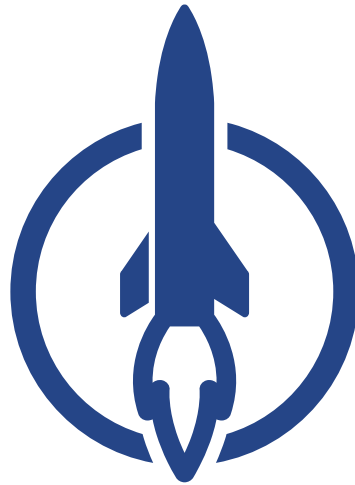


# EUROPEAN ROCKETRY CHALLENGE

## *RULES & REQUIREMENTS*



# EUROC

EUROPEAN ROCKETRY CHALLENGE

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# 1. INTRODUCTION

## 1.1. BACKGROUND

The Portuguese Space Agency organizes EuRoC – European Rocketry Challenge, 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 the Portuguese Space Agency, 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, the growth of the competition within Europe has been visible, and especially within Portugal, with an increasing number of interested teams applying to the competition. For the future, it is the Portuguese Space Agency’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 the Portuguese Space Agency. The Portuguese Space Agency reserves the right to change the EuRoC requirements and procedures at its discretion and at any time, including during the event.

## 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	<a href="http://www.euroc.pt">http://www.euroc.pt</a>
EuRoC Design, Test & Evaluation Guide	<a href="http://www.euroc.pt">http://www.euroc.pt</a>
EuRoC Entry Form	<a href="http://www.euroc.pt">http://www.euroc.pt</a>
EuRoC Academic Institution Participation Letter	<a href="http://www.euroc.pt">http://www.euroc.pt</a>
EuRoC Motors List	<a href="http://www.euroc.pt">http://www.euroc.pt</a>
EuRoC COTS Motors Acquisition Guide	<a href="http://www.euroc.pt">http://www.euroc.pt</a> (Teams’ Reserved Area)
EuRoC Technical Questionnaire	<a href="http://www.euroc.pt">http://www.euroc.pt</a> (Teams’ Reserved Area)
EuRoC Launch Operations Guide	<a href="http://www.euroc.pt">http://www.euroc.pt</a> (Teams’ Reserved Area)
EuRoC Waiver and Release of Liability Form	<a href="http://www.euroc.pt">http://www.euroc.pt</a> (Teams’ Reserved Area)
EuRoC Flight Card and Postflight Record	<a href="http://www.euroc.pt">http://www.euroc.pt</a> (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 of 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 altitude 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. If teams wish to change their proposed propulsion category (S/H/L and/or COTS/SRAD), a case-by-case review and EuRoC approval is required.

EuRoC reserves the right to change the category in which a project is initially entered based on the design presented (between COTS and SRAD, between 9000 m to 3000 m, or between S/H/L).

EuRoC reserves the right to remove projects and/or teams from the competition at any point (starting from the moment of application) due to safety concerns.

## 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. EuRoC organisation will only directly contact the team leader, as such, the team leader must be the single point of contact (PoC) with the EuRoC organisation; the designated PoC must be always reachable during the event. 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 competing at EuRoC will be limited.

## **3.2. SUBMISSION LIMITATIONS**

Each team may enter only 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/university.

# **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 a limited number of participating teams from all applicants. Thus, teams 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. 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 EuRoC need only to write one participation letter, covering all the 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 mentioning only the members enrolled in that same institution (i.e., each academic institution participation letter shall include only the members part of that same institution and not all the team members).

The Academic Institution Letter template is available for download on the EuRoC website. When submitting the Entry Form, on the EuRoC website, teams shall submit digital, PDF copy(s) of their signed participation letter(s), on the respective field.

**Note:** The Academic Institution Participation Letter shall only contain the team members to be present at the event.

## 4.4. STUDENT UNIVERSITY IDENTIFICATION

Each team shall submit copies of documents proving that all team members to be present at the event 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 only one of the above documents. The documents should preferably be written in English.

When submitting the entry form, the document from each individual team member to be present at the event shall follow the filename format “First Name Last Name” and the totality of the documents must be submitted in a package format (e.g., zip/rar file), on the respective field. Teams must ensure that the identification documents submitted correspond to the names present in the Academic Institution Participation Letter.

## 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 competing at 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 application process. Proof of the transfer (e.g., scan/photo/PDF of the transfer receipt) with clear identification of the team making the deposit and the bank account info (i.e., IBAN and swift code) for refund purposes, will be required. All teams admitted to the event will receive an info email containing all the necessary information.

The latest date for withdrawal from the competition will be the date the Technical Questionnaire is due, as will be announced by the organisers.

After this date, if a team accepted, registered, and confirmed as a participating team at EuRoC, withdraws, gets disqualified, arrives late or does not compete at the event, 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 all 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 on 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 organisers shall be notified, via e-mail (info@euroc.pt), 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. SAFETY BRIEFINGS**

The safety briefings will be given by EuRoC officials to all team members. Attendance is mandatory for all team members and advisors, without exception.

### **5.1.3. FLIGHT READINESS REVIEW**

Review done at the paddock by the Technical Evaluation Board in order to get the clearance to transfer the vehicle to the launch site.

### **5.1.4. LAUNCH READINESS REVIEW**

Review to be performed at the launch site in order to be granted permission to proceed to the launch pad.

### **5.1.5. POSTFLIGHT REVIEW**

Review session after recovery of the vehicle for the EuRoC officials to assess the condition of the vehicle. This review will serve as baseline for the filling out of the Postflight Record recovery related fields and for the evaluation team to score the success of the recovery operation (see Section 8.5 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

Teams are invited to present their postflight highlights. This moment is meant to provide an opportunity to showcase some lessons learned and 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 overly 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-second. 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, EuRoC officials will provide a list of motors that will be available for the competing teams. It is compiled in conjunction with European suppliers and will contain a range of motors from known manufacturers available on the market. Only COTS motors from the motors list and ordered via the official suppliers are permitted.

The procedure for the acquisition of COTS motors via the EuRoC official suppliers can be found in the COTS Motors Acquisition Guide, which will be made available before the event, in due time.

### 6.3. SRAD MOTORS

SRAD motors are subject to the detailed requirements listed in the EuRoC – Design, Test & Evaluation Guide. SRAD motors shall 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.

EuRoC reserves the right to remove projects and/or teams from the competition at any point (starting from the moment of application) due to safety concerns.

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  $N_2O_4$ ). Home-made propellant mixtures containing any fraction of toxic propellants are also prohibited.

Industrial bottled liquid/gas propellants (e.g., nitrous oxide, liquid oxygen, nitrogen, etc.) and propellants that cannot be imported to Portugal according to Portuguese regulations must be acquired through EuRoC, under no circumstances will a team be allowed to bring their own propellants. Propellants that do not require special transportation (i.e., without classification of dangerous goods) and that are permitted entrance in Portugal (e.g., alcohol, paraffin wax, demineralized water, etc.) are of the teams' responsibility.

Teams must be aware that the industrial bottle interface fittings available at EuRoC, 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 for having all the necessary equipment on site (e.g., cooling chamber, thermal protection, etc.).

Teams competing with SRAD solid motors can find more information on the EuRoC Launch Operations Guide. 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, described in the next sections.

## 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 8-9 m/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.

**Note:** In case of approval of a payload which does not fulfil the payload form factor, there will be a negative impact on the payload's score, since despite being approved by the organisation it is still not compliant with the EuRoC requirements established in this document.

## 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 will be done 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.

**Note:** If a payload does not fulfil the payload required mass, there will be a negative impact on the payload's score.

## 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. In case of doubts or concerns on hazardous materials, teams should consult the European Chemicals Agency (ECHA) database (<https://echa.europa.eu/information-on-chemicals/cl-inventory-database>).



In case of payloads with potential biohazards such as seeds or living beings, those must not contain for invasive species. For more information on the invasive species both plantae and animalia in Portugal, teams should refer to the following:

- Plants/seeds: <https://invasoras.pt/en/invasive-species-in-portugal>;
- Global Register of Introduced and Invasive Species: <https://griis.org/view-checklist?id=4f94d674-5a95-4c2c-9213-54881beed63a>.

Furthermore, in the documentation submitted to EuRoC teams shall specify the scientific name of the species and not only the generic name. The EuRoC organisation reserves the right to prohibit the deployment of payloads in case of safety concerns.

The use of radioactive materials shall not be permitted.

## 8. TECHNICAL REVIEW PROCESS

The Technical Review Process (see Figure 1) has the goal to ensure vehicle safety, maximize the chances of a successful launch and recovery, and to improve the learning experience for the teams. All teams are advised to use these moments to ask technical questions and discuss with the EuRoC officials their choices and design process.

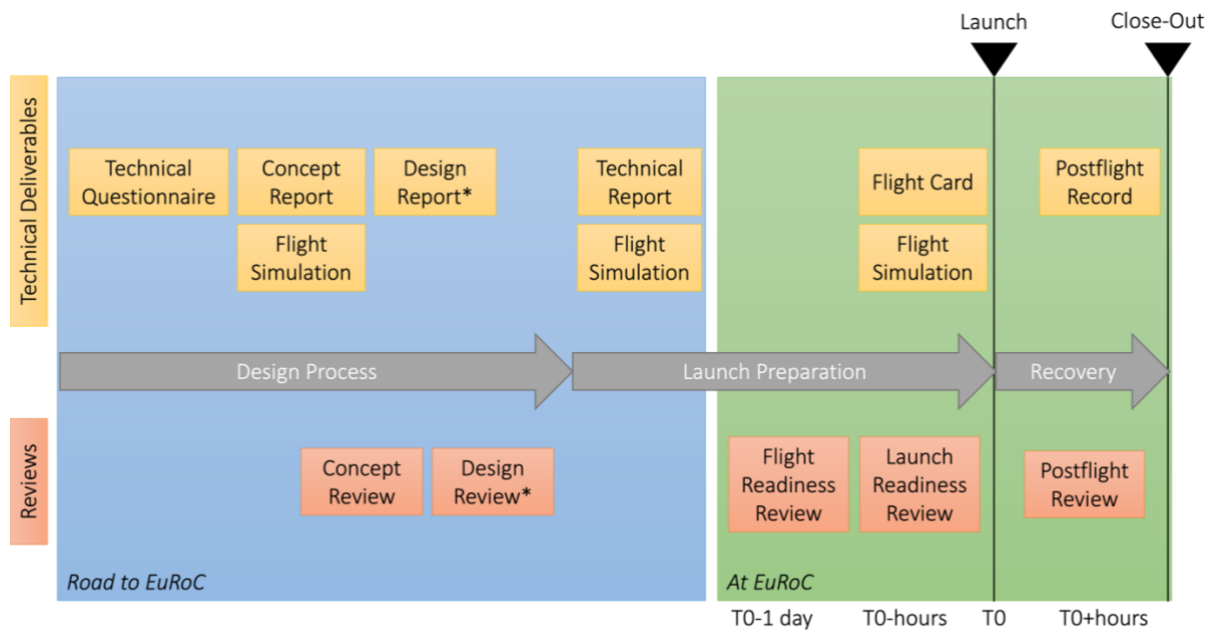
The process includes the following steps:

1. Concept Review;
2. 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;
2. Concept Report;
3. Design 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.



\* Only for certain teams, as determined at the Concept Review

Figure 1: Technical review process.

## 8.1. CONCEPT REVIEW

For a first overview of the vehicle at an early point before the competition, a 30-minute Concept Review (CR) will be held virtually. 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 of 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.

## 8.2. DESIGN REVIEW

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

The DR will be held virtually, with the team leader 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 DR causes unplanned delays, potentially jeopardizing a team's readiness for the event.

Any design feature from the following (non-exhaustive) qualifies for a DR:

- 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.

### 8.3. FLIGHT READINESS REVIEW

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's area and go through a detailed Flight Readiness Review checklist 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 (i.e., 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 EuRoC officials during LRR.

The FRR will usually take place the day before the launch at the paddock teams' area. Teams should ensure that the vehicle is in a 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 inspect all subsystems. In addition to the vehicle, any SRAD ground support equipment (e.g., mission control consoles, propellant loading equipment, etc.), shall be available for inspection during the FRR. Team-provided launch rails may be inspected at the launch site instead, rather than at the FRR.

## 8.4. LAUNCH READINESS REVIEW

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

- 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 team 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. Teams should ensure that the vehicle is in an LRR-ready state as early as possible during launch day, meaning that the vehicle is in a safed state and assembled as much as possible. Teams should provide evidence that action items given at the FRR have been closed. For most (minor) action items pictures and videos suffice as proof, especially if otherwise an assembly of the vehicle would be unreasonably delayed.

## 8.5. POSTFLIGHT REVIEW

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

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 EuRoC official altitude logging system and note the touchdown coordinates if available. With this, the launch activities are concluded. Teams shall upload all the required data, specified on the Postflight Record, to the reserved team’s area in the EuRoC website.

## 9. TECHNICAL DELIVERABLES

All technical deliverables shall be submitted through the reserved teams' area in the EuRoC website, or other means clearly specified, deliverables submitted by any other means than the ones specified will not be considered.

### 9.1. TECHNICAL QUESTIONNAIRE

On or before a specified date prior to the event each team shall fill 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);
- 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 and 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 202X EuRoC, would subtitle their Concept Report "Team 12 Concept Report to the 202X EuRoC".

The Concept Report's filename shall follow the format "Team[Your Team ID]\_ConceptReport\_v[Version Number]. For example, a team assigned the team ID "12", would name their Concept Report file "Team12\_ConceptReport\_v1".

### 9.3. DESIGN REPORT

The selected teams that need to participate in the 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. The Design Report should reflect the advanced status of the design close to the competition. Furthermore, teams should emphasise on the respective special design feature(s) that will be in the spotlight at the Design Review and previously mentioned in the Concept Review by the officials.

- Concept of Operations (1 diagram of the main operations stages, plus a brief text description);
- 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 202X EuRoC, would subtitle their Design Report "Team 12 Design Report to the 202X EuRoC".

The Design Report's filename shall follow the format "Team[Your Team ID]\_DesignReport\_v[Version Number]. For example, a team assigned the team ID "12", would name their Design Report file "Team12\_DesignReport\_v1".

### 9.4. TECHNICAL REPORT

Each team shall submit a Technical Report which describes their project to the 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. Teams should also bring at least one hard copy to EuRoC so competition officials may consult the contents at will during interactions with the team.

The competition officials welcome concise reports, that **shall 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 them concise as well**. Further information is given in Appendix D, including an overview of the required minimum Technical Report sections and appendices. Additional sections, subsections, and appendices may be added if needed.

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 202X EuRoC, would subtitle their Technical Report "Team 12 Technical Report to the 202X EuRoC".

The Technical Report's filename shall follow the format "Team[Your Team ID]\_TechnicalReport\_v[Version Number]". For example, a team assigned the team ID "12", would name their Technical Report file "Team12\_TechnicalReport\_v1".

## 9.5. FLIGHT SIMULATION

Each team shall submit a RocketPy simulation (.py, .ipynb or .m file) of their project with the respective propulsion system, aerodynamic coefficients, and all stages of the flight. The simulation file should use the latest RocketPy version and should run in the latest Python version.

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. For SRAD motors, an .eng file shall be submitted. The recovery systems must be included on the model with the parachutes trigger function, phase of deployment, size, and drag coefficient. Deployable payloads should also have its parachutes modelled. For active controlled systems (e.g., air brakes, parafoils, canards, etc.) teams shall provide the corresponding control algorithms.

Teams are required to submit a preliminary flight simulation with the Concept Report, an updated simulation with the Technical Report and to provide any updated simulation since the delivery of the Technical Report up to the event. During the event teams shall keep EuRoC simulations team updated of any change with impact in the flight simulation results.

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 RocketPy simulation file shall be named "Team[Your Team ID]\_RocketPy\_v[Version Number]". For example, a team assigned the team ID "12", would name their RocketPy file "Team12\_RocketPy\_v1".

RocketPy is an open-source software that can be found at [rocketpy.org](https://rocketpy.org) where different tutorials are also available. In case of any issues with the software, teams can contact the RocketPy developers on the official discord server or via e-mail at [rocketpyteam@gmail.com](mailto:rocketpyteam@gmail.com).

The use of a modified version of RocketPy is allowed and should be sent with the file project. A description of the modification should be submitted as well.

Teams can additionally use other software for the simulations which can be submitted as well to be analysed. All information used to simulate the rocket in other software should be provided, ensuring that the simulation can be reproduced after submission.

## 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 Review (see Section 8.5), 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, teams are asked to upload digital images of the recovered vehicle and components to the EuRoC website reserved teams' 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 system 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.

Teams shall upload all the required flight data, specified on the Postflight Record (i.e., altitude logging data, tracking data, flight simulation data and payload data), to the reserved team’s area in the EuRoC website, until 23h59 of the respective launch day.

## 10. NON-TECHNICAL DELIVERABLES

The following sections define the deliverable materials competition officials require from teams competing in EuRoC – including each deliverable's format and minimum expected content. Only correct, complete, and timely submission of deliverables will guarantee that the maximum points possible are achieved in the overall team score.

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, 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 should preferably be recorded vertically in order to better fit the social media content format.

The video shall be accompanied by a short team bio (maximum 300 characters) in a document format (e.g., word, PDF or .txt) to be uploaded alongside the video presentation through the reserved teams’ area of the EuRoC website.

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 202X EuRoC, would name their Video Presentation file “Team12\_VideoPresentation\_202XEuRoC”.

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

**Note:** If the video file is too large and compression would lead to a decrease in the video quality, teams shall upload to the reserved teams' area a document (e.g., word, PDF or .txt) with a link to a file sharing service for the EuRoC officials to download the video.

## 10.2. PROOF OF INSURANCE

Personal accident insurance is mandatory for all teams. It should cover travels and personal injuries, since 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.

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. In certain cases, teams may receive claims directly or be sued 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.

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.

On or before a specified date prior to the event, teams shall 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), each individual filename must follow the format "First Name Last Name" of the team member and the overall 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 202X EuRoC, would name the proof of insurance folder "Team12\_Insurance\_202X 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 teams shall submit the waiver and release of liability form of each individual team member with the filename in accordance with "First Name Last Name" and 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 filename format "Team[Your Team

ID]\_Waiver\_[Year]EuRoC". For example, a team assigned the team ID "12" competing in the 202X EuRoC, would name the waiver and release of liability form package file "Team12\_Waiver\_202XEuRoC".

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

## 10.4. FINAL TEAM COMPOSITION

Between the application process and the event slight changes may happen in the team composition. As such, on or before a specified date prior to the event, teams will be required to submit the final team composition document with all the team members to be present at the event and their respective contact information. A template will be made available on the teams' reserved area of the EuRoC website. For any new members not previously stated in the Academic Institution Participation Letter it will be necessary to submit their respective student university identification files.

Teams shall ensure that there is a direct correspondence between the team members stated on the final team composition and members for which the proof of insurance and waiver and release of liability form are submitted.

The student university identification must follow the previously specified filename format (see Section 4.4) while the final team composition file shall be named according with "Team[Your Team ID]\_FinalComposition\_[Year]EuRoC". For example, a team assigned the team ID "12" competing in the 202X EuRoC, would name the final team composition file "Team12\_FinalComposition\_202X EuRoC".

## 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 Vehicle Design, (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.) Vehicle Design	250	25%
(3.) Team Effort	200	20%
(4.) Flight Performance	350	35%
<b>TOTAL:</b>	<b>1000</b>	<b>100%</b>

## 11.2. COMPETITION CATEGORIES

Teams will compete against each other 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).

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

The total score of each team is the sum of their points in all four categories (1–4). The team with the highest score is overall winner of 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 Design Award for the best Vehicle Design;
- 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 that 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 awarded 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.) Vehicle Design	Design 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 below.

### **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. DESIGN AWARD**

Honours the overall best vehicle design, which displays a high competency in all its characteristics, is based on stringent strategic decisions, provided an exceptional challenge to realise, and might even go beyond pure rocketry to put special attention towards its innovation.

### **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, vehicle design, 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.

### **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](mailto:info@euroc.pt). Submissions of the feedback are accepted until no later than one week (7 days) 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 202X EuRoC by sending an e-mail entitled "TEAM 42 FORMALLY WITHDRAWS FROM THE 202X EuRoC".



## APPENDIX A. ACRONYMS AND ABBREVIATIONS

<b>AGL</b>	Above Ground Level
<b>APCP</b>	Ammonium Perchlorate Composite Propellant
<b>CONOPS</b>	Concept of Operations
<b>COTS</b>	Commercial of-the-shelf
<b>CR</b>	Concept Review
<b>DR</b>	Design Review
<b>DTEG</b>	Design, Test and Evaluation Guide
<b>ECHA</b>	European Chemicals Agency
<b>EuRoC</b>	European Rocketry Challenge
<b>FRR</b>	Flight Readiness Review
<b>GPS</b>	Global Positioning System
<b>H</b>	Hybrid
<b>L</b>	Liquid
<b>LRR</b>	Launch Readiness Review
<b>LOX</b>	Liquid Oxygen
<b>PoC</b>	Point of Contact
<b>RF</b>	Radio Frequency
<b>S</b>	Solid
<b>SRAD</b>	Student Researched & Developed
<b>TEB</b>	Technical Evaluation Board
<b>U</b>	Unit, as in Cube-Sat unit

## APPENDIX B. EVENT SESSIONS AND AREAS

*Table 5: Event sessions and areas.*

EVENT SESSIONS	
Check-in	<p>With the main purpose of team registration, receive event badges, and set up in each respective area.</p> <p>See Section 5.1.1 for more information.</p>
Postflight Review	<p>Review after recovery of the vehicle, for the officials to record the condition of the vehicle on the Postflight Record.</p> <p>See Section 8.5 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, 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	<p>The EuRoC area where teams can find and acquire pyrotechnic related items.</p>

**Note:** The event overview is intended to provide the teams with a 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 closer to the event.

## 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.</p> <p>See Section 4.1 for more information.</p>
Academic Institution Participation Letter	<p>Letter with all team members (students + advisors) 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 the respective Entry Form field.</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's 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 the respective Entry Form field.</p> <p>See Section 4.4 for more information.</p>
Deposit Fee & Proof of Transfer	<p>Refundable deposit fee of 100€ per team member, for teams competing at the event.</p> <p>Proof of Transfer: 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) that teams shall fill-in with technical information regarding their project.</p> <p>Details: Online form.</p> <p>See Section 9.1 for more information.</p>
Video Presentation	<p>Video presentation with no more than 2 minutes showcasing the team and respective project accompanied by a team/project short bio.</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). Short bio in PDF, word or .txt format.</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 9.3 for more information.</p>
Technical Report	<p>Report describing the team's project, to be evaluated by the competition officials. Main source of information in what regards the project.</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>RocketPy simulation file containing a highly detailed model of the team's rocket.</p> <p>Details: .py, .ipynb or .m 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) is 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.
Final Team Composition	<p>Excel file with the team members to be present at the event and their respective contact information.</p> <p>Details: excel file; template on EuRoC website; submission on EuRoC website.</p> <p>See Section 10.4 for more information.</p>
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

### D1. 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. Launch Support Equipment
    - 5.6.1. Launch Support Equipment list
    - 5.6.2. Launch Support Equipment simple operational manual
    - 5.6.3. Launch Support Equipment details
      - 5.6.3.1. Detailed Structural and Mechanical Calculation
      - 5.6.3.2. Detailed Logical Process Diagrams
      - 5.6.3.3. Detailed Software Architecture
      - 5.6.3.4. Detailed Electrical Architecture
      - 5.6.3.5. Detailed Hydraulic/Fluid Architecture
  - 5.7. Engineering Drawings

---- optional appendices ----

## 5.8. Subsystem Details (optional)

### D2. 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*

### D3. 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*

### D4. 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)

## D5. 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 D10.

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*



## D6. 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*

## D7. 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*

## D8. 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.

## D9. 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.

## D10. 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 Risk Assessment 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.

## **D11. 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.

## **D12. 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.

## **D13. 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.