WKM

Thermal process technology
Environmental simulation
Project planning

Whatever you are going to simulate.

We project it.

Environmental simulation

Contents

We are WKM

WKM has been active as an independent sales company since 1996. We work as Factory representation and sales partner together with renowned manufacturers. Lachendorf in Lower Saxony became our new headquarters in 2014.

You can reach us for a personal conversation - without an automativ telephone waiting loop! Technical consultation on site is a matter of course for us. We would be pleased to arrange an appointment for a visit to your company or on a virtual meeting. For us, advice does not end with the order. After delivery of the system, you will receive a commissioning and equipment training on request.

You are invited to visit our technical centre to get a detailed impression of our work and the quality characteristics of the product range. Here we can also carry out individual training and further education programmes for you.

WKM offers a comprehensive program to determine all project-specific basics. We implement your requirements precisely and consistently and assist you in all phases of your projects.

Our key to success: **Listen, Advise, Act**.

Environmental Simulation

The environmental influences on products and their effects are numerous and vary widely. The necessity for equipment and component manufacturers to bring functioning products on the market, requires in each case the correct test corresponding to the natural environmental condition.
The goal of the simulation is the detection of cause-effect connections, the qualification of products for the given environmental conditions and optimisation of an environmental-based product development. With aging and weathering processes and for reliability studies, the questions of time compression and artificial aging play a significant role.

Typical applications of the environmental simulations

Uniform and reproducible environmental test methods are used for a comparability of measurements and quality tests. The test options in the environmental simulation are comprehensive and thus frequently lead to use of the following types of simulation:

- Temperature
- Shock test
- Climate
- Sunlight
- Vibration
- Leakage test
- Corrosion
- Height simulation
- Emission

Available design models

If the cabinet or chest version is not sufficient for your project, it will have to be a size larger. We will be happy to advise you on this. Available designs are listed with the following icons:

- Cabinet
- Drawer cabinets
- Chest
- Continuous system
- Chamber (walk-in)
- Container systems

Safety

Several regulations must be considered to protect the system operator and process safety when handling devices and systems. The following regulations could be relevant for you:

- Hazard Level
- Explosion protection
- AMS 2750 F

Aging processes through temperature changes

Temperature test cabinets

Performance parameters

Temperature range
RT +15 °C to +300 °C
–10 °C to +100 °C
–70 °C to +210 °C

Device properties

Test room volumes
Test cabinet from 25 l to 4000 l
Walk-in chambers from 4 m³ to 230 m³

Design type

Safety

In the time-lapse effect, ageing processes in the life cycle of a product are simulated, so that quality defects can be detected and eliminated at an early stage. Corresponding to the necessary severity grade, temperature change rates from 2 to 4 K/min as stress factor can be achieved.

More additional options:

- adjustable fan speed
- CO_2 as alternative to coolant R 23
- compressed air dryer DP –40 °C
- digital and analogue channels
- hand hole feedthrough
- movable design
- notch feedthrough
- observation window in the door
- temperature expansion to +250 °C
- temperature measurement on test goods, switchable as control sensor
- tube passthroughs ø 50; 80; 125; 150 or 200 mm

Temperature storage cabinet 400 l

Temperature test cabinet 720 l

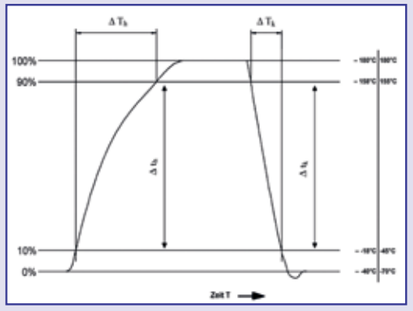
Temperature change test cabinet 25 l

Temperature test cabinet 350 l

DIN EN IEC 60068-3-5

Temperature change rate, an important indication for the performance capability of a system in the environmental simulation. Customarily in the industry the change times are determined according to IEC 60068-3-5 and published correspondingly in the technical data. Here it must be taken in to account that each 10 % of the performance range of the system does not flow in the calculation methodology.

Example:
For a test cycle of –70 °C to 180 °C there is a total sequence of 250 K. This value is shortened by 10 % with 25 K each from the start and end of the test cycle. Thus the entire stretch of 250 K is not observed, but rather only the range from –45 °C to +155 °C in order to determine the change rate.



The specified temperature change rate in the air always applies only for "in average" with an empty test chamber and without heat input from the test specimen. If "linear" change rates are desired with test goods, these are explicitly described.

WKM simply clarifies

**Would you like more information?
Then be sure to contact us!**

Extreme temperature changes

Temperature shock test chambers

Performance parameters

Temperature range
+50 °C to +220 °C (hot chamber)
– 80 °C to +100 °C (cold chamber)

Change times
< 10 s up to 130 l
< 20 s up to 2,100 l

Device properties

Test room volumes
Test cabinet from 32 l to 2,300 l

Design type

An extreme accelerated temperature change on the test specimen is achieved by a temperature shock test. The change between two temperature zones within < 10 seconds has a strong accelerated aging effect, in which the product weak points are revealed and optimisation potential on the test specimen is visible.

More additional options:

- cycle operation in the cold chamber
- heavy load design
- heavy load lift car
- movable design
- temperature expansion to +250 °C
- temperature measurement in lift car
- tupe feedthrough ø 80; 125 mm

Standards:

- DIN EN 60512-11-4
- LV 124 K05
- MIL-STD 810G
- MIL-STD 883E
- VW 80000 K05
- DIN EN 1183

Shock test chamber 1200 l

Shock test chamber 350 l

Shock test chamber 130 l

Shock test chamber control unit

Dry air dryer for deep dehumidification of the cold chamber

With an installed compressed air dryer a very high number of cycles is achieved without test interruption for defrosting of the evaporator in the cold chamber. The dried compressed air humidifies the usable space of the chamber in a targeted manner, so that when the lift car is changed, no air humidity can condense out on the evaporator. A reduction of performance due to freezing of the exchanger is prevented. Downtimes due to defrosting phases are thus significantly reduced.

Splash water test systems

Splash water test

Performance parameters

Temperature range
Chamber: up to +160 °C
Water: +2 °C to +4 °C

Splash medium
Water
Water & Arizona dust

Device properties

Test room volumes
from 250 l to 25 m³

Design type

Safety

DIN EN 1539

The test specimen can be heated by circulated air up to +160 °C and then is cooled shock-cooled by a defined and tempered test medium by splash water.

Arizona dust can be additionally mixed with the water. This test method supplements the classic leakage tests acc. to IP protection class with water and dust. The splash nozzle corresponds to ISO 16750-4, LV 124-K12 and VW 80000, among others.

This test simulates the life cycle stress and is used to safeguard the function during an abrupt cooling with splash water.
Here the cold splash imitates, for example, driving through a puddle.

The chamber meets, among others things, the following test standards:

- BMW GS 95003 6.6.2
- BMW GS 95024-3-1_K-12
- ISO 16750-4
- LV 124 K-12
- Renault 36-00-802-K
- VW 80000 K-12

Splash water test with the following product features:

- chamber temperature up to +160°C
- water temperature of the splash water +2°C to +4°C
- optionally the splash water nozzles can additionally be actively cooled
- splash water volumes per surge are 3 to 4 litres, the adjustable surge time is 3 seconds in many standards
- splash medium: City water or demineralised water or an alternate with additional mixing of 3% weight percentage Arizona dust (ISO 1203-1 Group fine)
- test room volumes can be individually laid out
- cycle times, splash duration and splash volumes are freely programmable
- ducts for integrating on-site supply lines

Splash water chamber SWK 100/100/75-16

Ice water shock test

Test methods for the ice water test

Performance parameters

Temperature range
Chamber: up to +200°C
Water: +2°C to +4°C

Immersion medium
Water
Water / Glycol mixture
Saltwater

Device properties

Test chamber volumes
from 250 l to 25 m³

Design type

Safety

DIN EN 1539

The test specimen is heated by circulating air up to +200°C and then shocked by immersing in a cold test medium. This test simulates the life cycle stress and is used to safeguard the function during shock-like cooling by immersion.

The goal of the simulation is to protect the test specimen from penetration of water, to ensure the functionality. The subsequent evaluation is done via a continuous parameter documentation.

Ice water test chamber EWT 1000

Ice water shock test with the following boundary conditions:

- furnace temperature up to +200°C
- water temperature of the immersion tank (to shock the test specimen) +2°C to +4°C
- immersion medium salt water
- the cooling of the immersion bath is done via a saltwater resistant heat exchanger
- individual layout of the reverse cooling device, depending on the heat input of the test specimen per immersion process
- smooth circulation of the saltwater in the immersion tank to avoid temperature stratification
- freely programmable cycle times, as well as duration of the heating and immersion process
- the test room volumes and the immersion tank volume can be individually dimensioned, depending on the test specimen
- the immersion depth can be set via the program control and is coordinated in detail

The chamber meets, among others things, the following test standards:

- BMW GS 95003 6.6.2
- LV 124 K-13
- VW 80000 K-13

Constant climate tests

Constant climate test systems

Performance parameters

Temperature range
+10 °C to +90 °C

Air humidity
10 to 98 % relative humidity

Device properties

Test room volumes
from 56 l to 4,000 l
Walk-in chambers from 4 m³ to 230 m³

Design type

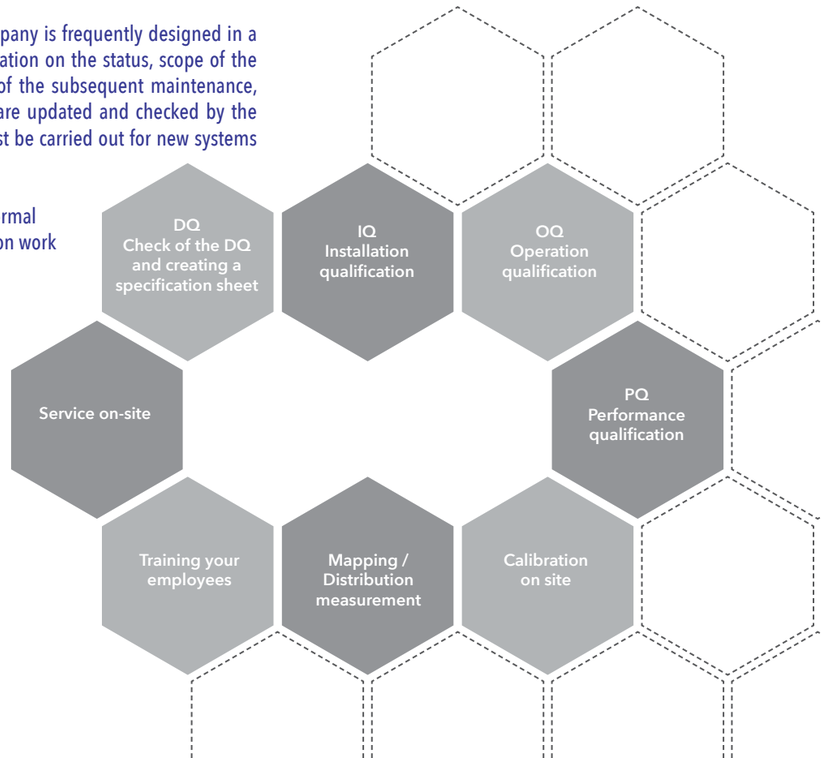
Safety

Walk-in climate chambers

Validation - Basis of your quality assurance

The equipment of a pharmaceutical company is frequently designed in a qualification matrix and contains information on the status, scope of the qualification as well as the scheduling of the subsequent maintenance, calibrations and requalifications. These are updated and checked by the responsible employee. Qualification must be carried out for new systems and equipment.

After each qualification stage, there is a formal confirmation that the required qualification work has been properly completed.
(see honeycomb diagram)



Constant climate tests / Stability tests

Real time tests with defined climate zones and climate conditions are not only important during the development phase, but also as a test criterion for the preparation of the BGA and the FDA. Based on your results, the minimum shelf life, specifications and storage information can be defined and included for product approval.

The following climate zones are frequently used:

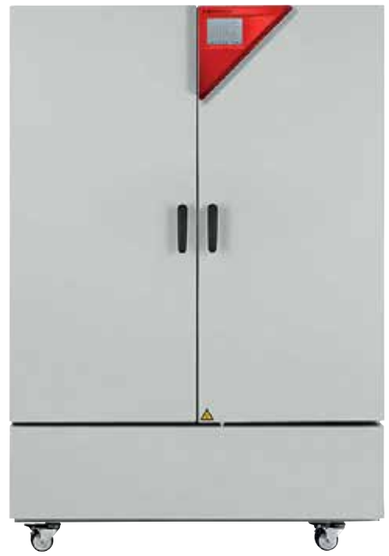
Zone I :	Moderate	21 °C / 45 % RH
Zone II:	Mediterranean, sub-tropical	25 °C / 60 % RH
Zone III:	Hot and dry	30 °C / 35 % RH
Zone IVa:	Hot and humid	30 °C / 70 % RH
Zone IVb:	Hot and very humid	30 °C / 75 % RH

Climate storage cabinet
2200 l

Standards:

- DBL 9202 4.1.3
- DIN EN 60068-2-67
- DIN EN 60068-2-78
- DIN EN 12721
- ICH Q1A
- LV 124 K-14

Light cabinet 400 l with 3 exchangeable light cassette



Climate storage cabinet
720 l

Climate change test

Climate test systems

Performance parameters

Temperature range
–40 °C to +180 °C
–70 °C to +210 °C

Temperature change rate
up to 4 K/min heating and cooling
> 5 K/min, see screening cabinets

Air humidity
10 to 98 % relative humidity

Device properties

Test room volumes
from 56 l to 4,000 l
Walk-in chambers from 4 m³ to 230 m³

Design type

Safety

Environmental influences are simulated on a test object under defined temperature and humidity. Subsequent functional tests of, for example electrical and mechanical elements, are important to ensure maintaining the product properties under extreme environmental conditions.

Standards:

- BMW PR 303.5
- DIN EN 60068-2-30
- DIN EN 60068-2-38
- Porsche PPV 4015
- PV 1200
- PV 2005-A

Climate test cabinet 1500 l

Climate change test cabinet 350 l

Options:

- adjustable fan speed
- analogue-Out 4 to 20 mA/0-10 V
- hand hole feedthroughs
- movable design
- notch feedthroughs
- observation window in the door
- temperature expansion to +210°C
- temperature measurement on test goods, switchable as control sensor
- tube feedthroughs

Climate test cabinet 56 l

Climate test cabinet 720 l

Dew point

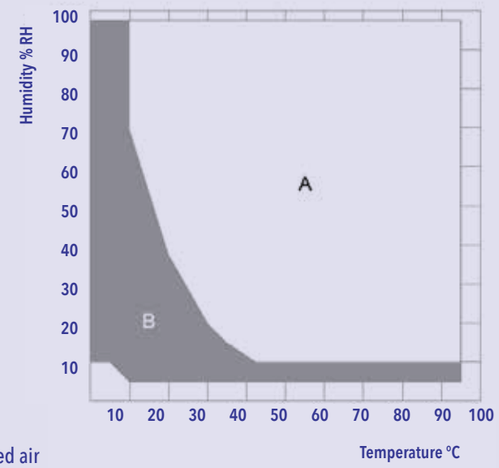
The actual performance capability of a climate test cabinet is defined in the climate operation via the dew-point range.

The possible climate values of a climate test cabinet can be taken from a Mollier diagram.

The dewp oint range can be expanded with the compressed air dryer, as the dehumidification performance can be significantly increased.

Example Value A — 25 °C / 80 % RH
possible without compressed air dryer

Example Value B — 20 °C / 30 % RH
can only be reached with additional compressed air flushing DP < –40 °C



A: Standard climate range
B: Expanded range with controlled compressed air dryer

Simulated aging processes

Screening test

Performance parameters

Temperature range
–40 °C to + 180 °C
–70 °C to + 180 °C

Temperature change rate
up to 30 K/min heating and cooling

Air humidity
10 to 98 % relative humidity

Design type

Device properties

Test room volumes
from 100 l to 4,000 l
Walk-in chambers from 4 m³ to 230 m³

Safety

Accelerated time effects are used to perform intensified ageing processes in temperature or climatic test chambers. The focus is on shortening test times and increasing product stress. Depending on the degree of severity, temperature change rates of 5 to 30 K/min can be set as stress factors.

Standards:

- BMW PR 303.5
- DIN EN 60068-2-30
- DIN EN 60068-2-38
- Porsche PPV 4015
- PV 1200
- PV 2005-A

Climate screening test cabinet 900 l
10K/min

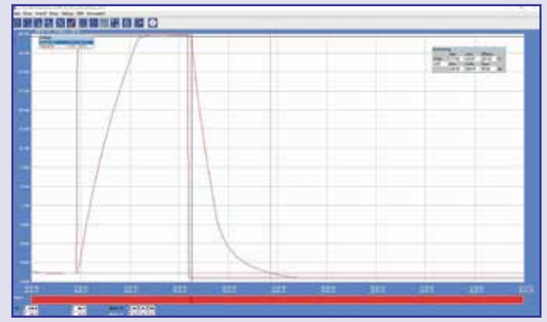
Options:

- adjustable fan speed
- analogue-Out 4 to 20 mA / 0-10 V
- hand hole feedthroughs
- movable design
- notch feedthroughs
- observation window in the door
- temperature expansion to +210 °C
- temperature measurement on test goods, switchable as control sensor
- tube feedthroughs

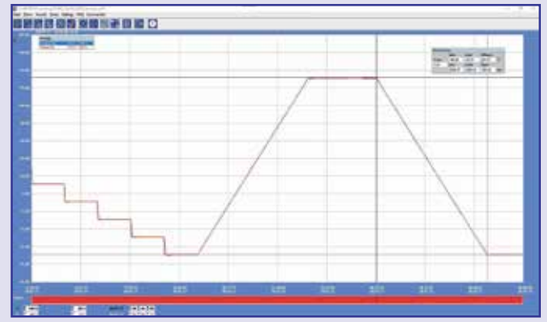
How fast is fast?

Kelvin is mainly used in science and technology to indicate temperature differences, according to DIN 1345 the unit kelvin is recommended. 1 degree Celsius temperature difference corresponds to 1K, the temperature curve is only moved by 273.15 K.

Graphic A:
Here a cooling curve is shown in average, the temperature changes faster up than down. The cooling performance of the cabinet reduces to the end temperature.



Graphic B:
Here a linear cooling curve is shown, the cooling curve remains the same over the entire range. The performance of the cabinet must be correspondingly higher.



Climate screening test cabinet 2100 l
10K/min

The correct test chamber volume

Walk-in test chambers

Performance parameters

Temperature range
–40 °C to + 180 °C
–70 °C to + 180 °C

Temperature change rate
up to 20 K/min heating and cooling

Air humidity
10 to 98 % relative humidity

Device properties

Test room volumes
from 2 to 230 m³

Design type

Safety

Large test specimen or test set ups must be able to be tested equivalent to small assemblies. For these requirements we plan and implement our walk-in test systems. In coordination with your on-site basic conditions we create solution concepts that have been proven in their diversity in practice.

Standards:

- BMW PR 303.5
- DIN EN 60068-2-30
- DIN EN 60068-2-38
- Porsche PPV 4015
- PV 1200
- PV 2005-A

Walk-in climate test chambers 60 m³
Airbag temperature test chamber 50 m³

Excerpt from a wide variety of options:

- chamber insulation in non-flammable insulation A1
- compressed air dryer DP –40 °C to prevent condensation on the test goods
- EUCAR Hazard Level safety equipment options
- floor load reinforced
- ground level accessibility to the walk-in chambers
- individual chamber volumes
- observation window
- speed controlled fans
- system design in split construction
- tube feedthroughs

Interior view

WKM

Whatever you are going to simulate.

We project it.

Working safely

ATEX safety

Performance parameters

Temperature range
RT +10 °C to +100 °C
–40 °C to +180 °C
–70 °C to +180 °C

Temperature change rate
up to 15 K/min heating and cooling

Air humidity
10 to 98 % relative humidity

Design type

Device properties

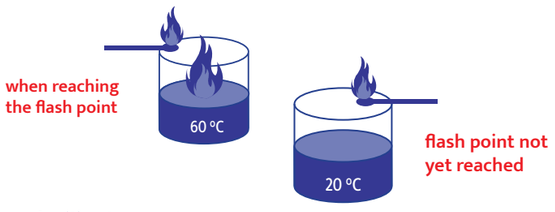
Test room volumes
from 50 l to 4,000 l
Walk-in chambers from 4 m³ to 230 m³

Safety

Triangle = Terms for Ex protection

Flash point

The flash point is the lowest temperature at which the vapours can develop from a liquid. These vapours can form a potentially ignitable mixture. The flash point is always significantly lower than the ignition temperature.



Ignition temperature

The ignition temperature (also ignition point or inflammation point) is the temperature of a substance at which it ignites spontaneously without external effect / ignition sparks.
At a significantly lower flash point the gas mixture ignites only by external ignition (see also combustion point). The ignitibility of a gas mixture is also dependent on the mixture ratio with oxygen. The mixture ratio with air, in which the gas mixture is ignitable is called the explosion range.

Ex-climate test cabinet 1500 l

WKM simply clarifies

Would you like more information?
Then be sure to contact us!

Definition of the safety zone

The explosion protection measure can be deduced with the definition of the safety zone. In the field of environmental simulation, the following have been tried and tested:

Primary explosion protection: By reducing the oxygen contents to < 3% an ignition is excluded.

Secondary explosion protection: Through the exclusion of hot surfaces and other ignition sources, an explosion protection using an indirect tempering is reached.

Zone classification

Zone 0:
Area in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is present continuously or for long periods or frequently.

Zone 1:
Area in which it can be expected that a potentially explosive atmosphere as a mixture of flammable substances in the form of gas, vapour or mist with air occurs occasionally during normal operation.

Zone 2:
Area in which during normal operation it is not expected that a potentially explosive atmosphere as a mixture of flammable substances in the form of gas, vapour or mist with air occurs, or if it occurs only briefly.

ATEX Directive 2014/34/EU

	II	1	G		Ex	h	II A	T3	Ga
	①	②	③		④	⑤	⑥	⑦	⑧
	Marking according to guideline requirements				Marking according to normative requirements				

① **Device group I:**
Devices for use in underground operations of mining as well as their above ground systems, which could be a risk due to mine gas and/or flammable dusts.

Device group II:
Devices to use in the other areas, which can be a risk due to a potentially explosive atmosphere.

② **Device category 1 corresponds to Zone 0:**
Very high level of safety -
Use in Zones 0/20, 1/21, 2/22 possible

Device category 2 corresponds to Zone 1:
High level of safety -
Use in Zones 1/21, 2/22 possible

Device category 3 corresponds to Zone 2:
Normal level of safety -
Use in Zones 2/22 possible

③ **Type of potentially explosive atmosphere:**
G= Mixture of air and gases, vapours or mist
D= Dust-air mixture

④ The symbol "Ex" indicates that the device corresponds to one or several ignition protection types.

⑤

Ignition protection type of non--elect. explosion protection	Symbol	Standard
Constructive safety "c"	h	EN ISO 80079-37
Ignition source monitoring "b	h	EN ISO 80079-37
Liquid immersion "k"	h	EN ISO 80079-37

⑥ **Explosion group:**
II A: e.g.: Acetone, benzine, ethane, methanol, phenol
II B: e.g.: Ethyl ether, ethylene, hydrogen sulphide, city gas
II C: e.g.: Acetylene, carbon disulphide, hydrogen

⑦

Temperature class	Max. surface temperature in °C
Temperature class T1	450 °C (ignition temperature > 450 °C)
Temperature class T2	300 °C (ignition temperature > 300 °C)
Temperature class T3	200 °C (ignition temperature > 200 °C)
Temperature class T4	135 °C (ignition temperature > 135 °C)
Temperature class T5	100 °C (ignition temperature > 100 °C)
Temperature class T6	85 °C (ignition temperature > 85 °C)

⑧ **Equipment Protection Level (EPL):**
EPL "Ga" corresponds to Category 1G
EPL "Gb" corresponds to Category 2G
EPL "Gc" corresponds to Category 3G
EPL "Da" corresponds to Category 1D
EPL "Db" corresponds to Category 2D
EPL "Dc" corresponds to Category 3D

Consideration of EUCAR hazard levels

Battery test systems

Performance parameters

Temperature range
0 °C to +80 °C
–70 °C to +180 °C

Temperature change rate
up to 4 K/min heating and cooling
> 5 K/min, see screening cabinets

Air humidity
10 to 98 % relative humidity

Design type

Device properties

Test room volumes
from 25 l to 3,000 l as test cabinet
walk-in chambers

Safety

The development of energy storage systems requires safe test benches for the development and quality assurance of lithium-ion batteries. Due to the high energy and power density of these systems, before a test the classification according to the EUCAR Hazard Levels must be carried out by the operating company in regards to personal safety. The employer (user) must assess the occurring risks (risk assessment) of the operating equipment before its use according to the Industrial Safety Regulations.

Standards:

- UN 38.3 T1
- ST/SG/AC.10/11/Rev.5
- DIN EN 50272-3

Equipment features:

- chamber in non-conductive special coating
- heated overpressure flap in the unit ceiling
- housing in largely gas-tight design
- inert gas connection
- lock tensioner for the door
- telescopic pull-outs with perforated plate levels
- tube feedthroughs NW 30

EUCAR Hazard Levels

Hazard-Level	Description	Effects
0	no effects	no effect. No influence on functionality
1	protection system responds	no defect, cell recoverable, repair protection system.
2	defect, damage	cell damaged. Repair necessary
3	leak, mass loss < 50 %	loss of electrolyte, blowing off the cell, no flame or fire*
4	gas leakage, mass loss > 50 %	loss of electrolyte, blowing off the cell, no flame or fire*
5	fire or flame	no breakage, no explosion, no flying parts
6	breakage	no explosion, no flying parts
7	explosion	destruction in a very short time

* The occurrence of a flame or fire implies the existence of an ignition source, a flammable substance and oxygen in a combustible/ignitable mixture. As soon as an ignition source is present and the escaping liquid (electrolyte) or gases are flammable, Hazard Level 3 or 4 unavoidably becomes Hazard Level 5.

Solution example for a forming cabinet
Temperature range 0°C to +80°C

Forming cabinet KB 400-S

No.	Optional safety options	basic bundle	bundle II	bundle III	bundle III altern.	bundle IV
1	electromagnetic door lock	x	x	x	x	x
2	independent temperature limit controller Tmax	x	x	x	x	x
3	pressure relief via reversible flap		x	x	x	x
4	CO sensor for fire detection			x	x	x
5	flushing device*** with CO_2 / N_2 / LN_2			x		x
6	N_2-inertisation (permanent-inertisation) and O_2-measurement				x	x
7	pressure relief via rupture disc					x
	achievable Hazard Level	0 - 3*	0 - 4*	0 - 5	0 - 5	0-6(7)**

Optional safety options

* Prerequisite: gas or fluid (electrolyte) escaping from the cell is not flammable.
For this observe information for Hazard-Level 3 & 4.

** Note: Level 7 must only be present with a very small risk, as tolerable residual risk.

*** Flushing unit with on-site supply of CO_2, N_2 or LN_2.

Safety equipment for battery cabinets

WKM simply clarifies

Would you like more information?
Then be sure to contact us!

Fuel cells

Test systems for fuel cells

Performance parameters

Temperature range
–70 °C to +180 °C
–55 °C to +200 °C

Temperature change rate
acc. to customer requirements

Air humidity
10 to 98 % relative humidity

Device properties

Test room volumes
from 25 l to 3,000 l as test cabinet
accessible test cells

Design type

Safety

H 1–7

Climate cell CW-40/27 Ex combined with conditioning unit CSR -60/900-S

Depending on the task, the fuel cell can be tested, for example, under the following considerations:

- direct connection of the air supply with the fuel cell
- non-preconditioned process air supply in the test room
- prepared process air supply in the test chamber and temperature controlled hydrogen

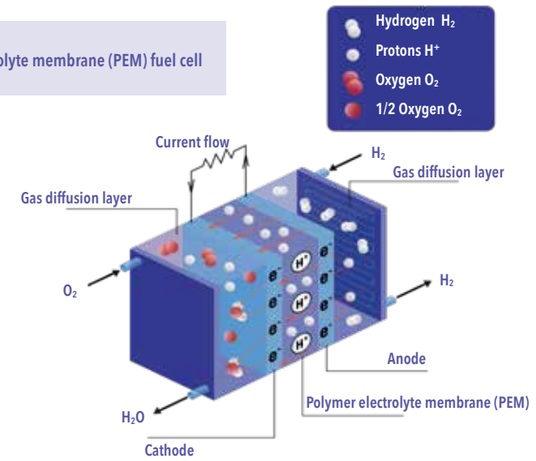
We can present corresponding safety equipment for your intended test bench:

- H_2 sensors in the process air piping or in the test room
- indirect heat carrier heating in the process air conditioning
- indirect heat carrier heating in the test chamber
- pressure relief flaps/rupture discs in the ceiling of the test chamber
- flushing unit with compressed air / fresh air
- temperature controlled hydrogen

The reaction in the fuel cell

Polymer electrolyte membrane (PEM) fuel cell

The heart of the fuel cell consists of two electrodes: the anode and the cathode. They are separated from each other by a membrane. This is impenetrable for gasses. Each of the electrodes is coated with a catalyst, for example of nickel or platinum. This is how the cell works, using the polymer electrolyte membrane fuel cell as an example: The anode is supplied hydrogen (H_2), the cathode oxygen (O_2). On the anode side the hydrogen is oxidised by submission of electrons to protons. The electrons flow from the anode over an external circuit to the cathode. Current flows. The protons diffuse through the electrolytes to the cathode. Water (H_2O) arises here from the protons and electrons together with the supplied oxygen. A fuel cell thus continuously produces electrical energy, heat energy and water.



What is a fuel cell?

A fuel cell is an element that converts the chemical energy of a fuel (hydrogen, natural gas, methanol, petrol, etc.) and an oxygen carrier (air or pure oxygen into electricity. Hydrogen can be fed directly into the fuel cell. When using natural gas, petrol, etc., a etc. an upstream reformer process is required. The so-called fuel-reformer converts, e.g., petrol, into a hydrogen-rich gas. CO2 is generated in this process.

Fuel cells as well as batteries are electrochemical devices. The difference from a battery is that the fuel cell cannot run “empty” or require charging. It will generate electricity and heat as long as fuel and oxygen carrier is supplied. The structure of a fuel cell generally consists of a fuel electrode (anode) and an oxygen electrode (cathode) separated by an ion-conductive membrane.

Temperature control systems

Medium water / Glycol or oil

Find more details here!

Performance parameters

Temperature range
–40 °C to +150 °C with
water / glycol mixture
–40 °C to +300 °C with oil

Device properties

Size according to demand

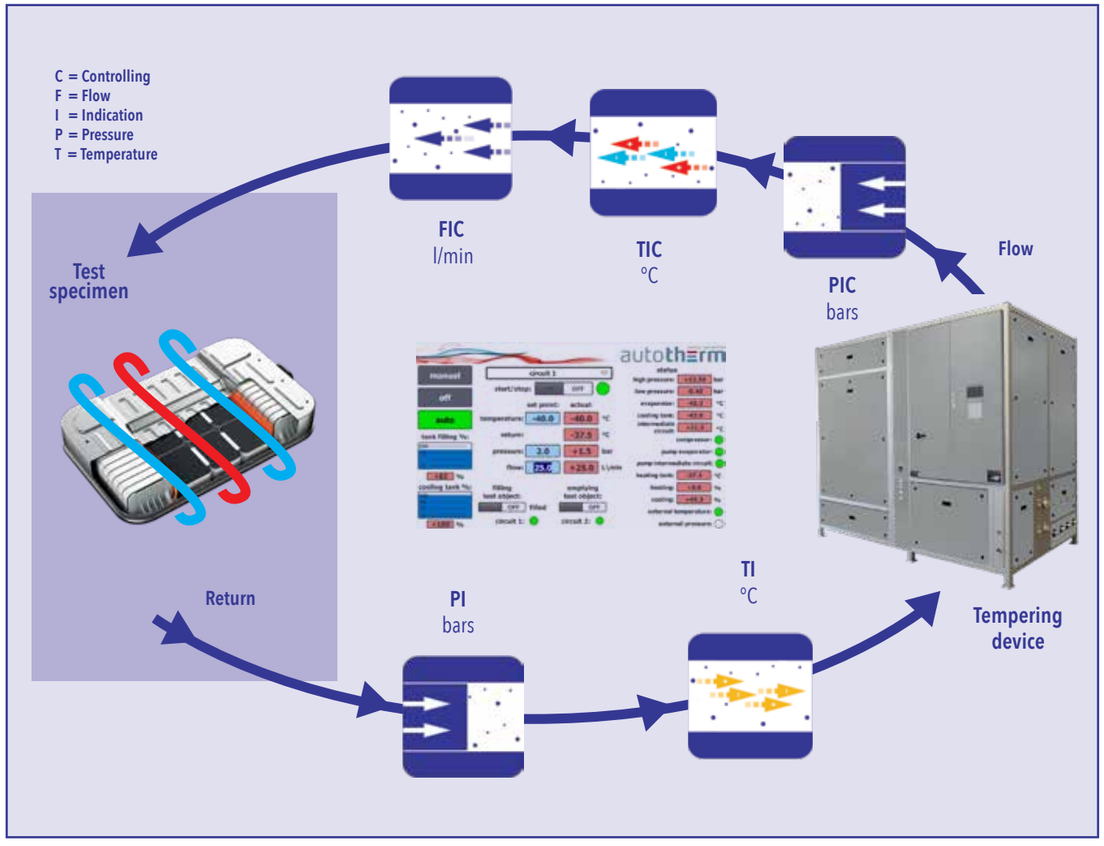
Heating / cooling performance
according to requirements profile

Especially in the field of electromobility and fuel cell research, different components (e.g. power electronics, batteries, electric motors) must be subjected to reproducible functional and endurance testing. Accelerated temperature change times are reached with the tempering of the internal water/glycol or oil circuit. Furthermore, the thermal energy emitted by the test specimen is dissipated via the medium. Thus the test specimen is protected from overheating and earlier test results can be achieved through faster test cycles.

Equipment features:

- central refrigeration
- isolating transformer for system separation
- leakage monitoring
- multi-circuit systems
- pressure measurement / control
- remote maintenance modules
- split construction method
- volume flow rate measurement/control
- water cooled condenser

Not much space? We design your tempering device according to your requirements. Profit from our experience.



Temperature control unit in moveable design

Conditioning system	Set up in control cabinet housing

Individual solutions

Test systems for your test bench

Performance parameters

Temperature range
–40 °C to +180 °C
–70 °C to +180 °C

Temperature change rate
up to 30 K/min heating and cooling

Air humidity
10 to 98 % relative humidity

Device properties

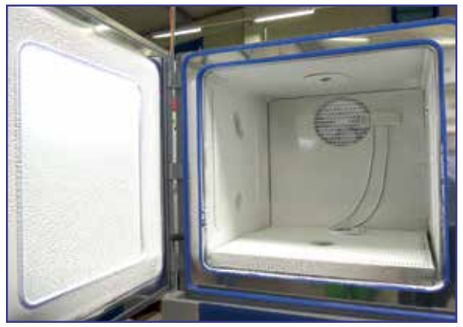
Test room volumes designed
to customer requests

Design type

Safety

Temperature and climate test systems can be designed diversely to the geometry of the test specimen as well as the desired test parameters. For this we realise a variety of customer-specific solutions, which we present in the following with several examples.

Snow cabinet C -40/ 600-S



Climate hood CS -60/2300-S with external refrigerator set

Engine test bench T -40/1800-S Ex

Conditioning unit CSR -60/810-10 with external test box

Vibration

Test chambers for combination with dynamic shaker systems

Performance parameters

Temperature range RT
up to 300°C
–40 °C to +180 °C
–70 °C to +180 °C

Temperature change rate
up to 30 K/min heating and cooling

Air humidity
10 to 98 % relative humidity

Design type

Device properties

Test room volumes
from 56 l to 4,000 l
Walk-in chambers from 4 m³ to 230 m³

Safety

Combined tests under influence of vibration, temperature and humidity intensify the test loads. Vibration tests are often performed on electrodynamic vibration generators (shaker systems), in order to achieve additional mechanical stress on the test units. The clamping surface of the shaker system and the geometry of your test parts determine the respective test room size of our temperature or climate vibration test chambers.

Type of excitation of the vibration test:

- impulsive excitation
- noise-shaped excitation
- sinusoidal excitation
- sinusoidal and noise-induced excitation

Climate-vibration test cabinet CV -70/1100-5

Climate-vibration test cabinet CV -40/1100-10

Standards:

- IEC 60068-2-6
- IEC 60068-2-27
- IEC 60068-2-50
- IEC 60068-2-64
- DIN EN 61373
- ISO 16750-3

Climate-vibration test cabinet CWV -50/14

Climate-vibration test cabinet CWV -50-24

Adaption options shaker with test chamber

In the time management of the test not only the pure test time, but rather also the setup times for the change of the excitation direction between vertical or horizontal alignment is an expenditure of time to be observed. For the connection to the temperature or climate test chamber there are many adaption options.

If the fitting size of the shaker is not sufficient, the clamping surface can be significantly enlarged through the use of a head expander. During the planning of the installation location the static structural framework data, the load carrying capacity of the foundation, the transfer heat and the occurring noise level in the operation of a vibration test system must be observed.

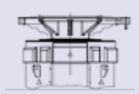
WKM simply clarifies

Would you like more information?
Then be sure to contact us!

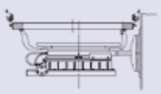
Exemplary representations of shaker connections

Vertical
Bellows on thermal barrier and shaker body

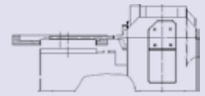
Vertical
Bellows on thermal barriers



Vertical
Bellows on fitting



Horizontal
On the under side of the test room floor and slip table



Horizontal
Without bellows with coupler element (Driver bar) between shaker and slip table

Emissions test

Emission test chambers

Performance parameters

Temperature range
+23 °C to +300 °C

Air humidity
5 to 80 % relative humidity

Emission
After a sample collection of the air and a possible condensate, the samples undergo an analytic assessment.

Device properties

Test room volumes
Emissions-free test chamber
250 l and 1,000 l

Design type

Measurements in emission test chambers for determining and assessing of environmental odours are a further area of product optimisation through material tests. A new product is not only noticed by people due to their optics. Our senses detect desirable values and undesirable properties of products and materials. To avoid turning up one's nose, this measurement is a way of determining the amount of organic chemical substances that are released under certain conditions.

If no air-conditioned installation room is available or if the usable room size of 250 l is too small, then the EK 1000 model provides the best test conditions. Easy handling and a high level of service and user-friendliness are additional reasons for being able to meet the comprehensive test standards.

Tests between room temperature +23 °C and +130 °C. If higher test temperatures are required, you get a reliable entry model with the EK 250A. With this standards such as PV 3942, PN780, ISO 12219-4 can be carried out.

Tests at room temperature +23 °C. With a 250 l test chamber volume you can carry out standard-conforming tests with small sample sizes. The "emission-free" test chamber EK 250B already meets important standards such as ISO 16000-9 or EN 16516.

Standards:

- EN 16516
- EN 717-1
- GS 97014-3
- SO 12219-4
- ISO 16000-9
- PN 780
- PV 3942
- VDA 276-1

Emissions cabinet 1000 l

Emissions test cabinet 250 l

Air pressure simulation

Height simulation chambers

Performance parameters

Temperature range
–60 °C to +120 °C

Air humidity
15 to 95 % relative humidity
under atmospheric pressure

Pressure
Vacuum up to 5 mbar

Device properties

Test room volumes
Test cabinet 50 l and up
Walk-in chambers possible

Design type

Low air pressure can have the effect of a stress factor. Components, which are approved for the air and space industry, as well as the freight goods in the airplane cargo hold, can be found in a zone without pressure equalisation. The technical parameters of a device are normally designed to ambient pressure (1013 hPa). However, with increasing altitude, the air becomes "thinner", i.e. the air density decreases significantly with the pressure. This can have an influence on the condition of the test item.

Standards:

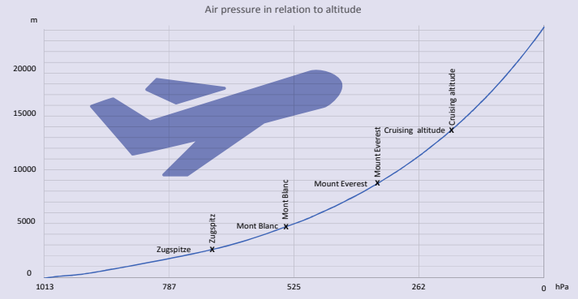
- DIN EN 60068-2-13
- DIN EN 60512-11-11
- MIL STD-810 500.6
- DO -160 G
- UN Transport Test UN 38.3
- ASTM D 6653

Negative pressure vacuum cabinet 115 l

Negative pressure vacuum chamber 1200 l

Height simulation

With increasing flight altitude the ambient pressure in the cargo hold reduces. A precise mathematic description of the pressure curve is not possible due to the weather dynamics and other influencing factors.



Artificial weathering

Sunlight simulation

Performance parameters

Temperature range
–70 °C to +180 °C (without irradiation)
–20 °C to +100 °C (with irradiation)

Air humidity
10 to 98 % RH (without irradiation)
10 to 70 % RH (with irradiation)

Device properties

Test room volumes
Test cabinet from 260 l to 4,000 l
Walk-in chambers from 4 m³ to 230 m³

Design type

Standards:

- BMW GS 95024-3-1_K17
- BMW PR 306.5
- DIN EN 60068-2-9
- DIN EN 75 220
- LV 124_K-17
- PV 2005-B

Artificial weathering (sunlight simulation) leads to an increased acceleration factor and better reproducibility compared to outdoor weathering.

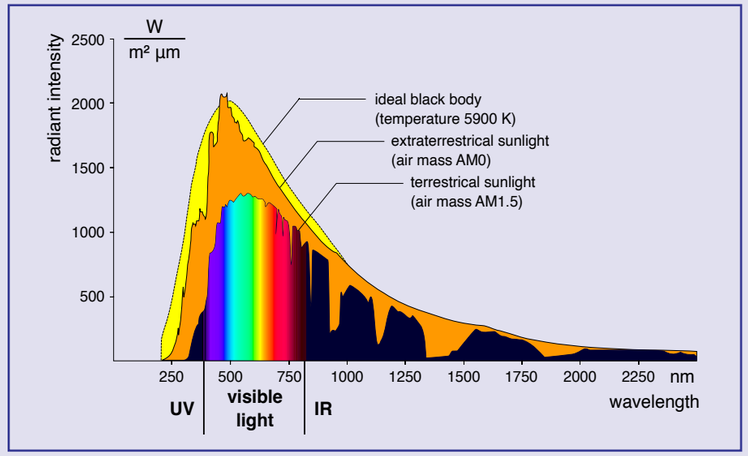
Especially with larger test parts the test execution according to DIN 75 220 has been proven in practice. The required number of light sources is determined corresponding to the desired irradiation area. In combination with a filter glass disc, the light spectrum corresponds to the global radiation CIE 85 Table 4. In this way, possible weak points can already be detected during a development phase and optimisations can be introduced.

Light climate test cabinet 1000 l

Climate test cell with sunlight module

Short and simple

The weathering with metal halide emitters (MHG), like xenon arc lamps for example, have a full spectrum with UV and infrared radiation, which quite well reflects the solar spectrum. The low percentage of infrared compared to the xenon light enables a simpler temperature control. The limitations of the UV limiting wavelengths connected with this is, however, to be ignored for tests with parts for the interior through the use of window glass filters.



The HMI light source used in combination with the borosilicate glass filter disc conforms to the light spectrum of the global radiation corresponding to CIE 85, Table 4, or DIN 75220 Outdoor. The lamp housings consist of anodised aluminium, the connection elements of stainless steel. In order to minimise the thermal stress of the light source, an optimum heat dissipation on the light source socket and reflector is required. The ignition device is housed separated from the hot lamp interior, the ignition device change is done via a service flap. The lamps are fastened in a passthrough in the chamber ceiling.

The special holder enables mechanical adjustment of the luminaires, e.g. for homogeneity settings. In addition, the luminaire can be folded out upwards, e.g. to change the lamp. When the luminaire is folded out and in, the adjustment settings are retained.

Indoor and outdoor area differences

Climate parameters	Outdoor - Day		Indoor 1 - Day		Indoor 2 - Day		Outdoor, Indoor 1+2 - Night	
	Dry	Humid	Dry	Humid	Dry	Humid	Dry	Frost
Test chamber temp. (°C)	+ 42	+ 42	+ 80	+ 80	+ 65	+ 65	+ 10	– 10
Relative humidity (%)	< 30	> 60	< 30	> 40	< 30	> 50	> 55	Condensation allowed
Radiation strength (W/m²)	1000	1000	830	830	830	830	– – –	– – –

Plant research

Plant growth chambers

Performance parameters

Temperature range
Light on: +5 °C to +45 °C
Light off: – 5 °C to +45 °C

Light intensity:
200 to 1,200 µmoles/m²s
Light spectra < 400 nm to 700 nm

Air humidity
40 to 90 % relative humidity

Device properties

Test room volumes
Test cabinet 600 l / 1200 l / 2500 l
Walk-in chambers from 5 m³ to 25 m³

Design type

Critical for plant research and plant cultivation is the optimum combination of light, temperature, humidity and oxygen. Only if these parameters are set very precisely on the needs of the plants to be researched can they grow wonderfully, to realise the desired research goals.

Application options:

- algae research
- arabidopsis
- entomology
- germs
- other life science applications
- plant growth
- tissue culture
- storage of insects

Light is an essential component of photosynthesis

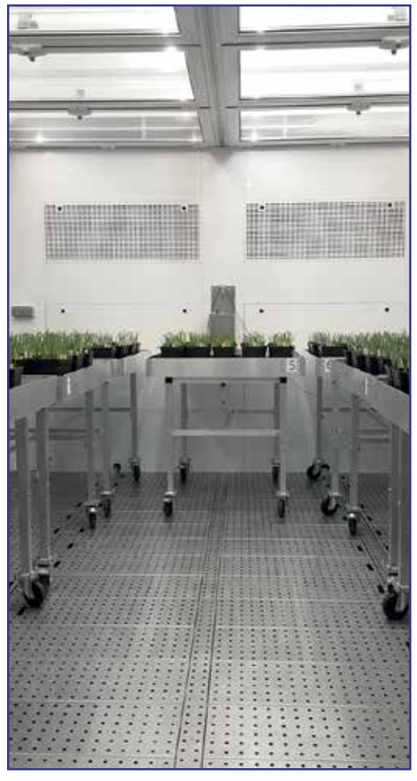
Light is one of the abiotic factors of the environment Light is jointly responsible for the growth and the germination and blossom formation of plants. These plants use light as an energy source to produce organic substances such as glucose, amino acids and fats from inorganic substances such as CO2 and water.

For a balanced, healthy and sustainable plant growth it is important to have available an authentic as possible light spectrum:

- Light intensities from 200 – 1200 µmoles/m²s

Select between fluorescent tubes or LED tubes

- fluorescent tubes also available in: blue, green, deep red and far red
- full spectrum ceramic metal halide with electronic ballast units with up to 1,100 µmoles/m²s
- high-performance fluorescent tubes or LED with 1000 µmoles/m²s
- LED options with multi-spectra and up to 600 µmoles/m²s
- several light levels from above or side illumination depending on device type



Walk-in climate chamber 24 m³

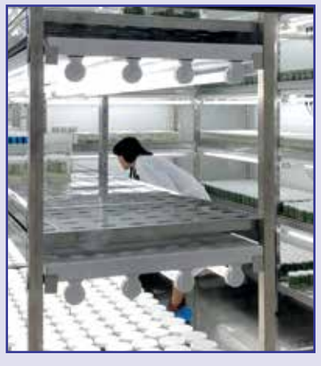
Plant growth cabinet
Volume selection 600 l / 1200 l

Plant growth cabinet
Volume selection 240 l / 400 l / 720 l

Plant communication

In order to give you a good base of information for a technical consultation, we need answers to the following questions:

1. Which temperature value contributes to the growth of the plants?
2. Which humidity range guarantees an optimum condition for growth?
3. Which light intensity do your plants require?
4. Is a day/night simulation desired?
5. Is an air exchange with CO_2 content required?
6. Which growth height is expected?
7. Which parameters are still important?



Corrosion test systems

Condensation water test

Performance parameters

Temperature range
RT up to +75°C

Air humidity
up to 100% relative humidity
(including condensation)

Device properties

Test cabinet from 300 l to 4,000 l
Walk-in chambers up to 100 m³

Design type

Find more details here!

Standards:

- BMW GS 95024-3-1_K17
- BMW PR 306.5
- DIN EN 60068-2-9
- DIN EN 75 220
- LV 124 K-17
- PV 2005-B

The resistance of coating materials to moisture is determined by exposing the test samples to condensation water.

With this simple but very effective quality test a permanent condensation on the test specimen is generated. The optional use of sulphur dioxide enables a test run for higher stresses (Kesternich test).

Condensation water and Kesternich test cabinet

The combination test cabinets offer a simple and inexpensive entry into corrosion testing. Through its basic structure they are suitable as a condensation water device or also as salt spray test cabinet. Optionally an automatic combination of condensate and salt spray test is available as change test device.

Combination test cabinet condensation water + Salt spray

Corrosion test systems

Salt spray test

Performance parameters

Temperature range
–20 °C to +70 °C

Precipitation
0.5 - 30 ml/h

Air humidity
up to 100 % relative humidity
(including condensation)

Device properties

Test cabinet from 400 l to 3,000 l
Walk-in chambers up to 100 m³

Design type

During the salt spray test the test specimen are exposed to a salt spray atmosphere with increased temperature and so the stress through oxidising corrosive substances is simulated in time-lapse effect. Salt spray tests are also combined with other corrosion tests into so-called cyclic corrosion tests, in which a wide variety of phases are run cyclical.

Corrosion test cabinet 1000 l

Standards:

- ASTM B 117
- DIN 55635 (prev. VDA 233-102)
- DIN EN 60068-2-11
- DIN EN 60068-2-52
- DIN EN ISO 9227-NSS/ASS/CASS
- DIN EN ISO 11997-1
- PV 1209
- PV 1210
- VW 80000 K-06+07

Corrosion test chest 550 l

Corrosion cycling test

Modern corrosion tests are becoming more complex and multi-layered.

Through the sequence of ingenious temperature and humidity processes up to frost storage, an attempt is made to simulate real environmental conditions in a comparable and time-related manner. For this purpose, we offer test cabinets and chambers with a wide range of options.

VDA corrosion test cabinet 1000 l

Walk-in corrosion test chambers

For very large and heavy test specimen we offer walk-in and movable chambers. In addition to standard designs, these systems are laid out specifically for the planned test concept. Chamber dimensions of up to 100 m³ are possible.

Walk-in test chamber 12 m³

Protection class tests

Dust test

Performance parameters

Temperature range
heated dust feed

Test medium quantity
Dust: e.g., 2 kg/m²

Device properties

Test room volumes
from 250 l and walk-in chambers

Design type

Find more details here!

Standards:

- DIN EN 60068-2-68
- DIN EN 60529
- ISO 20653
- JIS D203
- LV 124 M-03

During the execution of protective class tests the protection of the penetration of foreign bodies is done in the aspect of quality tests.

Mainly DIN EN 60 529 and ISO 20653 is used as a basis. The dust is held in suspension by an adjustable circulation blower. The negative pressure device for testing according to IP 6X is automatically controlled via pressure and volume flow sensors.

Dust test chamber 500 l

Dust test chamber 2000 l

WKM

Whatever you are going to simulate.

We project it.

Whatever you are going to simulate.

We project it.

Leakage tests

Spray water and pressurised water jet test

Performance parameters

Temperature range
up to +85 °C water temperature

Test medium quantity
0.07 l/min up to 250 l/min

Device properties

Test room volumes
from 250 l and walk-in chambers

Design type

Standards:

- DIN EN 60529
- DIN EN 60598-1
- ISO 20653
- JIS D 203
- LV 124 K10 & K-11
- Nema 250 4X

Leakage tests belong to the elementary environmental tests of housings and are divided into IP protective classes. The influence with effect of water on components and its penetration into housings is tested. The product spectrum ranges from fully automatic test systems as chamber solution up to walk-in room solutions. Also individual manual equipment can be used for the tests.

Spray water chamber
Pipe elbow 400 mm

The resistance of a coated test specimen against the loss of robustness is tested with a defined pressure water jet. Execution is done according to the test standard DIN EN ISO 16925.

Pressure water jet chamber 1000 l

WKM Service

Full Service

Our internal service team can be reached by phone workdays from 7:00 a.m. to 5:30 p.m. WKM is also your contact person after purchase and commissioning and ensures a proper function of your equipment and system. Our regularly trained service employees are always at your side. We also help without a maintenance contract.


ZERTIFIKAT

DIN EN ISO 9001

PÜG Prüf- und Überwachungsgesellschaft mbH
bescheinigt hiermit, dass das Unternehmen

WKM

Zertifikatsinhaber: WKM Wärmeprozess- und Klimaprüftechnik Michel GmbH & Co. KG

Zertifizierter Standort: Im Bulloh 30-32 29331 Lachendorf

Geltungsbereich: Vertrieb und Service von Geräten der Wärmeprozess- und Klimaprüftechnik

ein Qualitätsmanagementsystem entsprechend der DIN EN ISO 9001:2015 eingeführt hat und dieses wirksam anwendet.

Der Nachweis wurde im Rahmen des Zertifizierungs-Audits erbracht.

Dieses Zertifikat ist gültig vom: 18.08.2019 bis: 17.08.2022

Zertifikat- Registrier-Nr.: 3196-20190725-Q-de

Gäufelden, 25.07.2019

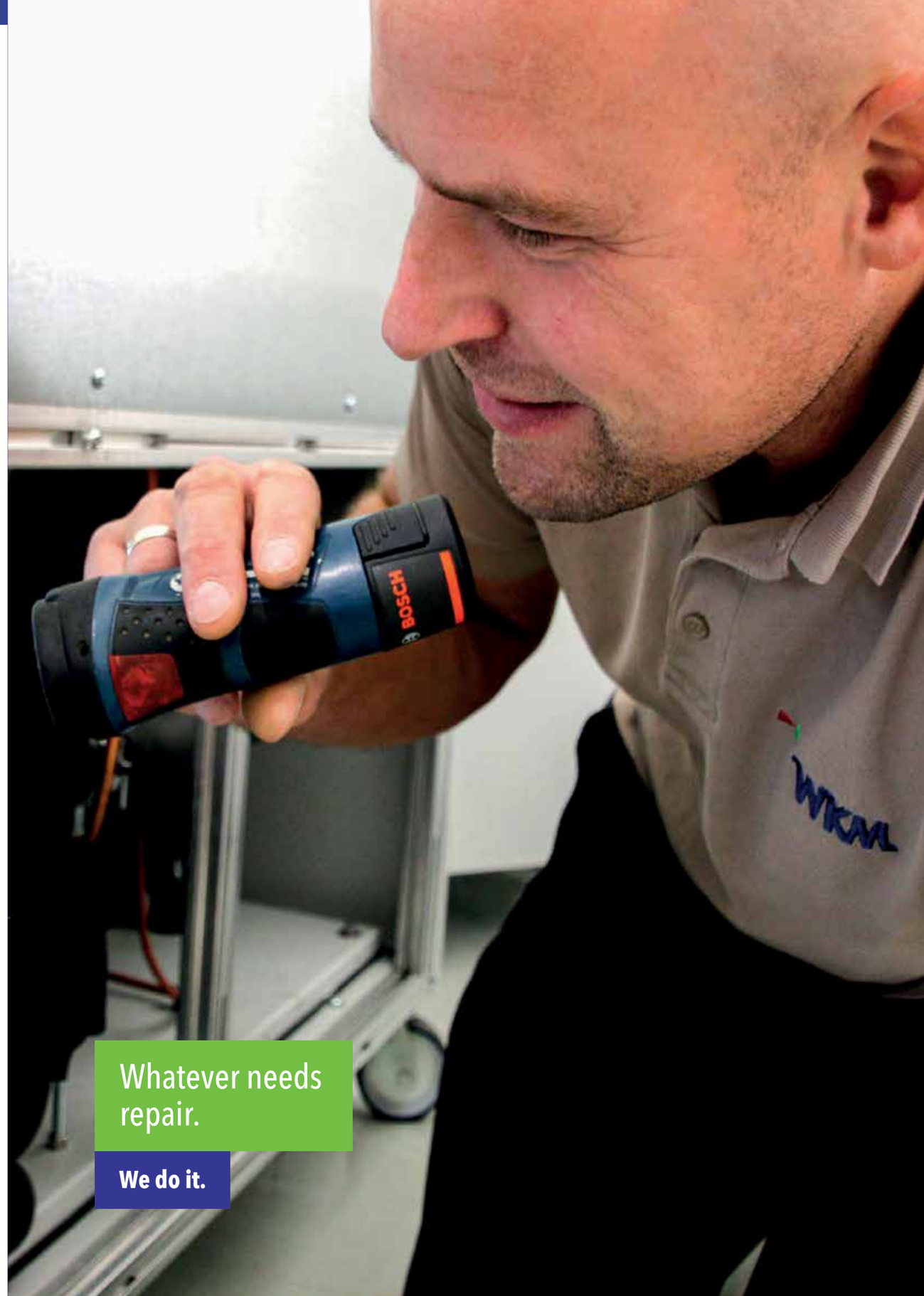
Repair, service, spare part supply

We are pleased to be available for you with our service employees for the following equipment manufacturers:

- Ahlborn GmbH
- Binder GmbH
- caldatrac® Industrieofenbau GmbH & Co. KG
- ELIOG Industrieofenbau GmbH
- ELPRO Messtechnik GmbH
- Memmert GmbH
- RSI TestSysteme GmbH & Co. KG
- Thermo Electron LED GmbH (previous Heraeus/Kendro)

Our services

- Repairs
- Maintenance
- Calibration of temperature / humidity
- Spatial distribution measurement (mapping) temperature / humidity
- Leakage test acc. to F-Gas regulation
- DGUV - V3 measurements (previous BGV-A3)
- Validation - Basis of your quality assurance
- Qualification acc. to GMP and FDA specifications
- Measurement and recording the air exchange rate
- Leased devices



Precise and reliable

Measuring and recording

Performance parameters

Temperature range
–196 °C to +1300 °C

Air humidity
10 to 98 % relative humidity

Safety

Our services for the pharmaceutical branch:

- DQ - check of the DQ and creating a specification sheet
- IQ - installation qualification
- OQ - operation qualification
- PQ - performance qualification
- calibration on site
- mapping / distribution measurements
- training your employees
- maintenance

As important as the reliable reproducibility of the tests is the quality and security of your measurement data. Precise and reliable measurements with data loggers, practical data backup and assessment via software. You receive from us a comprehensive product range with the right accessories for your industry, quality assurance, R&D, transport, inventory management and production. Temperature and humidity loggers from our portfolio are precision devices and can be DAkkS calibrated. We cover the requirement ranges from -196°C to +1300°C and 10% RH to 98% RH – from cryostats to the muffle furnace. Up to 60 million measurement values in intervals from one second up to several hours can be saved and read out via a computer. Using potential-free alarm outputs, you receive universal solutions, e.g., with the combination with a phone dialler. Especially important for the pharmaceutical industry is the GLP/GMP/FDA 21 CFR 11 compliant software due to its forgery and manipulation protection. Our data loggers are also available with approval for Ex zone I.

Measurement case for data mapping

Data logging systems

Temperature data logger

You can also benefit from our expertise

Environmental simulation

- Temperature
- Shock test
- Climate
- Plant growth
- Sunlight
- Vibration
- Leakage test
- Tempering Medium Oil
- Corrosion
- Height simulation
- Container systems
- Tempering Medium Water / Glycol

Thermal process technology

- Drying
- Tempering Heating
- Vulcanising
- Vacuum
- Solvents
- Coil-Coating Test
- Annealing - Hardening- Tempering
- Elastomer Plastic

We will be pleased to advise you in the fields of thermal process technology and environmental simulation, in order to project an individual solution for your application. Contact us under the phone number +49 (0) 5145-28666-10.

References

Airbus Operations GmbH
AKUVIB Engineering and Testing GmbH
ASAP Electronics GmbH
Aucoteam GmbH
Axalta Coating Systems Germany GmbH
B. Braun Melsungen AG
BASF Coatings GmbH
Bertrandt Ingenieurbüro GmbH
Brose Schließsysteme GmbH & Co. KG
Brunel Car Synergies GmbH
CEcert GmbH
Continental AG
Coroplast Fritz Müller GmbH & Co. KG
Daimler AG
DEKRA Testing and Certification GmbH
EDAG GmbH & Co. KG
FES GmbH Fahrzeug-Entwicklung Sachsen
FILK Freiberg Institute gGmbH
Fraunhofer Gesellschaft
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HELLA GmbH & Co. KGaA
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iLF Magdeburg GmbH
Joyson Safety Systems Aschaffenburg GmbH
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tesa Labtec GmbH
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Volkswagen AG
Voltavision GmbH
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ZF Friedrichshafen AG

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certified acc. to **DIN EN ISO 9001:2015**

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