

KLM

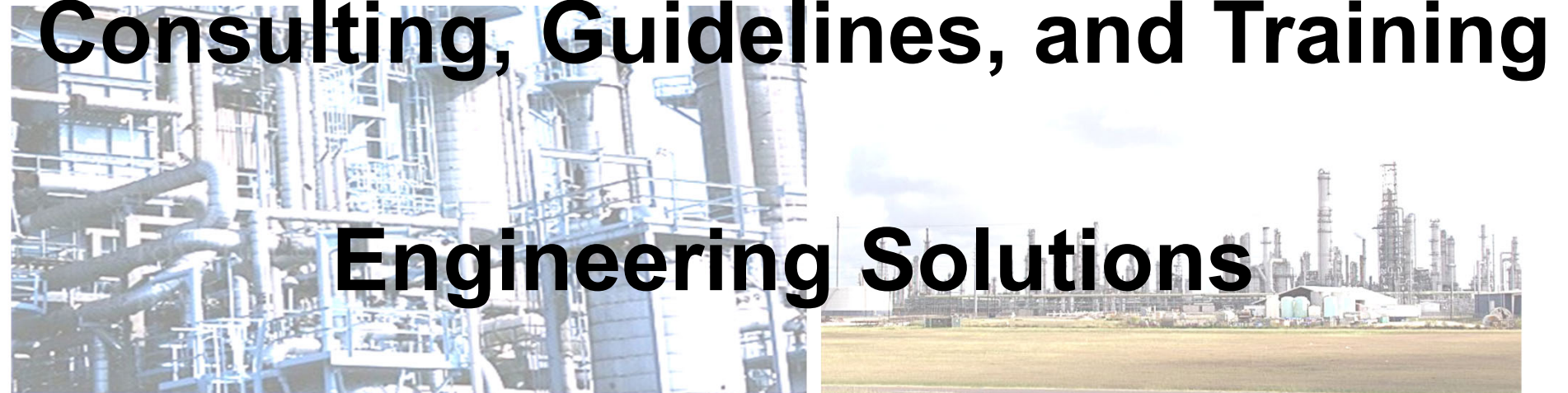
**Technology
Group**

KLM Technology Group
Engineering Solutions



KLM Technology Group

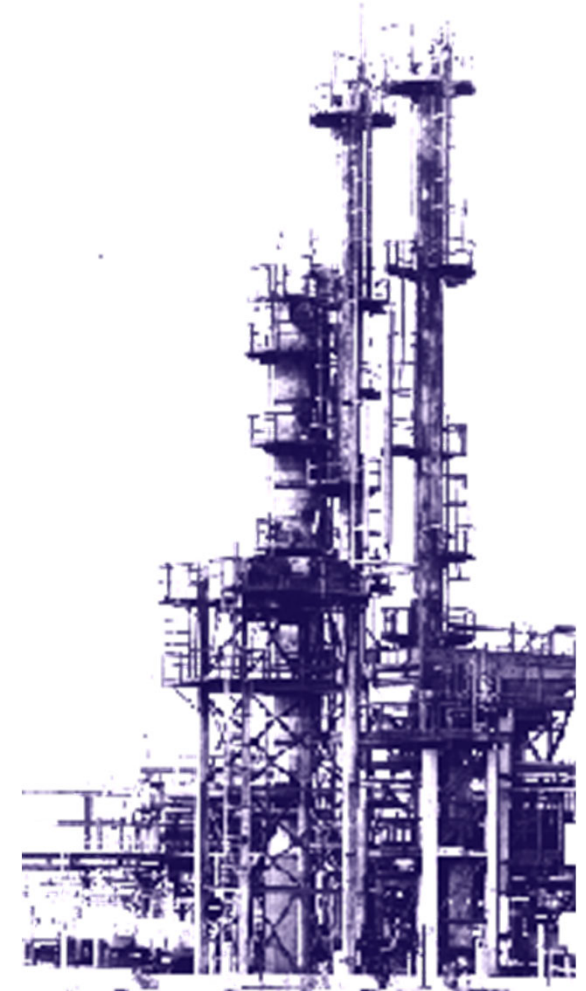
Consulting, Guidelines, and Training



Engineering Solutions

Based in USA since 1995,

KLM is a technical consultancy group, providing specialized services and equipment to improve process plant operational efficiency, profitability and safety.



Issues leading to low capacity and high energy usage

- 1. Incorrect installation – KLM sees this everywhere**

- 2. Operation**
 - A. Over refluxing**
 - B. High pressures**

- 3. Low efficiency / capacity designed and purchased equipment provided by the lowest bidder**

Distillation Equipment

KLM is recognized as a leader in Distillation Equipment Design, Operation, Inspection, Commissioning, and Troubleshooting.

KLM can provide

**Distillation Process Studies with Guarantees
Distillation Engineer / Operations Training,
Tower Equipment Inspections for correct installation
Distillation replacement equipment.**

KLM Provides

- 1. Process Simulations – 40+ running towers that passed performance guarantees**
- 2. Distillation Hydraulics – KLM and third party**
- 3. Tower Installation Supervision and Inspection – 75+ Towers**
- 4. Unit Commissioning – 20+ Commissionings**
- 5. Unit Troubleshooting – 20+ Troubleshooting**
- 6. Training for your team – 100+ Trainings**
- 7. Thirty+ Years Process Engineering Experience**

A large problem in many tower internal installations is incorrect installation, leading to loss of product quality, tower efficiency (higher energy), capacity and run length (plant reliability).

Many companies may not have the expertise to review the tower internal installation, because turnarounds only have every few years.

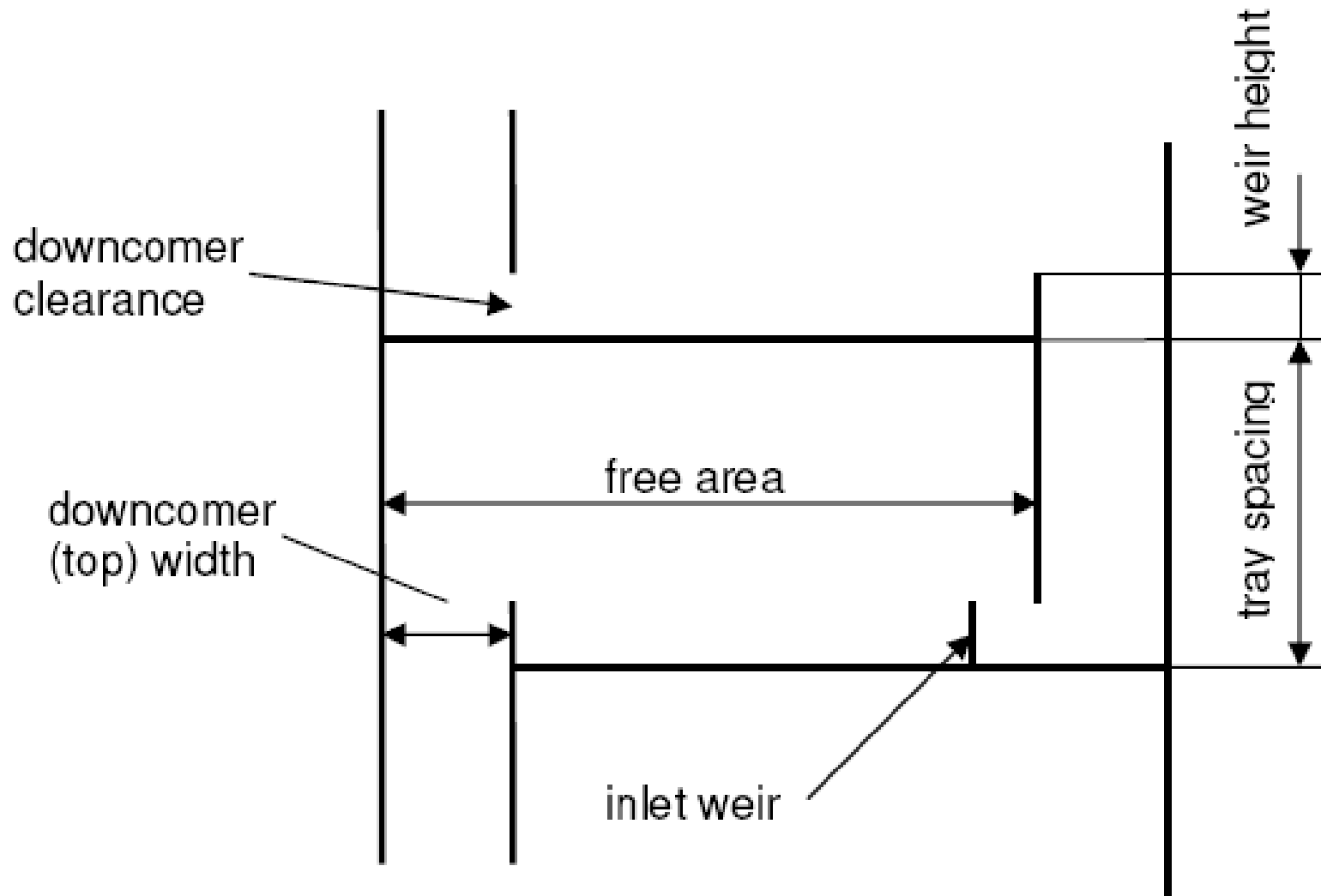
KLM can provide a senior tower inspector with 75+ tower inspections, for your turnaround to assist in optimized tower performance.

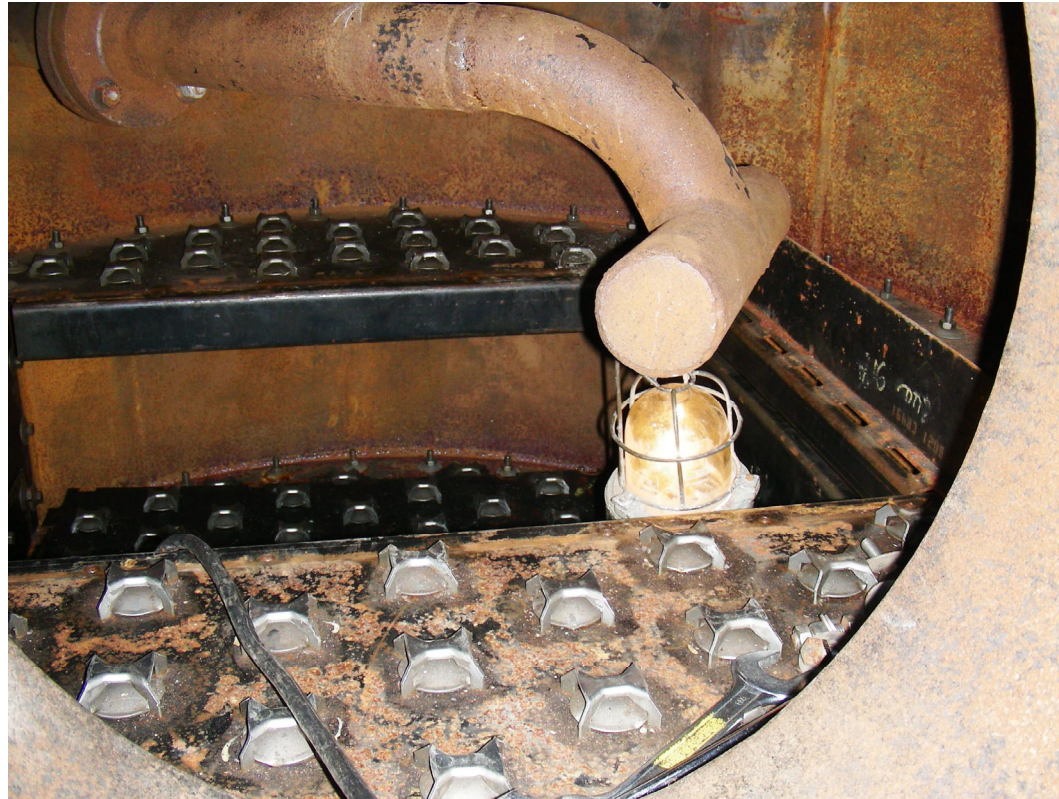
Most inspectors look at mechanical issues which are important, but they do not look at issues that effect capacity, energy consumption and product purities.

KLM is often one of the final inspectors after the tray manufacture inspectors, and mechanical inspectors. It is very common for KLM to find errors that effect capacity and efficiency (energy and purity).

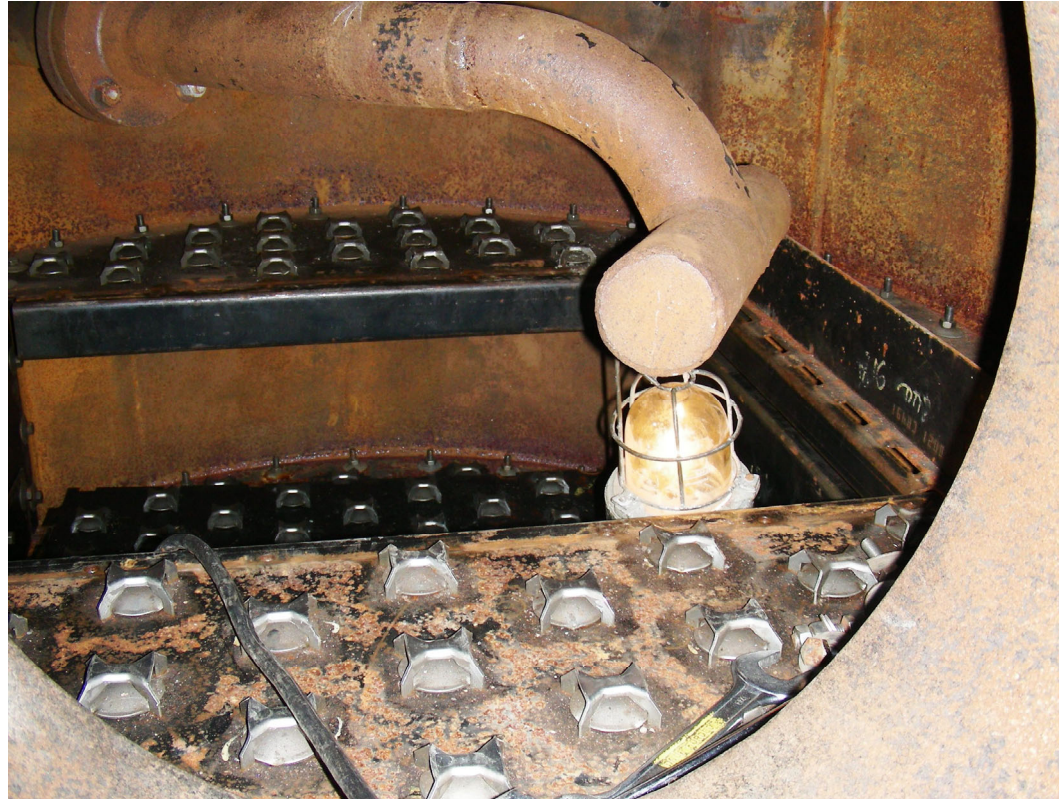
Item to Inspect

- 1. Downcomer Clearance**
- 2. Downcomer width**
- 3. Weir heights**
- 4. Inlet weir spacing – important for capacity**
- 5. Tray spacing**
- 6. Free area**
- 7. Levelness – important for efficiency**
- 8. Bolts are installed and tightened (should not really even need to say this – but amazing they are loose and missing)**
- 9. Poor Manufacturing**





Reflux piping not installed correctly, this was already passed by 1) tray manufacture inspector, 2) 3rd party inspector and 3) company inspector. Mechanically it is ok, the trays are ok – but it is an energy and purity disaster.



Reflux piping should be routed behind the top weir to allow the reflux to flow evenly across the tray. This design is mechanically sound, but not ok for purities and energy.

The Reflux / Feed Inlet Device can disrupt the flow on the tray leading to lower efficiencies (higher energy) and lower purities.

If you have a 30-tray column, each tray is 3.33% of tower efficiency – and you introduce the reflux poorly- you disrupt the flow on the top two trays at least – loss of about 5% of tower efficiency.

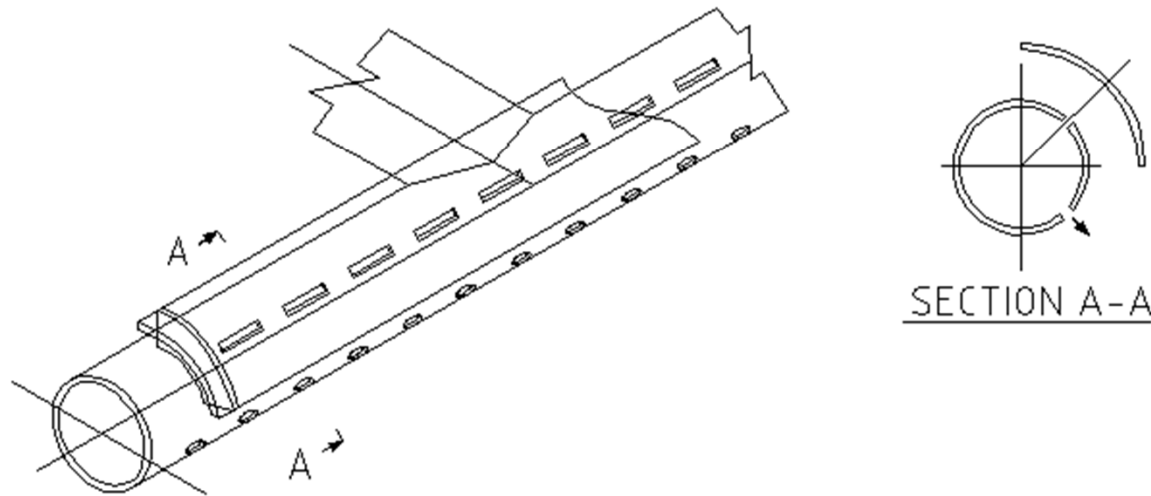
For a feed in the middle of the tower you can disrupt the flow for 3 trays – potential 6 to 9% of tower efficiency.

Mechanically you are fine, but you just lost several million dollars per year in energy.



Reflux piping installed correctly

Feed Inlet Devices



KLM designs specialty Feed Inlet Devices to increase tower capacity and efficiency (energy and purity)



Downcomer clearance is designed to maintain a liquid height in the downcomer to keep the vapor from flowing up the downcomer.



If the downcomer clearance is too high vapor can pass up the downcomer leading to loss of tray efficiency (energy and purities).



If the downcomer clearance is too low the liquid can fill the downcomer and back up on the tray leading to loss of capacity.

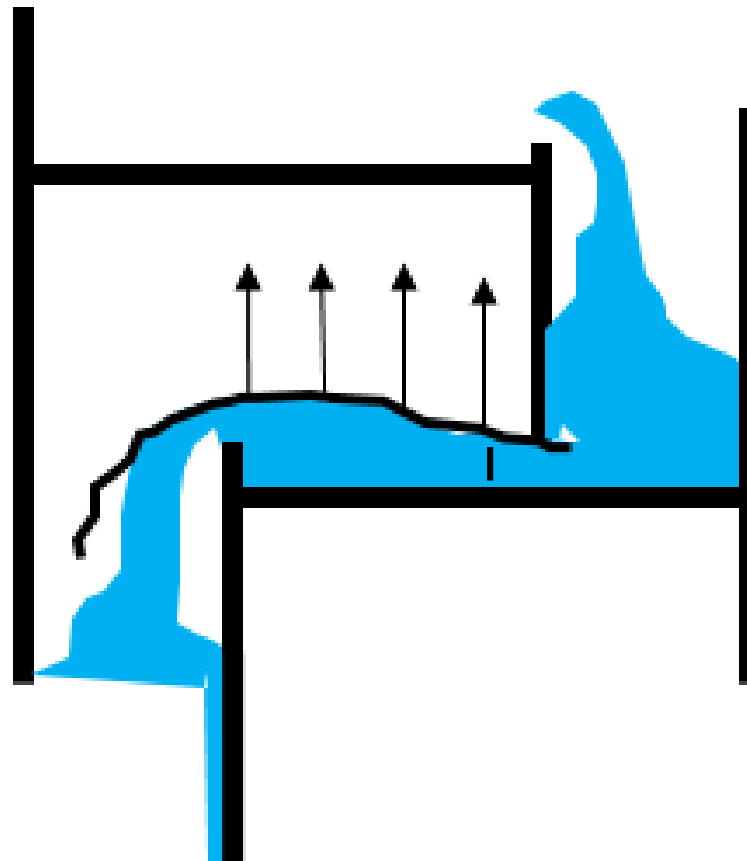


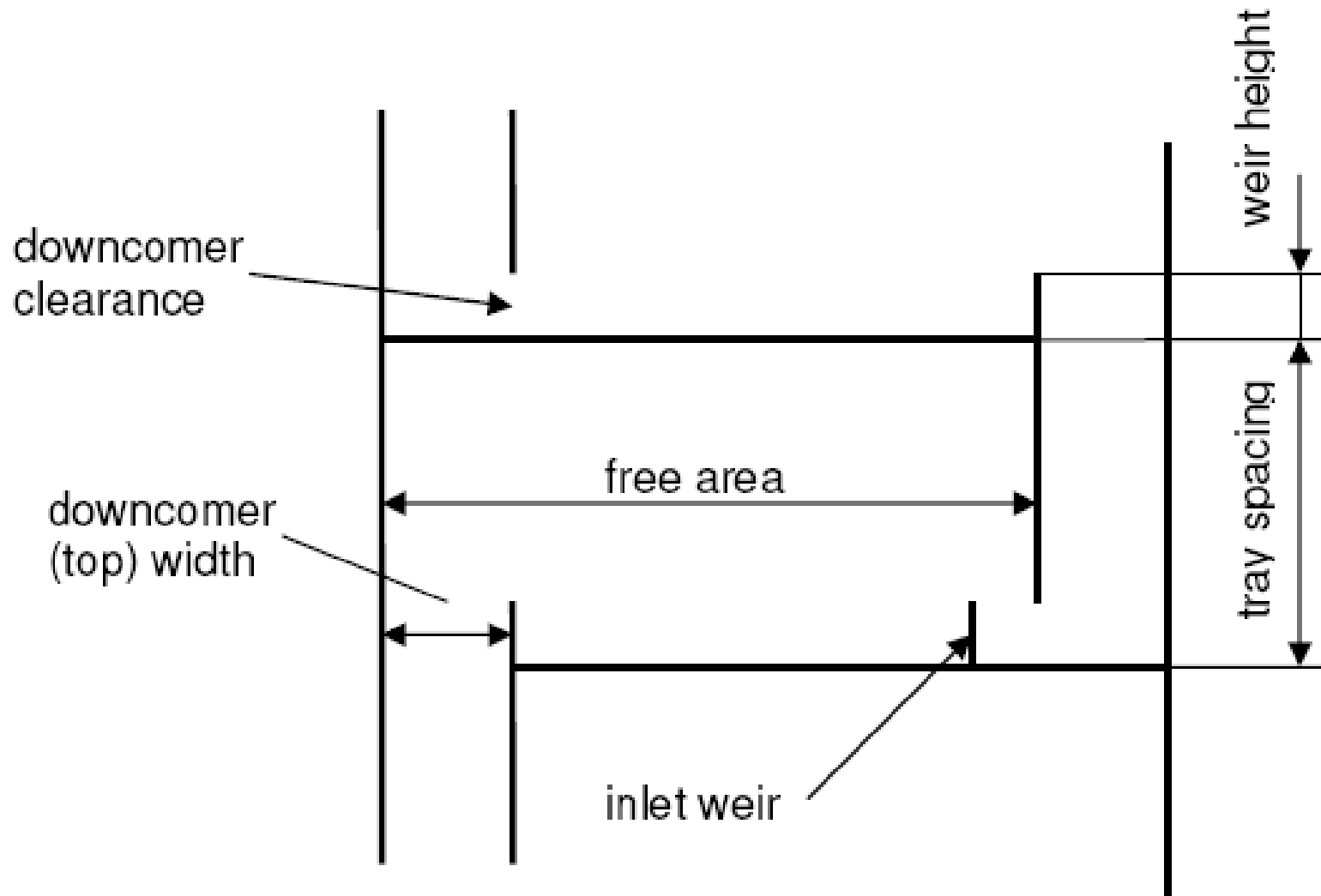
If the downcomer is not level – flow on the tray will be uneven leading to loss of efficiency and purities. On the right side the clearance is 37 mm and on the left side the clearance is 31 mm.



If the downcomer is not level – flow on the tray will be uneven leading to loss of efficiency and purities. This was passed by the tray manufacture inspector, 3rd party inspector, and company inspector – poor inspection quality.

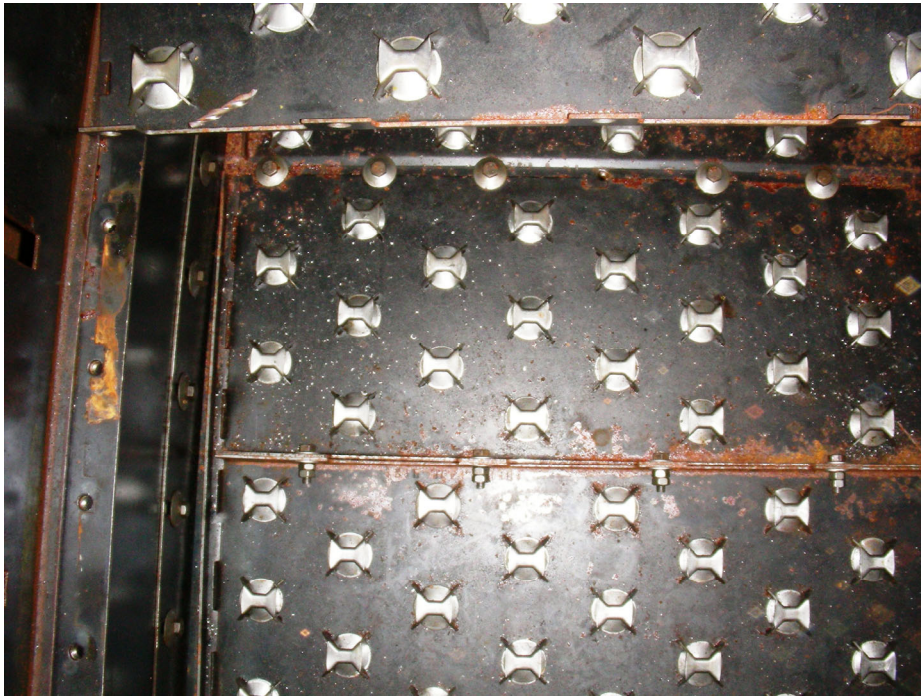
Straight Downcomer with inlet weir – it is important to measure the inlet weir clearance to maintain liquid flow to the tray from the downcomer.





Equipment Inspection

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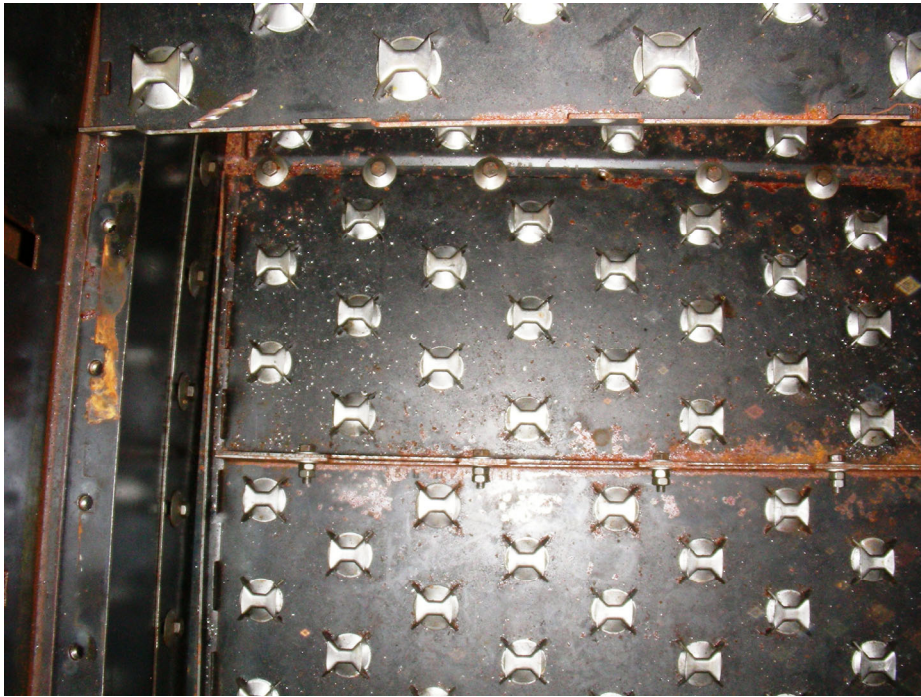
This inlet weir is installed touching the downcomer without the correct clearance, there is no liquid flow in this area. Again, this was passed by the tray manufacture inspector, 3rd party inspector and company inspector – disappointed the tray inspector did not see this.



Incorrect Inlet Weir Clearance

Equipment Inspection – Capacity Disaster

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This inlet weir is installed touching the downcomer without the correct clearance, there is no liquid flow in this area. At least a 30% loss of capacity. Capacity Disaster.



Bolts are installed and tightened (should not really even need to say this – but amazingly many are loose and missing). These bolts are at least installed, just not tightened. Again, passed by 3 inspectors.

Equipment Inspection

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KLM is inspecting this tray – and I do not like that the valves are lifted right before the bolts. I decide to check how tight the bolts are with my hand.



Middle bolt is not very tight, I removed it easily with my hand – did not have a nut on the bottom. Again, inspected by 3 inspectors.



None of the bolts were tight, installer said was difficult to install the nuts – if and when you start up this column without proper bolting, this tray will lift and restrict the flow through the column - capacity disaster



None of the bolts were tight, installer said was difficult to install the nuts – if and when you start up this column without proper bolting, this tray will lift and restrict the flow through the column - capacity disaster



Fabrication Errors



Fabrication Errors

Ensure that your column has the correct installation of process equipment by utilizing KLM's Senior Team of inspectors.

- 1. Downcomer Clearance**
- 2. Downcomer width**
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Distillation Equipment

Distillation Replacement Equipment – Trays, Random Packing, Structured Packing, Demister Pads

KLM provides distillation replacement equipment at significantly lower cost than the major distillation companies due to our lower overhead cost.

Most major distillation companies have thousands of employees and worldwide offices leading to a high fixed overhead cost.

KLM has limited overhead cost, and we pass the cost saving on to your team.

Distillation Replacement Equipment

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KLM provides the same specification trays, random packing, structured packing and demister pads as well a senior engineer to review the selection.

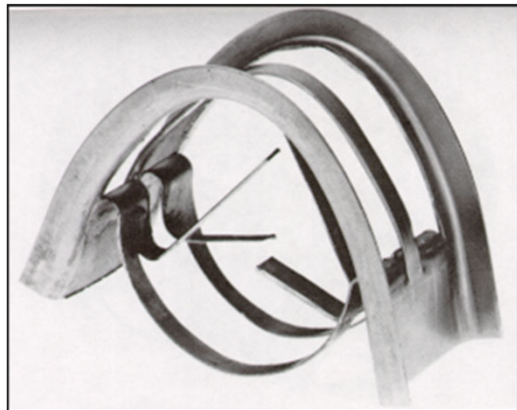
If your current system has short run lengths – should we consider a more reliable replacement – maybe a more fouling resistance design and a stronger design.



Distillation Replacement Equipment

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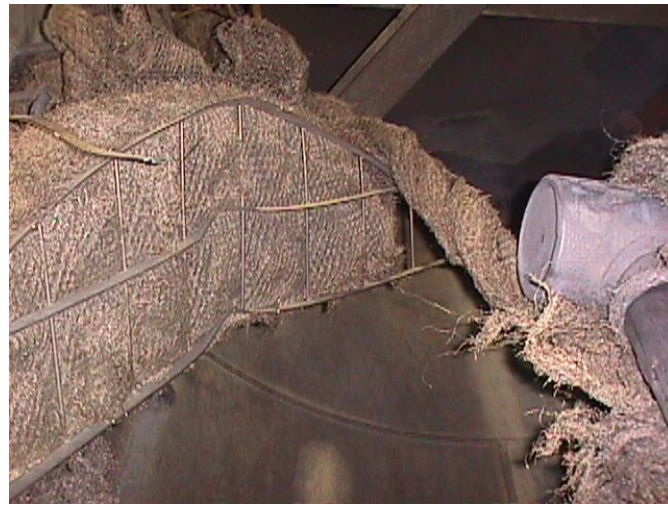
Stronger and more fouling resistance designs are very important for random packing and demister pads that have higher fouling failure rates.



Distillation Replacement Equipment

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It is important to understand the failure cases. KLM can provide equipment designed stronger, with a higher fouling resistance and longer run length. For example, should a caustic tower have a stainless-steel demister pad?



The pad may foul with material and fail due to pressure drop increases.



Quality Suppliers-Buyer Beware

There are hundreds of Tray Suppliers, some at very low cost. KLM only buys from Quality Suppliers that we have vetted.

Suppose you are buying trays and thickness is 0.30 mm. Low-cost vendor provides you thickness of 0.28, which is difficult to measure. His raw material cost is 6.66% percent lower.

This tray will have lower strength and corrosion resistance.

Quality Suppliers-Buyer Beware

Metallurgy is an important consideration in trays. A low-cost vendor buys slightly off spec metal at greatly reduced price from the metal supplier.

It is very important to confirm the metal specification. This can be easily done today with a Positive Material Identification Machine (PMI). Ensure your team checks the metal specifications.

Quality Suppliers-Buyer Beware

**There may be a good reason
someone's trays are lower cost –
and it may not actually save you
money.**

Equipment Installation

KLM can design and supply the very best distillation internals, but if they are not installed correctly the capacity and efficiency will be reduced.

Many organizations do not have the experienced tower inspectors because they only enter the towers on 3-to-5-year basis

KLM is happy to provide senior tower inspectors to assist in your turnaround and tower reviews.

Column Hardware

Column Hardware Can be ordered with normal lead times or can be sourced for immediate replacement

KLM has a stock of column hardware packing in key Countries for immediate replacement

We can also provide column hardware on a consignment basis for your turnaround



KLM Technology Group – Equipment References

- 1. Over 40 Distillation Projects with multiple columns**
- 2. Over 40 Heat Exchangers**
- 3. Over 25 Pumps**
- 4. Over 20 Pressure Vessels**

KLM Technology Group

- 1. Solid Track Record of Projects since 2005.**
- 2. Strength in Process Engineering**
- 3. Distillation Equipment Supply**
- 4. Strong Partners in Mechanical Engineering and Fabrication, especially Modular Fabrication.**
- 5. Wide Range of Industries Serviced.**
- 6. Ready to assist in your next project.**

KLM Core Business

Training (75+ Training Classes)

Engineering Design Guidelines

Process Optimization Studies

Process Energy Studies

Process Safety Management

HAZOP Facilitation

Facility Siting Studies

Engineering Support

Basic Design Packages

Detailed Design Packages

Process Equipment

Random Packing

Structured Packing

Marketing

Engineering Practice Magazine

Unit Commissioning

**Distillation Equipment Inspecting
and Correct Installation**

Unit Benchmarking

Evaluation of Process Units

KLM Core Business

Process Equipment

KLM as an EPC Company can purchase from many of the major equipment suppliers.

Distillation Equipment

Towers Shells

Random Packing

Structured Packing

Trays

Heat Exchange Equipment

Pumps and Compressors

KLM Core Business

Process Equipment

Distillation Equipment

Can be ordered with normal lead times or can be sources for immediate replacement

Random Packing

KLM has a stock of random packing in key Countries for Immediate replacement

Structured Packing

KLM has a stock of Structured Packing in key countries for immediate replacement

KLM Core Business

Process Equipment

KLM buys a large volume of process equipment each year, because we buy heat exchangers, pumps and distillation equipment for many end users.

Many times, our cost to the end user is lower than they can negotiate themselves because the end user may only be buying a few items per year and the vendor adds a large profit margin.

Be sure and let KLM bid on your projects.

An Engineering Resource

KLM Technology Group Engineering Solutions



Thank You

