



PORTUGUESE  
SPACE AGENCY



# EUROPEAN ROCKETRY CHALLENGE

## COMPETITION RULES

|                   |                         |
|-------------------|-------------------------|
| <b>Reference:</b> | PTS_EDU_EuRoC_ST_001905 |
| <b>Issue:</b>     | 1.1                     |
| <b>Date:</b>      | 30/04/2026              |
| <b>Status:</b>    | Approved                |

## APPROVAL

|                      |                                                                                       |             |
|----------------------|---------------------------------------------------------------------------------------|-------------|
| <b>Title</b>         | EuRoC Competition Rules                                                               |             |
| <b>Issue</b>         | 1.1                                                                                   |             |
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## CHANGE LOG

| Reason for Amendment                                          | Issue | Date       |
|---------------------------------------------------------------|-------|------------|
| First issue based on the previous EuRoC Rules & Requirements. | 1.0   | 07/03/2025 |
| Revised issue with small amendments for EuRoC 2026.           | 1.1   | 30/04/2026 |

## CHANGE RECORD

| Reason for Amendment                                          |     | Pages       | Paragraph(s) |
|---------------------------------------------------------------|-----|-------------|--------------|
| <b>Issue</b>                                                  | 1.0 | <b>Date</b> | 07/03/2025   |
| First issue based on the previous EuRoC Rules & Requirements. |     | -           | -            |
| <b>Issue</b>                                                  | 1.1 | <b>Date</b> | 30/04/2026   |

|                                                                                             |        |         |
|---------------------------------------------------------------------------------------------|--------|---------|
| Update of deposit fee and clarification on payment process.                                 | 16     | §6.5    |
| Addition of note on the rights to change the technical review process.                      | 18     | §7      |
| Clarification of the consequences of not delivering a complete and timely Technical Report. | 25     | §8.4    |
| Addition of Section 10.1.3. to clarify the mandatory attendance to the dry run.             | 31     | §10.1.3 |
| Small corrections/clarifications.                                                           | 34     | §11.3.1 |
| Clarification on the evaluation of the flight awards.                                       | 36     | §11.4.4 |
| Clarifications with regards to the delivery of test reports.                                | 44     | §A8     |
| Update of the mandatory fields of the compliance matrix.                                    | 47; 48 | §A11    |

## DISTRIBUTION LIST

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## 1. INTRODUCTION

### 1.1. BACKGROUND

The Portuguese Space Agency organizes EuRoC, the 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 Strategy, 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 is visible, and within Portugal, with an increasing number of interested teams applying to the competition. 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.

### 1.2. PURPOSE

This document defines the rules governing the participation in the EuRoC competition.

The content of the Competition Rules (CR) is based on the previously designated EuRoC Rules and Requirements, so teams should consider this document as a revision/update of that document. The main purpose of this revision is to facilitate the reading of such document and the understanding and applicability of the competition rules for teams wishing to compete at EuRoC.

For the system-level requirements that launch vehicles competing at EuRoC must obey please refer to the EuRoC System Requirements Document [RD01].

### 1.3. DOCUMENT OVERVIEW

The competition rules document is organised as follows:

- Section 1 contains the scope.
- Section 2 contains the reference documents.
- Section 3 contains the acronyms and abbreviations list.
- Section 4 contains the flight and propulsion rules.

- Section 5 contains the team composition and eligibility rules.
- Section 6 contains the application and registration process.
- Section 7 contains the technical review process.
- Section 8 contains the technical deliverables information.
- Section 9 contains the non-technical deliverables information.
- Section 10 contains the on-site milestones information.
- Section 11 contains the scoring and awards rules.
- Section 12 contains the unruly behaviour, disqualification and withdrawal rules.
- Appendix A contains the details for the technical report.

## 1.4. CHANGE AUTHORITY/RESPONSIBILITY

Major revisions of this document will be accomplished by complete document reissue. Smaller revisions will be reflected in updates to the document's effective date and marked by the issue 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 any EuRoC rules, criteria, procedures and requirements at its discretion and at any time, including during the event.

## 2. DOCUMENTS

### 2.1. REFERENCE DOCUMENTS

The documents listed in this section contain reference information useful in the application of this document.

| No.    | Reference                | Title                                      | File Location                                                                   |
|--------|--------------------------|--------------------------------------------|---------------------------------------------------------------------------------|
| [RD01] | PTS_EDU_EuRoC_ST_001928  | EuRoC System Requirements Document         | <a href="http://www.euroc.pt">http://www.euroc.pt</a>                           |
| [RD02] | PTS_EDU_EuRoC_RC_000570  | EuRoC Motors List                          | <a href="http://www.euroc.pt">http://www.euroc.pt</a>                           |
| [RD03] | PTS_EDU_EuRoC_PD_000599  | EuRoC COTS Motors Acquisition              | <a href="http://www.euroc.pt">http://www.euroc.pt</a><br>(Teams' Reserved Area) |
| [RD04] | PTS_EDU_EuRoC_ST_001932  | EuRoC Logistics & Launch Operations Guide  | <a href="http://www.euroc.pt">http://www.euroc.pt</a><br>(Teams' Reserved Area) |
| [RD05] | PTS_EDU_EuRoC_TPL_000469 | Academic Institution Participation Letter  | <a href="http://www.euroc.pt">http://www.euroc.pt</a>                           |
| [RD06] | N/A                      | EuRoC Technical Questionnaire              | <a href="http://www.euroc.pt">http://www.euroc.pt</a><br>(Teams' Reserved Area) |
| [RD07] | PTS_EDU_EuRoC_RC_000900  | EuRoC Flight Card and Postflight Record    | <a href="http://www.euroc.pt">http://www.euroc.pt</a><br>(Teams' Reserved Area) |
| [RD08] | PTS_EDU_EuRoC_TPL_000848 | EuRoC Waiver and Release of Liability Form | <a href="http://www.euroc.pt">http://www.euroc.pt</a><br>(Teams' Reserved Area) |
| [RD09] | PTS_EDU_EuRoC_TPL_000850 | Final Team Composition                     | <a href="http://www.euroc.pt">http://www.euroc.pt</a><br>(Teams' Reserved Area) |

### 3. ACRONYMS AND ABBREVIATIONS

|        |                                                  |
|--------|--------------------------------------------------|
| AGL    | Above Ground Level                               |
| c      | COTS                                             |
| CONOPS | Concept of Operations                            |
| COTS   | Commercial off-the-shelf                         |
| CR     | Concept Review                                   |
| CR     | Competition Rules                                |
| DR     | Design Review                                    |
| EuRoC  | European Rocketry Challenge                      |
| FMECA  | Failure Modes, Effects, and Criticality Analysis |
| FRR    | Flight Readiness Review                          |
| GPS    | Global Positioning System                        |
| H      | Hybrid                                           |
| IBAN   | International Bank Account Number                |
| ID     | Identification                                   |
| IMU    | Inertial Measurement Unit                        |
| L      | Liquid                                           |
| LRR    | Launch Readiness Review                          |
| N/A    | Not Applicable                                   |
| PoC    | Point of Contact                                 |
| RD     | Reference Document                               |
| RF     | Radio Frequency                                  |
| S      | Solid                                            |

|      |                                |
|------|--------------------------------|
| SRAD | Student Researched & Developed |
| SRD  | System Requirements Document   |
| TEB  | Technical Evaluation Board     |

## 4. FLIGHT AND PROPULSION COMPLIANCE

### 4.1. 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. Multistage and clustered launch vehicles are allowed.

Projects are 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 1.

*Table 1: 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 submission of the final Technical Report, e.g., switch from the 9000 m to the 3000 m or vice-versa.

If teams intend to change the proposed propulsion category (S/H/L and/or COTS/SRAD), a case-by-case review and EuRoC approval is required. Please note that this shall be the exception to the rule and teams shall provide a detailed reasoning for the request. While applying to EuRoC it's the team's responsibility to assess the feasibility of the intended project, as such justifications arising from the underestimation of complexity or lack of preparedness will not be accepted.

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.

## 4.2. FLIGHT STATUS

The flight status refers to the granting of permission to attempt a launch and the provisions under which that permission remains valid.

A project's flight status may be either nominal, provisional, or denied. The default flight status of any team is from the project onset "denied", until project deliverables, and ultimately a successful Flight Readiness Review and Launch Readiness Review, convinces the EuRoC officials to upgrade the flight status of teams.

- **Nominal:** A project assigned nominal flight status meets or exceeds the minimum expectations of the EuRoC System Requirements Document [RD01] and reveals no obvious flight safety concerns during the reviews at the competition.
- **Provisional:** A project assigned provisional flight status generally meets the minimum expectations of the EuRoC System Requirements Document [RD01] but reveals flight safety concerns during the reviews at the competition which may be mitigated by field modification or by adjusting launch environment constraints. Launch may occur only when the prescribed provisions are met.
- **Denied:** Competition officials reserve the right to deny flight status to any project which fails to meet the minimum expectations of the EuRoC System Requirements Document [RD01] or reveals un-mitigatable flight safety concerns during the reviews at the competition.

## 4.3. TOTAL IMPULSE 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.

## 4.4. COTS MOTORS

In due time, before the event, EuRoC officials will provide a list of motors [RD02] 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 [RD03], which will be made available before the event, in due time.

## 4.5. SRAD MOTORS

SRAD motors are subject to the detailed requirements listed in the EuRoC System Requirements Document [RD01]. 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 (see Section 7), 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 any specific design questions. Officials encourage a culture of open discussion about any doubts that might arise regarding design feasibility and safety.

## 4.6. PROPELLANTS FOR SRAD MOTORS

All chemical propulsion types (solid, liquid, and hybrid) are allowed.

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 Logistics & Launch Operations Guide [[RD04]]. High-level design and acceptance testing requirements are contained in the EuRoC System Requirements Document [RD01] in order to promote safety.

## 5. TEAM COMPOSITION AND ELIGIBILITY

### 5.1. 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% limit 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. 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 for all matters. Furthermore, the designated PoC must be always reachable during the event. 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 team's reserved area in the EuRoC website).

The number of teams competing at EuRoC will be limited.

### 5.2. 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 review by the EuRoC organisers. 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.

## 6. APPLICATION AND REGISTRATION PROCESS

A process will be put in place by the EuRoC organisation to down select a limited number of participating teams, aiming to enlist a broad pallet of 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.

### 6.1. ENTRY FORM

Each team shall apply to participate in EuRoC by filling the entry form on the EuRoC website. Completeness of the entry form is required, and teams should ensure that the information provided is, to the best of their knowledge, up to date, reliable and trustworthy.

Submission of the Academic Institution Participation Letter (see Section 6.3) and Student University Identification (see Section 6.4) will be required.

### 6.2. 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.

### 6.3. 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).

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

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 [RD05] 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.

## 6.4. STUDENT UNIVERSITY IDENTIFICATION

Each team shall prove 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 [RD05].

## 6.5. DEPOSIT FEE

Once a team is accepted to take part in the competition, to complete the registration process, a deposit fee per team member will be charged. For teams competing in the solid and hybrid categories a deposit fee of 100€ per team member will be charged. Teams competing in the liquid categories will be required a 150€ deposit fee per team member. The payment of the deposit fee shall be done in a single bank transfer, covering the team's total amount, before the deadline. 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 after the event.

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 e-mail containing all the necessary information.

The latest date for withdrawal from the competition will be the date the Design Report 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.

## 7. 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:

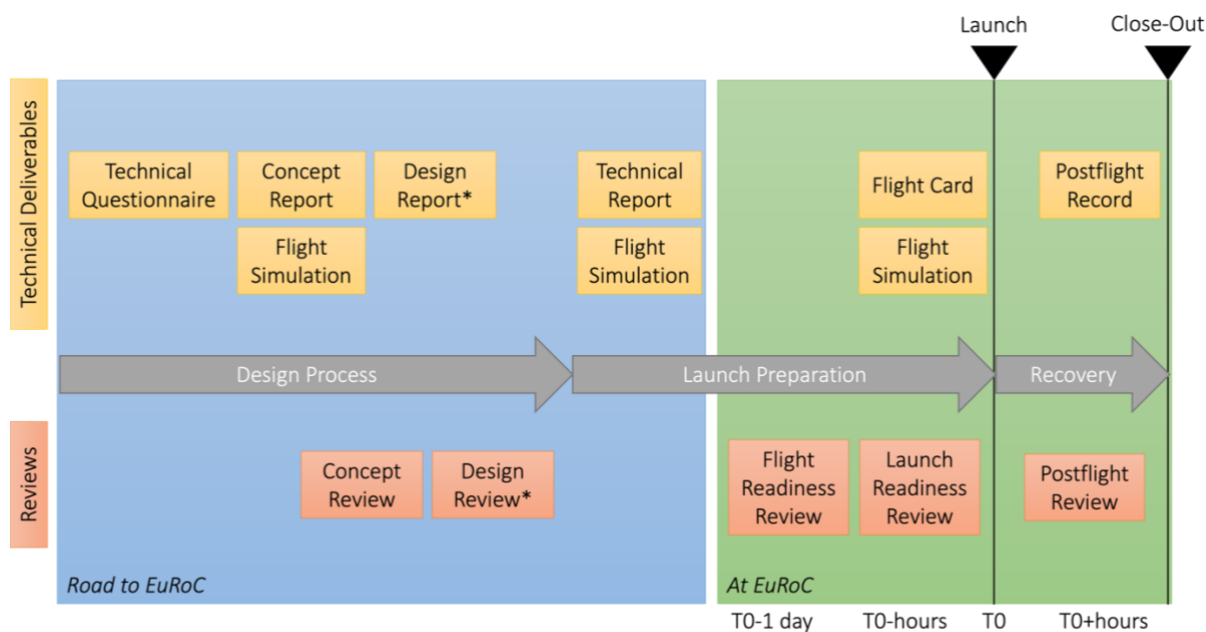
1. Concept Review;
2. Design Review (for selected teams only);
3. Flight Readiness Review;
4. Launch Readiness Review;
5. Postflight Review.

Furthermore, several technical documents and deliverables are required to be prepared or filled in by the teams (further details in Section 8):

1. Technical Questionnaire;
2. Concept Report;
3. Preliminary Flight Simulation;
4. Design Report;
5. Technical Report;
6. Flight Simulation;
7. Flight Card;
8. 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.

Please note that the Portuguese Space Agency reserves the right to change the technical review process at its discretion and at any time.



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

Figure 1: Technical review process.

## 7.1. 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 8.2). 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.

## 7.2. 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, with a duration of 1h, will be held virtually. The EuRoC organisers 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.

### 7.3. 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". 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 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 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.

## 7.4. 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 take 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 8.6) 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.

## 7.5. POSTFLIGHT REVIEW

After recovery of the vehicle, teams will place the vehicle into a safed state in a designated area 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 8.7). 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 teams' area in the EuRoC website, until 23h59 of the respective launch day.

## 8. TECHNICAL DELIVERABLES

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

### 8.1. TECHNICAL QUESTIONNAIRE

On or before a specified date prior to the event each team shall fill an online Technical Questionnaire [RD06]. The link for the questionnaire as well as a PDF version of it, purely for information purposes, will be made available in the reserved teams' area on 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 4.4), 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.

### 8.2. CONCEPT REPORT

In preparation for the Concept Review, teams shall submit, through the reserved teams' area on 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".

### 8.3. DESIGN REPORT

The selected teams that need to undergo a Design Review shall submit a Design Report (max. 10 pages) to be submitted through the reserved teams' area on the EuRoC website. The Design Report should reflect the advanced status of the design close to the competition. Furthermore, teams should emphasise 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.

- Main changes/developments since the Concept Review (1 or 2 paragraphs of text);
- Concept of Operations (1 diagram of the main operations stages);
- System design;
- General arrangement (diagram or drawing and 1 paragraph of text);
- Dimensions and masses (drawing and/or table);
- Main performance figures (table);
- Description of changes made in any main systems (1 paragraph for each, with optional drawing or diagram);
- 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 of text);
- Risks assessment (table);
- Actions/suggestions made by the EuRoC officials during the CR and the respective team action/implementation (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".

## 8.4. 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 a specified date prior to the event, teams shall submit a single digital PDF copy of their Technical Report through the reserved teams' area on 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, excluding figures etc. (A4, standard font size 11, 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 A, including an overview of the required minimum Technical Report sections and appendices. Additional sections, subsections, and appendices may be added if needed.

Teams that fail to submit a complete Technical Report within the deadline – including all mandatory sections, subsections, and appendices (e.g. detailed test reports) – will be disqualified from the competition. Such teams will not be evaluated in any category and will not be permitted to perform a flight.

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".

## 8.5. FLIGHT SIMULATION

Teams are required to submit a preliminary flight simulation with the Concept Report, and an updated flight simulation with the Technical Report. Each team must submit a RocketPy simulation file

(.py, .ipynb, or .m) that successfully simulates the most precise model of their rocket. The simulation must be compatible with the latest RocketPy and Python versions.

The submission must include the most recent rocket model data and all necessary auxiliary files, such as .csv and .eng files, required for execution. To ensure an accurate simulation, any supplementary scripts or algorithms, including those for active control systems and parachute deployment functions, must also be included. Teams with deployable payloads must also provide a simulation including the deployment. Relevant data and tutorials can be found at <https://docs.rocketpy.org/en/latest/user/deployable.html>.

The submission shall be done through the reserved teams' area on the EuRoC website, on or before a specified date, prior to the event. Any modifications to parameters like mass, length, centre of mass, or aerodynamic coefficients as well any updated versions of the flight simulations upon the delivery of the Technical Report and up to the event must be submitted through the reserved teams' area on the EuRoC website and to the RocketPy team through the respective communication channels, to ensure updated simulations before launch.

The deliverable must be a .zip file containing all required simulation files in one folder (executable file, along with any other supporting codes, .csv, .eng, .pdf and any other necessary document). The RocketPy file shall be named Team[Your Team ID]\_RocketPy\_v[VersionNumber]. For example, if a team's ID is "12", the file should be named: Team12\_RocketPy\_v1.

Teams may use modified versions of RocketPy but must submit both the modified files and a description of the changes. Multiple simulations can be sent if desired. Alternative simulation software may be used, provided that ALL relevant input data is included to ensure reproducibility on RocketPy software.

For support, teams can reach out to the RocketPy developers via the official [RocketPy Discord](#) or e-mail at [rocketpyteam@gmail.com](mailto:rocketpyteam@gmail.com).

## 8.6. FLIGHT CARD

The Flight Card [RD07] shall be filled out by the teams, on-site, prior to launch. A template will be available in the reserved teams' area on the EuRoC website, allowing teams to know what to expect. However, the officials will hand out printed copies at the event.

## 8.7. POSTFLIGHT RECORD

The Postflight Record [RD07] must be filled out by the teams (to the extent possible) after the launch and will contain flight information data, such as flight performance and recovery.

### 8.7.1. POSTFLIGHT REPORTING OF APOGEE AND RECOVERY

During the Postflight Review (see Section 7.5), teams will need to deliver the Postflight Record, which will, among other things, include the following information:

- Apogee of the official altitude logging system(s) (see EuRoC System Requirements Document 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 base camp 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.

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 touchdown. 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.

## 9. NON-TECHNICAL DELIVERABLES

The following sections define the non-technical deliverables that teams shall submit – 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 on the EuRoC website, deliverables submitted by any other means (e.g., e-mail) will not be considered.

## 9.1. 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 on 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 team's 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.

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.

## 9.2. 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 from the moment they leave their home countries, during the trip and 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 in the event and/or related to the trip. These types 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 participating in 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".

### 9.3. 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 [RD08]. 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.

### 9.4. 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 [RD09] 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 6.4) 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".

## 10. ON-SITE MILESTONES

There are several events, briefings, and reviews, mandatory or optional, that form the EuRoC on-site milestones.

### 10.1. MANDATORY MILESTONES

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

#### 10.1.1. REGISTRATION

Teams are expected to arrive on time so they can register, receive their event badges and be assigned to 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 ([euroc@ptspace.pt](mailto:euroc@ptspace.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.

#### 10.1.2. 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.

#### 10.1.3. DRY RUN

The dry run will be given by EuRoC officials. At the launch site, to two designated team members (preferably the team leader and other appointed member). Attendance is mandatory, without exception.

#### 10.1.4. 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.

### 10.1.5. LAUNCH READINESS REVIEW

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

### 10.1.6. 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 8.7 for details).

## 10.2. OPTIONAL MILESTONES

### 10.2.1. 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 aids they like.

Please note that the Postflight Highlights will be dependent on time availability.

### 10.2.2. 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.

## 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 2: 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 4.1).

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 the 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. SCORING 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.

### 11.3.1. POINTS DEDUCTION

Under the team effort and flight performance scoring categories there is the possibility for the EuRoC organisation to deduct points to the teams if the need arises, at any point. While unsportsmanlike conduct penalties are applied under the team effort, penalties for unsafe conduct during operations are applied under the flight performance (see Section 12.1 for more info on the penalties for unsafe or unsportsmanlike conduct). Furthermore, there are also points deduction under the flight performance category for teams that fail launches or miss launch slots due to technical issues, with the penalty increasing with the number of launch attempts.

## 11.4. 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 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 3.

*Table 3: Competition categories and respective awards.*

| Competition Category          | Corresponding Award          |
|-------------------------------|------------------------------|
| (1.) Technical Report         | Technical Award              |
| (2.) Vehicle Design           | Design Award                 |
| (3.) Team Effort              | Team Award                   |
| (4.1.) Flight Performance: S3 | Flight Award – Solid 3000 m  |
| (4.2.) Flight Performance: H3 | Flight Award – Hybrid 3000 m |
| (4.3.) Flight Performance: L3 | Flight Award – Liquid 3000 m |
| (4.4.) Flight Performance: S9 | Flight Award – Solid 9000 m  |
| (4.5.) Flight Performance: H9 | Flight Award – Hybrid 9000 m |
| (4.6.) Flight Performance: L9 | Flight Award – Liquid 9000 m |
| (5.) Overall Winner           | EuRoC Award                  |
| (6.) Best Payload             | Payload Award                |

#### 11.4.1. 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.

#### 11.4.2. 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.

### 11.4.3. 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.

### 11.4.4. 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 design that not only survive the harsh contact with reality, but furthermore represent an incredible achievement in concept, simulation, system integration, control, and practical realisation.

For the purposes of the Flight Award, only the first flight performed by the team shall be considered, without exception.

### 11.4.5. 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 the competition aspects, be it technical documentation, vehicle design, team effort, or flight performance, thus identifying a truly remarkable effort and achievement.

### 11.4.6. 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 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 score for this award will not count to the total scoring and hence to the Overall Winner.

## 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.

For more detailed questions or specific concerns regarding the scoring after it has been announced—such as teams requesting detailed feedback on a particular aspect of the score for clarification (e.g., to improve 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 [euroc@ptspace.pt](mailto:euroc@ptspace.pt). Submissions of the feedback are accepted until no later than one week (7 days) after official announcement of the score. Competition officials will review any 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 participate in a discussion questioning the evaluation team principal reasoning of the score given.

## 12. UNRULY BEHAVIOUR, DISQUALIFICATION AND 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., staff members, volunteers, 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, disrupting behaviour during launch operations, 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 recognised 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.

The EuRoC organisation reserves 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 EuRoC at any time prior to the event must send an e-mail entitled "TEAM [Your Team ID] FORMALLY WITHDRAWS FROM THE [Year] EuRoC" to

[euroc@ptspace.pt](mailto:euroc@ptspace.pt). For example, a team assigned the Team ID 12" would withdraw from the 202X EuRoC by sending an e-mail entitled "TEAM 12 FORMALLY WITHDRAWS FROM THE 202X EuRoC".

## APPENDIX A. DETAILS FOR THE TECHNICAL REPORT

### A1. REPORT STRUCTURE

For 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, excluding 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. Electronics thermal testing
    - 5.2.4. Static hot-fire test (SRAD) (if applicable)
    - 5.2.5. Hybrid/liquid propellant loading and offloading test (SRAD) (if applicable)
    - 5.2.6. Combustion chamber pressure test (SRAD) (if applicable)
    - 5.2.7. Proof pressure testing pressure vessels (SRAD, Modified COTS) (if applicable)
    - 5.2.8. Burst pressure testing pressure vessels (SRAD, Modified COTS) (if applicable)
    - 5.2.9. 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. Compliance matrix
- 5.6. Checklists
- 5.7. Launch support equipment
  - 5.7.1. Launch support equipment list
  - 5.7.2. Launch support equipment simple operational manual
  - 5.7.3. Launch support equipment details
    - 5.7.3.1. Detailed structural and mechanical calculation
    - 5.7.3.2. Detailed logical process diagrams
    - 5.7.3.3. Detailed software architecture
    - 5.7.3.4. Detailed electrical architecture
    - 5.7.3.5. Detailed hydraulic/fluid architecture
- 5.8. Engineering drawings
  - optional appendices ----
- 5.9. Subsystem details (optional)

## A2. ABSTRACT

The Technical Report shall contain an abstract (ca. 1 page), as a standalone 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

## A3. 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

## A4. 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)

## A5. 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 A10.

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

## A6. 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 outcomes, lessons learned, way forward, remaining design challenges, areas for improvement

## A7. 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

## A8. PROJECTS AND TEST REPORTS APPENDIX

The second Technical Report appendix shall contain applicable test reports from the minimum tests prescribed in the EuRoC System Requirements Document [RD01]. These reports shall appear in the following order. In the event any report is not applicable to the project in question, the team must include a page marked "THIS PAGE INTENTIONALLY LEFT BLANK" in its place.

- Recovery system testing: In addition to description 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.
- Electronics thermal testing: Description of testing performed and the results thereof.
- SRAD Propulsion System Testing (if applicable): Description of testing performed and the results thereof, including propellant loading and offloading.
- 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 this appendix. 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.

The applicable mandatory tests prescribed in the EuRoC System Requirements Document [RD01] shall be done in advance of the event and submitted with the Technical Report. No extension of the deadline will be provided. On-site testing will not be allowed. Teams without the mandatory tests will in no way and with no exception, be able to compete and fly at EuRoC. As such, teams that fail to comply with the submission of the test reports within the deadline will be disqualified from the competition. Such teams will not be evaluated in any category and will not be permitted to perform a flight.

## A9. 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.

## A10. 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 4: 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 5: 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 6: 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 7: Risk matrix example.

| 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                 | Apogee/ pilot chute deployment | 1                   | 3               | 3                   | Pilot chute system is flight proven on earlier missions. Deployment failure is                      |

|                                           |                     |       |       |       |                                                                                                                                                    |
|-------------------------------------------|---------------------|-------|-------|-------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| ejection failure                          |                     |       |       |       | 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.

## A11. COMPLIANCE MATRIX

The fourth Technical Report appendix shall contain a compliance matrix with the System Requirements Document [RD01] requirements. This appendix shall include all SRD requirements and the team project's compliance to them according to the following criteria:

- Fully compliant: The requirement is fully fulfilled;
- Partially compliant: The requirement is only partially fulfilled.
- Non-compliant: The requirement is not fulfilled.
- N/A: The requirements is not applicable to the team's project.

Furthermore, teams shall indicate the verification method applied, the reference section of the Technical Report where the EuRoC officials can find more information on the subject and the actions that were taken.

Table 8: Compliance matrix example.

| Requirement reference | Title                               | Text                                                                                                                                                                                                                                            | Compliance          | Verification method | Reference     | Actions                                             |
|-----------------------|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------|---------------|-----------------------------------------------------|
| EuRoC-LV-RQT-0250     | Redundant COTS recovery electronics | At least one redundant recovery system electronics subsystem shall implement a COTS flight computer.                                                                                                                                            | Fully compliant     | Review of design    | Section 2.4.2 | Two COTS flight computers implemented.              |
| EuRoC-LV-RQT-0830     | Identifying markings                | The Team ID shall be clearly and prominently displayed on the launch vehicle airframe, visible on all four quadrants of the vehicle, as well as fore and aft, and on all components that separate from the vehicle such as deployable payloads. | Partially compliant | Simple check        | Section 2.3.5 | Identifying marks only on 2 quadrants.              |
| EuRoC-LV-RQT-0850     | Payload form factor                 | Payloads shall fulfil one of following basic form factors: ...                                                                                                                                                                                  | Non-compliant       | Inspection          | Section 2.5.1 | Waiver sent and accepted by the EuRoC organization. |
| EuRoC-LV-RQT-0220     | Venting                             | For hybrid and liquid motors, teams shall facilitate oxidizer tank venting to prevent over-pressure situations.                                                                                                                                 | N/A                 | N/A                 | -             | Competing with a COTS solid motor.                  |

## A12. ASSEMBLY, PRE-FLIGHT, AND LAUNCH CHECKLISTS APPENDIX

The sixth 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 disarming/safing the system based on identified failure modes. These off-nominal checklist procedures shall not conflict with the EuRoC Logistics & Launch Operations Guide [RD04]. 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.

Teams shall present the checklists, in printed format, during the Flight Readiness Review for verification. After verification and approval by the TEB, it is mandatory for teams to present the checklists on the launch day to EuRoC officials 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. Several formats and variations from the checklists below examples, can be accepted, nonetheless checklists shall contain the following items:

- Team identification;
- Account for all vehicle modules and all stages from assembly to recovery after launch;
- Personnel responsible for each task/vehicle system or subsystem and the responsible for certification/approval;
- Description of each task;
- Tools and equipment necessary, including personal protective equipment;
- Small description of each step;
- Total time required for completeness of the task;
- Time required to complete each step based on previous wet-rehearsals;
- Clear space/square for a check mark on each step, for the personnel performing the task and the responsible for certification/approval;
- Detailed page numbering (e.g. motor assembly – Page 3 of 5);
- Signature from all the involved personnel in last the page of each checklist;
- Any additional comments;
- Clear the pad instructions shall be included.

For teams who have specific names, vehicle sections or parts, in case of the non-regular or standard names, the parts shall be identified with pictures, drawings or schemes.

Table 9: Checklist example.

|                                        |                                                                                                       |                        |                                                                                              |                  |                       |                       |                      |  |
|----------------------------------------|-------------------------------------------------------------------------------------------------------|------------------------|----------------------------------------------------------------------------------------------|------------------|-----------------------|-----------------------|----------------------|--|
| <b>Team Name:</b>                      | TEAM ONE                                                                                              |                        |                                                                                              |                  |                       |                       |                      |  |
| <b>Team ID:</b>                        | 01                                                                                                    | <b>Time to Launch:</b> | 3 hours                                                                                      | <b>Location:</b> | Tent/preparation area |                       |                      |  |
| <b>Combustion Chamber Integration</b>  |                                                                                                       |                        |                                                                                              |                  |                       |                       |                      |  |
| <b>Responsible(s):</b>                 | Member 1                                                                                              |                        | Member 2                                                                                     |                  | Member 3              |                       |                      |  |
| <b>Approved by:</b>                    | Member 4                                                                                              |                        | Member 5                                                                                     |                  | Member 6              |                       |                      |  |
| <b>Required time for completeness:</b> | 15 min                                                                                                |                        |                                                                                              |                  |                       |                       |                      |  |
| <b>Summary description:</b>            | In this task we will proceed with the integration of the Combustion Chamber in the following order... |                        |                                                                                              |                  |                       |                       |                      |  |
| <b>Tools:</b>                          | Torque wrench                                                                                         |                        | <b>Protective equipment:</b>                                                                 | Gloves           |                       | <b>Vehicle parts:</b> | Combustion chamber   |  |
|                                        | Lube XYZ                                                                                              |                        |                                                                                              | Goggles          |                       |                       | (...)                |  |
|                                        | (...)                                                                                                 |                        |                                                                                              | (...)            |                       |                       | (...)                |  |
| <b>Step #</b>                          | <b>Task description</b>                                                                               |                        | <b>Additional comment</b>                                                                    |                  | <b>Status</b>         | <b>Approved</b>       | <b>Time required</b> |  |
| 1                                      | Check assembly for completeness                                                                       |                        | Check previous signed checklists;<br><br>Check all wires and connectors, for possible damage |                  |                       |                       | 2 min                |  |
| 2                                      | Lube the O-rings                                                                                      |                        | Use lube XYZ on the O-rings, apply a thin layer                                              |                  |                       |                       | 6 min                |  |
| 3                                      | (...)                                                                                                 |                        | (...)                                                                                        |                  |                       |                       | 10 min               |  |
| 4                                      | (...)                                                                                                 |                        | (...)                                                                                        |                  |                       |                       | 2 min                |  |

We hereby confirm that all tasks of this checklist were completed:

\_\_\_\_\_  
Signature of member 1

\_\_\_\_\_  
Signature of member 2

\_\_\_\_\_  
Signature of member 3

\_\_\_\_\_  
Signature of responsible

Integration of Combustion Chamber Checklist – Page 1 of 1

*Table 10: Second checklist example.*

|                                 |                                                                                                                       |                 |           |           |            |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------|-----------------|-----------|-----------|------------|
| Team Name:                      | TEAM ONE                                                                                                              |                 |           |           |            |
| Team ID:                        | 01                                                                                                                    | Time to Launch: | 50 min    | Location: | Launch pad |
| Combustion Chamber Integration  |                                                                                                                       |                 |           |           |            |
| Responsible(s):                 | Member 6                                                                                                              |                 | Member 7  | Member 8  |            |
| Approved by:                    | Member 9                                                                                                              |                 | Member 10 | Member 11 |            |
| Required time for completeness: |                                                                                                                       |                 | 25 min    |           |            |
| Summary description:            | In this task we will proceed to place the filling station in position and proceed to the filling of the vehicle (...) |                 |           |           |            |

| Tools: | 6 mm Allen Wrench                                       |  | Protective equipment:                                                                                                                                                                                                        | Gloves  |        | Vehicle parts: | Filling Station |  |
|--------|---------------------------------------------------------|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|--------|----------------|-----------------|--|
|        | Hammer                                                  |  |                                                                                                                                                                                                                              | Goggles |        |                | Power cord      |  |
|        | (....)                                                  |  |                                                                                                                                                                                                                              | (...)   |        |                | Yagi-Antenna    |  |
| Step # | Task description                                        |  | Additional comment                                                                                                                                                                                                           |         | Status | Approved       | Time required   |  |
| 1      | Place in the filling station in the designated position |  | Check for the turned-off status of all lights and buttons.                                                                                                                                                                   |         |        |                | 1 min           |  |
| (...)  | (...)                                                   |  | (...)                                                                                                                                                                                                                        |         |        |                | X min           |  |
| 4      | Connect Filling Station Antennas cabling                |  | Connect the 3 m cable to 2,4 GHz antenna;<br><br>Connect one side of a longer ethernet cable to dish;<br><br>and other side to injector PoE Port;<br><br>Secure cables to tripod and extend tripod to max height.            |         |        |                | 2 min           |  |
| 6      | (...)                                                   |  | (...)                                                                                                                                                                                                                        |         |        |                | X min           |  |
| 12     | CLEAR THE PAD and inform mission control                |  | Check for clear pad and clear pad before filling starts. After pad clear, member 8 uses intercoms:<br><br>“Mission Control – do you copy?”<br><br>Only in case of “Yes” or “Copy” reply<br><br>“Pad is clear. Start filling” |         |        |                | 5 min           |  |

We hereby confirm that all tasks of this checklist were completed:

\_\_\_\_\_  
Signature of member 6

\_\_\_\_\_  
Signature of member 7

\_\_\_\_\_  
Signature of member 8

\_\_\_\_\_  
Signature of responsible

Filling station Setup – Page 5 of 5

## A13. ENGINEERING DRAWINGS APPENDIX

The seventh 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.

## A14. 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 any additional appendices concise.