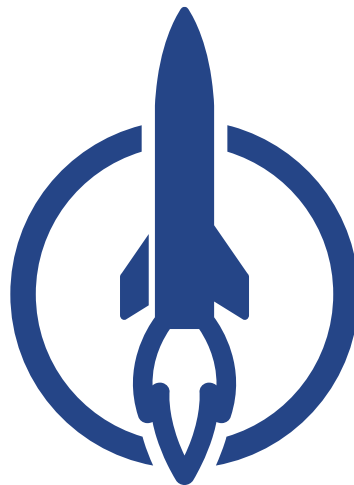


EUROPEAN ROCKETRY CHALLENGE

RULES & REQUIREMENTS



EUROC

EUROPEAN ROCKETRY CHALLENGE






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LIST OF REVISIONS

| REVISION | DATE | DESCRIPTION |
|------------|------------|---|
| Version 01 | 19/06/2020 | Original edition. |
| Version 02 | 03/03/2021 | Second version, major revisions for EuRoC 2021. |
| Version 03 | 04/02/2022 | Third version, major revisions for EuRoC 2022. |
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1. INTRODUCTION

1.1. BACKGROUND

The Portuguese Space Agency – Portugal Space promotes the EuRoC – European Rocketry Challenge, hosted in the Municipality of Ponte de Sor, a competition that seeks to stimulate university level students to fly sounding rockets, by designing and building the rockets themselves. It is widely recognized that such competitions foster innovation and motivate students to extend themselves beyond the classroom, while learning to work as a team, solving real world problems under the same pressures they will experience in their future careers.

EuRoC is fully aligned with the strategic goals of Portugal Space, namely the development and evolution of the cultural/educational internationalization frameworks capable of boosting the development of the Space sector in Portugal.

Since EuRoC's first edition, in 2020, where 100 students were present to 2021, with 400 students participating, the growth of the competition within Europe is visible, and especially within Portugal, with an increasing number of interested teams applying to the competition. For the future, it is Portugal Space's goal to continue to foster the exchange of knowledge and international interaction inherent to the event, allowing more students to gain from the Challenge and, at the same time, contribute to it.

This document defines the rules and requirements governing participation in EuRoC. Revisions of this document will be accomplished by document reissue, marked by the version number. The authority to approve and issue revised versions of this document rests with Portugal Space.

1.2. DOCUMENTATION

The following documents include standards, guidelines or required standard forms. The documents listed in this section (Table 1) are either applicable to the extent specified herein or contain reference information useful in the application of this document.

Table 1: Documents file location

| DOCUMENT | FILE LOCATION |
|--|--|
| EuRoC Rules & Requirements | http://www.euroc.pt |
| EuRoC Design, Test & Evaluation Guide | http://www.euroc.pt |
| EuRoC Launch Operations | http://www.euroc.pt |
| EuRoC Entry Form | http://www.euroc.pt |
| EuRoC Academic Institution Letter Template | http://www.euroc.pt |
| EuRoC Motors List | http://www.euroc.pt (Teams' Reserved Area) |
| EuRoC Technical Questionnaire | http://www.euroc.pt (Teams' Reserved Area) |
| EuRoC Temporary Admission Guide | http://www.euroc.pt (Teams' Reserved Area) |
| EuRoC Waiver and Release of Liability Form | http://www.euroc.pt (Teams' Reserved Area) |



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|---|--|
| EuRoC Flight Card and Postflight Record | http://www.euroc.pt (Teams' Reserved Area) |
| EuRoC Master Schedule | http://www.euroc.pt (Teams' Reserved Area) |

2. FLIGHT CATEGORIES

Teams competing in EuRoC must design, build and launch a rocket carrying no less than 1 kg of payload to a target apogee either 3000 m or 9000 m above ground level (AGL). Teams can use either commercial off-the-shelf (COTS) or student researched and developed (SRAD) propulsion systems, with SRAD propulsion systems being defined as those designed by students – regardless of whether fabrication is performed by students directly, or by a third party working to student supplied specifications – and can include student designed modifications of COTS systems.

Note: Multistage and clustered launch vehicles are allowed.

Projects will be divided into categories based on the propulsion system (solid [S], hybrid [H], or liquid [L]) and target apogee (3000 m [3] or 9000 m [9]). Thus, **the six flight categories are S3, H3, L3, S9, H9, and L9**. To distinguish COTS from SRAD systems, the origin of the propulsion will be noted in the COTS case by addition of the suffix [-c], while SRAD systems will not have a suffix. Propulsion systems of a similar type will compete in the same category, no matter their origin. A summary is given in Table 2.

Table 2: Flight categories

| TARGET APOGEE | | 3000 M | | 9000 M | |
|-------------------|--------|--------|------|--------|------|
| Origin | | COTS | SRAD | COTS | SRAD |
| Propulsion System | Solid | S3-c | S3 | S9-c | S9 |
| | Hybrid | H3-c | H3 | H9-c | H9 |
| | Liquid | L3 | | L9 | |

Teams are permitted to switch categories as necessary prior to submitting their final Technical Report, e.g., they may switch from the 9000 m to the 3000 m or vice-versa. EuRoC reserves the right to change the category in which a project is initially entered based on the design presented (from COTS to SRAD, or between S/H/L).

3. TEAM COMPOSITION AND ELIGIBILITY

3.1. TEAM MEMBERS

EuRoC teams shall consist of members who are currently enrolled in a Bachelor's or Master's degree or were matriculated undergraduate or graduate students (i.e., Masters) during the previous academic year (e.g., former students who graduated shortly before the competition remain eligible), from one or more academic European institutions (e.g., "joint teams" are eligible). Each student team is limited to



30 members. Teams may integrate advisory members (e.g., doctorate students, professors), as long as the number of advisors does not surpass 20% of the total number of team members. Please note that advisors are considered team members and will count for the 30 members limit.

The limitation in the number of team members only applies to the number of team members to be present at the event, and not to the constitution of the team itself. The same applies to the number of team advisors, the 20% limitation only applies to the number of advisors to be present at the event, and not the constitution of the team itself (i.e., the number of advisors to be present at the event cannot surpass 20% of the total number of team members to be present at the event).

Each team shall assign a team leader when applying to EuRoC. The team leader must be the point of contact with EuRoC for all matters, meaning that EuRoC organisation will always and only directly contact the team leader, and that the team leader must be the only one contacting the EuRoC organisation. Furthermore, the team leader should be responsible for disclosing and sharing all the information provided by EuRoC to the remaining team (e.g., by having access to the teams' reserved area in the EuRoC website).

The number of teams at EuRoC 2022 edition will be limited. Even though it is a declared goal of the EuRoC organisers to include teams from outside Europe, due to the current limitations only European teams will be admitted in the 2022 edition. National rules regarding Covid-19 in place at the time of the event will apply.

3.2. SUBMISSION LIMITATIONS

Each student organisation/association/team may enter one project into EuRoC. No project may be entered in more than one category. Deviation from this principle will require case-by-case negotiations with the event officials. To foster the diversity and spirit of the competition, under no circumstances will more than two teams be accepted from any single student organisation.

4. APPLICATION AND REGISTRATION PROCESSES

Although the organisers wish to admit all applicants, it is necessary to have a process in place to down select participating teams from all applicants. Thus, teams that will be selected under a process aiming to enlist a broad pallet of young European rocket teams. This will not be a first-come-first-served process and applications throughout the whole of the application period will be considered. All teams will be contacted by e-mail about the outcome of the selection process.



4.1. ENTRY FORM

Each team shall inform EuRoC of their desire to compete by applying on the EuRoC website. Total completeness of the entry form is required.

Submission of the Academic Institution Participation Letter (see Section 4.3.) and Student University Identification (see Section 4.4.) will be required.

4.2. TEAM ID

The Team ID is the competition officials' primary means of identifying and tracking the teams. Once assigned, any correspondence between a team and the organisers must contain the respective team's ID number to enable a timely and accurate response. In the entry form, teams can indicate a short name or acronym for easier identification.

4.3. ACADEMIC INSTITUTION PARTICIPATION LETTER

Each team is required to ask the academic institution(s), in which its members are enrolled, to provide a signed letter to EuRoC, acknowledging the team as the institution's representative and its intention to participate in the event. The signatory shall be a senior faculty member or senior staff representative (e.g., professor). Academic institutions sending more than one team to the EuRoC need only to write one participation letter, covering all their teams, but each included team must submit an individual copy of that letter. In the case of a joint team, comprised of students from multiple academic institutions, each affiliated institution must provide its own signed letter to the team. The Academic Institution Letter template is available for download on the EuRoC website. When submitting the Entry Form, teams shall submit digital, PDF copy(s) of their signed participation letter(s) on the EuRoC website, on the respective field.

4.4. STUDENT UNIVERSITY IDENTIFICATION

Each team shall submit copies of documents proving that all team members are eligible – i.e., team members are either currently enrolled in a Bachelor's or Master's degree or were matriculated undergraduate or graduate students during the previous academic year.

The accepted documents as student identification proof are:

- Student card, with valid expiration date or;
- Certificate of enrolment issued by the academic institution or;
- A print screen of the student personal area from the academic institution website that clearly shows that the team member is enrolled or was enrolled during the previous academic year.



Each team member must choose one, and only one, of the above documents. The documents should preferably be written in English. The documents from all team members must be submitted in a package format (e.g., zip/rar file), on the designated area of the EuRoC website, with the Entry Form submission.

4.5. DEPOSIT FEE

Once a team is accepted to take part in the competition, to complete the registration process and for commitment purposes, a deposit fee of 100€ per team member will be charged. For teams attending the event, the deposit fee will be refunded after the event. The refund will be carried out as a single money transfer.

The refundable deposit will be due shortly after the completion of the registration process.

All teams admitted to the event will receive an info email, containing all necessary payment information.

Proof of the transfer (e.g., scan/photo/PDF of the transfer receipt) must be submitted in the EuRoC website through the reserved area with clear identification of the team making the deposit and the bank account necessary info (i.e., IBAN and swift code) for refund purposes.

The latest date for withdrawal from the competition will be the date the Technical Questionnaire is due, as will be announced on the EuRoC website.

After this date, if a team (accepted, registered, and confirmed as a participating team at EuRoC) withdraws, gets disqualified, arrives late, or does not attend the event at all, the deposit fee will not be refunded.

This deposit fee is intended to guarantee the teams participation in the event, to ensure the correct use of the EuRoC material, as well as to cover any possible expenses due to inadequate use and operation (or other related matters that teams may impose).

5. MILESTONES

There are several events, briefings, and reviews, mandatory or optional, that form the EuRoC milestones. A more detailed overview of other building blocks of EuRoC that the teams can expect is given in Appendix B.

5.1. MANDATORY MILESTONES

The mandatory milestones in the sections below shall be completed in order to qualify for flight and to enter competition scoring.



5.1.1. CHECK-IN

Teams are expected to arrive in time so they can register, receive their event badges, and be assigned their respective areas. It is expected of every team to attend with all team members from day one. If individual team members cannot attend from the start due to reasons related to travel restrictions or similar, event officials should be notified, via e-mail, before the event, at the latest two weeks in advance before the first event day. This should however only be an exception to the rule.

5.1.2. WELCOME BRIEFING

During the morning of the first event day, a welcome briefing will be given to the teams to introduce the event officials, announce on-site details, and kick-off all activities. Attendance is expected.

5.1.3. SAFETY BRIEFINGS

During the event, safety briefings will be given by range safety officials to all team members. Attendance is mandatory for all team members and advisors, without exception.

5.1.4. JURY PITCH

As part of the overall scoring and associated to the “New Space Award” (see Section 11.3.2. for details), teams will be required to give a pitch to the jury at their booth in the paddock. Teams can think of this pitch as a scenario where the jury would represent a customer looking for a student team to hire to supply a fictional launch service with their rocket. Teams should showcase the team itself, the vehicle, the design implementation, the mission, and their long-term vision, among others. The jury will positively take note of the “New Space” spirit teams exhibit, for example their innovation, their resourcefulness, and their agility. Teams may also focus on the most important and distinguishing features, achievements, or experience that the jury might find convincing and would tilt a hiring decision in their favour. Teams can support their pitch by any suitable resources (hardware, multimedia, poster), within a frame of maximum 30 minutes (15 min pitch + 15 min Q&A).

5.1.5. POSTFLIGHT DEBRIEFING

Debriefing session after recovery of the vehicle for the officials to assess the condition of the vehicle. This debriefing will serve as baseline for the evaluation team to score the success of the recovery operation (see Section 8.6. for details).



5.1.6. AWARD CEREMONY

The Award Ceremony, to be held on the last day of the event, will be the final milestone of EuRoC where winners will be announced.

5.2. OPTIONAL MILESTONES

5.2.1. POSTFLIGHT HIGHLIGHTS

During the event, teams are invited to present their postflight highlights.

This moment is meant to provide an opportunity to showcase some interesting stories, both of success and failure and all the ups and downs that make for a great event and a memorable experience for all.

Teams wishing to share their experiences should inform the event officials after all launch activity has ceased, most likely the evening before the last day. No “high-gloss polished” slideshow is expected, but an interesting and engaging talk (5-10 min). Teams are encouraged to be creative and use any aides they like.

Note: The Postflight Highlights will be dependent on time availability.

6. MOTORS AND PROPELLANTS

6.1. AMATEUR ROCKET LIMITATIONS

Launch vehicles entered in EuRoC shall not exceed an installed total impulse of 40,960 Newton-seconds. Teams intending on launching vehicles, which exceed the official impulse limit, require prior case-by-case review and EuRoC approval.

6.2. COTS SOLID/HYBRID MOTORS

In due time, before the event, officials will provide a list of motors that will be available for the competing teams through the reserved teams’ area of the EuRoC website. It is compiled in conjunction with the official EuRoC pyrotechnics supplier and will contain a range of motors from known manufacturers available on the market. Teams will be asked on the Technical Questionnaire (see Section 9.1) to indicate their needed motor. Only COTS motors from the motors list and ordered via the official pyrotechnics’ supplier are permitted.



6.3. SRAD MOTORS

SRAD motors are subject to the detailed requirements listed in the EuRoC – Design, Test & Evaluation Guide. SRAD motors should satisfy the highest requirements regarding safety, thus the teams are required to take all necessary precautions during their design, adhering to sound engineering principles and supporting their design with simulations and tests. The event officials will evaluate the designs during the Technical Review Process, based on the submitted technical reports, and during the Flight Readiness Review. Only if event officials are fully convinced that the design is sufficiently sound, mature, and tested, will teams be allowed to fly.

Teams are welcome and encouraged to approach the officials during the Technical Review Process, before and during the event to discuss their specific design questions. Officials encourage a culture of open discussion about ANY doubts that might arise regarding design feasibility and safety.

6.4. PROPELLANTS FOR SRAD MOTORS

All chemical propulsion types (solid, liquid, and hybrid) are allowed. Note that all propellants used must be non-toxic. Ammonium perchlorate composite propellant (APCP), potassium nitrate and sugar (aka "rocket candy"), nitrous oxide, liquid oxygen (LOX), hydrogen peroxide, kerosene, propane, and similar substances, are all considered non-toxic. Toxic propellants are defined as those requiring breathing apparatus, special storage and transport infrastructure, extensive personal protective equipment, etc. (e.g., Hydrazine and N₂O₄). Home-made propellant mixtures containing any fraction of toxic propellants are also prohibited.

Teams competing with solid SRAD motors, after the delivery of the Technical Questionnaire, should as soon as possible contact the EuRoC pyrotechnics supplier to discuss and be informed about appropriate measures for participation preparation.

Liquid/gas propellants must be acquired through EuRoC, under no circumstances will a team be allowed to bring their own propellants. Teams must be aware that the bottle fittings might be different from the ones normally used by the team and shall take all necessary precautions to ensure the compliance with the EuRoC supplier products. Information on the EuRoC bottle fittings will be made available on the reserved teams' area of the EuRoC website in due time.

Teams are responsible by having all the necessary equipment on site (e.g., cooling chamber, thermal protection).

High-level design and acceptance testing requirements are contained in the EuRoC – Design, Test & Evaluation Guide in order to promote flight safety.



7. PAYLOAD

7.1. GOAL

Event officials encourage the teams to launch functional payloads in the form of creative scientific experiments and technology demonstrations. It is also encouraged that this is done in a collaborative fashion, so that rocket launching teams may reach out to other universities and/or student groups which develop CanSats/CubeSats/PocketSats that could provide payloads to be flown onboard the EuRoC rockets. Nevertheless, non-functional "dummy-mass" payloads are also permitted, if these comply with the Payload Required Form Factor and Mass.

7.2. PAYLOAD DEFINITION

A payload is defined as an independent component that is replaceable by a ballast of the same mass, with no change to the launch vehicle's functionality and trajectory in reaching the target apogee, or its' successful recovery. Participants are required to carry payload(s) on their vehicle, which can be of the following type:

- Non-functional (i.e., dummy mass) OR functional payload (i.e., a purposeful device, e.g., an experiment or technology demonstrator);
- Non-deployable OR deployable payload (e.g., deploying a CanSat to the ambient).

If a functional payload is chosen, it can either be:

- Passive (i.e., non-powered/non-energetic) OR active (i.e., powered/energetic).

This payload may be assumed present when calculating the launch vehicle's stability. In other words, launch vehicles entered in EuRoC need not to be stable without the required payload mass on-board.

The payload must comply with the Payload Required Form Factor and with the Payload Required Mass, presented in the next sections.

7.3. DEPLOYABLE PAYLOADS

Deployable payloads are characterized by the payload being ejected or separated from the main vehicle during flight. Therefore, deployable payloads require their own recovery system.

A special case exists for deployable (lightweight) payloads, in that they may be allowed to utilize a single-stage 8-9m/s descent velocity recovery system from apogee, on a case-by-case approval from the EuRoC organisation, since elaborate active deployable payloads will generally benefit from as much airborne time as possible.



If teams plan to develop a deployable payload that requires a specific unique recovery system, they shall contact the event officials prior to the event to clarify if the payload satisfies all requirements.

7.4. PAYLOAD REQUIRED FORM FACTOR

All payloads, whether they are non-functional or functional, non-deployable or deployable, must fulfil the requirements for the form factor as detailed below, which are generally based on common CanSat, CubeSat and PocketSat form factors.

The basic form factors are defined as follows:

- CanSat: Cylindrical shape with 115 mm height and 66 mm diameter;
- CubeSat: Cubic shape with one CubeSat Unit (1U) being defined as a 100 mm x 100 mm x 100 mm cubic structure;
- PocketSat: Cubic shape with 50 mm x 50 mm x 50 mm.

The form factors are given not including a parachute, if applicable as in the case of deployable payloads. "Point masses" with odd form factors are not allowed.

The volume of the payload may be a multiple/stack of the basic payload form-factors, e.g., 3 CanSats (345 mm height x 66 mm diameter), 2U (200 mm x 100 mm x 100 mm), 5 PocketSats (250 mm x 50 mm x 50 mm) or likewise.

Teams intending on carrying payloads, which do not fulfil the payload required form factor, require prior case-by-case review and EuRoC approval.

7.5. PAYLOAD REQUIRED MASS

The launch vehicle shall carry no less than 1000 g of payload – Payload Required Mass. There is no upper limit on payload mass. Teams are responsible for conducting a "weigh-in" on site in the presence of the competition officials. The weigh-in can be done prior to, or during the Flight Readiness Review. Competition officials will accept payload weigh-ins as much as 5% (50 g) less than the specified minimum. If this requirement is not met, "nominal" flight status for the payload may be denied by the officials during FRR, resulting in an action item to increase payload mass. Any payload unit weight greater than the specified minimum is acceptable.

All payloads, whether they are non-functional or functional, non-deployable or deployable, must fulfil either the CanSat, CubeSat or PocketSat mass requirements. The basic mass increments are defined as follows:

- A single CanSat-type payload has a mass between 300 g and 350 g;
- A single CubeSat-type payload has a mass between 1000 g and 1330 g;
- A single PocketSat-type payload has a mass between 200 g and 250 g.



If a functional payload is chosen, with the functional part itself not providing enough mass to reach the minimum requirements, additional dummy-masses may be added to the functional payload until the minimum mass requirement is reached.

Teams intending on using payloads, which do not fulfil the payload required mass, require prior case-by-case review and EuRoC approval.

7.6. MINIMUM PAYLOAD EXAMPLES

Some examples of payloads to fulfil the minimum mass requirements could be:

- A stack of three single CanSat-type payloads (115 mm height and 66 mm diameter each) with a mass between 300 g and 350 g each, amounting to a total mass of at least 1000 g;
- A 3-unit size CanSat-type payload (345 mm height x 66 mm diameter) with a mass of at least 1000 g;
- A CubeSat-type payload with a minimum form factor of 1U with a mass of at least 1000 g, but not exceeding 1330 g;
- A 4U CubeSat-type payload with a mass of 4000-5320 g;
- A 5-unit size PocketSat payload (250 mm x 50 mm x 50 mm) with a mass of at least 1000 g;
- A stack of five single PocketSat-type payloads (50 mm x 50 mm x 50 mm each) with a mass between 200 g and 250 g each, amounting to a total mass of at least 1000 g.

7.7. INDEPENDENT PAYLOAD FUNCTIONALITY

Launch vehicle recovery systems shall be able to bring the vehicle down in a safe and controlled manner, as per the recovery system requirements, independently of whether the payload is active, passive, deployable or fixed inside the launch vehicle.

An independent payload cannot be a part of the launch vehicle functionality (such as a guidance and control system). The functionality must be completely independent of the launch vehicles' ability to bring the payload to the designated apogee.

7.8. LOCATION AND INTERFACE

Neither the payload's location in the launch vehicle nor its method of integration and removal is specified. Therefore, teams must ensure that the payloads shall not be inextricably connected to other launch vehicle associated components (e.g., the launch vehicle's recovery system, internal structure, or airframe) while being weighed. If the payload cannot be removed for weigh-in, the teams will not get points for an on-board payload.



7.9. RESTRICTED MATERIALS

Payloads shall not contain significant quantities of lead or any other hazardous materials. The use of radioactive materials shall not be permitted.

8. TECHNICAL REVIEW PROCESS

8.1. GENERAL COMMENTS

The Technical Review Process (see Figure 1) at EuRoC has the goals to ensure vehicle safety, maximize the chances of a successful launch and recovery, and to improve the learning experience for the teams.

The process includes five steps:

1. Concept Review;
2. Focused Design Review (for selected teams only);
3. Flight Readiness Review;
4. Launch Readiness Review;
5. Postflight Review.

Furthermore, several technical documents and deliverables are required to be prepared or filled-in by the teams (further details in Section 9):

1. Technical Questionnaire (including Orders for COTS Solid Motors and Liquid/Gas Propellants);
2. Concept Review Report;
3. Design Review Report;
4. Technical Report;
5. Flight Simulation;
6. Flight Card;
7. Postflight Record.

It should be noted that the EuRoC Technical Review Process is meant to complement and challenge the team-internal technical design and review process, not substitute it.

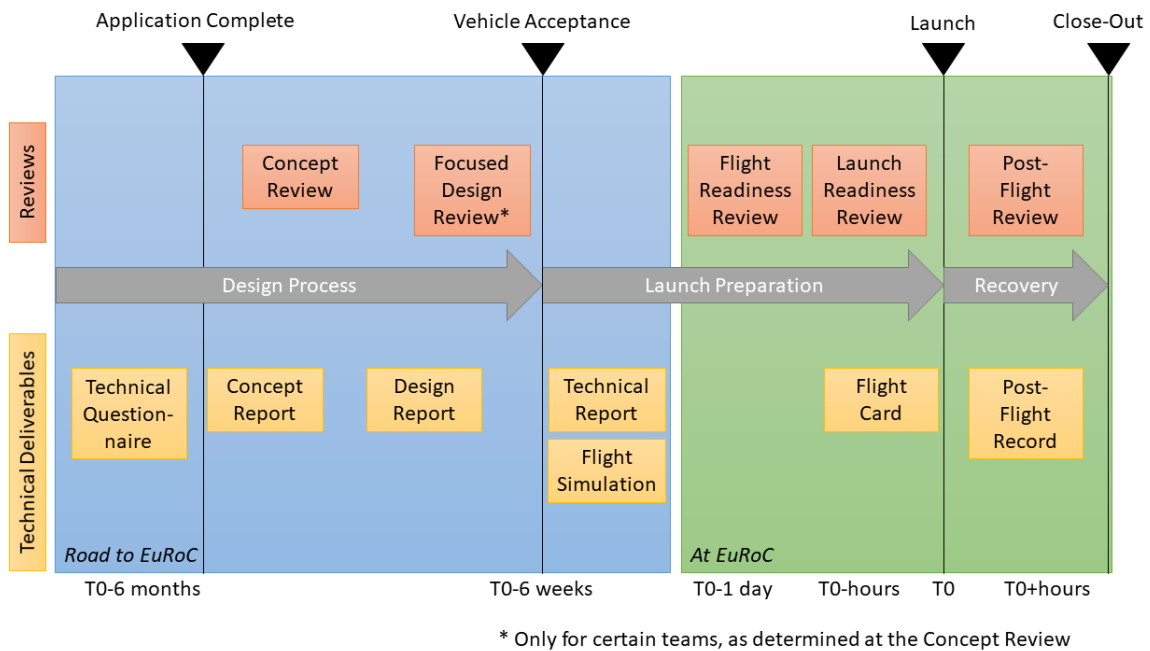


Figure 1: Technical review process.

8.2. CONCEPT REVIEW (CR)

To get a first overview of the vehicle at an early point before the competition, a 1-hour Concept Review (CR) will be held. Teams are requested to provide a Concept Report in advance (see Section 9.2). During this review, the following items will be discussed:

- General arrangement the system and its subsystems;
- Main system description;
- Main performance parameters;
- Planned mission concept of operations;
- Materials and manufacturing methods;
- Potential criticalities;
- Any features that might require special attention.

8.3. FOCUSED DESIGN REVIEW (FDR)

Some designs will require a more thorough review prior to and beyond the submittal of the Technical Reports, especially for any designs that have special requirements in terms of preparation or might have a higher risk of an unsuccessful mission. In these cases, a Focused Design Review (FDR) must happen in the months leading up to the event. Based on the Concept Review, the EuRoC officials will require an FDR from selected teams.



The FDR will be held virtually, with the team captain as well as the relevant technical officers, details will be given in due time. The EuRoC organizers will not be held responsible if negative feedback during a FDR causes unplanned delays, potentially jeopardizing a team's readiness for the event.

Any design feature from the following (non-exhaustive) qualifies for an FDR:

- Recovery System of vehicles in 9000 m category;
- SRAD Solid Propulsion;
- SRAD Hybrid Propulsion;
- SRAD Liquid Propulsion;
- Multistage Vehicles;
- Vehicles with clustered motors;
- Vehicles with deployable payloads;
- Vehicles with planned impulse greater than 40,960 Ns;
- Vehicles with planned aerodynamic design on the edge of the allowed aerodynamic stability margins, with very low lift-off velocities, or very sensitive to gusts;
- Vehicles with active control features that could lead to an unstable or unsafe flight;
- Any other unconventional and possibly safety critical design features.

8.4. FLIGHT READINESS REVIEW (FRR)

A major milestone to get the clearance to transfer the vehicle to the launch site and start the dedicated launch preparations is the Flight Readiness Review (FRR). Within this review, the technical evaluation board (TEB) will visit the team area and go through a detailed Flight Readiness Review checklist (see Appendix C of the Design, Test & Evaluation Guide) that all vehicles need to comply with. All criteria can be scored "red" (Denied), "yellow" (Provisional), "green" (Nominal), or "grey" (not applicable).

If any single criterion is scored "red", the overall Flight Status is "Denied". This will cause the teams to FAIL the FRR and not be allowed to launch their vehicle.

If any single criterion is "yellow", while no criterion is "red", the overall Flight Status is "Provisional" (Further details in the Design Guide). Any criterion that is scored "yellow" will result in an Action Item (= a mandatory task) that needs to be resolved by the team.

Any Action Items preventing a "Nominal" flight status can be addressed by the teams after FRR and before the subsequent Launch Readiness Review (LRR). Providing all Action Items have been addressed accordingly, the flight status can then be raised to "Nominal" by the jury during LRR.

The FRR will usually take place the day before the launch at the paddock teams' area. The teams should ensure that the vehicle is in an FRR-ready state. This means, the vehicle will be without energetics or propellants, will be disassembled at the joints, with the avionics system, payload, and recovery system outside of the body tubes, so that the TEB can have a good look at all subsystems.



8.5. LAUNCH READINESS REVIEW (LRR)

For a team to be accepted to proceed to the Launch Readiness Review (meaning to start the LRR, not to pass it), the following conditions need to be met by the teams:

- The team has completed the Flight Readiness Review with at least “Provisional” Flight Status;
- Following the FRR, the team has addressed all issues scored as “yellow”;
- The team has moved their vehicle to the launch range and is ready to begin launch activities, the next step being loading the solid motor/energetics or moving the launch vehicle to the launch rail for loading of liquid propellants.

During the Launch Readiness Review, the teams will be expected to explain:

- How they resolved the FRR Action Items, if applicable;
- Explain any changes on documentation/checklists they made prior to launch, if applicable;
- Why their rocket can now be considered ready to launch verification.

Furthermore, the launch officials will conduct the following steps:

- Re-inspect Action Items if necessary;
- Final visual inspection of the vehicle.

For a team to successfully pass the LRR, the officials will have to raise all criteria to “green” and the flight status to “Nominal”. They will do so if they are convinced all Action Items have been resolved by the teams and there are no further criteria preventing a safe and successful launch. At the end of the LRR, the issuance of the Flight Card (See Section 9.6.) by the officials to the team certifies that the LRR has been passed successfully.

The LRR will usually take place in the early morning of the launch day at the launch site teams’ preparation area. The teams should ensure that the vehicle is in an LRR-ready state as early as possible during launch day. This means that the vehicle is in a safed state and assembled as much as possible. Teams should provide prove that Action Items given at the FRR have been closed. For most (minor) action items pictures and videos suffice as prove, especially if otherwise an assembly of the vehicle would be unreasonably delayed.

8.6. POSTFLIGHT DEBRIEFING

After recovery of the vehicle, the teams will bring the vehicle into a safed state and inform the officials about the readiness for the Postflight Debriefing.

The officials will record the condition of the vehicle on the Postflight Record (See Section 9.7). This is the baseline for the evaluation team to score the success of the recovery operation. Furthermore, the officials will review the Postflight Record, download the data recorded by the official altitude logging system and note the touch down coordinates if available. With this, the launch activities are concluded.



9. TECHNICAL DELIVERABLES

All technical deliverables shall be submitted through the reserved teams' area in the EuRoC website, deliverables submitted by any other means (e.g., email) will not be considered.

9.1. TECHNICAL QUESTIONNAIRE

On or before a specified date prior to the event each team shall fill in a Technical Questionnaire that will be made available at the reserved teams' area in the EuRoC website. In this questionnaire, each team shall submit the information regarding the chosen motor (from the list of available motors, see also Section 6.), SRAD motors specifications, necessary propellants and respective quantities, special cares to have in consideration (e.g., handling, hazards, transport needs), among other technical information.

Teams should be aware that some of the information given in the questionnaire will be made available in the public areas of EuRoC website and/or social media, for promotion purposes.

9.2. CONCEPT REPORT

In preparation for the Concept Review, teams will be asked to submit, through the reserved teams' area in the EuRoC website, a Concept Report (max. 10 pages), including the following:

- Brief team intro with any relevant project context information (2 to 3 paragraphs);
- Stated project goals (1 paragraph or a list);
- Stated mission objectives (1 paragraph or a list);
- Concept of Operations (1 diagram of the main operations stages, plus a brief text description of the rocket's lifecycle during EuRoC);
- System concept;
- General arrangement (diagram or drawing and 1 paragraph of text);
- Dimensions and mass estimates (drawing and/or table);
- Main performance figures (table);
- Main systems description (1 to 2 paragraphs for each, with optional drawing or diagram, more info for any complex SRAD systems, especially propulsion);
- List of materials and methods of manufacture to be employed (1 paragraph or a list);
- Differentiating and unique characteristics (if any, 1 to 2 paragraphs plus drawing – this is to make sure teams explicitly point out any special design features that the officials should be aware of);
- Expected difficulties, criticalities (3 to 4 paragraphs).

The Concept Report's main title is left to the team's discretion, however it shall be subtitled "Team [Your Team ID] Concept Report to the [Year] EuRoC". For example, a team assigned the team-ID "12"



competing in the 2022 EuRoC, would subtitle their Concept Report "Team 12 Concept Report to the 2022 EuRoC".

9.3. DESIGN REPORT

The selected teams will need to participate in the Focused Design Review will be requested to submit a Design Report (max. 10 pages) to be submitted through the reserved teams' area in the EuRoC website. In essence, teams are allowed to reuse their Concept Report, however they should update it to reflect the advanced status of the design close to the competition. Furthermore, they should a specific emphasis on the respective special design feature(s) that will be in the spotlight at the Focused Design Review.

- Brief team intro with any relevant project context information (2 to 3 paragraphs);
- Stated project goals (1 paragraph or a list);
- Stated mission objectives (1 paragraph or a list);
- Concept of Operations (1 diagram of the main operations stages, plus a brief text description of the rocket's lifecycle during EuRoC);
- System design;
- General arrangement (diagram or drawing and 1 paragraph of text);
- Dimensions and masses (drawing and/or table);
- Main performance figures (table);
- Main systems description (1 to 2 paragraphs for each, with optional drawing or diagram);
- List of materials and methods of manufacturing (1 paragraph or a list);
- Detailed Special Design Features Description (diagrams and drawings, 2 to 3 paragraphs of text);
- Expected difficulties and criticalities, especially for Special Design Features (3 to 4 paragraphs, risk assessment table);
- Main Risks Assessment (table).

The Design Report's main title is left to the team's discretion, however it shall be subtitled "Team [Your Team ID] Design Report to the [Year] EuRoC". For example, a team assigned the team-ID "12" competing in the 2022 EuRoC, would subtitle their Design Report "Team 12 Design Report to the 2022 EuRoC".

9.4. TECHNICAL REPORT

Each team shall submit a Technical Report which describes their project to the judges, technical evaluation board and competition officials. The Technical Report can be formatted using any style guide.

On or before of a specified date prior to the event, teams shall submit a single digital PDF copy of their Technical Report through the reserved teams' area in the EuRoC website. The Technical Report shall



not exceed 20 Megabytes in size. Teams should also bring at least one hard copy to EuRoC so members of the judging panel and other competition officials may consult the contents at will during interactions with the team.

The Technical Report's main title is left to the team's discretion, however it shall be subtitled "Team [Your Team ID] Technical Report to the [Year] EuRoC". For example, a team assigned the team-ID "12" competing in the 2022 EuRoC, would subtitle their Technical Report "Team 12 Technical Report to the 2022 EuRoC".

The competition officials welcome concise reports, that should not exceed 50 pages, including figures etc. (A4, standard font size 11 in Times New Roman or Arial, line spacing 1.0, standard page margins 2.5 cm). This does not include the Appendices. The Appendices can have additional information but are not necessarily read in detail by the officials, thus teams are highly recommended to maintain it concise as well. Further information is given in Details for the Technical Report, including an overview of the required minimum Technical Report sections and appendices. Additional sections, subsections, and appendices may be added if needed.

9.5. FLIGHT SIMULATION

Each team shall submit an OpenRocket project file of their project with the respective propulsion system and all stages of the flight. The submission shall be done through the reserved teams' area on the EuRoC website, on or before a specified date, prior to the event.

The file must include a detailed model of the rocket, containing every section or component with the exact mass, size and relative position of the real counterparts and it shall be added to the file as an independent object, except for electronic clusters, as it can be represented as one module even if it is made with more than one component. Small components as screws, bolts, etc, should only be accounted as mass.

The recovery systems must be included on the model with the parachutes function, phase of deployment, size, drag coefficient, length and number of lines.

The OpenRocket file shall be named "Team[Your Team ID]_OpenRocketProject_v[Version Number.Revision Number]". For example, a team assigned the team-ID "12", would name their Open Rocker file "Team12_Open RocketProject_v1.02".

A revised OpenRocket file shall be submitted as it is updated, with the corresponding version number:

- If major changes to the project are made, as size and shape drastic changes, the version number increases by 1;
- If minor changes are made, as mass or positioning adjustments, the revision number increases by 0.01.

Note that the first version shall be numbered as v1.00.



The use of a modified version of OpenRocket is allowed and should be sent with the file project. A description of the modification should be submitted as well. For SRAD motors, an .eng file shall be submitted.

Teams can additionally use other software for the simulations which can be submitted as well to be analysed.

9.6. FLIGHT CARD

The Flight Card, together with the Postflight Record, should be filled out by the teams prior to launch (see EuRoC Launch Operations Guide for more information). A template will be made available in the reserved teams' area at the EuRoC website, so the teams know what to expect. However, the officials will hand out printed copies at the event.

9.7. POSTFLIGHT RECORD

The Postflight Record must be filled out by the teams (to the extent they are able to) after the launch and will contain flight information data, such as flight performance and recovery (see EuRoC Launch Operations Guide for more information).

9.7.1. POSTFLIGHT REPORTING OF APOGEE AND RECOVERY

During the Postflight Debriefing (see Section 8.6), teams will need to deliver the Postflight Record, which will among other things include the following information that needs to be passed on to the officials:

- Apogee of the official altitude logging system(s) (see EuRoC Design, Test & Evaluation Guide for more details), to determine the actual apogee above ground level;
- Status of the systems after recovery by showing hardware to officials.

In addition, the teams are asked to upload digital images of the recovered vehicle and components to the website team area, to document the degree of success of the recovery.

Teams shall report in person to competition officials this information after retrieval and return to the designated basecamp area, prior to the end of eligible launch operations on the respective launch day. Only in the special case that recovery operations cannot be concluded during the respective launch day, teams are allowed to provide this information before the end of the respective next eligible launch day. Further information on the official altitude logging system is given in the EuRoC Design, Test & Evaluation Guide.

If telemetry data from the EuRoC official altitude logging system is available, teams may report the apogee revealed in this telemetry to competition officials when a confirmation of nominal ascent and



recovery system deployment event has taken place. This apogee information, provided by the EuRoC telemetry system (and the mandatory GPS tracking system), will be used for scoring only in the event the launch vehicle is not recovered prior to the end of eligible launch operations on the final scheduled launch day.

Telemetry provided apogee information recorded in flight may be utilized in case no apogee data is retrievable from any onboard systems after “landing”. A minimum criterion is however that a GPS lock has been maintained around apogee and that the apogee trajectory is visible in the recorded data.

10. NON-TECHNICAL DELIVERABLES

The following sections define the deliverable materials (e.g., paperwork and presentation materials) competition officials require from teams competing in EuRoC – including each deliverable's format and minimum expected content. All deliverables will be submitted to EuRoC per the instructions provided to the teams. Only correct, complete, and timely submission of deliverables will guarantee that the maximum points possible are achieved in the overall team score (details on the scoring criteria will be uploaded to the reserved teams' area of the EuRoC website in due time).

The scheduled due dates of all required deliverables will be recorded on the EuRoC website.

All non-technical deliverables shall be submitted through the reserved teams' area in the EuRoC website, deliverables submitted by any other means (e.g., email) will not be considered.

10.1. VIDEO PRESENTATION

Each team shall submit on or before a specified date prior to the event a short video presentation via the reserved teams' area in the EuRoC website (alternatively via a link to a file sharing service, if the file is too large), with a duration of no more than 2 minutes, with the purpose of presenting the team and their project. The video can and should include, e.g., pictures or videos of the team history and team members, previous flights, tests, working facilities, hardware, teamwork, successes, and failures, etc.

The Video Presentation file to be submitted shall be named “Team[Your Team ID]_VideoPresentation_[Year]EuRoC”. For example, a team assigned the team-ID “12” competing in the 2022 EuRoC, would name their Video Presentation file “Team12_VideoPresentation_2022EuRoC”.

The video will be displayed on the EuRoC website and social media to showcase the participating teams. The footage submitted can be used by Portugal Space for publicity and marketing purposes.



10.2. PROOF OF INSURANCE

EuRoC is in the process of implementation of a Third-Party General Liability policy to cover Third Party Legal Liability, including property damaged and injuries directly related to the assembly and launch phases of the event. However, in certain cases, teams may receive claims directly or be sue by Third Parties based on their legal liability for damages to persons or properties, directly related to their participation on the event and/or related to the trip. These type of liabilities of the team and of the team members may **NOT** be covered under the organization insurance policies.

Additionally, the team members are subject to accident risks and may suffer personal accidents since they leave from their home countries, during the trip, until their return home.

To be protected against Third Party claims and Personal Accidents, teams can benefit from coverages from their college or university insurances, or the teams can acquire specific insurance covering the entire trip for the purpose of participate on the event.

The Personal Accident insurance, mandatory for all teams, should cover travels and personal injuries (for injuries occurring outside EuRoC).

The Third-Party Liability insurance is highly recommended for all teams, and should provide coverage of potential litigation directly involving the Team or its members.

On or before a specified date prior to the event, teams must submit the Proof of Insurance (e.g., photo/scan/pdf of the insurance policy dated and signed), through the reserved teams' area of the EuRoC website. In case of multiple Proof of Insurance files (e.g., one for each member of the team) the submission shall be done in package format (e.g., zip/rar folder) with the folder named according with "Team[Your Team ID]_Insurance_[Year]EuRoC". For example, a team assigned the team-ID "12" competing in the 2022 EuRoC, would name the Proof of Insurance folder "Team12_Insurance_2022 EuRoC".

10.3. WAIVER AND RELEASE OF LIABILITY FORM

It is mandatory that every individual attending EuRoC – including team members, faculty advisors, and others – signs the Waiver and Release of Liability Form. Individuals who do not sign this form will be unable to participate in any activities occurring at the EuRoC site.

The Waiver and Release of Liability Form can be downloaded on the teams' reserved area of the EuRoC website and must be signed, in handwritten form or digitally (qualified signature). On or before a specified date prior to the event the teams should submit the totality of such documents in a package format (e.g., zip/rar folder) through the reserved teams' area in the EuRoC website, respecting the following file name format "Team[Your Team ID]_Waiver_[Year]EuRoC". For example, a team assigned the team-ID "12" competing in the 2022 EuRoC, would name the Waiver and Release of Liability Form package file "Team12_Waiver_2022EuRoC".



Underaged team members should submit the specific underage version document of the EuRoC Waiver and Release of Liability Form, signed by their guardian.

11. SCORING AND AWARDS

11.1. SCORING CATEGORIES

Teams will be scored in four different scoring categories or areas, which are (1.) the Technical Report, (2.) the Jury Pitch, (3.) the Team Effort, and (4.) the Flight Performance. These are weighted according to the table below.

Table 3: Weight of the scoring categories.

| SCORING CATEGORY | POSSIBLE POINTS | % OF TOTAL POINTS |
|-------------------------|-----------------|-------------------|
| (1.) Technical Report | 200 | 20% |
| (2.) Jury Pitch | 250 | 25% |
| (3.) Team Effort | 200 | 20% |
| (4.) Flight Performance | 350 | 35% |
| TOTAL: | 1000 | 100% |

11.2. COMPETITION CATEGORIES

Teams will compete against all other participating teams in scoring categories (1.), (2.), and (3.). For scoring category (4.) Flight Performance teams will compete against other teams within their respective flight categories (S3, H3, L3, S9, H9, L9) (as defined in Section 2). The summed point score of each team is the sum of all four categories (1–4).

For each individual competition category (1.), (2.), (3.), and flight category (S3, H3, L3, S9, H9, L9), there will be a dedicated winner. The respective competition category winner is the team with the most points in the respective competition category.

Across all competition categories, the points will be added to determine the overall winner of the EuRoC.

Points are awarded according to criteria, weighted individually in each scoring category. Each competition category is also weighed against the other categories.

11.3. AWARDS

The following awards will be given:



- The Technical Award for the best Technical Report;
- The New Space Award for the best Jury Pitch;
- The Team Award for the best Team Effort;
- The six Flight Awards for the winners of the categories (S3, H3, L3, S9, H9, L9) for the respective best flight performance in each of these categories.

For a team to be eligible for any of the awards above, teams must score higher than 50% of the maximum possible points in one respective scoring category and higher than 50% of the maximum possible points of the overall scoring.

For example, a team competing in the S3 category with 100 out of 300 possible points (below 50%) and 700 out of 1000 total possible points (above 50%) will not be eligible for the Flight Award – Solid 3000 metres award due to do not surpassing the necessary minimum of the Flight Performance scoring category.

Another example would be any team competing in the Technical Report category with 250 out of 300 possible points (above 50%) but with 400 out of 1000 total possible points (below 50%) will not be eligible for the Technical Award due to do not surpassing the necessary minimum of the total possible points.

The EuRoC Award will be presented to the overall winner of the EuRoC.

A Payload Award independent from the EuRoC scoring will also be awarded.

A summary of all the awards is given in Table 4.

Table 4: Competition categories and respective awards.

| COMPETITION CATEGORY | CORRESPONDING AWARD |
|-----------------------------|------------------------------|
| (1.) Technical Report | Technical Award |
| (2.) Jury Pitch | New Space Award |
| (3.) Team Effort | Team Award |
| (4.) Flight Performance: S3 | Flight Award – Solid 3000 m |
| (5.) Flight Performance: H3 | Flight Award – Hybrid 3000 m |
| (6.) Flight Performance: L3 | Flight Award – Liquid 3000 m |
| (7.) Flight Performance: S9 | Flight Award – Solid 9000 m |
| (8.) Flight Performance: H9 | Flight Award – Hybrid 9000 m |
| (9.) Flight Performance: L9 | Flight Award – Liquid 9000 m |
| (10.) Overall Winner | EuRoC Award |
| (11.) Best Payload | Payload Award |

The emphasis and focus of each of the awards can be found bellow.



11.3.1. TECHNICAL AWARD

Recognizes the best technical report, displaying the ability to document clearly, correctly, and without unnecessary complication a complex technical system, aided by high quality figures, exhibiting exceptional quality in all formal aspects, making it an enjoyable and enriching read.

11.3.2. NEW SPACE AWARD

Values a positive and dynamic interaction with the jury. Awards the team with the best pitch about themselves, their project, respective vision and mission. It assesses the overall best design implementation, distinguishing the display of high competency in all its characteristics, and based on stringent strategic decisions, provided an exceptional challenge to realise. The jury will expect teams to even go beyond pure rocketry and to be innovative, resourcefulness and agile during all phases of project implementation. Will the teams be able to convince the jury to “hire” them?

11.3.3. TEAM AWARD

Credits the team that has displayed an outstanding effort as working as a unit towards a common goal, by being exceptionally organized, reliable, and prepared in all aspects of the competition, be it deliverables, communication, or operation, and goes above and beyond to display a great sense of team spirit and sportsmanship, either between team members, other teams and organisation officials.

11.3.4. FLIGHT AWARDS

Measures the degree of merit in meters away from the target apogee, but also by the state of the rocket after recovery, and thus honours designs that not only survive the harsh contact with reality, but furthermore represent an incredible achievement in concept, simulation, system integration, control, and practical realisation.

11.3.5. EUROC AWARD

Awarded to the team that has displayed excellence across the board in all aspects of the competition, honouring an overall exceptional and well-balanced effort without cutting back on any of one of the competition aspects, be it technical documentation, jury pitch, team effort, or flight performance, thus identifying a truly remarkable effort and achievement.



11.3.6. PAYLOAD AWARD

The Payload Award seeks to recognize the team with the overall best payload of EuRoC. This award praises innovation and reliability, focusing also on the applicability and impact of the payload on the society, such as if it were to be launched into space. It will be awarded to the most promising payload being only expected high expertise and singular design and implementation results.

The Payload Award is independent from the EuRoC award, meaning that the scoring for this award will not count to the total scoring and hence to the Overall Winner. For more details on the scoring categories please refer to Section 11.1, Table 3.

11.4. GRADING CRITERIA

In each scoring category, a set of grading criteria is established. These criteria will be evaluated by the evaluation team for each team individually. Each grading criterion has several, more detailed, topics that establish what the organisation will look for during the grading process. Details on the grading criteria will be uploaded to the reserved teams' area of the EuRoC website in due time.

11.5. ANNOUNCEMENT OF WINNERS

The competition category winners will be announced at the Award Ceremony. The evaluation team will document their judgement in individual scoring sheets for each team. These will be distributed to the teams after the event to give them feedback regarding strengths and weaknesses in all aspects of their performance in the competition.

11.6. HANDLING OF QUESTIONS AND COMPLAINTS REGARDING SCORING

Teams are welcome to approach the officials to ask for specific, non-binding, oral feedback regarding their perception of the teams' work during all points of the competition to provide the teams with an opportunity to learn and improve.

In the case the teams have more detailed questions or specific complaints regarding the scoring after the scoring has been announced, such as they would like to receive elaborate feedback on a particular aspect of the score for clarification, e.g., to improve upon for the next competition, or if they identify an honest mistake made by the jury, the following process applies:

ONLY the team leader can submit a written feedback request once to info@euroc.pt. Submissions of the feedback are accepted until no later than one week (7days) after official announcement of the score. To keep the workload on the officials to a reasonable amount, teams are asked to limit their



questions PLUS complaints to three in total. Competition officials will then review these three questions and/or complaints and provide written feedback.

If an honest mistake in scoring is apparent, competition officials will review the score provided to the team and decide on a case-by-case basis if and how to account for this, especially and only if this would significantly affect the overall score and placement of the team.

It should be noted that teams are expected not to abuse this possibility of questions and complaints for bagatelle. Officials will not partake in a discussion questioning the evaluation team principal reasoning of the score given.

12. UNRULY BEHAVIOR, DISQUALIFICATION, WITHDRAWAL

12.1. PENALTIES FOR UNSAFE OR UNSPORTSMANLIKE CONDUCT

Teams will be penalized for every instance of unsafe or unsportsmanlike conduct recorded by competition officials (e.g., judges, volunteers, staff members, etc.) depending on the severity of the incident. Unsafe conduct includes, but is not limited to, violating any of the established principles stated on EuRoC documents, failure to use checklists during operations, violating motor vehicle traffic safety rules, and failure to use appropriate personal protective equipment. Unsportsmanlike conduct also includes, but is not limited to, hostility shown towards any EuRoC participant and staff, intentional misrepresentation of facts to any competition official, intentional failure to comply with any reasonable instruction given by a competition official.

12.2. DISQUALIFICATION

A number of criteria constitute grounds for disqualification from consideration for any award and continuation at the competition. These can include a failure to meet the defining EuRoC mission requirements as recorded in this document, failure to submit a Technical Report (or otherwise failing to provide adequate project details in required deliverables), failure to submit duly recognized Waiver and Release of Liability Forms for all team members and failure to send eligible team member representatives to the EuRoC.

Substance abuse and intoxication (or after-effects thereof) during launch operations and purposeful endangering behaviours severely compromising the safety of EuRoC and respective participants will make the entire team immediately and without further warning, eligible for expulsion from the EuRoC event in disgrace.

If one or more members of a team fails to be utterly sober and clear-headed at the beginning of their launch day, this is regarded as outright contempt of the EuRoC spirit and safety guidelines. The consequence is the immediate and irrevocable grounding of the rocket and removal of the team from the EuRoC event.



EuRoC organisers reserve the right to assess any misconduct/mismanagement case by case and to take the necessary proper actions leading to disqualification of specific team members or the entire team.

12.3. WITHDRAWAL FROM COMPETITION

Teams which decide to formally withdraw from the EuRoC at any time prior to the event must send an e-mail entitled "TEAM [Your Team ID] FORMALLY WITHDRAWS FROM THE Competition [Year] EuRoC" to info@euroc.pt. For example, a team assigned the Team ID 12" would withdraw from the 2022 EuRoC by sending an e-mail entitled "TEAM 42 FORMALLY WITHDRAWS FROM THE 2022 EuRoC".



APPENDIX A: ACRONYMS AND ABBREVIATIONS

| | |
|--------|--|
| AA | Actual Apogee |
| AGL | Above Ground Level |
| APCP | Ammonium Perchlorate Composite Propellant |
| APRS | Automatic Packet Reporting System |
| ANAC | Portugal's National Civil Aviation Authority |
| CONOPS | Concept of Operations |
| COTS | Commercial of-the-shelf |
| DTEG | Design, Test and Evaluation Guide |
| EuRoC | European Rocketry Challenge |
| ESRA | Experimental Sounding Rocket Association |
| FDR | Focused Design Review |
| FRR | Flight Readiness Review |
| GNSS | Global Navigation Satellite System |
| GPS | Global Positioning System |
| H | Hybrid |
| HPR | High Power Rocket |
| IREC | Intercollegiate Rocket Engineering Competition |
| L | Liquid |
| LRR | Launch Readiness Review |
| LOX | Liquid Oxygen |
| OR | OpenRocket |
| P | Points |
| RF | Radio Frequency |
| S | Solid |
| SDR | Special Design Review |
| SAC | Spaceport America Cup |
| SRAD | Student Researched & Developed |



| | |
|------------|-----------------------------|
| TA | Target Apogee |
| TBD | To be determined or defined |
| TBR | To be resolved |
| TBC | To be confirmed |
| TEB | Technical Evaluation Board |
| U | Unit, as in Cube-Sat unit |



APPENDIX B: EVENT SESSIONS AND AREAS

Table 5: Event sessions and areas.

| EVENT SESSIONS | |
|-----------------------|--|
| Welcoming Session | <p>With the main purpose of welcoming and acquaint the teams to EuRoC, the Welcoming Session integrates the Check-in and Welcome Briefing.</p> <p>See Sections 5.1.1. and 5.1.2. for more information.</p> |
| Jury Pitch | <p>The Jury Pitch is a dedicated moment where each team performs a pitch to the jury presenting the mission, the vehicle, the team and other relevant points.</p> <p>See Section 5.1.4. for more information.</p> |
| Postflight Debriefing | <p>Debriefing session after recovery of the vehicle, for the officials to record the condition of the vehicle on the Postflight Record.</p> <p>See Section 8.6. for more information.</p> |
| Postflight Highlights | <p>Teams are invited to present their Postflight Highlights, depending on time availability.</p> <p>See Section 5.2.1. for more information.</p> |
| Award Ceremony | <p>During the Award Ceremony the winners of the different universal scoring and flight performance categories will be announced.</p> <p>See Section 11.5. for more information.</p> |
| EVENT AREAS | |
| Paddock | <p>Pre-flight area where teams can work/prepare/test and exhibit their projects prior to launch, as well as get to know the other teams better, socialize, get in touch with the public and do some networking. Each team will have their own private area with the team identification, designated by team's booth.</p> <p>The Welcoming Session, Safety Briefing, Jury Pitch, Flight Readiness Review, Postflight Highlights and the Award Ceremony will take place at the Paddock area.</p> |
| Launch Range | <p>Designated area where the launches will take place.</p> <p>All launches and Launch Readiness Reviews will take place in the Launch Range area.</p> |



| | |
|----------|---|
| PyroShop | The EuRoC area where teams can find all motors and propulsion related items. It will work as a shop, where teams can go and ask for what they need. |
|----------|---|

Note: The event overview is intended to provide the teams with roadmap of what to expect at EuRoC. It should be noted that the specific order and timeline of the different parts of the event are subject to change and will be announced close to the event date.



APPENDIX C: DOCUMENTATION SUMMARY

Table 6: Documentation summary.

| DOCUMENTATION | |
|---|---|
| Entry Form | <p>Online form (to be disclosed on EuRoC website) teams must fill in to apply to EuRoC. Total completeness is required.</p> <p>Details: Online form; submission on EuRoC website.</p> <p>See Section 4.1. for more information.</p> |
| Academic Institution Participation Letter | <p>Letter with all student and advisor teams members to be signed by a senior professor from the academic institution where the students are enrolled.</p> <p>Details: Digital copy in PDF; template on EuRoC website; submission on EuRoC website.</p> <p>See Section 4.3. for more information.</p> |
| Student University Identification | <p>Document proving the team members applying are either currently enrolled in a Bachelor or Master's degree or were matriculated undergraduate or graduate students during the previous year.</p> <p>Details: Digital copy in PDF/PNG/JPEG; submission on EuRoC website.</p> <p>See Section 4.4. for more information.</p> |
| Deposit Fee & Transfer Proof | <p>Refundable deposit fee of 100€ per team member, for teams arriving at the event.</p> <p>Transfer proof, a document proving the transfer of the deposit fee (e.g., photo of the transfer receipt).</p> <p>Details: Digital copy in PDF/PNG/JPEG; submission by email.</p> <p>See Section 4.5. for more information.</p> |
| Technical Questionnaire | <p>Online questionnaire (to be disclosed on EuRoC website) where teams shall fill with technical information regarding their project.</p> <p>Details: Online form; submission on EuRoC website</p> <p>See Section 9.1. for more information.</p> |
| Video Presentation | <p>Video presentation with no more than 2 minutes showcasing team and their project.</p> |



| | |
|--------------------------------------|---|
| | <p>Details: MP4; submission on EuRoC website (teams can submit a file with a link to a file sharing service, if the file is too large).</p> <p>See Section 10.1. for more information.</p> |
| Concept Report | <p>Short report describing the project's concept as preparation for the Concept Review, mandatory for all teams.</p> <p>Details: A4; digital copy in PDF; submission on EuRoC website.</p> <p>See Section 9.2. for more information.</p> |
| Design Report | <p>Report focusing on the project's special design features, as preparation to the Focused Design Review, mandatory only for selected teams.</p> <p>Details: A4; digital copy in PDF; submission on EuRoC website.</p> <p>See Section for more information.</p> |
| Technical Report | <p>Report describing the team's project, to be evaluated by the judges and competition officials. Main source of information in what regards to the projects.</p> <p>Details: A4; bring at least 1 hardcopy; digital copy in PDF; submission on EuRoC website.</p> <p>See Section 9.4. for more information.</p> |
| Flight Simulation | <p>OpenRocket project file containing a highly detailed model of the team's rocket.</p> <p>Details: .ork and .eng file (if applicable), submission on EuRoC website.</p> <p>See Section 9.5. for more information.</p> |
| Proof of Insurance | <p>Document proving the team (all team members) are covered by an insurance policy.</p> <p>Details: Digital copy in PDF/PNG/JPEG; submission on EuRoC website</p> <p>See Section 10.2. for more information.</p> |
| Waiver and Release of Liability Form | <p>Form to be signed by each individual team member (i.e., students and advisors) in order to participate in the event.</p> <p>Individuals not signing the form will be unable to participate in any activities.</p> <p>Details: Digital copy in PDF; template on EuRoC website; submission on EuRoC website.</p> |



| | |
|-----------------------|---|
| | See Section 10.3. for more information. |
| Flight Card | <p>Card to be filled out by the teams with their rocket information. Needs to be signed by the launch pad official to get the GO for launch. Will be handed out by the officials after successful LRR.</p> <p>To be delivered back to the officials together with the Postflight Record.</p> <p>Details: A4; paper copy handed out by EuRoC; template on EuRoC website; submission in person at the event prior to launch.</p> <p>See EuRoC Launch Operations Guide for more information.</p> |
| Postflight Record | <p>Record to be filled out by the teams with flight information (to the extent they are able to). To be delivered to the officials at the Postflight Debriefing.</p> <p>Details: A4; paper copy; template on EuRoC website; submission in person at the event after launch.</p> <p>See EuRoC Launch Operations Guide for more information.</p> |
| Postflight Highlights | <p>Presentation to showcase the highlights, stories, achievements and struggles of the teams.</p> <p>Only teams that show interest will present, depending on time availability.</p> <p>Details: Digital copy in PDF/PPT/MP4/JPG/PNG (if applicable).</p> <p>See Section 5.2.1. for more information.</p> |



APPENDIX D: DETAILS FOR THE TECHNICAL REPORT

D.1. REPORT OUTLINE

For the teams' convenience, an exemplary report outline is included below that should serve as a minimum guideline.

0. Abstract
1. Introduction
2. System Architecture
 - 2.1. Overview
 - 2.2. Propulsion Subsystem
 - 2.3. Aerostructure Subsystem
 - 2.4. Recovery Subsystem
 - 2.5. Payload Subsystem
 - 2.6. Active Flight Control Subsystem (if applicable)
 - 2.7. Special Subsystems (if applicable)
3. Mission Concept of Operations Overview
4. Conclusions and Outlook
 - maximum 50 pages until here, including figures etc. ----
5. Appendices
 - 5.1. System Data
 - 5.2. Detailed Test Reports
 - 5.2.1. Ground Test Demonstration of Recovery System
 - 5.2.2. Flight Test Demonstration of Recovery System (optional)
 - 5.2.3. Static Hot-Fire (SRAD) (if applicable)
 - 5.2.4. Hybrid/Liquid Propellant loading and off-loading (SRAD) (if applicable)
 - 5.2.5. Combustion chamber pressure (SRAD) (if applicable)
 - 5.2.6. Proof Pressure Testing Pressure Vessels (SRAD, Modified COTS) (if applicable)
 - 5.2.7. Burst Pressure Testing Pressure Vessels (SRAD, Modified COTS) (if applicable)
 - 5.2.8. Test of SRAD flight computers with capability of actuating the recovery systems (if applicable)
 - 5.3. Hazard Analysis Report
 - 5.4. Risk Assessment
 - 5.5. Checklists
 - 5.6. Engineering Drawings
 - optional appendices ----
 - 5.7. Subsystem Details (optional)
 - 5.8. Launch Support Equipment Details (optional)
 - 5.9. Detailed Structural and Mechanical Calculation (optional)
 - 5.10. Detailed Logical Process Diagrams (optional)



- 5.11. Detailed Software Architecture (optional)
- 5.12. Detailed Electrical Architecture (optional)
- 5.13. Detailed Hydraulic/Fluid Architecture (optional)

D.2. ABSTRACT

The Technical Report shall contain an Abstract (ca. 1 page), as a stand-alone synopsis of the report. At a minimum, the abstract shall give a brief general description of the launch vehicle, identify the launch vehicle's mission/flight category, identify any unique/defining design characteristics of launch vehicle (e.g., propulsion, number of stages, active control feature, innovative features, etc.), define the payload's mission (if applicable), and provide whatever additional information may be necessary to convey any other high-level project or program goals & objectives.

Keywords: *vehicle description, mission, flight category, design characteristics, payload, special features*

D.3. INTRODUCTION

The Technical Report shall contain an Introduction. This section provides an overview of the academic program, stakeholders, team structure, and team management strategies, the team vision, major suppliers and partners, major technical challenges, and other characteristics and team-defining information. The introduction may repeat some of the content included in the abstract, because the abstract is intended to act as a standalone synopsis if necessary.

Keywords: *academic programme, stakeholders, team, experience, vision, strategy, suppliers, partners, technical challenges*

D.4. SYSTEM ARCHITECTURE

The Technical Report shall contain a section on the System Architecture. This section shall begin with a top-level overview of the integrated system, including a cutaway figure depicting the fully integrated launch vehicle and its major subsystems – configured for the mission being flown in the competition. These subsystems are then explained in the subsequent sections, while more extensive details should be moved to the appendices.

- **Overview**

Keywords: *general introduction, vehicle cutaway, cross-section, system diagram, subsystems, interfaces, electrical and software system diagram*



- **Propulsion Subsystem**
Keywords: engine design, propellants, total impulse, arming, ignition, overview of propulsion tests, fluid system diagram, nominal pressures, SRAD tanks, SRAD valves
- **Aerostructure Subsystem**
Keywords: motor retention, thrust structure, staging separation, mechanical connections, flanges, design assumptions, expected forces, overview of structural tests, key results mechanical/structural analyses
- **Recovery Subsystem**
Keywords: initial deployment event(s), main deployment event(s), parachute, drogue, activation devices, parachute lines, swivel links, parachute coloration, redundant electronics, safety critical wiring, stored energy devices, SRAD pressure vessels, overview of recovery system tests
- **Payload Subsystem**
The extent and detail of this section depend on the type of payload. This section can be very brief in the case of a mere dummy payload, and more elaborate for a functional or deployable payload.
Keywords: mass, form factor, removal, functionality, experiment, power/energy, interface, deployment, recovery, data output, dissemination of results
- **Active Flight Control Subsystem** (if applicable)
Here, any safety, abort, control, or other systems capable of actively affecting the in-flight trajectory shall be described.
- **Special Subsystems** (if applicable)

D.5. MISSION CONCEPT OF OPERATIONS

The Technical Report shall contain a Mission Concept of Operations (CONOPS) Overview. This section shall identify the mission phases and describe the nominal operation of all subsystems during each phase (e.g., a description of what is supposed to be occurring in each phase, and what subsystems are responsible for accomplishing this). Furthermore, this section shall define what mission events signify a phase transition has occurred (e.g., "Ignition" may begin when a FIRE signal is sent to the igniter and conclude when the propulsion system comes up to chamber pressure. Similarly, "Lift-off" may begin at vehicle first motion, and conclude when the vehicle is free of the launch rail). Phases and phase transitions are expected to vary from system to system based on specific design implementations and mission goals & objectives. No matter how a team defines these mission phases and phase transitions, they will be used to help organize failure modes identified in the Risk Assessment Appendix.

To describe the phases, teams should include a figure of the flight trajectory (based on 3D calculation), expected point of descend for different expected wind situations, propulsion thrust curve, predicted apogee, aerodynamic stability over velocity/mission time, position of centre of gravity, position of



centre of pressure over mission time, velocity, acceleration, descent rates at recovery events initiation, and descent rates with drogue/main parachute.

Keywords: main logic for arming/ignition/stage separation/deployment events, trajectories, influence of wind, propulsion thrust curve, predicted apogee, aerodynamic stability, centre of gravity, centre of pressure, velocity, acceleration, descent rates

D.6. CONCLUSIONS AND OUTLOOK

The main part of the Technical Report shall close with the conclusions and outlook. Here, a summary should be given of the main achievements, reflections on the overall project outcome, lessons learned, way forward, remaining design challenges, areas for improvement. Lessons learned can span the areas of design, manufacturing, and testing of the project, both from a team management and technical development perspective.

Keywords: achievements, reflections, project outcome, lessons learned, way forward, remaining design challenges, areas for improvement

D.7. SYSTEM DATA

The first Technical Report appendix shall contain vehicle and system data such as System Weights, Measures, and Performance Data in a TABULAR MANNER. Technical data for electronics systems, stand-by time, telemetry system (frequencies, RF-power, range, antenna system, data rate, etc.), shall be included too, if applicable.

Keywords: Weights, Measure, Performance Data

D.8. PROJECTS AND TEST REPORTS APPENDIX

The second Technical Report appendix shall contain applicable Test Reports from the minimum tests prescribed in the EuRoC Design, Test & Evaluation Guide. These reports shall appear in the following order. In the event any report is not applicable to the project in question, the team will include a page marked "THIS PAGE INTENTIONALLY LEFT BLANK" in its place.

- Recovery System Testing: In addition to descriptions of testing performed and the results thereof, teams shall include in this appendix a figure and supporting text describing the dual redundancy of recovery system electronics. Ground testing of the recovery system is mandatory, while flight testing is optional.
- SRAD Propulsion System Testing (if applicable): Descriptions of testing performed and the results thereof, including propellant loading and off-loading.



- SRAD Pressure Vessel Testing (if applicable).
- SRAD flight computers with the capability of actuating the recovery system(s) shall be suitably tested and the results documented and included in the Technical Report. The entire chain of equipment and signals, from SRAD flight computer to recovery system actuators shall be tested under representable conditions, to the extent possible. Vacuum chambers are recommended for barometric pressure sensors and emulated IMU data is recommended for IMU sensors, and so forth.

D.9. HAZARD ANALYSIS APPENDIX

The third Technical Report appendix shall contain a Hazard Analysis Report. This appendix shall address as applicable, hazardous material handling, transportation and storage procedures of propellants, and any other aspects of the design which pose potential hazards to operating personnel. A mitigation approach – by process and/or design – shall be defined for each hazard identified.

D.10. RISK ASSESSMENT APPENDIX

The fourth Technical Report appendix shall contain a Risk Assessment. This appendix shall summarize risk and reliability concepts associated with the project. All identified failure modes which pose a risk to mission success shall be recorded in a matrix, organized according to the mission phases identified by the CONOPS. A mitigation approach – by process and/or design – shall be defined for each risk identified.

A common description of the Risk Assessment is FMECA (Failure Mode and Effect Criticality Analysis). A risk assessment/FMECA is often represented as a spreadsheet matrix. The input to the matrix is listed as follows:

- A description of the identified failure mode;
- The likelihood of the failure mode occurring;
- The severity and impact of the failure mode occurring.

The likelihood of a failure mode occurrence and the severity of the occurrence is assigned values according to the following tables:

Table 7: Likelihood of failure.

| FAILURE PROBABILITY | VALUE | ASSESSMENT OF RISK |
|---------------------|-------|----------------------------|
| Remote | 1 | This is unlikely to happen |
| Occasional | 2 | This might happen |
| Probable or likely | 3 | This is likely to happen |



Table 8: Severity of occurrence.

| MISHAP SEVERITY | VALUE | EFFECT OF FAILURE MODE |
|---------------------|-------|---|
| Minor or negligible | 1 | Minor impact on mission |
| Critical | 2 | Deterioration of performance and mission |
| Catastrophic | 3 | Safety hazard and/or likely loss of mission |

The "Criticality Ranking" is the product of the Failure Probability and the Mishap Severity. The criticality rating is a measure of how urgent and how severe mitigation actions will have to be taken, to reduce the Criticality Ranking.

Table 9: Criticality ranking.

| CRITICALITY RANKING (PRODUCT) | OVERALL IMPACT | SEVERITY OF NEED FOR ATTENTION/MITIGATION |
|-------------------------------|----------------|---|
| 1 | Minor | This failure mode is not a concern |
| 2 | Minor | This failure mode is of very minor concern |
| 3 | Medium | Justification needed. Jury may decide to review |
| 4 | High | Technical jury approval needed before launch |
| 6 | Critical | Action required to reduce ranking before launch |
| 9 | Critical | Action required to reduce ranking before launch |

The output of the matrix is highlighting and ranking failure mode liabilities to the mission, and the justifications and mitigations to reduce the Criticality Ranking. A typical FMECA scaled for the complexity of launch vehicles attending EuRoC should feature no less than 25 identified, ranked, commented, and justified failure modes – these should address at the minimum all important and critical failure modes. An illustrating excerpt is given below:

Table 10: Risk matrix.

| FAILURE MODE | MISSION PHASE | FAILURE PROBABILITY | MISHAP SEVERITY | CRITICALITY RANKING | TEAM'S COMMENTS AND JUSTIFICATION |
|----------------------------------|-------------------------------|---------------------|-----------------|---------------------|---|
| Fin flutter causing fin failure | Ascent phase | 2 | 3 | 6 | Fin-to-fuselage bonding not convincing. Glass fibre reinforcements will be added before launch. |
| Ignition failure | Ignition phase | 1 | 1 | 1 | COTS solid motor with COTS igniter is highly reliable and consequences of a misfire are very minor. |
| Pilot parachute ejection failure | Apogee/pilot chute deployment | 1 | 3 | 3 | Pilot chute system is flight proven on earlier missions. Deployment failure is however |



| | | | | | |
|---|---------------------|-------|-------|-------|--|
| | | | | | catastrophic. Packing procedure developed. |
| Vehicle leaves launch ramp at wrong angle | Ascent phase | 1 | 3 | 3 | Leaving the launch rail on a wrong trajectory is a severe safety hazard. Calculated vehicle velocity at top of launch rail is confirmed very high. |
| [some new cool feature...] | [some flight phase] | 2 | 2 | 4 | A mishap of this new cool feature may lower apogee and this feature has not been flight tested before. |
| | | | | | |
| | | | | | |

All identified failure modes must be reduced to a Criticality Ranking of 4 or less in order to successfully pass the Flight Readiness Review and obtain a flight status of Provisional or better.

D.11. ASSEMBLY, PRE-FLIGHT, AND LAUNCH CHECKLISTS APPENDIX

The fifth appendix to the Technical Report shall contain Assembly, Pre-flight, and Launch Checklists. This appendix shall include detailed checklist procedures for final assembly, arming, and launch operations. Furthermore, these checklists shall include alternate process flows for dis-arming/safe-ing the system based on identified failure modes. These off-nominal checklist procedures shall not conflict with the EuRoC Range Standard Operating Procedures. Teams developing SRAD hybrid or liquid propulsion systems shall also include in this appendix a description of processes and procedures used for cleaning all propellant tanks and other fluid system components.

Competition officials will verify teams are following their checklists during all operations – including assembly, pre-flight, and launch operations. Therefore, teams shall maintain a complete, hardcopy set of these checklist procedures with their flight hardware during all range activities.

D.12. ENGINEERING DRAWINGS APPENDIX

The sixth Technical Report appendix shall contain Engineering Drawings. This appendix shall include any revision controlled technical drawings necessary to define significant subsystems or components – especially SRAD subsystems or components.



D.13. OPTIONAL APPENDICES

Other optional appendices can include, but are not limited to further Subsystem Details, Launch Support Equipment Details, Detailed Structural and Mechanical Calculation, Detailed Logical Process Diagrams, Detailed Software Architecture, Detailed Electrical Architecture, and Detailed Hydraulic/Fluid Architecture. Teams are recommended to keep concise any additional appendices.