Obtaining desirable tower performance requires the proper handling of liquid and vapor entering the column. The types of feeds or inlets into a column can generally be classified into four major categories:

- Liquid only (contains less than 1% vapor by volume)
- Mixed liquid and vapor, flashing or suppressed flash
- Vapor only
- Reboiler returns

The selection criteria for each category of feed device is unique.

**Liquid-Only Feeds**

Among the factors Koch-Glitsch considers in designing a liquid feed device are:

- Type of distributor
- Expected distributor performance
- Flow rate
- Operating range
- Degree of sub-cooled liquid and whether mixing with overhead liquid is required.

When the feed or reflux liquid is significantly sub-cooled, a specially designed feed arrangement may be required. A liquid with a wide temperature gradient, even if properly distributed to a packed bed, can induce mal-distribution due to uneven condensation.

The feed arrangement for these conditions depends on the distributor type. Please consult a Koch-Glitsch technical representative for recommendations.

**Liquid-Vapor and Flashing Feeds**

For mixed liquid-vapor or flashing feed devices above a distributor, the selection depends on the distributor type, liquid and vapor flow rates, turndown, column height needed for disengagement and vapor distribution as well as the degree of mixing of the inlet liquid with the overhead liquid. In all cases, separating the vapor and the liquid phases is a primary concern. In some cases the requirements for additional pre-distribution may alter certain distributor designs.

**Vapor-Only Feeds**

Two factors must be considered in choosing the proper device for a vapor only feed.

1. The kinetic energy of the inlet vapor must be considered in relation to the pressure drop in the packed bed, the feed nozzle arrangement and the tower separation requirements.

2. If there is a gross mismatch in the composition and/or temperature between the inlet vapor stream and bulk vapor flow, mixing of the two vapors optimizes the performance of the packing above.

Specific equipment for vapor distribution may not be required if sufficient column height is available for equalization or if the pressure drop in the packed bed is sufficient to provide proper vapor distribution.

**Reboiler Returns**

To determine the need for and the type of device required for a reboiler return, the first step is to consider the condition of the stream and its kinetic energy.

For vapor-only returns, the kinetic energy of the inlet vapor must be considered in relation to the pressure drop in the packed bed, the feed nozzle size and arrangement, as well as the tower separation requirements.

For a mixed liquid-vapor or suppressed flash reboiler return stream, the selection of the device depends on flow rate, ratio of liquid and vapor flow, flow regime, nozzle size and arrangement, column height needed for vapor disengagement and the tower separation requirements.

**CFD Modeling**

Good vapor distribution is essential to achieve superior separation efficiency. Particularly in refinery towers, poor vapor distribution can be a major source of coke formation resulting in frequent unit shutdowns. Koch-Glitsch uses modern Computational Fluid Dynamics (CFD) modeling technology to analyze the performance of existing equipment and to develop new improved designs. This involves computer modeling of the 3-dimensional configuration of the column internals to provide detailed predictions of fluid flow (velocity profiles, etc). A commercially available CFD software package is used in conjunction with expertise developed by Koch-Glitsch to analyze vapor and liquid distributors as well as packing performance.

Koch-Glitsch offers CFD services for the following tasks:

- Development and optimization of new mass transfer equipment
- Troubleshooting or analysis of existing equipment
- Confirmation of equipment designs prior to fabrication and installation
Model 119 INTALOX® High Performance Liquid Only Feed Pipe

Feed to INTALOX high performance distributors

The Model 119 liquid only feed pipe is used when liquid is fed from outside the column onto a Koch-Glitsch INTALOX high performance distributor or redistributor. The incoming flow must contain less than 1% vapor by volume.

The Model 119 feed pipe is a metered piping system consisting of one or more headers in conjunction with lateral branches, downpipes, and/or pre-distribution channels or parting boxes that feed directly to an INTALOX distributor. It is limited in turndown to a 2 : 1 ratio. The Model 119 feed pipe meters flow to one or more appropriate feed areas, matching the hydraulic requirements of the distributor. Excessive turbulence and horizontal flow velocity in the distributor are eliminated.

Construction Details

The Model 119 feed pipe is attached to an internal column flange with further support by tower wall clips.

Branched piping is flanged as the standard, although, piping may have threaded connections for pipe diameters less than 4 in. [100 mm]. For large diameter headers, where manway access is limiting, field welding may be required.

Model 719 Liquid Only Feed Pipe

Feed to traditional liquid distributors

The Model 719 liquid only feed pipe is used when liquid is fed from outside the column onto a traditional distributor or redistributor. The incoming flow must contain less than 1% vapor by volume.

The Model 719 feed pipe is a piping system consisting of one or more headers in conjunction with downpipes, pre-distribution channels or parting boxes that feeds directly to a traditional style distributor. The standard turndown ratio is 2.5 : 1

Construction Details

The Model 719 feed pipe is attached to an internal column flange with further support by tower wall clips.

Piping may have threaded connections for pipe diameters less than 4 in. [100 mm]. For large diameter headers, where manway access is limiting, field welding may be required.

Design Options

- Bayonet-style construction for limited applications
- All-flanged construction
- Special design for subcooled feed
Model 705 Flashing Feed Chamber

- Diameters up to 48 in. [1200 mm]
- Handles most two-phase feeds

The Model 705 is a two-phase feed device that is attached to a radial inlet. By using centrifugal force, the vapor exits the top of the chamber and the liquid is conducted out the bottom to a distributor or pre-distributor located below.

One or more Model 705 chambers may be used in larger diameter columns if the flow rates are suitable.

Construction Details
For column diameters under 22 in. [530 mm], the Model 705 feed chamber is constructed in one piece. For larger diameters the chamber is constructed in multiple pieces.

For inlet pipe sizes less than 4 in. [100 mm], the Model 705 feed chamber attaches to a threaded, bayonet style pipe (supplied by others). Inlet sizes 4 in. [100 mm] and larger are attached with a flange as standard.

Model 745 Flashing Feed Pipe

- Diameters greater than 36 in. [900 mm]
- Feed device separates liquid and vapor of flashing inlet streams

The Model 745 feed pipe is used to handle flashing inlet streams by separating the phases. The liquid impinges on an angled baffle trough, promoting disengagement of the liquid and vapor phases. The vapor exits above and the liquid is directed downward. The liquid may be sent directly to a distributor, a pre-distributor or to a collector located between packed beds. An optional vapor hood is available to improve the mixing of the incoming vapor with the bulk vapor flow.

This model uses less column height than the Model 755 feed gallery but is limited to feeds that are flashing at the column inlet.

All pieces are designed to pass through vessel manways.

Construction Details
The Model 745 feed pipe is connected to an internal column flange and further supported by a wall clip. The flash trough bolts to clips, seats or beams depending upon location and size.

The inlet pipe flange is gasketed, while the need for gasketing of the flash trough depends on the type device below it.

Design Options
- Supply of bayonet inlet
- Bayonet type feed pipe
- Vapor hood
The inside of the gallery is normally polygonal, built in sections as necessary for column access. The gallery is clamped to a support ring as the standard attachment.

The Model 755 flashing feed gallery is a feed device to accommodate mixed liquid/vapor or flashing feeds. Incoming flow is directed tangentially against the tower wall. A gallery below the inlet deflector collects liquid into a pool, allowing the vapor phase to disengage. The liquid then flows directly to a distributor or into a parting box in a controlled manner.

In many cases the gallery can be fitted with covers to collect liquid from a packed bed above, providing a combination flash device with liquid collector.

The Model 788 V-Baffle is used for vapor-only, mixed liquid/vapor feeds or flashing feeds where the flow energy is excessive. This device reduces the inlet stream energy and can often be designed to provide a level of vapor distribution that eliminates the need for a more complex vapor distributor. It is a very effective phase separator for two phase feeds.

The vapor diffuser divides the inlet stream and then directs the streams tangentially to each side. A patented Enhanced V-Baffle design often provides additional control of the incoming stream. The pressure drop across this device is relatively low compared to deck or pipe type vapor distributors.
Vapor horns have been utilized primarily for two-phase inlets of refinery fractionators. These devices are designed to provide both bulk phase separation of the vapor and liquid as well as initial distribution of the feed vapor. Performance of these feed inlet devices is critical to ensure adequate gas oil quality and yield, maximum column capacity and proper washbed performance. Koch-Glitsch’s proprietary enhanced vapor horn, an extension of conventional vapor horn technology, provides improved vapor distribution and de-entrainment of the feed.

For vapor/liquid phase separation, the open bottom construction and the centrifugal action induced to the feed stream will direct entrained liquid particles to the column wall, where they will flow down into the column sump or collector tray below.

The patented enhanced vapor horn employs baffles, in a proprietary arrangement, to avoid excessive impingement and feed splashing which can result in the formation of small liquid particles that are more likely to be re-entrained. The baffles help break the high feed inlet velocity for both improved vapor distribution and de-entrainment. Uniform velocity (in both the vertical and horizontal direction) is desired to minimize re-entrainment of liquid.

Once the bulk phase separation is complete and the swirling motion is no longer desirable, patented anti-swirl baffles eliminate the cyclonic motion of the vapor.

Koch-Glitsch has applied both large scale laboratory testing and CFD analysis to evaluate, optimize and validate the de-entrainment and vapor distribution performance. Koch-Glitsch has hundreds of commercial installations of this technology in columns with diameters up to 50 ft [15 m].
The main header attaches to an inlet flange (supplied by others) and is further supported by a wall clip. The laterals are supported by wall clips, as needed. Access diameter must be sufficient to accommodate the header assembly. For large diameter headers, where manway access is limiting, field welding may be required.

Laterals are flanged as the standard, but may have threaded connections for pipes 4 in. [100 mm] and less.

Model 716 Deck Type Vapor Distributor

- **Diameters greater than 30 in. [760 mm]**
- **Vapor-only inlet streams**

The Model 716 vapor distributor is a deck type used to correct poor vapor distribution below a packed bed. This device can be used between packed beds where a vapor feed is introduced or above reboiler return streams.

The Model 716 vapor distributor is clamped to a support ring and typically requires bolting bars and segmental supports for its downcomer and seal pan. Midspan beams may be used for larger diameter towers.

Standard construction will withstand 50 lbs/ft² [0.024 bar] upward force. However, special designs are available which can withstand greater uplift requirements.

Model 746 Lateral Arm Vapor Distributor

- **Diameters greater than 18 in. [450 mm]**
- **Vapor-only inlet streams**

The Model 746 lateral arm vapor distributor is used when a vapor feed requires uniform distribution across the tower area. Typical applications include vapor feed at the bottom of the tower or between beds.

When used at the bottom of a tower it can save tower elevation compared to a deck type (Model 716) vapor distributor. When used between beds, it will ensure that the vapor feed is well distributed and well mixed with the vapor from the bed below.

To achieve good distribution the required pressure drop across the vapor distributor is determined by the flow rate and size of the inlet. Turndown is generally 4 : 1, but can be higher or lower depending upon the allowable pressure drop for the process.

To perform the task of vapor distribution, the Model 716 will consume some pressure drop.

The turndown ratio is generally about 4 : 1, provided pressure drop is not excessive for the process.
Model 748 Vapor Diffuser

- **Diameters greater than 48 in. [1200 mm]**
- **Vapor-only inlet streams**

The Model 748 vapor diffuser is used for vapor-only feeds where the flow energy is excessive. This device is not a vapor distributor. It reduces the vapor energy such that a more complex vapor distributor may not be necessary.

The vapor diffuser uniformly meters the vapor stream out the upper area of the pipe and the shroud and then directs the flow downward to each side. The pressure drop across this device is relatively low compared to the Model 746 vapor distributor.

Turndown is generally 4:1.

**Construction Details**

- This device is attached to an internal tower inlet flange (supplied by others) and is further supported by a vessel wall clip as the standard construction.

- Optionally, the inside pipe can be designed to bayonet into the vapor inlet nozzle, in lieu of an internal flange.

- One-piece construction is standard provided column access diameter is sufficient. Otherwise, multi-piece construction is provided. In some cases, field welding of multi-piece construction may be required.

**Model 748 Vap or Diffuser**

**Construction Details**

- **Multi-piece construction** is supplied for installation through a vessel manway. Flanged and bolted construction is supplied as the standard. Field welded construction is an available option.

- The inlet attachment requires welding to the vessel wall. Additional support clips welded to the vessel may be required. As an option, attachment can be made to an existing internal nozzle flange.

**Model 768 EVENFLOW™ Vane Type Vapor Distributor**

- **Diameters greater than 72 in. [1800 mm]**
- **Preferred for vapor-only feed**

The Model 768 EVENFLOW™ vane type vapor distributor is used for high energy vapor inlet streams entering through a radial inlet. Although the device has been utilized in applications with high velocity mixed phase feeds, the performance of the device is best when limited to vapor-only feeds.

Baffles used in conjunction with a tapered configuration provide vapor distribution with minimal pressure drop. The curved baffle plates partition the inlet vapor stream into multiple small segments, reducing the velocity and directing the segmented streams horizontally across the column area.

Performance of the EVENFLOW vapor distributor has been validated using CFD analysis as well as numerous successful commercial installations.

**Construction Details**

- Multi-piece construction is supplied for installation through a vessel manway. Flanged and bolted construction is supplied as the standard. Field welded construction is an available option.

- The inlet attachment requires welding to the vessel wall. Additional support clips welded to the vessel may be required. As an option, attachment can be made to an existing internal nozzle flange.

**Design Options**

- **Bayonet inlet construction**

**Design Options**

- **Field welded construction**
- **Attachment to existing flange**
- **CFD analysis**