PANTAN is a well-established leading designer and manufacturer of a complete range of Process Vessel internals for the Oil, Gas and Petrochemical Industries.

For well over a decade now, our company has developed a comprehensive range of products and services including:

- Fractionation Trays
- Packed Tower Internals
- Separator Internals
- Reactor Internals
- Site Services

PANTAN certified according to ISO 9001:2015 for Designing and Manufacturing of Process Vessel Internals. Our principal focus is on improving products quality and customer satisfaction.

**Packed Tower Internals**

Packed Columns play an important role in distillation, absorption and stripping processes. This brochure provides the information of the key design and specification of column packings and packed column internals including:

- Random Packing
- Structured Packing
- Liquid Distributor
- Collector/Chimney Tray
- Support Grid
- Hold down Grid
Packed Tower Internals

A packed bed provides a mechanism for mass or heat transfer through which the gas and liquid phases usually flow counter currently in the column. The presence of tower packing elements provides a resistance to the flow of these fluids that is greater than it would be in an empty column shell. The modification of existing mass transfer columns with modern column packings can increase the number of available mass transfer stages. These additional stages permit greater product recovery through a reduction in losses of product in recycled or waste streams.

Packings are divided into two main categories; Random or Dumped packing: These are discrete pieces of packing with a specific geometrical shape which are randomly packed into the column. Structured packing: These are corrugated sheets of thin gauge metal or wire gauze which are supplied in segments to form the packed bed.

Column Packing

Features
- Low pressure drop
- Operation flexibility
- Capacity enhancement
- Availability of materials with high resistance against corrosive services

Because of these outstanding advantages, substitution of existing trays by new packings can be the first approach for revamping of mass transfer processes to gain additional capacity or efficiency requirement.

Random Packing

This type of packing is available in a multitude of geometrical shape which are dumped in the tower, the higher capacity is achievable with larger packing but lower separation efficiency. Optimal design and performance of a packed bed is achieved by selecting a packing that optimizes the total gas to liquid interface with a low pressure drop.

RR-PantaRing™

RR-PantaRing™ has cylindrical design and is the first generation of random packings, well known as Raschig Ring.

Metal Ring

<table>
<thead>
<tr>
<th>Nominal Size (mm)</th>
<th>Equivalent Size (inch)</th>
<th>Bulk Density (Kg/m³)</th>
<th>Quantity (pieces/m³)</th>
<th>Surface Area (m²/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>φ 25</td>
<td>1&quot;</td>
<td>400</td>
<td>50000</td>
<td>220</td>
</tr>
<tr>
<td>φ 40</td>
<td>1 ½&quot;</td>
<td>245</td>
<td>14500</td>
<td>130</td>
</tr>
<tr>
<td>φ 50</td>
<td>2&quot;</td>
<td>320</td>
<td>6500</td>
<td>110</td>
</tr>
</tbody>
</table>

Carbon Ring

Carbon Rings as one of the most common and generic type of packings provides a corrosion resistance, thermal shock resistance, and high temperature stability conditions.

<table>
<thead>
<tr>
<th>Nominal Size (mm)</th>
<th>Equivalent Size (inch)</th>
<th>Bulk Density (Kg/m³)</th>
<th>Quantity (pieces/m³)</th>
<th>Surface Area (m²/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td># 25</td>
<td>1&quot;</td>
<td>520</td>
<td>45000</td>
<td>175</td>
</tr>
<tr>
<td># 40</td>
<td>1 ½&quot;</td>
<td>510</td>
<td>14000</td>
<td>125</td>
</tr>
<tr>
<td># 50</td>
<td>2&quot;</td>
<td>380</td>
<td>5800</td>
<td>92</td>
</tr>
</tbody>
</table>
PR-Panta Ring™

This second generation of random packings is well known as Pall Ring which is one of the most common type of packings media.

- **Features**
  - Most experienced random packing in industries and research institutes
  - Improved strength by proper material thickness
  - Lower pressure drop rather than Raschig Rings

<table>
<thead>
<tr>
<th>Nominal Size (mm)</th>
<th>Equivalent Size (inch)</th>
<th>Bulk Density (kg/m³)</th>
<th>Quantity (pieces/m³)</th>
<th>Surface Area (m²/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td># 25</td>
<td>1&quot;</td>
<td>385</td>
<td>51000</td>
<td>195</td>
</tr>
<tr>
<td># 40</td>
<td>1 ½&quot;</td>
<td>250</td>
<td>14400</td>
<td>135</td>
</tr>
<tr>
<td># 50</td>
<td>2&quot;</td>
<td>210</td>
<td>6600</td>
<td>105</td>
</tr>
</tbody>
</table>

IR-Panta Ring™

This 3rd generation of random packing media designed to give enhanced capacity and increased efficiency over the older style Pall Ring packing. This type of packing combines the high void fraction and the well-distributed surface area of the Pall Ring with the low aerodynamic drag of the saddle shape. This kind of random packing is used widely in separation columns. By comparison to the PR Series, PantaRing™ IR series provides a more open shape and improved liquid spread, also produce adequate mechanical strength resistance. This type is a direct replacement of well known IMTP packing.

- **Features**
  - 30% lower pressure drop rather than Pall Rings
  - More efficiency and capacity rather than other random packings
  - Minimum liquid hold up

<table>
<thead>
<tr>
<th>Nominal Size (mm)</th>
<th>Equivalent Size (inch)</th>
<th>Bulk Density (kg/m³)</th>
<th>Quantity (pieces/m³)</th>
<th>Surface Area (m²/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td># 25</td>
<td>1&quot;</td>
<td>270</td>
<td>130000</td>
<td>230</td>
</tr>
<tr>
<td># 40</td>
<td>1 ½&quot;</td>
<td>230</td>
<td>46000</td>
<td>145</td>
</tr>
<tr>
<td># 50</td>
<td>2&quot;</td>
<td>140</td>
<td>14000</td>
<td>100</td>
</tr>
<tr>
<td># 70</td>
<td>2 ½&quot;</td>
<td>110</td>
<td>4500</td>
<td>60</td>
</tr>
</tbody>
</table>

- Well surface utilization in transfer phenomena
- Shorter packed bed height.
- Outstanding mechanical strength
Structured Packing

Panta Pak™ Structured Packing is formed from corrugated thin sheet metal in a crisscrossing way and intersections to create vapor flow channels and mixing points for liquid and vapor phase. Structured packing is ideal for difficult separations requiring a large number of theoretical stages, in low liquid rate absorption/stripping systems or applications that require a wide operating range such as vacuum and atmospheric crude oil fractionators, FCC main fractionators and TEG contactors meanwhile it causes lower pressure drop than random packing. Panta Pak™ is a typical structured packing formed from corrugated sheets of perforated embossed metal [PS series] or wire gauze [PG series].

Panta Pak™ "PS" Series

An industry standard sheet metal which is available with specific surface ranging from below 125 m²/m³ for high capacity to more than 750 m²/m³ for high efficiency applications. The standard angle of the corrugations which is 45° [referred M1] and 60° [referred M2] also high capacity structured packing [referred MH] are fabricated in PANTAN. Metal Structured Packing provides high capacity, low pressure drop and good wettability in many process columns.

- **Features**
  - Ideal for vacuum services
  - Very low liquid loads (< 100 L/m²h) are possible
  - Low pressure drop per theoretical stage
  - High separation efficiency owing to larger mass transfer area
  - Good wettability of the packing surfaces
  - Superior compressive strength

Panta Pak™ "PG" Series

This type of Structured Packing is made of mesh type gauze woven by metal wire and is mainly used to enhanced separation characteristics for fine chemicals, perfumery, and pharmacy. It is normally manufactured with very high surface area [500 m²/m³ and 750 m²/m³]

- **Features**
  - Superior wetting ability owing to capillarity
  - High separation efficiency /High number of theoretical stages
  - Lower specific pressure drop
  - Small liquid hold-up
Flooding curves for Panta Pak™ structured packing

Relative capacity & HETP for Panta Pak™ structured packing

Note: Relative capacity and HETP are for estimation purposes only and may vary according to actual column loads and duty.
Hydraulic Design

The optimum efficiency and loading point are evaluated by using reliable design models, for selected random or structured packing the bed heights are determined from HETP (height equivalent theoretical plate) and the column diameter is determined from capacity and pressure drop.

PANTAN packed bed hydraulic design software not only consists of tried and tested correlations for HETP, pressure drop, Flooding, liquid hold up and etc but also contains a sufficient data bank of various experienced cases to check the design output.

Packing Efficiency

HETP as Packing Efficiency is determined to evaluate required height of packing to achieve specified number of theoretical equilibrium stages. Basic data such as number of theoretical stages, liquid-vapor loads and physical properties are derived from standard process simulation software. There are some direct parameters for HETP calculation such as liquid-vapor loads, physical and transport properties, packing type-size as well as indirect factors like liquid-vapor distributor quality. Proper liquid distribution is the key parameter in order to achieve optimum performance with any high efficiency random or structured packing. Below curve shows a typical HETP versus vapor rates of typical packing.

Packing Pressure Drop

Generalized pressure drop correlation (GPDC) is a common method for estimating pressure drop and maximum capacity of most generic random packings. Pressure drop estimated by using this model is accurate to within ±20% for most random packing styles.

Pressure drop for structured packing is calculated by related GPDC for rough estimation or by correlations and experimental data for more accurate evaluation.
To acquire the maximum efficiency in packed column, liquid should be distributed uniformly over the packed bed. Therefore, Liquid Distributors are used above each bed of packing. Good practice designed distributors have the following specifications:

- Uniform liquid distribution
- Low vapor pressure drop
- Low liquid residence time
- Capability to be used as combined with collector for re-distribution
- Minimum distributor height
- Fouling resistance
- Cross mixing capability

### Model TD-111

<table>
<thead>
<tr>
<th>Type</th>
<th>Drip Tube Trough Distributor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>&gt;1000 mm</td>
</tr>
<tr>
<td>Irrigation Rate</td>
<td>0.8 – 30 m³/ h m²</td>
</tr>
<tr>
<td>Resistance to Fouling</td>
<td>High</td>
</tr>
<tr>
<td>Turndown Ratio</td>
<td>2:1 (maximum 10:1 in multiple level holes)</td>
</tr>
<tr>
<td>Holes Position</td>
<td>Square pattern punched in the trough’s side which is covered with drip tubes (Multiple levels &amp; series of holes can be punched to achieve high turndown ratio)</td>
</tr>
<tr>
<td>Drip points Density</td>
<td>80 - 100 drip points /m²</td>
</tr>
</tbody>
</table>

### Model TD-112

<table>
<thead>
<tr>
<th>Type</th>
<th>Drip Panel Trough Distributor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>&gt;900 mm</td>
</tr>
<tr>
<td>Irrigation Rate</td>
<td>&gt; 30 m³/ h m²</td>
</tr>
<tr>
<td>Resistance to Fouling</td>
<td>Medium</td>
</tr>
<tr>
<td>Turndown Ratio</td>
<td>3:1</td>
</tr>
<tr>
<td>Holes Position</td>
<td>Square pattern punched in the trough’s side which is covered with drip Panel</td>
</tr>
<tr>
<td>Drip points Density</td>
<td>80 - 200 drip points /m²</td>
</tr>
</tbody>
</table>

### Model PD-121 / PD-122

<table>
<thead>
<tr>
<th>Type</th>
<th>Orifice Pan Distributor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>300 – 1000 mm</td>
</tr>
<tr>
<td>Liquid Range</td>
<td>2.5 - 75 m³/ h m²</td>
</tr>
<tr>
<td>Resistance to Fouling</td>
<td>Low</td>
</tr>
<tr>
<td>Turndown Ratio</td>
<td>2:1</td>
</tr>
<tr>
<td>Holes Position</td>
<td>Square or triangular pattern punched in the pan floor</td>
</tr>
<tr>
<td>Drip points Density</td>
<td>60 - 100 drip points / m²</td>
</tr>
<tr>
<td>Optional Features</td>
<td>Combined with hat to operate as re-distributor</td>
</tr>
</tbody>
</table>
### Model DD-131

<table>
<thead>
<tr>
<th>Type</th>
<th>Bottom Orifice Deck Distributor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>&gt; 300 mm</td>
</tr>
<tr>
<td>Liquid Range</td>
<td>&gt; 30 m³/h m²</td>
</tr>
<tr>
<td>Resistance to Fouling</td>
<td>Low</td>
</tr>
<tr>
<td>Turndown Ratio</td>
<td>2:1</td>
</tr>
<tr>
<td>Holes Position</td>
<td>Square pattern punched in the deck</td>
</tr>
<tr>
<td>Drip points Density</td>
<td>70-100 Drip points /m²</td>
</tr>
<tr>
<td>Optional Features</td>
<td>Combined with Hat to Operate as Re-distributor</td>
</tr>
</tbody>
</table>

### Model DD-132

<table>
<thead>
<tr>
<th>Type</th>
<th>Drip Tube Deck Distributor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>&gt;1000 mm</td>
</tr>
<tr>
<td>Irrigation Rate</td>
<td>0.8 – 30 m³/h m²</td>
</tr>
<tr>
<td>Resistance to Fouling</td>
<td>Medium</td>
</tr>
<tr>
<td>Turndown Ratio</td>
<td>2:1</td>
</tr>
<tr>
<td>Holes Position</td>
<td>Square pattern punched in the trough side which is covered with drip tubes (Multiple levels &amp; series of holes can be punched to achieve high turndown ratio)</td>
</tr>
<tr>
<td>Drip points Density</td>
<td>80-200 Drip points /m²</td>
</tr>
<tr>
<td>Optional Features</td>
<td>Combined with Hat to Operate as Re-distributor</td>
</tr>
</tbody>
</table>

### Model AD-141

<table>
<thead>
<tr>
<th>Type</th>
<th>Pipe Arm Distributor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>&gt; 400 mm</td>
</tr>
<tr>
<td>Liquid Range</td>
<td>4–25 m³/h m²</td>
</tr>
<tr>
<td>Resistance to Fouling</td>
<td>Low (can be used only for clean services)</td>
</tr>
<tr>
<td>Turndown Ratio</td>
<td>2:1</td>
</tr>
<tr>
<td>Holes Position</td>
<td>Orifices furnished in pipe below</td>
</tr>
<tr>
<td>Feature</td>
<td>Suitable for Low irrigation rate and limited height space services</td>
</tr>
</tbody>
</table>

### Model DD-131

- **Type**: Bottom Orifice Deck Distributor
- **Diameter**: > 300 mm
- **Liquid Range**: > 30 m³/h m²
- **Resistance to Fouling**: Low
- **Turndown Ratio**: 2:1
- **Holes Position**: Square pattern punched in the deck
- **Drip points Density**: 70-100 Drip points /m²
- **Optional Features**: Combined with Hat to Operate as Re-distributor

### Model DD-132

- **Type**: Drip Tube Deck Distributor
- **Diameter**: >1000 mm
- **Irrigation Rate**: 0.8 – 30 m³/h m²
- **Resistance to Fouling**: Medium
- **Turndown Ratio**: 2:1 (10:1 max in multiple levels holes)
- **Holes Position**: Square pattern punched in the trough side which is covered with drip tubes (Multiple levels & series of holes can be punched to achieve high turndown ratio)
- **Drip points Density**: 80-200 Drip points /m²
- **Optional Features**: Combined with Hat to Operate as Re-distributor

### Model AD-141

- **Type**: Pipe Arm Distributor
- **Diameter**: > 400 mm
- **Liquid Range**: 4-25 m³/h m²
- **Resistance to Fouling**: Low (can be used only for clean services)
- **Turndown Ratio**: 2:1
- **Holes Position**: Orifices furnished in pipe below
- **Feature**: Suitable for Low irrigation rate and limited height space services
Liquid Collector/Chimney tray is used in the columns to achieve one or more of following purposes:
- Vapor distribution
- Liquid collection from above bed and conduction to below distributor
- Total or partial liquid draw-off

Open area, allowable pressure drop, height of collector liquid & vapor loads, column diameter and quantity of Liquid draw-off are the main parameters in collector design.

**Model VC-211**

- Type: Vane Collector
- Diameter: > 800 mm
- Service: Suitable for vacuum services because of low pressure drop (high vapor & low liquid loads)
- Open Area: 50-80%
- Features: can be used as a part of combined distributor/collector for re-distributing liquid between packed beds

**Model CC-221**

- Type: Rectangular Chimney Tray
- Diameter: All diameters
- Service: Suitable for large columns total or partial liquid draw-off as seal welded
- Open Area: 15-30%
**Model CC-222**

<table>
<thead>
<tr>
<th>Type</th>
<th>Circular Chimney Tray</th>
<th>Diameter</th>
<th>All diameters</th>
<th>Service</th>
<th>Suitable for large columns total or partial liquid draw-off as seal welded- Usable for vapor distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Area</td>
<td>15-30%</td>
<td></td>
<td></td>
<td></td>
<td>------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>

**Model SG-311**

<table>
<thead>
<tr>
<th>Type</th>
<th>Structure Packing Support Grid</th>
<th>Diameter</th>
<th>All diameters</th>
<th>Service</th>
<th>Support sheet metal or wire gauze structured packing</th>
</tr>
</thead>
</table>

**Model SG-321**

<table>
<thead>
<tr>
<th>Type</th>
<th>Random Packing Support Grid</th>
<th>Diameter</th>
<th>All diameters</th>
<th>Service</th>
<th>Support Random packing media</th>
</tr>
</thead>
</table>

**Support Grid**

Packings are installed on support grids which are designed to provide sufficient strength to support packed beds under normal operating conditions without creating any capacity restriction in the column.

Criteria for selecting a support grid include:
- Type of packing (random or structured)
- Maximum design load
Hold Down Grid / Bed Limiter for random packing is used because vapor load has potential for moving the packing media. When top packing layers top have potential of upward displacement in the structured packing, Hold Down Grid is recommended. Where the upward displacement of structured packing is not a concern, the distributor over the packed bed can also be used as bed limiter.

**Model HG-411**

<table>
<thead>
<tr>
<th>Type</th>
<th>Structured Packing Hold Down Grid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>All diameters</td>
</tr>
<tr>
<td>Service</td>
<td>Retain the sheet metal or wire gauze structured packing</td>
</tr>
</tbody>
</table>

**Model HG-421**

<table>
<thead>
<tr>
<th>Type</th>
<th>Random Packing Hold Down Grid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>All diameters</td>
</tr>
<tr>
<td>Service</td>
<td>Retain the Random packing media</td>
</tr>
</tbody>
</table>

Type | Diameter  | Service                                       |
------|-----------|-----------------------------------------------|
**HG-411** | All diameters | Retain the sheet metal or wire gauze structured packing |
**HG-421** | All diameters | Retain the Random packing media |