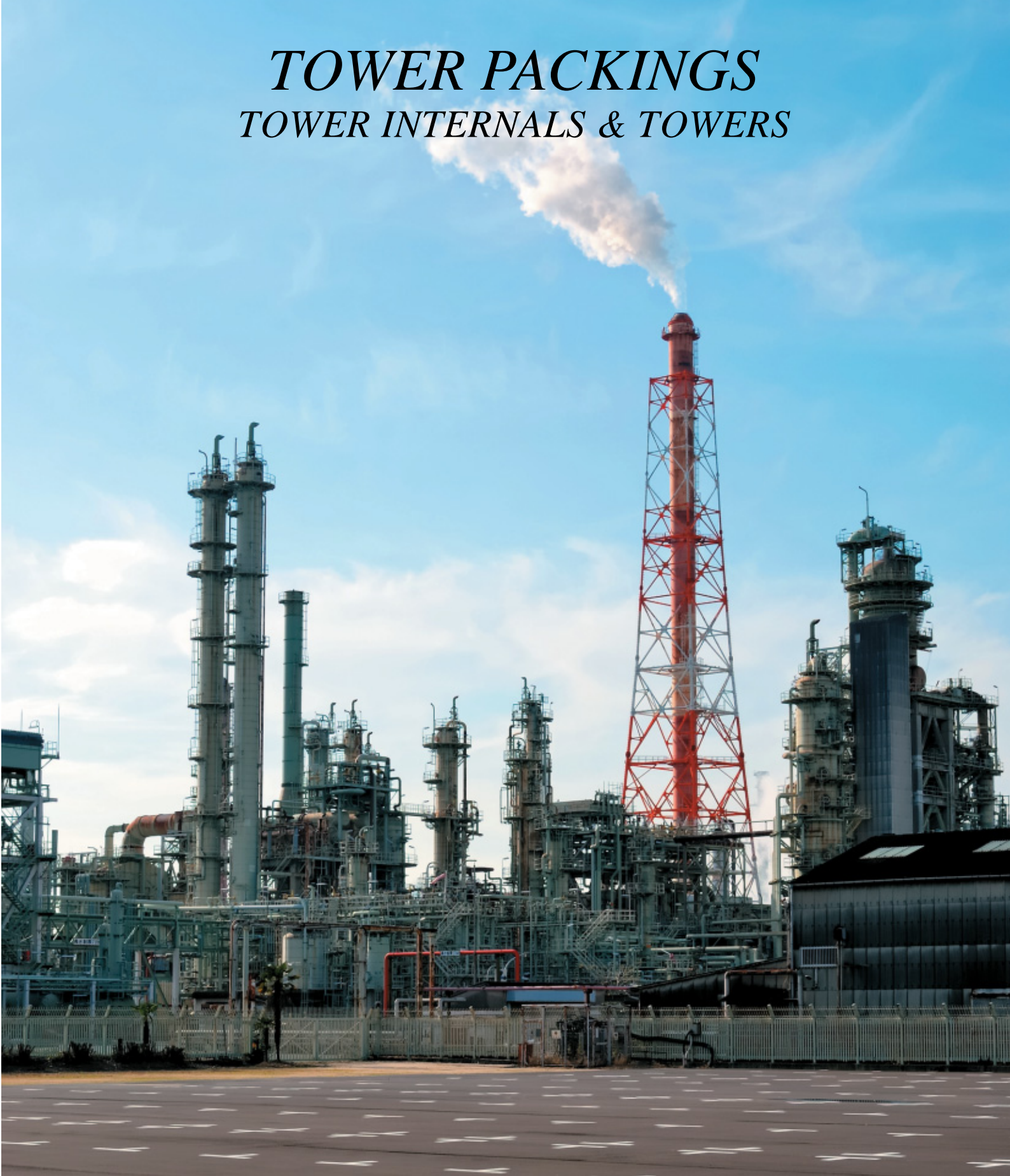


# *TOWER PACKINGS*

## *TOWER INTERNALS & TOWERS*



METAL  
PLASTIC  
CERAMIC  
RASCHIG RING



METAL  
PLASTIC  
PALL RING



PLASTIC  
CERAMIC  
INTALOX  
SADDLE



METAL  
M-PAK



METAL



PLASTIC  
CASCADE MINI RING



CERAMIC



SHEET



MESH



T-TYPE



CERAMIC

MC PACK

# Products and Services

## CASCADE MINI RING®

P.3~6



CASCADE MINI RING is a representative of random packing and has higher superiority and efficiency compared with other general packings. The configuration is cylindrical and flat. It performs confluence and segmentation of droplet in highly efficiency. We have a trademark of it in Japan.

## RANDOM PACKING

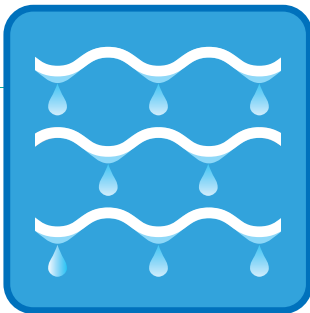
P.7~9



Random packing is a generic name of generalized packing as typified by Pall Ring. We have a wide variety of configurations and materials for random packing. The principle of the contact by liquid and gas is said that the liquid which is collided and divided by random packing carried out continuous counter flow contact with vapor.

## MC PACK

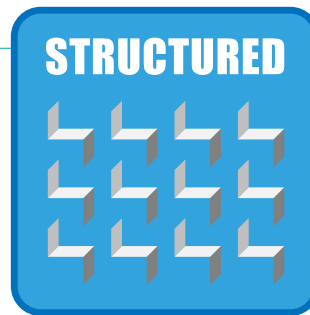
P.13~15  
P.17~18



MC pack is a typical structured packing. Especially T-type is an optimum packing for aqueous application that has a high surface tension recognized that structured packing is inappropriate. HETP as same as HETP of the liquid of organic use can be expected by a groundbreaking liquid film.

## STRUCTURED PACKING

P.16、19



Structured packing has, unlike random packing, a regular construction. We have not only metals but also ceramics. The principle of the contact by liquid and gas is said that a liquid film which covers on a surface of packing is carried out continuously counter flow contact with vapor.

## VESSEL

P.24



It is a vessel of a packed tower and a tray tower. We have not only metals but also resin materials such as FRP, PVC + FRP and a rubber lining. We can correspond to fabricate towers that are for facilities of from the fire laws to high-pressure gas regulation.

## CANDLE FILTER

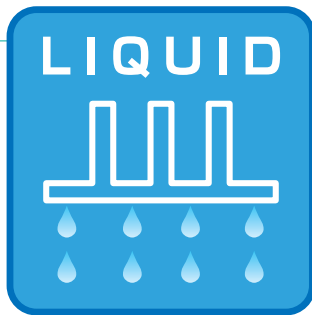
P.25



Candle filter almost eliminates a fine mist whose particle diameter is  $2\mu$  or less. It effectively eliminates the fine mist by combined effect from colliding and diffusion which principally involves Brownian movement because of compressed cylindrically fiber.

## INTERNALS FOR RANDOM PACKING

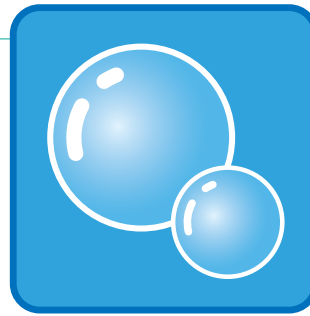
P.10



There are 70 types of internals for a random packing. Especially, we can design and fabricate a distributor with uniform distribution of high liquid load / about 600m<sup>3</sup>/H.

## CERAMIC BALL ALUMINA BALL

P.11~12



It is a material for catalysts. It is sintered in a globe shape by high temperature. The types are divided into Ceramic ball and Alumina ball. We have many sizes of them ranging from  $\phi$ 3mm to  $\phi$ 50mm.

## INTERNALS FOR STRUCTURED PACKING

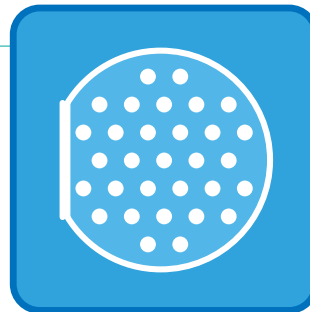
P.20~22



This internal is used for MC pack. Especially, MC distributor that has groundbreaking drip points is a high-performance distributor. This distributor can be also used for random packing.

## TRAY

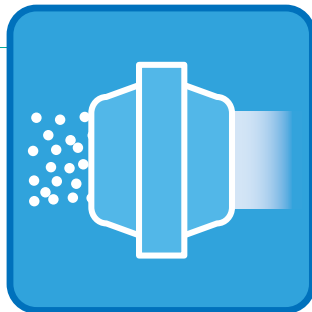
P.23



Tray is, unlike packing, a product for the contact by liquid and gas called also Plate type. We can provide you a wide range of types such as Sieve tray, Bubble cap tray and Cartridge type.

## MIST SEPARATOR

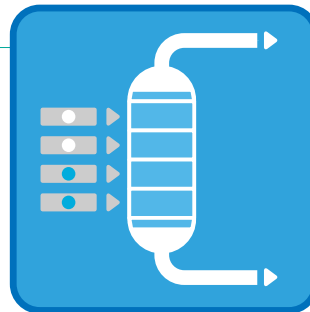
P.26



e-blade is a mist eliminator of blade type. This eliminator almost completely eliminates and recovers mist more than 20 $\mu$ . It is a compact unit and has a high-performance.

## SIMULATION FLOODING CALCULATION

P.27~28



We can perform distillation and abortion calculations by using a exclusive software for them. In the abortion calculation, we perform combined calculation including an approach from the mass transfer theory.



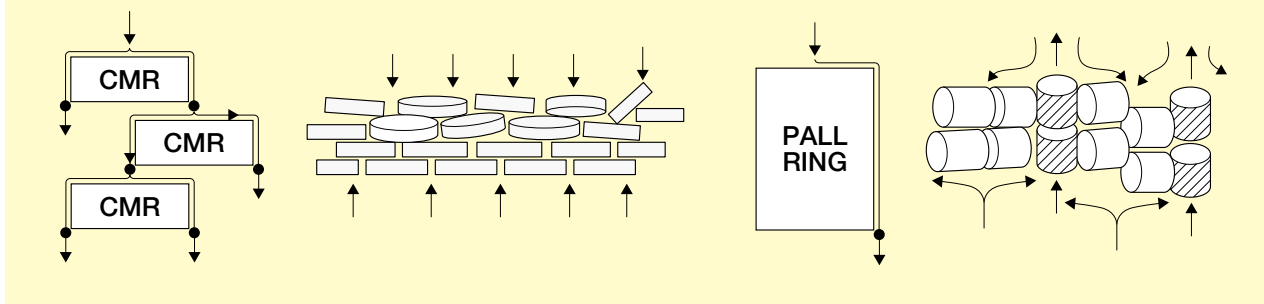
## CASCADE MINI RING® [CMR]

### The concept of flowing down droplet on a surface of packing

Liquid flowing down on a surface of packing turns into droplet which flows and joins to the next packing and the droplet moves and joins together to the packing after the next packing again. Mass transfer is performed by contacting with rising vapor and the droplet. The base principle of the contact by liquid and gas for random packing is said that it is a collision surface renewal so the appearance of random packing sizes does not make relative merits of the performance. The performance is more influenced by [conditions of packing which consist of each individual packing] more than specific surface areas and the conditions

of packing reduce potential of the packing. In fact, packed bed actually has the contact efficiency and it has the difference in effectiveness of the contact by liquid and gas. This becomes the relative merits of the performance. CMR can perform a surface renewal by joining and segmentation of droplet without loss. It is said that CMR has the high contact by liquid and gas. We can provide you that a size of CMR can be larger than a size of a target packings such as Pall ring when you need the alternative packing instead of the target packing and CMR has many advantages as throughput and pressure drop.

#### The principle of CMR advantages 1



### CMR vs Pall Ring



CMR has the good conditions of packing and the high contact efficiency by liquid and gas because CMR almost has a regular loading. The liquid flows all over CMR. The difference in the conditions of packing which has small dry areas makes the difference in grime.



Pall ring becomes matrix condition 50% of the time in a tower because of its configuration. In result, it arises drift of liquid-vapor and has the bad contact efficiency by liquid and gas and dry areas.





## CASCADE MINI RING® [CMR]

### The surface treatment of Metal CASCADE MINI RING

The surface of Metal CMR can be treated and it improves wet retention. The CMR whose surface is treated can be used in low-liquid load. It can maintain its performance because it controls the decline of the contact by liquid and gas. And also, it is effective

in water use that has a high surface tension. The procedure of surface treatment made by our company's unique technology accumulated over years is a shot blasting. Originally, this idea is not shared by another packing.

Regular

Surface treatment  
(SST)



Surface: luster  
Minimum wet liquid:  
 $3\text{m}^3/\text{m}^2\text{H}$

Surface: matte (translucent)  
Minimum wet liquid:  
 $1\text{m}^3/\text{m}^2\text{H}$

Regular

Surface treatment  
(SST)



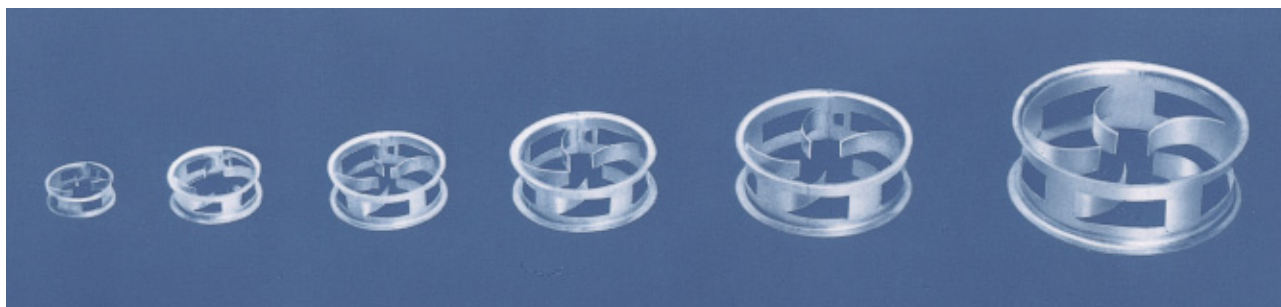
Surface: luster  
Minimum wet liquid:  
 $3\text{m}^3/\text{m}^2\text{H}$

Surface: matte (translucent)  
Minimum wet liquid:  
 $1\text{m}^3/\text{m}^2\text{H}$



# CASCADE MINI RING® [CMR]

## METAL CASCADE MINI RING® [CMR]



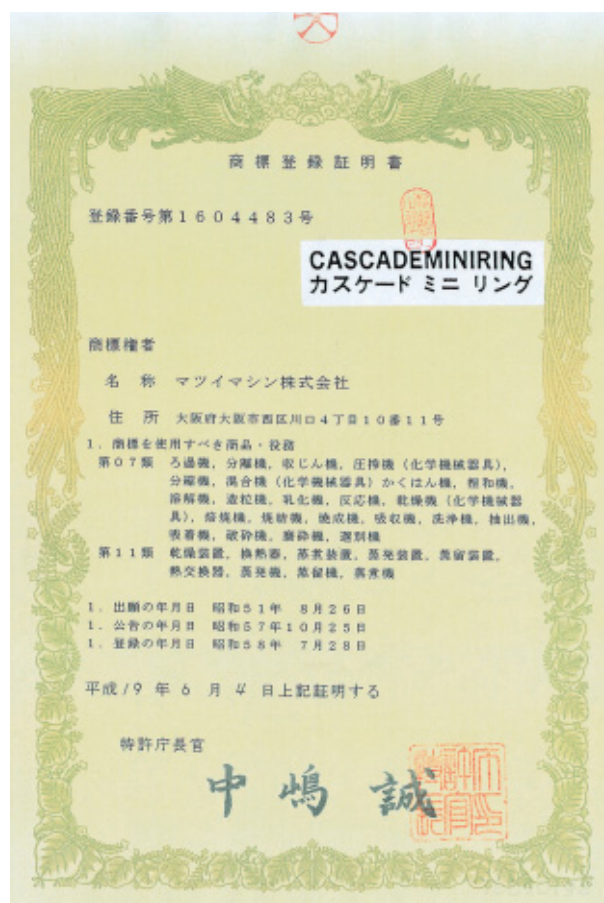
Metal CASCADE MINI RING size list

Size	Packing factor F (l/ft)	Bulk Density (kg/m³)	Surface (m²/m³)	Void Fraction (%)	Outline (mm, approx.)
No. 0P	55	320	435	96	17φ× 15φ× 6H
No. 1P	40	290	257	96.5	25φ× 22φ× 8H
No.1.5P	29	230	199	97.2	34φ× 29φ×11H
No. 2P	22	180	155	97	43φ× 38φ×14H
No.2.5P	18	165	132	97.3	51φ× 44φ×17H
No. 3P	14	158	108	97.6	66φ× 57φ×21H
No. 4P	10	120	77	98.3	86φ× 76φ×28H
No. 5P	8	110	55	98.6	131φ×118φ×41H

Bulk Density at a material specific gravity 7.93 for stainless steel type 304.

### Ex. materials:

SUS304, SUS304L, SUS316, SUS316L, SUS329J4L, CS, Titanium, HC-22, Monel, Pure nickel, Aluminum.

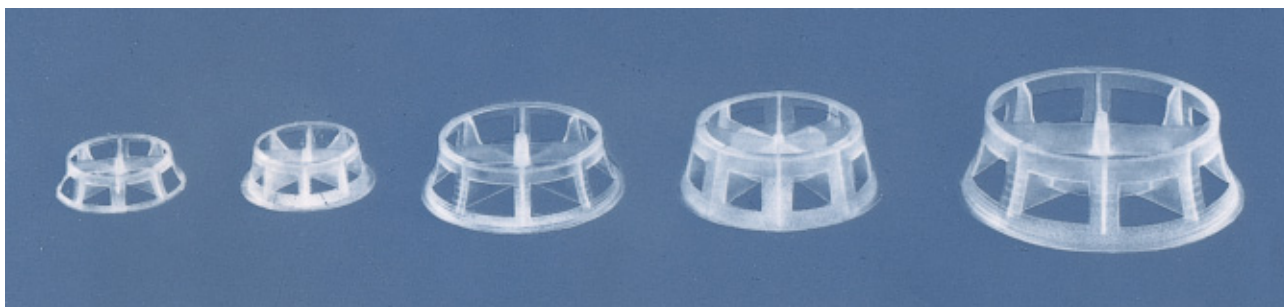


Certification of trademark for CASCADE MINI RING



## CASCADE MINI RING® [CMR]

### PLASTIC CASCADE MINI RING® [CMR]



Plastic CMR size list

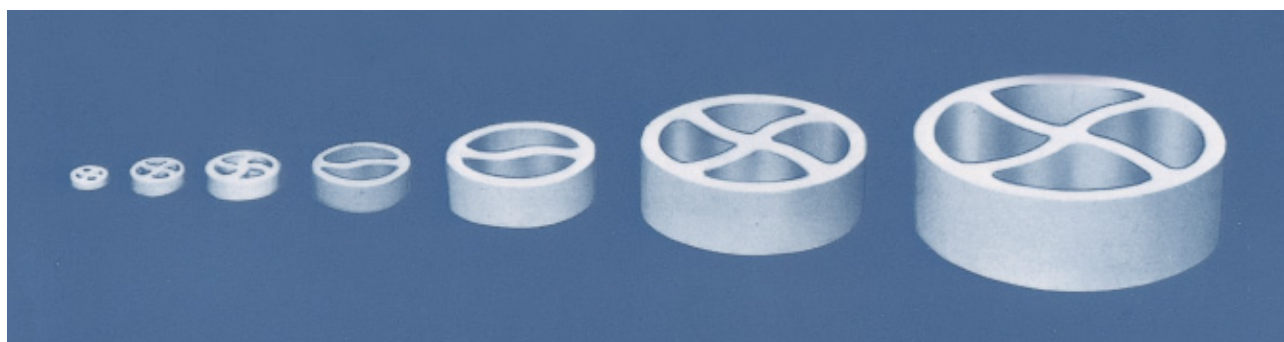
Size	Packing factor F (l/ft)	Bulk Density (kg/m³)	Surface (m²/m³)	Void Fraction (%)	Outline (mm, approx.)
No.0A	55	122	330	89	38φ×30φ×13H
No.1A	30	72	230	92	50φ×39φ×17H
No.2A	18	60	130	93	78φ×61φ×25H

Size	Packing factor F (l/ft)	Bulk Density (kg/m³)	Surface (m²/m³)	Void Fraction (%)	Outline (mm, approx.)
No.2	15	55	118	94	75φ×61φ×22H
No.3A	12	47	79	95	104φ×84φ×32H

Bulk Density at a material specific gravity 1.0

Ex. materials: 1) PP (s.g., 0.9) 5) PVDF (s.g., 1.75)  
 2) HRPP (s.g., 0.9) 6) ETFE (s.g., 1.74)  
 3) UPVC (s.g., 1.04) 7) PFA (s.g., 2.17)  
 4) CPVC (s.g., 1.56)

### CERAMIC CASCADE MINI RING® [CMR]



Ceramic CMR size list

Size	Packing factor F (l/ft)	Bulk Density (kg/m³)	Surface (m²/m³)	Void Fraction (%)	Outline (mm, approx.)
No. 0X	470	940	329	52	25φ×9H
No.0.5X	210	860	224	57	38φ×13H
No. 1X	108	840	166	63	51φ×17H
No. 1.5	80	700	121	71	60φ×20H




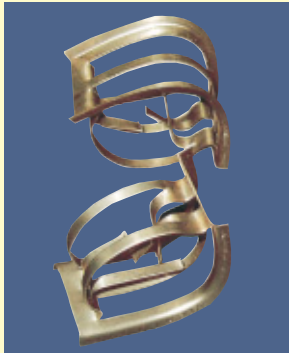
Size	Packing factor F (l/ft)	Bulk Density (kg/m³)	Surface (m²/m³)	Void Fraction (%)	Outline (mm, approx.)
No. 2	38	630	98	73	76φ×25H
No. 3	24	670	79	78	102φ×34H
No. 5X	18	720	60	69	152φ×51H
No. 7X	15	750	—	—	203φ×68H

Bulk Density at a specific gravity 2.29 for ceramic material



# METAL RANDOM PACKING

## Physical Data

Packing type	Size	Packing factor F(l/ft)	Packing Density (kg/m <sup>3</sup> )	Surface (m <sup>2</sup> /m <sup>3</sup> )	Void Fraction (%)
<b>Raschig ring</b> 	1/2" (12mm)	300	638	401	92
	5/8" (15mm)	260	592	366	91
	1" (25mm)	137	480	200	94
	1 1/2" (38mm)	83	423	130	95
	2" (50mm)	57	329	102	96
	3" (80mm)	32	286	70	96
<b>Pall ring</b> 	1/2" (12mm)	81	638	415	92
	5/8" (15mm)	71	592	366	91
	1" (25mm)	48	480	210	94
	1 1/2" (38mm)	28	423	136	95
	2" (50mm)	20	329	110	96
	3" (80mm)	—	286	73	96
<b>M-PAK</b> 	25M-L (25mm)	43	236	192	97
	38M-L (38mm)	26	170	140	98
	51M-L (51mm)	19	140	99	98
<b>MI-PAK</b> 	# 15 (15mm)	51	355	292	96
	# 25 (25mm)	41	356	210	97
	# 40 (38mm)	24	255	151	97
	# 50 (50mm)	18	165	98	98
	# 70 (70mm)	12	120	56	98

Ex. materials: SUS304, SUS304L, SUS316, SUS316L

※ Please feel free to contact us about special metal



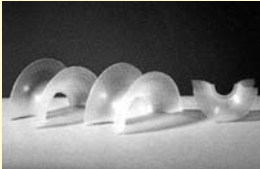
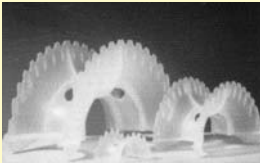
Bulk Density at a material specific gravity 7.93 for stainless steel type 304.





# PLASTIC RANDOM PACKING

## Physical Data

Packing type	Size	Packing factor F(l/ft)	Packing Density (kg/m <sup>3</sup> )	Surface (m <sup>2</sup> /m <sup>3</sup> )	Void Fraction (%)
<b>Raschig ring</b>					
	1" (25mm)	137	112	205	86
	1 1/2" (38mm)	83	70	130	90
	2" (50mm)	57	68	95	92
<b>Pall ring</b>					
	5/8" (15mm)	95	110	340	83
	1" (25mm)	52	100	205	90
	1 1/2" (38mm)	32	66	130	91
	2" (50mm)	25	63	100	92
<b>Intalox saddle</b>					
	1" (25mm)	33	76	206	91
	1 1/2" (38mm)	25	57	140	91
	2" (50mm)	21	64	108	93
<b>Super Intalox saddle</b>					
	1" (25mm)	33	96	210	90
	1 1/2" (38mm)	25	60	145	91
	2" (50mm)	21	68	110	93





Ex. materials: 1) PP (s.g., 0.9)      5) PVDF (s.g., 1.75)  
 2) HRPP (s.g., 0.9)      6) ETFE (s.g., 1.74)  
 3) UPVC (s.g., 1.04)      7) PFA (s.g., 2.17)  
 4) CPVC (s.g., 1.56)

Bulk Density at a material specific gravity.



# CERAMIC RANDOM PACKING

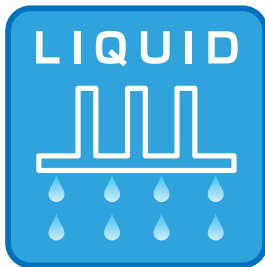
## Physical Data

Packing type	Size	Packing factor F(l/ft)	Packing Density (kg/m <sup>3</sup> )	Surface (m <sup>2</sup> /m <sup>3</sup> )	Void Fraction (%)
<b>Raschig ring</b> 	1" (25mm)	155	620	235	78
	1½" (38mm)	103	580	195	76
	2" (50mm)	65	530	150	81
	3" (80mm)	37	870	110	68
<b>Intalox saddle</b> 	1" (25mm)	98	620	250	74
	1½" (38mm)	52	610	164	75
	2" (50mm)	40	600	142	76
	3" (80mm)	22	560	92	78
<b>Super Intalox saddle</b> 	1" (25mm)	60	600	260	74
	2" (50mm)	30	560	140	76
	3" (80mm)	15	510	120	77
<b>Cross ring</b> 	φ100	—	1100	105	53
	φ120	—	1040	90	55
	φ150	—	1040	72	58

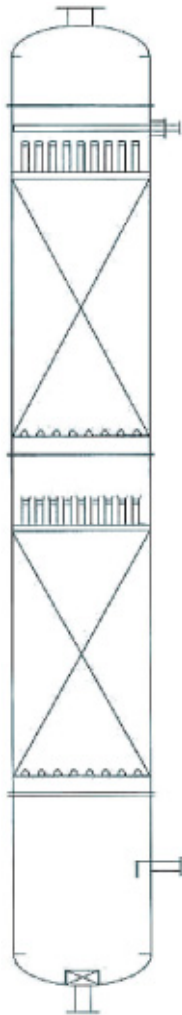
Bulk Density at a specific gravity 2.29 for ceramic material

Chemical Physicality list (%)

SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	MgO	CaO	K <sub>2</sub> O	Na <sub>2</sub> O	Leachable iron
68—72	18—22	≤1.0	0.6	0.6	3.5—4.5	0.1—0.3	<0.01



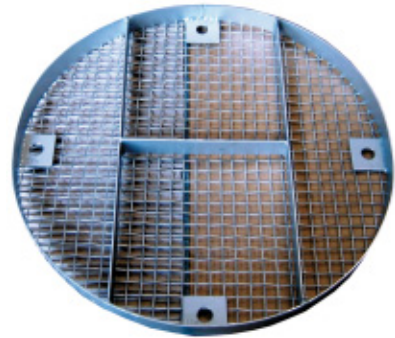
## INTERNALS FOR RANDOM PACKING



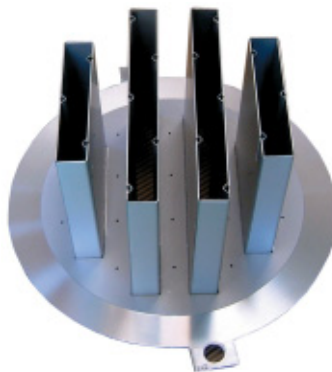
**Feed pipe**  
(Liquid supply pipe)



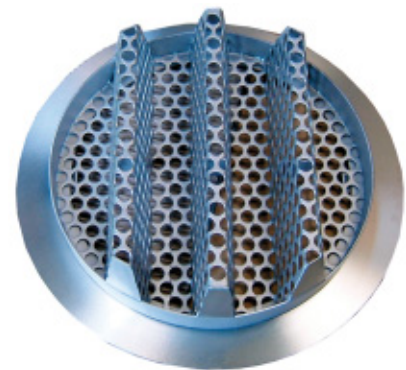
**Hold down grid**  
(Fixing packing)



**Distributor**  
(Liquid diffusion board)



**Packing support**  
(Support packing)

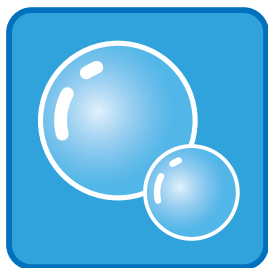


**【Materials】**

US304, SUS304L, SUS316, SUS316L, SUS329J4L, CS. Titanium, Hastelloy, PVC, PP, PVDF, FRP, Rubber lining, Carbon, Special metal

### Distributor for high liquid load (600m<sup>3</sup>/H)



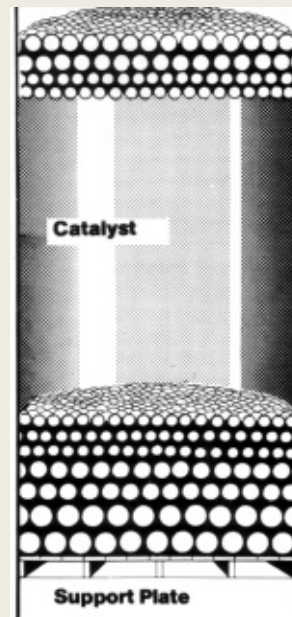
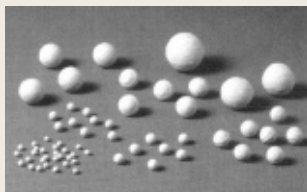


# CERAMIC BALL

## Ceramic Ball

### Chemical Composition

SiO <sub>2</sub>	68—72	MgO	0.6—1.2
Al <sub>2</sub> O <sub>3</sub>	17—23	CaO	0.6—0.9
Fe <sub>2</sub> O <sub>3</sub>	0.4—0.8	K <sub>2</sub> O	2.3—3.0
TiO <sub>2</sub>	0.5—0.8	Na <sub>2</sub> O	0.5—0.8
Soluble Fe: < 0.01%			



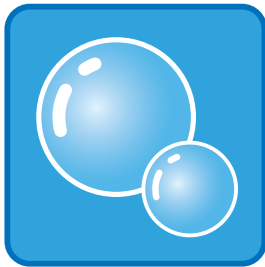
### Physical Properties

Density	g/cm <sup>3</sup>	2.3—2.4
Water Absorption	%	0.1—0.5
Compressive Strength	N/mm <sup>2</sup>	400
Elasticity Modulus	GPa	60
Mohs Hardness	Scale	7—8
Specific heat, 20°C—100°C	J/kgK	840
Thermal Conductivity 30°C—100°C	W/mK	1—1.5
Coefficient of thermal expansion	(20°C—600°C) 10 <sup>-6</sup> K <sup>-1</sup>	4.7
Heat Resistance	Up to °C	1000

### Size, Packing Density, Specific Surface, Void Fraction and Compressive Strength

Size (inch) — (mm)	Packing Density (kg/m <sup>3</sup> )	Spec. Surface (m <sup>2</sup> /m <sup>3</sup> )	Void Fraction (%)	Compressive Strength per ball (kg)
1/8" — 3mm	1400	720	44	30
1/4" — 6mm	1400	520	44	50
3/8" — 9mm	1400	360	44	120
1/2" — 13mm	1350	275	45	180
3/4" — 19mm	1350	190	45	300
1" — 25mm	1350	144	45	400
1 1/4" — 32mm	1350	120	45	520
1 1/2" — 38mm	1350	100	45	600
2" — 50mm	1350	75	45	720



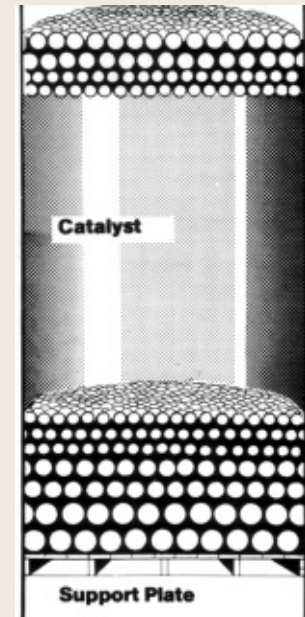
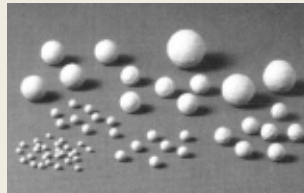


# ALUMINA BALL

## Alumina Ball

### Chemical Composition

SiO <sub>2</sub>	0.15—0.2	MgO	0.03—0.05
Al <sub>2</sub> O <sub>3</sub>	99—99.2	CaO	0.04—0.07
Fe <sub>2</sub> O <sub>3</sub>	0.05—0.2	K <sub>2</sub> O	0.1—0.15
TiO <sub>2</sub>	0.15—0.2	Na <sub>2</sub> O	0.2—0.25
Soluble Fe: <0.01%			

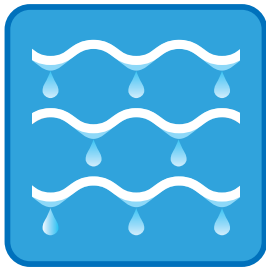


### Physical Properties

Density	g/cm <sup>3</sup>	3.5—3.6
Water Absorption	%	2—3
Compressive Strength	N/mm <sup>2</sup>	3K
Elasticity Modulus	GPa	60
Mohs Hardness	Scale	9
Specific heat, 20°C—100°C	J/kgK	840
Thermal Conductivity 30°C—100°C	W/mK	1—1.5
Coefficient of thermal expansion	(20°C—600°C) 10 <sup>-6</sup> K <sup>-1</sup>	4.7
Heat Resistance	Up to °C	1500

### Size, Packing Density, Specific Surface, Void Fraction and Compressive Strength

Size (inch) — (mm)	Packing Density (kg/m <sup>3</sup> )	Spec. Surface (m <sup>2</sup> /m <sup>3</sup> )	Void Fraction (%)	Compressive Strength per ball (kg)
1/8" — 3mm	2200	720	44	60
1/4" — 6mm	2200	520	44	160
3/8" — 9mm	2200	360	44	240
1/2" — 13mm	2100	275	45	450
3/4" — 19mm	2000	190	45	520
1" — 25mm	2000	144	45	800
1 1/4" — 32mm	2000	120	45	850
1 1/2" — 38mm	2000	100	45	920
2" — 50mm	2000	80	45	1000



## MC PACK

### MC PACK

#### Sheet

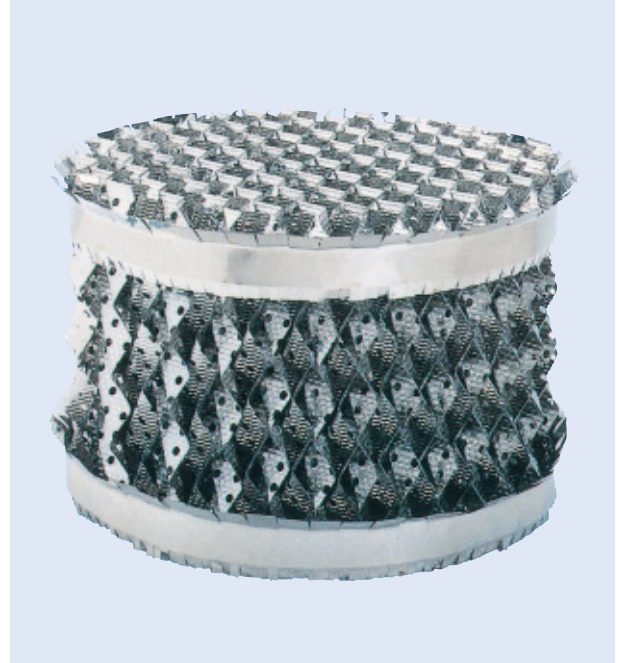
# MC250S

Sheet 250S can be used in any environmental from low to high gas load (F factor). Pressure drop is low and NTSM is high due to its embossed decoration over the surface of the sheet layer.

Especially, MC250S can achieve high NTSM and very low pressure drop in a high-load environment under the ordinary pressure.

#### CHARACTERISTICS

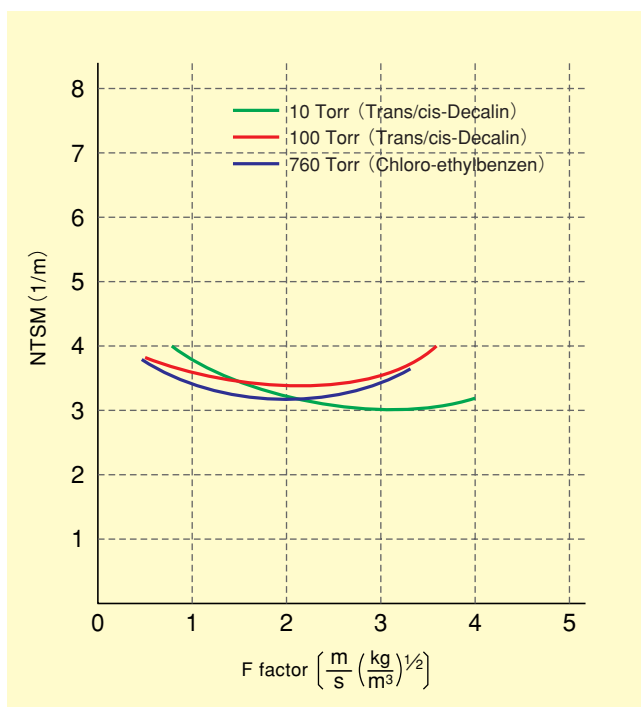
- High NTSM
- Pressure drop for single theoretical step --- 0.1 to 1 mmHg
- Proper liquid load range --- 0.2 to 60m<sup>3</sup>/m<sup>2</sup>H
- Maximum F factor --- 3.0



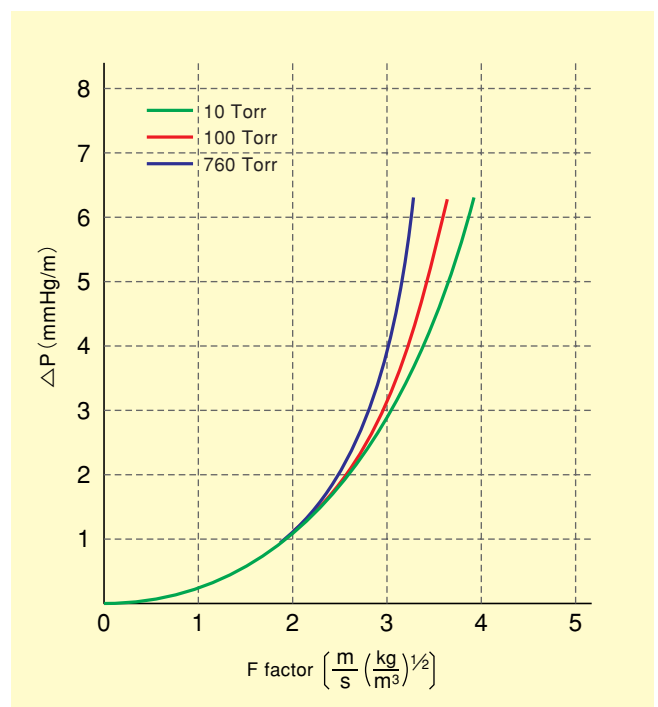
Name	Surface m <sup>2</sup> /m <sup>3</sup>	Void space %	Weight kg/m <sup>3</sup>	Height per mm	Substance
MC250S	250	98	87	180	Sheet

Bulk Density at a material specific gravity 7.93 for stainless steel type 304.

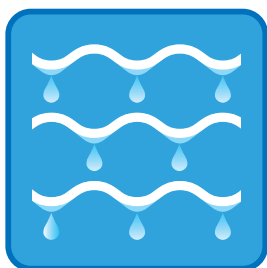
#### ■ NTSM DATA



#### ■ PRESSURE-DROP DATA



Ex. Materials: SUS304, SUS316L, SUS329J4L, Titanium, Hastelloy, Aluminum, Nickel, Copper



# MC PACK

## MC PACK

Sheet

# MC350S

Sheet 350S like the sheet 250S can be used in the environment from low to high gas load (F factor). Performance is steadily high due to its embossed decoration over the surface of the sheet layer.

Note that sheet 350S can achieve high NTSM and very low pressure drop in a high-load environment under the ordinary pressure.

### CHARACTERISTICS

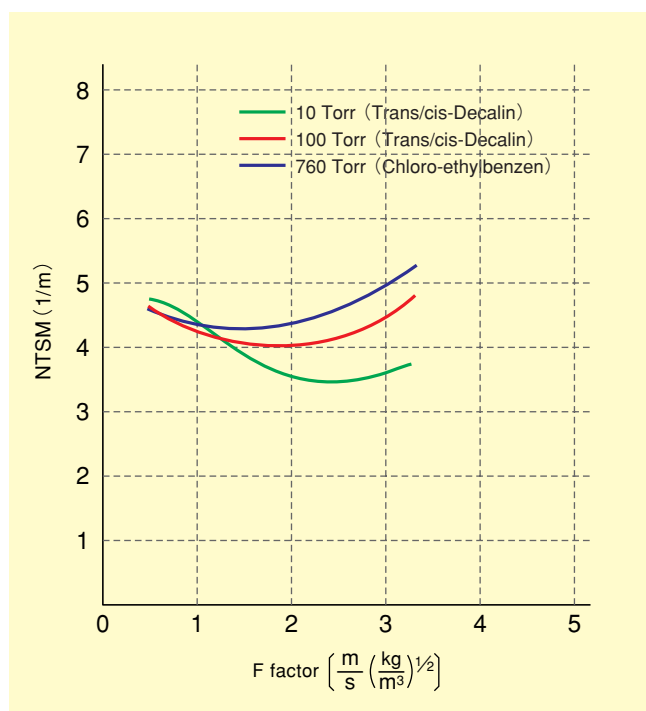
- High NTSM
- Pressure drop for single theoretical step --- 0.1 to 1 mmHg
- Proper liquid load range ---  $0.2$  to  $30 \text{ m}^3/\text{m}^2\text{H}$
- Maximum F factor --- 2.5



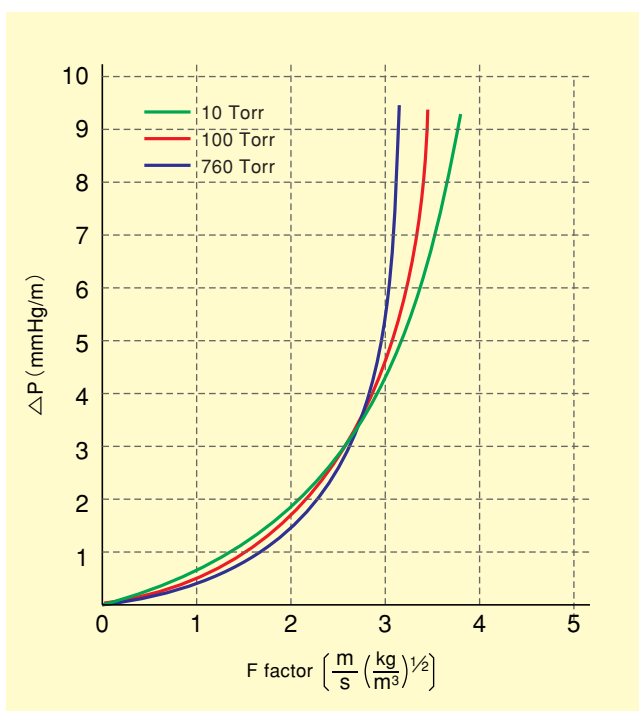
Name	Surface $\text{m}^2/\text{m}^3$	Void space %	Weight $\text{kg}/\text{m}^3$	Height per mm	Substance
MC350S	350	98	120	183	Sheet

Bulk Density at a material specific gravity 7.93 for stainless steel type 304.

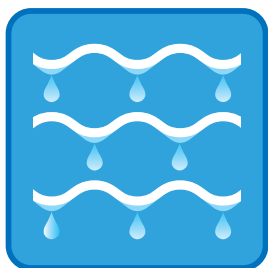
### ■ NTSM DATA



### ■ PRESSURE-DROP DATA



Ex. Materials: SUS304, SUS316L, SUS329J4L, Titanium, Hastelloy, Aluminum, Nickel, Copper



# MC PACK

## MC PACK

Sheet

# MC500S

Sheet 500S can be used in the environment from low to high gas load (F factor), and achieve overall high NTSM due to its unique structure design.

Note that sheet 500S can achieve high NTSM and very low pressure drop in a high-load environment under the ordinary pressure.

### CHARACTERISTICS

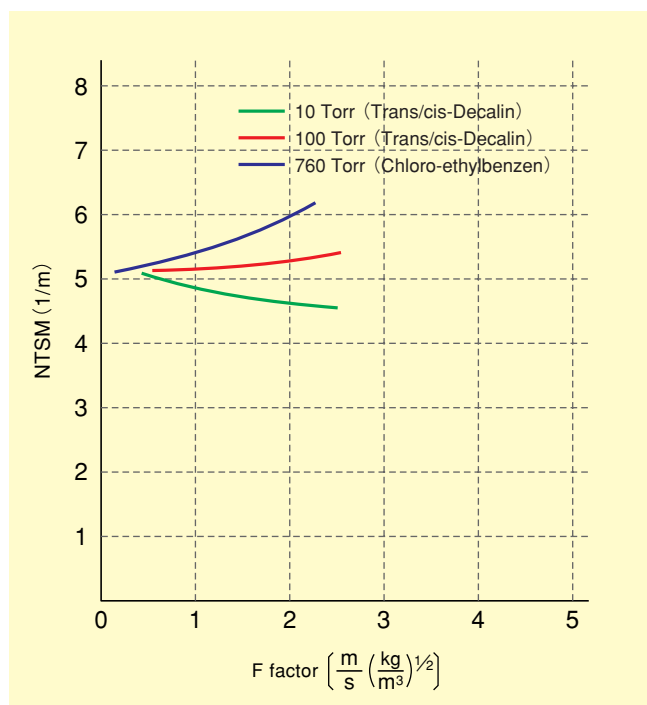
- High NTSM
- Pressure drop for single theoretical step --- 0.1 to 1 mmHg
- Proper liquid load range --- 0.2 to 20m<sup>3</sup>/m<sup>2</sup>H
- Maximum F factor --- 2.0



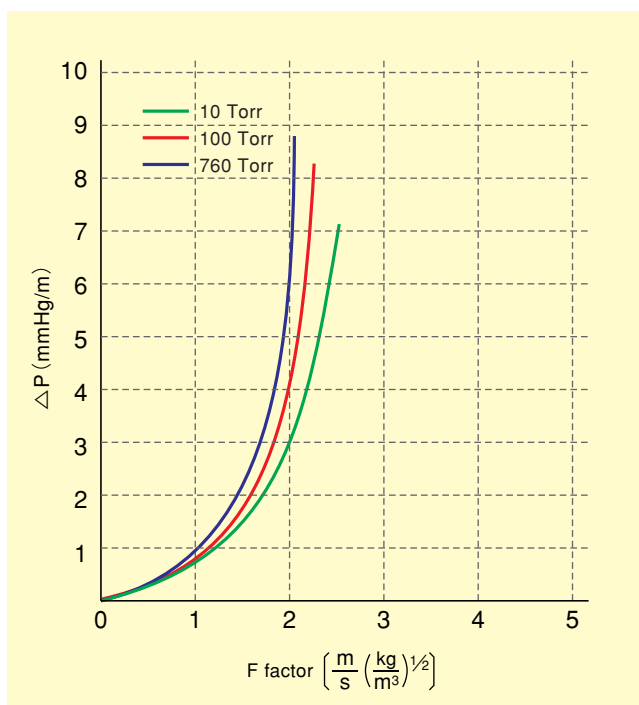
Name	Surface m <sup>2</sup> /m <sup>3</sup>	Void space %	Weight kg/m <sup>3</sup>	Height per mm	Substance
MC500S	500	97	170	178	Sheet

Bulk Density at a material specific gravity 7.93 for stainless steel type 304.

### ■ NTSM DATA

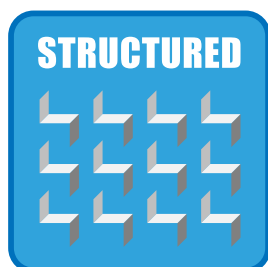


### ■ PRESSURE-DROP DATA



Ex. Materials: SUS304, SUS316L, SUS329J4L, Titanium, Hastelloy, Aluminum, Nickel, Copper





# STRUCTURED PACKING

## MC-Y PACK

### Mesh

# BY-W500X/ W700Y/W1000Y

BY-W500YX/W700Y/W1000Y are mesh type of special structured wire mesh. These are achieving a low pressure drop and high NTSM compared with sheet type.

These are appropriate for the process required NTS under decompression.

### CHARACTERISTICS

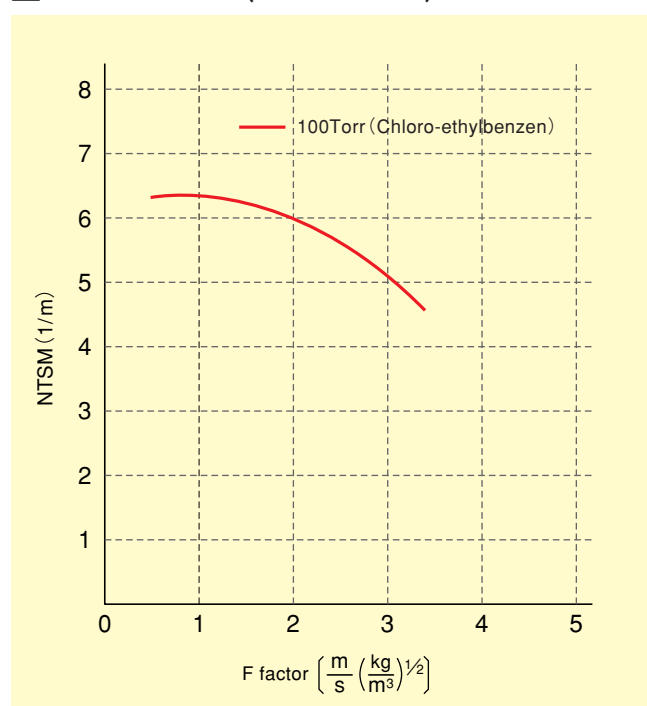
- High NTSM
- Pressure drop single theoretical step --- 0.1 to 0.5mmHg
- Proper liquid load range --- 0.05 to 20m<sup>3</sup>/m<sup>2</sup>H
- Maximum F factor --- BY-W500X :2.5  
BY-W700Y :1.8  
BY-W1000Y:1.0



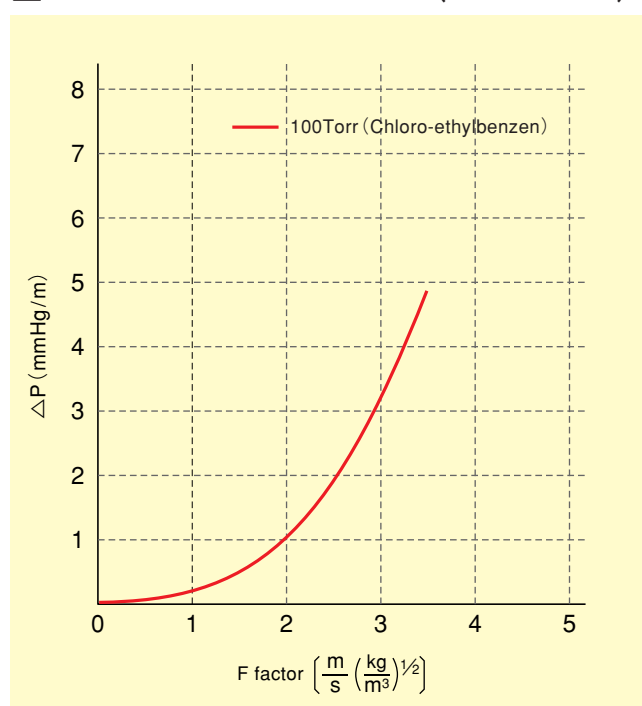
Name	Surface m <sup>2</sup> /m <sup>3</sup>	Void space %	Weight kg/m <sup>3</sup>	Height per mm	Substance
BY-W500X	500	94	266	175	Wire mesh
BY-W700Y	700	91	370	145	Wire mesh
BY-W1000Y	1000	88	531	145	Wire mesh

Bulk Density at a material specific gravity 7.93 for stainless steel type 304.

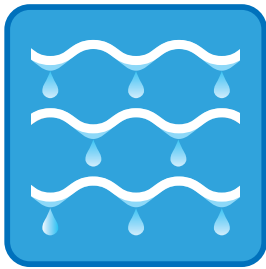
### ■ NTSM DATA (BY-W500Y)



### ■ PRESSURE-DROP DATA (BY-W500Y)



Ex. Materials: SUS304, SUS316L, Copper



## MC PACK

### MC PACK

#### Mesh-Sheet-Mesh

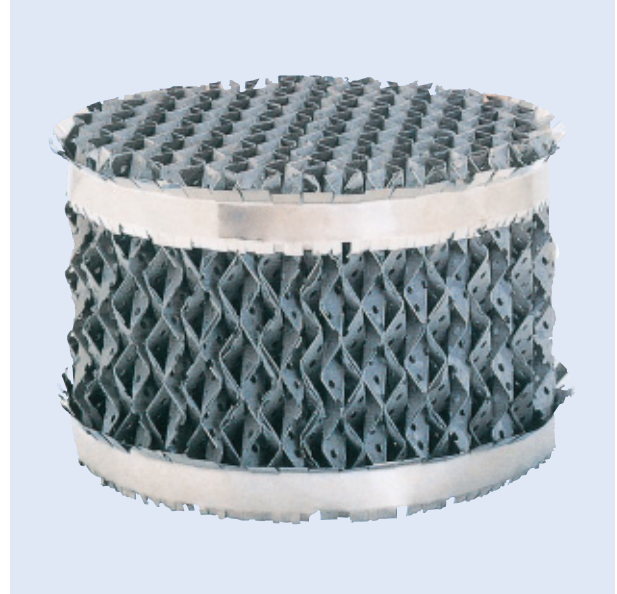
## MC250T/350T/500T

250T type consists of three layers: metal mesh layer, sheet layer, and metal mesh layer. Using 250T type, water with a high surface tension can spread well and maintain a suitable gas-liquid contact surface.

Structured Packing is usually ineffective for use with water with a high surface tension but 250T can properly maintain a liquid hold and liquid-gas surface, achieving a low pressure drop and high NTSM. 250T can be used in a wide range of environments from low to high load. It also achieves steady, high NTSM.

#### CHARACTERISTICS

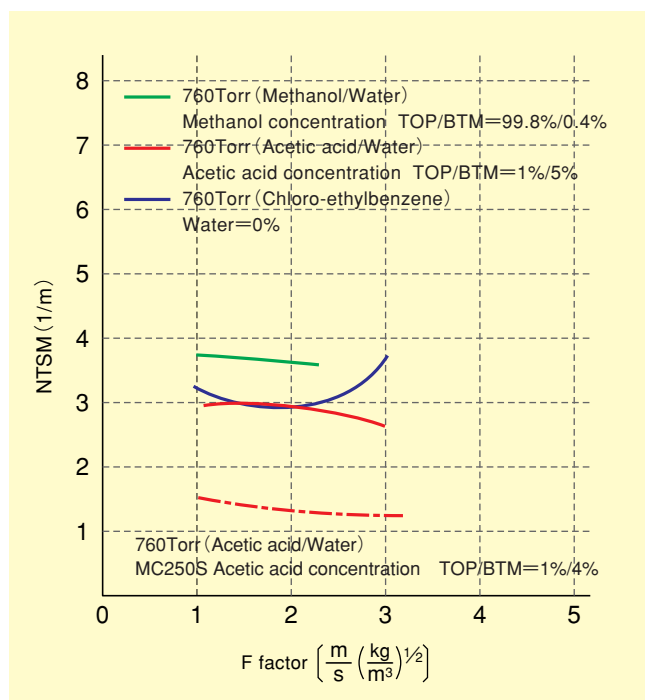
- High NTSM under water-use  
(over 40 dyne/cm of surface tension)
- Pressure drop for single theoretical step ---  
0.1 to 1 mmHg
- Proper liquid load range --- 0.2 to 70m<sup>3</sup>/m<sup>2</sup>H
- Maximum F factor --- MC250T: 3.0  
MC350T: 2.5  
MC250T: 2.0



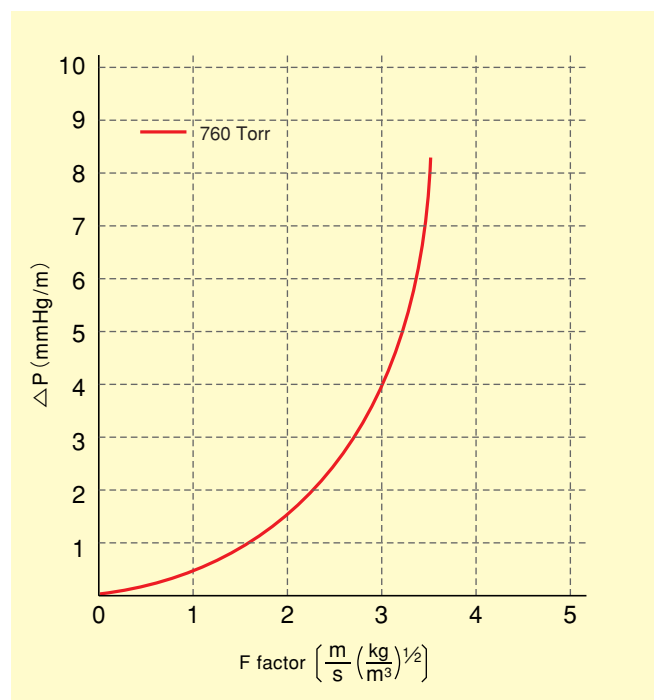
Name	Surface m <sup>2</sup> /m <sup>3</sup>	Void space %	Weight kg/m <sup>3</sup>	Height per mm	Substance
MC250T	250	97	150	182	Mesh-Sheet-Mesh
MC350T	350	—	227	183	Mesh-Sheet-Mesh
MC500T	500	—	293	178	Mesh-Sheet-Mesh

Bulk Density at a material specific gravity 7.93 for stainless steel type 304.

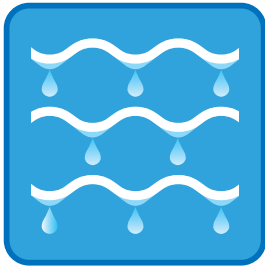
#### ■ NTSM DATA (MC250T)



#### ■ PRESSURE-DROP DATA (MC250T)



Ex. Materials: SUS304, SUS316L



## MC PACK

### Characteristic of the packing for water use. (T-type)

#### 【Comparison of HETP with the packing for water use (MC250T) and the packing of regular sheet. (MC250S)】

The following is examples of acetic acid/water use.

When MC250S is used for acetic acid or water use, HETP decreases more than twice of HETP for organic liquid.

However, when MC250T that is the packing for water use is used, HETP is the same as HETP for organic liquid

HETP (m) (CASE: F — factor = 2)

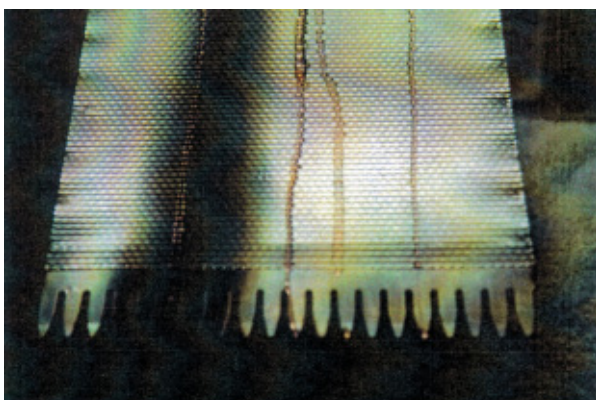
Experiment data of total reflex operation for 200A column.

	Acetic acid / Water use Acetic acid concentration TOP/BTM=1% / 4%	Organic liquid (Chlorobenzen/Ethylbenzen)
Packing for water use (MC250T)	0.33	0.33
Packing of regular sheet (MC250S)	0.77	0.31

In a case of water use, the numerical value of HETP varies enormously depending on what the object liquid is used except water, so please do not hesitate to contact us about individual numerical of HETP.

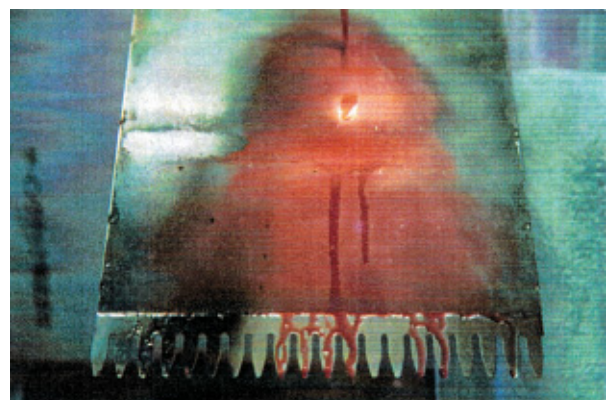
#### 【Aspect of experiment for liquid expansion with using colored water】

Sheet type

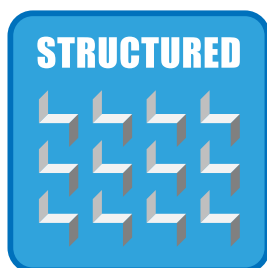


Spreading liquid on a surface of stainless sheet does not spread so much because of a high surface tension.

T-type



Spreading liquid on a surface of stainless sheet is good because colored water spreads on a wire mesh surface attached to stainless sheet.

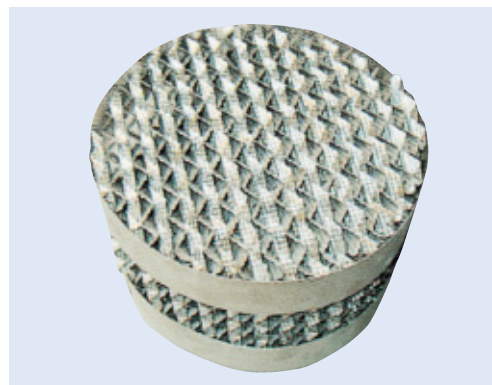


# STRUCTURED PACKING

## MC-Y PACK

### Sheet

Parameter	BY-M64X	BY-M64Y	BY-125X	BY-M125Y
Specific Area $\text{m}^2/\text{m}^3$	64		125	
Void Space %	99.5	99.5	99.2	99.2
MIN liquid load $\text{m}^3/\text{m}^2/\text{hr}$	0.5	0.5	0.5	0.5
MAX liquid load $\text{m}^3/\text{m}^2/\text{hr}$	100	100	100	100
Max F factor $\text{m/s}[\text{kg}/\text{m}^3]^{1/2}$	4.2	3.7	4.0	3.5
Standard HETP mm	2000	1500	1200	800
Weight $\text{kg}/\text{m}^3$	40	40	64	64
Height per Element mm	200	200	200	200
MAX Packing Height per Layer** mm	8000	8000	8000	8000



Ex. Materials:  
SUS304, SUS316L, SUS329J4L, Titanium,  
Hastelloy, Aluminum, copper, Nickel

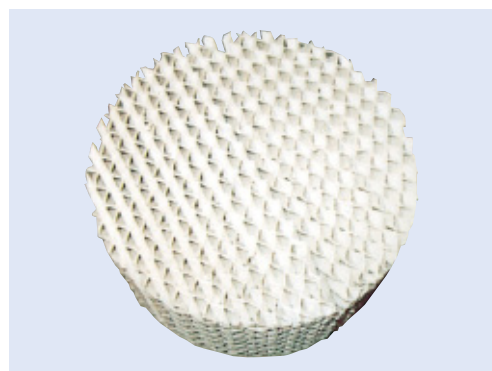
Parameter	BY-M200X	BY-M200Y	BY-M250X	BY-M250Y	BY-M350X	BY-M350Y	BY-M500X	BY-M500Y	BY-M750Y
Specific Area $\text{m}^2/\text{m}^3$	200		250		350		500		750
Void Space %	98.8	98.8	98.5	98.5	98	98	97.2	97.2	95.9
MIN liquid load $\text{m}^3/\text{m}^2/\text{hr}$	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
MAX liquid load $\text{m}^3/\text{m}^2/\text{hr}$	100	80	75	80	40	30	25	20	10
Max F factor $\text{m/s}[\text{kg}/\text{m}^3]^{1/2}$	3.7	3.2	3.4	3.0	2.8	2.5	2.3	2.0	1.6
Standard HETP mm	700	500	550	450	430	360	370	280	230
Weight $\text{kg}/\text{m}^3$	96	84	105	105	144	144	210	210	300
Height per Element mm	200	200	200	200	200	200	200	200	200
MAX Packing Height per Layer** mm	7000	7000	6000	6000	4500	4500	3500	3500	3000

\*\*3000mm when using a tower with 300  $\phi$  or less diameter

Bulk Density at a material specific gravity 7.93 for stainless steel type 304.

## MC-C PACK

### Ceramic



Parameter	125X	125Y	160X	250X	250Y	350Y	450X	450Y	700Y
Specific Area $\text{m}^2/\text{m}^3$	125	125	160	250	250	350	450	450	700
Void Space %	90	90	85	80	80	78	72	72	68
Oblique Angle $^\circ$	30	45	45	30	45	45	30	45	45
Liquid Load $\text{m}^3/\text{m}^2/\text{hr}$	0.2~100	0.2~100	0.2~70	0.2~65	0.2~50	0.2~30	0.2~20	0.2~15	0.2~7
MAX F factor $\text{m/s}[\text{kg}/\text{m}^3]^{1/2}$	3.2	3.0	2.7	2.8	2.4	2.0	1.7	1.5	1.2
NTSM l/m	1.5	1.7	1.9~2.2	2.3~2.7	2.5~3.0	2.8~3.2	3~4	3.5	6~8
Packing Density $\text{kg}/\text{m}^3$	320	320	370	420	420	500	550	550	730
Sheet Pressure mm	2.0~3.0	2.0~3.0	2.0~2.5	1.7~2.0	1.7~2.0	1.3~1.6	1.0~1.2	1.0~1.2	0.9~1.1
Height per Element mm	150		150	150		100	100		100

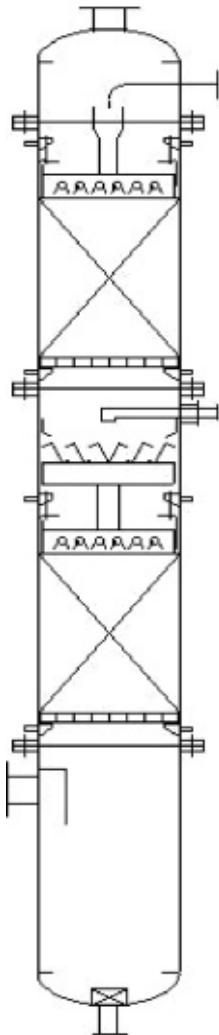
\*\*Ceramic plates manufactured can be porous or non-porous ones.

Bulk Density at a specific gravity 2.29 for ceramic material





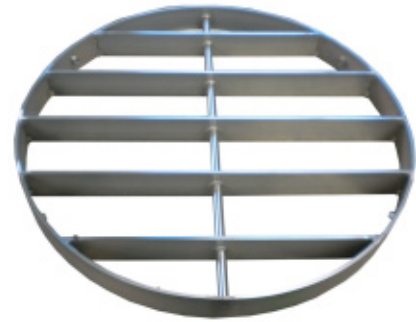
# INTERNALS FOR STRUCTURED PACKING



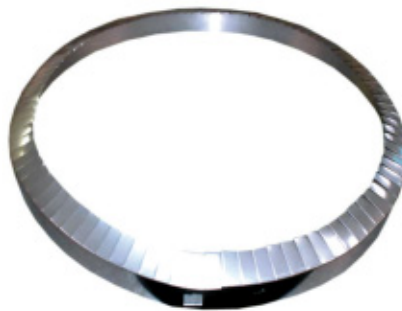
MC distributor



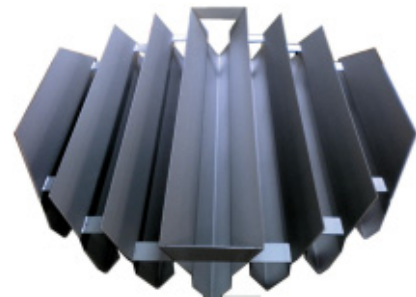
Support grid



Wall wiper



Collector



Example of materials:  
SUS304, SUS316L, CS, Titanium, Hastelloy, Aluminum, Copper

## Open channel type Distributor





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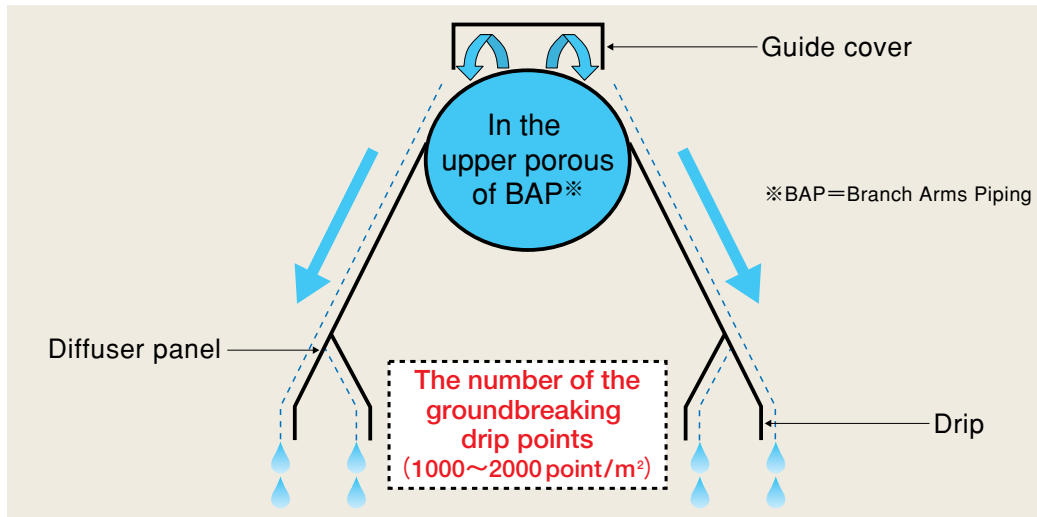
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# INTERNALS FOR STRUCTURED PACKING

## The principle of liquid dispersal for MC distributor



Aspect of flowing down liquid from a diffuser panel.

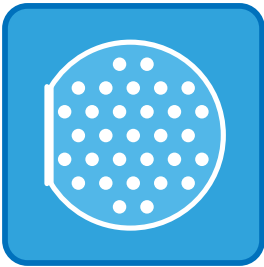


Aspect of liquid dispersal

## Example of dispersal of low liquid load.





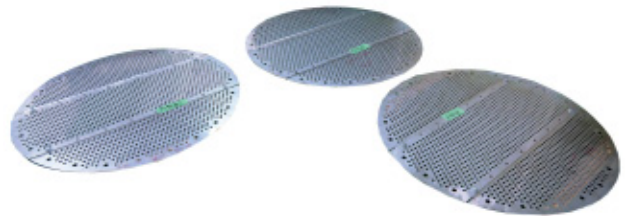


# TRAY

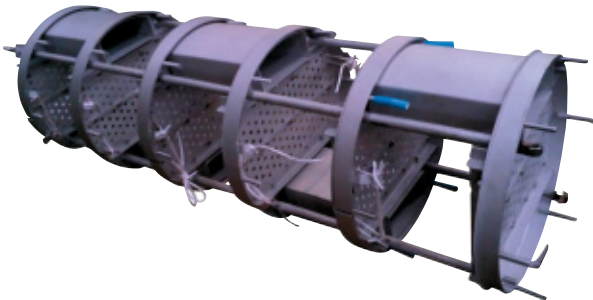
Non-weir cartridge tray



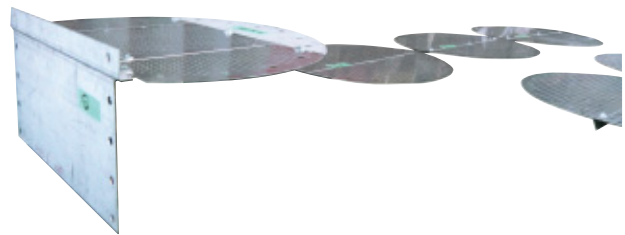
Non-weir tray



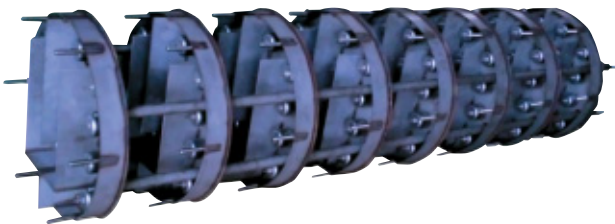
Cartridge shieve tray



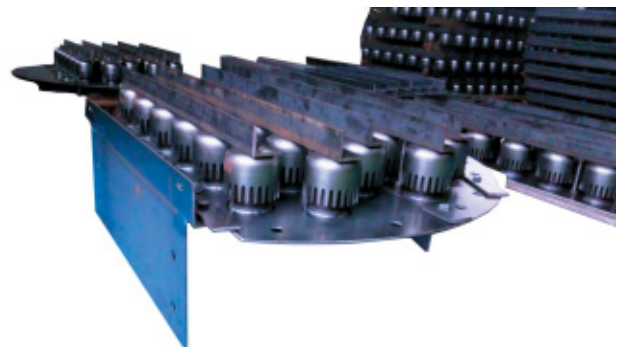
Shieve tray



Cartridge bubble cap tray

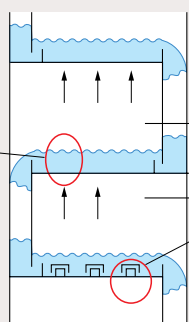
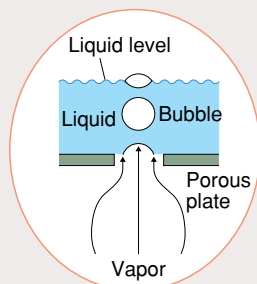


Bubble cap tray

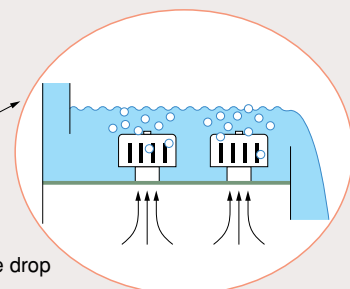


Materials : SUS304, SUS304L, SUS316, SUS316L, SUS329J4L, CS. Titanium, Hastelloy, Special metal  
Design : Tray detailed design, Tray dynamics calculation, Performance chart, Installation procedure,  
Mechanical strength calculation.

The principle of Sieve tray



The principle of bubble cap tray





## VESSEL

Metal



FRP



PVC + FRP



Rubber lining



Materials : Metal (SUS, CS) , FRP, PVC+FRP, Rubber lining, Teflon lining, Flake lining

Regulation : Facilities of the fire regulation, First pressure container, Second pressure container, Specialized high pressure gas

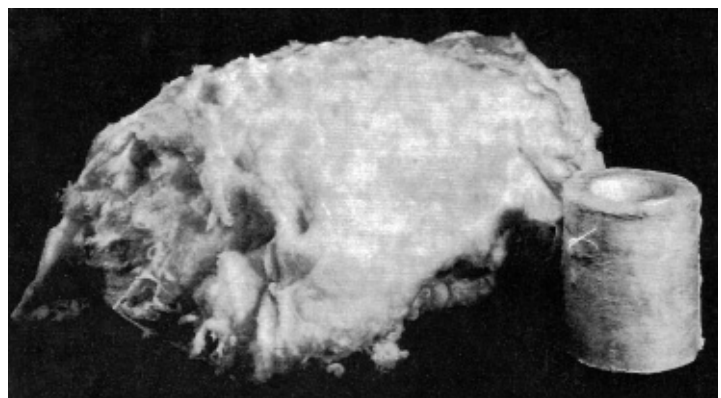




## CANDLE FILTER

This equipment is researched and developed by ICI PLC and Begg. Cousland & Co., Ltd. It is intended primarily for the removal of very fine mist particle of less than  $2\mu$ .

A combination of impingent and diffusion for finer particles where Brownian motion that is compressed and formed in a cylindrical housing eliminates effectively small particles.



Materials : SUS304, SUS304L, SUS316, SUS316L, PP, PVC, PVDF, FRP  
Main body : Filter, Glass wool, PP fiber, PE fiber, PTFE fiber



## MIST SEPARATOR

The high-performing blade type eliminator that has an excellent property of eliminating mist utilizing a technology of TOYO TIRE & RUBBER CO., LTD.



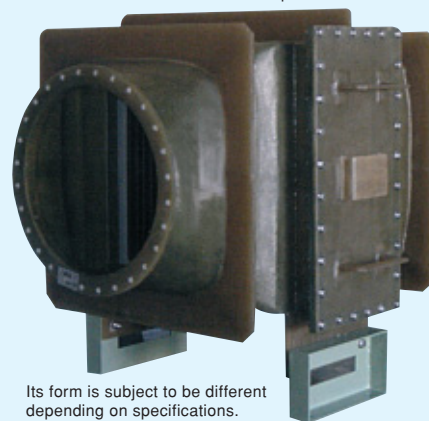
The high-performing blade type eliminator  
eTn Mist Eliminator

**Large  
numbers  
of delivery  
records**

# e-blade (Series of E922)

e-blade that has an excellent property to eliminate mist by technology of TOYO TIRE & RUBBER CO., LTD. is an equipment which has a large number of delivery records.

The photo of the e-blade



Its form is subject to be different depending on specifications.

### ■Property of e-blade

Becoming more compact and higher-performing

**High efficiency and low pressure drop**

e-blade has a performing to eliminate more than 99.9% of mist and recovery it by using an eliminator blade in a special form. It has low pressure drop and the maximum wind of the eliminator is 800Pa.

**Eliminating  
99.9% of  
mist**

### Standardized Units

e-blade is a compact equipment so that we can design e-blade which correspond to the mist whose current speed is 8m/sec. And also It is a low cost for special designs and we can shorten a delivery date because the liquid flow is standardized to 4500m<sup>3</sup>/min.

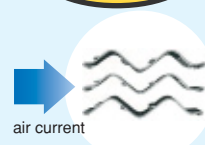
**Low cost,  
Shortening a  
delivery date**

**Light weight,  
High corrosion resistance,  
Thermal resistance**

e-blade has an excellent corrosion resistance because all of e-blade are manufactured by using corrosion-resisting FPR and Plastic.

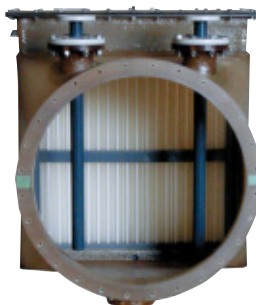
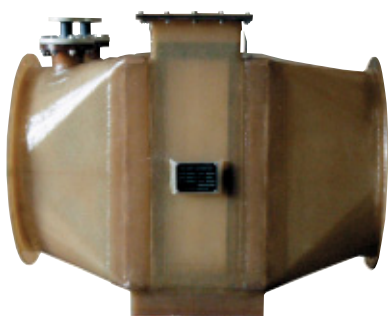
And also the type of plastic is selected from thermal resistance and corrosion resistance. (We can manufacture e-blade made from SUS depending on conditions)

**Long  
working life**



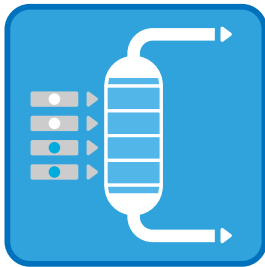
across section of high corrosion and thermal resisting.

## eTn Mist Eliminator (Series of E922)



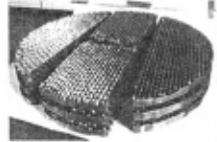






# FLOODING CALCULATION

## FLOODING CALCULATION FOR STRUCTURED PACKING



High-performance structured packing  
MC PACK



High-performance liquid distributor  
MC DISTRIBUTOR

MC PACK  
Packed Tower Design  
MATSUI MACHINE LTD.

Job No.  
Customer  
Tower Item

Date

		RECTIFY SEC.		STRIP SEC.	
		TOP	FEED	BELOW	BOTTOM
Pressure	kPaA	101.3	101.98	101.98	102.26
Temperature	°C	64.53	91.01	91.08	100.27
Vapor Load	kg/H	1700	1068	933	888
Vapor Density	kg/m <sup>3</sup>	1.16	0.76	0.63	0.59
Vapor Viscosity	mPa·s	0.011	0.012	0.013	0.013
Liquid Load	kg/H	1274	643	1132	1087
Liquid Density	kg/m <sup>3</sup>	750	897	896	916
Liquid Viscosity	mPa·s	0.35	0.31	0.31	0.28
Surface Tension	mN/m	19.03	57.11	57.12	58.16
Packed Height	mm	4368		2548	
Number of Layer		1		1	
Packing Type		MC250T		MC250T	
Tower Diameter	mm	500		500	
Vapor Velocity	m/s	2.08	1.99	2.09	2.12
F-factor	m/s(kg/m <sup>3</sup> ) <sup>0.5</sup>	2.24	1.73	1.66	1.63
Flooding %	%	67.1	41.96	46.59	44.87
Sp. Liquid Load	m <sup>3</sup> /(m <sup>2</sup> ·H)	8.66	3.65	6.44	6.04
Packing ΔP	kPa/m	0.2	0.097	0.094	0.09
Packing Total ΔP	kPa	0.88			
Internals Total ΔP	kPa	0.076			
Tower ΔP	kPa	0.96			

Load in column  
(Input data)

System Factor  
1.0

MATSUI MACHINE LTD.  
treasures teamwork with customers.

## FLOODING CALCULATION FOR RANDOM PACKING

\*\* Matsui Machine COMPUTER DESIGN OPTIMIZATION WITH CMR \*\*

DESIGN CONDITIONS	100% LOAD		50% LOAD		120% LOAD	
	TOP	BTM	TOP	BTM	TOP	BTM
OPERATING PRESSURE (mmHg)	530	536	530	536	530	536
OPERATING TEMPERATURE (°C)	89.3	90.5	89.3	90.5	89.3	90.5
VAPOR RATE (Kg/hr)	970	1,123	485	562	1,164	1,348
LIQUID RATE (Kg/hr)	9,000	9,000	4,500	4,500	10,800	10,800
VAPOR DENSITY (Kg/m <sup>3</sup> )	0.42	0.42	0.42	0.42	0.42	0.42
LIQUID DENSITY (Kg/m <sup>3</sup> )	940	940	940	940	940	940
LIQUID VISCOSITY (C.P.)	1.0	1.0	1.0	1.0	1.0	1.0
FOAMING FACTOR(ake)	1.0	1.0	1.0	1.0	1.0	1.0
DESIGN RECOMMENDATION						
(Number of Layer)						
TOWER PACKING NAME & SIZE & MATERIAL	1 CMR No.1P SUS304	1 CMR No.1P SUS304	1 CMR No.1P SUS304	1 CMR No.1P SUS304	1 CMR No.1P SUS304	1 CMR No.1P SUS304
TOWER DIAMETER (mm)	700	700	700	700	700	700
PACKED HEIGHT (mm)	5,000	5,000	5,000	5,000	5,000	5,000
CAPACITY FACTOR (Kg/m <sup>2</sup> /S)	1.08	1.25	0.54	0.62	1.29	1.50
PACKING FACTOR (1/ft)	40	40	40	40	40	40
FLOODING APPROACH (%)	43.3	48.0	21.7	24.0	52.0	57.6
PRESSURE DROP (mmH <sub>2</sub> O/m)	15.6	21.2	4.6	5.4	25.3	36.7
TOTAL PRESSURE DROP (mmH <sub>2</sub> O)	77.9	105.9	23.0	27.2	126.4	183.7
VAPOR MASS VELOCITY (Kg/m <sup>2</sup> /hr)	2,521.8	2,919.5	1,260.9	1,459.8	3,026.1	3,503.4
LIQUID MASS VELOCITY (Kg/m <sup>2</sup> /hr)	23,397.9	23,397.9	11,698.9	11,698.9	28,077.5	28,077.5
VAPOR LINEAR VELOCITY (m/sec)	1.66	1.92	0.83	0.96	1.99	2.31
Internals Pressure Drop (mmH <sub>2</sub> O/Layer)	6.49	8.36	2.37	2.84	8.91	11.60
Total Pressure Drop (mmH <sub>2</sub> O)	84.4	114.3	25.4	30.0	135.3	195.3
Design Factor (x1.5)	6.2	8.4	1.9	2.2	10.0	14.4
LIQUID VOL VELOCITY (m <sup>3</sup> /m <sup>2</sup> /hr)	9.3	12.6	2.8	3.3	14.9	21.6
LIQUID HOLD - UP (m <sup>3</sup> -Liq./m <sup>2</sup> -Packing)	24.9	24.9	12.4	12.4	29.9	29.9
	0.0487	0.0490	0.0297	0.0297	0.0559	0.0568

Load in column  
(Input data)

# Supplement 1

## PACKING FOR SHIPPING

### Package for Random packing



### Package for Structured packing



### Internal

#### ● Domestic package



#### ● Package for exportation





# Supplement 2

## TRADING

