Inspired by **temperature**

Extremely precise
temperature control solutions

for materials testing, quality assurance, environmental simulation and much more

huber

The right solution for every **Application**

There are numerous applications for Huber temperature control systems in the aerospace, aviation and automobile industries. Typical applications include environmental simulations, material inspection, and temperature-dependent stress and load tests for materials, motors, bearings, fuel and engine parts.

Other common uses include research work, test series and quality controls on batteries, rechargeable batteries, sensors and electronic components. Researchers and engineers all over the world rely on our temperature control technology when constructing and operating test rigs.

Applications:

- Test rig construction
- Material testing
- Quality control
- Stress tests
- Environmental simulation
- Battery testing
- Solar technology
- Motor / bearing testing
- Environmental / vacuum chambers
- Satellites, space probes
- Calibration
- and much more

Temperature change tests

Small thermal regulation baths can be used for temperature change tests. Tests and pre-examinations can be carried out on material samples in the bath, quickly and easily. High-performance circulation thermostats are ideal for thermal tests that require a wide temperature range.

Various temperature conditions can be simulated, -40 °C to 85 °C is a common test range but wider ranges are possible to as low as -120 °C up to 425 °C.

Test rigs

We supply individually designed temperature control equipment in every performance class for temperature tests on engines, drives, drivetrains and other components. Our temperature control solutions are ideal for integration into test rigs and deliver reproducible temperatures.

If a system division into primary and secondary circuits is required due to test rig requirements based on material incompatibilities, pressure, viscosity, flow rates etc, Huber can offer an option for design and delivery of external heat exchanger solutions in loose or built-on format.

Direct operation with water glycol

Many of our Unistats can be operated directly with water glycol as a temperature control liquid:

From -35 °C to +95 °C: Petite Fleur, Grande Fleur
From -30 °C to +95 °C: Unistat Tango w/wl, 405/w, 410/w, 425/w, 430/w, 510/w, 515w, 520/w, 525/w, 527w, 530w, 610/w, 615, 620/w, 625/w, 630/w, 635/w, 640/w

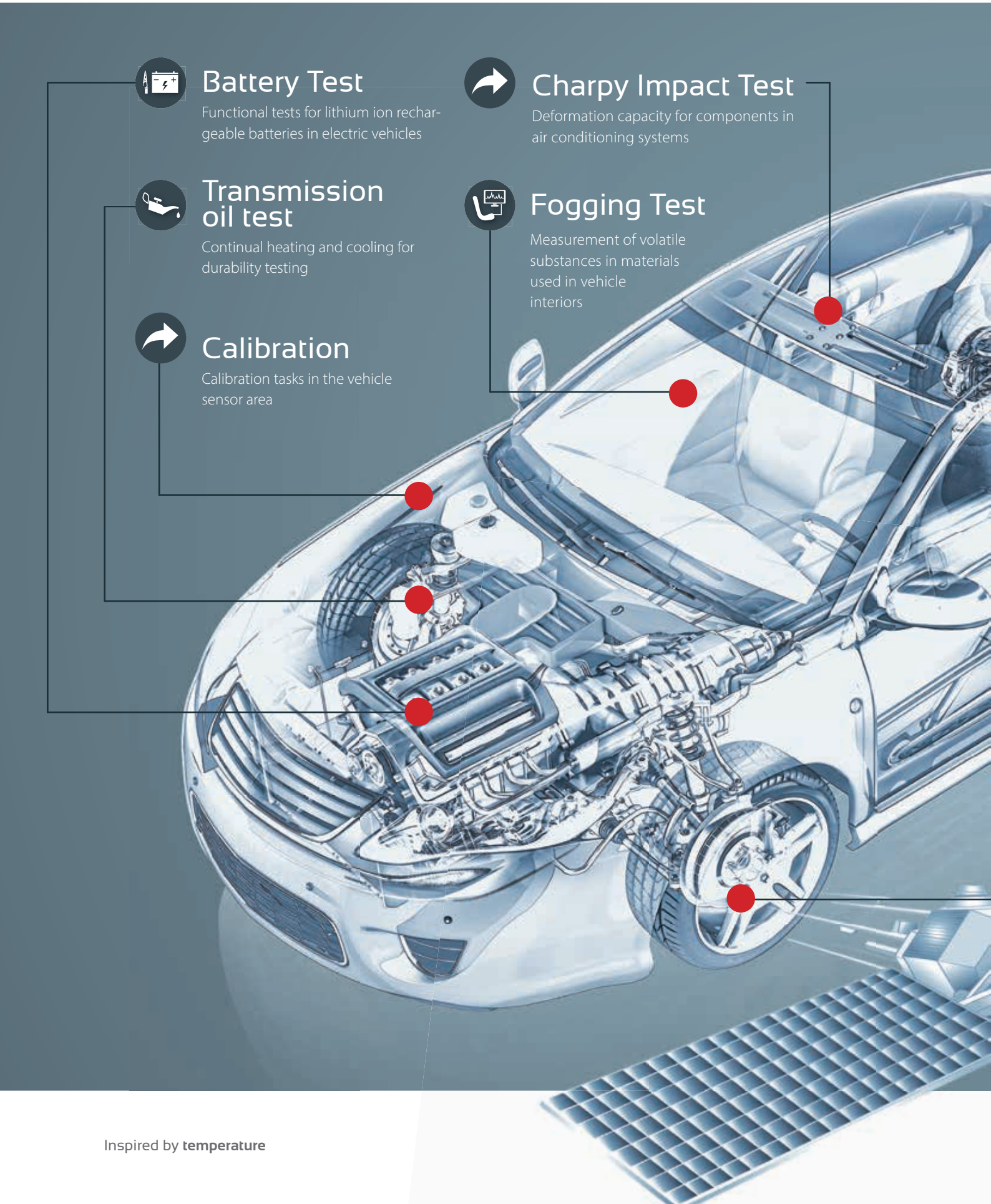
Unistats are capable of rapid heating and cooling, over a wide temperature range. Unichillers with optional heating offer a lower-cost alternative.

Addition/alternative to environmental chamber

Huber temperature control units are ideal as an alternative or extension to environmental chambers to lower their operational temperature range. Our temperature control units can be used in a wide range of tests, and often cost less than environmental chambers. Yet another benefit is the high temperature control speed which can be achieved with Unistats. Heating and cooling capacity can be transferred quickly and precisely – a critical advantage in many functional and material tests.
The combination of temperature control unit and environmental chamber allows simultaneous simulation of specimen temperatures as a function of environmental temperatures.

We would be happy to advise you with regard to applications with electrically non-conductive temperature media.

Temperature control solutions for **Test rig construction, aviation**



Battery Test

Functional tests for lithium ion rechargeable batteries in electric vehicles

Charpy Impact Test

Deformation capacity for components in air conditioning systems

Transmission oil test

Continual heating and cooling for durability testing

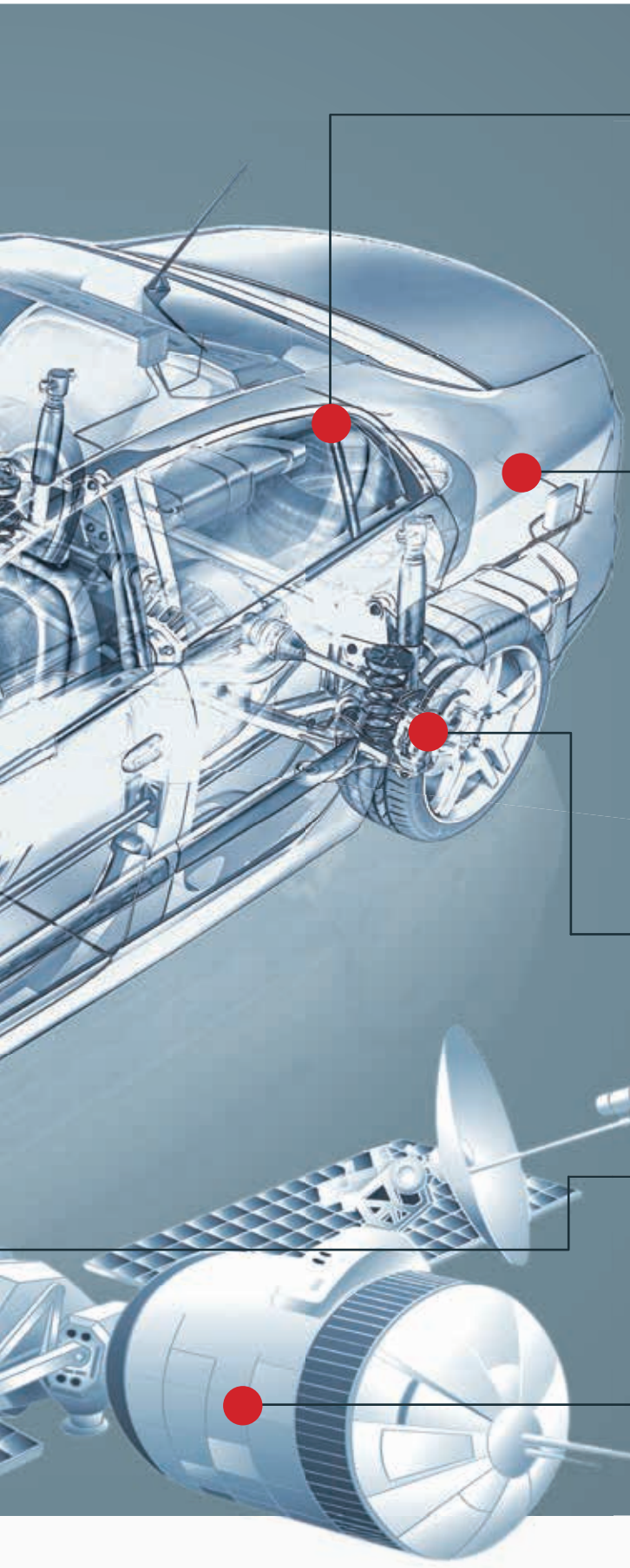
Fogging Test

Measurement of volatile substances in materials used in vehicle interiors

Calibration

Calibration tasks in the vehicle sensor area

and aerospace industries



Vicat test

Tests for softening point for plastics

Cold filter plugging point

Determination of cold filter plugging point of diesel fuels

Fuel temperature control

Durability tests for fuel tanks

AdBlue® temperature control

Exhaust post-treatment of diesel fuels in cars

Stress test in test rigs

Long-term loading of vehicle components over several weeks under conditions of extreme temperatures

Corrosion testing

Corrosion testing with cyclical temperature fluctuation, moisture and saline vapour

Thermal vacuum chamber (TVK)

Temperature control of thermal vacuum chambers for material and component tests under conditions found in space

Pilot ONE®

Overview of functions

As standard, Unistats® are equipped with the intuitive icon-driven Pilot ONE® controller with E-grade® "Professional".

Plug & Play technology
The modular controller concept permits easy service and the use of the controller as remote control.

Everything at a glance
All relevant temperatures can be viewed numerically and/or graphically on the Pilot ONE's screen.

Interfaces
As standard, the Pilot ONE is equipped with RS232, USB Device, USB Host, Ethernet and a Pt100 external sensor connection.

Record process data
If a USB drive is connected, process and service data can be recorded directly onto it in real time.

Integrated programme function
An integrated programmer capable of storing 10 different and individually named programs and also includes the ability to program linear and exponential ramps. Programs can be uploaded or downloaded from a USB drive.

5,7" touch screen
The operation of the Pilot ONE is easy and intuitive and is multilingual with a choice of 13 languages using the large colour touch display.

Optional Functions through "E-grades"
E-grades widen the Pilot ONE's capabilities. The "E-grade Explore" displays various Temperatures and the diffreces between them and when a Flow Sensor is fitted, the Flow Rate of the HTF is also displayed. The "DV E grade" widens the number of parameters that can be observed, recorded and/or controlled.

	Function/Feature	Pilot ONE E-grade "Professional" (standard for Unistats)	Pilot ONE E-grade "DV" (optional)	Pilot ONE E-grade "Explore" (optional, only Unistats)
Thermoregulation	Controller parameter tuning	TAC (True Adaptive Control)		
	Calibration for control sensor (Internal, Process)	5-Point		
	Monitoring (Level protection, Over temperature protection[1])	✓	✓	✓
	Adjustable limit alarms	✓	✓	✓
	VPC (Variable Pressure Control)[2]	✓	✓	✓
	Venting program	✓	✓	✓
	Compressor automatic control	✓	✓	✓
	Set point limits	✓	✓	✓
	Programmer	10 programmes / max. 100 steps		
	Ramp function	linear, non-linear		
	Temperature control mode (Internal, Process)	✓	✓	✓
	Maximum heating / cooling power adjustable	✓	✓	✓
Display and Operation	Temperature display	5,7" TFT touch screen		
	Display mode	graphic, numeric		
	Display resolution	0,1 °C / 0,01 °C		
	Graphic display of temperature curves	Window, full screen, scalable		
	Calendar, Date, Time	✓	✓	✓
	Languages menu navigation:	DE, EN, FR, IT, ES, PT, CZ, PL, RU, CN, JP, KO, TR		
	Temperature format	°C / °F / K		
	Display mode (screen) switch by swiping	✓	✓	✓
	Favourites menu	✓	✓	✓
	User menues (Administrator level)	✓	✓	✓
	2. set point	✓	✓	✓
Connections	Digital interface RS232	✓	✓	✓
	USB interface	✓	✓	✓
	Ethernet RJ45 interface	✓	✓	✓
	Pt100 control probe connection (external control)	✓	✓	✓
	External control signal / ECS STANDBY[3]	✓	✓	✓
	Programmable volt-free contact / ALARM[3]	✓	✓	✓
	AIF (analog interface) 0/4-20 mA or 0-10 V[4]	✓	✓	✓
	Digital interface RS485[4]	✓	✓	✓
Various	Alarm signal optical / acoustic	✓	✓	✓
	AutoStart (Mains failure automatic)	✓	✓	✓
	Plug & Play technology	✓	✓	✓
	Technical glossary	✓	✓	✓
	Remote control / Data visualisation via Spy Software	✓	✓	✓
	E-grade Evaluation versions available (30 days)	✓	✓	✓
	Service data recorder (flight recorder)	✓	✓	✓
	Saving/loading of temperature control programs	✓	✓	✓
	Process data logging direct to USB stick	✓	✓	✓
	Calendar start	✓	✓	✓
Process data	Display of process data directly on the device display			✓
	Query of process data via interfaces		✓	✓
	On-board display mode for heating / cooling capacity of the system			✓
	Access to temperature values for internal, process, return plus temperature differences ΔT internal, process, return and pump performance (pressure/speed, model-dependant)		interface query only	display and interface query

[1] For units with integrated over-temperature protection
[2] For models with variable-speed pump or an external bypass
[3] Standard on Unistats, otherwise via optional Com.G@te or POKO/ECS Interface
[4] Via optional Com.G@te

Individually configurable
Options for your application

HEAT EXCHANGER

External heat exchanger for separation of fluid circuits of temperature control unit and application allow indirect operation with almost all temperature control liquids (e.g. in the event of viscosity problems, material incompatibilities).

AUTOMATION

Support for common data communication standards and software solutions for data recording, remote operation and programming. Interfaces: e.g. Profibus, Modbus TCP, Ethernet, OPC-UA, RS232, RS485, USB, Analogue.

MEASUREMENT AND CONTROL OF HTF

VPC bypasses and various flow rate meters allow measurement and control of heat transfer fluid (HTF) pressure and flow volume.

CIRCULATION PUMPS

Various pump options and optional pressure booster pumps allow flexible alignment of pressure and flow volume for the application.

DRY CONNECT/ DISCONNECT

Press & Twist connections make it easier to change the application on the temperature control unit. Having a wide internal bore the pressure drop is low keeping flow resistance to a minimum to promote efficient thermal transfer and temperature control.

SENSOR OPTIONS

A selection of Pt100 sensors for temperature measurement and regulation at relevant points.

WATER GLYCOL

Direct operation with water glycol as a temperature control medium is possible with many Unistats, as well as use of electrically non-conductive liquids (e.g. 3M Novec).

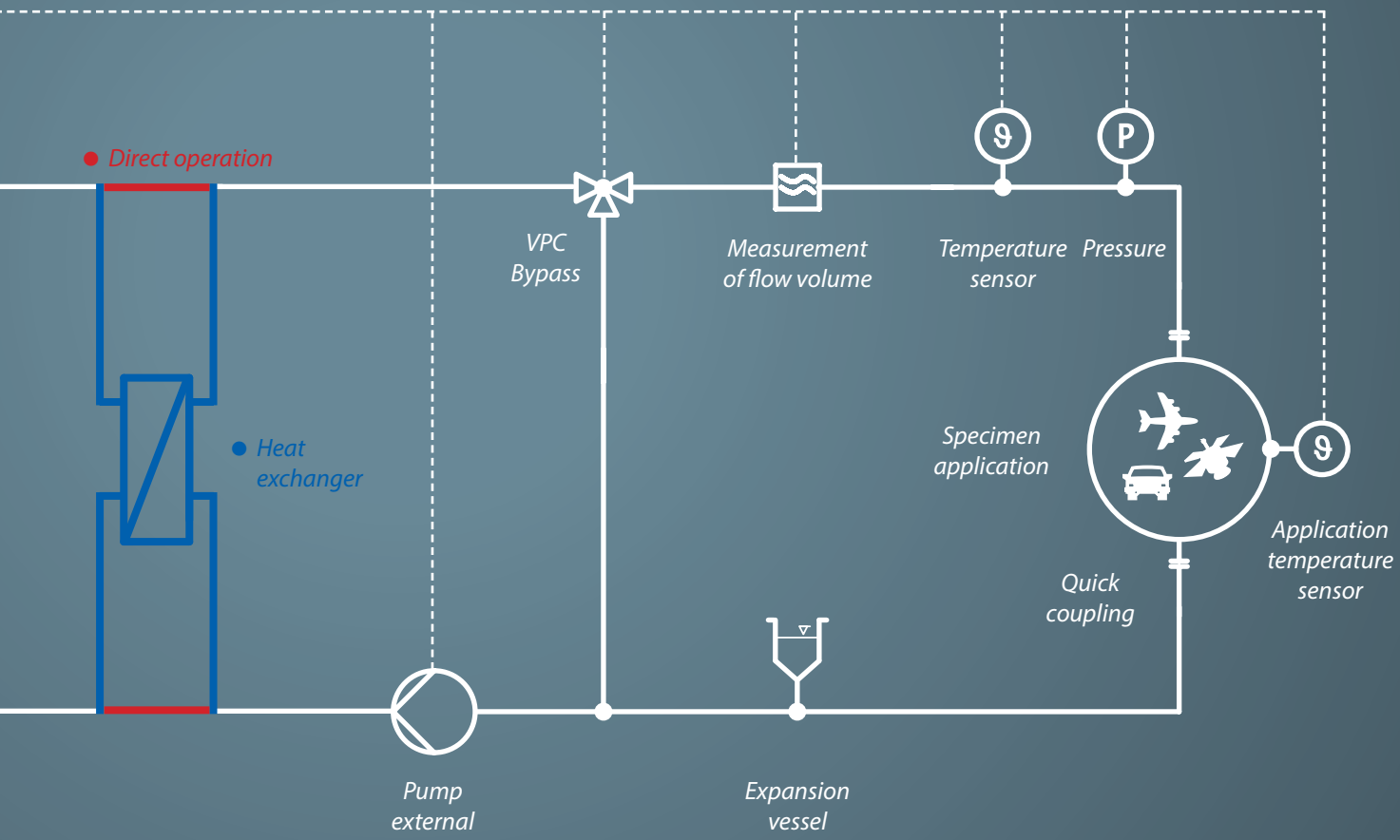
EXPANSION

A range of expansion vessels is available as accessories for compensation of temperature-dependant volume changes.

DIRECT OPERATION OR WITH HEAT EXCHANGER

There are basically two operation versions available for the temperature control unit. Version 1 is operation via an external heat exchanger. The advantage is this: The application circuit and temperature control circuit are separated, and on the application side, any temperature control liquid can be used. Version 2 is direct operation e.g. with water glycol, 3M Novec or other permissible temperature control media.

- Version 1: Secondary circuit with heat exchanger
- Version 2: Direct operation

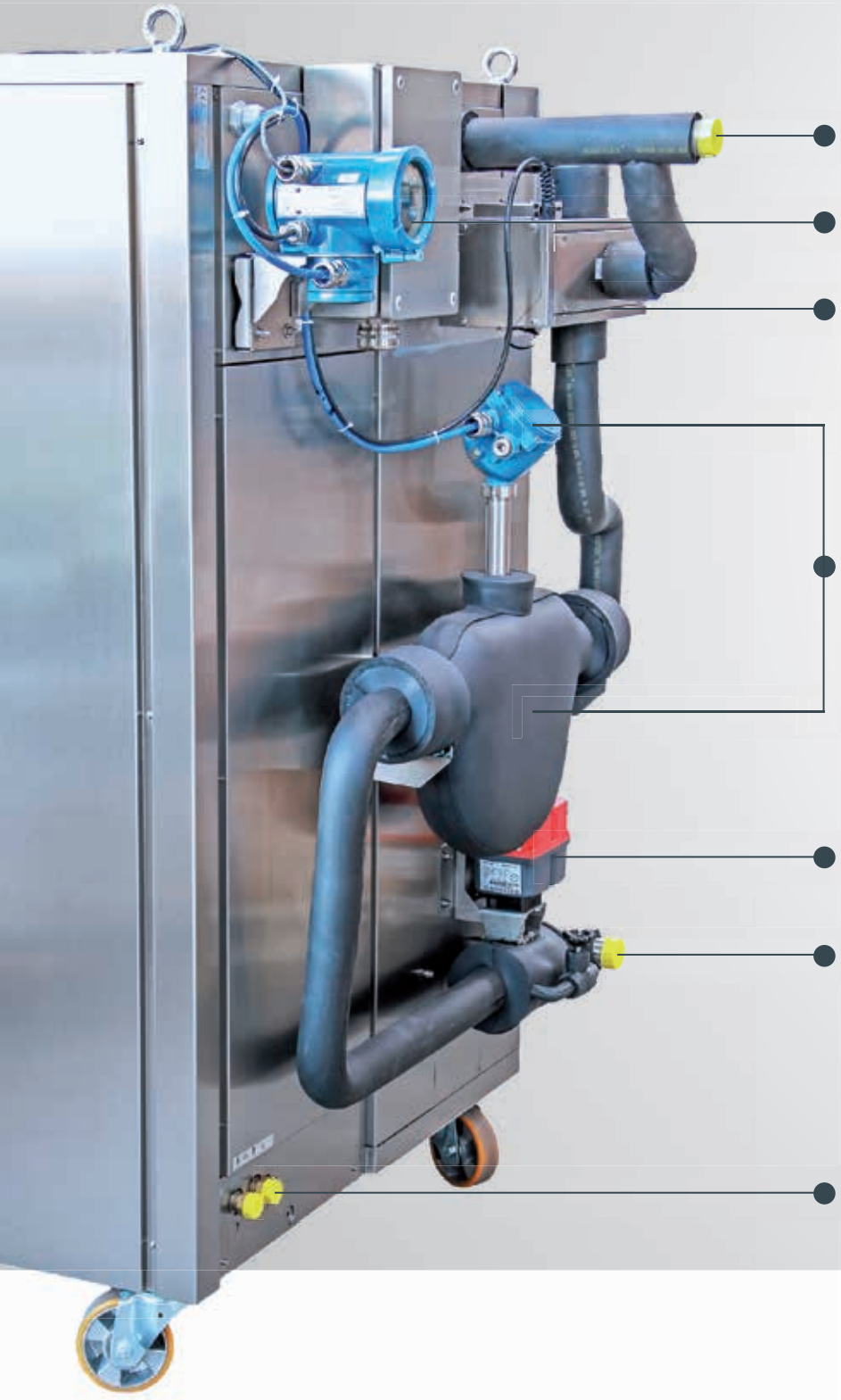


Space-saving
Complete solutions

ATTACHEMENTS ON THE BACK

Optional components such as flow meter, bypass etc can be fitted at the customer site or integrated onto the unit during the construction.

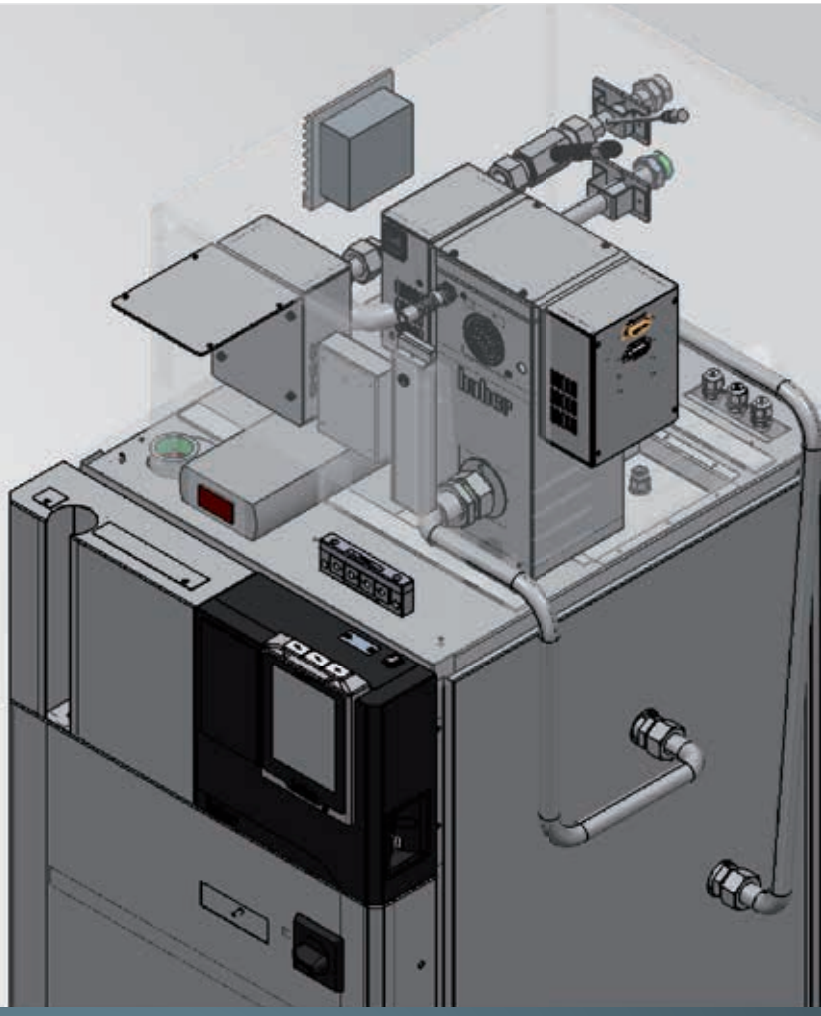
Our Engineering team are experience and knowledgeable and would be delighted to discuss the best solution for your application.



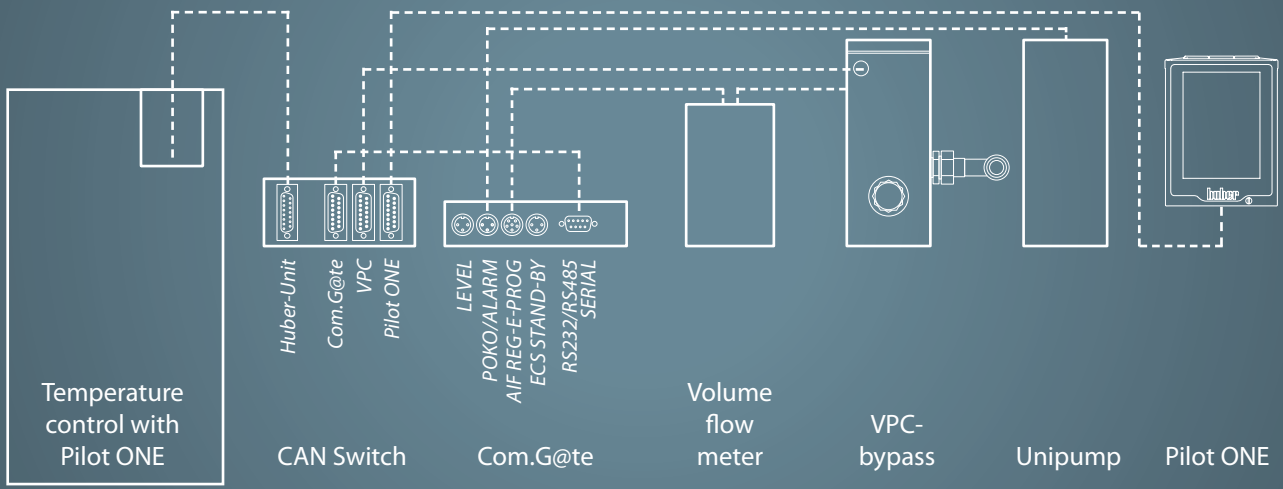
ATTACHMENTS "ON TOP"

In this example, all additional components have been built "on top" of the temperature control unit. This kept the footprint and required space to a minimum.

Equipment built into the structural housing includes a bypass, volume flow meter, extra pump, interfaces etc.



FUNCTIONAL DIAGRAM – FLOW VOLUME MEASUREMENT/REGULATION



Examples **of use**

Fuel temperature control

Huber temperature control equipment is used for cyclical heating/cooling of petrol or diesel. Dynamic temperature control systems are particularly suitable for this test, as they can change temperature quickly and cover a wide temperature range.

Cold filter plugging point

The most important test for the cold temperature resistance of the diesel fuel is the filter performance defined by the CFPP or Cold Filter Plugging Point Test in accordance with EN 116. At temperatures below the freezing point, paraffin crystals can increase the flow resistance in the fuel filter, reducing or stopping the flow of fuel.

Material deformation

Components such as condensers, air lines and exhausts are frequently exposed to temperature fluctuations from -90 °C to +150 °C. The behaviour of the materials in the different components can be tested with cold bath circulation thermostats under a range of load conditions.

AdBlue® temperature control

This application takes place in the SCR (selective catalytic reduction) catalytic converter. Using selective catalytic reduction, the emission of nitrogen oxide (NOx) is reduced by around 90% (in stationary operation). The liquid is a clear, synthesised 32.5 percent solution of high-purity urea in demineralised water.

Exhaust test

We supply a range of different temperature control units for fogging tests (in accordance with EN 14288 and DIN 75201) for individual components in car interiors.
When they warm up, the volatile constituents escape from the component and condense in the (colder) environment. The KISS and CC series are used to heat the sample while the (e.g.) Minichiller is used to condense the vapours for analysis.

Space conditions

To carry out thermal functional tests under the conditions found in space, Unistats are ideal for rapid and responsive temperature control of thermal plates and shrouds within vacuum chambers. Other areas of application for Unistats include test units with vacuum chambers, where thermal cycles and thermal vacuum tests for flight qualification of x-ray instrumentation and satellite sub-systems are carried out.

Transmission oil test

For transmission oil tests, you can use a Unistat with operational temperatures from -40 °C to +250 °C for temperature control. The transmission oil is pumped through a plate heat exchanger and flows through defined temperature profiles in various cycles.

Softening point

The Vicat Test is used to make statements about the softening point of plastics. A rounded needle with a flat end is pressed onto the sample with a defined pressure and continuous increase in ambient temperature. Depending on the test conditions chosen, the constant temperature increase must be 50 °C or 120 °C per hour, until the softening temperature (VST) is reached, and the needle can penetrate 1 mm into the material.

Examples **of use**

Optics, telescopes

Unistats are used for high-precision temperature control of calibration and vacuum chambers, in order to test and calibrate optical telescopes for space research. The parts and functional components are subjected to real conditions using high vacuum systems.

Additives, lubricants

Temperature-dependent test processes for development, optimisation and quality assurance of additives and lubricants. Typical objectives include improving the cold temperature behaviour of viscosity as well as optimisation of resistance to ageing, corrosion protection, dispersing capacity and foaming behaviour.

Pump test

Temperature control for pump test units for pumps for liquid and gaseous media. Exact temperature control delivers a high level of measurement accuracy and reproducibility for all parameters. Typical tests where the influence of temperature plays a major role include pressure tests, flow volume measurements, noise measurements, power consumption, leak tests and long-term durability tests.

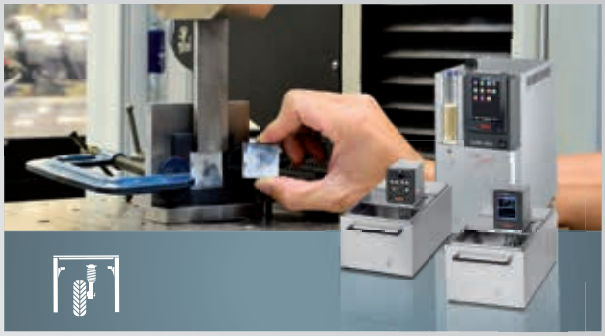
Sensors

Unistats combined with the Unical calibration bath are ideal for functional testing and calibration of sensors such as Pt100 sensors. The stainless-steel bath is set up like a calorimeter, and so achieves excellent temperature homogeneity.

The individual temperature cycles can be prescribed using a programmer or control via a digital interface.

Corrosion testing

Vehicle chassis components are exposed to temperature fluctuations, moisture and environmental influences every day. These environmental conditions are recreated in special test chambers using mist, dry phases, salt solutions and other corrosive solutions.
The cyclical temperature fluctuations are critical here. Dynamic temperature units from Huber are ideal here, to test precise temperature changes over several test phases.



Material stress test

In the automotive industry, all vehicle components must undergo a wide range of stress tests - often under extreme climatic conditions. The components must be able to withstand the stress of cyclical, changing temperatures for several weeks or months. Unistats are the perfect choice here. The units are designed for reliable, permanent operation, and facilitate extremely rapid temperature change.

Battery test

One use of lithium ion batteries is in electric vehicles. These must pass a range of temperature tests before installation. For this, an ambient temperature from -20 °C to +40 °C is created in an environmental chamber. A Unistat, which can control temperature from -40 °C to +100 °C, is connected at a test point inside the environmental chamber using hoses.

Special solutions

If you need a temperature control solution specially adapted to your requirements, then we look forward to your enquiry. We would be delighted to offer personalised advice and give you suitable approaches to a solution, or show you reference projects we have already completed with comparable requirements.

Success **Stories**

European Space Agency ESA tests CHEOPS satellite with Unistats

Since the early days of space travel in the first half of the 20th century, scientists have gained many fascinating insights into our universe. The milestones of space exploration, such as Neil Armstrong's first steps on the moon in 1969, are simply unforgettable. But space still conceals many secrets.

In neighbouring solar systems there are countless planets, which we know almost nothing about. They are outside the gravitational influence of our sun and orbit other stars. This is why they are known as extra-solar planets or "exoplanets". Up to now, we have only been able to research the characteristics of planets in our own solar system using existing examination methods, and the characteristics of planets in other systems remained a mystery.

The European Space Agency (ESA) has now initiated a mission to deliver findings about these exoplanets – CHEOPS (Characterisation of ExOPlanet Satellites). Working closely with a research institute in Switzerland, they have developed a 300 kg optical telescope with a 30-centimetre aperture and a length of 1.2 metres.

Since 2017, the telescope has been collecting information about the previously unknown exoplanets using the "transit method": If a planet travels in front of its central star, the latter's brightness decreases because of the shadow cast by the planet. This process is observed by the telescope in the transit method. The diameter of the planet is derived from the reduction in brightness. Using earth-based instrumentation and another method – the "radial velocity method", we can also determine the mass of the planets. If you know the diameter and mass, you can calculate the density. This then provides information about whether the planet consists of gas, ice, or rock. So, CHEOPS can help us gather a number of important indicators about previously unknown planets in other solar systems.

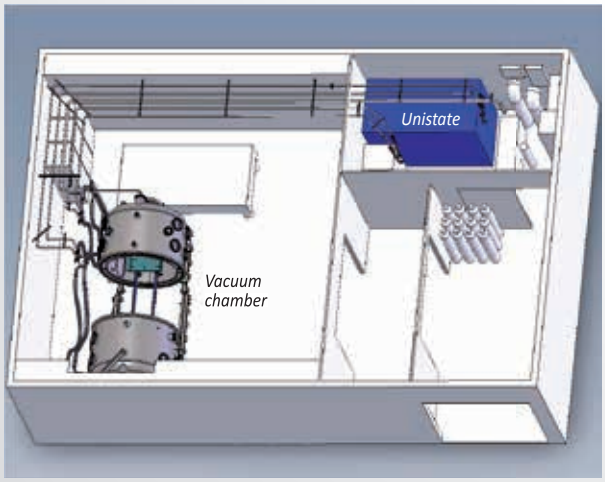
Vacuum chambers for simulating space

For the success of the CHEOPS mission, it is absolutely critical that the telescope operates extremely precisely and reliably. This requires exact preparation with a variety of tests. These can only be carried out on earth in simulation chambers which recreate the conditions found in space. For the tests on the CHEOPS telescope, a vacuum chamber was used, which was specifically designed for this challenging application..

High technical requirements

The space simulation chamber used to prepare the tele-

A Unistat 950w controls the temperature in the vacuum chamber, and another Unistat 915w controls the table for the experiments



The vacuum chamber and the two Unistats are connected via a 15-metre-long pipe connection

scope for deployment in space must meet a high level of requirements:

- Create conditions similar to those found in space
- High temperature spectrum for instrument tests at extreme temperatures
- Rapid temperature change
- Low exhaust chamber surfaces in the vacuum
- Surfaces without particle release for tests under clean room conditions

The vacuum experts at our clients developed a 5.5 tonne calibration and vacuum chamber for the CHEOPS telescope. All the specific requirements for the application were considered right from the start. This means the necessary conditions can be created in order to test and calibrate the telescope and its components under realistic conditions.

Accurate preparation of the chambers began even before the actual delivery. As no reflections should appear on the chamber walls during the optical tests of the telescope components, the interior is coated with a special, black paint. In addition, this paint is optimised for absorption of the heat radiation from the test objects. During the tests in a vacuum, no chemical substances may be released from the interior coating in the chamber. Because of this, the vacuum specialists built the chamber fully before delivery, commissioned it, and heated it to 160 degrees Celsius for several weeks to expel gas from the chamber surfaces.

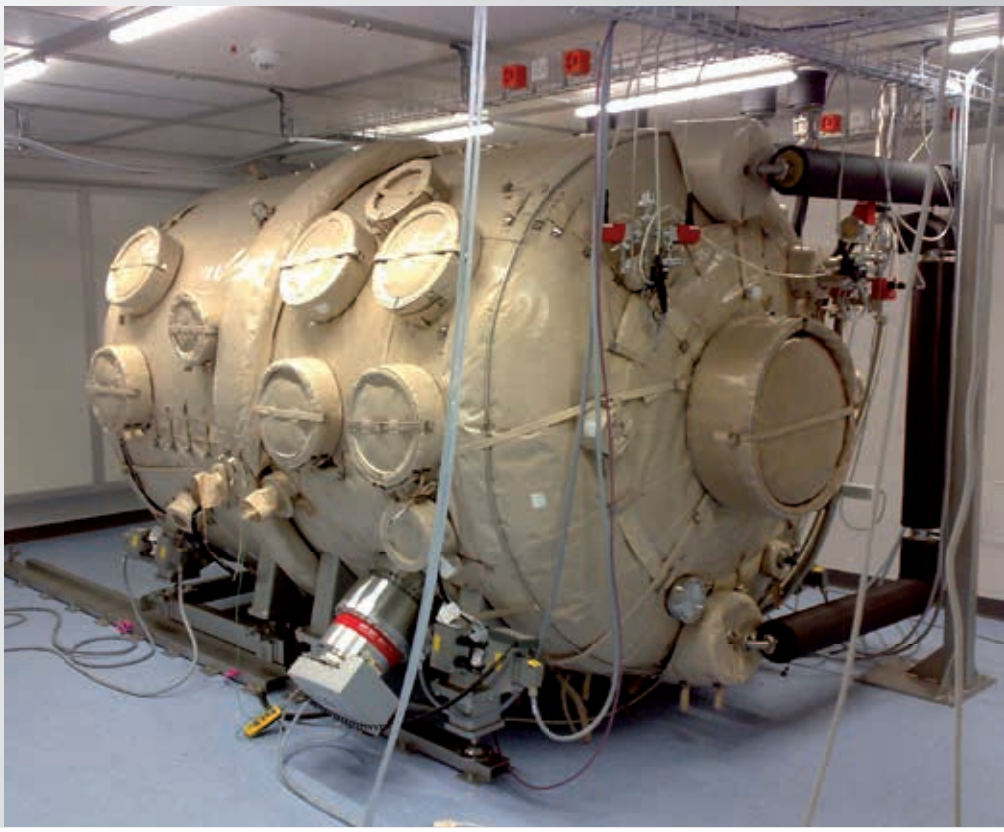
At the end of this process, the chamber was taken apart again and transported to the end user, along with three Huber temperature control units and the necessary vacuum accessories.

In the cleanroom lab at the research institute the telescope components were gradually exposed to temperatures from -80 °C to +140 °C in the vacuum. Later on, the structural model and then the flight instrumentation were also tested in the chamber.

Demanding vacuum system

The thermal vacuum chamber is three metres long, with diameter of 1.8 metres. The two halves of the chamber can be easily moved apart and together using a rail system. Using the integrated vacuum and valve technology, the chamber can be evacuated to UHV pressure. The interior surfaces of the chamber are electropolished, so they are reflective.

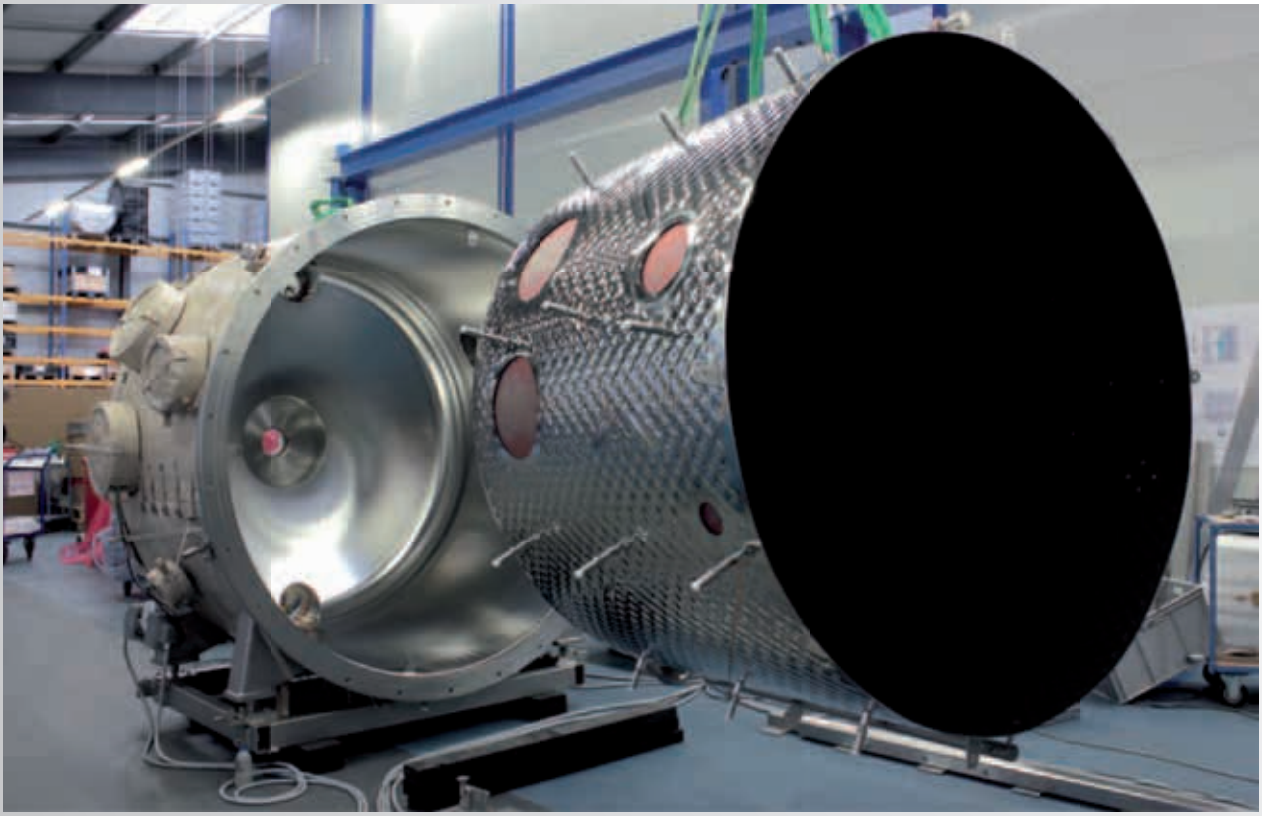
An optical table is positioned in the centre of the chamber to support the telescope. A temperature-controlled shroud surrounds the whole test volume and screens the telescope from the walls of the vacuum chamber. Facing the test object, the shroud is coated with special black paint which means it is optimised for the lowest possible level of



absorption and gas emission. The paint "swallows" the heat radiation from the sample in the same way as space does.

Using cleanroom-compatible insulated heating, the chamber can be heated up to +160 °C. The two Unistats pump a special thermal fluid through channels in the interior an facilitate cooling to -90 °C. The highly accurate regulating technology in the Unistats allows temperature control of the thermal fluid to a few hundredths of a degree.

This vacuum chamber delivers the basis for another, significant step in space exploration. It represents universal test equipment which can also be used beyond the CHEOPS project for future satellite missions.



The thermal vacuum chamber is three metres long, with diameter of 1.8 metres. The two halves of the chamber can be easily moved apart and together using a rail system

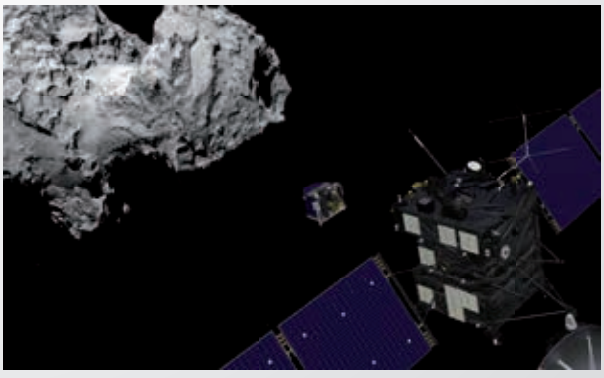
Success **Stories**

Material tests and temperature simulation in space research

In November 2014 the space probe Philae landed successfully on the surface of the comet Tschury. The lander from the German Centre for Air Space Travel had already been en route to the comet 67P/Tschurjumow-Gerassimenko with the space probe Rosetta 10 years before. This means Philae was the first space probe to land gently on a comet. "This is a major step for mankind" says ESA Director General Jean-Jacques Dordain in Darmstadt.

After the spectacular landing, the space probe completed its planned research tasks and then, slightly earlier than planned, it went into sleep mode. Nonetheless, the mission was a great success. In the roughly 60 hours that Philea was active for, numerous measurements were taken. The history of the origin of our solar system can be researched using these results. Temperature control technology from Huber Kältemaschinenbau was involved in the development of the space probe. For this, a high-vacuum environmental chamber was built at the Physical Institute at the University of Bern, which required rapidly changing and very low temperatures for the various tests. Unistat temperature control systems were used for temperature control in the tests and components in Philae.

Huber client Hanspeter Eichelberger (formerly Renggli AG) was responsible for the implementation of the environmental chamber. After the successful landing on the comet over ten years later, he is proud of the work he did. "Most of the tests and temperature simulations for the Philae space probe were completed in the environmental chambers at Bern Uni. We were just a small cog in this huge experiment, but I'm still absolutely delighted that it all kept going in outer space – thanks to the power of innovation and the cooling machinery from Huber. I'm proud that we were part of this major project!"



Decoupling of the lander unit Philae from the Rosetta space probe

Commissioning of the Unistats at Bern University

We would be delighted to solve your temperature control task.
We look forward to your enquiry.

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