Trays for any Application
Sulzer offers the largest tray portfolio on the market. Whatever the requirements, we have the right tray. Continuous innovations and improvements are:

- First movable valve
- V-Grid fixed valves
- First customer tray design program
- Use of push valves on commercial trays
- Alliance with Shell Global Solutions to widen our tray portfolio
- Incorporation of fixed valves on multi downcomer trays
- Development of VGPlus high capacity trays
- One of the highest capacity tray ever tested – Shell ConSep tray

Our goal is to be the continuous leader in the development of high performance trays. We led the way with MVG high performance tray decks and continue to provide cutting edge, high performance tray technology with VGPlus, Shell ConSep, and the newest UFM valve: an advanced movable mini-valve providing the highest efficiency and capacity.

Our technology alliance with Shell Global Solutions provides the market with a full range tray portfolio from one source. The complete spectrum of Shell Mass Transfer Technology, including high performance trays and associated internals, has been available from Sulzer since 2000.

The Shell-Sulzer alliance combines extensive resources and vast experience. Sulzer has several decades of knowledge as a global mass transfer supplier offering process know-how, design competence, manufacturing and installation practice, as well as a worldwide presence and supply chain. Shell has designed, applied and operated high performance mass transfer equipment for the past five decades. Now the joint research and development push these technologies continuously to new limits.

Our global expertise and wide array of conventional and high performance tray technologies allow us to provide you with an optimum solution for your demanding requirements for each service.
Sulzer is the only mass transfer component supplier on the market with a complete tray portfolio. The available trays range from conventional to high performance chordal downcomer, multi-downcomer, and also includes the latest developments of ultra high capacity trays.
High Performance Fixed Valves

V-Grid Trays

The V-Grid tray technology utilizes a fixed valve and combines the characteristics of sieve and float valve trays.

The tapered, rectangular valves are punched out from the tray deck and oriented parallel to the liquid flow providing unique advantages compared to traditional sieve trays:

- Lower froth height, less entrainment due to lateral vapor release
- Increased capacity and improved turndown compared to sieve-trays
- High efficiency over a wide operating range through improved vapor-liquid contact
- Superior mechanical strength by increased stiffness of tray deck, no moving parts and therefore no wear
- Excellent fouling resistance

Smaller valves provide more capacity than larger ones due to reduced pressure drop and entrainment rate. To meet your requirements we offer following standard sizes: SVG, MVG and MMVG.

MVG Trays

MVG trays provide higher capacity compared to standard sieve or valve trays, while providing higher efficiency and lower pressure drop per theoretical stage. The MVG tray deck offers better turndown capability than a sieve tray, i.e. up to 3:1.

MVG trays are well proven in various industrial applications ranging from low to high pressure distillation, i.e. Atmospheric towers to C3 Splitters.

They have been successfully tested at the independent Fractionation Research, Inc. (FRI) in the C6/C7 system at 0.34 and 1.65 bar pressure. Measurements showed up to 20% higher useful capacity than sieve trays.

MMVG Trays

MMVG trays are used where extremely high vapor capacity is required. The smaller size opening compared to MVG results in up to 7% additional capacity with equivalent tray efficiency.
High Performance Fixed Valves

**SVG Trays**

The SVG is a high lift fixed valve. The large lateral openings produce a vapor cleaning effect on the tray deck which results in an excellent operational performance in fouling services guaranteeing a long run time. SVG trays have been successfully applied in a variety of fouling services such as Acrylonitrile, Amine Contactors, Atmospheric and Vacuum Columns, Beer Towers, Butadiene, Caustic Towers, Cokers, Cumene Units, Deopropanizers, Debutanizers, HF Alkylation Units, Latex Stripper, PVC Slurry Stripper, Primary Fractionators and Waste Water Towers.

**SVG-H Trays**

The SVG-H is a free type of fixed valve which has the same or larger open area as the popular SVG, yet is not limited by material constraints. This valve is particularly suitable for fouling applications and tray material types subject to embrittlement (i.e., Titanium, Zirconium, Inconel, etc.). In some severe fouling applications, the required valve lift can be so high that most materials will crack if the fixed valve would be extruded from the tray deck. In these cases, the SVG-H valve is the preferred solution.

**Push Valves**

The push valve is a type of fixed valve which releases the vapor in one direction only - forward.

It is extensively used to boost tray performance and fouling resistance by:
- Pushing the froth and particles across the tray
- Eliminating stagnant zones
- Minimizing liquid gradient along the flow path
- Providing uniform residence time all over the tray deck
- Minimizing risk of polymerization

The push valves are available in three sizes to fit with the different types of V-Grid valves: SPV, MPV, MMPV.
High Performance Movable Valve

**UFM Valve**

UFM is an advanced type of movable mini-valve which maximizes the hydraulic capacity, the separation efficiency, and the operating range of fractionation trays. The main characteristics are:

**“Umbrella” shape to:**
- Reduce the jetting momentum of the released vapor
- Minimize entrainment
- Promote uniform mixing of the vapor and liquid on the tray deck
- Maximize the contact area of vapor and liquid on the tray deck

**Two wide legs to:**
- Maximize the robustness, to prevent spinning, wearing, and valve popping out from the tray deck
- Maximize run length and minimize maintenance cost

**Four spacers to:**
- Prevent sticking to the tray deck and maximize fouling resistance

**Two thicknesses and lifts to:**
- Maximize flexibility and operating range

**Orientation parallel to the liquid flo to:**
- Minimize the hydraulic gradient along with the flow path of the tray deck

UFM valve can be combined with the upgraded downcomer technology for the highest performances of fractionation trays.

**Fields of Application**

UFM valve shall be used when high performances and wide operating range are needed for any distillation column, absorber and regenerator:
- Main fractionators of refineries
- Gas concentration columns of refineries
- Light ends columns of petrochemical plants
- LNG / NGL fractionation columns
- Absorbers & regenerators of gas sweetening plants

**Independent Validation**

UFM valve has been tested at a well known independent test facility, in a 1.22 meter diameter tower, 1 pass, with C6 / C7 system at 1.4 bara.

At least 20 % additional capacity and efficiency has been observed over the best ever tested truncated downcomer high performance tray.
VGPlus Trays

VGPlus are Sulzer Chemtech’s high performance chordal downcomer trays. They offer industry proven and FRI validated advanced tray technology for today’s market.

VGPlus tray technology is the combination of enhanced tray deck design with high performance downcomers:

- The use of optimized valve layouts, redirecting and froth promoting devices enhances the vapor/liquid interaction on the tray deck.
- Improved downcomer technologies, such as sloped, truncated, stepped and multi-chordal downcomers, reduces downcomer flood and backup, while the tray deck area is maximized.

This combination of all above mentioned features provides maximum capacity and tray efficiency.

Computational Fluid Dynamics (CFD) assists Tray Development

Research and pilot testing has been supported by CFD special modeling techniques, enabling Sulzer to study complex two-phase phenomena, e.g. froth flow and liquid entrainment.

The figure represents the fluid distribution on the tray deck as a function of time. The lower row shows how the redirecting system creates a more uniform flow.
Sulzer High Performance Trays

VGPlus vs Conventional Trays

- Higher capacity: up to 30%
- Lower pressure drop: up to 20%
- Equal or higher efficiency
- Elimination of hydraulic gradient
- Uniform liquid flow and vapor distribution

Fields of Application

- Revamp and grassroots
- From atmospheric to high pressure systems
- Medium to high flow parameters ($\Phi$)

$$\Phi = \frac{L}{V} \cdot \left(\frac{\rho_v}{\rho_L}\right)^{0.6}$$

$L$, $V$ = mass flow rate of liquid and vapor
$\rho_L$, $\rho_v$ = density of liquid and vapor

Typical Applications

- C2 and C3 Splitters
- Demethanizers, Deethanizers, Depropanizers, Debutanizers, De-Isobutanizers
- Main and Primary Fractionators

FRI Validation in High Pressure Tower

The superiority of the VGPlus tray technology has been confirmed by independent experiments at FRI.

The tray has been tested in the 1.2 m diameter tower at 7 and 11 bar with i-C4/n-C4 system. VGPlus is one of the best ever tested high performance chordal downcomer trays.
Sulzer High Performance Trays

VG AF Trays

VG AF (Anti Fouling) trays are part of the VGPlus tray family and especially designed for fouling services. The combination of large fixed valve, high performance downcomer technology and tailored design features makes the tray less sensitive to plugging and increases the run time in fouling applications.

The VG AF provides superior anti-fouling performance while delivering high capacity and efficiency, making this tray ideal for debottlenecking fouling services.

Typical Applications

The VG AF is ideal for boosting capacity of existing towers suffering fouling problems such as:

- Heads and Dry Columns of Acrylonitrile plant
- PVC Slurry Strippers
- Depropanizers
- Debutanizers
- Primary Fractionators in Ethylene Plant
- Stripping section of Atmospheric and Vacuum Towers
- Coker Main Fractionators
- Beer Columns

Mechanically strong, rigid

Vapor passages remain clean even in heavily fouling services
Conventional Trays

**BDH Floating Valve Trays**

Floating valve trays are typically used in applications where wide operating range is required. Due to their ability to control vapor flow, they provide a higher sustained efficiency over a wider operating range than sieve trays. The unique rectangular-shape sets the BDH apart from the conventional round valves. The BDH is oriented parallel to the liquid flow direction, providing lateral vapor release and a closed upstream edge to minimize weeping. This contributes to an improved efficiency/capacity profile compared to conventional round valves. Further advantages of the rectangular valve are:

- Improved liquid flow along the flow path of the tray deck
- Higher operating range than round valves
- High mechanical resistance, no spinning, no valve popping out from the tray deck, thanks to the wide legs
- Suitable for top side valve installation and or replacement

The larger size BDP valve is available for replacement and special applications.

**Sieve Trays**

Sieve trays find a wide acceptance as a low cost mass transfer device where high turn-down is not required. Sulzer offers all common sieve tray designs including small holes for improved vapor capacity and Venturi holes for low pressure drop.

**Round Valves Trays**

Sulzer may offer conventional round valve trays mainly for replacement or whenever requested by the customer.

Two main types are available: free valve; caged valve.

Two types of free valves are available:
- RV1 for flat decks
- RV4 for decks equipped with Venturi hole

Two types of caged valves are available:
- CV1 for flat decks
- CV4 for decks equipped with Venturi hole

Tray deck equipped with Venturi holes is used to minimize pressure drop.
**Other Trays**

**Bubble Cap Trays**
Bubble Cap trays are used for low liquid loads and very high turn down ratios. Sulzer offers a standard cap for 3” and 4”, and a slotted type for 6”.

**Slit Trays**
The Slit Tray is a high efficiency device with circular symmetry, featuring rows of concentric slits for vapor passage. It is mainly used for the distillation of aqueous systems and specialty chemicals.

Main characteristics are:
- Low tray spacing: 150 – 250 mm (6” – 10”)
- High fractionation stages per given column height
- Self supporting structure
- Large operating range up to 1:4
- Suitable for 2 liquid phases systems
- Allow for any number of feed points or side draws

**Liquid-Liquid Extraction Trays**
Conventional extractor trays are designed with holes punched in the tray deck. Extractor trays are equipped with enhanced downcomers and extruded holes which allow for:
- Higher fouling resistance
- More uniform droplets, thus higher efficiency
- Wider operating range

**Baffle, Shower Deck, Disc & Donut Trays**
These trays are arranged in a tower in such a way that the liquid flows down the column by splashing from one baffle to the next lower baffle, and the ascending vapor passes through the curtains of liquid spray. These trays are used in washing sections where fouling resistance has priority over performance.

**Cartridge Trays**
Cartridge trays are typically used for small columns where a tray man way is not feasible. Tower diameters range between 300 to 800 mm (12” to 30”). Cartridge trays are assembled in bundles for an easy and fast installation. They can be equipped with all types of tray decks and downcomers.

**Dual Flow Trays**
Dual Flow trays are perforated trays without downcomers. They are typically equipped with large holes which make them particularly suitable for fouling applications. However they provide limited mass transfer efficiency and have a narrow operating range.
Shell High Performance Trays

Shell HiFi Plus Trays

The Shell HiFi is a fractionation tray equipped with multiple envelope downcomers, oriented offset to the tray’s center line. It’s supported on a 360° ring and a central major beam, without the need of the downcomer bolting bars. For a given column diameter, it allows for:

- Large downcomer area
- High weir length
- High number of passes
- Low tray spacing per given vapor & liquid loadings
- High hydraulic capacity
- High number of separation stages per given column height, and vapor & liquid loadings
- Low pressure drop per given vapor & liquid loadings

The HiFi Plus tray is an enhanced version featuring advanced valves (i.e. MVG, MMVG, UFM) to further boost the tray deck performance, and or the Crown Inlet Device CID™ to maximize the downcomer capacity as well.

Fields of Application

Shell HiFi trays are particularly suitable for high liquid loading applications, and or flow parameters higher than 0.1.

- Fractionators of petrochemical and LNG/NGL plants
  - C2 and C3 splitters
  - Xylene isomers splitters
  - De-Methanizer & De-Ethanizer
  - De-Propanizer & De-Butanizer
- Main Fractionators of refineries
  - Pump around sections
  - Stripping sections
- Absorbers and regenerators of gas sweetening units

Self Balance Operating Mechanism

The unique orientation of the downcomers allows for an uniform liquid distribution on each compartment of the tray deck (blue arrows). The liquid flow path length are practically constant all over the sections.

The vapor is uniformly distributed underneath the tray deck and released laterally through the MVG valves perpendicular to the liquid flow (red arrows).

Since there is no obstruction between the different compartments of the tray, both the liquid and vapor are naturally self balanced all over the tray for the most uniform mixing, contacting, and separating efficiency.
Shell High Performance Trays

Shell HiFi Extraction Trays

Shell HiFi extraction trays are particularly well suited for systems with interfacial tensions below 25 dyne/cm and large phase ratios. They can be used to increase the capacity of existing extractors in aromatics extraction, caustic treating and lube oil applications.

Shell HiFi extraction trays vs. Rotating Disc Contactor in Sulfolane extraction:
• Up to 25% additional capacity and 20% increase in separation stages

Shell HiFi Extraction vs. conventional sieve trays:
• Up to 20% additional capacity with same efficiency
• Less tray spacing without capacity loss

Shell CS Grid Trays

The Shell CS Grid tray is a high capacity dual flow tray:
• The contact area for liquid and vapor is achieved by means of adjacent bars
• The open area is defined by the size and the pitch of the bar
• They are equipped with 4 vertical baffles oriented radially, to achieve the most uniform froth distribution over the tray deck
• They are supported on a 360° support ring and major beams
• They are rotated to each other by 45° for the most uniform vapor and liquid contacting.

Fields of Application

Shell CS Grid trays are mainly used for heat transfer services in fouling and or corrosive environment:
• Slurry pump around of FCC Main Fractionators
• Oil and water quench towers of Ethylene plants
• Top pump around of CDU and Coker Main Fractionators
• Bottom pump around of Visbreaker and Thermal Cracker Main Fractionators
Shell ConSep Trays

The Shell ConSep tray is one of the highest capacity fractionation trays available on the market, it provides up to 80% additional capacity over conventional trays without any major impact on separation efficiency. It utilizes the principle of de-entrainment by centrifugal force to overcome the gravitational limitation of jet flooding, and the system limit of the vessel.

It consists of a HiFi tray equipped with a layer of swirl tubes located underneath the tray deck.

Fields of Application

Shell ConSep trays have been used reliably in refinery, petrochemical, and gas plants for:

- Debutanizer, Depropanizer, Deethanizer, C2 & C3 splitters, Main Fractionators, and wherever the hydraulic loadings exceed the system limit of the column.

FRI Validation

Shell ConSep trays have been tested at FRI, in a 1.22 meter diameter tower, 2 pass, with iso-butane / n-butane system at 11 bar.

At least 50% additional capacity has been observed over other high performance trays, with a separation efficiency as high as 90%. The capacity substantially exceeded the system limit of the tower.

Operating Mechanism

Shell ConSep trays start to work when the conventional ones reach incipient flooding. The vapor, before reaching the next tray, passes through the swirl tubes where the entrained liquid is separated by means of centrifugal acceleration, is collected in the swirl tube deck, and is refluxed back to the downcomer below by means of a secondary downcomer. Thus only clear vapor will rise up to the tray above.
Mechanical Features

**Lip-Slot™ Tray Panel Connection**

The Lip-Slot is an enhanced type of tray panels connection. It is used to connect adjacent panels, and or panel to truss for any type of metal sheet, and deck thickness up to 3.5 mm.

It allows for:

- Safe and easy installation
- Up to 30 % less installation time than conventional clamps
- Accurate positioning of the panels with high flexibility
- No bolting or nuts, thus less maintenance cost than conventional clamps
- It is mechanically as reliable as conventional clamps

The Lip-Slot is combined with universal clamps for the tray periphery assembly.

**Trays for Heavy Duty**

In some applications, particularly subject to operating upsets and or panels dislodgment, the trays must withstand high mechanical loadings i.e. 700 N / m² (1 psi) or even 1400 N / m² (2 psi).

In such cases, special features are foreseen in the mechanical design, among others:

- Through bolting panel connection
- Shear clips
- Downcomer spreaders
- Explosion doors

2 psi uplift BDH tray equipped with through bolting assembly, shear clips and explosion doors
**Mechanical Features**

**Welding Free Tray Installation**

In several revamp projects aimed to boost the separation stages of an existing column, the number of actual trays must be increased i.e.

3-for-2, 4-for-3, or even 5-for-4.

To accomplish this target, a tailored mechanical design is required to avoid any impact on the schedule of the plant’s turn-around, and minimize the costs.

Sulzer has developed a mechanical solution enabling installation of the trays by reusing the existing tower attachments, and without any direct welding to the tower wall, thus avoiding any post-welding heat treatment and/or hydraulic testing of the vessel. We have even been able to reduce consistently the turnaround time by using this technique.

The following devices may be used:

- Expansion rings
- Expansion joints
- Vertical struts
- Downcomer adaptors
- Solid or lattice beams

The system can be used also for other purposes: modify the geometry of existing downcomers; modify the number of passes; change the tray orientation; replace packing beds with trays.

---

**Horizontally Installed Trays**

Sometimes trays need to be installed at the shop. In such cases, the installation is done with the vessel in the horizontal position.

Sulzer has developed a specific procedure which:

- Avoids part deforming and or breaking
- Avoids panel shifting
- Avoids joint dislodging
- Reduces additional inspection at site
- Avoids parts readjusting at site
- Minimizes installation time
- Minimizes cost
Services

Computer-Aided Engineering (CAE)

Sulzer has integrated all major mass transfer products into an in-house design tool, creating a global standard. As a result, most mass transfer products can be automatically designed with Sulzer’s CAE tool. With this tool, models can be generated more efficiently allowing users to concentrate on the optimal equipment design. In addition, mechanical strengths of all relevant components are automatically calculated with each design. Various configurations can be checked in a very short time to find the optimal design that meets customer requirements.

Other Innovative Design Tools

Sulzer also employs other innovative design tools, for example finite elements method (FEM) and computational fluid dynamics (CFD) analysis for the development of new high-end products.

The tools can also be used for challenging components designs in the frame of a study if desired by the customer.

3D Models

Upon customer request layout drawings supplied in the course of the engineering phase will show a 3D sketch of the equipment being designed, for an easy and fast checking by the customer.

CAE Analysis: Deflection of support elements

Numerical analysis of mechanical strength of a lattice beam

3D model of a 4-pass tray
Vibration Phenomena on Fractionation Trays

In some critical applications and under specific operating conditions, vibration phenomena may be induced to the trays. If the frequency equals the natural frequency of the tray, the panels will crack and will be seriously damaged.

Based on plant feedback data and in-house know-how, Sulzer has developed a design tool to check for the following two main parameters:

- Natural frequency of the tray panels, as a function of the geometry, the supports, and the fabrication material type
- Vibration factor, as a function of the flow rates and physical properties of the streams being processed.

To prevent vibration damage a proper checking is required, and a high-tech mechanical design is a must.

Tower Field Service

Sulzer’s Tower Field Service has the expertise and experience to ensure that projects are executed with the highest standards of safety, quality, and efficiency. Our extensive depth of technical strength and project and construction management skills assist the client in obtaining the process goals they desire, within the constraints of a shutdown or construction environment.

The challenge to complete multiple tower revamps and retrofits safely and on time is what Tower Field Service most prides itself on.

For tower revamps and retrofits, Tower Field Service can provide a streamlined solution to ensure minimal downtime. A systematic, practical approach for tower revamping projects is essential in obtaining a successful outcome.

These capabilities have been tested and proven in thousands of projects around the world.
Services

Turn Around Service

The Sulzer Turnaround Services (TAS) team is known for its fast delivery and quality of the goods, its reliability and customer-oriented approach.

TAS is available 24 hours a day, 7 days a week, to provide customers with the best response time and premium quality service.

Our team can provide complete, around-the-clock support for your planned or emergency turnarounds. We offer material replacements with our complete line of products regardless of the original equipment manufacturer.

Our global manufacturing network allows us to bring our service and goods to you, day or night, in almost every country of the world.

The scope of supply includes all the mass transfer components and tower internals:

- Fractionation trays
- Structured packing
- Conventional grids
- Structured grids
- Random packing
- Support grids
- Hold down grids
- Chimney trays
- Feed inlet pipes
- Distributors
- Hardware
- Gaskets
- Fractionation valves
- Bubble caps
- Mist eliminators
- Coalescers
- Solid and lattice beams
- Expansion rings
The activity program comprises:

- Process components such as fractionation trays, structured and random packings, liquid and gas distributors, gas-liquid separators, and internals for separation columns.
- Engineering services for separation and reaction technology such as conceptual process design, feasibilities studies, plant optimizations including process validation in the test center.
- Recovery of virtually any solvents used by the pharmaceutical and chemical industry, or difficult separations requiring the combination of special technologies, such as thin film/short-path evaporation, distillation under high vacuum, liquid-liquid extraction, membrane technology or crystallization.
- Complete separation process plants, in particular modular plants (skids).
- Advanced polymerization technology for the production of PLA and EPS.
- Tower field services performing tray and packing installation, tower maintenance, welding, and plant turnaround projects.
- Mixing and reaction technology with static mixers.
- Cartridge-based metering, mixing and dispensing systems, and disposable mixers for reactive multi-component material.