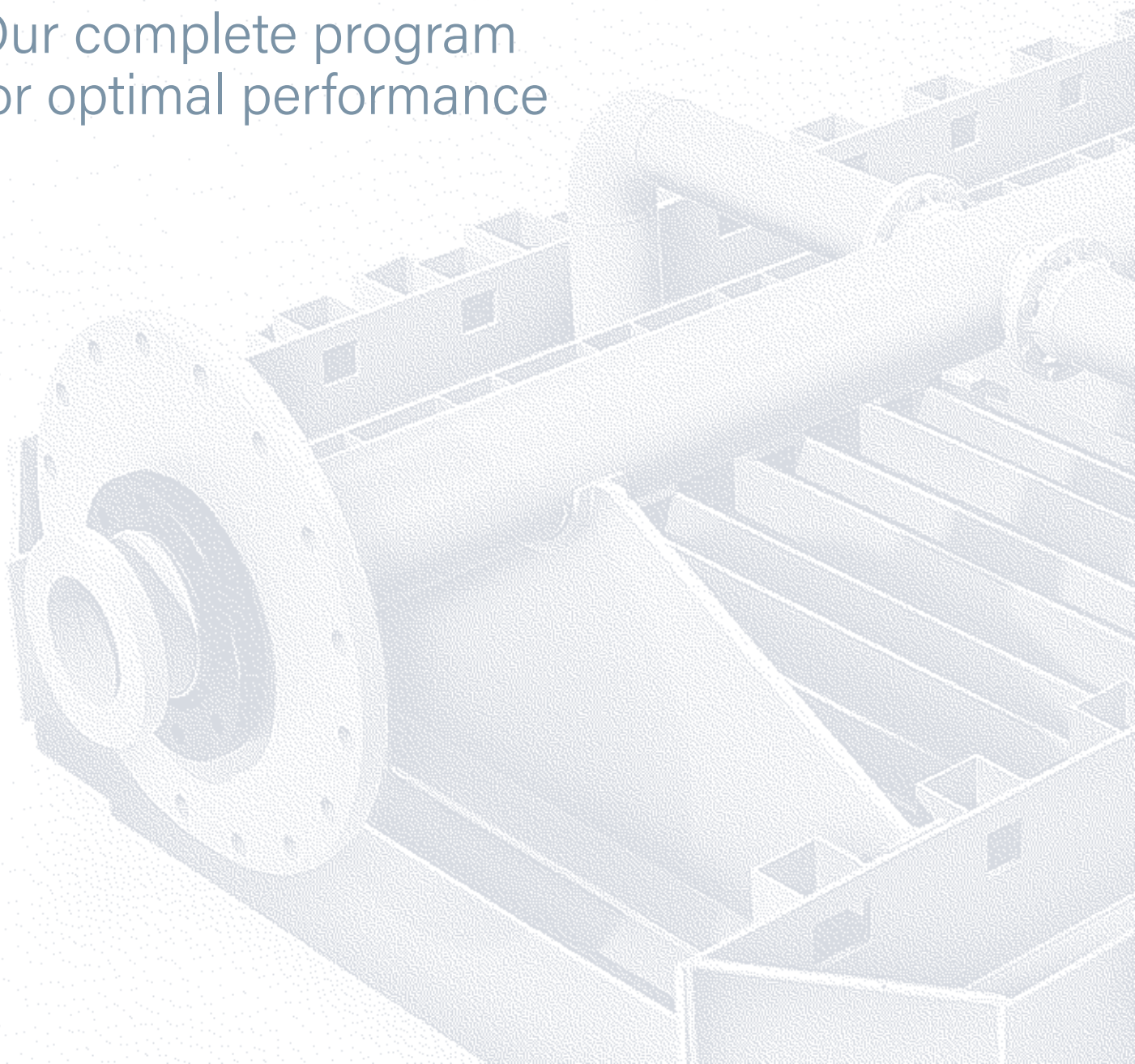


Column internals

Our complete program
for optimal performance



Column internals

Knowledge and experience from RVT Process Equipment



Mass transfer performance as well as the hydraulic characteristics of a packed column are highly dependant on the quality of the column internals used. The optimal configuration of the internals to the selected tower packings as well as to the individual operating conditions and material requirements demand comprehensive process engineering know-how and experience.

RVT Process Equipment is your skilled partner for all column internal and packing requirements. Our complete program includes the following items:

- Liquid distributors
- Collecting trays
- Liquid feed systems
- Bed supports
- Bed limiters
- Mist eliminators
- Gas distributors
- Custom made internals for special applications

RVT Process Equipment's column internals are manufactured in our fabrication facilities, where we process a wide range of metal and plastic materials, including fluoro-polymers (e.g. PTFE, TFM). We handle specific solutions and designs in cooperation with our customers as required for any special application. To complete the available material options, ceramic and graphite internals are also offered.

Designs and technical drawings for our column internals are generated by state of the art software programs, including AutoCAD, ANSYS and SolidWorks. RVT Process Equipment can provide an onsite supervisor or field crews to install column internals.

RVT Process Equipment's research and development facility, which includes a liquid distributor test facility and several test columns, ensures that quality control measures are executed and the results achieved meet or exceed the performance required.

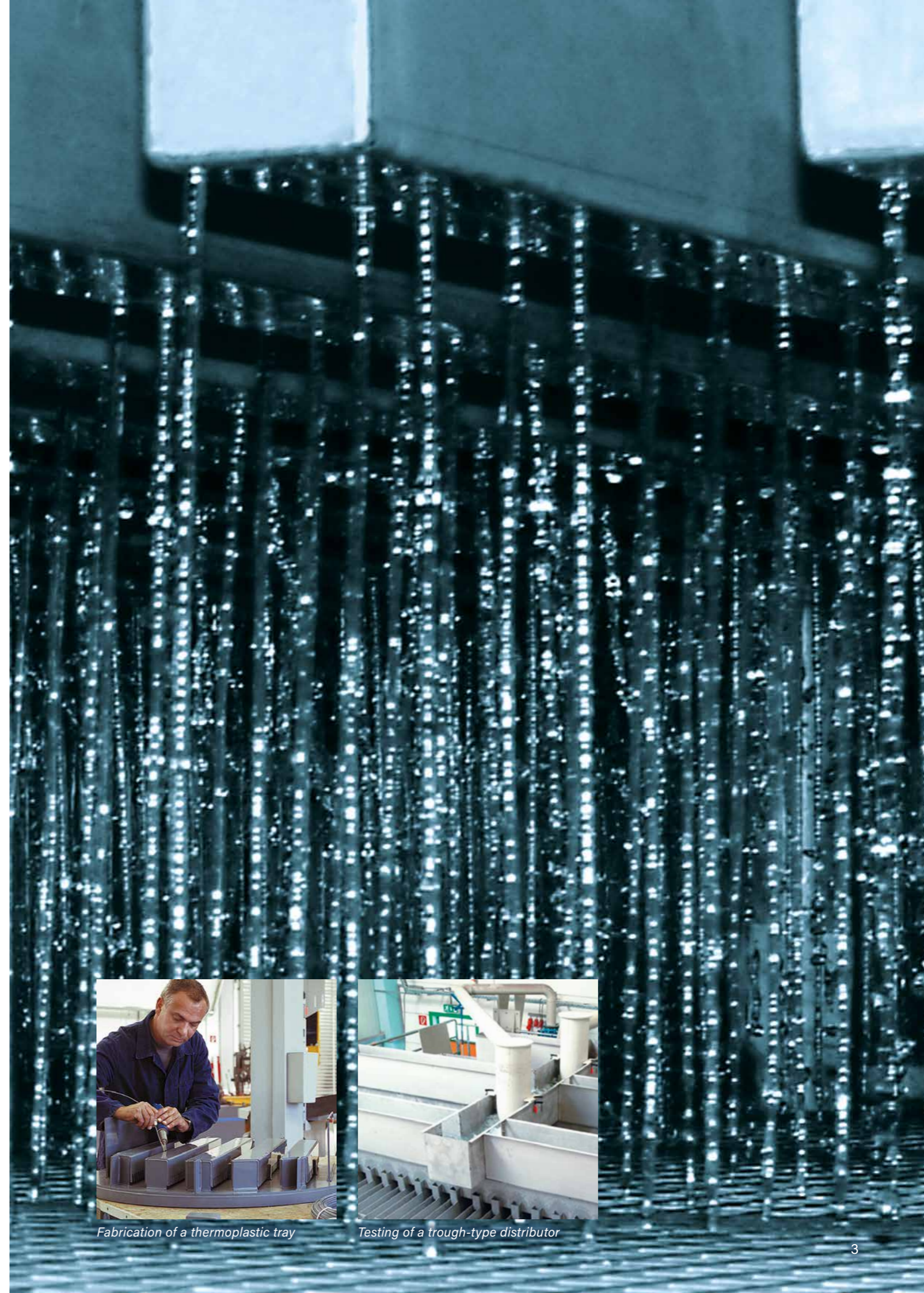
RVT Process Equipment is DIN ISO 9001 and 14001 certified. The qualification of our fabrication facility employees complies with strict workmanship and quality control standards, thus assuring high quality. We are a specialized industrial fabricator per § 19 WHG (German Law for Water Protection).



RVT Process Equipment has been certified according to ISO 9001 since 1996, and according to ISO 14001 since 2010.



Our German facilities in Marktrodach (headquarter, left; production & warehouse, right)



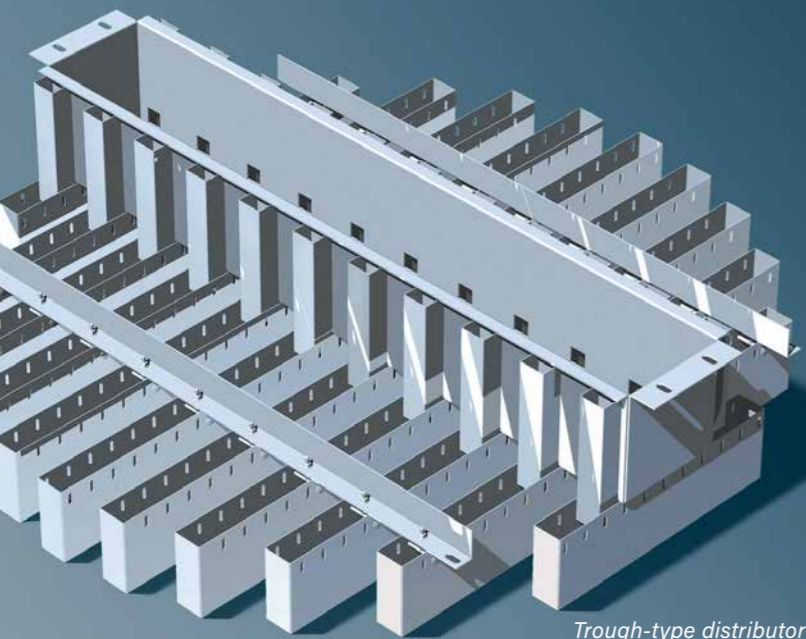
Fabrication of a thermoplastic tray



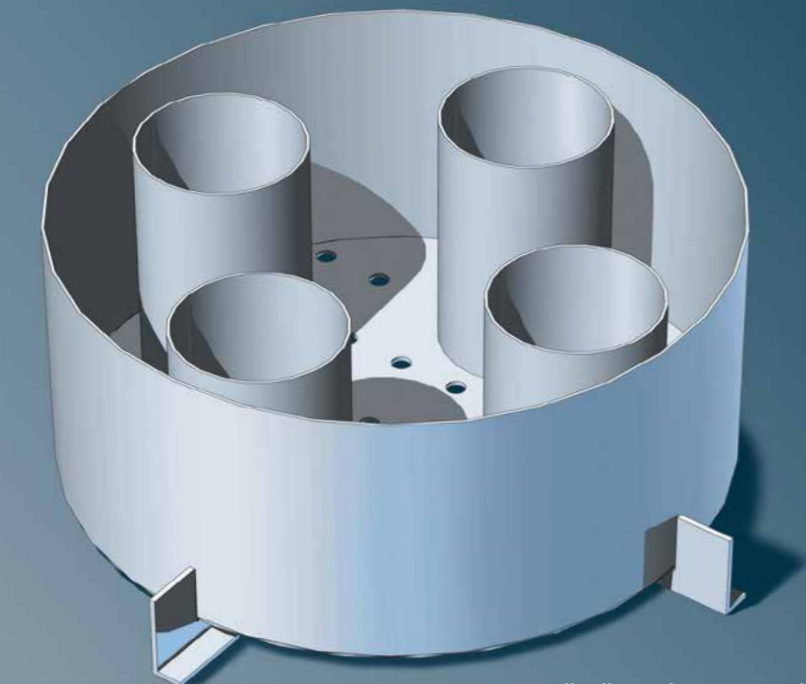
Testing of a trough-type distributor

Liquid distributors

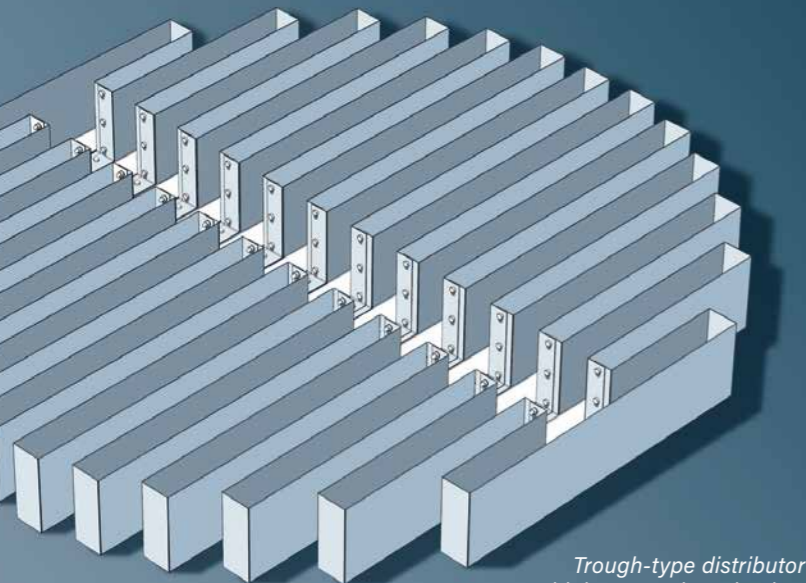
Design principles and types



Trough-type distributor with parting box (Type M150KK)



Pan-type distributor (Type M150T)



Trough-type distributor with integrated parting box (Type M150KQ)

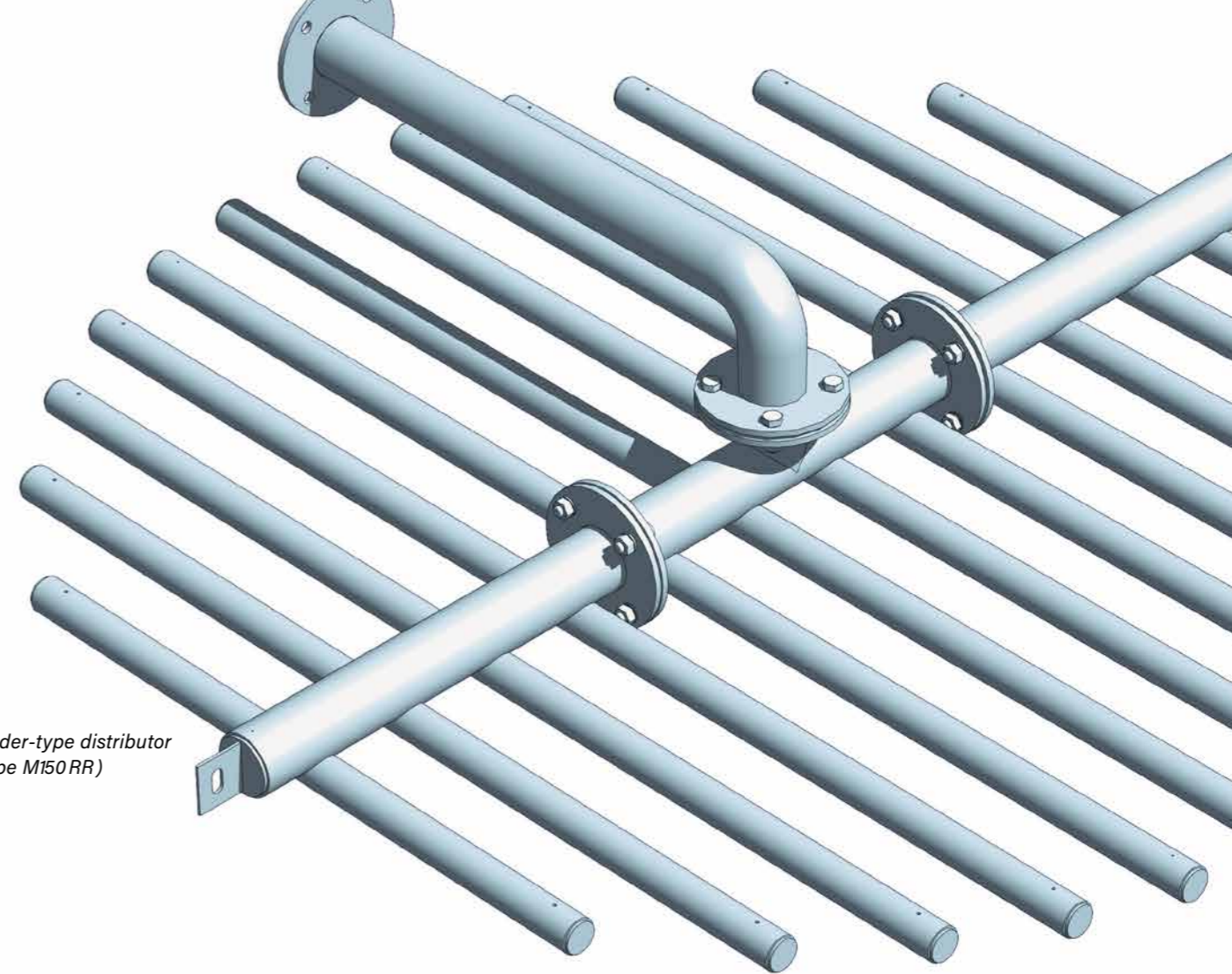
Packed columns require properly designed liquid distribution systems to irrigate the entire packed bed effectively. The mass transfer performance of a packed column is highly dependent upon the quality of liquid distribution through the packed bed. To achieve optimum mass transfer for the entire operating range of a packed column, equal distribution of liquid over the entire bed cross-section must be ensured.

Other important characteristics of liquid distributors include low gas-side pressure drop, low sensitivity to fouling and low overall height. The ability to handle multiple incoming feed streams may also be necessary. Additionally, liquid distributors must be designed to allow horizontal leveling to ensure equal distribution of liquid over the entire distributor cross-section.

RVT Process Equipment's comprehensive experience ensures the selection of the optimal solution for each application.

For a wide range of various applications, we provide the following basic designs of liquid distributors:

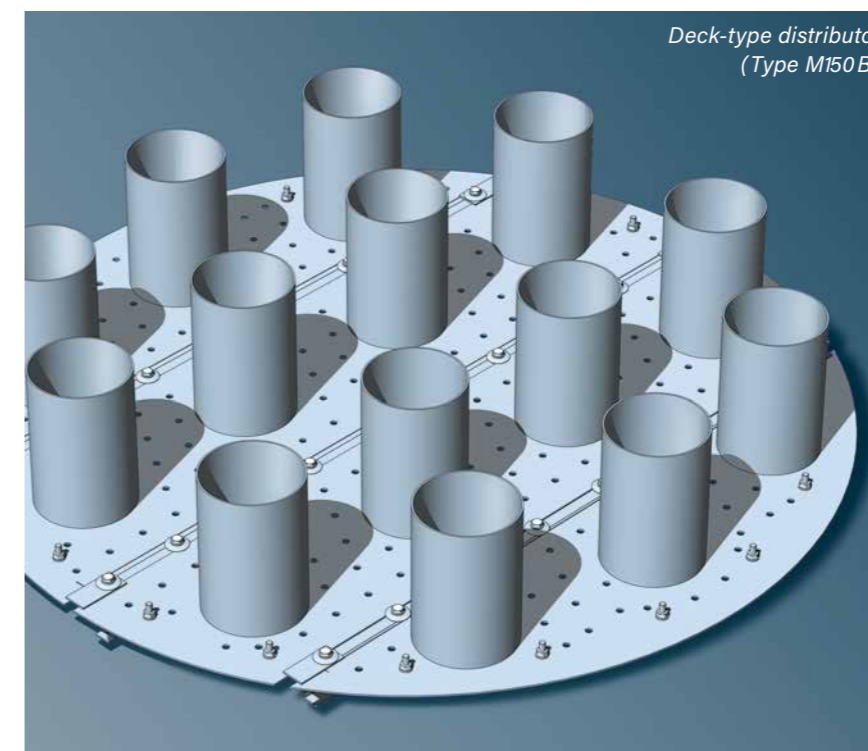
- Pan-type distributor
- Deck-type distributor
- Trough-type distributor
- Ladder-type distributor
- Spray-nozzle-type distributor



Ladder-type distributor (Type M150RR)

Standard values:

Design type	Liquid load in m ³ /m ² h	Recommended column diameter in mm
Pan-type distributor	0.3 - 200	100 - 1,600
Deck-type distributor	5 - 200	> 200
Trough-type distributor	0.3 - 50	> 600
Ladder-type distributor	4 - 100	all sizes
Spray-nozzle-type distributor	3 - 200	all sizes



Deck-type distributor (Type M150B)



Tube detail

Liquid distributors

Principles of distribution

Several key principles must be considered when assessing liquid distribution design.

Applicable principles are dependent upon the following:

- Liquid load
- Working range
- Liquid properties
- Potential for fouling or for foaming
- Allowable entrainment

The number of drip points generally ranges between 60-150 /m², depending on the particular application.

The following principles of liquid distribution are applied:

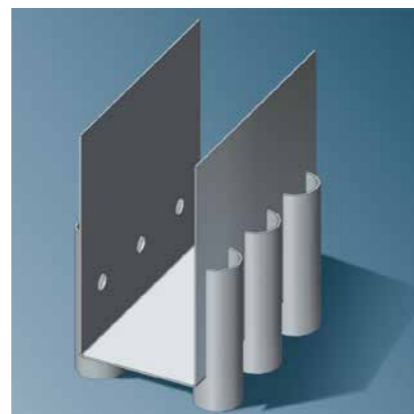
- Orifices at the bottom of the distribution troughs are used for clean systems with standard turndown.
- Orifices, weirs or attached distribution pipes on the sides of individual troughs are suitable for low liquid loads and wide operating ranges.
- Overflow distribution (e.g. via weirs on trough sides or dripe pipes) is recommended for systems where the risk for fouling exists.
- Spray nozzles, particularly for pipe (ladder) type distributors, can be used for solid-free systems.
- Combinations of the above mentioned systems can be used as needed.



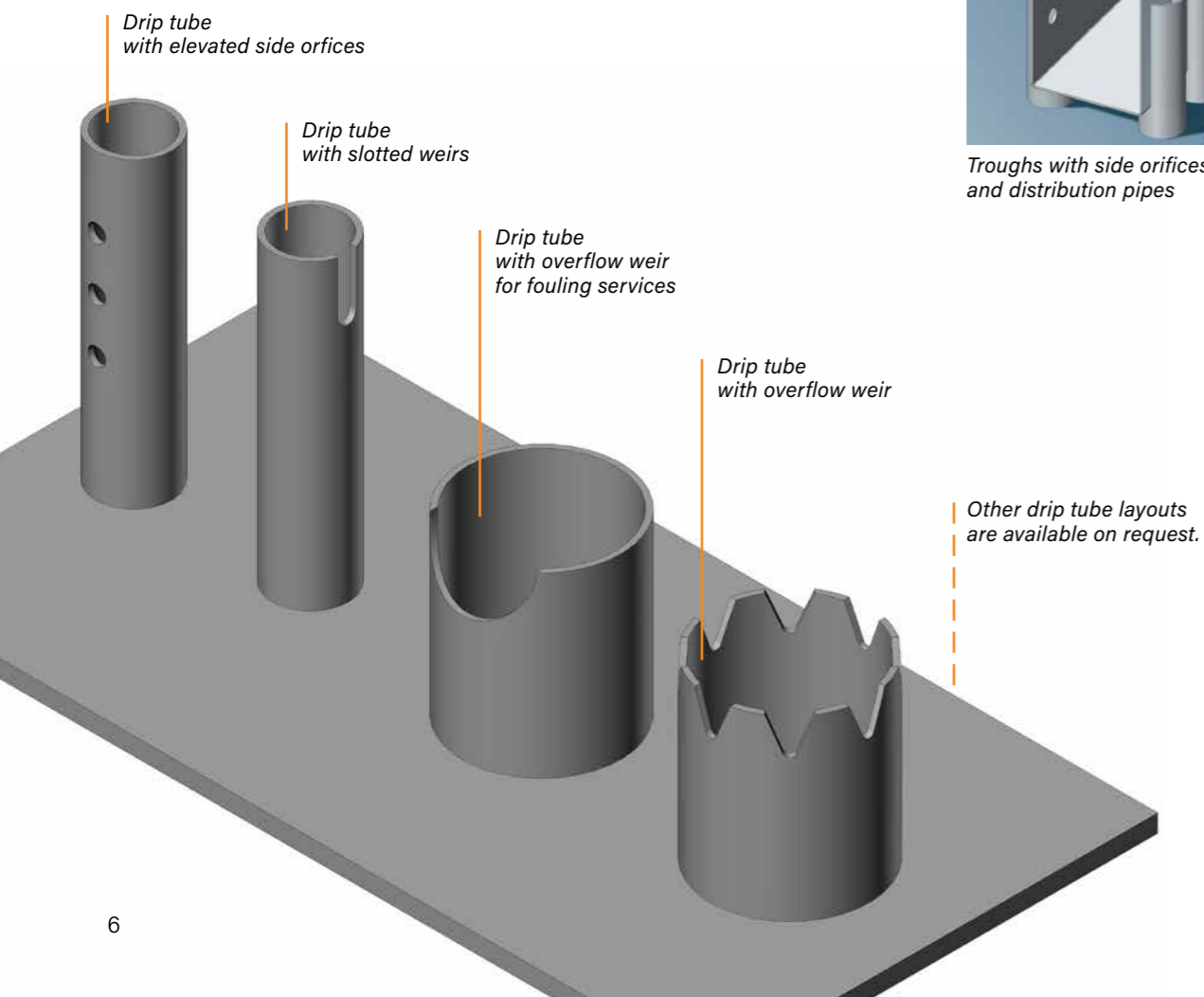
Troughs with orifices at the bottom



Troughs with overflow distribution weirs



Troughs with side orifices and distribution pipes



Liquid feed systems

Design principles and types

Uniform liquid feed to the liquid distributor selected for a particular application is critical to its optimum performance. The feed system must distribute liquid as evenly as possible to the entire liquid distributor while taking into consideration liquid discharge velocity and liquid pressure fluctuations.

The liquid feed system is especially critical in systems of high liquid loads and in large diameter columns.

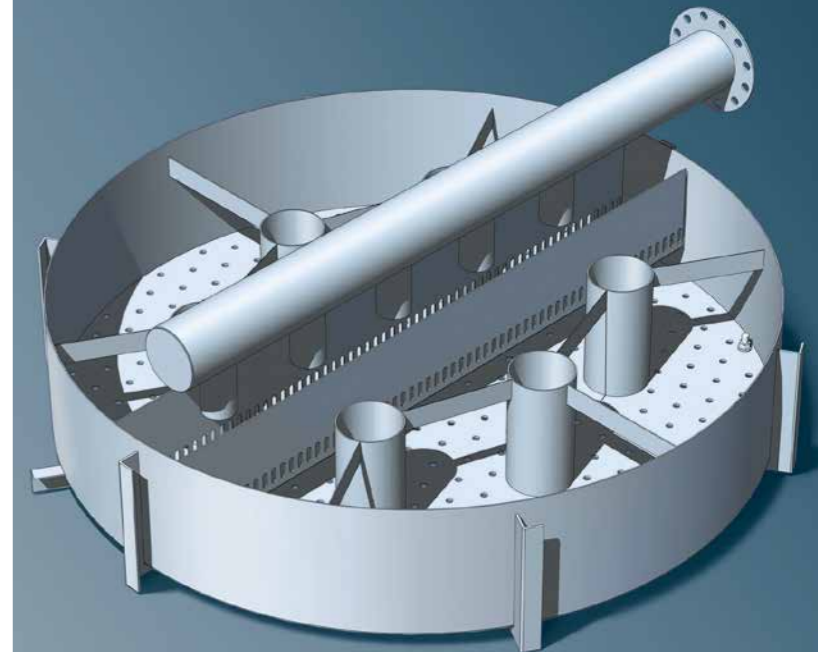
Fundamental design options are as follows:

- Ladder type feed system for low and medium liquid loads (< 80 m³/m²h, turndown ratio of 1:3) and
- Parting box with downcomers for high liquid loads and wide turndown ranges (1:10 or more)

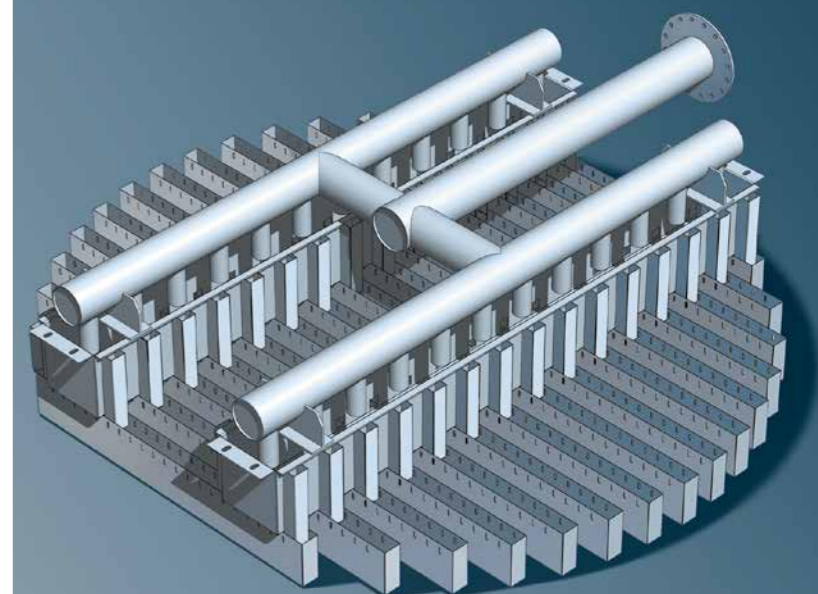
Special parting box designs are available to handle two phase mixtures at high temperatures.

A system that distributes liquid feed prior to the distributor is not required for low liquid loads (up to 5 m³/m²h) and small diameter columns.

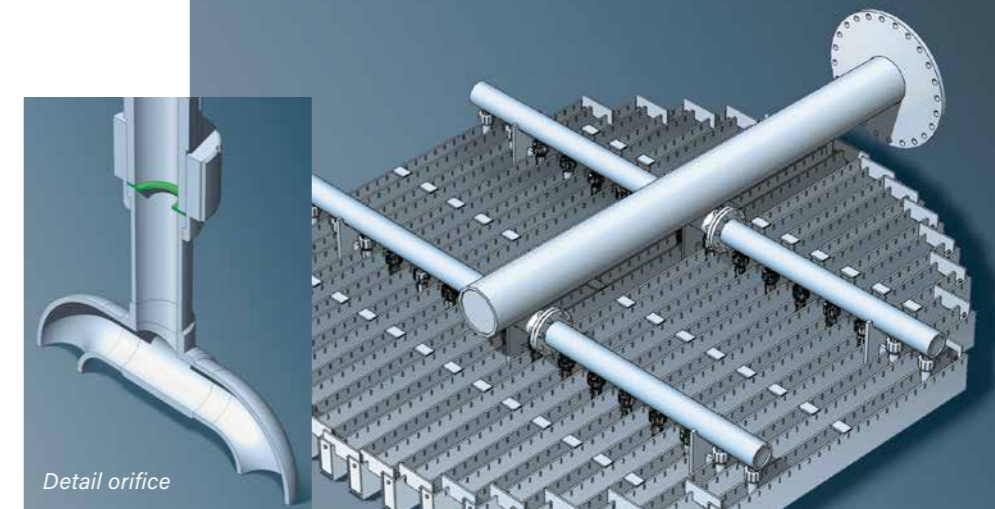
Each of the above-mentioned liquid feed designs has specific advantages. Not every design is able to be used with every type of liquid distributor. Our knowledge and experience allow us to support you in the optimal configuration of liquid feed system and distributor for your particular application.



Pan-type distributor with parting box and I-type feed pipe (M150 T and M155 I)



Trough-type distributor with parting box and H-type feed pipe (M150 KK + M155 H)



Detail orifice

Trough-type distributor with pipe redistribution system (M150 KR)

Collecting trays and distributors

Design principles and types

Collecting trays are used to collect downcoming liquid at the bottom of a packed bed and to allow for either removal of this liquid from the column or to feed it into a liquid redistributor below the collecting tray. This liquid redistributor distributes the liquid load over the entire cross-sectional area of a second, lower packed bed.

Collecting trays and redistributors are typically needed in the following cases:

- An additional liquid feed stream needs to be introduced or removed
- A high number of transfer stages must be achieved
- Maldistribution of the downcoming liquid caused by high bed heights must be prevented
- The weight or mechanical stability of the packed bed is limited

For less critical applications, the total height of the required collecting tray and subsequent liquid redistributor can be reduced by the use of a chimney tray/chevron collector construction as shown below.



Combi element (Type P500L)

Combi Element

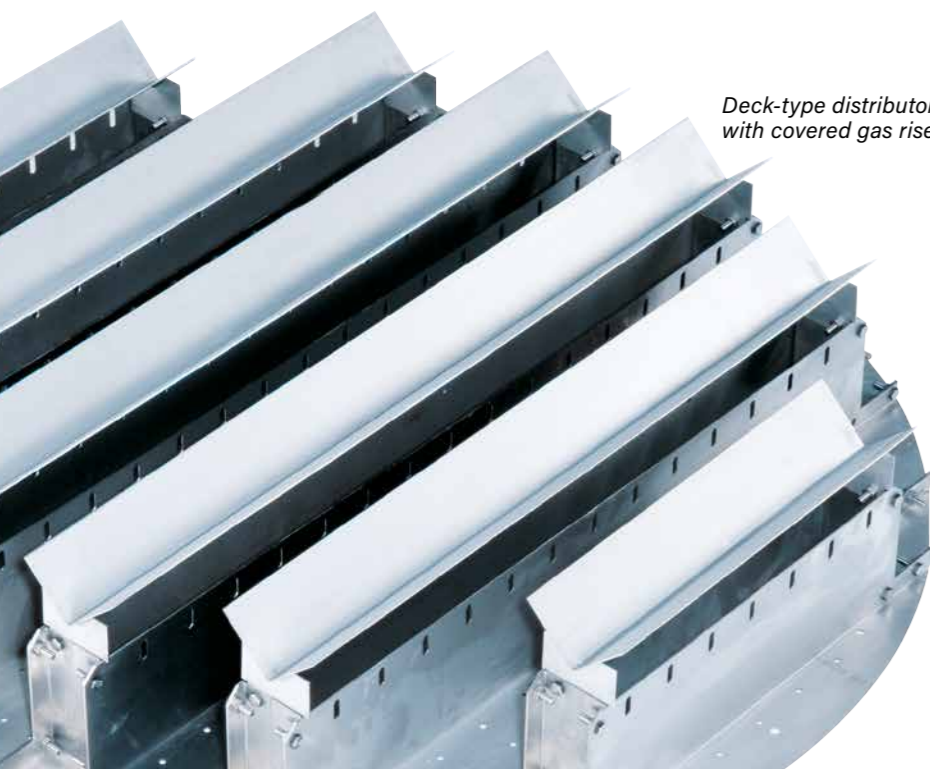
In order to reduce the overall height of a packed column and to reduce the number of internals used, various internals can be strategically combined into a single unit. Between two packed bed sections, a device for collecting and removing or redistributing the downcoming liquid is necessary. The patented RVT Combi Element accomplishes these multiple tasks in a single internal. In addition to reducing overall vessel height, further advantages are a relatively low pressure loss and very low weeping rates.

Collecting tray

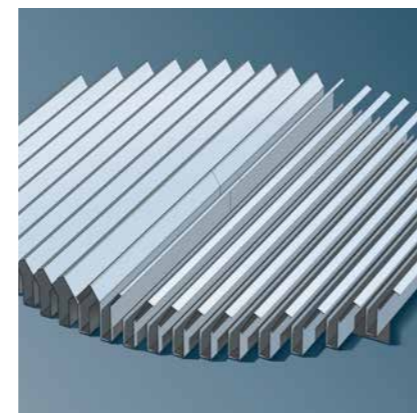
Typically, liquid in the collecting tray is removed either via a circulating collecting trough or a draw off nozzle. The collecting tray can be used as a sump. During equipment downtime, liquid is retained in this sump. The height of the chimneys determines the volume of liquid that can be retained. In order to prevent leakage, the collecting tray is often welded or laminated in the vessel by the vessel manufacturer.



Deck type collecting tray (Type M900K)



Deck-type distributor with covered gas risers



Vane-type collecting tray (Type P900L)

Multi-Phase feed systems

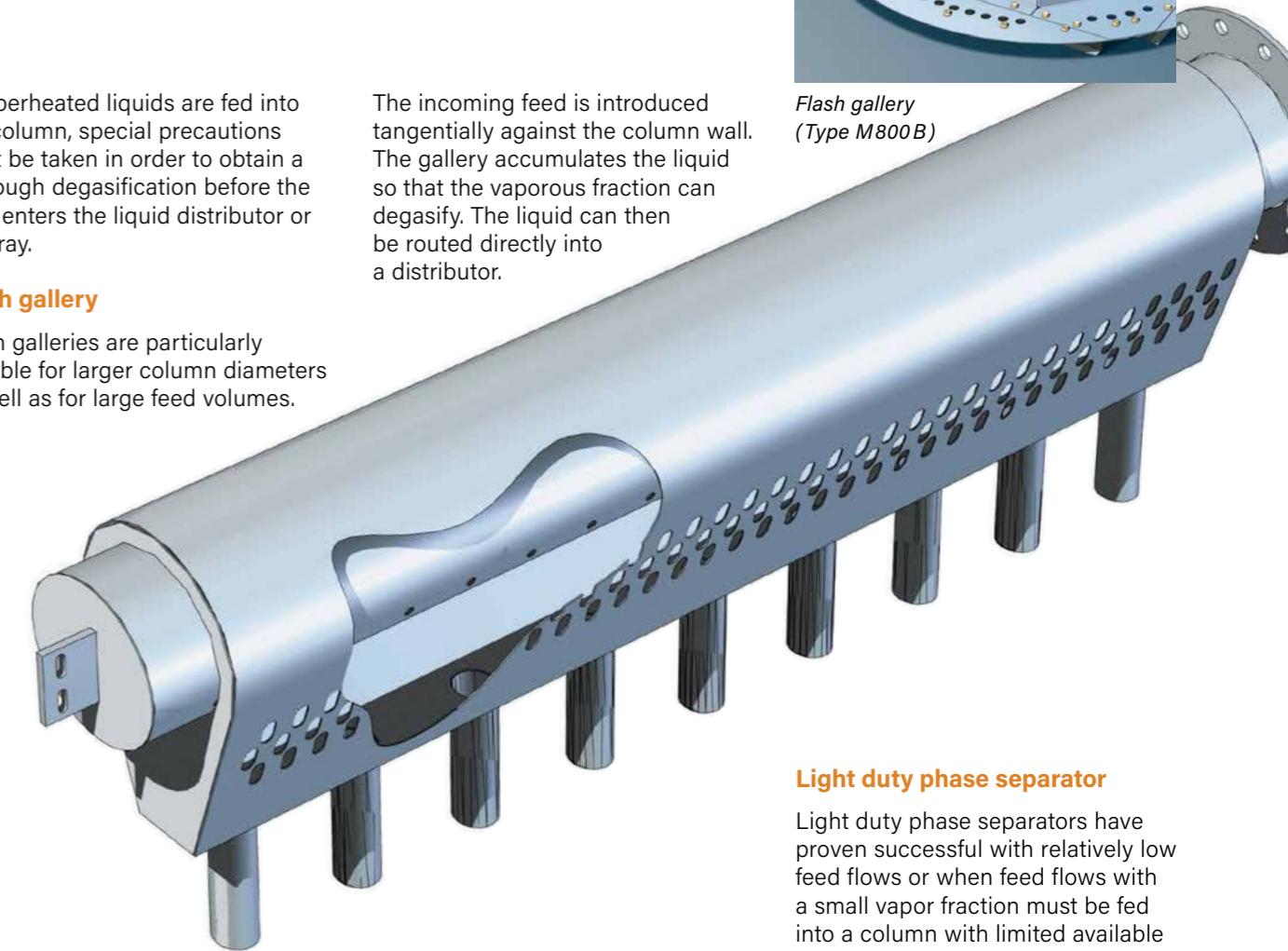
Design principles and types

If superheated liquids are fed into the column, special precautions must be taken in order to obtain a thorough degasification before the feed enters the liquid distributor or the tray.

Flash gallery

Flash galleries are particularly suitable for larger column diameters as well as for large feed volumes.

The incoming feed is introduced tangentially against the column wall. The gallery accumulates the liquid so that the vaporous fraction can degasify. The liquid can then be routed directly into a distributor.

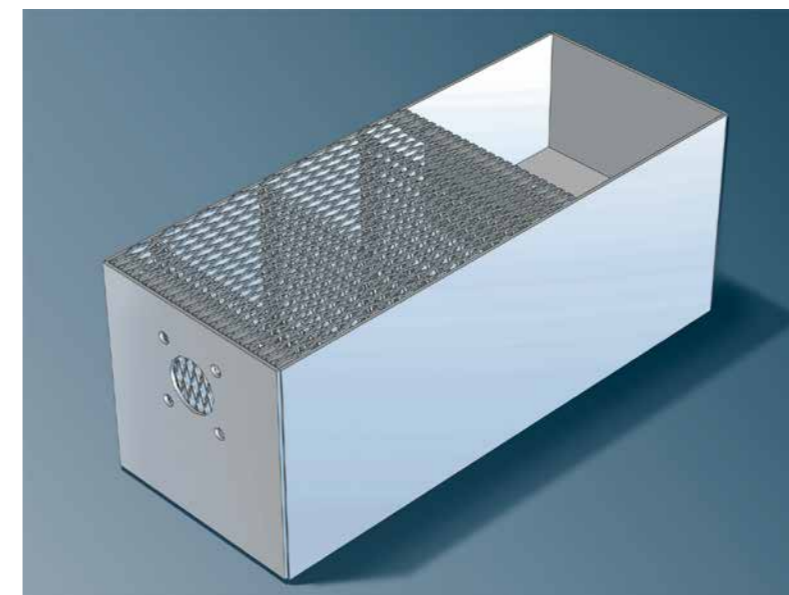


Flash gallery (Type M800B)

Light duty phase separator

Light duty phase separators have proven successful with relatively low feed flows or when feed flows with a small vapor fraction must be fed into a column with limited available space.

The entering gas-liquid mixture degasses in a central tube which has slots facing downwards and bore-holes in the upward direction. Overflow spouts are arranged in the encasing tube while the gas phase escapes upwards by way of bore-holes located on the sides.



Flash box (Type M800K)

Flash box

Flash boxes are suitable for low flows. These boxes are located in the column near the distributor. The incoming feed degasses in the flash box where the stabilized liquid is directed downwards and the vapour escapes upwards.

Gas distributors

Design principles and types

Gas distributors have the task of uniformly distributing the incoming gas stream over the entire cross-section of a tray or packed column.

Through proper design, the resulting pressure loss is kept as low as possible. Depending on the gas volume, gas velocity, temperature and gas stream constituents being handled, the design and the material of construction of the gas distributor is selected. If required by the customer, CFD simulations of the incoming gas stream for a specific gas distributor can be provided.

Gas distributors with guide vanes

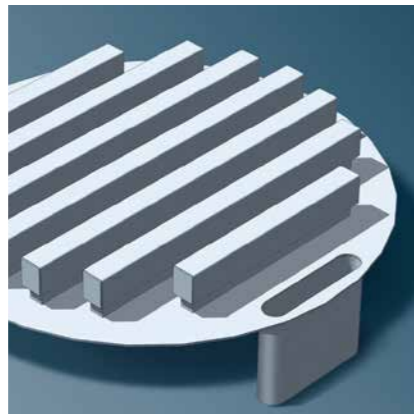
This distributor type uses an engineered arrangement of curved guide vanes to evenly distribute the incoming gas flow which then exits the distributor in a horizontal direction. This design is used particularly in large diameter columns with low gas velocities and for multiple phase feeds.



Vane type gas inlet device (Type 850L)

Chimney tray distributor

With the chimney tray distributor, the gas flow is distributed evenly by means of covered chimneys while downcoming liquid is collected and drawn off through a shaft or pipe. The pressure loss through this type of distributor can be relatively high.



Chimney tray distributor (Type M850B)



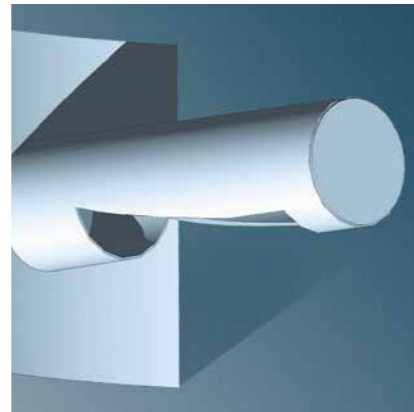
Ladder-type distributor (Type M850R)

Ladder-type distributor

The total required installation height of the ladder-type distributor is less than that of the chimney tray distributor. The operating range of this gas distributor depends, to a major degree, on the allowable pressure loss.

Inlet feed pipe

Inlet Feed Pipes are used in cases where the gas velocity is high. The kinetic energy of the incoming gas is reduced by this distributor, therefore improving the gas distribution to the column internals.



Inlet feed pipe (Type 850I)

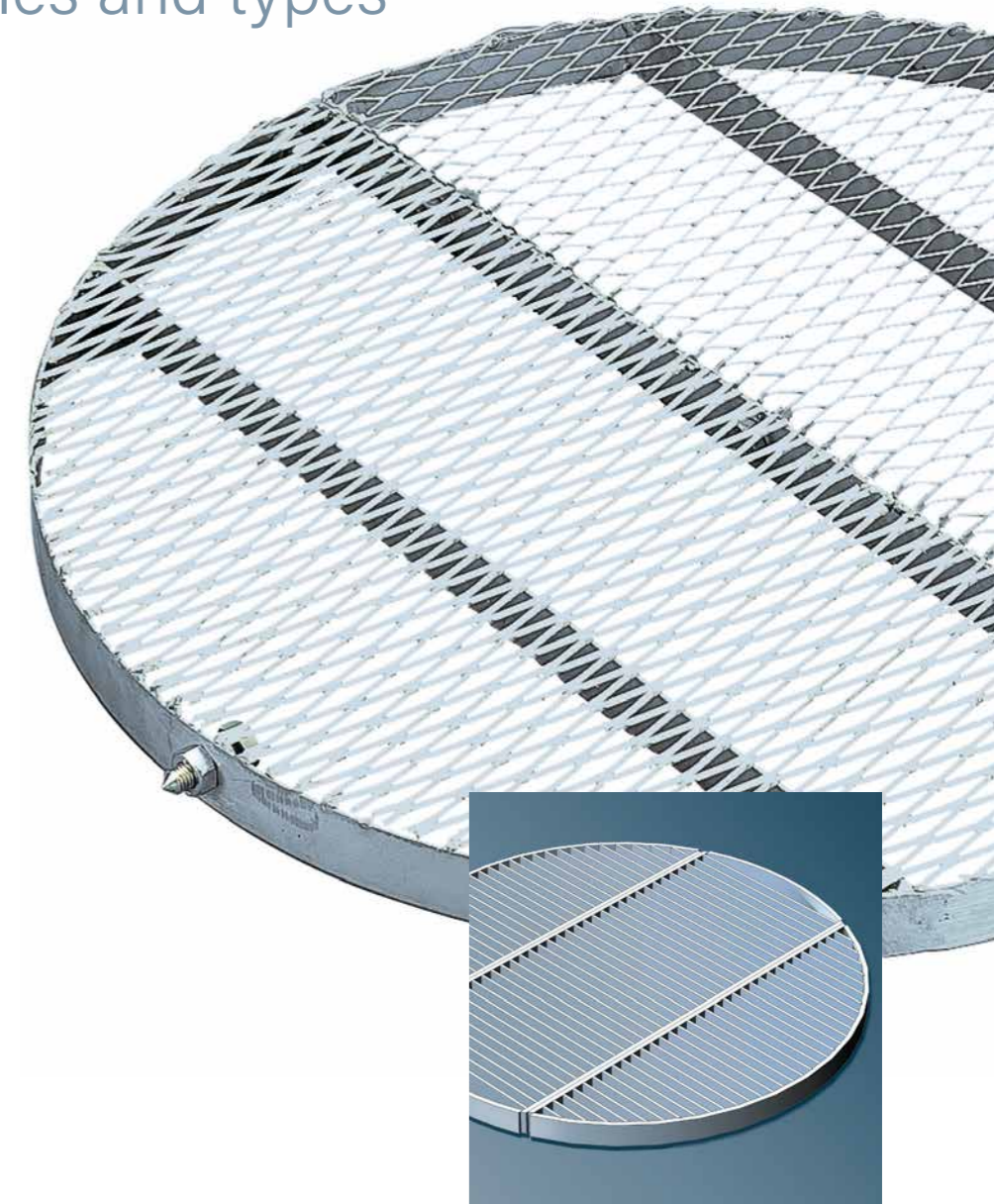
Bed Limiters

Design principles and types

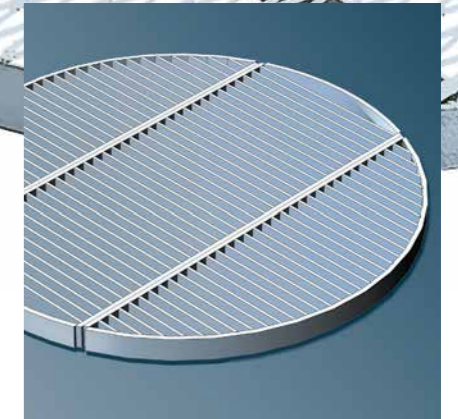
Bed limiters are installed directly above a packed bed to prevent the movement of the packing. They are particularly necessary in such cases where packing can experience uplift due to high gas loading or sporadic pressure surges. In addition, they can be used to separate packing of different sizes to avoid mixing of different packings inside the column.

Bed limiters are designed in such a way that they do not disturb the steady state of the liquid distribution.

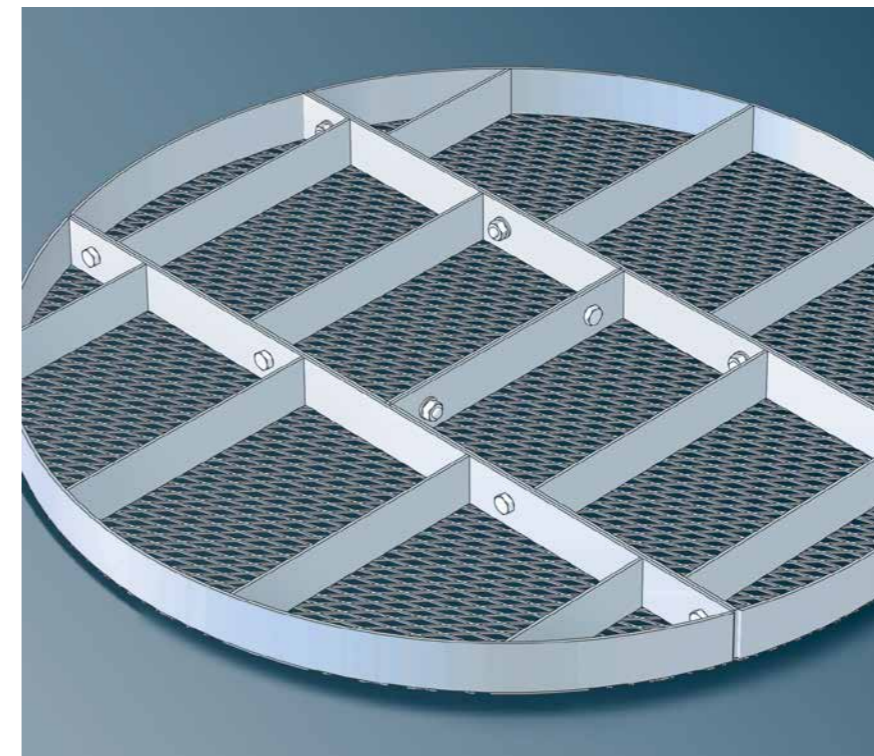
Depending on the model, bed limiters either sit directly on top of the packed bed or are mechanically attached to the vessel wall. It is also possible to hang them directly from the liquid distributor and/or redistributor. Additionally, bed limiters can be integrated into the design of the liquid distributor or redistributor.



Expanded metal bed limiter (Type M100)



Plastic bed limiter (Type P100)



Support grids

Design principles and types

A variety of support grids is available to support the column packed bed, depending on the specific application and the column diameter. The support grid must be constructed in such a way that it minimally hinders gas and liquid flows. Between the packed bed and the support grid, the risk of reduced hydraulic capacity can exist.

Support grids must be adapted to

- Type of packing
- Bed height
- Liquid holdup
- Additional weight from fouling
- Design temperature for specific application.

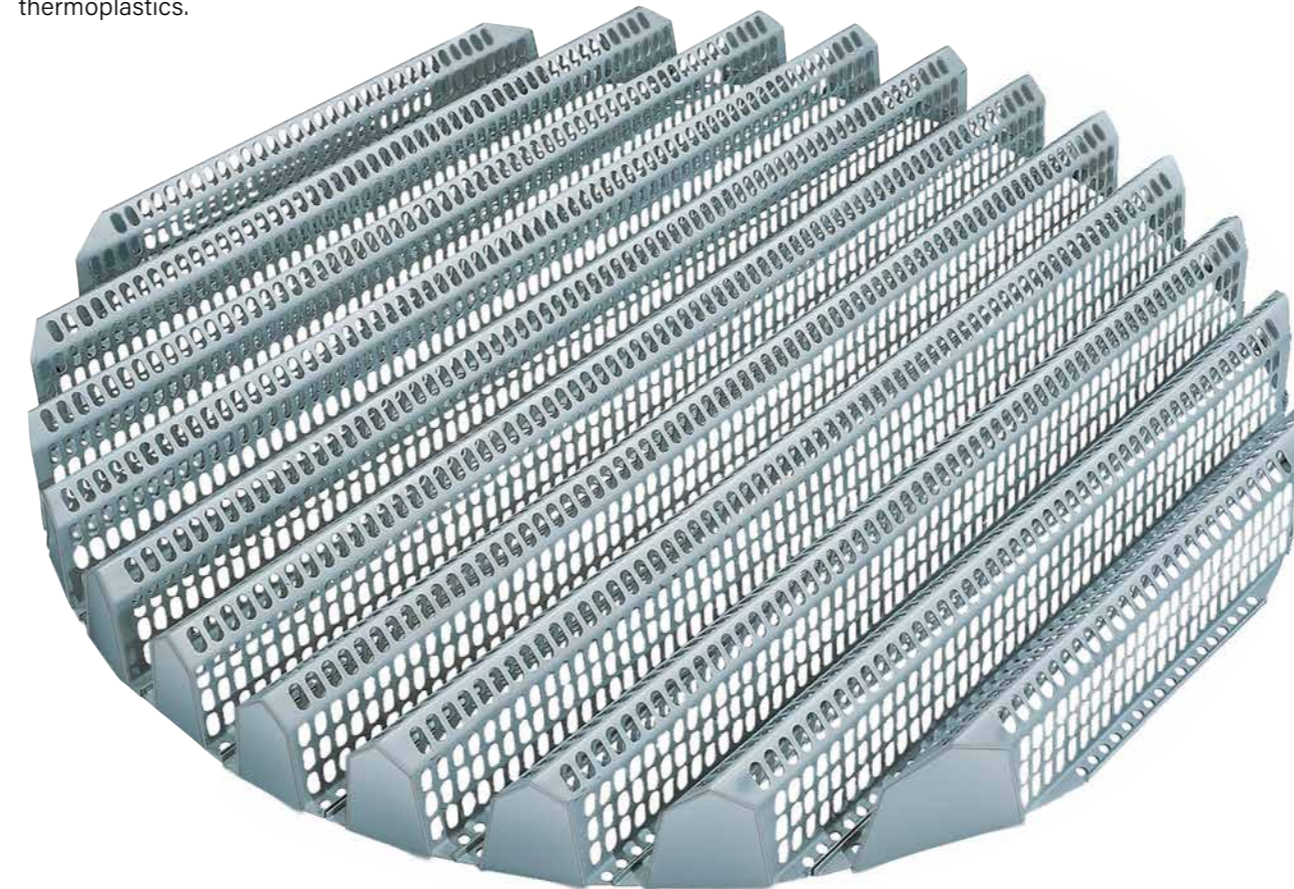
If high velocities are present, or pressure surges or flooding may occur, the bed support can be mechanically fastened to the support ring.



Flat support grid (Type P65)

Flat support grid

The most straightforward design is the flat support grid which is used for small column diameters. The hydraulic conditions need to be taken into consideration as this type of support grid has a relatively low free cross-section. Flat support grids are available in ceramic and graphite materials in addition to metals and thermoplastics.

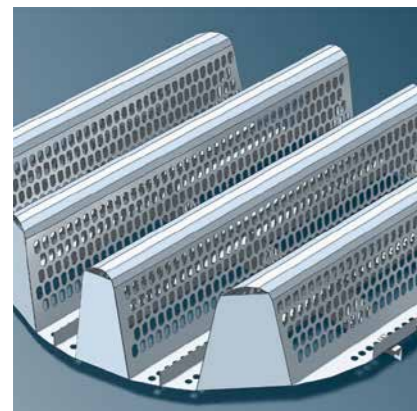


Profile support grid made of metal (Type MK65)

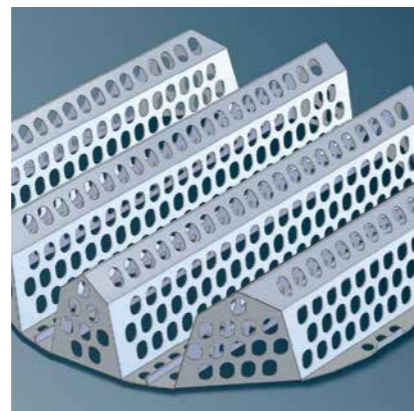
Profile support grid

Profile support grids offer a free cross section of 100% in relation to the entire column cross-section. Downcoming liquid flows separately from the upflowing gas stream, thus preventing the risk of flooding, even at high hydraulic loading.

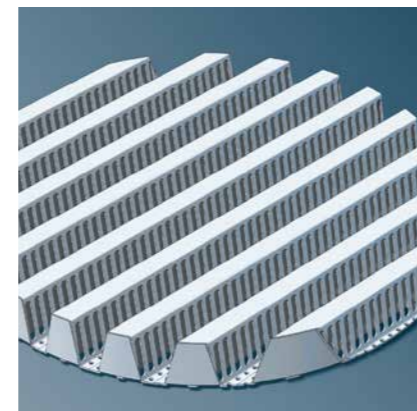
The height of the profile beams as well as the slot width are designed according to the specific application.



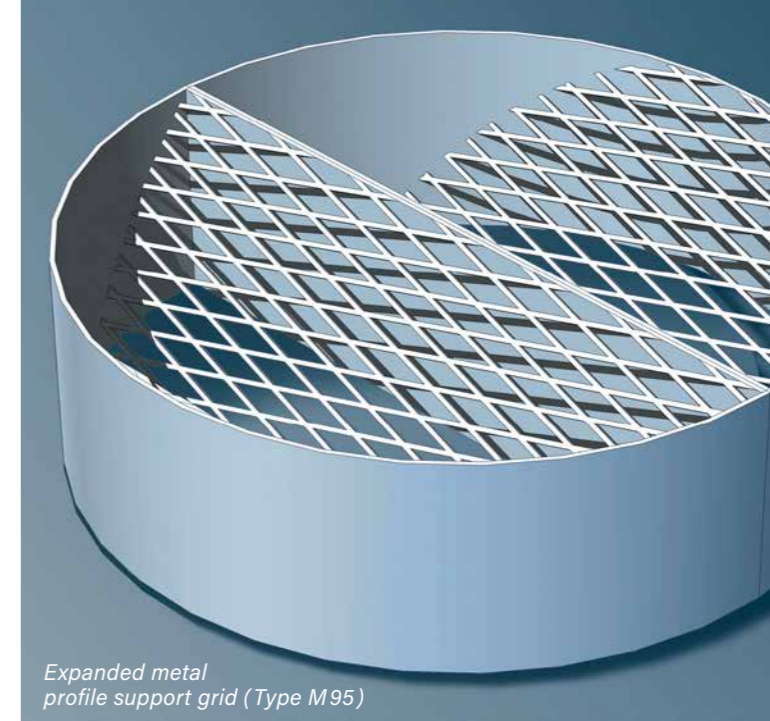
Profile support grid (Type M350)



Profile support grid (Type M165)

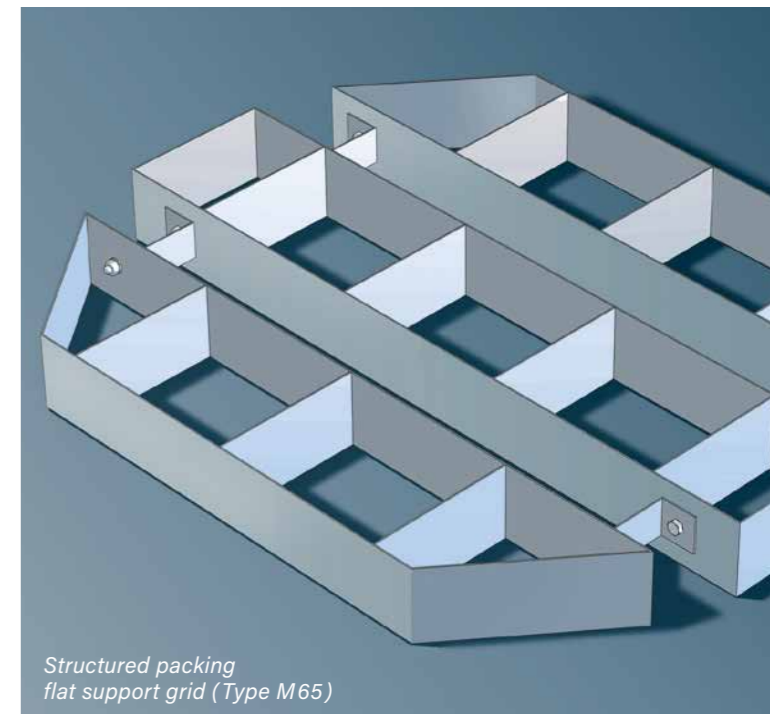


Profile support grid (Type P250)



Expanded metal profile support grid (Type M95)

A profile support grid made of expanded metal is an inexpensive alternative. This support grid is suitable for low loads as well as columns with small diameters.



Structured packing flat support grid (Type M65)

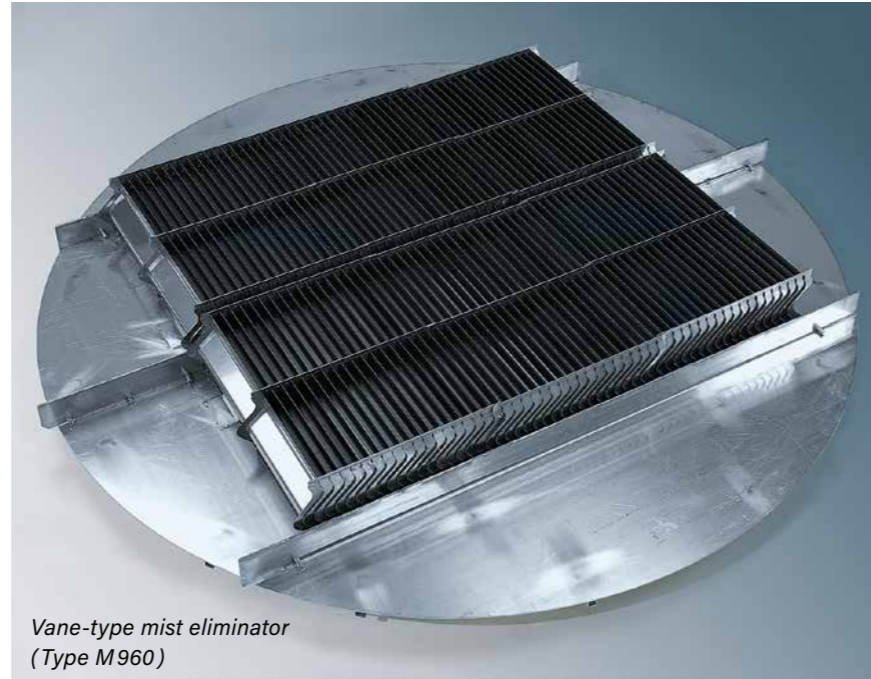
The open structure of the flat support grid for use with structured packing allows unhindered flow of liquid in relation to the gas stream, thus preventing limitation of hydraulic capacity in the column.

Mist eliminators

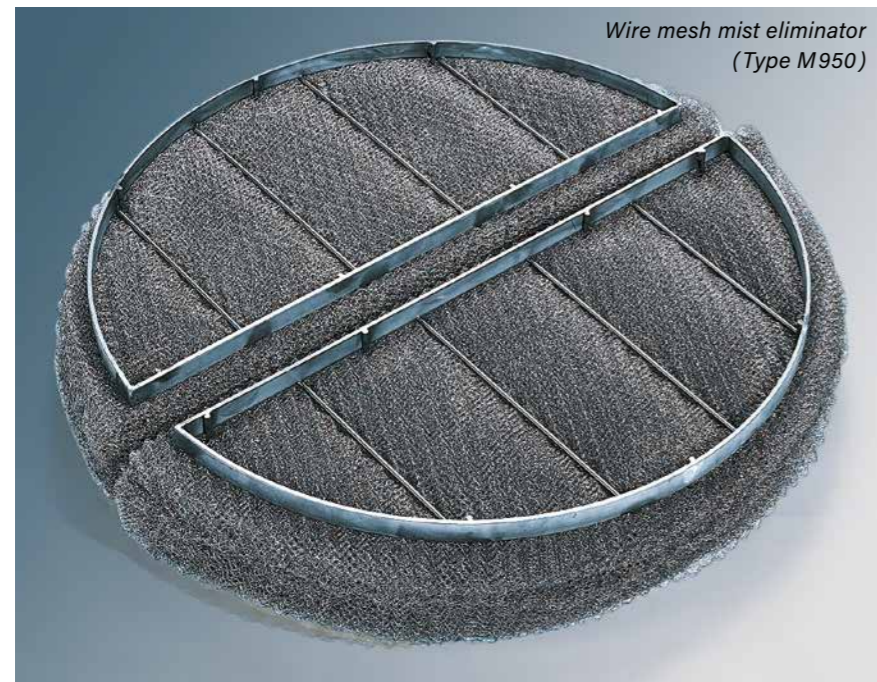
Design principles and types

Mist eliminators are employed at the top of a packed column or in conjunction with a collecting tray between two packed beds. They separate liquid droplets from the gas stream. Droplet discharge from the column and/or the liquid entrainment from one stage to the next is minimized.

Droplet separation is achieved utilizing mass inertia of the liquids. For this reason, droplet removal efficiency declines with smaller droplet diameter.



Vane-type mist eliminator
(Type M960)



Wire mesh mist eliminator
(Type M950)

Wire mesh mist eliminators operate by droplet coalescing. As the droplets hit the wire and collect, they are able to discharge from the mist eliminator via gravity. These mist eliminators are recommended for systems where no solids buildup is expected.

In vane-type mist eliminators, the gas flow is deflected several times so that the liquid droplets impinge on impact where they then flow from these surfaces in a downward direction.

Scaling of solids can be avoided or reduced with the use of spray nozzles situated above the mist eliminator.

Column internals

Unique applications and manufacturing abilities

Chemical processes sometimes demand very special materials or surface treatments of the equipment that will be affected by the process. RVT Process Equipment specializes in developing appropriate solutions for many different applications:

- Hydrogen peroxide production plants
- Chlor-Alkali plants
- Air separations
- Refining

Special capabilities:

- Surface polishing of sheets and pipes before processing
- Use of various welding methods
- Polishing work with abrasive pad on the weld seams
- Degreasing
- Immersion pickling
- Passivation
- Multiple rinses with distilled or deionized water

Detailed view of profile support grid: deburred holes



Deck-type distributor with gas risers





Zirconium liquid distributor



TFM Bed limiter



PTFE/TFM Pan-type distributor



PTFE/TFM Profile support grid



Tantalum liquid distributor

Special constructions

Highly corrosive and high temperature operations require high-grade materials. If chemical resistant plastic materials cannot be used due to their decreasing stability at high temperatures, high-grade special materials like Zirconium, Tantalum or carbon reinforced carbon (CFC) can be used.

In case of corrosive process conditions without increased temperatures, high value plastic materials like PTFE/TFM are the number one choice.

Internals made of combined materials

In some cases, we can offer chemical resistant and competitive constructions which combine several materials in one part.



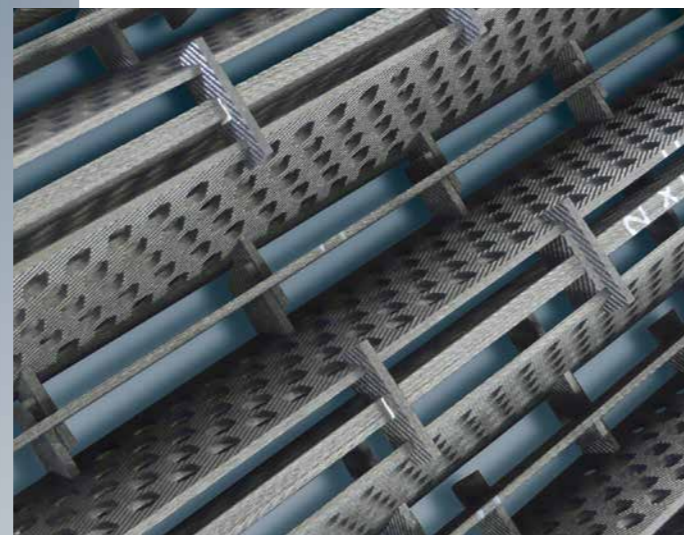
CFC load bearing frame



Distribution devices / Tantalum drip tubes



CFC profile support grid



Detail

Example

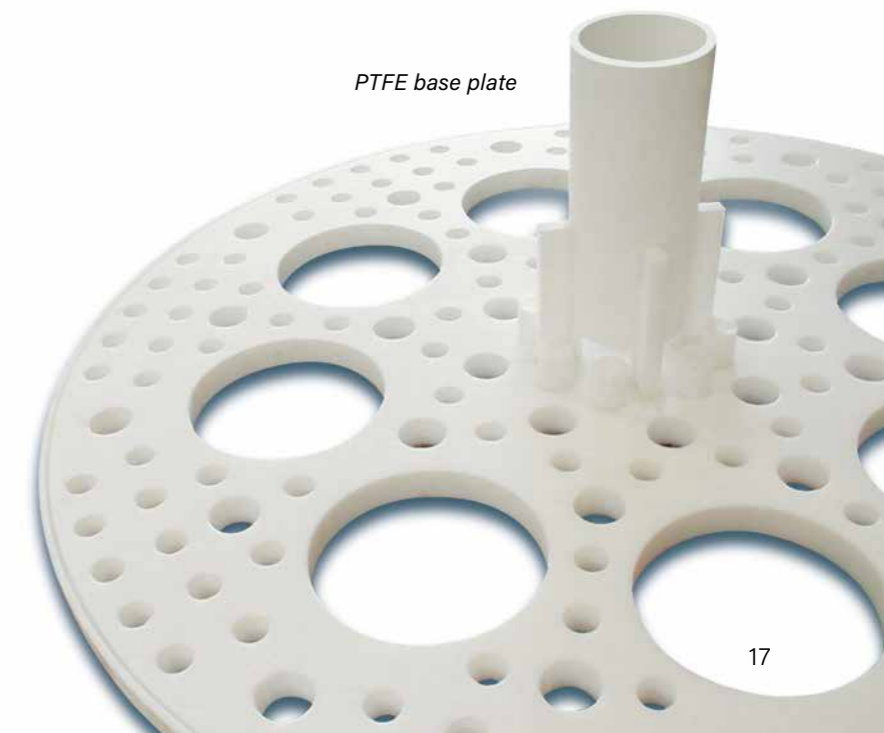
Task: Reduce cost of liquid distributor

Materials approved by customer:

- Tantalum = expensive
- Carbon fibre reinforced carbon (CFC) = high structural stability
- PTFE = poor mechanical stability

Solution

- (CFC) load-bearing frame
- Distribution devices / Tantalum drip tubes
- All other components made of TFM / PTFE



PTFE base plate

Our range of products

Overview

Description	Materials of construction		
	Metal	Plastic	Ceramics / Graphite
Liquid distributors			
Pan-type distributor	M 150 T	P 150 T	K 150 T
Trough-type distributor	M 150 KK	P 150 KK	K 150 KK
Trough-type distributor with integrated parting box	M 150 KQ	P 150 KQ	-
Deck-type distributor	M 150 B	P 150 B	-
Ladder-type distributor	M 150 RR	P 150 RR	-
Spray nozzle-type distributor	M 150 SR	P 150 SR	K 150 SR
Feed pipes			
L Type	M 155 L	P 155 L	-
H Type	M 155 H	P 155 H	-
T Type	M 155 T	P 155 T	-
I Type	M 155 I	P 155 I	-
Collecting trays - redistributors			
Chimney-type collecting tray	M 900 K	P 900 K	-
Vane-type collecting tray	M 900 L	P 900 L	-
Pan-type redistributor	M 200 T	P 200 T	K 200 T
Trough-type redistributor	M 200 KK	P 200 KK	-
Trough redistributor with integrated parting box	M 200 KQ	P 200 KQ	-
Deck-type redistributor	M 200 B	P 200 B	-
Feed Systems for two-phase mixtures			
Flash gallery	M 800 B	-	-
Flash box	M 800 K	-	-
Light duty phase separator	M 800 R	-	-
Gas distributors			
Vane type	M 850 L	P 850 L	-
Chimney tray	M 850 B	P 850 B	-
Ladder-type	M 850 R	P 850 R	-
Feed pipe	M 850 I	P 850 I	-
Support grids			
Flat support grid	M 65	P 65	K 65
Profile support grid (low beam)	M 95	P 95	-
Profile support grid (medium beam)	M 165	P 175	K 180
Profile support grid (high beam)	M 350	P 250	K 300
Bed limiters			
Expanded metal	M 100 S	-	-
Flat	M 100	P 100	K 100
Droplets / Mist eliminators			
Wire mesh	M 950	P 950	-
Vane type	M 960	P 960	-
Double pocket	M 96 L	P 96 L	-

Two stage packed column

Mist eliminator

Trough distributor with parting box and feed pipe

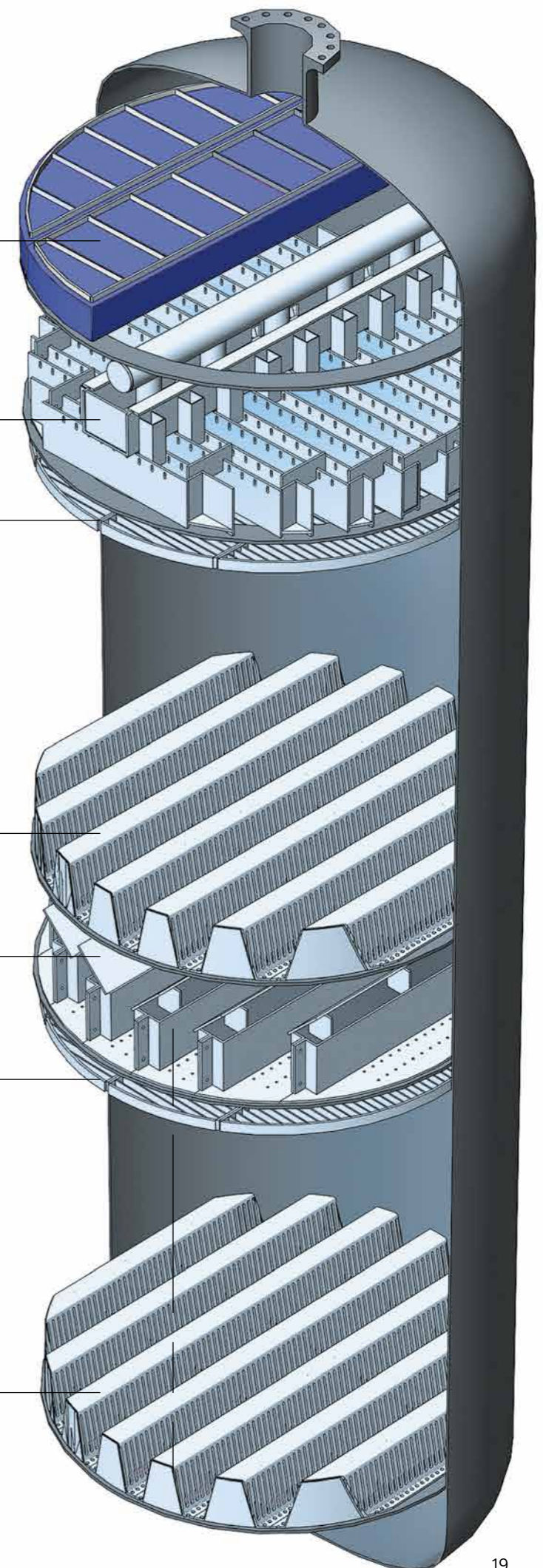
Bed limiter

Profile support grid

Redistributor

Bed limiter

Profile support grid



The way to RVT Process Equipment



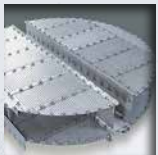
Tower packings for mass and heat transfer



Structured packings for mass and heat transfer



Column internals



Mass transfer trays



Biological carrier media



Turn-key units for waste gas scrubbing



Ammonia recovery processes



Combustion plants for the disposal of exhaust air, waste gases and liquid media



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