 2: CORE-TRAY column packing support with support grid on top for random packing and distributor spouts

Fig. 1: CORE-TRAY DIN 1000 assembly, here for packing with glass support

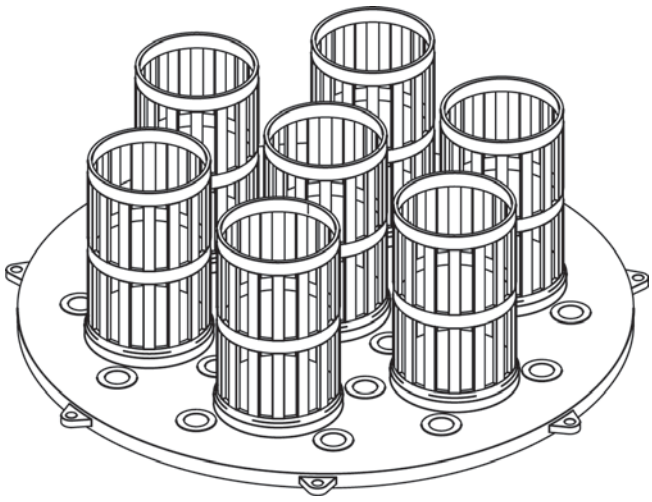

Fig. 3: CORE-TRAY packing support for structured packing

the plates clamped between the buttress ends, Borosilicate glass for the risers and PTFE for the gaskets, CORE-TRAY contains no metal and is highly resistant to corrosion.

FUNCTION

In counter-current columns the pressure drop cannot be high wherever liquid and vapour stream come into contact. CORE-TRAY separates the liquid and vapour stream over the cross-section of the perforated plate and prevents a build-up of liquid. In the area of the gas risers, however, the throughput surface of the gas is the equivalent of 120% of the column cross-section, so that here, where the liquid and vapour stream meet, the pressure drop remains low and no build-up of liquid occurs.

The illustration shows the various levels of the CORE-TRAY. It

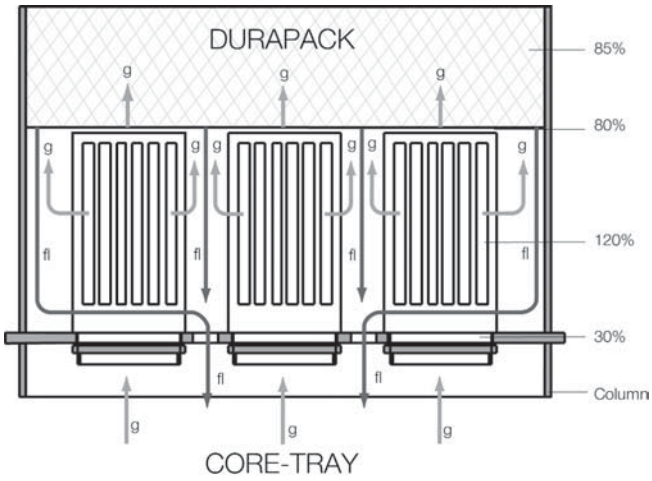

Fig. 4: Hydrodynamic levels of the CORE-TRAY

can be seen that the counter-current area which is crucial for the hydrodynamic layout is located between the packing and the perforated plate and thus reveals a free cross-section matching the DURAPACK high-performance packing. Up to 5 m of DURAPACK can be placed on a plate. If random packin is used instead of structured packing, the passages for the gas are covered with a glass grid to prevent any packing falling through.

NOTE

Liquid collectors, redistributors and liquid feeds based on the same design principle are also available. In each case the plate is clamped between the column flanges and can be centred with the welded-on eyes.

TECHNICAL DATA

Material:	Glass-lined steel, Borosilicate glass 3.3
Diameter:	600 - 1800 mm
Free cross-section:	up to 120%
Liquid loading:	0.5 - 100 m^3/m^2h
Drip points:	100 - 300 pro m^2
Operating temperature:	-40 to +200°C
Bearing capacity:	max. 5 m DURAPACK
Patent application:	No. 10140352.6

Fig. 5: Liquid collector and redistributor with distributor cup (view from below)

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CORE-THERM
QVF HIGH PRESSURE HEAT EXCHANGER

P136e.1

GENERAL

Heat exchangers made of inert, non-metallic materials are a requirement in the chemical and pharmaceutical industries where it is essential to avoid any interaction between the materials of construction and the substances being processed. In addition to chemical resistance there is a prime requirement for resistance to abrasion and ease of cleaning in equipment of this type.

It is usually not possible to fuse-join or weld non-metallic materials which meet these requirements, so that the quality of these combinations of materials rests on the reliability of the seals between the heat exchange tubes and the tube plate.

In view of the different thermal expansion coefficients and the possible temperature differences in the equipment, these seals must be capable of taking up any linear expansion that occurs.

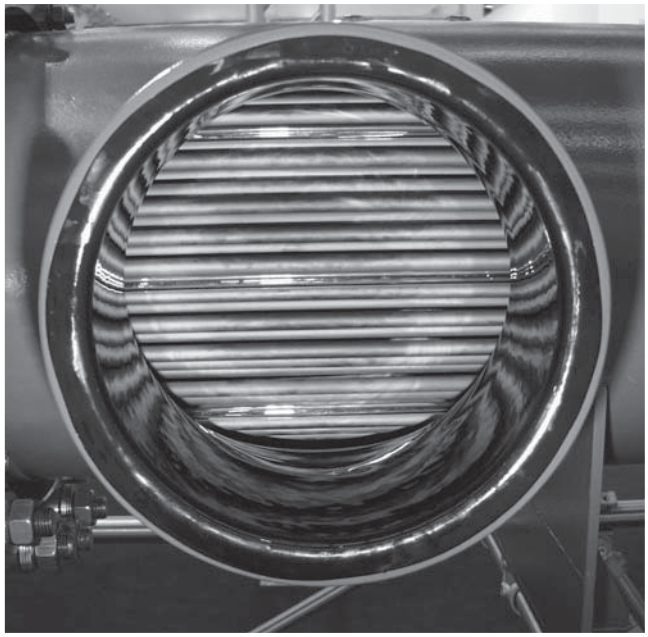

Fig.1: QVF high pressure heat exchanger

- Single tube seal with double clamp rings
- Diffusion-resistant tube plate
- DN 100-DN 300: -1/10 bar, -40/+200°C
  DN 450: -1/8 bar, -40/+180°C
- 0,4 - 40 m² heat transfer area

QVF SINGLE TUBE SEAL

The pure PTFE clamp seal for the individual tubes used by QVF provides a high degree of security here. Every seal is set to the required sealing force and when maintenance work is being carried out and the tube is changed it can be reset to the optimum setting.

The slopes on the contact surfaces between the screw connection (1) and the clamp seal (3) on the one side and between the clamp seal and the tube plate (2) on the other have been selected to ensure that the sealing ring applies pressure to the heat exchange tube in a double linear fashion. Together with the polished ends of the SiC tubes used, this principle guarantees high and controlled sealing forces and, as a result, maximum freedom from leaks even after a long time in service.

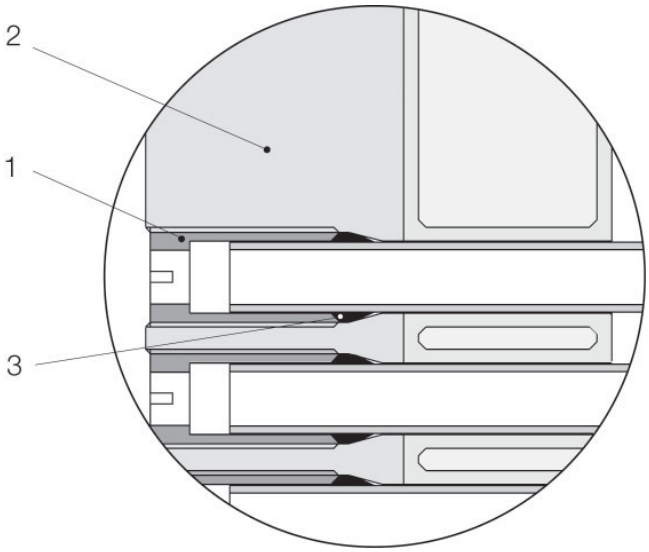

Fig. 2: QVF Single tube seal with screw connection (1), tube plate (2), clamp ring seal (3)

CLEANING THE SERVICE SIDE

In actual operation it is often not possible to prevent soiling of the heat exchanger tubes on the service side by the cooling water mains, so that efficient cleaning is one of the main criteria in the selection of a heat exchanger. CORE-Therm provides the possibility of cleaning the heat exchange tubes mechanically and replacing them individually without affecting the sealing force on the other tubes. Even when the service header is removed the tube plate remains clamped to the shell.

THE NEW TUBE PLATE

The diffusion-resistant CORE-THERM tube plate with its integral support plate and the corrosion-resistant materials PFA and PTFE can be used at high pressures up to 10 bar and also operated under vacuum. Because of the corrosion resistance of the heat exchange tubes and the shell the service and product sides can be selected to suit the particular operating requirements. Only the standard stainless steel headers need replacing with special corrosion-resistant headers.

The optimised tube layout permits the maximum number of tubes per diameter stage.

SILICON CARBIDE HEAT EXCHANGE TUBES

SiC of course meets all the requirements of an optimum heat exchange tube because of its heat conductivity of 125 W/m2K and its high corrosion resistance.

The benefits of SiC are:
- Very good chemical resistance, similar to borosilicate glass
- High pressure resistance
- Very good thermal conductivity
- Very good temperature and thermal shock resistance

Sintered SiC is a monolithic material which contains no further constituents in its structure other than SiC.

DDPS ENAMELLED SHELL

The usual way to operate a shell-and-tube condenser is with the product in the shell. This means that the same requirements as regards corrosion resistance and mechanical stability apply to both the shell and the heat exchange tubes. In such cases, particularly when operating alternately under vacuum and pressure, DDP enamelled shells have proved their suitability in addition to glass. The special roundness of DDPS enamelled shells guarantee optimum sealing of the baffles.

TECHNICAL DATA

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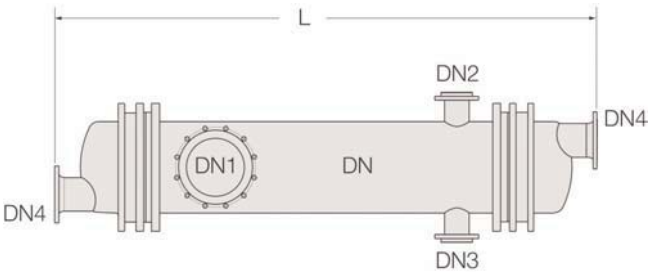

DN	Area [m³]	L [mm]	DN1	DN2/3	DN4
100	0,4	1588	80	50	25
	0,7	2368			
	1,0	3368			
	1,6	4588			
150	1,3	1588	100	50	50
	2,2	2368			
	3,5	3368			
	5	4588			
200	2,3	1638	150	50	80
	4	2418			
	6,2	3418			
	8,7	4638			
300	5	1739	250	80	100
	8,7	2519			
	13,5	3519			
	19,2	4739			
450	18	2716	300	100	150
	28	3716			
	40	4936			

OPTIONS

- Leakage chamber with two separate seals which excludes cross-contamination.
- Corrosion-resistant turbulence promoters for the heat exchange tubes

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QVF PHARMA REACTOR

P138e.1

SERIES

Reaction units are of considerable importance to the chemical and pharmaceutical industry in production and development. Particularly where small volumes are concerned batchwise reaction and distillation is an economic process.

Pharmaceutical applications resulted in demands for the

- ☞ - 16 to 63 litre compact version
- ☞ - new vessel design
- ☞ - according GMP needs

design of the QVF PHARMA REACTOR. The development goals were maximum purity and optimised heat and mass transfer combined with suitability for GMP use.

To suit the availability of space in the majority of laboratories the QVF PHARMA REACTOR is designed for reaction vessel capacities from 16 to 63 litres in a compact layout with reduced headroom requirements.

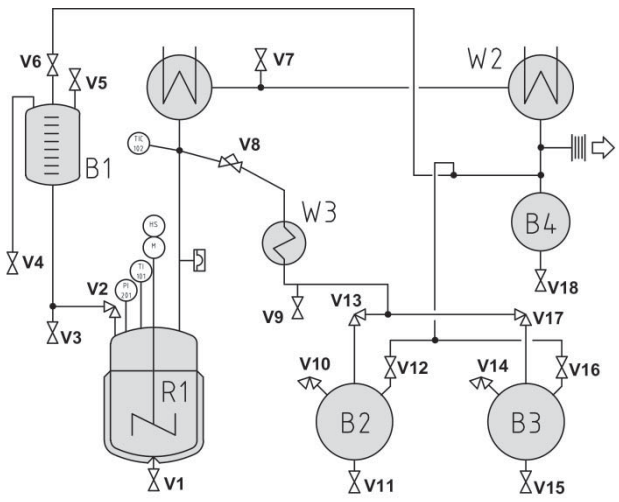

Fig. 1: PHARMA REACTOR 16 - 63 l

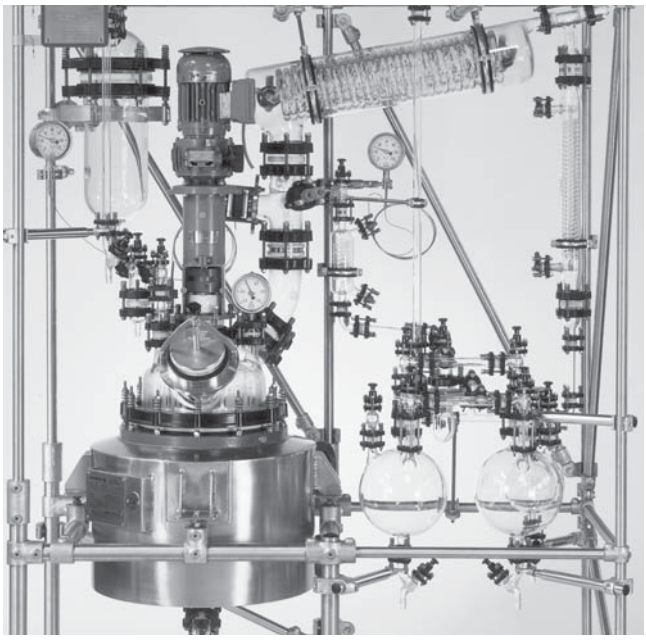

Fig. 2: PHARMA REACTOR 16 l

vessel l	hea-ting area	W1 m^2	W2 m^2	B1 l	B2/B3 l
16	0,25	1,0	0,2	5	5
25	0,37	1,0	0,2	10	10
40	0,53	2x0,7	0,3	20	20
63	0,75	2x1,0	0,3	20	20

Tab. 1: Technical data - PHARMA REACTOR

FUNCTION

The QVF PHARMA REACTOR is specially designed for the two process stages of reaction and distillation. The reaction stage operates under total reflux, whereupon the solvent can be distilled off as effectively as possible in the concentration phase. Both stages can be carried out under either positive pressure (0.6 bar) or vacuum. The materials of construction used are borosilicate glass 3.3, glass-lined steel and PTFE.

DISTILLATION OVERHEAD ASSEMBLY

The distillation overhead assembly comprises components from QVF's high quality World Product Range which is approved as meeting the Pressure Equipment Directive and the equipment safety regulations and which carries the CE mark. With its safety flat buttress end it provides not only a GMP-compliant coupling but also a wide variety of well thought-out individual solutions.

To ensure that the equipment drains completely the horizontal piping carrying the product is largely installed at an angle of 5°. The inclined condenser has a rinsing neck and the receiver vessel can be emptied and rinsed out during the process by means of valve V3.

The integral sampling valve V9 is used to take samples from the current distillate flow, even when operating under vacuum. In the basic version of the PHARMA REACTOR the instrumentation is restricted to basic functions. In addition to the temperature of the vessel content and the distillate, the pressure is indicated by a tantalum membrane manometer. A bursting disk provides protection against excess pressure. The rotation speed of the enamelled impeller stirrer can be adjusted by means of the handwheel on the drive.

All the valves are located close to the vessel involved, thus enabling direct and correct operation. Valve V8 controls the adjustment of the integral reflux separator.

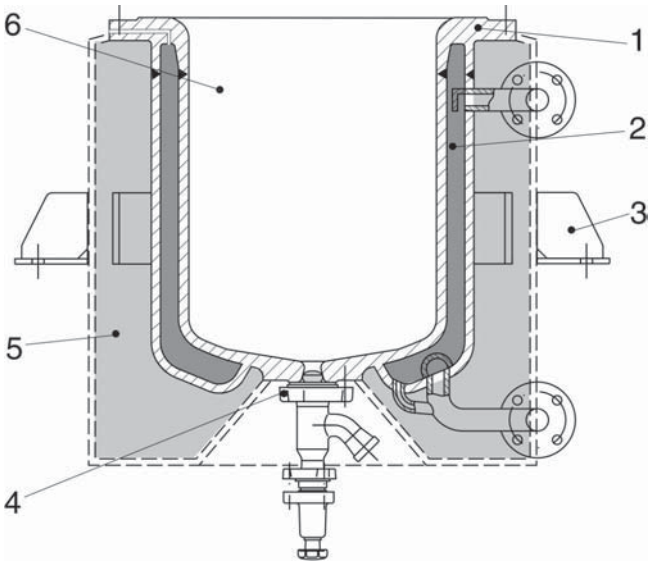

Fig. 3: Special reaction vessel developed by DDPS

REACTION VESSEL

The enamelled reaction vessel developed by DDPS for the PHARMA REACTOR has the following special features:

- Block flange for connection to the glass cover (1)
- Heating jacket up to the flange (2)
- Support brackets without thermal bridge (3)
- Block flange with minimal dead space bottom outlet valve (4)
- Polished insulating jacket with foam glass, stainless steel, tightly welded (5)
- White enamel to improve visual control (6)

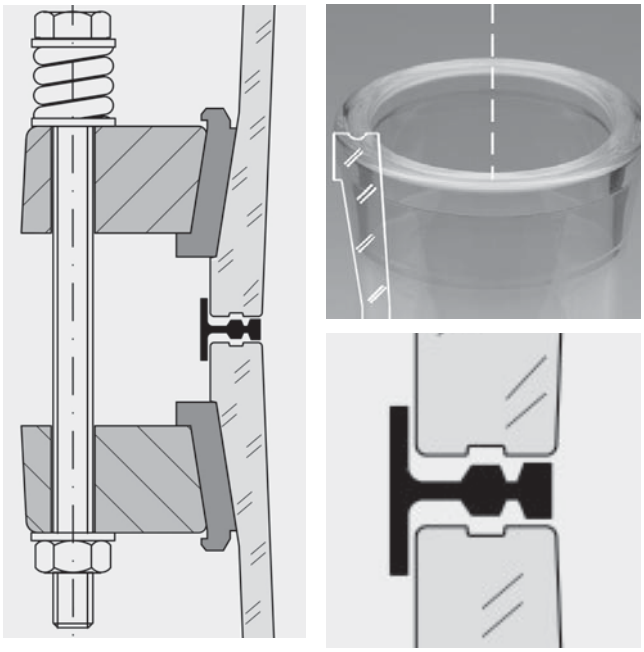

Fig. 4: Safety flat buttress end with GMP gasket

SAFETY FLAT BUTTRESS END WITH GMP GASKET

In addition to the basic benefits of the flat glass buttress end the "safety flat buttress end" (SPF) developed by QVF has two special features which make it the obvious choice for GMP-compliant plant. All nominal bores up to DIN 300 have fire-polished sealing faces and a groove. The groove stabilises and ensures positive location of the PTFE gasket seated on the extremely smooth sealing face. Together with the special GMP gasket, which, via centring in the groove and on the outer edge, effects a seal on the inside diameter of the flange, the safety flat buttress end provides a coupling with minimal dead space in pipelines laid out at an angle of at least 5°.

MODULAR CONSTRUCTION

Because of its modular construction the basic version of the PHARMA REACTOR can be expanded to handle various special functions. The following options are, therefore, available:

- Hydraulic lifting device for the reaction vessel
- Phase separator
- Electronic speed indicator
- High pressure version
- Coated glass components
- Weighting cells for reactor, feed and distillate vessel
- Double-acting mechanical seal
- Anchor, turbine and propeller type stirrers
- Process control engineering

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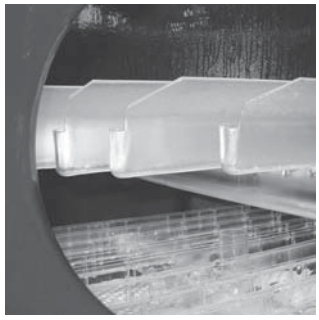
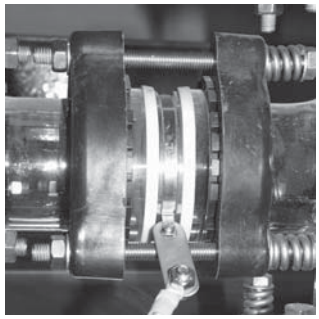
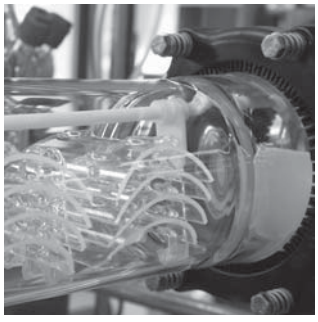
BOROSILICATE GLASS 3.3
A MODULAR KIT WITH A SYSTEM

P140e.0

There are above all four properties that make borosilicate glass 3.3 a recommendable material for plant and pipeline in the chemical and pharmaceutical industry. First and foremost of course its almost universal resistance to corrosion. In times of increased GMP requirements corrosion-resistant can also be translated as inert, i.e. having no interaction with the material being processed and thus absolutely ideal for pharmaceutical applications.







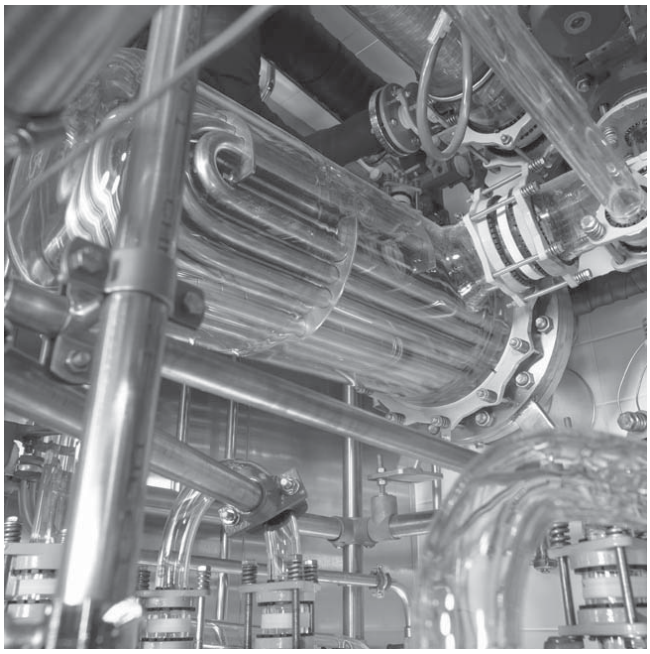
Its second special property is its extremely smooth surface which makes it difficult for materials to bake on and also indicates its suitability for GMP applications because it can be cleaned so well.

Although often seen as not important at in the case of PMS-controlled plants, its transparency is a decisive benefit of borosilicate glass 3.3 plant and pipeline. It is not only in the event of a breakdown or when starting up plants that visual control of the process is a benefit, but also, when monitoring production, the operating staff can often see changes in colour or the carry-over of droplets that long go unobserved by the measurement and control system.

The fourth special feature is the comprehensive modular kit system that has been developed for borosilicate glass 3.3. There is virtually no other corrosion-resistant material that has so many standard units and components available as borosilicate glass 3.3. The range available includes not only pipeline and fittings but also valves and related components, column components and vessels plus readings recorders for all the current measurement values.

Nominal bores DN15 to DN1000

- ☞ Corrosion-resistant
- ☞ Smooth inert surface
- ☞ Transparency
- ☞ Modular kit system with CE mark



Heat exchanger made from glass and stainless steel

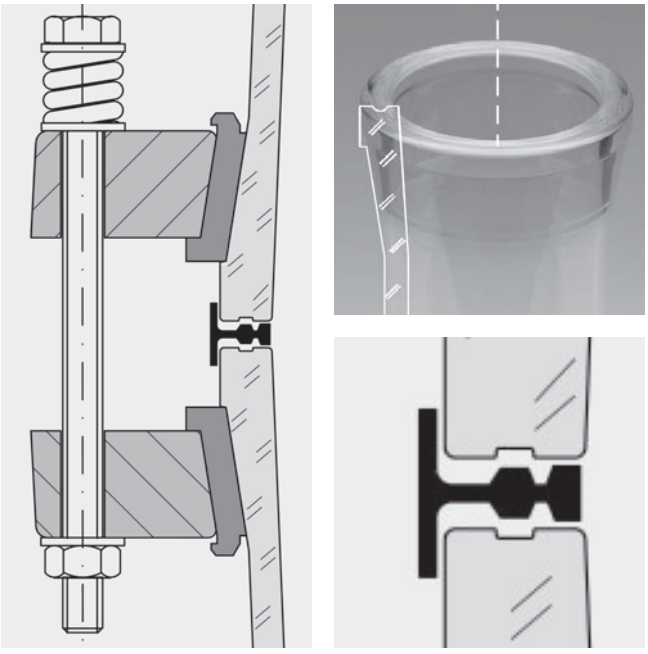
HIGH-TECH FROM SAND

Borosilicate glass 3.3 consists of silica (80%), boron trioxide (13%), aluminium oxide (2.25%), soda (3.5%), with its high boron content giving the glass its name. Its properties are laid down in ISO 3585. This standard lists its chemical and mechanical properties. The distinguishing feature of the material is its extremely low linear thermal expansion coefficient which is 3.3 x 10^{-6} K^{-1} and which is the derivation of the full designation of borosilicate glass 3.3.

THE BENEFIT OF THE FLAT BUTTRESS END

The fundamental benefit of the QVF modular kit system lies in the pipe ends used, the assessment of which has changed in recent years. Whereas priority was given at one time to supposed flexibility in modifying plants for short periods, nowadays, as it is no longer permissible to carry out modifications without prior planning and documentation, reliability and technical accountability are the main considerations.

In addition to the basic benefits of the flat glass buttress end the "safety flat buttress end" (SPF) developed by QVF has two special features which make it the obvious choice for GMP-compliant plant. All nominal bores up to DIN 300 have fire-polished sealing faces and a groove. The groove stabilises and ensures positive location of the PTFE gasket seated on the extremely smooth sealing face. Together with the special GMP gasket, which, via centring in the groove and on the outer edge, effects a seal on the inside diameter of the flange, the safety flat buttress end provides a coupling with minimal dead space in pipelines laid out at an angle of at least 5°.



Safety flat buttress end with GMP gasket

CE MARKING

The former basis for the calculation and layout of glass plant was the German pressure vessel regulations and the relevant sections of the AD data sheets, especially AD-N4. In the course of harmonisation within the EU the pressure vessel regulations changed into European Pressure Equipment Directive 97/23/EC. This specifies that since June 2002 all glass plant must comply with this new European standard. Since this date it has been compulsory throughout Europe for all glass components from DN25 nominal bore upwards to carry the CE mark at a permissible pressure greater than 0.5 bar.

The World Product Range 2002 complies with this requirement. All the components comply with the new standard and carry the CE mark and the accreditation number of the relevant technical testing organisation.

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MINIPLANT UNIT FOR RESEARCH AND DEVELOPMENT

P139E.0

MINIPLANT UNITS

Miniplant units provide you with the capability to carry out process development and process simulation in the laboratory and at the same time they facilitate scale-up to full production scale units. As the individual units are designed using appropriate model theories, the process stage involving pilot plant can be omitted. In many cases it is necessary to combine various individual stages in order to try out the feedback from the individual material flows and their effect on the process. In these cases the whole process can be reproduced true to scale.

The unit shown here is a multi-purpose unit that can be used for various process stages.

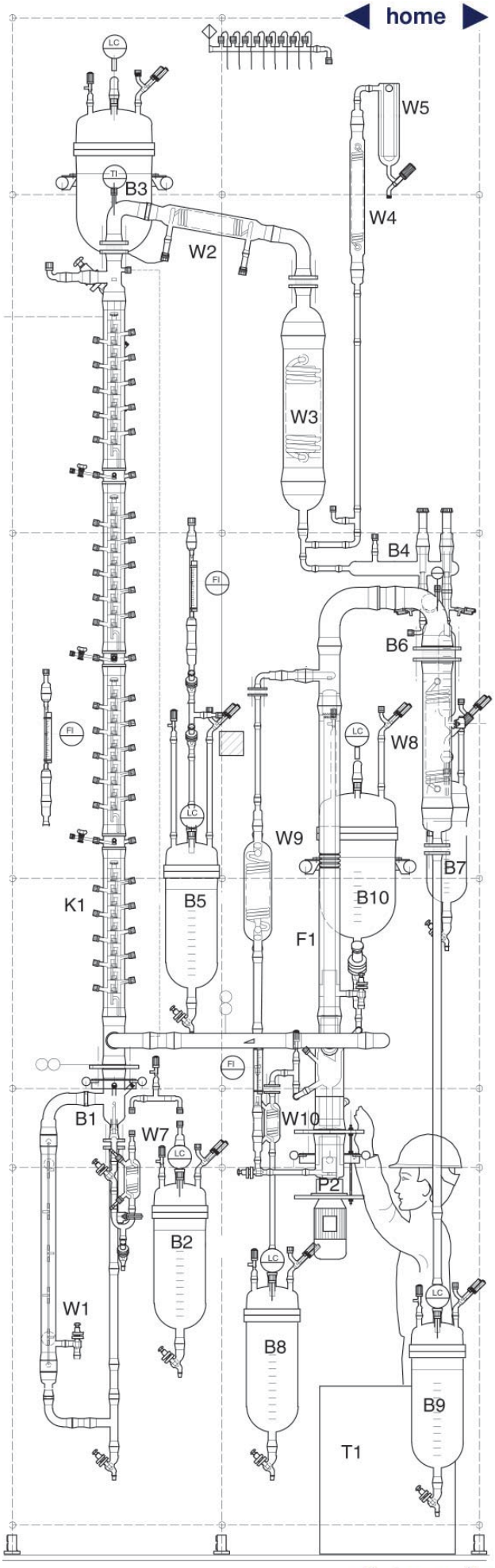
- ☞ Scale-up from laboratory to production
- ☞ Flexible standard unit adaptable to the duty required
- ☞ Borosilicate glass 3.3, the universal material

DN 50 BUBBLE-CAP COLUMN

Silvered jacketed column, with 10 practical bubble-cap plates per section. Standard bubble-caps with glass riser are used. Alternate plates have sampling and temperature measurement facilities. If required the bubble-cap column sections can be exchanged for packed columns, in which case support plates with a feed facility are provided between the sections.

CONDENSATION

For heat recovery purposes condensation takes place in two separate coil type heat exchangers. While the product can be preheated with the heat of condensation in W2 (0.3 m^2), full condensation takes place in W3 (0.7m^2). The guard condenser (W4) and the cold trap for dry ice (W5) makes it possible to hold back all the components even in the case of distillation of high volatile material.



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PHASE SEPARATOR AND RECEIVER

In the case of azeotropic distillations the distillate occurring is separated in separator B4 into its heavy and light phases. By changing over the two overflow valves fitted inside, both the light phase and the heavy phase can either be fed as reflux to the columns or collected in the receiver vessel B6/B7 as required.

EVAPORATOR VERSIONS

The column is heated by means of either a natural circulation evaporator or a falling film evaporator, depending on the requirements of the product.

The standard heating for the plate columns is by means of a shell and tube heat exchanger with three heat exchange tubes and a 0.1m² surface area. The natural circulation evaporator is suitable for products that are not sensitive to temperature.

Because of its short residence time in the evaporator the falling film type is, in contrast, also suitable for the evaporation of temperature-sensitive materials. The external circulation loop, with additional heating, is driven by a magnetically coupled circulation pump. The falling film evaporator is supplied as an independent unit and can be operated as an evaporator without the column. It can be changed from co-current to counter-current evaporation.

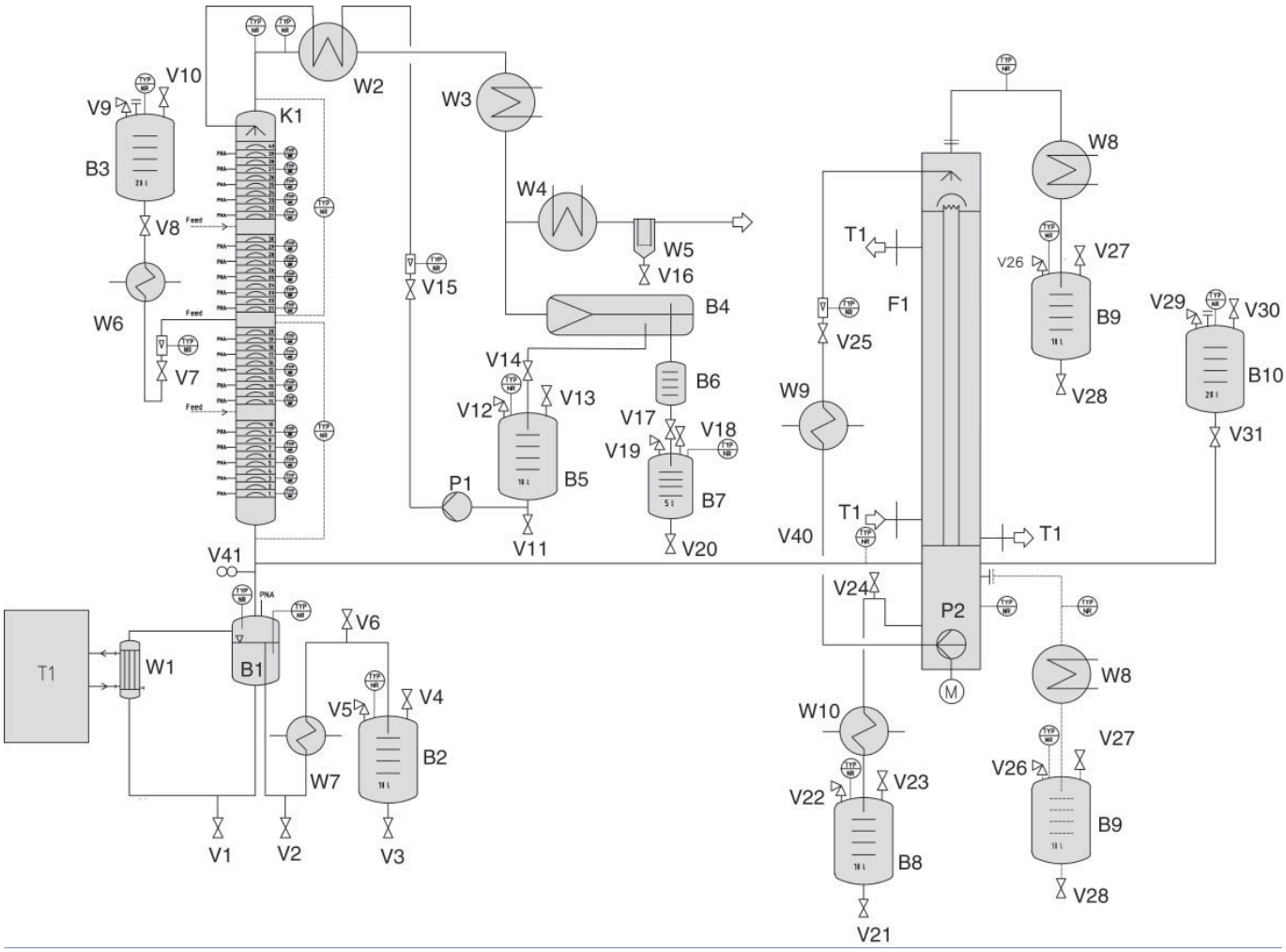
Both types of evaporator are heated with the "boiling thermostats" described below.

BOILING THERMOSTAT

If a boiler can be operated with phase transition of the heating medium, the heat transfer is usually greater than with pure heat conduction and without temperature gradient along the heating area. With this objective heating steam is produced in the boiling thermostat that is set by setting the pressure to boiling temperatures of 45° to 300°C, depending on the heat transfer medium. This results in optimised heat transfer even in temperature ranges in which heating is by means of heat transfer oil. Available heating power 6 kW.

ACCESSORIES

- All feed and distillate vessels are fitted with level sensors and have graduations for visual control.
- The feed and many of the product lines are in the form of flexible PTFE hoses and can be adapted to meet the requirements of the process.
- All vacuum connections are grouped together and connected centrally to the vacuum unit.
- Provision is made for operating the unit from several available platforms; remote control is available if required.



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RECOVERY OF HIGH BOILING SOLVENTS FROM WASTE WATER

P145.e.0

DESTROY OR RECOVER?

Industrial waste water often contains high boiling solvents, such as phenol or dichlorobenzene, and so cannot be discharged into a sewage treatment plant without reprocessing and cleaning. Since destruction through burning is not only a bad alternative ecologically but also too costly due to the high water content, the preferred way is phenol recovery with simultaneous cleaning of the waste water until it can be discharged into the sewage treatment plant. The example of phenol is used to describe the method used repeatedly by QVF.

The phenol content, which depends on the process, is normally 2-12%. The low phenol concentrations eliminate separation by distillation, in which the water is evaporated out, due to the high energy requirements. Here, extraction offers the decisive advantage. Methylisobutylketone (MIBK), an extracting agent, removes phenol from the waste water in the extraction column K1. The charged extracting agent is cleaned again in the distillation column K2 and returned to the bottom of the extraction. The phenol accumulates in the bottom of the subsequent rectification (column K2) and can be used again in production.

Fig. 1: Sieve plate extraction column and distillation column DN450

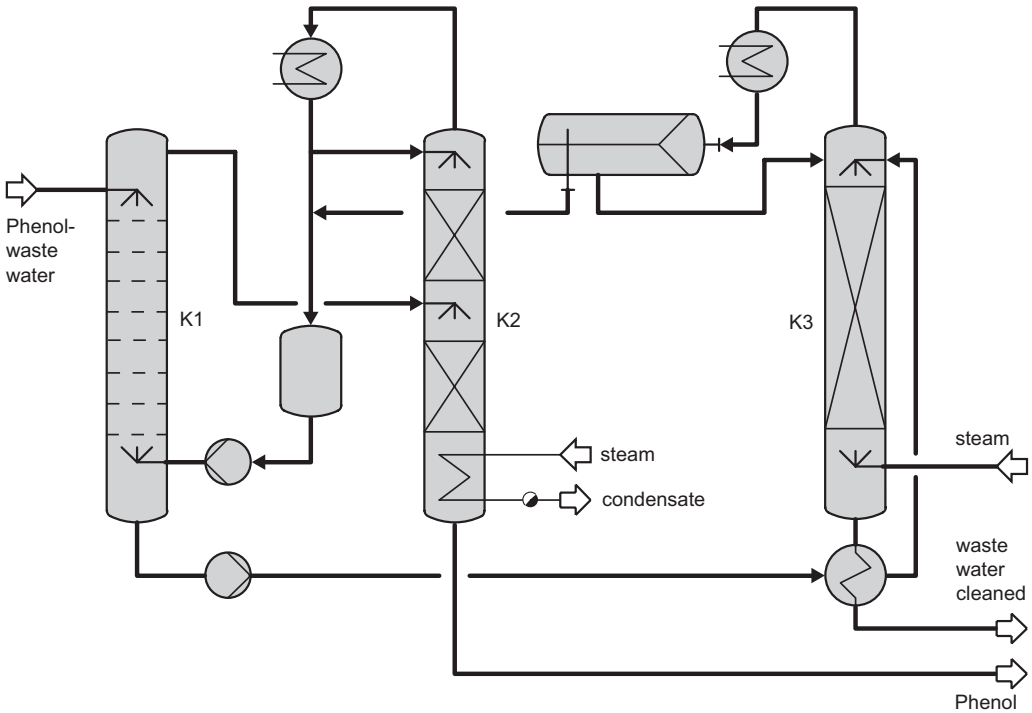

Fig. 2: Phenol recovery flow sheet

While the waste water flowing out of the extraction K1 may be free of phenol, it carries along traces of the extracting agent, which are recovered in the stripper K3. The MIBK/water azeotrope accumulates at the head of the column, where it is separated in the separator B1 into the light MIBK phase and the heavy water phase. Since the distillation column K2 is operated without water, indirect heating is planned here, while direct steam can be introduced into the stripper.

- ☞ Recycling of high boiling solvent
- ☞ Waste water that can be discharged
- ☞ Energetically favorable

ADVANTAGES OF THIS SYSTEM CONCEPT

The planned heat recovery in the waste water stream and the use of dephlegmators make the overall process energetically favorable and appropriate for the ecological requirements applicable today. With a phenol content in the waste water of less than 5 ppm, the water can be discharged into the biological sewage treatment plant. The extracting agent circulates and is not consumed to a noticeable extent. The recovered phenol can be used again in the process.

WHO NEEDS PHENOL RECOVERY?

Phenol waste water accumulates in many areas of plastic and resin production and in the production of alkylated phenols. The waste water volumes to be processed range from 0.5 m^3/h up to 10 m^3/h, whereby the chosen extraction unit depends on the waste water volume and the attendant material. With greater volume streams, extraction is performed continuously in serially connected mixer-settlers, since the technical effort is then more favorable than with the pulsed sieve plate column.

EXAMPLE OF A BUILT SYSTEM

The system shown in the illustrations processes a waste water stream of 4 m^3/h. In this case, we have chosen a pulsated sieve plate column DN400 with 105 plates for the extraction. The distillation column DN500/DN450 with ordered packing works at a pressure of 0.3 bar abs.

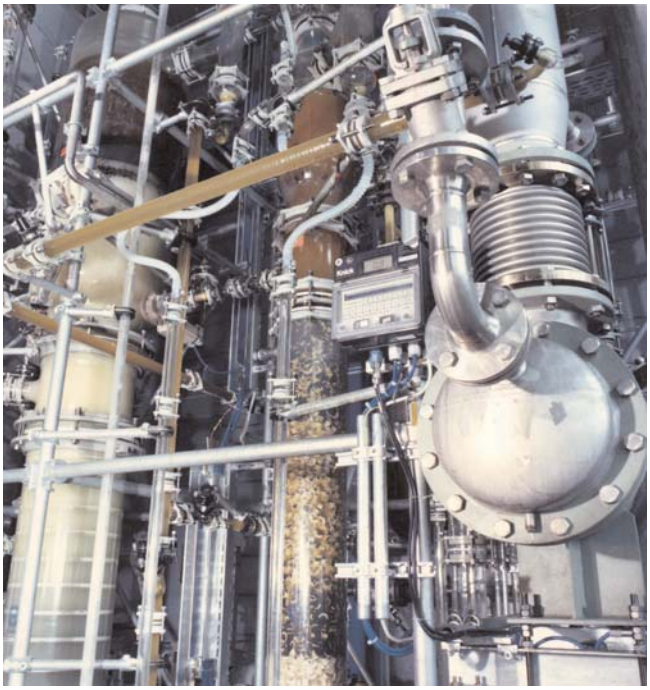

Fig. 3: Head vessel of extraction column

The waste water with the phenol removed, lightly overheated via a flash tank, enters the stripper DN450. The scope of supply contained the system with measurement and control devices, vacuum generator, vessels and receivers and the performance run with original product.

The special difficulty with every waste water cleaning lies in the attendant materials, whose effects on the main process can be critical. The feed can contain suspended matter, cresols, acetone, formaldehyde or methanol. In the system shown, for example, suspended matter collects in the extraction head and must be continuously fed out. Cresols crystallize at low temperatures so that, when auxiliary heating is lacking and the pipeline layout is unsuitable, a blockage of the system through solids must be feared. The lightly volatile solvent acetone, methanol and formaldehyde, which the waste water also contains, could be removed by means of a preceding stripper. Experience with the built systems has shown that it is precisely the investigation of secondary materials in our test facility that contributes to an optimal system concept.

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EXPLOSION PROTECTION FOR GLASS PLANTS

P147e.0

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1. EXPLOSION PROTECTION

One of the most important safety aspects for chemical plants is the avoidance of explosions, a topic covered in European Directive 94/9/EG ("Equipment and Protective Systems intended for use in potentially explosive atmospheres"), which is better known under the acronym ATEX 100a. The new aspect for plant construction engineers is that ATEX now covers electrical as well as non-electrical equipment. This means that the observation of the possible sources of explosions has been expanded from electrical sparks and hot surfaces to mechanical combustion sources, such as friction and electrostatic discharges. In this situation, plant engineers and device manufacturers must now also examine the moving parts in their equipment and take the appropriate precautionary measures to prevent combustion sources as a result of electrostatic discharge in accordance with the new BG Chemie guideline BGR 132 ("Trade Association Rules for Safety and Health at Work"). Both of these regulations have been applied by QVF Engineering GmbH for the World Product Range 2002 and implemented in graduated safety concepts.

2. DETERMINATION OF TERMINOLOGY

The classification of explosion zones is not clearly determined by the new standard either; it describes in words the probability of the occurrence of an explosive atmosphere. Only the provisions for gases and vapours are outlined below as these are the main problem areas in the field of chemical plant engineering.

While the probability of the occurrence of a dangerous, explosive atmosphere (see Tab 1) is merely circumscribed, the responsibility for determining this lies clearly with the plant operator, with the plant engineers providing only support and advice. Contrary to previous procedures, care is taken today when determining the zones not to fundamentally assume the most critical Zone 0 but to differentiate in accordance with the actual hazard potential, as the apparatus and control technology expenditure, and therefore the costs, increase sharply otherwise.

Zone 0	Zone 1	Zone 2
constant, long term	occasional	seldom, short term

Tab. 1: Zone Allocation After the Occurrence of a Dangerous, Explosive Atmosphere

Depending on the zones, demands are made on equipment in accordance with the safety functions and measures against electrostatic discharge which have been included in the QVF safety concepts and which will be explained later. Because the measures have to be differentiated within the various zones, however, especially when observing electrostatic discharge in the field of glass plants, we have to make use of the term Explosion Groups.

The ability of chemical substances to explode and combust varies and this is described in the explosion groups and temperature classes. The substances can be classified into explosion groups on the basis of the minimum ignition current and flame penetration capability, whereby a group-specific test gas is characteristic of each group: Propane (IIA), Ethylene (IIB) and Hydrogen (IIC). Two standardized measuring procedures determine the explosion group into which the substance is classified.

The flame penetration capacity MESG (Maximum Experimental Safety Gap) is used to assess "flame proof enclosure" and determine the gap width from which flame penetration no longer occurs.

The Minimum Ignition Current (MIC) serves to evaluate intrinsic safety of components (Ex i) and is given as a ratio to methane, the firedamp reference gas.

Irrespective of the explosion group, an ignition temperature is determined for each substance to establish the temperature at which the gas mixture just manages to burn with the appearance of flames when it comes in contact with the hot surface. The ignition temperatures are divided into 6 areas and are of

	IIA	IIB	IIC
MESG	>0,9 mm	0,5-0,9 mm	<0,5 mm
MIC	>0,8	0,45-0,8	<0,45
Test gas to determine group	Propane	Ethylene	Hydrogen

Tab. 2: MESG, MIC Parameters

decisive importance for the categorization of the electrical and mechanical ignition sources, while the explosion group has to be observed for the evaluation of the electrostatic ignition source, whereby the ignition temperature in the ignition spark is considered as having been reached in each instance.

3. ELECTROSTATIC IGNITION SOURCES

While we accept the occurrence of flashes and sparks as acts of volition in the world of magic, we would prefer to rely on technical criteria in plant engineering technology to predict the occurrence of ignition. Because it is difficult, however, to

T1	T2	T3	T4	T5	T6
>450	>300	>200	>135	>100	>85

Tab. 3: Limiting Values of Ignition Temperatures for the Temperature Classes in °C

calculate capacities, peak loads and charging processes under non-experimental conditions, it is customary to describe the conditions in which experience has shown that there is no risk of ignition. To this end, BGR 132 describes the substances (the gases, liquids or solids handled within a company) and materials (working materials out of which objects or appliances are made) on the basis of electrical parameters and in regard to their behaviour.

The prerequisite for the electrostatic charging of a material is the movement of a substance with medium to low conductivity (lower than 10^{-9} S/m) relative to the material to cause the separation of the charge. Where the substance is highly conductive (down to 10^{-9} S/m), no charging can be expected.

3.1. GLASS PLANTS

Glass plants cannot be charged up to a dangerous level under standard conditions (BGR 3.2.13). The defined exceptional circumstances are illustrated in Fig. 1, whereby we generally assume an operating temperature of 180°C for electrostatic observation. Under these preconditions, we can differentiate in two areas. If Zone 0 or Zone 1 IIC (Hydrogen Group) is defined, simultaneously with a substance whose conductivity is lower than 10^{-9} S/m, QVF Safety Package E1 is applied to the system.

With processes which produce a strong charge, on the other hand, the measures contained in QVF Safety Package E2 can

be applied locally to compensate the created charges, which could otherwise result in charging outside the glass plant through inverse field amplification. Processes which generate a strong charge are defined by a low conductive liquid under the following conditions (BGR 3.2.13):

- Spraying
- Visible drops of liquid over 20 m/s, (this charging source can also be observed with higher conductivity of the substance)
- Liquid velocity greater than 2 m/s
- Filters
- Flows of multiphase mixtures when both phases are low conductive

While the area of application of Safety Package E1 depends only on the zone determination and utilized substance and has to be applied to the entire system, Safety Package E2 remains restricted to the observed area.

3.1.1. QVF SAFETY PACKAGE E1

The package of measures presented below comprises new QVF developments which have already been implemented successfully by our customers and which are based on the following idea: a glass surface with a dissipative coating combined with dissipative double-collar gaskets makes the entire surface of the system electrostatically dissipative in a simple manner which is earthed through one single earth connection.

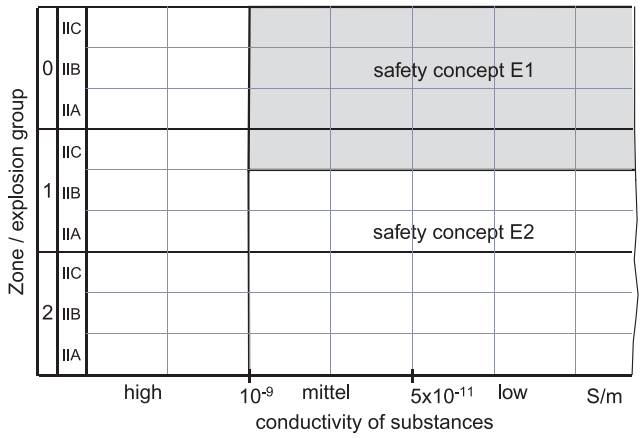


Fig. 1: Ranges of Measures against Electrostatic Charging

Metal flanges, if available, are earthed in accordance with BGR 3.2.13. The earthing of metal flanges, which depends on nominal widths and zones, is shown in Fig. 2 in line with capacity. Metal flanges must be earthed in the grey area. This nominal bore-dependent presentation form makes the decision easier.

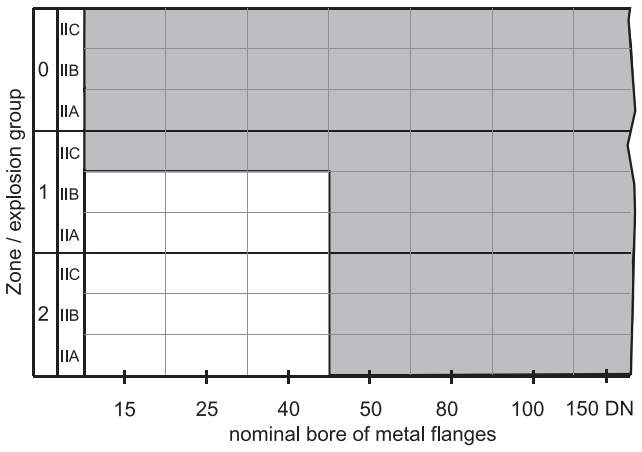


Fig. 2: Earthing of Metal Flanges

Yet another condition is the limitation of the non-conductive surfaces within the plant (PTFE parts). The maximum projection surfaces of the non-conductive surfaces are determined in accordance with BGR 3.1.2.1 (Fig. 3). In this way, with WPR components, it can be determined from when dissipative material has to be used for the various components.

In Safety Package E1, the coated glass surface means direct inclusion of the gaskets into the dissipative group; the separate earthing of these components is not necessary.

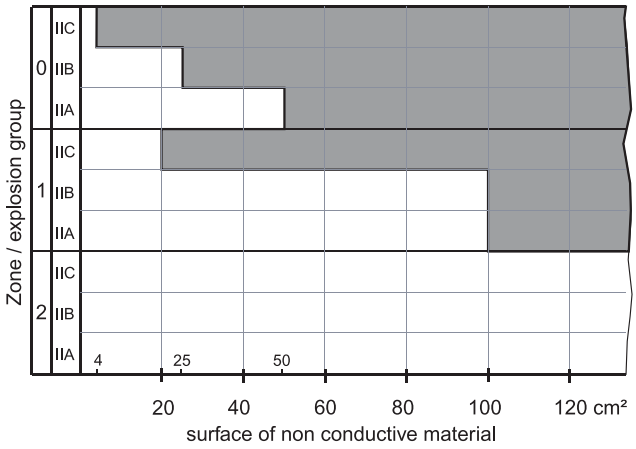


Fig. 3: Limiting of Surfaces with Electrostatic Charging

3.1.2. QVF SAFETY PACKAGE E2

These local measures are necessary because of the operating conditions that prevail within the plant.

In QVF Safety Package E2, glass surfaces are not given a dissipative coating so that dissipative double-collar gaskets are not required to connect the glass surfaces. Only in exceptional circumstances dissipative O-ring gaskets are used to limit the non-conductive surface which must be earthed in this case, however. Evaluation is made in line with the above criteria.

As in QVF Safety Package E1, metal clamp rings must be earthed from a specified size. As plastic clamp rings are used in WPR 2002 up to a nominal width of DN 300, however, not much earthing is required.

3.1.3. NEW DEVELOPMENTS FOR GLASS PLANT CONSTRUCTION IN THE EX AREA

In glass plants, components often have a PTFE/metal combination which may have to comply with both requirements: the limitation of the non-conductive surface and the earthing of the exterior metal parts. We have combined the requirements in the diagrams for these components. Based on the following illustrations, you can easily decide in which zone and with which group of substances you have to earth the metal parts of the components, and when the PTFE part has to be made of dissipative material.

3.1.3.1. FLEXIBLE GASKETS

Flexible gaskets are used to enable angling of up to 3° on sloping piping without having to give up the advantages of a fire-polished, flat sealing surface. They consist of three conical stainless steel rings that slide into one another inside a PTFE casing.

With the dissipative version, reference KSG...D, the PTFE casing is dissipative and an earth bracket is fitted around the metal parts. These earthing collars can also be procured separately to earth the metal parts of the "white" flexible gaskets in accordance with Fig. 4.

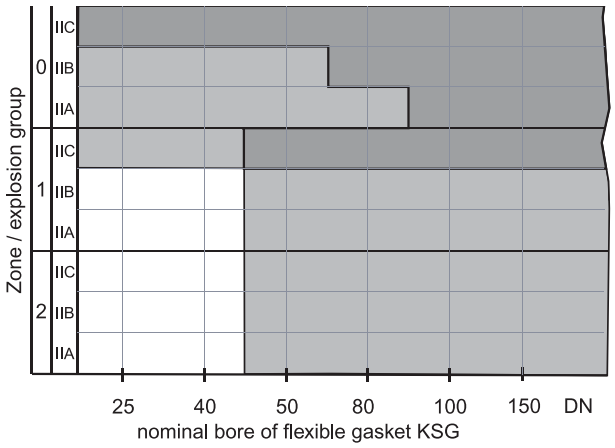


Fig. 4: Selection Diagram for KSG Flexible Gaskets

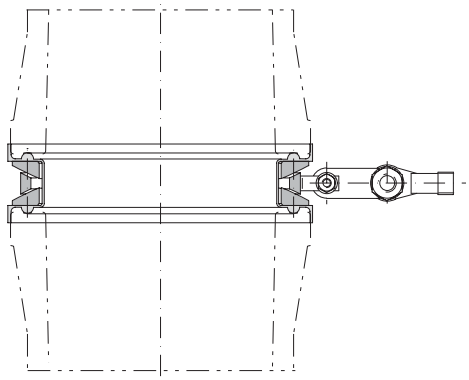


Fig. 4a: KSG Flexible Gaskets

3.1.3.2. BELLOWS

Bellows are required in the design of glass plants to compensate longitudinal expansion between two fixed points. The available versions are suitable for connecting two glass ends as well as other materials, such as plastic flanges, which have a different sealing diameter. In these cases, "connection bellows" are used.

The bellows developed for safety concepts E1 and E2 are dissipative. These bellows with the addendum ...D are only delivered with stainless steel flanges, as these are corrosion-proof without any coating so that all of the individual parts of the bellows are connected dissipatively. In this way, the entire structural component, including the bellows, can be earthed with little effort using only one earthing strap. This earthing strap is fastened with the stop screw which remains tight even when the glass connection is loosened.

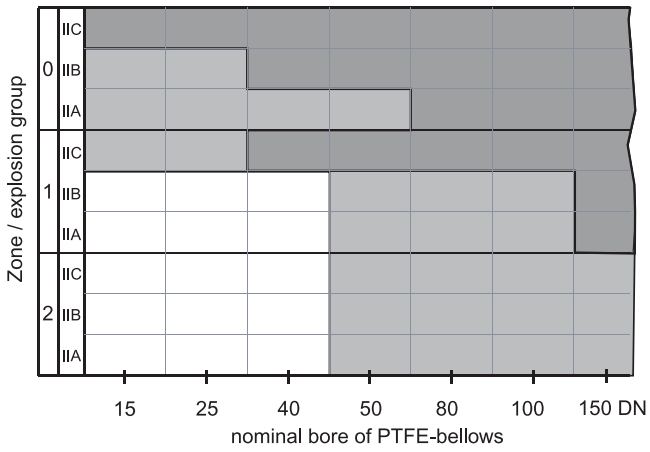


Fig. 5: Selection Diagram for Bellows FB, VB

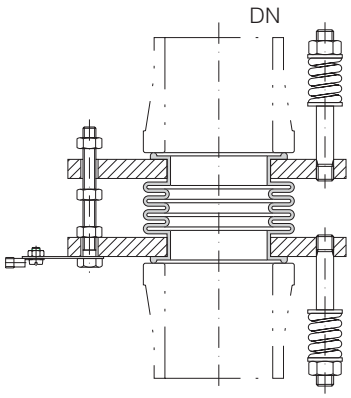


Fig.5a: Bellows FBSS

3.1.3.3. INTERFACE SPACERS

For glass-lined equipment large radii are used at the flange ends for technical reasons. To connect glass piping with sealing lines close to the nominal diameter, interface spacers (EMP) are required in some cases. The "white" version also has an earth bracket so that the metal flanges can be earthed in Safety Concept E2. With the addendum ...D, the PTFE is dissipative too and an earth strap is attached.

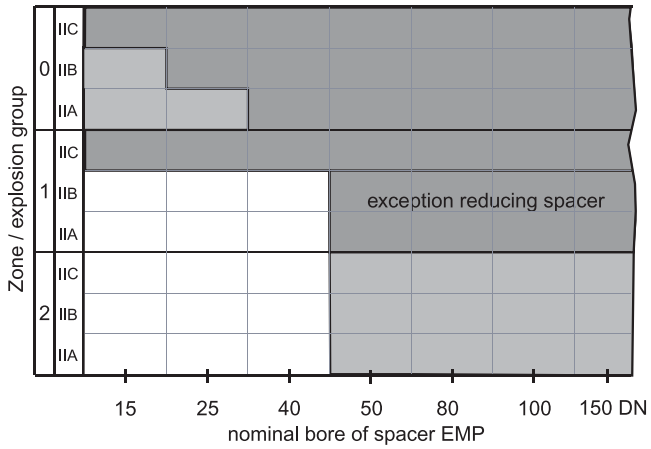


Fig. 6: Selection Diagram for Interface Spacers EMP

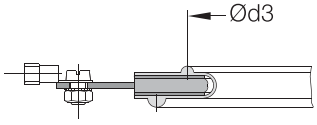


Fig. 6a: Interface Spacer EMP/PTFE

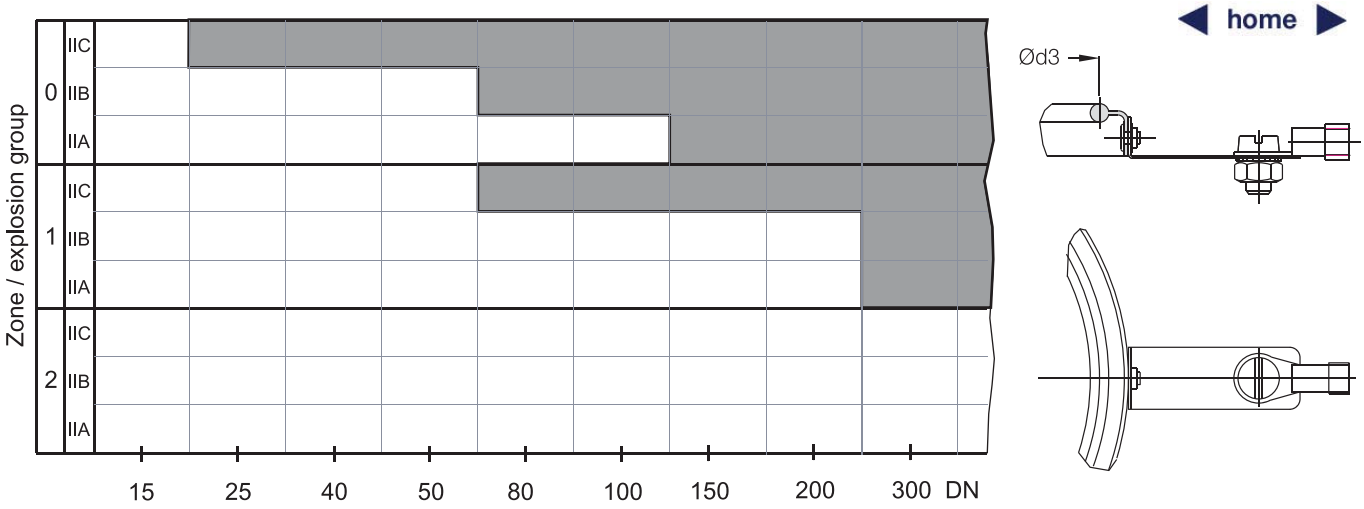


Fig. 7: Selection Diagram for O-ring Gaskets

3.1.3.4. GASKETS

For Safety Concept E1, dissipative double-collar gaskets are used which connect the two permanently dissipatively coated glass surfaces with each other. In Safety Concept E2, the gasket does not have the function of connecting dissipative surfaces; it only has to be made of dissipative material and have an earth connection to limit the non-conductive materials in the system in certain sizes. Fig. 7 shows the nominal diameters with which this is necessary.

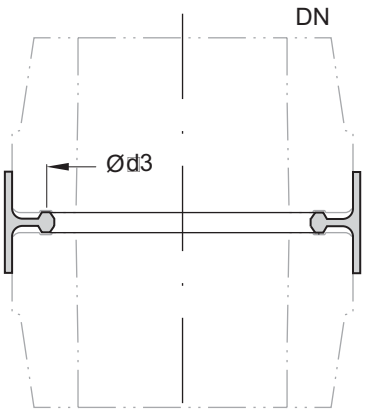


Fig. 7a: Dissipative Double Collar Gaskets

3.1.3.5. BELLOWS VALVES

Although the bellows valves in the QVF World Product Range do not have metal flanges, the PTFE bellows could charge up within the range of Safety Package E2 with fast flows, with the result that these are made of dissipative PTFE in the dissipative version. The charge that collects at the bellows is dissipated via a pressure pin on the spindle.

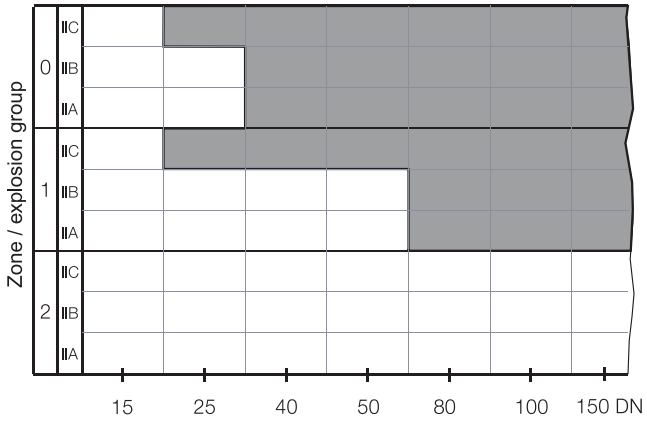
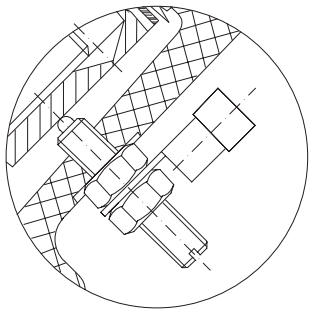


Fig. 8: Selection Diagram for Bellows Valves



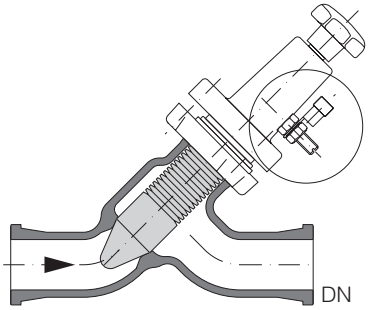


Fig 8a: Bellows Valve with Dissipative Bellows and Earthing via the Spindle

3.1.4 EXAMPLE FOR E1

If you want to apply Safety Concept E1 because you have defined Zone 0 and the substance is in Explosion Group IIA with low conductivity, then the dissipatively coated glass parts are connected dissipatively with double-collar gaskets. The KSG (flexible gasket), bellows and interface spacer EMP are made of dissipative material (e.g. KSG 40 D) and the bellows flange, KSG and EMP are earthed.

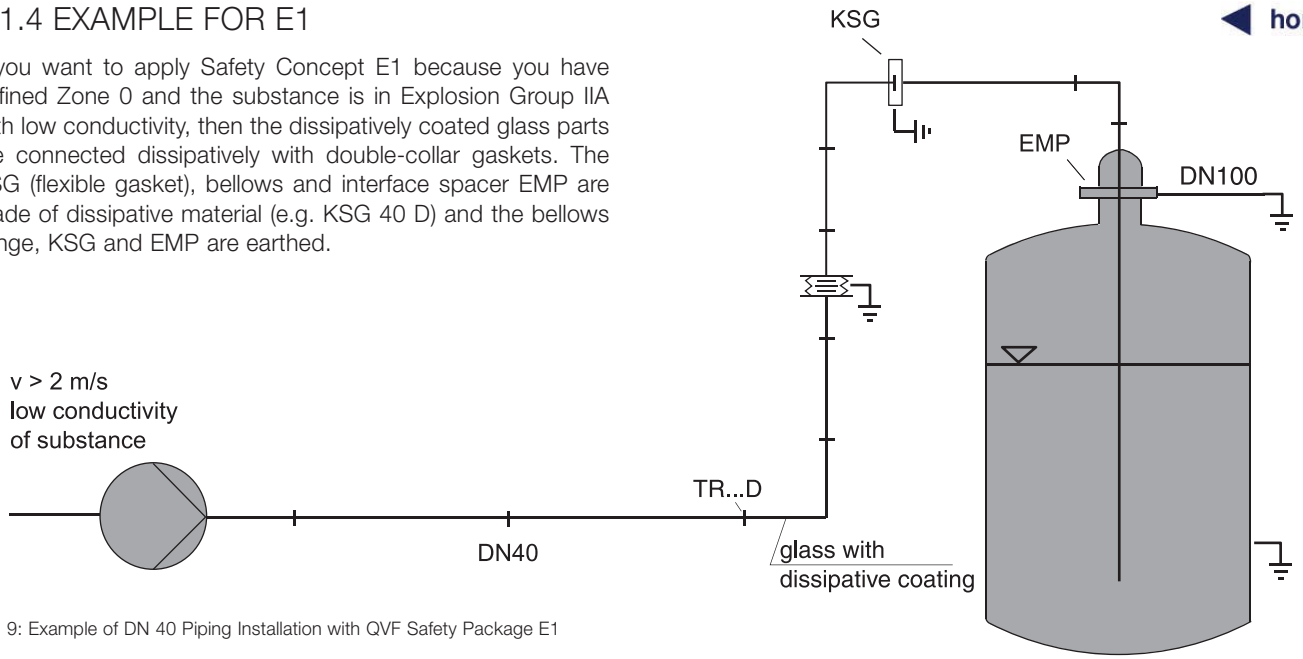


Fig. 9: Example of DN 40 Piping Installation with QVF Safety Package E1

3.1.5 EXAMPLE FOR E2

When installing the same system in Zone 1 IIA, no measures against electrostatic charging would be required in principle if the low-conductivity liquid were not pumped through the piping at high speed. QVF Safety Package E2 can be applied here. The glass surface is uncoated and the flexible gasket and bellows are not dissipative, but the metal flange is earthed and the EMP DN 100 is dissipative and earthed. This example makes it clear how much less effort is involved when the zone can be determined as 1 instead of 0 for the same substance by reducing the probability of the occurrence of an explosive atmosphere from "constant" (Zone 0) to "occasional" (Zone1) by taking the appropriate measures.

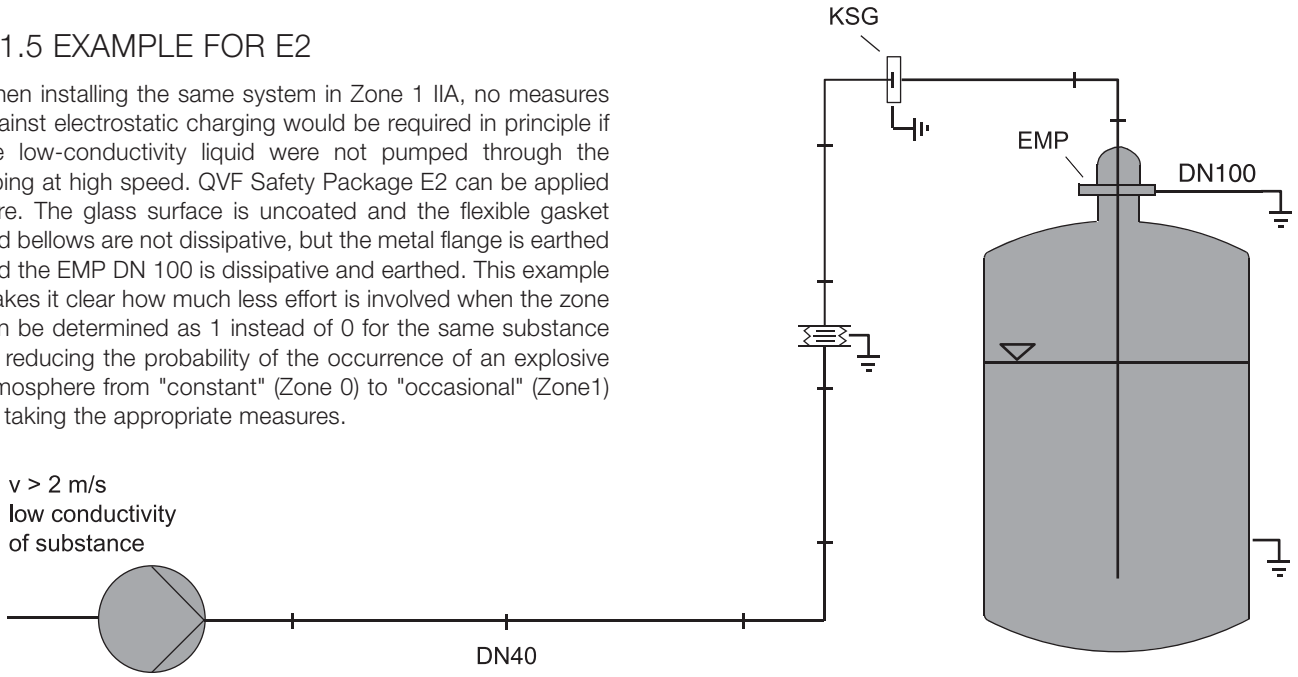


Fig. 10: Example of DN 40 Piping Installation with QVF Safety Package E2

3.2. CERTIFICATION OF SYSTEMS

The aids described above to help you select the suitable components are of course not necessarily known when a customer puts a new system into operation. All QVF drawings which show systems for the Ex area contain the conformity evaluation table illustrated in Fig. 11 which lists the necessary ATEX measures. The prerequisite for this is that the customer defines the Ex zone and lists the explosion group of the utilized substance.

In this way, the customer does not have to get involved with the two different safety packages for new systems. Only in the event of separate installation and the retrofitting of existing systems more extensive involvement with electrostatic charging and how to prevent it is necessary, and we would be pleased to provide assistance in this case.

Evaluation of Conformity with ATEX / BGR 132	
Ex zone interior	1
Ex zone exterior	1
Explosion Group	II B
Sectrans coating	dissipative
PTFE parts	dissipative ≥ 100 cm^2
Metal flanges	with earth bracket ≥ DN 50
Earthing	by the customer
Stirrer drive	Category 1

Fig. 11: Example of a Conformity Evaluation Table for a Glass System

4. MECHANICAL IGNITION SOURCES

The heat produced by friction in a chemical engineering component does not depend on the properties of the substance processed in the system but rather on the properties of the device itself, which the manufacturers must therefore evaluate and define. They determine what safety equipment must be available and establish the category and temperature class of their devices.

The defined categories describe the safety level of the devices and are allocated into explosion zones in accordance with Table 4 in such a way that, for example, at least a Category 2 device has to be used for Zone 1.

Zone 0	Zone 1	Zone 2
constant, long term	occasional	seldom, short term
Category 1	**Category 2**	**Category 3**
Very high safety level	High safety level	Normal safety level

Tab. 4: Categorization of the Safety Level

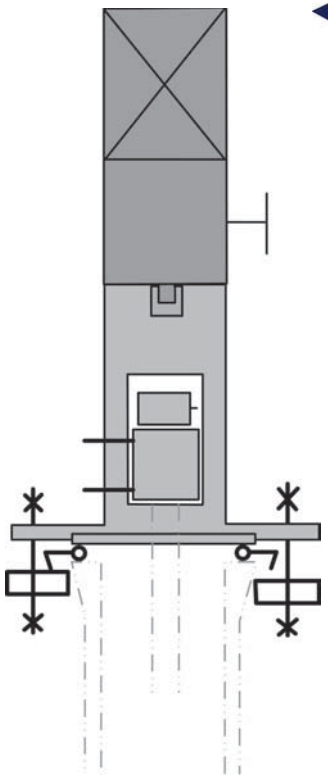


Fig. 13: Modular Construction

In the case of Category 1, the conformity certification can only be issued by the notified body which tests the device. For Category 2 (Zone 1), the manufacturers can issue the conformity certification by themselves after conducting the necessary risk analysis and filing the results of this with a "notified body" along with the technical documentation. This procedure is accepted if the manufacturer has a certified quality management system. Category 2 is the safety level of the QVF safety packages.

One component commonly used in the construction of glass plants which can generate frictional heat is the stirrer drive in a reaction unit or other stirred apparatus, such as mixer settlers and thin-film evaporators.

While frictional heat in the motor and transmission does not normally constitute a potential ignition source, a fact that is attested by motor/transmission manufacturers with their ATEX conformity certification, considerable frictional heat can occur around the mechanical seal which is dissipated by the coolant in the case of the double acting mechanical seal.

Fig. 12 shows the basic structure of our stirrer drives authorized for Zone 1 (Category 2). As long as the cooling circuit is assured, it is up to the customer which type of thermosiphon unit is used. The stirrer drive unit for the Ex area itself is designed in accordance with the requirements of the risk analysis. Two structural components have been combined here, the drive unit and the stirrer bearing. As a separate risk analysis has been filed with the notified body for each structural component, the design can be altered by combining existing conformity certificates.

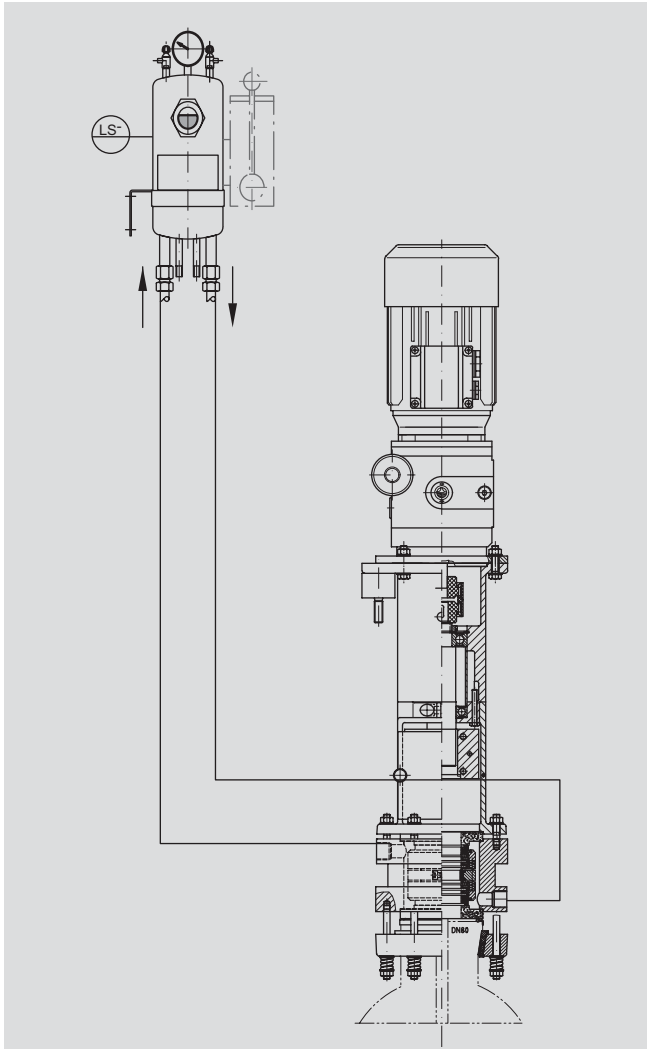


Fig. 12: Stirrer Drive with Stirrer

QVF

home

THE MATERIAL ADVANTAGE

QVF ENGINEERING GMBH

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D-55023 Mainz
Hattenbergstraße 36
D-55122 Mainz

Tel.: (+49) 0 61 31/ 97 04-0
Fax: (+49) 0 61 31/ 97 04-500
E-mail: mail@qvf.de
Internet: www.qvf.com

05.04. P147e.0. subject to change

home

a solution *ahead*

De Dietrich
PROCESS SYSTEMS

De Dietrich

Since its creation in 1684, the French-based company De Dietrich has evolved to become a world leader in the manufacture of glass-lined equipment and accessories for the pharmaceutical and chemical industry.

ROSENMUND

Founded in 1810, in Switzerland, Rosenmund is the recognized world leader in the design, development, construction, installation and support of filtration, mixing and drying equipment for the pharmaceutical and chemical industry.

QVF

QVF is a world force in process plant technology and is the leading supplier of borosilicate process plant and associated equipment to the chemical, pharmaceutical, fine chemicals, specialty chemicals and associated industries.

De Dietrich Process Systems

The new millennium marked the birth of a new global company, De Dietrich Process Systems **(DDPS)**, composed of the organizations formerly known as De Dietrich Glass-Lining, Rosenmund Guedu and QVF Engineering.

Through the integration and synergies of these companies, De Dietrich Process Systems brings to the market the most comprehensive global supply of engineered systems, equipment and services for the fine chemical, pharmaceutical and allied industries.

The purpose of this brochure is not only to show you who we are and what kind of solution we can propose to answer your process needs, but also provide an insight into the breadth of our entire range of capabilities.

I am pleased to welcome you in the world of De Dietrich Process Systems.

Daniel Steck
CEO

De Dietrich
PROCESS SYSTEMS


MK 1
MZ 091 Pos. 12.004

De Dietrich Process Systems

DDPS is **a solution ahead** provider

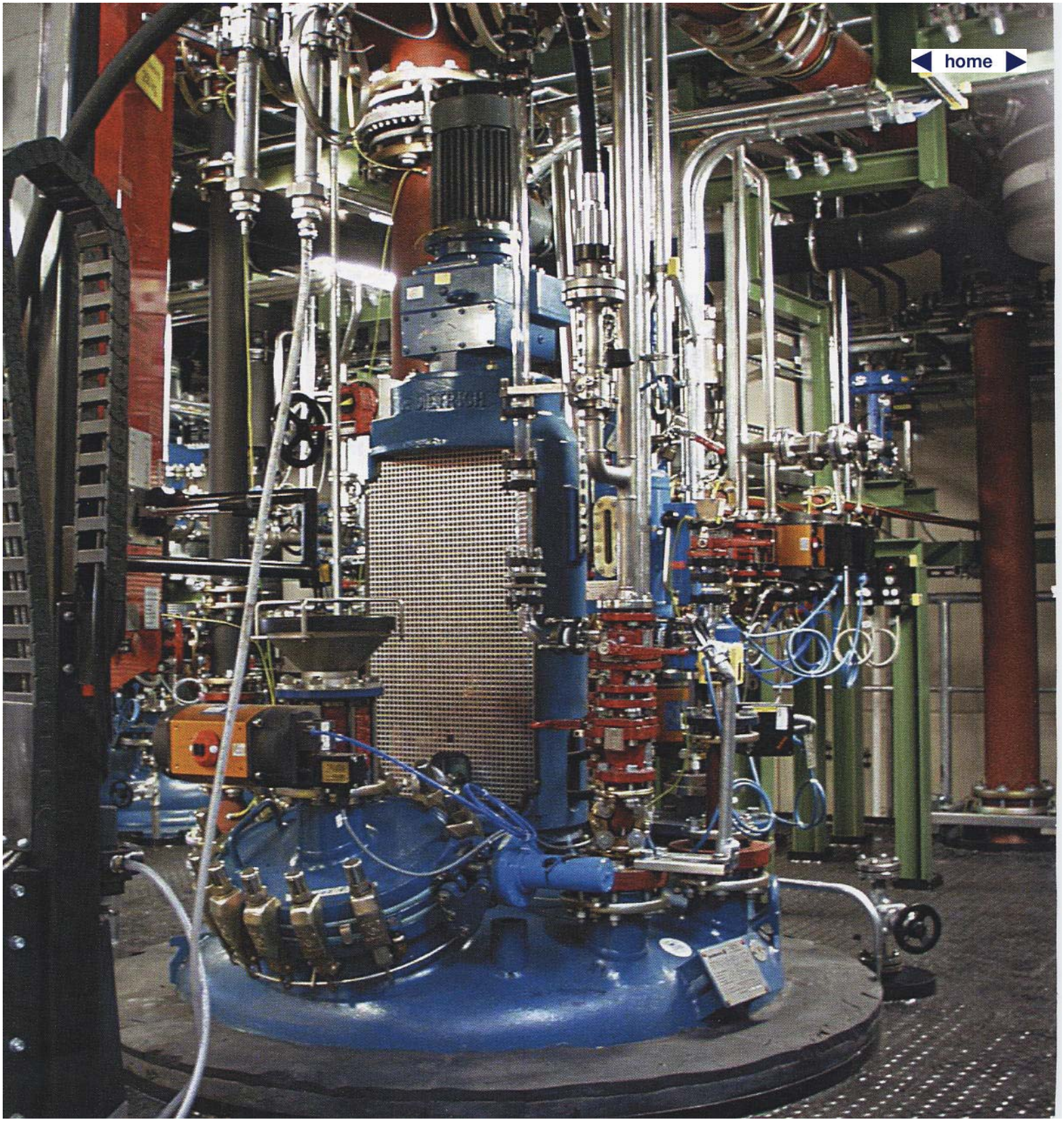
Strongly based on our core activities,

- our specialized and experienced process engineering teams are capable of developing conceptual studies and solutions to meet your requirements
- feasibility studies and/or performance guarantees can be provided through our broad range of available technologies, process simulations and tests facilities
- we are a leading specialist for highly-corrosive media and high-pure materials
- our technical expertise on the design and manufacture of key process equipment provides the optimum solution for specialty processes
- our world wide service, maintenance and support teams ensure your operations run efficiently

Our goal is to be your one stop shop for your complete processing needs

◀ *Fine chemicals production unit*

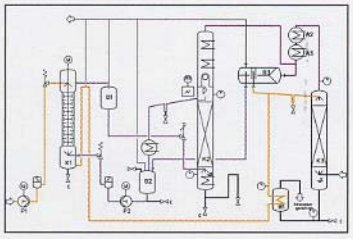
De Dietrich PROCESS SYSTEMS

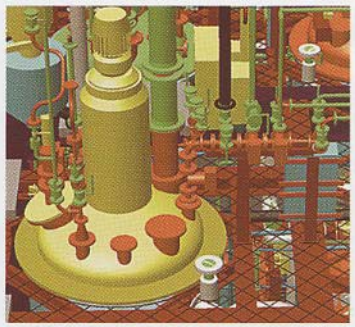

home

Systems

engineered systems

The wide scope of equipment available from DDPS is also supported by an equally impressive scope of engineering expertise, enabling a reduction in the overall cost of capital equipment projects.





▲ *3D implementation of the reactor shown on the left page*

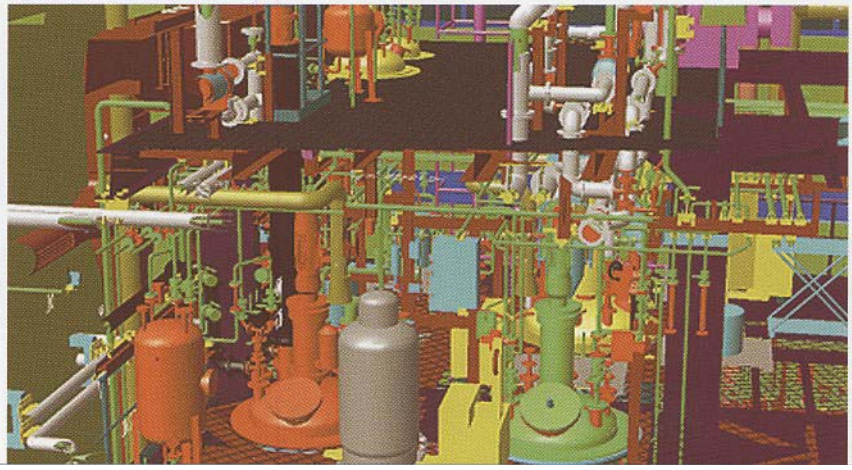
◀ **De Dietrich** *glass-lined reactor*

Our specialized and experienced engineering teams have the capability to design systems of equipment to meet specific application requirements based around one or more of our core technologies. In addition, we can include externally-sourced equipment that we design, specify and purchase on your behalf. This ensures that all the equipment is seamlessly integrated to achieve project milestones and processing goals.

A system provides many benefits over separately purchased components, including:

- combination of the various competences inside DDPS leading to unique solutions and specific designs to fulfill specific processes
- multi-purpose design with full consideration of cGMP constraints
- skid-design to allow off-site, pre-shipment testing and reduced installation time

Furthermore, by combining our unique and thorough knowledge of our own equipment with a variety of engineering expertise, we can tackle projects of any size, from small reaction systems to complete industrial plant.



▶ *3D design of the whole unit*


home

Systems

process systems

Using its customer focused engineering capabilities, DDPS has also developed its own process technologies and is offering performance guarantees on Process Systems.

◀ **QVF** *Hydrocloric acid recovery from waste gas under pressure*

DDPS is aware that a solution for a specific problem can generally not be regarded as an isolated system, but needs to be integrated into the entire process. Hence Process Systems by DDPS are designed not only based on its extended knowledge of its components but also taking the specific demands of its customers into consideration.

DDPS uses modern simulation tools, trials in its test facilities and of course its long term experience to design Process Systems meeting its customer's requirements. Furthermore DDPS has developed its own process technologies such as but not limited to :

- Product Recovery and Product Purification
- Waste Water Treatment
- Exhaust Gas/ Exhaust Air Purification
- Recovery, Concentration and Purification of Mineral Acids
- Reaction with Halogens

The service DDPS offers with Process Systems can cover the complete project comprising of conceptual design studies, feasibility studies, trials, basic and detailed engineering, HAZOP-studies, validation, procurement, plant erection and commissioning.

▶ *Solvent recovery unit engineered by* **QVF**


home

Process equipment

reaction

Many new compounds are developed every year as processes continue to be stretched beyond previous limitations. These syntheses, which are fundamental to your core activities, require many types of reactors which can be closely monitored and controlled.

DDPS offers a broad range of reactors and accessories manufactured from borosilicate glass, glass-lined carbon steel and stainless steel, as well as other material of construction.
DDPS can provide reactors to meet a wide variety of process chemistries, volume requirements (from laboratory scale and pilot plant sizes up to very large production units), incorporating local design and international code requirements.

All DDPS reactors have excellent resistance to corrosion, smooth non-stick properties and non-catalytic inertness. They can be designed for a high range of versatility in multi-product applications, or specialized to optimize a specific processing requirement. Many standard sizes and designs are kept in stock for quick delivery.

▲ **QVF** *Borosilicate 3.3 vessels and stirrers*

▶ **De Dietrich** *glass-lined reactor, 60 m³ 30 barg*

◀ *Standardized reaction unit:* **De Dietrich** *glass-lined 100 l reactor,* **QVF** *engineering and glass components*


home

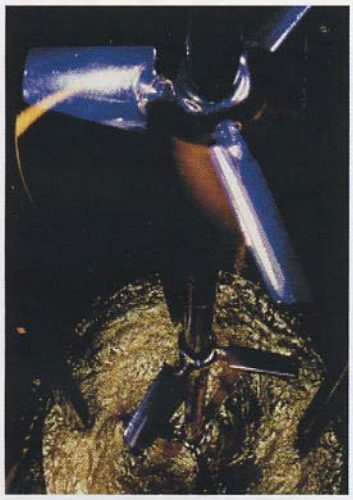
Process equipment

mixing

◀ **De Dietrich**
OptiMix® reactor series with integrated baffles

▼ **De Dietrich**
GlasLock® agitator

Mixing has become an increasingly important operation as chemical and pharmaceutical companies endeavour to increase the yield and product quality of their reaction processes.



Through computer simulations, laboratory testing, engineering studies, and many years of experience, DDPS has become a recognized supplier for the design, construction and performance review of agitation systems. Furthermore, in the area of glass-lined equipment, we have combined our process expertise with our state-of-the-art manufacturing to develop two world-wide products unique to DDPS :

- The GlasLock® system, which allows for the adjustment and removal of individual blades as well as many impeller choices for improved process mixing
- The OptiMix® reactor series has 3 wall baffles built into the glass-lined vessel. This provides superior mixing performance and frees up top head nozzles for improved process control

PROCESSES

Crystallization
Suspension
Dispersion
Gas / Liquid
Solid / Liquid
Liquid / Liquid
High / Low shear
High / Low pumping

AGITATORS

Single piece
Anchor
Impeller
Turbine
Frame
Removable blades
GlasLock®

GlasLock® BLADES

Standard
Flat blades
Hydrofoil
Trapezoidal
Special
Breaker bars
ViscoFoil
OptiFlow
Rushton turbine

MATERIALS

Borosilicate 3.3
Glass-lined
PTFE-lined
Stainless steel
Alloys

MECHANICAL SEALS

Lubricated
Single
Double
Dry
Single
Double
Gas (lift off)
Single rotation
Reverse rotation

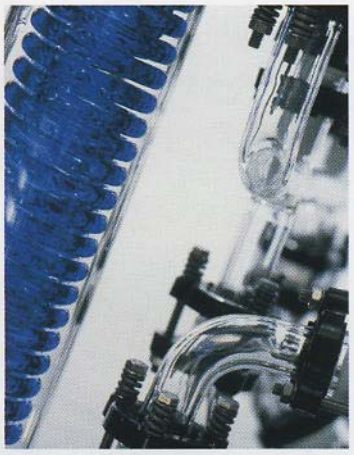
DRIVES : fixed or variable speed ; frequency controllers ; direct drive (belts and pulleys optional) ; all marks of motors


home

Process equipment

heat transfer

Heat transfer is essential to the reaction process, whether it is used to heat up batch reactors, control exothermic reactions, condense vapors and gasses, or to cool down final products.



Combining our process engineering knowledge with highly corrosion-resistant materials allows us to provide many high-performance heat exchangers and condensers for difficult applications. By selecting the appropriate materials for your application chemistry and sizing the heat exchanger using computer simulations for your specific process flows and requirements, we can provide many different heat exchanger designs, including:

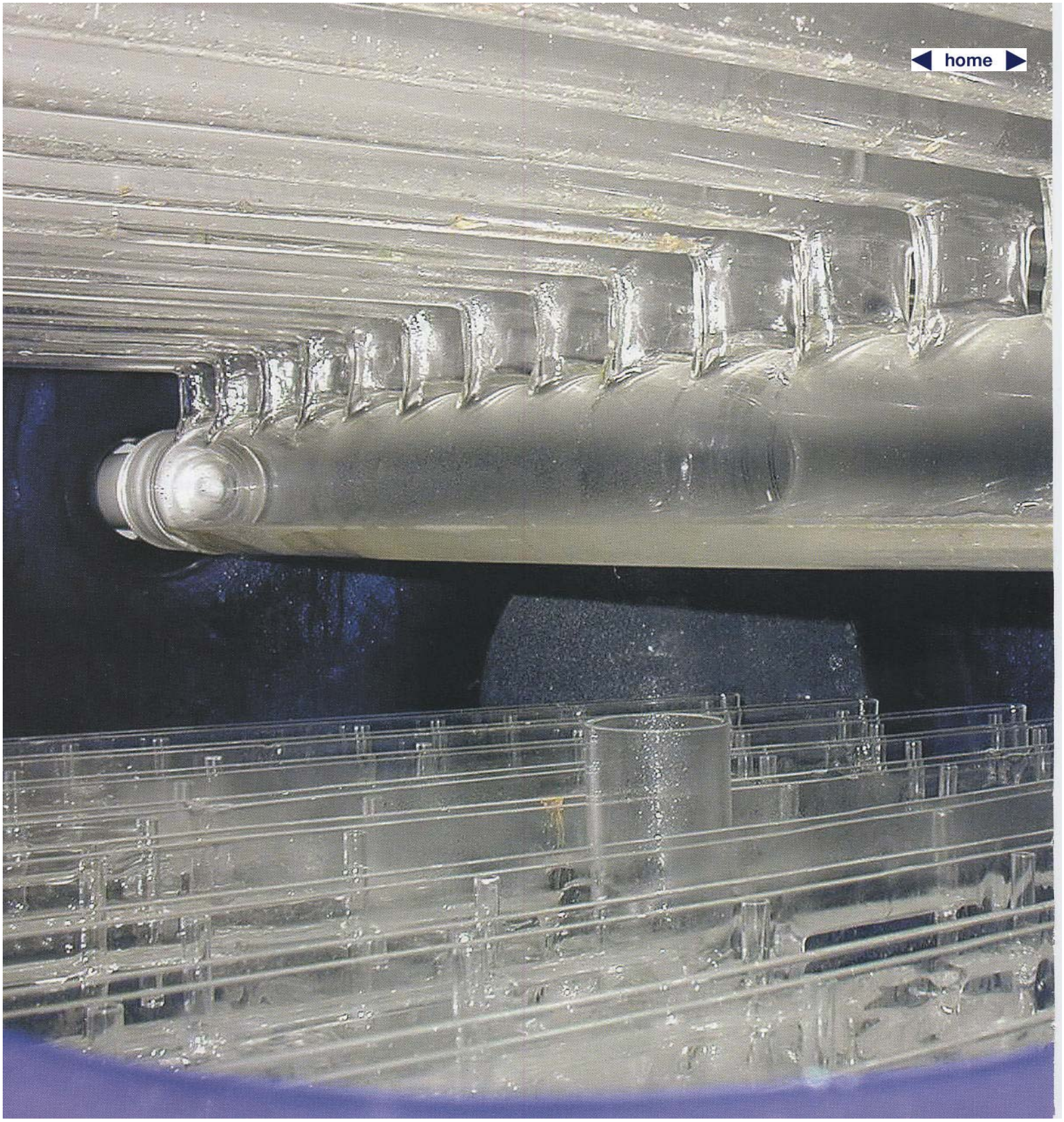
- Shell and tubes, coil condenser, immersion coil, jacketed pipe, dimpled plate designs
- Borosilicate 3.3 glass, Silicon Carbide, Stainless Steel, Alloys, Glass-lined Steel

We also provide skid-mounted heating and cooling systems for reactors, dryers and filter/dryers that utilize either engineered heat transfer fluids or conventional steam/water/brine circuits for temperature control of equipment.

▲ **QVF** *coil-type heat exchanger for hight purity*

◀ **QVF** *GMP distillation head*

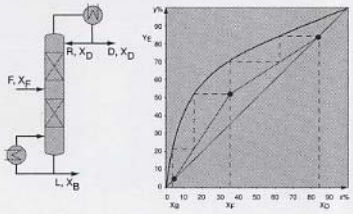
▶ **De Dietrich** *glass-lined dimpled plates in a 25 m³ reactor*


home

Process equipment

thermal separation

Whether it is involved at different steps of an intricate process, or at the end of a chemical synthesis, separation technologies are often used to isolate selected products from the rest of the reaction stream.



The unique combination of materials and equipment designs/sizes available within DDPS allows us to provide a broad range of solutions for thermal separation problems for your process, including:

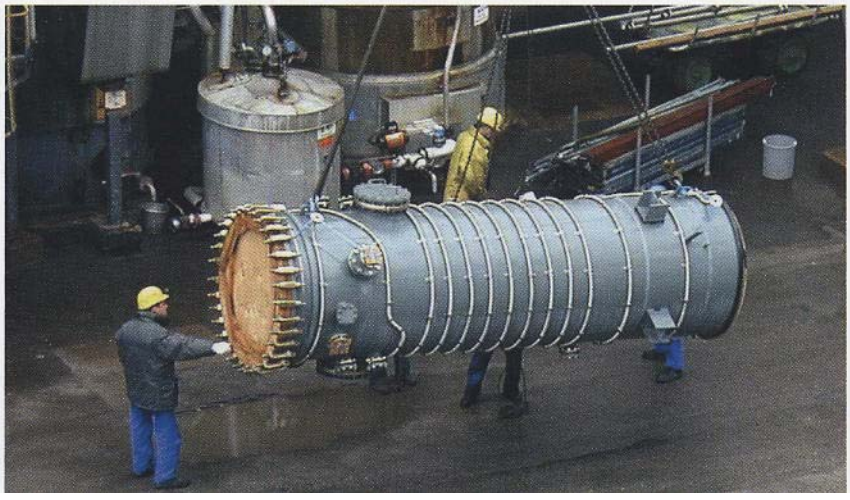
- evaporation systems with a wide range of packing choices, from simple evaporation up to complex azeotropic distillation with phase separators
- specially designed equipment for heat-sensitive products including thin-film, falling-film and climbing-film evaporators, as well as the unique centrifugal-film Evapor®
- liquid-liquid batch or continuous extraction systems, single and multi-stage mixer/settlers

We continue to develop brand new patented equipment, only available from DDPS, that offer great benefits to you. An excellent example of this is the combination of glass-lined columns, CORE-TRAY® plus DURAPACK® to provide unrivalled corrosion resistant separation systems.

▲ **QVF** *pulsed extraction column with DURAPACK®*

◀ **QVF** *glass distributor in a* **De Dietrich** *glass-lined column*

▶ **De Dietrich** *glass-lined column section*

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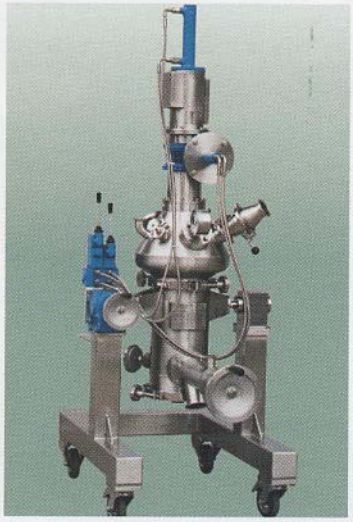
Process equipment

filtration
filtration / drying

In processes where the final product is a solid, it is usually necessary to remove the solid from a slurry. DDPS is world leader in Nutsche filtration for batch processes.



▲ **Rosenmund**
Filter/Dryer, 0.03 m²

◀ **Rosenmund**
Filter/Dryer in clean room version

▶ **Rosenmund**
Filter/Dryer with glove box discharge gate

With sizes ranging from 0.002 to 16 m² in stainless steel, hastelloy® and other materials, DDPS offers the broadest range of filters and filter/dryers in the world. The combination of specialized engineering knowledge of Nutsche filtration with our years of application experience allow us to provide the correct filter for each specific process.

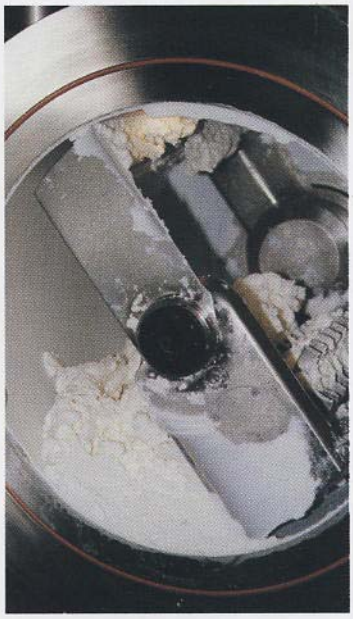
While Nutsche filtration is the heart of the process, DDPS has pioneered many features to increase the efficiency of these machines and improve the quality of the final product. Features like our side discharge valve utilizing metal-metal seals, heated "S-blade" agitators in our filter/dryers, and intricate control systems to automate the operation of the equipment have kept DDPS on the leading edge of this technology. Furthermore, combining accessory equipment packages like solvent recovery, heating and vacuum systems specially designed for the specific application allows us to provide the most cost-effective solutions for difficult solid processing problems.


home

Process equipment

drying

Almost all chemical and pharmaceutical production processes lead into a drying step to achieve the final product. DDPS offers a wide range of high-efficiency vacuum dryers which can improve production capacities by reducing drying times significantly, whilst fulfilling product quality and environmental and safety conditions.

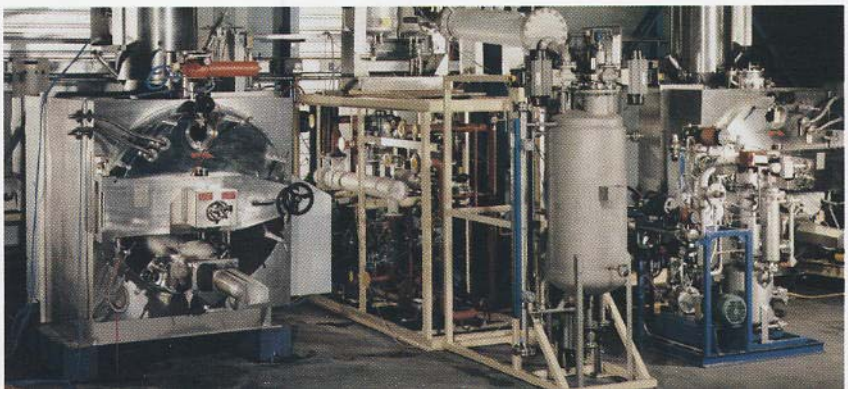


- Double cone blenders are easy and non expensive solutions for products easy to dry.
- Agitated Pan Dryers, top or bottom driven, are designed for batch drying. Final moisture levels as low as 0.1 % can be achieved.
- Spherical dryers are ideal for API products to be processed under cGMP. Easy inspection provided by removable bottom of sphere for Top driven version as well as agitator shaft seal not being covered by product is an essential feature of these dryers combined with almost total discharge.
- Horizontal universal dryers RGUD combine special process steps as evaporation, drying, mixing, milling and granulation. Depending on product properties these steps can be processed as one batch in one machine free from danger of contamination. A unique flexibility is given for drying sticky and/or lumpy products as well as suspensions to a fine and powdery product. Superior drying times result also from this flexibility.

Rental machines and Pilot Plant facilities give you opportunity in testing products and comparing various types of machines. You will therefore benefit from best suited process equipment to achieve higher throughput and better quality for your production.

▲ **Rosenmund** *agitator equiped with high speed dynamic choppers*

◀ **Rosenmund** *Universal Dryer*



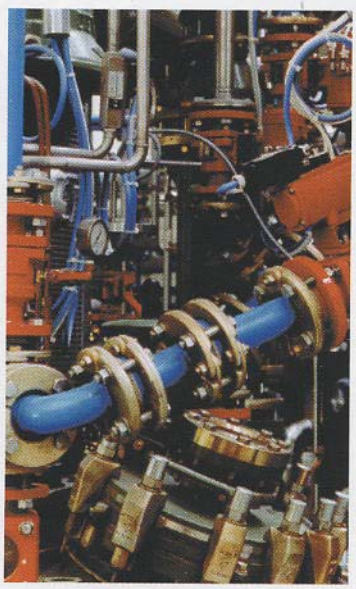
▶ *Processing system of a* **Rosenmund** *Dryer*


home
Ablufteitung

Ancillary equipment

handling containment

Corrosive, abrasive and other hazardous products can pose safety and environmental concerns as well as being very demanding on process equipment. DDPS has a complete range of piping, pumps, vacuum systems, valves and fittings constructed from extremely corrosion-resistant materials to handle transportation and removal of these products.



The wide range of corrosion resistant material expertise within DDPS activities allows us to optimize the selection of handling equipment. This allows us to provide the most cost-effective handling solution to each specific application.

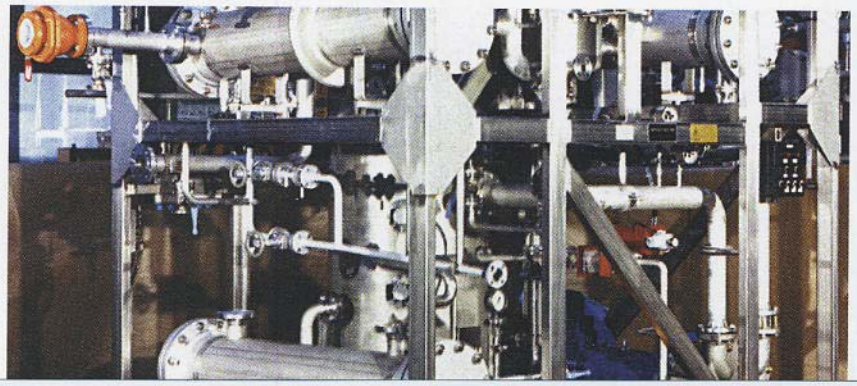
More and more, whether the product is chemically corrosive or pharmaceutically very active, strict containment is required and becomes a major concern. DDPS offers many innovative and efficient products for these applications, including:

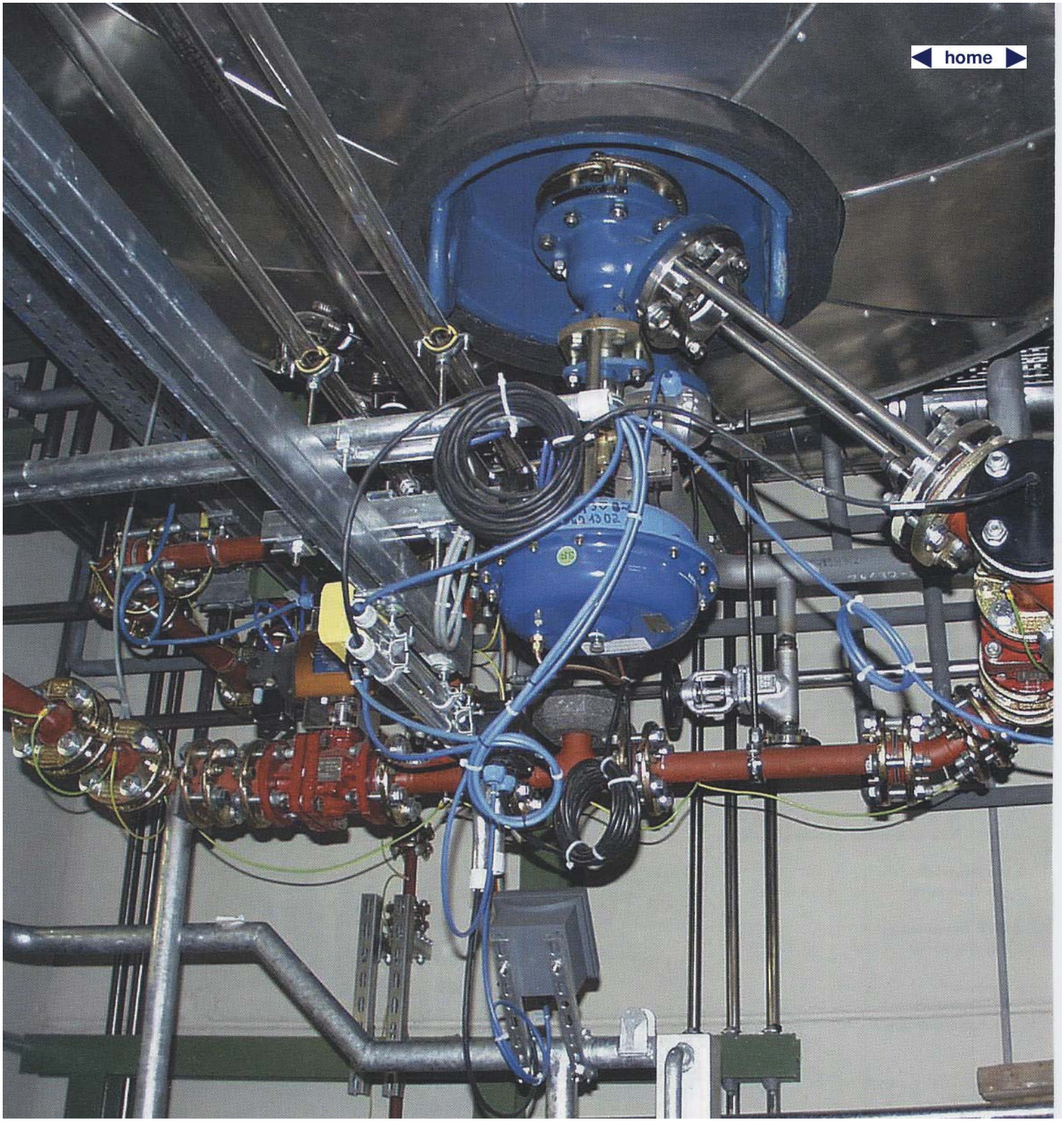
- powder transfer: to and from drums, loading reactors during processing, sampling dryers, mobile or fixed solutions, ideal for pharmaceuticals, fine chemicals, metal powders, dyes, etc.
- continuous and batch liner systems: multiple lot and campaign processing without breaking containment, compact portable and fixed designs, containment levels to below 1microgram/m^3
- sampling: without any exposure to operators and product, for solids (dryers, filter/dryers) and liquids (reactors, filters, piping), use of glove boxes and automated packages for transfer to remote locations.

▲**De Dietrich**
glass-lined piping

◀ **QVF** *Borosilicate 3.3 glass components*

▶ *Compovac®:* **Rosenmund**
gas recirculation system




home

Ancillary equipment

instrumentation controls

To achieve optimal performance of the equipment and systems that we provide requires precise specification and supply of the appropriate instrumentation and control packages.

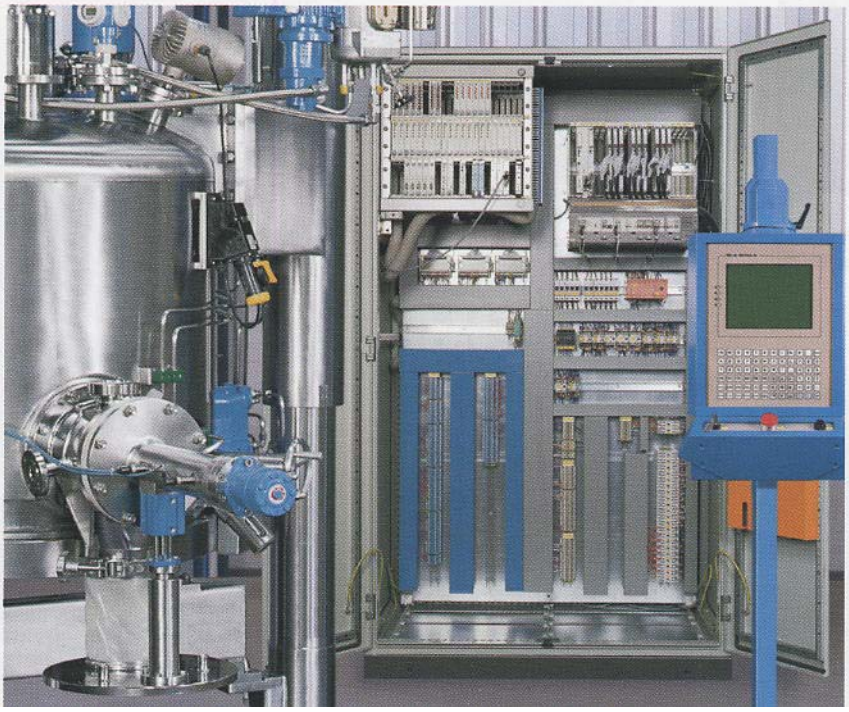
DDPS has developed many in-house technologies for measurement of temperature, pH, level and other operating conditions, especially for extremely corrosive environments. We also can specify and procure the appropriate instrumentation/control components from third party suppliers to meet specific application requirements.

Our Control Engineers can design and provide a wide range of monitoring and control systems, ranging from simple local readouts or man-machine interfaces up to fully integrated systems including graphic user interfaces. Packages can include QA documentation and qualification, Factory and Site Acceptance Tests and other services as required.

▲**De Dietrich** *glove box for sampling*

◀ *Instrumentation under a* **De Dietrich** *glass-lined reactor*

▶ **Rosenmund** *Filter/Dryer Control System*




home

Services

commissioning maintenance training

We strongly believe that the relationship between customer and supplier does not stop with the delivery of the equipment.

DDPS has developed a global network of local Tech Centers to provide maintenance and support through the entire life cycle of our equipments. These centers offer a broad range of services, including:

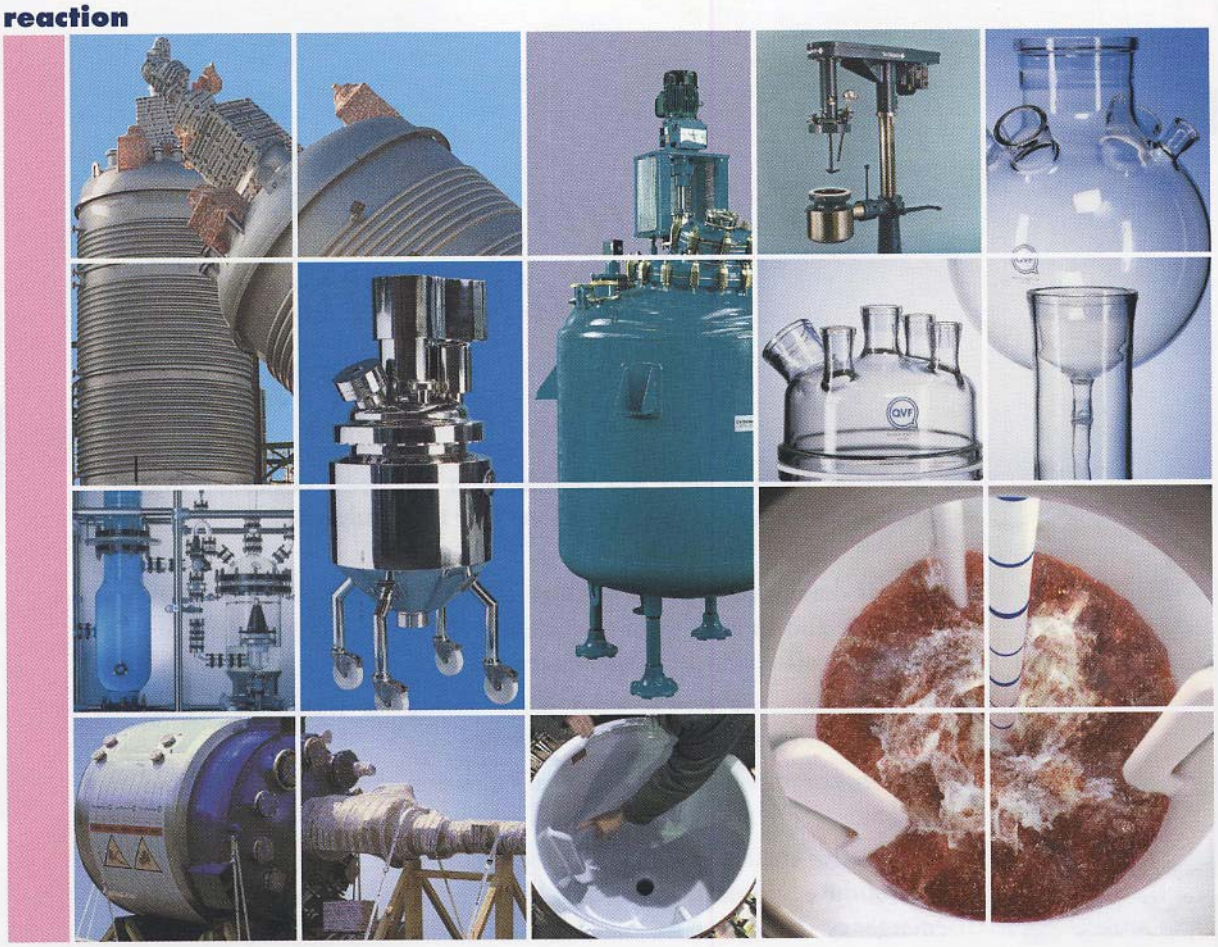
- rental equipment: on-site pilot plant testing for filtration, drying, sampling and powder transfer applications
- erection, commissioning and help to validation of new equipment and systems
- preventative maintenance: scheduled maintenance reduces the down time of the equipment, resulting in higher productivity and fewer costly emergency shut downs
- refurbishing services: older equipment can be restored to nearly new condition
- spare parts policy: in stock for quick delivery
- training seminars: offered for both maintenance and engineers personnel to ensure optimal operation of the equipment. Training sessions can also introduce plant personnel up to the latest developments and innovations.

◀ *Erection by* **DDPS** *fitters of a* **De Dietrich** *glass-lined column...*

▲*... with* **QVF** *DURAPACK® packing*

▲**DDPS** *training sessions for customers*

reaction



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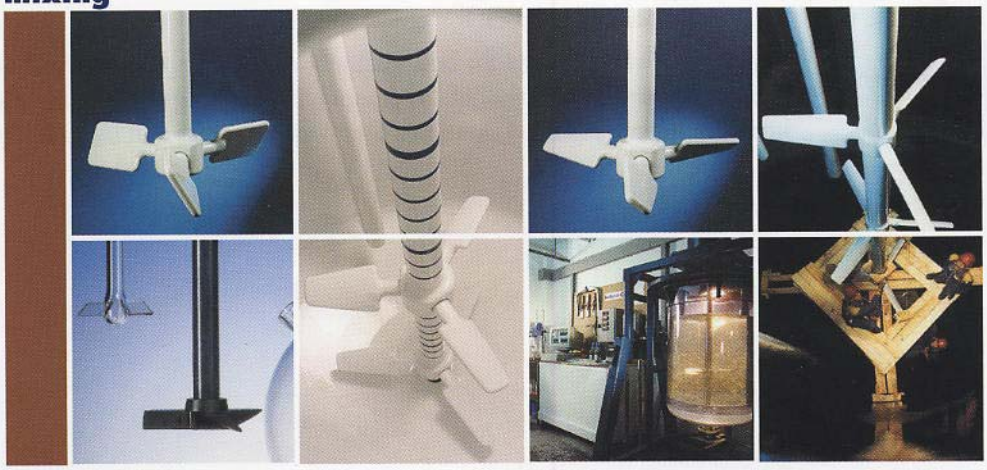
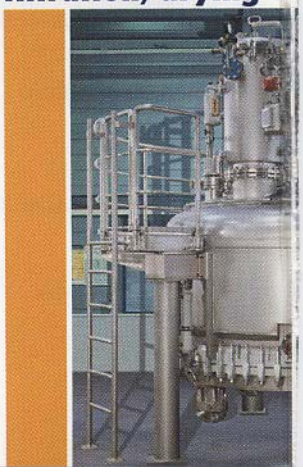
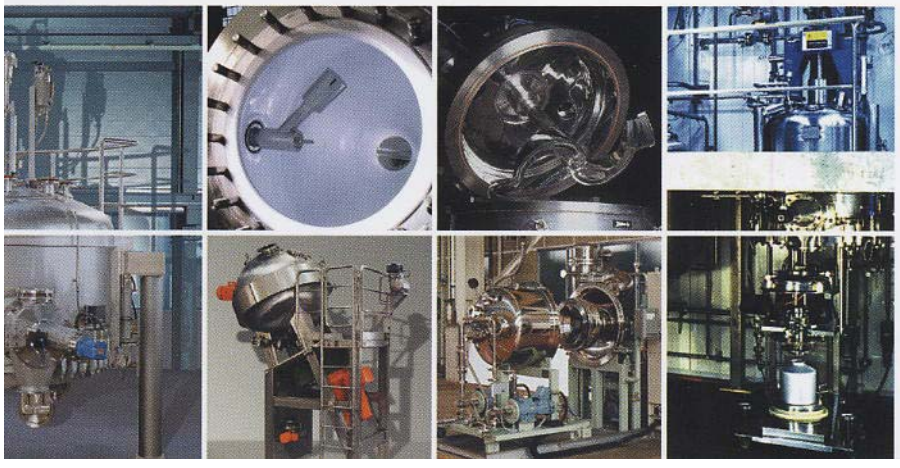
mixing



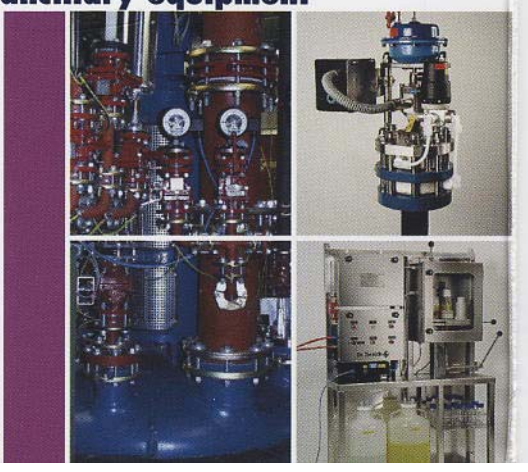
filtration/drying



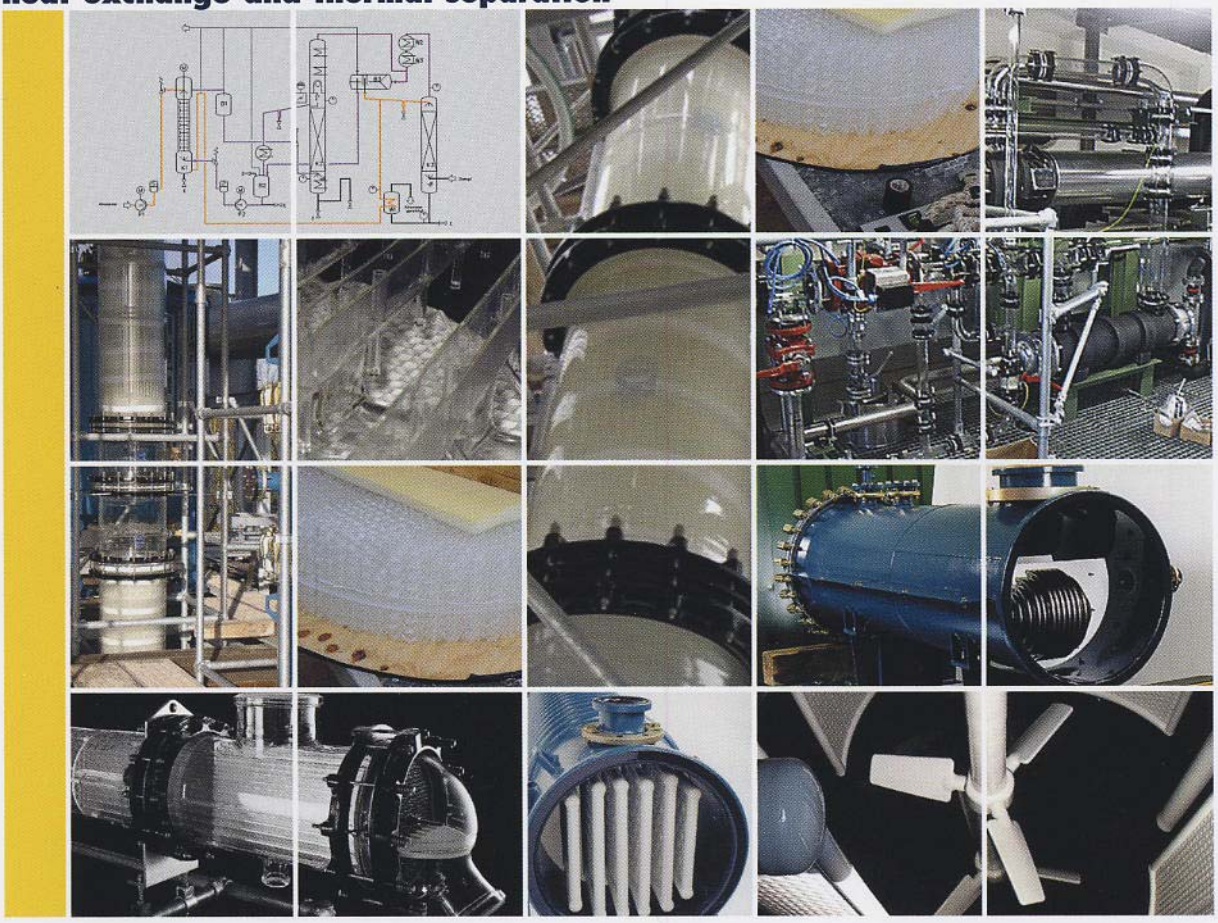
- Vessel
- Column
- Heat Exchanger
- Filter/Dryer
- Extraction
- Instrumentation
- Agitation
- Vacuum
- Pump



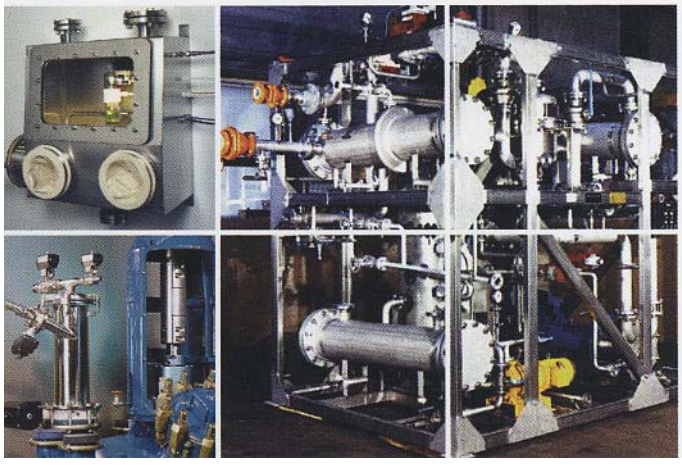
ancillary equipment



heat exchange and thermal separation



DDPS exclusivities



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De Dietrich Process Systems is proud to have expertise on design and manufacturing of a wide range of key process equipment to provide optimised solutions for your high-corrosive processes. Together with our world-wide network of service, maintenance and process support we

A SOLUTION AHEAD

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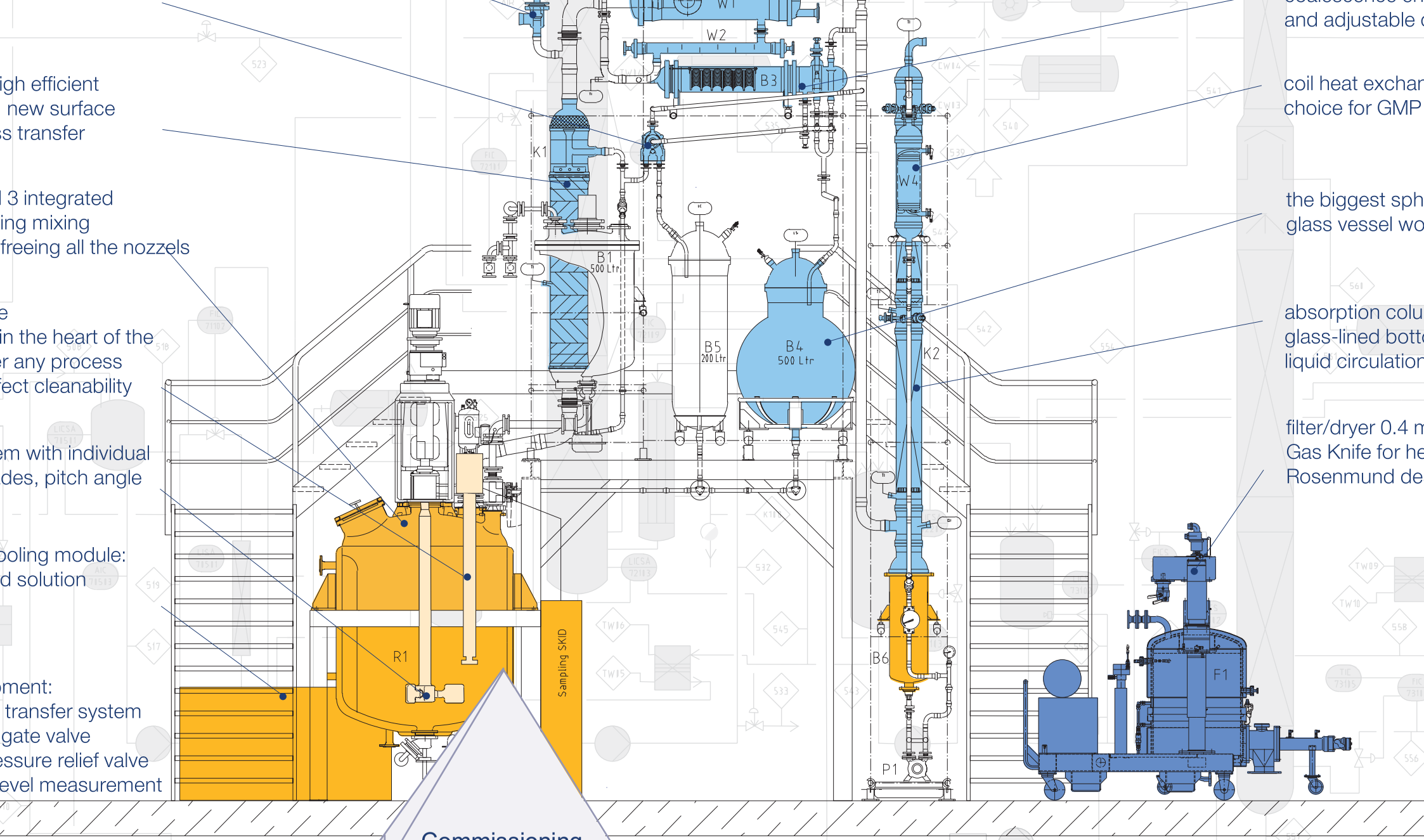
Our mission is to be your preferred provider of solutions, equipment, expertise and services to improve



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Commissioning

Construction

Procurement

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- Specialised and experienced process engineering
developing conceptual studies and solutions to me

DEGREASER RECONDITIONING CASE STUDY

P149e.0

GENERAL

Organic solvent mixtures, which are sold under the name "degreaser" are used to clean and degrease components. Because cleaning is often by hand, today chlorinated hydrocarbon-free mixtures are usually used.

Both solid matter and least and most volatile organic materials are contained in unknown quantities in contaminated products.

The parts-cleaning equipment is often provided including supply of degreaser with a trade-in policy. Cleaning and recovery is today preferred to burning.

- Corrosion resistance
- Turn-key equipment
- Support from official authorisation

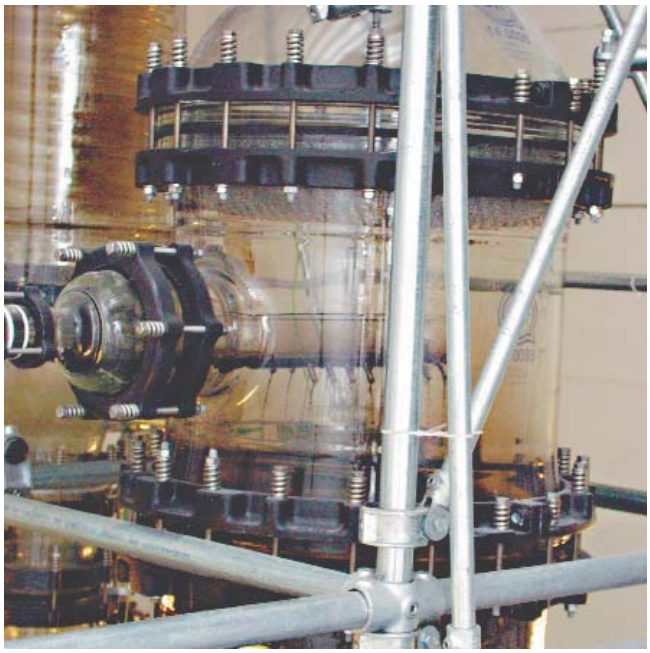

Fig. 1: Liguid distributor for column DN600

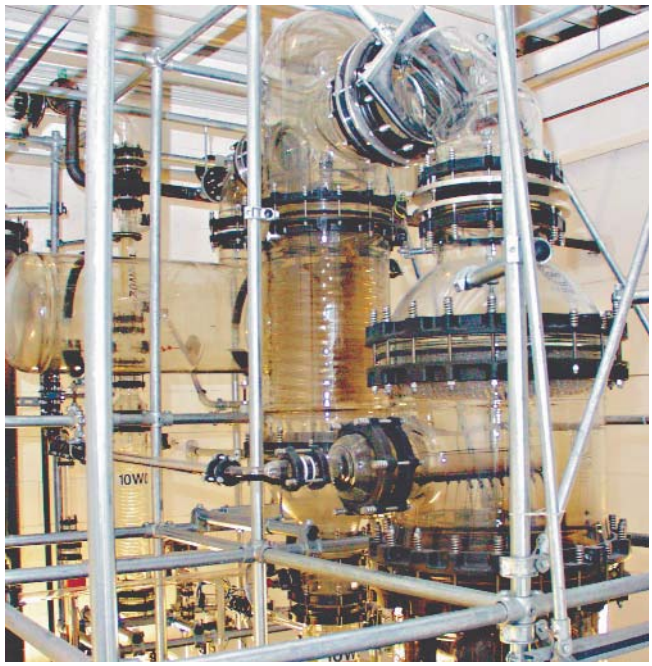

Fig. 2: Pre-cleaning

THE PROCESS

After mechanical cleaning the organic contaminants are separated in a 2-stage distillation with two different vacuums. In the first stage, at about 150 mbar, low boilers are striped, while in the second stage the degreaser is evaporated in a horizontal evaporator at 5 mbar. The product pre-cleaned in this way is finaly cleaned with sulphuric acid of organic contaminants in a 3-stage mixer settler and neutralised in the last stage. The recovered degreaser leaves the equipment transparent.

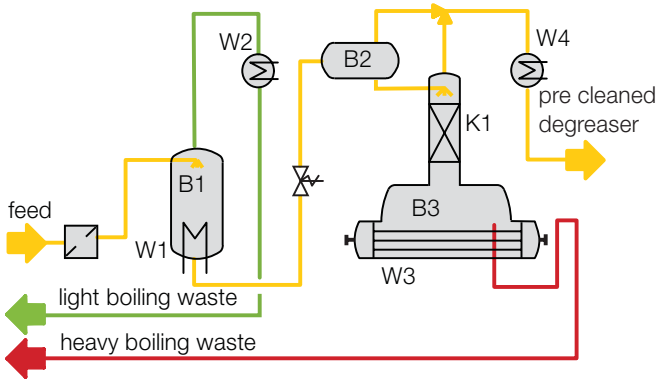

Fig. 3: P&ID for the pre-cleaning

Fig. 4: Stage 2 of the final cleaning

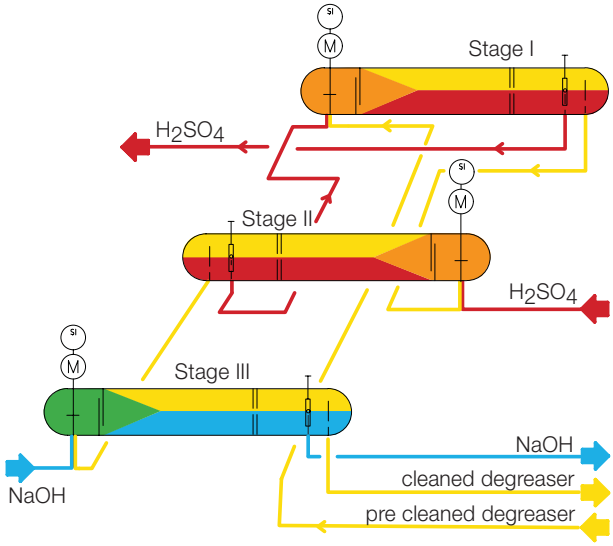

Fig. 6: P&ID of the final cleaning

THE EQUIPMENT

The evaporator stages and the mixer settler are made from borosilicate glass 3.3, the heater in stainless steel and silicon carbide. The steam generator is delivered with water conditioning, a cooling water unit and vacuum equipment in addition to complete pipework and measurement and control.

A requirement for the basic engineering was for experiments to be carried out in our customer test facility where the process engineering design data was recorded.

Fig. 5: Horizontal evaporator

THE HORIZONTAL EVAPORATOR

While usually the horizontal evaporator is used to optimally exploit the available temperature difference between heating steam and upgraded product, in degreaser evaporation the advantage lies in the beneficial pressure relationship in the deep vacuum. The silicon carbide pipes are sealed on both sides of the horizontal evaporator with the proven single-pipe sealing.

SCOPE OF SUPPLY

- Process development/engineering
- Feasability studies
- 2-stage evaporator (DN 600 = scond stage)
- 3-stage mixer settler DN 200
- Heating steam generator
- Cooling water circulation (air cooler)
- Vacuum generator
- Process control system with visualisation
- Guarantee of the process parameter

Fig. 7: Heating steam generator

Fig. 8: Air cooler

05.05. P149e.0. Subject to change.

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RECOVERY OF ACETIC ACID BY MEANS OF LIQUID-LIQUID EXTRACTION

P150e.0

GENERAL

Acetic acid is the most widely used aliphatic carbonic acid. Apart from its use as a reaction partner, e.g. during the production of acetic-acid esters, it is frequently also employed as a solvent, for instance, during the production of cellulose acetate or during the manufacture of pharmaceutical products. Aqueous acetic acid is obtained as a rule during the foregoing processes. In most cases its recovery is of great economic significance.

Separation of the acetic acid and water mixture by simple rectification or adjustment is ruled out in this respect, since this mixture has a very small separating factor. You would then need towers having a large number of stages, which would have to be operated with a high reflux ratio. This would necessarily involve high costs for energy and high operating costs, if rectification with vapour condensation is not used.

- ☞ High content of acid in extraction column
- ☞ Side stream dispatch for cost reduction
- ☞ Drawing off accompanying components

Fig. 1: Acetic-acid recovery unit

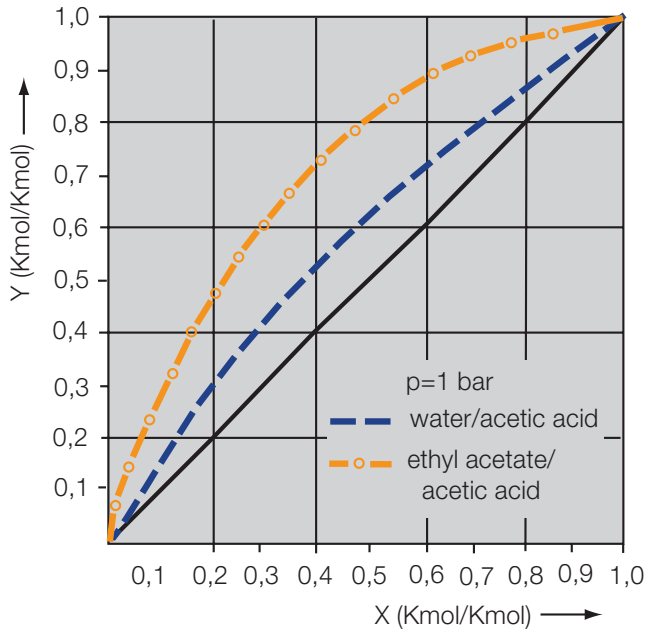

Fig. 2: Liquid/vapour equilibrium

In practice, therefore, azeotropic rectification has asserted itself and operates either with or without the extraction stage, depending on the respective acetic-acid concentration. The addition of an auxiliary substance means that the volatility of the water is increased, which in turn means that separation can be achieved with lower energy consumption. In the case of acetic-acid concentrations of below 40 wt%, the acetic acid is initially extracted from the aqueous solution with a suitable extraction agent, before pure recovery occurs during the rectification of the azeotropic mixture.

The recovery method using extraction must be taken into consideration, irrespective of the concentration, if supplementary impurities in the initial mixture, like salts, would be likely to cause problems during direct recovery by distillation.

This technical-information leaflet deals with the recovery of acetic acid by means of liquid-liquid extraction and downstream azeotropic rectification.

SELECTION OF THE EXTRACTION AGENT

Normally, more low boiling extraction agents are used. Characteristics like solubility in water, absorption capacity,

distribution coefficient, price, availability and composition of the azeotrope, and requirements in terms of environmental and health protection must be taken into account for the purpose of this selection.

Table 1 shows a selection of extraction agents suitable for the recovery of acetic acid, with details on the average distribution coefficient between the organic and aqueous phase, density of the extraction agent at 20°C; enthalpy of vaporisation and boiling point temperature of the extraction agent; and the proportion of water and temperature of the binary azeotrope between extraction agent and water.

The average distribution coefficients do not differ essentially from one another. As a result, all the extraction agents listed here must be regarded as practically equivalent with regard to the extraction. The economic viability of the overall process greatly depends on the energy requirements of the solvent

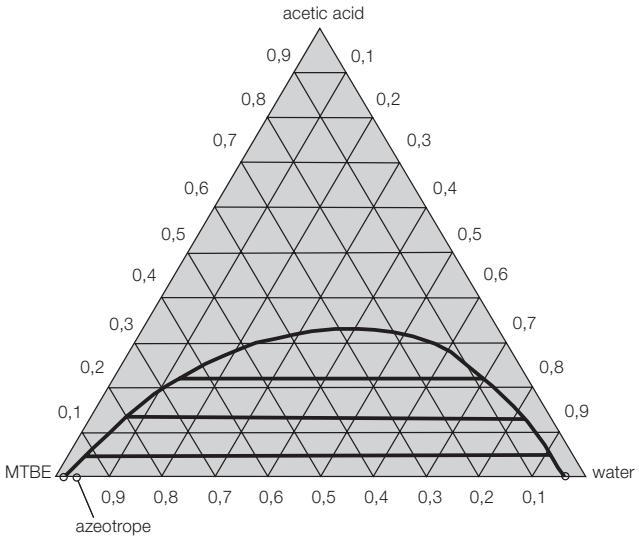

Fig. 3: Equilibrium diagram of the MTBE/acetic-acid/water system (information in wt% at 20°C).

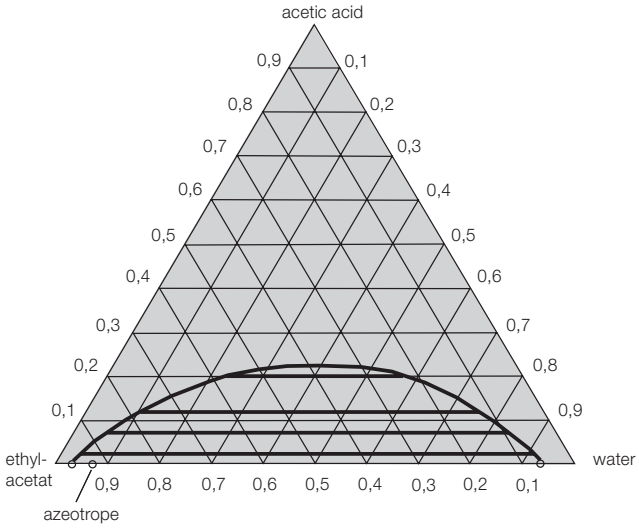

Fig. 4: Equilibrium diagram of the ethyl-acetate/acetic-acid/water system (information in wt% at 20°C).

rectification, which in turn depends on the reflux ratio and thus on the performance of condenser and evaporator. The difference in boiling temperatures between the pure acetic acid (118°C) and the azeotropic point provides clue on the size of the reflux ratio. According to this, the reflux ratio in the case of all the extraction agents listed here ought to be in the same order of magnitude. The energy consumption, however, also depends on the vaporisation enthalpy of the azeotropic mixture, which in turn is determined by the proportion of water in the azeotrope. Thus the energy consumption in the case of the use of EtAc or MTBE as extraction agents ought to be the lowest.

It can be shown that these observations only apply up to certain feed concentrations of acetic acid, which, for example, amount to approx. 15wt% in the case of ethyl acetate and MTBE. If the feed concentrations are higher, then the quantity of extraction agent must be increased in accordance with the balance and vapour-liquid equilibrium, which consequently causes an increase in the operating costs. A more favourable alternative in terms of energy is the QVF method described below. By means of appropriate process principle, economic working of the entire procedure can be achieved, even with high inflow concentrations of acetic acid.

It can be gathered from the liquid-liquid equilibrium for the two preferred ternary systems (see figs. 3 and 4) that if ethyl acetate is used, there is considerable reciprocal solubility with water. The space in the immiscibility gap is relatively small, so that feed concentration of 30 wt% should not be exceeded for safe extraction work. On the other hand, the immiscibility gap in the case of the MTBE / acetic-acid / water system is more pronounced, and the reciprocal solubility lower. Feed mixtures with acetic-acid concentrations of up to around 40 wt% can, therefore, be reprocessed without problem using MTBE as the extraction agent.

Name		Average distribution coefficient	Density	Enthalpy of vaporisation	Boiling point	Azeotrope	
		kg / kg	kg / m³	kJ / kg	°C	Water	T
						Wt %	°C
Ethyl acetate C4H8O2	EtAc	0,84	900	395	76,7	8,47	70,4
Isopropyl acetate , C5H10O2	iPrAc	0,55	877	361	88,6	10,50	76,5
n-Propyl acetate , C5H10O2	nPrAc	0,50	891	336	101,6	13,20	82,2
Methylpropyl ketone, 2-pentanon, C5H10O	MPK	0,97	810	384	102,3	19,50	83,3
Methylisobutylketon, 4-Methyl-2-Pentanon, C6H12O	MIBK	0,50	810	488	115,9	24,30	87,9
Methyl-tert.-butyl ether , C5H12O	MTBE	0,75	740	322	55	4	52,6

Table 1: Extraction agents for the separation of acetic acid from effluent

EXTRACTION PROCESS

Fig. 5 shows the flow chart of a conventional extraction plant for the recovery of acetic acid. It consists of the extraction tower, the rectification tower for the recovery of the extraction agent, and the water-stripping tower. As a rule, the feed mixture has a greater density than the solvent, and is fed in at the top end of the extraction tower. Inside the tower it streams towards the bottom and in the process gives off acetic acid to the extraction agent. Depending on the effort, residual concentrations of 0.1-0.5 wt% can be achieved. Since the aqueous phase is simultaneously saturated with the extraction agent in the extraction tower, it is recovered in a downstream stripping tower. It can in this respect be performed with live steam.

The extraction agent accumulate at the top end of the rectification tower and the acetic acid at the bottom of the tower resulting in acetic-acid concentrations of practically 100 wt%. If there is a risk of any higher-boiling components also passing into the organic phase during extraction, then it is recommended that the acetic acid should be discharged in vapour form.

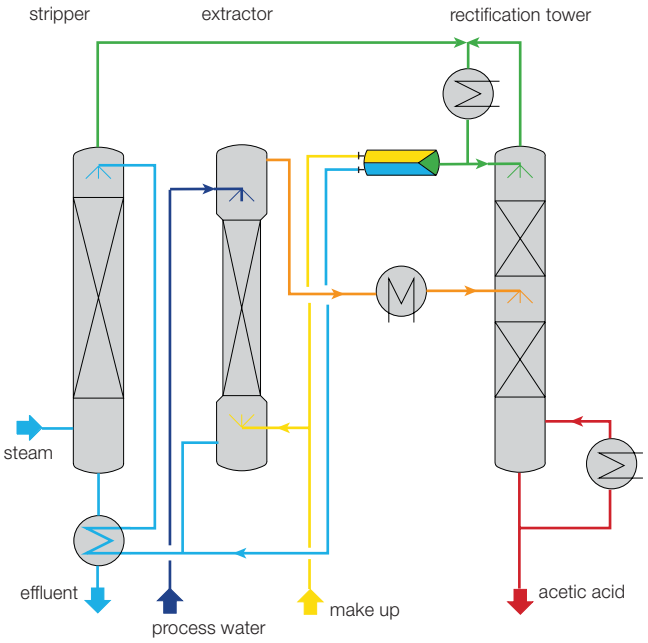

Fig. 5: Flow chart of the classical process

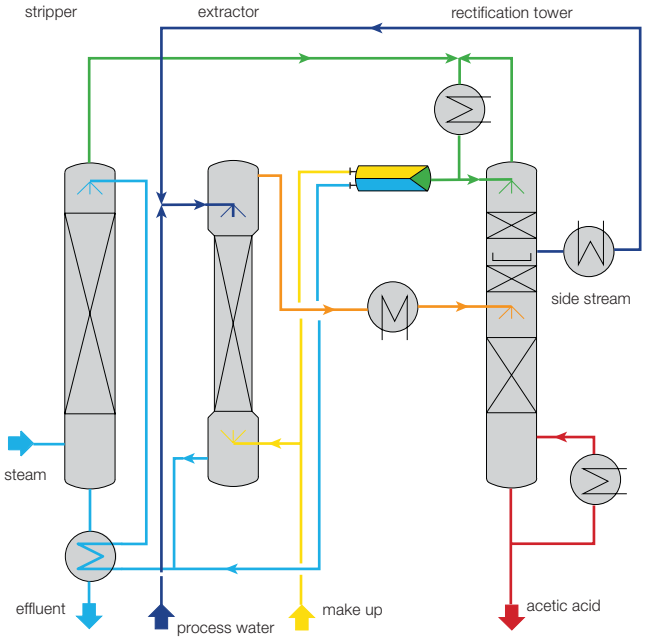

Fig. 6: Flow chart of the QVF process

Fig. 6 shows the flow chart of the QVF process. Here, similar to the conventional method, acetic acid is also extracted during the extraction stage from the process water with the aid of a suitable extraction agent (MTBE in most cases). The extraction tower, however, is operated in such a way that a high a concentration as possible of acetic acid is achieved during the extraction-sequence phase with simultaneous fulfilment of the required raffinate purity. During this operation the extracted phase contains a high proportion of acetic acid and, consequently, also water. In the downstream rectification stage, separation of the extracted phase now occurs in an azeotropic mixture consisting of extraction agent and water, and in acetic acid of the required concentration. The excess water present in the extracted phase is distilled as a liquid side-stream in the rectifying section of the rectification tower.

A particularly favourable choice of the draw off point and reflux ratio can result in a composition in the side stream, which approximately corresponds to that of the process water. After cooling to the operating temperature of the extract phase, the side stream is guided back into the extraction tower. The position of the feeding point depends on the concentration of the acetic acid in the side stream.

The costs of the whole process are determined by the costs for the separation of the extraction agent from the acetic acid. Meticulous care is therefore necessary both in terms of the design and layout of the control system of this process stage. In the case of the classical process with ethyl acetate or MTBE as extraction agents, separation can occur without problems. Nevertheless it should be taken into account that in the tower a ratio of ethyl acetate to water is set at which the separating factor relative to acetic acid is at its greatest. This is potentially very simple if the inlet concentration of acetic acid in the process water is below 15 wt%.

In the case of the QVF process the rectification step is also unproblematic. Nevertheless, the control system of the tower is more expensive by comparison with the conventional method, i.e. a certain concentration profile must be adjusted in the tower with a distinctive concentration maximum for water. In addition the flow rate of the side stream must be controlled. The automatic control-technology concept developed by QVF for this purpose has already proven outstandingly good in practical applications.

OPERATING COSTS

Greater expenditure in the case of the QVF process is justified by the up to 40% lower energy requirement by comparison with the classical process. This saving in energy results from the low extraction agent main stream.

As a result, high acetic-acid concentrations develop in the extract, so that the proportion of water in the extract is also higher than in the case of the classical process. However, this excess water is drawn off as a liquid side from the rectification tower. As a result, it is possible to achieve azeotropic composition in the distillate, and then only the quantity of water contained therein has to be condensed in the top end of the tower.

It is not possible to make any generally applicable statements on the operating costs of acetic-acid recovery, since these

depend on the inflow concentration of the acetic acid, run-off concentrations of the products, type of extraction agent, choice of method variations, and heat recovery etc. For the purpose of the assessment two (sets of) reference values are given below for each method. The figures apply to the use of MTBE, and assume that 99 wt% liquid boiling acetic acid is being distilled at the bottom of the rectification (tower).
The duty of the evaporator for the classical process amounts to the following:

- approx. 280 kW per 100 kg/h of acetic acid with an acetic-acid concentration of 10 wt%, and
- approx. 260 kW per 100 kg/h of acetic acid with an acetic-acid concentration of 35 wt%.

The following values have been calculated for the QVF process:

- approx. 260 kW per 100 kg/h of acetic acid with an acetic-acid concentration of 10 wt%, and
- approx. 180 kW per 100 kg/h of acetic acid with an acetic-acid concentration of 35 wt%.

DRAWING OFF ACCOMPANYING COMPONENTS

In many cases the process water contains low boiling components like ethanol or acetone, which must be removed along with the acetic acid. Using MTBE as an extraction agent, this can be performed as follows. During the steady-state operation the low boiling components pass the extraction tower without being extracted and reach a downstream stripper, which is equipped with a rectifying section (see fig. 7). In the stripper section of the tower the water is cleared of the extraction agent and accompanying components. On the other hand, the rectifying section of the tower is used to separate MTBE from the accompanying components. However, during the separation of components, which have a small boiling-temperature difference to MTBE (e.g. acetone), MTBE losses can be expected.
In this case it is possible to resort to another variation in the process. For this purpose a water stripper without rectifying section is used. Nevertheless, the stripper is operated in such a way that the accompanying components are driven to the bottom of the tower and the extraction agent driven to the top of the tower. In this case, however, it is necessary for the loaded aqueous phase to be purified, for example, by a biological treatment.

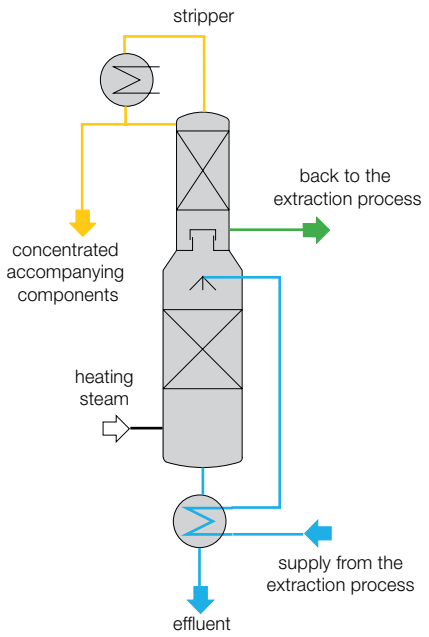

Fig. 7: Stripper with the additional draw off for accompanying components

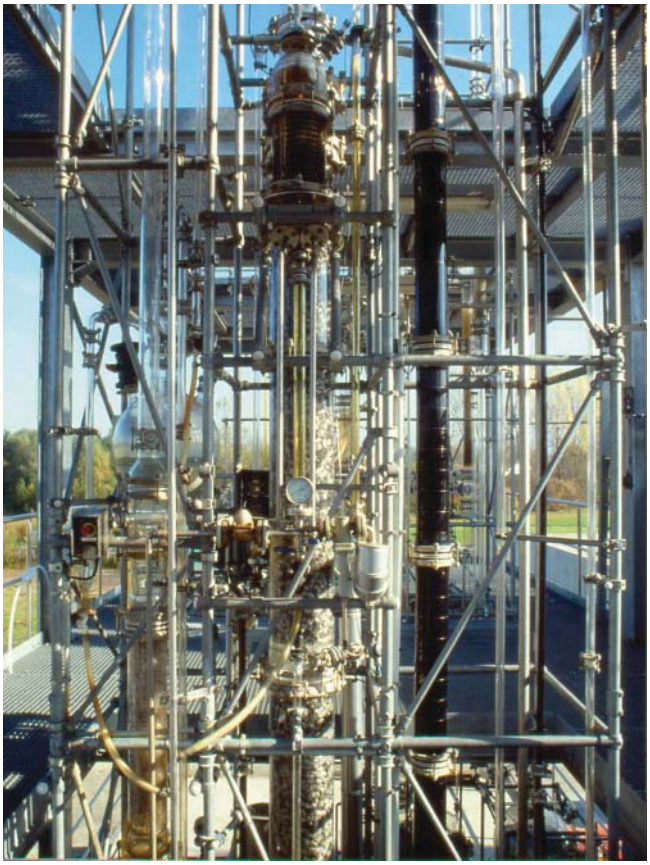

Fig. 8: Extraction Unit

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BOTTOM OUTLET VALVE WITH NO DEAD SPACE

P154e1

Borosilicate glass 3.3 is a preferred material in the chemical and pharmaceutical industry due to its smooth and inert surface. These properties also make it ideally suitable for cGMP applications. To keep within these stringent guidelines, all peripherals should utilize the same engineering designs to fit these specified requirements, e.g. safety flat buttress ends with GMP seals, or dead space free bottom outlet valves, etc. This type of bottom outlet valve is available for the following vessel types:

-Graduated receiving flasks

-Double-wall jacketed reaction vessel

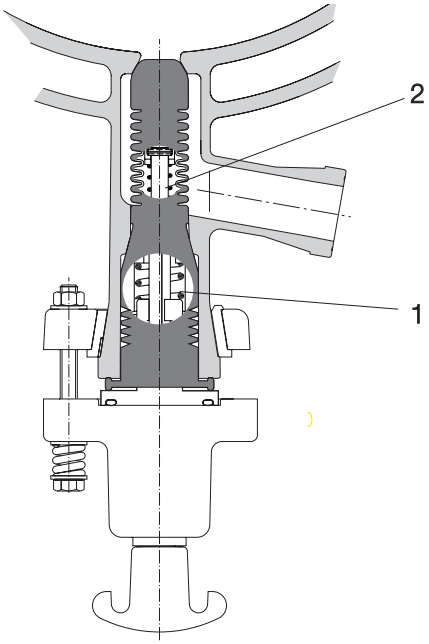
-Triple-wall jacketed vessels

-Glass vessels with OptiMix® baffles

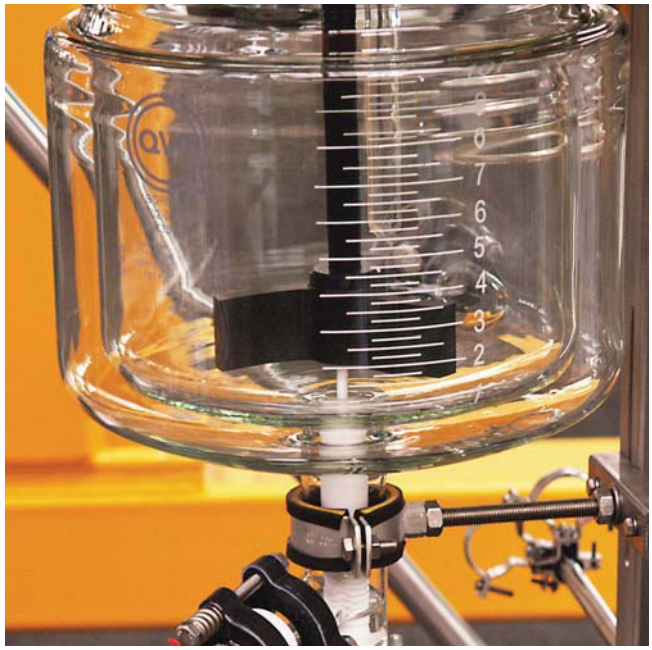
The vessels are equipped with a pre-fabricated nozzle, fused into the (add space) vessel walls The discharge port can then be precisely drilled and honed. This design maximizes sealing capability and eliminates dead space.

DESIGN OF THE VALVE

The new bottom outlet valve implements two sealing design capabilities that incorporate high-grade connections equipped with spring elements to account for PTFE's weakened state at high temperatures. The first sealing design capability located at position 1 (illustration 1) between the glass body and valve bellow and acts in a self-adjusting fashion. The spring at position 2 (illustration 2) is pre-loaded due to the closing movement of the valve, thus enabling resilience against PTFE flow upon warming and creating a seal at the same time.



Illustr. 1: Design structure of the bottom outlet valves



Illustr. 2: Bottom outlet valves with thermometer employed in a jacketed vessel

The smooth, rounded shape of the bellows that come in contact with product can be fully drained during open operational status, promoting cleanability.

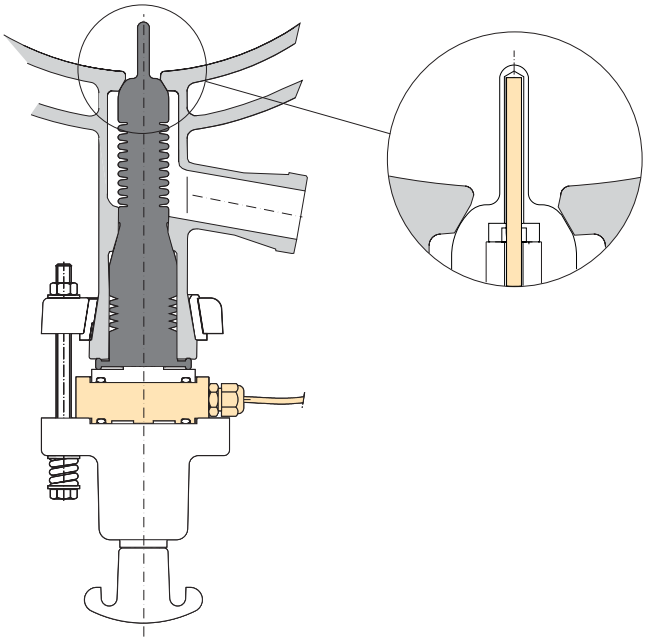
Three different valve lengths are available for different vessel types.

- Sealing capability in dead spaces near the floor
- Self-adjusting capability for high temperatures
- Integrated PT100

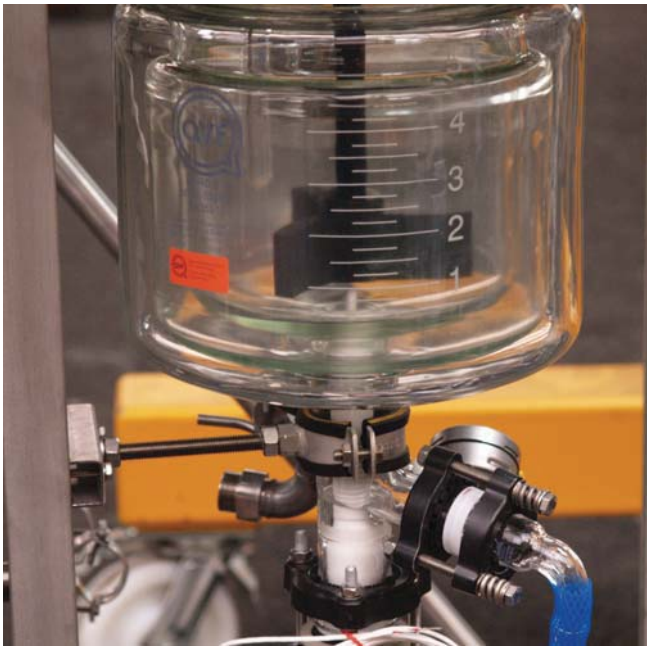
BOTTOM OUTLET VALVE WITH PT100 (RTD)

In many cases, temperature measurement is favorable by employing the bottom outlet valves, e.g.:

- Small residual amounts of fluid
- OptiMix® without a baffle installed in the cover



Illustr. .3: Bottom outlet valves employing PT100



Illustr. 4: Bottom outlet valves employed in triple-wall vessel

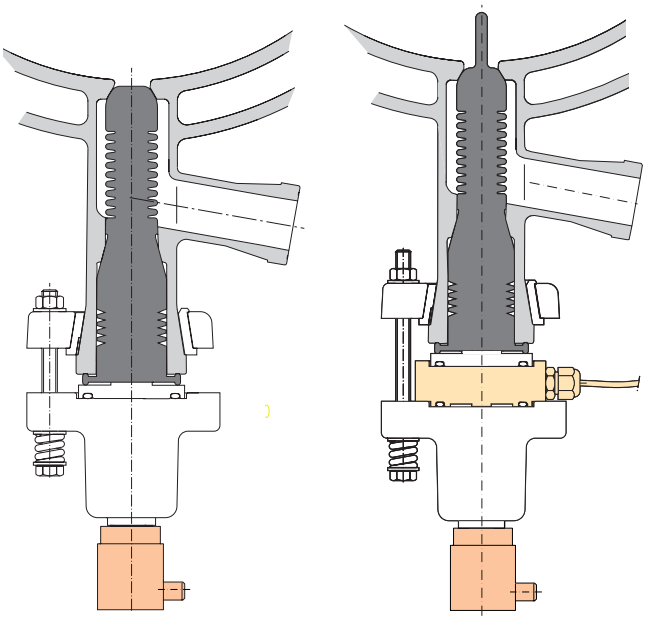
The QVF bottom outlet valves that feature a PT100 fully sustain the advantages of the standard dead space free design. The PT100 is assembled at the machined top, without the need of an additional seal. The thermometer is positioned in the vessel, allowing for fast, accurate temperature measurement as well as isolating it from the jacket temperature. A temperature deviation of about +/- 3°C results from the PTFE jacket, and may be taken into account during calibration of the thermometer.

TORQUE LIMITATION

Upon demand, the valve may be equipped with a torque limitation to avoid the possibility of over-tightening. This is a standard feature for triple-wall vessels.

TECHNICAL DATA

Active sensor tip:	30 mm protruding into the product
Sensor type:	4 cable-design PT100
ATEX license:	PTB 00 ATEX 2075 U
Ex protection grade:	II 2G EEx ell
Installation mode:	Using heat inductive paste
Response time:	About 3 minutes
Temperature deviation:	About 3°C
Connecting cable:	About 2.7 meters



Illustr. 5: Bottom outlet valves employing security device against over-winding

ORDER NUMBERS

BA S D TH T

- **T** – Torque limitation
- **TH** – With PT100
- **D** – Dead space free design
- **S** – Length contingent to vessel deployed,
  - S - graduated receiving flasks
  - M - jacketed vessels
  - L - triple-wall vessels
- **BA** – Bottom outlet valves

Caution:
The glass vessel must be equipped with a the integral valve body.

04.06. P154e.1. Subject to change.

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QVF

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home

DURAPACK®
STRUCTURED BOROSILICATE GLASS PACKINGS FOR MASS TRANSFER

P107e.1

home

THE MATERIAL ADVANTAGE

Structured packing made of borosilicate glass 3.3 for mass transfer application - DURAPACK®.

Structured packings have successfully been used for mass transfer intensification in absorption, desorption, distillation and extraction columns for many years.

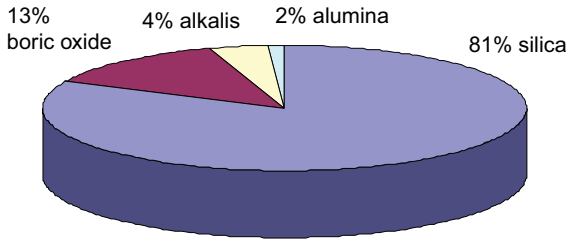
In order to allow for our customers to benefit from the known advantages of structured packings - such as high throughput at low pressure drop and at the same time high efficiency - the patented structured glass packing DURAPACK® was developed.

DURAPACK® mass transfer packings are comprising of alternating arranged corrugated plates of glass with flow channels inclined by 45 °. The glass plates are permanently fused together homogeneously so that borosilicate glass 3.3 is the only material of construction in contact with the process fluids. In this respect DURAPACK® is unique.

PROPERTIES OF BOROSILICATE GLASS 3.3

DURAPACK® structured packing is manufactured from temperature and corrosion resistant borosilicate glass 3.3. This glass has been used to manufacture laboratory and process plant components for many decades.

Chemical Composition:



Physical properties:

Density:	2230 kg/m^3
Coefficient of linear expansion:	3,3 x 10^{-6} K^{-1}
Thermal conductivity:	1,2 W/mK
Specific heat capacity:	0,98 kJ/kgK
Modulus of elasticity:	64 kN/mm^2
Poissons ratio:	0,2

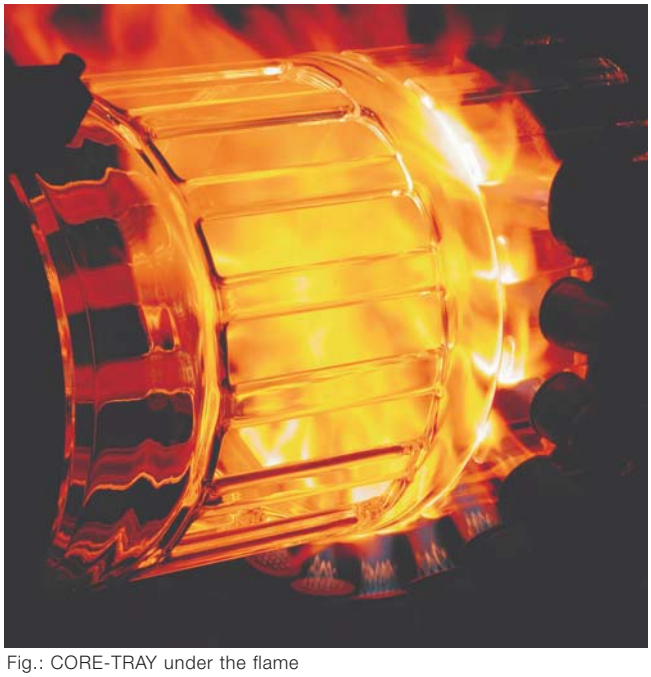


Fig.: CORE-TRAY under the flame

MATERIAL OF CONSTRUCTION AND FIELDS OF APPLICATION

The outstanding properties of borosilicate glass 3.3 are:

- almost universal corrosion resistance
- high temperature resistance
- good shape stability
- catalytic inertness
- physiological and ecological harmlessness
- non flammability.

This means that DURAPACK® is especially useful as a mass transfer packing for processing corrosive or extremely pure process fluids in, for example:

- multipurpose production and pilot plants
- absorption columns such as adiabatic HCl and HBr absorbers,
- desorption and stripping columns for the removal of chlorinated hydrocarbons from liquid effluents,
- distillations of highly sensitive active pharmaceuticals at vacuum and
- extraction columns, used for the extractive purification of aggressive process effluents.

CHEMICAL RESISTANCE

Highly resistant to	water, acids, salt solutions, organic substances such as, for example, halogens
Resistant to	cold alkalis
Not resistant to	hydrofluoric acid, concentrated phosphoric acid above 100 °C, strong alkalis above 50 °C
Temperature resistant	up to 200 °C Temperature resistance is limited by the physical properties of the peripheral equipment such as gaskets, bellows, couplings and supports. The DURAPACK® glass is temperature resistant up to 300 °C.

Hydrolytic resistance

- DIN ISO 719 (98 °C), class HGB 1
- DIN ISO 720 (121 °C), class HGA 1

Acid resistance

- DIN 12116, class 1
- DIN ISO 1776, class 1

Alkali resistance

- DIN 52322, class A2
- ISO 695, class A2

Values of maximum allowable stress in accordance with AD data sheet N4:

- maximum allowable tensile/bending stress:	7 N/mm2
- maximum allowable compressive stress:	100 N/mm2
- Maximum allowable rapid temperature change :	120 K

DURAPACK® ELEMENTS

Decisive for the performance of a mass transfer packing is the phase interface that is influenced by turbulence and wettability, the uniform distribution of gas and liquid as well as the low pressure drop, which is in particular important for vacuum applications.

The turbulence and the separation effect is enhanced by notches embossed into the corrugated plates. Because the individual packing elements of 200mm height are arranged 180° shifted to each other, a proper redistribution of liquid is ensured. In particular for columns of larger diameters a proper initial distribution and redistribution after approximately 3-5m is eminent. Therefore we would like to direct your valued attention to the integrated support plates and distributors developed by QVF, in particular to the CORE-Tray.

The packing elements are in one piece for nominal diameters from DN 100 to DN 300. For nominal diameter DN 450 it is comprising of two half circular segments and can also be used on a support ring. Packing layers with a nominal diameter of DN 600 or larger are divided into individual segments and a support frame is required .

Fig.: Plate structure, segmented packing, installation in glass columns

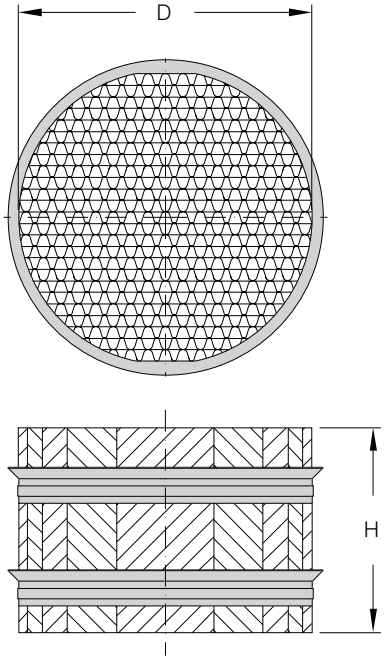


Fig.: DURAPACK® element DN 300

TECHNICAL DATA

DN	D*1)	H	Weight of one layer (kg)	Number of segments in a layer	Number of edge deflector	Reference
100	90	200	0,5	1	2	**DUPA100/300**
150	140	200	1,3	1	2	**DUPA150/300**
200	190	200	2,3	1	2	**DUPA200/300**
300	285	200	5,2	1	2	**DUPA300/300**
450	435	200	12,1	(1)	1	**DUPA450/300**
600	585	200	22,4	4	1	**DUPA600/300**
800	798	200	40,2	4	1	**DUPA800/300**
1000	973	200	60	7	1	**DUPA1000/300**

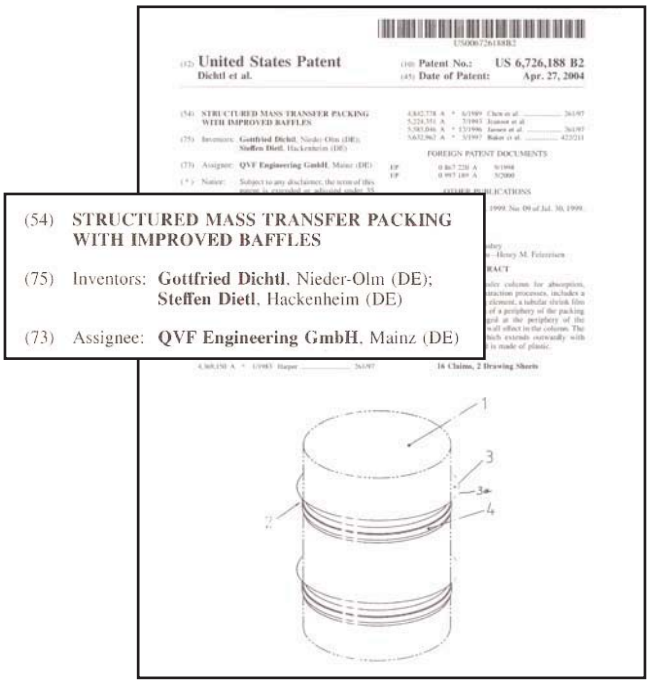
*1) specification for glass columns, for columns of other materials please specify the corresponding diameter.

WALL WIPER

DURAPACK® mass transfer packing can be used in both glass columns and columns made of other material such as glass lined steel . For glass columns up to a nominal diameter of DN 1000 the outer diameter of the packing is automatically adjusted to the column. For columns made of other materials the inner diameter of the column has to be specified including the corresponding tolerances with the order. To avoid wall effects the elements are equipped with patented wall wipers made of PTFE (included in delivery).

All packing elements have a height of 200 mm. Up to a nominal diameter of DN 300 the packing elements come with two wall wipers , from DN 300 on with one for each layer. Due to the flexible wall wipers the glass packing can be installed in standard column sections . Precision bore pipe sections are not required.

Fig.: DURAPACK® element DN300 with wall wiper.



(54) STRUCTURED MASS TRANSFER PACKING WITH IMPROVED BAFFLES

(75) Inventors: **Gottfried Dichtl**, Nieder-Olm (DE); **Steffen Dietl**, Hackenheim (DE)

(73) Assignee: **QVF Engineering GmbH**, Mainz (DE)

Fig.: Patent PTFE wall wipers

SUPPORTS AND SUPPORT FRAMES

The following standard components are available for glass columns:

PTFE SUPPORTING RING

Available up to a nominal diameter of DN300 and up to a maximum packing height of 1m.

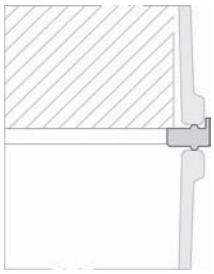


Fig.: PTFE support ring

SUPPOR RINGS STEEL/PTFE

Available up to a nominal diameter of DN 450 and up to a maximum packing height of 3 m. The support ring with a steel core can also be used for a fixed point in the frame.

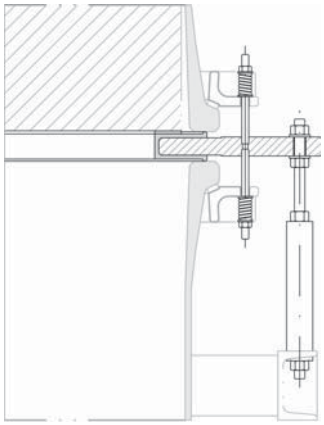


Fig.: Steel/PTFE support rings.

STEEL/PTFE SUPPORT RING WITH SUPPORT FRAME

Available from DN 600 up to a nominal diameter of DN 1000 and up to a maximum packing height of 2 m. Since the support frame is confining the free cross sectional area of the column to approx. 60%, the CORE-TRAY should be used for high performance applications and for columns of larger diameters.

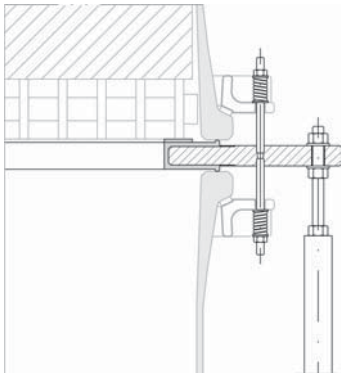


Fig.: Steel/PTFE support ring with support frame

CORE-TRAY - COLUMN INTERNALS

The CORE-TRAY support (patent applied) can also be supplied in a version acting as a liquid collector and distributor, and now also provides a solution for the problem of metal-free support trays with a large free cross-sectional area. Whereas previously available versions made of glass lined steel or graphite created a bottleneck in the column, CORE-TRAY provides a free cross-sectional area of approx. 120%. Using only glass-lined steel for the plates clamped between the buttress ends, borosilicate glass for the risers and PTFE for the gaskets, CORE-TRAY does not contain any metal and is highly resistant to corrosion.

Fig.: CORE-TRAY DIN 1000 assembly, here for packing with glass support

FUNCTION

In counter-current columns the pressure drop should not be too high wherever liquid and vapour streams come into contact. CORE-TRAY separates the liquid and vapour in the cross-section of the perforated plate and prevents a liquid accumulation. In the area of the gas risers, however, the opening for the gas is the equivalent of 120% of the column cross-sectional area, so that here, where the liquid and the vapour meet, the pressure drop remains

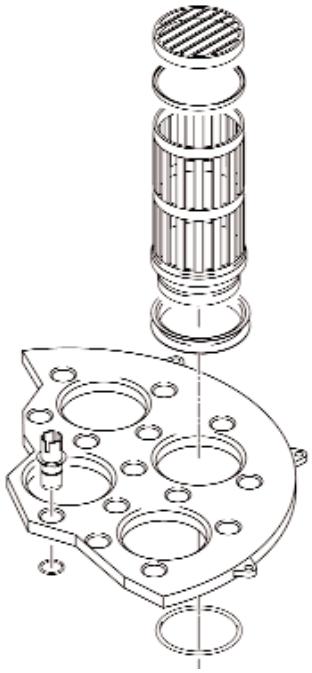


Fig.: CORE-TRAY column packing support with support grid on top for random packing and with distributor nozzles

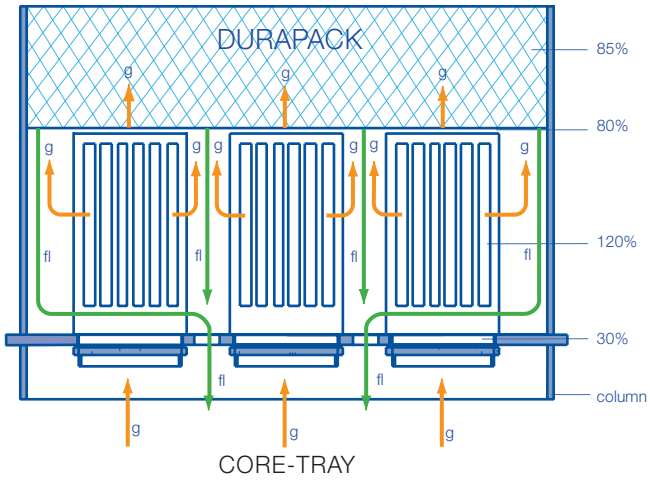


Fig.: Hydrodynamic levels of the CORE-TRAY

low and no liquid accumulation occurs.

The illustration shows the various levels of the CORE-TRAY. It can be seen that the counter-current area which is crucial for the hydrodynamic design is located between the packing and the perforated plate and thus reveals a free cross-sectional area matching the DURAPACK® high-performance packing. A hight of 5 m of DURAPACK® can be placed on a plate. If random packing is used instead of structured packing, the top of the gas risers are covered with a glass grid to prevent any falling through of packing.

Liquid collectors, redistributors and liquid withdrawals based on the same design principle are also available. In all cases the plate is clamped between the column flanges and can be centred with the welded-on eyes.

TECHNICAL DATA

Material:	Glass-lined steel, Borosilicate glass 3.3
Diameter:	600 - 1800 mm
Free cross-sectional area:	up to 120%
Liquid loading:	0,5 - 100 m^3/m^2h
Distribution points per unit area:	100 - 300 per m^2
Operating temperature:	-40 to +200°C
Bearing capacity:	max. 5 m
DURAPACK® Patent application:	No. DE 10140352.6

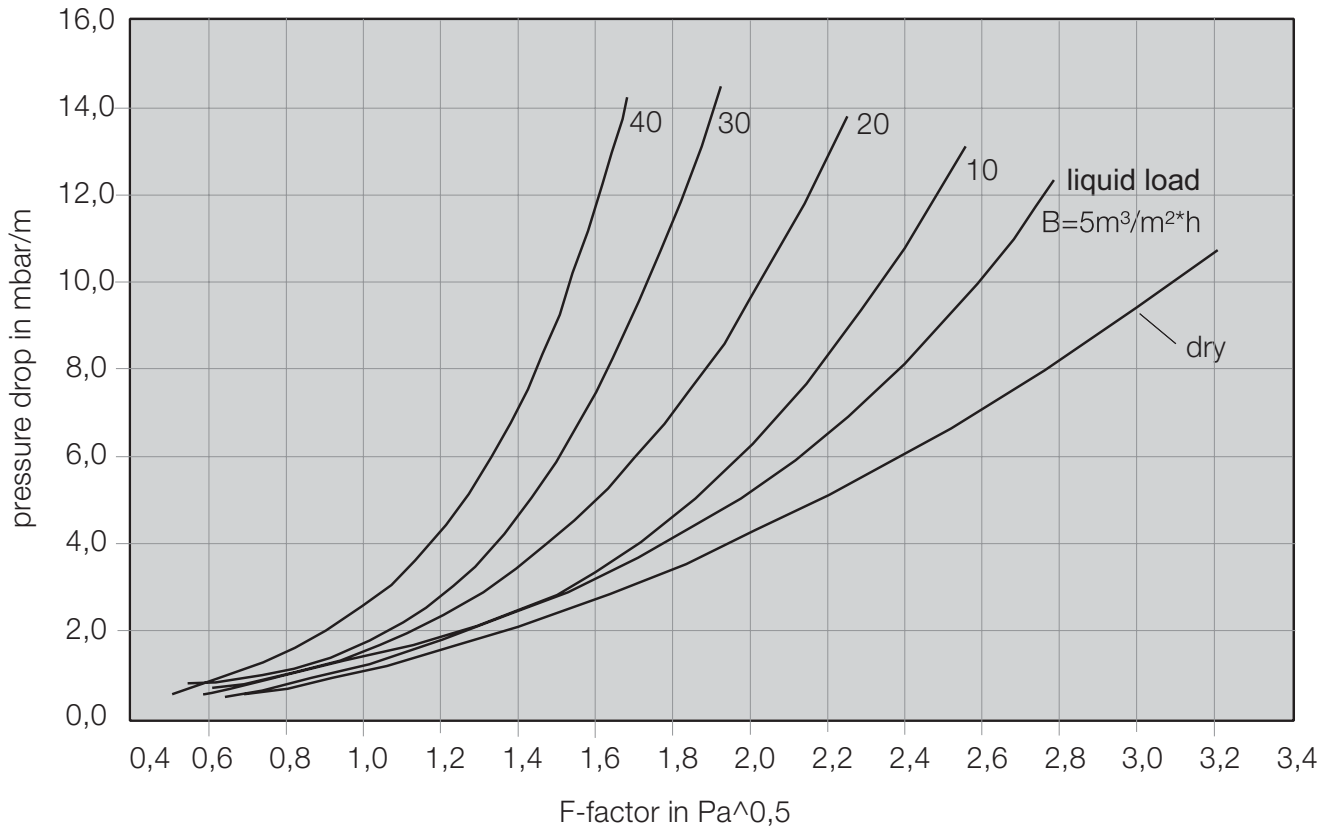
Fig.: Liquid collector and redistributor with distributor cup (view from below)

PERFORMANCE

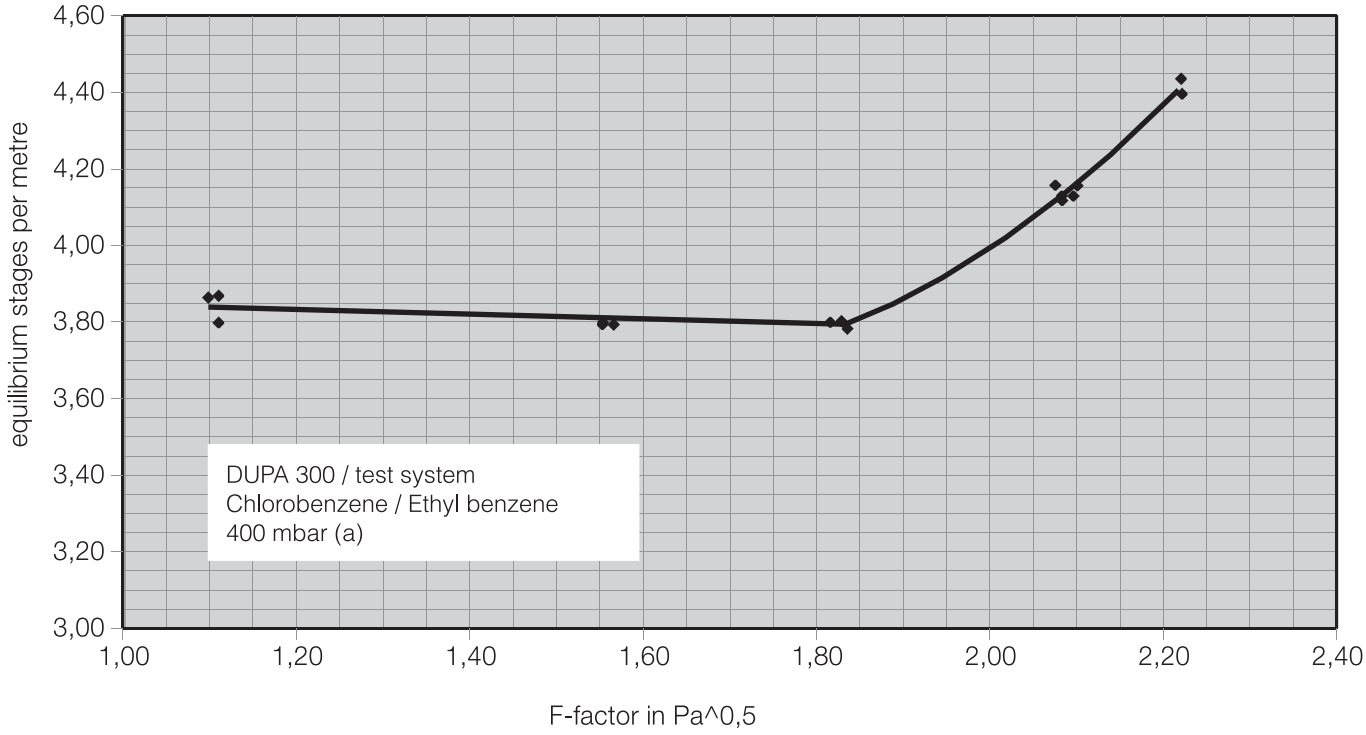
DURAPACK® packing can be used for distillation as well as for extraction processes. The easy-to-clean smooth and inert surface is extremely convenient. The specific surface amounts to 300 m²/m³. All following performance data have been obtained in standard glass columns

PERFORMANCE FOR DISTILLATION COLUMNS

Pressure drop

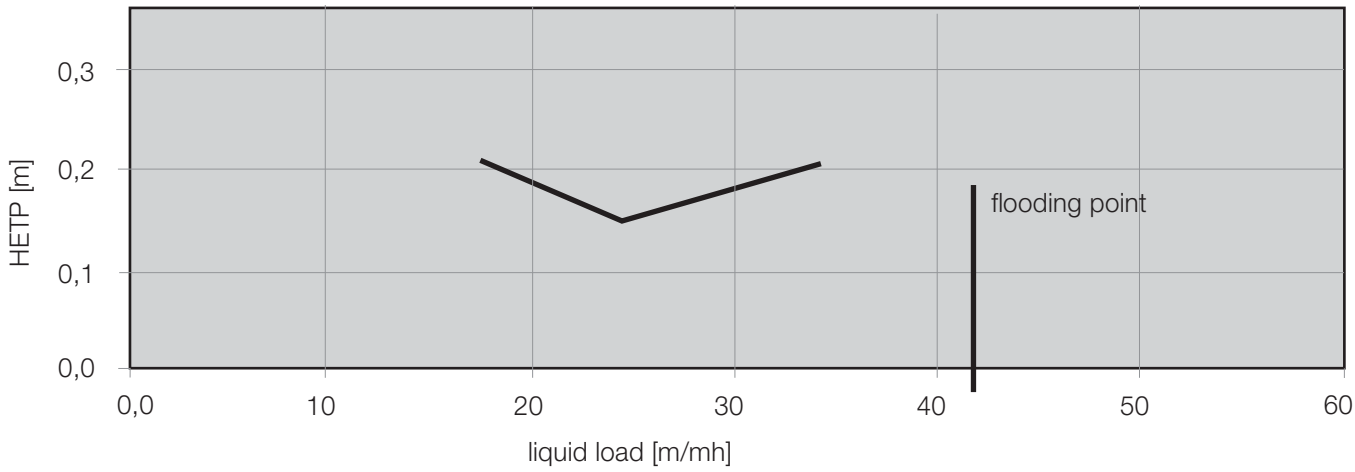


Number of theoretical stages



PERFORMANCE FOR EXTRACTION COLUMNS

Since it has to be avoided as far as possible that the packing surface become wetted by the normally organic dispersed phase during extraction, glass packings with smooth, fire-polished surfaces are very suitable for this application . The extraction experiments have been carried out in a pulsed column using toluene/acetone/water as a test system. During these experiments the flooding point was determined with an amplitude of 8 mm and a frequency of 100 min-1. The number of equilibrium stages have been measured for loads of 80, 60 and 40% of the flooding point.



QVF

THE MATERIAL ADVANTAGE

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12.05. P107.e1. subject to change.

NITROGEN SAVINGS WITH PRESSURE SIPHON

P112e.0

GENERAL

To avoid an explosive atmosphere or contamination of the product, chemical plants are normally made inert with nitrogen and fluids are covered in nitrogen. Pressure holding valves feed nitrogen, depending on the pressure permitted, so the inert atmosphere remains even during emptying procedures. When the apparatus is filled or heated, the nitrogen must be able to exit the apparatus via a reciprocating line without the permissible pressure being exceeded.

- ☞ Secure and low maintenance pressure holding even with the smallest permissible pressures
- ☞ Protection against under and overpressure
- ☞ N_O N_2 loss through imprecise or contaminated pressure holding valve
- ☞ High operating safety, since there are no moving parts

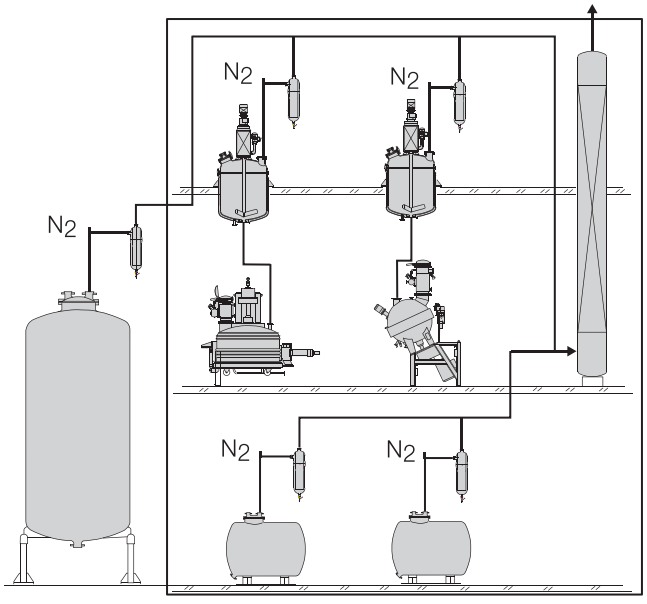

Fig. 1: Possible installations

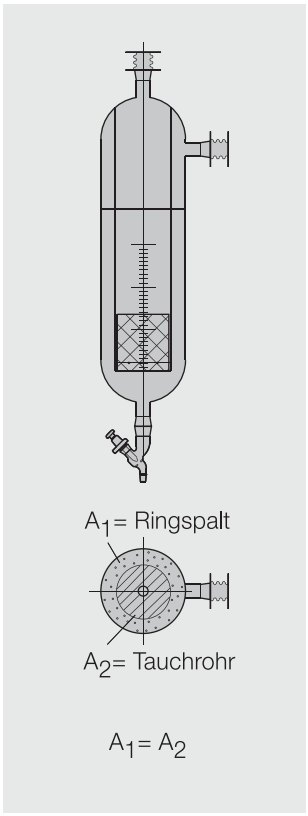

Fig. 2: Design of a pressure siphon

In particular storage containers, which are only designed for low under- or overpressure, must be additionally protected against the failure of the nitrogen valves. Valves used for this must work at the lowest pressures and are sensitive to contamintion. The pressure siphon from QVF offers an elegant alternative here. The set over-/underpressure is maintained through the fill level of a heavy boiling medium. The hydrostatic pressure can also be safely set via an integrated scale even at very small values.

FUNCTION

In the basic version, the cross-sectional surfaces of the inside tube and the nozzle clearance area are equally large, so the maintained over- and underpressure are also equally large. Through the change in the surface ratio, the maintained underpressure can deviate from the overpressure, which occasionally makes sense for tank facilities.

If the specified operating pressure is exceeded in the apparatus, the nitrogen bubbles out evenly through a PTFE knit. Nitrogen is backfed via a pressure reducer, which,

however, is set below the blowing-off pressure. Through this setting, blowing off of the nitrogen is avoided during normal operation and the operating safety simultaneously increased, since no moving parts are needed for proper functioning. Experience shows that using dip tanks can reduce nitrogen consumption considerably compared to pure valve circuits.

COMPOSITION

The QVF dip tank consists of the material borosilicate glass 3.3, which has universal corrosion resistance and permits optical control of the fill level. Standard containers are available in various lengths in the nominal bore DN 200 and DN 300. The delivered product contains the PTFE knit to even out the bubble flow, two connection bellows and an emptying valve.

All glass parts are produced in accordance with the pressure device guideline (PED) and are awarded a CE mark. The glass flange connections of the pipe lines have been granted permits in accordance with the Technical Instructions on Air Quality Control (TA-Luft).

Polyethylene glycol is often used as a locking fluid, but this does not belong to the scope of supply. The recommended throughput of the gas stream can be taken from the following table.

OPTIONS

- tubular frame, galvanized or made of stainless steel
- coating of the glass parts as protection against impact
- level indicator monitoring for integration into the C&I

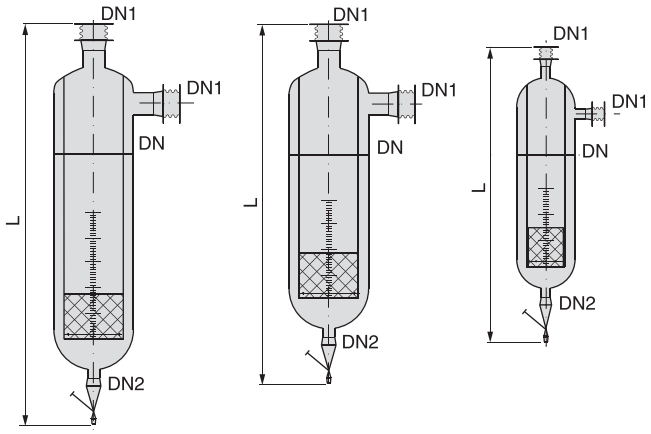

Fig. 3: Sizes of the pressure siphons

TECHNICAL DATA

	TFL50	TFL30	TFL10
DN	300	300	200
DN1	80	80	40
DN2	40	40	25
L [m]	ca. 1,5	ca. 1,3	ca. 1,1
all volumen [l]	50	30	10
p max* [m bar]	80	50	50
Gas throughput*	15m³/h	15m³/h	6m³/h

* at liquid viscosity 1000 kg/m³

Tab. 1: Technical data of the QVF pressure siphons

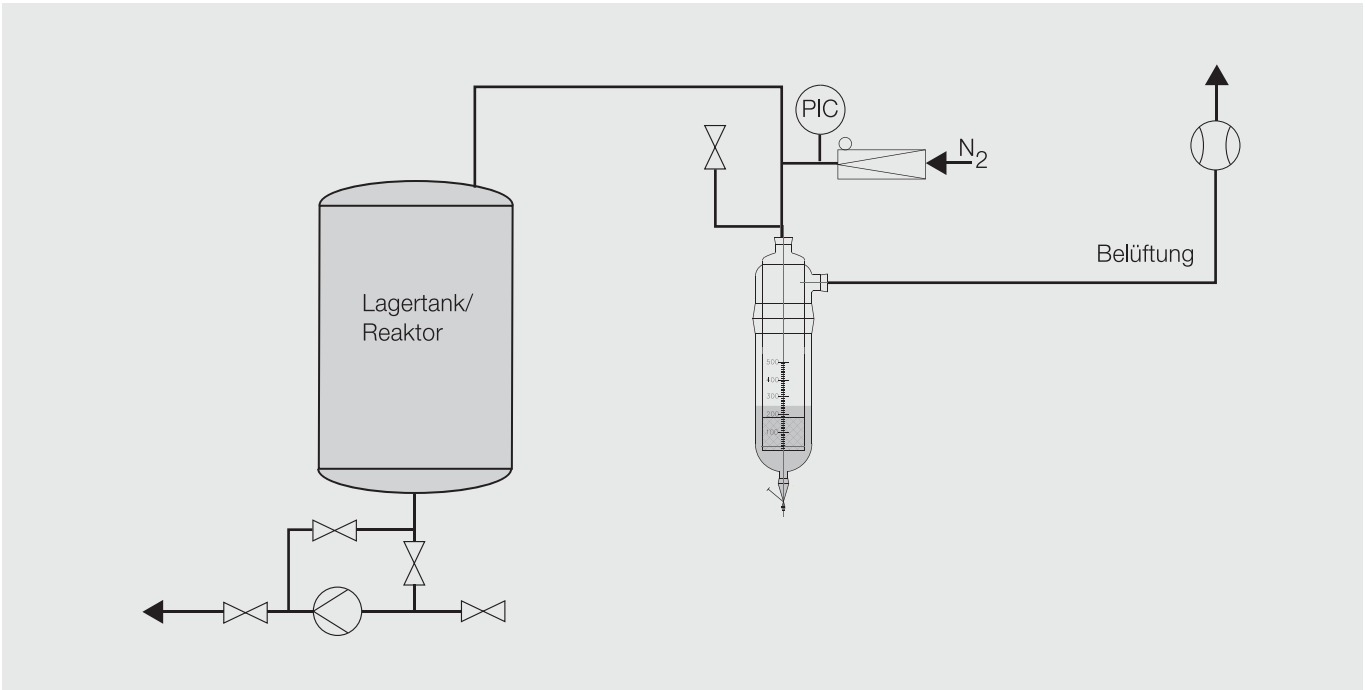

Fig. 4: Tank protection with pressure siphons

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MINIPLANT STANDARD-UNIT MIXER DN 50

M140e.0

GENERAL

During the extraction process, a valuable substance is dissolved out of the liquid phase A by means of a second, non-mixable phase B. Although the separation of the valuable substance from phase A by distillation is usually too elaborate, it is easily possible from phase B. Extraction is therefore a preliminary stage prior to subsequent separation by distillation.

A large interphase in the extraction apparatus for substance exchange is necessary to ensure that the valuable substance can dissolve from phase A to B.

Fig.1: Settler with height-adjustable overflow (left), mixer head (right)

CONSTRUCTION

The required interphase in the mixer head is produced in the mixer settler by stirring the two phases, which separate again in the settler. The two phases are sucked in and dispersed with each other by the speed-controlled stirrer in the mixer chamber. The two chambers can be separated by a double weir.

- ☞ Development of extraction processes
- ☞ Suitability as a teaching unit (manual available)
- ☞ Easy to clean and observe
- ☞ ATEX version available

For the height adjustment of the phase separation layer in the settler, the apparatus has an overflow for the heavy phase which is height-adjustable during the process.

Liquid/liquid extractions in the mixer settler have the advantage that they can be operated discontinuously and with fluctuating product flows. The concentration profile through the stages is maintained, even when there are interruptions. This makes the mixer settler ideally suited for research and development tasks, although it is also used in production with low separation stage figures.

Fig.2: Two-phase mixer settler apparatus DN 50

SAMPLE UNIT

The apparatus illustrated has two stages which operate in reverse flow. Each of the two phases is fed into the respective opposite stage with a metering pump and runs through the system due to the conveyance effect of the stirrers. The overflow phases are collected in two receivers.

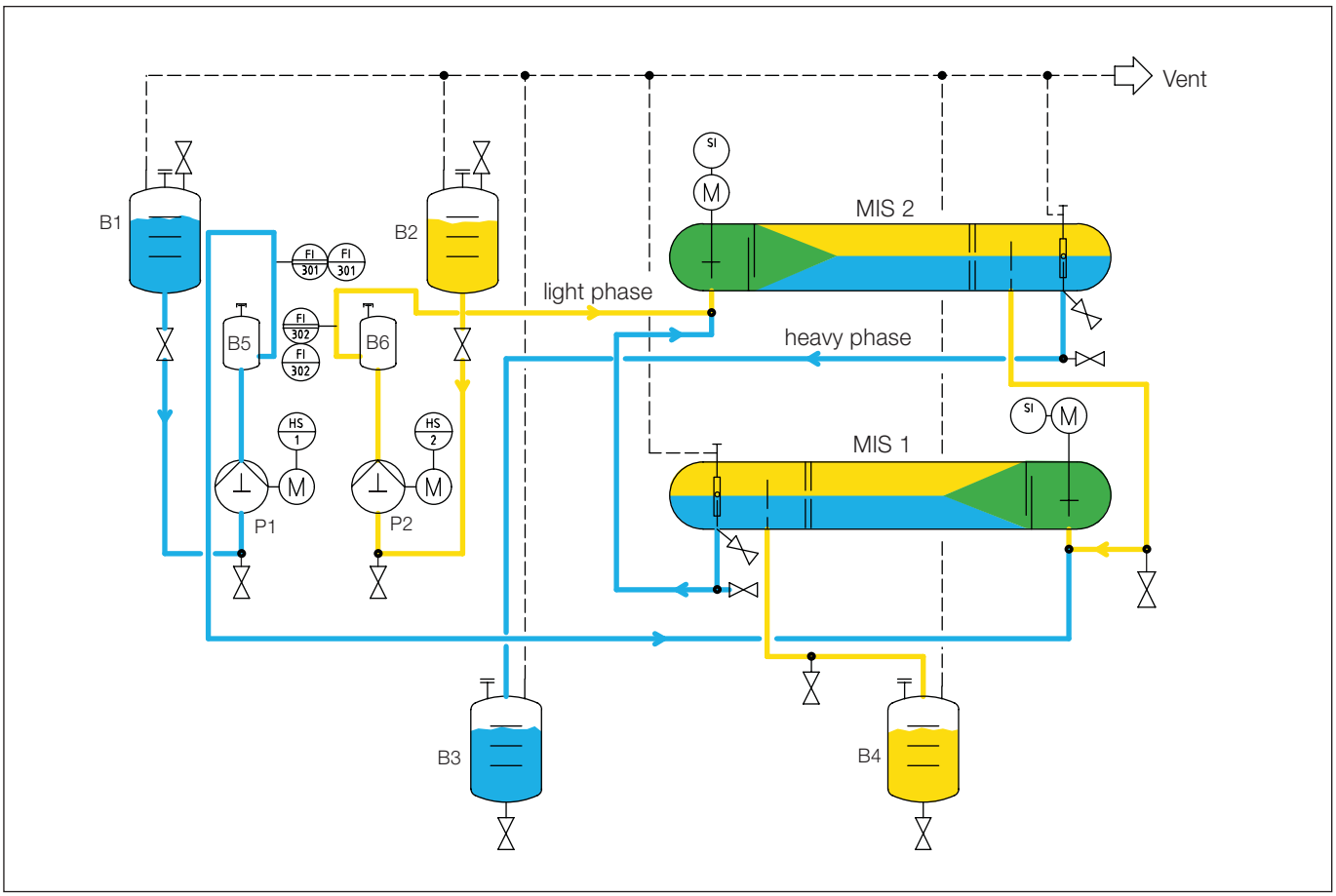

Fig. 3: Flow diagram of a two-stage mixer settler system

TECHNICAL DATA

- 2-stage mixer settler DN 50 (MIS1; MIS2)
- Volume of the settler 0.7 l
- 4 receivers 20 l (B1; B2; B3; B4)
- 2 metering pumps (P1; P2)
- Air vessel (B5; B6)
- Mixer drive with variable speed and digital speed display
- Power line for ventilation

OPTIONS

- Multi-stage version
- Process control system and data recording
- Heating jacket
- Temperature measurement in the settler (shown in front-page photo)
- Scale-up to QVF technical applications

NOTE

Miniplant systems are normally mounted at QVF and delivered with documentation and operating instructions once a FAT has been established.

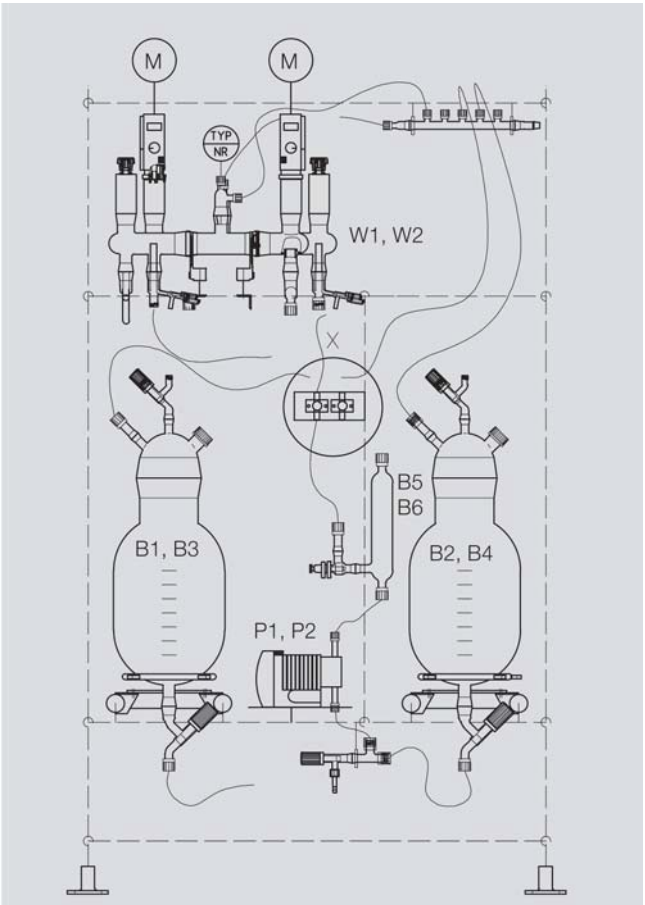

Fig. 4: Setup plan

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QVF

member of De Dietrich PROCESS SYSTEMS

home

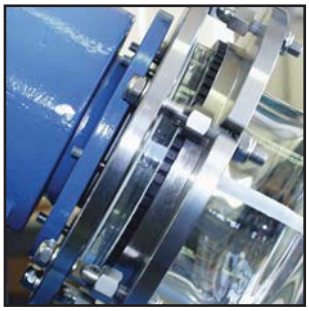
ROTARY EVAPORATOR ROTADEST® R20/R50/R100

P134e.0

home

GENERAL

Rotary evaporators belonging to the R product range, which are preferred in production and are used in engineering, are suitable for continuous and discontinuous distillation under normal pressure or in a vacuum. They have the advantage of providing careful thermal treatment of temperature-sensitive mediums. Application limits for the rotary evaporator arise among other things as a result of the relatively long dwell time and the attainable viscosity of the final product. Above reliable or attainable limit values, therefore, we recommend the use of our thin-film evaporator which permits a maximum viscosity of the residue of approx. 5000 cP.



Rotary evaporators are suitable for evaporating suspensions, initiating crystallisation processes and drying powders and granulates. It is also possible to carry out various chemical reactions.

Exclusive use of borosilicate 3.3 glass and PTFE for all product-based parts offers the following benefits:

- Proper observability of all process in the areas of evaporation and condensation.
- Total chemical resistance against nearly all mediums

Additional special features of this rotary evaporator are:

- The robust driving of the rotary sphere by a PTFE-lined steel sleeve shaft and their sealing of the condenser part using a proven PTFE axial face seal (suitable for permanent and maximum load).
- The possibility of choosing between different housing or bath models, types of heating, condenser parts and different varieties of display and control parts (modular system, see order number key).
- Simple operation

ORDER NUMBER KEY

	Module A [1]				Module B	Module C	
	Housing with heating bath, rotary sphere and drive				Condenser	Display and control part	
R	100	E	A	H	2	Spezial	Ex

- R — ROTADEST
- 100 — Content of rotary sphere (20, 50, 100 l)
- E — Bath heating (E=electrical, D= steam (Dampf)
- A — Lowerable heating bath (not with R20)
- H — Hydraulic or stroke setting
- 2 — Condenser part (mod. 1 to 3)
- Spezial — Special or standard
- Ex — Ex - model

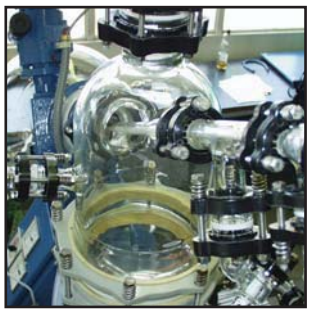
[1] housing with wheels are also available

PRINCIPLE OF OPERATION

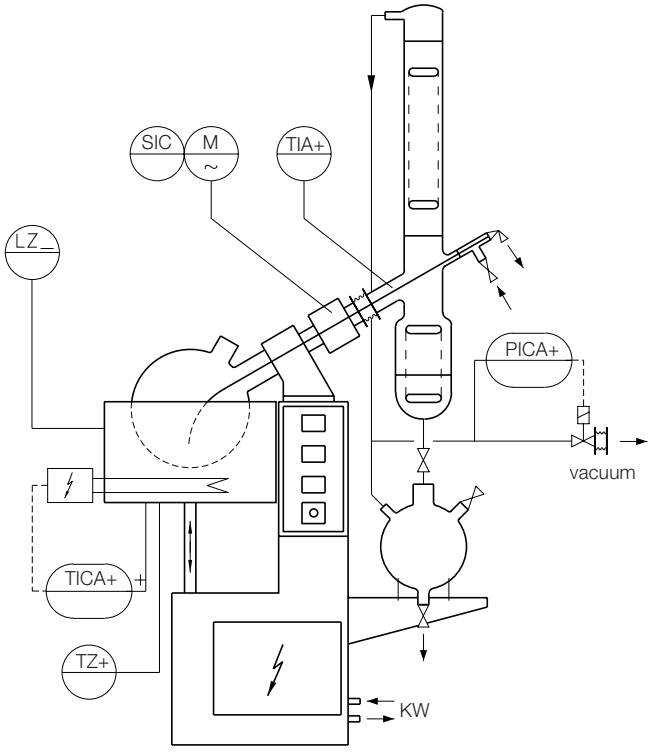
The liquid to be processed in the rotary evaporator is fed directly into the rotary sphere by a feed pipe conducted through the condenser part. When operating under normal pressure, i.e. with open air release valve, this happens by means of a pump or through gravitational force, depending on the arrangement of the supply vessel.

Evaporation takes place in the externally heated rotary sphere. In this way the rotational movement of the piston ensures a good intermixing of the medium, thus providing regular temperature distribution.

The rotary sphere is indirectly heated by a water or oil bath to which the necessary energy is fed in a regulated way by steam or an electrical heating unit. The steam abandons the sphere at the point where it is flanged to the drive motor. It flows through a sleeve shaft feeding through the drive and reaches the condenser part. There it is condensed in the condenser and cooled in an after cooler. Then the condensate reaches the recipient container(s).



A reversible alternating recipient enables condensate to be withdrawn during operation under normal pressure and in a vacuum. The simple recipient makes this possible only with distillation under atmospheric pressure.



EVAPORATION RATES

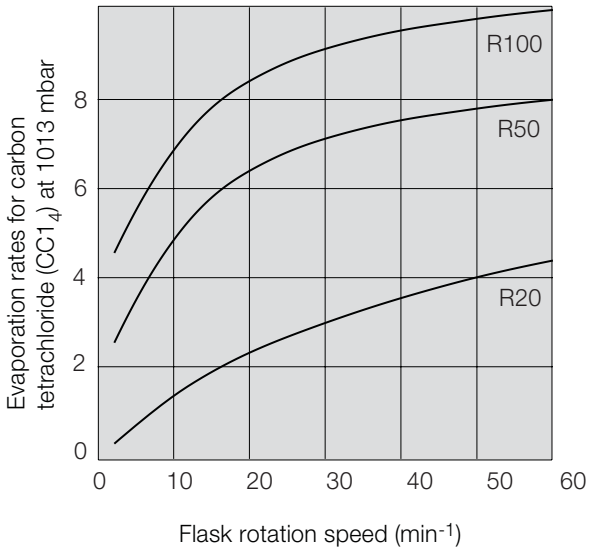
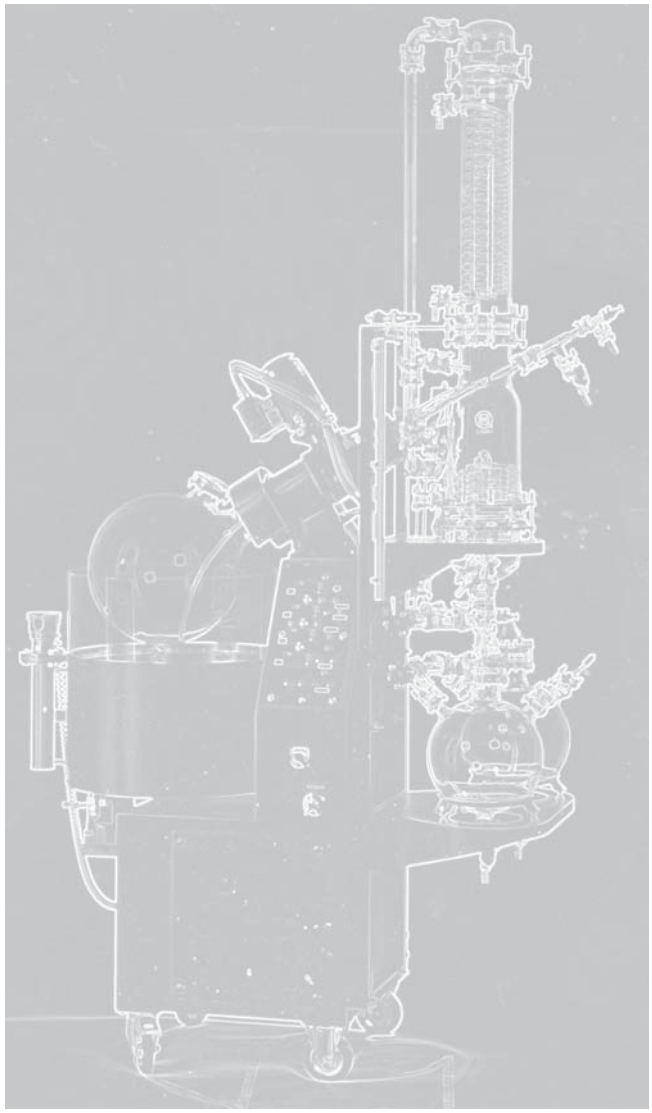


Fig. above: The variation of evaporation rates of carbon tetrachloride with the flask rotation speed.



MODULE A

HOUSING WITH HEATING BATH, ROTARY SPHERE AND DRIVE

Only housing models with integrated heating bath are available for size R20 rotary evaporators. The possibility of lowering the bath heating is not necessary here because the overall height and the content of the sphere are low. To make assembly and disassembly easier the sphere can be equipped with an additional support ring.

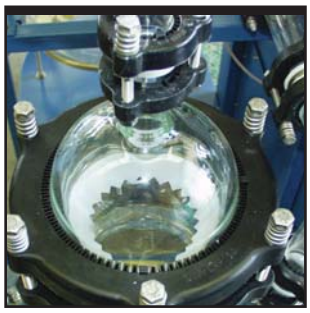
Housings for the R50 and R100 rotary evaporators can be delivered with permanently installed or lowerable heating bath. With the model just mentioned the bath heating is raised and lowered using a hydraulic cylinder. The standard version activates it with a hand pump or a pressure outlet valve. The special model on the other hand is delivered with an electrical oil pump and an on/off button on the operator panel. In the event of power failure or network shutdown, in both variants the heating bath is forcibly lowered with a magnetic valve. The entire hydraulic installation including the oil supply container is placed in the housing. All heating baths can be heated either electrically or with steam. Either water or other heat exchangers, e.g. oil, can be used as a bath liquid. A splash guard keeps back the entrained bath liquid with the rotation of the sphere and serves at the same time as protection against accidental contact.

The rotary evaporator's housings are delivered ready for connection i.e. including internal pipework and wiring. The accesses and outlets for the cooling water to and from condenser parts are in the housing wall. The associated manually actuated valve is placed on the operator side. A duct is planned for the electrical connection.

ROTARY SPHERE

In all rotary evaporators this consists of nearly totally corrosion-resistant borosilicate 3.3 glass. Attachment to the drive makes detachment easier using hasp screws. Use of special palettes when assembling and disassembing the spheres also simplifies this job. Such palettes are, however, only usable in housing versions with lowerable heating baths and can be delivered as an accessory.

The nominal capacity of the spheres is 20, 50 or 100 litres. For the purpose of intensive intermixing as well as for powdered substances the rotary spheres can also be delivered with indentations (internally raised) distributed above the surface.



DRIVE

In all models a robust and proven drive motor serves as a power plant for the rotary sphere. Its driving motor speed can be continuously adjusted by hand. Speed measurement with digital display on the operator panel can be provided.

An electric motor with frequency converter, setpoint adjuster and digital display can be provided as an alternative to the drive motor, likewise at extra cost.

A PTFE-lined steel sleeve shaft serving as a vapour pipe, to which the rotary sphere is permanently attached, is directly driven at the same time. This sleeve shaft is sealed against the condenser part by a PTFE axial face seal. The connection of drive and condenser part is made by a PTFE bellows.

All rotating parts, including the connection flange of the rotary sphere are sealed with a protective cap.

TECHNICAL DATA

TypE			R20...	R50...	R100...
Rotating flask	Capacity	l	20	50	100
	Rotation speed	min^{-1}	0 - 108	0 - 82	0 - 82
Drive	Type		Drive motor with continuous speed regulation [1]		
	Power	kW	0,25	0,37	0,37
Bath heating	Electrically heated [2]	kW	4,5	9	12
	Steam heated	bar	6	6	6
Bath activity	Hand hydraulics			Hydraulic cylinder, hand pump, pressure outlet valve, automatic lowering during power failure or network shutdown by magnetic valve	
	Motor hydraulics			Hydraulic cylinder, electrical oil pump, on/off button (forced gearing as in standard)	

[1] Alternative motor with electrical speed regulation by frequency converter at extra cost
[2] Surface temperature is limited to 160°C, for equipment in Ex-zones to 120°C.

MODULE B

CONDENSER PART

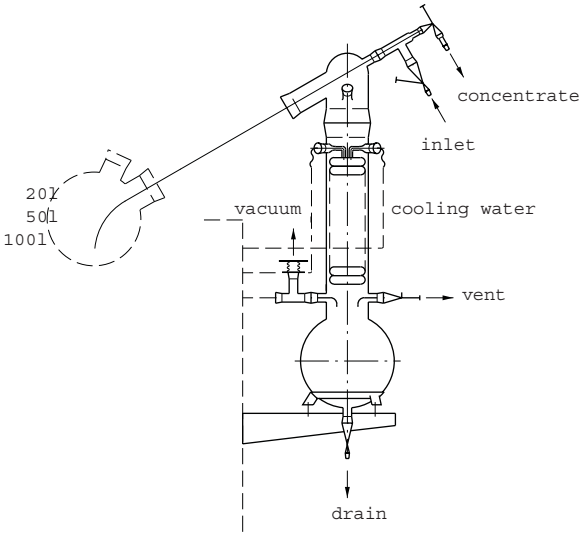
This module is the complete condenser part in which the condensate is condensed and collected. It essentially consists of a condenser with or without an after cooler, one or two recipients, the connecting pipes, including the necessary fixing as well as a vacuum connection. The condenser part is supported by a console attached to the housing.

Condenser parts have already been designed and delivered in a variety of different models to cater to the special desires of the user. However, experience has shown that a wide field of application is covered by the varieties described below. They all have product feeding, concentrate and distillation extraction, connections to cooling water and vacuum as well as a ventilation and pressure measurement connection.

CONDENSER OPTION 1

This condenser arrangement with integral spherical receiver has single vacuum, venting and drain connections fitted with valves. The vacuum connections is equipped with a bellows via tee-piece for connection to both vacuum pump and pressure gauge. There is also a facility for filling and suction emptying the rotating flask. This arrangement is supported by means of a bracket fixed to the cabinet.

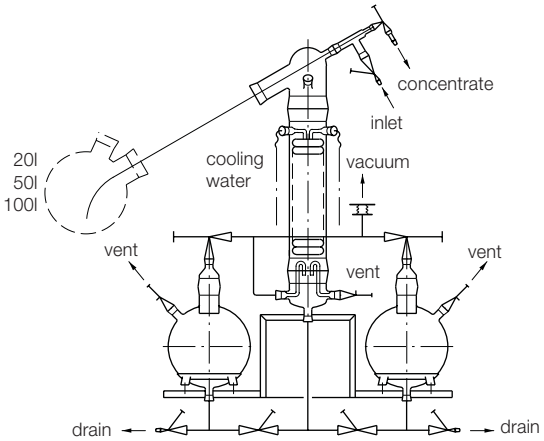
Rotary film evaporators incorporating this type of condenser arrangement are suitable for continuous operation at atmospheric pressure or batch operation under vacuum.



Option 1:

CONDENSER OPTION 2

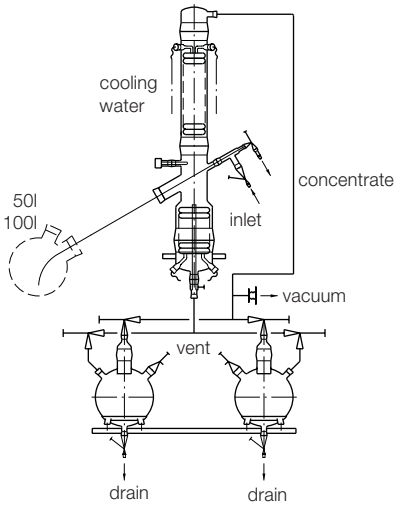
This version has the same principal as option 1 but utilises a standard condenser. This system is fitted with two spherical receivers, therefore allowing one to be exchanged, enabling continuous operation under vacuum as well as atmospheric pressure. The vacuum connection in this system is fitted with the bellows unit.



Option 2:

CONDENSER OPTION 3

This system incorporating a combined condense and product cooler was developed for particularly high performance cooling and continuous operation under vacuum. A rising condenser and a flooded secondary product cooler ensure optimum cooling of the condensate. The exchangeable receivers also provided, permit continuous operation under vacuum as well as atmospheric pressure. The flooding of the lower cooler is achieved by means of a overflow.



Option 3:

Condenser part			Option 1	Option 2	Option 3
Cooler	R20...	m^2	1,0	1,0	
	R50...	m^2	1,5	1,5	1,5+0,7
	R100...	m^2	2,5	2,5	2,5+0,7
Capacity	R20...	l	10	2x10	
	R50...	l	20	2x20	2x20
	R100...	l	50	2x20	2x20

MODULE C

This module includes all component parts of the rotary evaporator for monitoring and controlling the distillation process parameters. The operating panel with analogue and/ or digitally display devices and buttons, positioned for the convenience of the operator, is placed in the upper housing part. The main switch is directly below the operator panel.

All housings with their switch and control gear are, as with the terminal boxes, placed in the lower housing part of the rotary evaporator and easily accessible from outside by a removable cover. Explosion-protected models have compression-proof enclosed housings.

In all other cases they are designed splash-proof (IP 54 type of protection). The operator panels have analogue or digital displays depending on the model (see technical data):

- the head temperature in the condenser
- the bath temperature
- the vacuum
- the speed of the rotary sphere (special request)

One power supply 230/400 V, 3 Ph, N, PE.

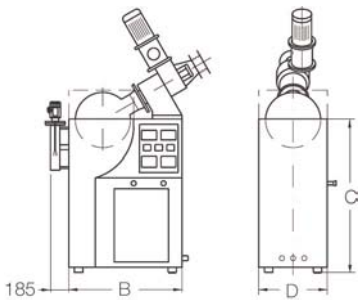
Fig. above: glass parts with dissipative coating.

TECHNICAL DATA

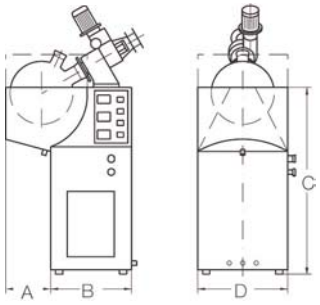
Function		Design	Standard Standard Ex	Special Special Ex
Head temperature		Measurement	Thermometer with expansion sensor [1]	Resistance thermometer with electric display [1]
		Display	Analogue	digital
Bath temperature	electrically heatable	Measurement	Thermometer with expansion sensor as two-position controller incl. limit value signal max.	Resistance thermometer with electr. two-position controller incl. limit value signal max
		Display	Analogue	digital
		Control	Two-position controller	Two-position controller
	steam heated	Measurement	Thermometer with expansion sensor incl. max. limit value signal	Resistance thermometer with electr. two-position controller incl. limit value signal max
		Display	Analogue	digital
		Control	direct-acting thermostat with set value area +50 + +150°C	
Vacuum		Measurement	Manometer with measurement range -1 to 0 bar [2]	Absolute pressure transmitter with electric indicator [2] [3]
		Display	Analogue	digital
RPM		Final control element Display	Handwheel with vernier scale	Handwheel with vernier scale at extra cost (with digital display)

[1] With limit value signalling Max at extra cost
[2] With limit value signalling min at extra cost
[3] Alternative electrical two-position controller at extra cost.

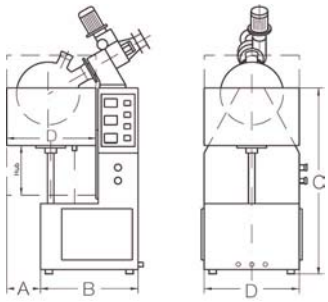
DIMENSIONS



R20...



R50.../R100...,
Spherical receiver integral



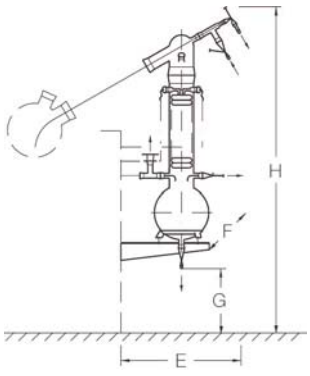
R50.. .A/R100... A,
Spherical receiver lowering

Spherical receiver [1]		integral	lowering	
Type		R20...	R50...A	R100...A
A	mm	0	290/475[2]	340/525[2]
B	mm	760/945[2]	760	810
C	mm	1150	1450	1550
D	mm	660	740	840
Hub	mm	-	320	380

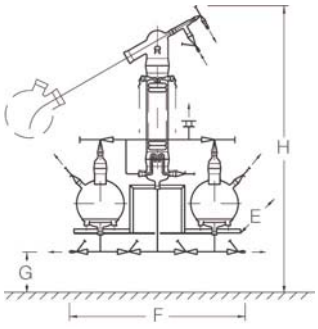
[1] control panel can be installed on the other side

[2] inclusive level control (in case of Ex-proof version)

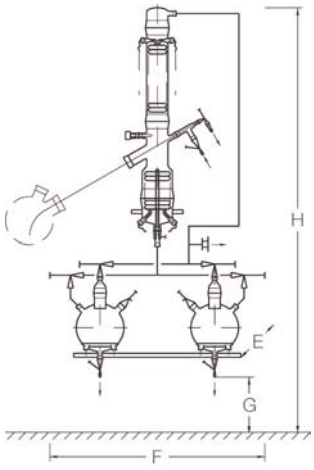
CONDENSER PART



Option 1



Option 2



Option 3

Condenser		Option 1			Option 2			Option 3	
Type		R20...	R50...	R100...	R20...	R50...	R100...	R50...	R100...
E	mm	720	750	815	720	750	815	765	815
F	mm	620	370	610	940	1230	1230	825	825
G	mm	420	530	450	420	530	375	525	510
H	mm	1950	2345	2480	1950	2345	2480	3285	3375

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