

# 28<sup>th</sup> Satellite Design Contest Application Guidebook

## Satellite Design Contest Executive Committee

**Organizer:** The Japan Society of Mechanical Engineers (JSME), The Japan Society for Aeronautical and Space Sciences (JSASS), The Institute of Electronics, Information and Communication Engineers (IEICE), The Society of Geomagnetism and Earth, Planetary and Space Sciences (SGEPSS), The Astronomical Society of Japan (ASJ), The Japan Aerospace Exploration Agency (JAXA), The Society for Promotion of Space Science (SPSS), Japan Space Forum (JSF) ,Japanese Rocket Society

**Co-sponsor:** The Japan Society for Aeronautical and Space Sciences

**Special Supporter:** KDDI Co., Ltd., SHINKOSHUPPANSHA KEIRINKAN Co,Ltd.

**Supporters:** National Space Policy Secretariat, Cabinet Office, The Ministry of Education, Culture, Sports, Science and Technology, The Ministry of Internal Affairs and Communications, Japan Ministry of Defense, Ministry of Economy, Trade and Industry, (TBC)

**Planning & Operation:** The Satellite Design Contest Executive Committee

### 1. Aims

This contest provides an opportunity to activate basic and applied research related to the space science and technology and is intended for high school students, technical college students, undergraduate and postgraduate students. It also aims to contribute to the expansion of space development in Japan.

We call on students to submit their free-thinking creative works including small satellites, various space related missions, design concepts etc., and will give awards to those groups (or individuals) who submit excellent works.

This contest also offers an opportunity for education by experts in satellite development. From this point of view, we will give appropriate guidance for challenging applications of satellite design of students, and encourage them to submit revised works again.

### 2. Category

There are three sections in the contest; a Design Section, an Idea Section and a Junior Section.

The "Design Section" is for design of satellite systems that are feasible and meet the

design conditions.

The "Idea Section" is for the originality and usefulness of space missions.

The "Junior Section" is for space missions with creative and useful ideas that could be utilized for the space. Detailed designs are not required. **\*International participants who wish to take part in Junior Section, please consult with the secretariat.**

### 3. Qualification

The "Design Section" and "Idea Section" is intended for high school students, technical college students, undergraduates and postgraduates, while the "Junior Section" is intended for high school students. Entries can be either from a group or individual. The group may include their teacher as a member or can be a joint-team consisting of students from different schools. However, the maximum number of group members is 10.

Even if it rejected in past contests, we will accept all works as new applicants, as long as the work has been developed with advices by the Review Committee and taken under reconsideration.

### 4. Application process

Applicants are first required to register, and once the registration is accepted, applicants may submit their works.

#### (1) Registration procedure

Please fill in the attached registration form and submit it to the secretariat by 5PM **Friday 15 May, 2020 (JST).**

**Application by students at universities, technical colleges, high schools with in Japan requires registration fee of Yen 3,000.**

**Jr session registration fee of Yen 1,000.**

#### (2) Deadline for submission of the work

**12PM Monday, July 6, 2020 (JST)**

#### (3) Address for Registration form and work submission

Works can be submitted either via post or via e-mail.

Satellite Design Contest Secretariat

c/o Japan Space Forum

Shin-ochanomizu Urban Trinity Bldg. 2F, 3-2-1 Kanda surugadai,

Chiyoda-ku, Tokyo 101-0062 JAPAN

Tel: +81-3-6206-4902 Fax: +81-3-5296-7010

E-mail: [satconjimu@jsforum.or.jp](mailto:satconjimu@jsforum.or.jp)

Satellite Design Contest Website: <http://www.satcon.jp/en/>

- (4) Please submit your work in either Word or PDF. If you sent your work in Word format, we recommend you send a fax of your work to prevent the characters from being garbled. (Fax: +81-3-5296-7010)

## 5. Screening Procedure

### 5.1 Initial Screening (Paper examination)

- (1) 10 to 15 works are selected in total through documentary examination.
- (2) The results of the examination are notified to representatives by an advice sheet.
- (3) The result notification period is from late August to early September.

### 5.2 Final review (Presentation)

- (1) **Date: Saturday, October 31, 2020**
- (2) **Venue: Toyama Prefectural Civic Centre (Toyama Prefecture, Hokuriku), Toyama-shi** (Toyama, Toyama Prefecture Shinsokawa No. 4 No. 18)
- (3) Presentation Time: Design Section 30-40 min / Idea Section 20-30 min (including Q&A) \*Please note that the presentation time may change depending on the number of groups that pass the initial screening.  
Junior section 5 min (Q&A will be held separately)
- (4) Presenter: Up to 3 people
- (5) Language: Japanese or English
- (6) Method: Use PowerPoint slides, movies, etc., with a model of a satellite/system.

### 5.3 Reviewing basis

#### 5.3.1 Design Section

Knowledge and applied skills on satellite design technique, the depth of consideration and accuracy are evaluated. Reviewing points are as follows.

- (1) Completeness of the design as a satellite system.
- (2) Clarity of the technical basis and feasibility of the design.
- (3) Originality and ingenuity of the design.
- (4) Significance and characteristics of the satellite mission.
- (5) Evaluation of the result for identification/questionnaire from the initial screening.

(Final review)

- (6) Presentation abilities and attitude. (Final review)

### **5.3.2 Idea Section**

Works are evaluated in terms of having a technical feasibility in particular and also innovative and a meaningful mission concept. Reviewing points are as follows.

- (1) Originality of the mission.
- (2) Significance and usefulness of the mission.
- (3) Clarity and accuracy of the technical basis for the realization of concepts.
- (4) Evaluation of the result for identification/questionnaire from the initial screening.  
(Final review)
- (5) Presentation abilities and attitude. (Final review)

### **5.3.3 Junior Section**

Works are evaluated in a point of view that it is a particularly innovative and meaningful mission concept. Reviewing points are as follows.

- (1) Significance, originality and specialty of the mission.
- (2) Accuracy and clarity of explanation for the realization of ideas.
- (3) Evaluation of the result for identification/questionnaire from the initial screening.  
(Final review)
- (4) Presentation abilities and attitudes. (Final review)

## **6. Awarding**

We will give the following awards during the final review.

Each award is to be decided by deliberation based on the points of the initial screening and the Final Review.

Grand awards will be given to the best work of each section, and other awards will be given to works that are suitable for each organizer's activity. In addition, the Best Model Award is to be decided by votes of members of Committees.

- (1) Design Award (Best work in Design Section)
- (2) Idea Award (Best work in Idea Section)
- (3) Junior Award (Best work in Junior Section)
- (4) The Japan Society of Mechanical Engineers Award, The Japan Society for Aeronautical and Space Sciences Award, The Institute of Electronics, Information and Communication Engineers Award, The Society of Geomagnetism and Earth, Planetary and Space Sciences Award, The Astronomical Society of Japan Award, The Society for Promotion of Space Science Award and The Japan Space Forum Award (Each award will be presented for work that is suitable for each organization.)
- (5) The Chairman of Review Committee Special Award, The Encouragement Award,

The Junior Encouragement Award and The Best Model Award

(The Best Model Award is to be chosen by votes by Committee members from all work from the Design Section and Idea Section)

\*Each award winner (except The Chairman of Review Committee Special Award, The Encouragement Award, The Junior Encouragement Award and The Best Model Award) will also receive a trophy as extra prizes.

## 7. Design Conditions

The design and consideration conditions of each section are as follows.

### 7.1 Design Section

#### (1) Constraints :

[Mass] Up to 50kg

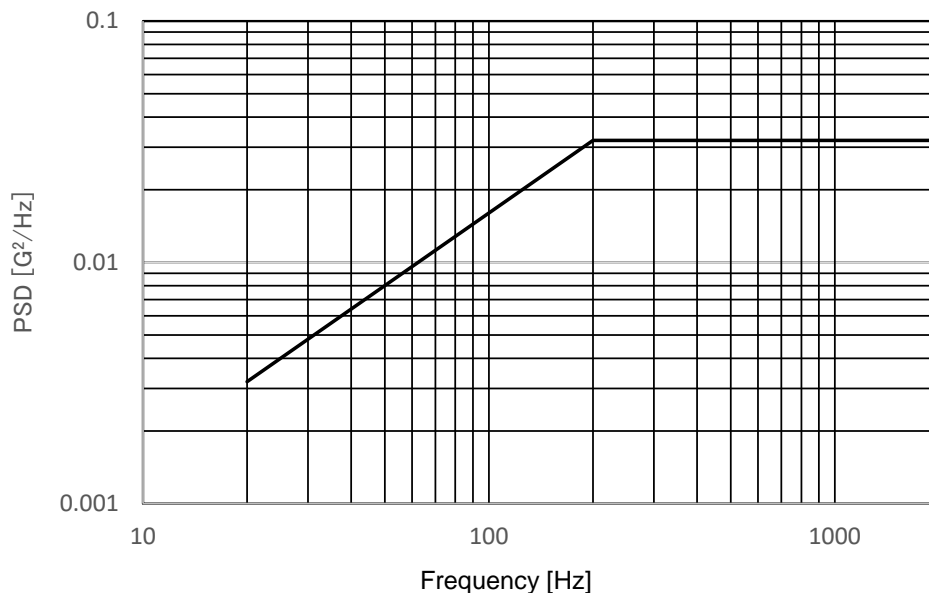
[Configuration] Fit in 50cm×50cm×50cm space when launched.

\* CubeSats are included except ISS deployment satellites.

[Launch environment] Please design based on following condition.

- Random vibration (3-axis common)

20~200Hz	+3db/oct	Effective value 7.8Grms
200~2000Hz	0.032G <sup>2</sup> /Hz	



- Sine wave vibration level

Axis direction 2.5 Go-p (5~100Hz)

Axis orthogonal direction 2.0 Go-p (5~100Hz)

- Quasi-static acceleration

Axis direction +5.0/-6.0G

Axis orthogonal direction  $\pm 5.0G$

- Rigidity request (The first-order natural frequency of the satellite of when satellite separation plane is rigidly fixed)

Axis direction more than 120Hz

Axis orthogonal direction more than 60Hz

The limit load is as above.

You are advised that to consider about load factors when you design the satellite.

\*Please design under the same environment condition both in 50kg class and CubeSat class.

\*Satellite need to satisfy the constraints (mass and form) even if the satellite system is consisted by plural satellites.

**(2) Objective:**

No restrictions on orbit conditions. Please note that ISS deployment satellite is excluded.

**(3)** Overall design of the satellite system is required based on the constraints above.

**7.2 Idea Section**

**(1) Constraints:**

The configuration and mass are limited to a small rocket, H-IIA Launch Vehicle, Epsilon Launch Vehicle and/or International Space Station.

**(2) Objective:** It can be any mission as long as it is a space utilization idea which includes satellite, lunar and planetary exploration, satellite instruments and ISS mission equipment.

**(3)** A detailed design is not required. Please clarify the technical basis for the realization of the proposed ideas.

**7.3 Junior Section**

**(1) Constraints:**

The configuration and mass are limited to a small rocket, H-IIA Launch Vehicle, Epsilon

Launch Vehicle and/or International Space Station.

**(2) Objective:** It can be any mission as long as it is a space utilization idea which includes satellite, lunar and planetary exploration, satellite instruments and ISS mission equipment.

## **8. Submittal Documents**

Documentation should all be publishable. The Overview is to be printed and handed out to the audience at the Final Review, please use the specified style. The Analysis is a very important document that to be used for the assessment. Please make the document easy to understand. In case the work contains techniques that can be patented, please apply and acquire them in advance.

In addition, please follow the guidelines for the preparation of the documentation (see attached "Document Preparation Guidelines").

- (1) The margin of the paper: top, bottom, left and right margins should be more than 20mm
- (2) Font size: 10.5 pt or large  
However, letters / numbers of formulas, figures, etc. are an exception.  
In addition, use large or bold characters for titles and items to clarify.
- (3) A cover page should be omitted to make effective use of pages and the explanation should be within the page limit. The analysis paper does not require any frames. You may divide a page into two columns.

**\*In case of using literary works, please go through the necessary procedures. Please specify the source when applicants use quotations from references.**

### **8.1 Design Section**

- (1) Please submit a "Satellite Overview" in the specified style (A template shall be provided). Please describe the purpose, orbit, operational methods, result obtaining methods, the ground station, satellite body and the entire system of the satellite. Applicants may use figures if necessary. Total number of pages is limited to up to 3 pages.
- (2) Please submit a "Satellite Design Analysis" that proves "Satellite Overview" following attached "'Satellite Analysis' Preparation Guidelines", The total number of pages is limited to up to 37 pages.

## **8.2 Idea Section**

- (1) Please submit a "Mission Overview" in the specified style (A template should be provided). Please describe the purpose, orbit, operational methods, result obtaining methods, the ground station, satellite/mission device and the entire system of the satellite/mission device. Applicants may use figures if necessary. Total number of pages is limited to up to 3 pages.
- (2) Please submit a "Mission Idea Analysis" that proves "Mission Overview" following attached "Mission Analysis' Preparation Guidelines", The total number of pages is limited up to 7 pages.

## **8.3 Junior Section**

- (1) Please submit an "Idea Overview" with the specified style (A template should be provided) following attached "Idea overview' Preparation Guidelines". The total number of pages is limited to up to 3 pages.
- (2) If necessary, please submit "Explanatory Material about the idea". The total number of pages is limited to up to 3 pages.

## **9. Production for the finalists**

### **9.1 Design Section / Idea Section**

Those applicants who pass the initial screening are required to produce a model of the satellite/mission device (any materials are accepted including aluminum, plywood, corrugated paper, etc.) In the Final Review, applicants must use this model and give a presentation.

The model should be produced in a full-scale. However, in case it is unable to fit on the conference desk, please consider a scale model. (Please consult the secretariat in advance)

In case the work is a proposal of new software or communication method etc., and it is not suitable to produce a model, applicants may present their work using CG, etc. Please consult with the secretariat.

### **9.2 Junior Section**

Those applicants who pass the initial screening, must produce a poster of their work. The size of the poster should be within A1 (applicants may use 2 pieces of A2). Furthermore, applicants may present their model or experiment equipment if they desire.

Applicants must give their presentation using PowerPoint slides, etc., This will be followed by a Question-Answer session with members of the Review Committee in front of



their poster.

## **10. Miscellaneous**

- (1) For inquiries about applications or screening results, etc., please contact the Satellite Design Contest Secretariat.
- (2) Any submitted documents will not be returned to applicants.
- (3) The copyright of documents materials is reserved for the author.
- (4) Photos and part of the submitted documents are to be posted on the website of the contest. In addition, the "Overview" will be published as "Presentation Abstracts" and be given out to the audience at the final review. The analysis documents are to be posted on the website of the contest in principle after the final review.  
(If there is document that applicants wish not to be published, please contact the secretariat in advance)
- (5) We will not use submitted documents for any purpose other than Satellite Design Contest related matters in principle. However, as the documents are to be published as "Presentation Abstracts" and the "Analysis Document" is posted on the website, they may be provided to the organizers of the contest or press to popularize and for publicity of achievements, or for space development related educational events which are arranged by the organizer of the contest.  
In case some organizations or institutions wish to use submitted documents, please consult the secretariat. Applicants need to be certified from the author or teacher in principle.
- (6) All applicants are responsible for all expenses including traveling, cost of communication, contest related budget, etc.

## **Design Section “Satellite Analysis” Preparation Guidelines**

### **<Items to be included in the “Satellite Analysis”>**

A satellite should be actually launched. Please describe about the details of the satellite including the following items in following order.

#### **1. Mission requirement (Aims of satellite) and significance**

Please state the mission requirements (aims of satellite), importance and technical significance etc.

#### **2. Anticipated Results**

Please state the expected results once the satellite is launched and operated.

#### **3. Originality and/or social effects**

Please state the originality or social effects of the designed satellite.

#### **4. Design result**

Please clarify the satellite system and each subsystems requirement conducted by the mission requirement and design a satellite that satisfies those requirements.

4.1 Please state the system configuration, the shape of the satellite, the mass, features, operational orbit, etc.

4.2 Please state the design result of the satellite system and subsystems such as; the assembly system, the thermal control system, the power supply system, the communication system, the data-processing system, the attitude/orbit control system. Please show the validity of design by analyses.

4.3 Please state the relationship between the ground-based system for data acquisition.

4.4 Please state the operational procedures of the satellite, data acquisition methods, etc.

#### **5. Concrete achievement methods, range and budget for manufacturing**

Please state concrete achievement methods, the range of manufacturing, the range of purchase, estimated budget, etc., from launch to operation of the designed satellite.

In addition, state the clarity of the technical basis and its feasibility.

#### **6. Development, manufacture and launch schedule**

Please state the assumed schedule from development to launch, using figures, etc.

**7. Conclusion, references, etc.**

Please state the conclusion and all referenced essays, literature, etc., for the design or analysis.

In addition, please refer to the [8. Submittal Documents] on the “Application Guidebook”.

## **Idea Section “Mission Analysis” Preparation Guidelines**

### **<Items to be included in the “Mission Idea Analysis”>**

#### **1. Aims and purposes of the mission**

Your idea is intended for a satellite or mission device for experiments mounted to the International Space Station etc. Please state the aims, importance, technical purposes, social significance, etc.

#### **2. Concrete achievement methods or necessary tasks and/or items to be developed.**

Please state the entire configuration, features, orbit, data acquisition methods including the ground station and mission device itself (use figures if necessary). In addition, please state expected tasks and/or items to be developed.

#### **3. Originality or social effects**

Please state the originality and expected results, social effects and the intended user specifically.

In addition, please refer to the [8. Submittal Documents] on the “Application Guidebook”.