
SBB CFF FFS
Testing laboratory/
climate chamber.
SBB Passenger Traffic Operations –
your partner for the climatic acid test.
www.sbb.ch/en/climate-chamber

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Testing laboratory/climate chamber.
Climatic testing for all weathers.

Rolling stock is subjected to a wide range of external and internal influences in day-to-day operations. SBB has been operating a climate chamber at its Olten works since 1978 to give it the capability of simulating the behaviour of rolling stock and components in snow, ice and heat.

Every rail customer appreciates being able to travel, irrespective of weather conditions, in comfortably heated or air conditioned vehicles. Thanks to air conditioning and good thermal insulation, a comfortable environment can be maintained in the coaches in the face of even the most uncomfortable temperatures and high vehicle occupancies, summer and winter alike.

Our services.

- Powerful climate chamber for running comfort and performance tests on single-decker and double-decker passenger carriages, power cars and locomotives in accordance with the current European standards
- Engineering and consultancy services in air conditioning and heating technology and acoustics; requirements specifications, functional specifications, concepts or expert's reports can be prepared as required
- Powerful measuring, diagnostic and simulation systems designed for multiple uses inside and outside the climate chamber
- Drafting measurement schedules, test programmes and test reports in accordance with standards or as requested by the customer
- Optimisation of control and regulation behaviour, as well as implementing use and operating cost enhancements on existing air conditioning systems
- High levels of competence in rolling stock air conditioning arising from our experience with the SBB fleet of more than 3,000 air conditioned coaches
- Wide-ranging infrastructure with solid focus on maintenance thanks to integration within the Olten works

The benefit to you.

- Thermal comfort with optimised heating, ventilation and air-conditioning systems (HVAC) and coaches with optimised heating technology
- Enhanced system security and reliability by conducting prior functional tests in heat and cold, ice and snow
- Lower operating costs with energy-optimised systems
- Lower risks of failure and hence higher coach availability
- Lower service life costs and longer operational life.

Why choose Operations as a partner?

- Engineering knowledge and many years of experience in the operation and maintenance of rail vehicles in combination with extensive inspection and testing skills
- Options to run tests on individual components or whole vehicles, including double-decker passenger coaches
- Specialised staff with excellent technical expertise
- Regular inspection by the state Swiss Calibration Service (SCS) of the climate chamber and the testing and measuring equipment used
- Accredited by the SAS as a testing laboratory for climatic investigations on railway vehicles under number STS 0614 in accordance with SN EN ISO/IEC 17025:2005
- ISO 9001 quality management certification
- ISO 14001 environmental management certification
- ISO 10012 measuring equipment management system quality standard
- OHSAS 18001 occupational health and safety management certification
- Regular internal audits carried out by our specialist Safety, Quality and Environment unit
- Regular external audits carried out by the Swiss Association for Quality and Management Systems (SQS) and the Federal Office of Transport (FOT)
- We were awarded the Prix Esprix prize 2014 for the basic concept of "Managing with vision, inspiration and integrity".

Testing laboratory/climate chamber.
Our full service portfolio at a glance.

Testing laboratory/climate chamber.
A high-performance testing and service centre has been created with the establishment of the testing laboratory and, in parallel with this, the modernised climate chamber. The testing laboratory acts as a provider of comprehensive inspection and testing capacity, as well as engineering services for rail and land vehicles, and also for subsystems from the commercial and industrial sectors, from the air conditioning equipment manufacturing industry or mechanical engineering, for instance.

With the climate chamber at the Olten works, the testing laboratory can provide a test environment which will deliver reliable data irrespective of the prevailing weather conditions. A completely controllable external climate, combined with the capability of simulating passengers, sun and snow allows the simulation of various realistic situations.

Our full service portfolio at a glance.

- Carrying out acceptance and type testing of vehicles and equipment of all types without sun from the side and travelling wind
- Measurements and studies of thermal comfort for passengers both in the climate chamber and in the field using modern stationary and portable data logger systems and measuring technology
- Optimising air conditioning systems' control and regulation behaviour
- Determination of the heat transfer coefficients of vehicles and assemblies
- Performance testing of subsystems such as toilets, doors, couplings, windscreen wipers and rear-view equipment using a variety of sun, ice and snow simulations
- Efficiency tests and energy consumption optimisation
- Thermographical examinations
- Route tests (testing climate and pressure comfort)
- Acoustic measurements
- Drafting measuring schedules, test programmes and test reports in accordance with standards or customer specifications
- Engineering and consultancy services on heating, physiological, acoustical and air conditioning matters; requirements specifications, functional specifications, concepts or expert's reports can be prepared as required
- Support in the definition of maintenance specifications and procedures.

Comfort and performance testing in the climate chamber.
By creating typical environmental conditions in the climate chamber in a range from + 60° C down to – 33° C, we achieve conditions that allow us to subject the coaches to lifelike situations. By simulating changes of passengers and door opening cycles, we can reach conclusions and gain knowledge about the operation of air conditioning system regulation and the real comfort situations.

You will be able to exercise targeted influence on the systems at any time on the basis of the documentation covering the measurements of the scenarios and thermal loading processes.

Mobile snow system.
The mobile artificial snow system, which has a refrigeration system, is used to pre-cool the water inside and outside the climate chamber to allow us to test the functionality of subsystems, such as the doors or windscreen wipers. Working together with subsystem suppliers, we are thus also able to minimise failure rates.

Artificial sunlight for driver's cabs.
Direct insolation is emulated with sunlight-balanced artificial light. The measurements show what real-life conditions and comfort situations should be expected in the driver's cab.

The artificial sunlight has a luminous density adjustable up to 800 W/m^2 and can be adjusted in both height and angle of incidence.

Simulation of people and the sun in the coach.
Passenger occupation and the effect of sunlight can be simulated in the interiors using switchable and steplessly adjustable static radiant and convection heaters and air humidifiers.

Air flows in coaches.
Smoke generators, test tubes and air speed measuring equipment can be used at any time to visually determine air flows for passenger comfort and the air volumes circulating in the ducts of the air conditioning system.

Measurement data acquisition system including sensors.
We use an Ethernet-based measurement data acquisition system comprising a measurement PC and measuring boxes with highly accurate measuring sensors in order to determine the thermal atmospheric components and the material states in the subjects being tested. This measurement data acquisition system communicates directly with the climate chamber's automation system via an OPC server so that data for the systems can be compared in real time.

In-service measurements in the real-life use of coaches (Route test).
Online recording of states of thermal comfort in the coaches and of air-conditioning system operating conditions using data loggers makes it possible to detect and assess the influences of a side wind and a travelling wind, and changes of passengers on the systems, as well as further real interactions in operation.

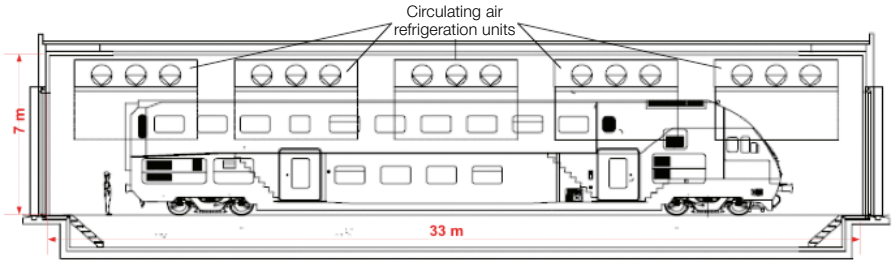
Testing pressure comfort.
With our mobile measurement data acquisition system, internal and external pressure can be recorded along the entire length of the train, making it possible to calculate static pressure differences and internal pressure gradients in order to test pressure comfort during operations. We use our own accredited testing procedure as a basis for this.

Testing laboratory/climate chamber.
Climate chamber infrastructure.

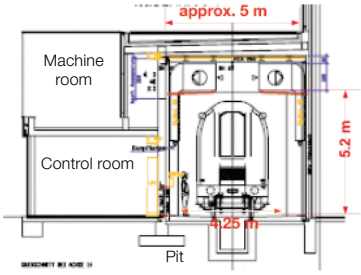
Climate chamber dimensions.
Various vehicle types with a maximum length of 33 metres can be investigated in the climate chamber. There is also sufficient space to accommodate double-decker coaches within a height of 5.2 metres. The generous width allows plenty of space for working on the coach being measured. Since the climate chamber is incorporated into the works' track layout, it is also possible to uncouple and leave complete multiple units on site and prepare them for the measurements in a protected siding immediately adjacent to the climate chamber. Non-rail-based test objects such as HGVs, containers, consumer goods and technical equipment can also be tested.

Power supply and exhaust gases.
The coaches being tested can be supplied directly with the usual RIC voltages via a train line on the one hand, or with 3 × 400 VAC from the industrial network, as the climate chamber has a separate feed for this. In addition to this, it is possible to provide the usual battery supply voltages from a separate charge. The exhaust gases from ICE vehicles, diesel locomotives and similar can also be exhausted to the exterior through an extraction system.

Compressed air supply.
With its independent compressed air supply it is possible to guarantee the working pressures required in 24-hour operation and to be able to carry out reference measurements to detect compressed air leaks in the coach, for instance.



Longitudinal section through climate chamber



Cross section through climate chamber

Cooling machines and heat distribution system.
With the new cold air generation system and the cold and warm air distribution system, it is possible to achieve ambient air temperatures of +60° C to –33° C in both summer and winter.

The air humidification system further allows regulated humidification of the scenarios in the climate chamber in a range up to a maximum of 90 % in the usual cooling mode states.

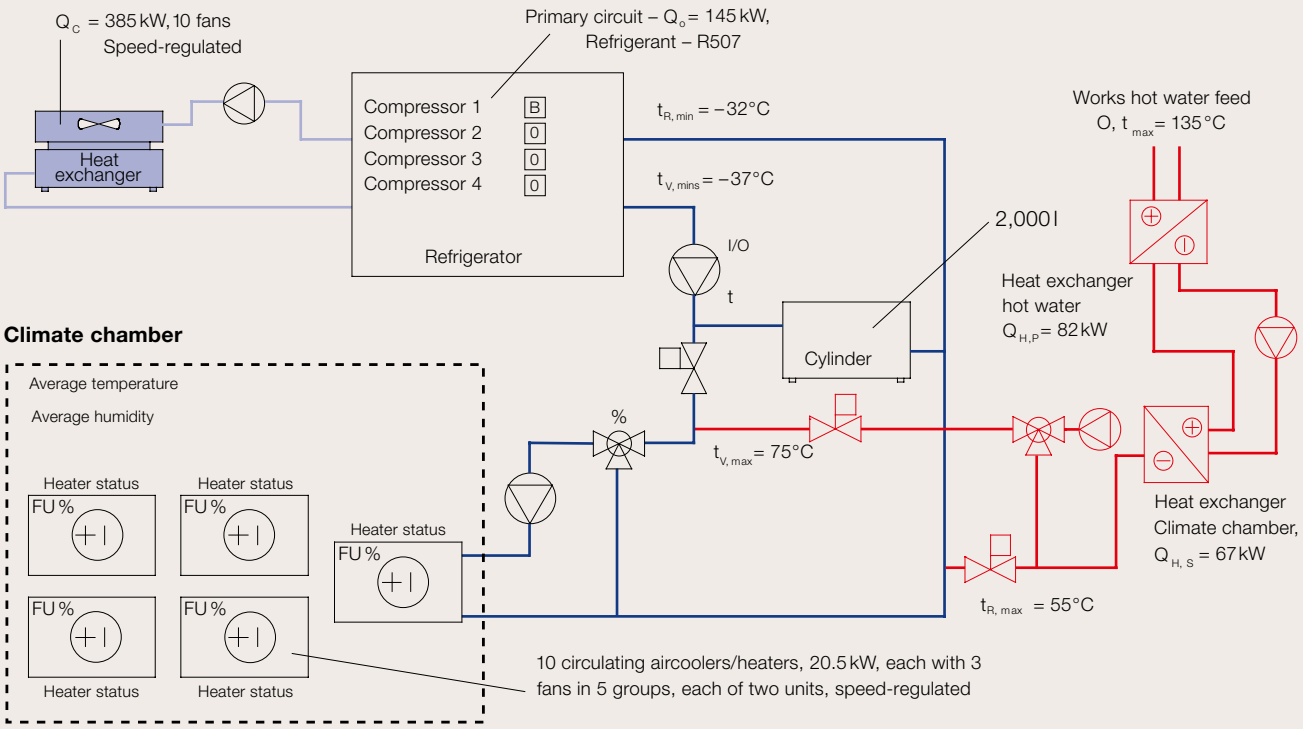
The heat supply of the climate chamber is provided via the district heating of the Olten works. The thermal energy demand in the climate chamber has been minimised by the efficient thermal insulation of the structural envelope of the climate chamber.

The design takes account of the waste heat performance of modern double-decker passenger coaches down to –20° C.

It is possible to achieve a very high level of air temperature regulation in the climate chamber by precisely regulating refrigerating plant output and using a cold sink. Very large volumes of air must be circulated to ensure that the temperature differences in the climate chamber can be kept as low as possible. For this reason up to 300,000 m^3/h are circulated by the 10 circulating air heating and cooling units installed. This is equivalent to circulating the volume of the climate chamber around 216 times an hour.

Testing laboratory/climate chamber.

Principle diagram climate chamber (HLK).



Testing laboratory/climate chamber.
Climate chamber automation system.

The principal task of the automation system is to keep the selected states in the climate chamber stable under all circumstances and to keep any influences emanating from the object under investigation. The climate chamber automation system is based on Ethernet Priva data bus and MBus systems in which the automation plant of the various subsystems in the HVAC installation are integrated.

The climate chamber automation system provides information on the objects being tested directly to the measuring data acquisition system via an OPC server.

With the user-friendly climate chamber automation system and the visualisation software, the important operating states and operating algorithms can be displayed online or via remote access. In addition to specifying defined, constant setpoint values for the operation of the climate chamber, it is further possible to program timed switch on/switch off algorithms or enter variable air states/ramp functions over a period of 24 hours.

In addition to this, all the operating modes of the HVAC installation are automatically monitored. As soon as irregularities arise in the operation of the climate chamber or the object being tested, the Priva system issues an immediate fault alarm that is forwarded to the operator's mobile phone.

Information on regulation:

- Regulation accuracy of the ambient air temperature: $\Delta t \leq \pm 0.5\,K$ and ambient air humidity $\Delta\varphi = \pm 5\,\%$
- Maximum permissible air temperature difference, horizontally and vertically: $\Delta t \leq 2.5\,K$

Railway-specific type test standards.
The testing laboratory works in accordance with the following standards:

- EN 13129-2
- EN 14750-2
- EN 14813-2
- UIC 553-1

Further standards may be applied by agreement with the customer. The testing laboratory works in accordance with its own processes and accredited testing procedures.

Reporting/expert opinions.
The inspection and the test results as well as the original measurement data are summarised in accordance with the accredited test procedure and issued as test documentation or expertise as a hard copy or in electronic form. Specific requirements may be agreed at any time on customer request.

SBB Passenger Operations affirms that this testing laboratory operates completely independently from any other organisations. Independence from internal organisational units is also guaranteed.

August 2019

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