

FFT *testing*
**Multi-Functional
Climatic Chamber
(MFCC)**

one step ahead in **INTELLIGENT** production systems



1

Introduction

2

Climatic Chamber Enclosure

3

Air Supply System

4

Control & Monitoring System

5

Reference Project

6

Contact

FFT testing MFCC

Introduction

Description

The **FFT** *testing* **MFCC** – **Multi-Functional Climatic Chamber** consists of:

- Climatic Chamber Enclosure
- Air Supply System

Purpose

The air flow, temperature and humidity are controllable to generate different environmental conditions.

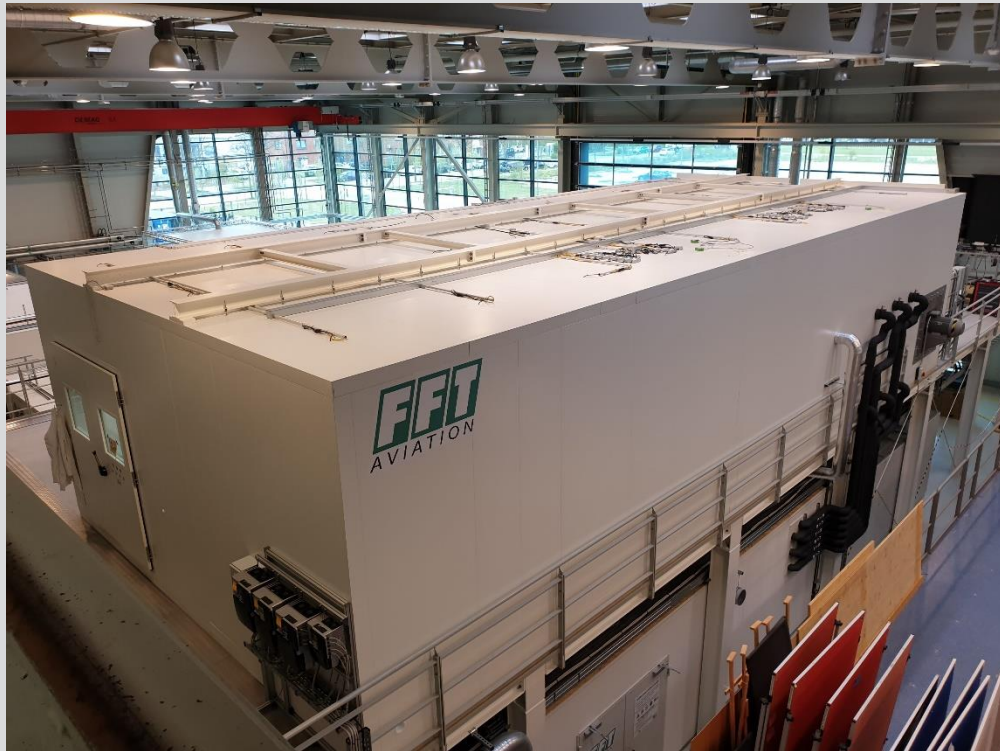
Area of Application

The **FFT** *testing* **MFCC** is highly customizable (e.g. enclosure dimensions and air supply system performance) which allows a wide range of applications.

Introduction

Overview

Climatic Chamber Enclosure



Air Supply System



Water Preparation Unit



Air Treatment Channel



Steam Generators



Chiller Unit

Introduction

Highlights

- Highly Customizable
- Green Refrigeration
- Integrated Safety System
- Chamber flexible in size
- Full-Recirculation Air Supply
- Control & Monitoring System
- Quick and easy Assembly and Reconfiguration of Climatic Chamber Components

2

Climatic Chamber Enclosure

FFT
AVIATION

one step ahead in **INTELLIGENT** production systems

Climatic Chamber Enclosure

General Design

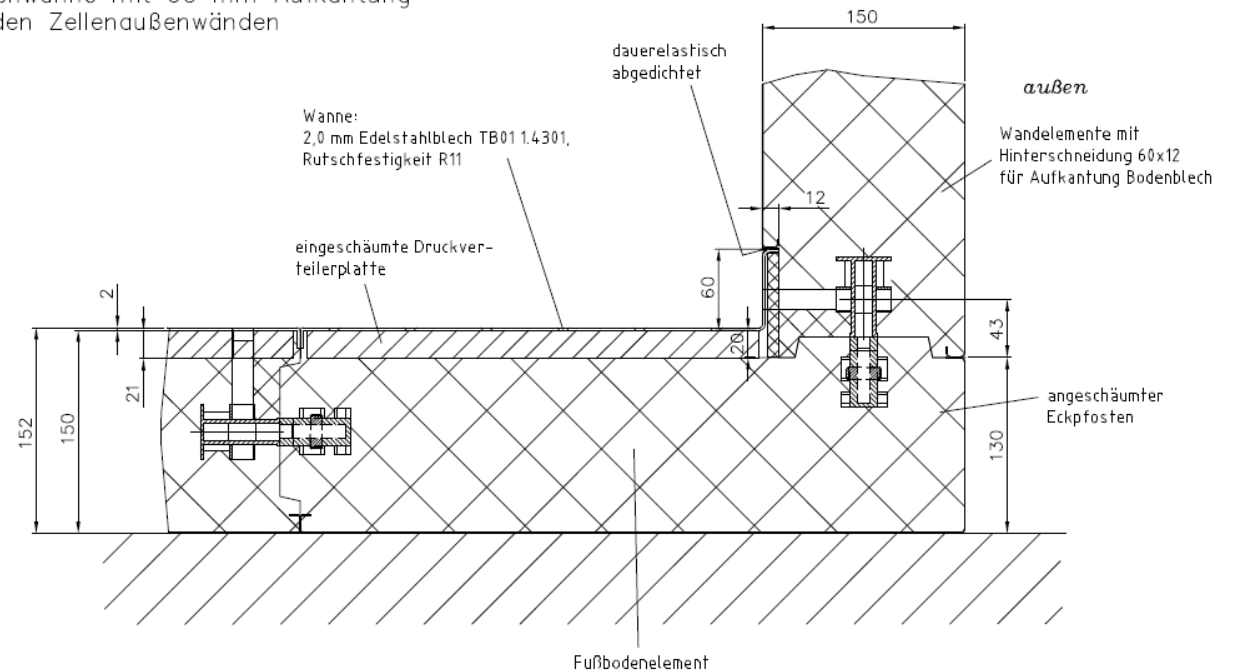
- Climatic chamber design **customizable**
- Use of **standard panels** for floor, wall and ceiling
 - Static of ceiling guaranteed using a HE-beam structure
- Quick and easy assembly and reconfiguration
 - Hook fastener to interconnect the wall, floor and ceiling panels
- Installation within a few days due to **modular system**
- Air treatment channel located inside the climatic chamber enclosure
- Installation of a **moveable intermediate** wall possible
- **Baseline Configuration:**
 - Overall outer dimensions: 14950 mm x 7050 mm x 3900 mm (L x W x H)
 - Climatic chamber enclosure separated into two rooms by intermediate wall
 - Room 1 (includes the air treatment channel): 8500 mm x 6750 mm x 3340 mm (inner dimensions)
 - Room 2: 6000 mm x 6750 mm x 3340 mm (inner dimensions)

Climatic Chamber Enclosure

Technical Data of the Panels

- **Standardized Sandwich Panels**
 - Standard width 1.200 mm
- **Insulation**
 - 150 mm Polyurethanes-Foam, CFC-free
 - Heat Transition: $U = 0,15 \text{ W/m}^2\text{K}$
- **Surfaces**
 - 0,75 mm galvanized steel sheet on both sides
 - Polyester lacquer coated, RAL 9010, pure white
- **Ceiling**
 - Static guaranteed using HE-Beam structure
 - Load distribution realized
- **Floor**
 - Stainless steel sheet, 1.4301; $t = 2 \text{ mm}$
 - Skid Resistance (R11)
 - Integrated pressure distribution plate
 - Surface Load: 50 kN/m^2 , Wheel Load: 4 kN/Wheel ($> 4 \text{ cm}^2$ contact surface)
 - Hygienic solution with special sealant
 - 60 mm trough upstand

Prinzipdarstellung
Bodenwanne mit 60 mm Aufkantung
zu den Zellenaußenwänden

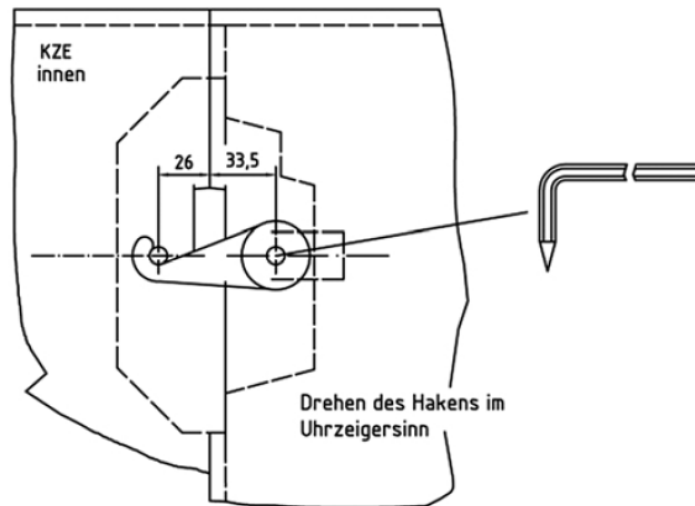


Climatic Chamber Enclosure

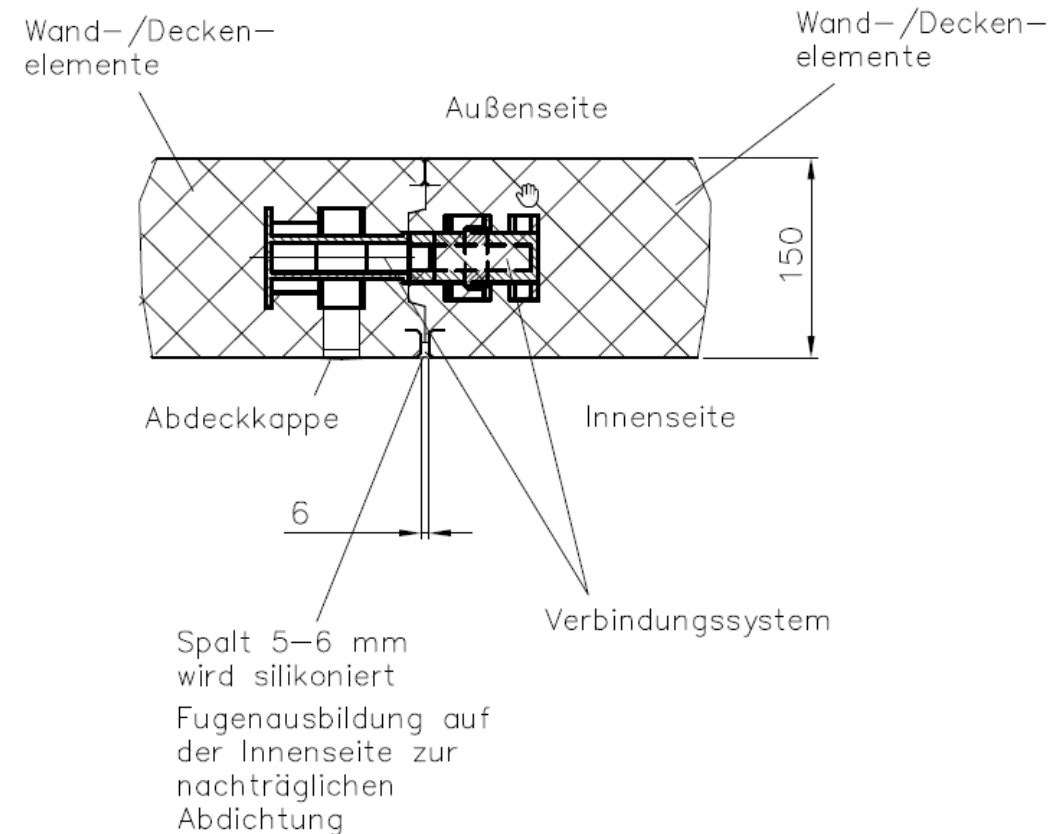
Technical Data of the Panels

Connection

- Tongue and Groove Joint
- Force-fit
- Eccentric hooks for interconnecting the panels
- Hygienic solution with special sealant
- No overlapping of components → Continuous surface
- Quick and easy assembly of panels



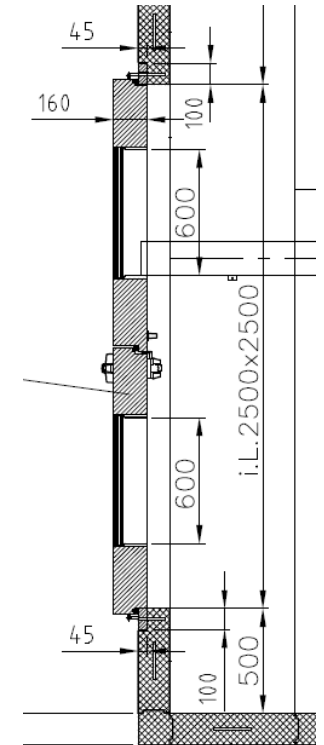
Prinzip Verbindung Elemente



Climatic Chamber Enclosure

Doors and Windows

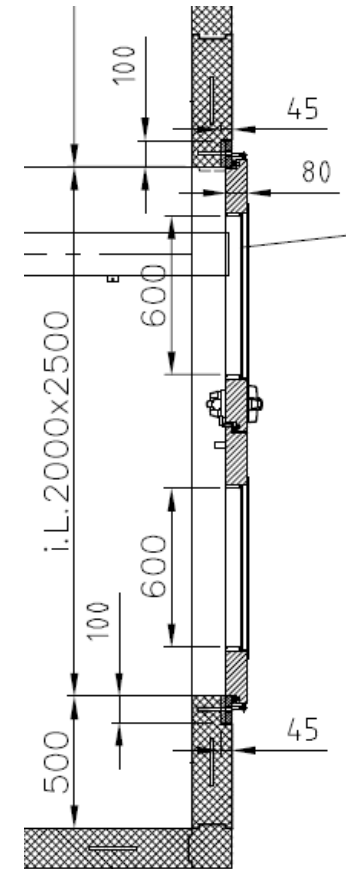
- **Double-Wing Door** (for temperatures -50°C to $+50^{\circ}\text{C}$)
 - Double wing door, divided in the middle, access panel on the right, inactive leaf with shoot bolt
 - 160 mm thickness
 - Inside width: 2.500 mm, clearance height: 2.500 mm
 - 3-point press lever lock
 - Lockable
 - Emergency release
 - Door frame heating (230 V)
 - Flat frame flush integrated in cell wall
 - Windows in both wing doors
 - Heated windows (48 V inside and outside panel heating)
 - Size: approx. 600 mm x 600 mm, 5-fold glazing



Climatic Chamber Enclosure

Doors and Windows

- **Double-Wing Door** (for temperatures 0°C to +50°C)
 - Double wing door, divided in the middle, access panel on the right, inactive leaf with shoot bolt
 - 80 mm thickness
 - Inside width: 2.000 mm, clearance height: 2.500 mm
 - Press lever lock
 - Lockable
 - Emergency release
 - Flat frame flush integrated in cell wall
 - Windows in both wing doors
 - Size: approx. 600 mm x 600 mm, double glazing

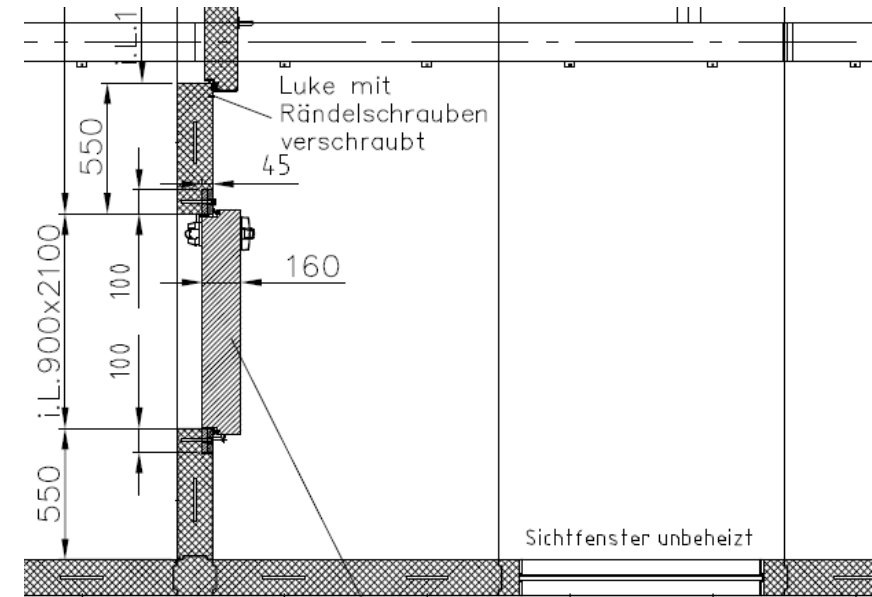


Climatic Chamber Enclosure

Doors and Windows

- **Connection Door** (between two rooms in intermediate wall)

- 1-leaf, DIN left
- 160 mm thickness
- Inside width: 900 mm, clearance height: 2.100 mm
- 3-point press lever lock
- Lockable
- Emergency release
- Door frame heating (230V)
- Flat frame flush integrated in cell wall



1 Stück Drehtür 900 x 2.100 mm i.L., 1-flg.,
DIN links, 3-Punkt-Presshebel-Verschluss,
abschließbar, Notentriegelung, Türrahmenheizung
(230V), Flachrahmen bündig in Zellenwand integriert

Climatic Chamber Enclosure

Doors and Windows

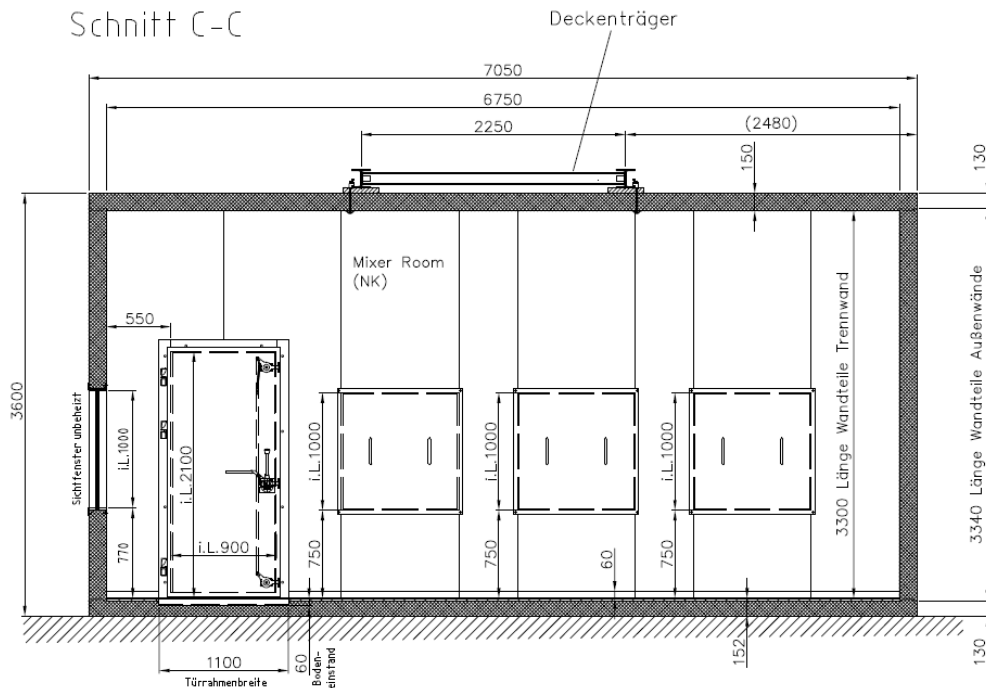
- **Windows (-50°C to +50°C)** in the chamber panels
 - Size 1.000 mm x 1.000 mm
 - Heated (48 V inside and outside panel heating)
 - 5-fold glazing
- **Windows (0°C to +50°C)** in the chamber panels
 - Size 1.000 mm x 1.000 mm
 - Double glazing



Climatic Chamber Enclosure

Intermediate Wall

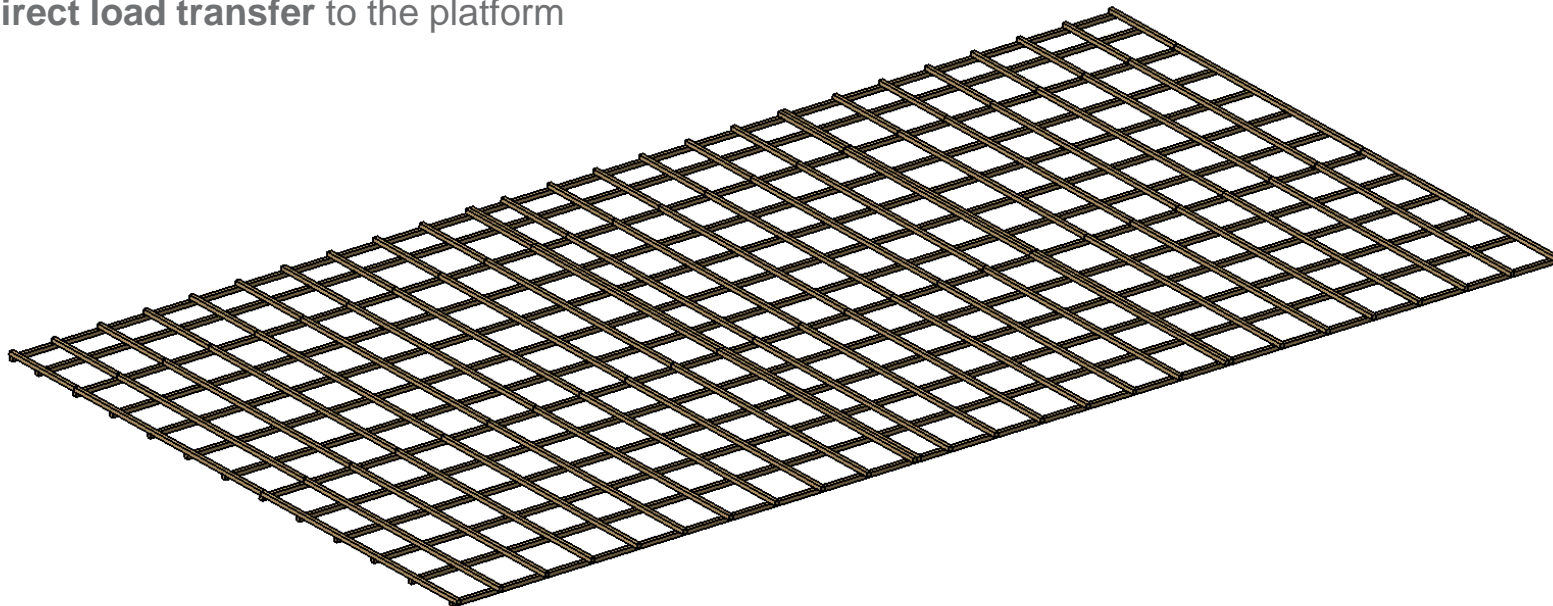
- **Moveable** intermediate wall
- Cut-outs with manually **removable panels** can be provided **optionally**
- Threaded pins provided at each panel to mount adapter plates to the intermediate wall
- **Additional breakthroughs** can be provided, e.g. for cable guidance



Climatic Chamber Enclosure

Wooden Basement

- The climatic chamber enclosure will be installed on a **wooden basement**
- Basement is made out of 40 mm x 60 mm KVH-Slats
- This ensures the necessary **ventilation** of the climatic chamber enclosure
- In case that the climatic chamber enclosure is located on a platform, the basement will be lined up with the basement structure
 - **Direct load transfer** to the platform



Climatic Chamber Enclosure

Floor Outlets

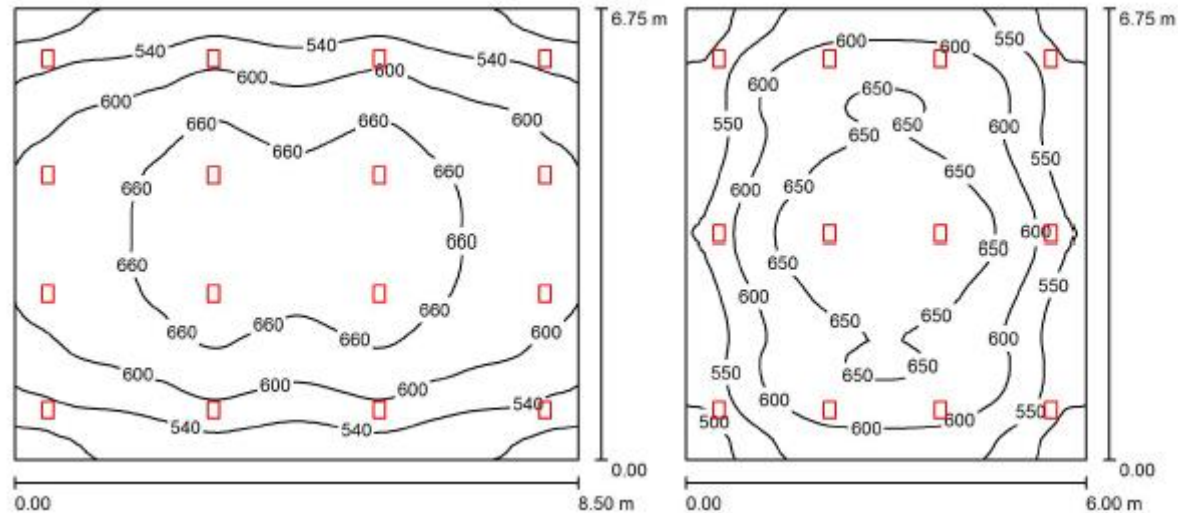
- **Stainless steel floor outlets** welded-in V2A box, approx. 250 mm x 250 mm x 50 mm, centered with stainless steel pipe DN 50
- Stainless steel **pipe heated** (230 V)
- Straight pipe section downwards approx. 100 mm
- **Removable grid**
- Manually removing of remaining water by swap or industrial vacuum cleaner



Climatic Chamber Enclosure

Illumination

- **LED projectors** mounted to the climatic chamber roof
- Amount and location of LED projectors will be determined according to customer illumination requirements



Illumination Analysis (Example)

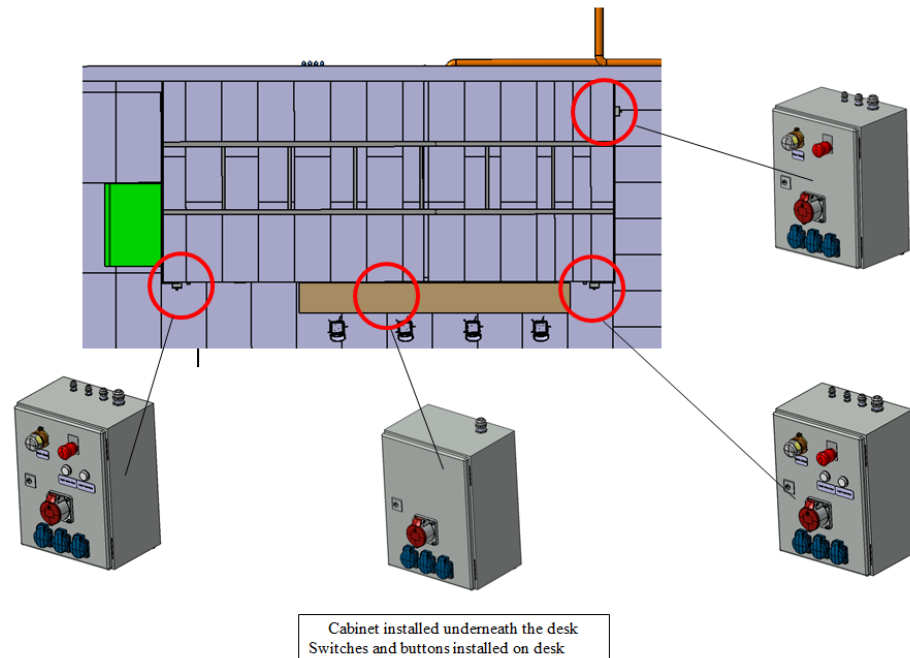


AlphaLUXX 25 W

Climatic Chamber Enclosure

Electrical Boxes

- **Electrical boxes** will be mounted **outside the climatic chamber enclosure**
→ Interface to electric
- Design will be adjusted according to the customer needs
- **Power sockets, shut-down button, light switches and emergency button** can be integrated in the electrical boxes



Climatic Chamber Enclosure

Further Components and Design Aspects

Pressurization Valves

- Pressurization valves will be provided to equalize the pressure differential between climatic chamber enclosure and environment
- Heating integrated

Breakthroughs

- Breakthroughs, e.g. diameter 100 mm, will be provided as, for example, cable guidances

E-Stop Buttons

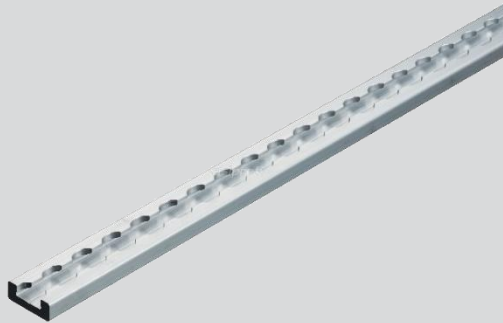
- E-Stop buttons will be mounted inside the climatic chamber enclosure

Climatic Chamber Enclosure

Upgrade Options

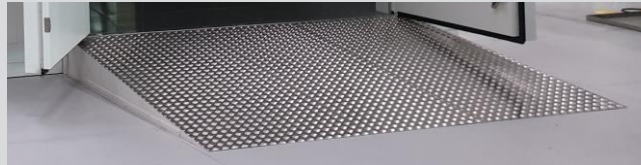
Attachment Rails

Attachment rail system to be mounted inside the climatic chamber enclosure.



Ramp

Ramp with integrated drain system for easy loading and unloading.



Intermediate Wall Cut-Outs

Cut-outs can be implemented in intermediate wall.



3

Air Supply System

one step ahead in **INTELLIGENT** production systems

Air Supply System

Overview

Air Supply System



Water Preparation Unit



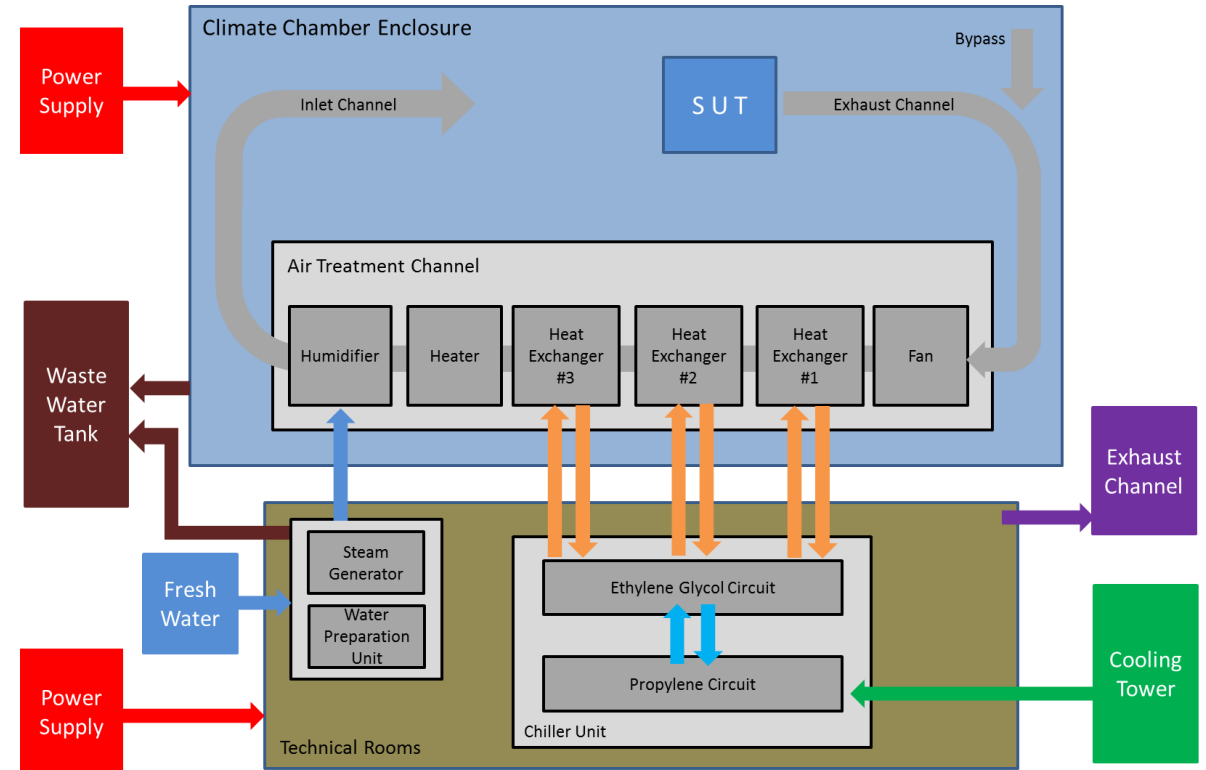
Air Treatment Channel



Steam Generators



Chiller Unit

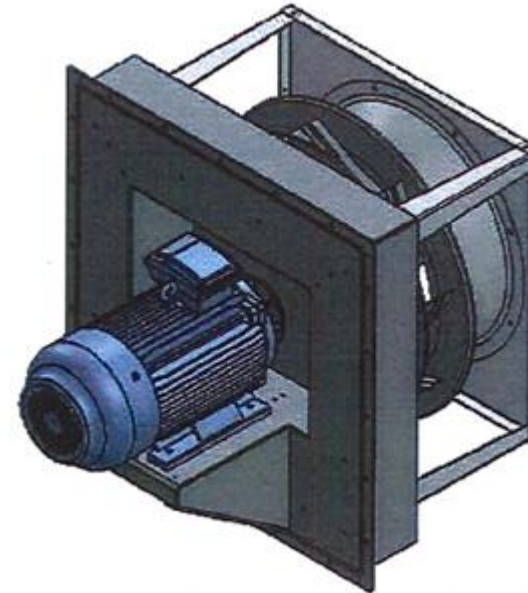


Air Supply System Overview
(Example for Test Bench Application)

Air Supply System

Air Treatment Components - Fan

- **Fan (impeller) integrated** into the **wall panel**
- Fan **motor is located outside** to avoid adding heat loads to the climatic chamber enclosure air and to avoid extreme environmental conditions for the motor
- Fan operation possible at temperatures of **-50°C to 150°C**
- Air Supply Flow: **8 kg/s**
- Fan controllable between **5 Hz and 50 Hz**
 - 50 Hz: 100% - (~8 kg/s)
 - 5 Hz: 10% - (~0,8 kg/s)
- Controller: **Frequency Controller**



Air Supply System

Air Treatment Components - Chiller & Heat Exchangers

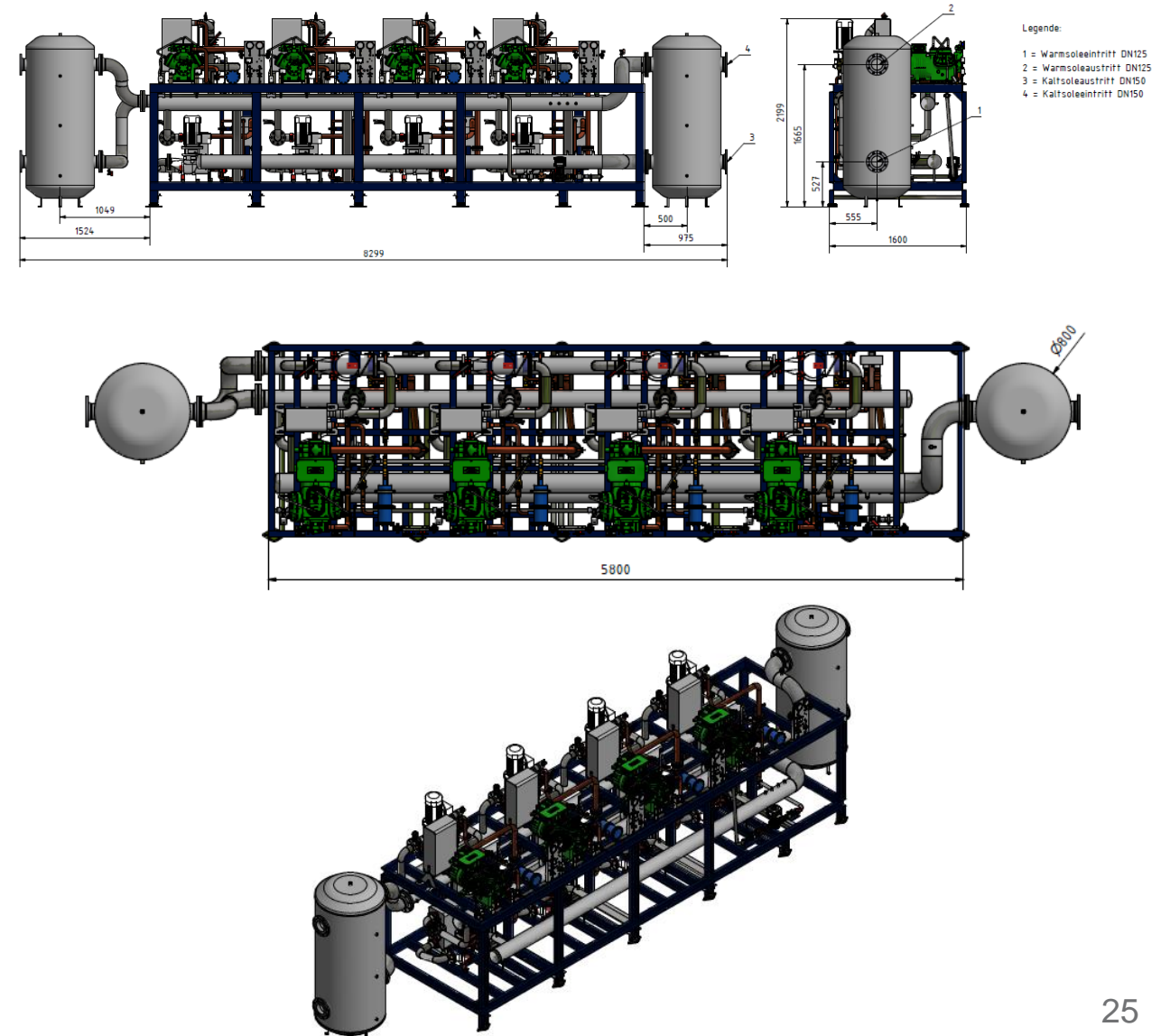
Cooling Performance

- Air Temperature: -23°C to +50°C
- Air Temperature Stability: +/- 1 K
- Heat Load Dissipation: 150 kW @ -23°C, 250 kW @ +50°C

Air Supply System

Air Treatment Components - Chiller & Heat Exchangers

- Chiller unit located in separate technical room
- Cooling media used: **Ethylene Glycol** and **Propylene** (R-1270, **GWP: 3**)
- **Green Refrigeration** by using natural refrigerants
- **Cooling cascade**
 - Facility cooling water is used to cool down compressed propylene and while expanding, propylene cools down Ethylene Glycol which is then pumped into the heat exchangers
- **Gas sensor and extraction system** integrated in technical room



Air Supply System

Air Treatment Components - Chiller & Heat Exchangers

- **Three Heat Exchanger Units** installed in RLT
- Each unit consists of:
 - Heat Exchanger
 - Removable drift eliminator
 - Heated drip tray
- **Slide-in rails** for Heat Exchanger Units provided
- Each Heat Exchanger circuit can be **controlled independently** by using **3-way mixing valves**

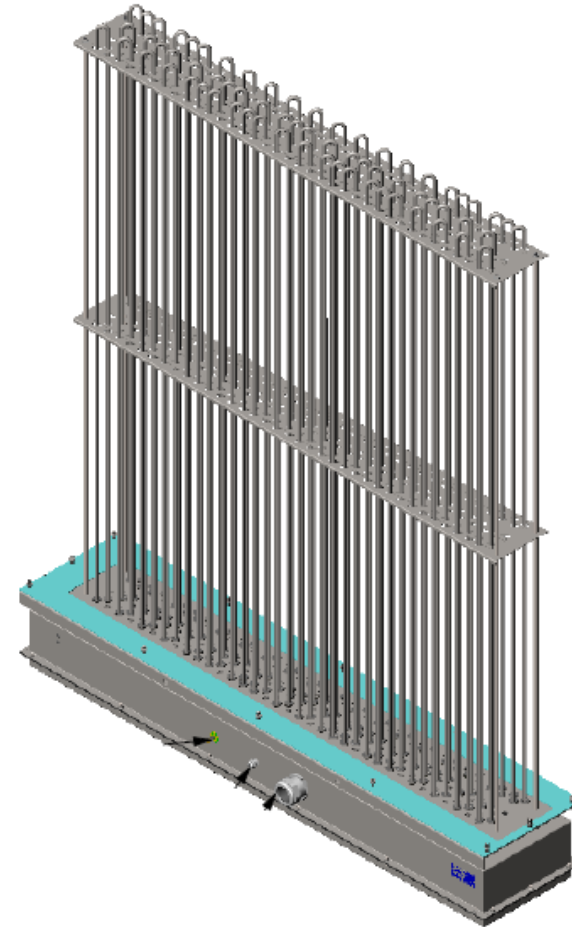


Heat Exchanger Unit installed in RLT
with Drift Eliminator removed

Air Supply System

Air Treatment Components - Heater

- Electrical heater installed in RLT
- Heating Capacity: **110 kW**
- Controller: Power Controller (**Thyristor**)
- **Heating Power continuously adjustable** between 0 – 100%
- Heater **output limited** to avoid overheating at low fan speeds
- An additional **safety thermostat** in the middle of the heater rods acts as a second level of overheat protection



Heater - 3D Model (left)
Heater installed in RLT (right)

Air Supply System

Air Treatment Components - Humidifier

- **Steam Humidifier** installed in RLT
- **Water preparation unit** and three **steam generators** located in separate technical room
- Generated steam is guided via pipes to the humidifier in the climatic chamber enclosure
- Humidification (continuously adjustable): **90% rH**
- Limited to 35 g/kg from 10°C to 50°C
- Humidification Stability: **+/- 0,5 g/s**



Water Preparation Unit (left) and Steam Generators (right)



Steam Humidifier

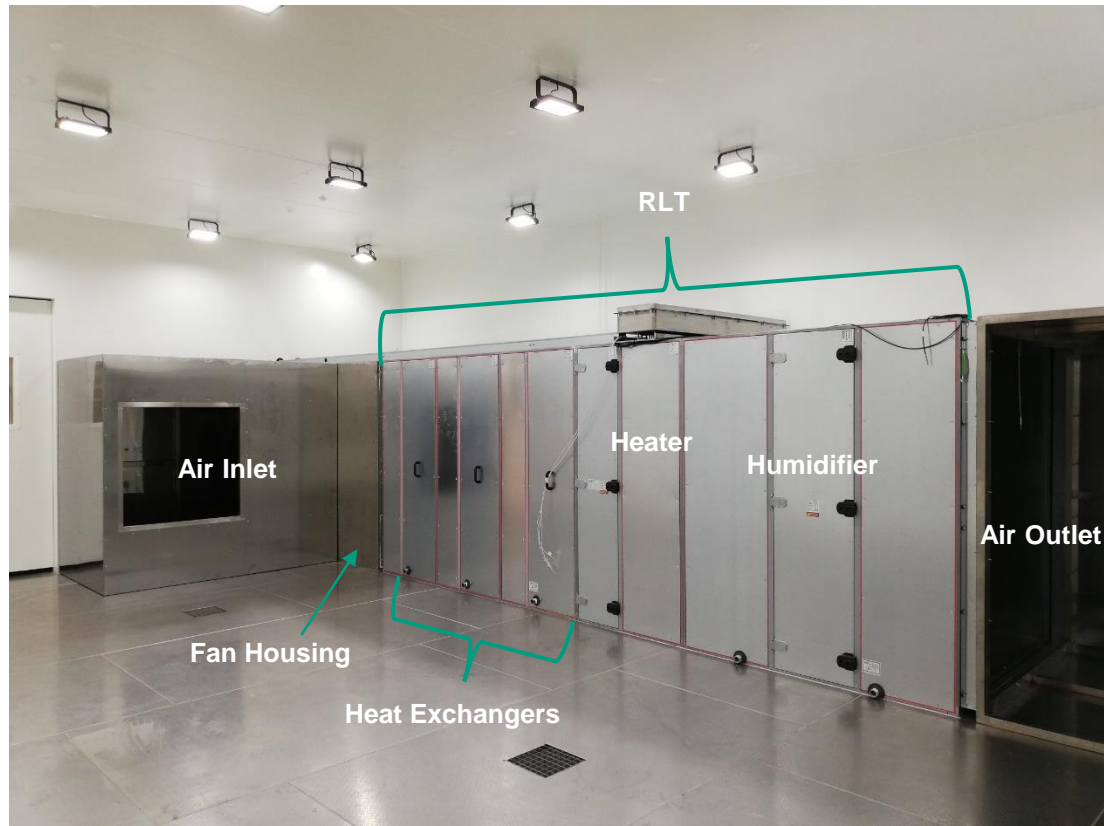
Air Supply System

Air Treatment Components - Air Treatment Channel

- The **Air Treatment Channel** consists of:
 - Air Inlet
 - Fan Housing
 - RLT
 - Air Outlet
- The **air inlet** is capable of **withstanding temperatures** of up to **150°C**, in case that an additional heat load of 250 kW at +50°C is implemented in the climatic chamber enclosure
- **Safety Grids** will be provided at the fan inlet and air outlet
- Consumers such as air conditioning units, SUTs, etc. can be directly connected to the air inlet via an **interface plate**
- A **closable bypass-valve** (manually operated) integrated into the air inlet will be provided

Air Supply System

Air Treatment Components - Air Treatment Channel



Approx. Dimensions (L x W x H)

Air Inlet

- 2000 mm x 1250 mm x 1900 mm

Fan Housing, RLT & Air Outlet

- 8500 mm x 1900 mm x 1900 mm

Air Supply System

Upgrade Options

-50°C Upgrade Option

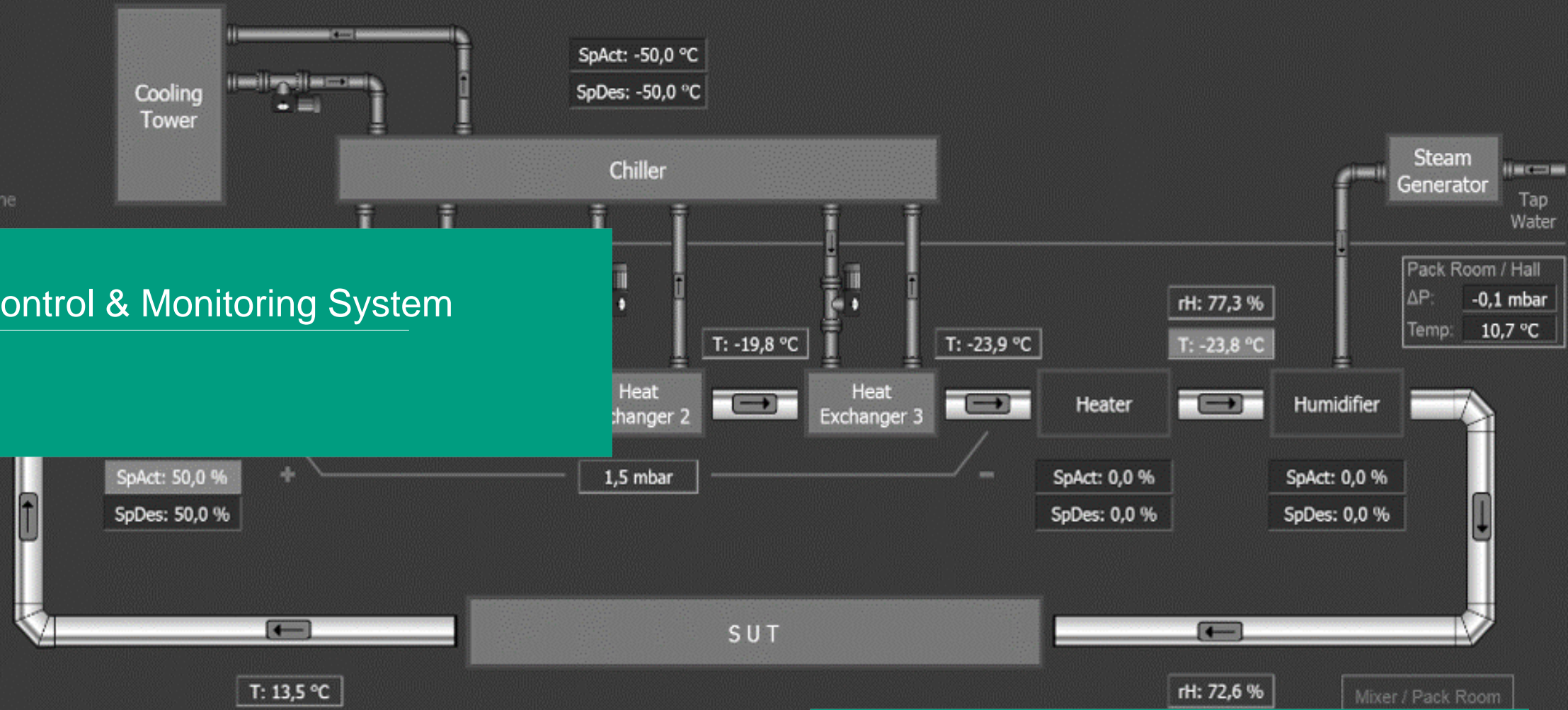
- -50°C to +50°C (100 kW @ -50°C)
- Four Ethan (R-170) direct evaporation circuits will be added
- One additional evaporator will be installed in the climatic chamber enclosure
- The Ethan circuits will be cooled and liquefied by the Ethylene Glycol ensuring an efficient and safe operation
- All three existing heat exchangers can be kept

→ This cascade connection ensures a stable cooling circuit operation and a high level of operational reliability even with strong system fluctuations.



Overview

4 Control & Monitoring System



one step ahead in INTELLIGENT production systems



Control & Monitoring System

Hardware & Software

Hardware

- Beckhoff Control Computer
- Beckhoff Terminal Cards
- Modular System according to customer demands

Software

- Windows OS
- TwinCAT 3

Control & Monitoring System

Working Mode and Shut Down Philosophies

Working Mode – Standard Mode

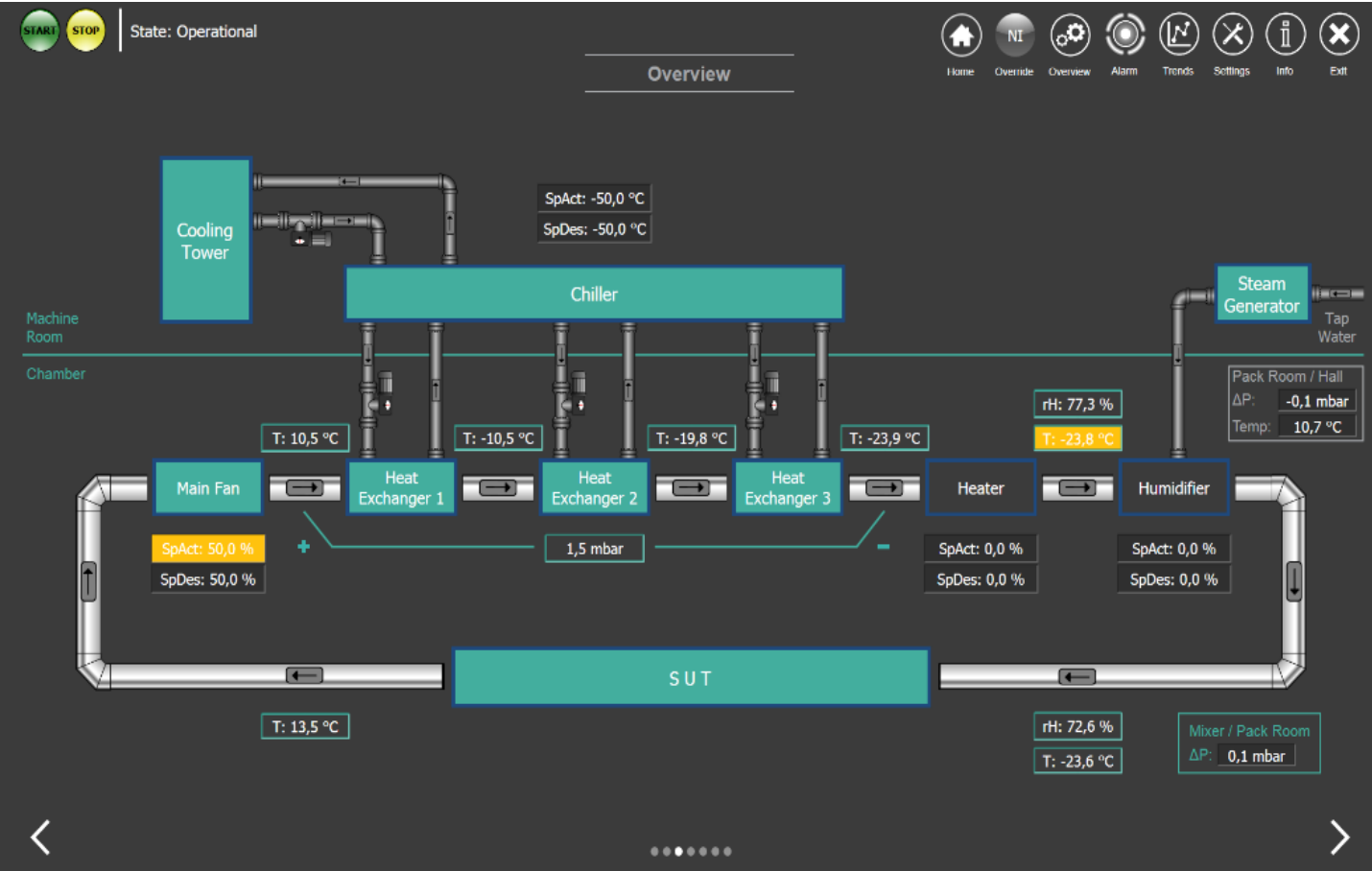
- Control & Monitoring System actively limits inputs causing exceedances (limits can be changed manually)
- Prevents unsafe situations – prevents premature shut-down

Shut Down Philosophies

- Warning Message
 - Safety conditions - first limit reached
- Alarm Message
 - Safety conditions – second limit reached
 - Control reaction from Control & Monitoring System
 - Soft shut down button
- Soft Shut Down
 - Soft shut down button
- Emergency Shut Down
 - Emergency shut down button
 - Watch dog triggered
 - Gas sensor

Control & Monitoring System

HMI



HMI – Overview Page



HMI – Different Graphs

Control & Monitoring System

Upgrade Options

Operator Desk

Construction, Manufacturing and Commissioning of Operator Desk:

- 4 x Integrated and retractable distributors for 230V mains voltage, network (RJ45) and USB
- Integrated PC holder in the substructure carcass
- Integrated drawers in substructure carcass
- Holding rig for 6 monitors 24"

Optional:

- 6 monitors 24"
- 4 office chairs
- Bin
- Wardrobe



5

Reference Project

one step ahead in **INTELLIGENT** production systems

Reference Project

AVANT – Test Bench

AVANT – Test Bench

Customer: Airbus Operations & ZAL (Center of Applied Aeronautical Research)

Location: Hamburg (Germany)

SuT: Current and Future Aircraft Cooling Systems

Project Closure: 2020



Core Topics

Qualification /
Certification

Climate
Chamber

Air Treatment

Green
Refrigeration

SERVICE OPTIONS

We support your project from the idea to the realization and gladly beyond.



We take into account quality and deadline requirements and we assume the responsibility for the project until turnkey handover.



Consulting

Use our experience for your tasks



Project Management

Support from the idea to the start of production



Risk Analysis

Identification of risks in the process



Custom design

Creation of individual solutions



Manufacturing

Successful manufacturing with modern technologies



Documentation

Clear and logical



Conformity

Compliance with standards and regulations



After Sales

Competent service through FFT



CONTACT

Your personal contact person

Steffen Krüger
Project Manager – Systems & Test Operations

FFT Produktionssysteme GmbH & Co. KG
Airbus-Allee 2, DE-28199 Bremen
Phone: +49 (0) 421 / 377 088 19
Mobile: +49 (0) 171 / 601 666 2
E-Mail: steffen.krueger@fft.de
www.fft.de



THANK YOU

Feel free to contact us.

WWW.FFT.DE | INFO@FFT.DE
TEL.: +49 (0) 661 2926-0

