

SERVICE DATASHEET

THERMAL VACUUM TESTING VACUUM BAKEOUT TESTING CLIMATE TESTING OVERPRESSURE TESTING

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1 Purpose and Scope

The present document provides detailed technical information about the Thermal Vacuum Testing services for ECSS-conform space equipment testing in the following cases:

- thermal vacuum test,
- thermal ambient test (vacuum and non-vacuum),
- thermal cycling test (non-vacuum),
- corona and arc discharge test (vacuum sweep),
- multipaction test,
- humidity test,
- vacuum bakeout, and
- overpressure test with thermal cycling.

The definitions and glossary of terms from ECSS-S-ST-00-01C [AD 1] apply to this document.



Figure 1. Thermal Vacuum Test Facility

2 Application and Key Features

2.1 APPLICATION

- ✓ **Thermal vacuum ECSS-conform tests including**
 - Thermal vacuum tests
 - Thermal ambient tests in vacuum conditions
- ✓ **Thermal ECSS-conform tests including**
 - Thermal cycling test in non-vacuum conditions
 - Thermal ambient test in non-vacuum conditions
- ✓ **Humidity ECSS-conform tests**
- ✓ **Other vacuum environment related specific ECSS-conform test including**
 - Corona and arc discharge test
 - Multipaction test
- ✓ **Space equipment vacuum bakeout**

2.2 KEY FEATURES

- ✓ **The following test chambers are available**
 - TVAC test chamber (deep vacuum)
 - Climate test chamber (non-vacuum)
 - Bakeout chamber (vacuum)
 - Overpressure vessel (vacuum or overpressure with N₂)
- ✓ **Contamination control and spectroscopy**
 - TQCM contamination monitoring and control system
 - Mass spectrometry up to 200 amu
- ✓ **Deep space vacuum test system**
 - Deep vacuum conditions down to 10⁻⁵ Pa in the temperature range of -70 ... +180 °C
 - Depressurisation with atmospheric air or purified N₂
- ✓ **Configurable test systems according to the user's need**
 - Controlled via graphical user interface
 - Fully autonomous test operation and remote access
 - Data collection via dedicated software (SpaceSim)
- ✓ **High level of safety assurance**
 - The facility is located at a closed, guarded site with limited number of access
 - Every area is video controlled
 - Any access to the facility area is logged
 - ESD-safe working environment with ESD-tester stations
- ✓ **Facility environmental parameters are logged**
 - Temperature and humidity monitoring stations are installed
- ✓ **ECSS-conform space testing engineering support is available upon request**

3 Specification

3.1 TVAC TEST CHAMBER

Table 1. TVAC test chamber general specification

Parameters	Values
Applicable ECSS test as per ECSS-E-ST-10-03C [AD 2], ECSS-E-20-01A Rev.1 [AD 3]	- Thermal Vacuum Test - Thermal Ambient (vacuum) - Corona and Arc Discharge (vacuum sweep) - Multipaction Test - Vacuum bakeout with TQCM monitoring any mass spectrometry
Chamber name or ID	EK TVAC Chamber
Chamber type	Custom made
Chamber dimensions (without TQCM)	length: 78 cm, internal diameter: 49 cm
Chamber dimensions (with TQCM)	length: 62 cm, internal diameter: 49 cm
Chamber volume	147.1 L
Operational temperature range	-70 ... +180 °C with ±2 °C stability
Operational pressure range	10 ⁻⁵ ... 10 ⁵ Pa with ±30% accuracy
Temperature monitoring and control	PT100 LakeShore sensors up to 10 measurement points - accuracy: ±0.5 or ±0.1 °C - range: -259 ... +600 °C (using thermal condition fixing plate)
Contamination control	CrystalTek 66TR TQCM monitoring system - dynamic range: solid film 50 kHz + non-solid 10 - 20 kHz - mass sensitivity: 1.96x10 ⁻⁹ g/cm ² Hz @ 15 MHz * - TQCM sensor frequency accuracy: ±1 Hz - TQCM sensor temperature range: -59 ... +100 °C - sensor FoV: 140°
Contamination spectrometry	INFICON Transpector MPH20P Residual Gas Analyzer - mass range: 1 to 200 amu - resolution: <1 amu @ 10% peak height over the mass range ** - sensitivity: 3.8x10 ⁻⁴ A/mbar
Cold-trap	No
Depressurisation	Athmospheric air or purified N ₂
Average heating velocity ***	3 °C/min ± 1 °C/min
Average cooling velocity ***	1.5 °C/min ± 0.5 °C/min
Data collection ****	Using SpaceSim software up to 1 Hz
Chamber mechanical interface	See ANNEX A – TVAC Test Chamber
Chamber electrical interface	4 pcs of DB25 female/male connectors inside/outside 2 pcs of SM4036 by Fairview Microwave inside/outside (type N female to type N female bulkhead adapter)

* 1.73x10⁻⁹ g/cm² Hz @ 16 MHz; 1.56x10⁻⁹ g/cm² Hz @ 16.8 MHz

** As per 1993 AVS Recommended Practice

*** In case of empty chamber without additional item inside

**** Pressure (in two points), temperatures (of used sensors), TQCM system data set, mass spectra

3.2 CLIMATE TEST CHAMBER

Table 2. Climate Test Chamber general specification

Parameters	Values
Applicable ECSS test as per ECSS-E-ST-10-03C [AD 2]	- Humidity Test - Thermal Cycling Test (non-vacuum) - Thermal Ambient (non-vacuum)
Chamber name or ID	EK Climate Chamber (S/N: 56766037170010)
Chamber type	Climats Excal 1421-HE
Chamber dimensions	length: 55 cm, depth: 50 cm, height: 50 cm
Chamber volume	137.5 L
Chamber window size	35 x 38 cm
Operational temperature change	-65 ... +175 °C with ±1.0 °C accuracy
Operational humidity change	10 ... 98% relH
Temperature control	Internal or external PT100 sensor with ±0.5 °C accuracy
Humidity control	For temperatures +10 ...+90 °C
Temperature regulation stability *	±0.1 ... ±0.3 °C
Work space homogeneity (as per IEC EN 60068-3-5) *	±0.5 ... ±1.8 °C
Humidity regulation stability	±1 ... ±3% relH
Average heating velocity (as per IEC EN 60068-3-5) *	7.0 °C/min (±0.5 °C)
Average cooling velocity (as per IEC EN 60068-3-5) *	5.0 °C/min (±0.5 °C)
Admissible dissipation at +20 °C	1.5 kW
Data collection period	Using Spirale3 software up to 1Hz
Chamber mechanical interfaces	3 pcs stainless steel inner shelves (maximum load 12 kg/shelf) For more details see ANNEX B – Climate Test Chamber
Chamber electrical interfaces	3 pcs access portholes (16 cmø left; 16 cmø right, 11 cmø right)

* In case of empty chamber in vacuum operation without internal additional heat sources

3.3 VACUUM BAKEOUT CHAMBER

Table 3. Vacuum Bakeout Chamber general specification

Parameters	Values
Applicable ECSS test as per ECSS-E-ST-10-03C [AD 2]	- Vacuum Bakeout (no monitoring)
Chamber name or ID	EK Bakeout Chamber (S/N: 42278348)
Chamber type	Thermo Scientific VT6060M
Chamber dimensions	length: 41.5 cm, depth: 34.5 cm, height: 37.1 cm
Chamber volume	53 L
Chamber window size	40 x 35 cm
Operational temperature change	(Ambient Temperature +15°C) +200°C with ±1 °C accuracy
Lowest final pressure	10 Pa
Depressurisation	Atmospheric air or purified N ₂
Temperature control	Internal PT100 sensor with ±1.0 °C accuracy
Work space homogeneity (as per DIN 128880 part 2) *	±4 °C (@200 °C)
Data collection period	No data collected
Chamber mechanical interfaces	2 pcs stainless steel inner shelves (maximum load 12 kg/shelf)
Chamber electrical interfaces	Inside: 1 pc MicroD 15pin (MIL-DTL-83513/01-Bx male) Outside: 1 pc MicroD 9pin (MIL-DTL-83513/04-Axxx female) plus 1 pc MicroD 9pin male ↔ DSUB 15pin male 1 pc BNC 50 Ohm (NBC50, female) 1 pc COAX 10pin (PLUG-MINI-1B-10, male) For more details see ANNEX C – Vacuum Bakeout Chamber

* In case of empty chamber in vacuum operation without internal additional heat sources

3.4 OVERPRESSURE VESSEL

Table 4. Overpressure Vessel general specification

Parameters	Values
Applicable ECSS test as per ECSS-E-ST-10-03C [AD 2]	- Thermal Cycling Test (vacuum, ambient or overpressure) - Thermal Ambient (vacuum, ambient or overpressure)
Chamber name or ID	EK Overpressure Chamber (S/N: 22027)
Chamber type	Custom made
Chamber dimensions	77 cm [diameter]; 131 cm [height]
Chamber volume	180 L
Chamber window size	63 mm
Operational temperature change	-70 ... +80 °C with ±1 °C accuracy
Final pressure	Ambient -1 bar/+0,5 bar
Depressurisation	Atmospheric air or purified N ₂
Temperature control	LAUDA RL 6 Thermostat with ±1.0°C accuracy
Data collection period	No data collected
Chamber mechanical interfaces	1 inner shelf with maximum load of 25 kg
Chamber electrical interfaces	3 pcs customisable access portholes For more details see ANNEX D – Overpressure Vessel

4 Accreditation and Audits

Table 5. Accreditation and Audits

Code	Title	Type	Validity	Remarks
ISO 9001:2015	Quality management system	Accredited	2024	Audit was performed in 2023
ISO 17025:2018	General requirements for the competence of testins and calibration laboratories	Accreditation planned	N/A	Accreditation is in progress
ECSS-Q-ST-20-07C [AD 2]	Quality and safety assurance for space test centres	Audit by ESA	N/A	Audit was performed in 2018

5 ANNEX A – TVAC Test Chamber

Here you find the TVAC Test Chamber mechanical interface information for designing the mounting of the test item and related temperature sensors.



Figure 2. Overview of the TVAC test chamber system

The TVAC test chamber is a cylindrical vessel mounted to its console horizontally. The door is hinged and can be opened to the right. The thermal conduction fixing plate is located in the back of the chamber vertically, the fixing points are placed with distance given in Figure 3 below (M6/10 screws can be used for mounting the DUT).

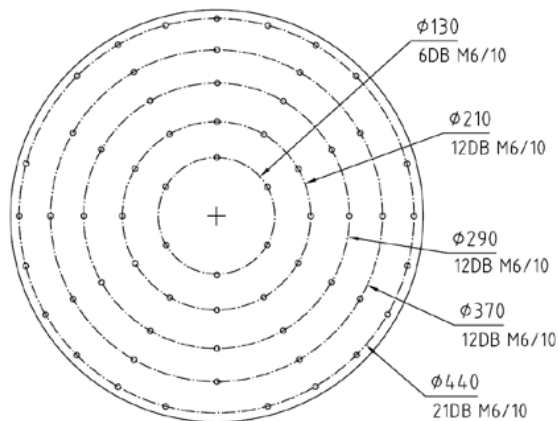


Figure 3. Thermal plate mounting holes

Different temperature sensors can be placed in the chamber and mounted at the desired locations. See Figure 4 and Figure 5 for details.

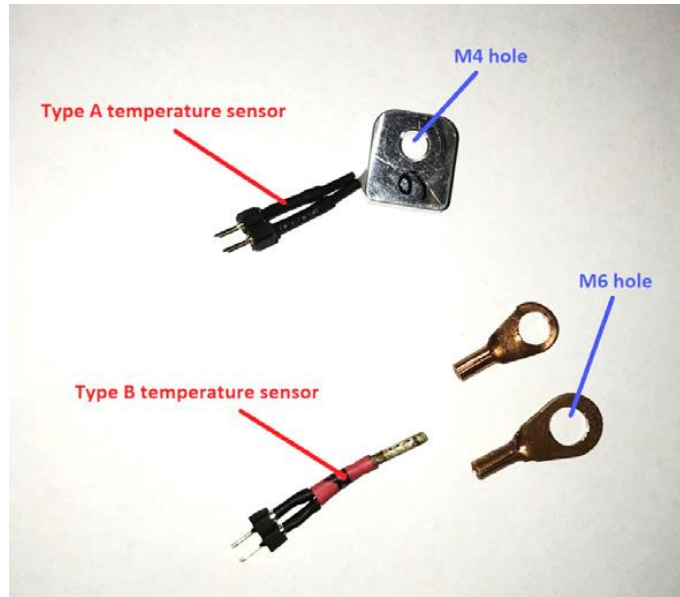


Figure 4. Available temperature sensors for the TVAC chamber

TYPE A TEMPERATURE SENSOR

TYPE B TEMPERATURE SENSOR

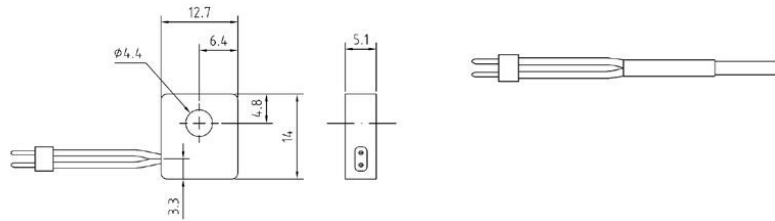


Figure 5. Temperature sensor types

There are 6 pcs. flat (type A) and 2 pcs. cylindrical (type B) sensors available. These can be used during the tests for temperature control and recording purposes. Recorded data is available upon the completion of the test cycle.

Table 6. Available temperature sensors in the TVAC chamber

Sensor type	Sensor manufacturer ID	No. of sensors	Range	Accuracy
Type A	LakeShore PT-103-AM	5	[-259; 600] °C	±0.5 °C
	LakeShore PT-103	1	[-259; 600] °C	±0.5 °C
Type B	LakeShore PT-103	2	[-259; 600] °C	±0.5 °C

6 ANNEX B – Climate Test Chamber

Here you find the mechanical details of the Climate Test Chamber which you can use during the preparation of the test process.



Figure 6. Climate test chamber

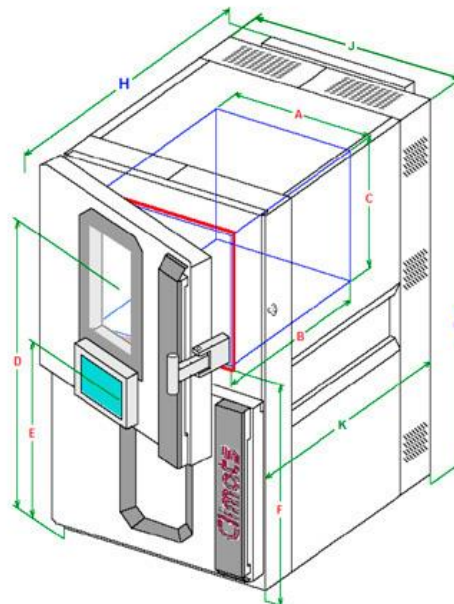


Figure 7. Schematic view of the climate test chamber

Dimensions in Figure 7 are: A=55 cm, B=50 cm, C=50 cm.

There are 2 portholes on each side of the chamber which are plugged using thermal insulating material during the test. These can be used for electrical cable and other feedthrough purposes.

7 ANNEX C – Vacuum Bakeout Chamber

Here you find the Vacuum Bakeout Chamber related mechanical and electrical interface details for designing the mounting and testing of the DUT.



Figure 8. Overview of the vacuum bakeout chamber system



Figure 9. Electrical feedthrough connectors

See Table 7 below for the available feedthrough connectors. Other connections can be made upon request.

Table 7. Feedthrough connectors installed

Inside	Outside	Notes
BNC receptacle	BNC receptacle	50 ohm
KF40-VB-1B-10		mates with PLUG-MINI-1B-10-xxx on both sides
MicroD 15-pin Male	MicroD 9-pin Female	for connection diagram, see Figure 11



Figure 10. Micro-D connectors

A microD 15-pin male connector is located inside, a microD 9-pin female is located outside the chamber, connection is made according to Figure 11.

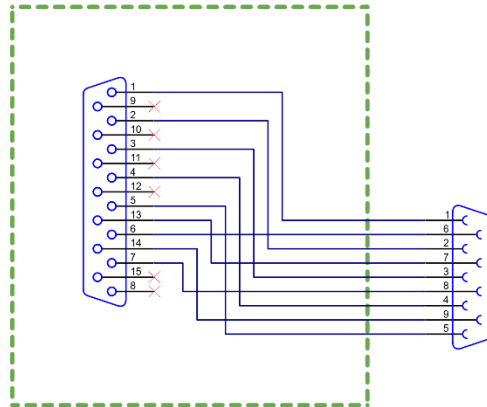


Figure 11. Connection of the feedthrough cable

Temperature measurement and regulation is done by the built-in temperature regulator. Setpoint is adjusted manually. The current temperature is displayed in digital form. Internal pressure (vacuum) can be checked using the built-in pressure gauge or by means of an electronic vacuummeter down to 1 mbar.

8 ANNEX D – Overpressure Vessel

You find here the Overpressure Vessel related mechanical and electrical interface details for designing the mounting and testing of the DUT.



Figure 12. Overview of the overpressure vessel

The DUT is placed either on the shoulder or directly on the bottom of the vessel. Shoulder diameter is 440 mm, total internal diameter is 610 mm.



Figure 13. Inside view of the overpressure vessel with the bottom tray for the DUT

Currently there is no dedicated electrical feedthrough connection. A custom type can be built upon request using one or more of the 3 available feedthrough ports.

Currently no internal temperature measurement is present. The LAUDA RL 6 thermostat is used in closed loop with manual setpoint adjustment. One or more temperature sensors can be added upon request using the remaining electrical feedthrough ports.

Internal pressure (vacuum) can be checked by means of the built-in pressure gauge. If more precise vacuum measurement is important, an electronic vacuummeter can be added.



9 List of Abbreviations

AD	Applicable Documents
BNC	Bayonet Neill-Concelman Connector
DUT	Device Under Test
DSUB	D Subminiature Connector
ECSS	European Cooperation for Space Standardization
EK	Energiatudományi Kutatóközpont (Centre for Energy Research)
ESA	European Space Agency
RD	Reference Documents
TC	Telecommand
TM	Telemetry
TQCM	Thermoelectric Quartz Crystal Microbalances
TVAC	Thermal Vacuum

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12.1 APPLICABLE AND NORMATIVE DOCUMENTS

Table 8. Applicable and Normative Documents

AD	Title	Reference	Version
[AD 1]	ECSS system - Glossary of terms	ECSS-S-ST-00-01C	1 Oct 2012
[AD 2]	Space product assurance – Quality and safety assurance for space test centres	ECSS-Q-ST-20-07C	1 Oct 2014
[AD 3]	Space engineering - Multipaction design and test	ECSS-E-20-01A Rev.1	1 March 2013
[AD 4]	Space product assurance - Thermal vacuum outgassing test for the screening of space materials	ECSS-Q-ST-70-02C	15 Nov 2008
[AD 5]	Space product assurance - Quality and safety assurance for space test centres	ECSS-Q-ST-20-07C	1 Oct 2014

END OF DOCUMENT