

**Team Bravo Request for
Proposal
Saint Louis University**



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1. Introduction

Before describing the proposed mission in detail, it is important to establish the meanings of various terms that are associated with any given CubeSat mission. Firstly, 1U, or one standard unit, is defined as a cube of a uniform edge length of 10 cm. A CubeSat-Class satellite (aka a “nanosatellite”) is a satellite whose dimensions derive from 1 or more of these standard units. An example of a 3U sized spacecraft is shown in Figure 1-1 below. The reason for creating such satellites is twofold: it greatly reduces the time and monetary investment associated with developing custom satellite shapes and structures, while also allowing the development of standard satellite deployers (such as the P-POD or NLAS deployer) for integration into any rocket configuration, thus allowing greater access to launch opportunities for university missions. The largest-volume deployer currently being manufactured can accommodate a 6U spacecraft configuration.

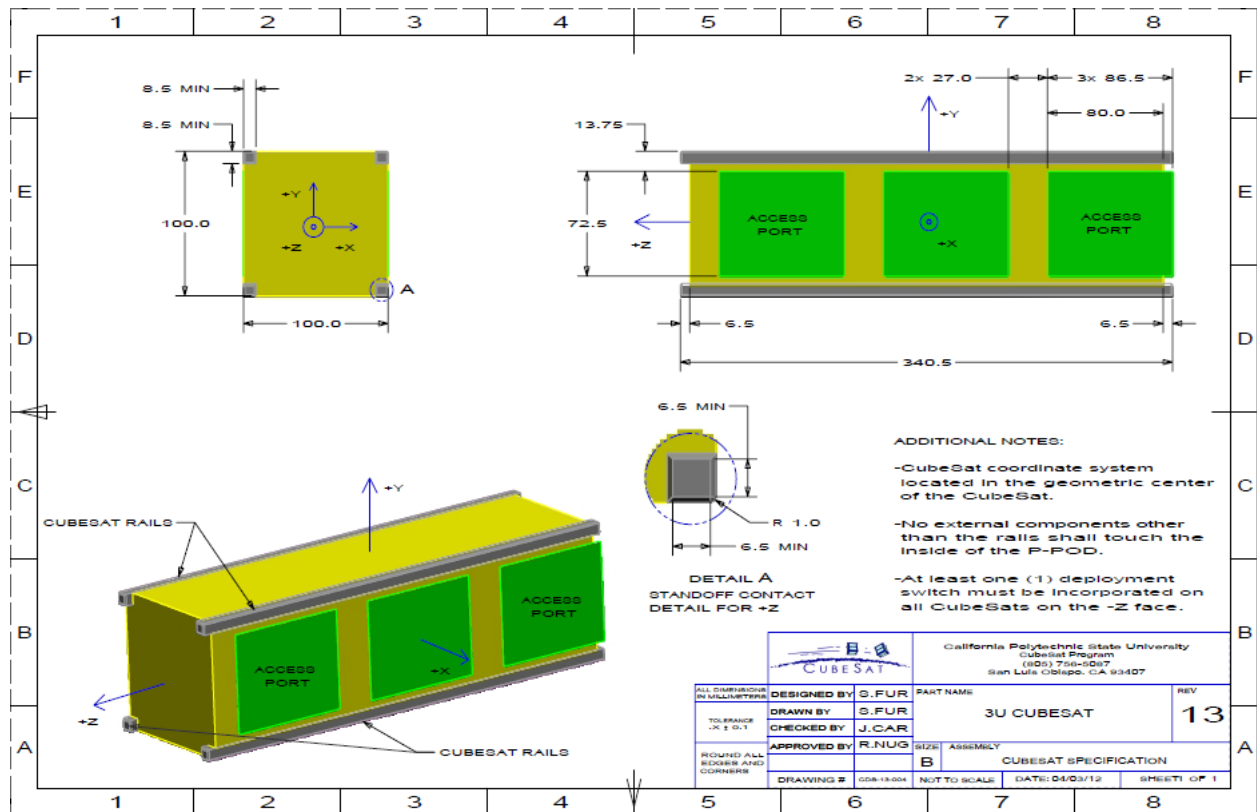


Figure 1-1. Example 3U CubeSat Architecture

Thus, the proposed mission shall have to fit within the 6U architecture dictated by these available deployers. Beyond this requirement, the requirements for the proposed mission consist of demonstrations of key proximity operations, such as stationkeeping, “escape” maneuvers, and rendezvous, relative to a resident space object, the definitions of which are described in Table 1-1 on the following page.

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Table 1-1. Key Proximity Operations Definitions

Proximity Operation Terms	Definition
Stationkeeping	Maintaining a set relative displacement between two space objects for a period of several orbits
“Escape” Maneuver	Performing an orbital maneuver that increases the relative displacement between two space objects, as to avoid on-orbit collisions and potential orbital debris creation.
Rendezvous	Performing an orbital maneuver that decreases the relative displacement between two space objects within a set distance for a period of several orbits.
Resident Space Object	Any satellite or space debris residing in an orbit around the Earth.

Along with having to demonstrate these key proximity operations, the proposed mission also has several constraints on its successful execution. One such constraint is mission lifetime, and thus, the range of orbits over which the mission can take place and still allow for the completion of all mission requirements, as described in the mission summary section.

Assuming a mission lifetime of at least 6 months, the minimum orbit at which the mission can be placed and still be able to complete said mission objectives is 300 km, which is easily reachable with launch providers that have taken missions such as this to low earth orbit in the past.

Along with this lower orbit bound, an upper orbit bound of 900 km can be set, since very few, if any, launch providers have transported past CubeSat missions beyond this point.

Finally, a maximum mission mass of 8 kg can be set, as defined by doubling the mass dictated by the standard 3U CubeSat design specification, as described in *CubeSat Design Specification, Rev 13, California Polytechnic State University CubeSat Program*.

The mission constraints discussed in the previous paragraphs are summarized in Table 1-2 below:

Table 1-2. Proposed Mission Constraints

Mass	Cube Size	Desired Orbit		Acceptable Orbit Range	Desired Mission Life
8 kg	6U	Altitude	400 km	300-900 km 40°-100°	6 Months
		Inclination	40°		

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2. Mission Overview

With the constraints discussed in the previous section in mind, the objective and success criteria of the proposed mission are defined as follows:

2.1. *Mission Objective*

The proposed mission shall demonstrate proximity operations and rendezvous within a 6U spacecraft architecture.

2.2. *Mission Success Criteria*

The success criteria for the proposed mission are as follows:

The proposed mission shall demonstrate:

1. Stationkeeping within a 10-100 m sphere of a resident space object.
 2. An “Escape” Maneuver by performing an orbital maneuver that intentionally increases the final relative displacement between a spacecraft and a resident space object.
 3. Rendezvous by performing an orbital maneuver that decreases the final relative displacement between a spacecraft and a resident space object.
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