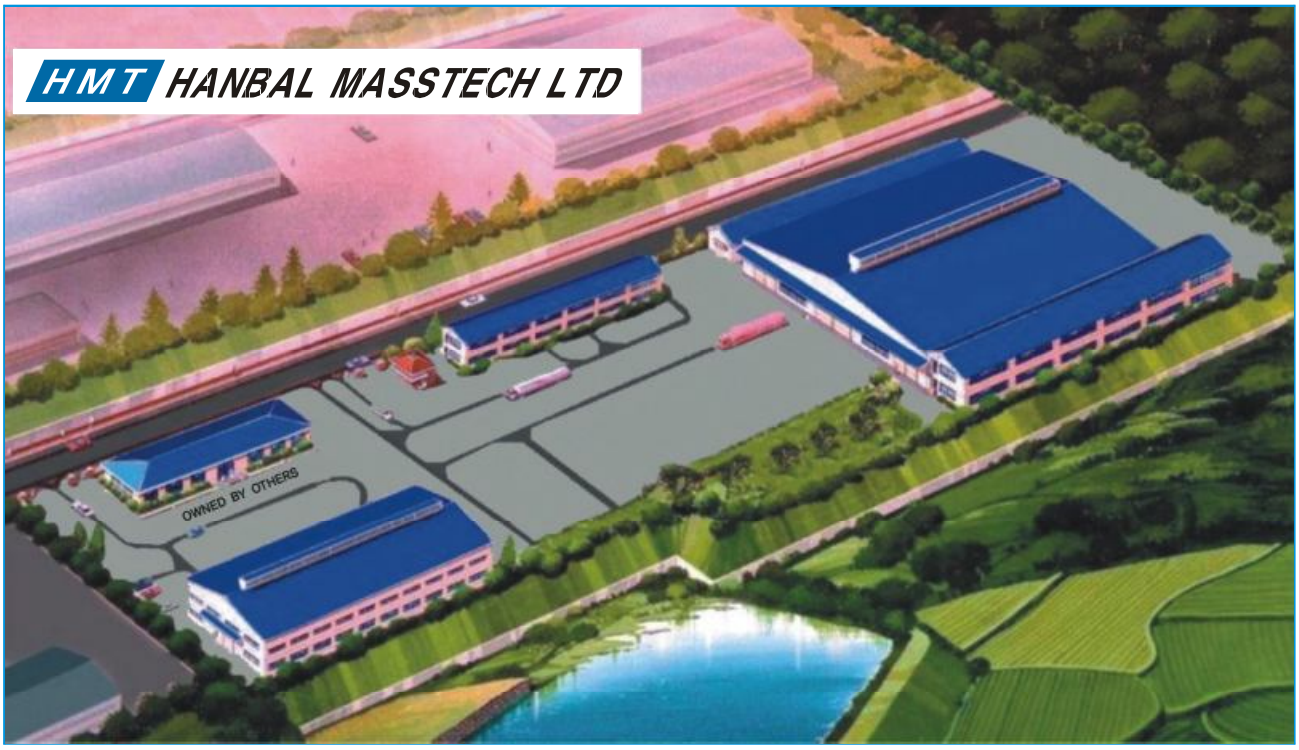
HMT

HANBAL MASSTECH LIMITED

MASS TRANSFER TECHNOLOGY

TOWER PACKINGS

		
NEW METAL RASCHIG RING	NEW METAL TOWER PACKING	NEW STRUCTURED PACKING
		
NEW METAL PALL RING	NEW PLASTIC PALL RING	NEW METAL N-PAK
		
NEW PLASTIC SUPER SADDLE	NEW CERAMIC SADDLE	NEW PLASTIC FROSTFLAKE®



INTRODUCTION

Hanbal Masstech was established in July 1971 as design and manufacturer of Tower Trays, Internals and Packings, Wire Mesh Mist Eliminators and their associated products to serve for Oil Refinery, Chemical, Petrochemical, Plant Engineering and Construction Companies and we are the pioneer of these items in Korea.

We joined Norton Chemical Process Products Corporation in 1979 as Sales Representative and worked with them as manufacturer, Joint Venture Partner(Norton Hanbal Korea Inc.), design/manufacturer and Licensee until April 2002.

We conducted R&D with Korea Institute of Energy Resources (KIER), especially noteworthy is the R&D held with KIER-Ruhr University in Germany-Hanbal as F.R.I. member for five years under government assistance and our R&D with KIER continues every year.

We learned most of the design and fabrication technologies from Norton CPPC, but we have some of our own that will meet our customer's specific requirements.

As we know what and how Norton had tested, and to continue to do that, we built an outdoor test facility, 20 feet(6 meters) square and 27 feet(8 meters) tall, for distribution quality test and what we have designed is questionable, we go for test to make it sure they are perfect.

We also design and produce traditional style internals which are good for easy towers and those cost about 30% less as compared to the high performance ones.

We thank you all for the finest helps and concerns rendered to us so far and wish the same in the future.

Sincerely, President & CEO

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NOTE :
1. OTHER TYPES OF PACKINGS ARE ALSO AVAILABLE.
2. NUMBERS FOR EACH VOLUME ARE APPROXIMATE AND VARIES DEPEND ON HEIGHT AND TOWER INSIDE DIAMETER.
3. USUALLY TO BE SAFE ENOUGH, 5-10% EXTRA VOLUME SHOULD BE ORDERED.
4. PLEASE CONSULT WITH US FOR INFORMATION AT THE TIME OF PLACEMENT OF ORDER.
5. CERAMIC AND CARBON RASCHIG RINGS ARE ALSO AVAILABLE ON REQUEST.

NEW METAL RASCHIG RINGS

Physical Data

Nominal Size Metric	10	12	16	19	25	32	38	50	75
Nominal Size Inch	3/8	1/2	5/8	3/4	1	1–1/4	1/1/2	2	3
Pieces per m^3	950000	410000	215000	120000	51000	25700	15000	6500	1900
Pieces per ft^3	26900	11610	6090	3400	1444	728	425	184	54
Void Space %	90.5	94	94.5	95.8	96	96.7	97	96.7	97.8

Pieces are approximate and weight varies depend on the thickness of material.
Available in Carbon Steel Stainless Steels of 410(S) 304(L) 316(L) 317(L) Titanium Monel Hastelloy C Aluminum Copper and other materials such as Carbon and Ceramic on request.

NEW METAL TOWER PACKINGS

Physical Data

Nominal Size Metric	NMTP 15	NMTP 25	NMTP 40	NMTP 50	NMTP 60	NMTP 70
Nominal Size Inch	5/8	1	1/1/2	2	2–1/2	3
Pieces per m^3	347000	135000	51400	15000	8700	4800
Pieces per ft^3	9825	3820	1455	425	246	136
Void Space %	94.7	96.7	97.3	97.8	98.0	98.1

Pieces are approximate and weight varies depend on the thickness of material.
Available in Carbon Steel Stainless Steels of 410(S) 304(L) 316(L) 317(L) Titanium Monel Hastelloy C Aluminum Copper and other materials on request.

NEW STRUCTURED PACKINGS

Physical Data

Type	NSP 1Y	NSP 1.5Y	NSP 2Y	NSP 3Y	NSP 4Y	NSP 5Y	NSP WG
Height per Layer Metric	266	266	281	273	273	273	171
Height per Layer Inch	10.47	10.47	11.06	10.75	10.75	10.75	6.75
Void Space %	97.6	98.2	98.4	98.6	98.7	99.1	97

Layers to be determined at the time of design by manhole size.
Available in Steels of 410(S) 304(L) 316(L) 317(L) Titanium Monel Hastelloy C Aluminum Copper and other materials on request.

NEW METAL PALL RINGS

Physical Data

Nominal Size Metric	16	25	38	50	90
Nominal Size Inch	5/8	1	1–1/2	2	3–1/2
Pieces per m^3	215000	51000	15000	6500	1200
Pieces per ft^3	6090	1444	425	184	34
Void Space %	93	94	95	96	97

Pieces are approximate and weight varies depend on the thickness of material.
Available in Carbon Steel Stainless Steels of 410(S) 304(L) 316(L) 317(L) Titanium Monel Hastelloy C Aluminum Copper and other materials on request.

NEW PLASTIC PALL RINGS

Physical Data

Nominal Size Metric	16	25	38	50	90
Nominal Size Inch	5/8	1	1–1/2	2	3–1/2
Pieces per m^3	214000	51000	15000	6500	1200
Pieces per ft^3	6060	1444	425	184	34
Wt. kg/m^3	95	80	70	60	43
Wt. lb/ft^3	5.93	4.50	4.35	3.85	2.70
Void Space %	87	90	91	92	93

Packing Material & Data are as shown on bellow. The weight is based on P.P.

Packing Material & Data on Plastics

Type of Plastic	Maximum Continuous Operating Temperature ℃	℉	Specific Gravity
General Grade Polypropylene	104	220	0.91
LTHA Polypropylene	119	247	0.91
LTHA Polypropylene (10% Glass reinforced)	127	260	0.97
High Density Polyethylene	100	212	0.95
Low Density Polyethylene	88	190	0.92
PVC	66	150	1.46
CPVC	85	185	1.55
Kynar[1] PVDF	143	290	1.77
Halar[2] E–CTFE	152	305	1.68
Tefzel[3] ETFE	149	300	1.70
Tefzel[3] ETFE (25% Glass reinforced)	200	392	1.86
Teflon[3] PFA	250	482	2.12

The actual temperature to be used at is the choice of customers.
C1. Trademark of Elf Atochem. 2. Trademark of Ausimont Corp. 3. Trademark of E.I. DuPont.

NEW METAL N-PAK

Physical Data

Nominal Size	No. 1	No. 1–1/2	No. 2	No. 3
Pieces per m^3	31400	10000	3900	1100
Pieces per ft^3	889	283	110	31
Void Space %	97	97	98	98

Pieces are approximate and weight varies depend on the thickness of material.
Available in Carbon Steel Stainless Steels of 410(S) 304(L) 316(L) 317(L) Titanium Monel Hastelloy C Aluminum Copper and other materials on request.

NEW PLASTIC SUPER SADDLES

Physical Data

Nominal Size	No. 1	No. 2	No. 3
Pieces per m^3	57500	6400	1500
Pieces per ft^3	1630	181	42
Wt. kg/m^3	95	60	48
Wt. lb/ft^3	5.85	3.75	3.0
Void Space %	90	93	94

Packing Material & Data are as shown on page 4 on Plastic. The weight is based on P.P.
Physical data for new ceramic saddles will be presented on request.

NEW PLASTIC FROSTFLAKE®

Physical Data

Size	50
Pieces per m^3	4925
Pieces per ft^3	139
Wt.* kg/m^3	45
Wt.* lb/ft^3	2.8
Void Space %	95

1. Packing Material & Data are as shown on page 4 on Plastic.
2. NEW PLASTIC FROSTFLAKE® has only one size and covers criteria of 1–1/2 inch, 2 inch and 3 inch Pall Rings.

INSTALLATION AND SUPERVISION

HMT HAS EXPERIENCES IN COUNTRIES SUCH AS: KOREA THAILAND MALAYSIA BRAZIL QATAR IRAN LIBYA SAUDI ARABIA INDIA INDONESIA EGYPT AZERBAIJAN P.R.C R.O.C U.S.A. (INSTALLED IN KOREA AT TOWER MAKERS SHOP)

HMT provides field consultants to assist customers with installation of our packings anywhere in the world and many companies save time by using our installation technicians and supervisors.
Please ask us for the installation manual for your specific project.

QUALITY ASSURANCE AND CONTROL POLICY

OUR ULTIMATE GOAL FOR QUALITY ASSURANCE AND CONTROL IS TO MAKE IT SURE WE DELIVER IN THE BEST QUALITY PRODUCTS WITH NO MISSING PARTS AT THE EXACT TIME WHERE THEY ARE REQUIRED.

WE HAVE LONG HISTORY, EXPERIENCES, SKILLED DESIGNERS, MANUFACTURERS, INSPECTORS, SUPERVISORS AND THE BEST MACHINES AND HAVE ENOUGH PLACE TO MAKE PRODUCTS GO STRAIGHT INTO BOXES FOR THE FINAL SHIPMENT.

OUR SYSTEM AND MACHINES DO THE MOST OF THE MISSIONS OUR CUSTOMERS WISH US TO ACCOMPLISH TO BE THEIR GOOD SUPPLIER.

PLEASE WRITE OR COME SEE US TO CONFIRM WHAT WE PROMISE IS TRUE.

PLEASE ASK US FOR ANSWERS BY REFERING THE FOLLOWING INFORMATION

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HMT HANBAL MASSTECH LIMITED

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http://www.hanbal.kr

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Certified ISO9001 by BVQI ANSI-RAB QMS ACCREDITED

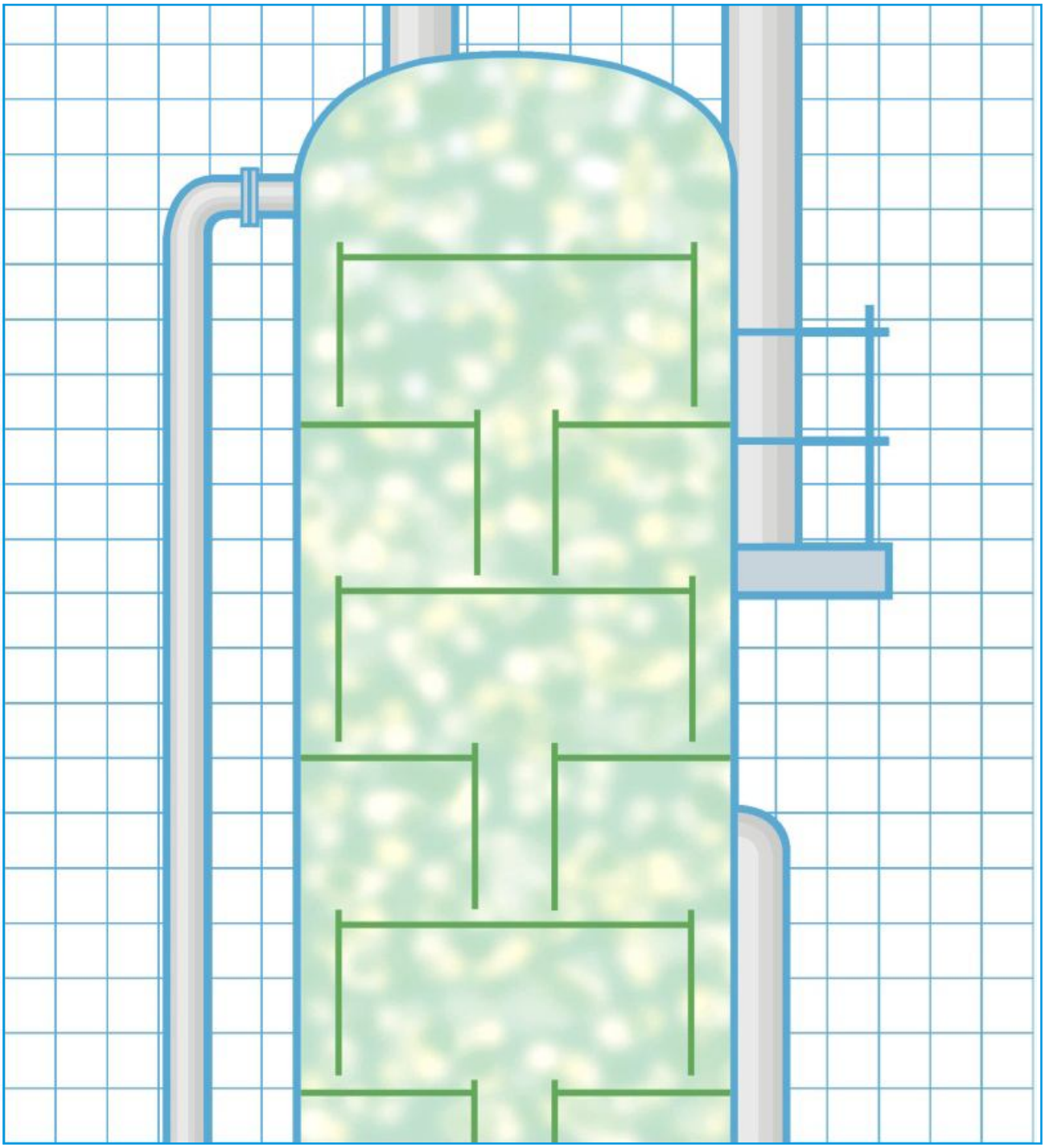
AGENT :

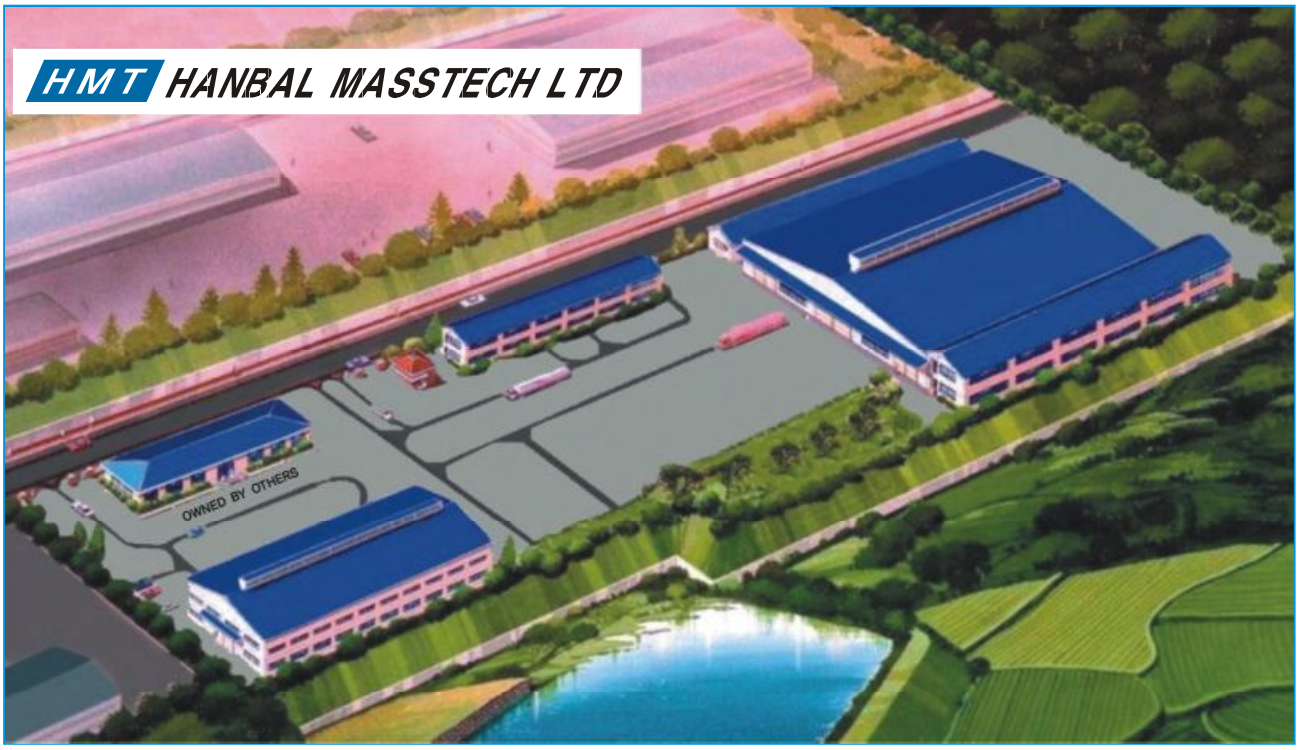
HMT

Fractionation Trays

HANBAL MASSTECH LIMITED

MASS TRANSFER TECHNOLOGY





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TYPE OF TRAYS

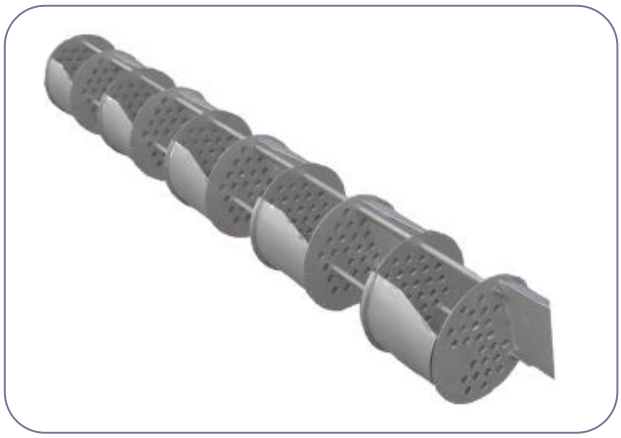
SIEVE TRAY

VALVE TRAY

FIXED VALVE TRAY FOR HIGH PERFORMANCE and CAPACITY

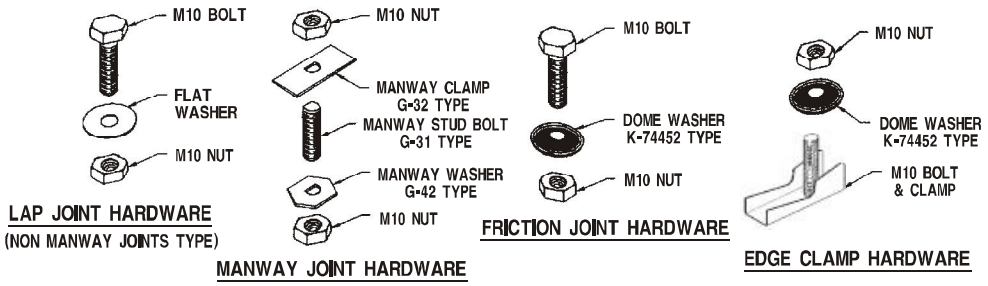
BUBBLE CAP TRAY

BUBBLE CAP TRAY IN P.P.



CARTRIDGE TRAY

TYPICAL TRAY LAYOUT AND HARDWARES

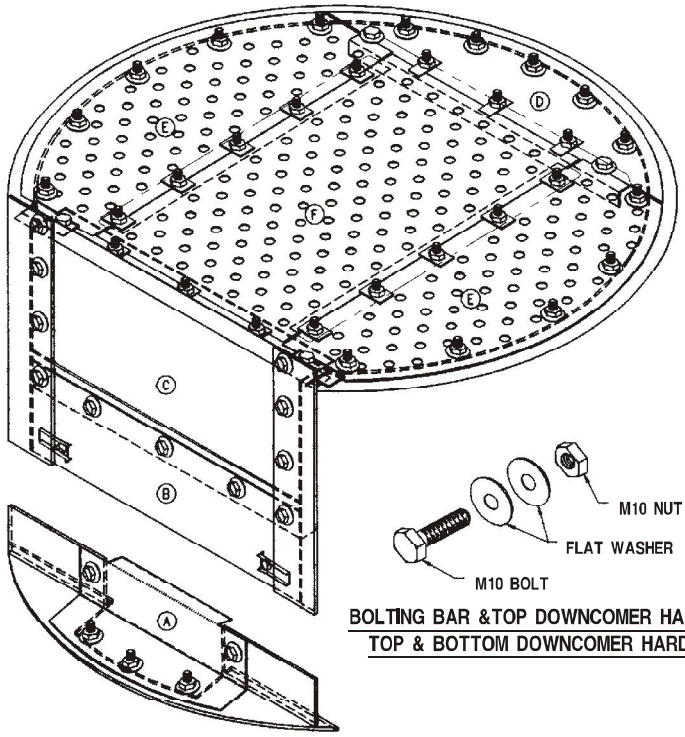


NOTE.
INCH STANDARD ALSO AVAILABLE

DESCRIPTION
Ⓐ SEAL PAN
Ⓑ BTM. DOWNCOMER
Ⓒ TOP DOWNCOMER
Ⓓ INLET DECK
Ⓔ ACTIVE DECK
Ⓕ MANWAY

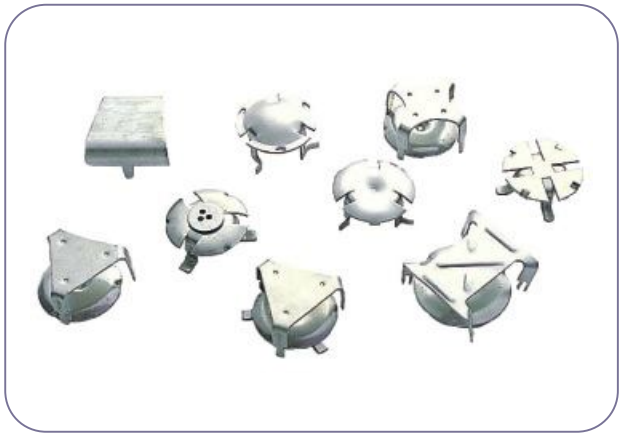
INSTALLATION
INSTALLATION FOR THIS DESCRIPTION PATTERN Ⓐ THRU Ⓕ

REMOVAL
REMOVAL FOR THIS DESCRIPTION PATTERN Ⓕ THRU Ⓐ



BOLTING BAR &TOP DOWNCOMER HARDWARE
TOP & BOTTOM DOWNCOMER HARDWARE

BUBBEL CAPS IN CARBON STEEL 304(L) 316(L) 410(S) S.S. TITANIUM P.P. PTFE CPVC FRP



CAPS FOR VALVE TRAY

SELECTION OF TRAY TYPE AND THEIR FEATURES

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 four 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 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 on 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 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 tray joints to prevent leakage.

- CARTRIDGE TRAYS (which are shop prefabricated into bundles of 4 of 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.

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

THE TERMS MOST FREQUENTLY ASKED ON TRAYS

ACTIVE AREA the mixing area of the tray (located between the inlet area and downcomer).

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.

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.

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 on the tray for proper vapor-liquid contact.

DOWNCOMER device which transfers or directs liquid from one tray to the tray or equipment below.

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.

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

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.

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.)

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.

TRAY EFFICIENCY ratio between the actual number of trays necessary and the number of theoretical equilibrium stages to accomplish a desired separation.

WEEP HOLES punched through the tray deck at locations where the liquid would otherwise accumulate and prevent complete tower drainage during shutdown.

DUMPING condition where all the liquid leaks through the tray openings and none flows over the weir.

SPECIAL TRAY DESIGN FEATURES TO ENHANCE PERFORMANCE

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 flow 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 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.

In addition to the special features listed above, Hanbal Masstech 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.

DISLODGEMENT RESISTACE 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).

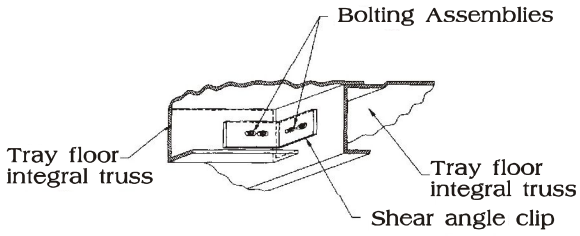


Figure a
(Integral truss to integral truss connection)

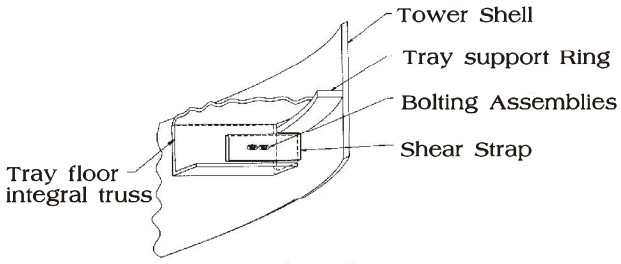


Figure b
(Integral truss to tray support ring connection)

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

- 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.

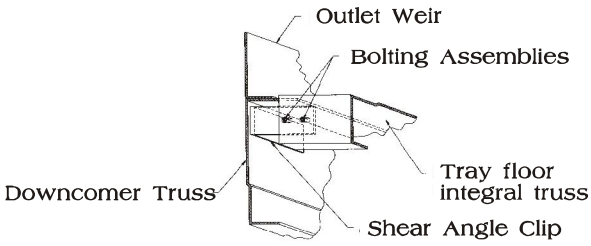


Figure c
(Tray to downcomer connection)

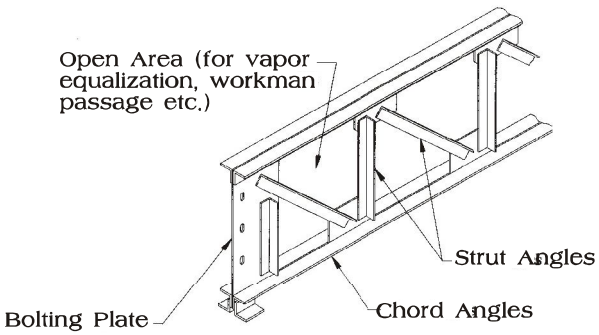


Figure d
(Lattice truss)

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

HMT 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.

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 HMT 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 (407mm) 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. (1828.8 mm)
Two	6 ft-0 in. to 8 ft-5 in. (2565.4 mm)
Three	8 ft-6 in. to 10 ft-11 in. (3327.4 mm)
Four	11 ft-0 in. and greater (3352.8 mm)

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 HMT utilizes are listed below starting from least expensive:

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

Other fairly common materials for tray fabrication are as follows:

- Type 304L stainless steel
- Type 317 stainless steel
- Type 321 stainless steel
- Type 904L stainless steel
- Type 316L stainless steel
- Type 317L stainless steel
- Type 347 stainless steel
- Type 254 SMO

HMT has experiences and skills at tray fabrication, utilizing many of materials bellow such as:

- Titanium
- Zirconium
- Hastelloy
- Monel
- Inconel
- Nickel
- AL-6XN
- Everdur
- Copper
- Aluminum
- Polypropylene
- Polyethylene
- C-PVC
- Teflon
- F.R.P.

INSTALLATION-DEMOLITION-SUPERVISION

HMT HAS EXPERIENCES IN COUNTRIES SUCH AS: KOREA THAILAND MALAYSIA BRAZIL QATAR IRAN LIBYA SAUDI ARABIA INDIA INDONESIA EGYPT AZERBAIJAN P.R.C R.O.C U.S.A. (INSTALLED IN KOREA AT TOWER MAKERS SHOP)

INSTALLATION SERVICES FOR :

- BUBBLE CAP, VALVE, SIEVE, CARTRIDGE AND DUAL FLOW TRAYS
- PACKED TOWER AND REACTOR INTERNALS
- RANDOM, STRUCTURED, METAL, PLASTIC AND CERAMIC PACKINGS
- CONSULTATION AND SUPERVISION

QUALITY ASSURANCE AND CONTROL POLICY

OUR ULTIMATE GOAL FOR QUALITY ASSURANCE AND CONTROL IS TO MAKE IT SURE WE DELIVER IN THE BEST QUALITY PRODUCTS WITH NO MISSING PARTS AT THE EXACT TIME WHERE THEY ARE REQUIRED.

WE HAVE LONG HISTORY, EXPERIENCES, SKILLED DESIGNERS, MANUFACTURERS, INSPECTORS, SUPERVISORS AND THE BEST MACHINES AND HAVE ENOUGH PLACE TO MAKE PRODUCTS GO STRAIGHT INTO BOXES FOR THE FINAL SHIPMENT.

OUR SYSTEM AND MACHINES DO THE MOST OF THE MISSIONS OUR CUSTOMERS WISH US TO ACCOMPLISH TO BE THEIR GOOD SUPPLIER.

PLEASE WRITE OR COME SEE US TO CONFIRM WHAT WE PROMISE IS TRUE.

PLEASE ASK US FOR ANSWERS BY REFERING THE FOLLOWING INFORMATION

CONTACT	TELEPHONE	FACSIMILE	E-MAIL
EXECUTIVE DIRECTOR	82-55-310-2121	82-55-338-1917	bhkang@hanbalmasstech.com
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TECHNICAL	82-55-310-2181	82-55-338-1919	mjkim@hanbalmasstech.com
MANUFACTURE	82-55-310-2161	82-55-338-2919	mjcho@hanbalmasstech.com
QUALITY MANAGEMENT	82-55-310-2176	82-55-338-1917	ydyu@hanbalmasstech.com
LOGISTICS	82-55-310-2162	82-55-338-2919	hclee@hanbalmasstech.com

HMT HANBAL MASSTECH LIMITED

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#1080-4 Naesam-ri, Juchon-myeon, Gimhae-si, Gyeongsangnam-do, Korea
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SEOUL OFFICE : TEL. +82- 2-412-0851 FAX. +82- 2-413-0272

Certified ISO9001 by BVQI ANSI-RAB QMS ACCREDITED

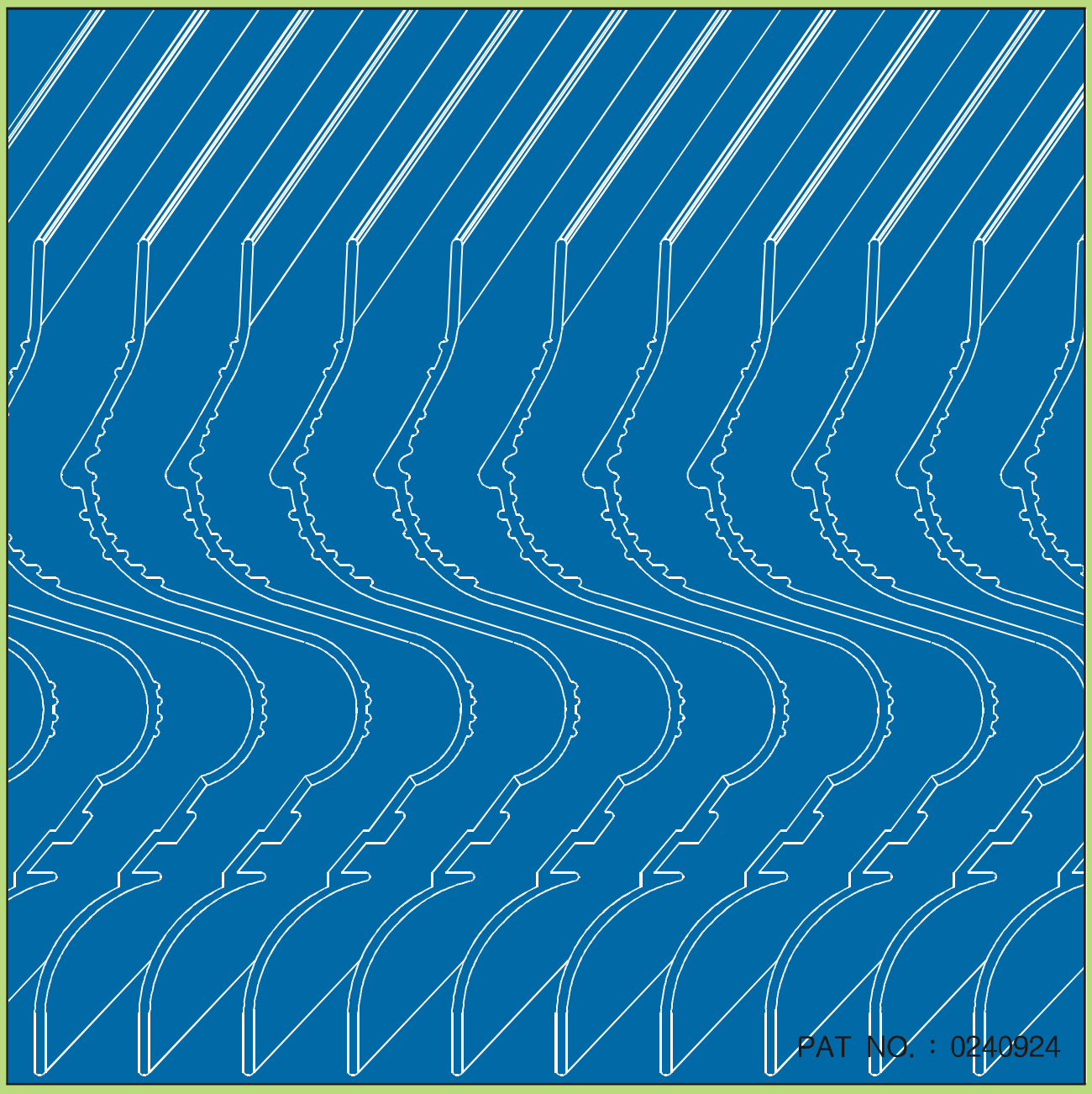
AGENT :

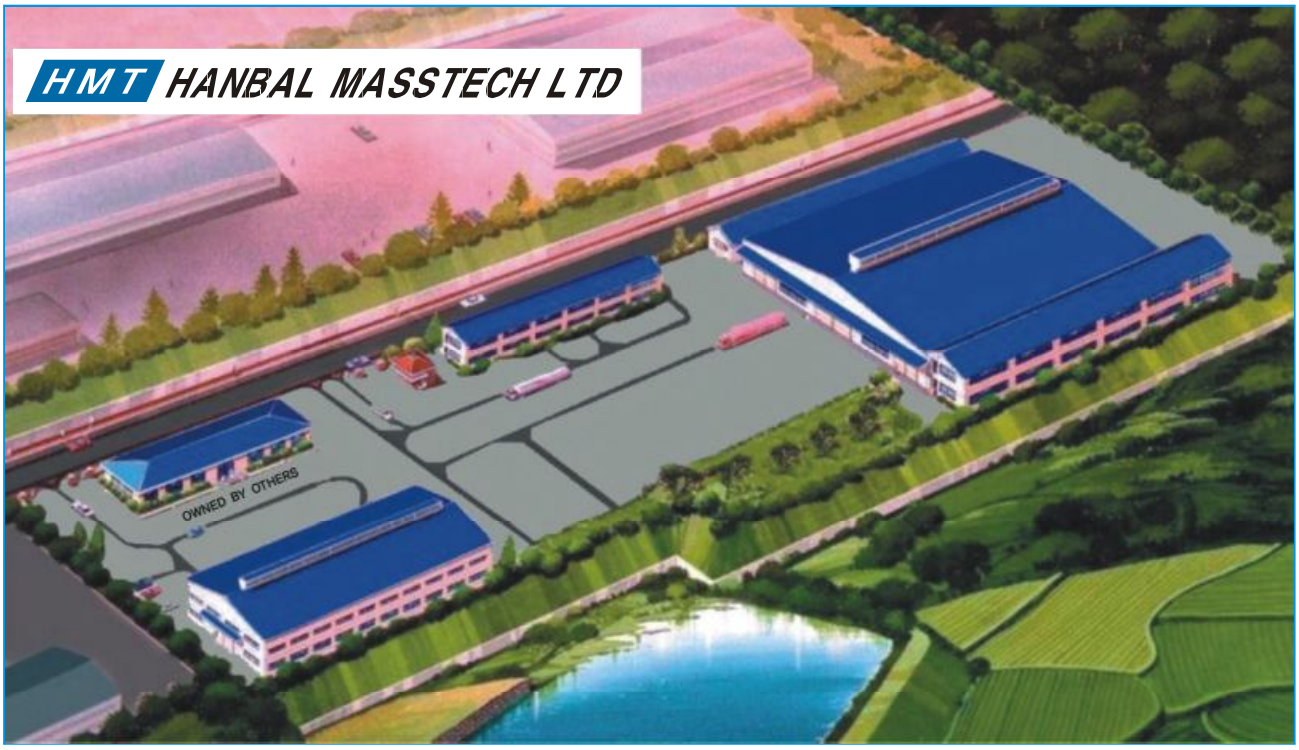
HMT

HANBAL MASSTECH LIMITED

ENVIRONMENT DIVISION

New Multi-Wave Vane Mist/Dust Eliminators





INTRODUCTION

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Sincerely, President & CEO

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NEW MULTI-WAVE ELIMINATOR의 개요 (WHAT IT IS)

유속이 빠르며 입자가 크고 점도가 높으며 먼지나 이물질이 함유된 유해 가스는 Wire Mesh Demister나 여과 휠터로는 제거할 수 없어, 대기 오염이나 생산 공정에 지장을 초래하는 문제점 해결을 위해 새로이 개발된 Separator/Eliminator로 20 micron 정도를 99.8% 이상 포집하는 고성능 Eliminator입니다.

Where most droplets are so viscous and contain many components and possibly some dusts and when wire mesh demisters can not obtain the purposes and cause problems on process streams or environmental control, our new multi-wave eliminator will give answers to your problems eliminating more than 99.8% of the mist/dust sizes up to 20 micron.

NEW MULTI-WAVE ELIMINATOR의 SEPARATION 원리 (HOW IT WORKS)

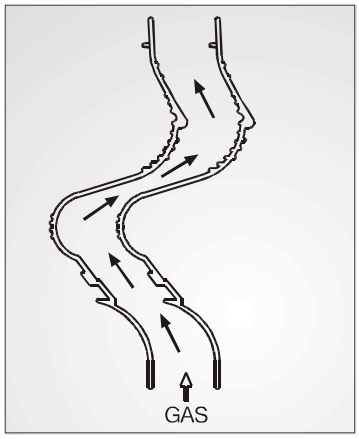


Fig.1

Fig.1 에 나타낸 것과 같은 구조로서 Eliminator를 통과하는 처리 Gas에 유로의 변경, 속도의 가속·감속을 행하여지게 하여 Gas에 포함된 Dust, 혹은 Mist에 관성력을 주어 Gas와 분리시켜 포함하는 것이다.

Fig.1 shows the gases go through the eliminator changes flow direction, make more faster or slower thereby making the droplets contact each other and glow in sizes and fall off.

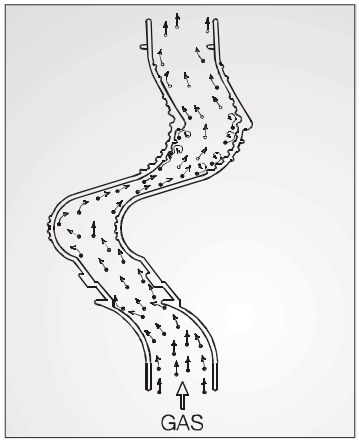


Fig.2

또한 Fig.2 에 나타낸 것과 같은 본 New Multi-wave Eliminator는 판의 표면에 요철을 다수 배치하여 Gas 흐름에 의한 정압·부압 영역을 만들게 하여 mist/dust separation 효율을 종래 Type보다 높은 것을 얻을 수 있는 구조를 가지고 있다.

Fig.1 shows why it can be done. The plate has many irregular points with different shapes and heights so that the different types of pressures can be given at each contact points thereby making extremely high performance achievement.

용 도 (APPLICATION)

GAS 냉각탑, 세정탑, 흡수탑, 반응탑, 도시가스 SCRUBBER, 습식 전기집진기 등의 배출구에는 이물질이 포함된 많은 mist/dust가 배출되어 비산하는 경우가 많으므로 이를 극소화 할 목적으로 새로이 연구 개발된 제품입니다.

기술 검토에 문제가 있을 시 당사로 문의해 주시면 설계/시공에 대한 상세한 설명을 해 드리겠습니다.

Where they are used :

Outlet area of Gas Cooler, Wash Tower, Reactors, City Gas Scrubber and Wet-type Electrostatic Precipitator, etc contain mists with many types of dusts and cause pollution problems. This eliminator has been developed to minimize these problems. Please ask us information for selection and application.

특 징 (PECULIARITY)

1. Mist 혹은 Dust를 99.8% 이상 포집할 수 있다.
   MIST OR DUST CAN BE REMOVED BY MORE THAN 99.8%

2. 압력 손실이 낮으며 경량이다.
   LIGHT WEIGHT AND LOW PRESSURE DROP.

3. 기존 Vane Type Eliminator보다 유속이 약 20~30% 빠른 상태에서 포집 가능하다.
   APPLICABLE AT THE VELOCITY OF MORE THAN 20~30% HIGHER AS COMPARED TO THE OTHER ELIMINATORS.

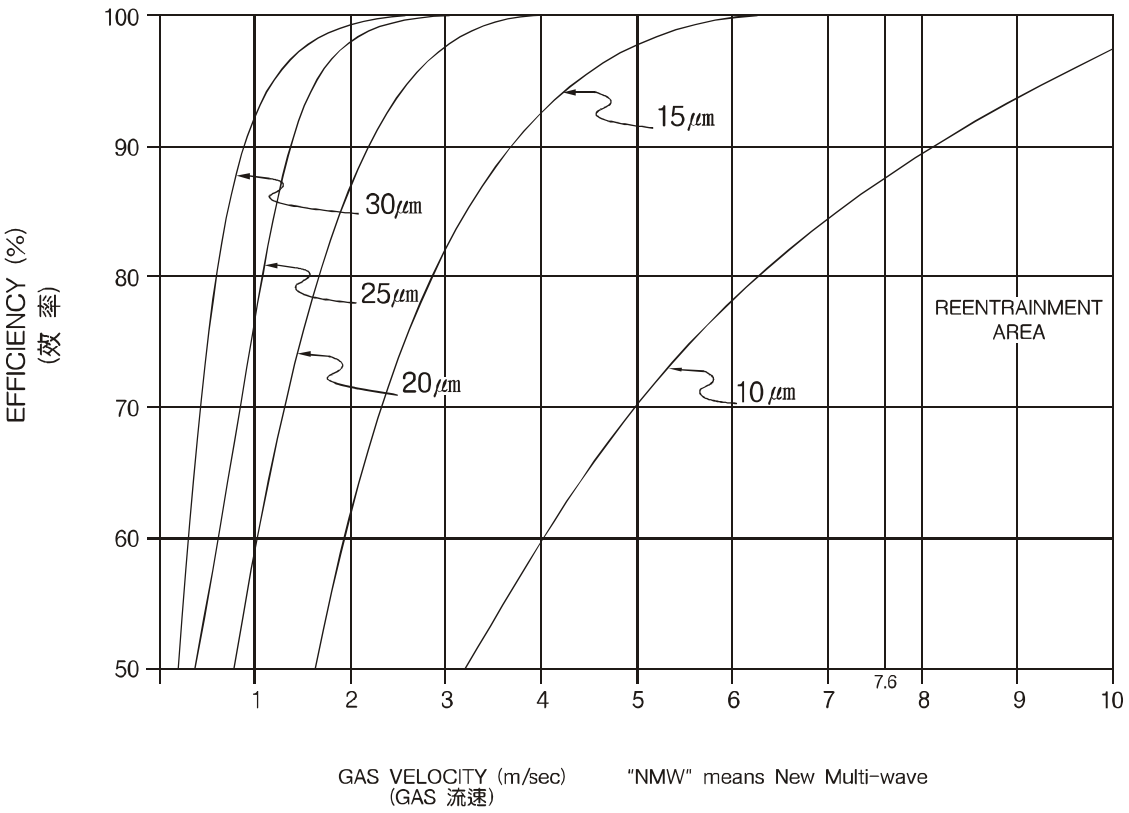
4. 자체 세정 (self cleaning)이 가능하므로 막힘이 없다.
   SELF CLEANS THEREBY HAVING LESS PLUGGING.

5. 수지이므로 부식이 거의 없다.
   AS THE MAIN MATERIALS ARE PLASTICS AND HAVE GOOD RESISTANCE TO THE CORROSION.

6. 어떤 형태나 크기로도 제작 가능하다.
   CAN BE MANUFACTURED AT ANY TYPE AND SHAPES.

7. 기존 Eliminator에 비해 설치공간이 1/2 정도 적게 소요된다.
   NEEDS ALMOST HALF OF SPACE AS COMPARED TO THE EXISTING ELIMINATORS.

NMW-36포집효율곡선도 (NMW-36 REMOVAL EFFICENCY CURVES)



재 질 (MATERIAL OF CONSTRUCTION)

1. Polypropylene (P.P.), Polyethylene (P.E.)

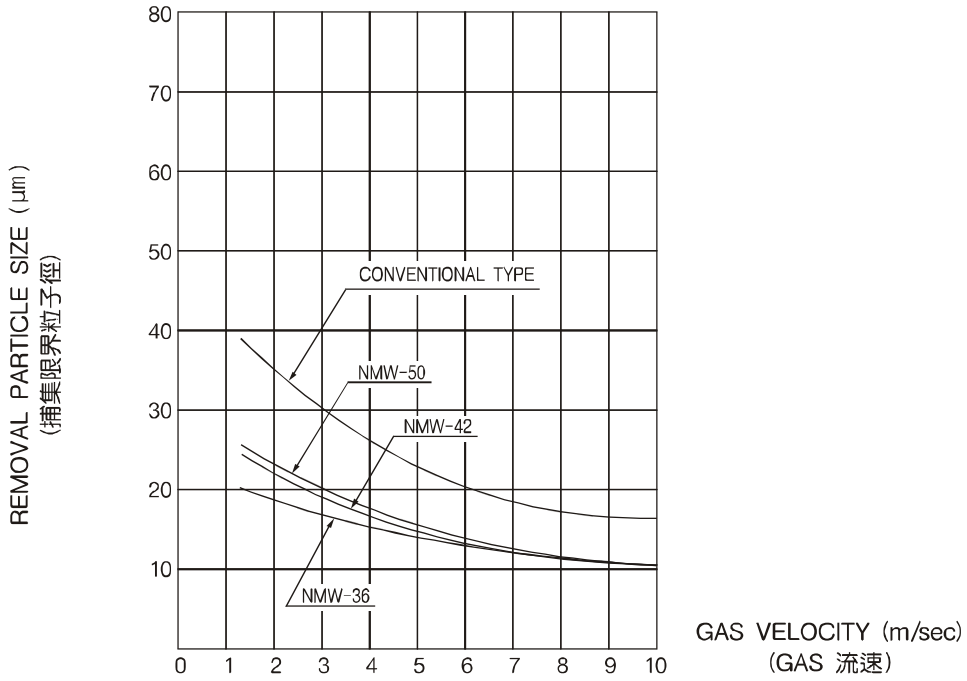
2. Glass reinforced of mixed P.P. or P.E.
   기타 사출 가능한 모든 재료
   OTHERS CAN BE MADE BY EXTRUDER

3. Carbon Steel and Stainless steels for Pre-Collectors

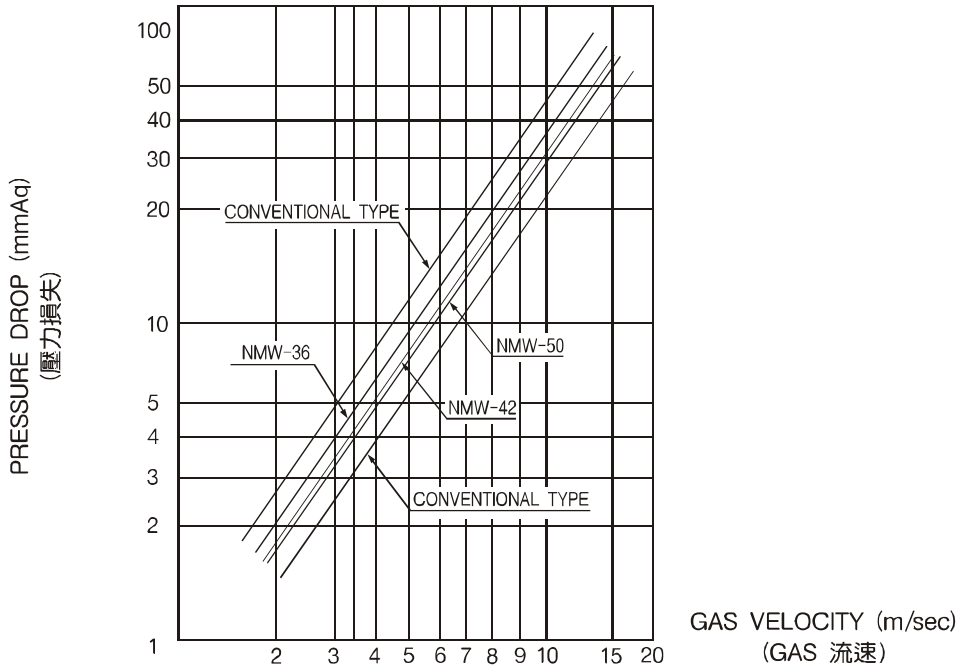
4. Titanium, Aluminum, Monel and Copper for Pre-Collectors

5. Other materials asked by users and agreed by Hanbal.

EFFICIENCY OF EACH TYPE



PRESSURE DROP OF EACH TYPE



TYPICAL DIMENSION AND FEATURES OF EACH TYPE

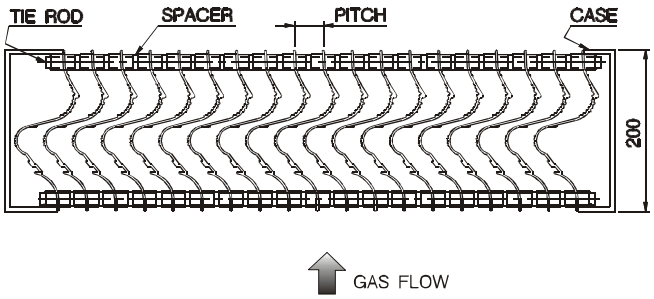


Fig. 1 General assembly

New Multi-wave(NMW) eliminators are 200 mm high and 900 mm long and can be assembled to any size to go through man ways. This type is made by plastics only.

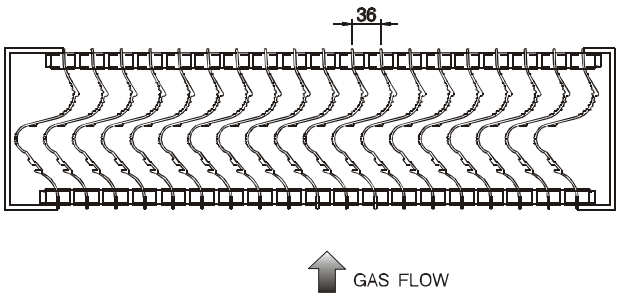


Fig. 2 Type NMW36

1. Good for velocity between 1.5 and 7.0 m/sec. but variable depend upon design conditions.
2. Case can be as same material as the blades or steels of any kind.

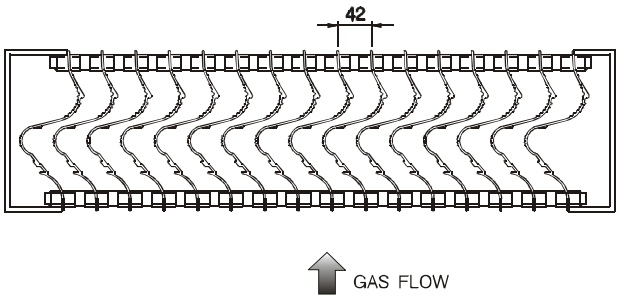


Fig. 3 Type NMW42

1. Good for velocity between 2.5 and 8.0 m/sec. but variable depend upon design conditions.
2. Case can be as same material as the blades or steels of any kind.

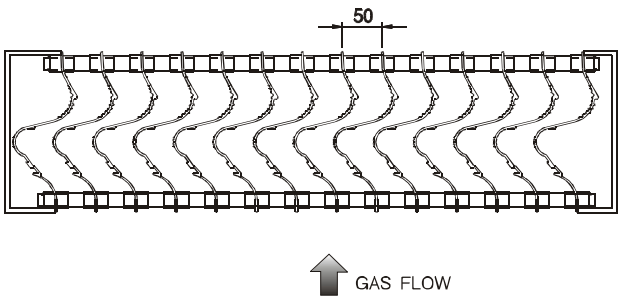


Fig. 4 Type NMW50

1. Good for velocity between 3.0 and 9.0 m/sec. but variable depend upon design conditions.
2. Case can be as same material as the blades or steels of any kind.

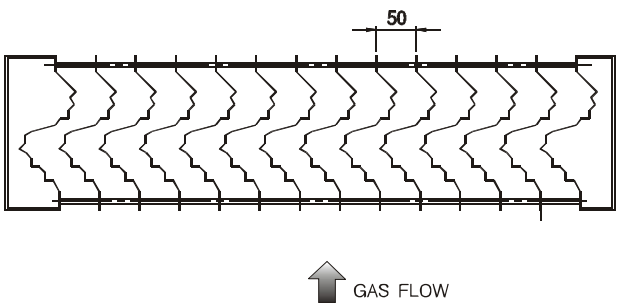


Fig. 5 Type NMW50S

This type is used as precollectors or for the services removal efficiency requirement is not so severe.Made of steels only
"S" means steel of any kinds.

SAMPLE OF ASSEMBLY

DIMENSION OF EACH PIECE IS 200 mm HIGH AND 950 mm LONG AND THEY CAN BE ASSEMBLED TO ANY SHAPE AND SIZE TO MEET THE SPECIFIC REQUIREMENTS.

각 PIECE의 SIZE는 200 mmH x 950 mm이며, 어떤 모양이나 크기에도 맞게 제작 할 수 있습니다.

EXAMPLE OF INSTALLATION

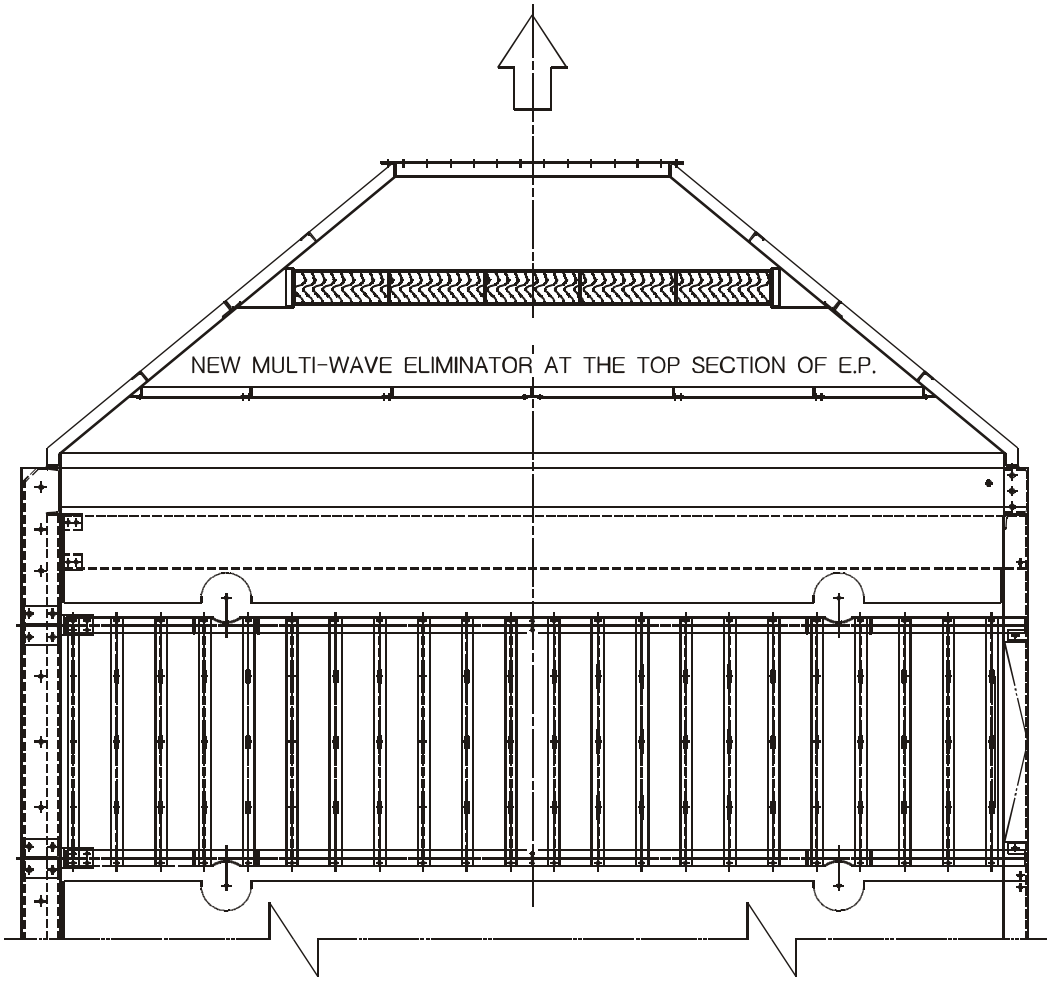
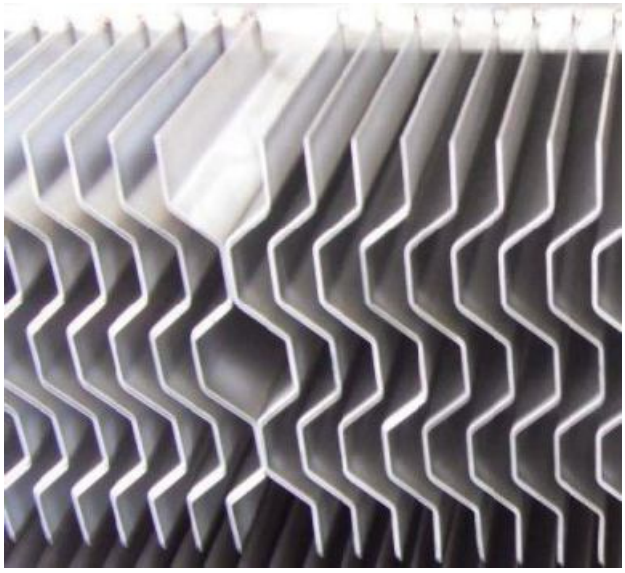
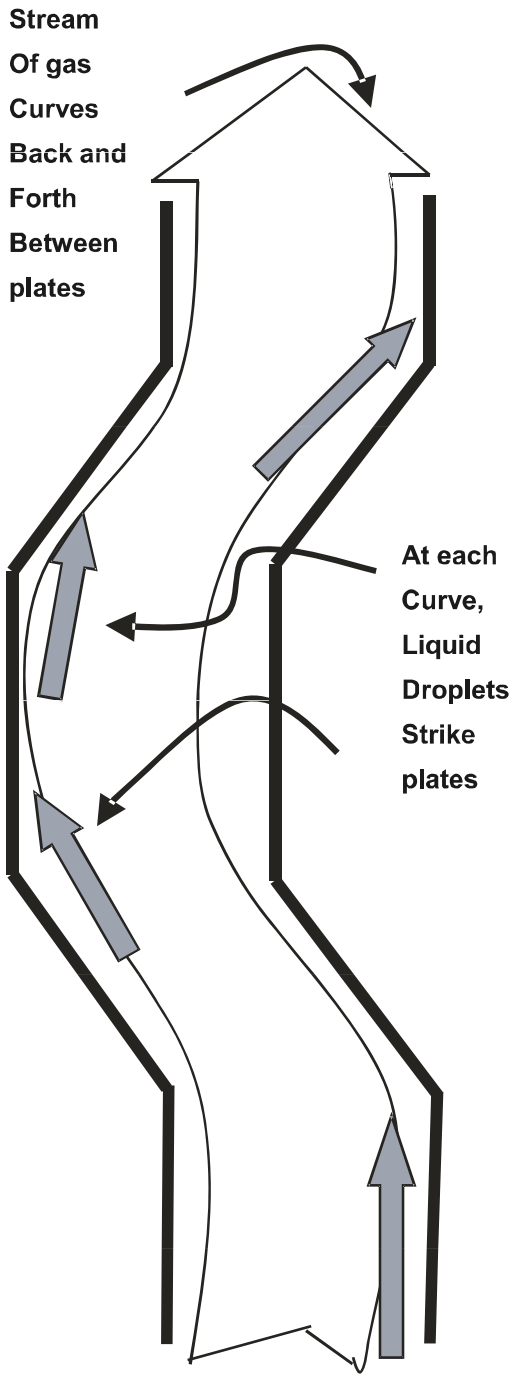


PLATE TYPE MIST ELIMINATOR

HMT STYLE HB-VH127



CONCEPT OF INERTIAL CAPTURE



Applications:

- FGD Absorbers
- Evaporators
- Cooling Towers
- Scrubbers
- High solids concentrators
- Applications with fouling potential

Mechanical:

- Height 152mm (3-pass); 250mm (5-pass)
- Weight 83kg/m2 (3-pass); 136kg/m2 (5-pass)

(Weight data refer to 304 SS)

DATA NEEDED FOR DESIGN OF NEW MULTI-WAVE ELIMINATORS

Please furnish us the following information for our design and guarantee.

NO.	DESCRIPTION	
1.	CUSTOMER	
2.	PROJECT NAME	
3.	TOWER DRAWING	
4.	VESSEL ID(mm)	
5.	NAME OF FLOW	
6.	VAPOR FLOW RATE(m^3/hr)	
7.	VAPOR VISCOSITY(cP)	
8.	VAPOR DENSITY(kg/m^3)	
9.	LIQUID DENSITY(kg/m^3)	
10.	PARTICLE SIZE(micron)	
11.	SEPARATION EFFICIENCY(%)	
12.	ALLOWABLE DELTA P.(mmH_2O)	
13.	MATERIAL OF DEMISTER	
14.	DESIGN TEMPERATURE(°C)	
15.	DESIGN PRESSURE(kg/cm^2)	
16.	FOULING TENDANCY	

설치 및 정비 시 주의사항
RECOMMENDED PROCEDURE FOR INSTALLATION AND MAINTENANCE

1. 땅 위에 모양대로 놓아 본다.
   PRE-ASSEMBLE THE ENTIRE SET ON THE GROUND.

2. 설치는 도면에 표시된 순서에 의해 실시한다.
   INSTALLATION SHOULD BE DONE ACCORDING TO THE PROCEDURE PRESENTED.

3. 각 조각의 최대 효율을 위해 수평과 수직이 맞게 한다.
   EACH PIECE SHOULD BE PERFECTLY VERTICAL AND HORIZONTAL LEVEL.

4. 형상이 약하므로 위해서 밟는 것은 절대로 하지 말아야 하며 가능한 한 밑에서 설치해야 한다.
   BECAUSE OF THE WEAKNESS OF THE BLADES, WALKING ON THE PIECES IS NOT PREFERABLE AND RECOMMENDED TO INSTALL FROM BELOW.

5. 고성능이므로 각 조각에 틈이 절대로 없게 한다.
   EACH PIECE SHOULD NOT HAVE GAPS TO OBTAIN THE MAXIMUM PERFORMANCE.

6. 유지 보수 시는 완전 해체 후 상기 요령에 의거 재설치 한다.
   PLEASE FOLLOW ABOVE PROCEDURES FOR RE-INSTALLTION AT THE TIME OF CLEANING.

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Certified ISO9001 by BVQI ANSI-RAB QMS ACCREDITED

AGENT :

HMT

HANBAL MASSTECH LIMITED

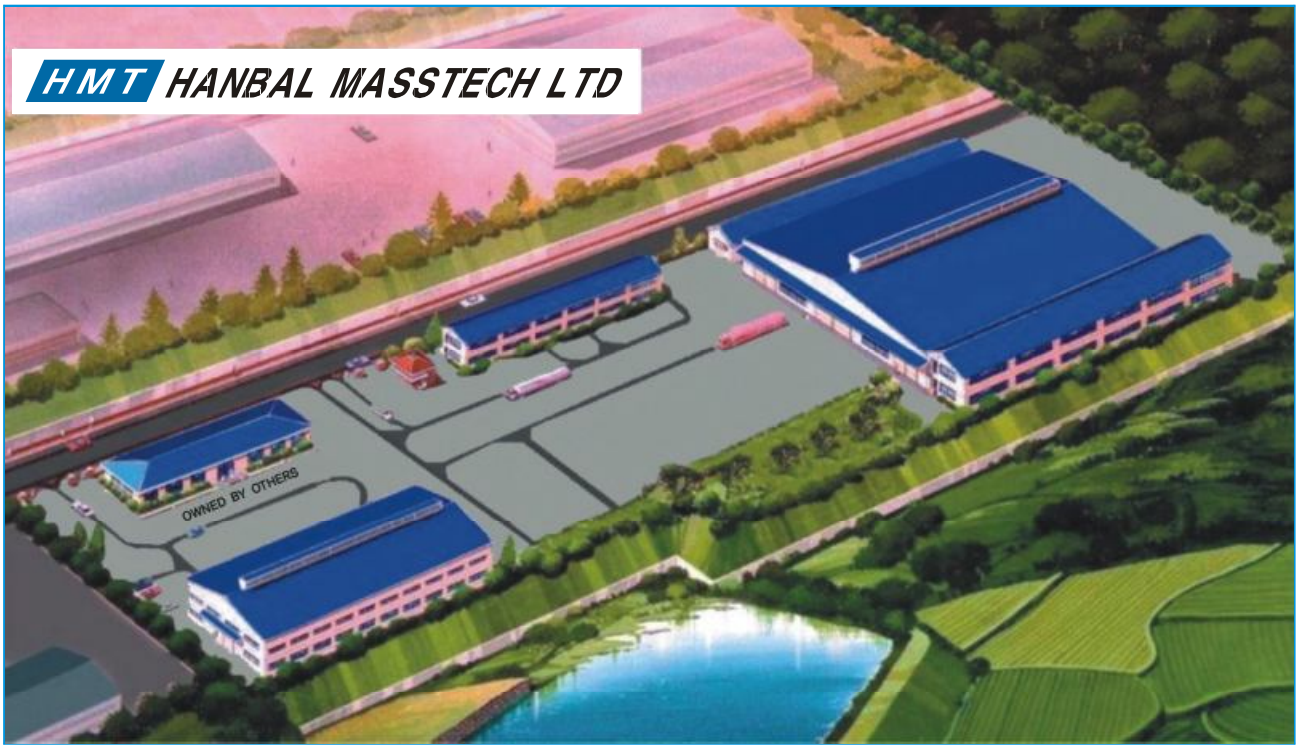
MASS TRANSFER TECHNOLOGY

WIRE MESH DEMISTERS

WHERE THEY ARE USED :

- VACUUM TOWERS
- STEAM DRUMS
- GAS ABSORBERS
- DESALINATION PLANTS
- SCRUBBERS
- EVAPORATORS
- KNOCK - OUT DRUMS
- POLLUTION CONTROL SYSTEMS

EACH PAD SECTIONS ARE ASSEMBLED WITH THE WIRE MESH KNITTED IN THE EXACT WIDTH WITH PROPER OVERSIZE TO INSURE MINIMUM CUTTING AND TIGHT FIT IN THE TOWER FOR THE BEST PERFORMANCE ACHIEVEMENT.



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Sincerely, President & CEO

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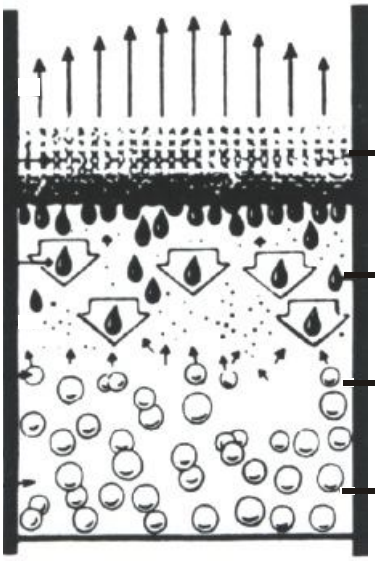
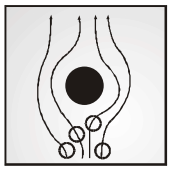
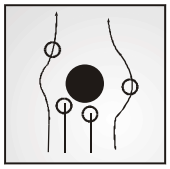
HOW WIRE MESH DEMISTER WORKS

Clean dry vapor

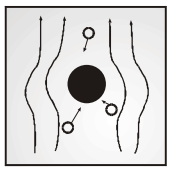




MIST를 동반한 GAS가 선에 부딪힐 때 관성충돌 원리에 의해 포집됩니다.
Removal by Inertial Diffusion



상승하는 GAS중 선경에 1/3 이상 접촉되는 미세한 MIST가 포집됩니다.
Removal by Non Inertial Diffusion



GAS중 아주 미세한 MIST는 BROWNIAN 원리에 의해 포집됩니다.
Removal by Brownian Concept

액체 표면의 기체가 분리되는 과정에서 비산하는 MIST의 미립자는 기체에 동반(ENTRAIN)되어 DEMISTER를 통과하게 되며, 통과하기 전의 미립자는 PAD 표면에서 1.관성충돌원리 2. 선경에 1/3 이상 접촉으로 인한 직접 제거 및 3. BROWNIAN 원리 등에 의거 입자가 커지므로 (GROW IN SIZE) 자중에 의거 이물질을 포함한 미립자는 자연낙하(FALL FREE)됨으로 통과한 기체는 불순물이 완전제거된 순수한 제품(PURE, CLEAN AND DRY VAPOR)이 됩니다.

당사는 1971년 이래 많은 실적과 경험을 갖고 있으며 구형은 물론 신형 DEMISTER도 설계 제작하고 있사오니 많은 협조를 부탁 드리겠습니다.

The function of wire mesh mist eliminator is when vapor with entrained liquid run through the pad, the droplets from the gas contact the wire surfaces by : 1. Inertial Diffusion 2. Non Inertial Diffusion 3. And/or Brownian concept which make droplets grow in size and fall free because of their sizes or weights, making clean products overhead.

With our more than 33 years of experiences, we now can engineer, design and manufacture and supply the traditional as well as new types which increase by about 25% more in capacity and efficiency to meet customer's requirements.

STYLES AND FEATURES

Style Density (kgs/m³)	Free Volume (%)	Surface Area (m²/m³)	Equivalent to			
			U.O.P	Nihon Mesh	York	Knitmesh
HB-80	99.0	158	B	H	931	4536
HB-80N	SEE NOTE 2.				708	
HB-120	98.5	210		L	631	
HB-128	98.4	460		SN	326	
HB-128N	SEE NOTE 2.				194	
HB-144	98.2	280	A	N	431	9030
HB-144N	SEE NOTE 2.				172	
HB-193	97.5	375	C	SL	421	9033
HB-193N	SEE NOTE 2.				709	
HB-300	96.2	575		SM		
HB-390	95.0	750		SH		
HB-220	97.2	905		T		
HB-432	94.5	1,780		R		
HB-GS	96.7	5,000		GS	371	
HB-GSN	SEE NOTE 2.				215	

NOTE

1. Wire Dia for metallic is 0.01" (0.254 mm)~0.011" (0.279 mm) and plastic and teflon yarn is 0.3 mm, We also knit combined mesh with metallic, PP, Pe, Nylon, Glass fiber and Teflon.
2. "N" means new styles developped by Hanbal and Nihon Mesh, Japan based upon the datas, experiences and examples of our past years and have more than 25% in capacity or efficiency.
* Ask us for detail information for application.
3. HB-xxxxHC
"HC" means high capacity type.

Style and material are selected based upon our engineering result, previous experience or sample furnished by the purchaser. Correct selection of the style and material are important for good performance and long life of the demister pads.

HB-80 : Low cost mesh pad good for high throughput capacity and solid retention.Used for good separation efficiency with viscous or dirty liquids and permits higher vapor velocities. Used in 6" thickness minimum.

HB-144 : For general purpose and all around use and has 95~99% removal efficiency against 8 micron mist at 1~5 m/sec velocity. Used in 4~6 inches thickness or thicker for better efficiency.

HB-193 : Practical and standard style and most popularly used for heavy duty and high efficiency. Removes 95~99% against 5 micron mist at 1~5 m/sec velocity.Thickness recommended is as same as HB-144 style.

HB-220 : Used for removing fine particles as much as 3 micron mist or wet dust. Especially good for where the entertainment is 1.0 g/m³ or less. Used in 8~12 inches thick or thicker for better efficiency.

HB-432 : Used for removing the finest particle mist as under 1 micron in greatness. Brings higher performance efficiency than HB-220 style. Recommended thickness is as same as the HB-220 style.

PRESSURE DROP CALCULATION

Pressure drop can be calculated by the following formula.

$$\Delta P = \frac{f \cdot V_g^2 \cdot X \cdot \rho_g \cdot (1-\epsilon)}{g_c D} \ (kg/m^2) \cdots\cdots (f)$$

$$\Delta P = \alpha \cdot \rho_g \cdot V_g^2 \cdots\cdots (g)$$

f = Friction Factor = $5.3 \times \left(\frac{DV_g\rho_g}{\mu_g}\right)^{-0.32}$

g_c = Gravitational Acceleration = 9.8 m/sec^2

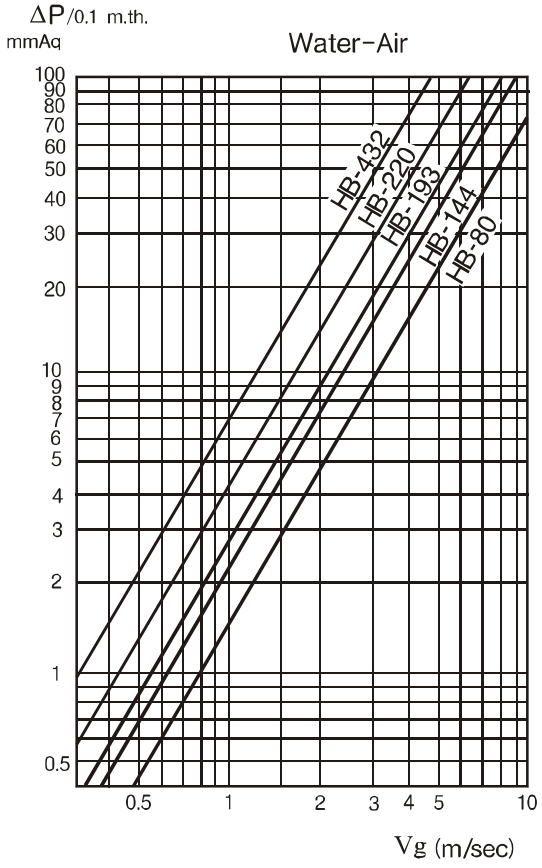
V_g = Vapor Velocity m/sec

X = Thickness of Mesh Demister m

ρ_g = Vapor Density kg/m^3

ϵ = Free Volume

D = Wire Dia m



OPERATING VELOCITY CALCULATION

The operating velocity can be calculated by the following formula.

1. Allowable max gas Velocity

$$V_{max} = k\sqrt{\frac{\rho_\ell - \rho_g}{\rho_g}} \ (m/sec)$$

2. Operating Velocity

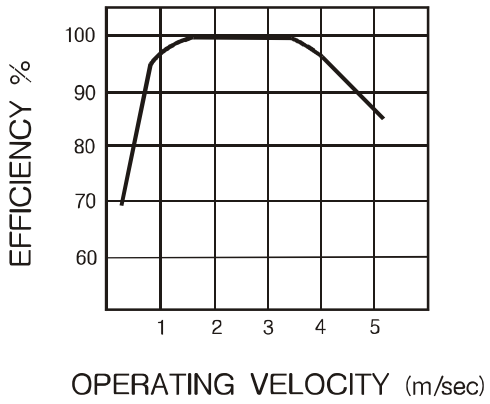
Vact = 0.2 (min) ~ 1.0 (max) · Vmax

Vopt = 0.8 (mean) · Vmax

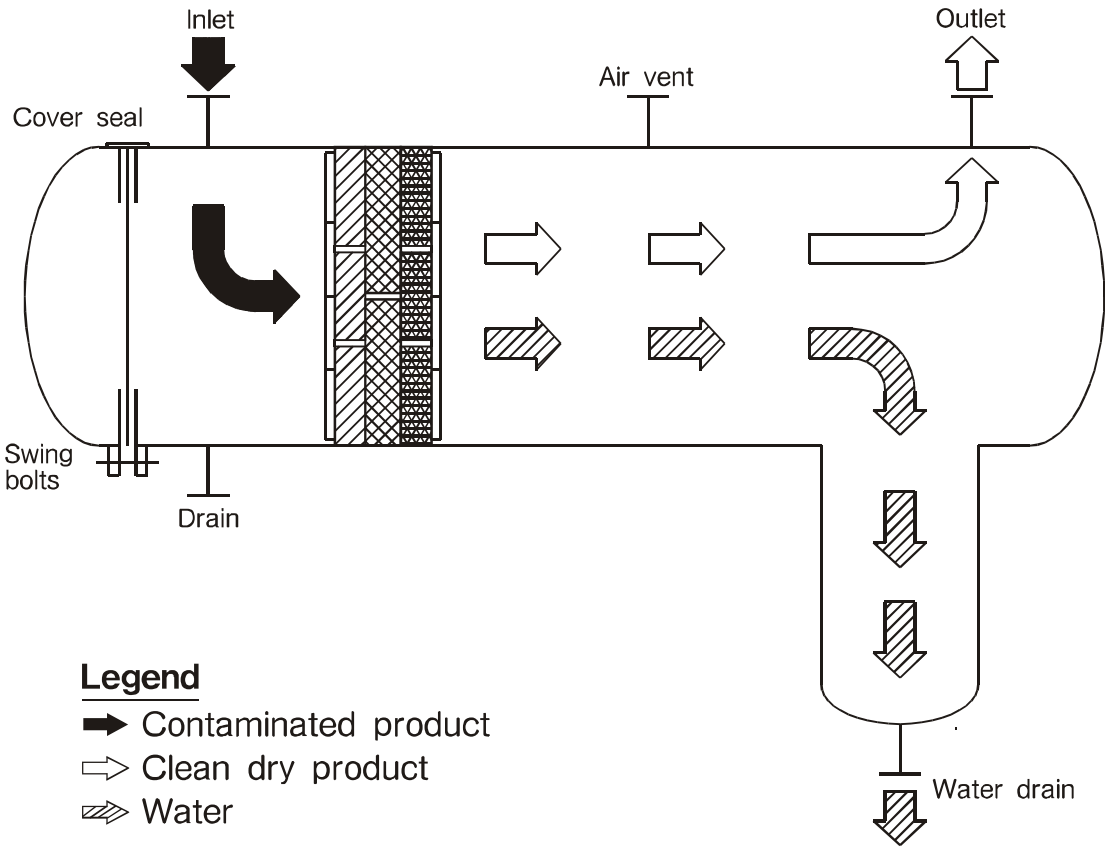
ρ_g = Vapor Density kg/m^3

ρ_ℓ = Liquid Density kg/m^3

k = Coefficient = 0.108 (HB-193 Style)



COALESCERS



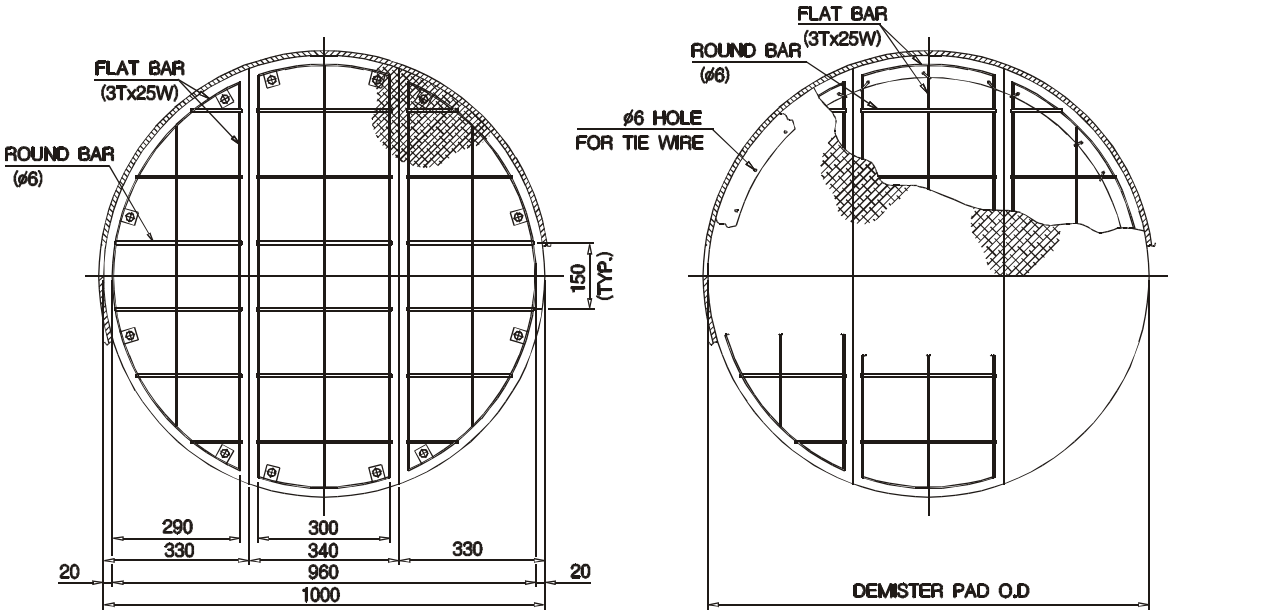
HYDROCARBON에 포함된 적은 양의 수분(FREE EMULSION WATER)을 관성충돌에 의한 비중차이로 유-수 분리하는 것으로 LIQUID-LIQUID SEPARATION SYSTEM에 속합니다.

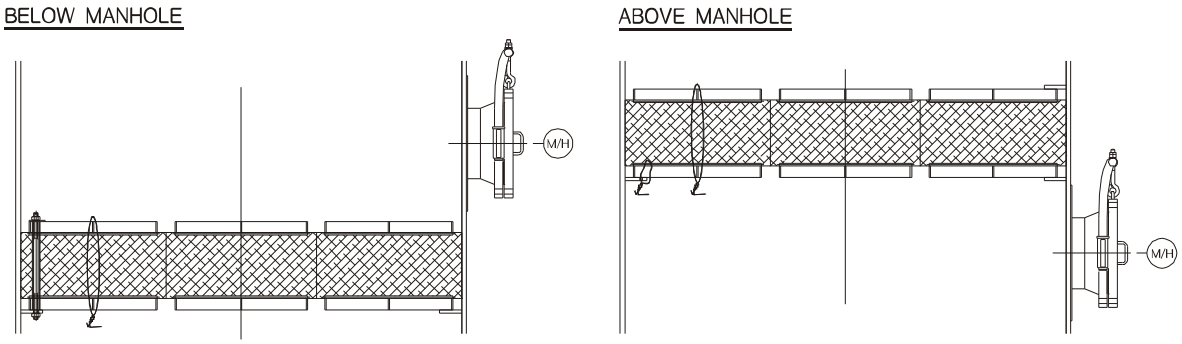
LIQUID-LIQUID SYSTEMS require coalescing medium for the coalescence and separation of finely dispersed droplets. In order to achieve this goal, a medium that is preferentially wetted by the dispersed phase, knitted wire or plastic mesh, beds of fibrous or special medium are used. Coalescing filters are suitable for separating small quantities of dispersed liquids from large throughputs by having them forcedly run through the medium.
The coalescing medium works by holding up the dispersed droplets long enough for them to form globlets of sufficient size to settle.

We review, sometimes simulate, design and guarantee for the performance and have many experiences for domestic & oversea projects.

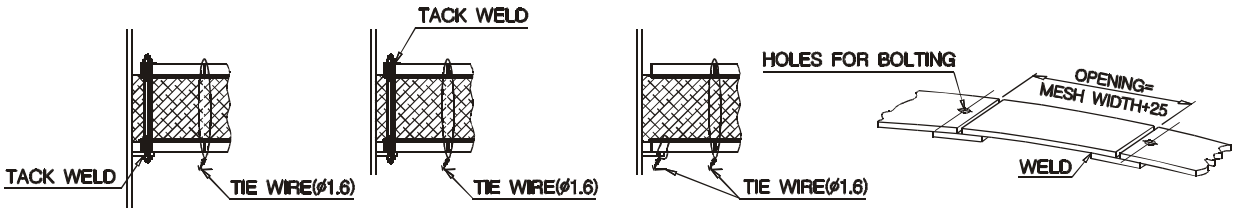
GRID AND INSTALLATION DETAIL

DETAIL OF GRID





DETAIL OF INSTALLATION



BOLT/NUT TYPE (BELOW MANHOLE)

BOLT/NUT TYPE (ABOVE MANHOLE)

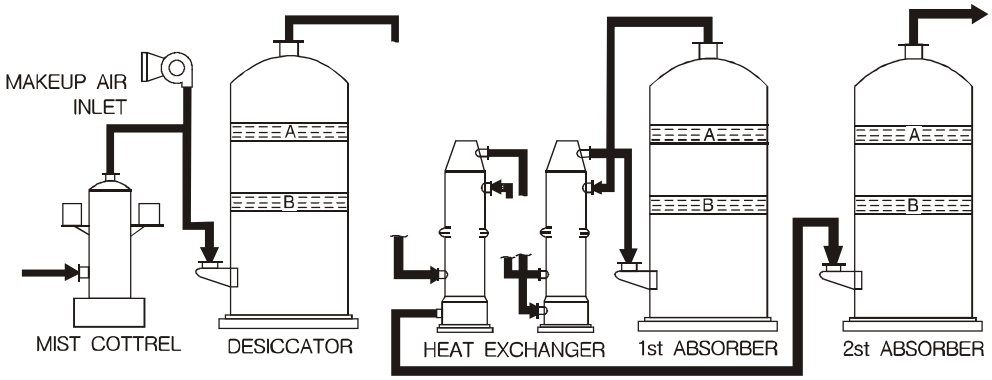
TIE WIRE TYPE (ABOVE MANHOLE)

REMOVABLE TYPE SUPPORT RING (ABOVE MANHOLE)

1. All dimensions are in millimeters.
2. Each pad section should be tied together to insure the same destiny all around.
3. Top and bottom grids should be welded together with rods for low destiny and extremerly high density demisters.

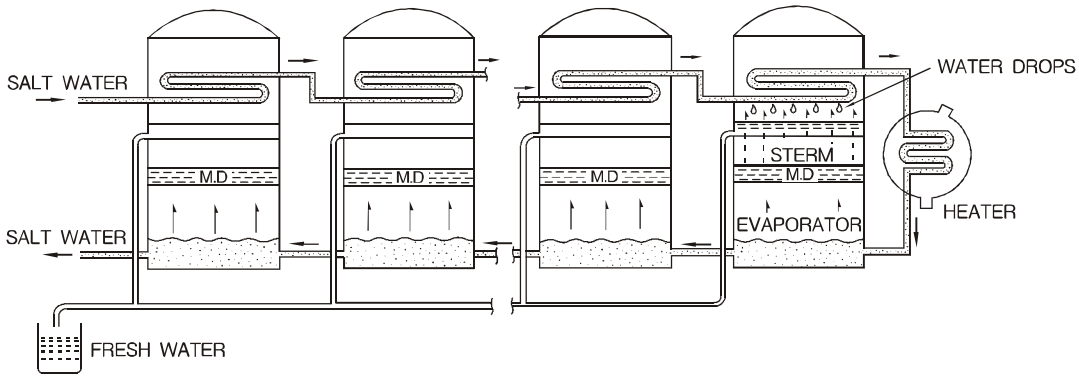
EXAMPLE OF INSTALLATIONS

1. SULFURIC ACID PLANT

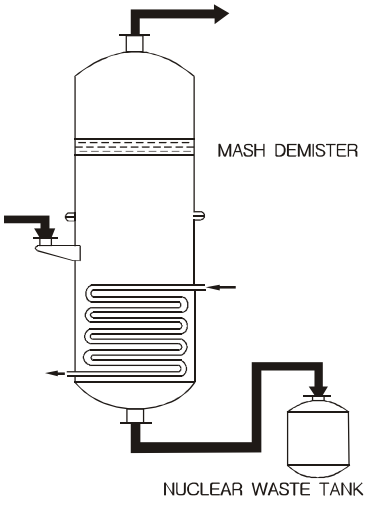


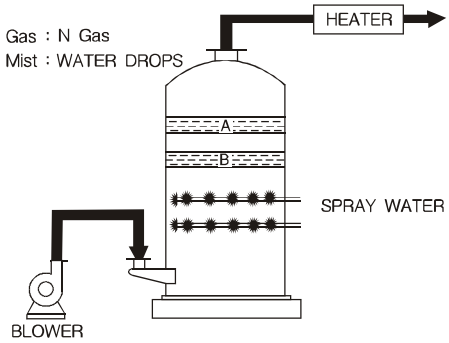
A : Low-Density Mesh Demister
B : High-Density Mesh Demister

2. MULTISTAGE FLASH TYPE DESALINATION PLANT



3. NUCLEAR WASTE CONDENSATION PLANT





MATERIAL OF WIRE MESH DEMISTER

They can be made in any wire materials, but the most commonly used materials are as follows:

304(L) 316(L) 317(L) 410(S)	Monel	Titanium
Glass Fiber	Polypropylene/Polyethylene	Carpenter 20
Aluminum	Copper	Teflon

Materials of Grids do not have to be as same as the wire material as much heavier gauge materials are used for flat and round bars.

However, the material of tie wire must be as same as the material of pads.

DATA NEEDED FOR DESIGN OF WIRE MESH DEMISTER

The engineering, design and selection of proper Wire Mesh Demister Style are most important of all for our guarantee for the optimum performance.
Please furnish us the following information as best as it can be done.

NO.	DESCRIPTION	
1.	CUSTOMER	
2.	PROJECT NAME	
3.	TOWER DRAWING	
4.	VESSEL ID(mm)	
5.	NAME OF FLOW	
6.	VAPOR FLOW RATE(m^3/hr)	
7.	VAPOR VISCOSITY(cP)	
8.	VAPOR DENSITY(kg/m^3)	
9.	LIQUID DENSITY(kg/m^3)	
10.	PARTICLE(micron)	
11.	SEPARATION EFFICIENCY(%)	
12.	ALLOWABLE DELTA P.(mmH_2O)	
13.	MATERIAL OF DEMISTER	
14.	DESIGN TEMPERATURE(℃)	
15.	DESIGN PRESSURE(kg/cm^2)	
16.	FOULING TENDANCY	
17.	WATER CONTENT(%)	COALESCER ONLY

WIRE MESH DEMISTER 의 교체 시기

WIRE MESH DEMISTER는 각 공정의 주요 LINE에 설치되어 있어
정기보수 등이 아니면 교체가 불가함으로 교체 검토시 아래 사항을 참고해 주시면 감사하겠습니다.

- 두께가 변했을 때
- 견고성이 없어졌을 때
- 심한 부식이 발견될 때
- 심한 압력 손실이 일어날 때
- 기타 경험에 의한 교체 시기가 되었다고 판단할 때

WHEN WIRE MESH DEMISTER SHOULD BE REPLACED

Due to the fact that the wire mesh demister is normally installed in a major process lines, it is almost impossible to replace them while the lines are in operation. Therefore, for economy purpose, it is important to have them replaced during annual or periodic shut-down period. For these reasons, the followings are presented for the user's consideration.

- When the thickness has changed.
- When the tightness of each pad sections has changed.
- When the corrosion of the wire has severely noticed.
- When the entrained mist or dust gives pressure drop hazard.
- Others as have been experienced by maintenance engineers.

PLEASE ASK US FOR ANSWERS BY REFERING THE FOLLOWING INFORMATION

CONTACT	TELEPHONE	FACSIMILE	E-MAIL
EXECUTIVE DIRECTOR	82-55-310-2121	82-55-338-1917	bhkang@hanbalmasstech.com
SALES	82-55-310-2141	82-55-338-1919	shjeon@hanbalmasstech.com
PROCESS	82-55-310-2191	82-55-338-1919	dsohk@hanbalmasstech.com
TECHNICAL	82-55-310-2181	82-55-338-1919	mjkim@hanbalmasstech.com
MANUFACTURE	82-55-310-2161	82-55-338-2919	mjcho@hanbalmasstech.com
QUALITY MANAGEMENT	82-55-310-2176	82-55-338-1917	ydyu@hanbalmasstech.com
LOGISTICS	82-55-310-2162	82-55-338-2919	hclee@hanbalmasstech.com

HMT HANBAL MASSTECH LIMITED

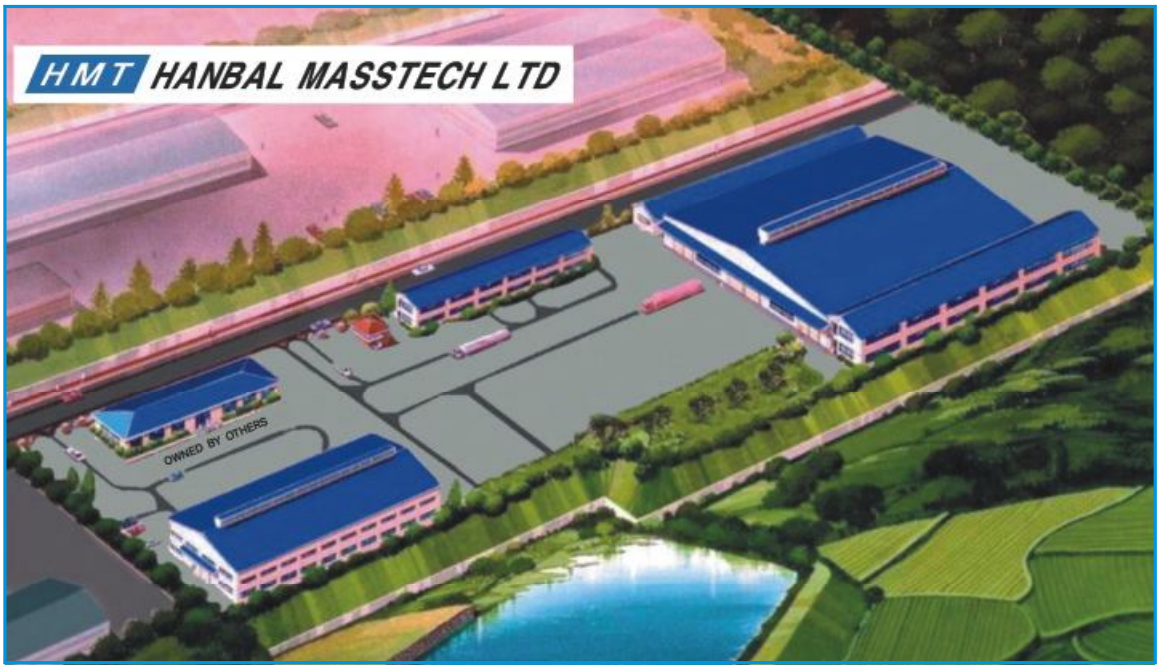
경남 김해시 주촌면 내삼리 1080-4번지 우 621-841
본사, 공장 : TEL. 055-338-1911 FAX. 055-338-1917
서울사무소 : TEL. 02-412-0851 FAX. 02-413-0272
http://www.hanbal.kr

#1080-4 Naesam-ri, Juchon-myeon, Gimhae-si, Gyeongsangnam-do, Korea
OFFICE & PLANT : TEL. +82-55-338-1911 FAX. +82-55-338-1917
SEOUL OFFICE : TEL. +82- 2-412-0851 FAX. +82- 2-413-0272

AGENT :

COMPANY IN GENERAL

會 社 槪 要



1. ESTABLISHMENT(設立年度) : JULY, 1971

2. MAIN PRODUCTS : TRAYS, INTERNALS, PACKINGS, WIRE MESH AND VANE TYPE MIST/DUST ELIMINATORS, REACTOR INTERNALS AND OTHER ASSOCIATED ITEMS
   主 生 産 品 目 : 塔槽類內裝品 及 其 關聯 製品

3. SIZE OF PLANT : LAND SPACE - 16,100 m^2 BLDG SPACE - 6,822 m^2
   會 社 規 模 : 垈 地 - 16,100 m^2 建 坪 - 6,822 m^2

4. MAJOR CLIENTS : OIL REFINERIES. PETROCHEMICAL & CHEMICAL PLANTS, ETC.
   主 顧 客 : 精油, 石油化學工場 及 化學工場 等

5. O T H E R S : INSTALLATION & REVAMP WORKS
   其 他 : 設置 及 改造

HMT HANBAL MASSTECH LIMITED

PRODUCTS AVAILABLE

We worked as NORTON (SAINT GOBAIN NORPRO) sales rep., design/manufacturer, joint venture partner, and licensee from 1979 to 2002 and now serve worldwide independently as fractionation research inc.(FRI) Member and business and technical collaborator of raschig GmBH germany and tar inc. Houston TX. USA. We also conduct R&D with KOREA institue of energy resources every year since 1981.

NO.	ITEM	TYPE
1.	TRAYS	SIEVE, VALVE, BUBBLE CAP, DUAL-FLOW AND SPECIALLY DESIGNED TRAY FOR HIGH CAPACITY AND PERFORMANCE.
2.	INTERNALS	SUPPORT PLATE, (RE)DISTRIBUTOR, BED LIMITER, FEED PIPES AND TRADITIONAL AND HIGH CAPACITY AND PERFORMANCE TYPES.
3.	PACKINGS	NEW RASCHIG RING, NEW PALL RING, NEW METAL N-PAK, NEW SADDLES, NEW FROST FLAKE, NMTP AND NEW STRUCTURED PACKING.
4.	ELIMINATOR	WIRE MESH DEMISTER, COALESCER AND VANE TYPE ELIMINATOR.
5.	REACTOR INTERNALS	INLET DISTRIBUTOR, BASKET TRAY, CATALYST SUPPORT GRATING , MIXING TRAY, OUTLET COLLECTOR AND QUENCH BOX.
6.	GUARD BEDS	DENSTONE CATALYST BED SUPPORT MEDIA.
7.	MATERIAL OF CONSTRUCTION	CARBON STEELS, STAINLESS STEELS, HASTELLOY, MONEL, TITANIUM, P.P., P.E., PVC, CPVC, F.R.P. AND TEFLON, ETC.

PLEASE ASK US FOR ANSWERS BY REFERING THE FOLLOWING INFORMATION

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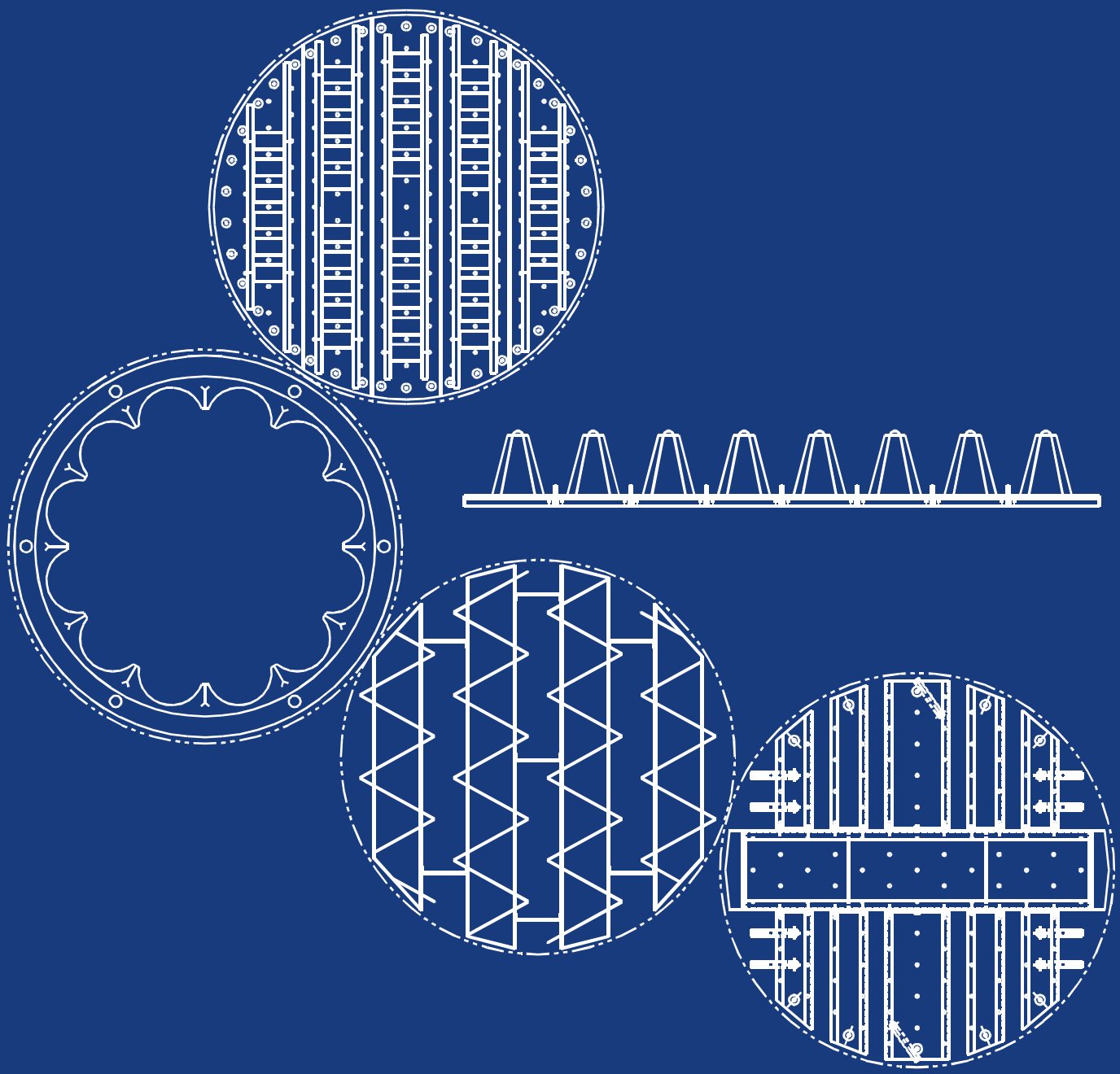
Certified ISO9001 by BVQI ANSI-RAB QMS ACCREDITED

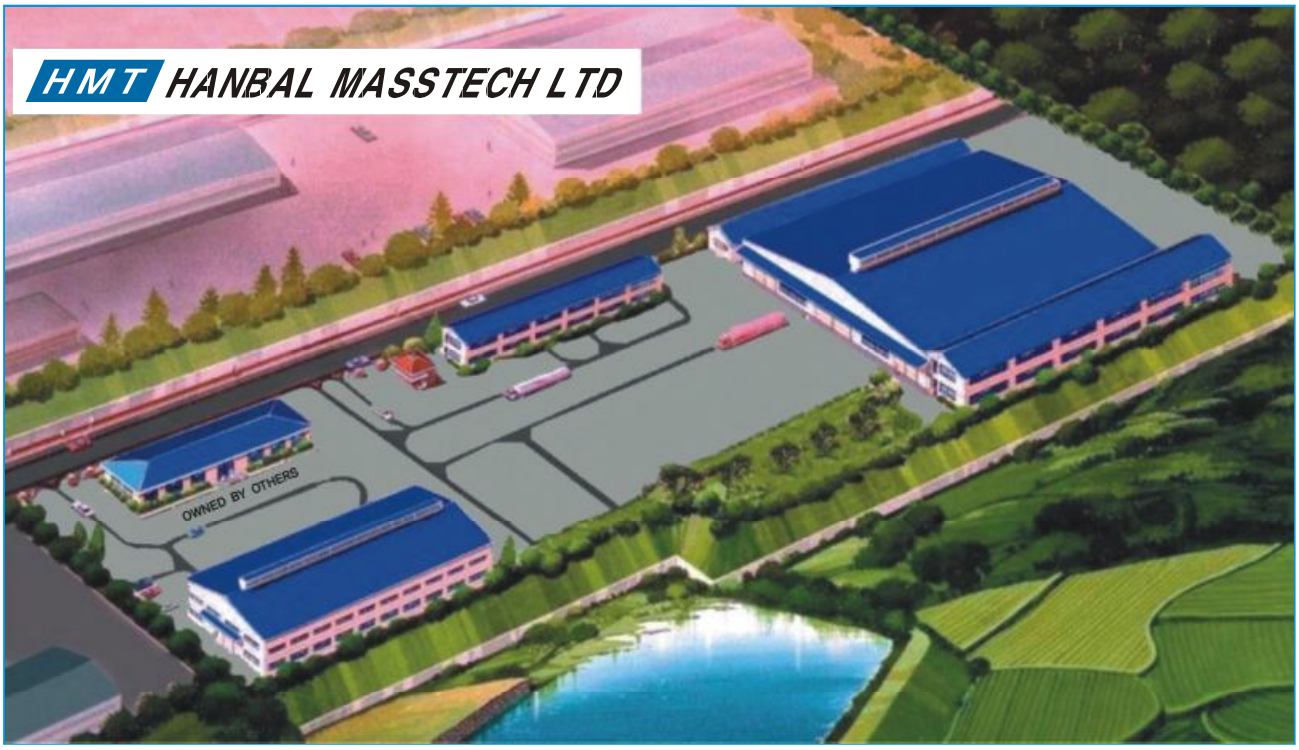
HMT

HANBAL MASSTECH LIMITED

MASS TRANSFER TECHNOLOGY

PACKED TOWER INTERNALS





INTRODUCTION

Hanbal Masstech was established in July 1971 as design and manufacturer of Tower Trays, Internals and Packings, Wire Mesh Mist Eliminators and their associated products to serve for Oil Refinery, Chemical, Petrochemical, Plant Engineering and Construction Companies and we are the pioneer of these items in Korea.

We joined Norton Chemical Process Products Corporation in 1979 as Sales Representative and worked with them as manufacturer, Joint Venture Partner(Norton Hanbal Korea Inc.), design/manufacturer and Licensee until April 2002.

We conducted R&D with Korea Institute of Energy Resources (KIER), especially noteworthy is the R&D held with KIER-Ruhr University in Germany-Hanbal as F.R.I. member for five years under government assistance and our R&D with KIER continues every year.

We learned most of the design and fabrication technologies from Norton CPPC, but we have some of our own that will meet our customer's specific requirements.

As we know what and how Norton had tested, and to continue to do that, we built an outdoor test facility, 20 feet(6 meters) square and 27 feet(8 meters) tall, for distribution quality test and what we have designed is questionable, we go for test to make it sure they are perfect.

We also design and produce traditional style internals which are good for easy towers and those cost about 30% less as compared to the high performance ones.

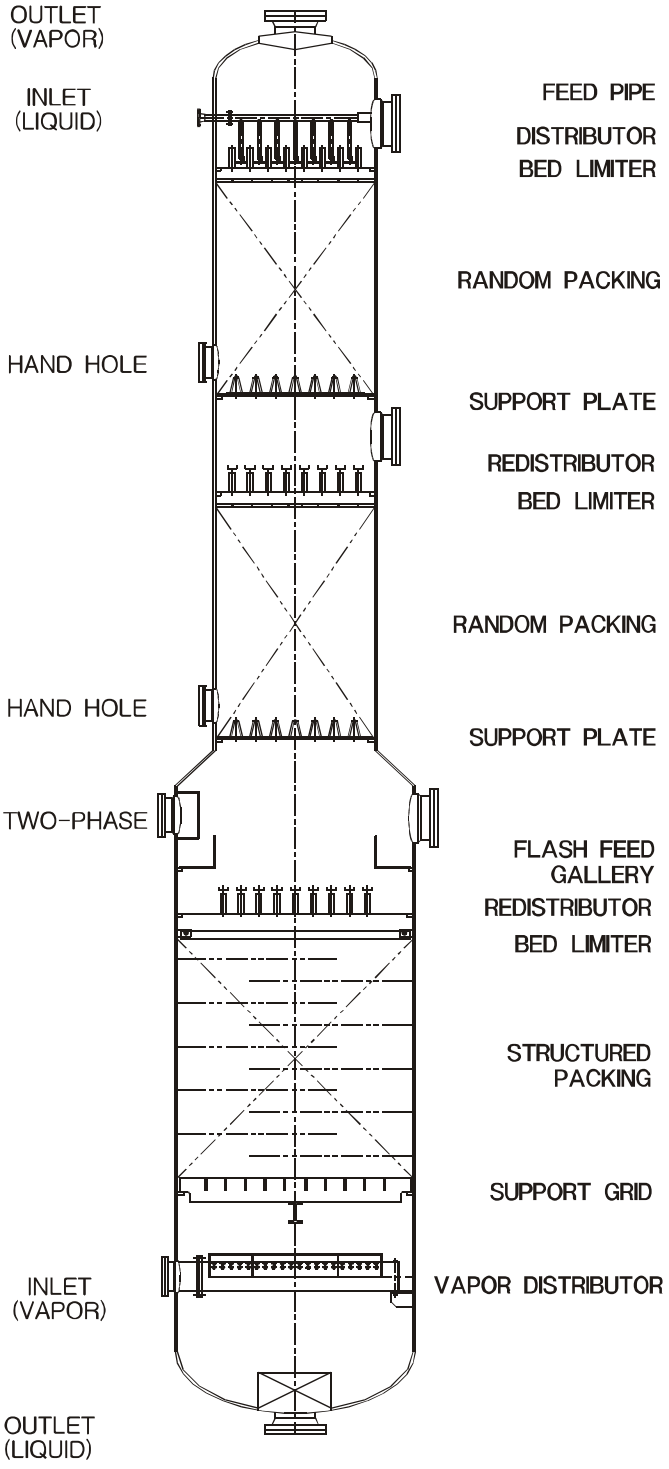
We thank you all for the finest helps and concerns rendered to us so far and wish the same in the future.

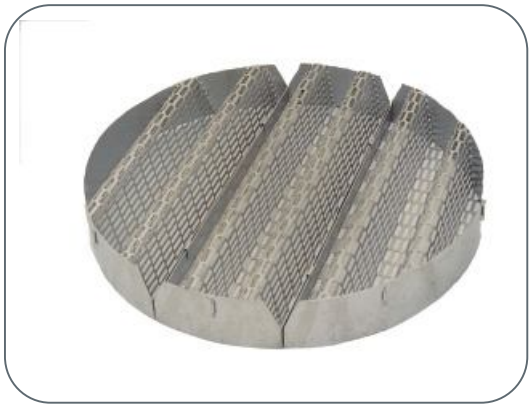
Sincerely, President & CEO

TABLE OF CONTENTS

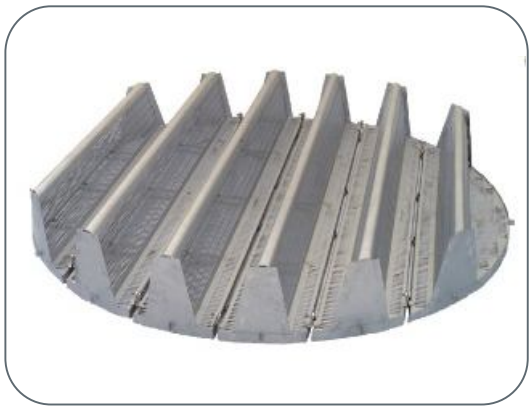
This brochure is intended to serve as a selection guide only and other types to meet specific requirements are also available. Please ask us information for design and application.

TYPICAL PACKED TOWER LAYOUT

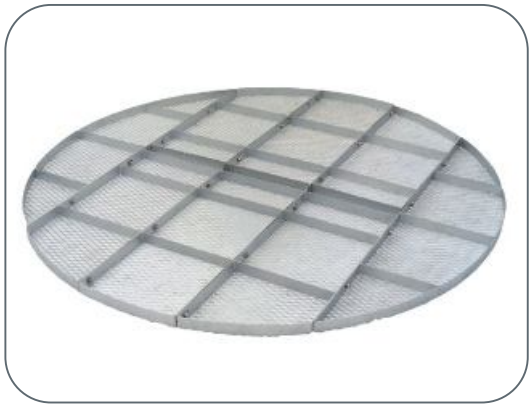




GAS INJECTION SUPPORT PLATE



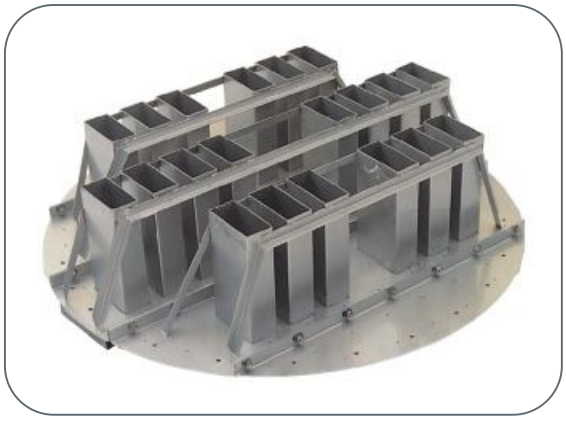
MULTI-BEAM
GAS INJECTION SUPPORT PLATE



BED LIMITER

TYPICAL PACKED TOWER INTERNALS

TROUGH TYPE DISTRIBUTOR



DECK TYPE DISTRIBUTOR

TROUGH TYPE REDISTRIBUTOR

DECK TYPE REDISTRIBUTOR

LIQUID ONLY FEED PIPE

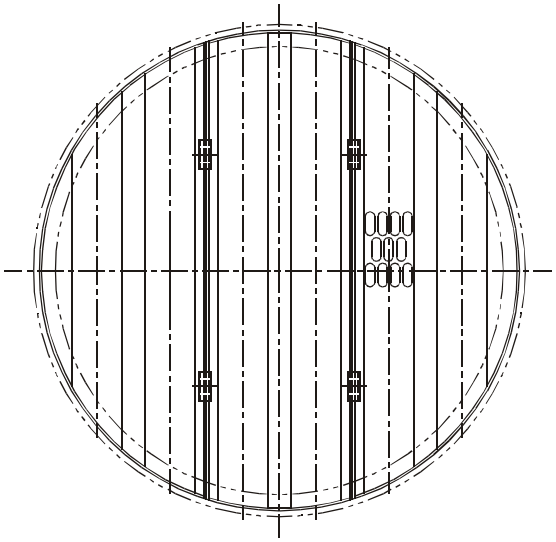
LADDER TYPE DISTRIBUTOR

TYPE 2818
Gas Injection Support Plate

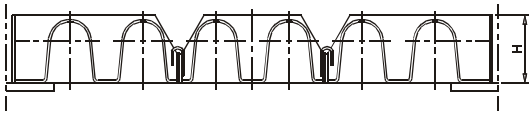
This type has high free area and the best mechanical strength. Most oftenly user for small towers as 12～48.62 in. (305～1235 mm) ID.

Available in any weldable sheet metal or Thermoplastic materials.

Please ask us information for design and application.



SUPPORT PLATE TYPE 2818

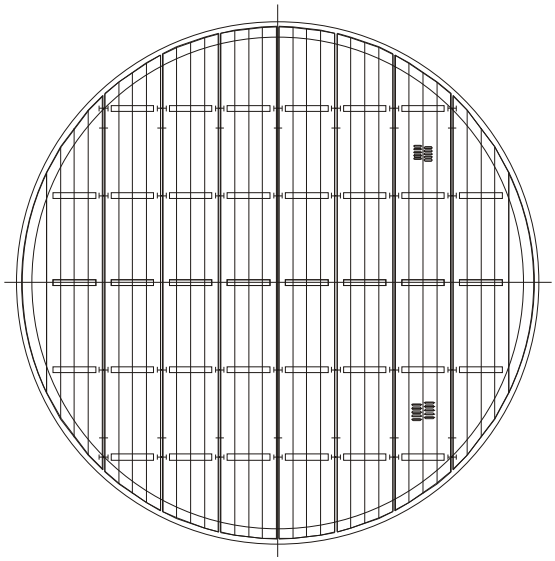


TYPE 2804
Multibeam Gas Injection Support Plate

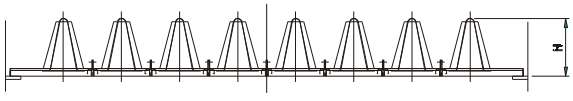
This type is used to support random packings for tower greater than 36 in. (900 mm) ID and has high open area and good mechanical strength as the support plate itself has beam(s). Recommended to use independent beam(s) as required.

Available in any weldable sheet metal or Thermoplastic materials.

Please ask us information for design and application.



SUPPORT PLATE TYPE 2804

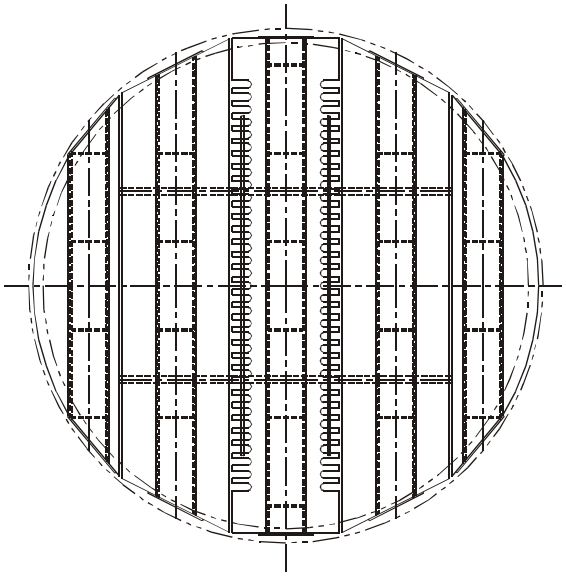


TYPE 2019
FRP Gas Injection Support Plate

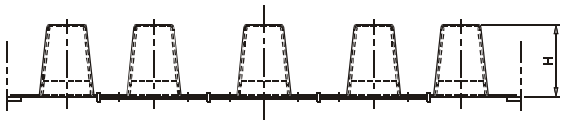
This is beam type construction and designed to support packed bed plus liquid hold-up.
Special data and much experiences are required for optimum design.

Available in FRP
or other similar material.

Please ask us information for design and application.



SUPPORT PLATE TYPE 2019

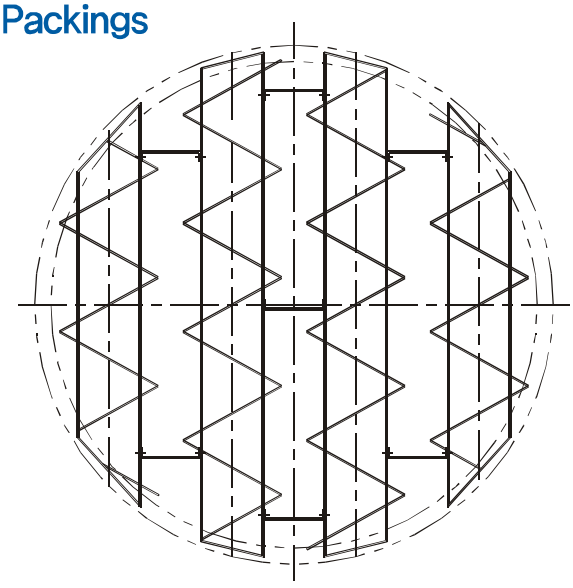


TYPE 2134
Support Grid for Structured or Wire Gauze Packings

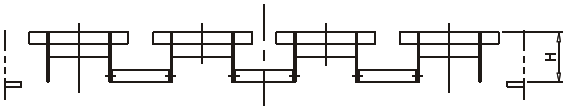
This type is used to support either structured or wire gauze packing, and the design itself allows free and uniform passage of liquid and gas for unlimited capacity.

Available in any weldable sheet metal.

Please ask us information for design and application.



SUPPORT GRID TYPE 2134

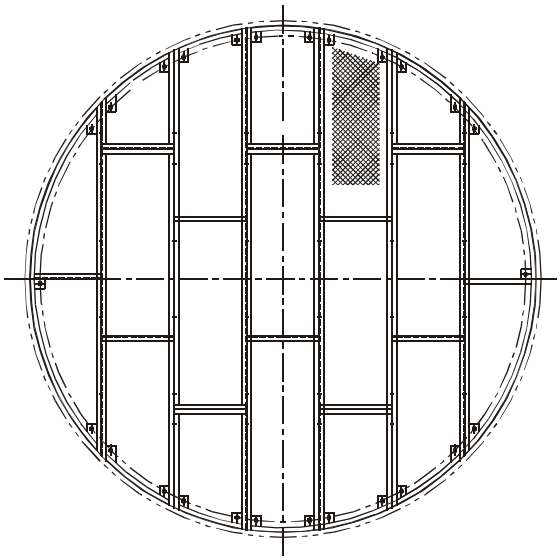


TYPE 2823
Bed Limiter for Random Packings

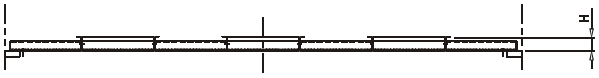
This type is used for traditional metal or plastic random packing. This type is fixed to the tower wall by clamps to a ledge welded in the column.

Available in any weldable sheet metal or Thermoplastic material in sheet form.

Please ask us information for design and application.



BED LIMITER TYPE 2823

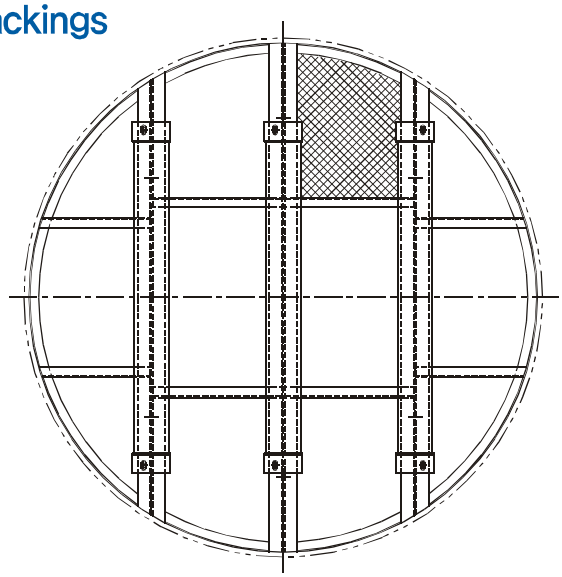


TYPE 2905/2925
Hold Down plate for Ceramic or Carbon Packings

These types rest directly on the packing. Type 2905 must be attached Weight bar to get approximately 1,000 kg/㎡

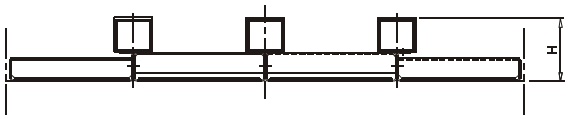
Available in any weldable sheet metal and most commonly used for carbon raschig ring or ceramic packings.

Please ask us information for design and application.



BED LIMITER TYPE 2905

(TYPE 2925 DOES NOT HAVE WEIGHT BAR.)

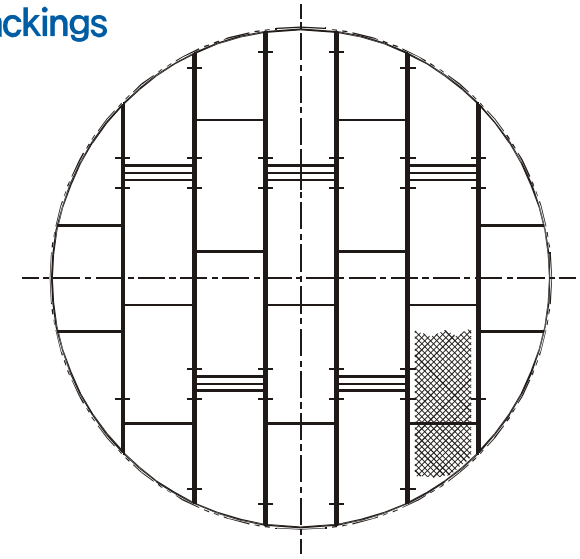


TYPE 2103
Non Interfering Bed Limiter for Random Packings

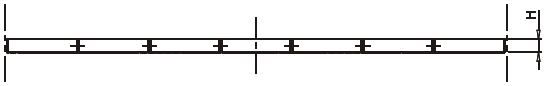
This type is used for minimum interference of liquid distribution with liquid distributor below. The outside diameter is expandable so that it can fit with tower wall and prevent packings from running away.

Available in any weldable sheet metal and most commonly used for metal packings.

Please ask us information for design and application.



BED LIMITER TYPE 2103

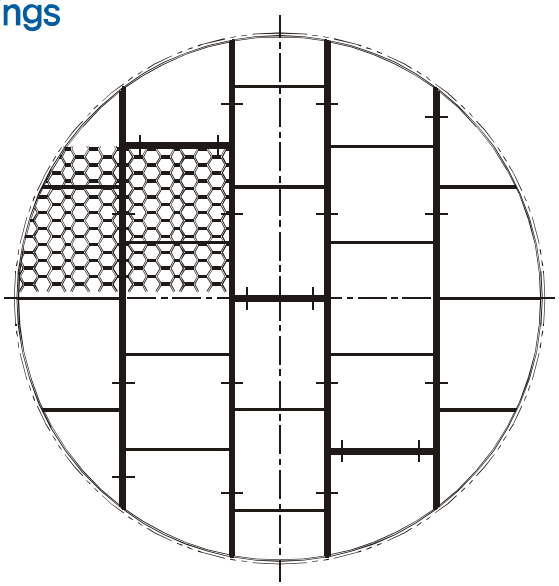


TYPE 2868
P.P. or P.V.C. Bed Limiter for Random Packings

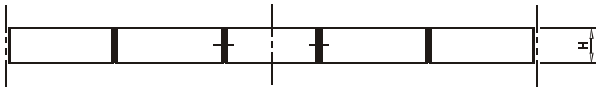
This is a beam type and designed primarily for use plastic packing and must be fastened to the column wall. All sections or beams must be bolted together.

Available in any P.P. or P.V.C. sheet.

Please ask us information for design and application.



BED LIMITER TYPE 2868



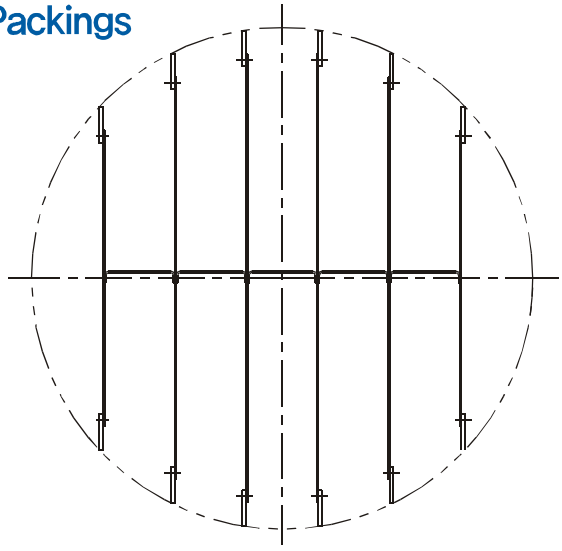
TYPE 2133
Bed Limiter for Structured or Wire Gauze Packings

This type is designed to minimize interference with liquid distribution and is bolted to the vessel wall by vertical clips in case of large towers.

This type can be integrated wiht the distributor when the space has limitation.

Available in any weldable sheet metal. And used for structured packings.

Please ask us information for design and application.



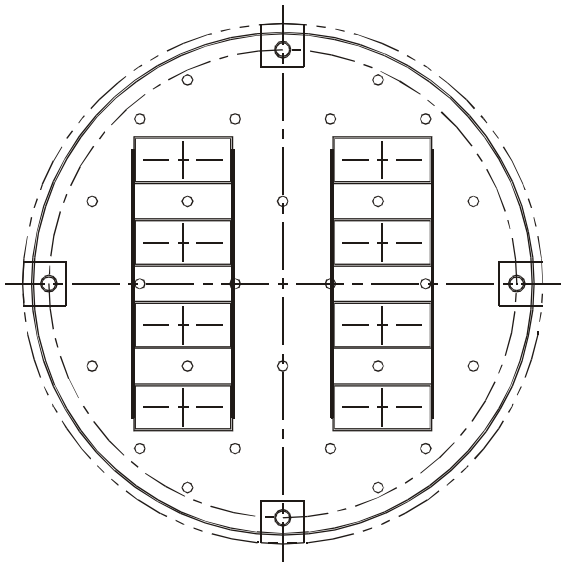
BED LIMITER TYPE 2133

TYPE 2106/2107
Pan Distributor/Redistributor

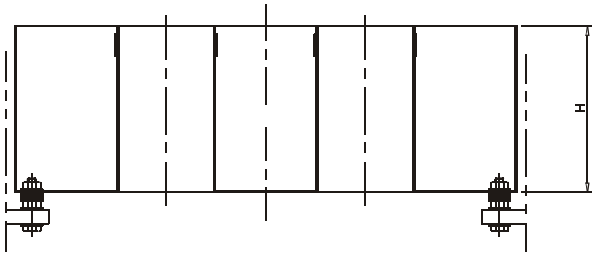
These types are used for towers is less than 36 in. (900 mm) ID with minimum liquid rates is more than 2 gpm/ft² (5m³/h·m²). These type construction allow easy liquid sealing and distributor leveling. The orifices are normally so large that can provide moderate fouling resistance.

Available in any weldable sheet metal or Thermoplastics or FRP.

Please ask us information for design and application.



DISTRIBUTOR TYPE 2106
(REDISTRIBUTOR HAS RISER COVERS)

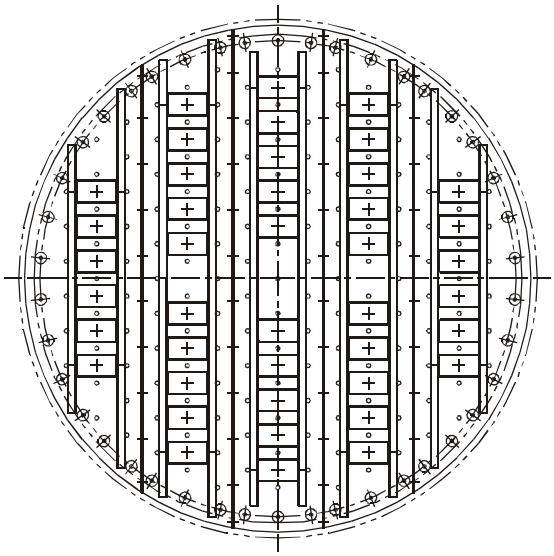


TYPE 2116/2117
Deck Distributor/Redistributor

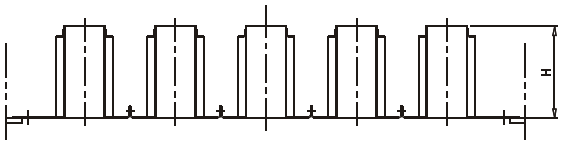
These types are used for towers with minimum liquid rates of 12 gpm/ft² (30m³/h·m²). The construction allows good liquid cross-flow.

Available in any weldable sheet metal. Carbon steel is not recommended except very high flow rates.

Please ask us information for design and application.



DISTRIBUTOR TYPE 2116
(REDISTRIBUTOR HAS RISER COVERS)

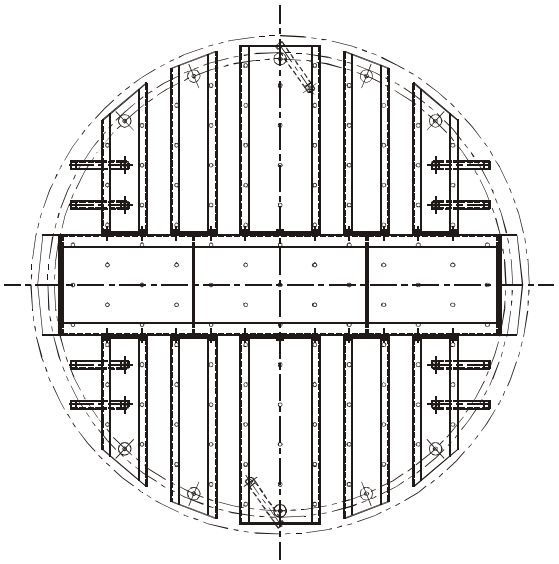


TYPE 2126/2127
Trough Distributor/Redistributor

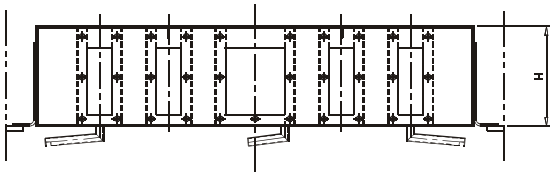
These types are used for towers greater than 55 in. (1400 mm) ID and have orifices in troughs. In case of liquid only feeds, a feed pipe and parting boxes may be used as required. Two phase feeds require flashing feed device to evenly separate phases.

Available in any weldable sheet metal, Thermoplastic or FRP materials.

Please ask us information for design and application.



DISTRIBUTOR TYPE 2126
(REDISTRIBUTOR HAS RISER COVERS)

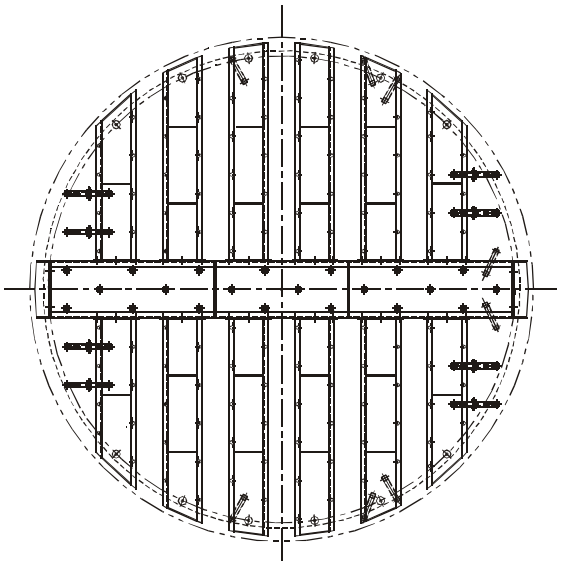


TYPE 2136/2137
Trough Distributor/Redistributor

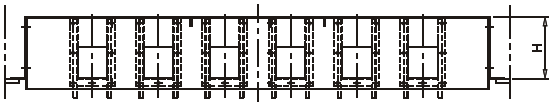
These types are used for towers greater than 10 in. (250 mm) ID with liquid rates between 0.3 and 12 gpm/ft² (0.75–30m³/h·m²) where fouling protection and/or high turndown is required.

Available in any weldable sheet metal. Carbon steel is not recommended except for very high liquid rates.

Please ask us information for design and application.



DISTRIBUTOR TYPE 2136
(REDISTRIBUTOR HAS RISER COVERS)

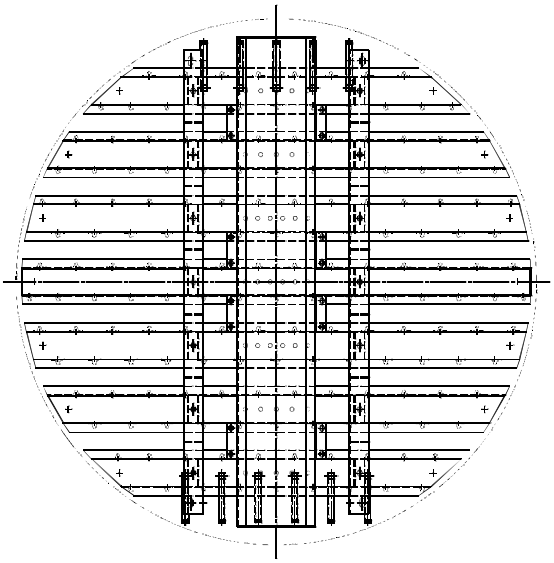


TYPE 2186
Trough Distributor

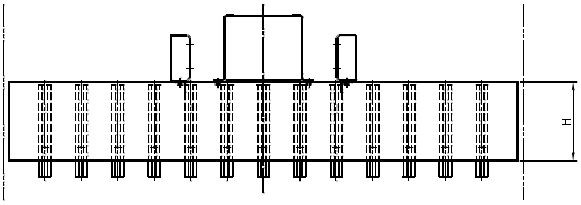
This type is used for towers greater than 36 in. (900 mm) ID with liquid rates between 0.3 and 8 gpm/ft² (0.75–20 m³/h·m²) where fouling protection is required.

Available in any weldable sheet metal. Carbon steel is not recommended except for very high liquid rates.

Please ask us information for design and application.



DISTRIBUTOR TYPE 2186

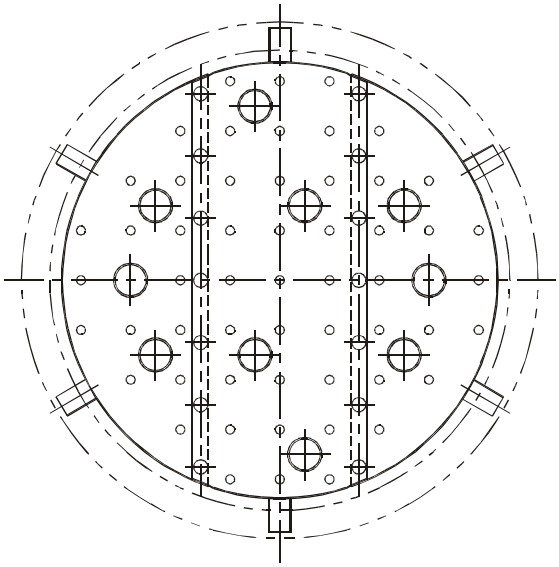


TYPE 2845
Pan Distributor (Traditional)

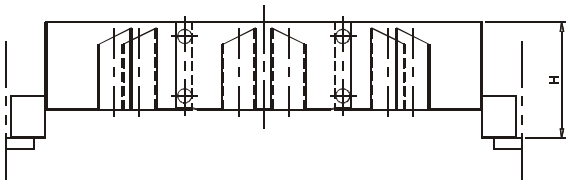
This is a traditional pan-type construction and used for towers less than 48 in. (1200 mm) ID with low liquid rates. For liquid only feeds. use a feed pipe to control feed velocity.

Available in any weldable sheet metal, Thermoplastics or FRP material.

Please ask us information for design and application.



DISTRIBUTOR TYPE 2845

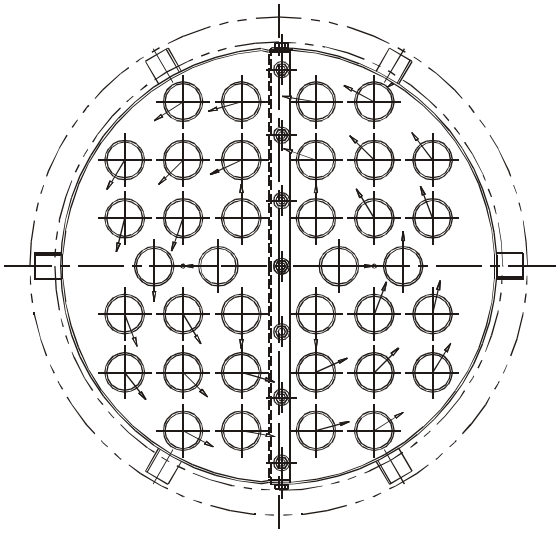


TYPE 2798
Pan Distributor (Traditional)

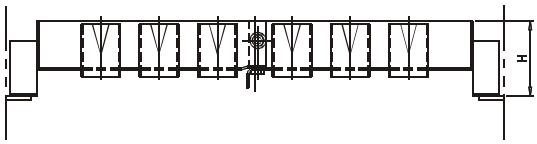
This is a "weir riser" distributor used for high fouling services for towers less than 48 in. (1200 mm) ID.
Cylindrical risers with "V" weirs are used as liquid downcomers and have wide turndown range. For liquid only feeds use a feed pipe to control feed velocity.
For liquid/vapor feeds require a flashing feed device. This type is not recommended for liquid redistributor.

Available in any weldable sheet metal.

Please ask us information for design and application.



DISTRIBUTOR TYPE 2798
(REDISTRIBUTOR HAS RISER COVERS)

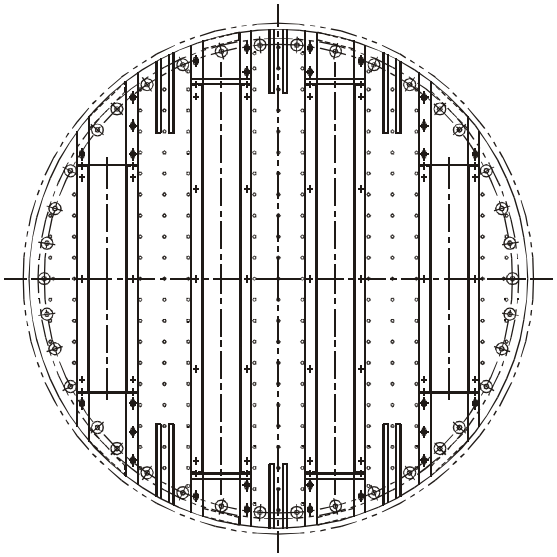


TYPE 2816/2817/2916/2917
Deck Distributor/Redistributor (Traditional)

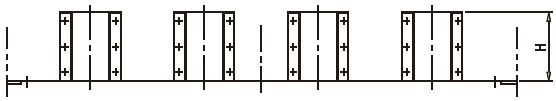
These types are traditional ones and used for towers from 10 in. (250 mm) ID with liquid rates of 0.8 and 50 gpm/ft² (2.0-120 m³/h·m²).
They all have identical features all except 2916 and 2917 give better distribution quality.
The redistributors have gas riser covers to collect liquid falling from above.

Available in any weldable sheet metal, Thermoplastic or FRP material.

Please ask us information for design and application.



DISTRIBUTOR TYPE 2816
(REDISTRIBUTOR HAS RISER COVERS)

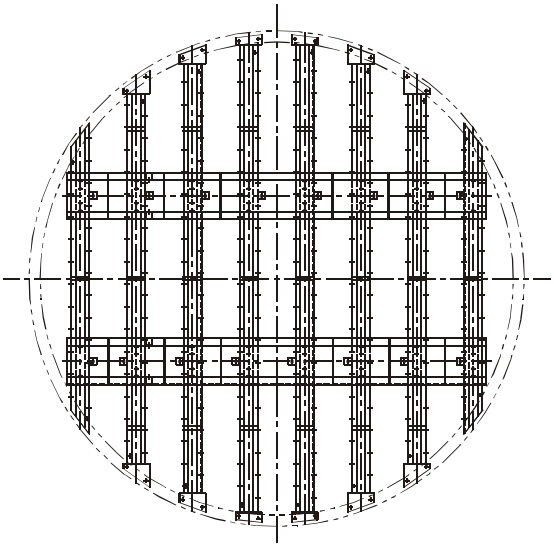


TYPE 2806
Trough Distributor (Traditional)

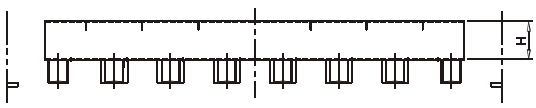
This is a weir-trough distributor for versatile liquid flow in towers larger than 36 in. (900 mm) ID.
This distributor is particularly effective in handling high liquid flow rates in severely fouling services.
This distributor can not be used as redistributor.

Available in any weldable sheet metal, FRP or Thermoplastic material.

Please ask us information for design and application.



DISTRIBUTOR TYPE 2806

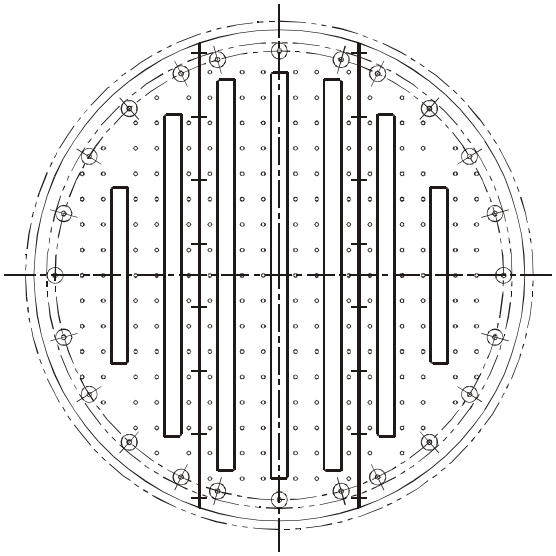


TYPE 2016/2017
Deck Distributor/Redistributor

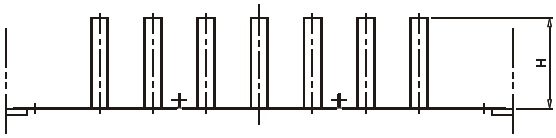
These types are used for deck types and used for towers larger than 55 in. (1400 mm) ID.
For liquid-only feeds use a feed pipe or parting boxes.
The redistributors have gas riser covers to collect liquid falling from above.

Available in any weldable sheet metal, Thermoplastic or FRP materials.

Please ask us information for design and application.



DISTRIBUTOR TYPE 2016
(REDISTRIBUTOR HAS RISER COVERS)

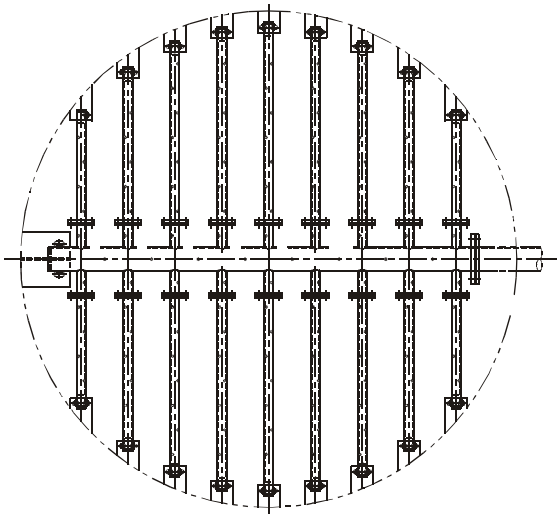


TYPE 2844
Pipe Arm Distributor

This type is used for towers larger than 17 in. (430 mm) ID and requires a little column elevation and provides high open area for high vapor flow and should be used for clean liquids only or with a filter designed to remove anything blocks the orifices.
The laterals should be removable to go through vessel manways.

Available in any weldable metal or Thermoplastic material.

Please ask us information for design and application.



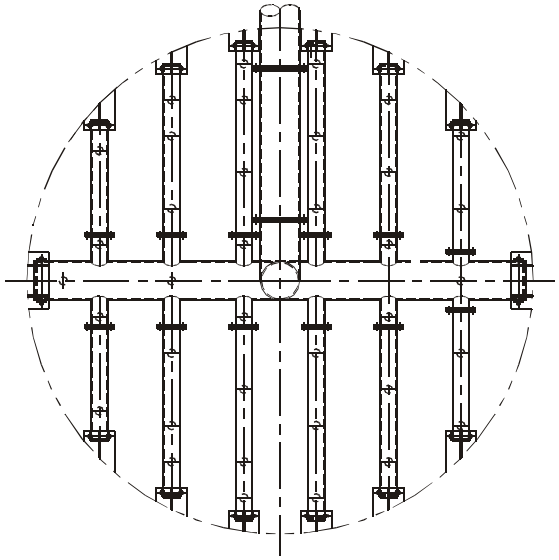
LIQUID DISTRIBUTOR TYPE 2844

TYPE 2044
Spray-Type Liquid Distributor

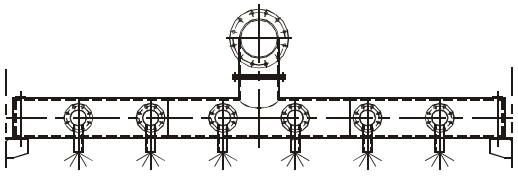
This type is an inexpensive distributor used for shallow beds of packing in heat transfer service. It can be used for very low liquid rates because each spray nozzle covers a large area of the tower.

Available in any weldable metal, pipe and flange must be used.

Please ask us information for design and application.



SPRAY DISTRIBUTOR TYPE 2044

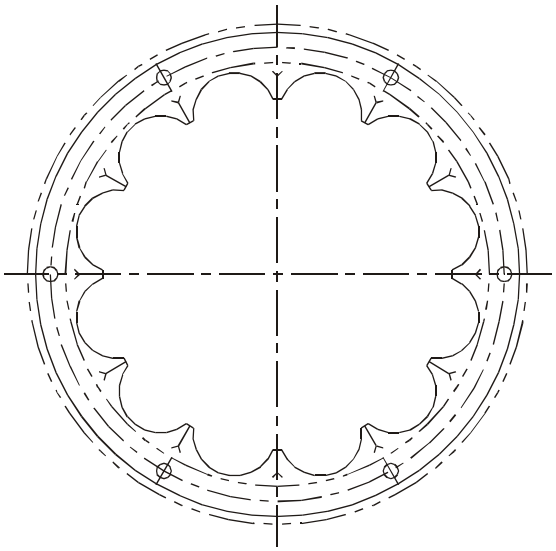


TYPE 2858
"Rosette" Type Redistributor

This type is used as wall-wiper redistributor and best suitable for small columns.
It offers
(1) High liquid handling capacity,
(2) Elimination of wall steaming,
(3) Non fouling design,
(4) Greater spacing between redistributors,
(5) And a constant percentage of free space. And assures uniform distribution to the bed below. This distributor must be sealed to the tower wall.

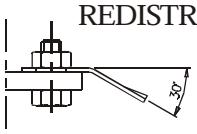
Available in any weldable sheet metal or Thermoplastic material.

Please ask us information for design and application.



"ROSETTE"

REDISTRIBUTOR TYPE 2858

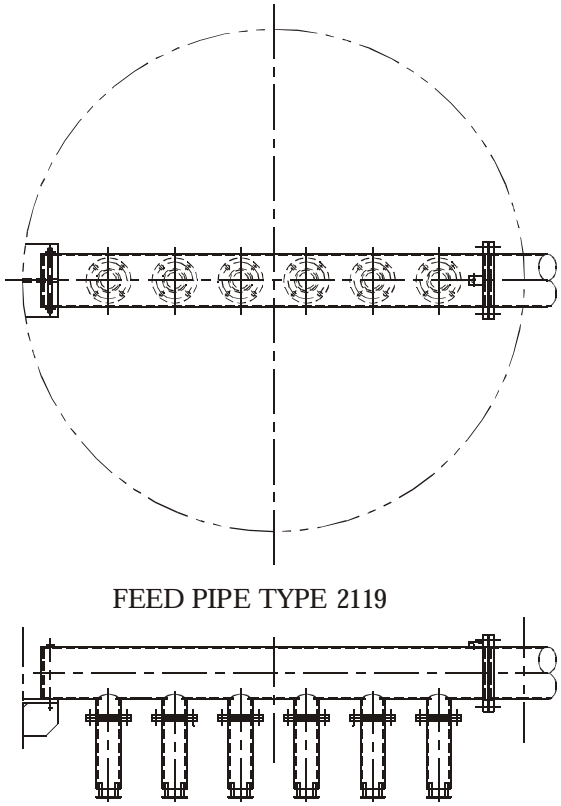


TYPE 2119/2129
Liquid Only Feed Pipe

These types are for liquid only feed pipes used when liquid is fed from outside the column on to a distributor/redistributor. The type 2119 feed pipe is a piping system and while the type 2129 is a parting box or calming box system and handles much higher turndown ratio than type 2119, but requires more tower height.

Available in any weldable metal or Thermoplastic material.

Please ask us information for design and application.



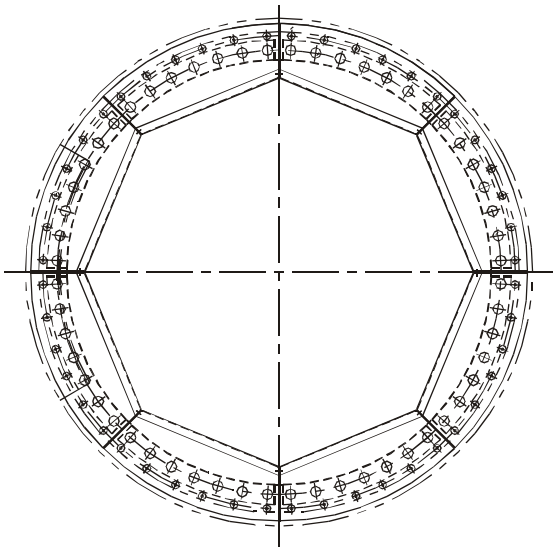
FEED PIPE TYPE 2119

TYPE 2755
Flashing Feed Gallery

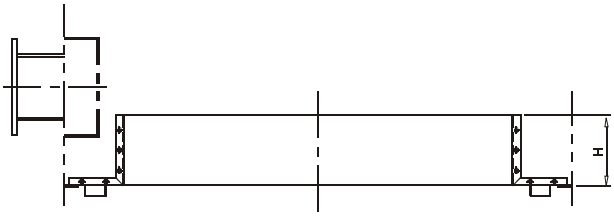
The flashing feed gallery is a two phase feed device fed by a tangential inlet tower or a radial nozzle with a flow deflector. The purpose of this type is to make incoming flow to be directed tangentially into the tower wall.
A gallery below the inlet collects liquid into a pool, making the vapor or gas to disengage so that the liquid can fall directly to a distributor or into a pre-distributor or parting boxes.

Available in any weldable metal.

Please ask us information for design and application.



FLASHING FEED GALLERY TYPE 2755

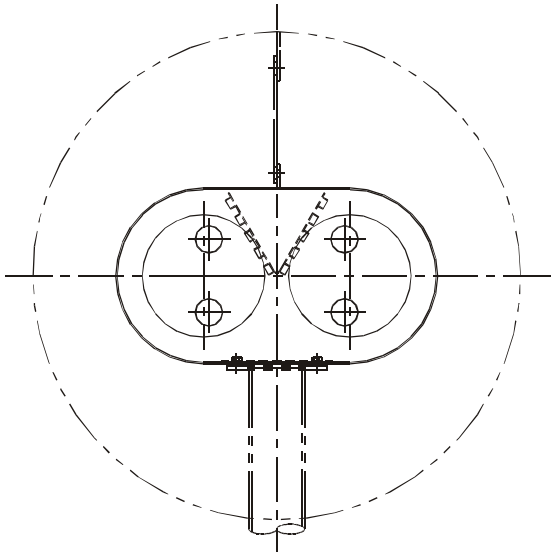


TYPE 2855
Flashing Feed Chamber

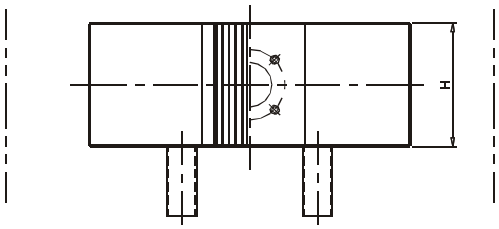
This is a two-phase feed device with a radial inlet. The feed is in the chamber and separates the phase-vapor out of the top and liquid out the bottom to a distributor below.
This can be used for traditional and new types.

Available in any weldable metal.

Please ask us information for design and application.



FLASHING FEED CHAMBER TYPE 2855

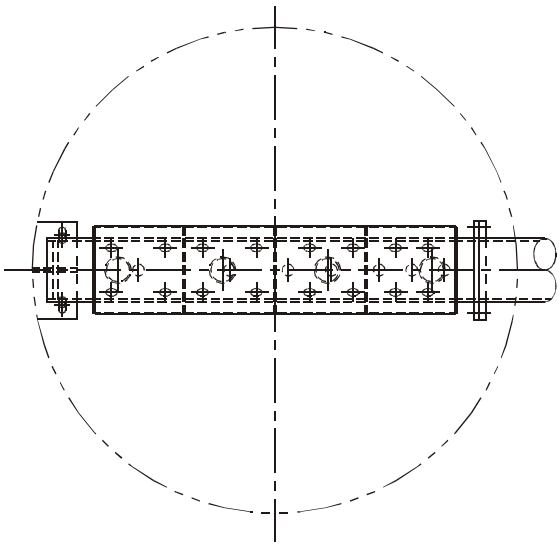


TYPE 2955
Flashing Feed Pipe

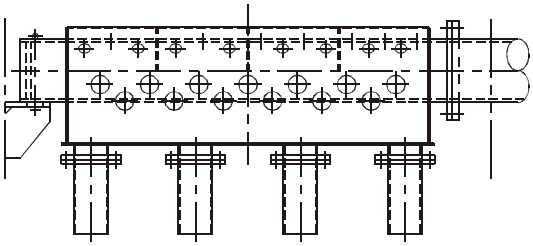
This is the type most commonly used for vacuum services when tower is larger than 48 in. (1200 mm) ID to separate two phase feed.

Available in any weldable metal.

Please ask us information for design and application.



FLASHING FEED PIPE 2955

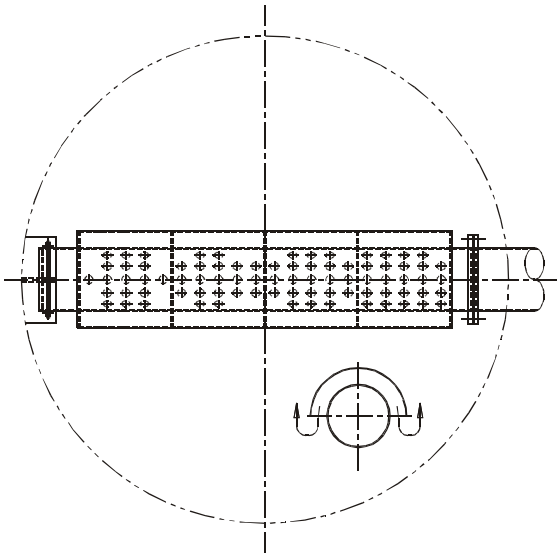


TYPE 2196
Vapor Diffuser

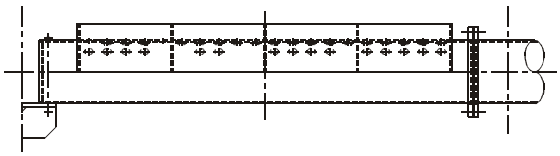
This type is used when the incoming flow is vapor only and the flow is excessive to prevent vapor maldistribution.

Available in any weldable metal.

Please ask us information for design and application.



VAPOR DIFFUSER TYPE 2196

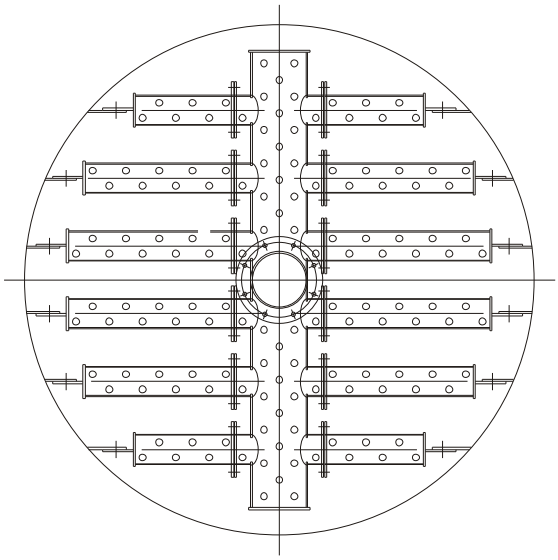


TYPE 2198
Vapor Distributor

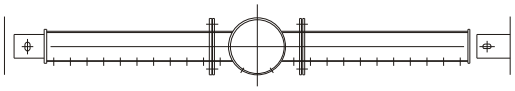
This is pipe arm type used for vapor distribution. And good for vapor feed at the bottom of the tower into a very tight space or the vapor has different composition or temperature.

Available in any weldable metal or Thermoplastic pipe material.

Please ask us information for design and application.



VAPOR DISTRIBUTOR TYPE 2198

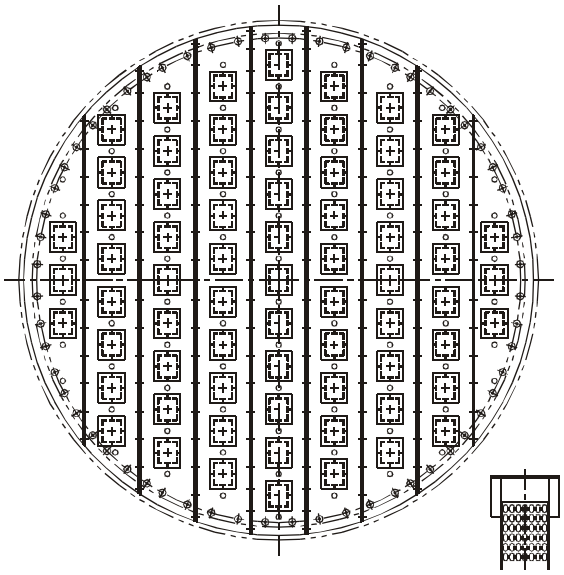


TYPE 2896
Vapor Distributor Plate for Self anchoring

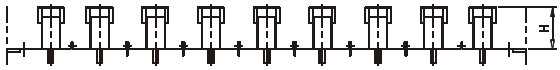
This is the type of distributor plate used above vapor-containing feeds to assure good vapor distribution to the packed bed above.

Available in any weldable sheet metal.

Please ask us information for design and application.



VAPOR DISTRIBUTOR TYPE 2896

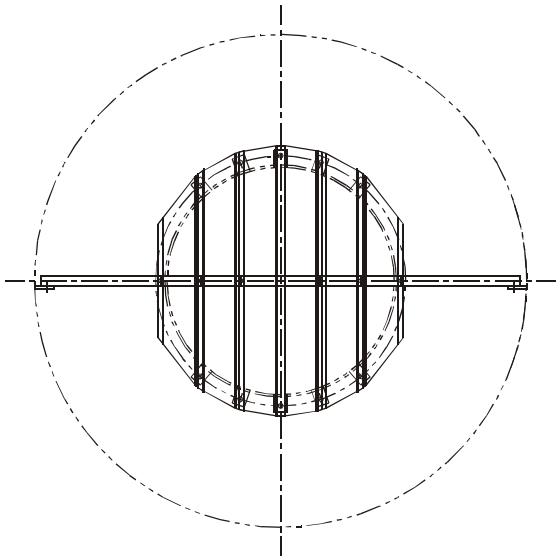


TYPE 2633
Chevron–Type Liquid Collector

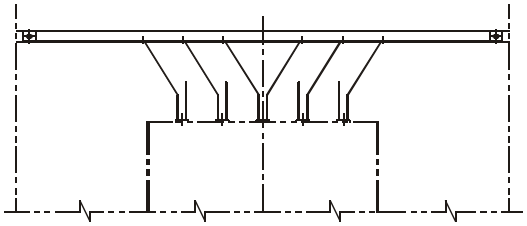
This is the type used for towers that are greater than 31.5 in. (800 mm) ID and that process high vapor roads and low liquid loads (Vacuum service).
The plate collects overhead liquid drawn from the tower or feed to a distributor below.
The plate consumes minmal pressure drop and avoids entrainment even at vapor rates high enough to cause entrainment from conventional gas risers.

Available in any weldable sheet metal.

Please ask us information for design and application.



LIQUID COLLECTOR TYPE 2633

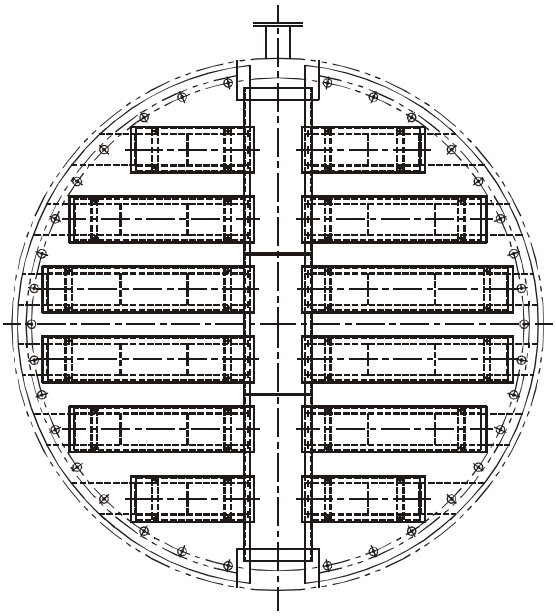


TYPE 2733
Trough Liquid Collector

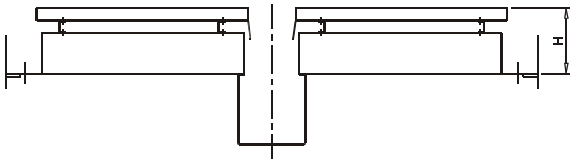
This is the type used for a wide variety of applications in towers greater than 55 in. (1400 mm) ID and generally is the best choice in larger towers where thermoexpansion is a concern.
The trough arrangement minimizes welding to the vessel wall.
The troughs are free to expand because they rest on the ledge.

Available in any weldable sheet metal, Thermoplastic of FRP material.

Please ask us information for design and application.



LIQUID COLLECTOR TYPE 2733

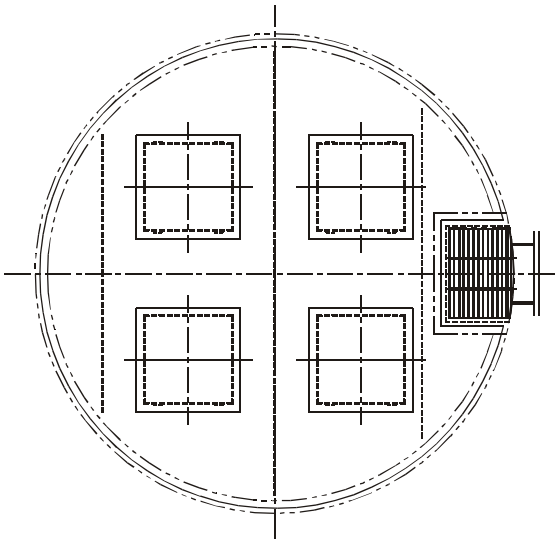


TYPE 2833
Deck Liquid Collector

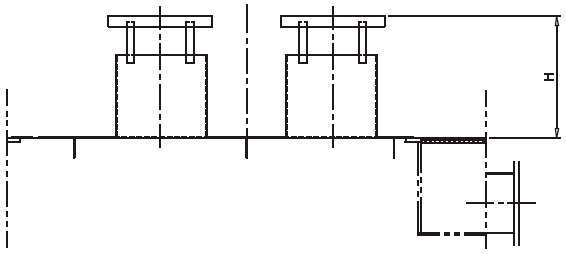
This is the type that can be used for towers of all sizes. Tall risers can be provided to allow a large volume of liquid on the deck. Sumps can be added on one side, both sides or across the center.

Available in any weldable sheet metal, Thermoplastic of FRP material.

Please ask us information for design and application.



LIQUID COLLECTOR TYPE 2833

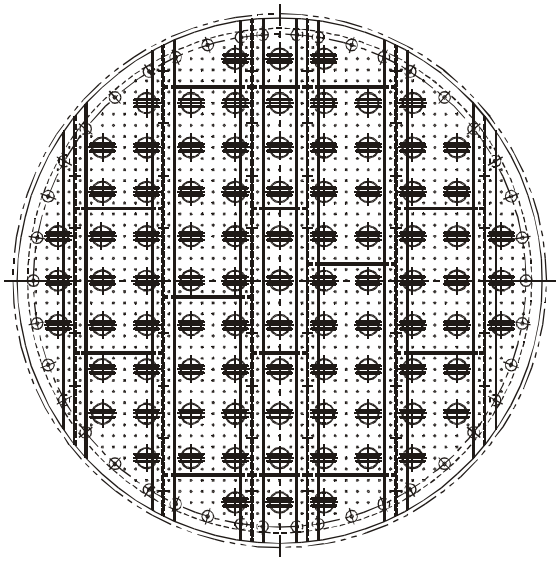


TYPE 2834
Liquid–Liquid Disperser Support Plate

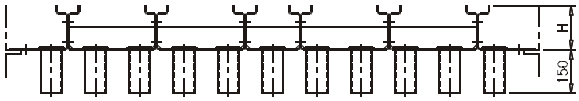
This type is used 1). to support the packed bed and 2). to disperses the light phase into the continuous heavy phase. Dump tubes allow the heavy phase to travel downward through the plate and the orifices generate droplets. The plate design depends on interfacial surface tension, viscosity and differential densities. This plate acts also as a re-disperser in multi-bed towers.

Available in any weldable sheet metal.

Please ask us information for design and application.



LIQ.-LIQ. DISPERSER
SUPPORT PLATE TYPE 2834

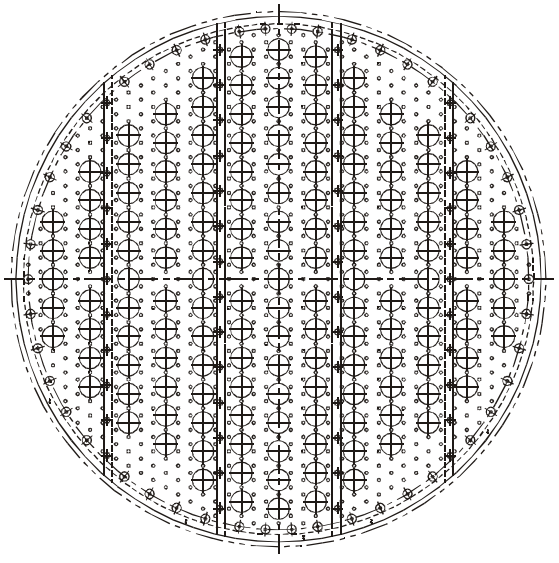


TYPE 2835
Liquid–Liquid Disperser Support Plate

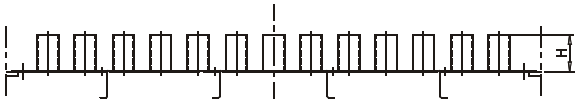
This type disperses heavy phase into the continuous light phase. Riser tubes allow the light phase to pass up through the plate. The heavy phase forms a head on the top of the plate and orifices generate droplets. The plate design depends on interfacial surface tension, viscosity and differential densities.

Available in any weldable sheet metal.

Please ask us information for design and application.



LIQ.-LIQ. DISPERSER
SUPPORT PLATE TYPE 2835

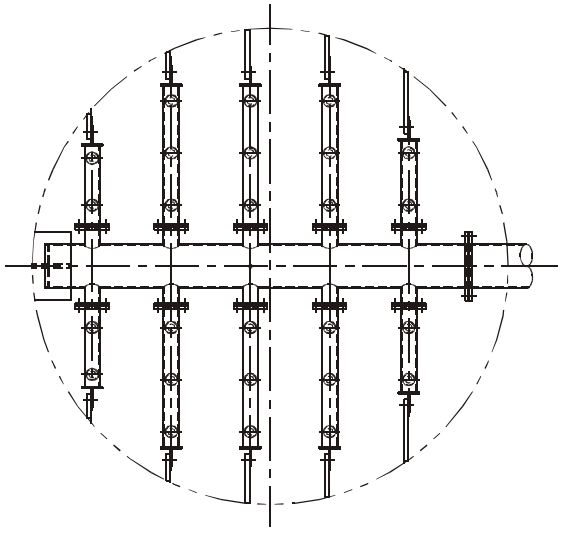


TYPE 2644
Liquid–Liquid Disperser–Phase Feed Pipe

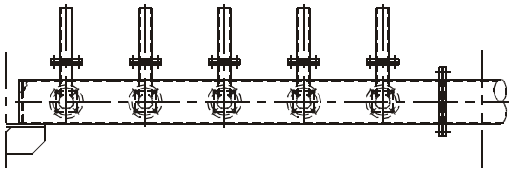
This type controls velocity of the dispersed phase. This type controls feed velocity and correctly positions the discharge points to minimize disturbance.

Available in any weldable metal in pipe.

Please ask us information for design and application.



LIQ.-LIQ. DISPERSER
PHASE FEED PIPE TYPE 2644

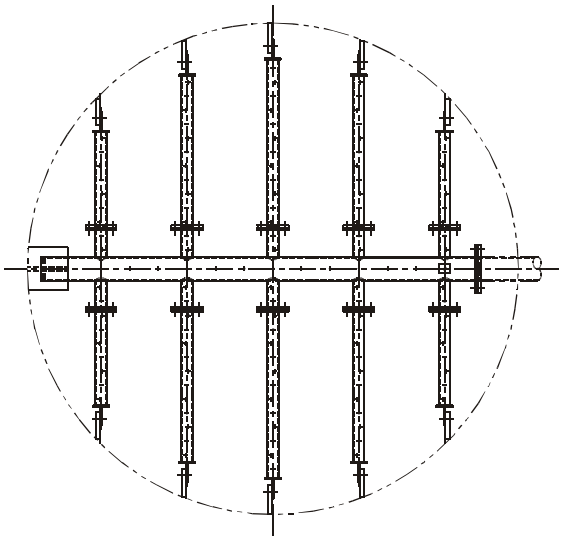


TYPE 2744
Liquid–Liquid Continuous–Phase Distributor

This type controls velocity of the continuous phase flow into the tower. Proper control of velocity is important to prevent excessive disturbance of the heavy/light interface.

Available in any weldable metal in pipe form.

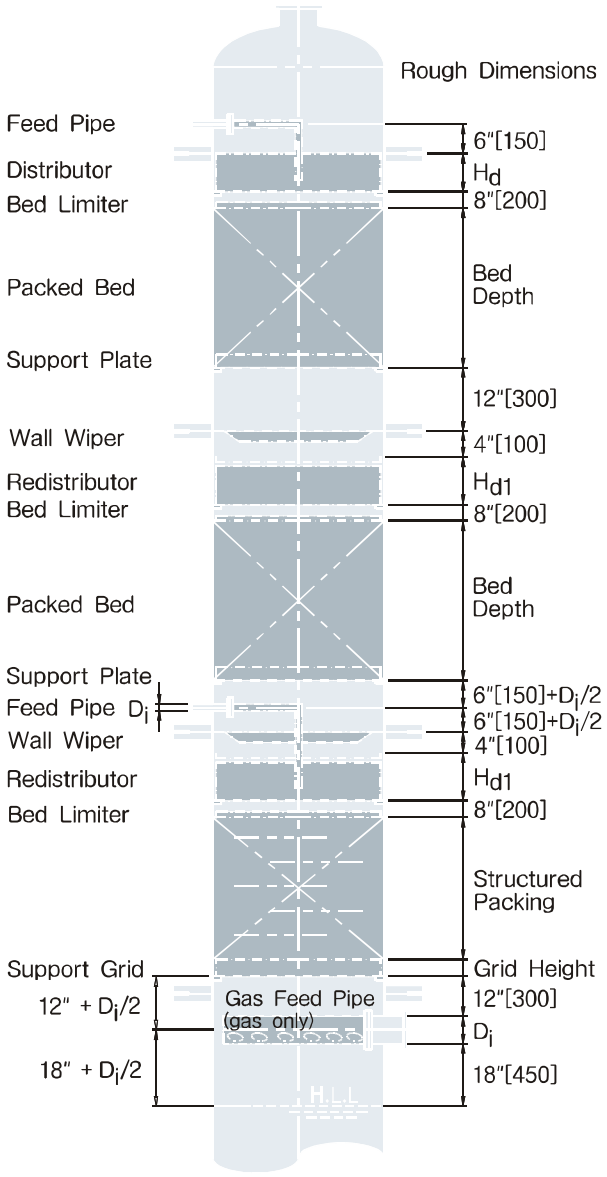
Please ask us information for design and application.



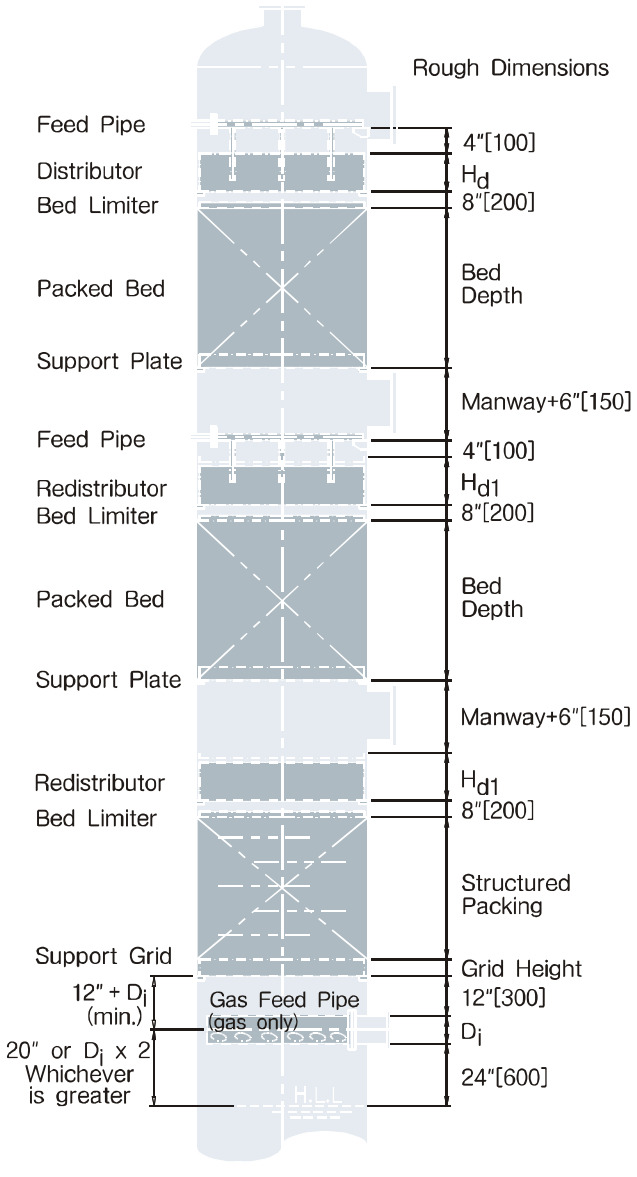
LIQ.-LIQ. CONTINUOUS
PHASE DISTRIBUTOR TYPE 2744

TYPICAL TOWER LAYOUT

Smaller Diameters (Flanged towers)



Larger Diameters (Internals and packing pass through manways for installation)



- Flash feed arrangement is not shown.
- Typical dimensions are offered for rough estimating purposes. Please contact Hanbal Masstech for exact dimension.

INSTALLATION-DEMOLITION-SUPERVISION

HMT HAS EXPERIENCES IN COUNTRIES SUCH AS: KOREA THAILAND MALAYSIA BRAZIL QATAR IRAN LIBYA SAUDI ARABIA INDIA INDONESIA EGYPT AZERBAIJAN P.R.C R.O.C U.S.A. (INSTALLED IN KOREA AT TOWER MAKERS SHOP)

INSTALLATION SERVICES FOR :

- BUBBLE CAP, VALVE, SIEVE, CARTRIDGE AND DUAL FLOW TRAYS
- PACKED TOWER AND REACTOR INTERNALS
- RANDOM, STRUCTURED, METAL, PLASTIC AND CERAMIC PACKINGS
- CONSULTATION AND SUPERVISION

NOTES FOR INSTALLATION

Good installation of packed tower internals has very much to do with tower performance and timely completion of new or turnaround projects.

Many may think that they can do it because they are shown on the drawing and written in the installation procedures.

Sometimes, the packings above the support plate have to be removed bacause of bad installation or the distributor/redistributor have to be removed for re-installation.

So please try to have our advice or make us feel for sure on your installation experience or technology.

Without a long experiences and many failures, no one can say for sure that their jobs can be done satisfactory.

Please ask us information to make it sure we all are doing safely.

PLEASE ASK US FOR ANSWERS BY REFERING THE FOLLOWING INFORMATION

CONTACT	TELEPHONE	FACSIMILE	E-MAIL
EXECUTIVE DIRECTOR	82-55-310-2121	82-55-338-1917	bhkang@hanbalmasstech.com
SALES	82-55-310-2141	82-55-338-1919	shjeon@hanbalmasstech.com
PROCESS	82-55-310-2191	82-55-338-1919	dsohk@hanbalmasstech.com
TECHNICAL	82-55-310-2181	82-55-338-1919	mjkim@hanbalmasstech.com
MANUFACTURE	82-55-310-2161	82-55-338-2919	mjcho@hanbalmasstech.com
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HMT HANBAL MASSTECH LIMITED

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서울사무소 : TEL. 02-412-0851 FAX. 02-413-0272
http://www.hanbal.kr

#1080-4 Naesam-ri, Juchon-myeon, Gimhae-si, Gyeongsangnam-do, Korea
OFFICE & PLANT : TEL. +82-55-338-1911 FAX. +82-55-338-1917
SEOUL OFFICE : TEL. +82- 2-412-0851 FAX. +82- 2-413-0272

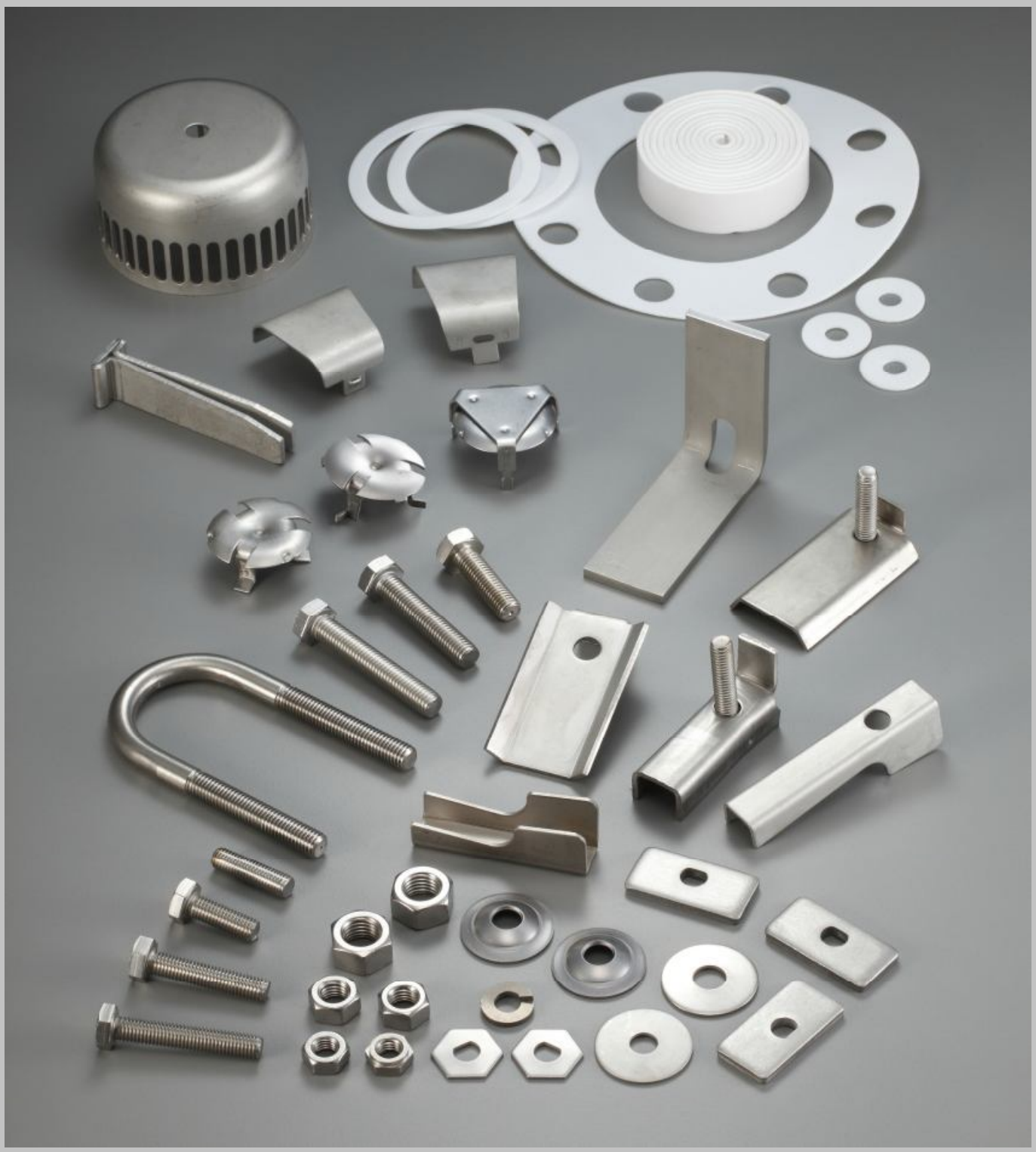
AGENT :

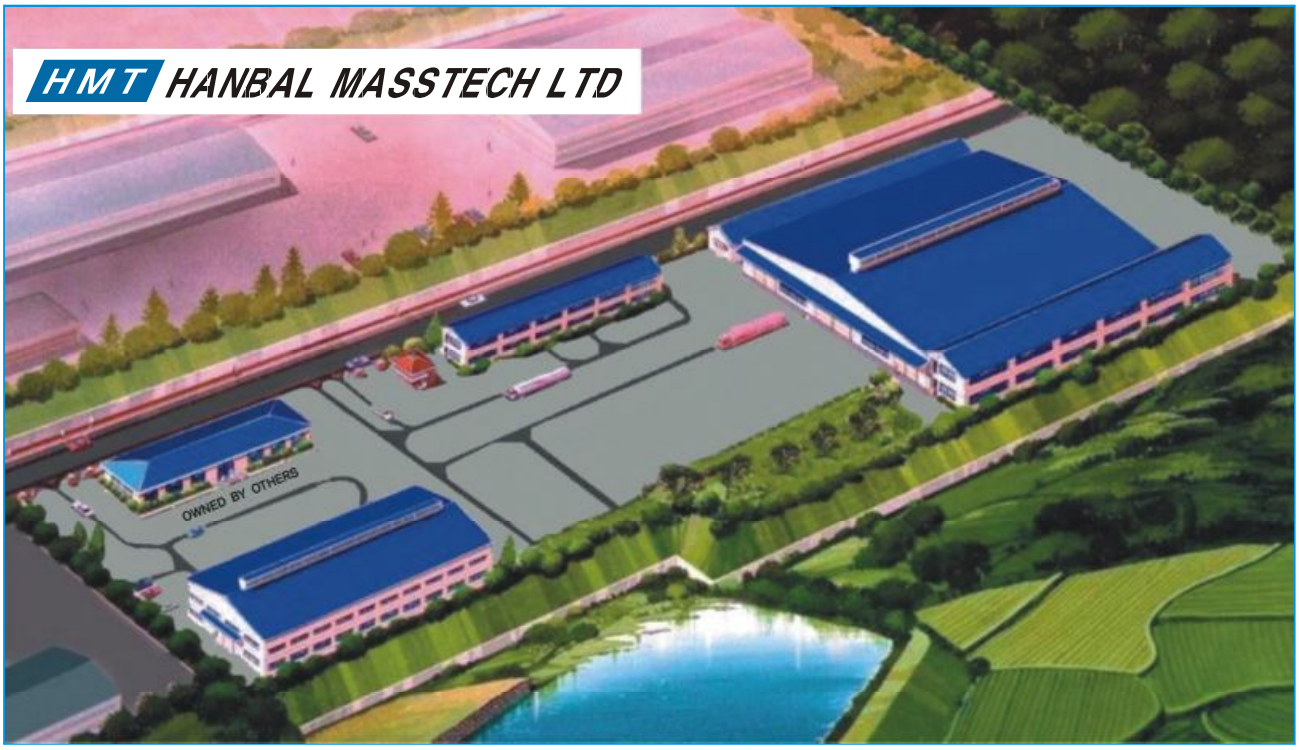
HMT

HANBAL MASSTECH LIMITED

MASS TRANSFER TECHNOLOGY

HARDWARE for TOWER INTERNALS





INTRODUCTION

Hanbal Masstech was established in July 1971 as design and manufacturer of Tower Trays, Internals and Packings, Wire Mesh Mist Eliminators and their associated products to serve for Oil Refinery, Chemical, Petrochemical, Plant Engineering and Construction Companies and we are the pioneer of these items in Korea.

We joined Norton Chemical Process Products Corporation in 1979 as Sales Representative and worked with them as manufacturer, Joint Venture Partner(Norton Hanbal Korea Inc.), design/manufacturer and Licensee until April 2002.

We conducted R&D with Korea Institute of Energy Resources (KIER), especially noteworthy is the R&D held with KIER-Ruhr University in Germany-Hanbal as F.R.I. member for five years under government assistance and our R&D with KIER continues every year.

We learned most of the design and fabrication technologies from Norton CPPC, but we have some of our own that will meet our customer's specific requirements.

As we know what and how Norton had tested, and to continue to do that, we built an outdoor test facility, 20 feet(6 meters) square and 27 feet(8 meters) tall, for distribution quality test and what we have designed is questionable, we go for test to make it sure they are perfect.

We also design and produce traditional style internals which are good for easy towers and those cost about 30% less as compared to the high performance ones.

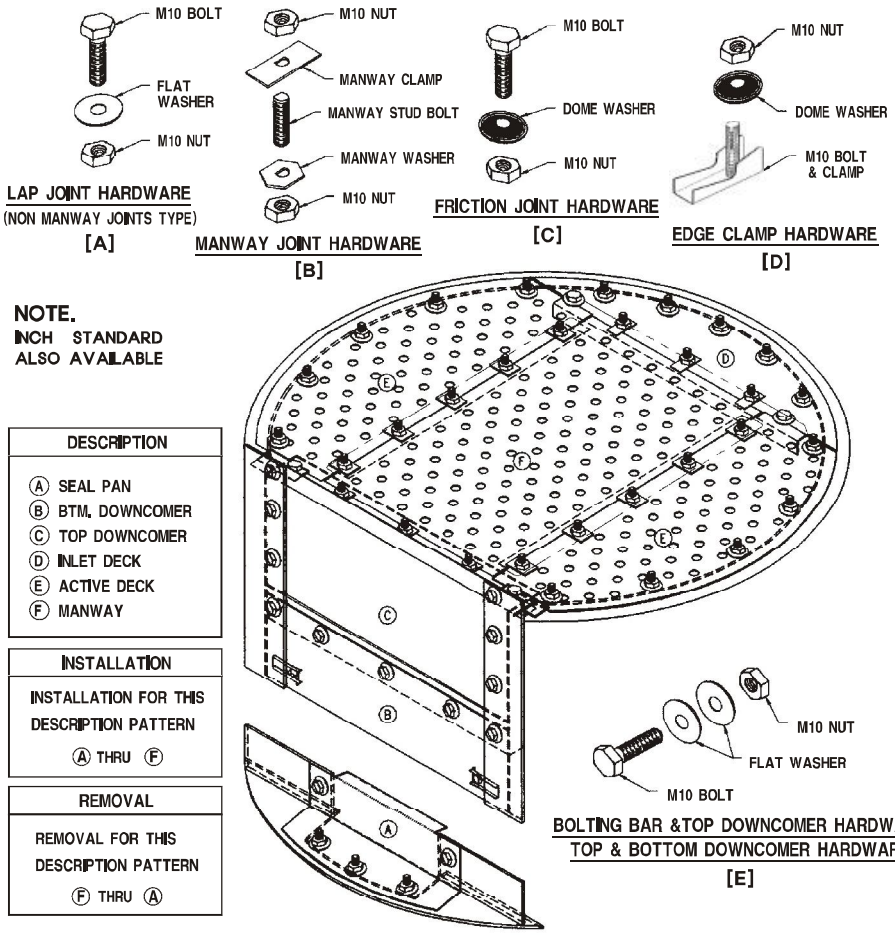
We thank you all for the finest helps and concerns rendered to us so far and wish the same in the future.

Sincerely, President & CEO

TABLE OF CONTENTS

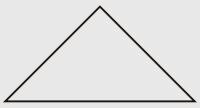
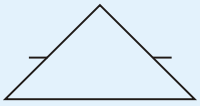
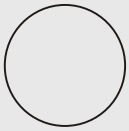
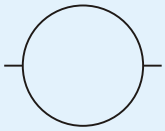
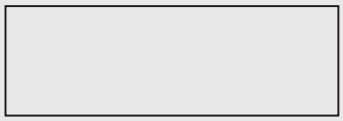
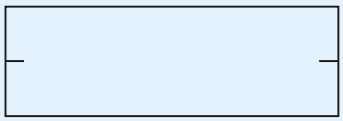
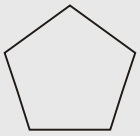
NOTE : 1. OTHER TYPES OF HARDWARE ARE ALSO AVAILABLE.
2. AVAILABLE IN CARBON STEEL, STAINLESS STEEL OF 410, 304(L), 316(L), 317(L), TITANIUM, MONEL, HASTELOY-C, PP, CPVC AND OTHER MATERIALS ON REQUEST.

TYPICAL HARDWARE DETAILS FOR TRAYS



ASSEMBLIES	COMPONENTS	PAGE NO.
[A]	M10 HEX BOLT	7
	FLAT WASHER	10
	M10 NUT	9
[B]	M10 NUTS	9
	MANWAY CLAMP	6
	MANWAY STUD BOLT	7
	MANWAY WASHER	10
[C]	M10 HEX BOLT	7
	DOME WASHER	10
	M10 NUT	9
[D]	M10 NUT	9
	DOME WASHER	10
	CLAMP	5
[E]	M10 HEX BOLT	7
	FLAT WASHERS	10
	M10 NUT	9

MATERIAL SYMBOLS AND DESIGNATIONS

MATERIAL	STAMPED SYMBOL
304 SS	
304L SS	
316 SS	
316L SS	
410 SS	
410S SS	
321 SS	
MONEL	M
TITANIUM	T

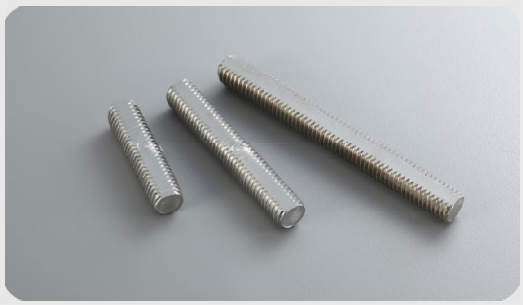
CLAMPS

ITEM NO.	ITEM DESCRIPTION	
HW-C01	CLAMP	
HW-C02 (Norton Type K-74452)	CLAMP	
HW-C03	CLAMP	
HW-C04	CLAMP	

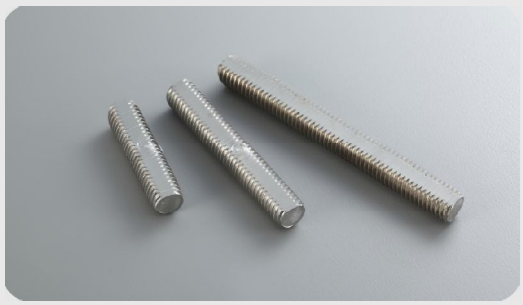
CLAMPS

ITEM NO.	ITEM DESCRIPTION	
HW-C05	CLAMP	
HW-C06	J-CLAMP	
HW-C07 (Norton Type G-32)	MANWAY CLAMP	

BOLTS (METRIC)

ITEM NO.	ITEM DESCRIPTION	
HW-B01	M6 HEX BOLT	
HW-B02	M8 HEX BOLT	
HW-B03	M10 HEX BOLT	
HW-B04	M12 HEX BOLT	
HW-B05	M16 HEX BOLT	
HW-B06	M20 HEX BOLT	
HW-B07	M6 J-BOLT	
HW-B08	M10 J-BOLT	
HW-B09	M12 J-BOLT	
HW-B10	M16 J-BOLT	
HW-B11 (Norton Type G-31)	M10 MANWAY STUD BOLT	
HW-B12	M10 STUD BOLT	
HW-B13	M12 STUD BOLT	
HW-B14	M6 U-BOLT	
HW-B15	M8 U-BOLT	
HW-B16	M10 U-BOLT	
HW-B17	M12 U-BOLT	
HW-B18	M16 U-BOLT	
HW-B19	M20 U-BOLT	

BOLTS (UNIFIED)

ITEM NO.	ITEM DESCRIPTION	
HW-B01U	1/4"-20UNC BOLT	
HW-B02U	5/16"-18UNC BOLT	
HW-B03U	3/8"-16UNC BOLT	
HW-B04U	1/2"-13UNC BOLT	
HW-B05U	5/8"-11UNC BOLT	
HW-B06U	3/4"-10UNC BOLT	
HW-B07U	1/4"-20UNC J-BOLT	
HW-B08U	3/8"-16UNC J-BOLT	
HW-B09U	1/2"-13UNC J-BOLT	
HW-B10U	5/8"-11UNC J-BOLT	
HW-B11U (Norton Type G-31)	3/8"-16UNC MANWAY STUD BOLT	
HW-B12U	3/8"-16UNC STUD BOLT	
HW-B13U	1/2"-13UNC STUD BOLT	
HW-B14U	1/4"-20UNC U-BOLT	
HW-B15U	5/16"-18UNC U-BOLT	
HW-B16U	3/8"-16UNC U-BOLT	
HW-B17U	1/2"-13UNC U-BOLT	
HW-B18U	5/8"-11UNC U-BOLT	
HW-B19U	3/4"-10UNC U-BOLT	

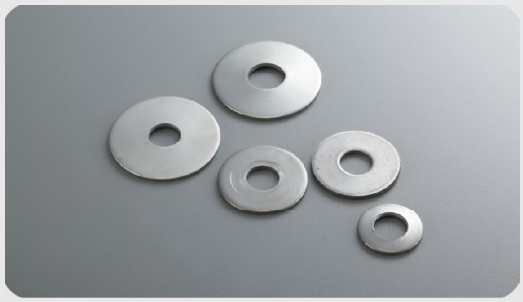
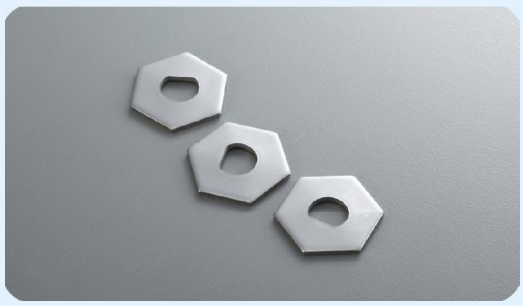
NUTS (METRIC)

ITEM NO.	ITEM DESCRIPTION	
HW-N01	M6 HEX NUT	
HW-N02	M8 HEX NUT	
HW-N03	M10 HEX NUT	
HW-N04	M12 HEX NUT	
HW-N05	M16 HEX NUT	
HW-N06	M20 HEX NUT	
HW-N07	M10 WELD NUT	

NUTS (UNIFIED)

ITEM NO.	ITEM DESCRIPTION	
HW-N01U	1/4"-20UNC NUT	
HW-N02U	5/16"-18UNC NUT	
HW-N03U	3/8"-16UNC NUT	
HW-N04U	1/2"-13UNC NUT	
HW-N05U	5/8"-11UNC NUT	
HW-N06U	3/4"-10UNC NUT	

WASHERS

ITEM NO.	ITEM DESCRIPTION	
HW-W01	ID11×OD25 FLAT WASHER	
HW-W02	ID13×OD25 FLAT WASHER	
HW-W03	ID11×OD30 FLAT WASHER	
HW-W04	ID13×OD30 FLAT WASHER	
HW-W05	ID11×OD39 FLAT WASHER	
HW-W06	ID13×OD39 FLAT WASHER	
HW-W07	M10 SPRING WASHER	
HW-W08	M12 SPRING WASHER	
HW-W09	M16 SPRING WASHER	
HW-W10	M20 SPRING WASHER	
HW-W11	DOME WASHER (ROUND)	
HW-W12 (Norton Type G-42)	MANWAY WASHER	
HW-W13	SHIM WASHER	

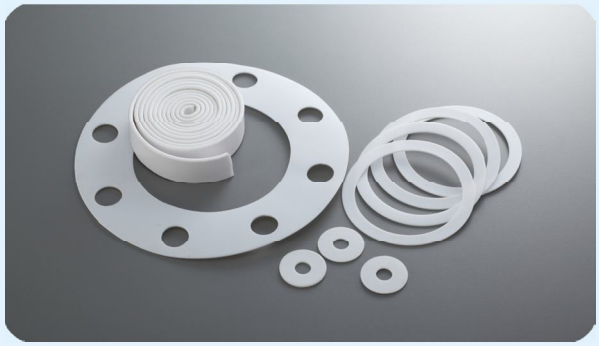
VALVES AND CAPS

ITEM NO.	ITEM DESCRIPTION	
HW-V01	NHP (STD) VALVE	
HW-V02	NHP (LTD) VALVE	
HW-V03	MR2 HEAVY VALVE	
HW-V04	MR2 LIGHT VALVE	
HW-V05	MR2L HEAVY VALVE	
HW-V06	MR2L LIGHT VALVE	

VALVES AND CAPS

ITEM NO.	ITEM DESCRIPTION	
HW-V07	MR2 CAGE HEAVY VALVE	
HW-V08	MR2 CAGE LIGHT VALVE	
HW-V09	MR7 CAGE HEAVY VALVE (VENTURI HOLE)	
HW-V10	MR7 CAGE LIGHT VALVE (VENTURI HOLE)	
HW-V11	3" BUBBLE CAP	
HW-V12	4" BUBBLE CAP	
HW-V13	6" BUBBLE CAP	

GASKETS

ITEM NO.	ITEM DESCRIPTION	
HW-G01	FIBER GLASS GASKET	
HW-G02	TEFLON GASKET	
HW-G03	NON-ASBESTOS GASKET	
HW-G04	CERAMIC FIBER ROPE GASKET	

OTHERS

ITEM NO.	ITEM DESCRIPTION	
HW-T01	BLANKING WEDGE	
HW-T02	SPLIT KEY	

PLEASE ASK US FOR ANSWERS BY REFERING THE FOLLOWING INFORMATION

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