

LICUFLON® PTFE and POLYFLURON® PTFE

The Right Column and Vessel Lining to Meet any Need

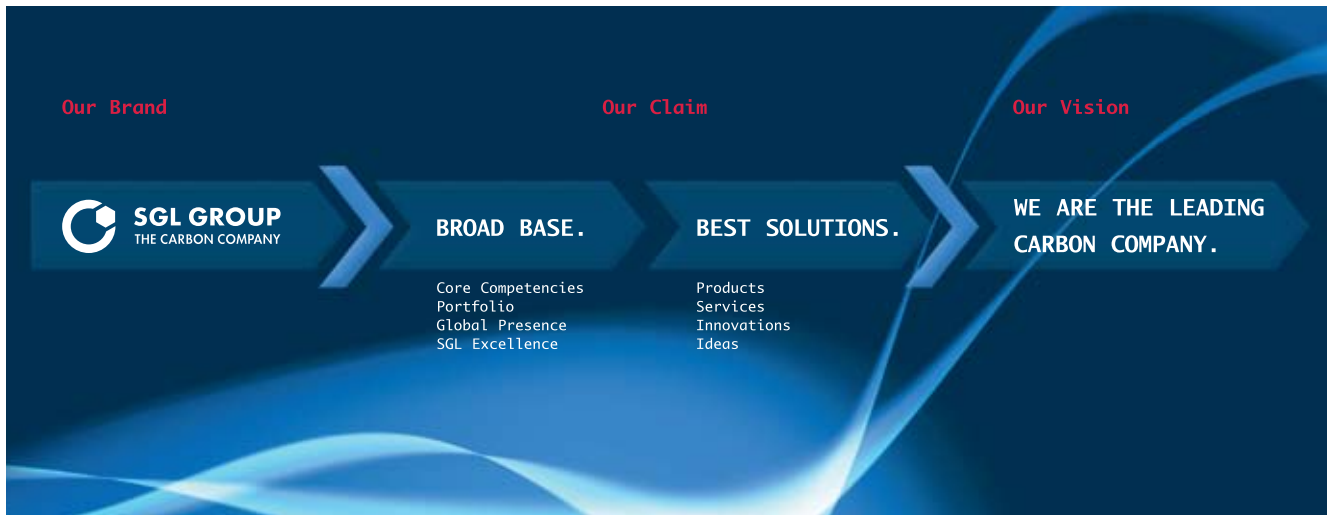
Process Technology



Broad Base. Best Solutions.



SGL Group – The Carbon Company



SGL Group – The Carbon Company – is one of the world’s leading manufacturers of carbon-based products. We have a comprehensive portfolio ranging from carbon and graphite products to carbon fibers and composites.

Our core competencies include a wide knowledge of raw materials, specialized production expertise and in-depth application and engineering know-how. As a result, we have built up a comprehensive technology and product portfolio. We operate on a global scale and are close to our customers anywhere at any time. Supported by this broad base, we offer our customers the best solutions. That is what SGL Excellence stands for.

Process Technology

Perfection in Graphite and PTFE

Our Business Line Process Technology is focused on supporting the technical processes of our globally operating customers in the chemical and pharmaceutical industries, metal manufacturing and environmental protection technology. A maximum degree of know-how and expertise in corrosion protection, a global presence and full-package systems from a single source: that's what our customers need – and get from us:

- ▶ Long-standing experience and a high level of expertise in process technology
- ▶ Comprehensive process, material and design know-how on graphite and PTFE
- ▶ Closeness to customers: cost-effective manufacturing to international and local standards at our production sites in Europe, America and Asia and worldwide customer service
- ▶ A consistently high standard of quality.

Our comprehensive range of products and services extends from process equipment and components made from DIABON® graphite and POLYFLURON® virginal, paste-extruded PTFE, through LICUFLON® skived PTFE sheet-lined steel equipment, FLUROFLEX® bellows, FLUROPIPE® pipe systems, FLUROSIC® silicon carbide heat exchangers and DIABON® graphite or exotic metal pumps, to the planning and assembly of complex systems.



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Experience and Competence in PTFE – Our Guarantee for Top Quality and Customized Package Solutions

For almost 40 years now, SGL Group/ Dr. Schnabel GmbH have manufactured not only PTFE-lined pipes and PTFE bellows but also PTFE-lined steel columns and vessels.

We have built up favorable experience with PTFE in hundreds of applications. This allows us to offer our customers cost-effective solutions that take advantage of the material's almost universal corrosion resistance. And the number of new applications is still increasing. Our range of services begins with the process-related and mechanical design of components, if requested. And it does not end with the delivery of columns complete with all process internals in such special materials as PFA/ PTFE, exotic metals or carbon fiber-reinforced carbon (C/C).

There's also the back-up provided by our stringent and comprehensive quality assurance. Together with our highly efficient LICUFLON® and POLYFLURON® materials, this ensures maximum service lives even at heavy duties. Our equipment is used mainly in the chemical and pharmaceutical process industry, but also in high-purity electronic applications and environmental protection technology.



Benefits of LICUFLON® PTFE and POLYFLURON® PTFE

LICUFLON and POLYFLURON PTFE are suitable for lining columns, reactors and vessels of up to 3000 mm in diameter.

The materials available for the steel shell are high-quality carbon and stainless steel in various grades. Design, manufacture and testing all conform to the international standards specified, e.g. the European Pressure Equipment Directive (PED), ASME Section VIII, Div. 2, or the "China Stamp". Seismic and windload calculations can be carried out in addition to the mechanical stress calculations.

Equipment lined with LICUFLON® or POLYFLURON®

- ▶ meets extreme demands for corrosion resistance
- ▶ ensures a very high level of operational reliability and safety
- ▶ provides economically viable solutions to problems
- ▶ is successfully used in operations involving the use of mixed corrosive media with differing and varying corrosion constituents
- ▶ provides lowest permeation and diffusion rates
- ▶ is insensitive to thermal shock
- ▶ tends not to accumulate fouling – due to the anti-adhesive properties of the LICUFLON or POLYFLURON PTFE materials
- ▶ can be supplied as vacuum-resistant.



Lining Materials to Meet Highest Standards – LICUFLON® PTFE and POLYFLURON® PTFE

PTFE is characterized by excellent corrosion resistance to all chemicals apart from a few such as alkali metals and special halogenous mixtures.

PTFE-lined components can withstand temperatures from $-10\text{ }^{\circ}\text{C}/-29\text{ }^{\circ}\text{C}$ to $+200\text{ }^{\circ}\text{C}/250\text{ }^{\circ}\text{C}$, depending on requirements. They can be operated at pressures from -1 bar to 12 bar .

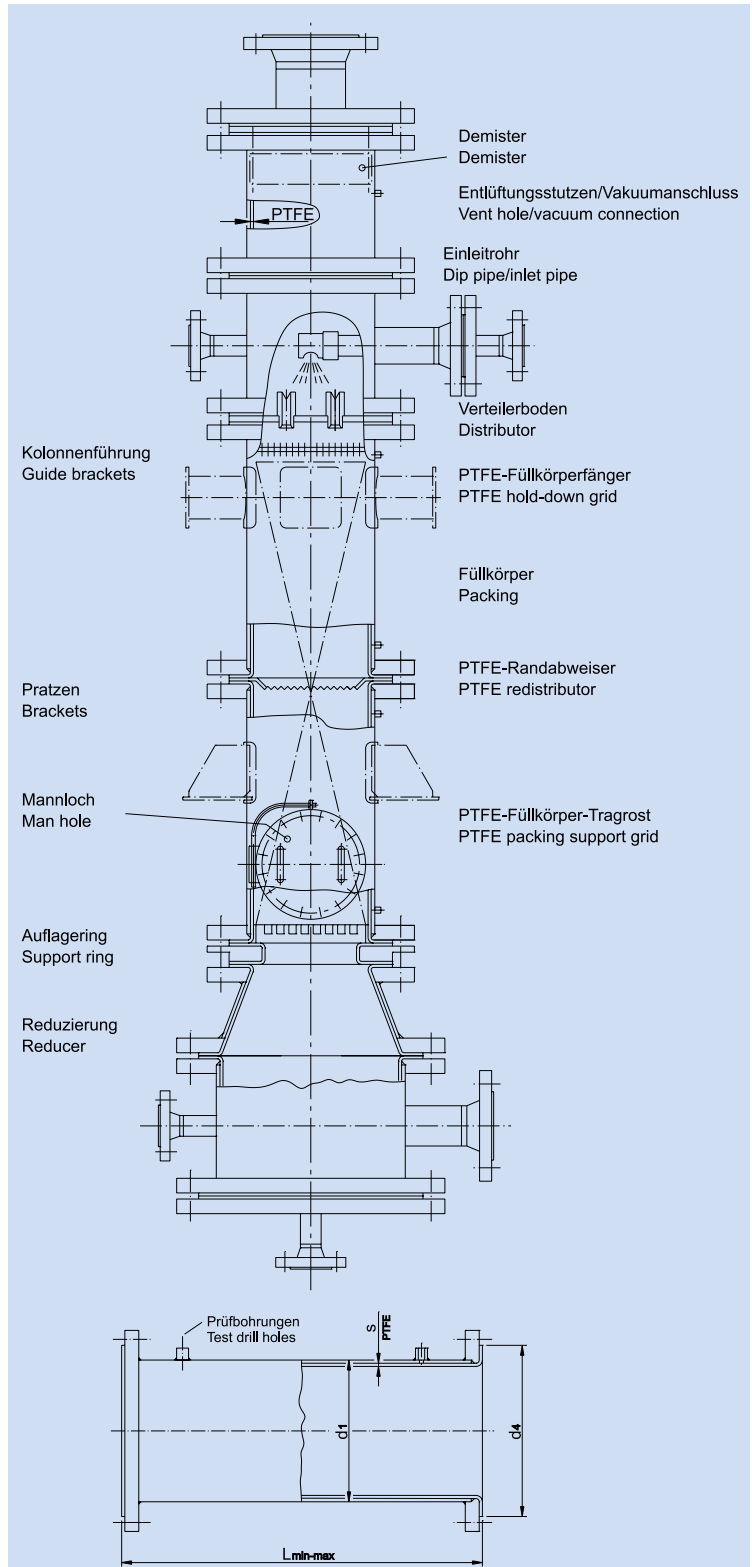
Whether LICUFLON or POLYFLURON PTFE is used depends on the application, design and customer specification.

LICUFLON PTFE is a special 4 mm thick skived sheet based on modified PTFE. It is upgraded into an ultrahigh-quality product by automatic welding and other special processes. LICUFLON PTFE is also suitable for lining components with a special design geometry, e.g. conical shapes.

POLYFLURON PTFE is a virginal, paste-extruded PTFE material with optional thicknesses of 5.5 mm or 8 mm. Over 50 years' experience combines with stringent quality tests to guarantee a top-quality product, providing long service lives even in contact with critical media. POLYFLURON PTFE is also available as black, antistatic or modified PTFE.

Nozzles can be fitted at almost any location at the column with either lining material. Minimum distances to main flanges and adjacent nozzles are defined by our specialists in their detail engineering work.

Vent holes provided with couplings for pipe extensions ensure that any small amount of permeate is reliably drained off.



PTFE-Lined Columns and Vessels – A Wide Range of Sizes to Meet any Need

Nozzles with flange dimensions meeting DIN 2501 PN 10 or ASME B 16.5 150 lbs are supplied as standard. We welcome inquiries about special flange dimensions and diameters exceeding DN 2500.

DN		Steel pipe Outside diam. x wall thick.	PTFE Flange DIN	LICUFLON			POLYFLURON				Weight	
DIN	ASME			L min	L max	PTFE Thick- ness	L min	L max	PTFE Thickness standard	PTFE Thickness heavy duty	Lined	Pair of
											pipe	flanges
mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	kg/ m	kg	
200	8"	219.1 x 6.3	268	130	700	4	150	6000	5		40	19
200	8"	219.1 x 6.3	268				150	6000		8	44	
250	10"	273 x 6.3	320	130	1400	4	150	4000	5		50	24
250	10"	273 x 6.3	320				150	4000		8	56	
300	12"	323.9 x 7.1	370	150	1400	4	150	4000	5.5		68	34
300	12"	323.9 x 7.1	370				150	4000		8	73	
350	14"	355.6 x 8	430	150	1400	4	150	4000	5.5		82	54
350	14"	355.6 x 8	430				150	3500		8	87	
400	16"	406.4 x 8.8	482	150	1400	4	150	2500	5.5		102	64
400	16"	406.4 x 8.8	482				150	2500		8	108	
450**	18"	457 x 8	532	200	1400	4	200	2200	5.5		105	80
450**	18"	457 x 8	532				200	2500		8	113	
500	20"	508 x 8	585	200	1400	4	200	2500	5.5		117	90
500	20"	508 x 8	585				200	2000		8	125	
600	24"	610 x 8	685	200	1400	4	200	1800	6		143	124
600	24"	610 x 8	685				200	1600		8	152	
700	28"	711 x 8	775	200	1400	4	200	1600	5.5		169	126
700	28"	711 x 8	775				200	1600		8	178	
800	32"	813 x 8	880	250	1400	4	250	1600	5.5		193	170
800	32"	813 x 8	880				250	1600		8	204	
900	36"	914 x 10	980	250	1400	4	250	1600	5.5		262	212
900	36"	914 x 10	980				250	1600		8	275	
1000	40"	1016 x 10	1080	250	1400	4	250	1600	5.5		306	250
1000	40"	1016 x 10	1080				250	1600		8	320	
1200	48"	1220 x 10	1295	300	1350	4	300	1600	5.5		350	450
1200	48"	1220 x 10	1295				300	1600		8	365	
1400	56"	1420 x 10	1510	350	1350	4	350	1600	5.5		410	670
1400	56"	1420 x 10	1510				350	1600		8	430	
1500**	60"	1524 x 10	1600	350	1350	4	350	1600	5.5		440	760
1500**	60"	1524 x 10	1600				350	1600		8	460	
1600	64"	1620 x 10	1710	400	1350	4	400	1600	5.5		470	850
1600	64"	1620 x 10	1710				400	1600		8	490	
1800	72"	1820 x 10	1920	400	1350	4	400	1600	5.5		525	1180
1800	72"	1820 x 10	1920				400	1600		8	550	
2000	80"	2020 x 12	2125	450	1350	4	450	1600	5.5		585	1550
2000	80"	2020 x 12	2125				450	1600		8	610	
2200	88"	2220 x 12	2335	500	1300	4	500	1600	5.5		740	1990
2200	88"	2220 x 12	2335				500	1600		8	770	
2400	96"	2420 x 12	3545	500	1300	4	500	1600	5.5		815	2420
2400	96"	2420 x 12	3545				500	1600		8	850	
2500**	100"	2620 x 12		500	1300	4	500	1600	5.5		885	2700
2500**	100"	2620 x 12					500	1600		8	920	

** not included in DIN 2632

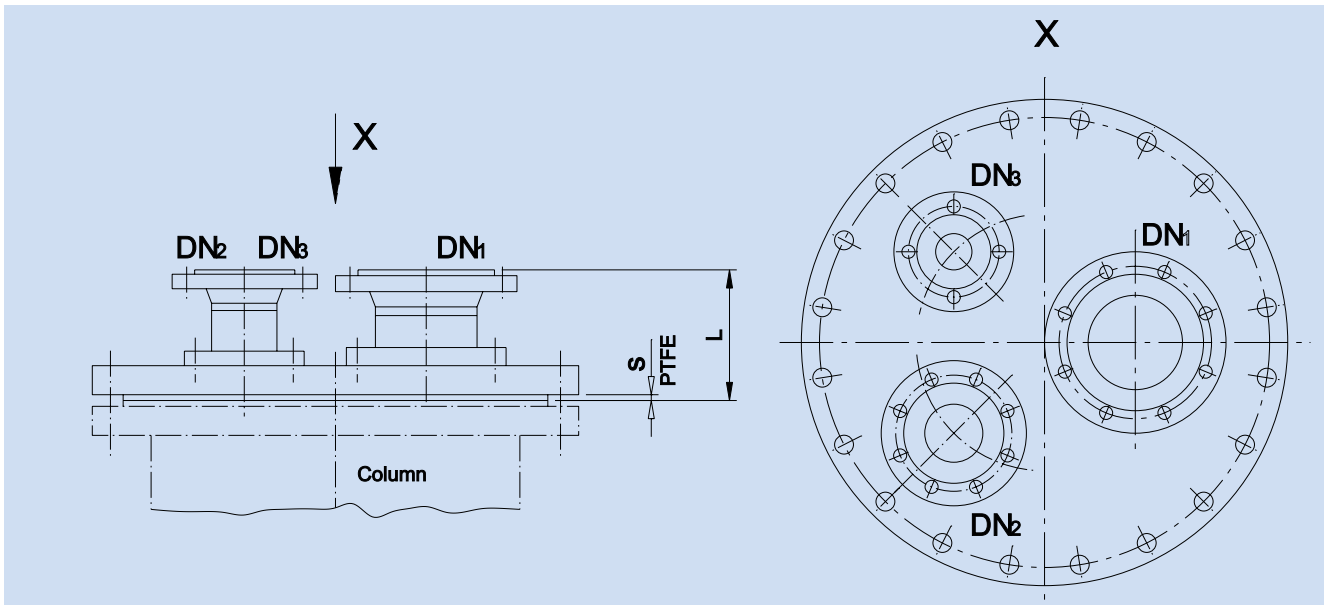
Subject to technical changes

PTFE-Lined Bottom and Top Plates

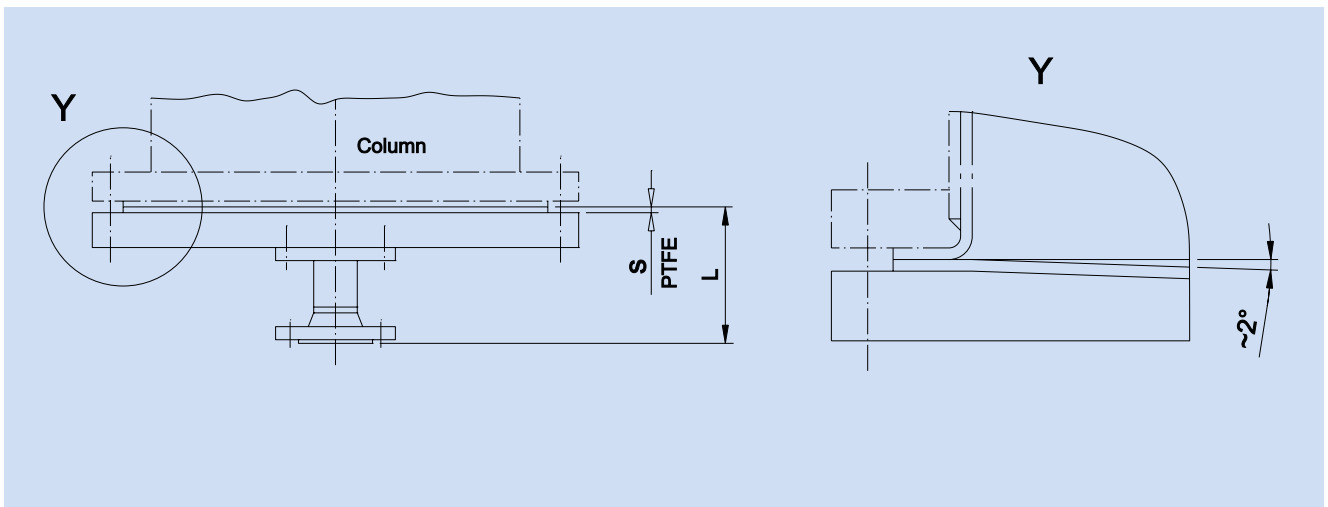
Flat solid bottom and top plates allow a plain but durable lining with LICUFLON or POLYFLURON PTFE. On request, the bottom plates can be produced in a slightly conical shape on the inside to facilitate drainage.

Lined bottom and top plates can be fitted with one or more nozzles. Nozzles with flange dimensions meeting DIN 2501 PN 10 or ASME B 16.5 150 lbs are supplied as standard. We welcome inquiries about special flange dimensions.

Examples:

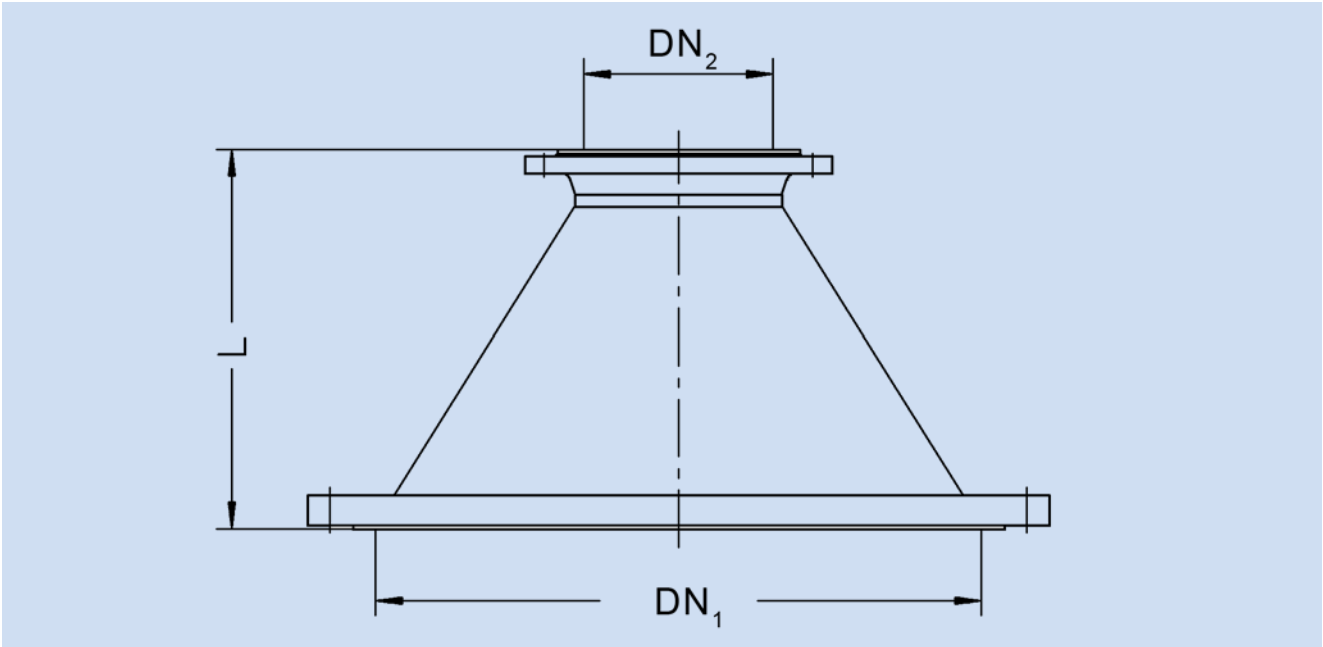


Optional:



Special-Design Bottom and Top Plates with LICUFLON® Lining

The LICUFLON PTFE lining allows for conical bottom and top plates.



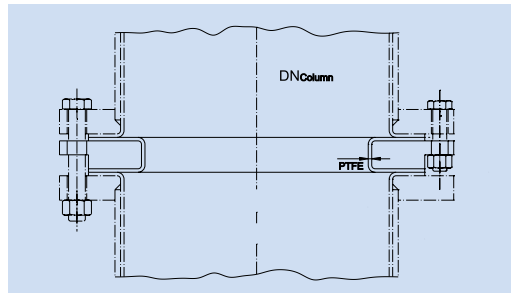
DN ₁ (nominal diameter)		DN ₂ (smallest diameter)					
		L = 500 mm		L = 750 mm		L = 1000 mm	
DIN	ASME	DIN	ASME	DIN	ASME	DIN	ASME
300	12"	250	10"	250	10"	250	10"
400	16"	250	10"	250	10"	250	10"
500	20"	250	10"	250	10"	250	10"
600	24"	250	10"	250	10"	250	10"
700	28"	300	12"	250	10"	250	10"
800	32"	300	12"	250	10"	250	10"
900	36"	300	12"	300	12"	300	12"
1000	40"	350	14"	300	12"	300	12"
1200	48"	400	16"	300	12"	300	12"
1400	56"	400	16"	350	14"	300	12"
1500	60"	500	20"	400	16"	350	14"
1600	64"	-	-	400	16"	350	14"
1800	72"	-	-	400	16"	350	14"
2000	80"	-	-	500	20"	400	16"
2200	88"	-	-	500	20"	400	16"

Subject to technical changes

Column Internals

Distributors and support grids are available in a wide range of designs and materials such as PTFE/ PFA (also available with steel core), DIABON® graphite and carbon fiber-reinforced carbon (C/C). Depending on the application and design involved, they can be either flanged direct between the column sections or placed on support rings, which are themselves flanged between two column sections.

Support rings are PTFE-lined steel rings bolted to the upper column section. This special design allows dismantling of the column without the need to remove the packing above or the distributor. Valuable time can thus be saved during maintenance work.



Dimensions of POLYFLURON® PTFE-lined support rings.
LICUFロン® PTFE-lined support rings are also available
in other dimensions.

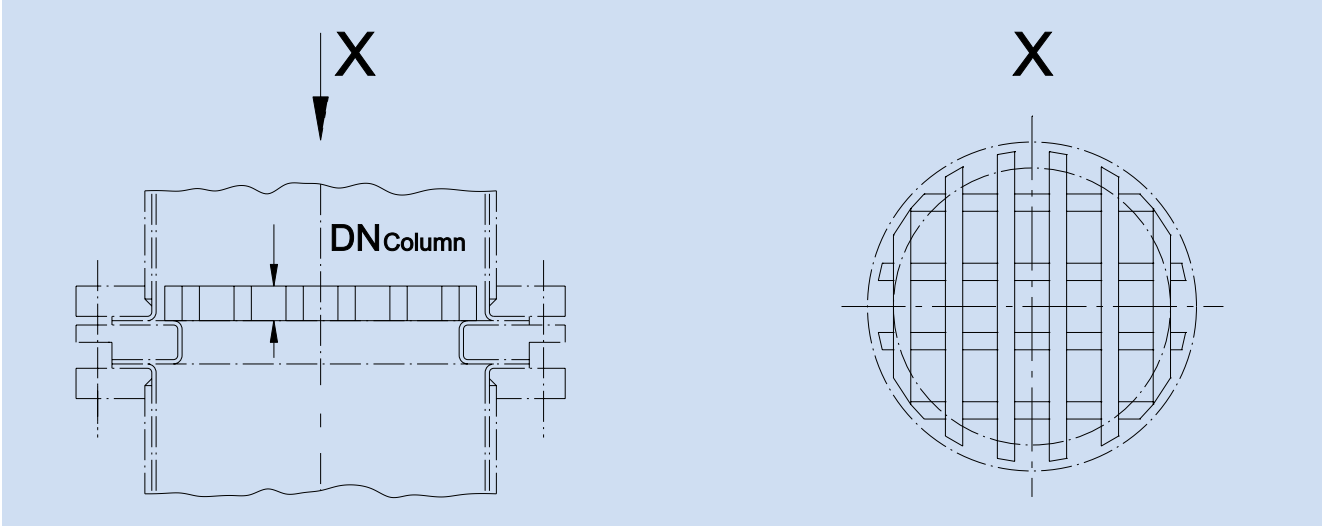
DN		L	~d	PTFE Flange d4	PTFE s	PTFE s	Weight
DIN	ASME						
mm	in.	mm	mm	mm	mm	mm	~kg
200	8"	34	150	268	4.5	6.5	12
		38	146				13
250	10"	40	200	320	5	8	17
			194				18
300	12"	40	250	370	5	8	21
			244				22
350	14"	40	270	430	5.5	8	29
			264				30
400	16"	40	310	482	5.5	8	34
			302				36
450*	18"	40	360	532	5.5	8	39
			354				41
500	20"	50	410	585	5.5	8	58
			404				60
600	24"	50	500	685	5.5	8	74
			494				76
700	28"	50	600	775	5.5	8	80
			594				83
800	32"	60	700	880	5.5	8	117
			694				120
900	36"	60	800	980	5.5	8	132
			794				136
1000	40"	60	900	1080	5.5	8	146
			894				150

Dimensions are based on flange connecting dimensions to DIN 2501 PN 10 and/or ASME B 16.5-150 lbs (from DN 28" to API Std. 605-150 lbs). Other flange dimensions and sizes on request. Subject to technical changes

Column Internals

Support grids are used to hold the mass transfer packing in place. They are available either in the form of interlocking PTFE supports (Fig. 1), or as PTFE-lined metal tubes, DIABON graphite or carbon fiber-reinforced carbon (CFC) supports for use at higher bearing loads and elevated temperatures.

Fig. 1:

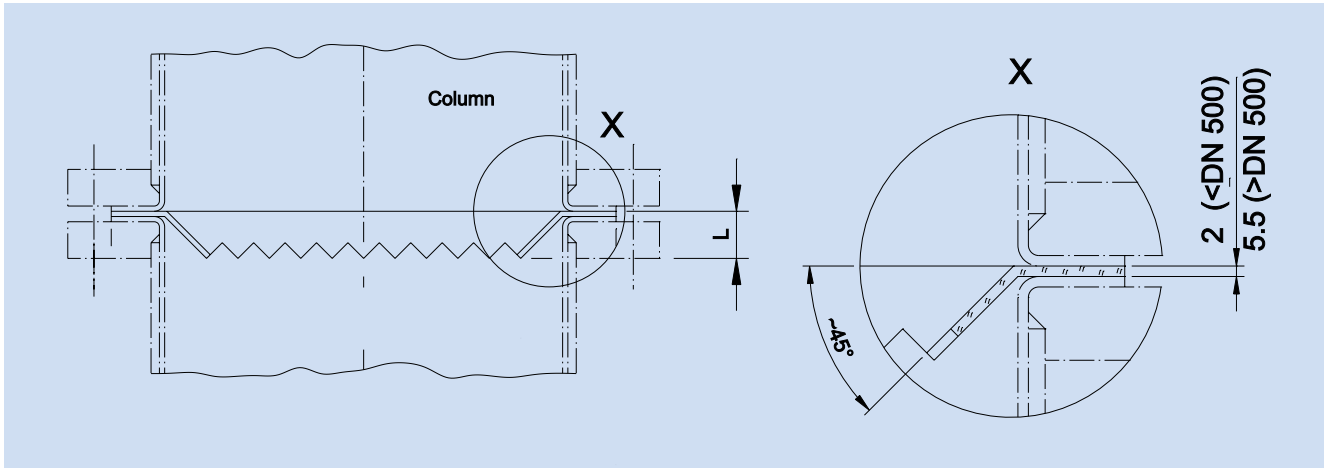


Both the distributor and redistributor are designed to meet the individual process requirements. The photos below show distributors made of PTFE and DIABON graphite.



Process Optimization and Process Design

One main reason for declining efficiency in columns with random or structured packings is poor liquid distribution (wall effect). PTFE downcomers as shown below are a suitable remedy and avoid the need for costly redistributors.



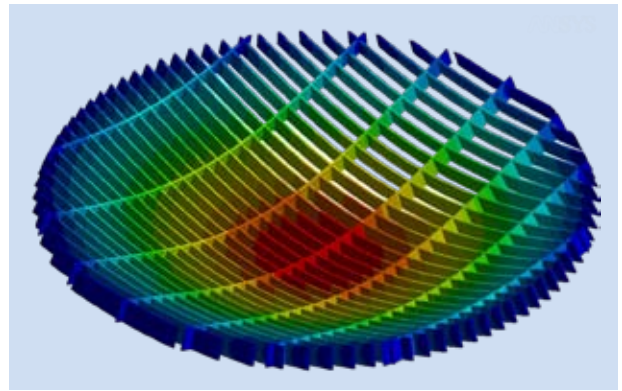
DN* Column	DIN mm	200	250	300	350	400	450	500	600	700	800	900	1000
	ASME In.	8"	10"	12"	14"	16"	18"	20"	24"	28"	32"	36"	40"
L mm	30	35	40	40	50	50	50	50	60	60	60	60	
d mm	130	170	210	240	270	325	375	480	555	655	755	855	
D4 DIN mm	268	320	370	430	482	532	585	685	800	905	1005		
D4 ASME mm	270	324	381	413	470	533	584	692	762	864	972		

Process Optimization and Process Design

Standard columns with mass transfer packings in the corrosive service have a bottle-neck at the support grids. Especially high packing beds in large diameter columns at high temperatures need strong support grids, which leads usually to small free flow cross-sections. The solution provides our support grid made of SIGRABOND® with large free flow cross-section due to the high specific strength and the wide corrosion resistance even at high temperatures.



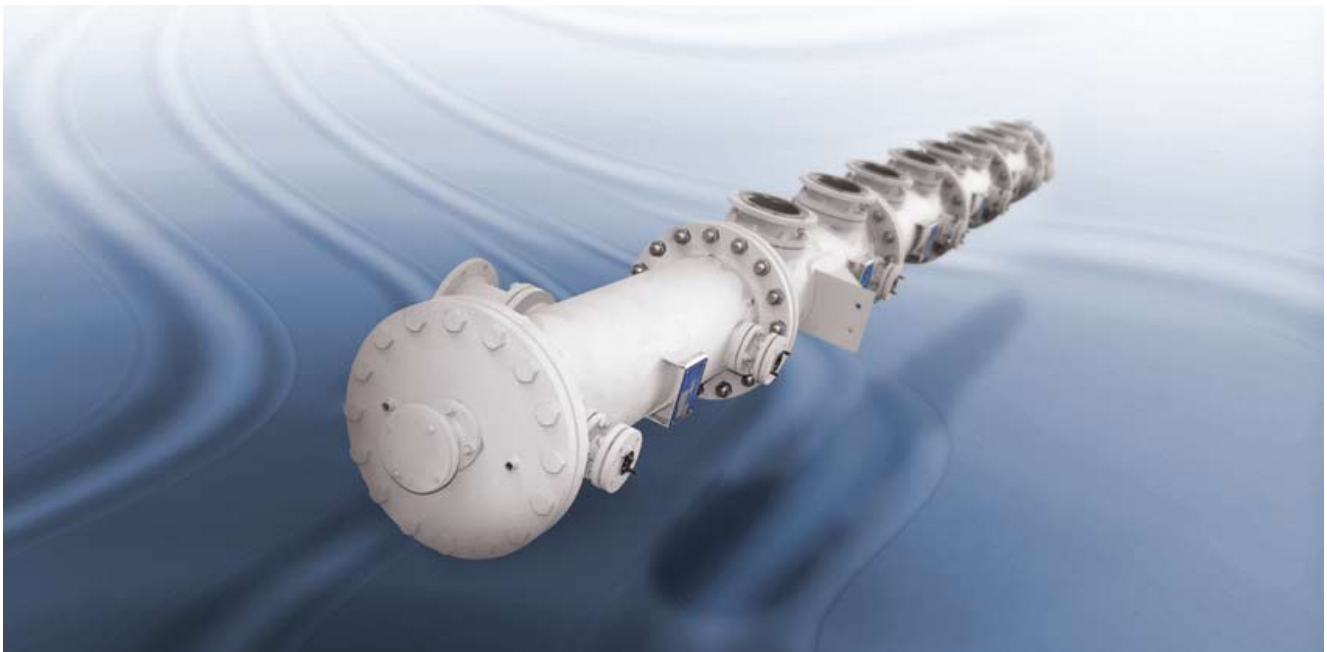
Segmented SIGRABOND® support grid



Finite Element Analysis for optimization

Process Design

Our computer-aided process simulation tools help us design our customers' lined columns with suitable mass transfer packings. Please contact us for details.



Anti-static POLYFLURON® PTFE-lined column

We Supply Complete Systems as Well



Besides individual high-quality components, we also supply complete systems for processing plants worldwide. A typical example of the processes handled with our complete systems is the production of HCl gas from hydrochloric acid. This process demands high corrosion resistance of the materials used, and also high standards of plant layout.

Many processes, such as the production of fumed silica (highly dispersed SiO_2) with the intermediate product SiCl_4 or the production of bisphenol, require HCl gas as feed. Besides direct synthesis from H_2 and Cl_2 , HCl gas can be produced by distillation of hydrochloric acid solution.

Desorption

HCl gas is produced by distillation of hydrochloric acid solution with a concentration of 25 – 35 % under pressure. For this purpose, the HCl solution is fed in at the top of a DIABON or LICUFLON/ POLYFLURON column.

The bottom product (azeotropic acid) has a concentration between 16 and 20 %, depending on process conditions. It can be fed back to the absorption process and preheats the highly concentrated acid feed in the DIABON interchanger (recuperator).

To minimize the consumption of steam and cooling water, the feed stream to the column is heated with hot azeotropic acid, e.g. in a DIABON plate heat exchanger serving as an interchanger (recuperator). The heat supply to the column can be ensured by an integrated DIABON falling-film evaporator or an external DIABON reboiler. An HCl-rich gas is generated at the top of the column.

Water is removed from the gas stream, thereby increasing the concentration of the HCl gas in the first DIABON condenser and in subsequent DIABON gas coolers. After passing through a LICUFLON/ POLYFLURON high-performance demister, a moisture content of 5 – 10 ppm in the product gas can ultimately be achieved.

Quality Management by Process Technology

As a manufacturer of carbon and graphite products, process equipment and systems for the chemical industry and environmental protection technology, SGL Group maintains a targeted quality management system designed to attain and meet the product quality standards demanded by customers. Our quality management system meets the requirements of DIN EN ISO 9001:2000 and Pressure Equipment Directive 97/23/EC Annex III, Module H/H1 and has been certified by the approved associations of DQS and TÜV SÜD. In process equipment construction, Quality Management is responsible for the testing and approval of semi-finished graphite products, impregnating resin, cement components, outsourced parts, process equipment and components.



Heat exchanger during pressure testing

Synthetic resin impregnation, cementing and assembly are all subject to continuous monitoring. Appropriate marking of the semi-finished graphite products before and after synthetic resin impregnation, during machining and thereafter until assembly of the complete equipment or plant provides comprehensive evidence of the semi-finished products employed. Consequently, they meet the traceability requirement of specification AD 2000-Merkblatt N2 for pressure vessels made from electrographite and hard burned carbon. The conditions for synthetic resin impregnation of the semi-finished graphite products and those for cementing of the components are stipulated, monitored and checked.

dence of the quality characteristics of the material grades yed, as required by specification AD 2000-Merkblatt N2, ded in a report issued by the testing laboratory of TÜV SÜD Service GmbH.



Process Technology Brochures

- ▶ Process Technology – We Combat Corrosion –
from Process Equipment and Components to Complex Systems
- ▶ DIABON® Graphite for Engineered Process Equipment
- ▶ DIABON® Shell and Tube Heat Exchangers
- ▶ DIABON® Block Heat Exchangers
- ▶ DIABON® Plate Heat Exchangers
- ▶ DIABON® Economizers for Heat Recovery
- ▶ DIABON® and LICUFLON® Columns and Column Internals
- ▶ DIABON® Hydrogen Chloride Synthesis Plants
- ▶ DIABON® and Exotic Metal Pumps
- ▶ DIABON® Safety Disks
- ▶ Systems – Solutions for Corrosive Processes
- ▶ ECOPOR® Porous Reactors
- ▶ FLUROFLEX® POLYFLURON® PTFE Bellows DIN/ASME
- ▶ FLUROPIPE® ANJA Safety Tapes
- ▶ FLUROPIPE® POLYFLURON® PTFE-lined Steel Pipes and Fittings, DIN
- ▶ FLUROPIPE® POLYFLURON® PTFE-lined Steel Pipes and Fittings, ASME
- ▶ FLUROPIPE® POLYFLURON® PTFE-lined Dip Pipes, DIN/ASME
- ▶ FLUROSIC® Silicon Carbide Plate Heat Exchanger
- ▶ FLUROSIC® Silicon Carbide Shell and Tube Heat Exchangers

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The data contained herein represent the current state of our product knowledge and are intended to provide general information on our products and their application spectra. In view of the variety and large number of application possibilities, these data should be regarded merely as general information that gives no guarantee of any specific properties and/or suitability of those products for any particular application. Consequently, when ordering a product, please contact us for specific information on the properties required for the application concerned. On request, our technical service will supply a profile of characteristics for your specific application requirements without delay.

Process Technology

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