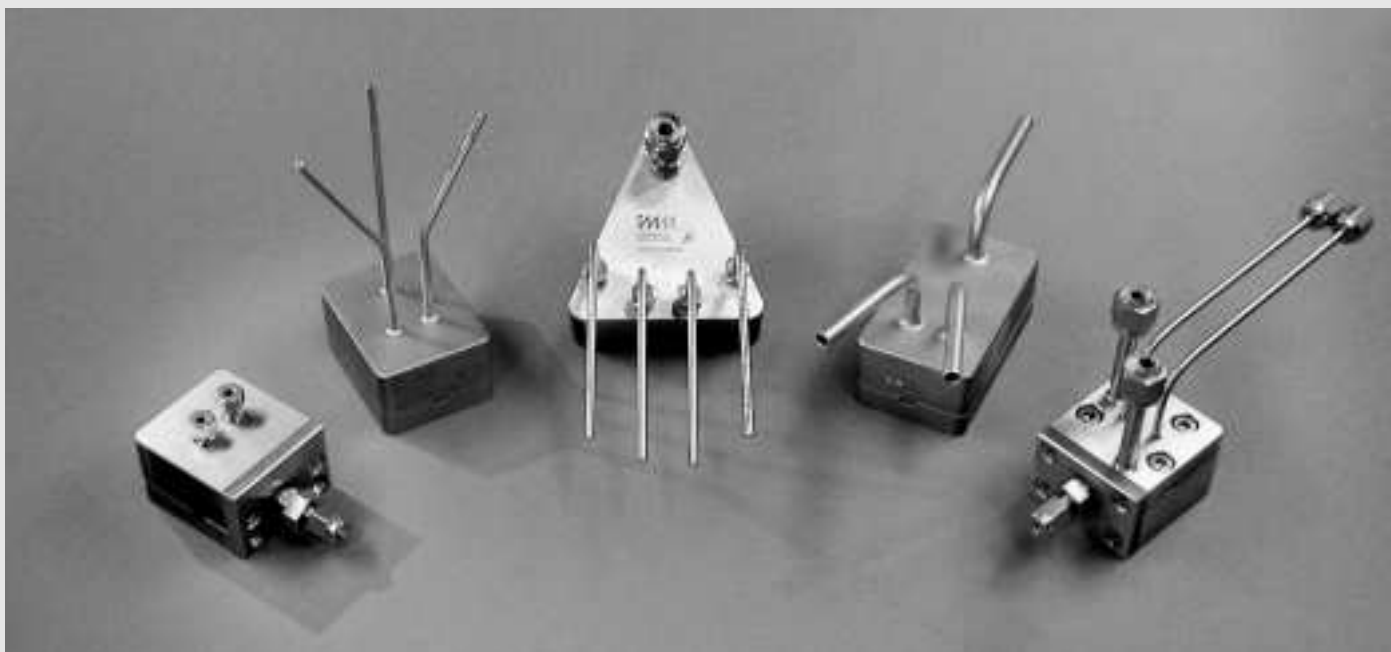


# CATERPILLAR SPLIT-RECOMBINE MICRO MIXER

CPMM-V1.2 GROUP CLASS-R300, -R600, -R1200, -R2400

03



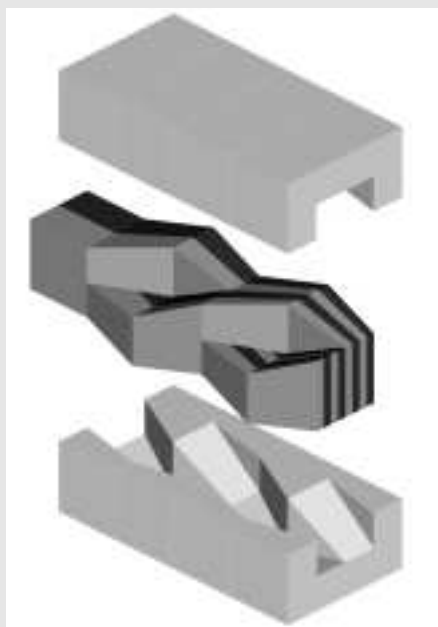
CPMM group class

## Principle

The Caterpillar Micro Mixers are particularly suitable for applications where fast mixing at higher throughput is desired, providing highest performance for l/l-mixing as well as for g/l- or l/l-dispersing. As they consist of a structured single channel, these devices may also be used successfully if precipitation occurs during the reaction or if fine slurries shall be processed.

The higher flowrates enable production scales of a few up to about 100 tons per year with all the advantages of our micro mixers, such as mixing quality, availability of different housing materials and safety gains.

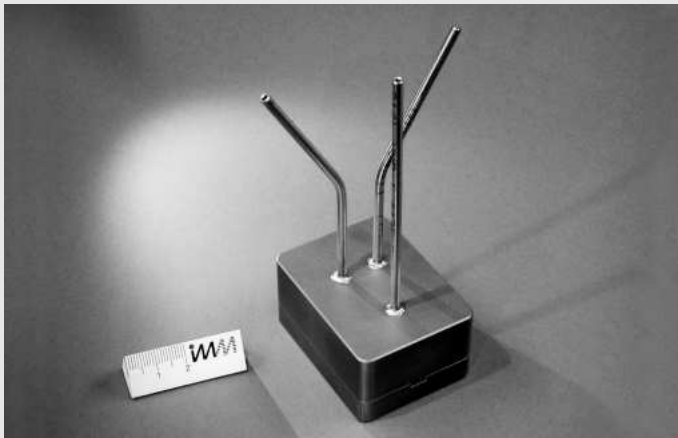
Caterpillar Micro Mixers use a different mixing principle, called "split-and recombine": Dividing the streams, folding/guiding over each other and recombining them per each mixing step, consisting of 8 to 12 such steps. This ideally ends up in 512 to 4096 fine lamellae, each approximately 2.4  $\mu\text{m}$  wide. Mixing finally occurs via diffusion within milliseconds, exclusive of residence time for the multi-step flow passage. Additionally, at higher flowrates – as determined by simulations – turbulences add to this mixing effect, improving the total mixing quality further.



Split-and-recombine mixing principle shown for two of eight mixing steps



Simulated "real" flow profiles at high flow rates in caterpillar mixers



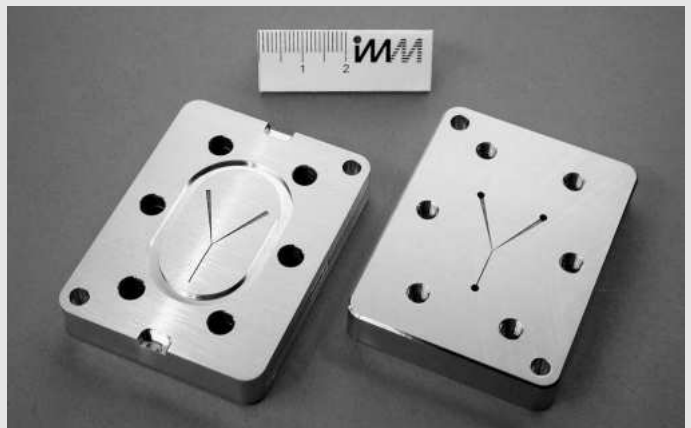
CPMM-R1200/8



CPMM-R2400/10



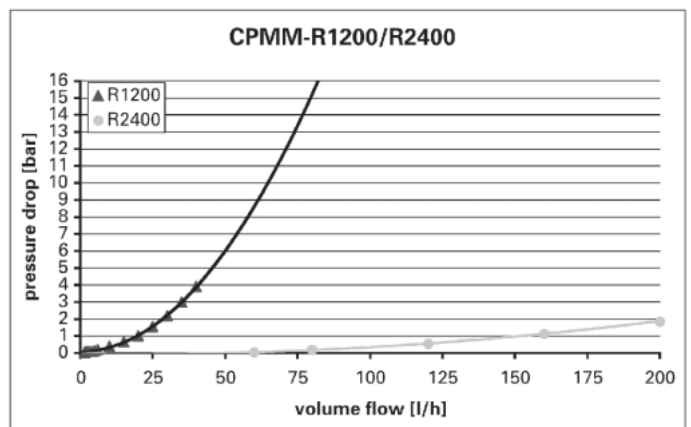
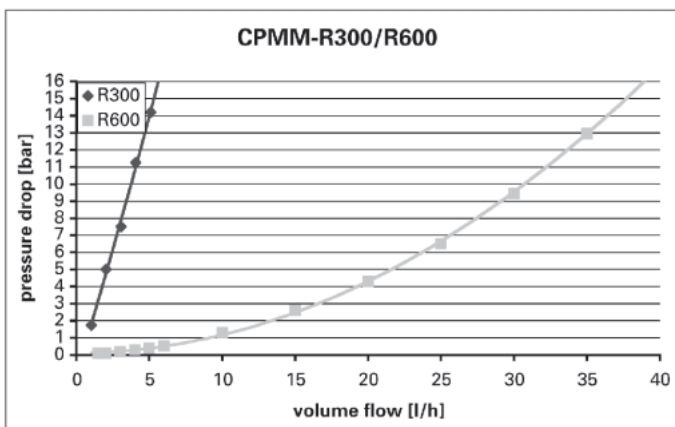
CPMM group class



CPMM-R300/12

This standard version 1.2 of the Caterpillar Micro Mixers is provided with welded-in tubing or HPLC-connectors enabling 50 – 100 bar system pressure for l/l-mixing or for g/l-, l/l-dispersing. Operation temperatures are limited through the used gasket materials to -40 – +220°C but can be extended

by use of graphite gaskets to 500°C. Thus, as fine slurries can be processed, heterogeneously catalysed high-temperature and -pressure reactions are easily performed in small hold-up volumes.



# CATERPILLAR SPLIT-RECOMBINE MICRO MIXER

## CPMM-V1.2 GROUP CLASS-R300, -R600, -R1200, -R2400



CPMM with a straight outlet



CPMM with a straight outlet made of PP

The Caterpillar Micro Mixers with straight outlet are particularly suitable for applications where fast mixing is desired though precipitation occurs during the reaction or if fine slurries shall be processed. Due to the construction principle only 30 bar system pressure can be applied, nonetheless enabling production of slurries containing up to some 100 kg per year of fine powders. These mixers consist of a single structured mixer channel with an adapted outlet. As the

emerging reaction fluid is not forced to leave the mixer via the 90° elbow flow configuration and in addition the rectangular mixer geometry is smoothly adapted to the round shape outlet tube, eddies can be prevented in this region and therefore fouling is diminished or even prevented. This effect can further be promoted by the application of suitable special housing materials as e.g. PTFE.

### Technical Data

Name	Caterpillar Split-Recombine Micro Mixer R300	Caterpillar Split-Recombine Micro Mixer R600	Caterpillar Split-Recombine Micro Mixer R1200	Caterpillar Split-Recombine Micro Mixer R2400	Caterpillar Split-Recombine Micro Mixer R300-straight outlet	Caterpillar Split-Recombine Micro Mixer R600-straight outlet	Caterpillar Split-Recombine Micro Mixer R1200-straight outlet	Caterpillar Split-Recombine Micro Mixer R2400-straight outlet
Order number	CPMM-V1.2-R300	CPMM-V1.2-R600	CPMM-V1.2-R1200	CPMM-V1.2-R2400	CPMM-V1.2-R300-so	CPMM-V1.2-R600-so	CPMM-V1.2-R1200-so	CPMM-V1.2-R2400-so
Mixing principles	Split-Recombine	Split-Recombine	Split-Recombine	Split-Recombine	Split-Recombine	Split-Recombine	Split-Recombine	Split-Recombine
Size (L x B x H)	60 x 45 x 20	60 x 45 x 30	60 x 45 x 30	79 x 45 x 30	51 x 45 x 20	51 x 45 x 30	51 x 45 x 30	70 x 45 x 30
Connectors (Inlet/Outlet)	1/16" / 1/8"	1/8" / 1/8"	1/8" / 1/4"	1/4" / 3/8"	1/16" / 1/16"	1/8" / 1/8"	1/8" / 1/8"	1/4" / 1/4"
Standard mixing channels (µm)	300 x 300	600 x 600	1200 x 1200	2400 x 2400	300 x 300	600 x 600	1200 x 1200	2400 x 2400
Standard material	1.4435	1.4435	1.4435	1.4435	1.4435	1.4435	1.4435	1.4435
Options	Heat exchanger function is possible; other materials like Hastelloy, Monell, Titan, PTFE or other plastics on request							

### Operating Conditions

Order number	CPMM-V1.2-R300	CPMM-V1.2-R600	CPMM-V1.2-R1200	CPMM-V1.2-R2400	CPMM-V1.2-R300-so	CPMM-V1.2-R600-so	CPMM-V1.2-R1200-so	CPMM-V1.2-R2400-so
Temperature (°C)	-40 – 220	-40 – 220	-40 – 220	-40 – 220	-40 – 220	-40 – 220	-40 – 220	-40 – 220
Pressure stability (bar)	100	100	100	100	30	30	30	30
Flowrate (l/h)	0.5 – 4	2 – 40	4 – 80	15 – 250	0.5 – 4	2 – 40	4 – 80	15 – 250
Residence time (ms)	3.6 – 72	2.25 – 45	3.15 – 70.2	3.6 – 60	5.4 – 108	2.7 – 54	4.05 – 81	4.32 – 72
Inner volume (µl)	10	25	78	250	15	30	90	300
Max Viscosity (mPas)	100	100	100	100	100	100	100	100
Leakage Class	< L <sub>0.001</sub>	< L <sub>0.001</sub>	< L <sub>0.001</sub>	< L <sub>0.001</sub>	< L <sub>0.01</sub>	< L <sub>0.01</sub>	< L <sub>0.01</sub>	< L <sub>0.01</sub>



*CPMM-R2400/10-HEX-ss-wt assembled and disassembled*



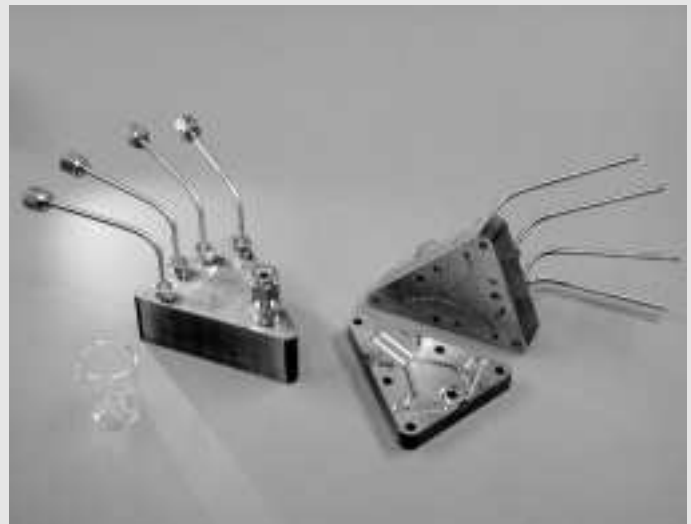
*CPMM-R2400/10-HEX-SO-ss-wt assembled with straight outlet connector and integrated heat exchanger*

As an additional feature the Caterpillar Micro Mixers may be offered with an integrated heat exchange function particularly suitable for applications where pre-heating/cooling of the mixture is desired prior to the subsequent reactor (by means of e.g. heat exchanger delay loop) thus extending

the application range to more exothermic reaction or application of molten materials. Of course, this heat exchange version may also be combined with the straight outlet and its housing can be produced in nearly any material desired.



*8CCPMM-R1200/8.7-PMMA*



*4CCPMM-R952/8.2-R1200/8.1-ss-hplc*

For special mixing or dispersion applications, where no residence time/delay loop is needed, the Caterpillar Micro Mixers may be combined to arrays thus enabling a nearly simultaneous mixing of more than 2 fluids at once. With such arrays e.g. multi-component creams can easily be generated.