

SERVICE DATASHEET

Thermal-Vacuum 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.

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**
 - T-VAC test chamber (deep vacuum)
 - Climate test chamber (non-vacuum)
 - Bakeout chamber (vacuum)
- ✓ **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 $[-65;+95]^{\circ}\text{C}$
 - Depressurisation with air or purified N_2
- ✓ **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, humidity)**

✓ **ECSS-conform space testing engineering support is available upon request**



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3 Specification

3.1 T-VAC TEST CHAMBER

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 T-VAC Chamber
Chamber type	Custom made
Chamber dimensions (without TQCM)	78 cm [length]; 49 cm [cilindrical diameter];
Chamber dimensions (with TQCM)	62 cm [length]; 49 cm [cilindrical diameter];
Chamber volume	147.1 L
Operational temperature range	-70...+170°C with ±2°C stability
Operational pressure range	10 ⁻⁵ ...10 ⁵ Pa with ±30% accuracy
Temperature monitoring and control	Up to 10 pcs of PT100 LakeShore sensors with ±0.5°C or ±0.1°C accuracy in the range of [-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: 1.96*10 ⁻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: 3.8*10 ⁻⁴ amps/mbar
Cold-trap	No
Depressurisation	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
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)

* 1.73*10⁻⁹ g/cm² Hz (@16MHz); 1.56*10⁻⁹ g/cm² Hz (@16.8MHz)

** As per 1993 AVS Recommended Practice.

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

**** Measured pressures (in two points), used temperature sensor data set, TQCM system data set, measured mass spectrums.



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3.2 CLIMATE TEST CHAMBER

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	55 cm [length]; 50 cm [depth]; 50 cm [height]
Chamber volume	137.5 L
Chamber window size	35 cm 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
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

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	41.5 cm [length]; 34.5 cm [depth]; 37.1 cm [height]
Chamber volume	53 L
Chamber window size	40 cm x 35 cm
Operational temperature change	(Ambient Temperature +15°C) +200°C with ±1°C accuracy
Lowest final pressure	10 Pa
Depressurisation	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	1 pc MicroD 9pin (MIL-DTL-83513) 1 pc BNC 50 Ohm (NBC50) 1 pc COAX 10pin (PLUG-MINI-1B-10) For more details see ANNEX C – Vacuum Bakeout Chamber

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



4 Accreditation and Audits

Code	Title	Type	Validity	Remarks
ISO 9001:2015	Quality management system	Accredited	2025	Audit was performed in 2022
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



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5 ANNEX A – T-VAC Test Chamber

You find here the T-VAC Test Chamber related mechanical interface information for designing the mount of the test item and related temperature sensors.

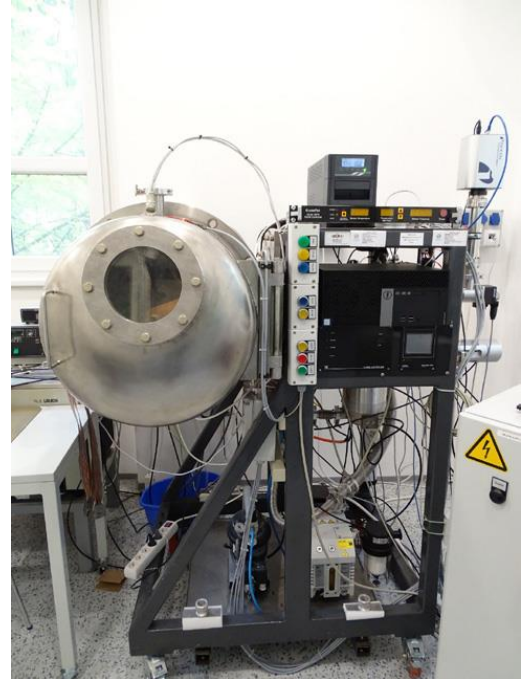


Figure 2 – The picture of the T-VAC Test Chamber

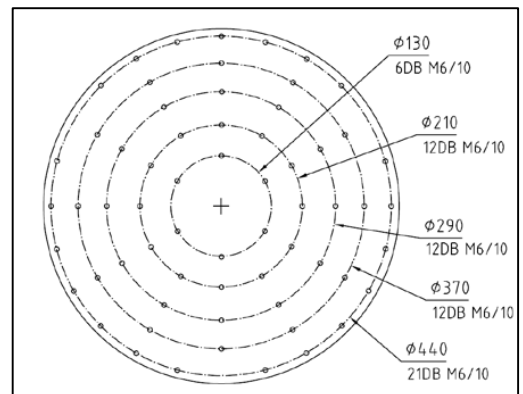


Figure 3 – The thermal conduction chamber fixing plate is in the back of the chamber, the fixing points are placed with distance given on the picture above (M6/10 screws can be used for fixing)



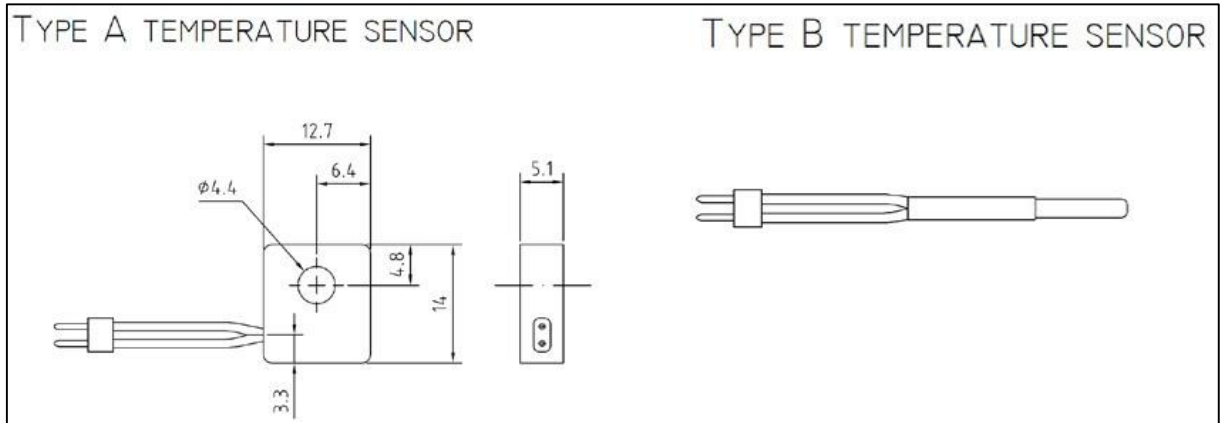


Figure 4 – Temperature sensor types

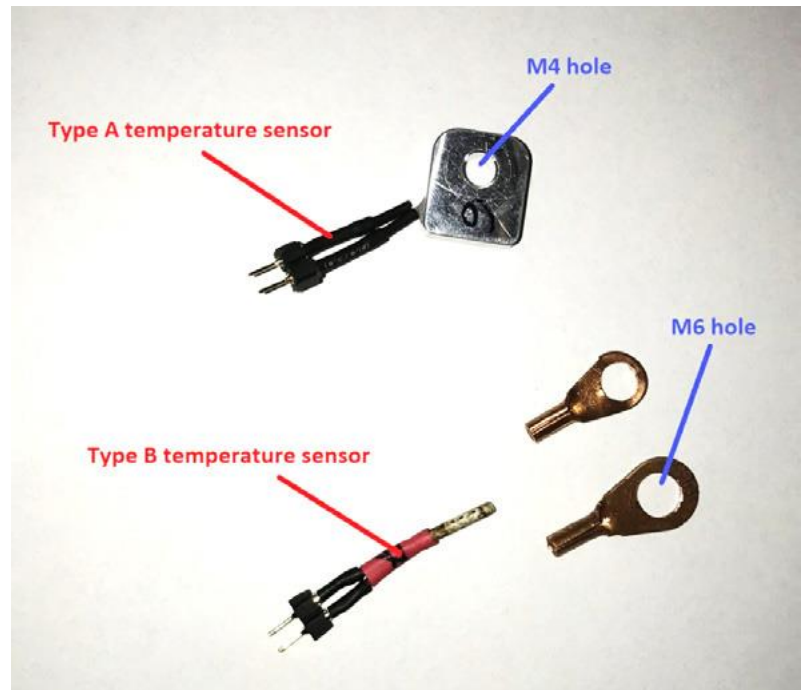


Figure 5 – There are six flat (type A) and four cylindrical sensors (type B), which can be use for T-VAC testing

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-AM-14H	1	[-259; 600] °C	±0.1°C
Type B	LakeShore PT-103	3	[-259; 600] °C	±0.5°C
	LakeShore PT-103-14H	1	[-259; 600] °C	±0.1°C



6 ANNEX B –Climate Test Chamber

You find here the Climate Test Chamber related mechanical interface information for designing the mount of the test item.



Figure 6 – The picture of the Climate Test Chamber

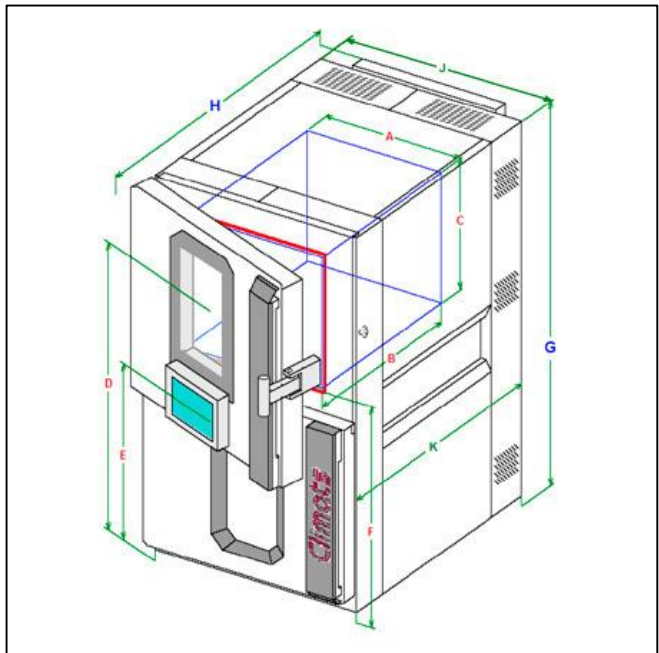


Figure 7 – The schematic view of the Climate Test Chamber (A=55 cm, B=50 cm, C=50 cm)



7 ANNEX C – Vacuum Bakeout Chamber

You find here the Vacuum Bakeout Chamber related mechanical and electrical interface information for designing the mount of the test item.



Figure 9 – The picture of the Vacuum Bakeout Chamber



Figure 8 – The picture of the Vacuum Bakeout Chamber electrical interfaces (outside)



8 List of Abbreviations

AD	Applicable Documents
ECSS	European Cooperation for Space Standardization
RD	Reference Documents
TC	Telecommand
TM	Telemetry
TQCM	Thermoelectric Quartz Crystal Microbalances
T-VAC	Thermal-Vacuum



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11 References

11.1 APPLICABLE AND NORMATIVE DOCUMENTS

Table 6 – 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

11.2 REFERENCE DOCUMENTS

Table 7 – Reference Documents

RD	Title	Reference	Version
[RD 1]	-	-	-



END OF DOCUMENT



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