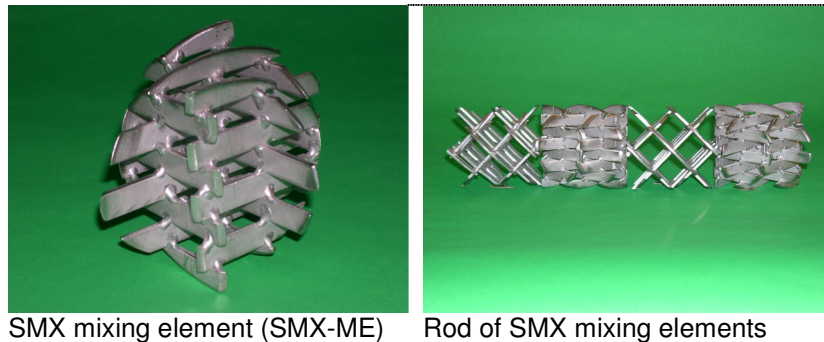


Static SMX Mixing Elements for Mixing/Dispersing of Viscous Fluids



SMX mixing element (SMX-ME)

Rod of SMX mixing elements

Characteristics of the SMX Mixers

Since more than 25 years static SMX mixers are successfully used for mixing and/or dispersing of viscous fluids. They mix efficiently liquids of equal and/or very different viscosity to the degree of homogeneity as required by the specific application.

The design of the SMX static mixer is made to customers needs considering flow rates, viscosities, pressure drop, homogeneity required, etc. of the mixing duty. With the tables 1 and 2 below the number of SMX mixing elements required for a certain application can be selected.

Usually the SMX mixing elements are welded to one or two rods which is/are inserted into a pipe and fixed. It assures a correct orientation of neighbouring elements and simplifies the mixer assembling / disassembling.

Required number of SMX mixing elements for mixing at laminar flow conditions*

Mixing ratio of components A : B	Viscosity ratio of components A : B	Pre-mixing (mixing degree 80%) CoV** = 0.2	Good homogeneity (mixing degree 95%) CoV = 0.05	Very good homogeneity (mixing degree 99%) CoV = 0.01
1 : 1	1 : 1 – 100 : 1	4	6-7	9-10
9 : 1	1 : 1 – 100 : 1	6	9	12
99 : 1	1 : 1 – 100 : 1	9	12	15

Table 1

**CoV = Coefficient of variation of mixing

*The numbers of mixing elements given above are approximate. They can deviate from the given values depending on the viscosity behaviour of the media to be mixed. The validity of the table is limited to media which are under operating conditions in every mixing ratio completely soluble in each other.

If the viscosity ratio component A : component B is >100 : 1 (high viscous : low viscous), the numbers of mixing elements mentioned in table 1 have to be increased by the number of mixing elements mentioned in the table 2 below.

Viscosity ratio A : B	>100 - 300	>300 – 1'000	>1'000 – 3'000	>3'000 – 10'000
Additional SMX ME required	2-3	3	3-4	4

Table 2

Calculation of the Pressure drop

$$\Delta p [\text{bar}] = K \times \text{Total Flow Rate} [\text{m}^3/\text{h}] \times \text{Viscosity of the Mixture} [\text{Pas}] \times \text{Number of SMX-ME}$$

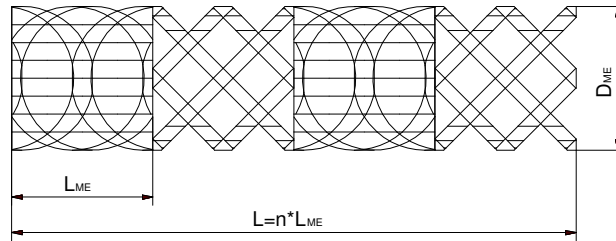
In case of non-newtonian liquids/melts the viscosity is depending on the shear-rate. Therefore, for the pressure drop calculation the viscosity corresponding to shear-rate in the mixer has to be used.

The shear-rate "Gamma" is calculated as follows:

$$\text{Gamma} [\text{s}^{-1}] = K_G \times \text{Total Flow Rate} [\text{m}^3/\text{h}]$$

K and K_G : See on next page, table 3 "Dimensions of the SMX Mixing Elements"

Dimensions of the SMX Mixing Elements

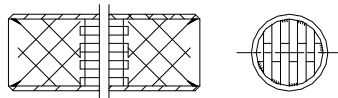


Nominal Pipe Size		Standard-Pipe Dimension			Data of Mixing Element								
DN / NPS		O.D.	s _w	D _i	D _{ME}	L _{ME}	ε	K	K _G	Δp _{max. all.} [bar]		Item No.	
mm	in	mm	mm	mm	mm	mm	[-]	bar x (Pas x m ³ /h) ⁻¹	s ⁻¹ x (m ³ /h) ⁻¹	100°C	300°C		
40	1 1/2	48.3	3.7	40.9	40.2	40.6	0.88	0.065	275.7	32	25	X-040	
50	2	60.3	3.9	52.5	52.0	52.5	0.88	0.0315	132.3	34	27	X-050	
65	2 1/2	76.1	3.6	68.9	68.2	69	0.91	0.012	53.4	19	15	X-065	
80	3	88.9	5.5	77.9	77.1	78	0.90	0.00976	38.1	24	18	X-078	
80	3	88.9	4.05	80.8	80.0	80	0.91	0.0085	33.6	22	17	X-080	
100	4	114.3	6.0	102.3	101.3	102	0.91	0.00368	16.4	20	15	X-100	
125	5	141.3	6.6	128.2	126.9	128	0.90	0.00193	8.49	22	17	X-125	
150	6	168.3	7.1	154.1	153.0	154	0.90	0.00113	4.63	24	19	X-150	
200	8	219.1	8.2	202.7	200.7	203	0.91	0.000475	2.11	20	15	X-200	
250	10	273.1	9.3	254.5	252.0	255	0.90	0.000247	1.09	23	18	X-250	
300	12	323.8	9.6	304.6	301.6	299	0.89	0.000158	0.64	25	20	X-300	

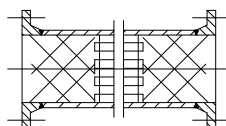
Table 3 ε = Void fraction; K = Coefficient for calculation of the pressure drop at laminar flow conditions; K_G = Coefficient for calculation of the shear-rate in the mixer; Δp_{max. allowable} for material DIN 1.4571 = AISI 316 Ti. The values given in table 3 are for ME under pressure load conditions; in case of tensile load conditions the max. allowable values are 50% only.

Installation of the Mixing Element into Mixer Housings

non removable

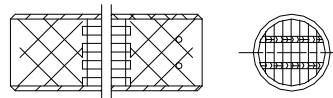


Bars of ME on inlet and outlet side welded to the pipe wall

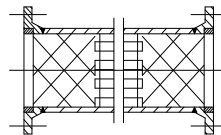


Bars of ME on inlet and outlet side welded to the pipe wall

removable



On outlet side two round pins as support are welded into the pipe



ME welded to two (2) rods, each rod welded to a ring, rings countersunk into a recess of the flanges

Pipe with welding ends

Pipe with flanges

Mixer Length

Nom. Size		Pipe Dimension			Length of Mixer L with:					
DN / NPS		O.D.	s _w	D _i	3 ME	6 ME	9 ME	12 ME	15 ME	18 ME
mm	in	mm	mm	mm	mm	mm	mm	mm	mm	mm
40	1 1/2	48.3	3.7	40.9	140	260	380	505	625	745
50	2	60.3	3.9	52.5	175	330	485	640	800	955
65	2 1/2	76.1	3.6	68.9	220	430	640	850	1065	1275
80	3	88.9	5.5	77.9	250	490	725	960	1200	1440
80	3	88.9	4.05	80.8	260	500	740	980	1220	1460
100	4	114.3	6.0	102.3	330	635	950	1260	1570	1880
125	5	141.3	6.6	128.2	400	790	1175	1570	1960	2350
150	6	168.3	7.1	154.1	490	960	1425	1890	2360	2825
200	8	219.1	8.2	202.7	625	1240	1860	2475	3090	3710
250	10	273.1	9.3	254.5	785	1555	2340	3120	3880	4655
300	12	323.8	9.6	304.6	920	1840	2750	3660	4570	5480

Table 4

Mixer Design Calculation Example

	Item	Value-No.	Unit	Value		
Process Data:						
Component A	Mass flow rate	V1	kg/h	1200		
	Density	V2	kg/ m ³	900		
	Volume flow rate	V3	m ³ /h	1.33		
	Viscosity	V4	Pas	10		
Component B	Mass flow rate	V5	kg/h	133		
	Density	V6	kg/ m ³	1000		
	Volume flow rate	V7	m ³ /h	0.133		
	Viscosity	V8	Pas	0.02		
Mixture	Mass flow rate (= A + B)	V9	kg/h	1333		
	Density	V10	kg/ m ³	911		
	Volume flow rate (= A + B)	V11	m ³ /h	1.463		
	Viscosity	V12	Pas	7.5		
	Homogeneity CoV	V13	[-]	0.05		
	Pressure drop (max.)	V14	bar	5		
	Required / preferred pipe diameter	V15	DN (mm)	50		
Calculations:						
Conversion of mass flow into volume flow	Mass flow / density	= V1/V2 = V5/V6				
Mixing ratio A:B	Volume flow rate comp. A: Volume flow rate comp. B	= V3 : V7	1.33 / 0.133	10		
Viscosity ratio A:B	Viscosity comp. A : Viscosity comp. B	= V4 : V8	10 / 0.02	500		
Number of SMX-ME	for mixing ratio 9 : 1 and viscosity ratio 1:1 to 100:1	from Table 1		9		
Additional SMX-ME	For viscosity ratio >300 :1'000	from Table 2		3		
Total no. SMX-ME		V16		12		
Pressure drop	<i>for newtonian liquids / melts</i>					
	Coefficient K for DN 50 / NPS 2"	from Table 3 for V15		0.0315		
	Pressure drop Δp <i>without safety margin</i>	= K x V11 x V12 x V16	bar	4.15		
Pressure drop	<i>for non-newtonian liquids / melts</i>					
	Coefficient K _G for shear- rate „Gamma“	from Table 3 for V15		132.5		
	„Gamma“	= K _G x V11	s ⁻¹	193.8		
	Viscosity	V17 → from flow curves of components	Pas			
	Pressure drop Δp <i>without safety margin</i>	= K x V11 x V17 x V16	bar			
Check	Pressure drop Δp calcul. ≤ $\Delta p_{\text{max. allowable}}$ ME	$\Delta p_{\text{max.all.}}$ ME from Table 3	bar	4.15 ≤ 27 → OK		
L for ME only	for 12 SMX-ME DN 50	from Table 3	mm	630		
L with mixer pipe	for 12 SMX-ME DN 50	from Table 4	mm	640		

Table 5

- In case where instead of the pipe diameter the max. allowable pressure drop of the application is specified, the calculation has to be repeated using different nominal pipe sizes until the resulting pressure drop is within the specified range.
- The tolerance of the calculated pressure drop is +/- 25%. Therefore, in most cases a safety margin of 25% is added to the calculated pressure drop.
- In case a specified nominal pipe size can not be changed but the resulting pressure drop is above the max. allowable value given for the ME in table 3, please contact StaMixCo Technology Ltd. In most cases the problem can be solved by applying a special installation method of the ME.

Price List for SMX-Mixers of STAMIXCO TECHNOLOGY LTD.

Valid from October 1, 2004

Price basis: unpacked ex works, in EURO, VAT excluded, payment within 30 days upon date of invoice, net.

Material: ME: DIN 1.4571/ AISI 316 Ti; Pipe, flanges: DIN 1.4404/AISI 316L

Dimensions: Pipe diameter and ME dimensions acc. to table 3, length of pipe acc. to table 4

Delivery ex works upon receipt of order:

- for mixing elements with item-no.: 1 to 4 weeks, depending on size and actual stock

- for complete mixers (ME with mixer pipe): 2 – 6 weeks, depending on size and design

Nominal pipe size	DN	40	50	65	80	80	100	125	150	200	250	300
	NPS	1 ½	2	2 ½	3	3	4	5	6	8	10	12
Mixing elements (= ME) SMX:												
- Item-no. ME SMX	X-	040	050	065	078	080	100	125	150	200	250	300
- per 1 pcs. ME SMX	EURO	125	165	230	290	290	400	545	685	1065	1445	1970
- welding ME to a rod, per ME	EURO	8	8	8	8	8	10	10	10	12	12	12
- Additional price for non-standard diameter ME SMX		Basic costs: 200 EURO per non-standard diameter ME price of ME: price of corresponding standard NPS ME +20 %										
Pipe with welding ends (pipe, welding ME to rod(s), installation into the pipe) for:												
- 3 pcs. ME SMX	EURO	100	125	150	175	175	195	350	350	600	890	1250
- 6 pcs. ME SMX	EURO	138	167	204	235	235	285	515	530	945	1430	2060
- 9 pcs. ME SMX	EURO	176	209	258	295	295	375	680	710	1290	1970	2870
- 12 pcs. ME SMX	EURO	214	251	312	355	355	465	845	890	1635	2510	3680
- 15 pcs. ME SMX	EURO	252	293	366	415	415	555	1010	1070	1980	3050	4490
- 18 pcs. ME SMX	EURO	290	335	420	475	475	645	1175	1250	2325	3590	5300
Additional price for:												
- 2 flanges DIN2633 PN16	EURO	155	180	200	230	230	270	375	415	500	875	1030
- 2 flanges DIN2635 PN40	EURO	165	190	220	255	255	340	505	560	845	1555	1800
- 2 flanges ANSI 150 lbs. WN	EURO	165	210	250	295	295	380	450	490	645	875	1200
- 2 flanges ANSI 300 lbs. WN	EURO	175	220	260	305	305	400	540	600	920	1510	2300
Options:												
- Removable mixing elements	EURO	65	85	100	135	135	145	150	155	220	320	460
- Strength calculation for mixer housing acc. to AD2000 or ASME VIII Div. 1, including drawing	EURO	450	450	450	450	450	450	450	450	450	450	450
- Certificates / tests												
- Hydraulic pressure test with cert.	EURO	125	125	160	160	160	160	160	240	240	240	240
- Material certificates for housing												
- to EN10204-2.1	EURO	10	10	10	10	10	10	10	10	10	10	10
- to EN10204-3.1B	EURO	50	50	50	50	50	50	50	50	50	50	50
- Material certificate for ME												
- to EN10204-2.1 only	EURO	10	10	10	10	10	10	10	10	10	10	10
- Packing for:												
- land transportation		2% of mixer price, costs for packing and transport excluded										
- sea transportation		as per result										
- Transportation insurance		0.8 % of mixer price; costs for packing and transport excluded										
- Transportation costs		as per result										
Special execution/design and mixer made of different material												
		Please send us your specification in detail for working out an offer.										

Table 6

Price Calculation Example

Example 1: 12 ME SMX DN 50 (Item-No. X-050); ME welded to a rod

Example 2: 12 ME SMX, DN 050 (Item-No. X-050), installed into a pipe with flanges to DIN 2635 PN40, ME removable, strength calculation acc. to AD2000 including drawing; hydraulic pressure test with cert.; material certificate for housing to EN10204-3.1.B and for ME to EN 10204-2.1

Item	Example 1			Example 2		
	Number	EURO/pcs.	Euro	Number	EURO/pcs.	Euro
ME SMX	12	165	1980	12	165	1980
Welding to rod	12	8	96	1	Incl. in pipe	0
Mixer pipe 12 ME				1	710	251
2 flanges to DIN2635 PN40				1	560	190
ME removable				1	155	85
Strength calc. incl. drawing				1	450	450
Hydraulic pressure test + cert.				1	240	125
Mat. cert. pipe EN 10204-3.1B				1	50	50
Mat. cert. ME EN 10204-2.1				1	10	10
Total price of mixer			2076			3141

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