BS EN 16602-70-02:2014

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Space product assurance — Thermal vacuum outgassing test for the screening of space materials

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee ACE/68, Space systems and operations.

A list of organizations represented on this committee can be obtained on request to its secretary.

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EN 16602-70-02

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ICS 49.140

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English version

Space product assurance - Thermal vacuum outgassing test for the screening of space materials

Assurance produit des projets spatiaux - Essai de dégazage sous vide thermique pour sélection des matériaux d'un projet spatial

Raumfahrtproduktsicherung - Thermo-Vakuum-Ausgasungstest für die Auswahl von Raumfahrtmaterialien

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Foreword

This document (EN 16602-70-02:2014) has been prepared by Technical Committee CEN/CLC/TC 5 “Space”, the secretariat of which is held by DIN.

This standard (EN 16602-70-02:2014) originates from ECSS-Q-ST-70-02C.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2015, and conflicting national standards shall be withdrawn at the latest by April 2015.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 14091:2002.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

This document has been developed to cover specifically space systems and has therefore precedence over any EN covering the same scope but with a wider domain of applicability (e.g. : aerospace).

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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Introduction

The kinetics of an outgassing process is influenced by vacuum and temperature conditions.

The method described in this Standard gives reliable data for material screening use exclusively. The nominal temperature for the screening test, as described in this standard is 125 °C. Results from the nominal screening test can be used for the screening of materials that have an operational temperature below 50 °C, especially if they are exposed for an extended period of time (in the order of weeks and above).

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1 Scope

This Standard describes a thermal vacuum test to determine the outgassing screening properties of materials proposed for use in the fabrication of spacecraft and associated equipment, for vacuum facilities used for flight hardware tests and for certain launcher hardware.

This Standard covers the following:

- critical design parameters of the test system;
- critical test parameters such as temperature, time, pressure;
- material sample preparation;
- conditioning parameters for samples and collector plates;
- presentation of the test data;
- acceptance criteria;
- certification of test systems and their operators by audits and round robin tests.

The test described in this Standard is applicable for all unmanned spacecraft, launchers, payloads, experiments. The test is also valid for external hardware of inhabited space systems and for hardware to be used in terrestrial vacuum test facilities.

The outgassing and condensation acceptance criteria for a material depend upon the application and location of the material and can be more severe than the standard requirements as given in clause 5.5.3.1.

This standard may be tailored for the specific characteristics and constrains of a space project in conformance with ECSS-S-ST-00.

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Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this ECSS Standard. For dated references, subsequent amendments to, or revision of any of these publications do not apply, However, parties to agreements based on this ECSS Standard are encouraged to investigate the possibility of applying the more recent editions of the normative documents indicated below. For undated references, the latest edition of the publication referred to applies.

EN reference	Reference in text	Title
EN 16601-00-01	ECSS-S-ST-00-01	ECSS system – Glossary of terms
EN 16602-10	ECSS-Q-ST-10	Space product assurance – Product assurance management
EN 16602-10-09	ECSS-Q-ST-10-09	Space product assurance – Nonconformance control system

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3 Terms, definitions and abbreviated terms

3.1 Terms defined in other standards

For the purpose of this Standard, the terms and definitions from ECSS-S-ST-00-01 and ECSS-Q-ST-70 apply.

3.2 Terms specific to the present standard

3.2.1 bakeout

activity of increasing the temperature of hardware to accelerate its outgassing rates with the intent of reducing the content of molecular contaminants within the hardware

NOTE Bakeout is usually performed in a vacuum environment but may be done in a controlled atmosphere.

3.2.2 cleanroom

room in which the concentration of airborne particles is controlled, and which is constructed and used in a manner to minimize the introduction, generation, and retention of particles inside the room, and in which other relevant parameters, e.g. temperature, humidity, and pressure, are controlled as necessary

[ISO 14644-6]

3.2.3 collected volatile condensable material (CVCM)

quantity of outgassed matter from a test specimen that condenses on a collector maintained at a specific temperature for a specific time

NOTE CVCM is expressed as a percentage of the initial specimen mass and is calculated from the condensate mass determined from the difference in mass of the collector plate before and after the test.

3.2.4 outgassing

release of gaseous species from a specimen under high vacuum conditions

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3.2.5 quartz crystal microbalance (QCM)

device for measuring small quantities of mass deposited on a quartz crystal using the properties of a crystal oscillator

3.2.6 recovered mass loss (RML)

total mass loss of the specimen itself without the absorbed water

NOTE 1 The following equation holds:
RML = TML - WVR.

NOTE 2 The RML is introduced because water is not always seen as a critical contaminant in spacecraft materials.

3.2.7 sticking coefficient

probability that a molecule, colliding with a surface, stays on that surface before thermal re-evaporation of that molecule occurs

3.2.8 total mass loss (TML)

total mass loss of material outgassed from a specimen that is maintained at a specific constant temperature and operating pressure for a specified time

NOTE TML is calculated from the mass of the specimen as measured before and after the test and is expressed as a percentage of the initial specimen mass.

3.2.9 water vapour regained (WVR)

mass of the water vapour regained by the specimen after the optional reconditioning step

NOTE WVR is calculated from the differences in the specimen mass determined after the test for TML and CVCM and again after exposure to atmospheric conditions and 65 % relative humidity at room temperature (22 ± 3) °C.

3.3 Abbreviated terms

For the purpose of this Standard, the abbreviated terms from ECSS-S-ST-00-01 and the following apply:

Abbreviation	Meaning
CVCM	collected volatile condensable material
EOL	end-of-life
IR	infrared
MIC	materials identification card
PTFE	polytetrafluorethylene
QCM	quartz crystal microbalance
RH	relative humidity

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RML	recovered mass loss
RT	room temperature
TML	total mass loss
VCM	volatile condensable material
WVR	water vapour regained

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4 Test overview

4.1 Test process description

Figure 4-1 and Figure 4-2 are included as a guide to the test procedures. The sequence for the test is given in the flow chart (Figure 4-2).

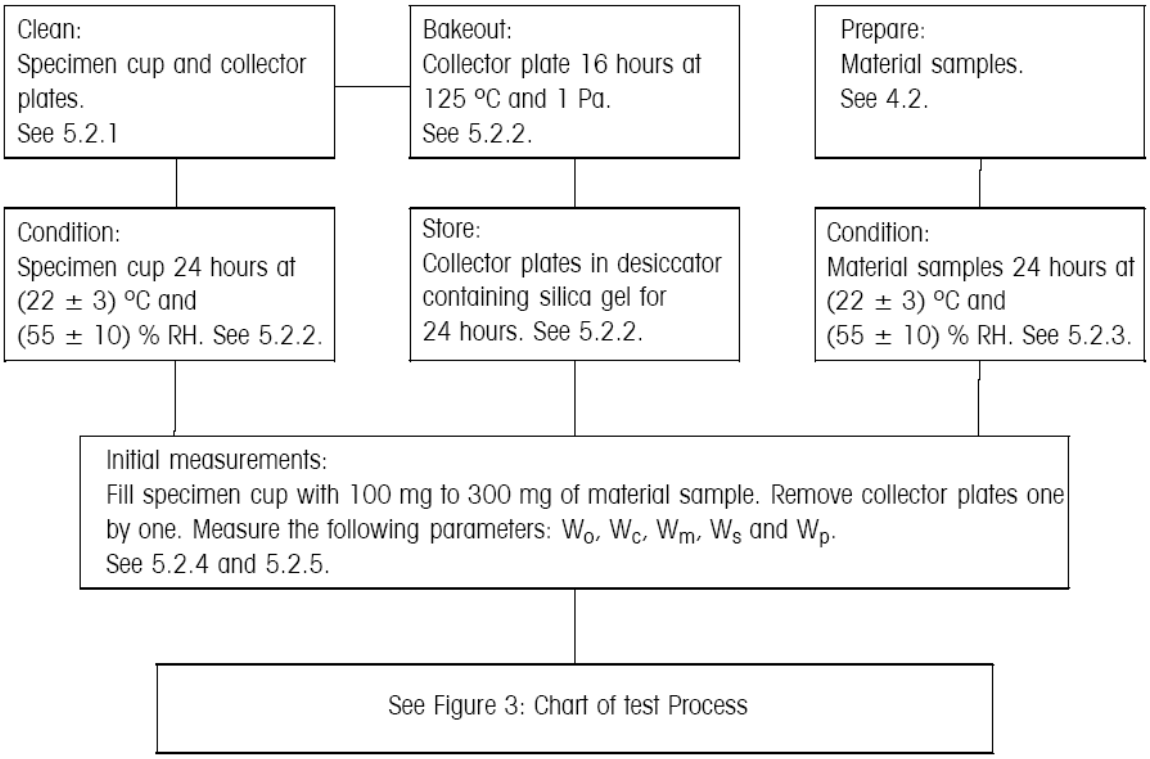

Figure 4-1: Flow chart of preparation and initial measurements

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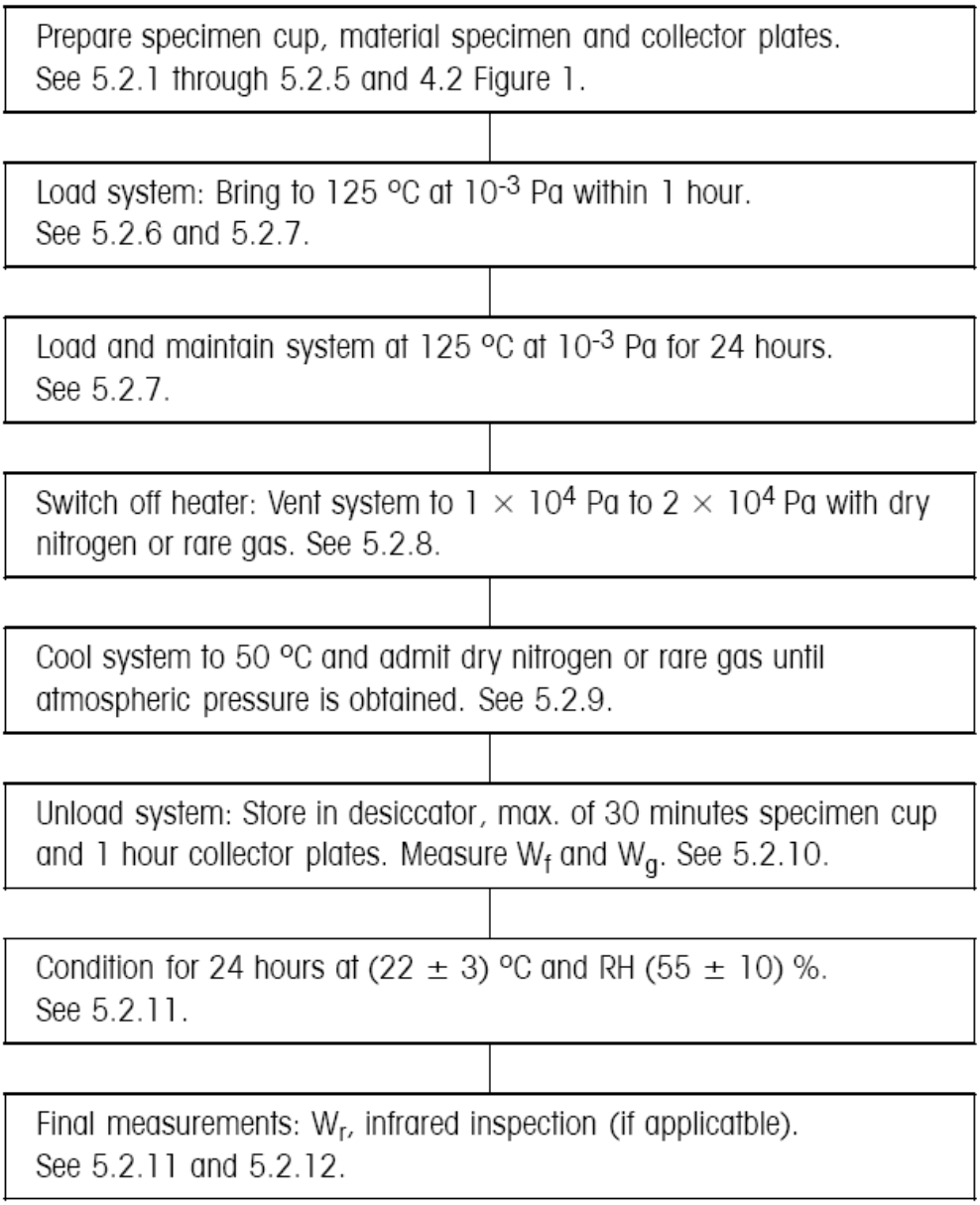

Figure 4-2: Flow chart of test process

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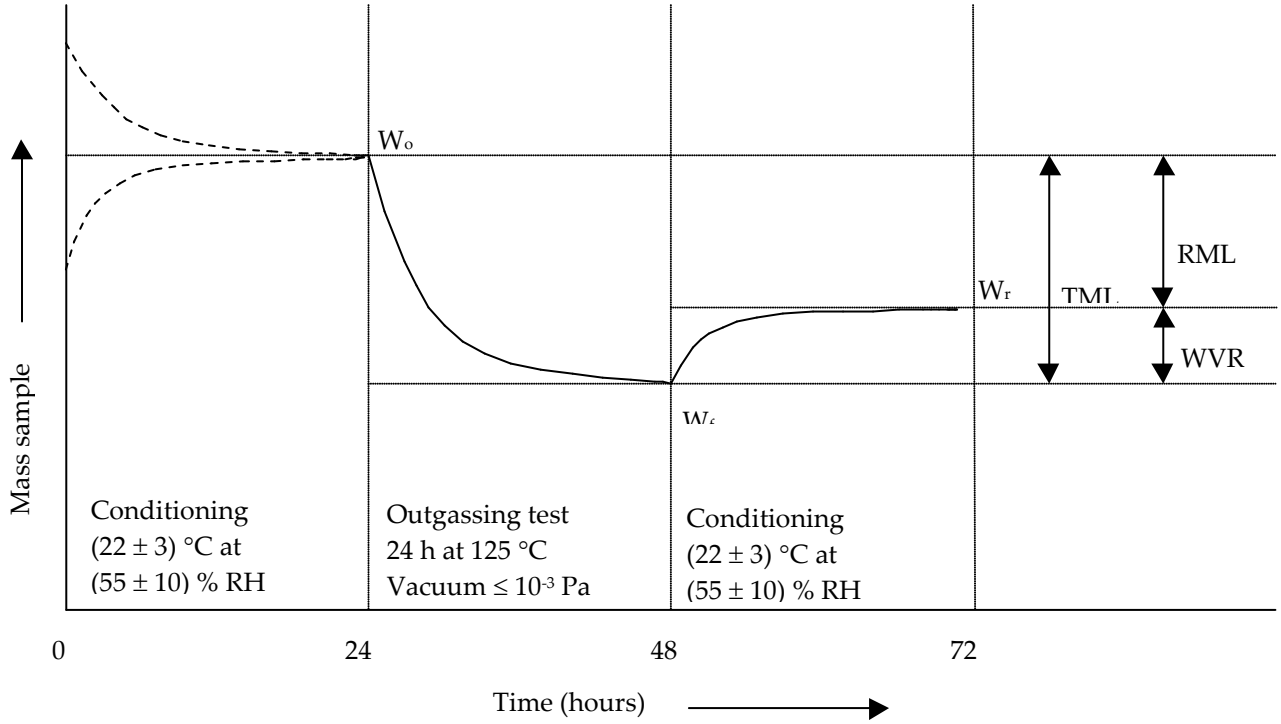

Figure 4-3: Parameters for sample

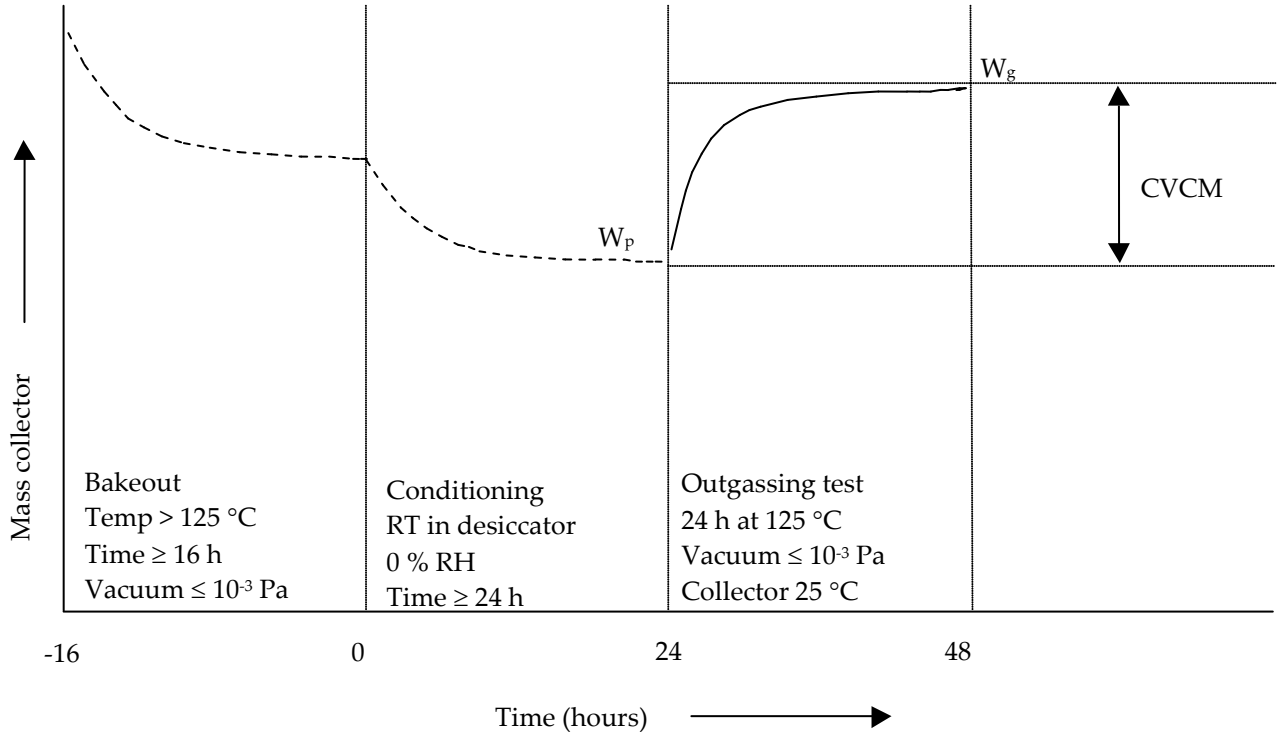

Figure 4-4: Parameters for collector plate

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