



Whatever you are  
going to simulate.

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► **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 automatic 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.**

► **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.

Our services:

- Maintenance
- Calibration
- Repairs
- DGUV V3 measurements (previous BGV-A3)
- Leakage checks on cooling systems
- Mapping



## Overview of important test criteria

### Our icons

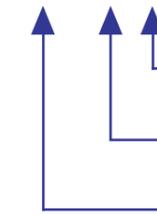
Temperature range	Test medium quantity	Flow rate
Splash medium	Water pressure	Dust quantity

### Tests according to IP code

The following international designation system is used for the classification of housings and electrical components in regard to their protection class. The IP mark shows you the extent to which a product is protected against external influences. The IP codes define the degree of protection against penetration of foreign bodies and water.

Example: IP 65 means complete protection "dust-tight" and protected against jet water from all directions. These code digits are fixed in the German standard DIN EN 60529 and in the international standard ISO 20653.

# IP 65



The second number indicates protection against water.  
The first number indicates the protection against penetration of foreign bodies.  
Code letters  
(International Protection IP)

### Presentation of the IP codes for dust tests



**IP 5X dust test "dust protected"** for housing acc. to Category 2

Test equipment Dust chamber  
Dust quantity 2 kg/m<sup>3</sup>  
Test duration 8 hours



**IP 6X dust test "dust-tight"** for housing acc. to Category 1

Test equipment Dust chamber with vacuum device 20 mbar  
Dust quantity 2 kg/m<sup>3</sup>  
Test duration 8 hours or 80-fold volume extraction

## Introduction

The test "Protection from penetration of solid foreign bodies and water" has been a fixed and important test component in environmental simulation for many years. Good protection from foreign bodies such as dust and sand increase the product quality and reliability of the tested parts. If penetration of dust, e.g. in an electric motor, can be eliminated, then the risk of an electrical shock is reduced and thus contributes to an important aspect for accident prevention.

# Test systems for dust and sand

## Dust chambers

The dust chamber enables tests acc. to VDE 0470 part 1 as well as DIN EN 60529, among other things. The dust is kept in suspension by an adjustable circulation fan. The vacuum device for the test acc. to IP 6X is automatically controlled by pressure and volume flow rate sensors.

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

- DIN EN 60068-2-68
- DIN EN 60529
- ISO 20653
- JIS D203
- IEC 60598-1
- LV 124
- BMW GS 950003-4
- SAE 575



IP 5X and 6X with vacuum device | Dust chamber SK 2000 Q

## Standardised dusts

The use of standard dusts is a basic requirement for the reproducibility of the dust tests. The following types are frequently used:

- Arizona dust      Acc. to ISO 12103-1  
A1:ultrafine, A2:fine, A3:medium, A4:coarse
- Talcum              Acc. to IEC 60068-2-68, Test La and ISO 60529
- Quartz dust        Acc. to IEC 60068-2-68, Test Lb, Lc1 and Lc2
- Portland cement    Acc. to ISO 40500-9
- Fly ash              Acc. to ISO 40500-9
- MIL dusts          Test dusts acc. to MIL-STD- 810



For the practice, attention must be paid to good flowability and that exposure to dust that is hazardous to health can be ruled out. **Caution:** Only dusts may be used that have as an air-dust mixture no tendency to a danger of dust explosion. Furthermore, the dusts must only be used in a limited way and the storage of the dusts should be done in closed tanks, taking into consideration the room conditions acc. to IEC 60068-1.

## Sand / Dust test chambers with pre-speed

Test requirements e.g. MIL-STD-810G, RTCA-DO160F or DIN EN 60068-2-68 describe a test under dusty atmospheres with adjustable flow direction (horizontal / vertical) as well as adjustable air speed between 1.5 m/s to 30 m/s.

The positioning of the sample can be carried out as a fixed sample holder or via a turntable. The test methods Lc1 and Lc2 distinguish between blown sand / dust in a recirculation chamber and free blowing.

The sand / dust chamber enables a test of components and electrical components with horizontal air guide under dusty atmospheres between 1.5 m/s and 30 m/s air speed. The useable space is abrasion resistant. Sand and dust can be added via various methods.

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

- DIN 40050 Part 9
- IEC 68-2-68 -Lc1
- ISO 20653
- MIL-STD 810G method 510.6
- DO 160

dusty atmospheres with pre-speed | Sand / Dust chamber SKV 1000



## Test methods for water tests acc. to IP code

### ► Presentation of the IP codes

	IP X1 dripping water test	Test equipment Test specification Test duration	drip device 1 mm/min 10 minutes	Simulation light rain
	IP X2 dripping water test at 15°	Test equipment Test specification Test duration	drip device with 15° support 3 mm/min 4 angle settings per 2.5 minutes	Simulation light rain, falling slightly angled
	IP X3 spray water test	Test equipment Test specification Test duration	swivelling tube with nozzle, $\phi = 0.4$ mm, spray +/- 60° from vertical Test specification $qv = 0.07$ l/min per nozzle 0.10 l/min (ISO20653), $p \approx$ approx. 0.8 bar Test duration 10 minutes	Simulation rain shower, falling slightly angled
	IP X4 splash water test	Test equipment Test specification Test duration	swivelling tube with nozzle, $\phi = 0.4$ mm, spray +/- 180° from vertical Test specification $qv = 0.07$ l/min or per nozzle 0.10 l/min (ISO20653), $p \approx$ approx. 0.8 bar Test duration 10 minutes	Simulation strong rain shower, spray water from all sides
	IP X4K splash water test with increased pressure	Test equipment Test specification Test duration	swivelling tube with nozzle, $\phi = 0.8$ mm, spray +/- 180° from vertical Test specification $qv = 0.6$ l/min per nozzle, $p \approx$ 4.0 bar Test duration 10 min/m <sup>2</sup> , minimum 3 min	Simulation cleaning with especially strong jet water
	IP X5 water jet test	Test equipment Test specification Test duration	water jet nozzle, $\phi = 6.3$ mm Test specification $qv = 12.5$ l/min, $p \approx$ 0.3 bar Test duration 1 min/m <sup>2</sup> , minimum 3 min	Simulation cleaning with jet water distance to test specimen 2.5 to 3 m
	IP X6 water jet test	Test equipment Test specification Test duration	water jet nozzle, $\phi = 12.5$ mm Test specification $qv = 100$ l/min, $p \approx$ 1.0 bar Test duration 1 min/m <sup>2</sup> , minimum 3 min	Simulation cleaning with strong jet water, distance to test specimen 2.5 to 3 m
	IP X6K water jet test	Test equipment Test specification Test duration	water jet nozzle, $\phi = 6.3$ mm Test specification $qv = 75$ l/min, $p \approx$ 10 bar Test duration 1 min/m <sup>2</sup> , minimum 3 min	Simulation cleaning with especially strong jet water, distance to test specimen 2.5 to 3 m
	IP X7 temporary flooding	Test equipment Test specification Test duration	plunge pool, depth < 1 meter Test specification Water column over the test specimen < 150 mm Test duration 30 minutes	Simulation temporary immersion or water passage
	IP X8 continuous flooding	Test equipment Test specification Test duration	plunge pool, depth > 1 meter Test specification Water column over the test specimen > 150 mm Test duration according to application	Simulation continuous immersion or water passage
	IP X9K test with flat jet nozzle	Test equipment Test specification Test duration	flat jet nozzle and turntable Test specification $qv = 14-16$ l/min, $p = 80-100$ bar $TW = +80^\circ \pm 5^\circ C$ Test duration 30 seconds per position	Simulation cleaning with pressure washer

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## Spray water chambers and room solutions

### ▶ Test methods for water tests

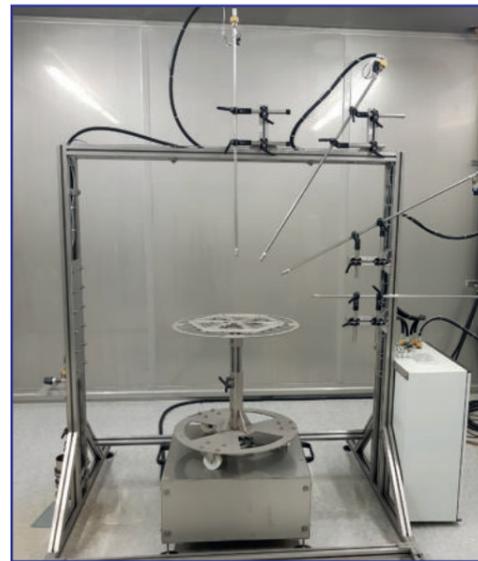
Spray water chambers enable the checking of the IP Protection classes IP X1 to IP X9K according to all relevant standards. The basic component of these test systems is a water-tight test room with a turntable for holding the test specimen fixture and the equipment for tests according to IP X3 and IP X4.

All tests can be done fully automatically. The parameter sets are already installed in the controls for all standard IP protection test types. The device users can parameterise, save and perform their own test-routine at any time. The automatic data recording and the independent creation of a test protocol offers easy and reliable documentation.

We can also offer components for IP room solutions instead of the compact devices. The design of the test room depends on the structural conditions and the desired examination. The turntable and the further layout of the peripheral devices are decided by the test weight and the test specimen geometry. A room solution is frequently used for very heavy and large test specimen due to the handling.

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

- BMW GS 95003-4
- DIN 40050-9
- DIN EN 60529
- DIN EN 60598-1
- ISO 20653
- JIS D 203
- LV 124 K-10 & K-11
- Nema 4
- UL 50 E



IP X9K Test with flat nozzle



IP X6 K Test in room solution

IP X5 and IP X6 with attached tunnel and expansion to IP X6 K test

Spray water chamber SPK R600



## Splash water test systems

### ▶ Splash water test

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

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 among other things ISO 16750-4, LV 124-512 and VW 80000.

This test simulates the life cycle stress and is used to safeguard the function during shock-cooling by using splash water. Here the cold splash imitates e.g. driving through a puddle.



Splash water test with the following boundary conditions:

- usable room temperature up to +160 °C
- water temperature of the splash water +2 °C to +4 °C
- optionally the surge water nozzles can also be actively cooled
- splash water volumes per splash are 3 to 4 litres, the adjustable splash time is 3 seconds in accordance with many standards
- splash medium: city water or demineralised water or alternatively with admixture of 3 % weight percentage Arizona dust (ISO 1203-1 group fine)
- test room volumes can be individually designed
- cycle times, splash duration and splash volumes are freely programmable
- feedthroughs for the insertion of on-site supply lines

The chamber meets, among other 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



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



Splash medium  
Water  
Water & Arizona dust

Splash water chamber SWK 100/100-75-16

## Test systems for ice water tests

### ▶ Test methods for the ice water test

The test specimen is heated up to +200°C by circulating air 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-cooling by immersion.

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

#### 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 other things, the following test standards:

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

	Temperature range Chamber: up to +200 °C Water: +2 °C to +4 °C		Immersion medium Saltwater (brine)	Ice water test chamber EWT 1000
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## Pressurised water jet test chambers

### ▶ Pressurised water jet tests

The resistance of a coated test specimen against the loss of adhesion is tested with a defined pressure water jet. The extent of the damage to the test specimen is dependent, among other things, on the

- water pressure
- distance of the nozzle to the test specimen
- volume flow rate
- test time
- geometry of the nozzle
- impact surface and impact angle
- water temperature

of the test jet and cutting or scoring tool. The subsequent evaluation takes place on the basis of a visual comparison.

#### Pressurised water jet test chamber acc. to ISO 16925 with the following boundary conditions:

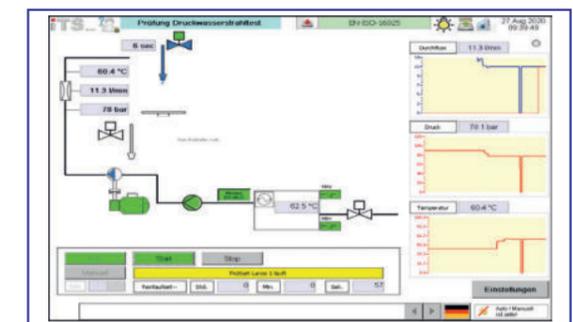
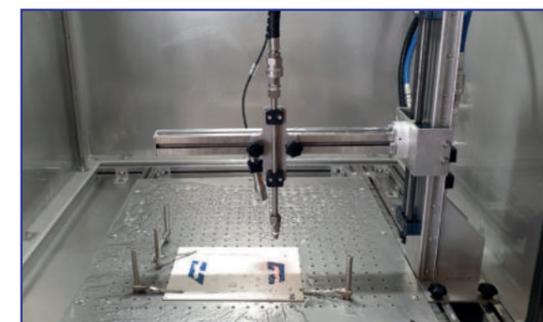
- all parts coming into contact with water are corrosion-resistant
- a clamping table is present in the test chamber
- M6 threads provided in the holes are used for fixing the test specimen
- the test lance is positioned centred above the clamping table and the height can be adjusted using a handwheel
- a line laser, which is fixed to the nozzle, indicates the point of impact of the water jet
- pre-made parameter sets are defined for the tests acc. to ISO 16925. During a running test the pressure, temperature and flow rate values are documented and noted
- at any time user-defined tests and new parameter sets can be saved

For carrying out tests according to:

- DIN EN ISO 16925



	Temperature range Water: +25 °C to +85 °C		Test medium quantity 8 l/min - 18 l/min		Pressure 4MPa (40bar) to 13MPa (130 bar)	Pressurised water jet test chamber DWT 1000
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► Environmental simulation

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

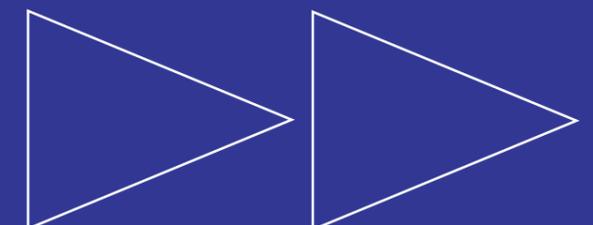
► Thermal process technology

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

- |                                       |  |  |
|---------------------------------------|--|--|
| AKUVIB Engineering and Testing GmbH   | Hella GmbH & Co. KGaA                        | SCHÜCO International KG                |
| Bertrandt Ingenieurbüro GmbH          | INOTEC Sicherheitstechnik GmbH               | SLG Prüf- und Zertifizierungs GmbH     |
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