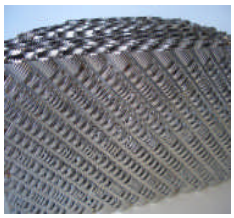
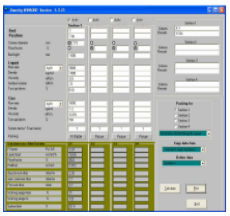
General Product Information

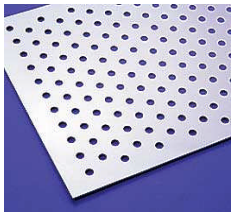
Product Bulletin 100



Superior performance by design™

Raschig GmbH - Jaeger Products, Inc





RASCHIG JAEGER TECHNOLOGIES

A new Alliance in Mass Transfer Business.
Together we are creating more!

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RASCHIG JAEGER TECHNOLOGIES

A new Alliance in Mass Transfer Business.
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Raschig Jaeger Technologies – September 2006

In order to establish a new alliance in mass transfer business RASCHIG GmbH and its parent company PMC GLOBAL INC have acquired JAEGER PRODUCTS INC., a Houston Texas based company, which is a major manufacturer of tower packings, column internals and speciality trays and very active in the Mass Transfer and Environmental Business.

RASCHIG JAEGER will be integrated into the PMC network of highly specialized, internationally operating companies and will therefore be better prepared to meet increased globalization and further improved customer orientation. Wherever in the world – in all continents – RASCHIG JAEGER is on the spot.

Synergies

This strategic acquisition combining RASCHIG and JAEGER into one larger group gives a great advantage to our customers giving them access to products of both entities in Europe, The Americas and in other parts of the world. It will create new dimensions in mass transfer technology. The advantages of our process engineering know-how and our technologies benefit even more the planning, modernization and construction of our clients' processes. And: saving energy and investment cost is part of it.

The new alliance offers a diverse array of products to meet the mass transfer needs of the industries. While specializing in high performance products, the comprehensive products line of RASCHIG JAEGER also includes traditional fractional trays as well as structured and random packing types that best fit the application.

Leading In-house distributor test-facility

The company operates one of the largest in-house distributor test-facilities worldwide. Liquid distributors can be tested up to 12m in diameter at a maximum liquid load of 2400m3 per hour.

All products of RASCHIG JAEGER are the result of consistent development work long years of experience. Comprehensive quality management in all stages of production and the principle of offering complete solutions are the basis of our excellent reputation – worldwide.

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THE COMPANY

Jaeger Products, Inc. is a manufacturer of tower packings, column internals, and specialty trays. Our products are common to many chemical processes and environmental applications where mass transfer equipment is needed. In 1978, Jaeger revolutionized the plastic random packing industry with the introduction of the high performance Jaeger Tri-Packs®. It is still the plastic random packing to which all others are compared. Other performance products include Max-Pak™, a sheet metal structured packing, Cascade Mini-Rings®, and the CoFlo™ Tray, a new high capacity tray. While specializing in performance products, our comprehensive product line includes traditional packing types in plastic, metal, and ceramic. No other company offers such a diverse array of products to meet the mass transfer needs of the chemical and environmental industries. Jaeger has the product to meet your most demanding application.

Technical Experience

Of course, with such a comprehensive product line comes the need to design and build the many associated internals required to make mass transfer systems work effectively. Jaeger's capable engineering staff has the knowledge and experience to recognize the nuances of each system and offer the design that best fits the application. Each internal is custom made and matched exactly with the appropriate packing and operating conditions. Our vast database of experience will work for you. Ask about our written process guarantees.

Customer Service

A huge factor in the success of any company is their commitment to customer service. Our professional sales and customer service staff will provide competitive quotations promptly without having to wait weeks. Our commitment to quality products, ample inventories, same day air shipments, just in time delivery scheduling, and no minimum order quantities is partly why Jaeger has the best customer service ranking in the industry. Jaeger has an able and ready staff to meet your service requests.

Facilities and Plants

Jaeger's corporate offices are located in Houston, TX, just inside the north beltway area. This five acre, multi-use facility houses the sales and engineering departments as well as light manufacturing and limited inventory. Our primary molding facility, Century Plastics, is a corporate-owned subsidiary centrally located in El Dorado, KS for timely shipments anywhere in North America. Additional plant and warehouse facilities are located in Toronto, ONT. Other affiliated offices include locations in Germany and other parts of the world.

The purpose of this brochure is to offer a brief overview of our product line. Should you require additional information on a product, please contact us for a brochure specific to that product or request a complete catalog. The additional information will offer performance curves, data for design use, as well as other information. We look forward to the opportunity to be of service

RASCHIG JAEGER TECHNOLOGIES

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Raschig Super-Ring

Aspects involved in the design of modern packing elements

Packing elements are successfully used in the chemical industry and related sectors, as well as in environmental protection installations, i.e. in absorption, desorption, extraction and rectification columns. The manifold process engineering demands on modern packing elements are determined by these thermal separation processes.

High-performance packing elements are intended to bring about effective mass transfer between the phases flowing through the columns. Large interfacial area and uniform distribution of the phases over the column cross-section are desirable. A high loading capacity permits high column throughputs, while low pressure drop results in low operating costs.

Loading capacity

Counter-current packed columns are preferably operated below, or in the immediate vicinity, of the so-called loading point, this being characterised by the fact that the falling film is backed up by the counter-current gas stream at higher loads. The loading point of a packing element is defined by its fluid dynamic properties. Fluid dynamic studies in the past have repeatedly shown that the droplets forming in a column packing are entrained earlier than down-ward flowing liquid films at high gas loads. In contrast to previous packing element designs, the Raschig Super-Ring meets this demand in that it was purposely designed without any projecting metal tongues which could act as dripping points.

Liquid and gas distribution

The most uniform possible distribution of the liquid and gas phase across the packing element itself and the entire column cross-section is one of the fundamental prerequisites for a column packing that works effectively. If, at the same time, a low resistance to fluid flow of the gas phase is to ensure the minimum possible pressure drop, the structure must be largely open. The alternating wave structure of the Raschig Super- Ring has not only created a form which is open on all sides but, at the same time, has also realised a large number of contact points for homogeneous liquid and gas distribution.

PRODUCT APPLICATION

Mass transfer is defined as the transfer of a chemical species from one phase to another, i.e., gas phase to liquid, commonly called scrubbing and liquid phase to gas, commonly called stripping. This process is generally achieved through the use of a column with trays or packing.

Contents of a Packed Column

The contents of a packed tower will vary based on application and performance requirements. The column at the right illustrates the various components that might be used in typical installations. Generally, the column will contain a gas inlet, a packing support plate, random or structured packing, a bed limiter, a liquid distributor, vapor outlet, and perhaps a mist eliminator. Most column internals are custom designed for the intended application and therefore vary in description and performance. Many process columns utilize multiple liquid feed inlets and draw trays requiring careful and detailed design.

What does the Packing do?

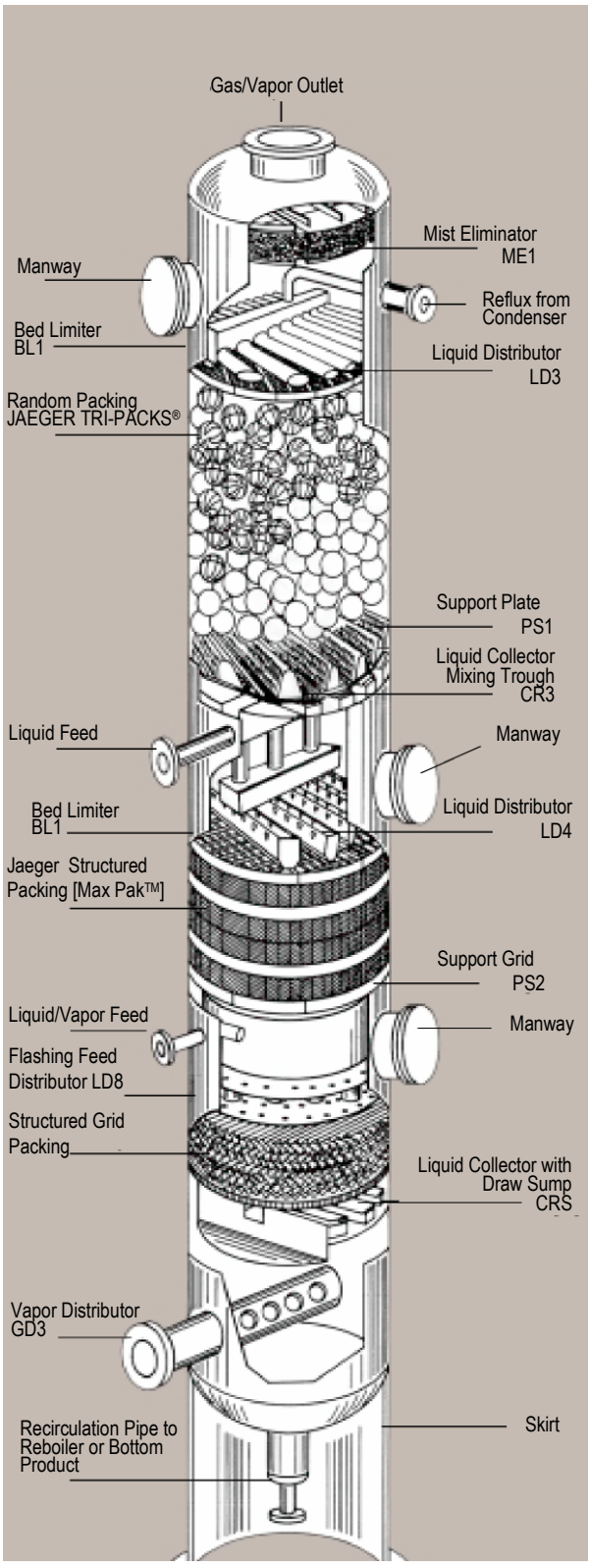
The purpose of the packing is to provide surface area to enhance contact mixing of a gas and liquid usually flowing counter current to one another. Generally, there are two types of packing: structured and random dumped. Structured packing is made from corrugated sheet material. It is installed in bulk sections with a specific layout and thickness. Random dumped packing gets its name from its installation method. It is simply dumped into the tower and allowed to fill in a random manner. Both types are available in a variety of materials; metal alloys, plastic, and ceramic. There are different configurations within each type of packing, especially with random packings.

Packed Column Performance

Performance of any packed column is greatly dependent on the type of packing chosen, the specific element configuration, and the design of related internals. Each type of packing may require different design considerations for optimum performance. Care should be taken in making performance comparisons.

Structured packings of comparable crimp size are generally close in performance and, due to similar shape and installation method, comparative data is readily available. Likewise, similar shaped random packings such as rings and saddles have been used for a long time, and published data is available.

Performance packings offer significant benefits which can result in reduced capital and operating costs. However, care should be taken when comparing these unique packings. A column optimized for one packing may not be optimized for another, and comparative data can be misleading. Jaeger has built a solid reputation based on reasonable, yet conservative designs. Contact Jaeger's engineering staff for professional and reliable design assistance.



Typical Applications

Absorption	Mixing	Drying	Desalting
Desorption	Separating	Cooling	Demisting
Distillation	Aerating	Biofiltration	Humidifying
Rectification	Degassing	Scrubbing	Stripping
Extraction	Precipitation	Condensing	Heat Transfer

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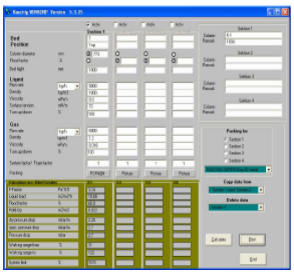


WINSORP
Modern Software for Calculating Mass Transfer Columns

What WINSORP Can Do

Modern computer programs are being used more and more in the planning of production plants for the chemical and allied industries or technological environmental protection processes since they solve even complex tasks in a reasonable time by using modern mathematical calculation methods. Raschig GmbH, Ludwigshafen presents a new computer program for the design of absorption, desorption, chemisorption and rectifying columns. It is based on extensive practically relevant data measured by the company and, thanks to the latest theoretical calculation approaches, it ensures reliable dimensioning.

The program for calculating the mass transfer efficiencies and the fluid dynamics of absorption, desorption, chemisorption and rectifying columns runs with "Microsoft Windows" and therefore has a user- optimised graphic interface. The following calculation algorithms can be called up by choosing from the relevant menu items:

- ❖ Absorption
- ❖ Desorption
- ❖ Chemisorption
- ❖ Separation Efficiency in Rectificatio
- ❖ Separation Efficiency in Absorption and Desorption
- ❖ Fluid Dynamics
- ❖ Heat Transfer
- ❖ Conversions

A description of the individual menu items will illustrate what WINSORP can do.

PLASTIC RANDOM PACKINGS

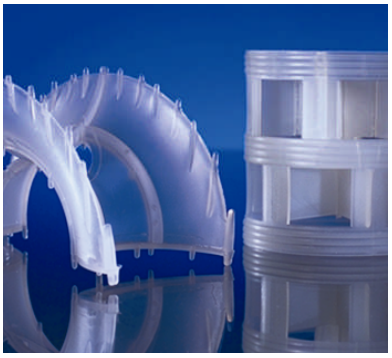
Jaeger Tri-Packs®

Jaeger Tri-Packs®

Jaeger Tri-Packs® is a spherical, plastic packing constructed with a unique network of ribs, struts, and drip rods. Its superior geometry offers optimum balance between open area and surface area. High mass transfer rates are achieved by excellent wetting of its active surface area and increased capacity through an open, consistent design. Each packing element rolls into its packed position without forming large void areas, common to irregular shaped packings or those with excessive pins or appurtenances. There is no need to allow for settling, and nesting is virtually impossible. One can have confidence in the predictable performance offered by the Jaeger Tri-Packs®.

Jaeger Tri-Packs® are available in four nominal sizes, 1", $1^{1/4}$", 2", and $3^{1/2}$" in many different thermoplastic resin choices. There is a size and material to match most any application, from PVC to PFA. Jaeger Tri-Packs-PP® was the first plastic performance packing to be certified to NSF® standard 61 for use in potable water applications. They are used in most mass transfer applications, primarily scrubbing, air stripping, and distillation. They work well in mist elimination, biological treatment, and cooling tower applications. For additional information and design data, please request Brochure 600.

Jaeger Rings and Saddles

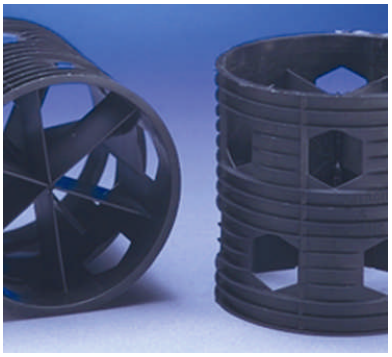


Jaeger Rings and Saddles

Jaeger Rings and Saddles are conventional shaped packings that offer an economic choice. They represent the oldest, and perhaps most common, type of plastic packing used over the past 40 years. Jaeger' s Rings and Saddles are comparable to most other manufacturer's, as patents on these types of packings have long since expired.

Jaeger Rings are available in 5/8", 1", $1^{1/2}$", 2", and $3^{1/2}$" nominal sizes. Jaeger Saddles are available in 1", 2", and 3" sizes in a variety of injection moldable plastics. Request Brochure 700.

Jaeger Bio-Rings ®



Jaeger Bio-Rings ®

Jaeger Bio-Ring® is a cylindrical packing with specific design features for use in biological applications. They replace existing rock bed aerobic trickling filters, and offer increased capacity and efficiency to waste water treatment.

Performance is offered by large hexagonal windows that allow passage of solids and their unique external ribs provide additional surface for greater biomass growth. Bio-Rings are available in a UV-stabilized polypropylene or in a weighted polypropylene for specific gravity greater than 1.0. Bio-Rings® are available in $3^{1/2}$" diameter .

Jaeger Cascade Mini-Rings ®

Jaeger Cascade Mini-Rings ®

Jaeger Cascade Mini-Rings® have a unique geometry made of ridged cylindrical surfaces and linear internal braces which provide large surface areas for thin-film liquid formations and a multiplicity of drip points. When randomly installed, the bed forms an integral reticulated structure with excellent resistance to deformation to allow higher bed heights than other types of packing. Cascade Mini-Rings® have a low aspect (height/diameter) ratio of 0.3 compared to 1.0 for standard cylindrical ring packings. The low aspect ratio offers opportunity for efficient gas and liquid contact and increased performance. Cascade Mini-Rings® have no protruding edges which minimizes chance of nesting and offers more uniform liquid distribution. Cascade Mini-Rings® allow increased hydraulic capacity while maintaining a low pressure drop.

Cascade Mini-Rings® are available in three nominal sizes, 1", 2", and $3^{1/2}$" in most common injection moldable plastics. Additional information is available in Brochure 800 .

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Raschig Super-Ring

Mass transfer

Effective mass transfer between the phases demands not only a large interfacial area, but also the most turbulent possible flow conditions and frequent renewal of the phase interfaces. With the Raschig Super-Ring, several thin films of liquid displaying turbulent flow are formed on the sinusoidal webs and are constantly intermixed as the result of the recurrent contact points within the packing element.

Concluding Remarks

The Raschig Super-Ring demonstrates that this high-performance packing element meets the numerous demands of process engineering in an outstanding manner. The above description illustrates that a modern packing element design today must fulfil a number of fluid dynamic conditions. This is particularly true because, in most applications, only a fraction of the surface of a filling material is wetted and used for mass transfer between the phases. However, unused surfaces can easily corrode or generate unnecessary pressure drop. The Raschig Super-Ring offers decisive advantage in this context, as its surface utilisation has been optimised in terms of process engineering.

Performance data of the Raschig Super-Ring

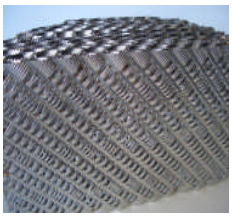
Experimental studies have confirmed the relationships described above. The following Figures show the pressure drop of the Raschig Super-Ring as a function of the gas capacity factor at various liquid loads. As a result of a very open structure of the Raschig Super-Ring, the pressure drop of the dry packing is already lower than that of a 50 mm metal Pall ring. The differences increases at higher liquid loads. The Raschig Super-Ring generates also a substantially lower pressure drop than other high-performance packing elements made of metal with a nominal size of 50 mm.

The loading capacity of the Raschig Super-Ring can also been seen from the following Figures. The Raschig Super-Ring not only has a higher loading capacity than the 50 mm metal Pall ring, but also displays a substantially higher loading capacity than previous modern packing element designs.

The Figures show also the results of trials involving the absorption of ammonia from air in water. The separation efficiency of this new packing element is thus up to 14% better than that of a 50 mm metal Pall ring or previous high-performance metal packing elements.

Furthermore, the low specific packing weight of the Raschig Super-Ring allows the design of low-cost supporting elements in the columns. The Raschig Super-Ring is also lighter than other packing element designs, but without sacrificing stability. Experimental studies have shown that packing heights of 15 m and more can be realised owing to the alternating wave frequency and amplitude of the metal webs of the Raschig Super-Ring.

The alternating wave structure additionally prevents entanglement of the packing element within the packing, thus guaranteeing problem-free assembly and dismantling in a column. Owing to its open structure, the Raschig Super-Ring is also suitable for liquids contaminated with solids.



Raschig Super-Pak

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 structured packing is fundamentally different to the standard and high capacity corrugated sheet metal structured packings existing since years on the market. A common feature of these standard and high capacity structured packings is that both have discreet crimped channels that force vapour-liquid traffic along preferred flow paths. Additionally the vapour-liquid traffic is forced into sharp directional changes at the packing layer interface when packing elements are vertically stacked. The net result is that the enforced vapour-liquid flow patterns within the 'closed' structure of a common packing element do not necessarily utilize all of the available surface area for mass transfer and impose restrictive forces that reduce capacity and increase pressure drop.

Raschig adopted a different approach in developing Raschig Super-Pak. It is a more open structure such that vapour-liquid traffic can flow freely within a packing element and no sharp directional changes are existing at the layer interface.

The rows of sinusoidal waves within vertical packing sheets are surface enhanced to encourage greater turbulent radial spread of thin liquid film flows on the front and back of the waves on each sheet within an element.

The open structure resulted in excellent hydraulic and mass transfer efficiency characteristics.

The following figures are describing the advantages.

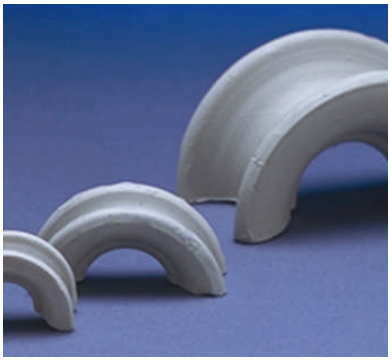
CERAMIC PACKINGS

Novalox® Saddle

Ceramic Novalox® saddles are a traditional packing shape produced from porcelain or stoneware. Our use of high quality clay in a proven manufacturing process ensures smooth, beveled, and longitudinally ribbed bodies that are consistent and uniform in shape. It is fired to a precise and controlled temperature ensuring excellent mechanical, abrasion, and heat resistance properties. Typical applications indicate temperature ratings to 2000°F. The quality and uniformity of the Novalox® Saddle ensure reliable performance through the entire packed bed, an important factor in both thermal and mass transfer applications.

Novalox® Saddles are available in 1/2",1", $1^{1/2}$", 2", and 3" nominal sizes. Additional information is available in Brochure 1000.

Novalox® Saddles



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METAL MAX-PAK™

Jaeger Metal MAX-PAK™ is the most efficient and economical structured packing in the industry today. MAX-PAK™ 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 (turn down). MAX-PAK™ offers very low pressure drop across the bed and superior liquid spreading characteristics over the packing surface.

MAX-PAK™ 's performance benefits are attributed to its method of manufacture. Most structured packing manufacturers punch holes in the sheet metal disposing of up to 10% of material surface area and potential efficiency. MAX-PAK™ structured packing is manufactured using a patented process incorporating pressure drop reducing, liquid diversion openings that are strategically located, resulting in a higher volume throughput capacity with no dead space. The shapes of the openings are specially designed for guiding and directing gas and liquid flows for full integration of gas/liquid contacting. The unique design of these openings and tabs favor communication between the back and front of each layer of sheet metal thus providing maximum surface area and liquid/gas distribution.

These unique tabs also make it possible for MAX-PAK™ to effectively handle a wide operating range. In a typical application, the fluid flowing down the column drips off the downward facing tabs and spreads on the surface of the sheets. In high liquid loading applications where the liquid may have a tendency to bridge the opening, an upward bent tab directs the liquid to the underside of the corresponding sheet.

MAX-PAK™ has been thoroughly tested by Fractionation Research, Inc. (FRI) and by the Separation Research Program (SRP) at the University of Texas Center for Energy Studies. Copies of these tests are available.

MAX-PAK™ is currently available in 1/2" crimp in most common alloys. Future sizes will become available to include 1" and 1/4" crimp. Please contact our sales offices for copies of test reports, pricing and availability, or other specific details. Additional information is available in Brochure 500.

Metal MAX-PAK™ Structured Packing

Services

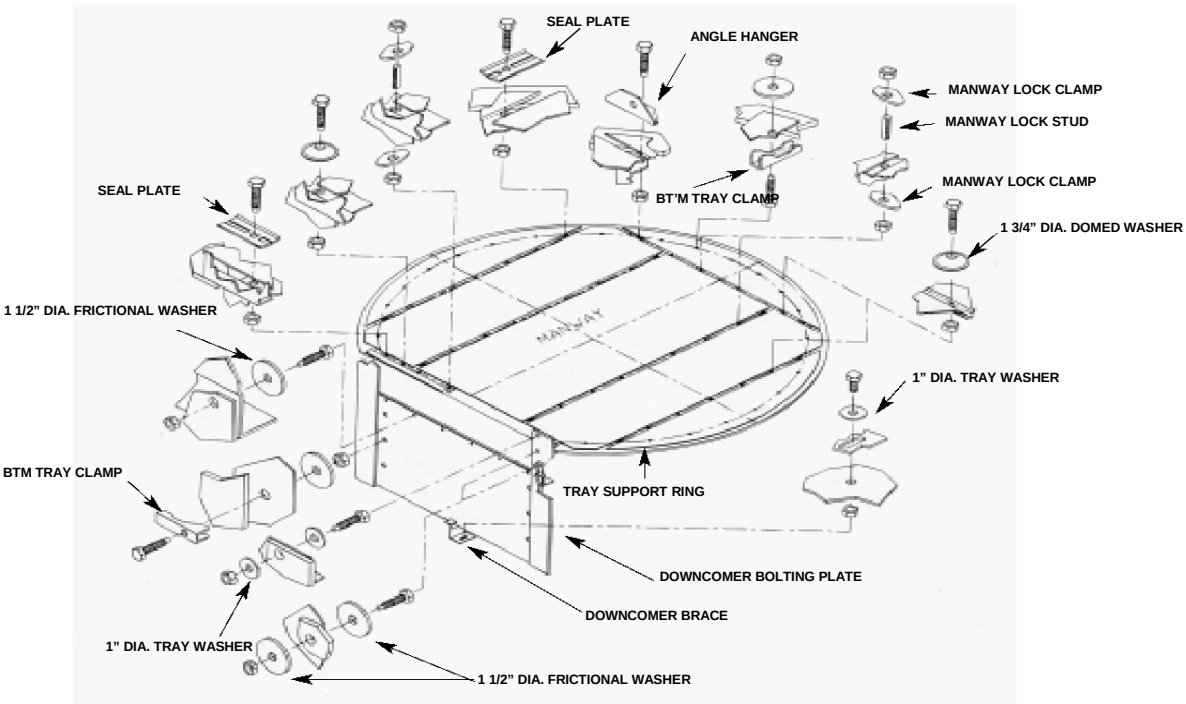
Raschig Jaeger specializes in the design and manufacture of mass transfer equipment for the Chemical Process Industries (CPI). Our primary tray products include conventional sieve, valve, and bubble cap trays; packed internals such as liquid distributors, chimney trays, packing support plates, and holddowns; and multiple styles of random and structural packing.

Raschig Jaeger also offers specialty trays such as high capacity trays, high uplift strength trays, dual flow, disc & donut, and side-to-side baffle trays.

Our products are backed by decades of experience and employees committed to quality, excellence, and service. Raschig Jaeger, a member of FRI (Fractionation Research Institute) has a staff fully capable of providing complete hydraulic and mechanical design of any new equipment required to suit all your needs. Process designs are made based on proven concepts. Our computerized mechanical engineering and fabricated systems are integrated to permit efficient and accurate processing of orders.

Raschig Jaeger focuses on effective design, responsive service, and efficient manufacturing. Whether small diameter or large, new construction, revamp or replacement, we will provide reliable solutions to our customer's requirements at an economical price.

To compliment Raschig Jaeger's product line of tray internals, we also supply replacement parts and installation hardware. Raschig Jaeger's hardware response group is dedicated to our customer's immediate and future requirements for replacement hardware. Our inventory is maintained and staffed by experienced personnel dedicated to quality, service and customer satisfaction.



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Quality Tray Products

Tray Selection

Tray type selection is generally accomplished by balancing various process and mechanical considerations. Major mechanical and process factors taken into consideration include capacity, efficiency, turndown, pressure drop, susceptibility to corrosion and fouling, and actual experience in the system.

What may be an overriding consideration in one case may be unimportant in another; therefore, each situation must be examined on its own merits. With the exception of special licensed tray technologies, Raschig Jaeger has the capability to produce virtually any type of conventional or specialty tray type

GENERAL TRAY CLASSIFICATION

Tray Type	Capacity	Efficiency	Turndown	Pressure Drop	Fouling Resistance
Sieve	Medium	Very High	Low	Low	Medium
Moving Valve	Medium	Very High	High	Medium	Low
High Capacity Valve	High	Very High	Medium	Medium	Low
Fixed Valve	Medium	Very High	Medium	Low	High
Bubble Cap	Low	Very High	Very High	High	Low
Dual Flow	High	Medium	Very Low	Low	High
Baffle	High	Very Low	Medium	Very Low	Very High
Disc & Donut	High	Very Low	Medium	Very Low	Very High
NYE	High	High	Medium	Medium	Medium
EC Technology	Very High	Very High	Medium	Medium	Low
CoFlo	Ultra High	High	Medium	High	Low

Materials of Construction

Raschig Jaeger trays can be fabricated from numerous types of materials. In addition to working with the most common carbon, ferritic, and austenitic steels, we also work with many exotic materials such as Hastelloy® alloys, titanium and specialty duplex stainless steels. A brief listing of acceptable materials of construction include:

carbon steel
410S stainless steel
304L stainless steel
316L stainless steel
317L stainless steel
321 stainless steel
347 stainless steel
904L stainless steel
Hastelloy®
Monel®
Inconel®
nickel
titanium
alloy 2205
alloy 2

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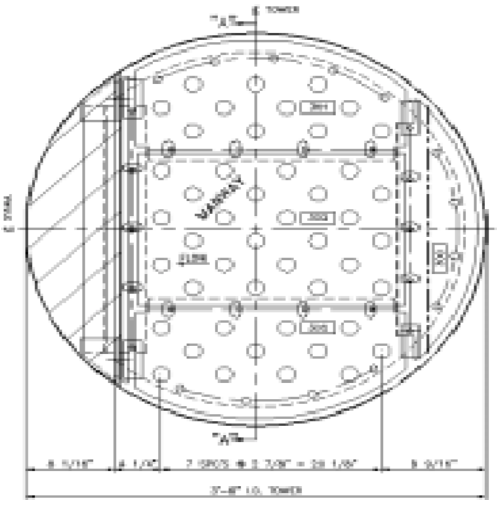
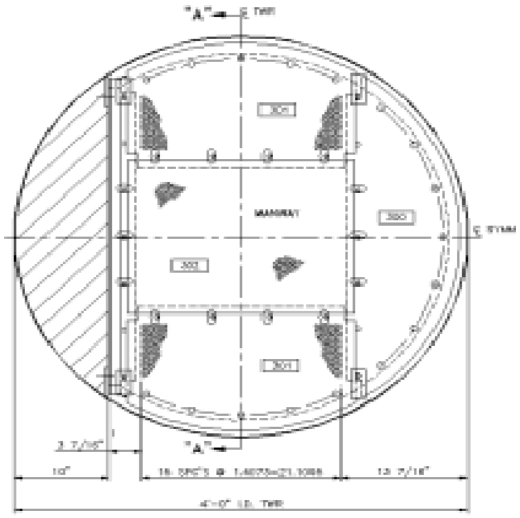
Conventional Fractionation Trays



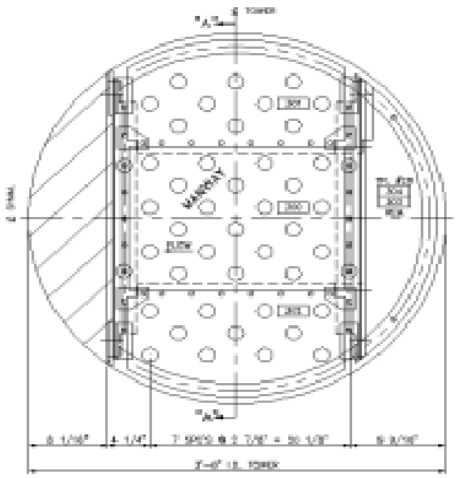
Valve Trays

Raschig Jaeger offers a vast array of conventional and High Capacity moving and fixed valve types to meet all of our customer's needs. The single piece RJ-V1 is our standard moving valve and is recommended for many applications. The RJ-V1 incorporates tabs to raise the main body of the valve off of the tray floor thereby reducing the chance of sticking. Raschig Jaeger manufactures many types of 1 piece, 2 piece cage and disc (RJ-A2 or RJ-A3), and 3 piece high turndown (RJ-A1) valve units with thickness, material type, and leg lengths as needed to meet any process and mechanical conditions required. Additional variations include extruded tray floor openings to reduce pressure drop and multiple valve weights to permit uniform operation over a wider operating range. See section -- for a complete listing and description of our most common styles



Sieve Trays

Sieve trays began to dominate the CPI's mass and heat transfer applications in the 1950's. Prior to that, bubble cap trays were the industry's workhorse. The sieve tray is a flat perforated plate. If extreme turndown conditions are not required, sieve trays will likely meet your process performance objective. Additionally, sieve trays have better anti-fouling characteristics and lower pressure drop when compared to standard moveable valve trays. Raschig Jaeger has the capability to provide virtually any type of sieve tray. Perforation sizes as small as 1/8" in diameter are offered



Bubble Cap Trays

Raschig Jaeger designs and provides numerous variations of bubble cap trays. Our most common designs include conventional slotted caps and the standard FRI solid cap (no slots). Standard cap sizes are 3", 4", and 6". Of course, custom designs are available as well. Typical manufacturing methods to secure the riser and cap assembly to the tray floor include extrusion and press fitting, seal welding, and pull-through bolting connections.

Bubble cap trays usually have a lower capacity (10-20 percent) than properly designed valve or sieve trays; however, they are capable of efficient performance over a wider operating range due to their superior leak proof characteristics.

Although some bubble cap tray towers have been retrofitted with the more modern three piece RJ-A1 valve unit, bubble caps still enjoy wide-spread industrial application in systems where low liquid rates and large variations in vapor loadings are present

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NYE TRAYS®

Raschig Jaeger has the worldwide exclusive license for high capacity NYE TRAYS. NYE TRAYS have been successfully used in hundreds of installations since the 1980's and incorporate advanced technology to increase the capacity of columns by 10 to 30% over conventional trays. NYE TRAYS achieve these improvements by use of a patented inlet area design that reduces tray pressure drop and increases the available area for vapor/liquid contacting. NYE TRAYS are a good general purpose high capacity tray as they are well suited for a wide variety of mass and heat transfer services. Most revamps can be accomplished with little or no welding to the vessel. NYE TRAYS are also well adapted to upset prone services where upgraded mechanical strength is required.

EC Technology

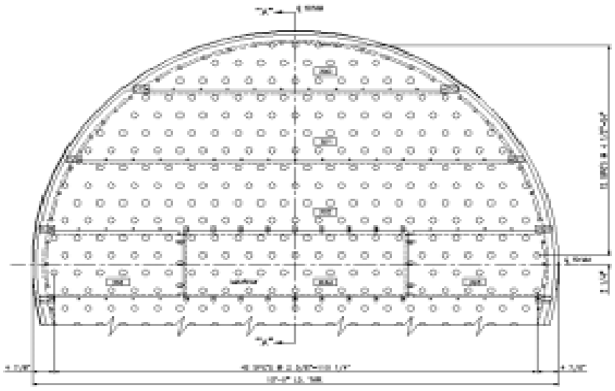
Trays equipped with EC (entrainment capture) Technology can achieve capacity increases up to 50% over conventional fractionation tray designs. The maximum benefit is realized for trays that are limited by entrainment flooding mechanisms. However, downcomer limited systems can also be debottlenecked because less area needs to be allocated for liquid/vapor contacting on the deck. EC Technology can be integrated with any tray deck contacting device (valve, fixed valve, sieve, bubble cap) and is compatible with any flow pass configuration. Trays with EC Technology have equal or better separation efficiency compared to conventional trays due to enhanced vapor/liquid contacting within the entrainment capture zone .

CoFlo Trays

The CoFlo™ Tray is a Ultra High Capacity gas-liquid contacting device. Performance tests demonstrate 100+% capacity increases over conventional fractionation trays while maintaining excellent contact efficiencies. Each tray consists of three components: a liquid disperser, the contacting zone, and the liquid/vapor separator. High capacities are achieved due to cocurrent flow of liquid and vapor phases through the contacting zone. CoFlo trays are ideally suited for debottlenecking where an existing tower can be used in lieu of replacement with a larger diameter. Tray components are modular and self supporting and in most cases can be fitted onto existing support rings and downcomer bars. Cartridge construction is recommended for column diameters < 30in (762mm).

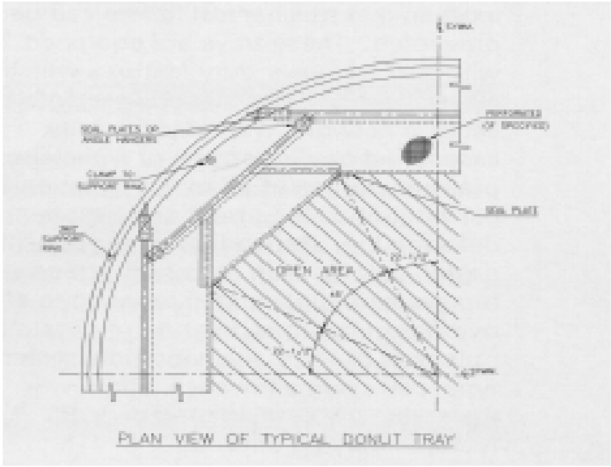
Specialty Trays

Dualflow Trays



Dualflow trays are sieve trays that do not have downcomers. The entire active or bubbling area is perforated with holes with typical hole sizes ranging from 1/2” - 1” in diameter. Vapor and liquid counter-currently flow through the perforations; hence, the name Dualflow. Under normal operating conditions, liquid splashes about on top of the tray in a wave-like manner. Liquid flows downward momentarily through perforations in the areas of wave crests whereas vapor flows upward through perforations in the area between crests.

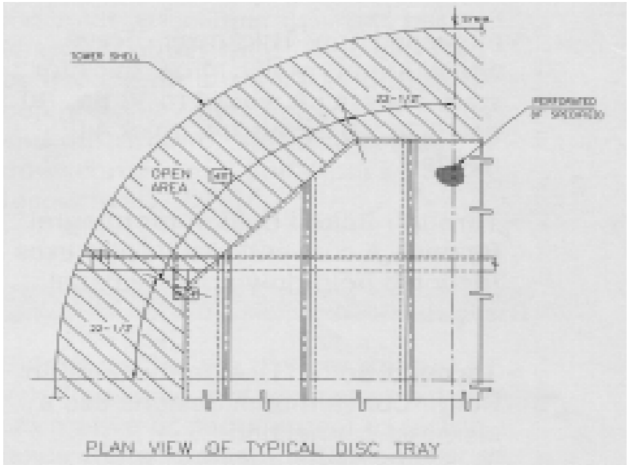
High open area dualflow trays have a higher capacity and lower pressure drop compared to conventional fractionation trays at the same tray spacing and are particularly well suited to systems containing a moderate to high level of solids or where polymerizable compounds are present. The main disadvantage of dualflow trays is their narrow efficient operating range. The majority of industrial applications are more common in small to moderate tower diameters. However, large diameter designs have also been employed. Levelness is especially important with dual-flow trays. Trays which are not level potentially suffer from gross liquid and vapor flow partitioning through the deck



Baffle and Disc & Donut Trays

Side-to-side baffle trays and disc & donut trays are arranged in a tower in such a manner that the liquid and vapor contacting is accomplished by vapor passing through a curtain of liquid falling from one tray to the next or through rivulets of liquid flowing through perforations in the tray deck. Tray decks are flat or slightly inclined plates that occupy 40-60 percent of the tower area. Designs which incorporate perforated decks are typically 40 percent open so that there is sufficient overlap between adjacent rows of plates.

For a given tray spacing, both types of trays have a higher capacity and lower pressure drop than conventional sieve or valve trays or even dualflow trays; however, their liquid/vapor contacting efficiency is significantly lower. Baffle trays and disc & donut trays are particularly well suited to heavy fouling systems due to their extremely high open area. Typical applications include heavy oil refining and petrochemical heat transfer services having a high solid and/or petroleum coke content. Raschig Jaeger can provide any of these specialty trays with mechanically robust features to improve resistance to dislodging



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Special Design Features

Raschig Jaeger offers a full complement of modern tray features to permit an optimized solution to almost any tray design challenge. Process and/or mechanical considerations dictate when special features are required. Our experienced process design team understands these requirements so that our customer's needs are realized

Downcomer Designs

In addition to the standard chordal / segmental design, Raschig Jaeger also offers multichordal, circular, and envelope styles

Anti-Jump Baffles

Anti-jump baffles are used on 2, 3 and 4 pass trays. Their purpose is to prevent the liquid which is flowing across the tray from jumping over the downcomer onto the opposing flow path. This condition primarily occurs when the width of the center or off-center downcomer is small and the tray loading is high

Picket Fence Weirs

Picket-fence weirs are devices used to artificially increase the effective liquid height on the bubbling area and reduce blowing. They are commonly used when the liquid flow over the weir < 1 gpm/in (8.94 m3/hr m). Alternately, the picket fence weir is used on multipass trays to achieve hydraulic balance between the passes. The picket-fence weir is constructed of either a continuous metal plate having rectangular notches or by attaching individual baffles to the weir at a uniform spacing

Recessed Inlet Pans

Recessed inlet pans are used in conjunction with sloped downcomers to reduce the head loss under the downcomer. Sloped downcomers with recessed inlet pans are primarily used in heavy liquid loaded services prone to downcomer backup flooding.

Swept-Back Weirs

Swept-back weirs are used on side downcomers to reduce the effective liquid height on the tray by lowering the volumetric liquid flow rate per unit length of outlet weir. They can also be used in multipass tray design to balance weir loads between the side and off-center or side and center downcomers of 3 and 4 pass trays, respectively.

Splash Baffles

Splash baffles are devices utilized in very low liquid rate services as either an alternative or complement to picket-fence weirs. Splash baffles consist of a metal plate oriented vertically and parallel to the overflow weir having a 1/2" - 1" setback away from the weir above the tray deck. The purpose of the splash baffle is to maximize the liquid retention time on the tray

OTHER PRODUCTS AND SERVICES

Sequesterant

JP-7

Jaeger is the only packing supplier to offer products to enhance the longevity and use of your packing. Fouling can be detrimental to any system and Jaeger has options for many applications. Our pretreatment product, called JP-7 is a proven technology using inorganic polyphosphates. The non-toxic formulation specifically sequesters soluble iron, manganese, calcium, magnesium, and silica in the process water. JP-7 also acts as a corrosion inhibitor, laying down a microscopic film to lower the corrosion rates of iron, copper, lead, stainless steel, and other piping components.

JP-7 is introduced to the process stream through a common chemical feed pump. It can be supplied in 5, 15, 30, and 55-gallon drums, or delivered in bulk form. JP-7 is thermally stabilized which offers enhanced shelf life and use. Call Jaeger with your water analysis for prompt dosage calculations and quotation. For additional information on this product, request Brochure 900.

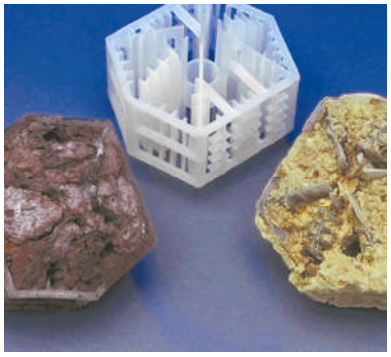
Bio-Technology

Bio-Technology Products

Through a national distribution agreement with Bio-Systems Corporation, Jaeger now offers a broad range of bio-augmentation products for municipal, industrial, and commercial applications. Our products are used world-wide to reduce wastewater treatment, spill cleanup, soil remediation and solid waste disposal problems. Our products enhance and stabilize the existing biomass by making available a selected range of high performance microbial strains leading to higher efficiency and fewer plant management problems. Produced in and ISO 9002 certified facility, each biological product is formulated and packaged for your specific need. Our microorganisms are blended with potent nutrients and stimulants to assure optimal performance under the toughest of conditions.

Technical services include consultation, product recommendation, assistance with toxicity testing, treatability studies, chemical and bacterial analysis, and microscopic photography. For additional information on Jaeger' s bio-technology products, call our corporate office or request Brochure 900.

Fouling Problems



Getting The Most From Your Packing

Fouling problems can cause packed towers to perform below expectations and design. Fouling is caused by solids in the process liquid, precipitation of minerals during the process, or bacterial deposition that eventually build up on internal surfaces of the tower and packing elements. Problems associated with fouling are generally not present immediately after startup, but typically will build and degrade performance over a period of time. The result is a loss in efficiency, capacity, and increased pressure drop. The added weight of entrapped solids can also have detrimental effects on other internals as well as the structural integrity of the tower shell.

Claims have been made that a particular shape of packing element is more resistant to plugging than others. These claims are based on “tests” in the field where variables are anything but controlled. Unfortunately, there is no single “truly non-plugging” packing type.

Over the years, Jaeger Tri-Packs® have become the standard by which plastic random packings are measured. In the laboratory, as well as in the field, Jaeger has accumulated a wealth of knowledge on how to deal with fouling problems while optimizing your stripping and absorption efficiencies. Additional information is available in Brochure 600–FP.

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Physical Properties of Jaeger Packings

	Size (nominal)	Packing Factor [1/ft]	Weight [lb/ft³]	Surface Area [ft²/ft³]	Void Space [%]
Plastic Packing					
Jaeger Tri-Packs®	1"	28	6.2	85	90
	1 1/4"	25	5.6	70	92
	2"	16	4.2	48	93.5
	3 1/2"	12	3.3	38	95
Raschig Super-Ring	Nr. 0.6		3.9	63	93
	Nr. 2		3.5	30.5	96
Cascade Mini-Rings®	1"	26	4.0	85	92
	2"	16	3.5	50	93
	3 1/2"	12	3.2	40	94
Jaeger Rings	5/8"	97	7.8	108	86
	1"	52	5.9	64	80
	1 1/4"	32	4.8	44	91
	2"	25	4.3	33	92
	3 1/2"	16	3.8	26	93
Jaeger Saddles	1"	33	4.7	60	91
	2"	21	3.3	30	94
	3"	16	2.8	20	95
Bio-Ring™	3 1/2"	NA	2.8	32	95
Cascade Bio-Rings™	7"	NA	2.2	30	95
Random Metal Packing					
Raschig Super-Ring	Nr. 0.3		21.2	96	96
	Nr. 0.5		17.2	76.2	97
	Nr. 0.7		11.6	55	98
	Nr. 1		10.3	45.7	98
	Nr. 1.5		10.6	36.5	98
	Nr. 2		10.6	30.5	98
	Nr. 3		9.4	24.4	98
Metal Structured Packing					
Raschig Super-Pak	100Y			30.5	98
	150Y			45.7	98
	200Y			61	98
	250Y			76.2	98
	300Y			91.5	98
	350Y			106.7	97
	400Y			122	97
	500Y			152.4	96
	750Y			228.6	96
Max-Pak™	1/2"	19-22	12.8	77	97
Ceramic Packing					
Novalox® Saddles	1/2"	201	43.0	190	73
	3/4"	131	41.0	102	74
	1"	97	40.3	78	74
	1 1/2"	52	40.3	61	75
	2"	40	36.8	37	77
	3"	22	35.9	28	77

Weights of plastic based on polypropylene
Weights of metal based on 300 series stainless steel
All weights are dry weights

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Locations / Production Sites

Ludwigshafen and Espenhain,
Germany

Houston, Texas
El Dorado, Kansas
And Monterrey, Mexico.

Furthermore we co-operate with reliable partners all over the world

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