

# State of the Art PU Machinery

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Faipur 2012

FASCINATION  
FASCINATION PUR  
>> PUR

- Hennecke Today
- Metering Machines and new Mixing Heads
- CSM Technology
- Applications with a growing Future (Clean Blowing Agent Pentane)
- How does Hennecke work with blowing Agent Pentane?




# Hennecke in Germany



- 1945** Founding of the company by Karl Hennecke
- 50ties** Development of the first High-Pressure machine
- 1967** Bayer takes majority of the Hennecke shares
- 1975** Bayer takes 100% ownership
- 2005** Celebration of Hennecke's 60th anniversary
- 2008** Adcuram takes 100% ownership



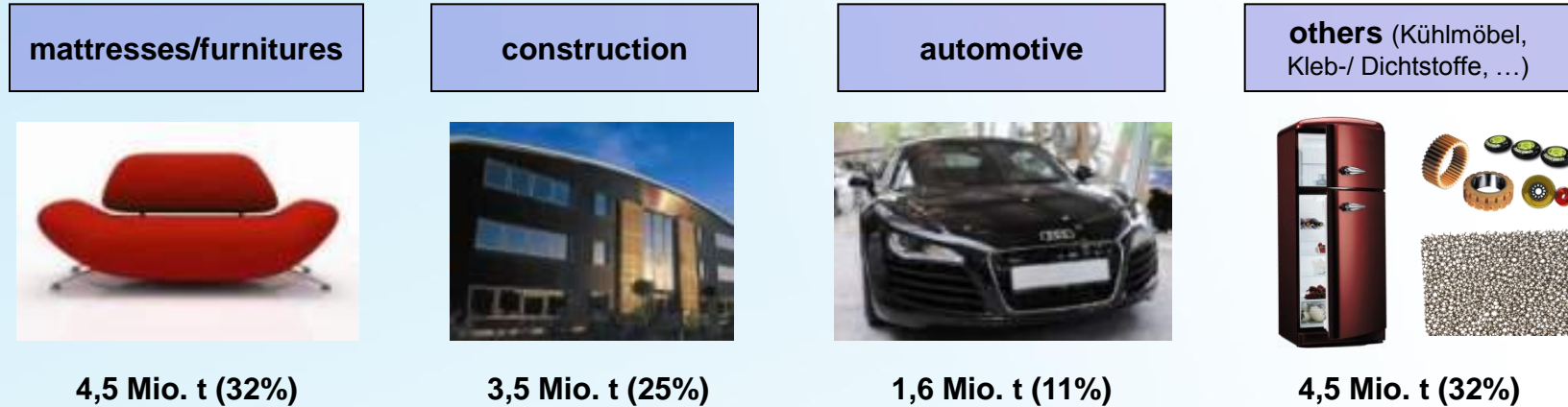
# Hennecke Worldwide

-  Hennecke is represented
-  Hennecke is not represented
-  Big growth in PUR industry



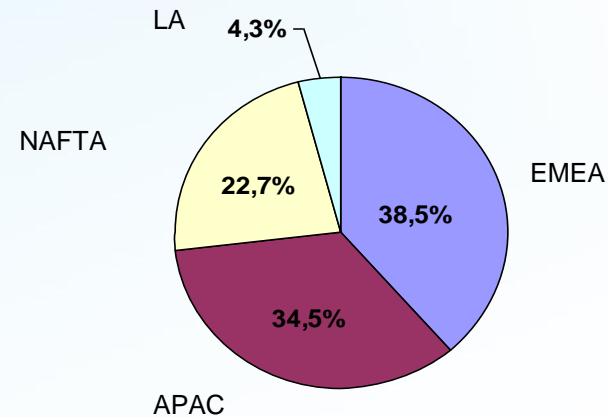
# New features in plant technology - What are the plans in future?

World-wide PUR - consumption 2009 in sectors in mio. tons (total: 14,1 Mio. tons\*)



## World-wide consumptions, divided into regions 2011 in %

EMEA = Europe, Middle East und Africa  
 APAC = Asian-Pacific  
 LA = Middle and South America  
 NAFTA = USA, Canada, Mexico)



\* estimated with a yearly growth of 5%



# Product Lines

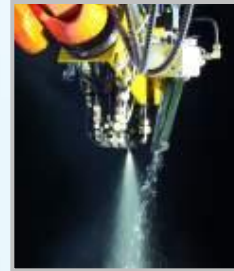
## Metering Machines



## Automotive



## PUR-CSM



## Refrig. Appliances



## Sandwich Elements



## Slabstock



## 360° Service



# Metering Machines





# What is special about PU processing

- At least two liquid reactants (Polyol A and Isocyanate B) are mixed in a predefined formulation and react into solid material.
- During the process, it is important to monitor
  - Mixing ratios (metering output of the individual components)
  - Temperatures
  - Pressures
- By changing the formulation, different physical properties of the end product can be achieved in particular.
- By adding „fillers“, the physical properties of the end product can be improved (strength, flexural strength, thermal conductivity etc.).

# What makes the high-pressure process the better solution

- **High-pressure machines**

High-pressure machines are used to inject the reactants via the mixhead nozzles into the small mixing chamber at such a high pressure, which transferred into speed, that this energy is sufficient to ensure an excellent mixing of the two components. There is no need for mechanical mixing elements.

- **Low-pressure machines**

Low-pressure machines are used to meter the reactants at low pressure into the mixing chamber. Due to the chamber geometry and a static mixer or a dynamic stirrer, the components are mixed.

# What makes the high-pressure process the better solution

## Low-pressure process

- Low machine price
- The mixhead has to be rinsed
- Smaller outputs
- Difficult mixing ratios are feasible
- Health effects at the workplace due to rinsing agent
- High operating costs because of rinsing agent and waste
- Inferior nucleation for foam formation

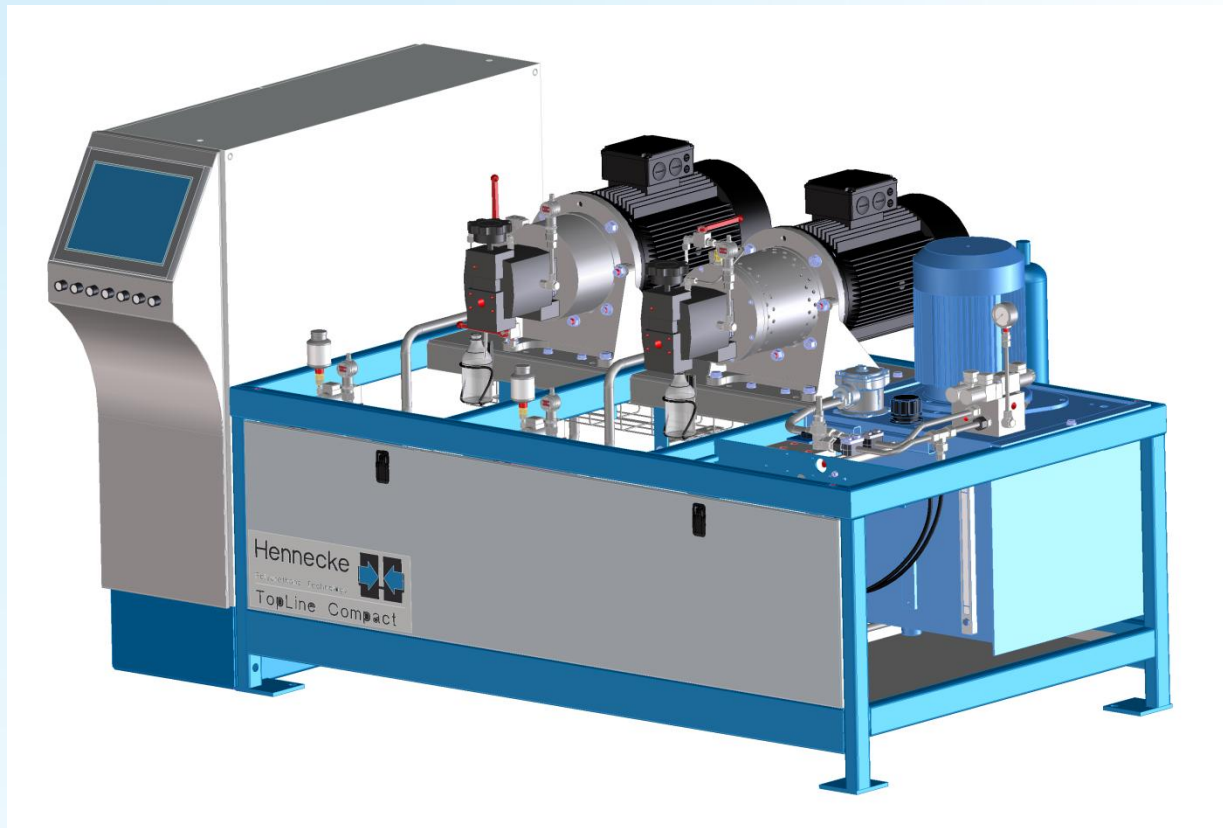
## High-pressure process

- High machine price
- The mixhead is cleaned mechanically
- Output rates of up to 7.8 kg/sec
- Limitation of mixing ratios to 100:25
- Insignificant health effects at the workplace because the mixhead is not rinsed
- Lower operating costs because of small amount of production waste
- Very good nucleation, excellent foam structure

# What makes the high-pressure process the better solution

- **By choosing the high-pressure process, you will cut your operating costs**
- **You will reduce the health effects at the workplace**
- **You will save precious raw material and counteract rising raw material prices**
- **You invest into a safe, forward-looking technology**
- **You invest into a flexible technology**

# Design of new TOPLINE HK



# TOPLINE Standard Delivery Program

- Improved range of performance:
  - Wintronic with high-class operator panel
  - Liquid temperature control system
  - More mixhead options
  - Upgrading for the Use of pentane as blowing agent
- Quality and flexibility of the TOPLINE within a short delivery time included in the standard delivery program
- Cost-effective entry into TOPLINE technology
- More flexibility at a low entry-level price
  - Easier production upgrade
  - Extension of components
  - More flexible installation of machine



# Standard Configuration of the TOPLINE HK

- High-class HMI operator panel with touch-screen integrated into an ergonomic console
- Wintronic control system
- Tank with liquid temperature control system, control unit integrated into the machine control as a decentralized system
- Standard mixhead: **MT** type series
- Rotary-Power metering pumps with drive
- Tank sizes: 500l 250l and 60l
- Separate frames for machine and the two tanks (tank position: 0.5 metres behind the machine)
- Acoustics package

# Standard Configuration of the TOPLINE HK Control System

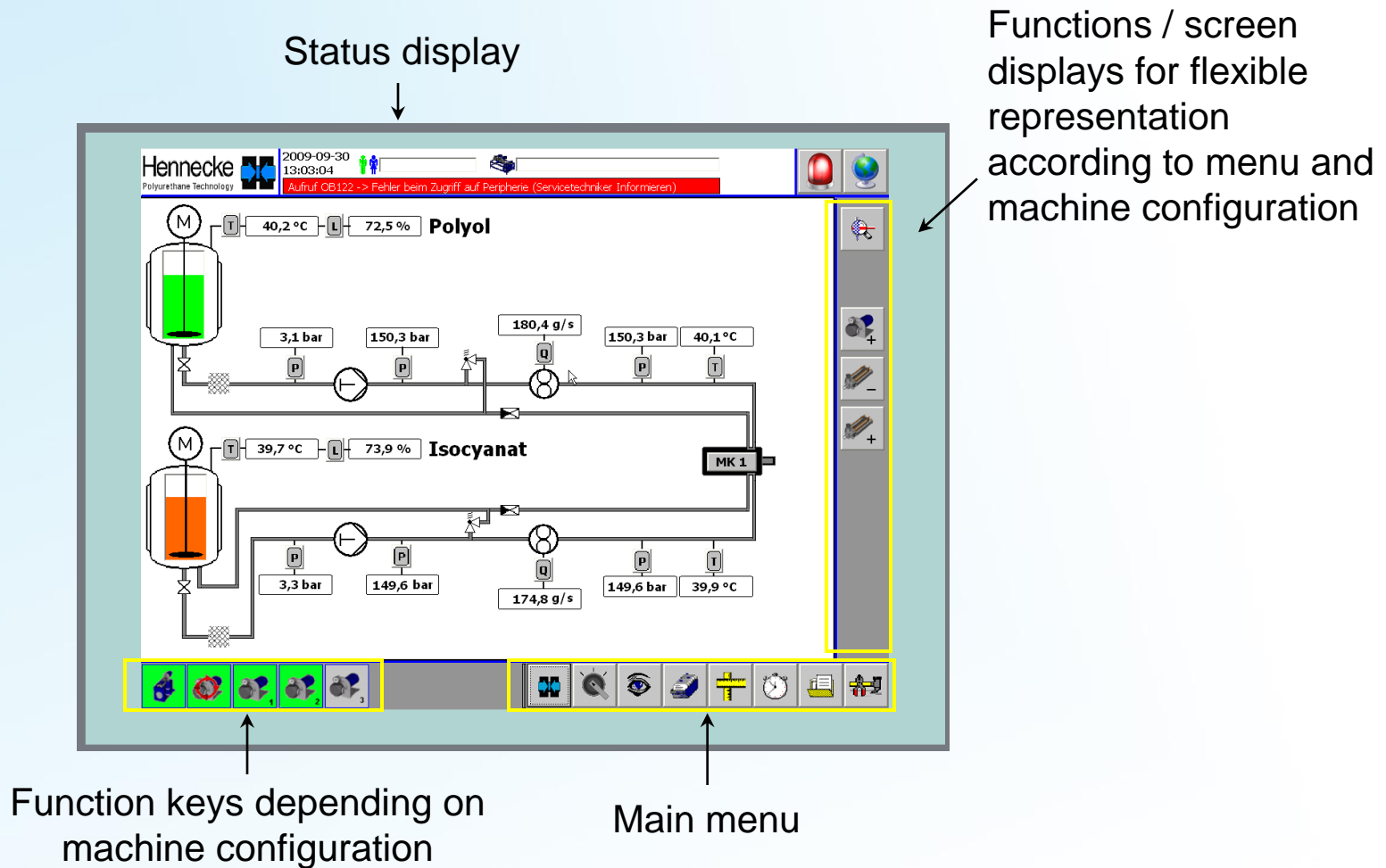


Low overall height of control cabinet

Electrical sensors / actuators  
pluggable for easy service



# New TOPLINE HK Wintronic: MP377 Touch, 15" Monitor (New)



# TOPLINE HK

## Ergonomic Console for OP

Integration of the new operator panel *MP 377 Touch* into a console installed on the side of the control cabinet

Ergonomically angled arrangement for an optimal control and observation of the process values by the operator



# TOPLINE HK Wintronic: MP377 Touch, 15“ Monitor (New)

## Benefits

Larger screen displaying more content

More user-friendly

Clearly structured and forward-looking operation

Easy entry of characters -> directly via online keyboard

More flexible in terms of program modifications/extensions

Easier change to other touch operator devices

Ergonomic lateral / angled arrangement

for an optimal observation of the process values  
(separate operator terminal available as an option)

Upgrade for blowing agent Pentane available

# Options of new TOPLINE (Selection)

*Sensor package for mixhead (pressure, temp. close to mixhead)*

Flow measurement

(gear counter or *mass flow meter*)

Automatic output adjustment / frequency control

Mixhead

MX piston-cleaned with throttle sleeve for better mixing

**MXL** piston controlled air-cleaned incl. constant pressure injectors

Magnetic coupling for metering pumps

Spring-loaded constant pressure injectors

Boom (3 m) with balancer

Extended hose or pipe length with multi mixing heads

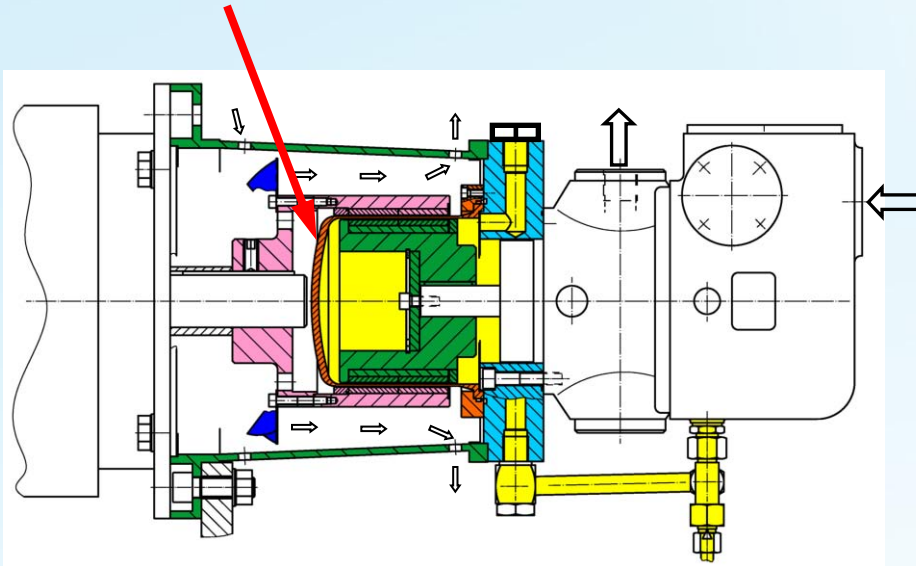
Separate operator terminal

Up to 6 component lines available



# New Magnetic Couplings with Plastics Containment Shell

Non Steel containment shell



## Benefits

Production safety

(no dynamic seal)

More solid than other  
containment shells

But most of all:

No eddy current losses,  
i.e. raw materials are hardly  
heated up

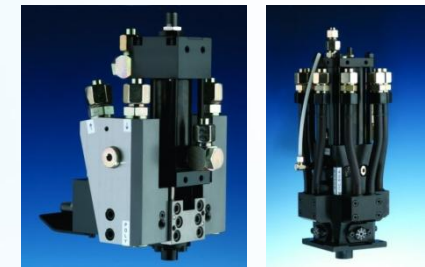
The TOPLINE HK can be equipped with the following mixhead types



MT (standard)

MX

MXL

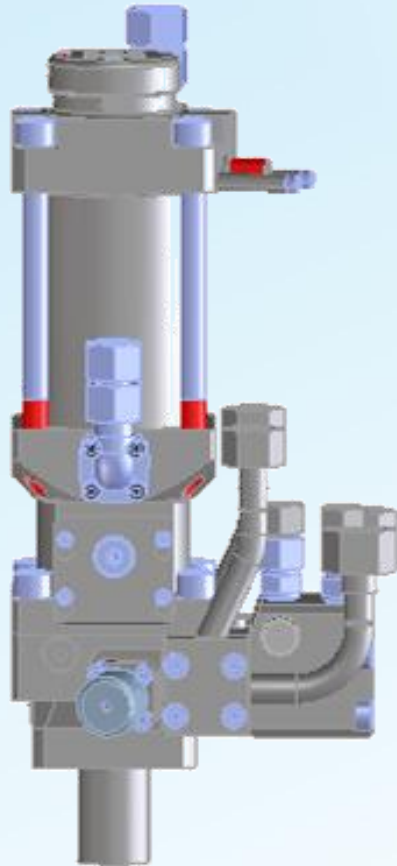


2-component design each

The right choice for your application!

# MT Mixhead

## The New Standard Mixhead



### Features

L-type mixhead with control piston

Piston cleaning

Available for 2 to 6\* components  
(depending on size)

### Benefits

Simple design

Versatile applications

Optimal mixing quality

Compact design

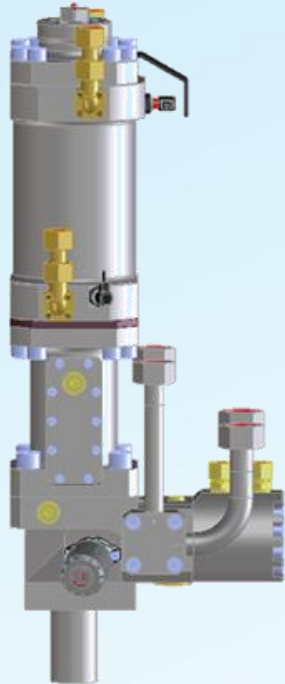
Excellent shot reproducibility

\* 4C-versions and 6C-versions available

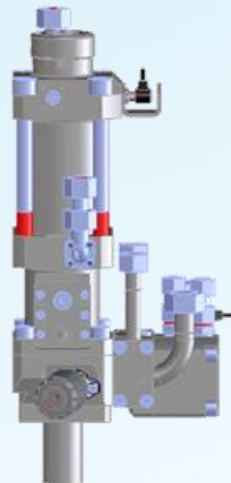
# MT Mixhead

## The New Standard Mixhead

MT36-2



MT26-2



MT18-2



MT12-2\*



MT8-2\*



MT6-2



Min: 500 cm<sup>3</sup>/s  
Laminar: 2500 cm<sup>3</sup>/s  
Max.attachment: 5000 cm<sup>3</sup>/s

300 cm<sup>3</sup>/s  
1300 cm<sup>3</sup>/s  
2600 cm<sup>3</sup>/s

125 cm<sup>3</sup>/s  
600 cm<sup>3</sup>/s  
1200 cm<sup>3</sup>/s

50 cm<sup>3</sup>/s  
300 cm<sup>3</sup>/s  
600 cm<sup>3</sup>/s

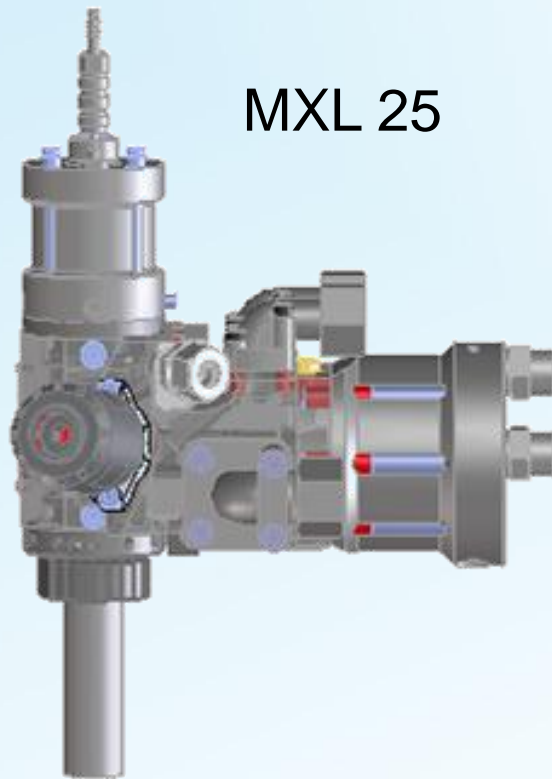
25 cm<sup>3</sup>/s  
150 cm<sup>3</sup>/s  
300 cm<sup>3</sup>/s

8 cm<sup>3</sup>/s  
50 cm<sup>3</sup>/s  
50 cm<sup>3</sup>/s

\* available from 01-2010

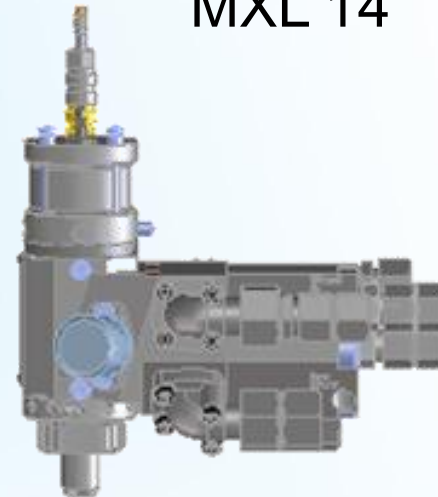
# MXL Mixhead

## New Air-Cleaned Mixhead Option



MXL 25

Min: 750 cm<sup>3</sup>  
Laminar 2500 cm<sup>3</sup>  
Into closed mould: 6000 cm<sup>3</sup>

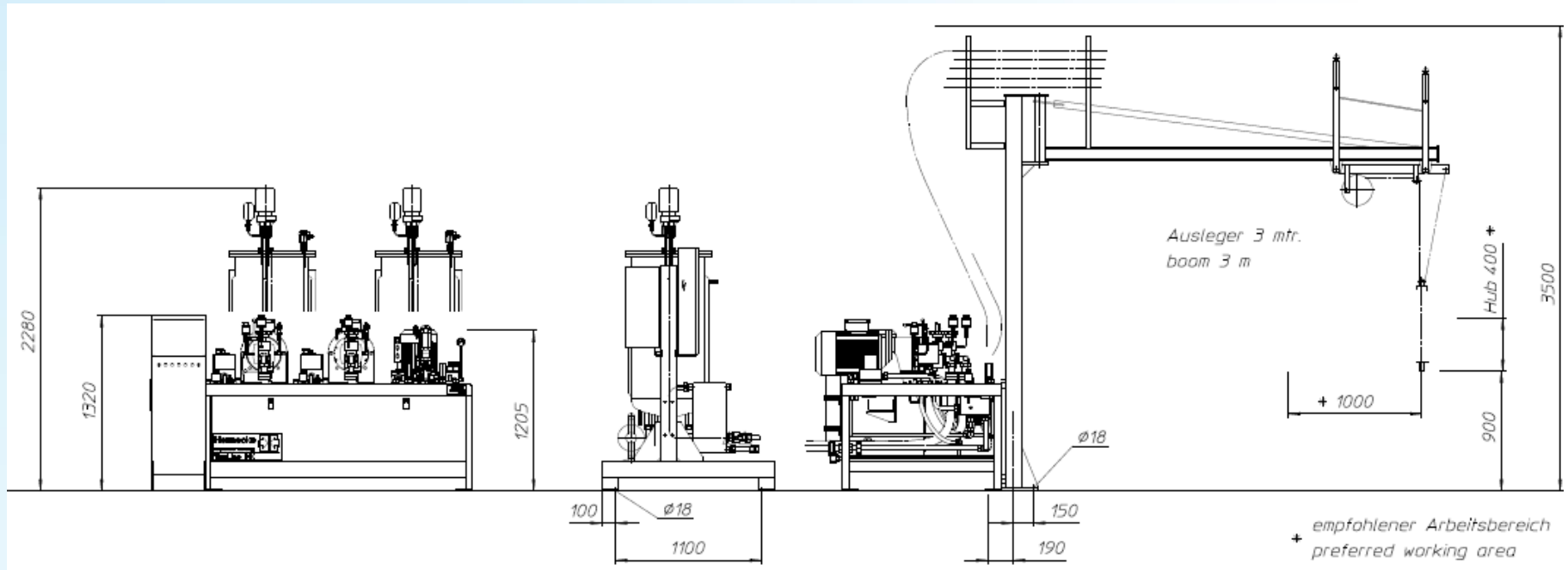


MXL 14

100 cm<sup>3</sup>  
400 cm<sup>3</sup>  
1500 cm<sup>3</sup>

# Machine Layout Standard TOPLINE HK

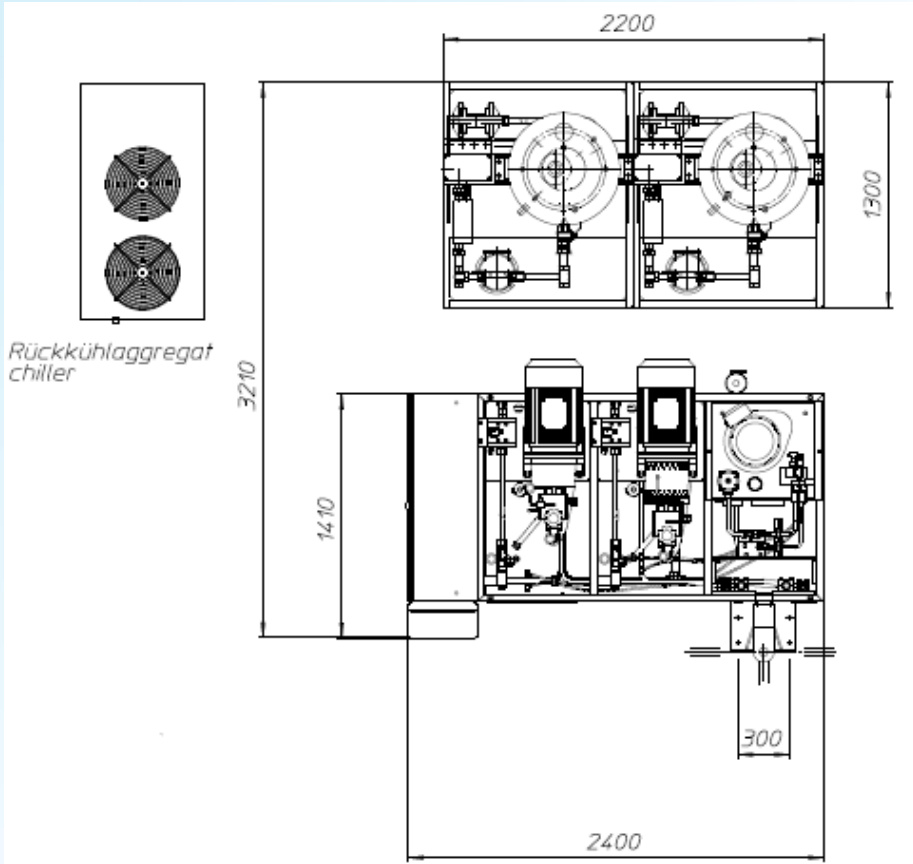
## Standard configuration





# Machine Layout Standard TOPLINE HK

## Standard configuration

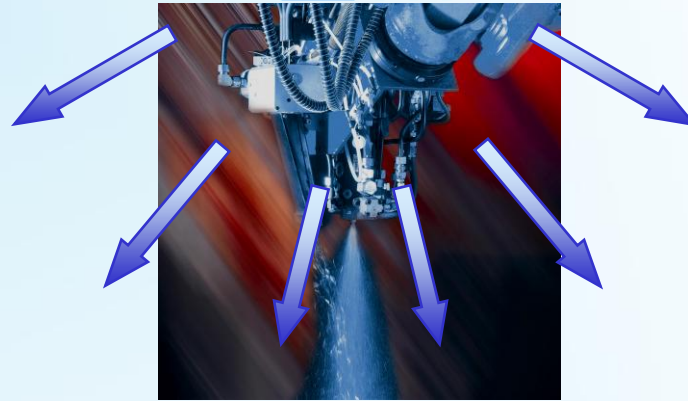


# PUR-CSM – Manifold Spray Knowhow

## Chopped Fibre Technique Open Mould



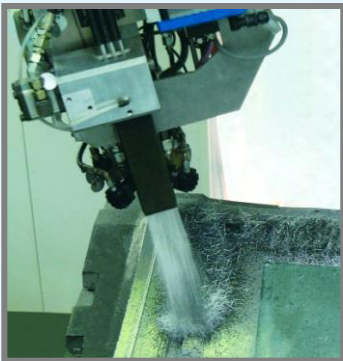
PUR  
CSM  
by HENNECKE



## Compression Moulding Honeycomb or Nat. Fiber



## Closed Mould (LFT)



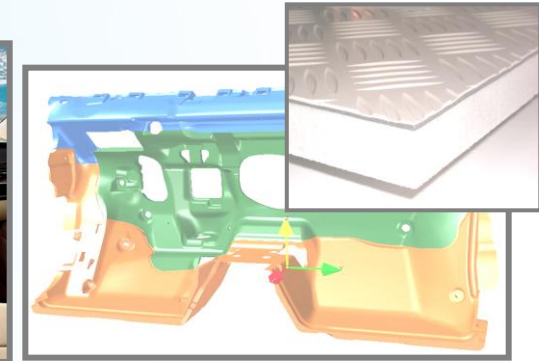
## Pipe Insolation



## Sprayed Skins



## Spraying with Fillers



- **2-4C Metering Unit**
  - MicroLine 45 / 130
  - Topline HK 65 / 135 / 270
  - Topline HT 80 / 180 / 500
- **Robot Unit:**
  - industrial 6 axis robot
  - linear axis / turntable
- **Chopped fibre module**
- **Clamping Unit**
- **Transport system**
- **Spray booth / exhaust system**
- **Others (e.g. gripper)**
- **Safety system**
- **Plant control unit**



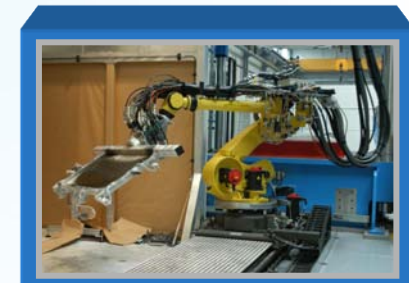
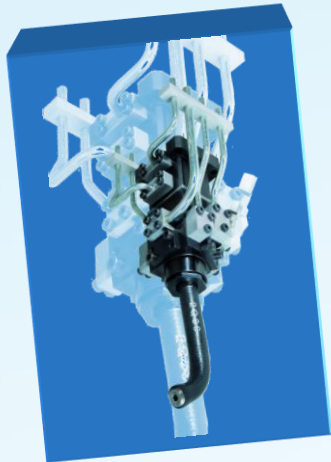
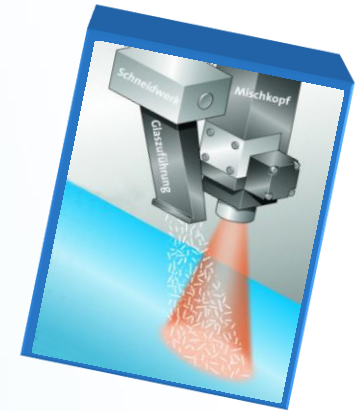
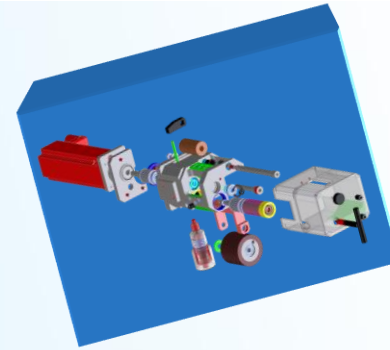
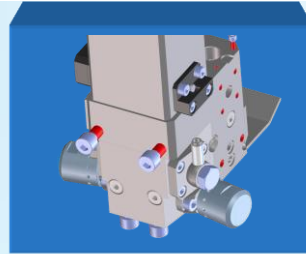
# CSM - Mixheadtechnology

- **MN6 for smallest Output from 6 - 40 g/s\* in 2 until 3 component Version**
  - Sprayed skin
  - Chopped fibre glas in open mold technology
- **MN10 for Outputs from 30 - 350 g/s\* in 2 until 4 component Version**
  - Paper Honeycomp Technology
  - Long fibre technology (LFT)
  - Chopped fibre glas in open mold technology
  - CSM - multi component technology
- **MN10 F for Outputs from 30 - 350 g/s\* in 2 until 4 component Version (Filled material proofed)**
  - Heavy layer parts
  - Spray of filled material
- **MN14 for Outputs from 150 - 800 g/s\* in 2 component Version**
  - Long fibre technology (LFT)
  - Chopped fibre glas in open mold technology





# PUR CSM modular system

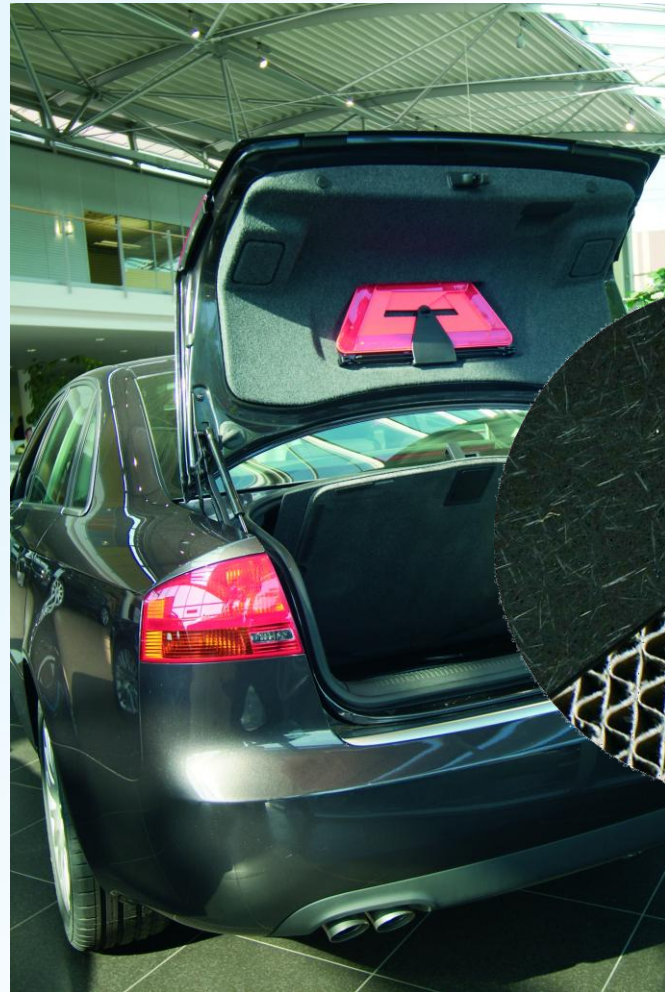


# Structure of PUR Paper Honeycomb

**Fibre-reinforced  
top facing**

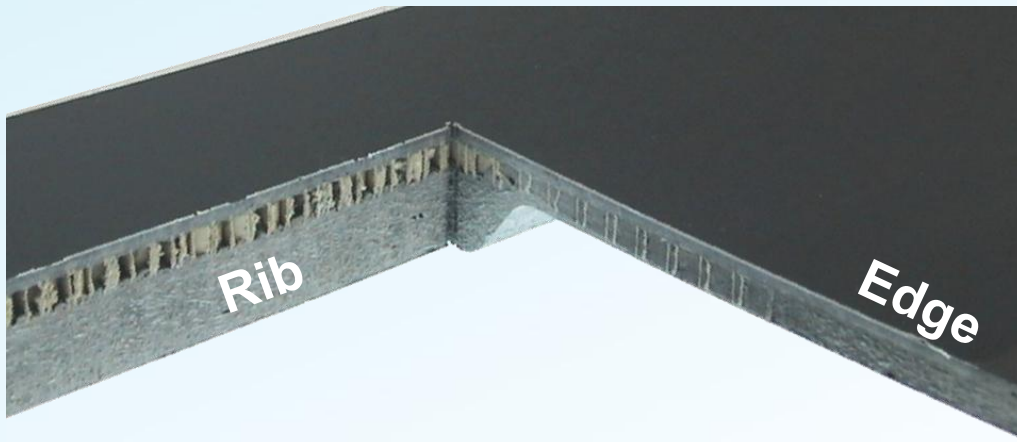
**Paper honeycomb core**

**Fibre-reinforced  
bottom facing**



# Enhanced Benefits through CSM Module Concept

- **Combination of chopped fibre technique with lighter/ cheaper glass mats**
  - ⇒ **lower weight and more efficient use of material**
- **Higher stiffness through reinforcement ribs and reinforced edges**

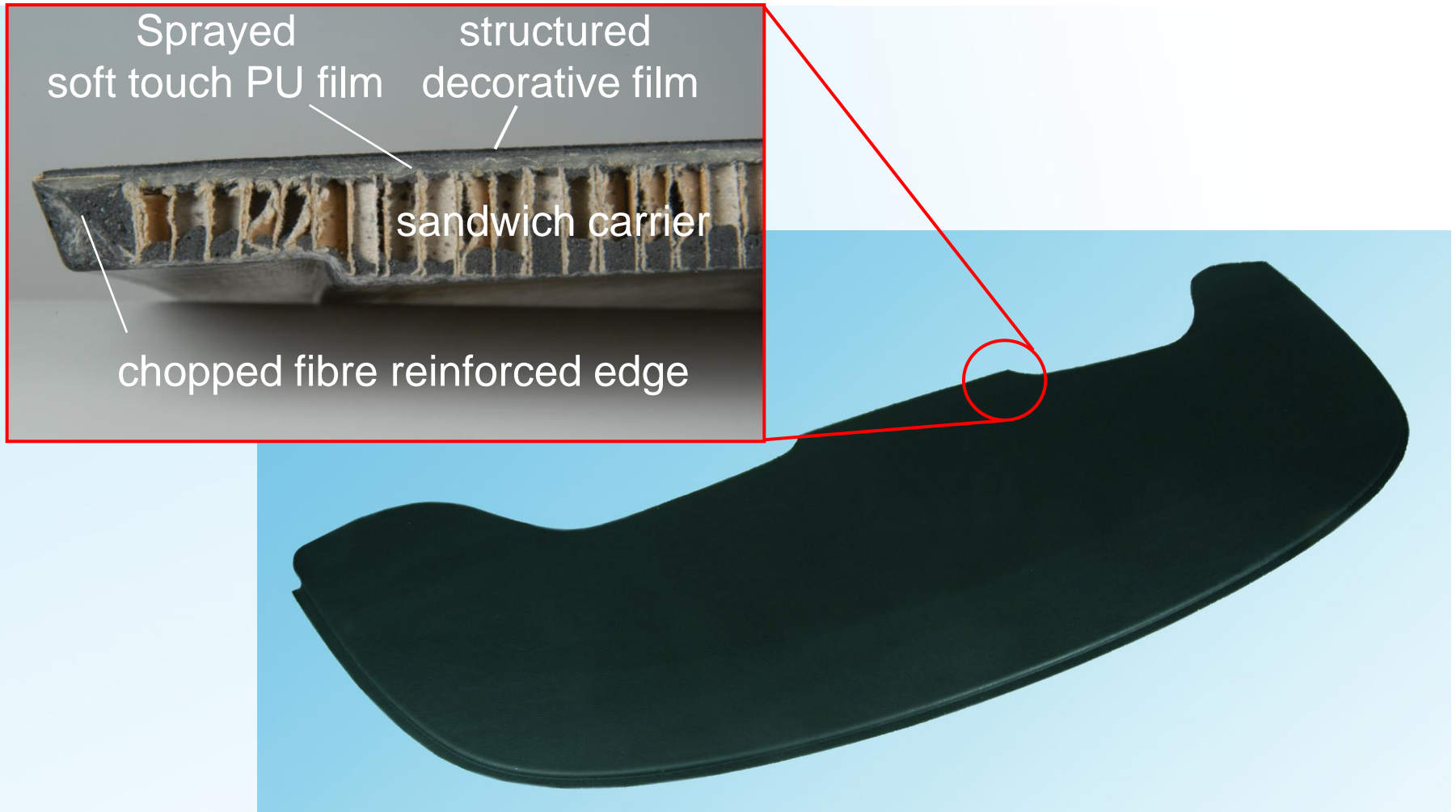




# PUR Mehrkomponenten Automotive Abdeckklappe

## *Multi Component PUR Automotive cover*

Polymere Technologie



# CSM Spray Technique – Honeycomb sandwiches

## Requirements

- **2-comp. HK 65 / 270 CSM or MicroLine 45 / 130 CSM**
- **Sprayhead MN**
- **Industrial 6-axis robot with min. 120 kg / 3.200 mm**
- **Spraybooth with exhausting equipment**
- **Sandwich-gripper with supply table**
- **Mould carrier**
- **Options**  
**Glass chopping unit, Carbomat, constant pressure nozzles**



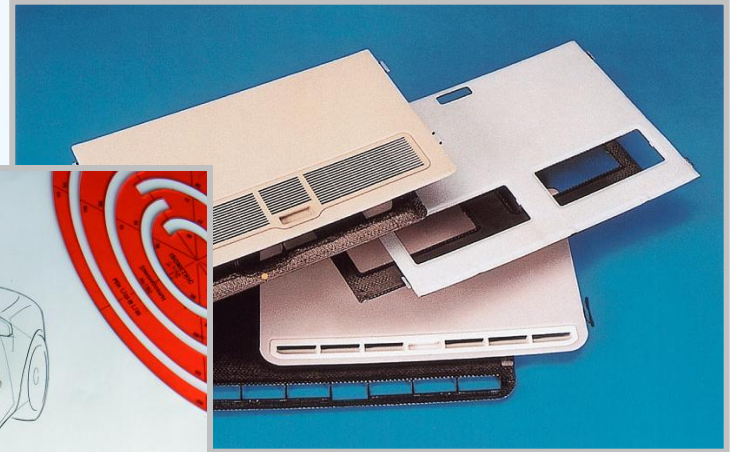
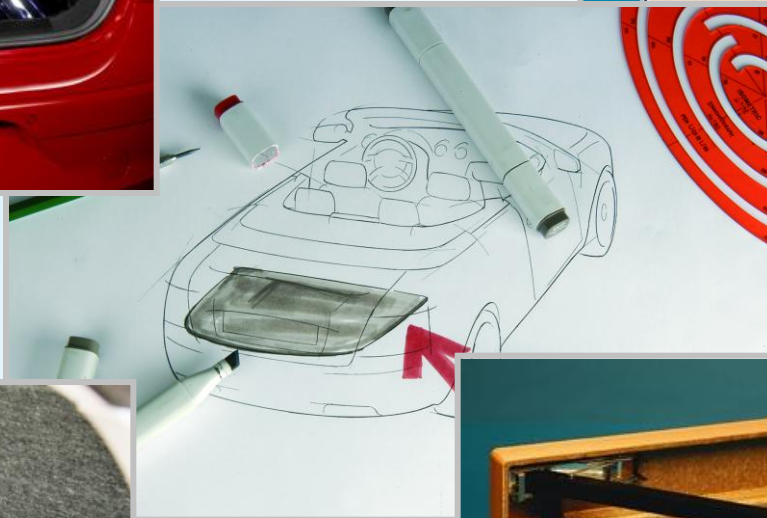
## Saving money with CSM

### with the CSM highlights

- ⇒ start spraying directly in the part
- ⇒ unlimited shot-interruptions
  - in the turning points of the robot,
  - robot moving to different areas of the part
- ⇒ self-cleaning spray head
- ⇒ no cleaning station for the spray-head

**saving between up to 15 % of PU Material from part to part**

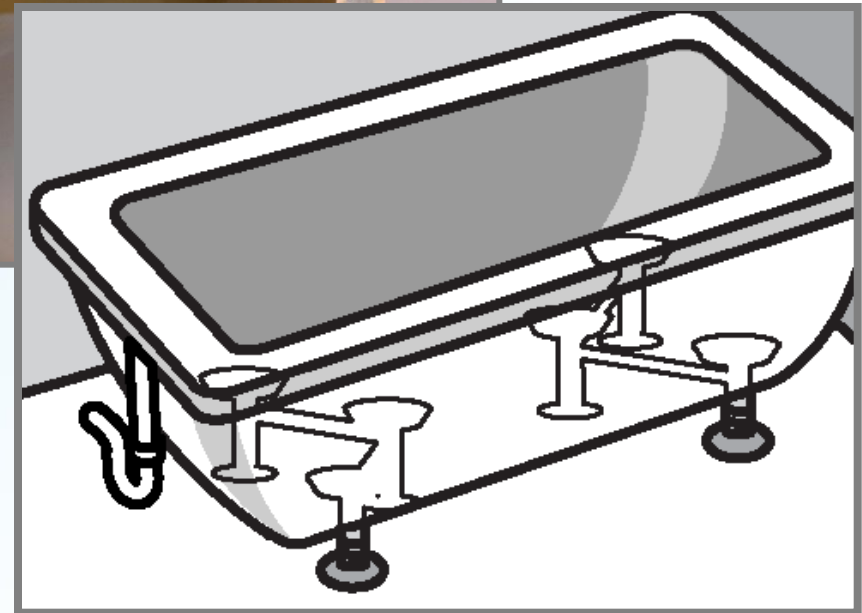
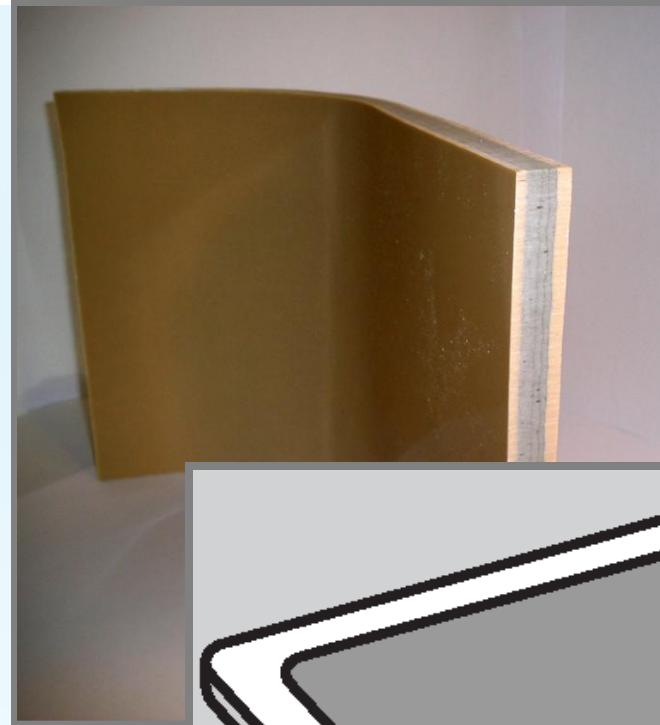
# PUR Sandwich Products



# Sanitary Ware

## *Advantages:*

- Constructing sandwich layers
- Direct mounting of bathtub socket
- Temperature insulation
- Reduced acoustic emissions

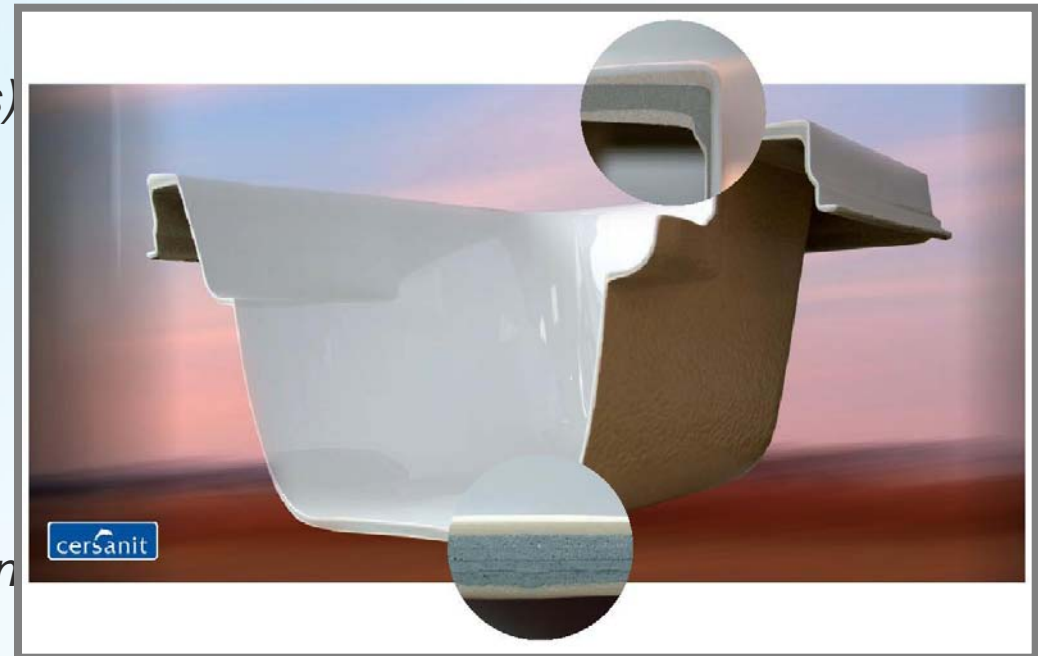




# Sanitary Ware

## FACTS:

- *Reinforcement of a thermoformed foil with PUR*
- *Ecological production (no solvents)*
- *Constant product quality*
- *Improvement of production processes*
- *Flexible Line concepts available*
- *Total cost of Ownership calculation gives a positive feedback*



# References

- **Artweger Austria**
- **One machine Installed in Brazil**
- **Autotop Romania**
- **Aquaproduction France**
- **Mascobath USA**





# Technology Profile „Bathtub“

## Selling points for Hennecke Technology

- Reinforcement of a thermoformed foil with PUR CSM
- Ecological production (no solvents)
- Constant product quality
- Improvement of production processes
- Flexible Line concepts available
- World wide service



# Motivation for better Insolation

- Worldwide Growing Demand for more Energy
- Demand for higher Comfort
- Growing Demand for a bigger Variation in Food
- Growing Demand to Use Energy more Effective

## This all calls for an Effective Thermal Insulation



# Blowing Agent – Motivation

- Increasing energy costs  
→ higher demand more effective insulation
- Reduced CO2 emission  
→ Is leading to a higher demand in insulation
- Increasing labor costs in building industry  
→ higher demand for Sandwich Panels (easy installation)
- Increasing costs for transportation  
→ increasing number of Sandwich Panel production in place
- Increasing demand in Africa / Asia for cold / frozen food  
→ higher demand for Sandwich Panels (Cold store chain)
- Use of new Foam Systems (PIR) offering better product properties  
→ need of new/better metering and production equipment

# Sandwich elements basic insulation

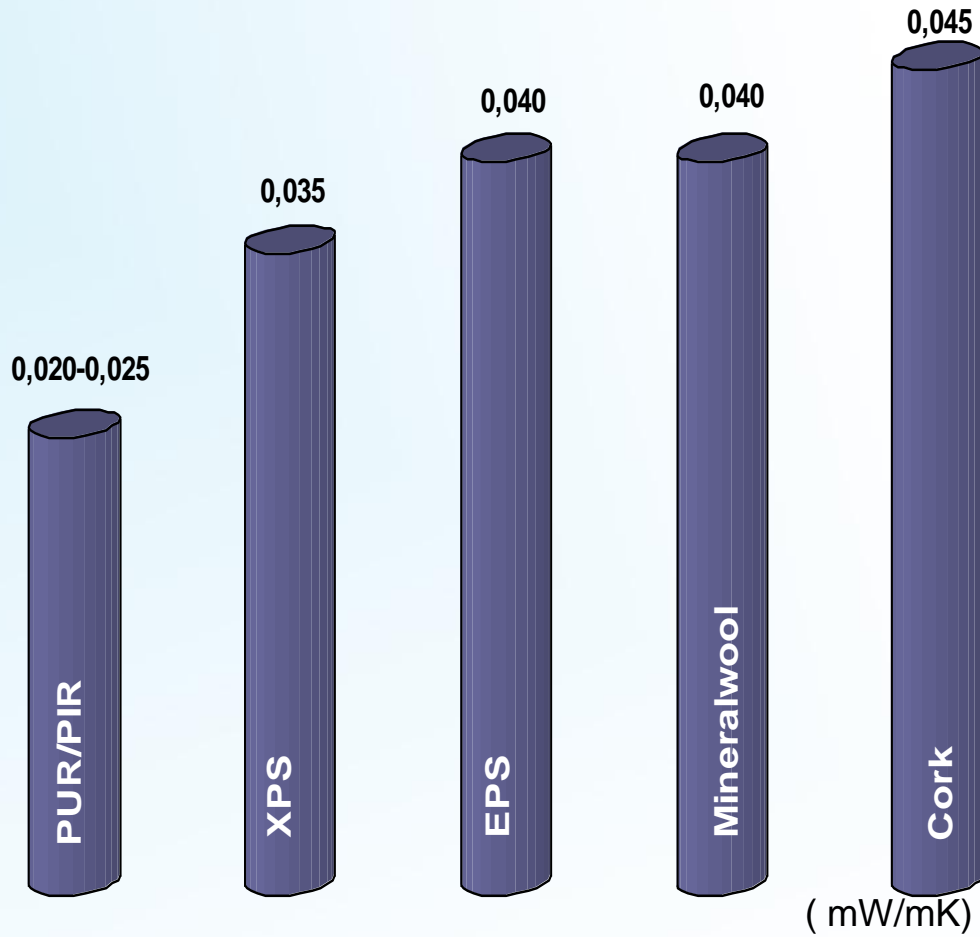
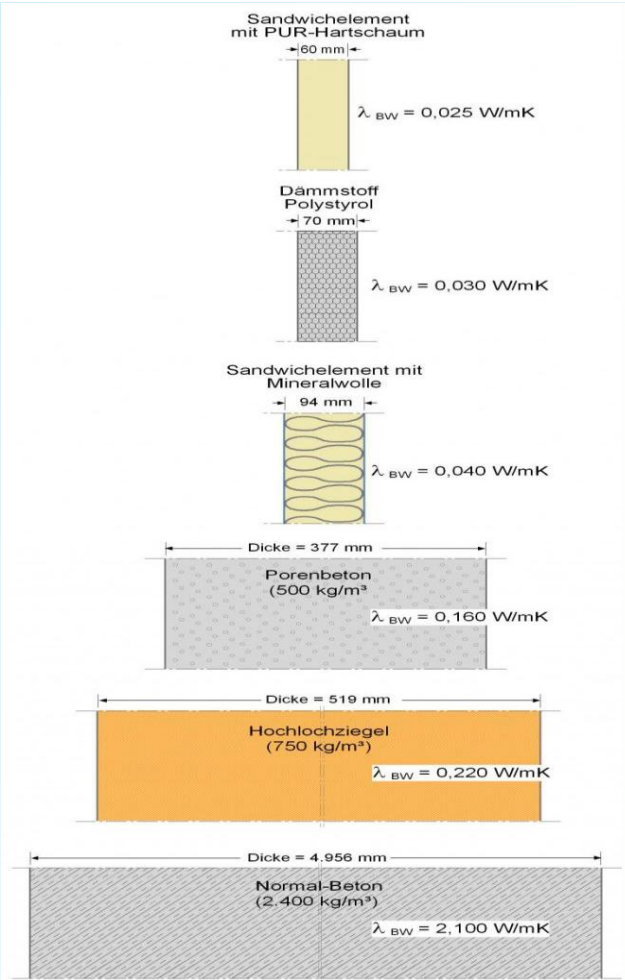
## Insulation and how it works



Only a minor part of the Polyurethane rigid foam volume consists of solid material.

Based on a density of abt.  $30 \text{ kg/m}^3$  as usual in building and construction, the content of solid plastics only amounts to roughly 3 % of the volume. It forms a grid structure made of cell numbers and sizes serving to withstand mechanical stress. The blowing agent remains in the cell and contributes to the insulation.

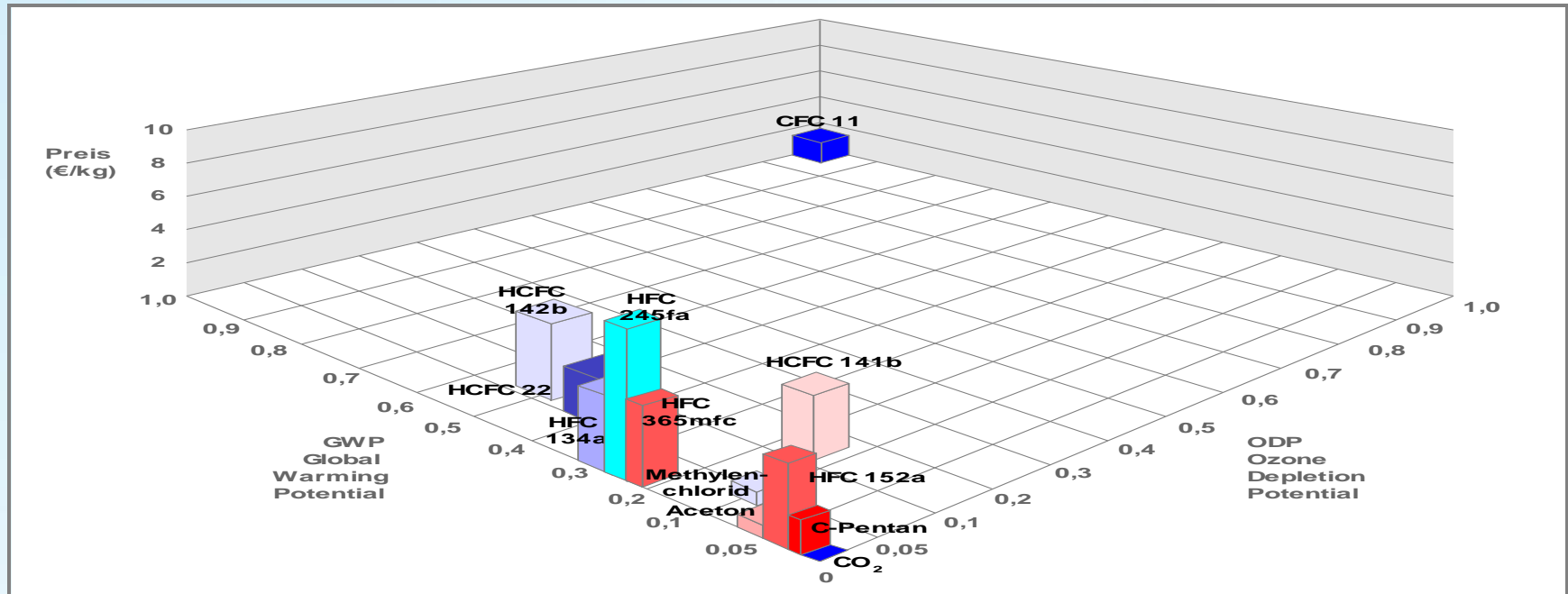
# Comparison thermal conductivity





# Why is Pentane the right blowing agent

- Pentane is the most environmentally compatible blowing agent



- Pentane has excellent insulation values
- Pentane is inexpensive

# Why is Pentane the right blowing agent

## ■ Comparison of Pentane

	Molecular weight	Boiling point	Price
141 B	117	+ 32° C	1,95 € / kg
245 FA	134	+ 15° C	3,25 € / kg
C <sub>5</sub> H <sub>10</sub> (Cyclopentane)	70	+ 50° C	0,50 € / kg

When the molecular weight is taken into consideration, the raw material price of 141b and 245 FA is 10 times more expensive than Pentane. The acquisition costs of a safe Pentane manufacturing system compared to a conventional manufacturing unit are about 120,000 € higher. With a blowing agent content of approximately 10% Pentane and an annual consumption of about 130 tons/year the "break even" is reached. The low boiling points have technical disadvantages for the rod manufacturing process.

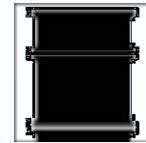
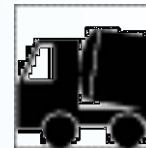
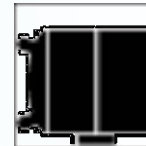
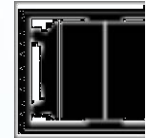
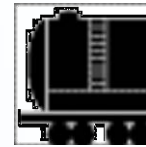
The indicated prices are approximate prices for Germany.



# Pentane storage systems

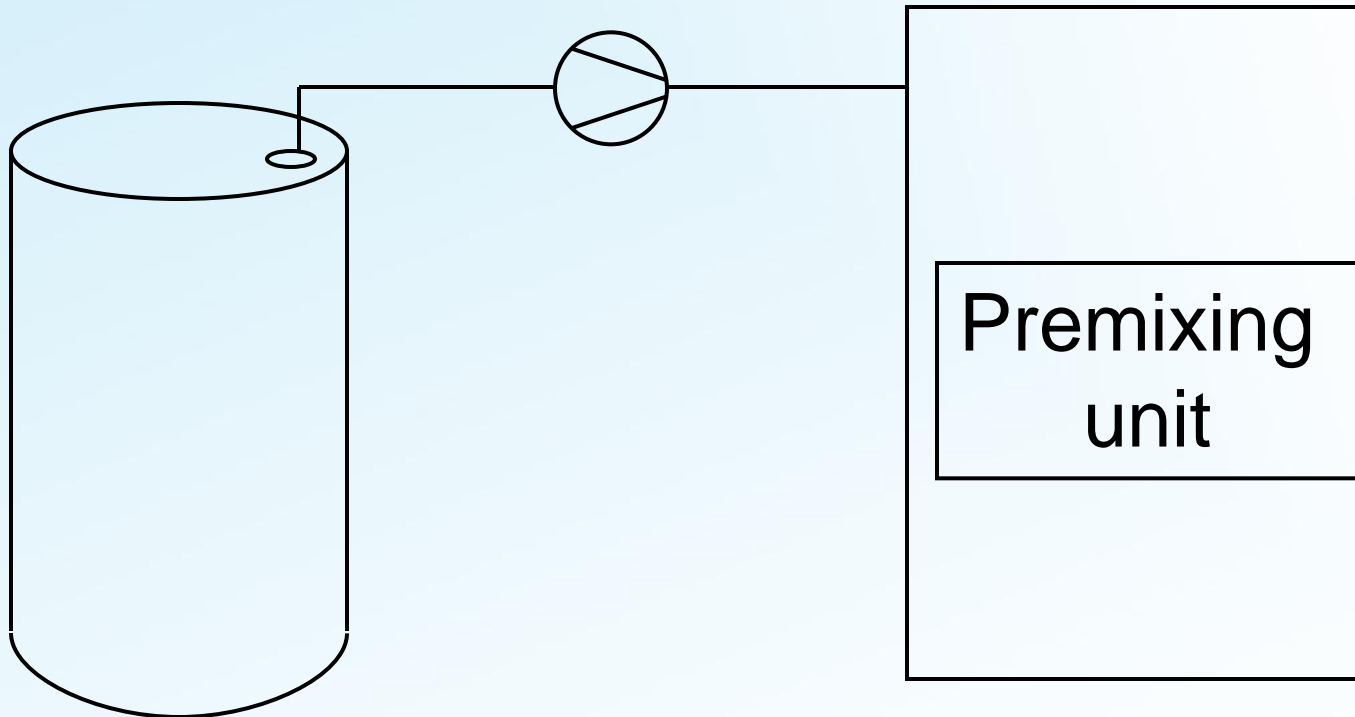
## ■ Influencing factors on choice of Pentane storage system

- consumption
- how will Pentane be supplied?
- how regular can Pentane be supplied?
- local regulations in different countries



# Pentane storage systems

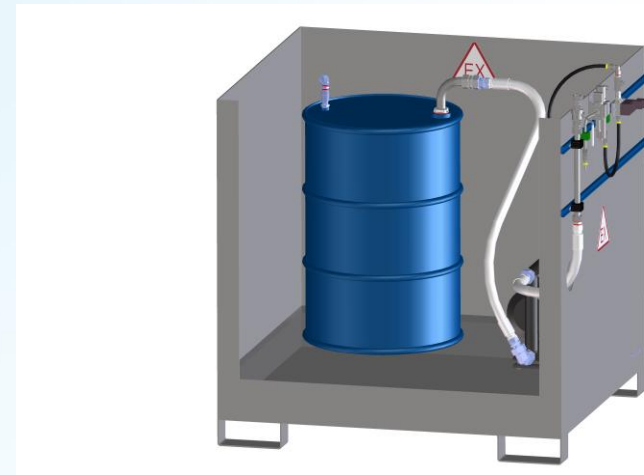
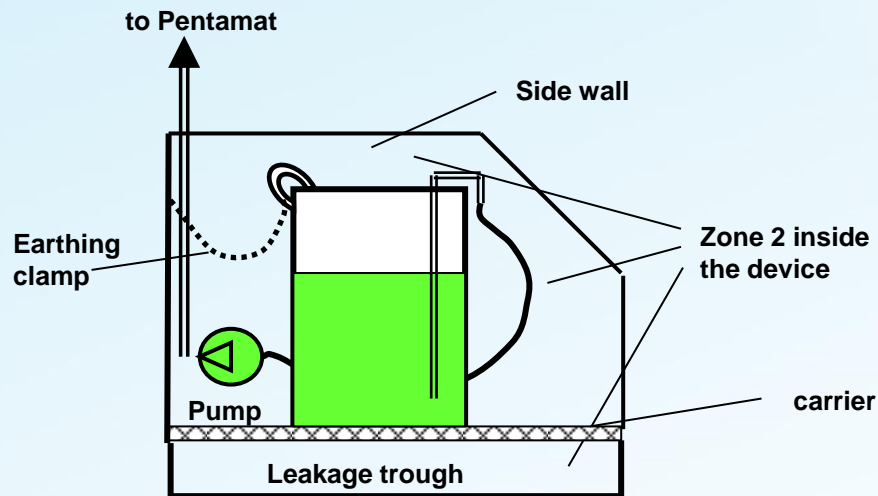
- Storage solution for Pentane supply in barrels



# Pentane storage systems



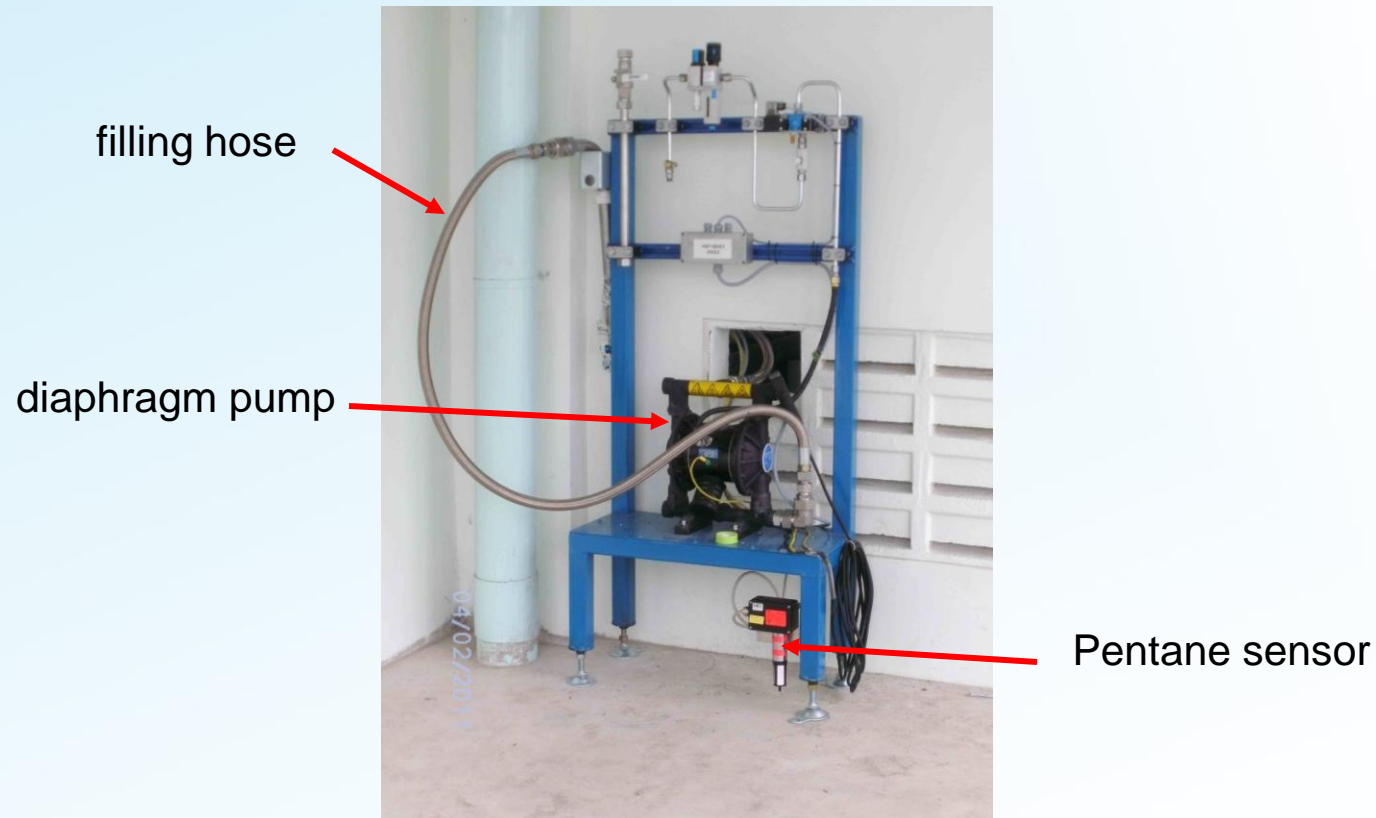
- Storage solution for Pentane supply in barrels
  - Drum discharging unit



- Placement outside of the building (with exhaustion system also inside)

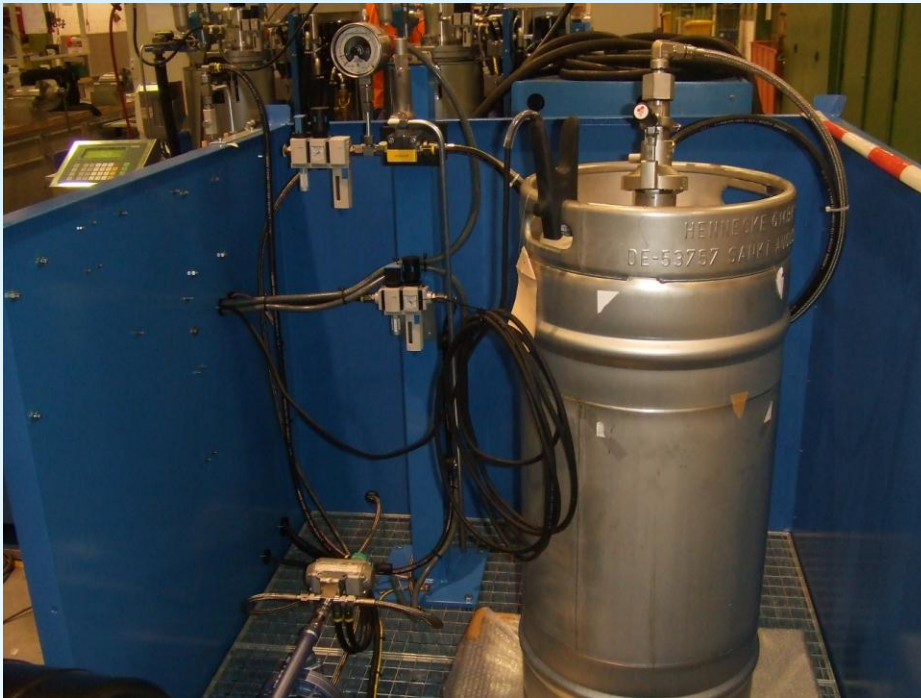
# Pentane storage systems

- **Storage solution for Pentane supply in barrels**
  - Drum discharging unit



# Pentane storage systems

- Storage solution for Pentane supply in pressure vessels
  - Drum discharging unit



Connection via KEG



grounding

# Pentane storage systems

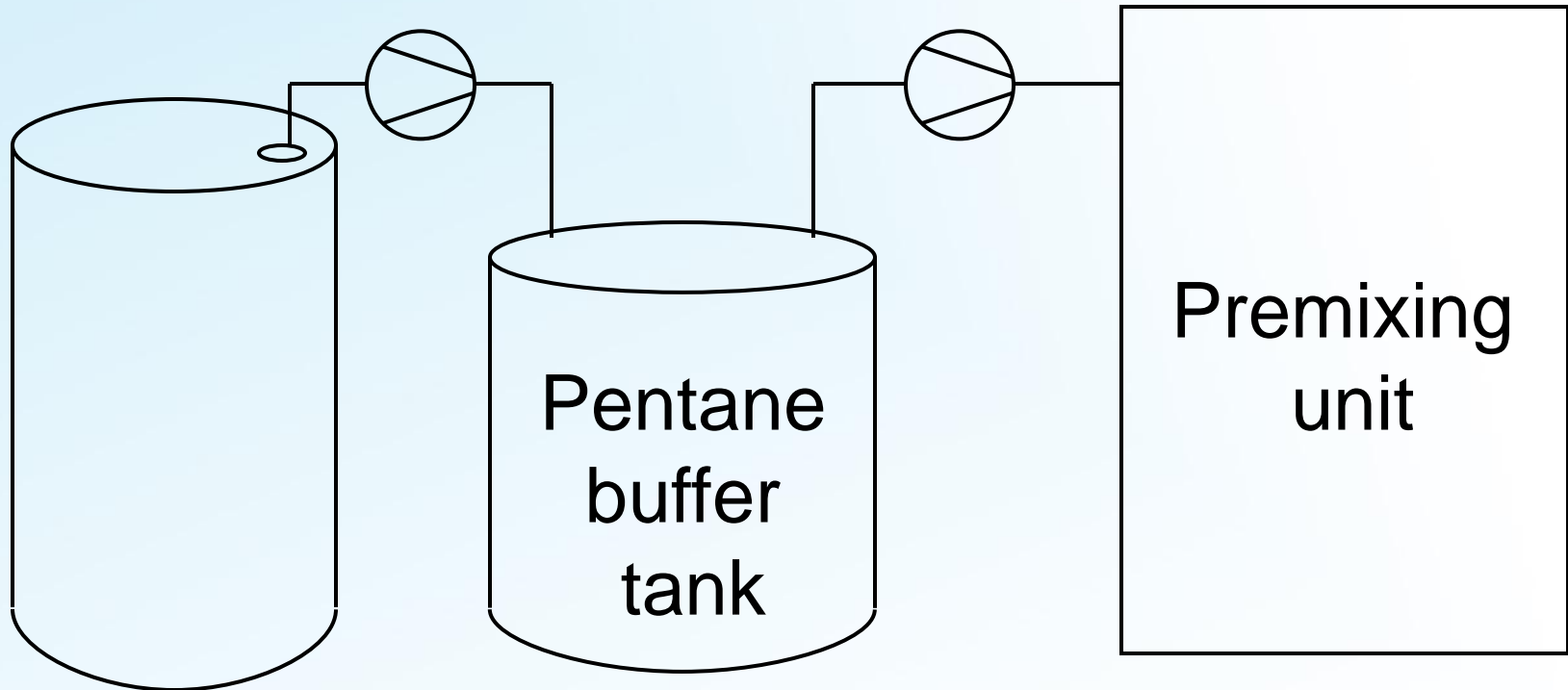
- **Storage solution for Pentane supply in pressure vessels**
  - Drum discharging unit





# Pentane storage systems

- Storage solution for Pentane supply in barrels





# Pentane storage systems

- Storage solution for Pentane supply in barrels



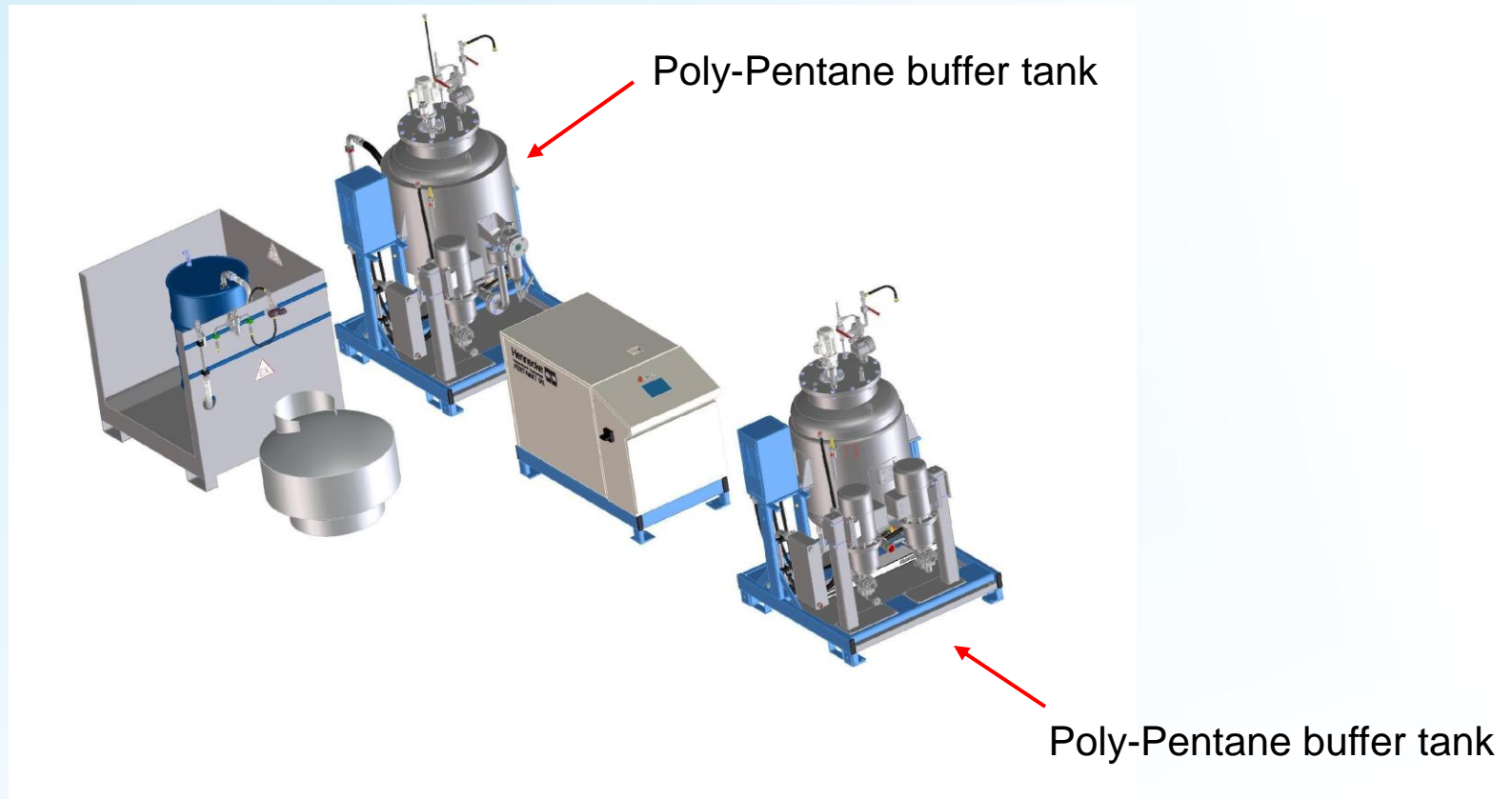
Pentane buffer tank (400 l)



drum discharging unit

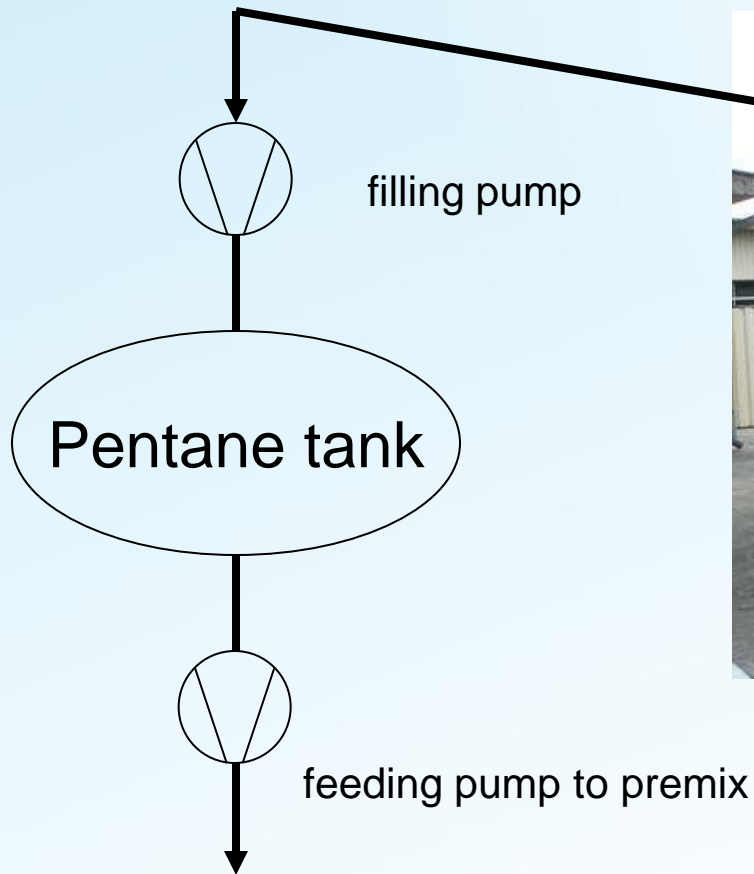
# Pentane storage systems

- complete premix system for Pentane supply in barrels



# Pentane storage systems

## Overview



# Pentane storage systems

## ▪ Pentane tank



### Hennecke standard features

- double walled tank
- explosion proof
- flexible capacity
- design according to DIN 6608/2
- man hole DN 600

Tank can be supplied by Hennecke or only design drawings for local supply.

# Pentane storage systems

- **Why double walled?**

- Additional safety

- Leakage supervision

- volume between tank and outer shell is filled with air (pressure > 1 bar) and this pressure is supervised by pressure sensor. If pressure is reduced a leakage in inner or outer wall has occurred. Alarm will be released.



# Pentane storage systems

- **Valve kit for filling & gas displacement**
  - leakage control device
  - fan for man hole pit
  - inlet filter
  - filling pump
  - protection against dry running
  - pressure gauge



- **With-drawel kit**
  - several detonation protection
  - overfill protection
  - continuous level measurement
  - 1 or 2 displacement pump (9 l/min (or bigger), 6 bar) ATEX execution
  - over pressure release valve
  - filling hose
  - hose for gas recycling

# Pentane storage systems

## ■ Technical features Pentane storage tanks

- red jacket submersible pump (no pneumatic actuated diaphragm pump!)
- well established in fuel stations
- easy for maintenance
- long lifetime
- optimized for vertical discharge



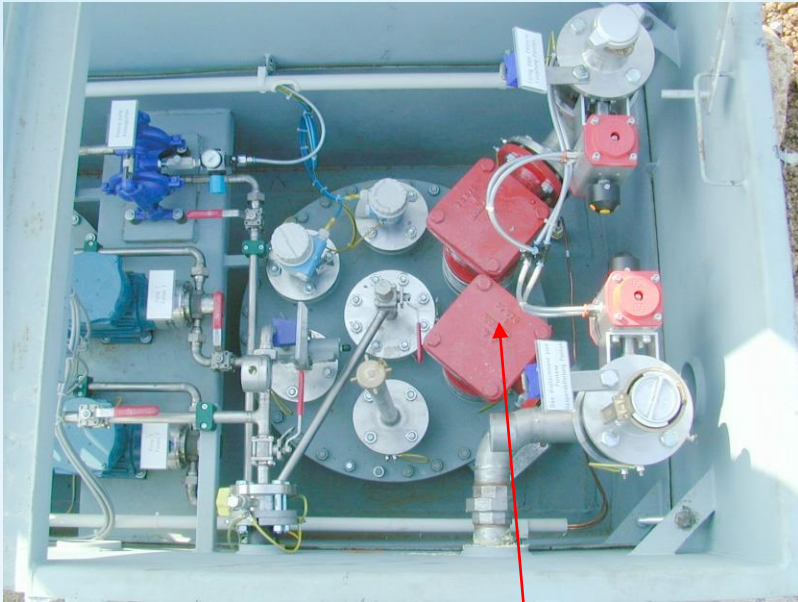
# Pentane storage systems

- Control panel



# Pentane storage systems

- Man hole pit
  - pump installation

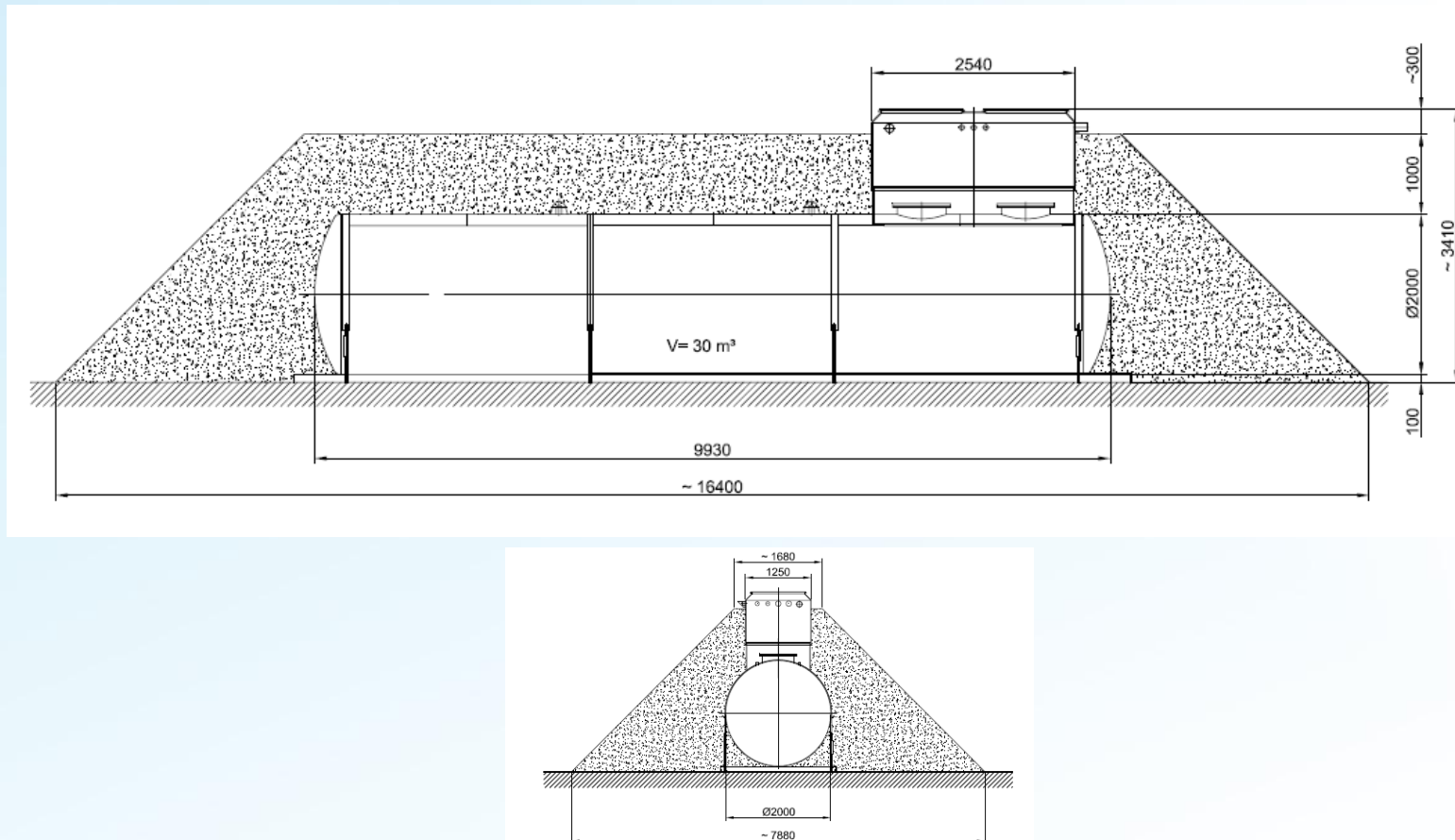


Detonation protection device

# Pentane storage systems



- Overground installation



# Pentane storage systems

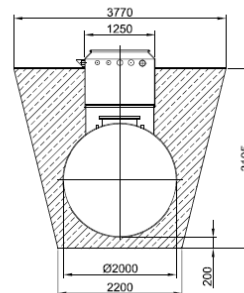
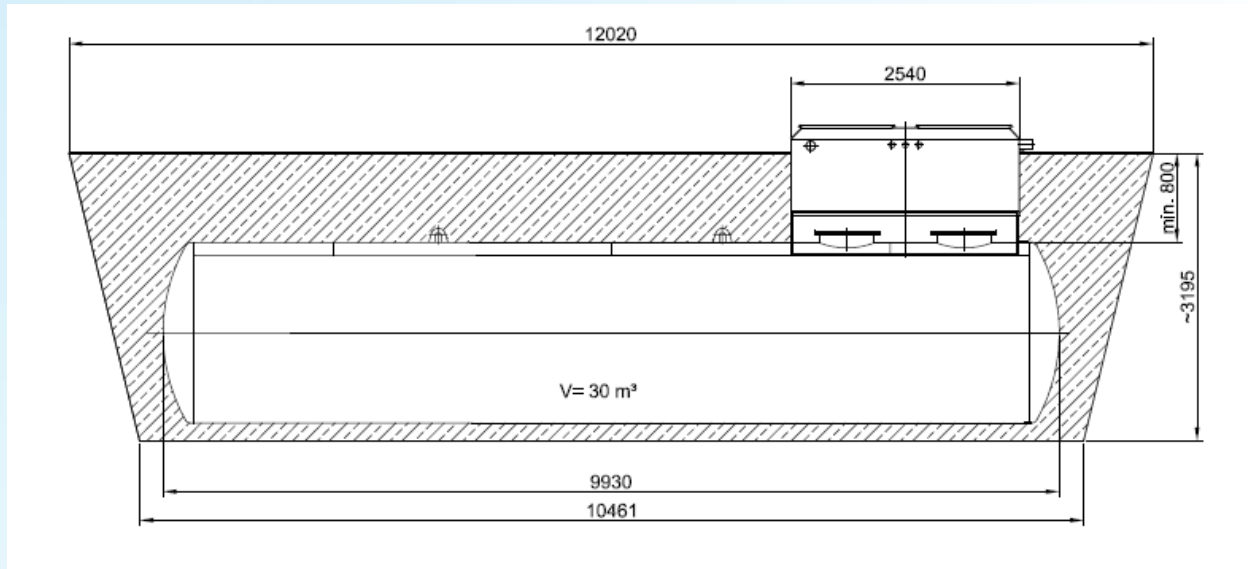
## ▪ Overground installation

- distance to building needs to be considered (local regulations)
- filling pump necessary (might be included in tank truck)
- cover with soil (sun and UV-protection)
- concrete base necessary
- tank will be fixed by steel belts on concrete base in order to avoid ascending force



# Pentane storage systems

- **Underground installation**



# Pentane storage systems

- **Underground installation**
  - distance to building needs to be considered (local regulations)
  - in most cases the tank can be installed very close to building
  - filling by gravity (or pump)
  - earth works necessary
  - tank fixation by steel belts (not necessarily)

# Pentane storage systems

- **Underground installation**



# Pentane storage systems

- **Underground installation**



cover for manhole pit





# Pentane premix systems

- Pentamat 30i

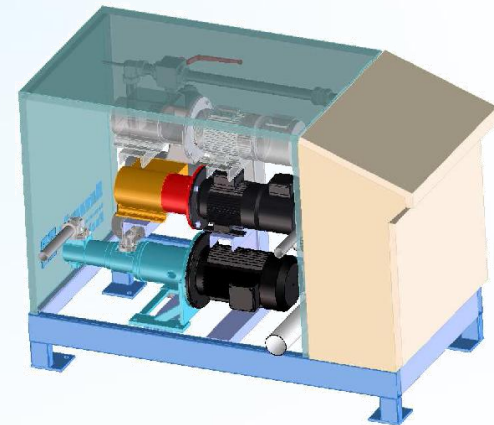


# Pentane premix systems

## ■ Pentamat 30i

- The Pentamat is the world's most common premixing station for discontinuous metering and mixing of Polyol with blowing agents. The batch is stored in a work tank or buffer tank station
- now available in new version with a lot of improvements!
- for metering of

- cyclo-, iso-, n- Pentane
- 245fa
- 141b
- 354mfc

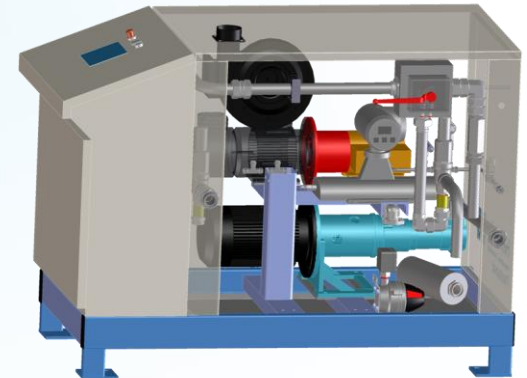
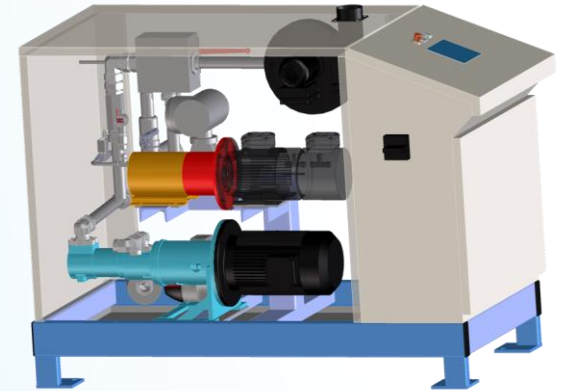




# Pentane premix systems

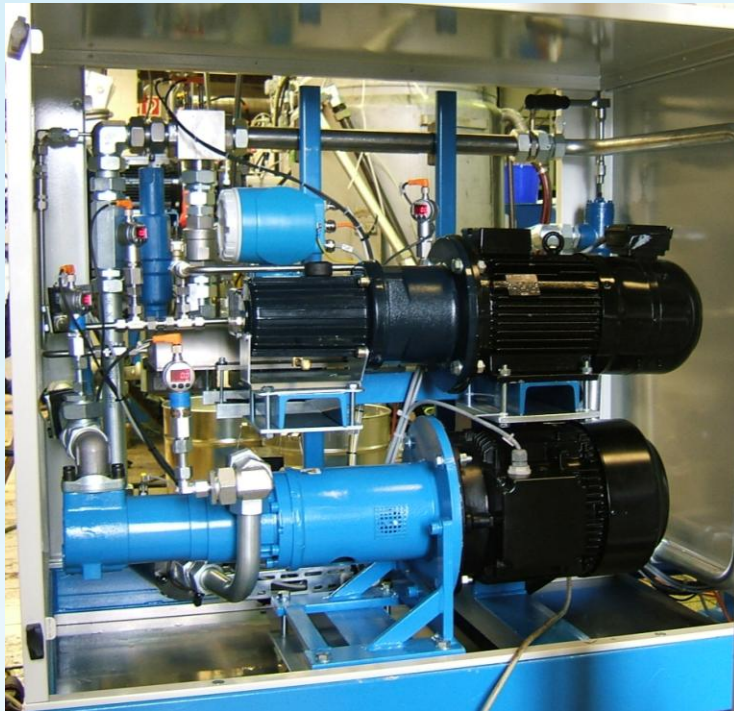
## ▪ Pentamat 30i - Highlights

- All components are individually metered
- Designed for Polyol viscosities up to 15.000 mPas
- Hermetically sealed piston-diaphragm pump for Pentane
- Screw spindle flow meter for Polyol, Mass flow meter for Pentane
- Flow monitoring switch for exhaust fan
- Exhaust fan (optional)
- All components can be individually calibrated
- Housing with two large maintenance access doors
- Optional second additive
- Siemens S7 / OP 77 controls, Protocol of last 50 refills



# Pentane premix systems

- Pentamat 30i



Easy maintenance!

# Pentane premix systems

## ▪ Pentamat i-series

### Technical Data

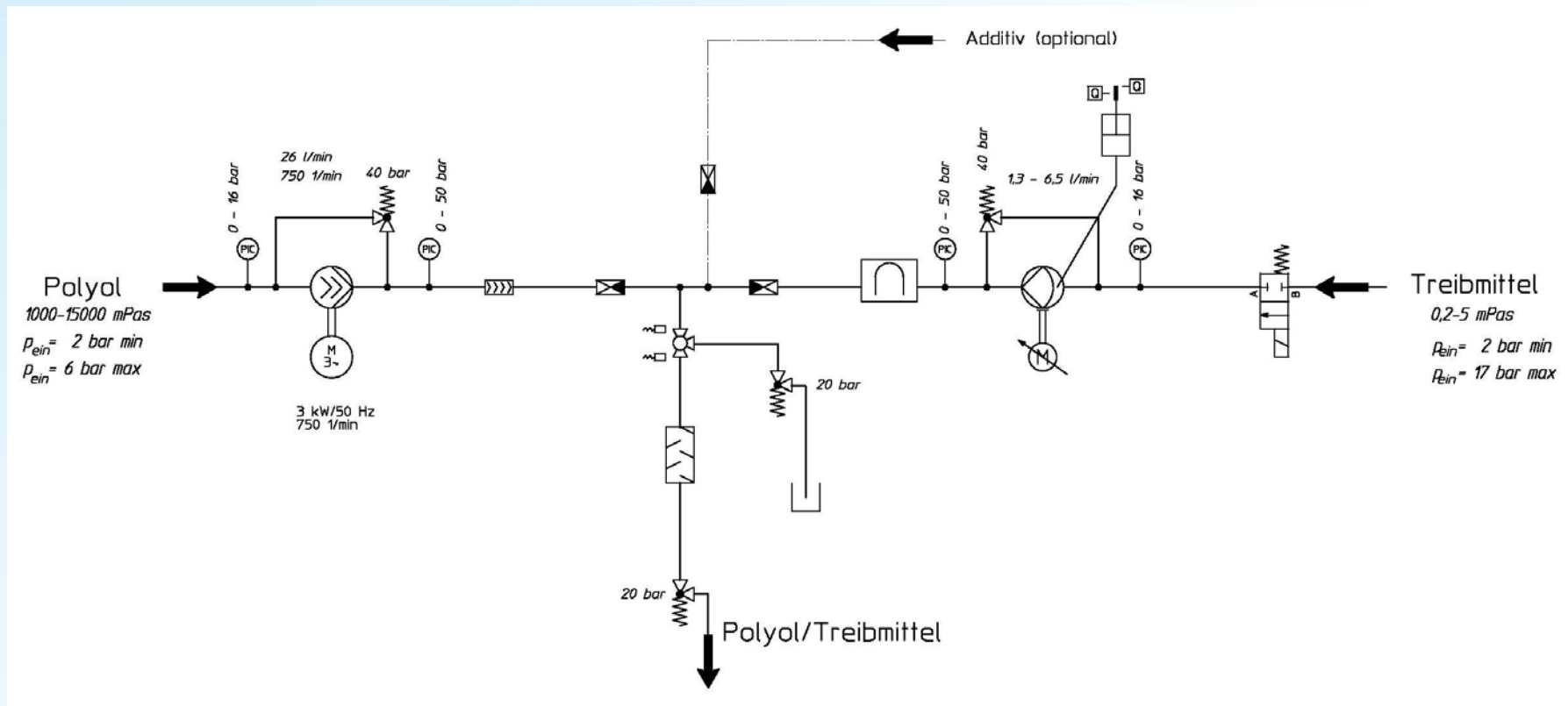
- Output Polyol:
- Viscosity Polyol
- Output Pentane:
- Output Additive 2 (Option):
- Ratio Pentane / Polyol:
- Outlet pressure Poly/Pentane:
- Supply pressure Polyol:
- Supply pressure Pentane:
- Closed loop control start after:

Pentamat 30i	Pentamat 50i
26 ltr/min	40 ltr/min
1.000 - 15.000 mPas	
1,3 – 6,5 ltr/min	2 - 11 ltr/min
0,15 – 0,8 ltr/min*	
5 – 25 vol. %	5 - 27 vol. %
max. 15 bar	
min. 2 bar / max. 6 bar	
min. 2 bar / max. 17 bar	
(min. 2 bar above vapour pressure)	
~ 2 sec	

\* can be changed according to specific demands

# Pentane premix systems

## ■ Pentamat 30i - flow diagram



# Pentane premix systems

- **Pentamat 30i - your benefits**
  - Exactness of mixing accuracy further enhanced
  - future safe: Suitable for high-viscous Polyol types
  - best reproducibility
  - fast start-up of the closed loop control
  - second component can be retrofitted if necessary

# Pentane premix systems

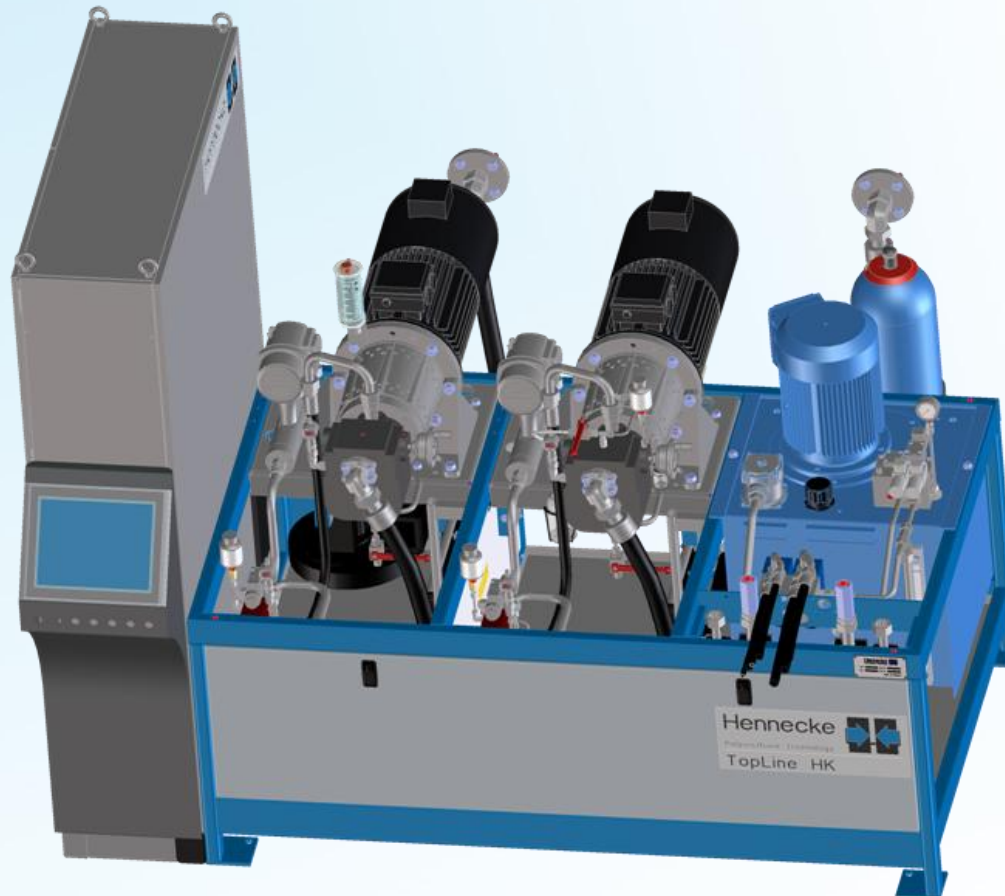
- Outdoor installation is possible






# Pentane features metering machines

- Actual Topline series metering machine for Pentane



# Pentane features metering machines

- **General remarks on Hennecke exhaustion system**
  - reduction of exhaust capacity (volume) as much as possible
  - partial encapsulation
  - integrated exhaust equipment (fans)

 Energy efficient exhaustion system!

# Pentane features metering machines

- **Modifications of metering machines for processing Pentane are mainly related to**
  - Polyol tank station
  - tank refilling
  - metering machine (pump group)
  - electronic control system
  - electrical installation

# Pentane features metering machines

- **Modifications of tank station for processing Pentane**
  - stirrer with magnetic coupling
  - exhaustion system
  - control unit for nitrogen filling of tank (tank inertization)
  - special safety valves (self-closing, pneumatic actuated ball valve with electronic supervision) for refilling and suction side to pumps
  - safety release valve, adjusted to 4 bar
  - PT 100 for max temperature control (50°C)
  - interface to PPT control

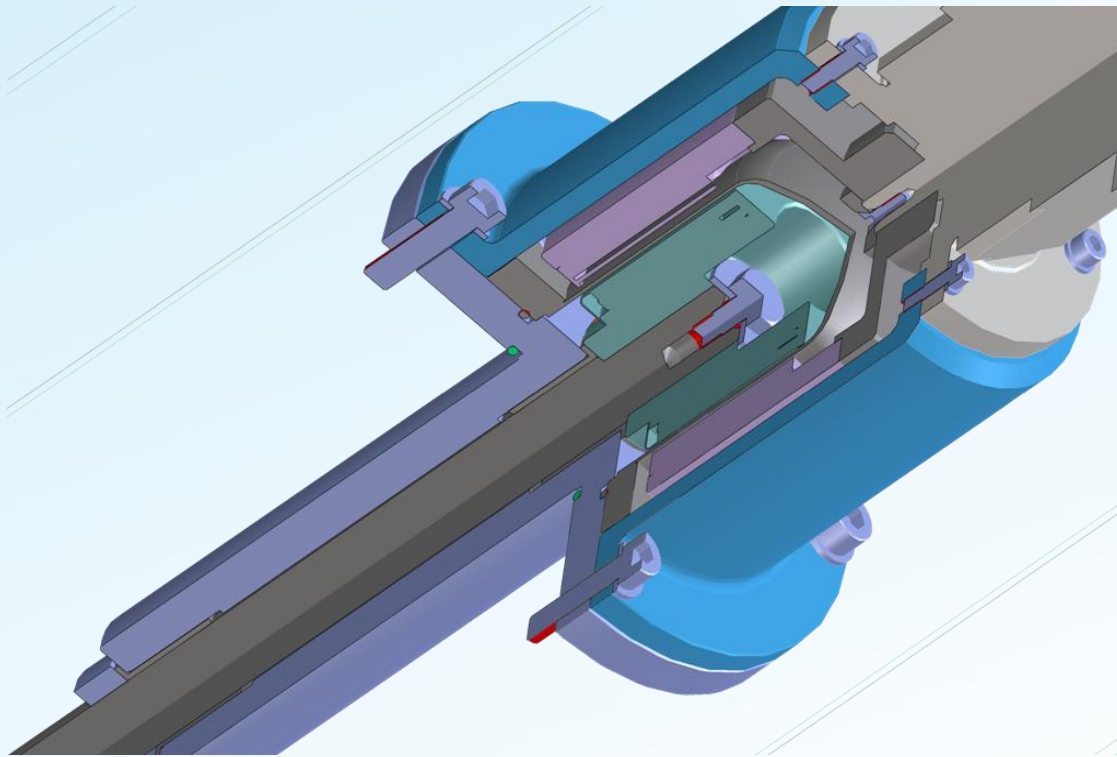
# Pentane features metering machines

- Tank station



# Pentane features metering machines

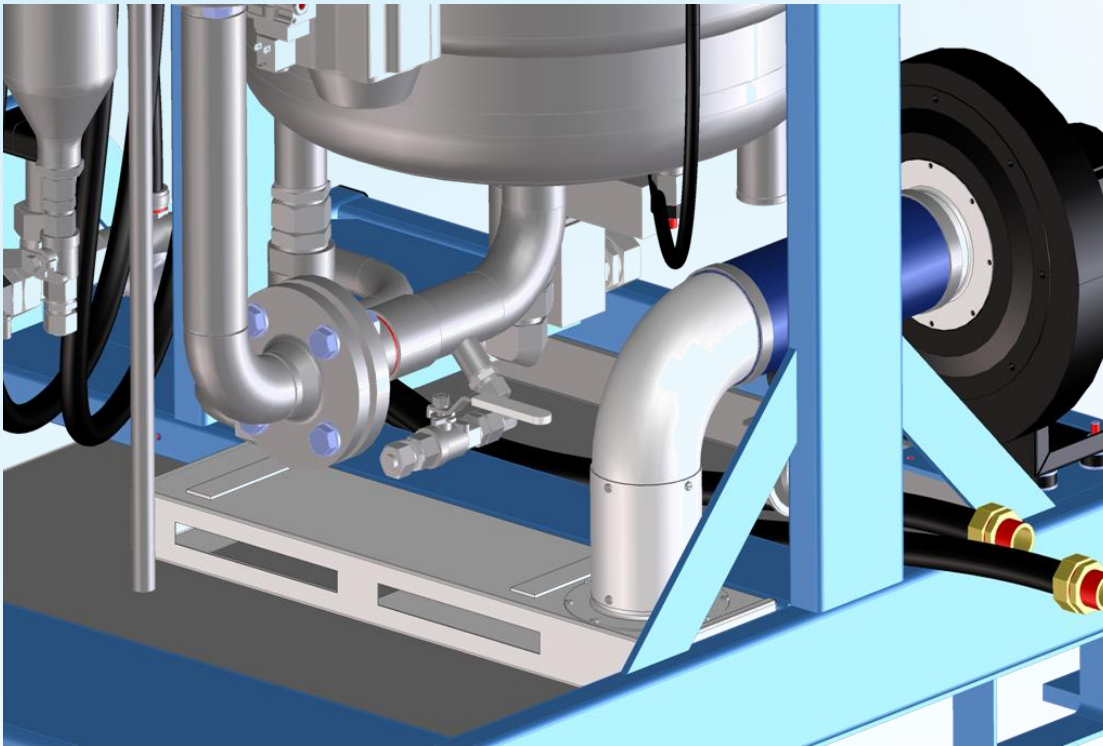
- Tank station
  - stirrer with magnetic coupling tank





# Pentane features metering machines

- Tank station
  - exhaustion system with channel

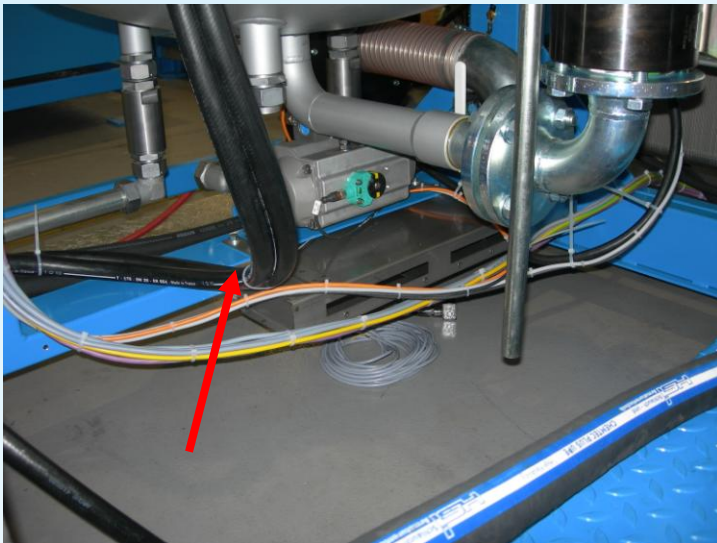


free access to:

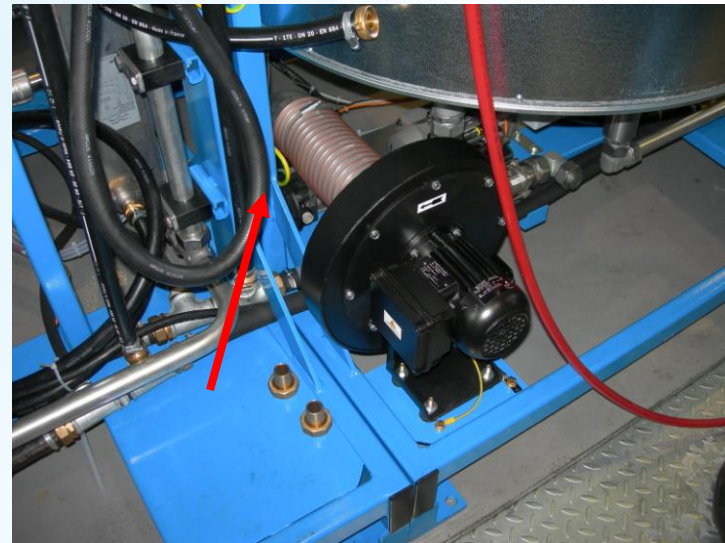
- refilling valve
- tank flanges
- fan (option)

# Pentane features metering machines

- Tank station
  - exhaust system with channel



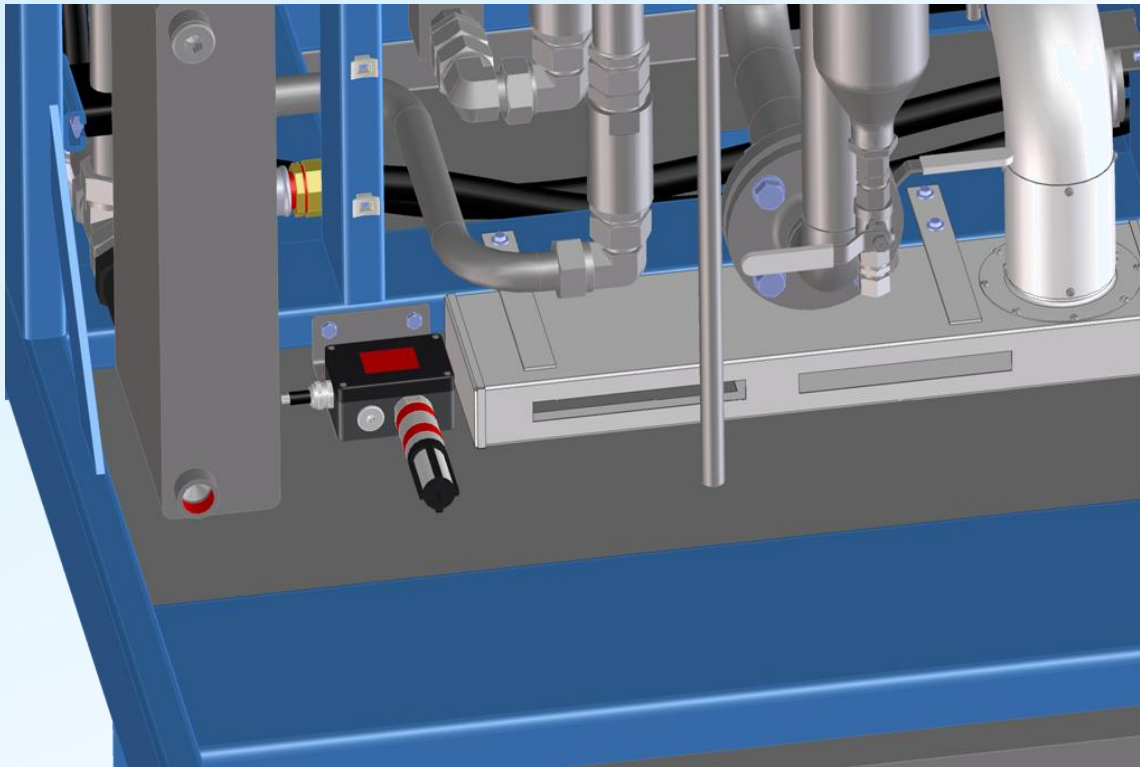
integrated exhaust channel



integrated fan (option)

# Pentane features metering machines

- Tank station
  - Pentane sensor installation (part of PPT control)

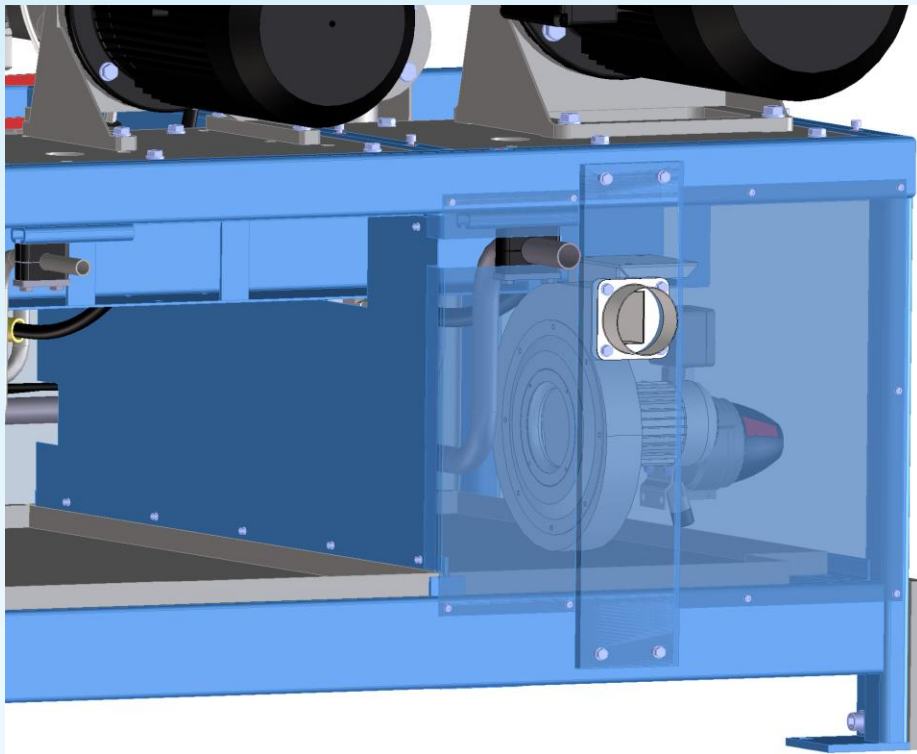


# Pentane features metering machines

- **Modifications of metering machine for processing Pentane**
  - control box for mixhead in special execution (intrinsically safe)
  - main switch with undervoltage release switch
  - interface to PPT control
  - local encapsulation below Polyol pump area (for directed exhaustion)
  - leakage control system for high/low pressure circulation switch-over valve
  - self closing valve in special design for pump venting

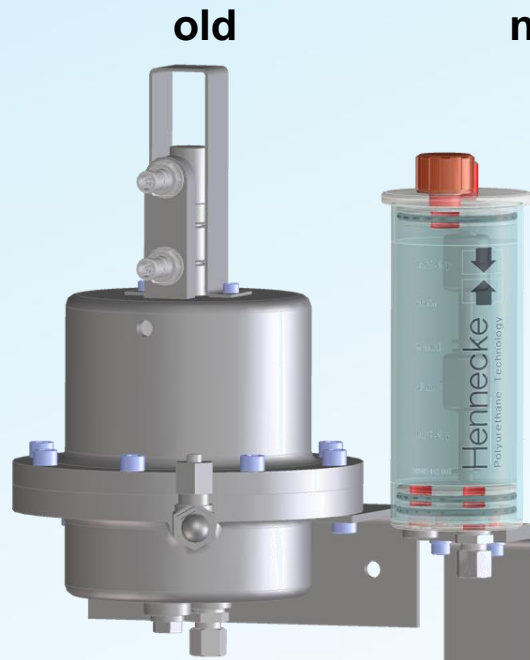
# Pentane features metering machines

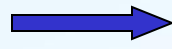
- **Metering machine**
  - Integrated fan in machine bottom (Option)



# Pentane features metering machines

- Metering machine
  - New leakage control system

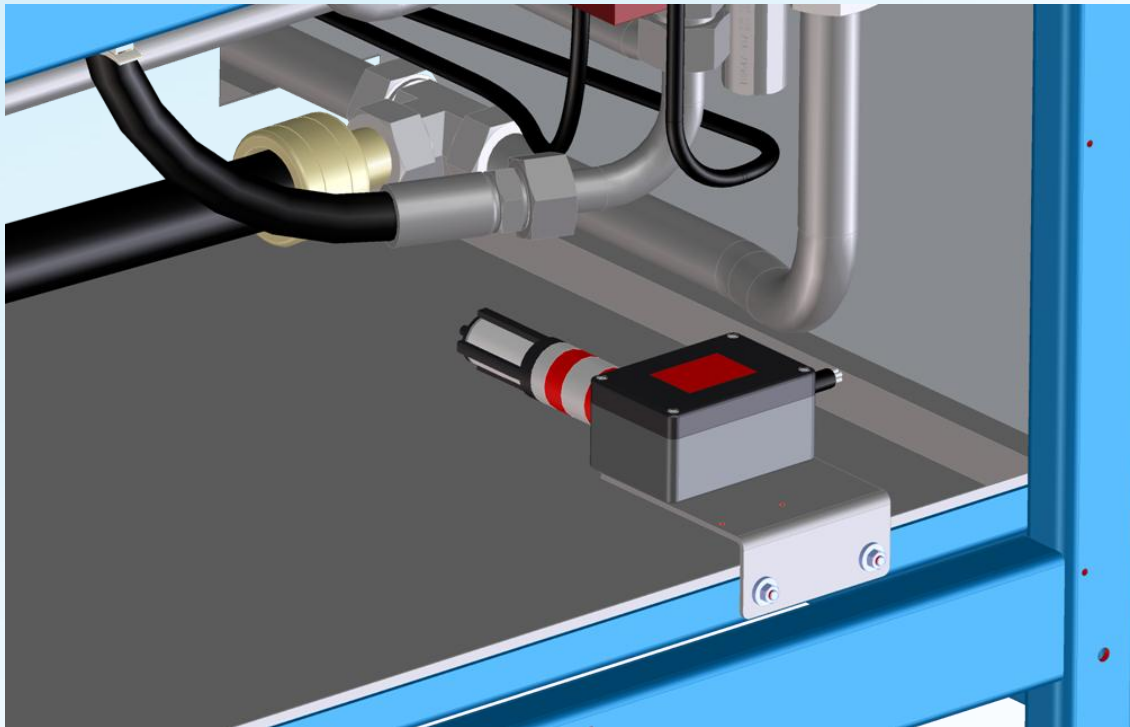


 Easy refilling, optical filling control



# Pentane features metering machines

- Metering machine
  - Pentane sensor installation (part of PPT control)

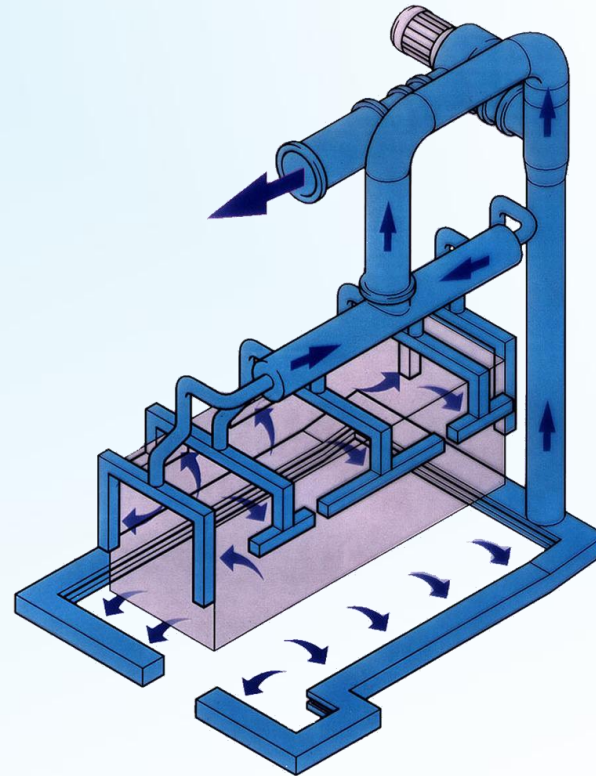


# Pentane features dry part

- **For processing Pentane the following components need to be added**
  - Exhaustion system
  - Inertization
- **Additional changes are related to**
  - fixtures
  - core heating
  - electronic control system
  - electrical installation

# Pentane features dry part

- **Exhaustion system cabinet line**
  - cabinet line fixtures will be equipped with directed exhaustion system



Exhaustion concept for fixtures

# Pentan features dry part

- **Exhaustion system cabinet line**
  - in Hennecke standard configuration the exhaustion system is effective on all 4 fixture side walls and additionally an exhaustion channel is mounted on the floor



# Pentane features dry part

- Exhaustion system door line





# Pentane features dry part

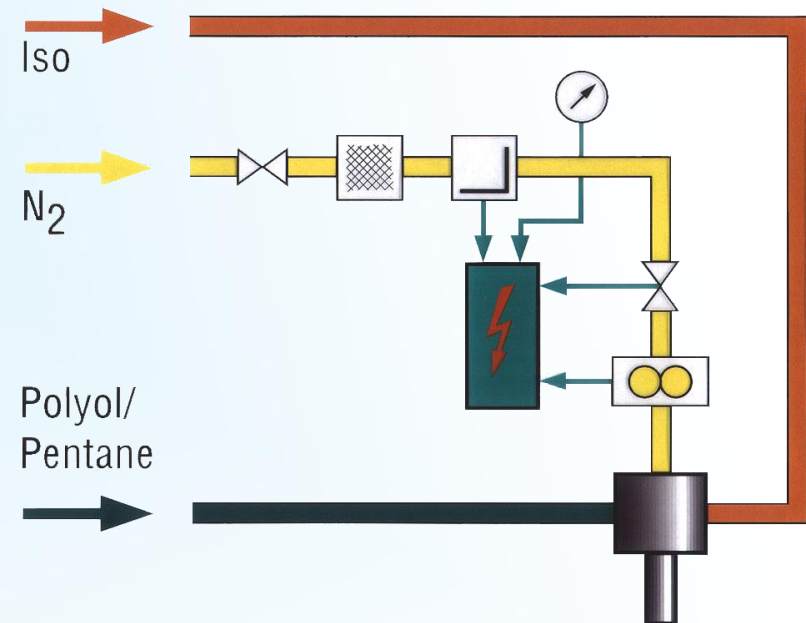
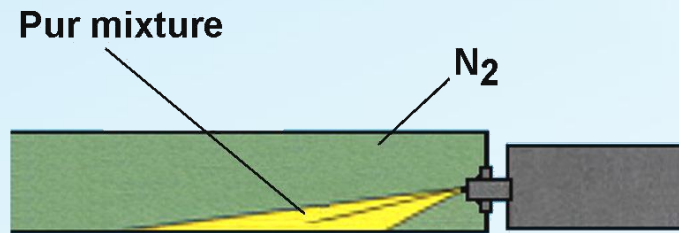
## ▪ Inertization

- means filling the cabinets with inert nitrogen to prevent explosive atmosphere inside the cabinet
- due to electrostatic charge of PS/PBS inliner sparks could easily appear
- can be done via mixhead or by additional device
- supervision by control system



# Pentane features dry part

## ▪ Inertization



# Pentane features dry parts

- **Modification on fixtures**

- feeding conveyor belts made of special material
- grounding cables to prevent sparks due to electrostatic charge
- electrical installation needs to be checked and eventually be modified
- integration of exhaustion system
- core heating only by water or electrical system

# Pentane features dry parts

- **Modification on electronic control system**
  - Interface to PPT control system
  - in case of electrical heating in fixture during foaming and rising time the heating platens are switched off automatically
  - in case of electrical heating for cores during foaming and rising time the core heating will be switched off automatically
  - grounding needs to be installed on many areas

# PPT

## Hennecke Pentane Safety system

### Primary safety-measures

→ All measurements to avoid explosive atmosphere

→ Goal: Prevention or reduction of Ex-zones

- Intelligent solutions for processes
- Durable technical tight solutions
- Leakage monitoring for dynamic sealings
- Inerting of tank volumes
- Inerting of closed cavities / mould volumes
- ventilation of open foaming processes and mould ventings



# PPT

## Hennecke Pentane Safety system

### Secondary safety measures

- ➡ All measurements to prevent ignition sources
- ➡ redundant measurements

- Explosion approved equipment in remaining Ex-zones
- Definition of alarm zones and fire prevention zones
- Encapsulation / separation of wet part (machinery area)
- Monitored ventilation of wet part (machinery area)
- Gas- and / or leakage monitoring



# PPT

## Hennecke Pentane Safety system

### Additional safety measurements

- ➡ Attending measurement to ensure a safe use
- ➡ Measurements to ensure sustainability

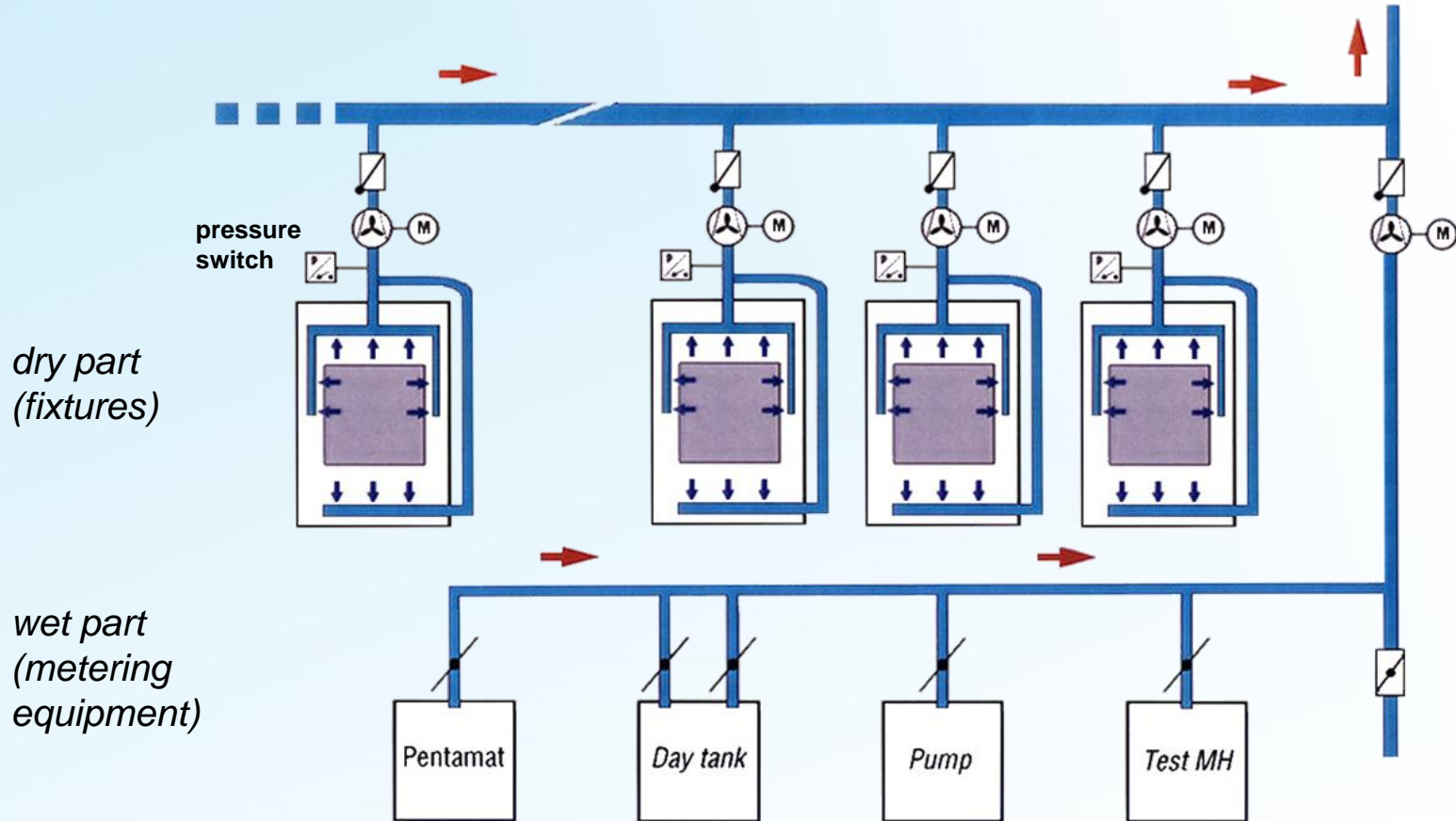
- Manuals
- Safety checklists
- Recommendations for personal protective equipment
- Instructions for maintenance
- Advices to users responsibilities
- General items like tidiness and proper technical condition of equipment





# PPT Hennecke Pentane Safety system

## ▪ Exhaustion concept for cabinet plant



# PPT Hennecke Pentane Safety system

➔ **Challenge: Ensuring sustainability of a high safety and technical standard !**



„online water heater“

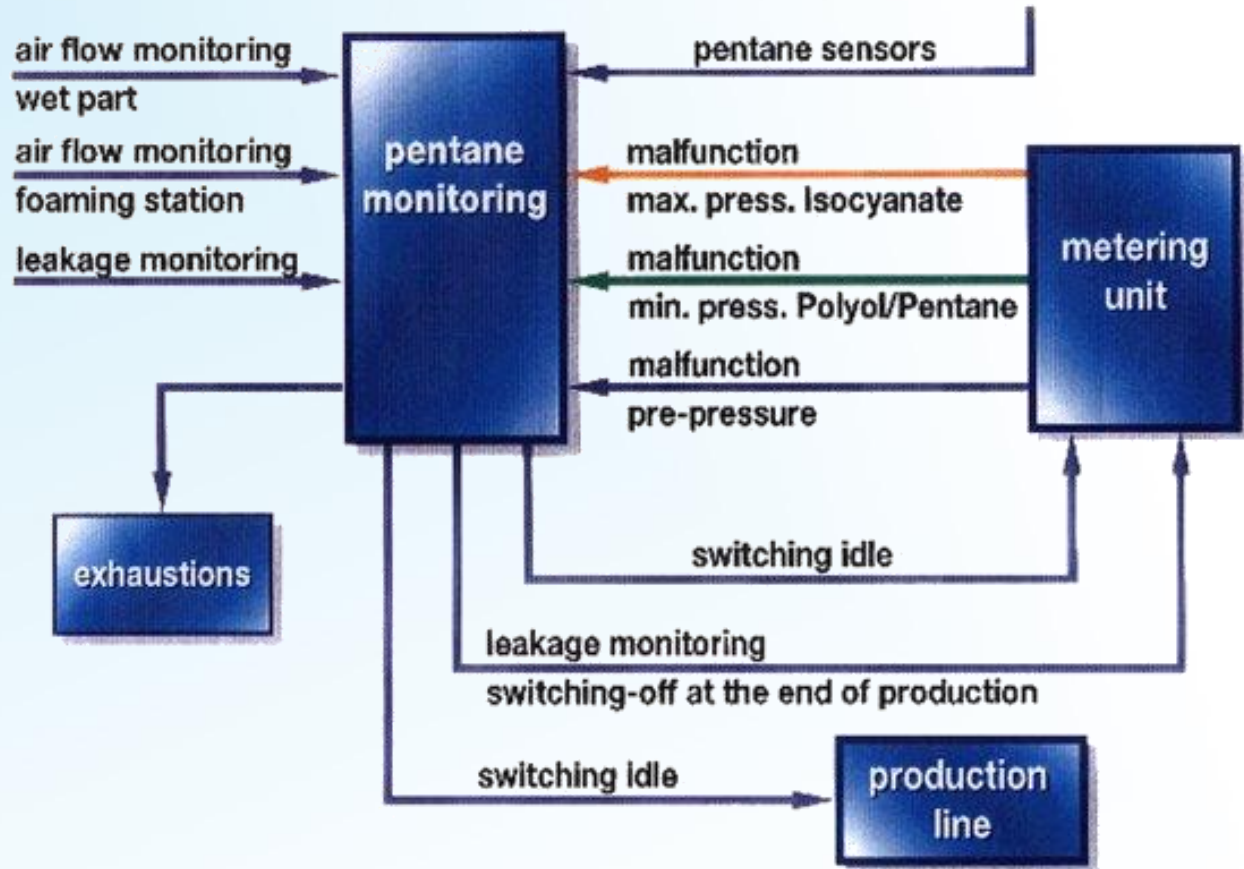


„universal plug system“



# PPT Hennecke Pentane Safety system

## Pentane conversions



## PPT Control

- **Some facts about 245fa**
  - leads to frothing effect (influence on filling)
  - temperature control of mixed Polyol is very important
  - pressure level at mixing and in day tanks must be 4 bar at the minimum
  - much more expensive than cyclopentane
  - higher content of 245fa necessary in Polyol compared to Pentane
  - slightly better lambda value than all Pentane types
  - no safety control necessary

- **Necessary modifications for the processing of 245fa**
- **storage and premix:**
  - pressure and temperature control is very important
  - bigger chillers normally recommended
  - special attention to seals
  - Pentamat suitable for 245fa
  - storage tanks for 245fa must be pressurized, if not pre-blended

- **Necessary modifications for the processing of 245fa**
- **metering machine:**
  - pressure and temperature control is very important, for existing equipment the situation must be checked
  - bigger chillers normally recommended, must be checked
  - special attention to seals, for existing equipment the situation must be checked

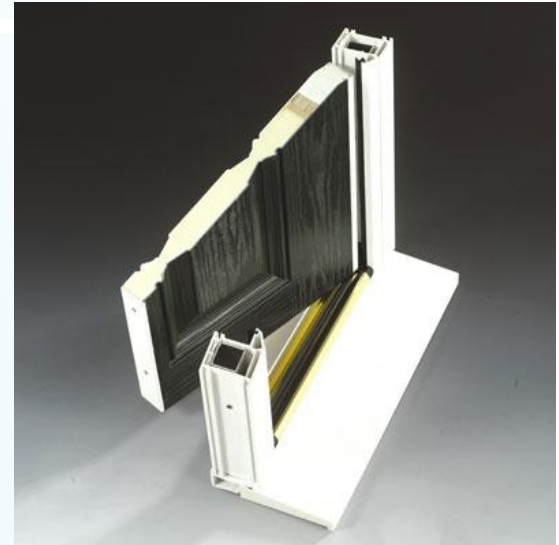
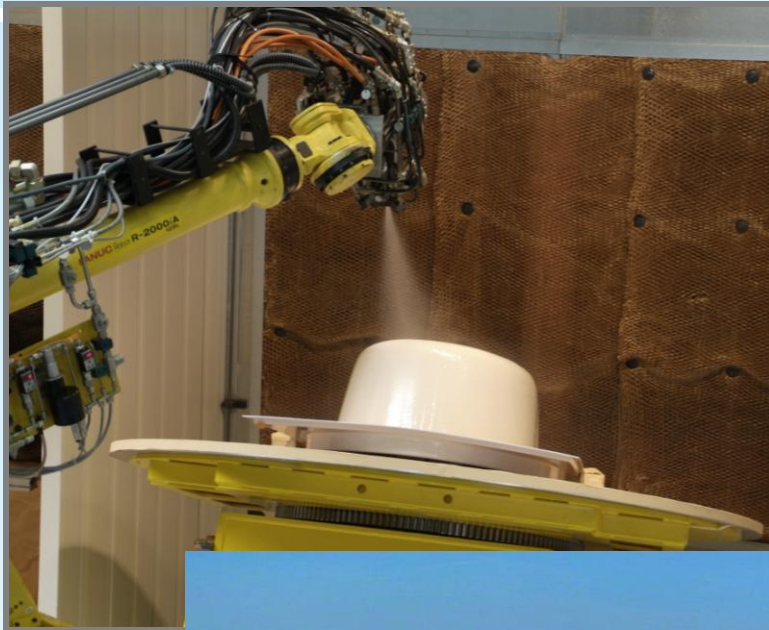


# 245fa processing

- **Necessary modifications for the processing of 245fa**
- **dry part cabinet:**
  - normally no changes required

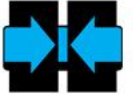
- **Necessary modifications for the processing of 245fa**
- **dry part door:**
  - 245fa requires closed mould foaming
  - existing equipment needs to be modified, but when considering necessary effort, a modification of an existing door line is not economical if the complete system needs to be changed from open mould to closed mould pouring
  - if existing equipment is already prepared for closed mould pouring, normally no changes are necessary

# What can we develop together with you?





**Thank you for your  
attention!**



**Please,  
feel free to ask your question!**