

RANDOM PACKING

# RANDOM PACKING



CHEM GROUP  
AZAR ENERGY Co.

## **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. Metal Random Packing (Metal Tower Packing) is made of materials like carbon steel, stainless steel or Aluminum alloy, etc.

### **Materials:**

S.S.302, 304, 316, 316L, 317, 317L, carbon steel, Stainless steel (AISI304), aluminum, alloy, Plastics, etc.

### **Advantages:**

1. Thin
2. Heat resistant
3. Big flow
4. Low physical resistance
5. High separation efficiency
6. It is especially suitable for the vacuum rectifying apparatus. Processing the thermo sensitive, easy-decomposition, and easy-coking materials.

### **Application:**

Widely used in the packing towers in petrochemical industry, fertilizer industry, and environmental protection industry etc. We offer a wide range of random packing types and sizes that operators and process licensors are familiar with.

### **Product design:**

If our product standard didn't meet your needs, Azar Energy is glad to work with your company and design it for your specific application. At Azar Energy Chem Group, decades of design, construction and manufacturing experience combine to ensure our column internals meet the requirements of your application.

### **Emergency Delivery:**

Azar Energy has the random packing – metal or plastic – to provide optimum performance whatever your application. In common materials, most packings are in stock for immediate shipment to get you back on line. For emergencies call the Azar Energy office.

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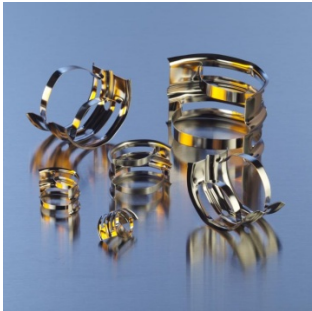




## Structured Packing versus Random Packing

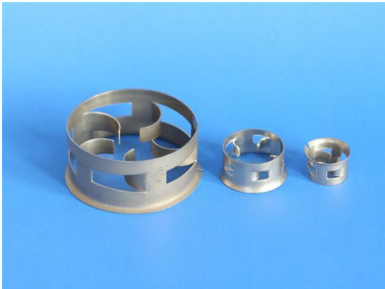





Experience shows an advantage for structured packing over random packings at low ( $<14 \text{ lit}/(\text{s.m}^2)$ ) liquid rates. At a given capacity structured packing offer a far greater specific area (therefore greater efficiency). As liquid rate increases beyond  $14 \text{ lit}/(\text{s.m}^2)$ , this advantage dwindles rapidly.

Packing efficiency is not a function of the specific surface area alone. Other factors, such as spread of the surface area, also affect efficiency. We suggest that at low specific surface areas ( $<18\text{m}^2/\text{m}^3$ ), these factor tend to favor random packings.

Overall, structured packings have an efficiency and/or capacity advantage over random packing when operated at lower liquid loads ( $<14 \text{ lit}/(\text{s.m}^2)$ ). In random packings, resistance to vapor flow is mostly due to expansion and contraction. This mechanism gives a high pressure drop. In structured packing, the regular flow channel keeps expansion and contraction to a minimum. The main friction loss mechanism becomes pressure loss through bends; witch incurs a far lower resistance to vapor flow. This lower resistance permits incorporating more surface area in a bed of structured packings. Structured packings have a much lower pressure drop per theoretical stage than random packings. This is a major advantage in deep vacuum services.

Due to large number of failures experienced in the industry at high pressure and/or high liquid rates, we recommend extreme caution with structured packings at high liquid rates and pressures higher than 10 bara. We suggest use of structured packings only in services where a demonstrated trouble-free track record has been established.

	Type of Packing	Typical Application	Characteristics
	Nutter Rings	<ul style="list-style-type: none"> <li>✓ Gas treatment(<math>\text{CO}_2/\text{H}_2\text{S}</math> Absorber and regenerator)</li> <li>✓ Quench columns</li> <li>✓ Debutanizer, Deethanizer</li> <li>✓ Stripping columns/Water treatment</li> <li>✓ Formaldehyde and other organic compounds</li> <li>✓ Ethylene Oxide</li> </ul>	<ul style="list-style-type: none"> <li>✓ Higher operational efficiency</li> <li>✓ Superior surface utilization in mass and heat transfer</li> <li>✓ Maximum piece to piece contact</li> <li>✓ Free flowing particle design promotes uniform randomizing and facilitates installation</li> </ul>
	Raschig Rings	<ul style="list-style-type: none"> <li>✓ distillation and extraction applications,</li> <li>✓ Absorption in gas processing and combustion plants,</li> <li>✓ Desorption in water treatment</li> </ul>	<ul style="list-style-type: none"> <li>✓ Cheap per unit cost</li> <li>✓ Low efficiency</li> <li>✓ More internal channeling</li> </ul>
	Pall Rings	<ul style="list-style-type: none"> <li>✓ Absorption, Aeration, Degassing, Desorption, Distillation, Stripping, Heat Recovery, Extraction</li> </ul>	<ul style="list-style-type: none"> <li>✓ Lower pressure drop</li> <li>✓ Lower HETP</li> <li>✓ High capacity</li> </ul>
	Hy-pack Rings	<ul style="list-style-type: none"> <li>✓ Absorption, Aeration, Degassing, Desorption, Distillation, Stripping, Heat Recovery, Extraction</li> </ul>	<ul style="list-style-type: none"> <li>✓ Higher capacity and lower pressure drop than Pall rings</li> <li>✓ Similar efficiency compared to Pall rings</li> <li>✓ Higher mechanical strength than Pall rings</li> </ul>
	Intalox Metal Tower Packing (IMTP)	<ul style="list-style-type: none"> <li>✓ low liquid rate vacuum systems</li> <li>✓ distillation, absorption, and stripping</li> <li>✓ benefit to distribute gas-liquid</li> </ul>	<ul style="list-style-type: none"> <li>✓ Low pressure drop and high capacity</li> <li>✓ High distillation, absorption, and stripping efficiency</li> <li>✓ High specific heat transfer coefficient</li> <li>✓ High strength to weight ratio</li> <li>✓ Genuine industry</li> <li>✓ High performance standard</li> </ul>

	Type of Packing	Typical Application	Characteristics
	Cascade Mini-Rings (CMR)	<ul style="list-style-type: none"> <li>✓ Desulphurization and decarburization system in compound ammonia plant</li> <li>✓ Decompressed plant in crude oil separated plant</li> <li>✓ Separation of organic acid</li> <li>✓ Absorbing or desorbing tower</li> </ul>	<ul style="list-style-type: none"> <li>✓ Reduced pressure drop</li> <li>✓ Increased plant capacity</li> <li>✓ Improved resistance to "fouling"</li> <li>✓ Higher operational efficiency</li> </ul>
	Hiflow Rings	<ul style="list-style-type: none"> <li>✓ large volume processes</li> <li>✓ processes with high solids loadings</li> </ul>	<ul style="list-style-type: none"> <li>✓ High Capacity Fluid Flow</li> <li>✓ Low Pressure Drop</li> <li>✓ Very High Void Fraction</li> <li>✓ maximum protection against fouling and plugging</li> </ul>
	Conjugate Rings	<ul style="list-style-type: none"> <li>✓ Distillation</li> <li>✓ Gas absorbing, desorbing system</li> </ul>	<ul style="list-style-type: none"> <li>✓ Low pressure drop</li> <li>✓ High flux, excellent quality and high efficiency</li> <li>✓ Higher Hydrodynamics mass transfer performance</li> </ul>
	Raschig-super Rings	<ul style="list-style-type: none"> <li>✓ Absorption</li> <li>✓ Diffusion</li> <li>✓ Distillation towers</li> </ul>	<ul style="list-style-type: none"> <li>✓ Great strength-to-weight ratio.</li> <li>✓ low pressure drop</li> <li>✓ high capacities</li> <li>✓ excellent mass transfer efficiency</li> </ul>
	Intalox Saddle Rings	<ul style="list-style-type: none"> <li>✓ Distillation, absorption</li> <li>✓ High pressure towers</li> <li>✓ Deep vacuum towers where low pressure drop is crucial</li> </ul>	<ul style="list-style-type: none"> <li>✓ High efficiency</li> <li>✓ low pressure drop</li> <li>✓ large effective interfacial area</li> <li>✓ high mechanical strength</li> </ul>
	FLEXIMAX	<ul style="list-style-type: none"> <li>✓ Chemical Processing</li> <li>✓ Gas Processing</li> <li>✓ Oil Refining</li> </ul>	<ul style="list-style-type: none"> <li>✓ Higher capacity</li> <li>✓ Higher efficiency</li> <li>✓ High mechanical integrity</li> </ul>

## Nutter Rings

Nutter rings retain the low aerodynamic drag of the saddle shape, while offering a more open structure with improved liquid spread. The rib-and-hop design minimizes nesting and interlocking and achieves adequate mechanical strength. Nutter ring has unique features which are based upon fundamental principles of liquid flow.

### Application

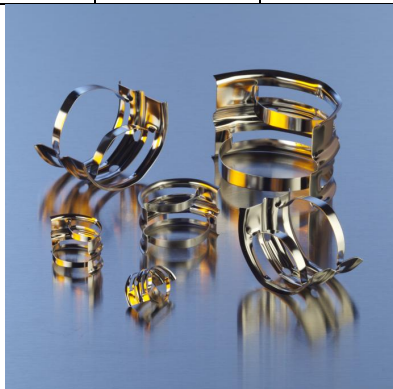
- Gas treatment(CO<sub>2</sub>/H<sub>2</sub>s Absorber and regenerator)
- Quench columns
- Debutanizer, Deethanizer
- Stripping columns/Water treatment
- Formaldehyde and other organic compounds
- Ethylene Oxide

### Advantages

- Higher operational efficiency
- Superior surface utilization in mass and heat transfer
- Maximum piece to piece contact
- Free flowing particle design promotes uniform randomizing and facilitates installation

AzarEnergy has accurate empirical models to calculate pressure drop and capacity for packings. Calculations have proven reliable over wide range of system properties and gas-liquid loadings.

Nutter Rings Specification						
Size No.	# 0.7	# 1	# 1.5	# 2	# 2.5	# 3
Pieces/m <sup>3</sup>	167400	67100	26800	13600	8800	4200
Area (m <sup>2</sup> /m <sup>3</sup> )	226	168	124	96	83	66
Bulk Density (kg/m <sup>3</sup> )	176	179	181	173	145	133
%Void	97.8	97.8	97.8	97.9	98.2	98.4
Relative HETP	0.72	0.83	0.94	1	1.18	1.40
Thickness (mm)	0.2	0.3	0.4	0.5	0.5	0.5





## Raschig Rings

These are the oldest, cheapest, and previously most widely used packings, first patented by Dr. Raschig in Germany in 1907. The height of the ring is equal to its diameter. The rings are cut from pipes, but in case of metal they may also be rolled from metal strips.

### Advantages

- High capacity
- Low pressure drop
- High separation
- Cold and heat resistant
- Long life

### Application

- Petrochemical distillation and extraction applications
- Absorption in gas processing and combustion plants
- Desorption in water treatment

Raschig Rings Specification									
Size (in)	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	2	3
Pieces/m <sup>3</sup>	951030	402590	207700	110900	49330	25675	13210	5790	1860
Area (m <sup>2</sup> /m <sup>3</sup> )	525	403	348	268	203	162	129	96	65
%Void	81	85	87	89	92	87	90	92	95





## Pall Rings

Pall ring is developed by cutting windows in the Raschig ring and bending the window tongues inward. This opened up the ring, lowered its friction, and improved packing area distribution, wetting, and distribution of liquid.

### Advantages

- Lower pressure drop
- Good liquid / gas distribution and higher mass transfer efficiency
- Versatility, easily wettable, high resistance to fouling, high temperature
- High Mechanical Strength, suitable for deeper beds
- High temperature resistance

### Application

Absorption, Aeration, Degassing, Desorption, Distillation, Stripping, Heat Recovery, Extraction etc.

Pall Rings Specification						
Size (mm)	16	25	38		50	90
Size (in)	5/8	1	1.5		2	3.5
Pieces/m <sup>3</sup>	207700	49330	13210		5790	1160
% Void	93	94	95		96	97
Area (m <sup>2</sup> /m <sup>3</sup> )	360	205	130		105	66
Bulk Density (kg/m <sup>3</sup> )	510	325	208		198	135



## Hy-Pak Packing

Similar to the Pall ring, Hy-Pak has more internal tongues in an effort to improve the spread of surface area. The resulting claimed efficiency improvement was traded off for greater capacity by making the ring slightly larger than the equivalent Pall ring. Compared to the Pall ring, Hy-Pak has been shown to give better capacity at an equivalent efficiency.

### Advantages

- Higher capacity and lower pressure drop than Pall rings
- Similar efficiency compared to Pall rings
- Higher mechanical strength than Pall rings

Hy-Pak Packing Specification				
Size (in)	1.18	1.75	2.37	3.54
Size (mm)	30	45	60	90
Pieces/m <sup>3</sup>	29900	9390	3670	1090
% Void	97	98	98	98
Bulk Density (kg/m <sup>3</sup> )	262	180	161	181
Area (m <sup>2</sup> /m <sup>3</sup> )	174	118	92	69



## Intalox Metal Tower Packing (IMTP)

IMTP combines the high void fraction and the well distributed surface area of the pall ring with the low aerodynamic drag of the saddle shape. Compared to the Pall ring, it provides more open shape and improved liquid spread, while incorporating adequate mechanical strength and entanglement resistance.

### Advantages

- Low pressure drop and high capacity
- High distillation, absorption, and stripping efficiency
- High specific heat transfer coefficient
- High strength to weight ratio
- High void fraction compared to other random packings of similar size
- Genuine industry high performance standard

### Application

IMTP tower packing has been used in a wide range of applications from very low liquid rate services, such as DMT purification and glycol separation, to high liquid rate applications, such as hot carbonate absorbers and demethanizers. IMTP tower packing's lower pressure drop, combined with high mass transfer efficiency, provides superior performance in low liquid rate vacuum systems.

IMTP Specification							
Size (in)	5/8	1	1 1/2		2	2 3/8	2 3/4
Size (mm)	15	25	40		50	60	70
Bulk Density (kg/m <sup>3</sup> )	283	224	153		166	137	141
%Void	96	97	98		98	98	98
Area(m <sup>2</sup> /m <sup>3</sup> )	232	207	151		98	72	60



## Cascade Mini-Rings (CMR)

These rings are similar to the Pall rings, but have an aspect ratio (height to diameter) of 1:3 compared to 1:1 in the Pall ring. The lower aspect ratio orients the particles with their open side facing the vapor flow, thus reducing friction, and exposing more surfaces to mass transfer.

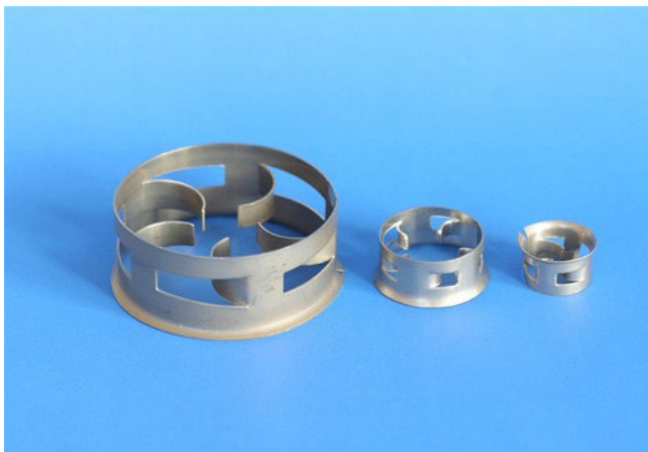
### Advantages

- Reduced pressure drop
- Increased plant capacity
- Improved resistance to “fouling”
- Higher operational efficiency

### Application

- Desulphurization and decarburization system in compound ammonia plant
- Decompressed plant in crude oil separated plant
- All kind of separation process such as separation of methanol
- Separation of organic acid
- Absorbing or desorbing tower

Cascade Mini-Rings Specification							
Size (mm)	25	38	50		64	76	101
Bulk Density(kg/m³)	389	285	234		195	160	125
%Void	96	96	97		97	98	98
Area(m²/m³)	250	190	151		121	103	71
Pieces/m³	98120	30040	12340		7560	3540	1355



## Hiflow Rings

The Hiflow rings are a high performance tower packing. The strong lattice structure combines high mechanical stability with a very high void fraction. The low weight and enhanced mechanical stability enables high packed heights without packing supports. Additional properties of the Hiflow Rings packing are high capacity gas and liquid flow rates, extremely low pressure drop, very low wall flow, and low sensitivity to pollution and fouling.

### Advantages

- Low Weight & High Mechanical Stability
- High Capacity Fluid Flow
- Low Pressure Drop
- Very High Void Fraction

### Applications

Typical applications for Hiflow rings include large volume processes where low pressure drop can translate into significant operating cost savings. Other applications include processes with high solids loadings that tend to foul and plug other packings.

Hiflow Rings Specification					
Size (mm)	25	38	40	50	110
Bulk Density(kg/m <sup>3</sup> )	298	255	244	175	147
%Void	95	96	97	98	98
Area(m <sup>2</sup> /m <sup>3</sup> )	185	145	143	95	52



## Conjugate Ring

This product combines the advantages of ring and saddles. The structure of the product is conjugate curve, and Metal Conjugate Ring has some features of structured packing for its uniformity holes and low resistance.

### Advantages

- Low pressure drop
- High flux, excellent quality and high efficiency
- Higher Hydrodynamics mass transfer performance

### Applications

- Distillation
- Gas Absorption
- De-absorbing system

Conjugate Rings Specification				
Size (mm)	25	38	50	76
Bulk Density(kg/m <sup>3</sup> )	312	275	275	245
%Void	95	96	96	97
Area(m <sup>2</sup> /m <sup>3</sup> )	185	116	86	81
Pieces/m <sup>3</sup>	75000	19500	9770	3980



## Raschig-Super Ring

The design of the Super Raschig Ring offers an optimal solution to industry's demands for a modern heavy-duty packing. Unlike previous packing shapes, the Super Raschig Ring avoids the droplet formation which is such a frequent interference accompanying large gas loads. The Super Raschig Ring has a more than 30% greater load capacity, an almost 70% lower pressure drop and a mass transfer efficiency exceeding that of conventional metal packings by over 10%.

### Advantages

- First generation of random packings, industry experience outperforms fractionation trays.
- Great strength-to-weight ratio.
- low pressure drop
- high capacities
- excellent mass transfer efficiency

### Application

- Absorption
- diffusion
- distillation towers

Raschig-Super Rings Specification							
Size (mm)	15	20	25	30	38	50	70
%Void	96	97	98	98	98	98	98
Area(m <sup>2</sup> /m <sup>3</sup> )	315	250	180	150	120	100	80
Pieces/m <sup>3</sup>	180000	145000	45500	32000	13750	9500	4300
Bulk Density(kg/m <sup>3</sup> )	340	275	185	165	170	165	150





## Intalox Saddle Ring

Intalox Saddle Ring is high performance random packing successfully used in mass transfer towers both small and large diameter. It is frequently used in deep vacuum towers where low pressure drop is crucial and also high pressure towers where capacity significantly exceeds conventional trays. CHEMPACK Metal Intalox Saddle Ring or metal saddle is available in various sizes, which give different combinations of efficiency and pressure drop.

### Advantages

- low pressure drop and high efficiency
- large effective interfacial area
- high mechanical strength
- low cost

### Application

- Transfer towers both small and large diameter
- Deep vacuum towers where low pressure drop is crucial and also high pressure towers where capacity significantly exceeds conventional trays
- Distillation, absorption etc
- High pressure towers

Intalox Saddle Rings Specification				
Size (mm)	25	38	50	76
%Void	96	96	96	97
Area(m <sup>2</sup> /m <sup>3</sup> )	185	112	75	58
Pieces/m <sup>3</sup>	101160	24680	10400	3320



## FLEXIMAX

FLEXIMAX high performance random packing provides improved performance in efficiency and/or capacity and pressure drop relative to conventional random packings. FLEXIMAX has a unique geometry that provides excellent radial spreading combined with superior mechanical integrity. This high performance packing makes deep beds possible without packing deformation. Available in various size and constructed of virtually any metallic material, it is the most advanced random packing design available today.

### Application

- Chemical Processing (Acetic Acid, Ammonia Absorption, Benzene Stripping, Ethylene Oxide Stripping/Absorption, Caustic Scrubbing, Amine Absorption, Scrubbing and Contacting)
- Gas Processing (Demethanizers, Depropanizers, Deethanizers, Debutanizers, Strippers, Acid Gas Absorbers)
- Oil Refining (Naphtha Splitters, Crude Vacuum Towers, Light Ends Fractionators)

### Advantages

- Higher capacity than conventional random packings
- Higher efficiency
- High mechanical integrity allows for deep beds without packing deformation
- Available in virtually any metallic material of construction

FLEXIMAX Specification		
Size No.	# 300	# 400
Area (m <sup>2</sup> /m <sup>3</sup> )	141	85
%Void	98	98

