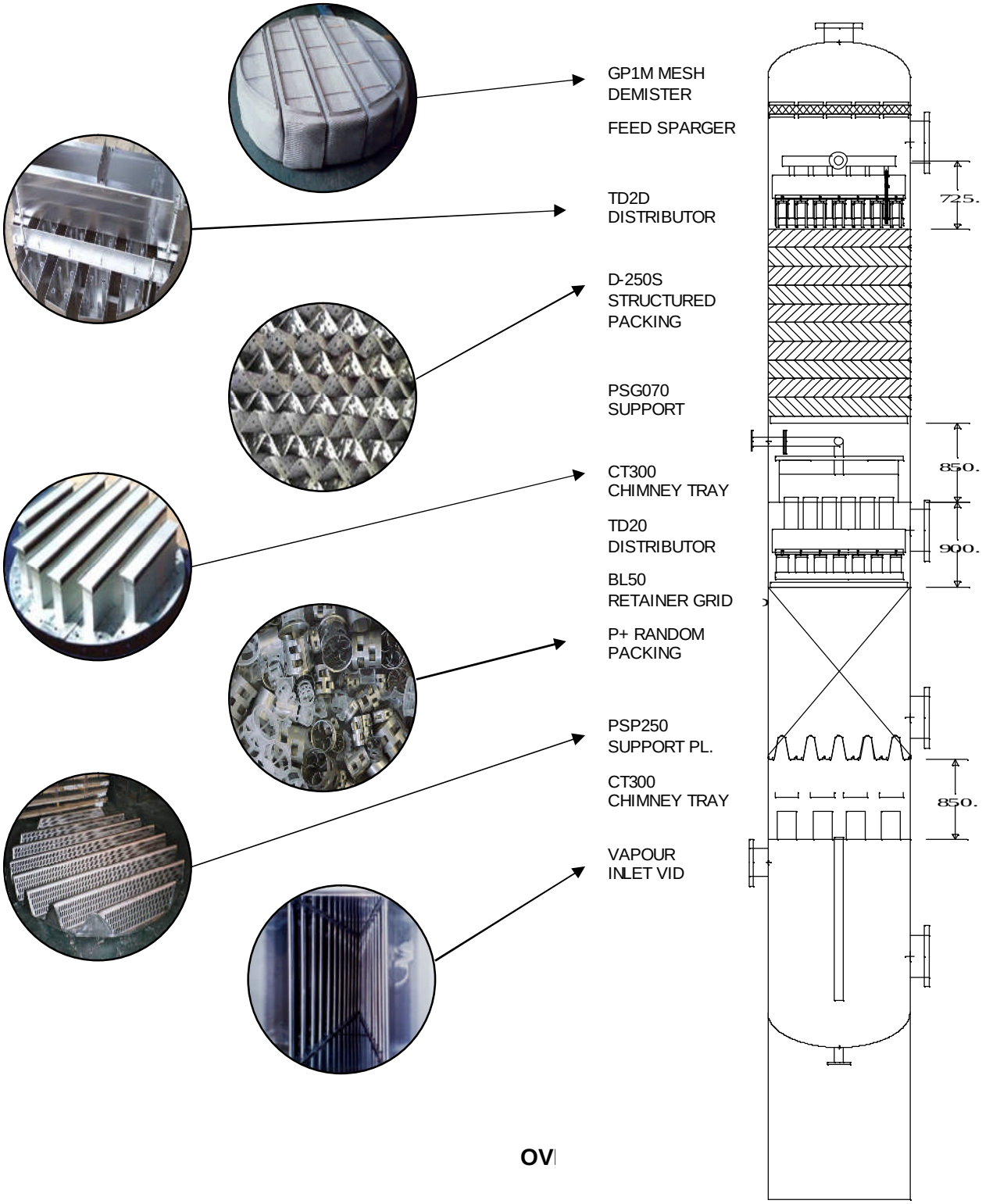
Tower Internals

TYPICAL ARRANGEMENT OF A PACKED COLUMN



OV

Tower Internals

Columns packed with either random or structured packing must also include several additional key internal components that are necessary for the packing to function. These internals include vapour and liquid feed distributors, packing support and hold down plates, entrainment separators and liquid draw trays, all of which must be designed to suit the specific service requirements. HAT have developed comprehensive engineering standards for the design and manufacture of high performance column internals based upon many years of installation experience and industry feedback. These standards are applied to custom design and manufactured internals to suit individual process and installation requirements resulting in consistent and reliable column performance.

General Arrangement

The typical arrangement of a packed column on page 1 indicates locations and space requirements for a range of internals. The internal clearances shown are the normal minimum required for access. Access manway locations should take account of future maintenance work which would typically include checking chimney trays and distributors and also possibly removal and replacement of the packing.

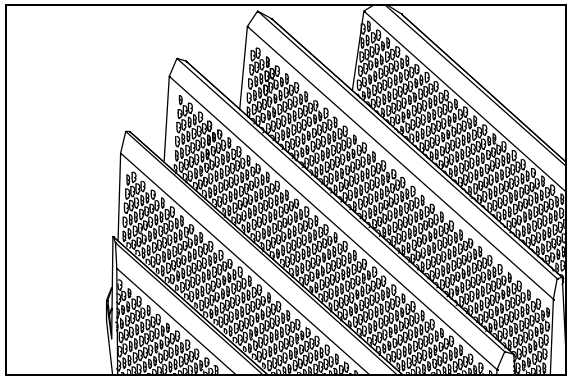
HAT have considerable experience in retrofitting existing columns with new internals by using unique design variations to overcome space restrictions and to use existing welded-in attachments.

PSP Packing Support Plates

To support a bed of random packings, an **AlphaPLUS™** "**PSP**" style of packing support plate, incorporating the following features should be installed:

- Gas Injection design for maximum capacity.
- Perforated beam design gives optimum strength.
- Standard perforation is suitable for most random packings.
- Modular construction to fit through vessel manways.

This "PSP" range is designed to ensure that the packing support plate will not present a capacity restriction in the column whilst providing sufficient strength to support a packed bed .



PSP250 PACKING SUPPORT PLATE

To support a bed of structured packing, an **AlphaPLUS** "**PSG**" style of packing support grid should be installed.

CT Chimney Trays

A purpose designed Chimney Tray must be installed to function as a collector device either for feeding to a liquid distributor (particularly flashing feeds) or for a liquid draw off. A leaky chimney tray will result in liquid by-passing the distributor causing maldistribution in the packed bed. To avoid

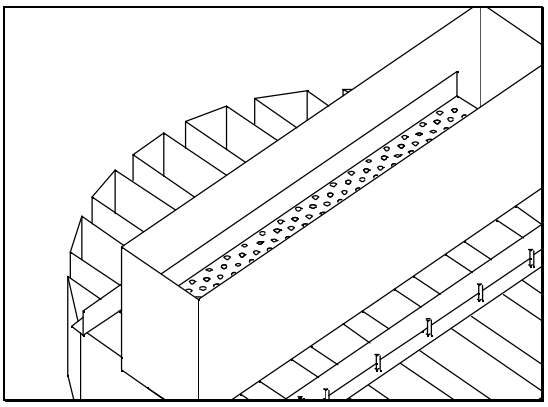
this, all chimney trays which are used to collect liquid to feed a liquid distributor should have all joints seal welded after installation.

Liquid Distributors

It is good design practice to avoid bolted joints that may result in leaks or level distortions. "OD" Pan type liquid distributors are favoured in small columns where the pan can be installed through a vessel flange as a complete unit. The "TD" range of liquid distributors are a Trough design for larger towers with installation through column manways to provide leaktight results.

The AlphaPLUS "TD" style of liquid distributors incorporate the following features:

- 100 distribution points/m^2 on a uniform pitch.
- The levelling mechanism can be adapted to suit access limitations.
- Metering of liquid is by punched orifices either in the trough floor or in drip tubes.
- Designed for 2:1 turndown as standard with design variations for extended range.



TD2O LIQUID DISTRIBUTOR

In high vapour rate systems, liquid distributors fitted with drip tubes to guide the liquid onto the surface of the packing (eg. TD2D) should be specified to avoid entrainment and vapour induced maldistribution. In addition to the gravity distributor range, we also supply "PD" Pipe Distributors for more precise control of the liquid.

Specific information on the full range of liquid and vapour distributors in the **AlphaPLUS** range are provided in separate design sheets.

BL Bed Limiter

To restrict packed bed movement in service, a suitably designed grid or screen should be fitted to the top of each packed bed. The levelling beams of the liquid distributor can be designed to prevent the movement of structured packing. Beds of random packing require separate structure consisting of a suitably sized wire screen attached to grid or frame (eg. type BL50). This must be secured to the vessel wall immediately above the packed bed to ensure that the top of the packing remains level.

Mist Eliminators

Vapour flowing through a packed bed at typical loading rates below the flood point will shear liquid from the surface of the packing and carry it out of the packed bed as entrainment. In such cases a dis-entrainment device should be fitted at the top of the column to remove entrained liquid from the vapour before it exits the vessel. Knitted wire mesh pads, vane packs or axial swirl cyclones provide effective mist elimination over a range of vapour rates compatible with normal packed column operation.

Liquid Distributors

The **AlphaPLUS™ OD1O** Distributor is a version of the orifice pan configuration. The design is suitable for small diameter columns (normally less than 1200mm diameter) with clean liquid feeds and irrigation rates exceeding $10m^3/m^2$. Good quality liquid distribution is provided over a maximum turndown range of 2:1 through holes punched on the pan floor on with the standard giving 150 points/m^2 on an 80mm square pitch.

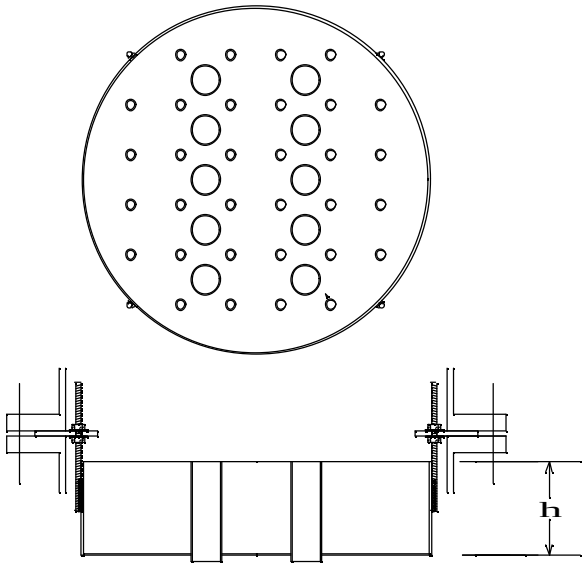
If the vapour rate is high and can cause distortion of liquid flow pattern or liquid entrainment in the space between the bottom of the pan and the top of the packing, guide tubes are fitted below the orifices.

The standard design is suitable for feed irrigation rates not exceeding $50m^3/m^2.h$. Higher irrigation rates require a special design with increased pan height to maintain distribution quality.

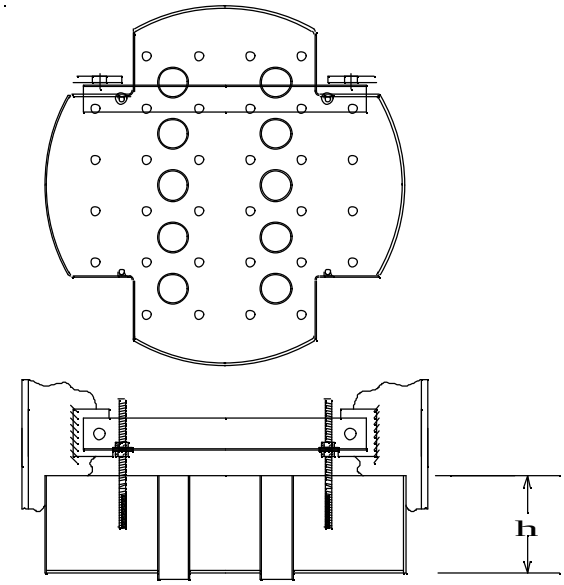
To avoid maldistribution from leaking joints as well as simplifying installation procedure, the distributor pan should be installed as a complete unit through a suitably located vessel flange.

To achieve good liquid distribution it is essential that the distributor is installed level to within +/- 3mm.This will result in achieving the design standard of liquid distribution quality and good overall operation of the packed bed.

TYPICAL ARRANGEMENT OF OD1O LIQUID DISTRIBUTOR



Flange mounted installation.



Wall cleat type installation.

IN ADDITION TO THE ABOVE TYPES OF INSTALLATION THE PAN MAY BE FIXED TO LUGS WELDED TO THE VESEL WALL.

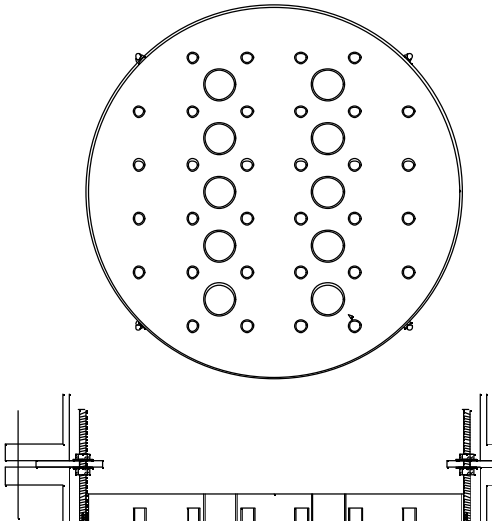
Liquid Distributors

The **AlphaPLUS™ OD1D** Distributor is a pan distributor with drip tubes, specifically designed to provide accurate distribution in low liquid feed rate applications (from less than 1 to 15 $m^3/m^2.hr$) within a turndown range of 2:1. The design is suitable for small diameter columns (normally less than 1200mm). Metering of the liquid is by orifices in the drip-tubes above the level of the bottom of the pan which allows solids to settle out on the floor of the pan thus making the OD1D suitable for use in low to moderate fouling services. The OD1D will provide good quality liquid distribution through drip-tubes arranged on a 80mm square pitch, giving 150 distribution points/m^2 across the total tower cross section. The drip-tube length is normally sized to extend to within 25mm of the top of the packed bed in order to effectively eliminate liquid maldistribution and entrainment induced by the effects of vapour flow on the liquid flowing from the troughs.

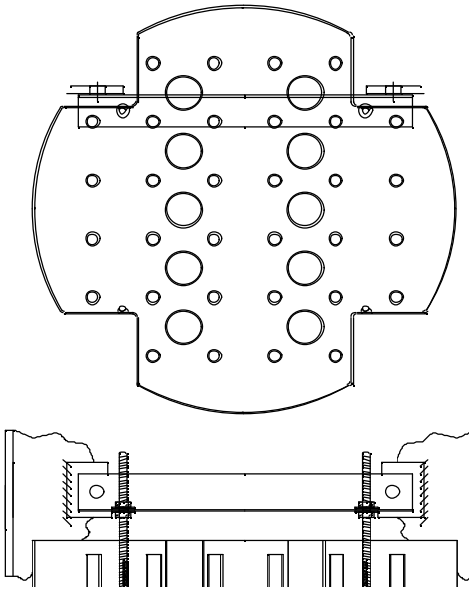
Where required, a wider turndown range can be accommodated by using a variation to the standard design with multiple levels of perforation in the drip tubes. Thus the OD2D liquid distributor will operate over a 4:1 turndown range.

Proper installation of the liquid distribution system is essential to achieve the design standard of liquid distribution quality and good overall operation of the packed bed. The distributor must be levelled to within +/- 3mm by adjustment of the locknut positions on the tie bars.

TYPICAL ARRANGEMENT OF OD1D LIQUID DISTRIBUTOR



Flange mounted installation.



Wall cleat type installation.

IN ADDITION TO THE ABOVE TYPES OF INSTALLATION THE PAN MAY BE FIXED TO LUGS WELDED TO THE VESSEL WALL.

Liquid Distributors

The **AlphaPLUS™ TD2O** Trough Distributor is an optimised design for clean liquid feeds where the irrigation rate is greater than 12 m^3/m^2.hr and where the required maximum turndown range does not exceed 2:1. Within these parameters, the TD2O will provide good quality liquid distribution through orifices punched in the bottom of the troughs arranged on a 100mm square pitch across the total tower cross section.

The TD2O is ideally suited to high liquid rate fractionation duty in columns packed with either random or structured packing where distribution quality greatly influences separation efficiency.

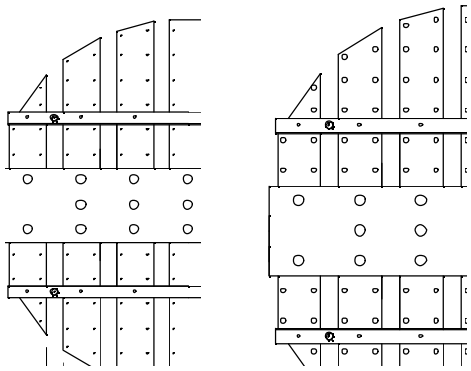
The standard design is suitable for feed irrigation rates not exceeding 60m^3/m^2.h. Higher irrigation rates require a special design with larger troughs to maintain distribution quality at turndown rates.

The TD2O Liquid Distributor is designed to be suspended from wall cleats with tie rods from which the unit is levelled.

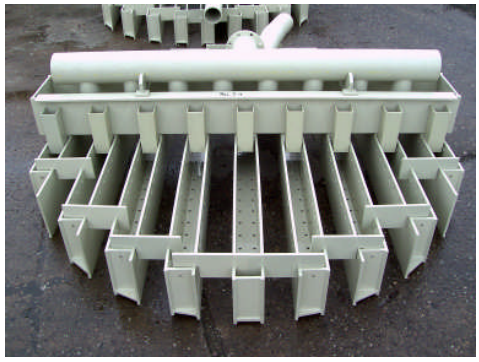
The **AlphaPLUS™ TD2D** Trough Distributor is specifically designed for accurate distribution in low liquid feed rate applications (less than 18 m^3/m^2.hr) with a turndown requirement of 2:1. The liquid is distributed by orifices in the drip-tubes above the level of the bottom of the troughs which allows solids to settle out on the floor of the trough thus making the TD2D suitable for use in low to moderate fouling services. The TD2D provides good quality liquid distribution through drip-tubes arranged on a approx. 100mm square pitch) across the total tower cross section. The drip-tubes are sized to extend to within 25mm of the top of the packed bed to effectively eliminate liquid maldistribution and entrainment induced by the effects of vapour flow on the liquid flowing from the troughs.

Where required. a wider turndown range can be accommodated with multiple levels of perforation in the drip tubes with minimum effect on distribution quality. Thus the TD4D liquid distributor will operate over a 4:1 turndown range.

TYPICAL ARRANGEMENT OF
TD20 and TD2D
LIQUID DISTRIBUTORS



Proper installation of the liquid distribution system is essential to achieve the design standard of liquid distribution quality and good overall operation of the packed bed. The distribution troughs and parting box must be leveled to within +/- 4mm in accordance with the installation instructions supplied with the TD Liquid Distributors.

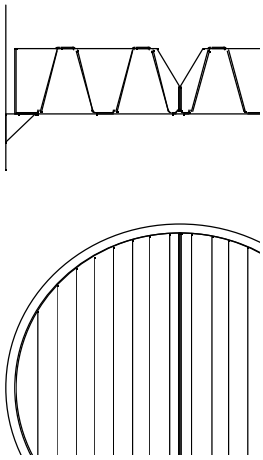


Packing Supports

The **AlphaPLUS™ PSP110** is a gas injection packing support plate for use in small random packed columns with diameter less than 1200mm. The multi-beams perforated with slots are fabricated in sections to pass through the vessel manways and bolt together inside the column. The PSP110 provides approximately 85% open area for the gas flow.

The support plate should be supported on wall clips or annular ring welded to the inside vessel wall. It is recommended that clips be used on smaller column up to 600mm diameter as not to effect the gas and liquid flow rates.

TYPICAL ARRANGEMENT OF PSP110
PACKING SUPPORT PLATE

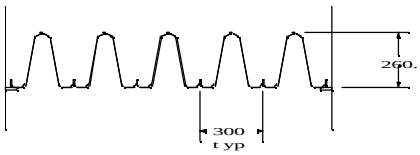


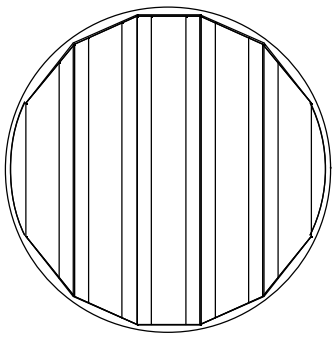
View of PSP showing perforations

The **AlphaPLUS™ PSP250** is based on the industry standard "Gas Injection" type packing support plate for columns larger than 1200mm diameter. The multi-beams perforated with slots are fabricated in sections to pass through the vessel manways and bolt together inside the column. The standard perforations provide a total open area for vapour and liquid flow equivalent to about 95% of the column cross section area whilst retaining all random packings of nominal size 12mm and larger.

A full annular support ring needs to be welded to the column of the wall to hold the support plate. The width of the support ring should be 50mm for column diameters up to 2000mm, 65mm for column diameters from 2000mm to 3500mm and 75mm for column diameters greater than 3500mm. Columns greater than about 2000mm in diameter may require midspan support depending upon bed height and liquid hold-up. Generally it is not necessary to bolt or clamp the support plate sections together or to the support ring since the weight of the packing will in most cases be sufficient to prevent any movement of the support plate in service.

TYPICAL ARRANGEMENT OF PSP250
PACKING SUPPORT PLATE



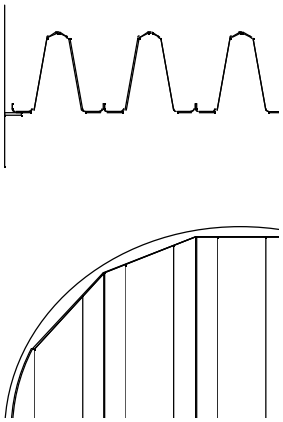


Packing Supports

The **AlphaPLUS™ PSP290** is an industry standard high capacity "Gas Injection" type packing support plate for columns larger than 1200mm internal diameter. The multi-beams perforated with slots are fabricated in sections to pass through the vessel manways and bolted together inside the column. The standard perforations provide a total open area for vapour and liquid flow equivalent to 100% of the column cross section area whilst retaining all random packings of nominal size 19mm and larger.

A full annular support ring needs to be welded to the column of the wall to hold the support plate. The width of the support ring should be 50mm for column diameters up to 2000mm, 65mm for column diameters from 2000mm to 3500mm and 75mm for column diameters greater than 3500mm. Columns greater than about 2000mm in diameter may require midspan support depending upon bed height and liquid hold-up. Generally it is not necessary to bolt or clamp the support plate sections together or to the support ring since the weight of the packing will in most cases be sufficient to prevent any movement of the support plate in service.

TYPICAL ARRANGEMENT OF PSP290
PACKING SUPPORT PLATE



The **AlphaPLUS™ PSG070** is a flat bar type support grid designed for use with structured packing. The standard grid is made up in 375mm wide segmental sections which can be installed through column manways (minimum manway size 450mm NB) and bolted together inside the column. The standard design has grid bars spaced on 75mm centres but variations with closer grid spacings can be manufactured to support random packings where the support plate capacity is not critical.

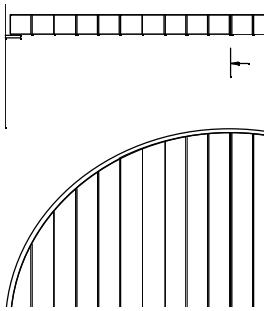
A full annular support ring needs to be welded to the wall of the column to hold the support plate. The width of the support ring should be as stated for the PSP250.

The load capacity for PSG070 support grids are manufactured from standard gauge stainless steel is 2200 kg/m^3 where the maximum free span length does not exceed 2100mm.

Column I.D. (mm)	Number of Sections	Mass* (kg)
750-1150	3	42
1150-1530	4	74
1530-1900	5	116
1900-2280	6	158
2280-2660	7	220
2660-3040	8	270
3040-3420	9	365
3420-3800	10	450
3800-4280	11	565

* Approximate for standard gauge stainless steel construction.

TYPICAL ARRANGEMENT OF PSG070



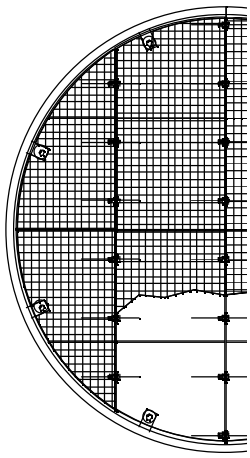
Retainers/Redistributors

The **AlphaPLUS™ BL50** Bed Limiter is designed for installation directly above a bed of random tower packing to contain any tendency of the bed to fluidise and thus maintain the levelness of the top of the bed. It can be secured to the vessel wall by attachment to wall clips or annular ring, but these should not effect the liquid distribution. Alternatively in smaller columns it can be supported from the distributor above. The bed limiter also prevents packing from being blown into the distributor pan or troughs.

The bed limiter is manufactured from a wire screen fastened to an annular frame In general, the bed limiter will have not less than 85% free area for gas and liquid flow. For columns larger that 400mm internal diameter, the BL50 bed limiter is fabricated in sections which can be installed through the column manway, this is achieved by bolting the sections together inside the column.

The BL50 bed limiter is designed to prevent the movement of the packing and not to provide a working platform and should in not under any circumstances be used for this purpose.

TYPICAL ARRANGEMENT OF BL50 BED LIMITER

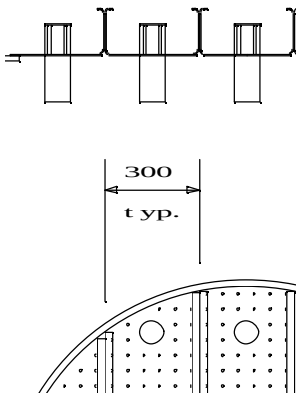


The **AlphaPLUS™ DSP300** is designed to function both as a support plate for random packing and as a collector/distributor/support plate for the dispersed phase in liquid-liquid extraction columns.

For liquid-liquid applications, when the light phase is the dispersed phase it collects below the plate and is distributed evenly across the tower cross section through orifices which are sized to provide optimum injection velocity. The heavier continuous phase is able to pass down through the coalesced head of dispersed phase which collects below the plate through a series of downpipes. In order to retain the packing, the downpipes extend 100mm above the plate and are formed into slotted caps. If the heavy phase is dispersed, the plate is turned over with slotted caps on the underside and is located at the top of the packed bed to function in the same way as a liquid distributor in a vapour liquid system.

The plate is supplied in 300mm wide segmental sections to be installed through column manways and bolted together inside the column. The plate should be clamped to a full annular support ring which needs to be welded to the wall of the column.

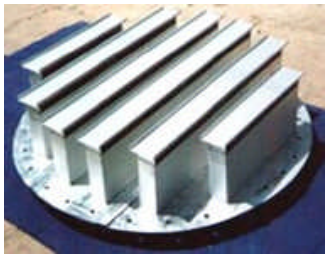
TYPICAL ARRANGEMENT OF DSP300 DISPERSER SUPPORT PLATE



Retainers/Redistributors

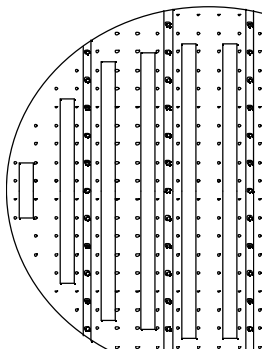
The **AlphaPLUS™ CT20** Chimney Tray is an industry standard chimney tray. The basic design is adaptable for use in a variety of applications such as a combined collector/redistributor between two packed beds or as a flashing feed distributor, with matching flashing feed gallery. When used to distribute high liquid rate feeds in large columns, a predistributor may be required. Essentially, the CT20 is a simple, low budget device which may be used where separation efficiency is not critical.

The standard version is designed to operate over a liquid rate turndown range of 2:1. Metering of the liquid is through orifices on 100mm square pitch punched in the tray deck across the total tower cross section.



CT Chimney Tray

TYPICAL ARRANGEMENT OF CT20 CHIMNEY TRAY



The CT20 Chimney Tray is supplied in sections for installation through vessel manways. The configuration as shown above should be clamped, through-bolted or seal-welded to a level support ring located between 100mm and 150mm above the top of the packed bed. The alternative arrangement is a one-piece design for clamping between vessel flanges and should be evaluated as a more practical design for installation in small diameter columns of less than 900mm

CT20 Chimney Trays are also available in fully sealed designs e.g. where a column has an integral vapour separator or knock-out section in its base, and with either pipe or box (as illustrated) type gas risers.