

Operating Manual



Fully Automatic Climate Test Cabinet
Type MultiCORR® 400-FL

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Corrosion Test Equipment**

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| Content | Page |
|--|-------------|
| 1. Generalities | 4 |
| 1.1 Purpose of the document | 4 |
| 1.2 General indications | 4 |
| 1.3 Operators | 4 |
| 1.4 User's assessment | 4 |
| 2. Basic safety instructions | |
| 2.1 Safety symbols | 5 |
| 2.2 Obligations and liabilities | 5 |
| 2.3 Instrument safety | 5 |
| 2.4 Correct use | 6 |
| 2.5 Approved operators | 6 |
| 2.6 Organizational measurements | 6 |
| 2.7 Informal safety measurements | 6 |
| 2.8 Protective equipment | 6 |
| 2.9 Conduct in the event of emergency | 6 |
| 3. Transport | |
| 3.1 Transportation | 8 |
| 4. Installation | |
| 4.1 Preparation of the location for the cabinet | 10 |
| 4.2 Positioning of the test chamber | 11 |
| 4.3 Connections | 12 |
| 4.3.1 Water Supply | 13 |
| 4.3.2 Drain Water Connection | 14 |
| 4.3.3 Compressed Air Supply | 14 |
| 4.3.4 Exhaust Hose | 14 |
| 4.3.5 Power Supply (Electricity Safety Considerations) | 15 |
| 4.3.6 Connecting the Tank with Soution | 15 |
| 4.4 Checklist Before Starting the Operation | 16 |
| 5 Technical Description | |
| 5.1 MultiCORR Climate Change Test (CCT) Device | 18 |
| 5.2 Main Systems of the CCT | 19 |
| 5.3 Front View | 20 |
| 5.4 Test Chamber | 21 |
| 5.5 Test Chamber with Climate Module | 22 |
| 5.6 Control Panel | 23 |
| 5.7 Dimensions | 24 |
| 5.8 Technical Specification | 25 |
| 6. Operational Procedures | |
| 6.1 General Principle of Operation | 28 |
| 6.2 Relevant Standards | 30 |
| 6.3 Operational Range of the Test Chamber | 30 |
| 6.3.1 What are the Main Advantages of MultiCORR Technology | 30 |
| 6.3.2 General Description of the Test Process | 30 |
| 6.4 SaliCORR Pure Sodium Chloride | 31 |
| 6.5 Water Condensation Test According to DIN EN ISO 6272-2 DIN/30014 | 32 |
| 6.6 Controlled Water Condensation (CWC) System | 33 |
| 7. MultiCORR Control System | |
| 7.1 Basic Functions | 36 |
| 7.2 Main Screen | 37 |
| 7.2.1 User Management - Log In | 38 |
| 7.2.2 Test Management | 39 |
| 7.2.3 Diagnostics | 40 |
| 7.2.4 How to Define New Tests Fro Segments | 41 |
| 7.2.5 Description of the Preprogrammed Test Segments | 43 |

| | |
|--|----|
| 7.3 Alarm Screen | 44 |
| 7.4 Manual Control | 45 |
| 7.5 Backup of Test Results | 46 |
| 8. Commissioning | |
| 8.1 Genral Infromation | 49 |
| 8.2 Test Preparations | 49 |
| 8.3 Staring Salt Spray Test | 50 |
| 8.4 Rainfall Rate | 51 |
| 8.5 Corrosivity of the Test Chaber | 51 |
| 8.6 Adjustment of the Water Level of the Condensation Test | 52 |
| 9. Service and Maintenance | |
| 9.1 Maintenance Intervals | 55 |
| 9.2 How to Replace Filter in the Humidifier | 56 |
| 10. Troubleshooting | |
| 10.1 Alarms | 59 |
| 10.2 Functional Problems | 60 |
| 10.3 Bleeding of the Diaphragm Pump | 62 |
| 10.4 Reseting Overtemperature Protection of the Humidifier | 63 |
| 10.5 Nozzle Adjustment | 64 |
| 11. Accessories and Consumables | |
| 11.1 Consumables | 67 |
| 11.2 Accessories for Functional Tests According to DIN EN ISO 9227 | 68 |
| 11.3 Accessories for Water Processing and Compressed Air | 69 |
| 11.4 Accessories for Preparation of Test Samples | 70 |

1. Generalities

1.1 Purpose of the document

This operation manual familiarizes the operator of the VLM Corrosion Test Cabinet with

- Working method,
- Operation
- Safety instructions
- Maintenance

The operation manual has always be ready to hand

1.2 General indications

These corrosion test cabinets have been developed to carry out Salt spray tests according to ISO 9227 as well as for condensed water tests pursuant to ISO 6270-2 part 1 CH and further comparable international standards. Please see further details in the corresponding standard specifications.

Please read this operation manual thoroughly before starting operation of the unit.

The operation manual instructs the operator to handle this test cabinet with safety and only for the purpose it is designed for. Knowledge of the relevant chapters is an imperative precondition for the safe and correct use.

Operators are duty bound to familiarise themselves with the safety instructions and operating conditions in order to avoid injury and damage.

Claims and liabilities will be rejected if they are due to incorrect operation and/or incorrect use.

Necessary maintenance works may only be carried out by personnel of VLM or their representatives. Otherwise all claims and liabilities will be rejected.

Our indications are based on the state of our current knowledge. Legal rules have to be observed on own responsibility. Shown devices and details can partly be presented with options.

Subject to technical alterations!

1.3 Operators

VLM corrosion testing instruments may only be operated by personnel instructed and authorized by the owner.

1.4 Users` s assessment

Dear reader,

Our operating instructions are updated regularly. You will find the latest version on our website www.vlmgmbh.de. You are welcome to provide us with your suggestions by e-mail info@vlmgmbh.de or fax +49 5205 87 963-0.

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2. Basic safety instructions

2.1 Safety symbols

The following designations and symbols are used for safety indications throughout this manual:



DANGER!

Immediate danger to life and health of persons. Ignoring these indications can result in severe health hazards.



WARNING!

Signification: possibly dangerous situation
Ignoring these signs may result in slight injuries or causes material damages.



IMPORTANT!

Important indications for the correct use of the unit and other useful information.
Ignoring these signs may result in material or surrounding damages.

2.2 Obligations and liabilities

Please observe the indications in this operating manual!



A precondition for the safe and trouble-free use of the VLM corrosion testing instrument is the knowledge of the basic safety instructions. This operating manual, especially the safety indications, have to be followed by all persons who work with this unit. Furthermore, the regulations and instructions of accident prevention decisive for the place of work are valid.

2.3 Instrument safety

The devices are equipped with electrical and mechanical protectors. They were subjected to a strict safety and acceptance test.

Incorrect use can

- threaten life and limb of the operator
- damage the instrument and the operator's property
- diminish the instrument's operating efficiency

All persons concerned with the installation, commissioning, operation, maintenance and repair of the instrument must

- Be correspondingly qualified
- Respect this manual exactly

Sort out any difficulties immediately that can affect the safety.

2. Basic safety instructions

2.4 Correct use

The unit is intended exclusively for the performance of salt spray tests (DIN EN ISO 9227) as well as condensed water test according to DIN EN ISO 6270-2 part 1 Constant Water Condensation. The instrument was specifically developed for this purposes and must not be operated in a manner in which it was not intended to be used.



Important!

The conditions mentioned in this manual concerning operation and maintenance must be strictly observed.

2.5 Approved operators

- Only approved persons are allowed to operate the instrument.
- The minimum age of operators is 18
- The operator is responsible for third parties within working area
- The areas of responsibility for the different activities in connection with the instrument must be clearly defined and observed. Ambiguous areas of competence are a safety risk

2.6 Organisational measurements

The owner must

- Make this manual accessible to the operator
- Check that the operator has read and understood this manual
- Provide the necessary personal protective equipment

2.7 Informal safety measurements

- The operating manual must be kept at the unit at all times
- The general as well as the local regulations for accident prevention and conservation must be accessible and followed
- All safety and danger instructions must be kept at the unit in a readable condition and renewed if necessary

2.8 Protective equipment

The unit has the following protective equipment:

- Lockable testing chamber door
- Main switch with thermal overcurrent protection

The protective equipment

- has been installed for the safety of the operator in the surrounding area.
- must , under no circumstances, be changed, removed or by-passed as a result of changes to the instrument



Important:

Attention is drawn to the possible existence of additional statutory requirements of national institutions responsible for the health and safety of the operators



2.9 Conduct in the event of emergency

In case of emergency turn the main switch immediately to the 0 setting and disconnect the mains plug.

3. Transport

3.1 Transport

Transport / Storage

VLM corrosion test cabinets and accessories are put into fumigated wooden crates thoroughly protected against damages.

Nevertheless check the outer packaging if there are damages such as scratches, cracks, holes which may indicate an impact on the goods. If so accept the consignment only under protest.

Be careful, when you take the cabinet and accessories out of the crate. If you use a forklifter you can take the cabinet from the front side as the forks are longer than the depths of the cabinet.

However, if you want to transport the cabinet through narrow doors you should take it from the left hand (heavier) side. In this case we strongly recommend to use wooden bars transversely to protect the bottom of the cabinet.

If the cabinet shall be stored for a while make sure that the room is dry. The temperature should not fall below 0°C.



Important!

Remove all packaging materials such as foam particles from all in- and outlets. Be aware of all components under the bottom of the cabinet when you transport the cabinet by a forklifting or hand pallet truck.

4. Installation

4.1 Preparation of the Location for the Cabinet

Room

- sufficient space around the test chamber, especially if other heat-generating equipment is installed in the vicinity
- ventilation with clean (dust-free) air, without oil or fumes with pollutants
- no direct influence of sunlight (radiation) or draft
- possible floor drain
- no major fluctuations in temperature, room temperature (18 °C - 28 °C)
- good accessibility to facilitate an easy transportation of the test chamber to the room

Compressed Air

- Compressed air supply: pressure 6-7 bar permanently
- Air quality: oil-and particle-free according to DIN EN ISO 9227
- Installation of an air filter unit is required (see Accessories)

Water

- Tap water or deionized water conductivity max. 20 MS/cm
- Air pressure: 4-6 bar
- Water tap with 3/4" male fitting in the vicinity of the test chamber connected to an ion exchanger with a pressure hose and couplings
- All pipes and fittings connecting the ion exchanger and the test chamber tubes must be made either of plastic or of stainless steel. No brass, zinc or copper material are allowed!
- Water Leak Detector (see Accessories)

Drainage Water

Siphon with the grommet diameter of 20 mm for the hose connection of 20 mm diameter

Air Exhaust

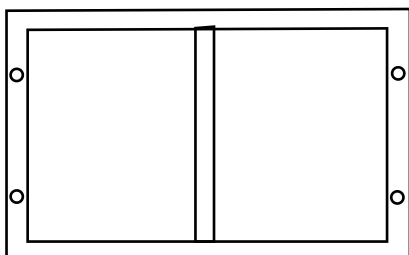
Warning: The air exhaust of the test chamber is corrosive and can cause damage

- Exhaust pipe free of counter pressure from outside or on the roof, the pipe-end is provided with an windshield to avoid adverse wind effects on the climate in the test chamber.
- Exhaust pipe (e.g. HT-pipe) up to 5m should have diameter of 50mm, for pipe lengths > 5m the diameter of pipe should be 75mm - 100mm
- When connected to a laboratory exhaust system for atmospheric pressure compensation make sure that the salt spray does not enter the testing room .

Electrical Power

| | | |
|---|--------------------|---|
| 1 | 230 V power socket | Test chamber (1900 W) |
| 1 | 230 V power socket | Conductivity meter for ion exchanger |
| 1 | 230 V power socket | Water leak detector at the tap |
| 1 | 230 V power socket | Pump for preparing the test solution |
| 1 | 230 V power socket | free, e.g. for auxiliary test equipment |

4.2 Positioning of the Test Chamber



If the test chamber and the underlying cabinet are shipped separately for easier transportation than the test chamber has to be connected to the cabinet and fixed with by four supplied screws. These are openings at the bottom of the right and left square tubes of the cabinet and screw on the bottom of the frame of the cabinet. Make sure that screw openings are aligned and well above the other.



Loosen the upper lock nut (M) of the feet of the cabinet.

First unscrew the middle foot as far as it at they no longer touch the ground.

Adjust the height of the feet such as that the floor of the test chamber is slightly sloped towards the water drain.

Screw the middle feet back so that they can support the cabinet again.

Check that the water drains completely and evenly from the bottom of the chamber floor.



Make sure that the test chamber is not twisted so the door of the test chamber can closes properly.

The door of the test chamber has been set and aligned in the factory. The door can be alsao opened without the door-open button on the control panel by using the emergency door open line as described below.

In case that the door does not close properly after alignment of the test chamber the door hinges can be adjusted. Loosen the outer screw carefully, while holding the door open with right hand at 90 degrees.

If necessary, move the loosened hinges with left hand slightly to the inside or outside.

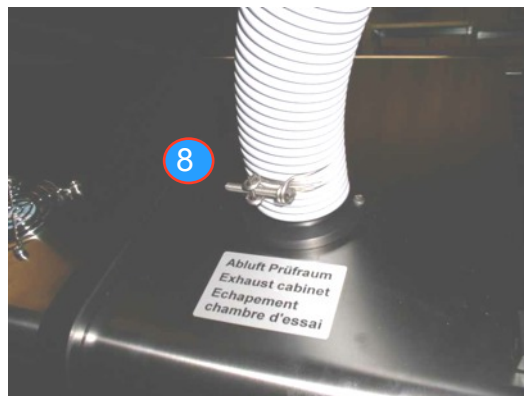
Tighten the screws and check that the door closes properly and that the door contact is triggered when opening. If necessary correct the door in the vertical direction and turn the screws firmly again after this procedure.



The proper functionality of the test device is guaranteed only after the test chamber is screwed to the underlying cabinet and carefully aligned.

4.3 Connections

Except for the exhaust pipe all the connections for water and sewage lines are located in the lower part of the rear wall of the test chamber.



Important!

The first few helical rings of the exhaust hose must be lubricated with silicone to prevent leakage of the back-flowing condensate.

| | | |
|---|---|------------|
| 1 | Socket for the PE hose coming from the tank with test solution | ID* 4 mm |
| 2 | Socket for the PE hose coming from the second tank (optional) | ID 4 mm |
| 3 | Compressed air connection nipple | Gr. 5 |
| 4 | Power supply cable with plug | 230 V |
| 5 | Socket for demineralized or tap water for flushing of test room | 3/4" AGew. |
| 6 | Socket for demineralized water with PE-Sinter filter | 3/4" AGew. |
| 7 | Wastewater socket for spiral hose | ID 19 mm |
| 8 | Duct for exhaust pipe | ID 50 mm |

* ID - Inner Diameter

To protect the water inlet (3/4") a white protective cap is provided. Please remove this cap before connecting the plastic hose for water supply.

There is a white PE sintered filter in the 3/4" water inlet. Its purpose is to protect the inner solenoid valve from mechanical impurities. The filter is subject to regular maintenance and should be replaced from time to time depending on water quality. Replacement filters are available from the original equipment manufacturer.

4.3.1 Water Supply

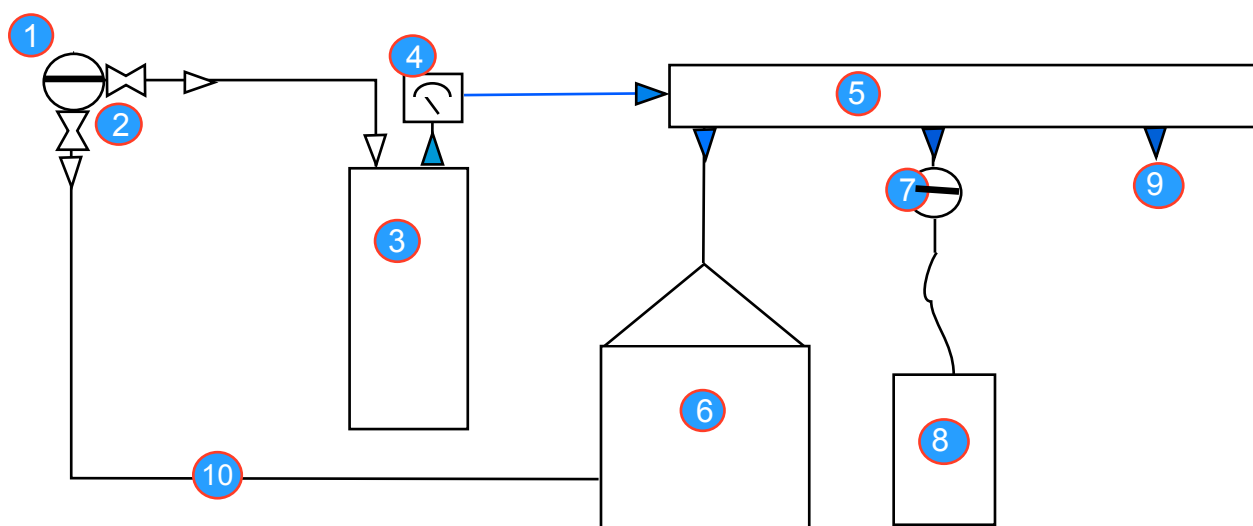


To overcome the atmospheric pressure in the humidifier a water supply pressure of 2-4 bar is required. If possible the tap water valve with 3/4" fitting should be installed in the vicinity of the test chamber and connected with a pressure hose to ion exchanger. If the flushing of the test chamber is not done with deionized water a second valve is provided (see figure below).

For the protection against a water leakage (broken water line) a leak detector with solenoid valve (see accessories) is installed to prevent damage caused by leaking water.

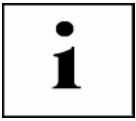
Important !

Note that, the connection between the ion exchange cartridge or other source of demineralized water can be only done by stainless steel or plastic piping/fitting. Under no circumstances shall the piping / fitting be made of copper or brass because the demineralized water has a very corrosive effect on these materials.



| | |
|----|--|
| | |
| 1 | External source of tap water with 3/4" fitting |
| 2 | Valve of the water leak detector |
| 3 | Ion exchange cartridge with 3/4" fitting |
| 4 | Conductivity meter (analog) with 3/4" fitting |
| 5 | Water distributor with 3/4" fitting |
| 6 | Test chamber with 3/4" fitting |
| 7 | Additional tap with hose |
| 8 | Tank with test solution |
| 9 | An alternative connection for supplying the test chamber with demineralized water for flushing |
| 10 | Tap water supply for flushing test chamber |

4.3.2 Drain Water Connection



The external drain water connector should be positioned as low as possible compared to the level of the water drain of the test chamber. This will allow the condensate to drain freely. Furthermore, during installation please make sure that there is no pressure difference between the test chamber and the sewer system.

Also please pay attention to the proper installation of the siphon so that no odors may escape from the

4.3.3 Compressed Air Supply



In order to ensure the purity of compressed air according to the DIN EN ISO 9227 standard (no oil / particles <5 microns, 0.2 mg/m³) a filter for compressed air is installed (see Accessories). This filter also prevents any particles or chips from old or new cables to enter the test chamber. All these impurities can otherwise block the valves or clog the filter in the humidifier.

Connect the pressure hose to the nipple (size 5) on the back of the test chamber.



The constant supply of compressed air is required in order to operate the test chamber. If the central supply is switched off over the weekend, VLM can provide a diaphragm or a screw compressor which is switched on automatically when the pressure of compressed air supply drops below certain level.

4.3.4 Exhaust Hose



The exhaust pipe should be preferably a plastic tube with outer diameter (OD) 50 mm which is located in the vicinity of the test chamber. The easiest way is to lead the pipe directly through the outside wall of the room with the test chamber. On the other side of the wall the pipe should be at least 30 cm long and fitted with a wind shield (to avoid influences of the wind on the tests). The pipeline should not exceed 5 m, otherwise, a larger pipe diameter should be chosen.

The exhaust pipe should be inclined downwards toward the test chamber such as to allow the condensed salt fog to flow back into the plastic tubing of the test chamber.

The exhaust pipe may also be connected to a laboratory exhaust system. However, it may not be connected directly to any circumstances since otherwise it could negatively influence the results of the salt spray test chamber.

If a flexible spiral tube is used for guiding the exhaust air please make sure that it does not sag and form a water trap which prevents the exhaust or block would do.

Before connecting the spiral hose end to the exhaust duct of the test chamber (see picture) please apply liquid silicone (see Accessories) to it so no salt condensate will leak in to the compartment of the test chamber with electromechanical and control systems. The hose end is fitted with a stainless steel schellen fix.



4.3.5 Power Supply / Electrical Safety Considerations



Provide adequate (3-4) power sockets for the following:

- the test chamber
- the conductivity meter in the ion exchange cartridge
- the pump for dissolving the sodium chloride in the tank with solution
- air compressor (if available)

The electrical installation must be made only by a professional. Make sure that the rated voltage of the device corresponds with the nominal voltage of the mains. For electrical safety, it is recommended to use an earth leakage circuit breaker of 30mA.

4.3.6 Connecting the Tank with Solution



Before the tank is connected for the first time to the test chamber please make sure that the tank is clean before you put the demineralized water in it.

Attach the hose which is transported within the tank to the fitting on the exterior of the tank. Loosen the lock nut and run the hose through it and slide the ring on the conical end of hose. Push the hose over the connecting pipe. Tighten the nut firmly. Connect the other side of the hose to the similar fitting at the back of the test chamber. Make sure that the hose is not bent or blocked when the tank is replaced in the cabinet.



4.4 Checklist Before Starting Operation

| | To do | Has been done |
|---------------------|---|---------------|
| Demineralized Water | Connect the hose to the test chamber, also provide a separate water tap | |
| Conductivity Meter | Power plug inserted in the 230 V mains | |
| Water Tap | Slightly open, check for water leakage | |
| Water Leak Detector | Plugged into 230V mains, sensor connected | |
| Druckluft | Open the valve, pressure regulators set on at least 6 bar | |
| Waste water | Hose connected | |
| Air Exhaust | Exhaust hose connected | |
| SAL Dosing pump | No air in the pump, operating mode "Manual" | |
| Mains Connection | Power cable connected to the mains | |
| | | |
| | | |

Before the test chamber is put in operation please check:

- Are all supply and waste lines connected?
- Are all connections tight?
- Is the supply of demineralized water open and is there sufficient solution in the tank?
- Is the valve for the compressed air open?
- Is the pressure of the compressed air at least 6 bar?
- Does the mains power supply match rated voltage of the test chamber?
- Is the test chamber screwed to the supporting cabinet?
- Are all feet of the cabinet standing on the ground, is the supporting cabinet in horizontal position and is there a slight slope in the test chamber for water drainage?
- Is the SAL-pump in manual mode?



Please use only the main switch to switch the power of the test chamber on or off

5. Technical Description

5.1 MultiCORR® Climate Change Test Device

Type MC 400-FL for performing cyclical climate change tests, e.g. according to Nissan CCT I, VW PV 1210, VDA 621-415 and other laboratory standards, GM 14872



Test Chamber

- Volume of the chamber: 400 L
- Inside dimensions: W / D / H 600 x 800x 920 mm
- Materials: stainless steel coated with ECTFE (Halar®), polypropylene side walls with milled openings for (with plastic coated) stainless steel rods for supporting test samples
- Double shell roof construction with built-in cooling fans for the roof cooling system in accordance to the CWC
- Gas springs and pneumatic cylinders for easy opening and secure closing of the test chamber
- Rotating nozzle for washing the test chamber
- Grommet for electrical cables
- GRP protection grid for positioning of test pieces and protection of the floor of the test chamber



Temperature Regulation - Heating

- Operating temperature is 5 °C > room temperature, up to +80 °C
- Over temperature protection
- Mikanit surface heating under the floor and side wall
- Corrosion resistant highly sensitive temperature sensors on the floor, nearby side wall and under the roof (CWC system)
- Mobile temperature sensor in the sample zone; the values provided by this sensor are included in the regulation of the temperature of the test chamber

Proces Control

- Windows CE operating system, remote control possible
- MultiCORR® process control system for generating optimal test conditions over the entire operating range
- Touch Screen for a user friendly interface
- Data Communications Ethernet port, USB port
- Password-protected access, three user levels
- High performance software controller for controlling temperature and humidity under very tight tolerances to achieve high reproducibility of test conditions
- Menu driven operation
- Individual tests and widely used climate change tests in the automotive industry; all tests are preconfigured in the factory
- Easy programming of new tests by combining given test segments
- Manual activation and deactivation of device components for functional testing
- Alarm list with a history of error messages



5.2 Main Systems of the MultiCORR® Climate Change Test Device

System for Salt Spraying



- Electronically controlled self-venting membrane pump with electronic flow check (bubble detectors)
- Adjustable high precision nozzle (compressed air + solution) made of polycarbonate with a cap made of PEEK
- Transparent humidifier of Duran glass with easily replaceable PE sintered filter for fine distribution of compressed air; the humidifier allows a full saturation of air with moisture and features automatic water refill
- automatically and manually activated air purging to blow out the salt mist from the test area
- Accessories: 1-2 tanks of 200L as test solution containers, on wheels with covers, with optional level sensors in the control and display



System for Water Condensation

- Uniform heating of the water bath through the floor heating installed under the floor surface, uniform evaporation of water
- System CWC (Controlled Water Condensation) for controlled condensation
- 100% condensing humidity

System for Regulated Humidity



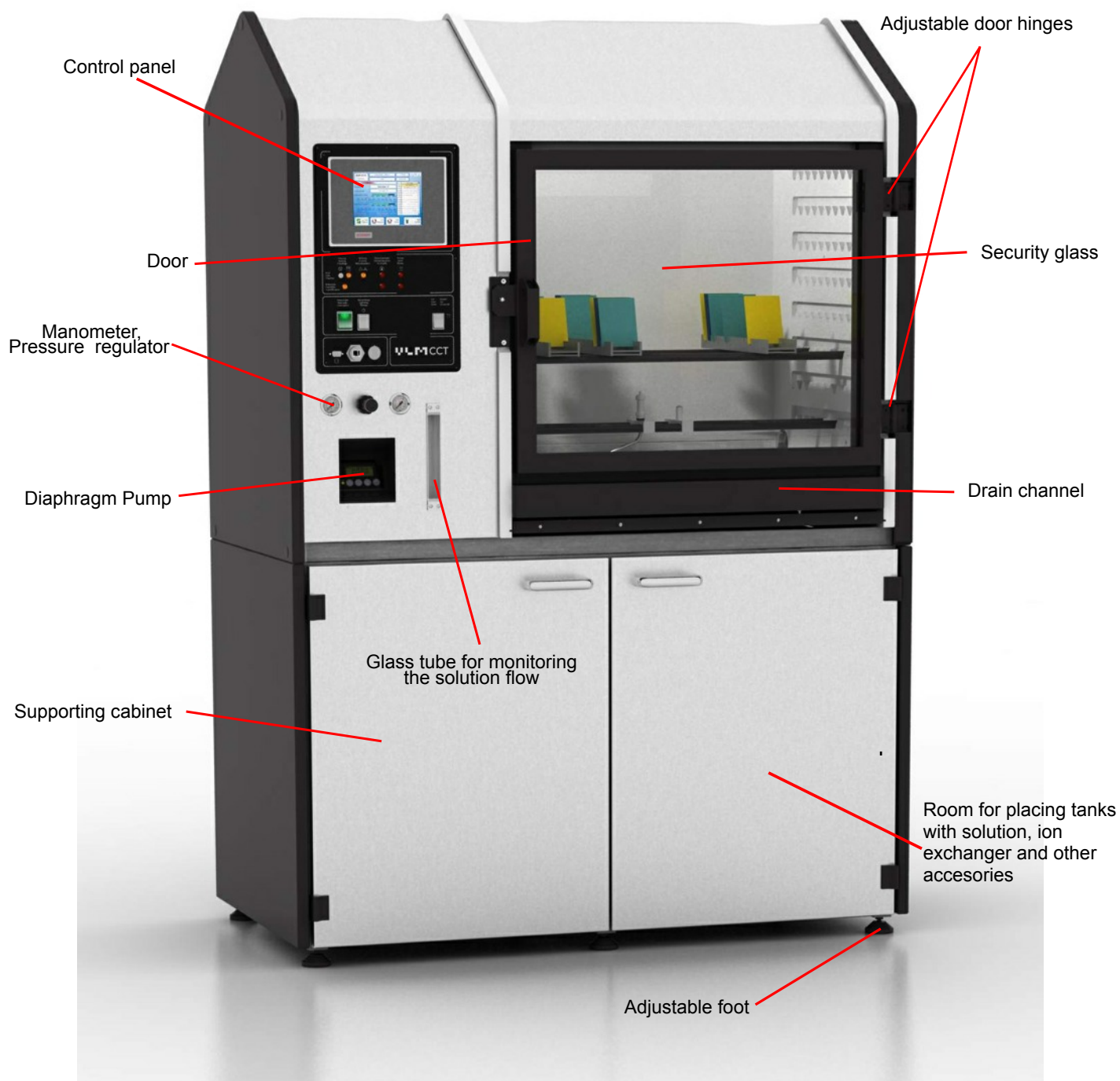
- Highly sensitive humidity sensor in the test area; the sensor is pneumatically inserted into and extracted from the test chamber
- Compact steam generator
- Quick and even distribution of moisture through the precision nozzle

System for Ventilation and Hot Air

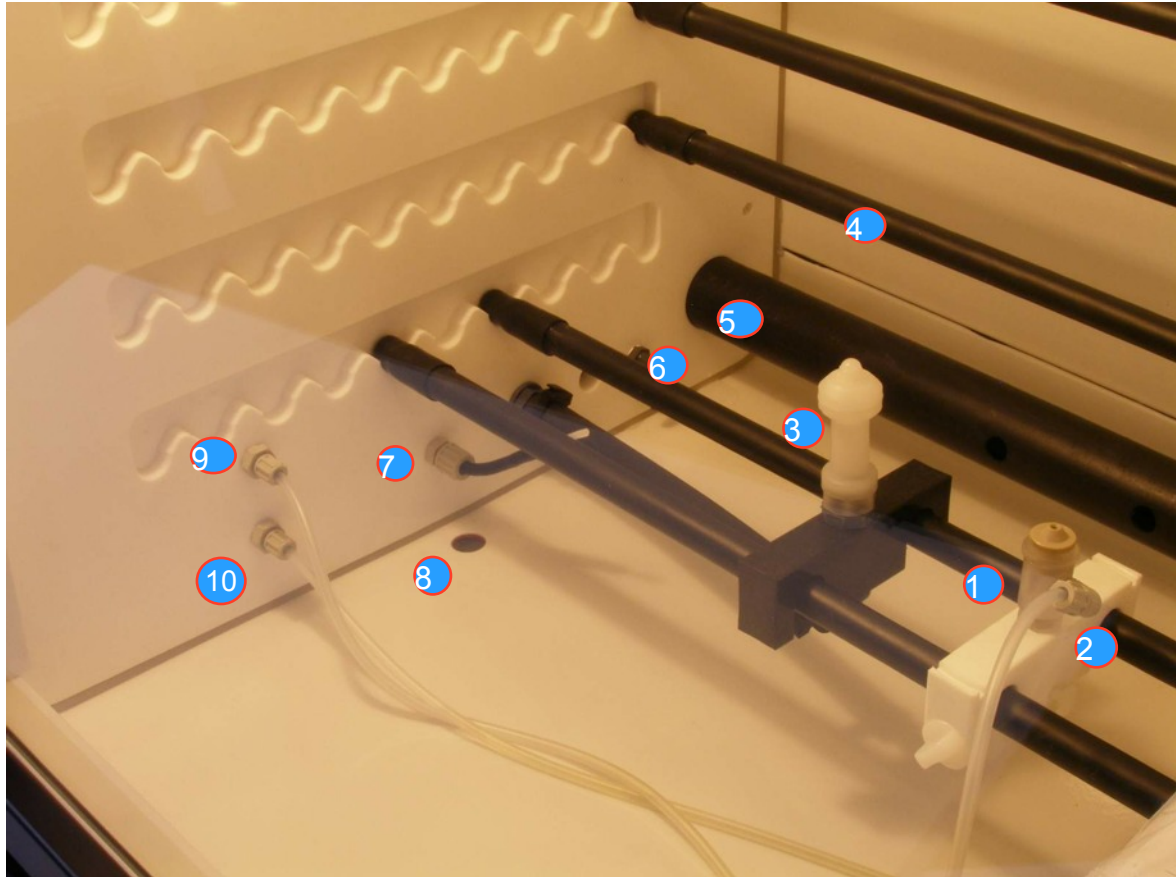


- Adjustable fan to adjust the ventilation rate
- Adjustable air conducting tube for even drying of the test samples
- Optional module for connecting an air supply with standardized room air $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and $50\% \pm 5\%$ rel. humidity
- Hot air drying to $+80^{\circ}\text{C}$

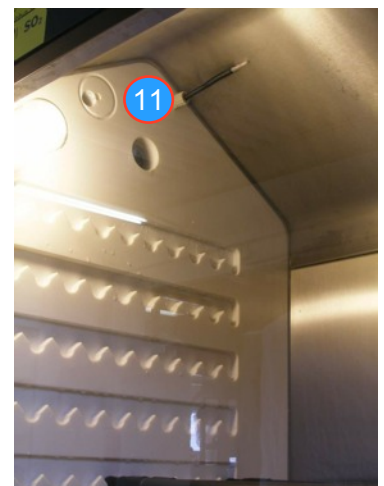
5.3 Front View



5.4 Test Chamber



- 1 Nozzle for spraying solution
- 2 Inlet compressed air
- 3 Rotating nozzle for washing the test chamber
- 4 Metal rod for placing the test samples
- 5 Air conducting tube for uniform drying of the test samples
- 6 Inlet demi water for condensation test
- 7 Temperature sensor Pt 100 (2 additional sensors under the ceiling)
- 8 Water drain
- 9 Inlet socket for compressed air
- 10 Inlet socket for test solution
- 11 Temperature sensor for roof cooling



5.5 Test Chamber with Climate Module



MC 400-FL with a climate module for air regulation according to DIN 50014 which is a necessary prerogative for implementing VW PV 1210 Tests

Note:

For the operation of the climate module a separate operating manual is available. It is important to leave the climate module running at all times when a water condensation test or a climate change test is running.

5.6 Control Panel

Control panel of the fully automatic MultiCORR control

Control light heating test chamber (hot air)

Control light heating test chamber (MICANIT heaters)

Control light heating humidifier

Main switch

Switch for internal illumination

Ethernet interface



Control light over temperature test chamber

Control light over temperature humidifier

Control light max water level exceeded in the test chamber

Control light max water level exceeded in humidifier

Switch for opening the door

Glass showing the solution flow

Electronic Diaphragm pump



Manometer for measuring the pressure of compressed air

Air pressure regulator

Symbols used:



Measurement air pressure



Water level humidifier



Illumination of the chamber



Air pressure nozzle



Temperature regulator

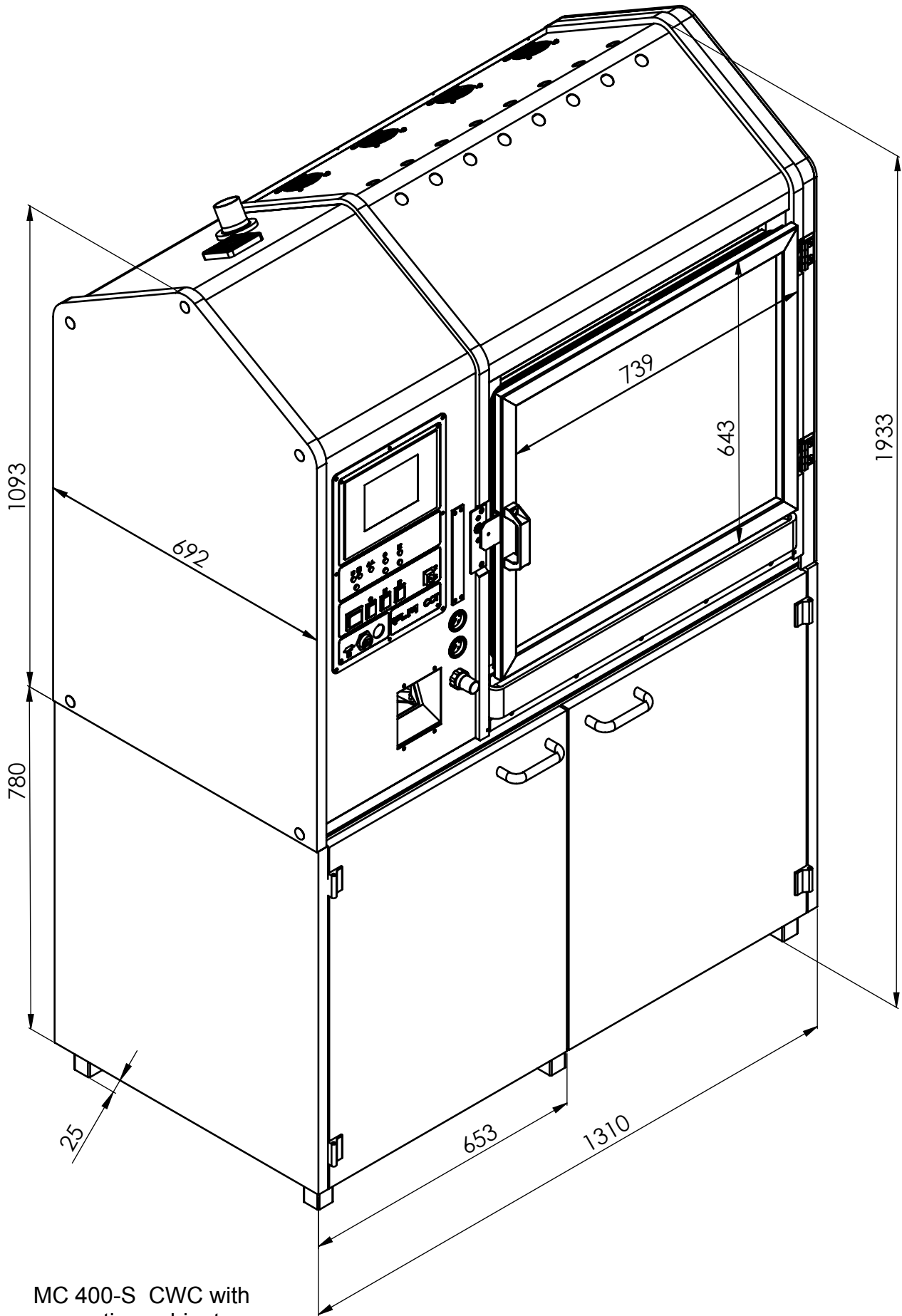


Control heating (test chamber)



Over temperature protection

5.7 Dimensions



MC 400-S CWC with supporting cabinet

5.8 Technical Specification

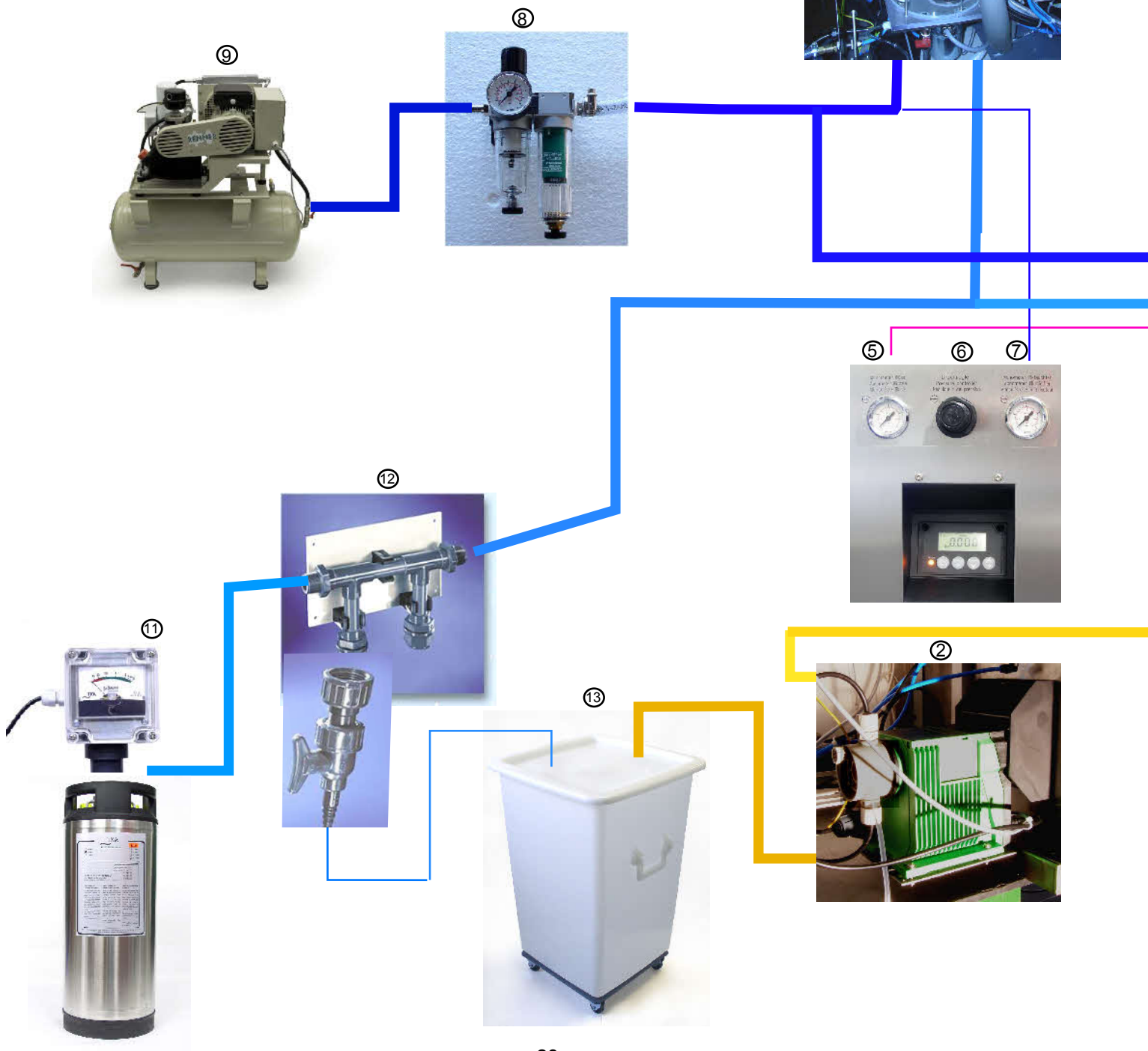


| Description | MC 400-FL CWC |
|---|--|
| Material outer shell | stainless steel |
| Material test chamber | stainless steel PTFE - coated |
| Material door test chamber | security glass with clear-shield coating |
| Weight (empty) | 160 Kg |
| Dimensions (external WxDxH) mm | 1310x670x1093 mm |
| Dimensions test chamber (WxDxH) mm / Volume Liter | 800x605x920/733 mm 400 l |
| Door opening (WxH) mm | 740x643 mm |
| Max. load of test samples per metal rod | 20 kg |
| Mains voltage | 230V |
| Frequency | 50-60 Hz |
| Electrical power requirements | 1800 W |
| Max. Temperature test chamber °C | Max. 60°C HT: max. +80°C |
| Temperature regulator | Electronic PLC control with touch screen |
| Temperature stability | ± 0,3 °K |
| Temperature indicator resolution on LCD display | 0,1 °C |
| Interface | Ethernet |
| Water quality | Demineralized water, conductivity max. 20µS/cm |
| Water consumption humidifier | +/- 0,5 l /24 h |
| Consumption test solution | +/- 0,4 l/h |
| Required water pressure | 3/4" 2-4 bar |
| Compressed air consumption | +/-16 m³/h |
| Compressed air supply | 6-8 bar |

6. Operational Procedures

6.1 General Principle of Operation

- ① Test chamber
- ② Electronically regulated diaphragm pump
- ③ Spraying nozzle
- ④ Humidifier
- ⑤ Manometer showing the air pressure in the nozzle
- ⑥ Regulator of the compressed air
- ⑦ Manometer showing the air pressure in the humidifier
- ⑧ Compressed air filter
- ⑨ Air compressor
- ⑩ Ion exchange cartridge (demineralized water)
- ⑪ Conductivity meter (analog)
- ⑫ Water distributor
- ⑬ Tank with test solution
- ⑭ Chamber ventilation
- ⑮ Pneumatically controlled ball valve
- ⑯ Water drain



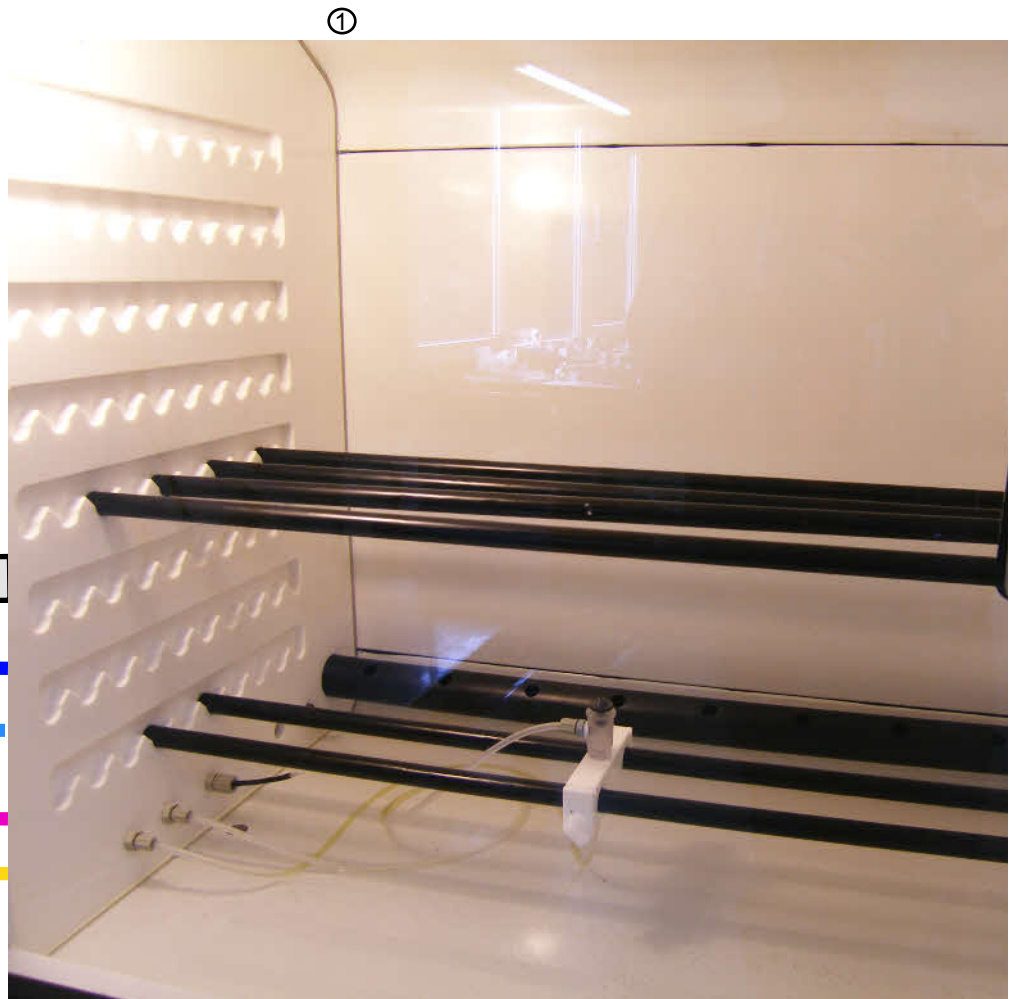
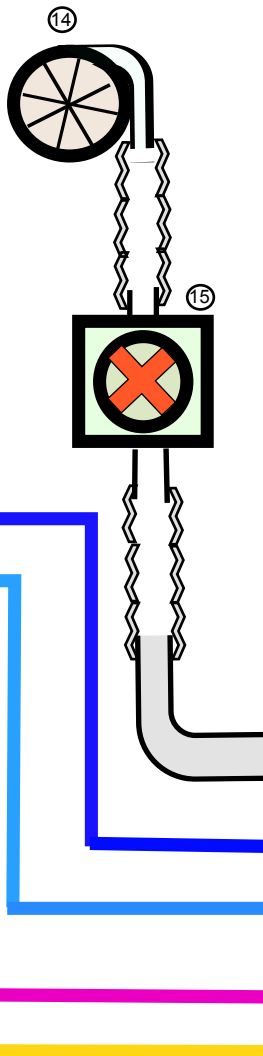
5% sodium chloride solution is pumped by a diaphragm pump from the tank to the test chamber via a polycarbonate nozzle.

The test solution is heated with moisturized air at about 1 bar pressure and continuously vaporized so that a fine mist is created. The mist is evenly distributed in the test room.

The salt spray is being continuously condensed on the surface of test specimens and is testing resistance of these specimens (material or coating) on corrosion.

According to ISO 9227-2 standard the corrosiveness of material is determined by measuring the rate of the mass-loss of test specimens. It is essential that the test equipment can guarantee the repeatability of the salt spraying conditions under all circumstances.

More details please find in chapter Accessories or visit our web shop <http://www.vlm-laborshop.de>



- Inlet compressed air
- Inlet solution
- Ventilation tube
- Nozzle holder
- Overflow opening
- Temperature sensor
- Drain

6.2 Relevant Standards

Salt Spraying:

DIN EN ISO 9227

(DIN 50021, SS, ESS, CASS)
DIN 50942, DIN 53 167
ASTM B 117-73
ASTM B 287-74
ASTM B 368-68
ISO 7253 ISO 3678BS 1224,
BS 2011, BS3900 F4, BS 3900
F12,
BS 5466 Part I
BS 5466 Parts 2 + 3
NFX 41002,
AS 21331 Section 3.1
SIS 1841190
JIS Z 2371
Werksnormen z.B.:
VW, GM 44, AUDI, BMW,
Toyota, Nissan, Honda,
Jaguar, Rover,

Water Condensation:

DIN EN ISO 6270-2

Kesternich test (option)

DIN EN ISO 6988

Literature:

Standards can be found in the following literature:

Beuth Verlag GmbH,
Burggrafenstr. 6,
10787 Berlin

ASTM International, 100 Barr
Harbor Drive,
PO Box C700, West Consho-
hocken,
PA 19428-2959
United States
Annual Book of ASTM Stand-
ards Vol 03.02

6.3 Operational Range of the Test Chamber

Temperature range: 5 °C higher than the room temperature (max. + 80 °C)

Relative Humidity (RH): 20% < RH < +/-100% RH

6.3.1 What are the Main Advantages of the VLM MultiCORR® Technology

In conventional test chambers the salt solution is sucked by the compressed air out of constant level vessels. In this case the size of the droplets depends on the pressure of the compressed air.

Moreover the level vessels cause frequently test failures by blocking the solution flow (clodging). The needle valves used in conventional test chambers are expensive and often not resistant to corrosion. This decreases the reliability and increases the maintenance costs.

The VLM test chambers, based on MultiCORR® technology, are equipped with an advanced peristaltic pump which allows a very accurate adjustment of the flow rate of the salt solution and is independent from the pressure of the compressed air. Flow rate and air pressure can be preselected independently. Consequently a maximum reproducibility of the salt mist can be achieved regardless of the size of droplets.

6.3.2 General Description of the Test Process

Demineralized water flows in the test chamber until the bottom of the chamber is covered with at least 10mm water. The water bath is then heated evenly to 40 °C by Mikaniit heaters which are located under the chamber floor. The water evaporates and condenses in the upper part of the test chamber.

The double shell design of the VLM test chambers protects the air inside the chamber from outside influences, e.g. from Sunlight or draft.

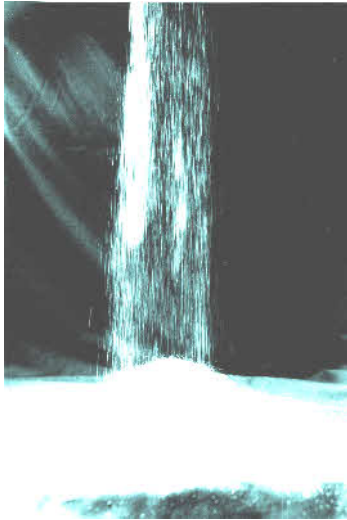
For the implementation of water condensation - climate change test the heater is switched off after a pre-programmed period of time and the fresh air is blown evenly into the chamber. The water remains at the bottom of the chamber and is heated again after the ventilation phase.

For the implementation of Kesternichtest with SO₂ (option) additional exhaust valve is installed. This valve remains closed during the condensation phase. This valve opens after switching to the ventilation phase. After one test cycle the water drain will open and the water will flow out of the chamber.

When the next test cycle starts the water drain valve will close and the floor of the test chamber will be again filled with the fresh demineralized water.

6.4 SaliCORR® Pure Sodium Chloride

SaliCORR® Sodium Chloride for Salt Spray tests



According to DIN ISO 9227: 2006 a corresponding amount of sodium chloride in deionized water with a conductivity of not more than $20\mu\text{S}/\text{cm}$ (25 ± 2) °C is achieved, so that the NaCl concentration of the final solution 50 ± 5 g/liter. The sodium chloride must contain less than 0.001% copper and less than 0.001% nickel. The sodium content is set at 0.1%. The sum of all impurities must be less than 0.5% calculated on the dry salt.

SaliCORR® is a special high-purity sodium chloride for high performance Corrosion testing. It is warranted to be free of anti-clodding agents and meets the requirements of DIN EN ISO 9227 and ASTM B117

Specimen

Quality Certificate

SaliCORR® Sodium Chloride, NaCl Special quality for Salt Spray Tests acc. to EN ISO 9227, ASTM B117, NASM1312-1

Batch: V-AP 32204600-12.07

Batch values

Assay (argentometric; calculated on dried substance)

100.0 %

Identity

passes test

Appearance of solution

passes test

Acidity or alkalinity

passes test

pH-value (5 % Water)

6.5

Bromide (Br)

$\leq 0,005 \%$

Nitrite (NO₂)

passes test

Hexacyanoferrate (Fe(CN)₆)

$\leq 0,0001 \%$

Iodide (I)

$\leq 0,001 \%$

Phosphate (PO₄)

$\leq 0,0025 \%$

Sulphate (SO₄)

$\leq 0,01 \%$

Nickel (Ni)

$\leq 0,0005 \%$

Copper (Cu)

$\leq 0,0005 \%$

Barium (Ba)

passes test

Calcium (Ca)

$\leq 0,002 \%$

Iron (Fe)

$\leq 0,0002 \%$

Potassium (K)

$\leq 0,003 \%$

Ammonium (NH₄)

$\leq 0,002 \%$

Magnesium, Earth alkali metals (as Ca)

$\leq 0,01 \%$

Loss on drying (130°C)

$< 0,1 \%$

VLM GmbH

Hans-Ulrich Vogler
Managing Director

33689 Bielefeld, 2010, 02.19

- No weighing required
- Always flowing
- No clods
- Easy to transport
- Convenient storage
- Saves time and money



6.5 Water Condensation Test According to DIN EN ISO 6270-2 DIN / 50 014

Relevant Standards

DIN EN ISO 6270-2
(DIN 50017 KK, KTW KFW,)
DIN 50014
BS 3900F2, BS 3900 F15,
ASTM D2247

DIN EN ISO 6988
DIN 50018
ASTM G 87-02

- ☐ **Water Condensation - Constant Climate CH (KK)**
- ☐ **Water Condensation - Changing Climate AHT (KFW)**
- ☐ **Water Condensation - Changing Climate AT (KTW)**

Table of the different High Humidity Test Procedures

| Testing Climate | | | Duration of a Cycle | | Conditions of the Chamber after equilibration | |
|---------------------------------------|--|--------------|---------------------|---|---|---|
| Description | | Abbreviation | Total | 1. Test Section 2. Test Section | Air temperature | Relative Humidity |
| High Humidity Constant Climate | | CH | | From heating up until end of the test | 40 ±3 °C | Ca. 100% with condensation on the specimen |
| Alternating High Humidity Climate | With change of the humidity and -temperature | AHT (Option) | 24 h | 8 h including heating up | 40 ±3 °C | Ca. 100% with condensation on the specimen |
| | | | | 16 h Including cooling down to ambient (Chamber opened of ventilated) | 18 - 28 °C | < 100% |
| | With change of the air temperature only | AT (Option) | 24 h | 8 h including heating up | 40 ±3 °C | Ca. 100% with condensation on the specimen |
| | | | | 16 h Including cooling down to ambient Chamber closed | 18 - 28 °C | Ca. 100 % |

Literature:

Beuth Verlag GmbH,
Burggrafenstr. 6,
10787 Berlin

DIN Taschenbuch 219,
"Korrosion und Korrosionsschutz -
Beurteilung, prüfung, Sofort-
maßnahmen" Beuth Verlag, Berlin,
ISSN 0342-801X, ISBN 3-410-
13167-1

To comply with these conditions, the test chamber is located in an environment without corrosive constituents (eg not in a chemical laboratory) at room temperature 18 - 28 °C according to DIN 50014 and a relative humidity up to a maximum of 75%. The ambient should be also protected from draft and direct sunlight.

In comparative studies, the ambient temperature should be (23 ± 2) °C according to DIN 50 013 have.

Note: Lowering the temperature leads to increased condensation

6.6 Controlled Water Condensation (CWC) System



Salt spray test



Water condensation test

The test chambers based on MultiCORR technology feature a patented system for Controlled Water Condensation (CWC). This system allows for very high level of reproducibility of the test climates which is essential for comparison of test results. This is valid not only for individual tests but in particular for cyclical climate change tests.

During the salt spray test the air in between the roof shells acts as a thermal insulator. This insulation is removed after transition to the water condensation test. During the water condensation test the fresh environmental air is forced through the double shelled roof by means of fans. This allows a cooling down of the humidified air in the test chamber and consequently condensation of water on test samples.

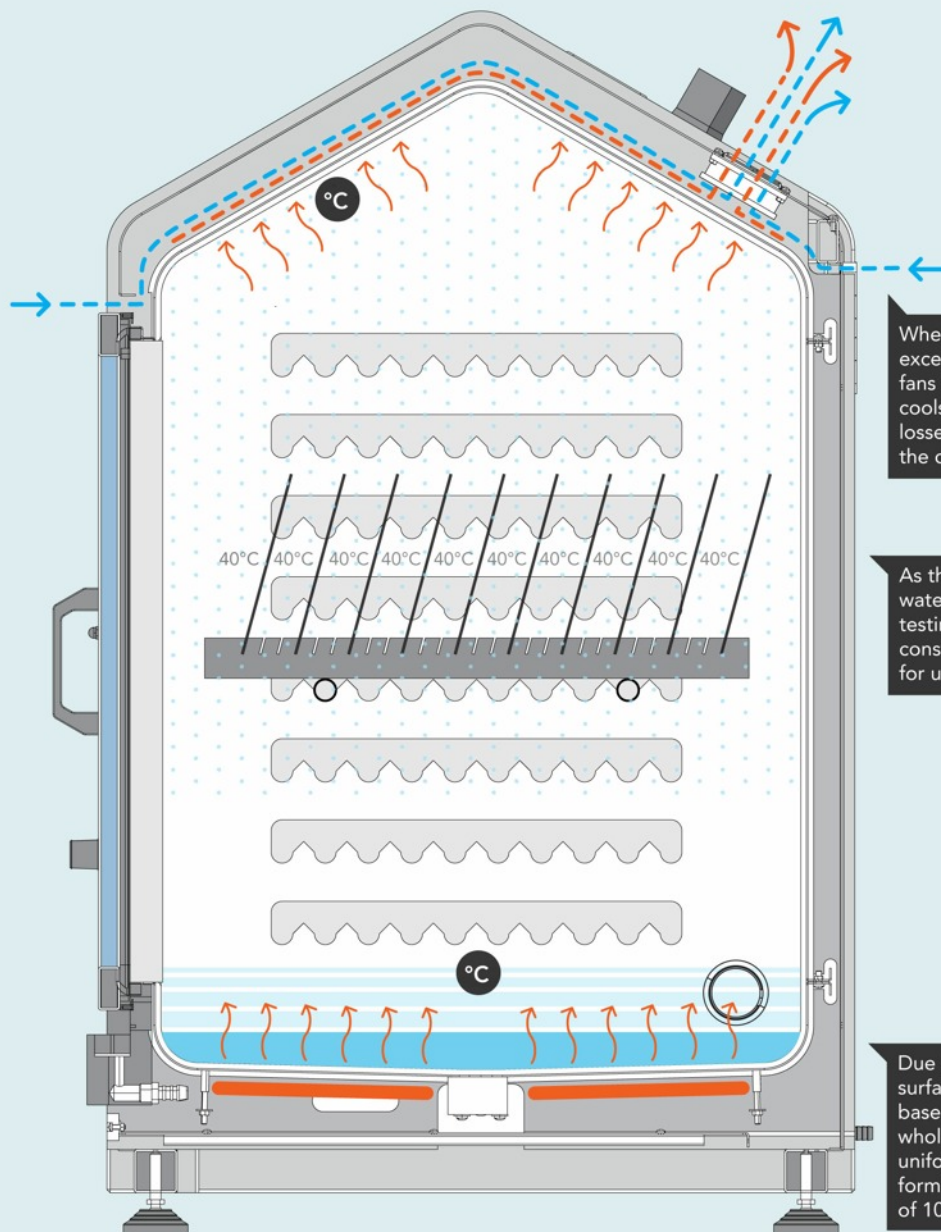
The interaction of all these measures leads to a very good horizontal temperature stability, and reproducibility of climate conditions.

Ventilation according to ISO 554



VLM climate change test chambers are equipped with fans and valves such as pneumatically operated ball valves and in this sense meet the requirements of ISO 554. This standard specifically prescribes the ventilation and air for cooling.

This standard recommends that the fresh air can flow from the lower rear part of the test chamber where an air tube is installed and can be adjusted such to ensure uniform drying of the test samples.



When the inner roof temperature exceeds the set point value (39°C) fans suck ambient air thus the roof cools down. So the controlled heat losses are an essential contribution to the constancy of the testing climate.

As the heat rises equably from the water bath the temperature in the testing zone of 40°C shows a high constancy of $\pm 0,2$ K; best conditions for uniform water condensation.

Due to the heat transfer from the surface heaters below the chamber base the water is heated up over the whole area. Consequently there is an uniform evaporation of water forming a constant relative humidity of 100%.

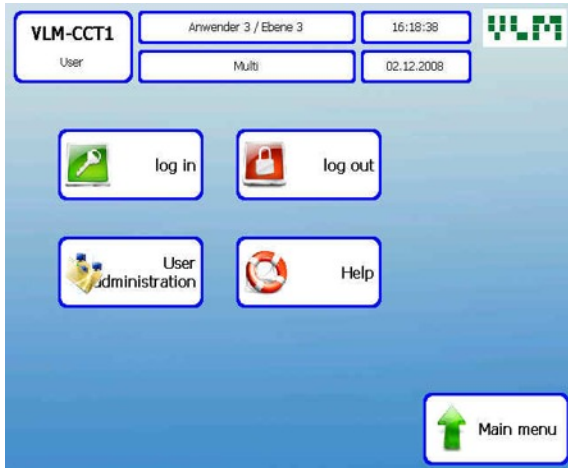
— — — fresh air

— — — heat

°C sensors

7. MultiCORR® Control System

7.1 Basic Functions



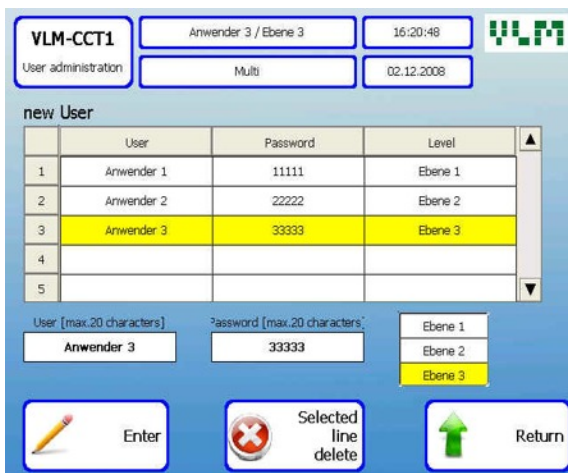
After switching on the cabinet the welcome screen appears followed by the screen "User". From this screen the user can navigate through the control program. The menu structure is clearly structured allowing an easy navigation.

To avoid faulty operations and to exclude unauthorized access to the control system three (from in total 4) access levels can be defined as follows:

1. Level Observer

2. Level User

3. Level Administrator

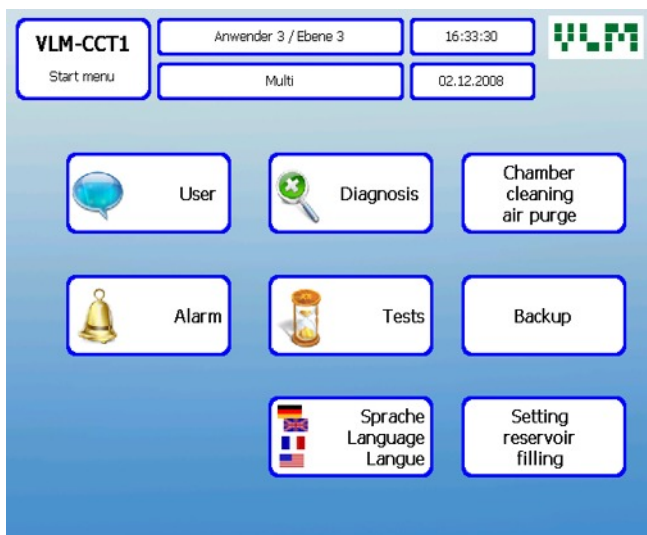


The "observer" can only browse between few screens but can not impose any change of the running program or select a new Test.

The "operator" may start prescribed / preconfigured test procedures, make selections between existing tests. However he can not define new tests or change existing test procedures. The "administrator" has access to all screens, unless they are reserved for VLM personnel only (Level 4). The administrator can assign the access rights, can assemble new test procedures from various segments, performs all the queries (alarm diagnostics) and changes.

The login and logout of operators will be logged (documented) in a form of a text file (Test data file).

7.2 Main Screen



From any submenu in which various parts of the system are controlled it is possible to return to the Start Menu. This screen allows the following choices:

User

The button "user" opens a submenu where the user can login or logout. The administrator can, for example, assign authorizations of personnel, chose the language or view the help screen.

Diagnosis

With the button "diagnosis" it is possible to monitor the set values of control parameters.

Tests

The "Test" opens the submenu where various corrosion tests can be selected. It is also possible to modify tests, compile new ones or delete them. The menu shows the information about the test procedures.

Manual Control

This button allows manual control of certain functions, e.g. manual control of a valve.

Alarm Status

This command shows a list of alarms that took place during the operation of the test cabinet.

Data Backup

The backup of data can be turned on or off.

Test chamber Wash Air Plunge

This button opens a submenu which allows the removal of the salt fog or of the hot water steam (by compressed air) before opening the test chamber. Furthermore, the rotating cleaning nozzle is turned on to flush the test chamber. This function is disabled during a test.

7.2.1 User Management / Log In

VLM-CCT1

Anwender 3 / Ebene 3

16:21:31

Log in

Multi

02.12.2008

Select user

☒ User

☐ Administrator

| | User |
|---|------------|
| 1 | Anwender 1 |
| 2 | Anwender 2 |
| 3 | Anwender 3 |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |

Input password

7 8 9

4 5 6

1 2 3

0 Delete

OK

Return

Login Screen

In the factory the user password is set to 33333. It is useful to put this "super user" on the last place in the list (number 50) so that it is not immediately visible. In emergency, if any other user has been by chance deleted this level can be always used for administrator access.

In this menu it is also possible to change the information for other users in order to protect the system from unauthorized access.

Once the access rights are assigned, the login is done by the following action:

- select your name and enter your code number on the box. Confirm with "OK"

VLM-CCT1

Anwender 3 / Ebene 3

16:20:48

User administration

Multi

02.12.2008

new User

| | User | Password | Level |
|---|------------|----------|---------|
| 1 | Anwender 1 | 11111 | Ebene 1 |
| 2 | Anwender 2 | 22222 | Ebene 2 |
| 3 | Anwender 3 | 33333 | Ebene 3 |
| 4 | | | |
| 5 | | | |

User [max.20 characters]

Anwender 3

Password [max.20 characters]

33333

Ebene 1

Ebene 2

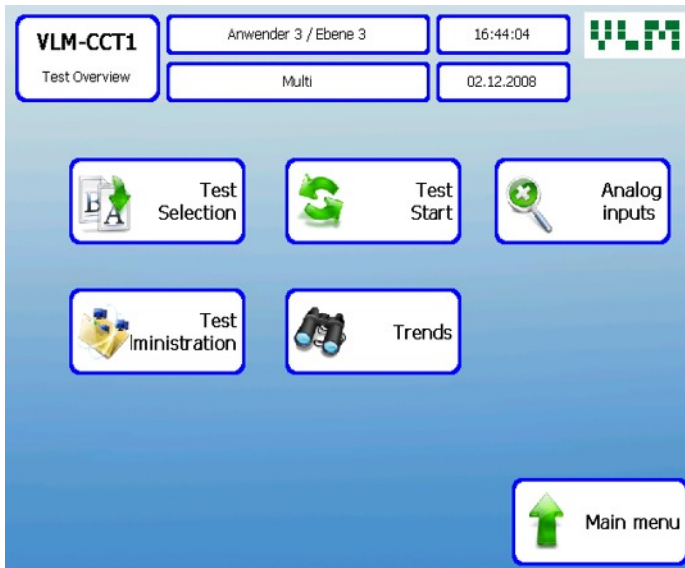
Ebene 3

Enter

Selected line delete

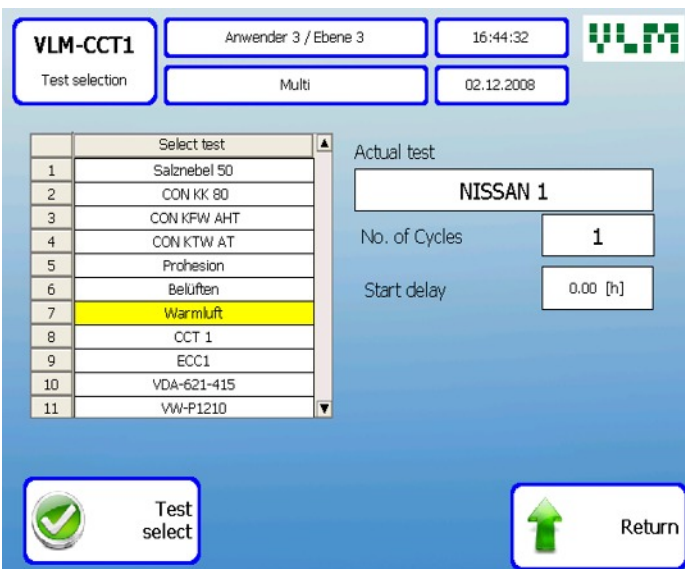
Return

7.2.2. Test Management



Screen: Test Selection

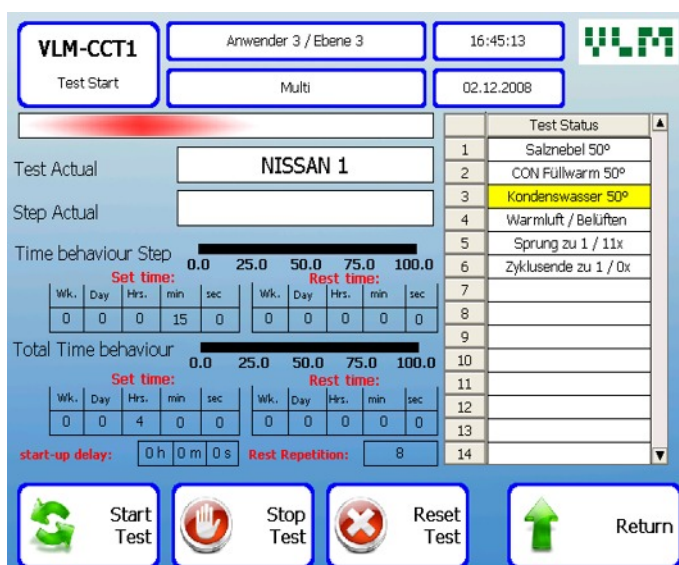
This screen appears after pressing the button "test" in the main menu. This screen appears only if the test is not running.



Screen: Test selection

In this list the user can select which corrosion test will be selected. The selection is made by ticking the corresponding box and then pressing the button "Select Test". The name appears in the "test date". Enter the number of cycles.

If necessary, it is possible to choose a delay of the startup. For example, on Friday it can be decided that the test should start on Sunday. Confirm with pressing on "Select Test" button. Changes in test parameters can be performed only in the access level 3.



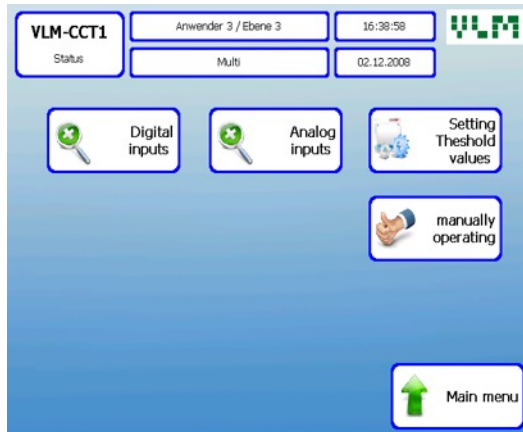
Screen: Test Start

After starting a test the test indicator will appear "currently testing" in the bottom of the test section. In addition, the at that moment active segment in the list on the left is highlighted in yellow. The time flow is shown graphically in the upper part and with numbers in the lower part for the entire test. An ongoing trial is to recognize the back and forth horizontally migrating red flag.

With the button "Stop testing" the test can be stopped and with the button "Run test" the test will continue.

If a test is completed according to schedule or need to be cancelled then the button "reset trial" should be pressed at least 7 seconds. This time delay serves to prevent resetting the test by accident. The test parameters such as temperature or humidity can be observed in the diagnostic screen under "Analog Inputs".

7.2.3 Diagnostics



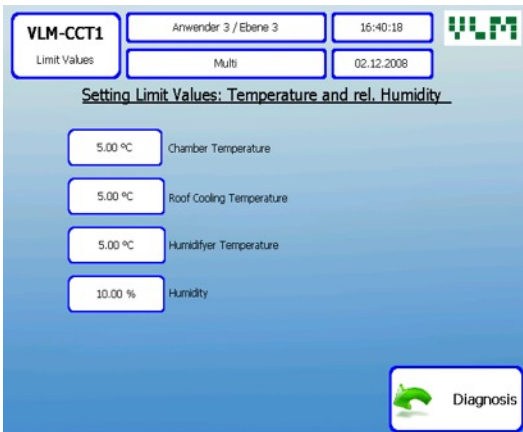
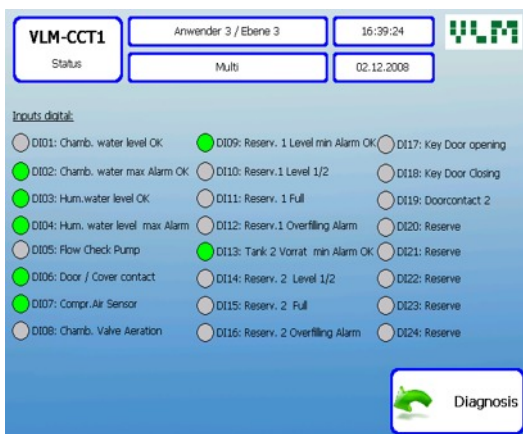
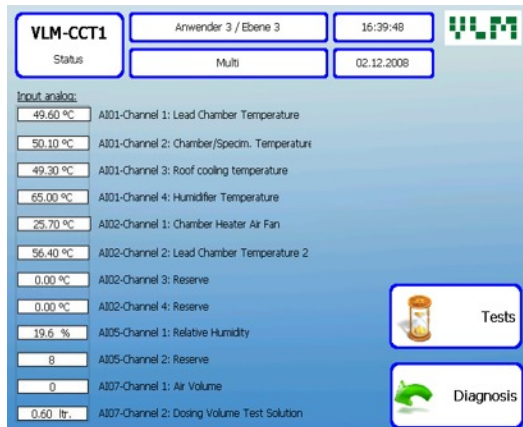
Diagnostics Screen

After pressing the button "Analog inputs" the corresponding screen appears with the current values for temperature and humidity.

Please note that the humidity is also measured by the sensor when it is outside the test room.

In the screen "Digital inputs" all components are listed which can be either on or off. This makes possible to monitor the right function.

Tolerance values for temperature and humidity can be changed by pressing the button "Setting Thresholds".



7.2.4 How to Define New Tests From Segments

On this screen the existing tests can be changed or new ones created. In this case, select an empty position in the left column and enter a test name.

Click Select from list of segments (left column) by the respective segment from. Transfer the segment in your new test procedure by pressing the button "segment take over".

The segment is defined by given test parameters which can be individually changed by pressing the button "step parameters".

The MultiCORR® control allows to connect an external device to the test chamber, such as the climate module. The external device can be turned on at any given time. In order to turn it on click on Ext1 output and allow some time for the device to start (time delay).

The "jump" allows to repeat the test several sections of the test, ie program loops.

With two green arrows it is possible to change the positions of any segment or create space in case a specific step has been missed.




The total duration of a test cycle is shown in the boxes next to the two green arrows.

Important:

Please always end every new test program with "**End of cycle**" (**Zyklusende**).

Save the test sequence by pressing the left button "**Save Input**".

Note that it is very important to blow the salt spray out of the test chamber when a "Salt Spray" segment is followed by a "Humidity" segment. Failure to do so will cause a damage of the humidity sensor. In such a case it is necessary to run "Air Purge" segment after the "Salt Spray" segment.

| | | | |
|-----------------|----------------------|--|---|
| VLM-CCT1 | Anwender 3 / Ebene 3 | 17:07:09 |  |
| Test Parameter | Multi | 02.12.2008 | |
| Actual Step | Zyklusende zu 1 / 0x | | |
| | | | |
| Jump to Step | 1 |  Exit  Save Data | |
| No. of Jumps | | | |

Input of jump command

To repeat a group of test segments within one test the command "**Jump**" is used. Simply insert the line "**Jump**" at the location from where the program should jump to a specific location in the segment list. Then enter the number of hops (repetitions) of the selected segments.

Important:

The list of segments as well as individual steps in a cyclic tests must be completed with "**End of Cycle**".

7.2.5 Description of the Preprogrammed Test Segments

| Nr. | Segment Name | Description, Objective, Function |
|-----|-----------------------|--|
| 01 | Jump | Should be selected if a repetition of a test segment (program loop) is required. |
| 02 | End of Cyclus | Must be always put at the end of a cycle! |
| 03 | Salt Spray | Salt Spray Test according to DIN EN ISO 9227 NSS (35°C) from Tank 1 |
| 04 | Salt Spray CASS | Salt Spray Test according to DIN EN ISO 9227 CASS (50°C) from Tank 2 |
| 05 | Salt Spray Prohesion | Salt spray test according Mebon Prohesion test with dry compressed air |
| 06 | Water Condensation | Condensation test according to DIN EN ISO 6270-2 CH (constant climate) |
| 07 | Ventilation/PR Water | Venting the test chamber with water in the bottom tray acc. AHT DIN EN ISO 6270-2 AHT |
| 08 | Cooling/PR Water | Cooling of the test chamber with water in the bottom tray acc. DIN EN ISO 6270-2 AT |
| 09 | Cooling Drying | Cooling of the test chamber without water and without venting |
| 10 | Warm Air/ Ventilation | Forced drying with hot air or venting without water in the test chamber |
| 11 | Heating Drying | Test chamber is only heated with no ventilation |
| 12 | Humidity | Increasing humidity from 20% to 95% |
| 13 | Test Chamber Cooling | Acceleration of the cooling of the test chamber to observe time-limited transitional periods of temperature change from temperature A to temperature B |
| 14 | CON Warm Fill | Avoid temperature drops by filling the bottom tray with water from the humidifier instead with cold water |
| 15 | Blowing Fog | Expelling the salt spray with compressed air, if the salt fog disrupts the subsequent test segment or if it could damage the humidity sensor |
| 16 | Spray Test Solution | Direct spraying of the test solution on the test samples ("wetting") with a separate pump |
| 17 | Climatized Air | Ventilation of the test room with conditioned air (air conditioning module) |
| | | |

These segments are programmed in the factory and for reasons of safety these functions can not be changed by the user. In case of special test to be programmed (possibly with hardware adjustments) please call VLM at : +49 5205 879630.

Temperature, humidity and test duration can be changed by the user at level 3

7.3. Alarm Screen

| Alarm table | | | |
|-------------|------|------|---------|
| No. | Date | Time | Message |
| 0 | 0 | | |
| 1 | 0 | | |
| 2 | 0 | | |
| 3 | 0 | | |
| 4 | 0 | | |
| 5 | 0 | | |
| 6 | 0 | | |
| 7 | 0 | | |
| 8 | 0 | | |
| 9 | 0 | | |
| 10 | 0 | | |
| 11 | 0 | | |
| 12 | 0 | | |

Screen: Alarms

In this screen, all alarm messages are chronologically listed. After user confirmation these messages are archived.

Alarm Messages

Mains power loss (duration...)

Lack of compressed air

Cabinet door or cover of the chest is not closed

Level water in the test chamber too high (Overflow)

Level water in the humidifier too high (Overflow)

Diaphragm pump failure

Air valve not opened

Solution tank 1 empty

Solution tank 1 level too high (Overflow)

Vorratstank 1 Überfüllung

Temperature test chamber too high

Temperature test chamber too low

Roof cooling temperature too high

Roof cooling temperature too low

Temperature humidifier too high

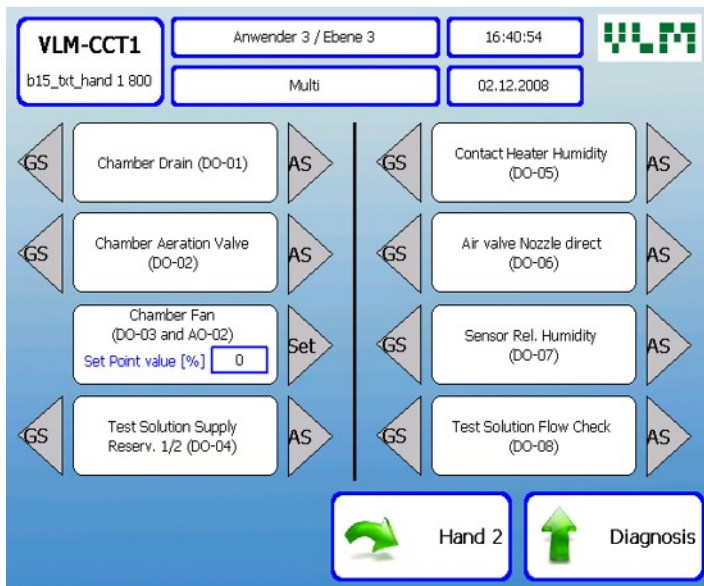
Temperature humidifier too low

Relative humidity too high

Relative humidity too low

Failure valve cooling test chamber

7.4 Manual Control

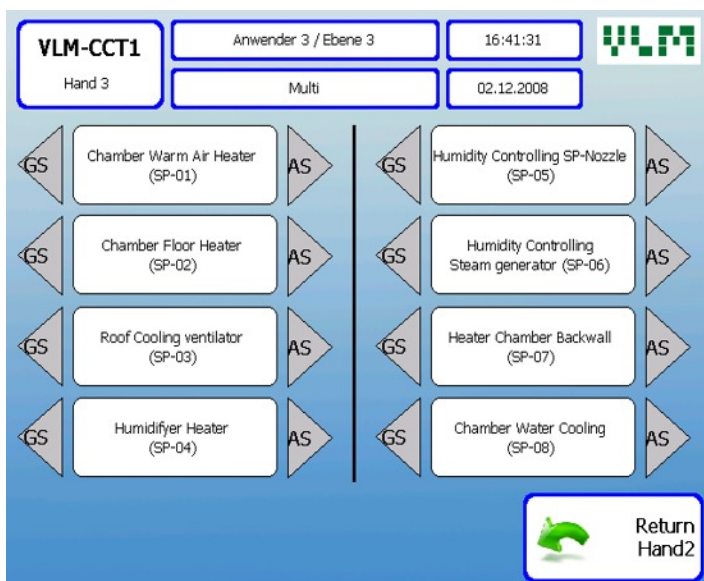
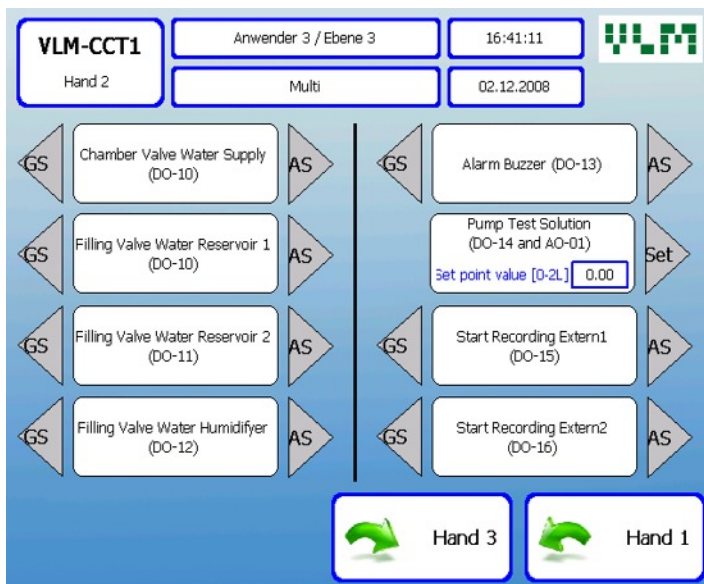


Screen: Manual Operation

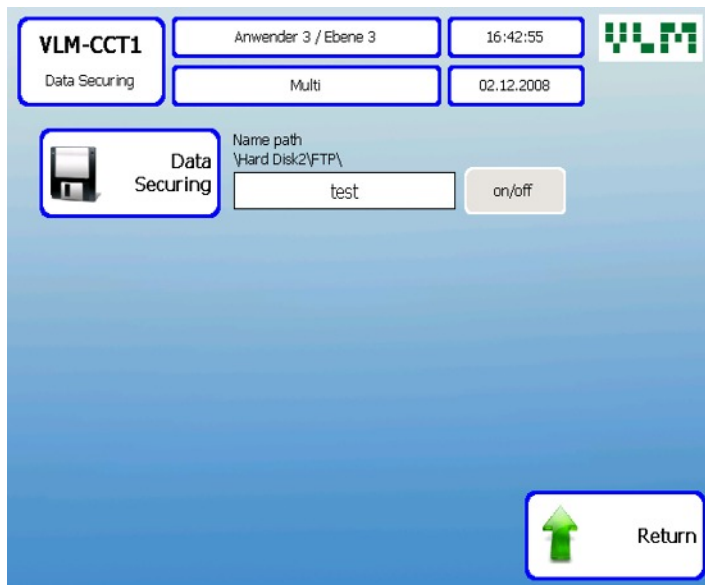
This screen allows manual control of all systems in the MultiCORR test chamber. To activate various hardware components manually choose the corresponding AS button. To manually disable the specific function choose the corresponding GS button on the Manual Control screen.

Note:

Manual control is disabled when automatic tests are running.



7.5 Backup of Test Results



Screen: Backup Data

The test results are stored on an internal USB memory stick (flash drive). To enable storing test results please choose this option on the Backup Data screen.

There is a new data file (in txt format) with test results created every. This file is accessible via Windows Explorer (or any Internet browser) on a PC which is connected to the MultiCORR® control unit of the test chamber. To access the data file the followin ftp address should be entered in the address line of the Windows Explorer (or browser):

ftp://192.168.1.100

The data can be copied to another PC and than used for graphical presentation (import to Excel).

Note:

There are two possibilities to extract the data file out of the MultiCORR® control unit:

1. Connect a PC directly to the control panel of the test chamber via Ethernet interface (use standard UTP network cable). The default (factory) setting of the Win CE network adapter is a fixed IP address **192.168.1.100** (subnet mask **255.255.255.0**). For this reason the PC which is connected to test chamber should also have the fixed IP address **192.168.1.xxx** (where xxx should be any number between 1 and 255 except for 100) and the subnet mask **255.255.255.0**.
2. Connect the test chamber to the local network (Intranet). Make sure that the network adapter on the Win CE based controller is setup to automatically obtain an IP address from the local DHCP server. Please consult your local IT support for making all arrangements. Please note that only level 4 Administrator has acces to the Win CE network configuration. This access level is reserved for VLM specialists or local VLM distributors.

8. Commissioning

8.1 General Information



Caution:

Do not open the test chamber before the salt spray is completely evacuated. The salt fog in the environment is very aggressive and might cause damage of the laboratory equipment.

Note that the condensate has to be evacuated from the chamber through the drain. It must not be under any circumstance reused!

Purity of the water

Do not use fresh water neither for the preparation of the test solution nor for the humidifier. Follow the specification indicated in the standards, such as the ISO 9227.

It is strongly recommended to use the ion exchanger cartridges as a reliable source of demineralized water. Always check the conductivity of demineralized water on the measuring gauge and timely replace the cartridge by a regenerated one.

Regard and treat this cabinet as a testing device. Keep it clean and make sure that it is serviced within the recommended intervals.

Note the the coating of the interior of the test chamber is made of ECTFE (Halar®) which may only be cleaned by a soft cloth and non abrasive cleaning agent.

Remove any salt residues on the outer case with a wet cloth.

8.2 Test Preparations

Never put specimens directly on the bottom of the test chamber.

Place specimens in the testing chamber in accordance with the ISO 9227. The racks for placing specimens with slits having 20° inclination are available from VLM as standard accessories. Moreover we offer further specimen holder for special parts such as very small specimens, disc brakes, or wheels.

Place the specimens in the testing chamber as stipulated in the ISO 9227 so that they will not affect each other. Make sure the no condensate can rinse or drop from one specimen to another one below. Make sure that no test solution will accumulate in cavities of specimens.

A variety of Stylus tools for the applying cuts and scratches on coated surfaces are available from VLM as standard accessories.



Caution:

- **Check if there is enough test solution in the reservoir to run the test.**
- **Make sure that the compressed air at the required pressure is permanently available.**
- **Check if the fresh water tap is open and the pure water supply is guaranteed all the time**

8.3 Starting Salt Spray Test



Before starting the test make sure that:

1. There is sufficient test solution
2. The fresh water tap is open
3. The distribution of the salt solution from the reservoir to the inlet of the cabinet is clear.
4. The door of the chamber has been closed thoroughly



Starting the test:

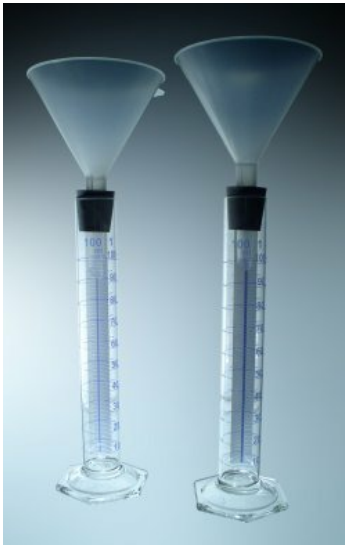
1. Press the green main switch
2. Press the purge switch to top position (Spraying Symbol)



Check if:

1. The correct flow rate is indicated on the display of the dosing pump .
2. The inspection tube is full of test solution
3. The manometer indicates the correct pressure of 1.0 bar and the green pilot lamp on the panel is permanently illuminated
4. The set value of the chamber temperature has been set to 35 °C and the orange pilot lamp is blinking
5. The set value of the humidifier is set to + 15 °C > chamber temperature (= 50 °C NSS-Test) and the orange pilot lamp is blinking

8.4 Rainfall Rate



When the cabinet is running you should place the measuring cylinders in the middle of the areas on the right and left hand side besides the spray nozzle in order to check the condensation rate pursuant to the ISO standard 9227.

If the fall-out rate is out of the range of 1,0 - 2,0 ml/h after at least 16 hours or shows big differences among the cylinders you should check the pressure of the compressed air. Lower pressure will increase the share of bigger droplets. Preferably the pressure should be set at 1,0 bar in order to produce a fine salt mist.

If the fall-out rate is less than 1,0 ml/hour you should increase the flow rate by pressing the up key on the operating panel of the pump.

Only if these optimising measurements are not sufficient the spray nozzles have to be adjusted.

8.5 Corrosivity of the Test Chamber

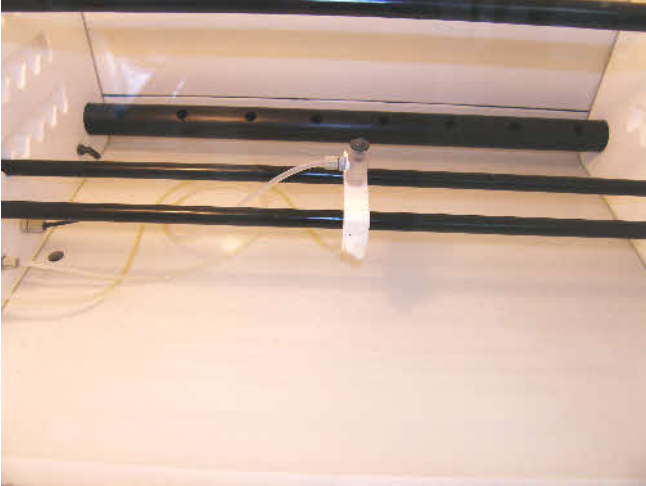


The corrosiveness of the CCT 400-S is very close to the theoretical value of $70 \pm 20 \text{ g/m}^2$. However, it can be influenced by local conditions. It is therefore recommended to determine the corrosiveness according to the conditions in situ. Refer to the DIN EN ISO 9227, which is available from Beuth Verlag, Berlin, (www.beuth.de).

The working standards, all accessories and chemicals are available from VLM (www.vlm-laborshop.de).



8.6 Adjustment of the Water Level for the Condensation Test



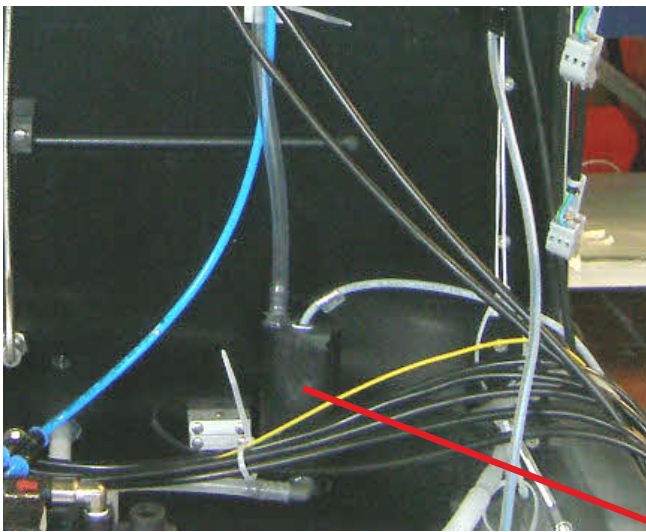
According to DIN EN ISO 6270-2 the water depth at all points of the water bath must be at least 10 mm.

This requirement has to be checked after the supporting cabinet (on which the test chamber is placed) is leveled. A simple way of doing this is to select and start the CON 40 test (water condensation in constant climate test).

At the start of the CON 40 test the floor pan is filled with water. Check the water depth at various points. If the water depth is less than 10 mm, the level vessel has to be adjusted such as to allow for a higher water level in the test chamber.

To adjust the level vessel turn the screw with a (Philips) screwdriver clockwise so that the switching point for the vessel is in the level float switch is set higher.

After finishing the water condensation test let the water flow out from the test chamber. Make sure that the water flows evenly from the front and back of the test chamber. If this is not the case the feet of the cabinet should be adjusted such as the floor of the test chamber has a slight inclination towards the drain.



Level vessel

9. Service and Maintenance

9.1 Maintenance Intervals

| What ? | When ? | Who? |
|--|-------------|----------|
| Cleaning the testing chamber, but do not scratch the ECTFE coated base. | monthly | Operator |
| Checking the door sealing for proofness and if necessary changing it | monthly | Operator |
| Checking the salt solution filter in the reservoir, if necessary changing it | monthly | Operator |
| Checking the filter of the humidifier by reading the difference of the pressure of the compressed air before the humidifier and before the nozzle, change it, if the difference is > 0,6 bar | monthly | Operator |
| Checking the filter of the pure water inlet port and change it if necessary | quarterly | Operator |
| Checking the filter of the filter unit for clean compressed air, change it if necessary | quarterly | Operator |
| Cleaning the drain system by rinsing water through the drain port in the base. | monthly | Operator |
| Cleaning and polishing the case | monthly | Operator |
| Determination of the corrosivity of the chamber according to ISO 9227 | Six monthly | Operator |



In the course of time the elasticity of the silicon foam seal can decrease. Consequently there may be not enough even surface pressure against the door so the chamber will not be hermetically closed anymore.

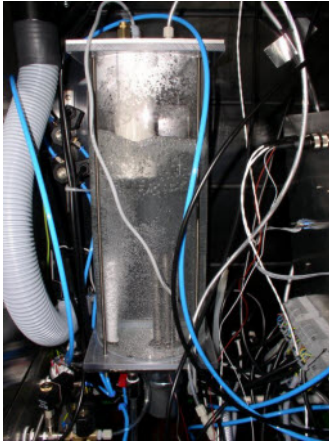
In this case adjust the hinges of the door such as to increase the pressure on the seal when door is closed .

If the seal has been damaged for chemical or mechanical reasons it has to be replaced. The seal can be removed very easily as it is not fixed by adhesives.

Functional testing accessories according to DIN EN ISO 9227

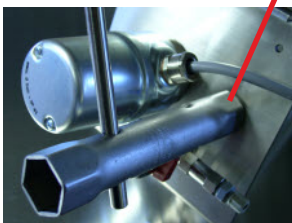


9.2 How to Replace the Filter in the Humidifier



The humidifier is equipped with an air filter necessary to clean the compressed air in compliance with the standards such as DIN EN ISO 9227 or ASTM B117-73. In the course of time the micro pores of this filter may become blocked.

The operator can determine when this filter has to be replaced by monitoring the difference between the pressure of the compressed air before and after the humidifier (pressure at the spray nozzle). These two pressures can be monitored on two manometers located on the control panel. This pressure difference should not exceed more than 0,7 bar. When the difference exceeds this value the filter has to be replaced. For this maintenance job the control compartment is accessible from the open underside. The only tool you will need is a box spanner No. 30.



- Switch the power off (main switch on "0")
- Wait a while until the water in the humidifier is cooled below 40 °C.
- Push a hose on the spout and place a bucket on the bottom.
- Open the stop cock by turning the red lever downwards so the water will rinse out of the humidifier
- Push the blue ring of the connector on the valve for compressed air and pull off the blue plastic hose
- Loose the (biggest!) screw on the filter unit with the box spanner
- Replace the new filter and screw the unit into the threaded hole again. Make sure that the connection is tight.
- Push the blue plastic hose back into the connector
- Close the stop cock by turning the red lever back in to initial (closed) position
- Switch the cabinet on again and the humidifier will be refilled with pure water

We strongly recommend to regularly change this filter unit to guarantee the supply of oil and particle free compressed air as stipulated in the ISO 9227.

10. Troubleshooting

10.1 Alarms

| Mains voltage breakdown (Duration...) | |
|--|--|
| Lack of compressed air | |
| Door of the cabinet or cover of the chest not closed | |
| Water overflow test chamber | |
| Water overflow humidifier | |
| Diaphragm pump failure | |
| Air valve not opened | |
| Tank 1 solution level minimum | |
| Tank 1 solution level maximum | |
| Excessive temperature of the test chamber | |
| Temperature of the test chamber too low | |
| Temperature roof cooling too high | |
| Temperature roof cooling too low | |
| Temperature humidifier too high | |
| Temperature humidifier too low | |
| Relative humidity too high | |
| Relative humidity too low | |
| Failure valve for cooling of the test chamber | |

10.2 Functional Problems

Fault: Red warning light "humidifiers overheating" on the front panel lights up. Max humidifier temperature is exceeded. Salt spray operation is interrupted,

| Cause | Action | |
|--------------------------------------|--|--|
| Overtemperature protection triggered | Reset overtemperature protection after removing the bottom cover of the heater in the humidifier | |

Fault: Salt spray test stopped or does not start

| Cause | Action | |
|---|---|--|
| Supply of compressed air is disrupted | Check the supply of the compressed air | |
| Door of the cabinet not closed | Close the door | |
| Filter for the test solution clogged | Change the tank filter | |
| Hose for test solution blocked or bent | Remove the block | |
| Check valve balls in the SAL pump bonded by crystallized salt | Clean the valve balls. Prevention: Rinse the test solution line with demin. | |
| Filter im Befeuchter dicht | Change filter | |
| Silicon hose in the in test chamber is broken | Change the hose | |
| SAL Pump does not operate | Turn off the pump and look for the cause of failure | |

Fault: **Solution level in the humidifier below the minimum value**

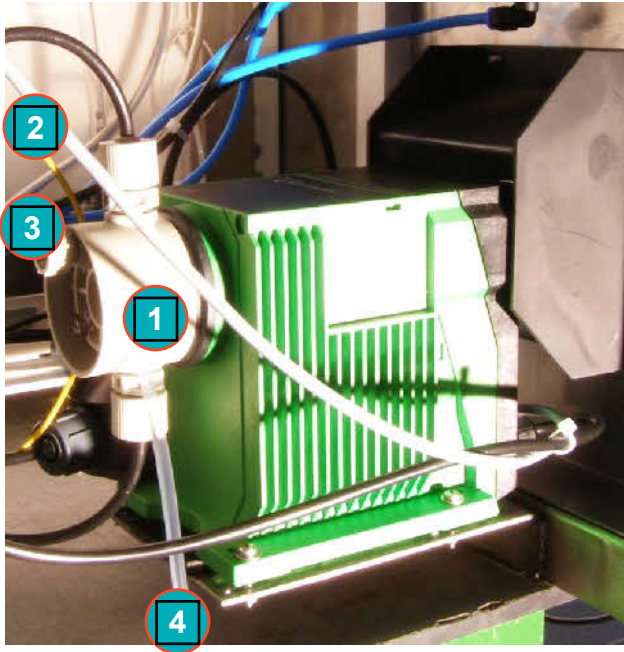
| Cause | Action | |
|--------------------------------|----------------------|--|
| Check valve dirty or defective | Change the valve | |
| Float switch dirty or broken | Clean or replace | |
| Water inlet valve broken | Change, renew | |
| Humidifier dirty | Clean the humidifier | |
| | | |



Fault: **Maximum level of the solution in the humidifier is exceeded. Controller display shows "FULL" and the salt spray operation is interrupted**

| Cause | Action | |
|-------------------------------|----------------------|--|
| Inlet valve for water broken | Change | |
| Floating switch does not work | Clean or replace | |
| Humidifier does not work | Clean the humidifier | |
| | | |
| | | |

10.3 Bleeding of Diaphragm Pump



Before the first start of the membrane pump the head (1) and the connecting hose to the test solution containers are not filled with liquid. To remove the air as quick as possible remove the pump head (1), open the bleed screw (3) by turning clockwise. Attach a hose (4) and put the other end in a container with the test solution.



Press the left start/stop button firmly and do not release it. The pump will run at maximum power. Keep the button pressed until all air is displaced from the system through the test solution in the tank. The process is finished when no more air bubbles rise through the sight glass on the control panel.

Close the bleeder screw on the pump head again!



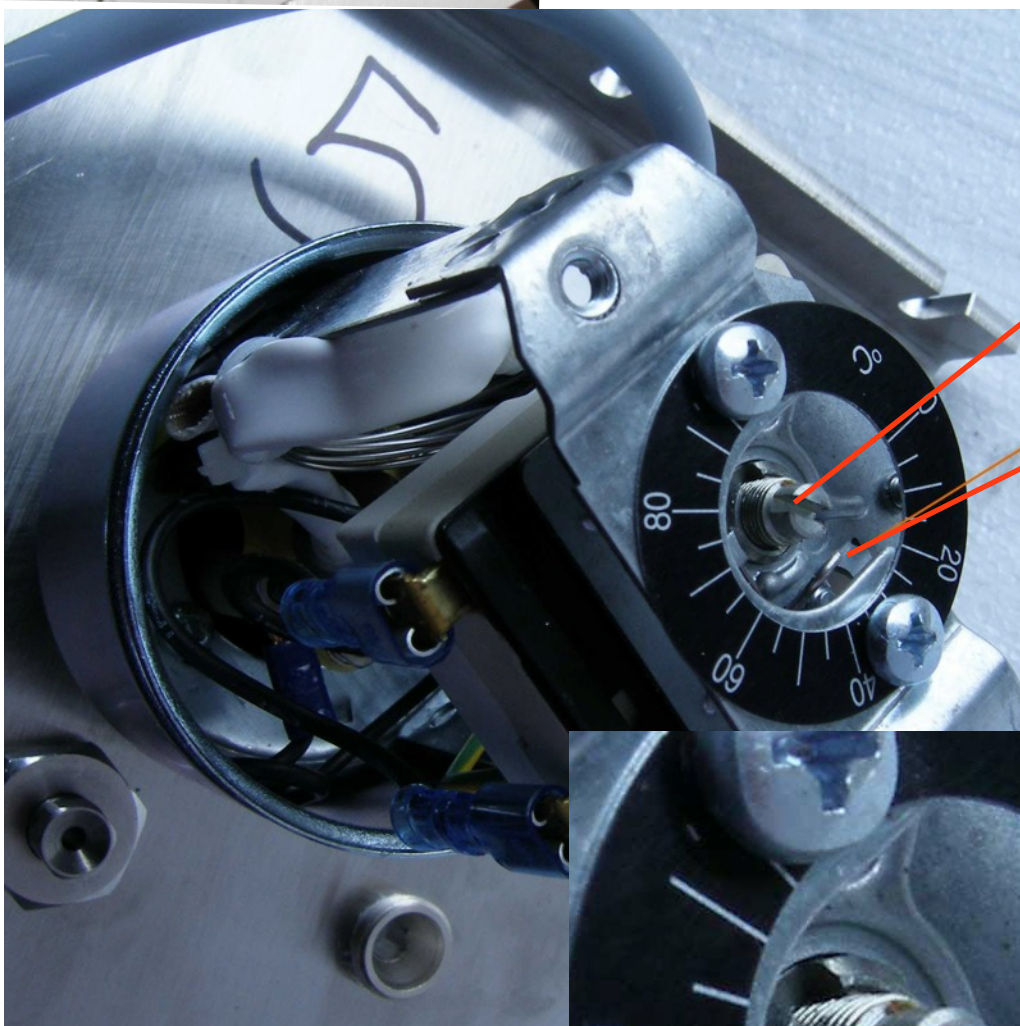
10.4 Resetting Over Temperature Protection of the Humidifier



Unplug the machine from the mains and wait until the humidifier cools down.

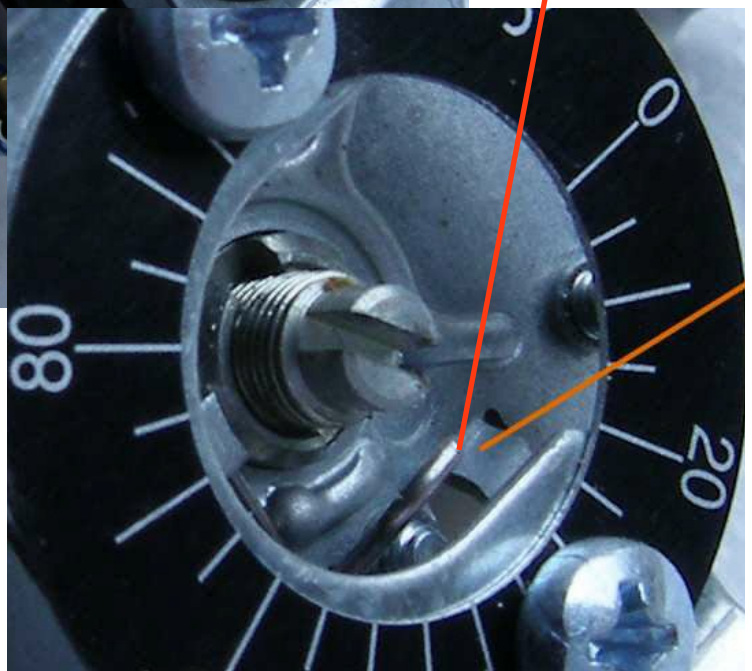
Remove the protective cap from the heating element. If the overtemperature protection has been triggered the spring has jumped out into the top position. To reset the over temperature protection press the spring back into its lower position.

Do not change the position of the adjustment screw!



Adjustment
screw

Spring



10.5 Nozzle Adjustment



Caution:

The test chamber, including the nozzle, has been configured to meet the requirements of the salt spray test according to DIN EN ISO 9227. If there is a need for additional adjustment of the nozzle the following procedure should be followed:

Fill a clean bucket with 10 L of demineralized water to avoid contamination of indoor air by salt fog. Place the bucket on the SAL-storage tank. Take the test solution hose from the tank and plug it into the bucket. In this way a pure water will be introduced to the nozzle.

- set the compressed air pressure regulator to 1 bar
- open the test chamber and bypass the door switch with a dummy connector (service items) so that the unit remains in operation.
- loosen the lower lock plate of the nozzle by turning it counterclockwise
- turn the top cap of the nozzle gently clockwise which will result in a more uniform spray cone



Caution:

Never turn the spray cap with violence. This might cause damage of the delicate nozzle and make it useless!

- When a uniform spray cone is achieved fix this setting by turning the wheel lock anti-clockwise
- Attach the pump hose back into the working position and adjust the desired flow rate (0.35 l/h).
- Use the graduated cylinder with two funnels on both sides of the nozzle, where later the samples will be positioned (see DIN EN ISO 9227)
- Close the test chamber and run the unit approximately for 16 hours
- During above test check whether the precipitation rate is 1.0-2.0 ml/hr
- Change if necessary the flow rate of the test solution, the air pressure or double check the setting of the nozzle



Solution

Compressed Air 0,8 bis 1,0 bar



Caution:

Make sure that the conditions in the test room is not caused by external influences such as Be adversely affected under-or over-pressure in the exhaust system.



11. Accessories and Consumables

11.1 Consumables



| Description / Name | Order Nr. |
|--------------------------------------|---------------|
| Filter for the humidifier | V.424.013.120 |
| Filter for the solution in the tank | V.852.221.000 |
| Filter for demineralized water inlet | |
| Nozzle set | V.241.231.000 |
| | |
| Cleaning and maintenance spray | V.852.280.000 |

| Description / Name | Order Nr. |
|-------------------------------|----------------|
| Door seal for SAL 400-S | V. 435.912.100 |
| Security glass door SAL 400-S | V.452.011.400 |
| | |
| | |
| | |
| | |
| | |
| | |

11.2 Accessories for Functional Tests According to DIN EN ISO 9227



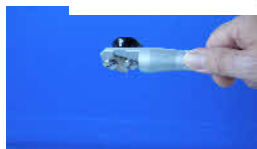
| Order Nr. | Description | |
|--------------------------|---|--|
| V.852.000.502 | Steel test panels for functional testing CR4 according to ISO 3574 150 mm x 70 mm, thickness $1 \pm 0,2$ mm, cleaned, Corrosion protection, single plate per sealed package | |
| V.852.100.513 | Adhesive tape, width 75 mm, roll length 66 m | |
| V.852.000.504 | Zinc test panels for functional testing, 50 mm x 100 mm, cleaned, corrosion protection, single piece per sealed package | |
| V.852.100.512 | Adhesive tape, width 50 mm, roll 66m | |
| A.0761.2500 | Petroleum benzin 80-110 °C for cleaning of test panels | |
| A.5007.2500 | Ethanol denatured, for drying of test panels | |
| A.3998.1000 | hydrochloric acid 20% desensitized with Hexamethylentetramin | |
| A.1667.1000 | di-Ammoniumhydrogencitrat for chemical analysis, 1 kg package | |
| A.1377.0500 | Glycin for chemical analysis and chemical cleaning of zinc test panels | |
| V.851.210.030 | Holder of test plates according to EN ISO 9227, length 550 mm, 21 slots, 3,5 mm, 20 ° | |
| V.851.210.130 | Holder of test plates according to EN ISO 9227, length 650 mm, 26 slots, 3,5 mm, 20 ° | |
| 112111653 | Beaker, 800 ml, tall form | |
| 330502100 | Tongs, length 200 mm | |
| V.852.100.510 | Brush for cleaning the test panels | |
| V.1.117.200.003 oder 004 | Chemical protective gloves, package with 50 Stck. Size L oder XL | |
| | Trockenbox aus PC zum Lagern der Gebrauchsnormale | |
| KE.EG-220-3NM | Precision scales for weighing the working standards | |
| V.852.100.552 | Complete set for evaluating the corrosivity, Including 10 test plates made of steel | |
| V.852.100.553 | Complete set for evaluating the corrosivity, including 10 test plates made of zinc | |

11.3 Accessories - Water Processing - Compressed Air



| Test solution | | Order-No. |
|--|-------|----------------|
| Sodiumchloride NaCl Purity acc. to DIN EN ISO 9227 PE Bags á 5000g, further packages upon request | | V.1.06400.5000 |
| Reagents for CASS Test upon request | | |
| PH-Meter Set for testing the NaCl-solution and fall-out | | V.852.220.000 |
| Reagents for adjusting the pH-value upon request | | |
| Fall-out rate measuring set (2 Cylinders, stoppers and funnels) | | V.852.000.610 |
| Chloride Test + Accessories | 1 Pc. | V.852.270.000 |
| PE-Reservoir on castors 130 L with hoses and filter | 1 Pc. | V.852.220.000 |
| PE-Reservoir 130 L | 1 Pc. | V.852.221.130 |
| Container pump for convenient solving of the NaCl | 1 Pc- | V.852.225.130 |
| Duct for even distribution of fine mist | 1 Pc | V.852.000.620 |
| Water purification plant | | |
| Ion exchanger stainless steel cartridge DI 2800 | 1 Pc. | V.852.250.028 |
| Ion exchanger stainless steel cartridge DI 2000 | 1 Pc. | V.852.250.020 |
| Adapter for quick release coupling Pack. 2 Pc. | 1 Pc. | V.852.250.1500 |
| Quick release coupling Pack. 2 Pc. | 1 Pc. | V.852.250.1506 |
| Conductivity meter, analog mountable on top of the cartridge | 1 Pc. | V.852.250.1601 |
| Conductivity meter, digital, mountable on the wall | 1 Pc. | V.852.250.1805 |
| Distribution unit 1 inlet port 3 outlet ports | 1 Pc. | V.852.250.1402 |
| Stop cock straight, plastic | 1 Pc. | V.852.250.1400 |
| Hose 1,50 m length with 3/4" connectors | 1 Pc. | V.852.901.000 |
| Hose 2,00 m length with 3/4" connectors | 1 Pc. | V.852.901.001 |
| Extension hose 2,00 m | 1 Pc. | V.852.901.005 |
| Compressed Air Supply | | |
| Screw compressor | 1 Pc. | V.852.211.101 |
| Laboratory compressor | 1 Pc. | V.852.211.000 |
| Capsuled laboratory compressor | 1 Pc. | V.852.211.100 |
| Coupling No. 5 | | |
| Plastic hose | | |
| Purification unit for oil- and particle free clean air | 1 Pc. | V.852.210.100 |
| GFK Grid to protect the base | 1 Pc. | V.852.221.003 |

11.4 Aecessories for Preparation of Test Samples



| Article | | Order Nr. |
|---|--|------------------|
| Original CCT 300/400 Unterschrank, Stabile Edelstahlrahmenkonstruktion mit Edelstahlfronttüren | | V.852.203.200 |
| Labortisch mit 1 Einlegeboden L/B/H 1500 mm | | V.852.012.200 |
| Labortisch mit 1 Einlegeboden L/B/H 1200 mm | | V.852.011.200 |
| Untergestell aus Aluminium Profilen L 1100mm | | V.852.020.000 |
| | | |
| Probenvorbereitung | | |
| Prüfbleche auf Anfrage | | nach Wahl |
| DIN RITZGERÄT MIT 0.5MM SCHNEIDE - SALZNEBEL TEST | | 'K0001538M202 |
| 'DIN RITZGERÄT MIT 1MM SCHNEIDE -- CASS TEST | | 'K0001538M201 |
| Ritzstichel nach Sikkens | | 'V.1.130.101.020 |
| Gitterschnitt-Prüfer mit beweglichem Schneidkopf, kompl. Set Mehrschneidenmesser 6 /11 Scheiden, Imbusschlüssel, Bürste, Rolle, Klebeband 22 m, Lupe, Bedienungsanleitung, Herstellerzertifikat, Transportkoffer. | | |
| Gitterschnitt-Prüfer ZCC-1 nach DIN EN ISO 2409 kompl Set Schneidenabstand 1 mm | | V.1.130.101.001 |
| Gitterschnitt-Prüfer ZCC-2 nach DIN EN ISO 2409 kompl Set Schneidenabstand 2 mm | | V.1.130.101.002 |
| Gitterschnitt-Prüfer ZCC-3 nach DIN EN ISO 2409 kompl Set Schneidenabstand 3 mm | | V.1.130.101.003 |
| Gitterschnitt-Prüfer ZCC-1.0 nach ASTM D3002/D3359 kompl Set 11 Schneiden Schneidenabstand 1 mm | | V.1.130.101.011 |
| Gitterschnitt-Prüfer ZCC-2.0 nach ASTM D3002/D3359 kompl Set 6 Schneiden Schneidenabstand 2 mm | | V.1.130.101.012 |
| Ritzgerät mechanisch | | V.1.130.102.000 |
| | | |
| Auswertung der Prüfergebnisse | | |
| Schichtdickenmessgerät für FE-und NFE-Substrate | | QN.1500 |
| Lupen, Mikroskope | | auf Anfrage |
| | | |
| Schwedische Rostkala | | auf Anfrage |
| | | |

