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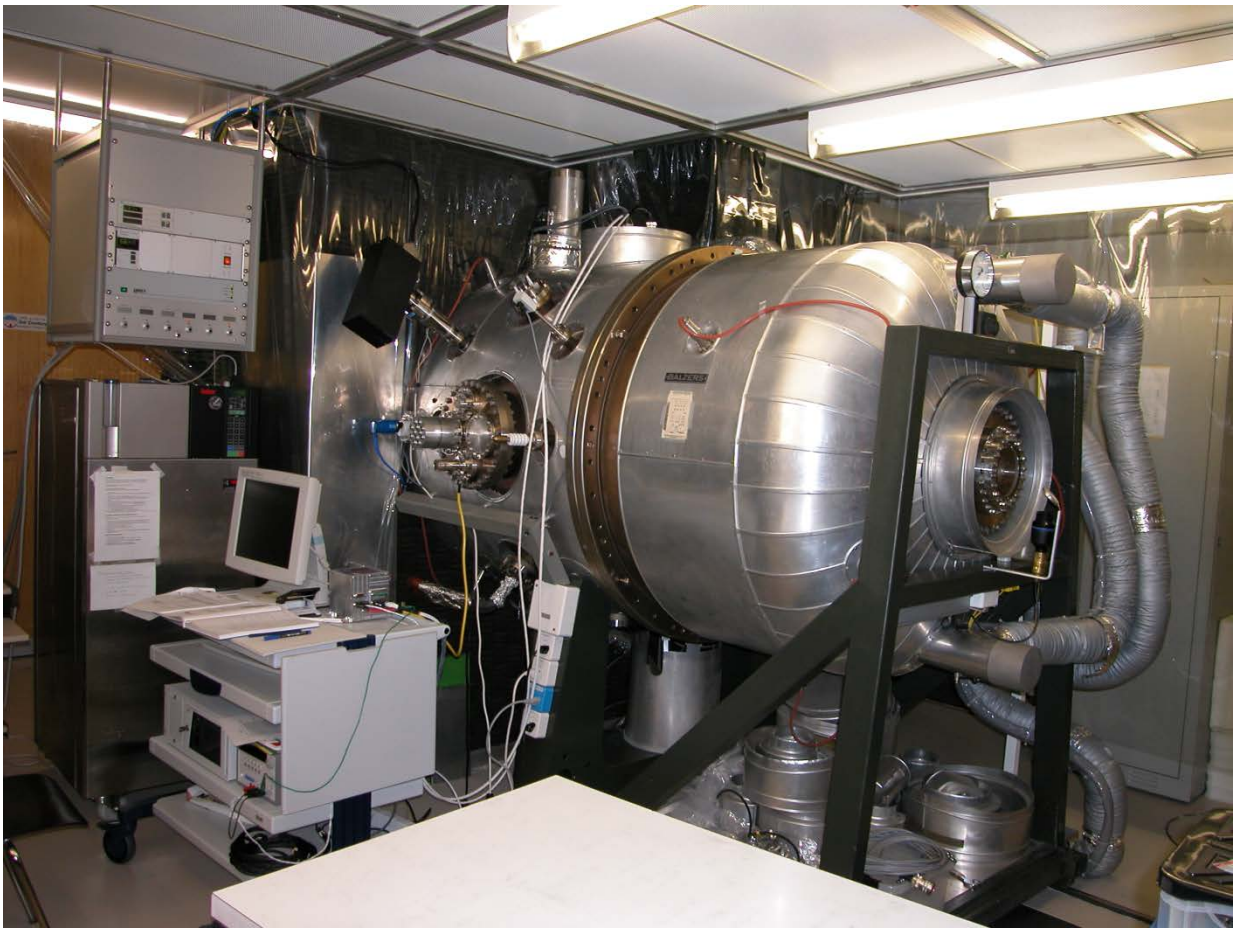
Thermal Vacuum Test Facility

System Specification



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1 System description

1.1 Chamber

Cylindrical horizontally oriented chamber with 1200 mm (inside diameter) main flange. The main flange is Viton sealed for normal operation, all other flanges are metal sealed. A liquid media circulated shroud, blackened on the inside and split at the main flange is mounted within the chamber. A resistive electrical heating system is mounted between the shroud and the chamber walls. It can be used to perform a bake-out of the chamber. 11 tapped holes are available for specimen support at the shroud.

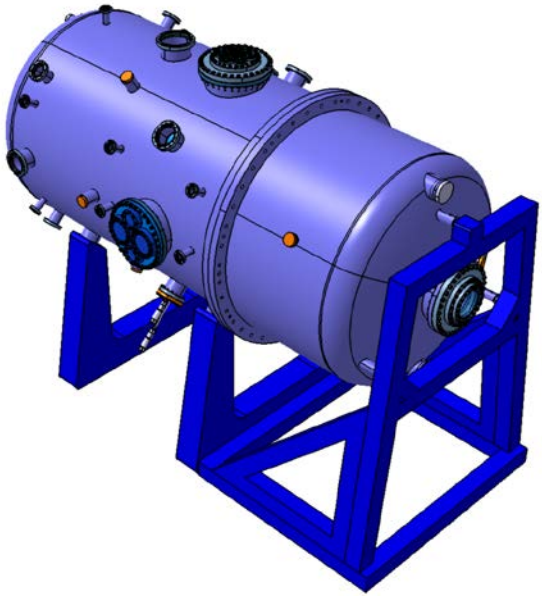

Figure 1: Virtual model of the TV-chamber

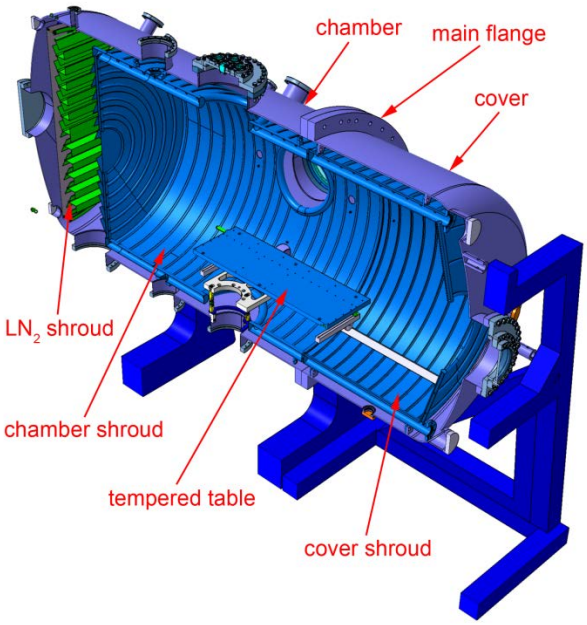

Figure 2: Section view of the model

A temperature controlled aluminium table for specimen support is mounted within the chamber. The temperature of the table is controlled by a second liquid media circle and is independent of the shroud temperature.

1.1.1 Dimensions

The position of the tempered table is adjustable along the chamber axis. The CAD model and technical drawings of the different chamber setups are available. Detailed information is provided on demand. The main dimensions of the chamber are as follows:

- Inner diameter of shroud: 1000 mm
- Max. length of test item: 2020 mm (1340 mm within chamber, 680 mm within cover)
- Dimension of tempered aluminium plate: 860 mm x 545 mm

1.1.2 Flanges

Several flanges are mounted on the chamber. Some of them are blocked by the equipment of the standard configuration of the facility, including pumps, data acquisition and feedthroughs for the

control of the facility. The following bullet list shows the flanges which are available for the test setup. More flanges might be available on demand.

- Ø300 mm copper wire sealed flange (12" Wheeler) on the top of chamber, equipped with 5 pieces 37-pin Deutsch connectors
- Ø300 mm copper wire sealed flange (12" Wheeler) on the side of chamber, supporting 2 x CF Ø100 mm and 2 x CF Ø63 mm flanges, or a Ø285 mm Suprasil window (optical quality)
- Ø285 mm Suprasil window (optical quality) on the side of the chamber (at the moment blocked by the solar simulator system)
- Ø100 mm CF flange, oriented 45 ° off horizontal and vertical axis
- 2x Ø35 mm CF flange
- Ø250 mm CF flange in line with chamber axis, equipped with Ø150 mm CF viewport

1.2 Feedthroughs

Many different feedthroughs are on stock at the laboratory and could be mounted on the above mentioned flanges. Please contact us for further information. As standard test setup are followed feedthroughs mounted or available:

- 2 x Deutsch feedthroughs for totally 32 T-Typ (Copper-Constantan) Thermocouples, fix installed for experiment thermocouples. The thermocouples will be plugged inside the chamber by ceramic miniature thermocouple connectors.
- 5 x Deutsch 37-pin (DM 5606 37-37 PP, MIL-C-26482)
- different D-SUB (15pin, 25pin as an example)
- MDM connector 51pin
- different high voltage feedthroughs
- coax / sma feedthroughs
- linear movement
- rotational movement
- precision gas inlet valve

1.3 Pumping System

Different vacuum pumps are installed at the chamber. The pumping system is, for cleanliness reasons, oil free. The main pump is a turbomolecular pump backed with either a screw pump (for high flow rate at the beginning) or a scroll pump. For ultra-high vacuum operation a cryogenic pump is available.

1.3.1 Pre vacuum pumps

Screw Pump:

Type:	Leybold Screwline SP250
Pumping speed:	270 m3 / h

Scroll pump:

Type:	Leybold Scrollvac SC 15 D
Pumping speed:	13 m3 / h

1.3.2 Turbo molecular pump

Type: Leybold Turbovac MAG W 2800
Pumping speed: 2400 l/s (Nitrogen)
Rotor bearing system: magnetic

1.3.3 Cryogenic pump

Type: CTI-Cryogenics Cryo-Torr 8
Pumping speed: depending on the residual gas composition

1.3.4 Ultimate pressures

- Using turbo molecular pump $<10^{-8}$ mbar *
- Using cryogenic pump and liquid nitrogen shroud <TBM mbar *

* measured with empty chamber

1.4 Purging system

An automatic purging system for the chamber with nitrogen is available. The purging is controlled by the TV-chamber controller.

- Nitrogen class N50
- Chemical purity ≥ 99.999 Vol %

1.5 Liquid Nitrogen shroud

In the rear section of the chamber (see Figure 2), a liquid nitrogen shroud is installed. This shroud could be used as a cold trap during testing (no significant effect on the temperature inside chamber).

1.6 Cleanliness

The loading section of the chamber is located in a class 100 laminar flow clean-room environment.

1.7 Solar simulation system

A solar simulation system is connected to one of the 285mm Suprasil windows, which provides a light beam with an intensity of 6.5 solar constants and a solar like spectrum. See solar simulator specification for detailed information.

2 Facility operation / controlling

2.1 Vacuum section

The complete vacuum section including the pumps, gate valves and the security systems are controlled by the TV-Chamber pump facility controller.

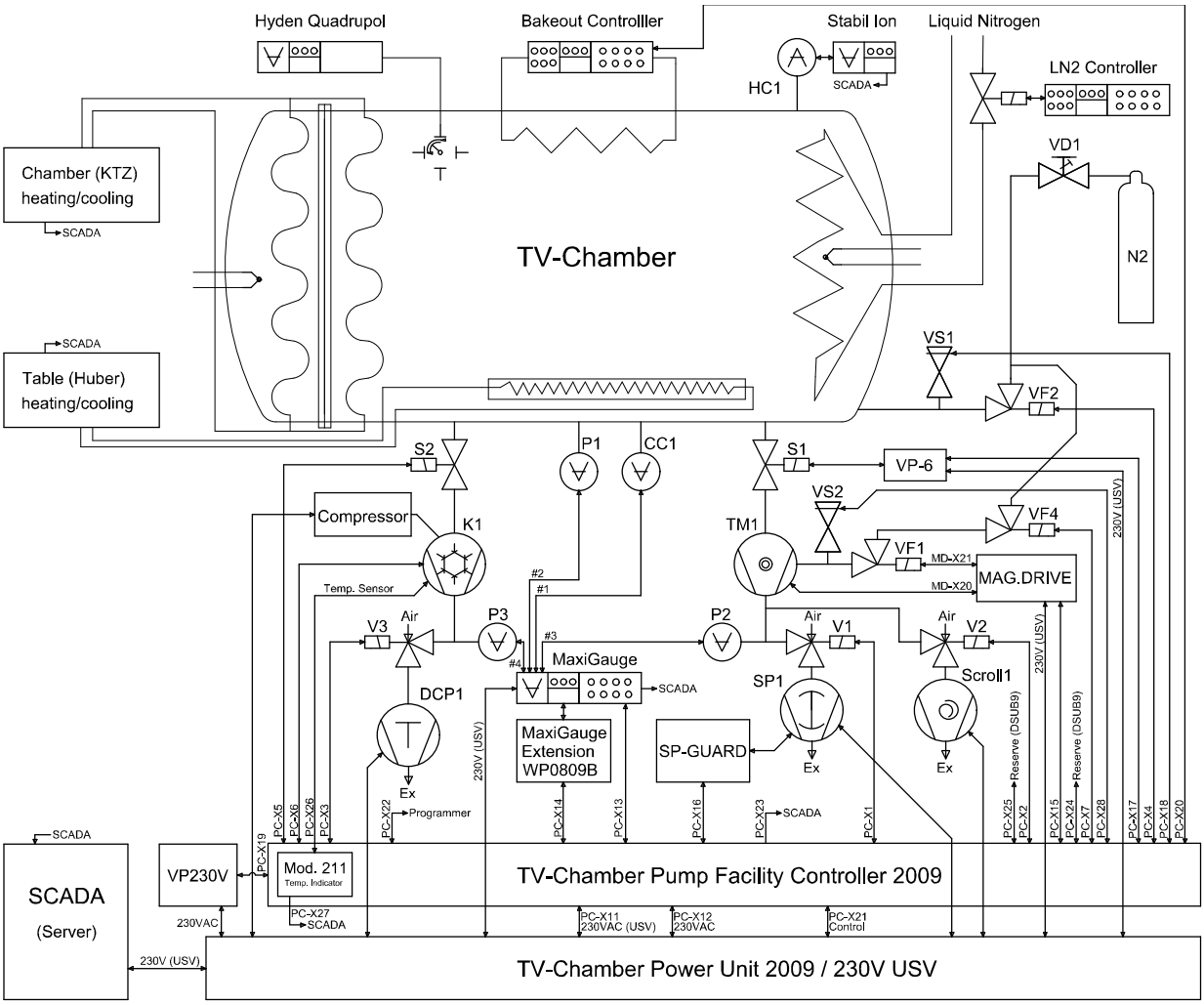

Figure 3: Block diagram of the TV facility

The sequences during pump-down are predefined in the controller logic. This prevents the facility from damages due to handling errors. Failure modes like an interrupted power distribution, a damaged pump, etc., are automatically detected and will trigger a fail-safe mode to conserve the vacuum and shut down systems to protect the test hardware from damages.

2.2 Temperature control

The temperatures of the shroud and the tempered table are controlled by two independent liquid media circles. The temperature set points can be selected by a web based monitoring system. An electrical heating system is installed between the chamber wall and the shroud to bake out the chamber.

All temperature control systems are equipped with independent security systems to prevent under- / overshooting of minimum / maximum temperatures.

2.2.1 Shroud temperature control system

Type:	KTZ heating / cooling unit
Heat carrier:	Novec HFE-7500
Temperature range:	-75 °C*[1] – 160 °C
Heating / cooling rate:	between -75 °C and 100 °C, minimum 2 °/min above 100 °C, slow cooling rate, because no active cooling is possible

2.2.2 Table temperature control system

Type:	Huber heating / cooling unit
Heat carrier:	HTF 190
Temperature range:	-80 °C*[1] – 200 °C
Heating / cooling rate:	averaged 2 °/min, (depending on temperature, much higher gradients are feasible)

*[1] measured without any specimen heat load

2.3 Electrical heating system

Type:	electrical resistance heating
Temperature range:	up to 450 °C*[2]

*[2] for temperatures above 150 °C the main flange has to be sealed with a gold wire and the liquid media circles need to be drained.

2.4 Infrared hot plate

Type:	Electrical resistance heating
Maximal temperature:	300 °C
Emissivity:	0.807 +/-0.06 @ 270.5 °C (TBV)

3 Data acquisition

3.1 Temperatures

The temperatures for the facility operation and the experiment are measured with thermocouples and a high precision TEMPpoint temperature measurement device. All temperatures can be logged by the web based monitoring system.

Type:	Data translation TEMPpoint DT8871U
Supported thermocouples:	B, E, J, K, N, R, S, and T
Channels:	48, fully galvanic isolated
Accuracy:	±0.16 °C (with T-type thermocouples)

Channels available for experiment:	32 T-type (copper / constantan) thermocouples Other channels/types may be available on request

3.2 Pressures

The following pressure measurement devices are installed. All the pressures can be logged by the web based monitoring system.

- Pirani gauge, measuring pressures > 10^{-3} mbar
- Cold cathode gauge, measuring pressures from 10^{-3} to 10^{-7} mbar
- Stabil-Ion Bayard-Alpert gauge, measuring pressures from 10^{-5} to 10^{-11} mbar
- HIDEN quadrupole mass spectrometer (0.4 to 300 amu), measuring partial pressure down to 10^{-14} mbar (currently not available)

3.3 Other equipment

Other measurement / controlling equipment (data loggers, power supplies etc.) is available at the laboratories of the University on demand.

3.4 Monitoring Capabilities

A web based monitoring interface is available for recording and monitoring purposes. Detailed information is available on request.

4 Contact data

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