33th 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

Sponsor:

National Space Policy Secretariat, Cabinet Office; The Ministry of Education, Culture, Sports, Science and Technology; The Ministry of Internal Affairs and Communications; Ministry of Economy, Trade and Industry; Japan Ministry of Defense

Co-sponsor:

Technosolver Corporation, BCC; Broadcasting Satellite System Corporation (B-SAT); Aska Electric Co.,Ltd; LSAS Tec CO., Ltd.; HANYUDA.CO.,LTD.; TAMAGAWA SEIKI Co.,Ltd.; High-Reliability Engineering & Components Corporation; Sumitomo Heavy Industries, Ltd.; Advanced Engineering Services Co.,Ltd. ; Altair Engineering Ltd.

Special cooperation:

National Institute of Information and Communications Technology, an incorporated administrative agency (NICT); Mitsubishi Electric Corporation; NEC Corporation; ElevationSpace Inc.

Planning & Operation: The Satellite Design Contest Executive Committee

1. Aims

This Contest provides an opportunity to more actively conduct basic and applied research related to space science and technology and is intended for high school students, technical college students, and undergraduate/postgraduate students at universities and colleges. It also aims to contribute to the expansion of space development in Japan. We call on students to submit unique, creative ideas including small satellites, various space related missions, and design concepts. We hope that students will improve their skills in the part of the process that occupies an important position in the development of a series of satellites, from the launch of the concept to the design. Awards will be given to those groups (or individuals) who have submitted excellent proposals.

In the Design Category in particular, we evaluate skills in "reliable manufacturing", starting from the emerging stage of the concept to its actual realization.

This contest also offers an opportunity for education by experts in satellite developments. From this point of view, we will give appropriate guidance to promising applicants, and encourage them to re-

submit revised ideas that were unsuccessful in past contests.

2. Category

The Contest consists of three categories: the Design Category, Idea Category, and Junior Category.

- **Design Category:** For postgraduate and undergraduate students
- **Idea Category:** For postgraduate, undergraduate, and technical college students

* High school students can participate, but please be aware that their proposals will be judged according to a university-level standard of knowledge.

* More than a high level of design completeness is required for postgraduate students. Their idea must be truly creative and unique, and appropriate for the graduate school level.

- **Junior Category:** For technical college (1st to 3rd grade only) and high school students

* Junior high school students can apply, but they must comprise half or fewer of the group members.

<Please note (for all three categories>)

* Groups or individuals can apply.
* The number of members is limited to 10 or fewer per group.
* The group may include their teacher as a member.
* The team can consist of students from different schools.
* A proposal that was unsuccessful in the Initial Screening (documentary examination) of a past Contest can be treated as a new application as long as it has been improved significantly, taking into account guidance from the Review Committee during the screening process, additional developments, etc. In that case, you must clearly write what has been improved on a separate sheet of paper.

3. Application process

* Please visit the website for details.

[Satellite Design Contest website] <https://www.satcon.jp>

(1) Registration procedure

You must register before submitting your work. For more details, see “How to apply” and “Documents to be submitted” on the website. <https://www.satcon.jp/contest/>

- Registration form: Download from the website.
- How to submit the registration form: Send the registration form by e-mail to the secretariat or register online (form).
- E-mail address: (Satellite Design Contest Secretariat) satconjimu@jsforum.or.jp
- Registration deadline: **Monday, May12, 2025, 5:00PM (JST)**

(2) Bank transfer of the registration fee

- Design Category/Idea Category: 3,000 Japanese Yen
- Junior Category: 1,000 Japanese Yen
- Bank account information:

* Please transfer the registration fee for each theme.

Sumitomo Mitsui Banking Corporation TOKYOKOUMUBU (096)
Ordinary Account: 3014468
Beneficiary's Name: NIHON UCHU FORUM

* Please note that we cannot return the registration fee, even if you withdraw from the Contest.
* Make sure to complete the bank transfer by the registration deadline.

(3) Submission of works

For information about the documents to be submitted, see "How to apply" and "Documents to be submitted" on the website. <https://www.satcon.jp/contest/>

- Submission method: Send your work to the secretariat via e-mail as PDF or Word files.
- E-mail address: (Satellite Design Contest Secretariat) <satconjimu@jsforum.or.jp>
- Submission deadline: **Monday, July 7, 2025, 12:00PM (JST)**

4. Screening Process

4.1 Initial Screening (Paper examination)

(1) 10 to 15 works are selected in total through documentary examination.

(2) The selection results are notified to the representatives, together with advice, questions, and comments from the Review Committee.

(3) The result notification period is early September.

4.2 Final Review (Presentation)

(1) **Date: Saturday, November 22, 2025 (JST)**

(2) Format: Hybrid conference with a choice of in-person or remote participation

*** Overseas schools will participate online.**

* The Zoom app will be used for online sessions.
* The venue (in Tokyo) has not yet been determined. Final Round participants will be contacted with more information.
* Presentations will be streamed live on YouTube.

(3) Presentation time (per entry)

Design Category: 40 minutes (presentation 20 minutes, Q&A 20 minutes)

Idea Category: 20 minutes (presentation 10 minutes, Q&A 10 minutes)

Junior Category: 15 minutes (presentation 5 minutes, Q&A 10 minutes/the Q&A session will take place in front of your poster for in-person presentations)

* The presentation times may change depending on the results of the Initial Screening.

(4) Presenters: Up to three people

(5) Language: Japanese or English

(6) Method: See page 8 for details, including the documents to be submitted and deadline.

- Online presentation: Can include PowerPoint slides, video, a mockup model, etc. (all categories).
- In-person presentation: Can include PowerPoint slides, video, a mockup model, etc. You can bring your mockup model to the venue and exhibit it (all categories).

4.3 Evaluation criteria

4.3.1 Design Category

The evaluation is based on the following points, with particular focus on the applicant's knowledge and application skills related to satellite design technology, their depth of consideration, and accuracy.

(1) Significance, uniqueness, and value of the mission

(2) Originality and ingenuity of the design

(3) Clarity of the design's scientific and technical basis, feasibility that has been quantitatively tested

(4) Sufficient completeness of the design as a satellite system/subsystem

(5) Sufficient and suitable improvements considering the advice, questions, and comments from the Initial Screening (Final Review only)

(6) Good presentation abilities and attitude, sufficient persuasive skills (Final Review only)

4.3.2 Idea Category

The evaluation is based on the following points, with particular focus on scientific and technical feasibility, whether the proposal has been verified based on university-level knowledge, and the novelty and usefulness of the mission concept.

(1) Sufficient originality of the mission

(2) Significance and usefulness of conducting the mission in space, such as no alternative means on Earth

(3) The scientific basis of the idea and technical basis for its realization are clearly described and verified

(4) In case the idea resembles a past mission, clear differences and improvements based on the evaluation of that mission

(5) Sufficient responses to the advice, questions, and comments from the Initial Screening (Final Review only)

(6) Good presentation abilities and attitude, clear explanations (Final Review only)

4.3.3 Junior Category

The evaluation is based on the following points, with particular focus on whether the mission concept can be utilized in space, whether simple experiments have been conducted, and the novelty and usefulness of the mission concept.

(1) The idea has sufficient merit to be implemented in space
(2) Clearly stated sequence for coming up with the mission (including reference materials, documents, etc.)
(3) The idea is not just a vision; its feasibility has been appropriately validated
(4) Responses to the advice, questions, and comments from the Initial Screening (Final Review only)
(5) The members have actually conducted simple experiments, etc. (Final Review only)
(6) Good presentation abilities and attitude (Final Review only)

5. Awarding

Based on the total points of the Initial Screening and the Final Review, a comprehensive evaluation will be made, and the following awards are granted to those proposals that proceeded to the Final Review. The Grand awards will be given to the best work (usually one) of each Category, and the other awards will be given to works that are suitable for the activity of the respective award presenters. In addition, the Best Model Award is decided by a vote by the committee members. Each award winner, except those of (6), will also be given a trophy as an auxiliary prize.

(1) Minister of Education, Culture, Sports, Science and Technology Award (The best work that received extremely high praise)
(2) Design Grand Award (The best work in the Design Category)
(3) Idea Grand Award (The best work in the Idea Category)
(4) Junior Grand Award (The best work in the Junior Category)
(5) 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.
(6) The Special Award from the Review Committee Chair, The Encouragement Awards (The Design and Idea Categories), The Junior Experiment Award (the Junior Category), The Junior Encouragement Awards (the Junior Category), and The Best Model Award (the Design and Idea Categories).

6. Design Conditions

The proposals for each Category must meet the following design conditions.

6.1 Design Category

(1) Constraints (Interface condition between the launch vehicle and the satellite) :

a. satellite that deploys from CubeSat deployer

[Configuration] 1U, 2U, 3U, or 6U

[Mass] Less than or equal to 1.5kg for 1U, 3g for 2U, 4.5kg for 3U, and 9kg for 6U

[Stiffness] Minimum natural frequency must be higher than 110 Hz on when all ends of the four rails of the CubeSat are tightly fixed.

[Launch environment] The mechanical design must be made to withstand the following conditions.

・Random vibration (3-axis common)

20～100Hz	0.001 G^2/Hz
100～300Hz	(+11.2 dB/oct)
300～500Hz	0.06 G^2/Hz
500～2000Hz	-9.5 dB/oct

・Sine wave vibration level (3-axis common)

40～50Hz	1.0 $G_{0\text{-}p}$
50～60Hz	0.5 $G_{0\text{-}p}$

・Quasi-static acceleration (following both cases must be satisfied)

	longitudinal	lateral
Case 1	±3.5 G	±2.5 G
Case 2	±10.0 G	±1.0 G

b. satellite that does not use CubeSat deployer

[Configuration] Keep within W60cm×D60cm×H80cm when launched

[Mass] Less than or equal to 70kg

[Stiffness] Minimum natural frequency must be higher than 80 Hz in the longitudinal direction and 40Hz in the lateral direction when its separation plane is rigidly fixed.

[Launch environment] The mechanical design must be made to withstand the following conditions.

・Random vibration (3-axis common)

20～100Hz	+6.0 dB/oct
100～600Hz	0.015 G^2/Hz
600～2000Hz	-8.5 dB/oct

・Sine wave vibration level (3-axis common)

40～50Hz	1.0 $G_{0\text{-}p}$
50～60Hz	0.5 $G_{0\text{-}p}$

・Quasi-static acceleration (following both cases must be satisfied)

	longitudinal	lateral
Case 1	±3.5 G	±2.5 G
Case 2	±10.0 G	±1.0 G

The above launch environment is regarded as the acceptance test (AT) level (to confirm issues with the satellite/limit load equivalent). It is preferred if the design can withstand the qualification test (QT) level (to confirm issues/ultimate load equivalent) in consideration of the safety margin (e.g. 1.25).

* If the proposal employs multiple satellites that are deployed from CubeSat deployers, the total satellite volume must be less than or equal to 24U.
* If the proposal employs multiple satellites that do not use CubeSat deployers, the total mass must be less than or equal to 70kg and keep within W60cm×D60cm×H80cm when launched.
* If the proposal employs multiple satellites including the satellites deployed from CubeSat deployers and those using no CubeSat deployer, the CubeSats must be installed into the primary satellite when launched, and the primary satellite must satisfy the above condition b. The mechanical condition of each CubeSat must be calculated from the above condition of the primary satellite.
* You can refer to the technical documents published by the space agencies (e.g. https://sma.jaxa.jp/techdoc.html, https://humans-in-space.jaxa.jp/library/item/kuoa/kuoa_jem_handbook_eng.pdf, https://ecss.nl/hbs/active-handbooks/).

(2) Mission objectives:

The mission objectives are unspecified, and can be various, including technology demonstrations, scientific observations, space explorations, civil and business applications, and entertainments. To achieve the mission objective(s), the applicants may freely choose the most appropriate orbit configurations, such as near-Earth orbits, Lagrange and points, transfer and Lunar orbits, and deep-space trajectories. If the constraints of (1) are considered inappropriate or inapplicable to the selected orbit condition, these may be modified, on the condition that a suitable alternative launching vehicle is specified, and the associated launch/operation environments are elucidated.

(3) Based on the constraints as stated above, the applicants must concretely design the overall satellite system, which should satisfy the evaluation criteria shown in Section 4.3.1.

6.2 Idea Category

(1) Constraints: The configuration and mass are limited to either a small rocket, an Epsilon Launch Vehicle, an H-IIA Launch Vehicle, or International Space Station.

(2) Objective: Any mission that utilizes space environment effectively is acceptable, e.g. satellite mission, lunar and planetary exploring mission, and the mission using the equipment mounted on

launch vehicle, ballistic flight vehicle, or International Space Station.

(3) Unlike the Design Category, detailed designs are not required, but the technical basis for the realization of the proposed ideas must be clarified.

6.3 Junior Category

(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: Any mission that utilizes space environment effectively is acceptable, e.g. satellite mission, lunar and planetary exploring mission, and the mission using the instruments mounted on launch vehicle, ballistic flight vehicle, or International Space Station.

7. Documents to be Submitted (for the Initial Screening)

Documents should all be publishable, except the personal information. In the Design and the Idea Categories, the Analysis document is a very important document which is to be used for the evaluation. Be sure to make the documents easy to understand. If the work contains techniques that can be patented, the applicants are advised to apply for the patents and acquire them in advance.

More specifically, follow the guidelines for the document preparation (see the attached "Document Preparation Guidelines).

(1) All documents must use A4 format, with the top, bottom, left and right margins more than 20 mm.

(2) Font size: 10.5 pt. or larger, except mathematical formulae and figure captions. For clarity, use large or bold letters for titles and points to be emphasized.

(3) Each document must strictly keep the page limit as specified below. A cover page should be omitted to make an effective use of pages. Unlike the *Satellite Overview* part, The *Analysis* document does not require any frames. Each page may be divided into two columns.

*** In order not to violate the copyright credits, explicitly state the source(s) when the works by others (including ideas, papers, calculations, images, music, and any other forms) are quoted, and go through the necessary procedures such as getting a license.**

***** Generative AI does not always give the correct answer for highly specialized items. Therefore, be extremely careful when using it. If you publish incorrect information as a result, you will be responsible for the consequences, so please be sure to check that there are no mistakes (please state that you used the generated AI as well as the citation).

7.1 Design Category

(1) The *Satellite Overview* document, prepared in the specified style (a template shall be provided).

It should describe the purpose, the orbit, operational methods, the ways to obtain the aimed results (including the mission instruments), the ground station(s), the satellite body, and the entire system of the satellite. Applicants are encouraged to use appropriate figures. The total length should be 3 pages at most.

(2) The *Satellite Design Analysis* document, which complements (1) by providing the basis for the employed techniques, detailed calculations (say, of the power budget and of the needed telemetry rate), and preliminary experiments if any. It should be prepared conforming to the attached "*Satellite Analysis* Preparation Guidelines", keeping the total length of maximum 37 pages.

(3) If you have made improvements to a past application and are re-submitting it, clearly write what has been improved on a separate sheet of paper. The paper is not included in the specified page count.

7.2 Idea Category

(1) The *Mission Overview* document. See 7.1 (1).

(2) The *Mission Overview* document prepared following the attached "*Mission Analysis* Preparation Guidelines". It complements (1) and explains from various aspects that the proposed mission concept is feasible. The total number of pages is limited to 7. If this page limit appears too tight, you may consider applying to the Design Category instead.

(3) If you have made improvements to a past application and are re-submitting it, clearly write what has been improved on a separate sheet of paper. The paper is not included in the specified page count.

7.3 Junior Category

(1) The *Junior Mission Overview* document, prepared in the specified style (a template should be provided) as described in the attached *"Junior Overview* Preparation Guidelines". The total number of pages must be 3 pages at most. It should explain the aim and methods of the proposal, its novelty and uniqueness, and results from preliminary experiments if any.

(2) If necessary, you may submit *Supplementary Material* for further explanation. The total length must be up to 3 pages.

(3) If you have made improvements to a past application and are re-submitting it, clearly write what has been improved on a separate sheet of paper. The paper is not included in the specified page count.

8. Instructions to the finalists

8.1 Design Category / Idea Category

If you pass the Initial Screening, fabricate a mockup model of the satellite/instrument (any materials

are accepted including aluminum, plywood, corrugated paper, etc.). The model should preferably be full size, but if it is too big, a scale model is acceptable. If the work is not suitable for a mockup model (such as a proposal for a new software or communication method), a CG movie or similar image is acceptable. Please consult with the secretariat.

- Online presentation: Create a presentation movie (two minutes) and give an explanation using your mockup model.
- In-person presentation: Present on stage using your mockup model. It will also be exhibited at the venue.

8.2 Junior Category

If you pass the Initial Screening, create one poster about your work.

- Online presentation: Submit your poster in advance as PDF data. You can also make a mockup model or experimental device and submit images of them.
- In-person presentation: Create a poster (A1 size or smaller; you can also combine two A2-size pages, etc.) and bring it to the venue. You can also make and bring a mockup model or experimental device.

  On the day of the presentation, you will give a presentation on stage using PowerPoint slides, etc. Afterwards, there will be a Q&A session in front of your poster with Review Committee members.

9. Miscellaneous

(1). If you have any question about the application procedure, or the selection results (after the Initial Screening), do not hesitate to contact the Satellite Design Contest Secretariat

(2) Any submitted documents will not be returned to the applicants.

(3) The applicants keep the copyright of the materials which they submitted to the Contest.

(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 the applicants do not want some of their materials to be made public, they should contact the secretariat in advance.)

(5) The submitted documents will not be used, in principle, for any purpose other than the Satellite Contest related matters. 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 some of the Contest organizers or press, to advertise the Contest, or for space-related educational events which are arranged by the Contest organizers. If some organizations or institutions wish to use some of the documents submitted to the Contest, a consultation should be made to the secretariat. Such attempts need to be certified, in principle, by the document

authors or the teacher.

(6) Applicants are responsible for all the Contest-related expenses, including traveling and communication costs, those needed to fabricate the models, and others.

Design Category: *Satellite Analysis* Preparation Guidelines

<Items to be included in the S*atellite Analysis* document>

The satellite should be those which can actually be launched, instead of being imaginary or fictional. Describe the details of the proposed satellite, including the following items approximately in this order.

1. Mission requirements (aims of the satellite) and significance of mission

Clearly describe the mission requirements (the aims of the satellite), as well as its importance and significance in technology, science, civil life, education, art, and other aspects.

2. Anticipated results

State the expected results once the satellite is put into orbit, with emphasis on their social, technological, scientific, and other impacts. In addition, explain the means to achieve these results, including, for example, the selection of the orbit, the ways of satellite operation and data acquisition, the onboard mission instruments to be used, the mission life needed, and possible relations to other space activities (e.g., the ISS, other satellites, and ground facilities) if applicable.

3. Originality

Identify the originality/uniqueness of the proposed satellite that is contained within the mission objectives, the method of its operation and data acquisition/utilization, the technologies utilized, the instruments to be onboard, and others. If some of them are inherited from previous missions or R&D attempts (by anybody), these should be credited.

4. Detailed design results

State how the mission objectives translate into the requirements for the satellite and its subsystems and describe how the satellite system and its subsystems have been designed to fulfill the requirements. In particular, the following points must be covered.

4.1. The mass, shape, and the overall satellite system design, as well as the orbital constraints.

4.2. Details of the design of the individual subsystems such as the mechanical structure and assembly, the thermal control subsystem, the power generation/supply subsystem, the communication subsystem, the data processing/storage subsystem, the mission instrument(s), and the attitude/orbit control subsystem (if applicable). Demonstrate the validity of the design by quantitative (numerical in particular) analyses.

4.3. The description of the ground facilities required for the command up-links and data down-links.

4.4. The actual operational procedures of the satellite, and the data acquisition methods.

5. Specific methods for achieving mission, budget for development and operation of satellite

Keeping in mind the phases from the development to the operation of the designed satellite, explain such aspects as the concrete achievement methods to realize the proposed satellite, to what extent the satellite shall be manufactured, and which components should be purchased. The budget must be estimated as well. In addition, describe the state-of-the-art basis, availability/feasibility, and near-future prospects of the key technologies/components employed in the proposed satellite. Identify potential difficulties/risks in these items and consider conceivable means to get around them.

6. Development and launch schedule

Explain the assumed schedule from the development to launch. The use of figures/tables is encouraged.

7. Conclusion, references, and others

State the conclusion, and give reference to all the literature (books, papers, articles, essays, figures, photos, illustrations, calculations, and others) used/quoted in the proposal. A failure in this point would lead to a potential violation of the copyright credits.

In addition, refer to **7. Documents to be Submitted (for the Initial Screening)** on the “Application Guidebook”.

Idea Category: *Mission Analysis* Preparation Guidelines

<Items to be included in the *Mission Idea Analysis* document>

1. Aims and purposes of the mission

The proposed concept should be on Earth-orbiting satellites, planetary/interplanetary missions, their onboard instruments, experiments on the International Space Station, or other similar space activities. State the aims of the proposal, together with its significance in social, technological, scientific, and other aspects. Also, clarify the reason why the objectives cannot be achieved by space-unrelated means.

2. Concrete design and necessary future tasks

Using figures/tables/photos, if necessary, describe the overall configuration, the mass and shape, and the orbit of the proposed mission concept. Explain how the mission works, in relation to the mission instruments, and the methods of operation and data acquisition (including the assumed ground station configuration). In addition, identify remaining tasks, additional studies, and future technological developments that are needed toward the realization of the proposed mission.

3. Originality and impacts of the expected results

State the originality of the proposed mission and describe the expected results. Also, identify the anticipated social, technological, and scientific impacts, including those on future space exploration/utilization, and who will mainly benefit from the mission.

In addition, refer to **7. Documents to be Submitted (for the Initial Screening)** on the “Application Guidebook”.

Junior Category: *Junior Overview* Preparation Guidelines

Although detailed design of the proposed satellite/instrument/experiment is not needed in this Category, the document should clearly describe the following points, using figures, tables, and illustrations if necessary.

1. The overall configuration of the satellite/instrument/experiment, an approximate mass and size, the mission instruments to be onboard, the orbit to be employed, the method of operation and data acquisition, and the necessary ground facilities (for sending commands and receiving the data).
2. The advantages of using space, and reasons why the objectives cannot be achieved by space-unrelated means.
3. The originality, uniqueness, and novelty of the proposal, and the expected benefits in civil life, technology (including future space exploration in particular), science, education, business application, entertainments, and other aspects.

In addition, refer to **7. Documents to be Submitted (for the Initial Screening)** on the “Application Guidebook”.