Metal Random Packing
Superior random packings combined with innovative mass transfer technology
Sulzer Chemtech is dedicated to developing solutions that optimize the performance of industrial processes and plants through greater energy efficiency, higher product quality, and increased capacity. Our application know-how, dedication to exacting fabrication standards and rigorous quality management characterize all our products.

Our steadfast commitment to providing the right mass transfer equipment is supported by an in-house development group and a state of the art research facility with multiple pilot and industrial scale columns. This innovation and commitment to our customers has taken existing random packing technologies beyond its past threshold and created a new outlook in a conventional product.

Random Packing

Random packings have been used for separations in chemical and refining plants for many years. The practical, chemical process and commercial benefits of random packing are well-established in many applications and is a mainstay in the area of mass transfer equipment. For example at high liquid load and in high pressure applications, random packings improve distillation or absorption efficiency and reduce pressure drop compared to other mass transfer contacting devices.

Sulzer Chemtech's portfolio of random packing includes standard and latest generation random packings, comprising the Nutter Ring, I-Ring, C-Ring, P-Ring and R-Ring. The I-Ring, C-Ring, P-Ring and R-Ring are similar to the widely accepted IMTP®, CMR™, Pall Ring® and Raschig Ring respectively.

The Pall Ring is a second-generation random packing, and except for the Raschig Ring, it has been on the market longer than any of the others. The P-Ring can be used as a replacement of the Pall Ring and in applications where performance needs are not sufficient to warrant a third-generation packing, such as the Nutter Ring or I-Ring.

The revolutionary geometric design of the third-generation Nutter Ring, I-Ring and C-Ring minimize pressure drop and liquid hold-up while maintaining efficiency. All three types of Nutter Ring, I-Ring and C-Ring can handle greater capacity than the P-Ring. They all provide up to 30% lower pressure drop than the P-Ring.
Colum Internals
Liquid distribution is critical to ensure optimal tower performance. Attributes such as distribution quality, drip point density and operating range are important parameters to a well designed distributor. Our extensive experience in designing and fabricating both high performance and fit-for-purpose internals will ensure that you will get the proper equipment for your application.

Customer Benefits
- We offer our customers the worldwide presence, extensive technical services, and recognized leadership in the design of column internals.
- We offer a wide range of random packing types and sizes that operators and process licensors are familiar with.
- At Sulzer Chemtech, decades of design, construction and manufacturing experience combine to ensure our column internals meet the requirements of your application.
- Each individual product offered by Sulzer Chemtech has been thoroughly researched at our test facilities, and consistently provides superior reproducible results no matter the worldwide location your purchase from.

Emergency delivery
Sulzer Chemtech has the random packing for optimal performance of your application. For urgent deliveries, we have on stock common stainless steel random packing of various sizes in our warehouses to get you back onstream. For emergencies, contact your nearest Sulzer Chemtech office at our website:
www.sulzerchemtech.com

Contents
Nutter Ring™ ............................................................. 4 - 5
I-Ring™ .................................................................... 6 - 7
C-Ring™ ................................................................. 8
P-Ring™ ................................................................. 8
R-Ring™ ................................................................. 9
Separation Technology Test Facilities ......................... 10
Colum Internals .......................................................... 11 - 13
Applications .............................................................. 14
Nutter Ring

Nutter Ring Advantages

- Efficiency enhanced by lateral liquid spreading and surface film renewal.
- Superior surface utilization in mass and heat transfer, allowing shorter packed bed heights.
- A high performance random packing verified by tests conducted at Fractionation Research Institute (FRI).
- Mechanical form provides maximum randomness with minimal nesting.

<table>
<thead>
<tr>
<th>Mechanical Specifications</th>
<th>No. 0.7</th>
<th>No. 1</th>
<th>No. 1.5</th>
<th>No. 2</th>
<th>No. 2.5</th>
<th>No. 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pieces (m$^3$)</td>
<td>167,400</td>
<td>67,100</td>
<td>26,800</td>
<td>13,600</td>
<td>8,800</td>
<td>4,200</td>
</tr>
<tr>
<td>Surface Area (m$^2$/m$^3$)</td>
<td>226</td>
<td>168</td>
<td>124</td>
<td>96</td>
<td>83</td>
<td>66</td>
</tr>
<tr>
<td>Weight (kg/m$^3$)*</td>
<td>177</td>
<td>179</td>
<td>181</td>
<td>144</td>
<td>121</td>
<td>133</td>
</tr>
<tr>
<td>Void (%)</td>
<td>97.8</td>
<td>97.8</td>
<td>97.8</td>
<td>97.9</td>
<td>98.2</td>
<td>98.4</td>
</tr>
</tbody>
</table>

* For stainless steel with standard material thickness. Other thicknesses are available upon request.

The technical data are average values and approximate sizes. Subject to changes and improvements. No claims may be derived from information given.

K_ga of Nutter Ring

Liquid Load, gpm/ft$^2$

Conditions
Diameter: 0.3 m, Bed height: 2.25 m
Liquid concentration: 4% NaOH
Conversion to carbonate (Na$_2$CO$_3$): < 1%
Inlet gas concentration: 400ppm CO$_2$
Temperature: 25 °C
F = 1.5 vPa
Bracket indicates extrapolated data

HETP of Nutter Ring

Conditions
Valid for atmospheric distillation with standard organic test mixture at total reflux.
NR #0.7

Air-water system, ambient conditions

NR #1

NR #1.5

NR #2

NR #2.5

NR #3
I-Ring Advantages

- I-Rings provide over 30% lower pressure drop than the Pall Rings.
- Revolutionary design enhances greater capacity and efficiency than other random packings.
- Geometric design minimizes liquid hold-up.
- Direct replacement of the widely used IMTP.

<table>
<thead>
<tr>
<th>Mechanical Specifications</th>
<th>No. 15</th>
<th>No. 25</th>
<th>No. 40</th>
<th>No. 50</th>
<th>No. 70</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pieces (m³)</td>
<td>347,500</td>
<td>135,000</td>
<td>50,000</td>
<td>15,000</td>
<td>4,600</td>
</tr>
<tr>
<td>Surface Area (m²/m³)</td>
<td>291</td>
<td>226</td>
<td>151</td>
<td>100</td>
<td>60</td>
</tr>
<tr>
<td>Weight (kg/m³)*</td>
<td>336</td>
<td>252</td>
<td>180</td>
<td>163</td>
<td>116</td>
</tr>
<tr>
<td>Void (%)</td>
<td>95.6</td>
<td>96.6</td>
<td>97.7</td>
<td>98.0</td>
<td>98.5</td>
</tr>
</tbody>
</table>

* For stainless steel with standard material thickness. Other thicknesses are available upon request.

The technical data are average values and approximate sizes. Subject to changes and improvements. No claims may be derived from information given.

Kₐa of I-Ring

Conditions
Diameter: 0.3 m, Bed height: 2.25 m
Liquid concentration: 4% NaOH
Conversion to carbonate (Na₂CO₃): < 1%
Inlet gas concentration: 400ppm CO₂
Temperature: 25 °C
F = 1.5 vPa
Bracket indicates extrapolated data

HETP of I-Ring

Conditions
Valid for atmospheric distillation with standard organic test mixture at total reflux.
C-Ring Advantages

- First commercially successful third-generation random packing replacing the widely used Pall® Ring.
- Low aspect ratio (element height : element diameter is 1:3) favors a packing orientation that results in higher capacity, lower pressure drop and better fouling resistance.
- The arrangement of tabs provides more drip points per element offering better liquid distribution and higher efficiency.
- Direct replacement of the widely used CMR.

<table>
<thead>
<tr>
<th>Mechanical Specifications</th>
<th>No. 1.5</th>
<th>No. 2</th>
<th>No. 2.5</th>
<th>No. 3</th>
<th>No. 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pieces (m³)</td>
<td>71,000</td>
<td>29,500</td>
<td>20,500</td>
<td>10,200</td>
<td>4,300</td>
</tr>
<tr>
<td>Surface Area (m²/m³)</td>
<td>187</td>
<td>144</td>
<td>126</td>
<td>103</td>
<td>74</td>
</tr>
<tr>
<td>Weight (kg/m³)*</td>
<td>207</td>
<td>162</td>
<td>205</td>
<td>149</td>
<td>108</td>
</tr>
<tr>
<td>Void (%)</td>
<td>97.0</td>
<td>97.5</td>
<td>97.5</td>
<td>98.0</td>
<td>98.5</td>
</tr>
</tbody>
</table>

P-Ring Advantages

- Highest industry experience and extensively tested by research institutes worldwide.
- Material thickness overcomes mechanical weaknesses, and can be used in extremely corrosive services enabling cheaper materials to be used.
- Strength-to-weight ratio stronger than most other random packings.
- Direct replacement of the well known Pall Ring.

<table>
<thead>
<tr>
<th>Mechanical Specifications</th>
<th>No. 5/8</th>
<th>No. 1</th>
<th>No. 1.5</th>
<th>No. 2</th>
<th>No. 3.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pieces (m³)</td>
<td>214,000</td>
<td>50,000</td>
<td>14,000</td>
<td>6,100</td>
<td>1,100</td>
</tr>
<tr>
<td>Surface Area (m²/m³)</td>
<td>360</td>
<td>215</td>
<td>135</td>
<td>105</td>
<td>66</td>
</tr>
<tr>
<td>Weight (kg/m³)*</td>
<td>560</td>
<td>320</td>
<td>208</td>
<td>213</td>
<td>158</td>
</tr>
<tr>
<td>Void (%)</td>
<td>95.0</td>
<td>95.0</td>
<td>96.0</td>
<td>97.0</td>
<td>97.0</td>
</tr>
</tbody>
</table>
R-Ring Advantages

- First generation of random packings, industry experience outperforms fractionation trays.
- Great strength-to-weight ratio.
- Direct replacement of the well known Raschig Ring.

### Mechanical Specifications

<table>
<thead>
<tr>
<th></th>
<th>No. 5/8</th>
<th>No. 1</th>
<th>No. 1.5</th>
<th>No. 2</th>
<th>No. 3.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pieces (m³)</td>
<td>214,000</td>
<td>50,000</td>
<td>14,000</td>
<td>6,100</td>
<td>1,100</td>
</tr>
<tr>
<td>Surface Area (m²/m³)</td>
<td>350</td>
<td>220</td>
<td>130</td>
<td>110</td>
<td>66</td>
</tr>
<tr>
<td>Weight (kg/m³)*</td>
<td>560</td>
<td>400</td>
<td>260</td>
<td>256</td>
<td>220</td>
</tr>
<tr>
<td>Void (%)</td>
<td>86.0</td>
<td>88.0</td>
<td>90.0</td>
<td>92.0</td>
<td>95.0</td>
</tr>
</tbody>
</table>

* For stainless steel with standard material thickness. Other thicknesses are available upon request.

The technical data are average values and approximate sizes. Subject to changes and improvements. No claims may be derived from information given.
Separation Technology Laboratory
Comprehensive customer service

Distributor Test Facility
Uniform liquid distribution is decisive in securing good separation performance from a rectification/absorption column incorporating packings especially for columns of large diameter.

This requirement was recognized early on in the development of the Sulzer structured packings. Hence a whole series of liquid distributors has been developed, which are optimally matched for column diameter, packing type and operating conditions.

The distributor test facility has provided results which have contributed significantly to the construction of large distributors with diameters ranging from 3 m up to 15 m. Sulzer Chemtech is certified in accordance to ISO 9001:2000 and ISO 14001.

Laboratories
Sulzer Chemtech has set up a process engineering laboratory in Winterthur, Switzerland.
In addition to the further development and testing of packings, column internals and trays, this laboratory carries out customer trials and pilot tests. An analytical laboratory and trained personnel are available.
Column Internals

Sulzer columns of sectional design
All internals can be installed through the column flange openings

Sulzer packing 1
in various types and different materials

Support plate 2
for the packing

Liquid collector 3

Feed pipe 4
to distributor

Liquid distributor 5

Retaining grid 6

Collector / distributor 7

Nozzle with inlet baffle 8

Column sump 9

Variations on the above design
Feed:
• vapor
• two phases with flash box

Side stream:
• liquid from collector
• vapor collector

Welded column, monoblock type
All internals in segments for installation and removal through manhole, nominal diameter 500 up to 1000 mm
Liquid distributors
Discharge systems

Type VEG2
Type VKR2
Type VES

Collector/distributor, VS

Channel-type distributor VKG2\(^1\) or VKR2\(^1\)

Independent arm & main channels VEG2

\(^1\) Can be supplied in a flanged version, also for diameters > 0.8 m
<table>
<thead>
<tr>
<th>Type</th>
<th>Column diameter</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Support plates</strong></td>
<td></td>
<td>The EMS and GIS grids are used as support grids for random packing, as well as gas injection devices to distribute vapor to the bottom layers of the packing. Both grids have an open cross sectional area of between 80 to 100%.</td>
</tr>
<tr>
<td>[Image] Support plates</td>
<td>[Image] Support plates</td>
<td>250 - 1200 mm 1200 - 9000 mm</td>
</tr>
<tr>
<td>EMS</td>
<td>GIS</td>
<td></td>
</tr>
<tr>
<td><strong>Collectors</strong></td>
<td></td>
<td>The vane collector SL is used as a separate unit to accumulate liquids from packed sections within a column. This collector requires a ring channel welded to the column wall. The collector SLF is designed to be installed between the column flanges in smaller flanged columns.</td>
</tr>
<tr>
<td>[Image] Collectors</td>
<td>[Image] Collectors</td>
<td>250 - 1200 mm 1200 - 9000 mm</td>
</tr>
<tr>
<td>SLR/SLM</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Chimney trays</strong></td>
<td></td>
<td>The collector SK is an established and versatile tray design, available either in bolted or seal-welded construction. It is generally used in large diameter columns with high liquid loads. The collector SK can also serve as a liquid draw off tray.</td>
</tr>
<tr>
<td>[Image] Chimney trays</td>
<td>[Image] Chimney trays</td>
<td>250 - 1200 mm 1200 - 9000 mm</td>
</tr>
<tr>
<td>SK</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Retaining grid for random packing</strong></td>
<td>[Image] Retaining grid for random packing</td>
<td>Retaining grids, consisting of wire mesh welded to the underside of grid frames, are required above random packing beds. Such grids may be either suspended from a liquid distributor above it or bolted to wall support angles welded to the column wall.</td>
</tr>
<tr>
<td>RPB</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Acid Gas Removal**

Gas streams containing H$_2$S, CO$_2$ and mercaptans are sweetened by contact with solvents in an absorption tower. Afterwards, the solvent is restored in a regenerator. Traditional natural gas sweetening plants are based on MEA, DEA, DGA, DIPA or MDEA solvents. Several proprietary solvents use activated formulations of potassium carbonate (or MDEA) based solvents to enhance its performance. Examples of such proprietary solvents are the Benfield™, Catacarb®, aMDEA® and UCARSOL® processes. Similar operations in the petrochemical industry, such as ethylene oxide and ammonia production plants, utilize proprietary solvents that address specific requirements of these applications. Due to the typical high liquid load and high pressure nature of these systems, you will find Sulzer’s random packing particularly well suited. Our random packing are therefore often specified and extensively applied.

Some natural gas absorbers are specially designed using MDEA or DIPA to selectively remove H$_2$S and slip CO$_2$. The majority of grassroots acid gas removal plants are equipped with trays owing to past design experience. A significant number of such plants however, are now being specified new or retrofitted with packing to take advantage of the unique benefits offered here. Random packing such as the Nutter Ring or I-Ring have one third the liquid hold-up compared to trays, a benefit which can boast the slipage of CO$_2$ in selective MDEA gas treatment plants. Due to the foaming tendency of these systems, some trayed units are limited by capacity. Sulzer’s latest generation random packing such as Nutter Ring, I-Ring or C-Ring, offers about one-third the pressure drop of trays and hence the higher capacity desired. You will also reap significant saving in energy consumption from this change.

Combined with our extensive experience in column internals design and fabrication, you will be ensured optimal performance from your gas treating unit.
Natural Gas Liquids (NGL) Treating.

Natural gas liquids produced from liquids recovery plants contain \( \text{H}_2\text{S}, \text{CO}_2 \) and mercaptans, which must be removed to satisfy contract purity requirements. Some of these impurities can be removed by contacting the NGL with amine solvent in a liquid treater. Liquid treaters are frequently equipped with random packing owing to the higher mass transfer efficiency, ability to decrease droplet size, increase dispersed phase hold-up, and reduce the effect of back-mixing compared to trays. The heavy amine solution is introduced at the top of the column, and the light natural gas liquids are introduced at the bottom. To achieve intimate contact between both solvents, one liquid must be dispersed into the other. The amine solution is usually the continuous phase, and the hydrocarbons are the dispersed phase.

As droplets of the dispersed phase rise through the column, the droplets are sheared by the edges of the packing, providing thorough mixing of the phases and helping maximize mass transfer. At the top and bottom of the column, the difference in density allow for the separation of the two phases.

In meeting with increasingly stringent emission regulations and production demands, revamping with Sulzer’s latest generation random packing such as Nutter Rings, I-Rings or C-Rings, will provide you with higher efficiency while maintaining capacity. Coupled with our experience in fabrication and design of liquid treater internals, you will be assured of maximizing your column’s full utilization.

In a similar way, mercaptans can be removed by contact with aqueous caustic.

---

**Formula Notation**

<table>
<thead>
<tr>
<th></th>
<th>Metric Units</th>
<th>Imperial Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \ell ) Liquid load</td>
<td>( \text{m}^3/\text{m}^3\text{h} )</td>
<td>( \text{gpm/ft}^2 )</td>
</tr>
<tr>
<td>HETP Height equivalent to a theoretical plate</td>
<td>mm</td>
<td>inches</td>
</tr>
<tr>
<td>( \Delta p/\Delta z ) Pressure drop per unit height</td>
<td>mbar/m</td>
<td>in ( \text{H}_2\text{O}/\text{ft} )</td>
</tr>
<tr>
<td>( K_a ) Volumetric mass transfer coefficient</td>
<td>kg-mol / (h ( \text{m}^3 ) atm)</td>
<td>lb-mol/(h ft(^2) atm)</td>
</tr>
<tr>
<td>( F ) F factor</td>
<td>( \sqrt{\text{Pa}} )</td>
<td>ft/s ( \sqrt{\text{lb}/\text{ft}^3} )</td>
</tr>
</tbody>
</table>
Sulzer Chemtech Ltd, a member of the Sulzer Corporation, with headquarters in Winterthur, Switzerland, is active in the field of process engineering and employs some 2000 persons worldwide.

Sulzer Chemtech is represented in all important industrial countries and sets standards in the field of mass transfer and static mixing with its advanced and economical solutions.

The activity program comprises:

- Process components such as trays, structured and random packings, internals for separation columns and reaction technology
- Engineering services for separation and reaction technology such as optimizing energy consumption, plant optimization studies, pre-engineering for governmental approval, basic engineering
- Separation and purification of organic chemicals by means of crystallization and membranes
- Mixing and reaction technology with static mixers
- Mixing and Cartridges Technology
- Tower field services

Headquarters
Sulzer Chemtech Ltd
PO. Box 65
CH-8404 Winterthur, Switzerland
Phone +41 (52) 262 50 28
Fax +41 (52) 262 01 82
E-mail chemtech@sulzer.com
Internet www.sulzerchemtech.com

North and South America
Sulzer Chemtech USA, Inc.
8505 E. North Belt Drive
USA-Humble, TX 77396
Phone +1 (281) 441 5800
Fax +1 (281) 291 0207

Asia Pacific
Sulzer Chemtech Pte. Ltd.
10 Benoi Sector
SGP-Singapore 629845
Phone +65 6515 5500
Fax +65 6862 7563