PFAUDLER

Glass-Lined Technology

Heat Exchangers

SCO with silicon carbide tubes, glass lined

GMM Pfaudler

PFAUDLER

Glass-Lined Technology

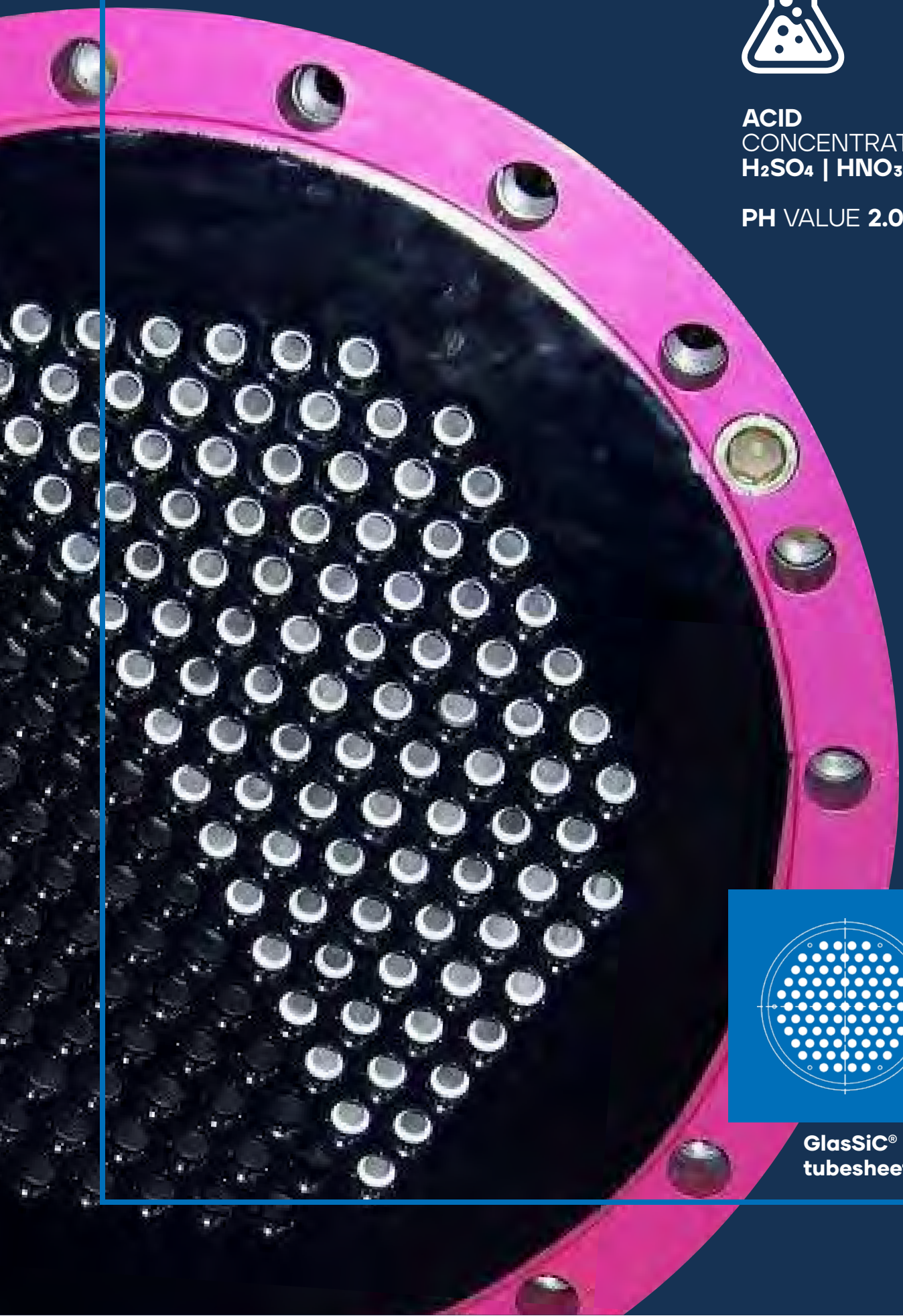
For over 130 years, Pfaudler is the leader in developing new technologies to meet the highly specific chemical processing needs of its clients. One reason why our glass-lined equipment is trusted by over 90% of the world's top chemical companies is the sheer reliability of our reaction technologies and comprehensiveness of our glass-lined accessories. These technologies are critical to the safe containment of corrosive contents, maintaining the vessel pressure and ensuring the final batch quality.

In short, our glass-lined technologies are absolutely integral to an effective process.

PRODUCTS & EQUIPMENT

- Glass Lined Reactors
- Glass Lined Mixing Systems
- Baffling Technologies
- Storage Tanks & Receivers
- Glass Lined Columns
- Accessories
- Glass Lined Instrumentation
- Glass Lined Heat & Mass Transfer


50/5/50t



ACID
CONCENTRATION
H_2SO_4 | HNO_3

PH VALUE **2.0**

GlasSiC®
tubesheet

SCO
Heat Exchangers

Glass-lined with silicon carbide tube bundle

The SCO series is a range of high efficiency glass-lined heat exchangers, with silicon carbide tube bundle for use with highly corrosive fluids.

Typical application
The SCO heat exchanger is well suited for a very wide variety of uses: heating, cooling, evaporating and condensing.

Heat transfer surface
0,3 to 73 m2 (3 to 788 sq.ft)

Construction design
The SCO heat exchanger design is based on the traditional shell and tube with fixed tube sheets configuration.

Tube sheets and design data
The tube sheets can be supplied into two versions: either PTFE or glass-lined. The version with PTFE tube sheets has the following operating range (tube and shell side):
Dimensions: Max. DN 300 (12")
Pressure: -1 to 6 bar (FV to 90 PSIG)
Temperature: -30 °C to +165 °C.
**

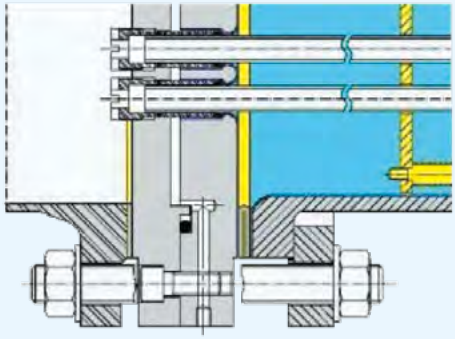
The **GlasSiC®** version has glass-lined tubesheets with a wider operation range:
Dimensions: Max. DN 300 (12").
Pressure: -1 to 6 bar (FV to 90 PSIG)
Temperature: -30°C to +200 °C. **
The tube sheets of the **GlasSiC®** version can be double to prevent any contact between product and heating or cooling media in the event of leakage in the joints between tubes and tubesheet. This double tubesheet is provided with a leak collectiong circuit that can be alarmed to give instantaneous warning of leakage. The double tube sheets can be supplied with the glass-lining on shellside, tubeside or both.
(*) (**)

Design and calculation codes
VSR/ISPESL, AD-Merkblätter/TÜV, SVTI, ASME VIII div. 1, CE stamp (PED).

Construction tolerances
To DIN 28006 T2

Thermal design
On request, our Eng. Dep. can provide also the thermal design, using the most advanced software available today. A "Heat Exchanger Specification Sheet" is available for your process data communication.

PTFE tubesheet



* For larger size or different design data, please contact Pfaudler.

** Design temperature according to product and medium type.

SCO Heat Exchangers

Glass-lined with silicon carbide tube bundle

Constructional features

- The bundle is formed by Hexoloy® SA tubes (a special type of silicon carbide).
- The shell and heads can be in glass-lined steel, stainless steel or carbon steel depending on the corrosiveness of the process fluid.
- The corrosive fluid can flow in the shell side, tube side or both at the same time. If there is no particular necessity, shellside flow is preferred.
- Each tube is fixed individually to the tubesheet by a special system with double O-Rings. This permits very high operating pressures and wide temperature variations. The tubes are free to expand or to contract but their movement is limited within the sleeves pressing the O-Rings.
- The heat transfer on the shellside is optimized by baffles which also support the tubes to minimize their vibration. Baffles, spacers and tie-rods are of glass-reinforced PTFE.
- FDA approval on request .

Special versions

Multipass tube side
Multipass shell side

Glass-lining

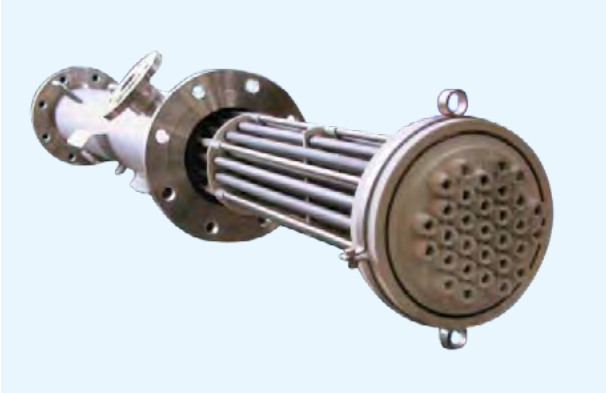
Shell and/or distributors: Standard glass
Available also specialized for specific requirements (impact, resistance, abrasion resistance, non-stick properties, etc.).
More specific data can be obtained from our Laboratories.

Test and inspection of the glass-lining

- Visual inspection
- Thickness check of the coating
- Statiflux (electrified particle test)
- Spark test to ISO 2746:
  - at 20.000 V immediately after glass-lining
  - at 12.000 V prior to shipment

Installation and supports

- Vertical on brackets
- Horizontal or inclined on saddles



SCO Heat Exchangers

Hexoloy® SA SiC tube bundle

The Hexoloy® SA used for the heat exchanger tubes is produced by pressureless sintering of ultra-pure submicron alpha silicon carbide powder.
The sintering process (above 2000 °C) resultes in self-bonded, fine grain (less than 10µm) SiC product which is extremely hard, lightweight, virtually not porous, with an as-fired finish and a greater than 98% theoretical density.
Hexoloy® SA is highly resistant to corrosion, erosion, sliding wear, high temperature and thermal shock.
Thanks to its exceptional physical and chemical properties the Hexoloy® SA can be used for critical applications where it can replace at the same time ceramics or high alloy.

Corrosion resistance

Hexology® SA contains no free silicon, which makes it highly chemically resistant in both oxidizing and reducing environments. The virtually universal corrosion resistance of Hexoloy® SA permits superior performance in environments of hot gases and liquids including strong acids and bases, even at extremely high temperatures.

Erosion resistance

Hexoloy® SA is one of the hardest high performance materials available: second only to diamonds, 50% harder than tungsten carbide and ten times harder than conventional stainless steel.
This extreme hardness combined with high purity and fine micro-structure made Hexoloy® SA particularly resistant to wear and erosion under mechanically abrasive conditions.

Thermal properties

The thermal conductivity is so high that makes the SiC wall as virtually non-existent in resisting heat transfer processes. Because of this high thermal conductivity combined with a low coefficient of thermal expansion, Hexoloy® SA is very resistant to thermal shock and will survive rapid thermal cycling as compared to conventional materials.

Mechanical properties

Hexoloy® SA exhibits excellent strength at room temperature and maintains that strength even at elevated temperatures due to its single phase fine grain structure. Hexoloy® SA's compressive strength is 10 times greater than its tensile strength.

SCO Heat Exchangers

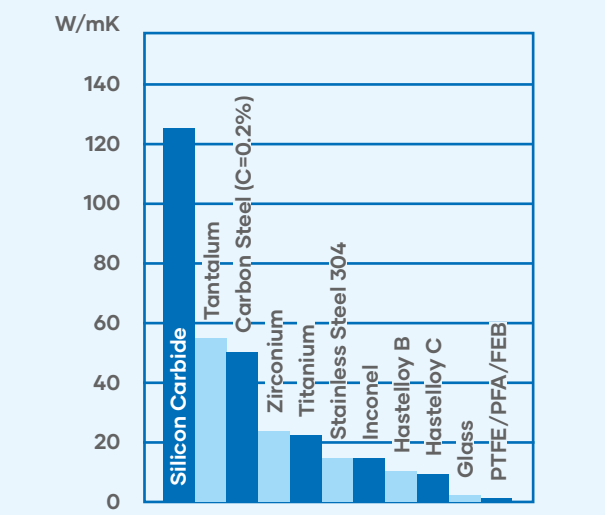
Hexoloy® SA SiC: Properties and data

Physical properties of Hexoloy® SA tubes (at room temperature)

Density	kg/dm³	3,1	lb/in³	0,112
Flexural strength	N/mm²	462	psi	67*10³
Compressive strength	N/mm²	3.860	psi	560*10³
Modulus of elasticity	N/mm²	406.800	psi	59*10⁶
Knoop hardness	N/mm²	28.000	psi	3,98*10⁶
Poisson ratio	–	0,14	–	0,14
Thermal conductivity @ 20 °C	W/mK	125,6	Btu/ft h °F	72,6
Thermal conductivity @ 200 °C	W/mK	102,6	Btu/ft h °F	59,3
Mean specific heat	KJ/kgK	0,67	Btu/lb °F	0,16
Coefficient of thermal expansion	1/°C	3,96*10⁻⁶	1/°F	2,2*10⁻⁶
Thermal shock	°C	>260	°F	>500
Permeability R to 1000 °C	Impervious to gases over 31 MPa			
Erosion/Abrasion	50% harder than Tungsten Carbide			

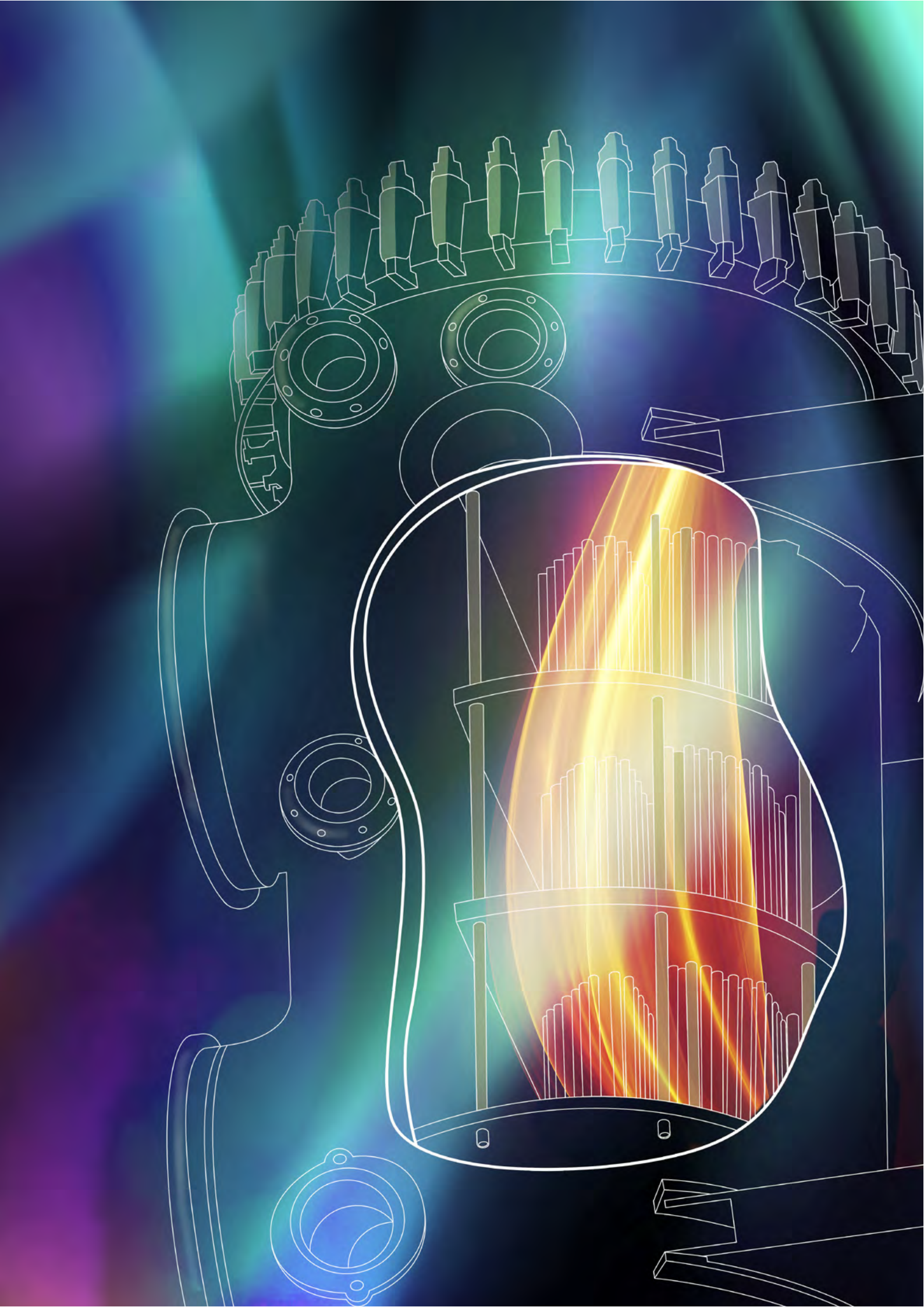
The thermal conductivity of SiC in comparison with other materials

Materials	Thermal conductivity	
	W/mK	Btu/ft h °F
Silicon Carbide	125,6	72,6
Tantalum	54,5	31,5
Carbon Steel (C=0.2%)	50	28,9
Zirconium	23,8	13,8
Titanium	22	12,7
Stainless steel 304	15	8,7
Inconel	15	8,7
Hastelloy B	11,2	6,48
Hastelloy C	10,1	5,84
Glass	1,16	0,67
PTFE/PFA/FEP	0,225... 0,467	0,13... 0,27



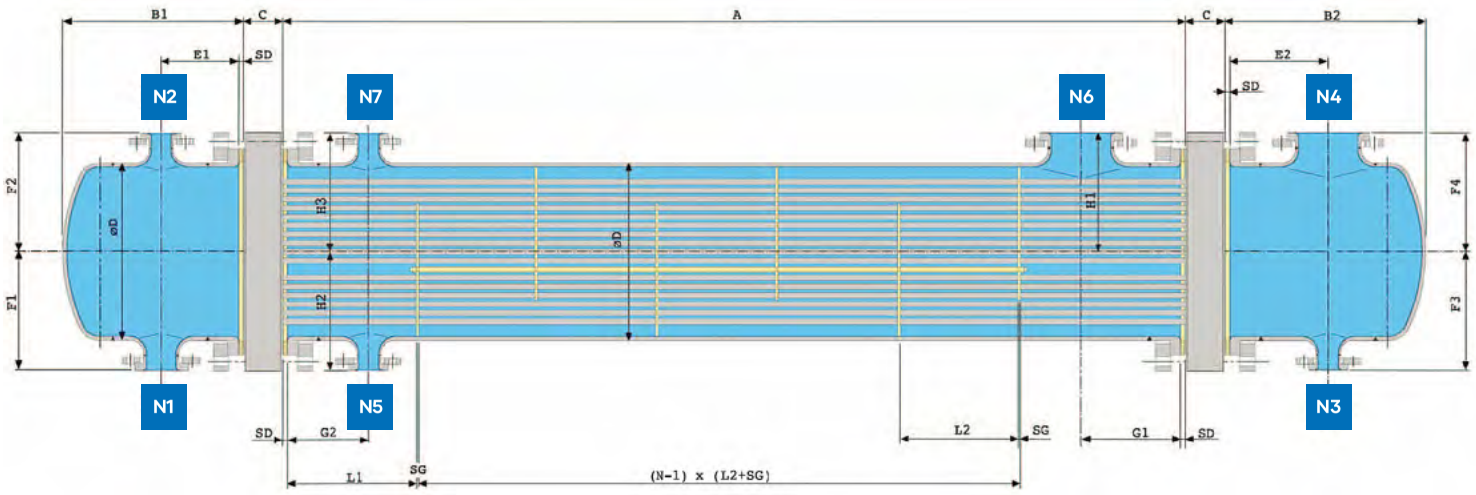
Tubes features

- High thermal conductivity (very high heat transfer coefficient and very wide thermal shock limits)
- Virtually universal corrosion resistance (even up to 200 °C)
- Do not contain any binder (high purity, no contamination)
- Extreme hardness (high erosion and wear resistance)
- No porosity (total non-permeability at extreme temperature and pressure)
- Anti-stick property (minimize scaling and fouling)
- Every single tube is proof tested with a pressure of 186 bar (2700 psi)
- Material approved by:
  - FDA (Food and Drug Administration)
  - WRC (Water Research Center)
  - DVGW (Deutsche Vereinigung des Gas- und Wasserfaches, German Federal Health Office)



SCO GlasSiC® Series

With glass-lined tube sheets

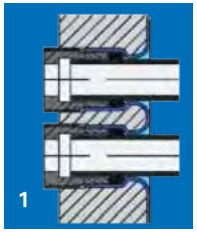


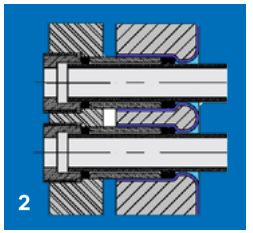
SiC tube – glasslined tubesheet connections

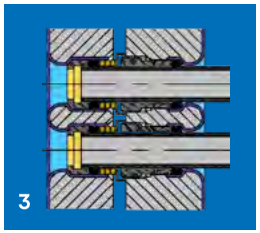
Fig. 1: Simple tubesheet shellside glass-lining

Fig. 2: Double tubesheet shellside glass-lining

Fig. 3: Double tubesheet shellside and tubeside glass-lining







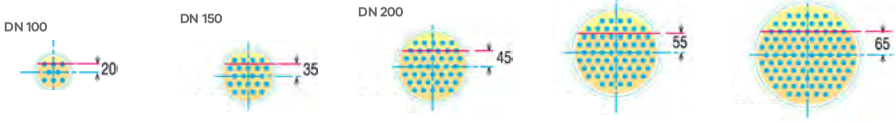
Dimensions																							Nozzles						
DN	tube	OTL	A	B1	B2	C	D	E1	E2	F1	F2	F3	F4	G1	G2	H1	H2	H3	L1	L2	N	SD	SG	N1	N2	N3	N4	N5	N6	N7
	no.	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	no.	DN	DN	DN	DN	DN	DN	DN
100	8	90,79		260	260	59	114,3	125	125	130	125	125	130	130	110	135	125	125	160			5	5	40	25	25	40	25	50	25
150	22	141,15		290	290	59	168,3	135	135	165	150	150	165	160	135	170	165	150	200			7	5	50	25	25	50	50	80	25
200	42	192,49		330	330	59	219,1	150	150	190	180	180	190	180	145	200	190	180	210			7	6	50	25	25	50	50	100	25
250	64	234,82		400	400	59	273,0	170	170	225	205	205	225	220	170	225	225	205	260			7	6	80	25	25	80	80	150	25
300	96	285,87		410	410	69	323,8	175	175	250	230	230	270	220	175	260	250	230	265			10	8	80	32	32	80	80	150	32

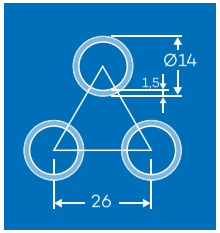
A = L - 2 x (C-14,5) Effective tube length						
DN	L (mm)				Tube length	
	750	1000	1250	1750	2500	3000
100	661	911	1161	1661		
150		911	1161	1661	2411	
200		911	1161	1661	2411	2911
250			1161	1661	2411	2911
300				1641	2391	2891

Heat transfer surface m²						
DN	L (mm)				Tube length	
	750	1000	1250	1750	2500	3000
100	0,23	0,32	0,42	0,58		
150		0,88	1,12	1,61	2,33	
200		1,68	2,14	3,07	4,45	5,38
250			3,27	4,68	6,79	8,19
300				6,93	10,10	12,21

L2 Baffle distance						
DN	L (mm)			Tube length		
	750	1000	1250	1750	2500	3000
100	92	103	108	94		
150		85	95	104	109	
200		130	125	122	121	120
250			170	141	156	146
300				192	186	196

N Baffle numbers						
DN	L (mm)			Tube length		
	750	1000	1250	1750	2500	3000
100	4	6	8	14		
150		6	8	12	18	
200		4	6	10	16	20
250			4	8	12	16
300				6	10	12

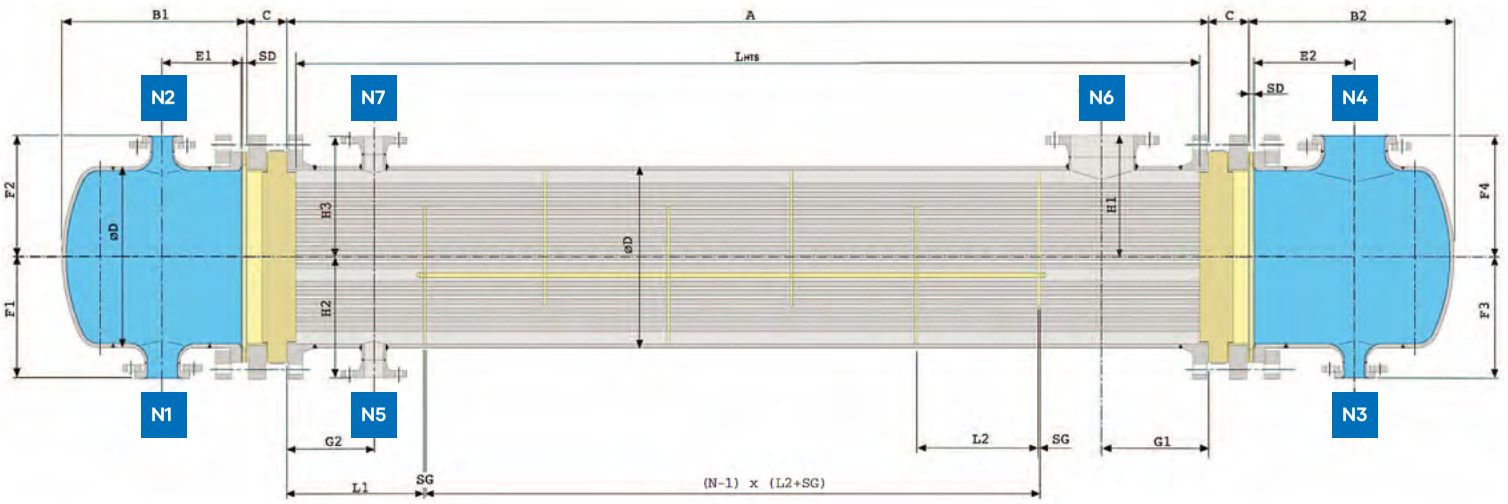




Tube dimensions, layout and pitch

SCO Series

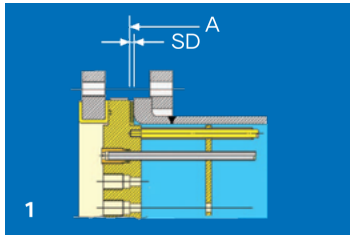
With PTFE tube sheets

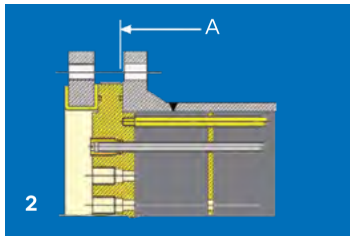


Main flanged connection

Fig. 1: Shell in glass-lined steel

Fig. 2: Shell in carbon steel or stainless steel





Dimensions																Nozzles								
DN	tube no.	OTL mm	A mm	B1 mm	B2 mm	C mm	D mm	E1 mm	E2 mm	F1 mm	F2 mm	F3 mm	F4 mm	G1 mm	G2 mm	DN	H1 mm	H2 mm	H3 mm	L1 mm	L2 mm	L_{HTS} mm	N mm	SD mm	SG no.	N1 DN	N2 DN	N3 DN	N4 DN	N5 DN	N6 DN	N7 DN
100	13	94		260	260	70	114,3	125	125	130	125	125	130	130	110	100	135	125	125	160				5	5	40	25	25	40	25	50	25
150	31	136		290	290	80	168,3	135	135	165	150	150	165	160	135	150	170	165	150	200				7	5	50	25	25	50	50	80	25
200	55	180		330	330	94	219,1	150	150	190	180	180	190	180	145	200	200	190	180	210				7	6	50	25	25	50	50	100	25
250	85	225		400	400	102	273,0	170	170	225	205	205	225	220	170	250	225	225	205	260				7	6	80	25	25	80	80	150	25
300	139	294		410	410	120	323,8	175	175	250	230	230	270	220	175	300	260	250	230	265				10	8	80	32	32	80	80	150	32

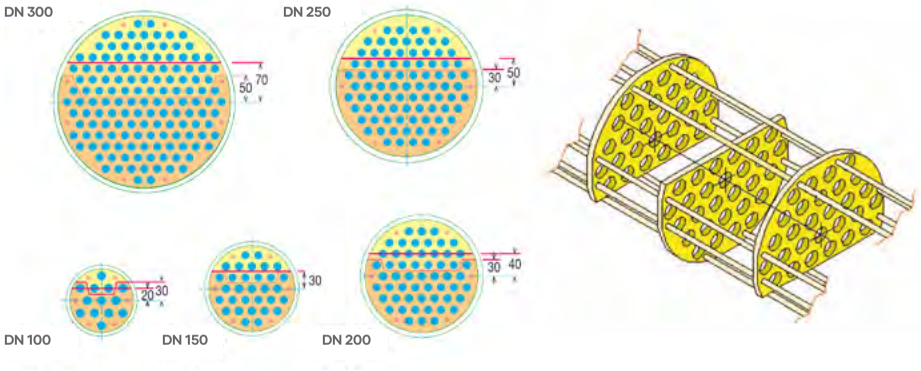
L_{HTS} (Effective tube length)						
DN	L (mm) Tube length 750	1000	1250	1750	2500	3000
100	670	920	1170	1670		
150		892	1142	1642	2392	
200		864	1114	1614	2364	2864
250			1086	1586	2336	2836
300				1554	2304	2804

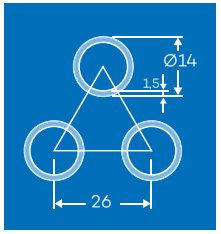
Heat transfer surface m^2						
DN	L (mm) Tube length 750	1000	1250	1750	2500	3000
100	0,38	0,53	0,67	0,95		
150		1,22	1,56	2,24	3,26	
200		2,09	2,69	3,90	5,72	6,93
250			4,06	5,93	8,73	10,60
300				9,50	14,09	17,14

N Baffle numbers						
DN	L (mm) Tube length 750	1000	1250	1750	2500	3000
100	4	6	8	14		
150		6	8	12	18	
200		4	6	10	16	20
250			4	8	12	16
300				6	10	12

L2 Baffle distance						
DN	L (mm) Tube length 750	1000	1250	1750	2500	3000
100	102	110	112	96		
150		87	96	105	110	
200		125	123	120	120	120
250			157	136	152	144
300				184	182	193

A						
DN	L (mm) Tube length 750	1000	1250	1750	2500	3000
100	684	934	1184	1684		
150		910	1160	1660	2410	
200		884	1134	1634	2384	2884
250			1112	1612	2362	2862
300				1584	2334	2834





Tube dimensions, layout and pitch

Worldwide Presence

GMM Pfaudler

GMM Pfaudler is a global leader in corrosion-resistant technologies, systems, and services for the chemical, pharmaceutical, food and energy industry.

Our Branded Product Lines that include PFAUDLER, NORMAG, MAVAG, MIXION, INTERSEAL, EQUILLOY, EDLON and HYDROAIR showcase our strength as a group, our capabilities, and our pursuit for constant innovation. With an end-to-end solutions-oriented approach, a global footprint, and a perfectly integrated offering system we are able to meet complex industry demands worldwide.

GMM Pfaudler is driven by 1800+ individuals across 4 continents and 16 global manufacturing facilities around the world. The Group's targeted investments in strategic markets, innovation and competitiveness paves the way forward for GMM Pfaudler's continued legacy.

80+
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1800+
Employees

04
Continents

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3 - 6E | 05/2023