

---

---

**Space systems — Cube satellites  
(CubeSats)**

*Systèmes spatiaux — Satellites cubiques (CubeSats)*

STANDARDSISO.COM : Click to view the full PDF of ISO 17770:2017



STANDARDSISO.COM : Click to view the full PDF of ISO 17770:2017



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2017, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
Ch. de Blandonnet 8 • CP 401  
CH-1214 Vernier, Geneva, Switzerland  
Tel. +41 22 749 01 11  
Fax +41 22 749 09 47  
copyright@iso.org  
www.iso.org

# Contents

	Page
Foreword .....	iv
Introduction .....	v
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>1</b>
<b>3 Terms and definitions</b> .....	<b>1</b>
<b>4 Abbreviated terms</b> .....	<b>2</b>
<b>5 CubeSat requirements</b> .....	<b>2</b>
5.1 General requirements .....	2
5.2 CubeSat mechanical requirements: External dimensions .....	3
5.3 CubeSat mechanical requirements: Mass .....	5
5.4 CubeSat mechanical requirements: Materials .....	5
5.5 Electrical requirements .....	6
5.6 Operational requirements .....	6
<b>6 Interface to the launch vehicle: The CubeSat Deployer</b> .....	<b>7</b>
6.1 Enclosure .....	7
6.2 Interface .....	7
6.3 Mass .....	7
6.4 Modularity .....	7
6.5 Parts attachment .....	7
6.6 Release from the Deployer .....	7
<b>7 CubeSat and Deployer assurance/quality verification</b> .....	<b>7</b>
7.1 General .....	7
7.2 Random vibration .....	8
7.3 Thermal/Vacuum bakeout .....	8
7.4 Shock .....	8
7.5 Visual inspection .....	8
<b>Bibliography</b> .....	<b>9</b>

## 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 on 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 the following URL: [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*.

## Introduction

Recent years have seen an increase in the number of student satellites developed at universities around the world. To date, most university satellites require several years to develop and significant financial resources, making them prohibitive for small programs. New technological developments in small low-power electronics make smaller, lower-cost satellites feasible.

The CubeSat program has developed a picosatellite standard that significantly reduces the cost and development time of picosatellites with a specific form factor. In addition, CubeSats can serve as platforms for in-space experimentation, as well as a means of space-qualifying future small-satellite hardware.

The CubeSat Standard is an evolution of the picosatellites developed for Stanford's OPAL mission. CubeSats are constrained to a 100 mm cube (not including deployment interface rails) with a mass of one kilogram or less. Led by Stanford University's Space Systems Development Lab (SSDL), the CubeSat project is developed jointly by universities and industry worldwide. Within this international community CubeSat developments at the California Polytechnic State University (CalPoly) have been twofold: first, develop the standardized launcher-interface/deployer mechanism for CubeSats, and second, demonstrate the feasibility of developing a working CubeSat using low-cost, commercial off-the-shelf components. The project involves a multidisciplinary team of software, aerospace, manufacturing, electrical, and mechanical engineering undergraduate students.

In recent years, more sophisticated capabilities have been demonstrated in CubeSats by major space corporations and major space customers. CubeSat concepts for inclusion in Mars exploration are in development. Entire companies have been established to solely support the global CubeSat marketplace.

[STANDARDSISO.COM](https://standardsiso.com) : Click to view the full PDF of ISO 17770:2017

# Space systems — Cube satellites (CubeSats)

## 1 Scope

This document addresses CubeSats, CubeSat Deployer and related verification of assurance/quality terms and metrics.

This document defines a unique class of picosatellite, the CubeSat. CubeSats are ideal as space development projects for universities around the world. In addition to their significant role in educating space scientists and engineers, CubeSats provide a low-cost platform for testing and space qualification of the next generation of small payloads in space. A key component of the project is the development of a standard CubeSat Deployer.

This Deployer is capable of releasing a number of CubeSats as secondary payloads on a wide range of launchers. The standard Deployer requires all CubeSats to conform to common physical requirements, and share a standard Deployer interface. CubeSat development time and cost can be significantly reduced by the development of standards that are shared by a large number of spacecraft.

Normative control of the CubeSat design, qualification and acceptance testing is generally applied from other small satellite specific standards with the exception of CubeSat/Deployer launch environment test.

## 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 14620-1, *Space systems — Safety requirements — Part 1: System safety*

ISO 24113, *Space systems — Space debris mitigation requirements*

## 3 Terms and definitions

### 3.1

#### **CubeSat**

picosatellite measuring 100 mm cubic and weighing 1,33 kg or less

Note 1 to entry: Variations on the basic form factor are also considered CubeSats.

### 3.2

#### **deployer**

encloses CubeSats within a confined volume with a lid at one side that closes the ejection port during the launch phase

Note 1 to entry: It is capable of carrying one or multiple standard CubeSats and serves as the interface between the CubeSats and launch vehicle.

### 3.3

#### **P-POD**

#### **Poly Picosatellite Orbital Deployer**

example of a CubeSat Deployer

Note 1 to entry: In recognition of the original design by the California Polytechnic State University – Cal Poly.

Note 2 to entry: The P-POD is Cal Poly's standardized CubeSat deployment system. It is capable of carrying three standard CubeSats.

### 3.4

#### **single CubeSat**

single 100 mm CubeSat

Note 1 to entry: Single CubeSat is also described as "1U".

### 3.5

#### **triple CubeSat**

common three CubeSat configuration, where it is three CubeSats long connected along the longitudinal axis

Note 1 to entry: Triple CubeSat is also described as "3U".

## 4 Abbreviated terms

CVCM	Collected Volatile Condensable Mass
FCC	Federal Communication Commission
IARU	International Amateur Radio Union
LV	Launch Vehicle
P/N	Part Number
P-POD	Poly Picosatellite Orbital Deployer
RBF	Remove Before Flight
RF	Radio Frequency
STD	Standard
TML	Total Mass Loss
U	Used with a number [e.g. 1U (see 3.4), 3U (see 3.5)] to denote CubeSat units

## 5 CubeSat requirements

### 5.1 General requirements

5.1.1 All parts shall remain attached to the CubeSat during the launch phase, ejection, and operation to ensure safety (see ISO 14620-1). No additional space debris shall be created (see ISO 24113).

5.1.2 Pyrotechnics shall not be permitted.

5.1.3 Propulsion systems shall have at least three inhibits to activation.

5.1.4 Total stored chemical energy shall not exceed 100 Watt-hours.

5.1.5 CubeSat materials shall satisfy the following out-gassing criterion to prevent contamination of other spacecraft during integration, testing and launch.

NOTE A list of NASA approved out-gassing materials can be found at <http://outgassing.nasa.gov>.

5.1.5.1 Total Mass Loss (TML) shall be <1,0 %.

5.1.5.2 Collected Volatile Condensable Material (CVCM) shall be <0,1 %.

5.1.6 The CubeSat shall be designed to accommodate ascent venting per ventable volume/area <50 800 mm (Note: derived from 2000 inches).

## 5.2 CubeSat mechanical requirements: External dimensions

5.2.1 The CubeSat shall use the coordinate system as defined in [Figure 1](#) for single CubeSat, and [Figure 2](#) for triple CubeSat.

5.2.2 The Z-face of the CubeSat will be inserted first into the Deployer.

5.2.3 The single CubeSat configuration and physical dimensions shall be per [Figure 1](#), the triple CubeSat per [Figure 2](#).

5.2.4 The CubeSat shall be 100,0 mm  $\pm$  0,1 mm wide (X and Y dimensions per [Figure 1](#)).

5.2.5 A single CubeSat shall be 113,5 mm  $\pm$  0,1 mm tall (Z dimension per [Figure 1](#)).

5.2.5.1 A triple CubeSat shall be 340,5 mm  $\pm$  0,3 mm tall (Z dimension per [Figure 2](#)).

5.2.6 All components shall not exceed 6,5 mm normal to the surface of the 100,0 mm cube.

5.2.7 Exterior CubeSat components shall not contact the interior surface of the Deployer other than the designated CubeSat rails.

5.2.8 Deployable items shall be constrained by the CubeSat. The Deployer rails and walls shall not be used to constrain deployable items.

5.2.9 The rails shall have a minimum width of 8,5 mm.

5.2.10 The rails shall have a surface roughness less than 1,6  $\mu$ m.

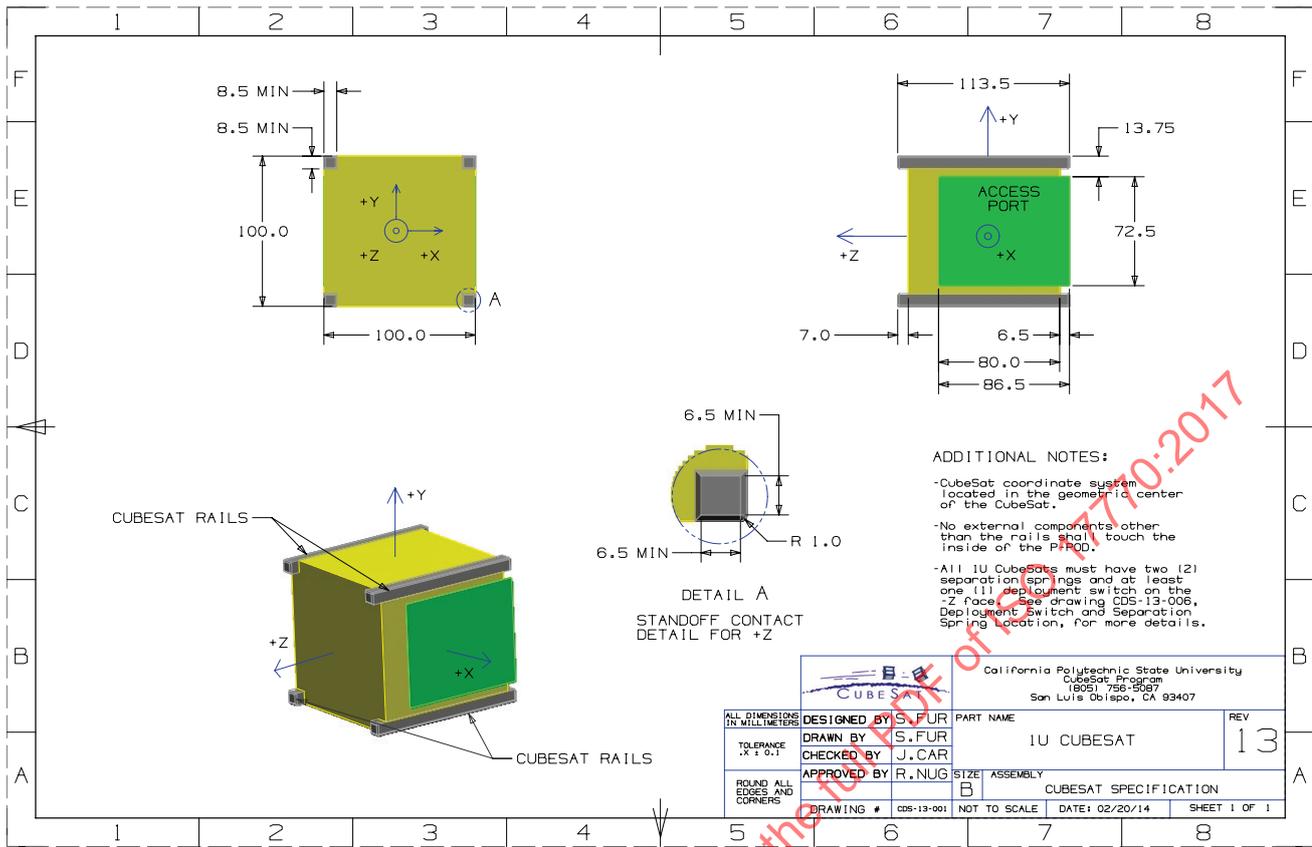


Figure 1 — Single CubeSat

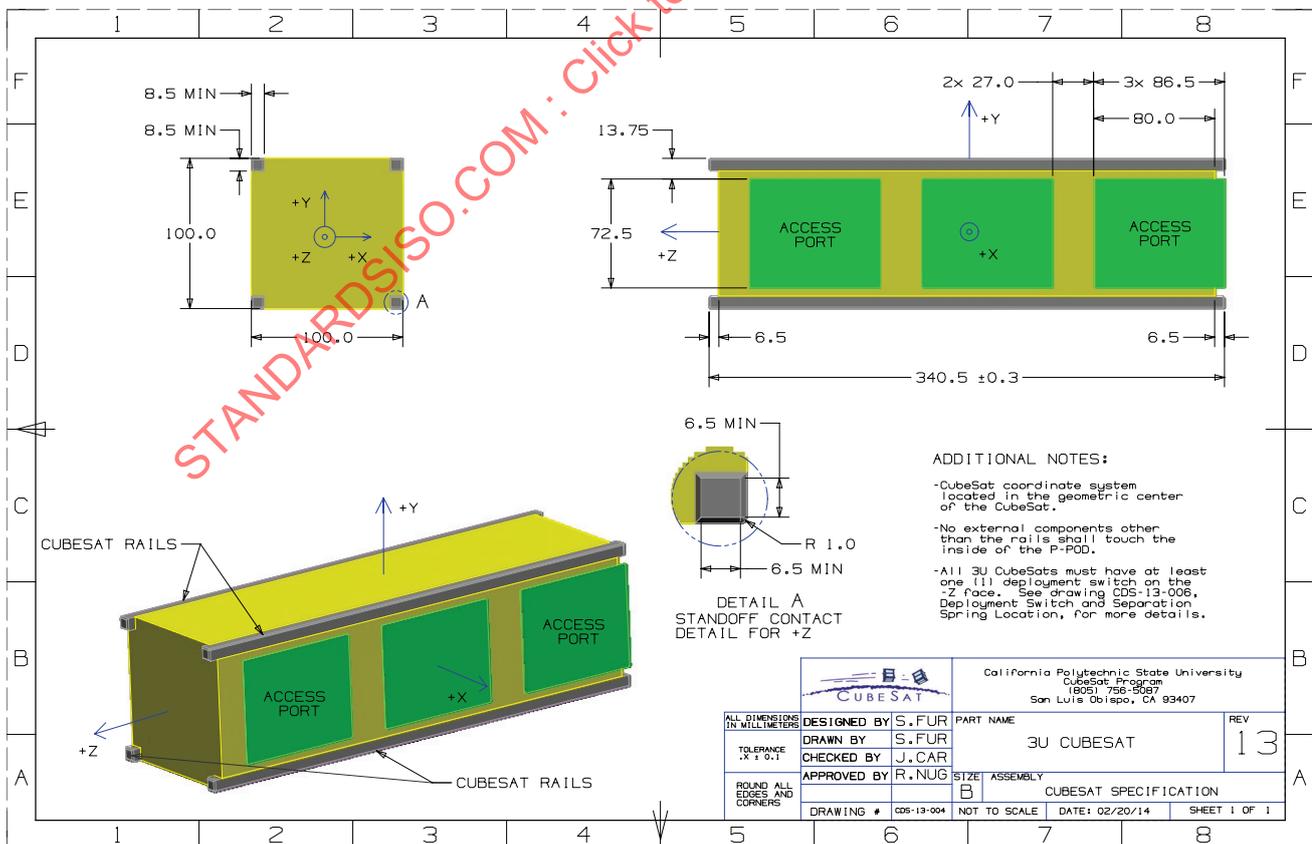


Figure 2 — Triple CubeSat

**5.2.11** The edges of the rails shall be rounded to a radius of at least 1 mm.

**5.2.12** The ends of the rails on the +Z face shall have a minimum surface area of 6,5 mm × 6,5 mm contact area for neighbouring CubeSat rails (as per [Figure 1](#)).

**5.2.13** At least 75 % of the rail shall be in contact with the Deployer rails. 25 % of the rails may be recessed and no part of the rails shall exceed the requirement.

### 5.3 CubeSat mechanical requirements: Mass

**5.3.1** Each single CubeSat shall not exceed 1,33 kg.

**5.3.2** Each triple CubeSat shall not exceed 4,00 kg.

**5.3.3** The CubeSat centre of gravity shall be located within a sphere of 2 cm from its geometric centre in the X and Y direction.

**5.3.3.1** The 1U CubeSat centre of gravity shall be located within 2 cm from its geometric centre in the Z direction.

**5.3.3.2** The 3U CubeSat centre of gravity shall be located within 7 cm from its geometric centre in the Z direction.

### 5.4 CubeSat mechanical requirements: Materials

**5.4.1** The main CubeSat structure and the rails shall be made from aluminium materials in [Table 1](#). Reference [2] contains other national designations for these materials.

**Table 1 — Equivalent designations for allowed material**

ASTM/EN AW	GOST	ISO
7075	1950/V95	AlZn5.5MgCu
6061	1330/AD33	AlMg1SiCu
5052	AMg	AlMg2.5
5005	1510/AMg1	AlMg1

**5.4.2** The CubeSat rails and standoff, which contact the Deployer rails and adjacent CubeSat standoffs, shall be hard anodized aluminium to prevent any cold welding within the Deployer.

**5.4.3** The CubeSat shall use separation springs with characteristics defined in [Table 2](#) on the designated rail standoff. The separation springs provide relative separation between CubeSats after deployment from the Deployer.

**Table 2 — Separation spring characteristics**

Characteristics	Value
Plunger Material	Stainless Steel
End Force Initial/Final	2,224 N/6,672 N
Throw Length	1,27 mm minimum above the standoff surface

**5.4.4** The compressed springs shall be at or below the level of the standoff.

5.4.5 Separation springs shall not be required for Triple (3U) CubeSats.

## 5.5 Electrical requirements

Electrical requirements shall be designed with the following safety features:

5.5.1 The CubeSat power system shall be at a power off state to prevent CubeSat from activating any powered functions while integrated in the Deployer from the time of delivery to the launch vehicle through on-orbit deployment.

5.5.2 The CubeSat shall include, at a minimum, one deployment switch on the designated rail standoff (shown in [Figure 1](#)) to completely turn off satellite power once actuated. In the actuated state, the deployment switch shall be centred at or below the level of standoff.

5.5.2.1 All systems shall be turned off before the integration into Deployer and stay off until the ejection, including any real-time clocks.

5.5.3 To allow for CubeSat diagnostics and battery charging after the CubeSats have been integrated into the Deployer all CubeSat umbilical connectors shall be within the designated Access Port locations, as shown in [Figure 1](#).

5.5.3.1 Triple CubeSats shall use the designated Access Port locations as shown in [Figure 2](#).

5.5.4 The CubeSat shall include a Remove Before Flight (RBF) pin.

5.5.4.1 The RBF pin shall be removed from the CubeSat after integration into the Deployer.

5.5.4.2 The RBF pin shall be accessible from the Access Port location, areas shown in [Figure 1](#).

5.5.4.2.1 Triple CubeSats shall locate their RBF pin in one of the three designated Access Port locations shown in [Figure 2](#).

5.5.4.3 The RBF pin shall cut power to the satellite once it is inserted into the satellite.

5.5.4.4 The RBF pin shall not protrude more than 6.5 mm from the rails when it is fully inserted into the satellite.

5.5.5 CubeSats shall incorporate battery circuit protection for charging/discharging to avoid unbalanced cell conditions.

5.5.6 The CubeSat shall be designed to meet at least one of the following requirements to prohibit inadvertent radio frequency (RF) transmission. An inhibit is a physical device between a power source and a hazard. A timer is not considered an independent inhibit.

5.5.6.1 The CubeSat shall have one RF inhibit and RF power output of no greater than 1,5 W at the transmitting antenna's RF input.

5.5.6.2 The CubeSat shall have two independent RF inhibits.

## 5.6 Operational requirements

CubeSats need to meet requirements pertaining to integration and operation to meet legal obligations and ensure safety of other CubeSats. Additionally, LV and primary spacecraft may impose or allow