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## Space systems — Thermal vacuum environmental testing

*Systèmes spatiaux — Essais environnementaux sous vide thermique*



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ISO copyright office  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

The on-orbit environments of spacecraft, with their vacuum state, cryogenic and black background, and complex heat transfer, are harsher and more complex than the ground environment. They have a strong impact on the success of spacecraft mission. Thermal balance tests (TBT) and thermal vacuum tests (TVT) at spacecraft level are conducted to ensure the units in spacecraft operate normally in specified pressure and thermal range.

This document provides methods and specifies general requirements for spacecraft level thermal balance tests and thermal vacuum tests. However, the technical requirements in this document can be tailored by the parties for some special spacecraft, such as manned vehicle, deep space explorer, extra-terrestrial body lander or the satellites with emphasis on low-cost and fast delivery, which are characterized by extensive use of non-space-qualified commercial-off-the-shelf (COTS) units.

This document acts as a supplement to ISO 15864 and ISO 19683. It is applicable to test project designers and test organizations. It also serves as a reference for spacecraft designers and test facility manufacturers.

# Space systems — Thermal vacuum environmental testing

## 1 Scope

This document provides methods and specifies general requirements for spacecraft level thermal balance tests (TBT) and thermal vacuum tests (TVT). It also provides basic requirements for test facilities, test procedures, test malfunction interruption emergency handling and test documentation. The methods and requirements can be used as a reference for subsystem-level and unit-level test article.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 15864:2021, *Space systems — General test methods for spacecraft, subsystems and units*

ISO 17566:2011, *Space systems — General test documentation*

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

### 3.1

#### **maximum predicted temperature**

highest temperature that can be expected to occur during the entire life cycle of the *subsystem* (3.4)/*unit* (3.8) in all operational modes plus an uncertainty factor

### 3.2

#### **minimum predicted temperature**

lowest temperature that can be expected to occur during the entire life cycle of the *subsystem* (3.4)/*unit* (3.8) in all operational modes plus an uncertainty factor

### 3.3

#### **spacecraft**

integrated set of *subsystems* (3.4) and *units* (3.8) designed to perform specific tasks or functions in space

### 3.4

#### **subsystem**

assembly of functionally related *units* (3.8), which is dedicated to specific functions of a system

### 3.5

#### **thermal balance test**

test conducted to verify the adequacy of the thermal model and the adequacy of the thermal design