

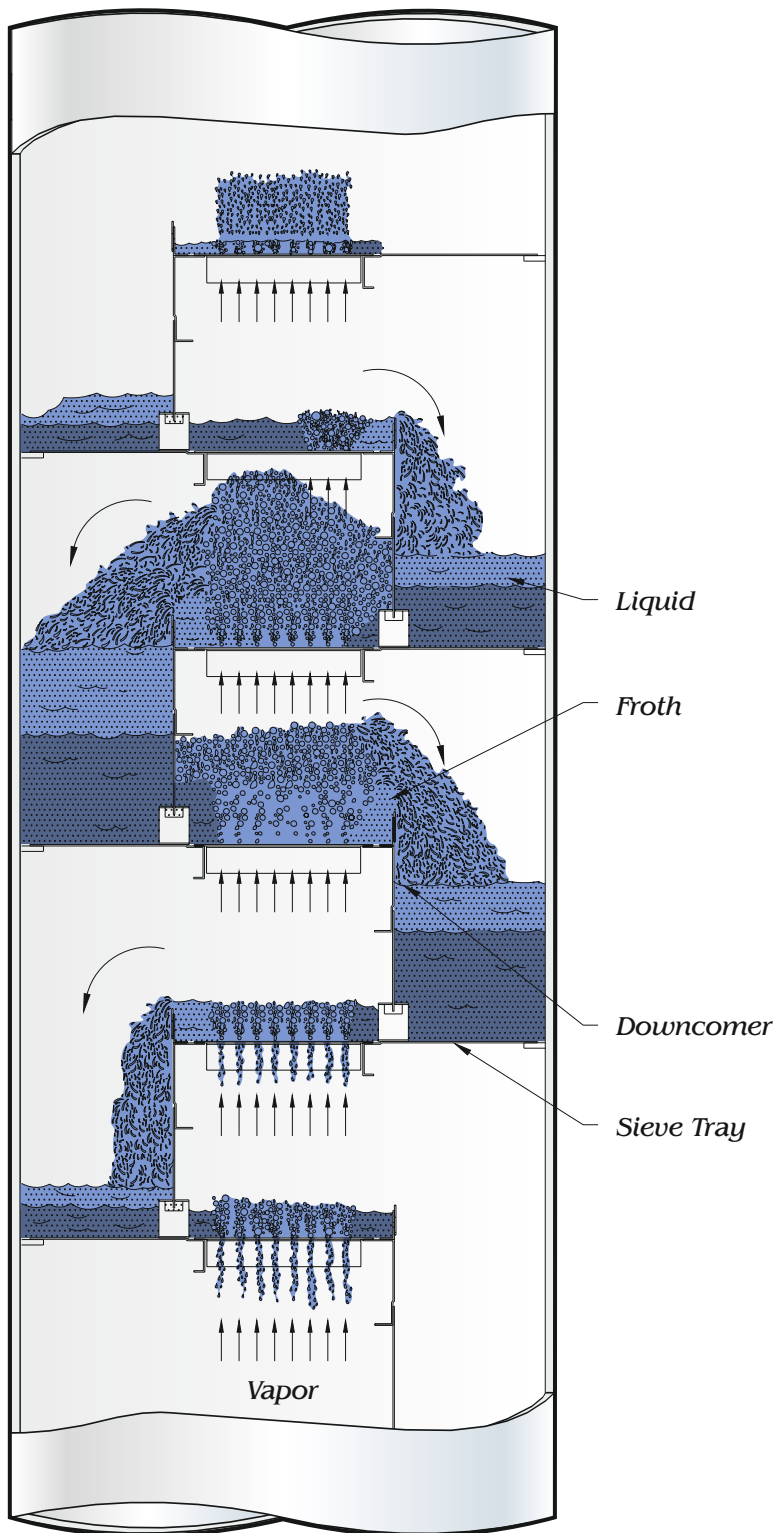
# Tower Tray Bulletin 300



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# Various Tray Hydraulic & Vapor Conditions



## **Blowing Tray**

Tray floor visible, low  $\Delta P$   
(low efficiency)

## **Tray partially active**

May Leak  
(some loss of efficiency)

## **Tray at 80% flood**

Beginning to Entrain  
(loss of efficiency)

## **Tray at 70% flood**

Optimum operation  
(peak efficiency)

## **Tray at weep point**

Occasional weeping  
(efficiency still satisfactory)

## **Tray at dump point**

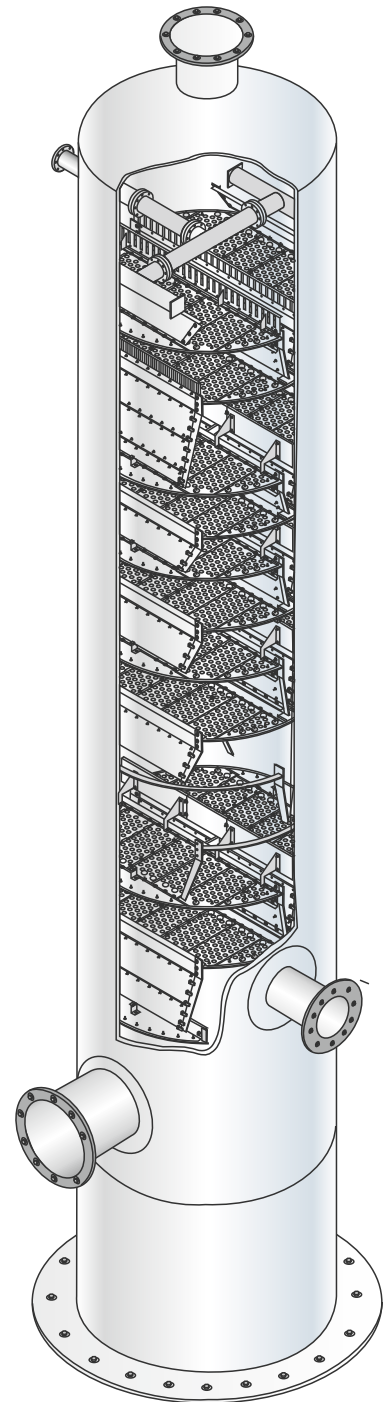
No liquid flow over weir  
(half efficiency)

# Services and Products

**Mapesa** specializes in the design and manufacture of many types of mass transfer equipment for the Chemical Process Industries. Our primary products include conventional sieve, valve and bubble cap trays; packed tower internals such as structured grid equivalent to "EF-25A", Style II, Style III and "C" Grid, liquid distributors, chimney trays, packing support plates, hold downs, and pall type rings. **Mapesa** also offers specialty equipment such as dislodgement resistant "D.R." trays, dual flow, disc & donut and side-to-side baffles.

All our products are backed by decades of experience and employees committed to quality, excellence and service. Process designs are based on proven concepts. Our computerized mechanical engineering and fabrication systems are integrated to permit efficient and accurate processing of orders.

**Mapesa** focuses on customer communication to accomplish effective design, responsive service and efficient manufacturing. Whether small or large diameter, new construction, revamp or replacement, **Mapesa** will provide reliable solutions to our customer's needs and requirements at a competitive cost.



**Typical Tower Elevation**  
(Depicts Tower Attachments  
and Installed Trays)



# Selection of Tray Type

*The three basic types of fractionation trays are the perforated (sieve), valve and bubble cap trays. In general, tray type selection is determined by evaluating various factors, such as process, cost, mechanical, installation and maintenance considerations. Some important areas of performance to be taken into account when selecting the type of tray are capacity, turndown, efficiency, pressure drop, tendencies toward fouling and scaling, corrosion and actual historical data from previous experience in the system*

*A brief overview of the benefits or disadvantages of each of the three basic conventional tray types are mentioned below:*

- **Perforated trays** are often used when a wide range of flexibility is not required and the lowest tray cost is desired. For very low liquid rate applications, perforated trays are not a good choice. Some instances that require extensive blanking of perforations could result in an ultimate cost greater than valve trays.
- **Valve trays** which usually have a cost comparable to perforated trays, afford the widest operating range and greatest capacity. Considering the additional operating range and capacity of valve trays over perforated trays, it can be concluded that valve trays are actually lower in cost. In many applications, vapor loading controls capacity. In many cases, valve trays may have as much as ten percent more capacity than perforated trays. Trays with valves comprised of three pieces (fixed caged, valve plate and orifice cover) have proven to be very efficient for glycol dehydrators and other services with low liquid rates. In many cases these valve trays can effectively be utilized to replace bubble cap trays (which are considerably more expensive) for these low liquid rate services.
- **Bubble cap trays** provide the lowest capacity and the highest cost of the conventional trays, but they are the best choice for use when leakage must be minimized. Bubble cap trays also require additional installation time due to the need to gasket all of the tray joints to prevent leakage.

*Some less conventional trays such as dualflow, side-to-side and disc and donut trays are advantageous for special use where extremely high capacity, fouling and pressure drop are major considerations.*

**Mapesa** has the technology and manufacturing capability to design and fabricate almost any type of conventional or specialty tray.

# Tray Construction Materials

Fractionation trays are fabricated from a wide variety of materials. When corrosion is expected to be extremely low and design temperatures are not excessive, carbon steel is a logical choice because of its favorable mechanical design properties, malleability and low cost. However, since the material of construction is dictated by the process of each particular system for which the trays will be used, many different material types may be required because of unique properties which allow some materials to have resistance to corrosion and to maintain their mechanical strength at elevated temperatures.

The most common tray materials that **Mapesa** utilizes are listed below starting from least expensive:

- **Carbon steel**
- **Type 410S stainless steel**
- **Type 304 stainless steel**
- **Type 316 stainless steel**

Other fairly common materials for tray fabrication are as follows:

- **Type 304L stainless steel**
- **Type 316L stainless steel**
- **Type 317 stainless steel**
- **Type 317L stainless steel**
- **Type 321 stainless steel**
- **Type 347 stainless steel**
- **Type 904L stainless steel**

**Mapesa** is also experienced and skilled at tray fabrication, utilizing many of the more exotic materials such as:

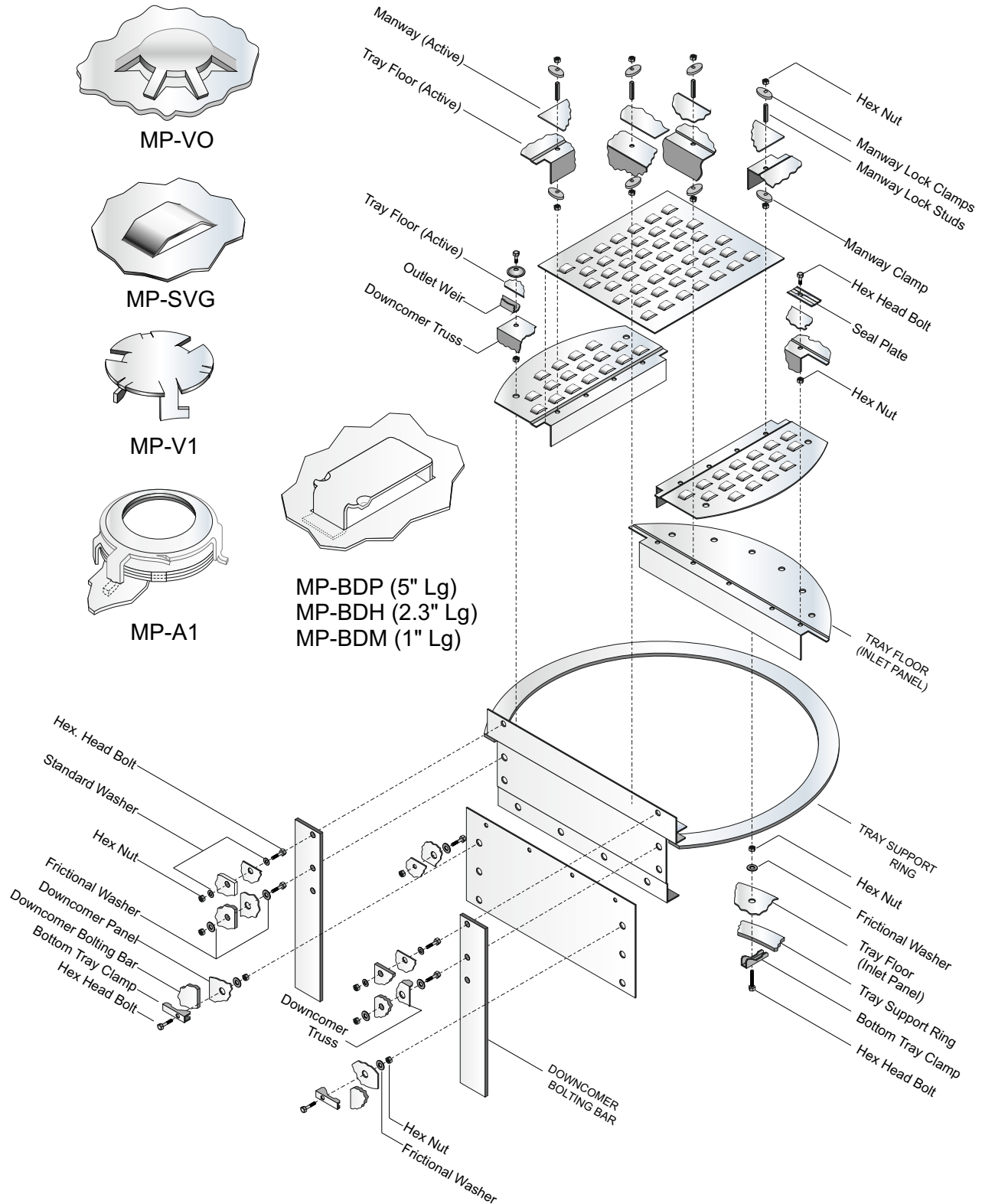
- **Titanium**
- **Zirconium**
- **Hastelloy**
- **Monel**
- **Nickel**
- **AL-6XN**
- **Everdur**

## Number of Tray Flow Paths

Fractionation trays for smaller towers are normally one pass design (trays which have a single downcomer and a single direction of liquid flow). Multi-pass trays of two, three or four pass can be designed and fabricated by **Mapesa** when process loadings require. Due to the need of having workman passage manways in each flow path for installation and maintenance, flow path lengths of less than 16 inches are not recommended. The chart shown below, lists guidelines for the maximum number of flow paths possible for a given tower diameter.

| Maximum Number of Flow Paths |                                  |
|------------------------------|----------------------------------|
| Number of Flow Paths         | Tower Diameter                   |
| One                          | Less than 6 Ft. - 0 In.          |
| Two                          | 6 Ft. - 0 In. to 8 Ft. - 5 In.   |
| Three                        | 8 Ft. - 6 In. to 10 Ft. - 11 In. |
| Four                         | 11 Ft - 0 In. and greater        |

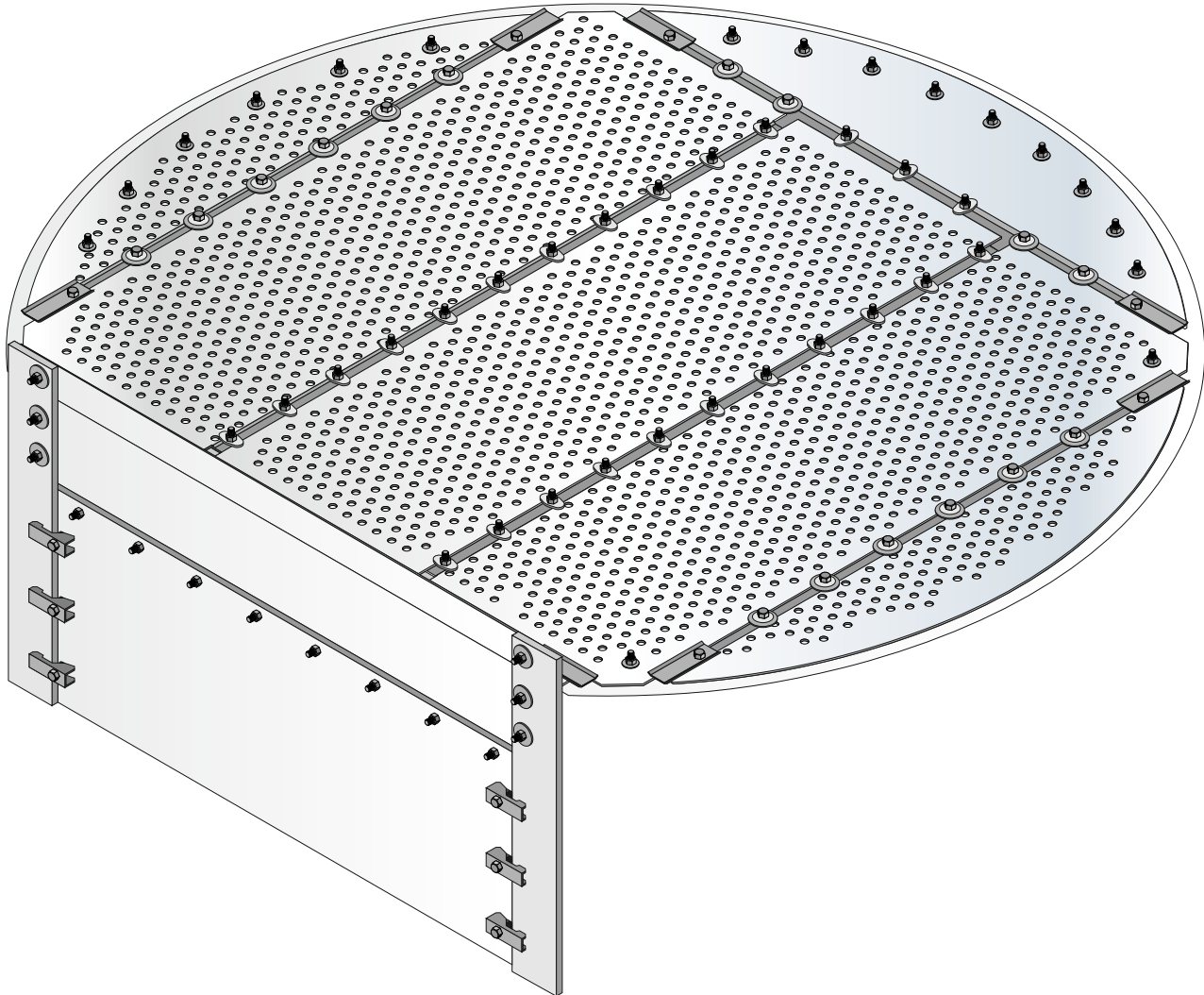
# Standard Tray Component Assembly and valve unit configurations



# Perforated Trays

**Mapesa** has the capability of manufacturing almost any type of sieve (perforated) tray. Although one half inch diameter holes are the most commonly used size, we have tooling for punching holes as small as 1/8" diameter (for 14 ga. tray decks) up to 1 17/32" diameter. Our ability to "gang punch" and "cluster punch" perforations allows us to be very competitive when large quantities of hole punching is required and would otherwise require many additional fabrication hours for the punching process.

The perforated tray depicted below is a single pass design with swept-back outlet weirs and peripheral baffles.

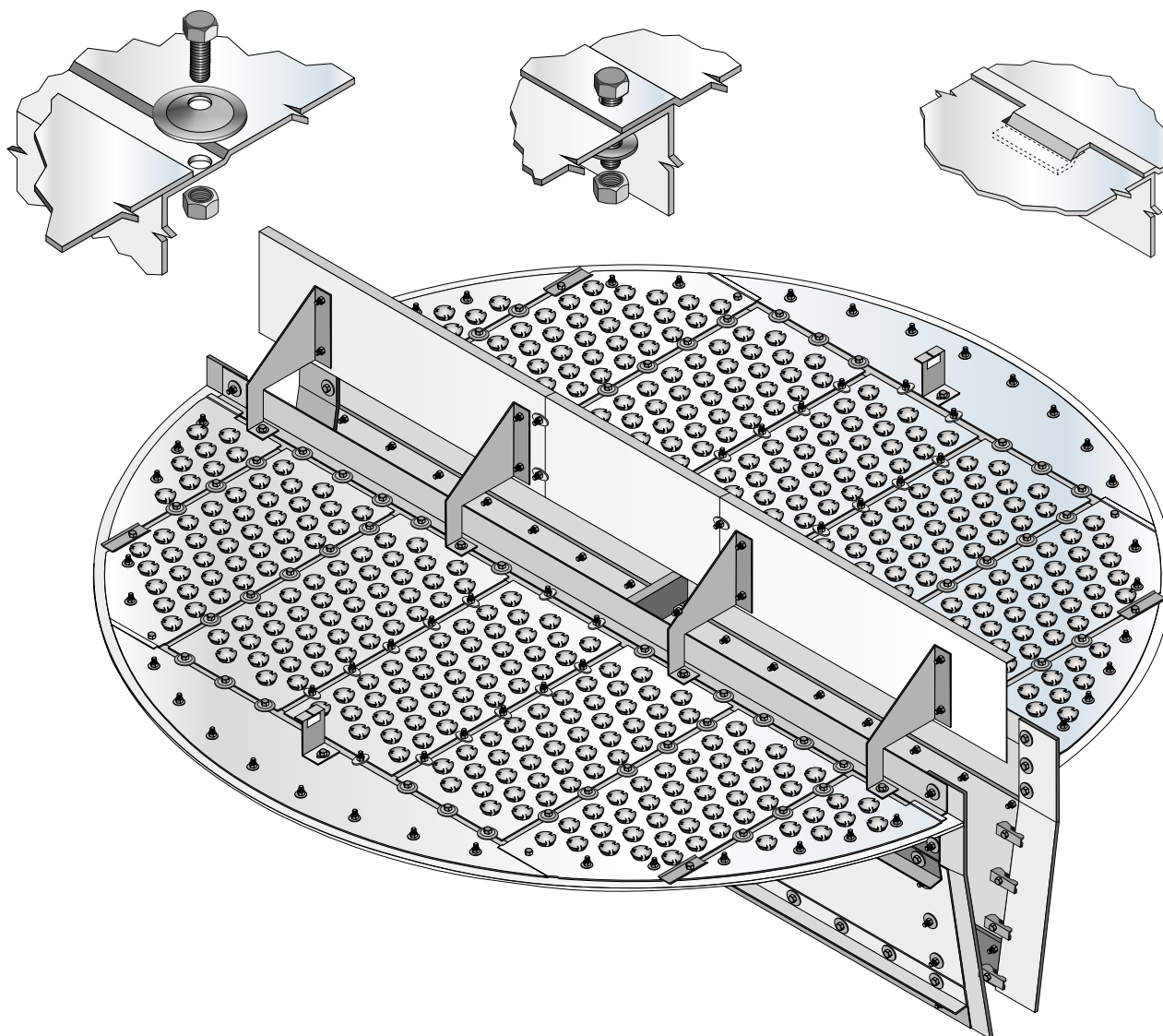


## Valve Trays

*In addition to our standard general purpose valve (the one piece "MP-1" which is recommended for its low cost and efficient performance in most applications), **Mapesa** offers and in many cases stocks a wide variety of valves to meet any of our customer's needs in applications where valve trays are an option. The next page describes some of the valves available.*

***Mapesa** equivalent valves are identical to the original manufacturers design. These high quality valves allow us to offer very competitive prices on replacement of existing valve trays regardless of who originally manufactured the trays. All patents on the popular valve trays have expired, so there is no longer any need to pay excessive prices for replacing existing equipment.*

*The valve tray depicted below is a two pass design with center downcomer baffles, sloped downcomers and joint configurations.*

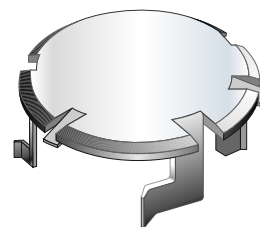




# Description of Valve Types

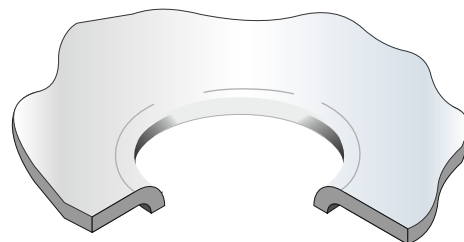
## **MP-V1**

A general purpose standard size valve, used in all services. The legs are integrally formed with the valve for tray deck thickness up to 0.25 inch. Anti-stick dimples are standard. A non-rotating feature can be obtained by utilization of an optional deck opening. Flush-seated and multiple weight valve options are also available.



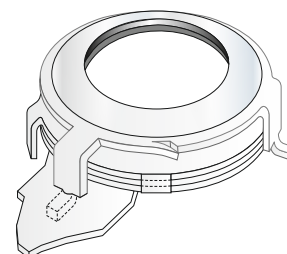
## **MP-V4**

A low pressure drop standard size valve, that utilizes a venturi-shaped orifice in the tray deck which is designed to substantially reduce the parasitic pressure drop at the entry and reversal areas. The permissible tray deck thickness is 16-10 gauge. The venturi opening results in a lower vapor rate flexibility as compared to the square-edge orifice.



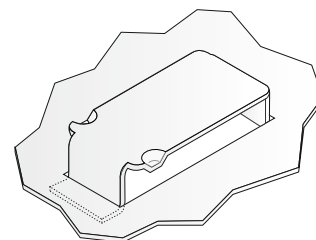
## **MP-A1**

The most popular form of the 3-piece valve for maximizing vapor rate flexibility. It is comprised of a lightweight orifice plate, a valve unit and travel stop or cage. The orifice cover can completely close. The valve unit provides a 2-stage effect while the cage holds the 2 moveable units in place. The cage has legs integrally formed that rest on top of the tray deck, with tabs that bend back below the deck.



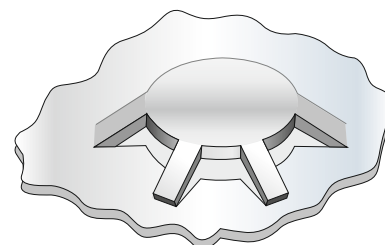
## **MP-A2**

Same as the MP-A1 except the orifice cover is omitted.



## **MP-BDH, MP-BDM, MP-BDP**

A unique rectangular-shaped valve. The valve is oriented parallel to the liquid flow direction, providing lateral vapor release and a closed upstream edge to minimize weeping.

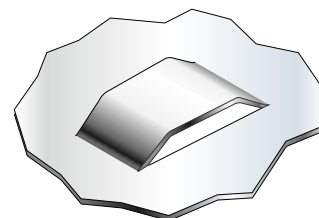


## **MP-V0**

A fixed valve similar in appearance to the MP-V1 unit in a fully open position. The legs of the valve are formed integrally with the tray deck. The flexibility of the MP-V0 is similar to that sieve trays and is desirable in services prone to fouling.

## **MP-SVG**

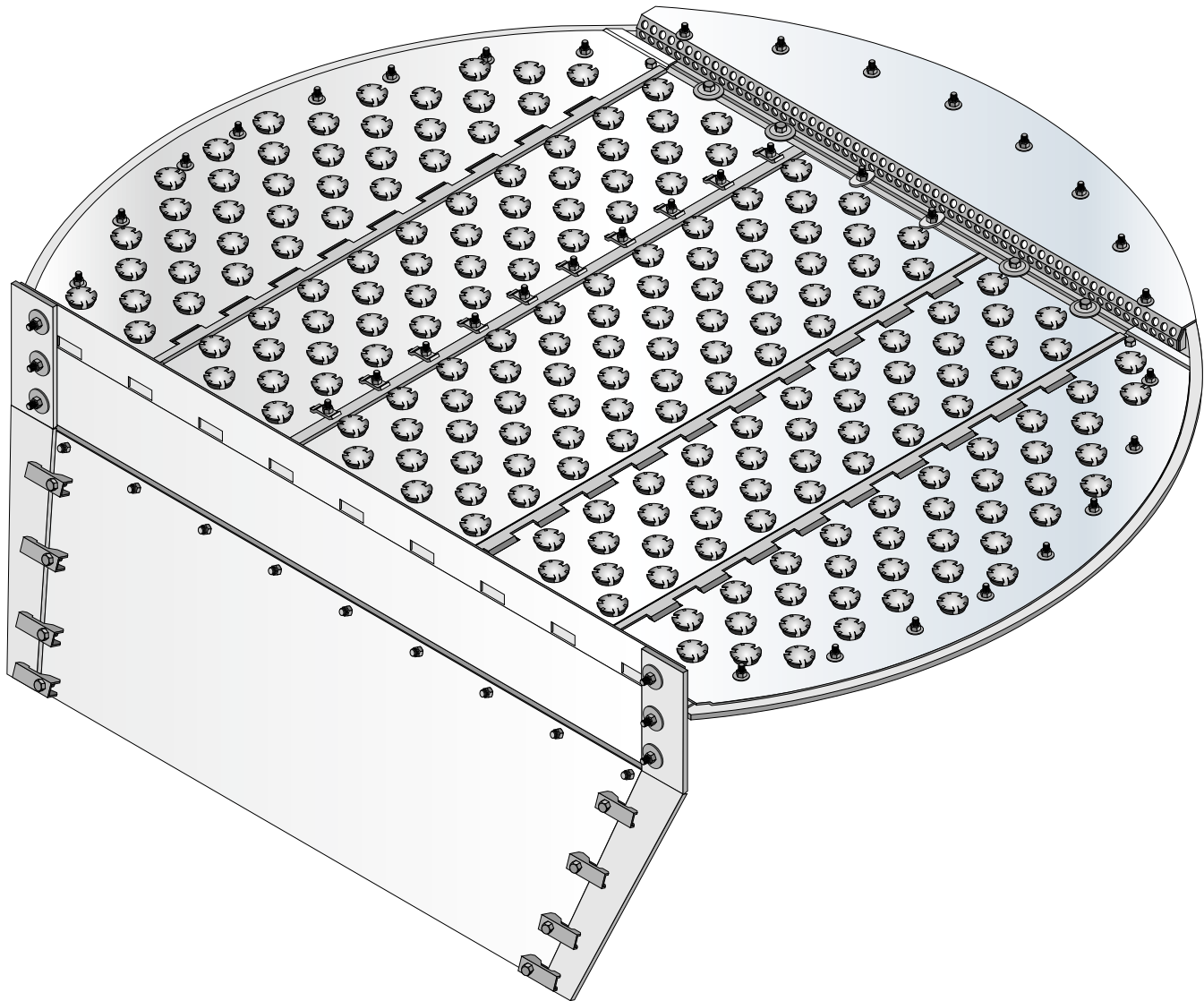
A fixed valve, have been successfully applied in a variety of fouling services.



# High Capacity Trays

**Mapesa** has the experience to design and manufacture the high capacity Nye Tray. Nye Tray offers advance technology to produce 10% to 20% capacity increase over the conventional trays. The Nye Tray achieves this improvement vy using a modified inlet area which increases the area available for vapor-liquid disengagement.

Furthermore to this consideration is should be noted that the Nye Tray is no longer protected under US patent.

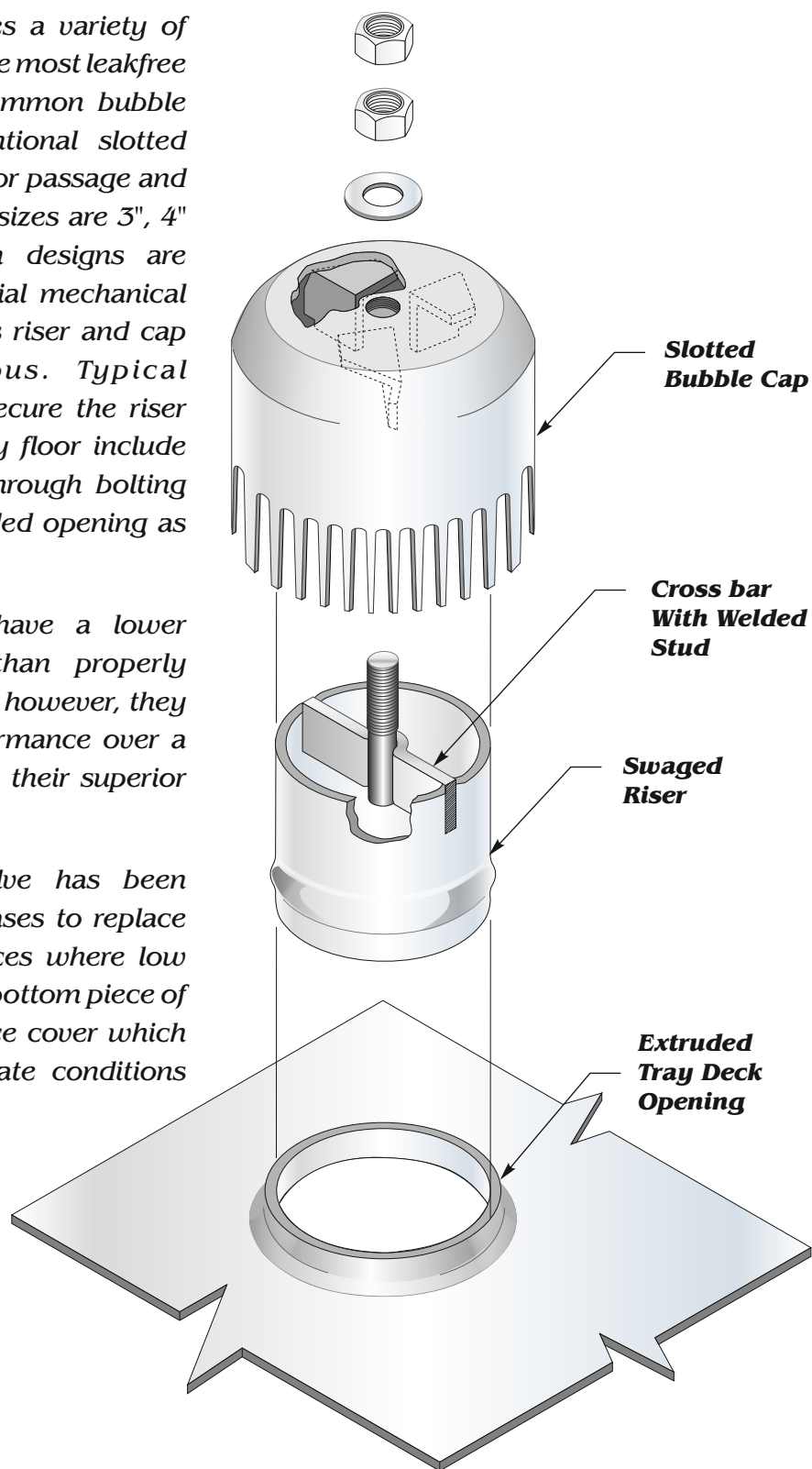


# Bubble Cap Trays

**Mapesa** designs and provides a variety of bubble cap trays which are the most leakfree trays available. Our most common bubble cap designs include conventional slotted caps (some have slots for vapor passage and others do not). Standard cap sizes are 3", 4" and 6". Of course, custom designs are available as well. The potential mechanical configurations for the various riser and cap assemblies are numerous. Typical manufacturing methods to secure the riser and cap assembly to the tray floor include seal welding, press fitting, through bolting and swaging riser into extruded opening as depicted at right.

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.

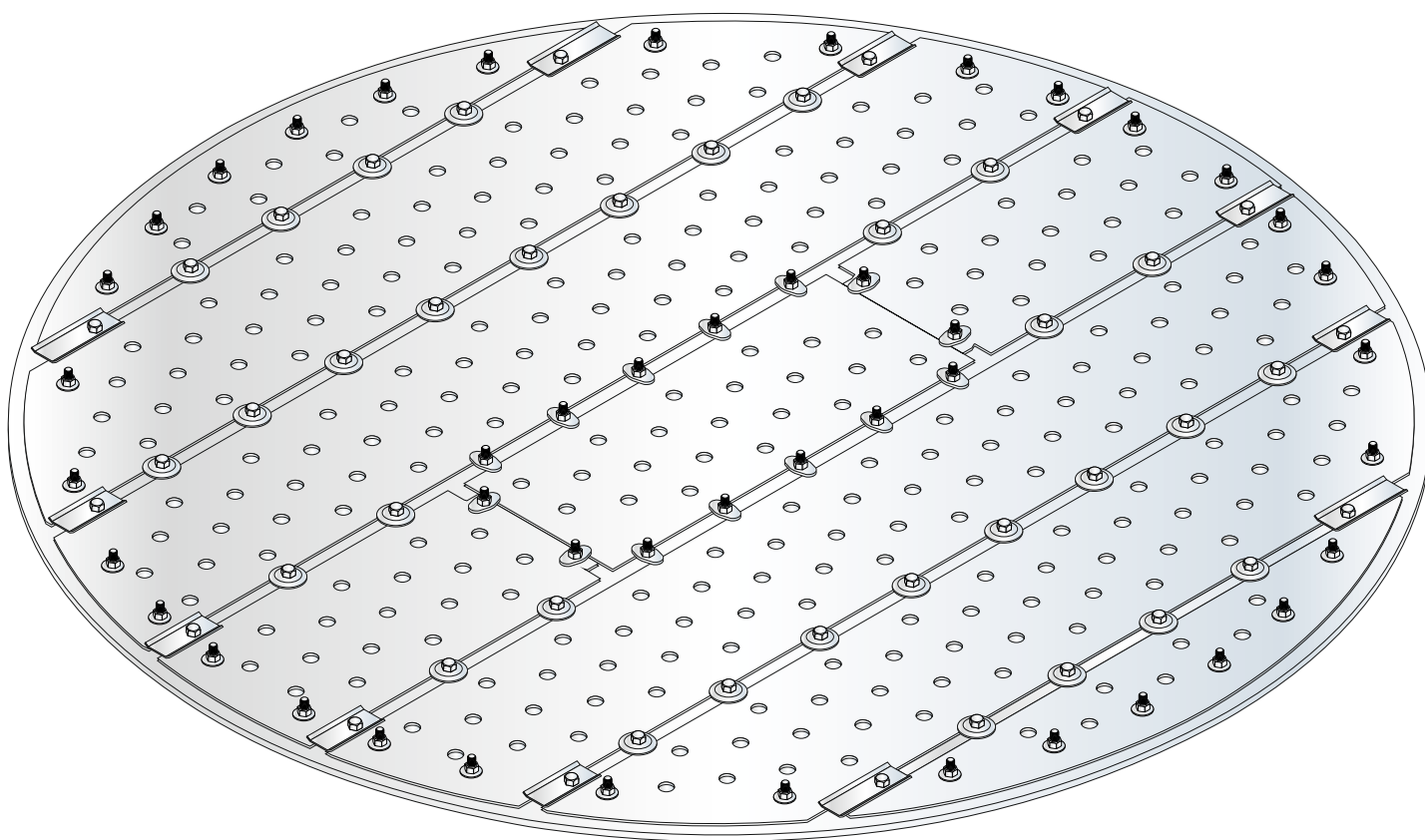
Our MP-A1 three piece valve has been successfully used in many cases to replace the bubble cap tray in services where low liquid rates are common. The bottom piece of the unit is a lightweight orifice cover which seals off under low vapor rate conditions thereby minimizing leakage.



## Dualflow Trays

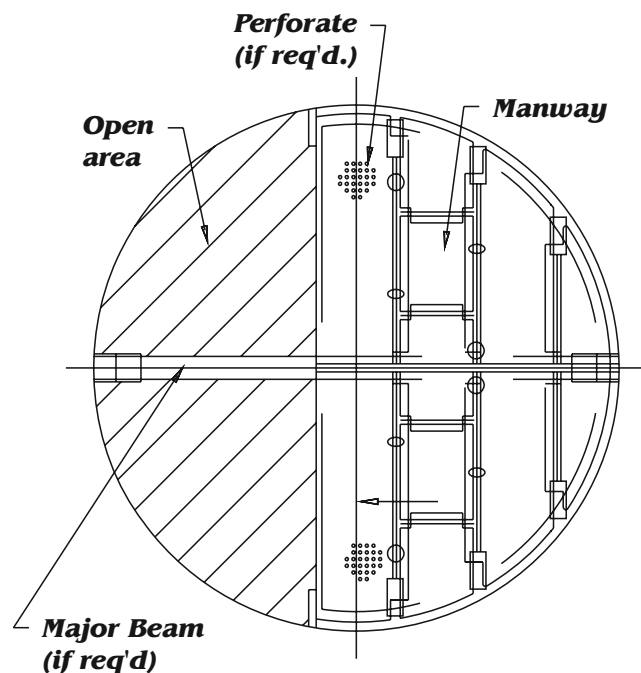
*These trays are typically used in smaller diameter towers due to the difficulty in achieving the required levelness tolerances. Dualflow trays are normally perforated with large diameter holes on a uniform pattern across the full cross section of the tower. They are supported by 360 degree tray support rings, since downcomers are not required. The perforations in the tray provide the dual purpose of vapor and liquid exchange. In a normal operating mode, liquid moves and splashes on top of the tray in a wavelike manner. Liquid will periodically flow through the perforations under the areas of liquid peaks while vapor rises through holes in the valleys or liquid low points.*

*The dualflow tray depicted below is of typical design without special features.*

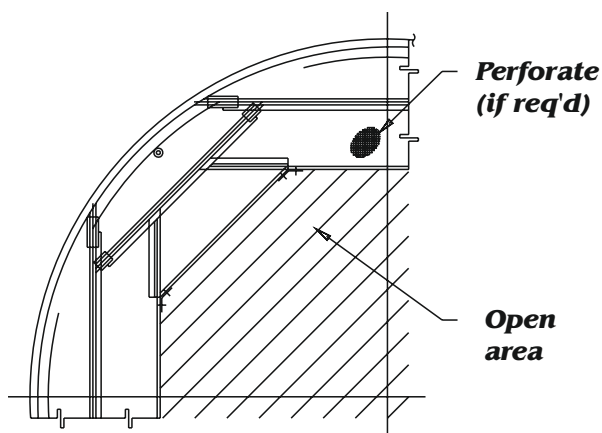


## Side to Side Baffle and Disc and Donut Trays

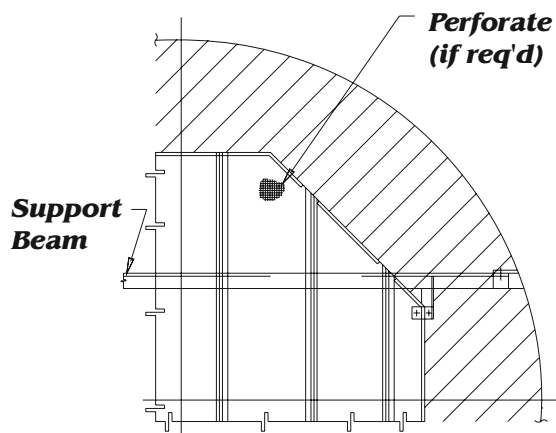
For systems where extremely high capacity, fouling and pressure drop are major concerns, side to side baffle and disc and donut trays may be a suitable choice. For both of these tray types, liquid and vapor contacting is accomplished by vapor passing through a curtain of liquid falling from one tray to the next tray below. The tray decks are flat or inclined plates that block 40-60 percent of the cross sectional tower area. In addition to the sloped configuration for the tray decks, other design variations may include inlet or outlet weirs, uniform or partial perforated design. Typical side to side trays are depicted at right. Typical disc and donut trays are depicted below.



**Side to Side Tray**



**Donut Tray**



**Disc Tray**



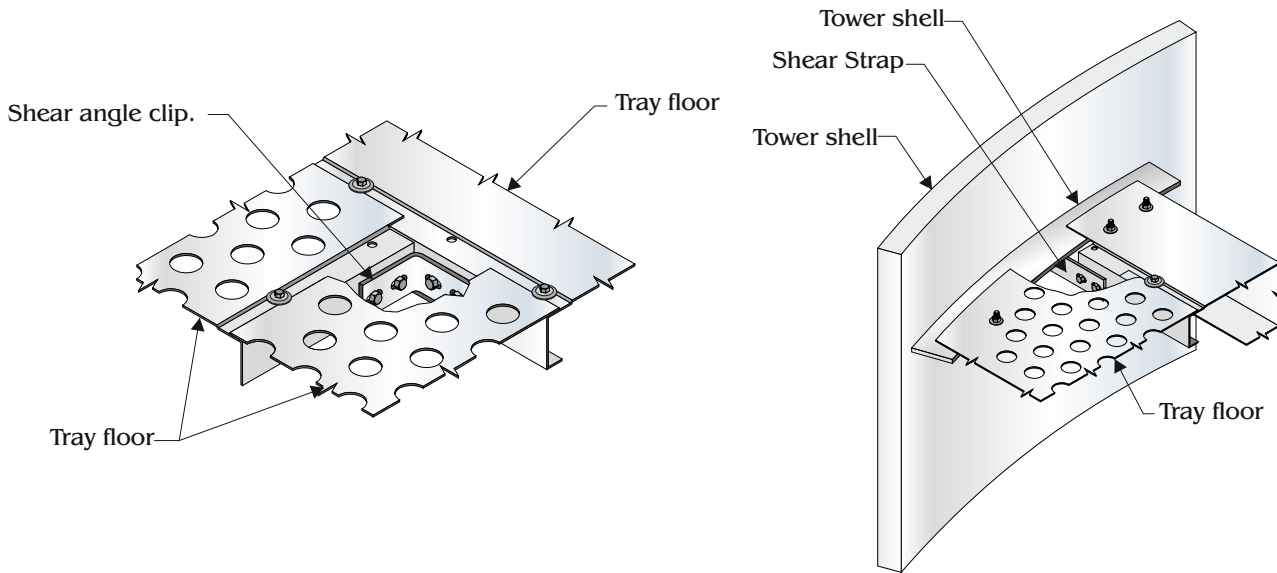
## ***Mapesa Dislodgement Resistant Trays***

**Mapesa "D.R."** (DISLODGE<sup>M</sup>ENT RESISTANT) trays are specifically designed for applications where unusual uplift surges exist so that mechanical failure is prevented. These trays are equipped with special heavy duty features which allow the individual tray components to act as a network, whereby, the fully assembled tray is capable of withstanding pressure surges of up to one, two or even three p.s.i., without permanent deformation or dislodgement of any of the components. Depending upon the specific design criteria, such as vessel design temperature, anticipated magnitude of pressure surge, consideration of possible pulsation or excessive vibration, material analysis, corrosion allowance and tower diameter, any combination of the following **Mapesa D.R.** features may be utilized in tray design:

- Increased tray thickness (trays which are normally 14 ga. for stainless are increased to 12 ga., 10 ga., 3/16" or even 1/4" thick as needed).
- Thru-bolted integral beams (normal design allows for a frictional holddown of tray panel edges).
- Increased quantity of bolting and hardware assemblies to utilize 3" spacing (normal spacing for hold down on tray panel edges is approximately 6").
- Lock washers or double nuts (for use when excessive vibration is anticipated).

# Mapesa Dislodgement Resistant Trays

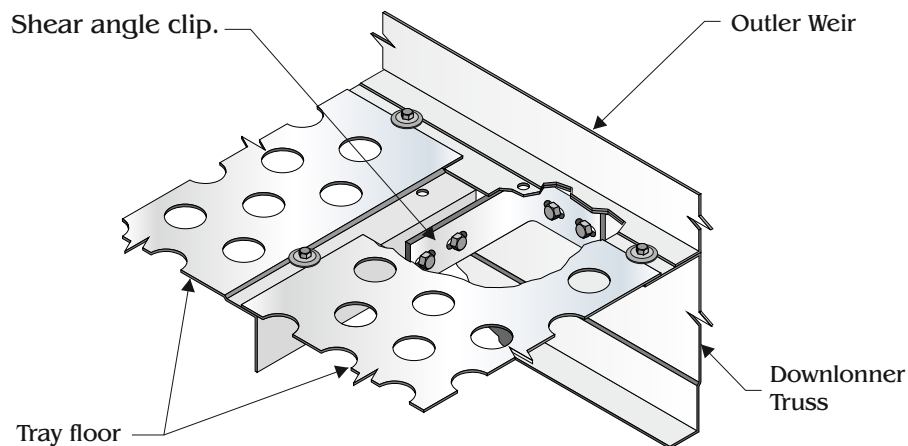
- Thru-bolted clips at ends of integral beams for attachment to adjacent beams (see **figure a** below) or tray support ring (see **figure b** below).



**Figure (a)**  
(integral truss to integral truss connection)

**Figure (b)**  
(integral truss to Tray support ring connection)

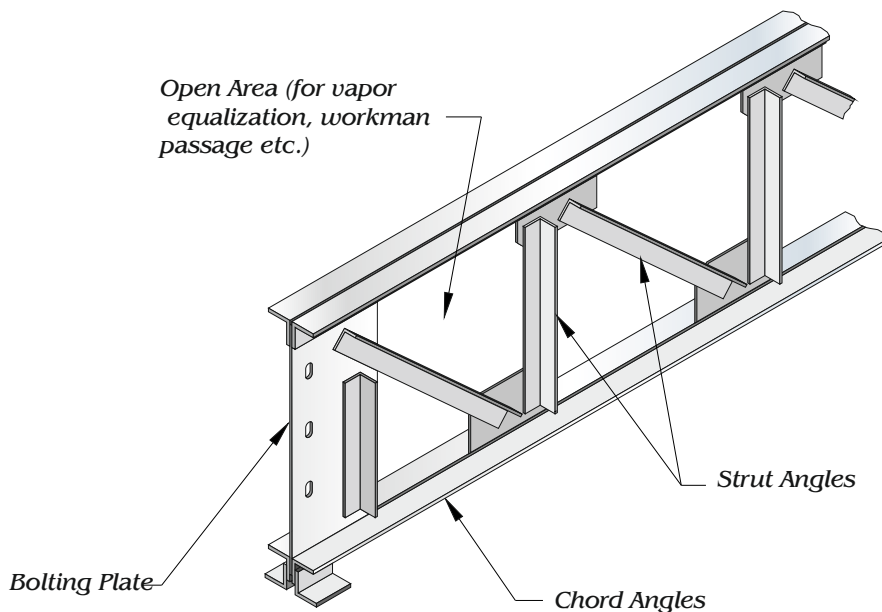
- Thru-bolted clip angles at ends of integral beams for attachment to downcomer truss (see **figure c** below).



- Welded tray design (for use when installation time and future removal considerations allow).
- Additional major beams or support channels (these beams are bolted to welded-in attachments at tower shell).

# Mapesa Dislodgement Resistant Trays

- Plate and angle lattice trusses (see **figure d**). This configuration often provides the necessary requirements for maximum strength and vapor equalization with minimum weight and use of material.



**Figure d**  
(Lattice truss)

- D.R. Hardware (heavy duty, extra thick washers and clamps which greatly resist dislodgement).

**Mapesa** does not recommend D.R. trays for all applications because of minor problems such as increased installation time and effort due to the extra bolting and hardware assemblies required and additional tray purchase price. Under normal liquid and vapor loadings most trays will operate adequately without D.R. features. In cases where there is a history of tray mechanical failure (particularly above and below vapor feeds), D.R. tray design will substantially increase their operating life. This extended tray operation can often result in extended service life and reliability in a vessel and even the entire plant by eliminating the necessity for unplanned shut downs.

# Special Tray Design Features

**Mapesa** personnel are knowledgeable from both a design and manufacturing standpoint of virtually all fractionating tray enhancement features. Many of these special features can often greatly improve overall tray performance. Not only do we offer these features upon customer request, but in many cases, we suggest the use of them in instances where our experience indicates the benefits.

Some of these special features and explanations of their uses are as follows:

- **Swept-back weirs** are side outlet weirs which are multichordal in lieu of a single chord design. This design is sometimes utilized for side flow trays of a multipass design to balance liquid loads or sometimes for a single pass tray to reduce the effective liquid height on the tray by decreasing the volume of liquid per unit length which flows over the outlet weir.
- **Splash baffles** are used to maximize the liquid retention time on trays used in very low liquid rate services. These baffles are located adjacent and parallel to the outlet weir and clear the tray deck and the outlet weir by 1/2" to 1" whereby exiting liquid is forced to flow under the baffle prior to flowing over the top of the outlet weir.
- **Picket-fence baffles** are used to decrease effective weir length. They are often utilized in cases where the liquid flow over the weir would otherwise be less than one gpm per inch. Picket-fence baffles can increase the effective liquid height on the bubbling (active) area and reduce "blowing". These baffles (which either attach or can be formed integrally with the outlet weir) are uniformly spaced to allow evenly distributed flow into the downcomer. They can be used in conjunction with splash baffles when both features are needed.
- **Anti-jump downcomer baffles** are used on multipass trays for center and off-center downcomers when needed to prevent liquid which is flowing across the tray from blowing or jumping over the downcomer and onto the opposing flow path. When the width of the downcomer is small and the loading is high, these are particularly advantageous.
- **Sloped downcomers with recessed inlet sumps** can be effectively utilized in heavy liquid loaded services that would otherwise be prone to downcomer flooding.
- **Cartridge trays** (which are shop prefabricated into bundles of 4 or 5 trays each, equipped with enveloped downcomers, peripheral packing glands and spacer rods) are a viable approach to the installation and removability of trays for towers which are too small for workmen passage.

In addition to the special features listed above, **Mapesa** has experience in the utilization of many other tray enhancement features and is open to consideration of the use or development of any new ones that could improve performance in any way.

# Packed Tower Internal Equivalents

|  | <b>Mapesa</b>   | <b>Sulzer/Nutter</b> | <b>Koch/Glitsch/Norton</b> |
|--|-----------------|----------------------|----------------------------|
| <b>Support<br/>Plates</b>              | MP-201          | 101                  | UTS-201                    |
|  | MP-209          | 103                  | UTS-209                    |
|  | MP-218          |                      | UTS-218                    |
|  |                 |                      | UTS-111                    |
|  | MP-201          |                      | UTS-201                    |
| <b>Holddown &amp;<br/>Bed Limiters</b> | MP-451, 461     | 401                  | BLG-451, BLM-461           |
|  | MP-451, 461     |                      | BLG-451, BLM-461           |
|  | MP-461          |                      | BLG-461 (w/weights)        |
|  | MP-451, 461     |                      | BLG-451, BLM-461           |
|  | MP-454          |                      | BLG-454                    |
|  | MP-401, 461     | 501, 551             | HDG-401, BLM-461           |
| <b>Liquid<br/>Distributors</b>         | MP-651          | 306                  | NRD-651                    |
|  | MP-701          |                      | VND-701                    |
|  | MP-901          | 304                  | POH-901                    |
|  | MP-601          |                      | DRO-601                    |
|  | MP-551          |                      | RTD-551                    |
|  | MP-551          |                      |                            |
|  | MP-901          |                      |                            |
|  | MP-951          |                      | SNH-951                    |
| <b>Liquid<br/>Re-Distributors</b>      | MP-551 (w/hats) | 301                  | RTD- 551 (w/hats)          |
|  | MP-551 (w/hats) |                      | RTD- 551 (w/hats)          |
|  | MP-551 (w/hats) | 301                  | RTD- 551 (w/hats)          |
|  | MP-551 (w/hats) | 301                  | RTD- 551 (w/hats)          |
|  | MP-551 (w/hats) |                      | RTD- 551 (w/hats)          |



# Valve Conversion Table

| Mapesa Valves        | Koch Valves | Glitsch Valves     |
|----------------------|-------------|--------------------|
| MP-V1 #1616 ó 1614   | AB-5-U      | V-1 #1616 ó 1614   |
| MP-GV1 #1616 ó 1614  | AB-51-U     | GV-1 #1616 ó 1614  |
| MP-GV1X #2616 ó 2614 | AB-51-Z     | GV-1X #2616 ó 2614 |
| MP-V1 #1716 ó 1714   | AC-5-U      | V-1 #1716 ó 1714   |
| MP-V1 #1716 ó 1714   | AC-5-Y      | V-1 #1716 ó 1714   |
| MP-GV1 #1716 ó 1714  | AC-51-U     | GV-1 #1716 ó 1714  |
| MP-GV1 # 1916 ó 1914 | AC-51-Z     | GV-1 #1916 ó 1914  |
| MP-V1 # 1916 ó 1914  | AD-5-U      | V-1 # 1916 ó 1914  |
| MP-GV1 #1916 ó 1914  | AD-51-U     | GV-1 #1916 ó 1914  |
| MP-V1 #1616 ó 1614   | AE-5-U      | V-1 #1616 ó 1614   |
| MP-A1                | "T" Cap     | A-1                |
| MP-A2                |             | A-2                |
| MP-A4                |             | A-4                |
| MP-V0                |             | V-0                |

- "G" indicates guided or non-rotating feature which is obtained by utilization of an optional tray deck opening.

## Stock Numbers for MP-V1 Valves

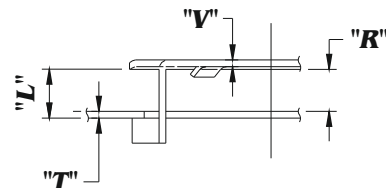
| Valve Gage | 3/8" Leg length<br>(used for 14 ga.<br>tray decks) | 7/16" Leg length<br>(used for 10 & 12 ga.<br>tray decks) | 9/16" Leg Length<br>(used for 3/16" & 1/4"<br>tray decks &<br>extruded<br>openings) |
|------------|--|--|---|
| 16         | 1616   | 1716   | 1916  |
| 14         | 1614   | 1714   | 1914  |
| 12         | 1612   | 1712   | 1912  |

12 Ga. valves (by industry standard practice) are actually 14 Ga. valves w/welded slugs to achieve 12 Ga. equivalent weight.

(for further explanation of **Mapesa** valves see page 10)

## Stock Number Example

**MP-V1** stock no. 1716 is for a 16 ga. valve with a 7/16" leg length. If installed in a 12ga. (.104") tray deck the net rise = .4375" - .104" = 0.334"



"L" = valve leg length

"T" = tray deck thickness

"V" = valve thickness

"R" = net rise

# Hardware Conversion Table

| <b>Mapesa</b>             | <b>Sulzer/Nutter</b>     | <b>Koch/Glitsch/Norton</b> |
|---------------------------|--------------------------|----------------------------|
| Bottom Tray Clamp #BTC-50 | Universal Lever Clamp #1 | Bottom Tray Clamp #50      |
| Bottom Tray Clamp #BTC-51 | Universal Lever Clamp #2 | Bottom Tray Clamp #51      |
| Bottom Tray Clamp #BTC-52 | Universal Lever Clamp #3 | Bottom Tray Clamp #52      |
| Bottom Tray Clamp #BTC-24 | Single Lever Clamp       | Bottom Tray Clamp #24      |
| Top Tray Clamp #TTC-2     | Single Bar Clamp         | Top Tray Clamp #2          |
| Bottom Bar Clamp          | Double Lever Clamp       | Bottom Bar Clamp           |
| Top Bar Clamp             | Double Bar Clamp         | Top Bar Clamp              |
| Manway Lock Clamp #MLC-3  | Manway Washer            | Manway Lock Clamp #3       |
| Manway Lock Clamp#MLC-20  |                          | Manway Lock Clamp #20      |
| Manway Lock Stud #MLS-5   | Manway Stud              | Manway Lock Stud #5        |

## Seal Plates

|                |        |              |
|----------------|--------|--------------|
| MP-10 X 2 1/2" | 2.0"   | 10- X 2 1/2" |
| MP-10 X 3.0"   | 2 1/2" | 10- X 3.0"   |
| MP-10          | 3.0"   | 10           |
| MP-10A         | 3 1/2" | 10-A         |
| MP-10B         | 4.0"   | 10-B         |
| MP-10C         | 4 1/2" | 10-C         |
| MP-10D         | 5.0"   | 10-D         |
| MP-10E         | 5 1/2" | 10- X 6.0"   |
| MP-10DF        | 6.0"   | 10- X 6 1/2" |

# Tower Tray Loading Specifications

Customer \_\_\_\_\_ Date \_\_\_\_\_  
 Ultimate User \_\_\_\_\_ Revision No. \_\_\_\_\_  
 Unit Name \_\_\_\_\_ Mapesa Job No. \_\_\_\_\_  
 Vessel # \_\_\_\_\_ Inquiry No. \_\_\_\_\_  
 Service \_\_\_\_\_

Section

Number of Trays

|  |  |  |  |
|--|--|--|--|
|  |  |  |  |
|  |  |  |  |

## Process Data

Vapor to Tray #

Flow Rate (lb/hr)

Density (lb/ft<sup>3</sup>)

Temperature (°F)

Pressure (psig)

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Liquid from Tray #

Flow Rate (lb/hr)

Density (lb/ft<sup>3</sup>)

Viscosity (cp)

Surface Tension (dyne/cm)

Temperature (°F)

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System Factor (see Page 24)

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|--|--|--|--|

## Performance

Maximum DP per Tray (mmHg)

Maximum % Flood

Vapor rate ratio (min% / max%)

Liquid rate ratio (min% / max%)

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## Mechanical Data

Tray Type

Number of passes

Tower ID (in)

Tray Spacing (in)

Tray Deck Thickness (in)

Material type

Tower Access Manway ID (in)

|  |  |  |  |
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# Tray Design Considerations

Prompt and thorough processing of a tray inquiry usually requires a minimum of information as listed in the tray design data sheet shown at left, although unique conditions and needs will often dictate the necessity of special design considerations. Providing more information at the inquiry stage prior to placement of the purchase order is highly recommended by **Mapesa** for several reasons:

- This information can be very helpful in order to provide the most accurate pricing for the product that will ultimately be designed and manufactured.
- Potential tower trouble spots can be checked and alleviated or totally resolved.
- If existing equipment in a tower is being replaced, it is very important for the supplier to know the reason for the change. For instance, sometimes a corroded tray will be replaced with the exact design presently in a tower. (In this case, it would be logical to assume without further data that the performance of the tray was satisfactory). However, a different type of design or tray may be necessary if an increase in capacity is required.
- A tray that is known to experience excessive vibration, heavy liquid or vapor loading or pulsation should be noted as such. This will prompt us to propose our special dislodgement resistant trays that will increase its serviceable life and greatly reduce the potential for unnecessary tower shutdowns.
- It should always be considered that with any change of equipment, whatever the reason, an opportunity exists to improve other aspects of the equipment design, whether it be an improved metallurgy, process or mechanical design.

**Mapesa** is ready to help in the process of selecting and designing the optimum equipment for the needs of its customers. We realize the importance of up-front design considerations. For instance, we know that designing tray and tower attachment drawings for new vessels can be accomplished at an early stage, long before the vessel design drawings have been completed. This can potentially save extensive vessel piping and platform re-engineering time.

# System Factors

## SERVICE

## TYPICAL SYSTEM FACTOR

*Amine Units (MEA, DEA, MDEA, TEA)*

0.73

*Absorbers*

0.85

*Regenerators*

*Glycol*

*Absorbers*

0.73

*Regenerators*

0.75

*Caustic Wash (merox, Merichem)*

*Absorbers (if foam satable)*

0.30

*Regenerators*

0.60

*Hot Carbonate Processes*

*Absorbers*

0.85

*Regenerators*

0.90

*Primary Absorbers (Lt Ends)*

*Ambient Temperature*

0.85

*Refrigerated*

0.80

*Sponge Absorbers (FCC and Coker Units)*

*Ambient Temperature*

0.80

*Refrigerated*

0.75

*H2S Strippers (Naptha, Gas Oil)*

0.85

*Futural Fractionation*

0.85

*Sour Water Strippers*

0.60

*Asphalt Blowing Absorber*

0.40



# Tray General Terms and Definitions

**Active area:** the mixing area of the tray (located between the inlet area and downcomer).

**Blowing:** flooding condition encountered usually at very low liquid rates whereby a fine dispersion of liquid droplets are formed from excessive vapor velocities. Results are poor vapor/liquid contact and thus poor tray efficiency.

**Collector Tray:** contains chimneys permitting passage of vapor upward through the tray. It is placed at various levels in the tower for accumulating and drawing off liquids.

**Downcomer:** device which transfers or directs liquid from one tray to the tray or equipment below.

**Downcomer residence time:** average time span that the liquid (flowing down) remains in the downcomer cavity.

**Downcomer static seal:** prevents vapor from passing up the downcomers and encourages even liquid distributions over the tray. It is the height difference between the overflow or inlet weir and clearance height of the downcomer at the bottom of the apron.

**Downcomer flooding:** excessive liquid velocity in the downcomer that prevents the vapor from disengaging the aerated liquid exiting the downcomer. These excessive downcomer liquid velocities result in low residence time and poor vapor disengagement. Premature flooding occurs when poor vapor disengagement reduces the density of the vapor/liquid mixture in the downcomer, prompting a higher liquid (ie vapor/liquid mixture) level than a higher liquid density.

**Drawoff sump:** reservoir on a tray which collects liquid which will be drawn off.

**Dumping:** condition where all the liquid leaks through the tray openings and none flows over the weir.

**Entrainment separator:** device consisting of layers of wire mesh or baffles which is used to separate liquid droplets from the vapor.

**Flooding:** unstable operation where the tower is full of (or in the process of filling with) liquid and/or liquid/vapor mixture. The two main causes of flooding are: excessive downcomer filling and excessive entrainment (jet flood).

**Free area:** available tower area for vapor flow (tower area less the maximum area in the top of the downcomer(s)).

**Inlet weir:** barrier which is parallel and adjacent to the inlet downcomer. It evenly distributes the liquid flow and provides (in some cases) a liquid seal for the downcomer. Commonly used with valve trays to minimize leakage in the first rows of valves by creating a calming zone.

**Jet (entrainment) flooding:** caused when there is excessive vapor velocity through the active area of the tray and the liquid droplets carry over or "jet" to the tray above. Loss of efficiency, high pressure drop and an increase in liquid tray hold-up occurs. At the limit, liquid will not flow down through the tower resulting in massive liquid entrainment with the overhead vapor leaving the tower.

**Liquid entrainment:** condition where liquid is carried up from tray to tray by excessive vapor velocity. May cause poor tray efficiency.

**Liquid gradient:** liquid depth difference on the tray from the inlet to the outlet.

**Liquid loading:** liquid volume rate passing over a tray.

**Manways:** removeable panels provided in trays or reinforced openings in tower shells which allow workmen passage for installation, maintenance or inspection.

**Outlet (overflow) weir:** barrier located at the outlet side of the tray creating a seal with the downcomer from the tray above and maintaining a liquid level on the tray for proper vapor-liquid contact.

**Relative volatility:** comparative ratio of corrected vapor pressure of one material to another (ratio of their equilibria constants).

# Tray General Terms and Definitions

**Risers (bubble cap trays):** pipes (usually circular) which conduct the vapor from the vapor space below the tray to the annular space in the bubble cap above the slots.

**Risers (accumulator trays):** pipes (circular, rectangular or square) that conduct the vapor from the space below the tray to the open space above the liquid level.

**Seal pan:** reservoir normally located below the bottom tray in a vessel to prevent vapor from by-passing the downcomer of the lowest tray.

**Sump:** well or cavity which is used to collect all or a portion of liquid from a tray.

**Thermal expansion joint:** allows free thermal expansion which prevents cracking, buckling or warping of tray components.

**Tray beams:** large structural support members used for tray support which are usually parallel to the flow of liquid across the tray.

**Tray clamp (peripheral):** effective device utilized for firmly attaching tray edges to the support ring while still allowing thermal expansion without buckling trays.

**Tray efficiency:** ratio between the actual number of trays necessary and the number of theoretical equilibrium stages to accomplish a desired separation.

**Tray inlet sump:** located at the inlet side of a tray for the purpose of controlling and assuring equal and even distribution of liquid flow across a tray floor. Also provides downcomer clearance for high liquid rates.

**Tray layout:** installation drawings which show location, arrangement and size of valves, perforations, caps, risers, downcomers and weirs.

**Tray support rings:** flat rolled bars or angles welded to the tower on which the tray is clamped or through bolted.

**Tray spacing:** distance that separates two adjacent trays. This distance between trays should be adequate to enable the separation of the liquid and foam from the vapor before the vapor reaches the tray above.

**Truss:** lattice type framework comprised of top and bottom chord and strut angles used for support of larger trays. These members provide maximum support without blockage of vapor flow.

**Turndown ratio (flexibility):** range of operating conditions which a tray will perform satisfactorily is bound by the ratio of maximum to minimum tray loads.

**Ultimate system capacity (limit):** maximum vapor/liquid loads that the tower can handle, depending on the vapor/liquid physical properties. When the ultimate system capacity has been reached, the vapor loads cannot be increased by design or spacing of the trays, but only by increasing the internal diameter of the tower.

**Vapor crossflow:** condition where the vapor predominantly enters the tray at the outlet area and then flows over the tray counter to the flow of the liquid to enter the tray above. When the percent hole area is large, the flow path length is long and a significant liquid gradient exists, this usually occurs.

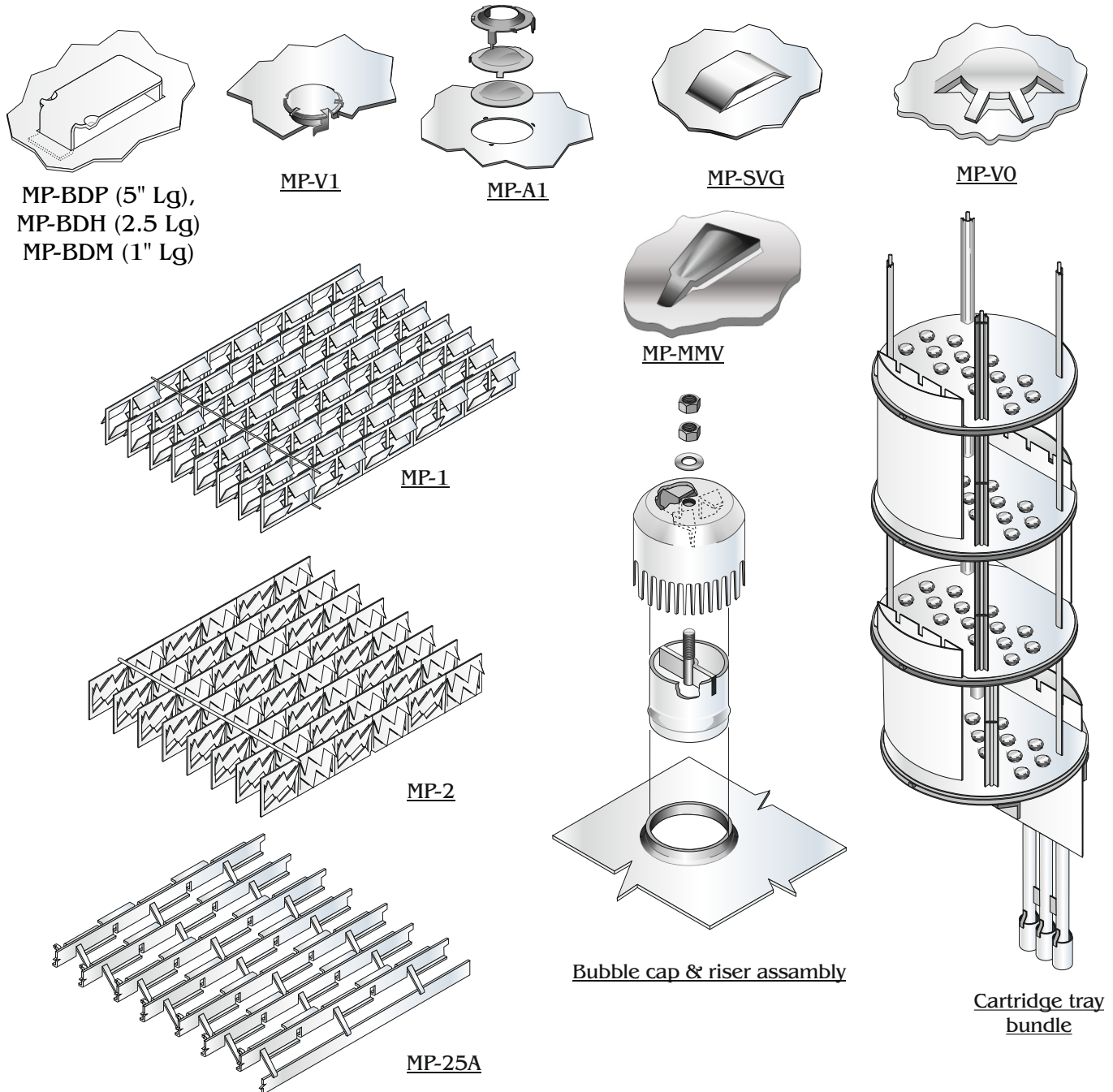
**Vapor entrainment:** carry down of vapor from one tray to the next by excessive downcomer velocity.

**Weep holes:** punched through the tray deck at locations where the liquid would otherwise accumulate and prevent complete tower drainage during shutdown.

**Weep point:** vapor rate at which the liquid starts leaking continuously through the active area openings.

**Mapesa** is a designer and manufacturer of high quality fractionation trays and tower internals. We are capable of handling small or large jobs in a short amount of time and at a very competitive price.

**Mapesa** can provide substantial cost savings to our customers by replicating trays originally furnished by Koch/Glitsch/Norton or Sulzer/Nutter.



Although competitive pricing is automatic, **Mapesa** maintains a constant focus on its mission; to successfully achieve complete customer satisfaction by, providing consistent on-time delivery of superior products which are designed and manufactured by an experienced and knowledgeable staff to surpass all customer expectations.



[www.mapesamx.com](http://www.mapesamx.com)