EN–2020-01

# Product Bulletin 101
## Mass Transfer Products

RASCHIG

# Index
# Mass Transfer Products

To be a global player in the field of separation technology, Raschig is more than just a supplier of random packings. We offer a wide range of trays and structured packings in addition to high performance random packings to meet customers' needs.

For decades, Raschig has reacted to constant changes driven by market forces and global supply and demand. This is reflected in Raschig's mass transfer portfolio and the desire to utilize the most efficient devices, which are highlighted on the following pages.

## General overview of Raschig products and services:

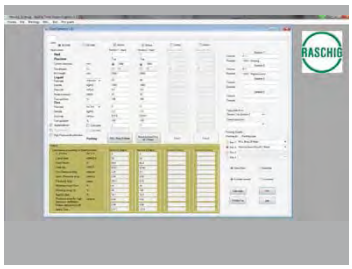
Mass Transfer Products

Engineering Service

Process Development

Applications

Performance Test

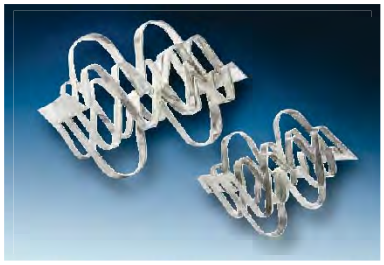



Design Software "WINSORP"

# Metal Random Packings

# Metal Random Packings
## Process Data

The design of Raschig Super-Ring® was published in 1998 and had set a new standard in the performance of random packings. Nowadays it is called the first fourth generation random packing compared to earlier designs like Raschig-Rings, Pall-Rings and IMTP packings. Soon after the Raschig Super-Ring® was available to the industry it was a new reference line for



**Raschig Super-Ring® Plus (FRI-tested)**

| Size | Surface ($m^2/m^3$) | Free Vol. % | |
|---|---|---|---|
| 0.7 | 175 | 98 | Neu |
| 1 | 150 | 98 | |
| 2 | 100 | 98 | |

**Raschig Super-Ring® (FRI-tested)**

| Size | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|
| 0.1 | 450 | 95 |
| 0.3 | 315 | 96 |
| 0.5 | 250 | 97 |
| 0.6 | 215 | 98 |
| 0.7 | 180 | 98 |
| 1 | 150 | 98 |
| 1.5 | 120 | 98 |
| 2 | 100 | 98 |
| 3 | 80 | 98 |
| 4 | 70 | 98 |

**Available Materials:** Carbon Steel, Stainless Steel, Hastelloy, Titan, Copper, Aluminium, Nickel, special Alloys

# Metal Random Packings
# Process Data

packing comparisons in terms of pressure drop, capacity and efficiency. Raschig Super-Ring® Plus is the result of a consequent design development based on many years of research. The target was to stay with all advantages of Raschig Super-Ring® but improve capacity and reduce pressure drop.

**RI-Ring**
**(equivalent to IMTP)**

| Size | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|
| 15 | 300 | 96 |
| 25 | 235 | 97 |
| 40 | 150 | 97 |
| 50 | 98 | 98 |
| 60 | 85 | 98 |
| 70 | 60 | 98 |

**LPR Low Profile Ring**
**(equivalent to**
**CASCADE MINI-RINGS)**

| Size | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|
| 0.5 | 356 | 96 |
| 1 | 247 | 96 |
| 1.5 | 187 | 97 |
| 2 | 157 | 98 |
| 2.5 | 130 | 98 |
| 3 | 102 | 98 |
| 4 | 79 | 98 |
| 5 | 46 | 98 |

**Available Materials:** Carbon Steel, Stainless Steel, Hastelloy, Titan, Copper, Aluminium, Nickel, special Alloys

# Metal Random Packings
## Process Data

**Pall-Ring**

| Size | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|
| 10 | 515 | 94 |
| 15 | 360 | 95 |
| 25 | 215 | 95 |
| 38 | 135 | 96 |
| 50 | 105 | 96 |
| 80 | 80 | 96 |

**Ralu-Ring®**

| Size | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|
| 25 | 215 | 96 |
| 38 | 135 | 97 |
| 50 | 105 | 98 |

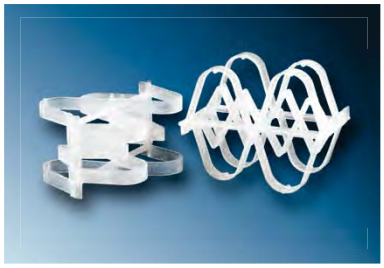
**Raschig-Ring**

| Size | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|
| 5 | 1.000 | 87 |
| 6 | 900 | 89 |
| 8 | 630 | 91 |
| 10 | 500 | 92 |
| 12 | 430 | 94 |
| 15 | 350 | 95 |
| 25 | 220 | 95 |
| 38 | 135 | 93 |
| 50 | 110 | 95 |
| 80 | 65 | 96 |
| 100 | 48 | 96 |

**Available Materials:** Carbon Steel, Stainless Steel, Hastelloy, Titan, Copper, Aluminium, Nickel, special Alloys

# Plastic Random Packings

# Plastic Random Packings
## Process Data



**Raschig Super-Ring®**

| Size | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|
| 0.3 | 325 | 92 |
| 0.6 | 205 | 93 |
| 2 | 100 | 96 |
| 3 | 75 | 97 |

**Ralu-Flow®**

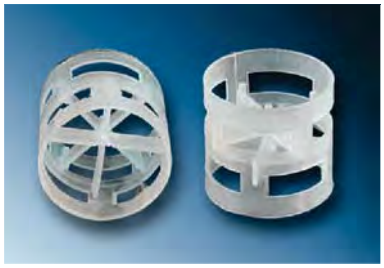
| Size | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|
| 1 | 165 | 95 |
| 2 | 100 | 95 |

**Ralu-Ring®**

| Size | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|
| 15 | 320 | 90 |
| 25 | 190 | 94 |
| 38 | 150 | 95 |
| 50 | 110 | 95 |
| 90 | 75 | 96 |
| 125 | 60 | 97 |

**Available Materials:**
PP, PE, PPH, PFA, PVC, PVDF, HDPE. E-CTFE, FEP, etc.

# Plastic Random Packings
## Process Data



**Pall-Ring**

| Size | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|
| 15 | 350 | 88 |
| 25 | 220 | 91 |
| 90 | 78 | 94 |

**Super-Torus-Saddle**

| Size | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|
| 1 | 240 | 90 |
| 2 | 110 | 94 |
| 3 | 90 | 96 |

**Hacketten® / Tri-Packs®**

| Size | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|
| 25 | 279 | 90 |
| 50 | 157 | 94 |
| 90 | 125 | 95 |

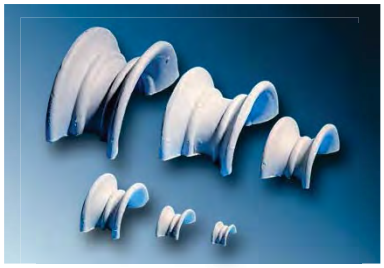
**LPR Low Profile Ring (equivalent to CASCADE MINI-RINGS)**

| Size | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|
| 25 (1A) | 280 | 92 |
| 50 (2A) | 164 | 93 |
| 50 (2) | 144 | 95 |
| 90 (3A) | 131 | 94 |

**Available Materials:**
PP, PE, PPH, PFA, PVC, PVDF, HDPE. E-CTFE, FEP, etc.

# Ceramic and Carbon Random Packings Process Data

# Ceramic and Carbon Random Packings
# Process Data



Torus-Saddle

| Size | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|
| 12 (½") | 622 | 73 |
| 20 (¾") | 335 | 74 |
| 25 (1") | 255 | 74 |
| 38 (1½") | 166 | 75 |
| 50 (2") | 120 | 77 |
| 75 (3") | 92 | 79 |

Balls

| Ball-Ø (inch) | Ball-Ø (mm) | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|---|
| 1/8 | 3 – 5 | 1.285 | 44 |
| 1/4 | 6 – 8 | 500 | 44 |
| 3/8 | 9 – 11 | 350 | 44 |
| 1/2 | 11 – 14 | 280 | 45 |
| 5/8 | 14 – 17 | 220 | 45 |
| 3/4 | 19 – 21 | 170 | 45 |
| 1 | 23 – 28 | 125 | 45 |
| 1 1/2 | 29 – 35 | 105 | 48 |
| 2 | 48 – 55 | 65 | 45 |

# Ceramic and Carbon Random Packings
## Process Data

Pall-Ring

| Size | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|
| 25 | 220 | 75 |
| 35 | 165 | 78 |
| 50 | 120 | 78 |
| 80 | 80 | 79 |
| 100 | 55 | 81 |

Raschig-Ring (Ceramic)

| Size | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|
| 5 | 1.000 | 63 |
| 6 | 940 | 64 |
| 8 | 550 | 65 |
| 10 | 440 | 66 |
| 12 | 360 | 67 |
| 15 | 310 | 72 |
| 25 | 190 | 74 |
| 35 | 140 | 76 |
| 50 | 98 | 78 |
| 80 | 60 | 77 |
| 100 | 44 | 81 |

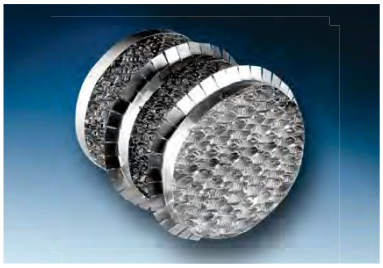
Raschig-Ring (Carbon)

| Size (inch) | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|
| 1/4 | 623 | 53 |
| 1/2 | 392 | 66 |
| 3/4 | 210 | 73 |
| 1 | 179 | 76 |
| 1-1/2 | 126 | 77 |
| 1-1/2+ | 113 | 71 |
| 2 | 91 | 72 |
| 3 | 67 | 70 |
| 4 | 43 | 68 |

# Metal Structured Packings

# Metal Structured Packings
# Process Data

The new Raschig Super-Pak® is a novel development in mass transfer technology because of its optimized surface design. It enables, to an extent never known before, great separation efficiency and high loading capacity while keeping the pressure drop extremely small.



**Raschig Super-Pak®**

| Size | Style | | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|---|---|
| 150 | X | Y | 150 | 98 |
| 200 | X | Y | 200 | 98 |
| 250 | X | Y | 250 | 98 |
| 300 | X | Y | 300 | 98 |
| 350 | X | Y | 350 | 97 |
| 500 | | Y | 500 | 96 |

**Raschig-Pak**
**(equivalent to Mellapak)**

| Size | Style | | | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|---|---|---|
| 125 | X | Y | – | 125 | 98 |
| 170 | X | Y | – | 170 | 98 |
| 200 | X | Y | – | 200 | 98 |
| 250 | X | Y | HC | 250 | 98 |
| 300 | X | Y | – | 300 | 98 |
| 350 | X | Y | HC | 350 | 97 |
| 500 | X | Y | HC | 500 | 98 |
| 500 Gauze | X | – | – | 500 | 95 |

Y = Angle of inclination 45°
X = Angle of inclination 60°
HC = High Capacity Packing

**Available Materials:** Carbon Steel, Stainless Steel, Hastelloy, Titan, Copper, Aluminium, Nickel, special Alloys

# Ceramic Structured Packings
# Process Data

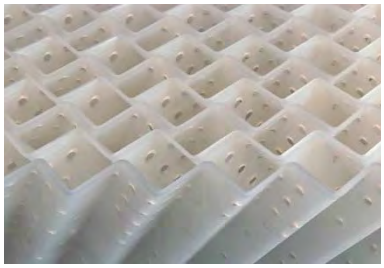
The CERADUR® is a special ceramic with unique chemical composition, what results in superior chemical resistance. This often allows the use of CERADUR® as alternative to more expensive glass packings.

Raschig-Pak Ceradur®

| Size | Style | | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|---|---|
| 100 | X | Y | 100 | 83 |
| 125 | X | Y | 125 | 82 |
| 160 | X | Y | 160 | 81 |
| 200 | X | Y | 200 | 80 |
| 250 | X | Y | 250 | 80 |
| 300 | X | Y | 300 | 79 |
| 350 | X | Y | 350 | 78 |
| 400 | X | Y | 400 | 78 |
| 450 | X | Y | 450 | 77 |
| 500 | X | Y | 500 | 76 |
| 550 | X | Y | 550 | 75 |
| 600 | X | Y | 600 | 75 |
| 650 | X | Y | 650 | 74 |
| 700 | X | Y | 700 | 73 |
| 750 | X | Y | 750 | 72 |
| 1000 | X | Y | 1000 | 70 |
| 1200 | X | Y | 1200 | 68 |

Y = Angle of inclination 45°
X = Angle of inclination 60°

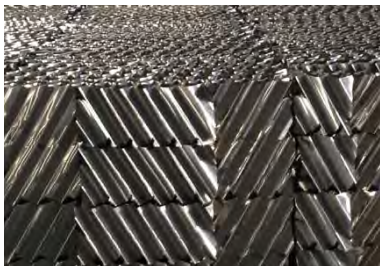
# Plastic Structured Packings, Metal Grids
# Process Data



**Raschig-Pak (plastic)**

| Size | Style | | | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|---|---|---|
| 110 | X | – | – | 110 | 88 |
| 220 | – | Y | HC | 220 | 82 |

**Available Materials:** PP, other materials on request



**Raschig-Grid (metal)**

| Size | Style | | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|---|---|
| P40 | X | Y | 40 | 98 |
| P64 | X | Y | 64 | 97 |
| P90 | X | Y | 90 | 96 |

Y = Angle of inclination 45°
X = Angle of inclination 60°
HC = High Capacity Packing

**Available Materials:** Carbon Steel, Stainless Steel, Hastelloy, Titan, Copper, Aluminium, Nickel, special Alloys

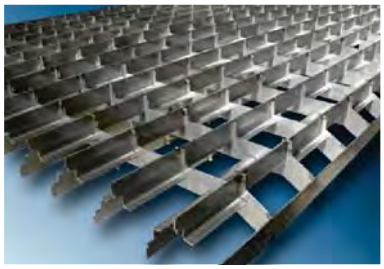
# Special Grid Packings
# Process Data

# Special Grid Packings
## Process Data

Main usage is in refinery columns where coking has to be expected and still heat transfer should be realised. Main applications are vacuum tower wash sections, atmospheric column above flash sections, FCC fractionator, quench section in coker units, ethylene water quench towers.

Raschig-Grid 3A

| Size | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|
| 3A | 47 | 91 |



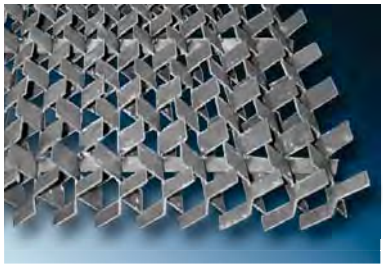
Raschig-Grid 25A

| Size | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|
| 25A | 37 | 93 |

Raschig-Grid SG

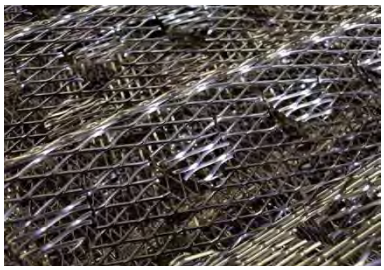
| Size | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|
| SG | 37 | 94 |

# Special Grid Packings
## Process Data



Raschig-Grid CFG

| Size | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|
| 25 | 25 | 96 |
| 50 | 50 | 91 |



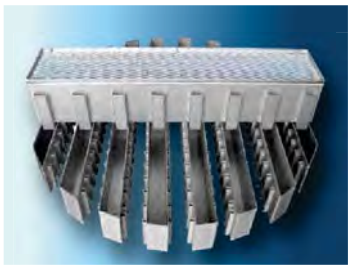
Raschig-Grid PG

| Size | Surface ($m^2/m^3$) | Free Vol. % |
|---|---|---|
| PG | 30 | 98 |

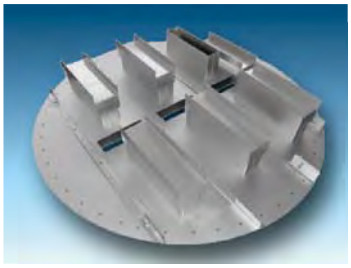
# Internals

For optimum performance, proper liquid and vapor distribution are of critical importance. To complement the random and structured packings, a wide range of internals is available such as high quality liquid distributors besides the standard type, support plates, hold-down plates, gas/vapor distributors, liquid collectors and gas/liquid flash devices.

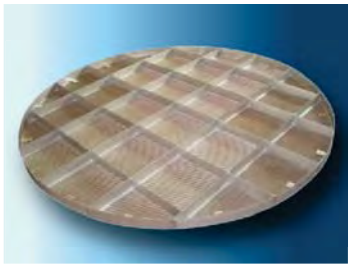
Gas-Liquid Phase Separator



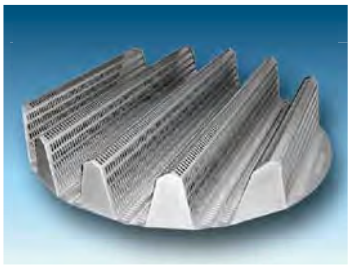
Liquid Distributor



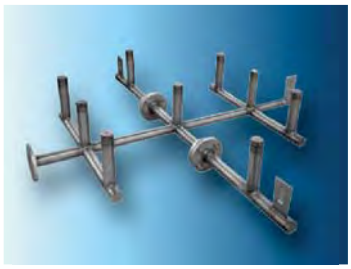
Liquid Collector



Hold-Down Plate



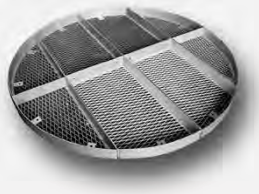
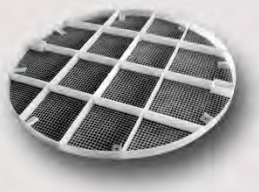
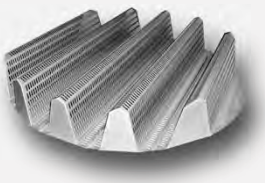
Support Plate



Gas Distributor

# The Importance of Internals in Packed Columns

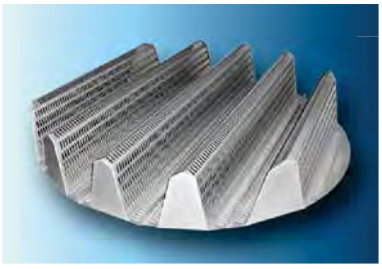
Nowadays, the ever-increasing efforts to achieve a process with optimal chemical engineering characteristics demand modern mass-transfer columns, i.e. high mass-transfer efficiency but a minimal energy requirement. These demands can only be met by the use of modern packed beds if the internals in the packed columns – liquid and gas distributors, hold-down and support structures, liquid collectors and redistributors – are designed according to modern principles. The gas and liquid distributors, which must be carefully designed and mounted with the greatest accuracy, are of prime importance in this respect. Detailed investigations into the uneven distribution of liquid in packed columns (maldistribution) have highlighted the influence on mass transfer efficiency of uniform distribution over the column cross-section. Properly designed support and hold-down plates are also important if a reduction in throughput is to be avoided. Increased pressure drops may sometimes result from the use of an inadequate support plate. Furthermore, there have been cases in which the tower packings have been damaged or even swept away due to the absence of a hold-down plate. The costs arising from the resultant malfunction in the downstream plant installations due to this damage are generally higher than the price of a hold-down plate. Our range of internals includes many types and sizes, manufactured in metal or plastic, and designed according to the state of the art of chemical engineering. A modern column design demands a basic understanding of the fluid-dynamic flow relationships in mass transfer columns. Experiments in the pilot plants at Raschig have in the past produced important criteria for designing internals, criteria which are taken into account in every new design project today. We would be happy to advise you and are able to offer tailor-made solutions to your individual problems.

| Metal | Plastic |
|---|---|
|  |  |
| **High Quality Liquid Distributor DT-S** | |
|  |  |
| **Hold-Down Plate HP–1** | |
|  |  |
| **Multibeam Support Plate SP-1** | |

**Available Materials:** Carbon Steel, Stainless Steel, Hastelloy, Titan, Copper, Aluminium, Nickel, special Alloys…

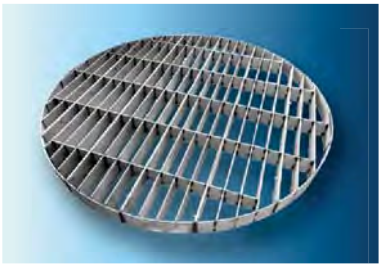
**Available Materials:** PE, PP, PVDF, ECTFE, PFA, Teflon, TFM, FRP…

# Support Plates
# in Metal and Plastic

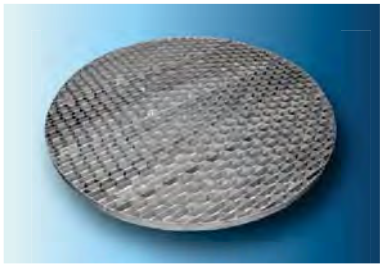


**Multibeam Support Plate**
**Type SP-1,**
Ø > 1200 mm
for metal and plastic packings

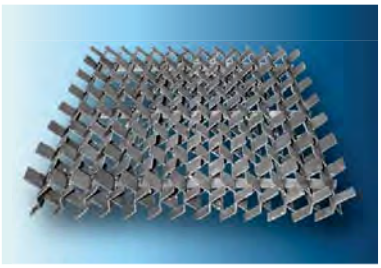
**Multibeam Support Plate**
**Type SP-2 and SP-3,**
100 mm < Ø < 1200 mm
for metal and plastic packings



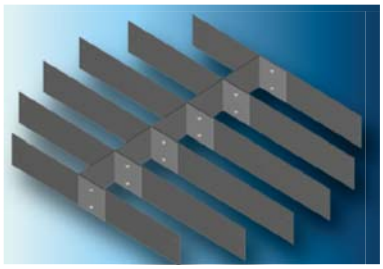
**Flat Bar Support Plate**
**Type SP-P,**
Ø > 100 mm
for structured packings



**Hexa-Grid Support Plate**
**Type SP-HG,**
Ø > 500 mm
for metal and plastic packings
for fouling services

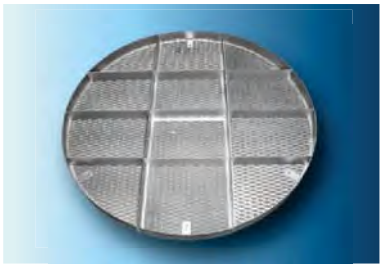


**Cross-Flow-Grid Support Plate**
**Type SP-CF,**
Ø > 500 mm, for metal and plastic packings for fouling services and enhanced gas distribution

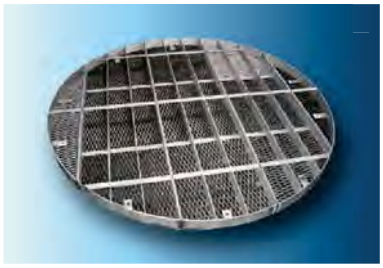


**Raschig-Super Grid Support Plate**
**Type RSG (in plastic),**
Ø > 500 mm
for plastic packings

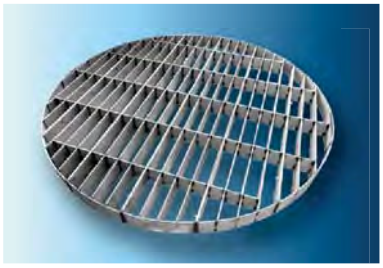
# Hold-Down Plates
## in Metal and Plastic



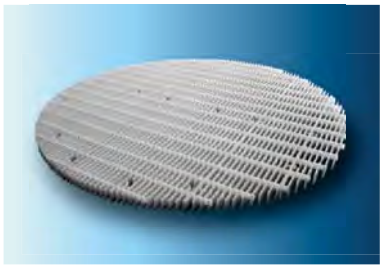
**Hold-down Plate**
**Type HP-1,**
Ø > 100 mm
for metal and plastic packings



**Hold-down Plate**
**Type HP-2,**
Ø > 100 mm
for ceramic packings



**Hold-down Plate**
**Type HP-P,**
Ø > 100 mm
for structured packings



**Hold-down Plate Raschig Grid**
**Type RG in plastic,**
Ø > 100 mm
for plastic packings

# Liquid Distributors and Redistributors
# in Metal and Plastic

Standard liquid distributors are usually used for liquid loads in a range of 5 to 80 $m^3/m^2/h$. Their simple design allows short production times and low cost.

Various applications in industry require special liquid distributors to ensure optimal distribution quality, highest wettability, controlled gas flow, low pressure drop, fouling resistance or high operating ranges.
For all of the different industrial demands, Raschig has a standardized or customized solutions.
The liquid distributor selection matrix below offers a first indication on the liquid distributor for the individual application.

## Liquid Distributor Selection Matrix:

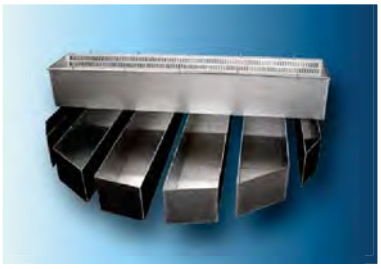
**Standard Distributor**

| Type | Column diameter (mm) | Standard loading range | Liquid load $u_L$ $[m^3/m^2\,h]$ | | | Gas capacity factor $[\sqrt{Pa}]$ | | | Sensitivity to fouling |
|---|---|---|---|---|---|---|---|---|---|
| | | | $u_L < 5$ | $5 < u_L < 80$ | $u_L > 80$ | $F_V < 1$ | $1 < F_V < 2{,}5$ | $F_V > 2{,}5$ | |
| DT-1 | > 800 | 2:1 | | x | x | x | x | | yes |
| DT-2 | > 800 | 10:1 | | x | x | x | x | | no |
| DR-2 | < 1200 | 2:1 | | x | x | x | x | | yes |
| DR-3 | < 1200 | 10:1 | | x | x | x | | | no |
| DP-1 | > 100 | 2:1 | | x | x | x | x | x | yes |
| DP-S | > 500 | 3:1 | | x | | x | x | | no |
| RP-1 | > 1200 | 2:1 | | x | x | x | x | | yes |
| RP-2 | > 300 | 2:1 | | x | x | x | x | | yes |

**High-quality Distributor**

| Type | Column diameter (mm) | Standard loading range | Liquid load $u_L$ $[m^3/m^2\,h]$ | | | Gas capacity factor $[\sqrt{Pa}]$ | | | Sensitivity to fouling |
|---|---|---|---|---|---|---|---|---|---|
| | | | $u_L < 5$ | $5 < u_L < 80$ | $u_L > 80$ | $F_V < 1$ | $1 < F_V < 2{,}5$ | $F_V > 2{,}5$ | |
| DT-MF | > 500 | 2:1 – 5:1 | x | x (<10) | | x | x | x | no |
| DT-S | > 300 | 2:1 – 5:1 | x | x | | x | x | x | no |
| RP-P2 | > 300 | 2:1 | | | x | x | | | yes |
| RP-S | > 300 | 2:1 – 5:1 | x | x | x | x | x | x | no |
| DR-S | < 1200 | 2:1 – 5:1 | x | x | x | x | x | x | no |
| DT-W | > 300 | 2:1 | | x | | x | x | | yes |
| DR-LL | < 1200 | 2:1 – 5:1 | x (<2) | | | x | x | | no |

# Standard Liquid Distributors and Redistributors in Metal and Plastic



**Trough Distributor**
**Type DT-1,**
Ø > 800 mm

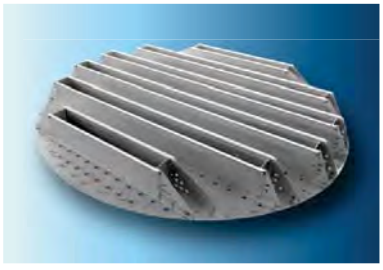
**Trough Distributor**
**Type DT-2,**
Ø > 800 mm
Fouling service

**Pan Distributor**
**Type DR-2,**
100 mm < Ø < 1200 mm

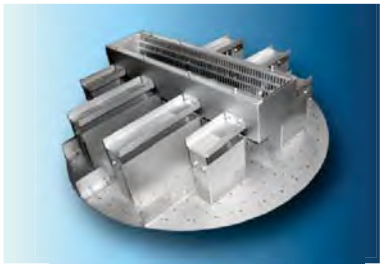
**Pan Distributor**
**Type DR-3,**
100 mm < Ø < 1200 mm
Fouling service

**Pipe Distributor**
**Type DP-1,**
Ø > 100 mm

**Spray Distributor**
**Type DP-S,**
Ø > 500 mm



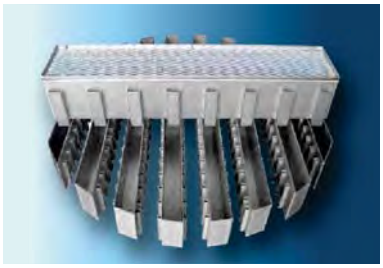
**Chimney Distributor**
**Type RP-1,**
Ø > 1200 mm



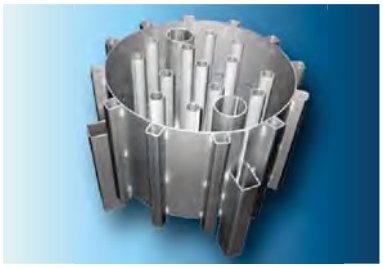
**Chimney Distributor**
**Type RP-2,**
Ø > 300 mm

# High Quality Liquid Distributors
## in Metal and Plastic

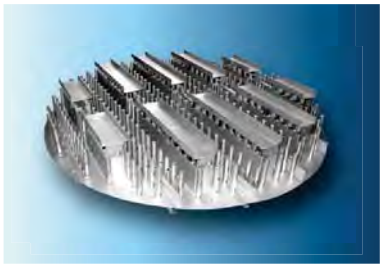
**High quality Distributor**
**Type Multi-Flow DT-MF,**
Ø > 500 mm
Very low liquid rates



**High quality Distributor**
**Type DT-S,**
Ø > 300 mm
Low to medium liquid rates



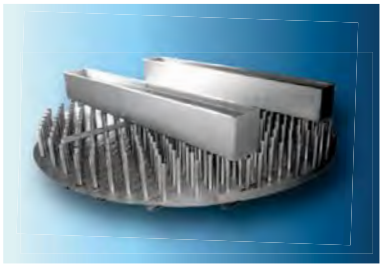
**High quality Distributor**
**Type DR-S,**
100 mm < Ø > 1200 mm
Low to medium liquid rates



**High quality Distributor**
**Type RP-S,**
Ø > 300 mm
Low to medium liquid rates

**High quality Distributor**
**Type DT-W,**
Ø > 300 mm
Medium liquid rates

**High quality Distributor**
**Type DR-LL,**
Ø < 1200 mm
Very low liquid rates

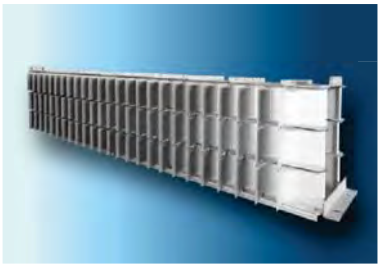


**High quality Distributor**
**Type RP-P2,**
Ø > 300 mm
High liquid rates beside low gas velocity

# Gas/Vapor Distributors
# in Metal and Plastic

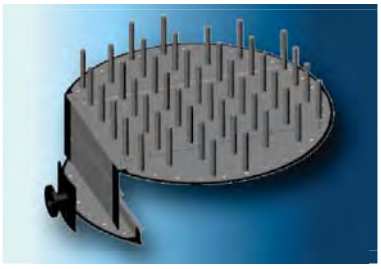
**Pipe Distributor**
**Type GV-1,**
Ø > 300 mm

**Pipe Distributor**
**Type GV-P1,**
Ø > 300 mm
Lowest gas flow rates



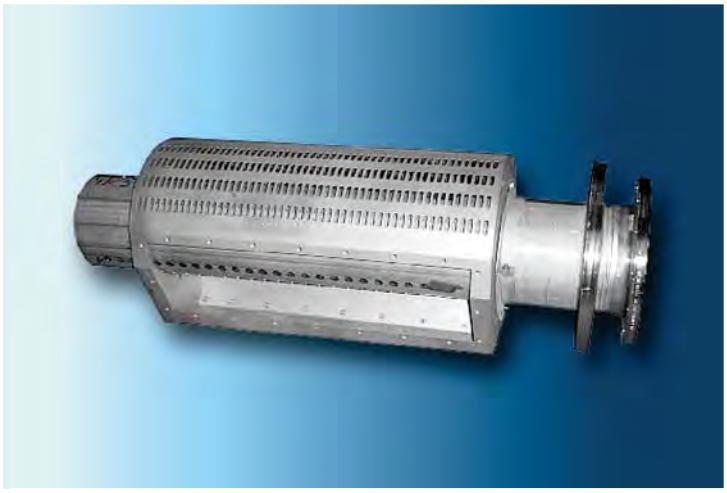
**Vane Distributor**
**Type GV-2,**
Ø > 500 mm

**Chimney Distributor**
**Type GV-3,**
Ø > 800 mm

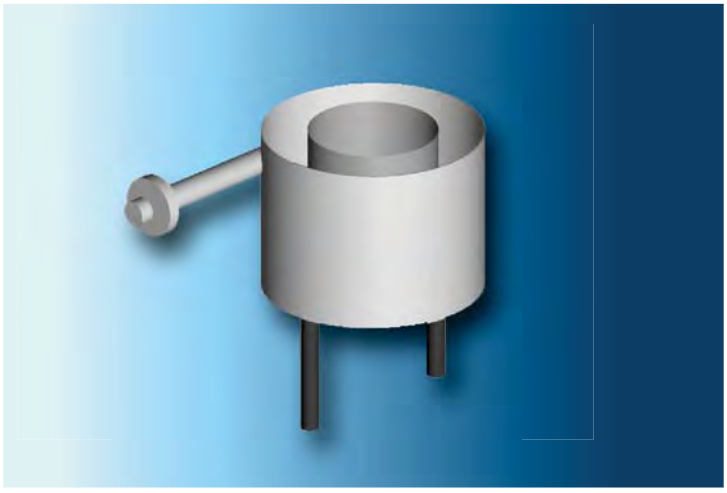


**Chimney Distributor**
**Type GV-P3,**
Ø > 800 mm
Lowest gas flow rates

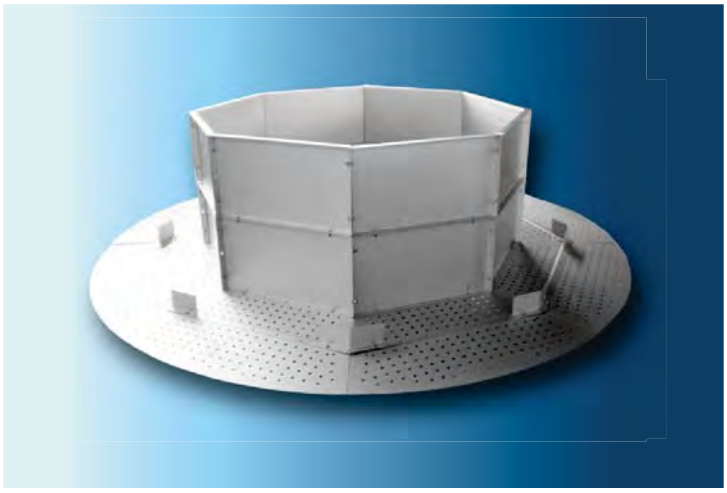
# Gas-liquid Phase Separators
## in Metal and Plastic



**Two-phase**
**Double-shell**
**Flashbox**
Type FB-1

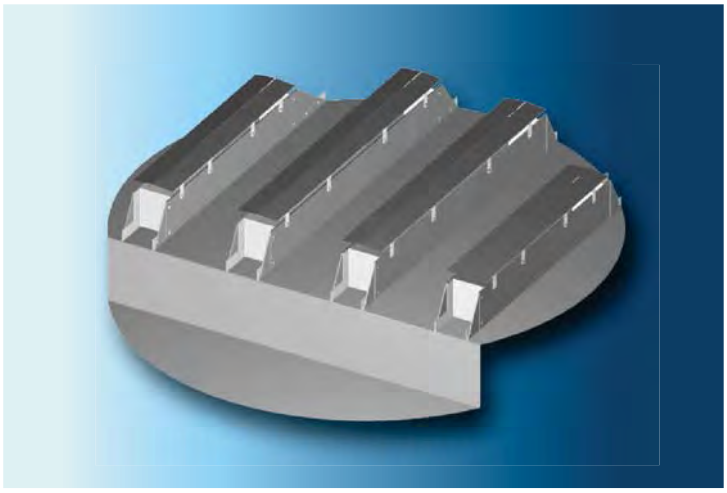


**Two-phase**
**Centrifugal**
**Flashbox**
**Type FB-2**

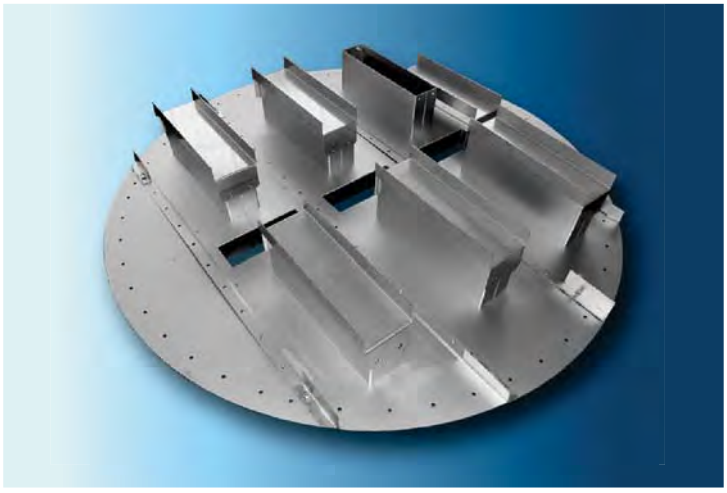


**Two-phase**
**Flash Gallery**
**Type FB-3**

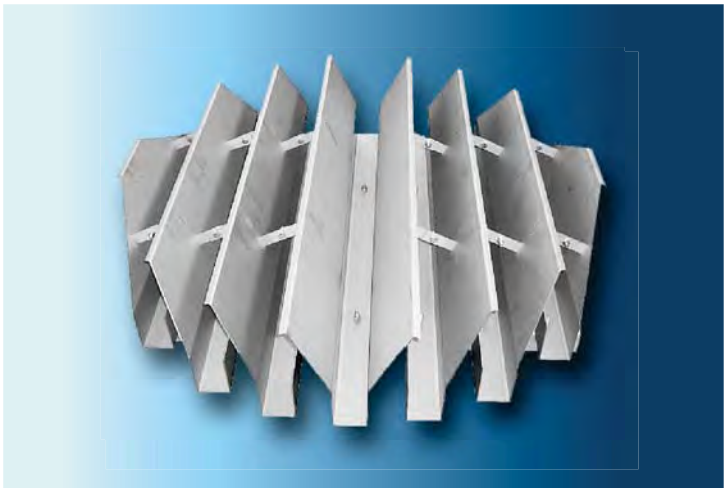
# Liquid Collectors
## in Metal and Plastic



**Chimney Collector**
**Type CP-1**
Ø > 1200 mm



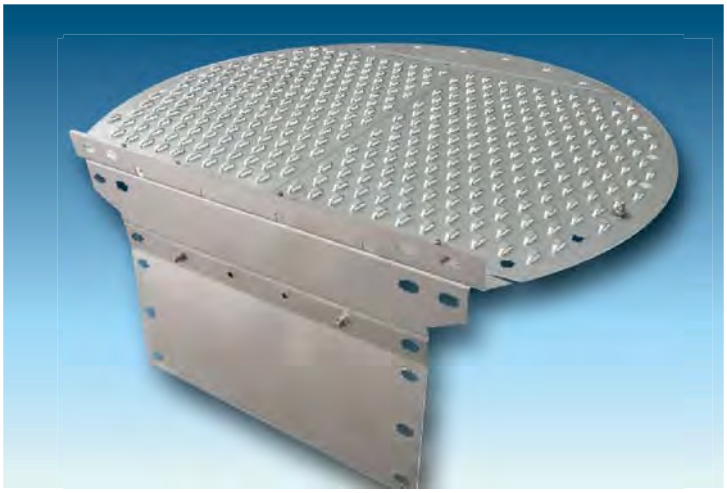
**Chimney Collector**
**Type CP-2**
Ø > 300 mm

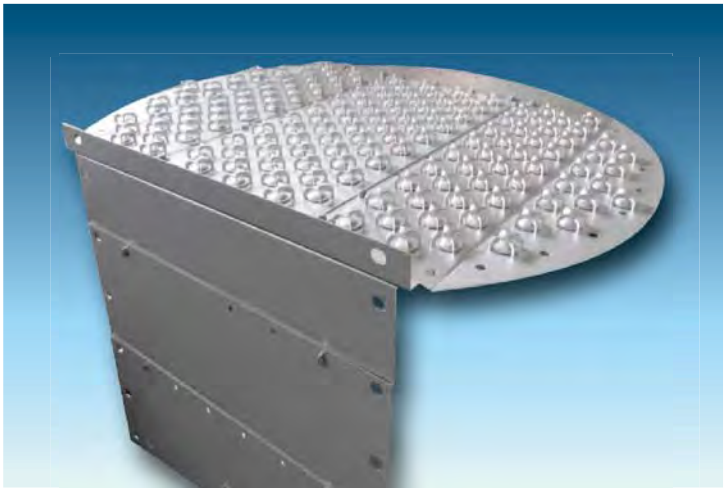


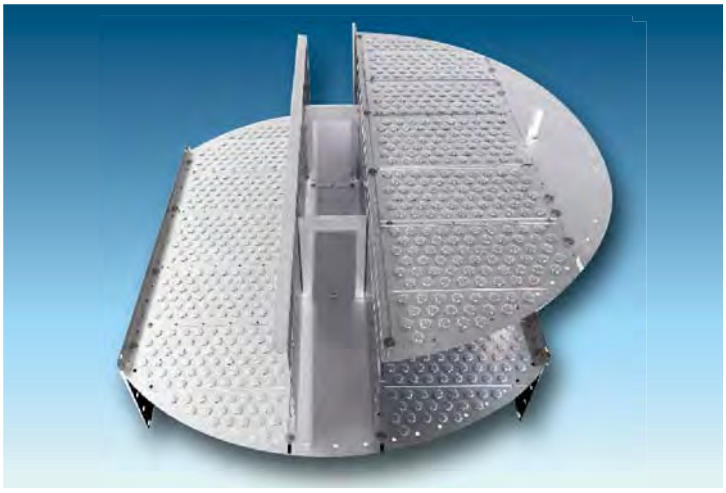
**Vane Collector**
**Type CV-1**
Ø > 800 mm

# Tray Technology

# Tray Technology







Raschig offers you an extensive product portfolio and engineering expertise in the field of mass transfer trays, from the design of completely new columns to status analysis and revamps of existing installations. We provide the hydraulic and mechanical design matching your individual application and reliably supply conventional trays and enhanced capacity trays. Ranging from sieve and valve trays towards bubble and tunnel cap trays, various 1- to 4-pass assemblies are manufactured from diverse metallic or specific thermoplastic materials.

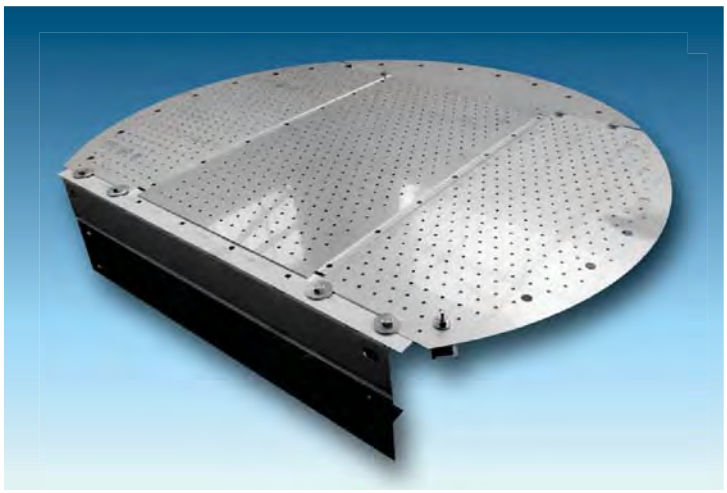
Moreover, we procure spare parts for rapid repairs. If desired, we also provide assembly technicians and supervisors.

We offer cartridge-trays for flanged columns with small diameters, chimney trays and special tray types like baffle trays or disk and donut trays.

# Tray Technology

### Sieve Trays

Our sieve trays are the unbeatably low cost solution for applications with clearly defined flow rates. These trays perforated with holes are suitable for relatively high loads. They show a moderate pressure drop and are suited for applications with high fouling tendency. Metallic and thermoplastic materials can be used and the hole diameters vary from 3.0 mm to 25 mm.



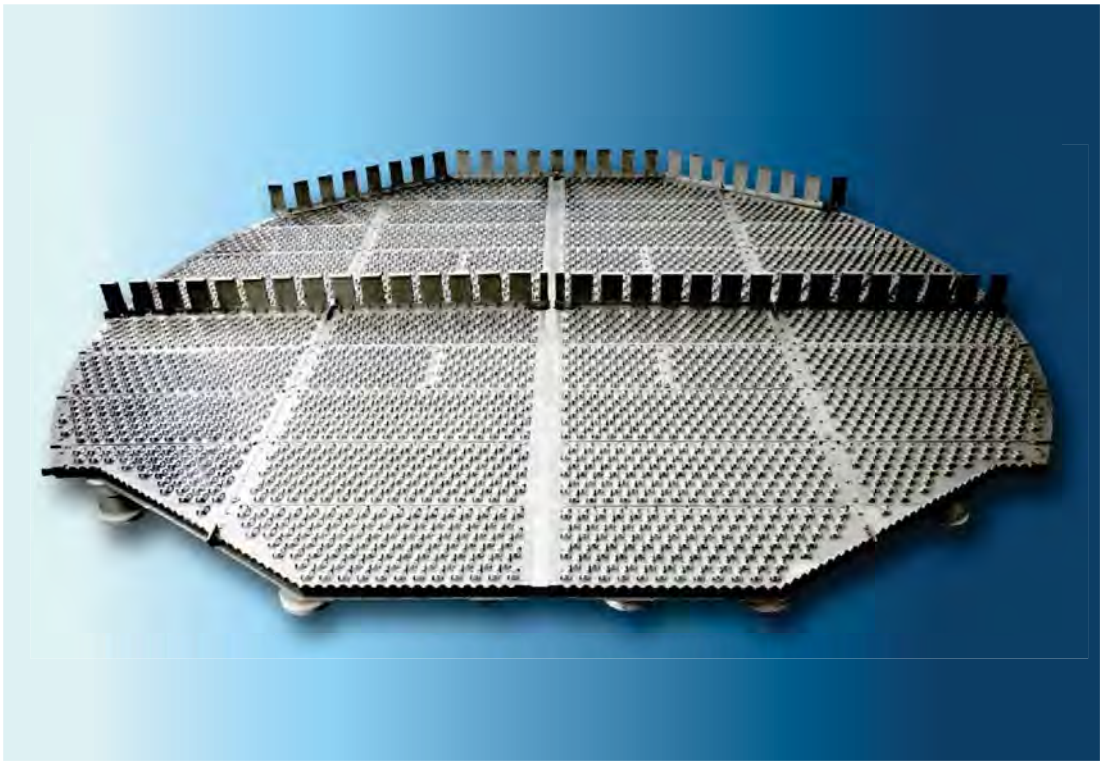
### Extraction Trays

These trays used for liquid-liquid extraction serve to distribute the disperse phase within the continuous phase. Therefore, a high surface quality is required for the tray decks usually equipped with small holes. These trays feature either downcomers or upcomers.

### Dualflow Trays

Specific sieve trays without downcomers, where vapor and liquid are sharing the same orifices. As these trays are working at counter current flow, the operation range is very narrow. The active area spans the entire cross section of the column and is completely perforated with holes. Dual flow trays are excellently suited for systems with contaminants or a tendency to polymerise.

# Tray Technology

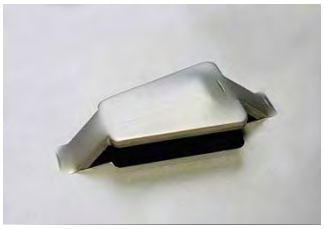
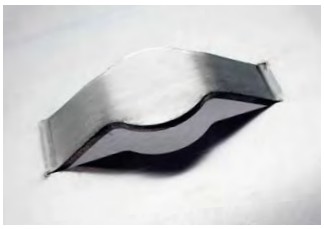


## Valve Trays

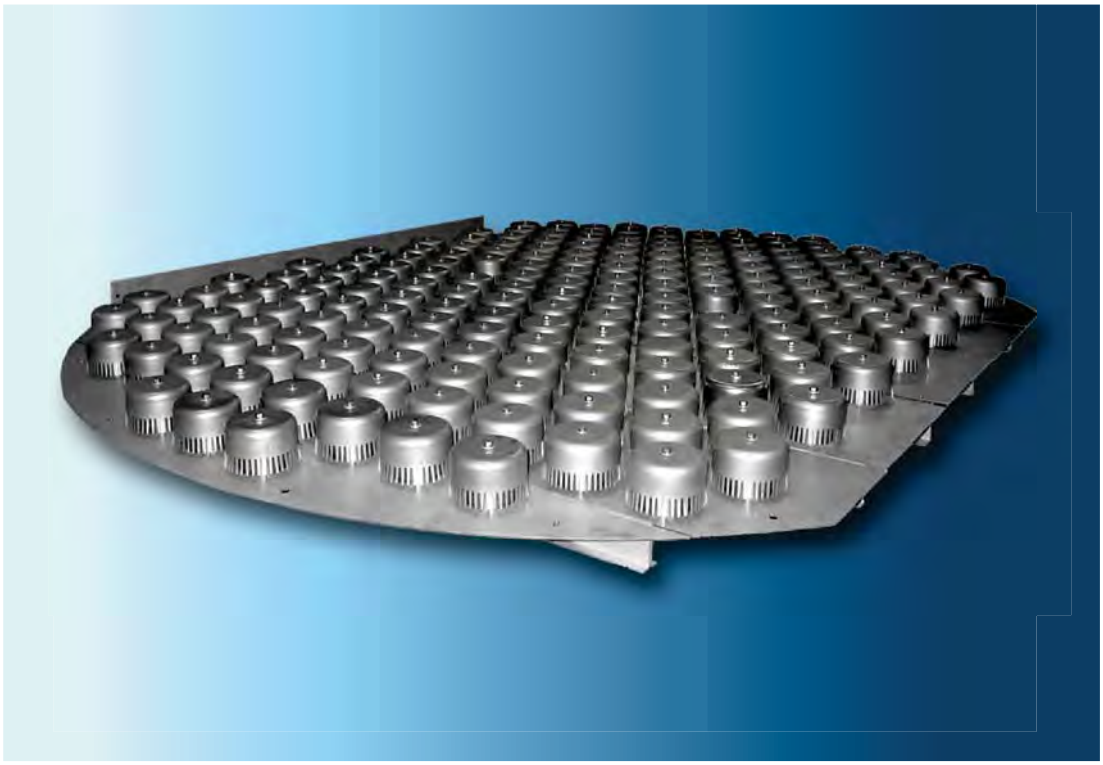
For realizing large and very large operating ranges, Raschig offers a variety of valve tray designs, ranging from round standard valves and caged valves to fixed valves with large and small size (minivalves). Valve units cover the orifices and direct the vapor stream more horizontally than vertically into the liquid. By this change in direction of the vapor phase, entrainment is reduced significantly in comparison to sieve trays. Special designs like venturi-shaped orifices for lower pressure drop are available.

Valve trays have large capacities and can realize good separation efficiencies over wide operating ranges. Especially moveable valve units achieve high turndown flexibilities. Fixed valves are a cost-effective solution for various applications with medium operating range, even for corrosive systems. Large fixed valves produce relatively low pressure drops, yet show a low weeping tendency. The use of smaller-sized minivalves clearly augments tray capacity.

# Tray Technology

| | Valve Types | |
|---|---|---|
|  | **R-V1** | Round, movable standard valve with integral legs. Three dimples define the initial lift. Universal purpose, large operation range, variable weights.<br>**R-V1X:** Flush seating version. |
|  | **R-T3** | Caged, round, movable valve with high mechanical strength. Three lugs in valve plate for initial lift and anti-spin. Low wear, used in fouling services.<br>**R-T:** Four dimples (instead of lugs) in valve plate.<br>**R-T3-11:** Version with small diameter orifice. |
|  | **R-T1** | Double-disk (orifice cover and ballast plate) within a mechanically strong valve cage. Wide operating range with excellent weeping characteristics.<br>**R-A1:** Classic three-leg cage. |
|  | **R-MV** | Fixed minivalve with a unique, domed cover. Net rises of 3.5 to 5.5 mm. Higher capacity compared to conventional sieve or valve trays. Applicable for 2.0 mm material thickness. Excellent pressure drop, entrainment and weeping characteristics. FRI tested. |
|  | **R-RV** | Round, fixed minivalve. Net rises of 4.5 to 8.0 mm. Applicable for 2.0 to 2.5 mm material thickness. Good pressure drop, entrainment and weeping characteristics. |
|  | **R-FV** | Trapezoid, standard fixed valve. Net rises of 4.5 to 11.0 mm. Applicable for 2.0 to 3 mm material thickness. Versatile, good pressure drop and capacity performance. |
|  | **R-LV** | Round, large fixed valve. Net rises of 5 to 11.0 mm. Applicable for 2.0 to 3 mm material thickness. Low pressure drop, robust, used in fouling services. |

# Tray Technology



**Bubble Cap Trays**

Being the most traditional representative of mass transfer equipment, the bubble cap tray is still today indispensable for applications with very low vapor or liquid loads, or wide variations of the flow rates. The liquid tight risers and the flow of the vapor stream through the submerged slots in the bubble caps ensure a permanent contacting between both phases. Using sealed constructions, very low leakage rates can be achieved.

Various shapes, sizes and types of design allow tailor-made solutions for your individual needs. Bubble cap trays can be manufactured from metallic as well as from thermoplastic materials.

# Tray Technology

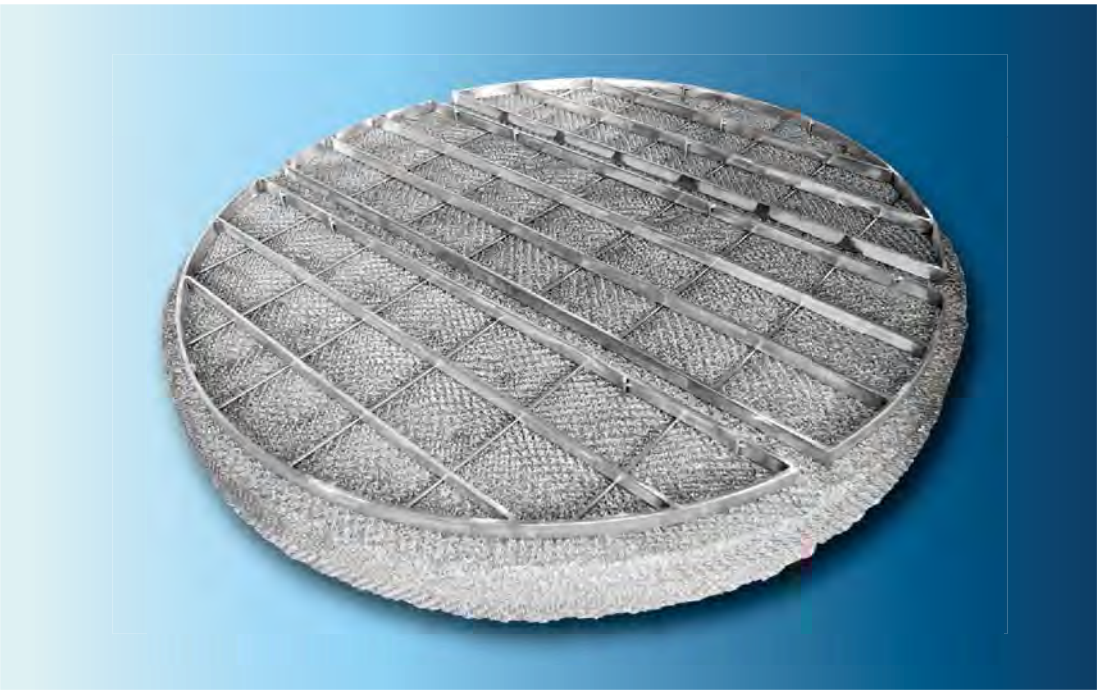
**Tunnel Trays**

Tunnel trays are equipped with tunnels arranged either in parallel or crosswise to the flow direction. The elongated vapor risers are covered by slotted caps. Shape and number of the slots in the caps are variable as in the case of bubble cap trays.

Trays with tunnels in parallel to the flow direction suit medium to very high liquid loads. Trays with tunnels crosswise to flow are appropriate for very low liquid loads and provide long residence times. They can be manufactured also from thermoplastic materials like bubble cap trays.

## Droplet Separator

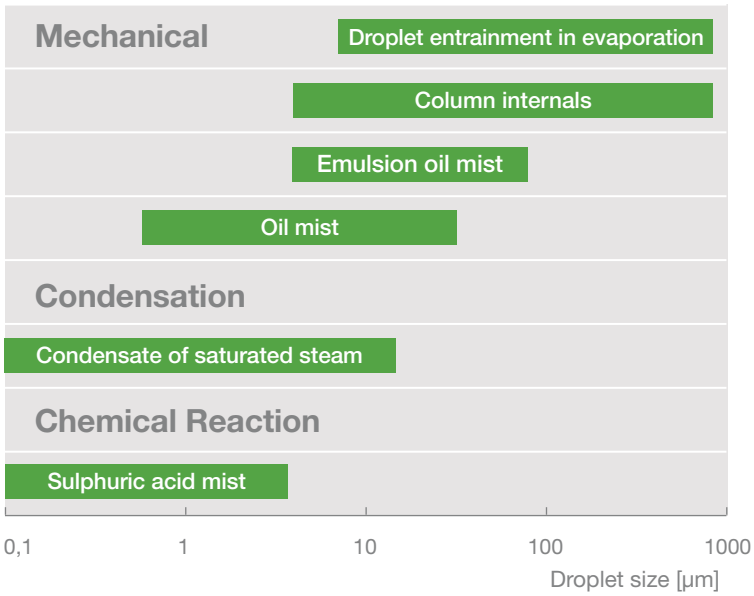
# Droplet Separator
## in Metal and Plastic



In many separation processes, gas and vapor flows play an essential role. Mechanical and thermal droplet formation take place in gas streams of absorption columns, gas scrubbers and liquids accumulators.

For certain processes, these liquid fractions must be separated from the overall gas or vapor flow. Especially droplet separators made from knitted wire mesh and fiber materials are very effective for the tradeoff between good separation efficiency and low pressure drop.

The size of the droplets mostly depends on their kind of origin and their prehistory. Two principal mechanisms are responsible for their formation: mechanical generation as well as condensation. A rough distinction of the droplet size can be made to the effect, that droplets bigger than 10 µm are called spray and smaller ones are called mist or aerosols.

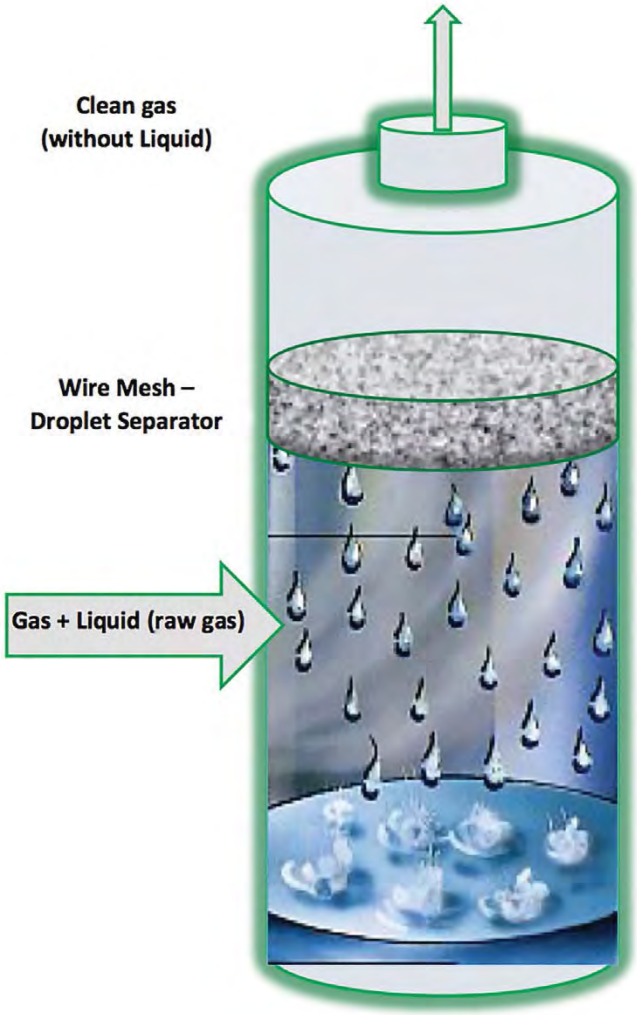



### Applications

- Evaporators (To avoid entrainment and to improve product purity)
- Absorption- and distillation columns (Increase of flow rates and products purity)
- Vacuum- and compressed air systems (Separation of the condensate generated)
- Oil mist separator (Waste air abatement and recovery of oils and lubricants)
- Fat filters/fatty acid systems (Separation of fatty acids)
- Paint shops (Separation of painting particles)
- Sulphuric acid plants (Separation of sulphuric acid mist)
- Air conditioning and waste air systems (Separation of liquid and solid particles)
- Cooling towers (Retaining aerosols)

# Droplet Separator
## Overview of the separation systems

| Seperation System | Limit Droplet [µm] | Free Vol. % |
|---|---|---|
| Separation by Inertia (vessel / column) | > 100 | – |
| Cyclone or Cyclone liquid Collector | 50 – 100 | 10 – 20 |
| Impact baffle or Vane Type Separator | > 15 | 3 – 10 |
| Knitted Wire Mesh Separator | > 3 | 3 |
| Knitted Wire Mesh + Agglomerator | > 1 | < 3 |




The following figure on the right side provides information about commercially available Droplet Separation systems and precisely defined, in which process conditions with respect to the limit drop size and stream velocity existing one separator is used.

The application limits arise from the separation mechanism, which come into effect depending on the droplet size and the gas velocity.

The column figure is showing a droplet separation process with an installed knitted wire mesh droplet separator in the top of the column.

The separation of liquid droplets is based on the effect, that the particles cannot follow the streamlines of the gas when they hit an obstacle and stick to a periphery.

Each individual wire of the knitted wire mesh separator constitutes an obstacle in a gas stream, so that a deflection of the streamlines occurs. Entrained droplets cannot follow due to its inertia this redirection and rebound on the single wire. The mist important separation mechanism are:

- Separation by Inertia
- Separation by Interception
- Separation by Diffusion

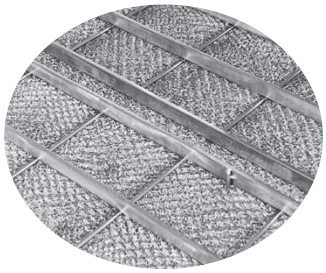
# Droplet Separator
# Standard-Types

| Types | Density [kg/m³] | Density [lbs/ft³] | Surface [m²/m³] | Surface [ft²/ft³] | Porosity [%] | Application |
|---|---|---|---|---|---|---|
| **Metal Types** | | | | | | |
| RA-80-S0-0,28 | 80 | 5 | 145 | 44 | 99,0 | High liquid load – big droplets > 15 µm |
| RA-130-S0-0,28 | 130 | 8 | 236 | 72 | 98,3 | High gas velocity |
| RA-145-S0-0,28 | 145 | 9 | 265 | 80 | 98,1 | Normal process conditions |
| RA-192-S0-0,28 | 192 | 12 | 350 | 107 | 97,5 | Emuslsion mist - droplets > 5 µm |
| RA-240-S0-0,28 | 240 | 15 | 435 | 133 | 97,0 | |
| RA-240-S0-0,15 | 240 | 15 | 868 | 265 | 97,0 | Agglomeration droplets > 2-3 µm |
| RA-350-S0-0,10 | 350 | 21,8 | 1772 | 545 | 95,6 | Oil - mist droplets 1 - 3 µm |
| **Plastic Types** | | | | | | |
| RA-50-P0-0,40 | 50 | 3,1 | 550 | 167 | 94,5 | Normal process conditions High separation efficiency |
| RA-100-P0-0,40 | 100 | 6,2 | 1100 | 335 | 89,0 | |
| RA-100-P0-0,22 | 100 | 6,2 | 2000 | 610 | 89,0 | |
| RA-80-P2-0,27 | 80 | 5 | 665 | 200 | 95,5 | Acid mist droplets 2-3 µm Special for high temperature ≥150°C |
| RA-100-P3-0,27 | 100 | 6,2 | 870 | 265 | 94,2 | |
| **Combination Types** | | | | | | |
| RA-200-S0/P0-F | 200 | 12,5 | < 900 | < 280 | 92,8 | Oil-Emulsion mist separation ≤ 10 mg/m³ |
| RA-240-S0/Y3 | 240 | 15 | > 480 | > 150 | 96,6 | Acid - droplets 2-3 µm |
| RA-175-Y3/P8 | 175 | 11 | > 360 | > 110 | 97,5 | High concentrated sulphuric acid mist by high temperature up to 220 °C |

# Droplet Separator
## Material and Wire Diameters

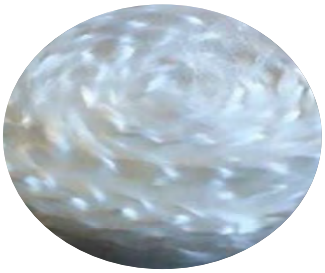
| Metals | Plastics | Fiber – Materials |
|---|---|---|
| **Galvanized steel** | PP (Polypropylen) | |
| **Stainless steel – Variants** | PE (Polyethylen) | |
| **Aluminum** | PVDF (Polyvinylidenfluorid) | GSF (Glas staple fiber) |
| **Monel** | ETFE (modif. PTFE) | GF (Glas fiber) |
| **Inconel** | PFA (Perfluoralkoxycoplymer) | PP-Fiber |
| **Incoloy** | FEP (Perfluorethylenpropylen) | PES-Fiber |
| **Titan** | PVC (Polyvinylchlorid) | PTFE-Fiber |
| **Copper** | PTFE coated | |
| **Brass** | PFA coated | |

| Wire Diameters | Dimensions of monofilament | Fiber materials |
|---|---|---|
| **Ø 0,10 – 0,70 mm** | Ø 0,22 – 0,50 mm | 4 µm – 100 µm |
| **(ironed material available)** | Dimensions of coated wire:<br>Ø 0,28 – 0,45 mm | |



**Metal – Demister**

**Plastic – Demister**



**Fiber Material – Demister**


Servicepartner

# More information under
# www.raschig.com

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