STEM RACING™ SPAIN

Dev & Pro Competition Regulations

(Ages 11-19)

From apprentice to master.

26/27 Season

Welcome to STEM Racing™ The Formula 1® STEM Challenge!

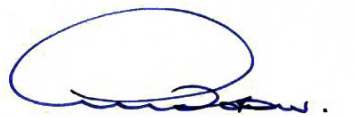
I would like to give you a warm welcome to the challenge and hope you have fun working as a team to compete in this life changing experience. There are awards, prizes and bursaries up for grabs to all teams who compete, recognising design flair, innovative thinking and much more.

STEM Racing is open to all SPAIN based secondary schools, colleges and youth groups. The challenge is to design, analyse, make, test and race innovative F1 cars of the future, using a combination of design and make skills, CAD / CAM software and marketing talent to promote and grow your team.

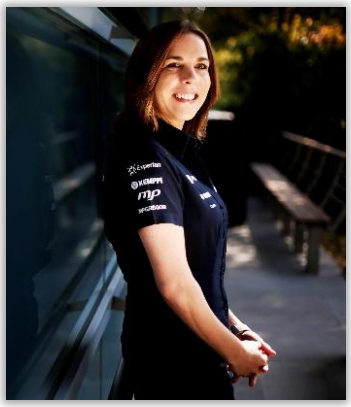
The Development and Professional Classes are open to students aged **11-19**, in teams of **3-6**. By entering these classes you'll be mixing it with some of the SPAIN's best teams, aiming to reach the SPAIN National Finals. The prize at stake here is not only the title of **National Champions**, but also the chance to represent the SPAIN at the **STEM Racing World Finals**, which is contested by over 60 countries and runs alongside an international F1 Grand Prix…

Our rules committee have created this document to give you all the information needed to compete in the Development and Professional Class competitions, attend your nearest Race Day and compete for a chance to be crowned Regional, National and maybe even World Champions.

Best of luck, we look forward to seeing you on Race Day!



Andrew Denford
Founder and Chairman, STEM Racing™



A note from our patron…

Claire Williams

"I am delighted to be a Patron for STEM Racing. The tasks that all participating students have to go through to establish their own Formula One team during the Challenge not only exposes to them the type of work required for creating, producing and running a team such as Williams but also equips them with a variety of life skills. It will be fascinating for us to see first-hand what the designers, engineers and marketeers of the future come up with year after year".

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How to use this document

This document has been created to cover both Development **and** Professional Class competitions; however, some sections will only apply to one of the classes. Here's a quick key so you know what to look out for:

CLASS DIFFERENTIATION

SYMBOL	MEANING
D	Applies to Development Class **ONLY**
P	Applies to Professional Class **ONLY**
D P	Applies to **BOTH** classes

RULE REVISIONS FROM THE PREVIOUS SEASON

NEW!

Just like in the real world of Formula 1, at the end of each season we reflect on our rules and make any changes we think are important. If you see the 'NEW!' symbol next to any rule, we've made changes to it for the new season so make sure you read it extra carefully.

HELP TEXT

When you see green italic text, this is intended to help clarify a regulation or diagram.

SUPPLEMENTARY TEXT – PROJECT MANAGEMENT GUIDEBOOK

In partnership with the Project Management Institute Educational Foundation (PMIEF), STEM Racing has created a supplementary resource to help inspire and equip your teams with industry-level Project Management terminology and techniques. This guide can be downloaded from the STEM Racing website and is suitable for use with higher level teams competing in the Development and Professional Classes, to help access the higher marks for the Enterprise portfolio.

What to do

Your first steps

Your STEM Racing journey – Where to start:

1. DOWNLOAD AND READ THE RULES

- Download and carefully read through this season's Technical Regulations, alongside this document.
- Download the supplementary Project Management Guidebook, which is also available on www.stemracing.es
- . This guide will help your teams pick up and use industry level techniques and termonology to use in their project.

2. Register your team(s)

- Register your teams through the STEM Racing website. **Schools can enter up to FIVE teams** across all classes. Get creative and think of ways to raise your registration fee - aim not to pay it yourself!

3. Design the F1® car of the future

- First, get yourselves kitted out with an STEM Racing starter kit from **https://stemracing.es/material/**. Then, starting with a fresh piece of paper and a head full of ideas, start designing the basic aerodynamic shape of the body and wings of your car. ***Remember no idea is too crazy at this stage…***

4. Download our stock CAD files

- Download the official CAD files from the **STEM Racing Spain downloads page**. We strongly recommend the **FREE Autodesk Fusion 360** software package, which is available to download through the **STEM Racing Spain website**. There are plenty of helpful tutorials available to help you get started.

5. Manufacture your car

- **Make sure your design is fully legal before manufacturing your car**. Using a CNC router such as a Denford SR Router and a 3D printer such as a Makerbot, manufacture and finish your car assembly using the official STEM Racing Model Block, available direct from Denford at **https://stemracing.es/material/. You only need 1 car for Regionals, and 2 for Nationals!**

6. Create your two Portfolios

- You must create one Design and Engineering Portfolio and one Enterprise Portfolio.
- See the **Judging: Criteria and the Scorecards** section for guidance.

7. Prepare your Verbal Presentation

- You must prepare a 5 minute (Regional Final) or 10 minute (National Final) Verbal Presentation.
- See the **Judging: Criteria and the Scorecards** section for guidance.

8. Register for a Regional Final

- Teachers **must** confirm the attendance of their team(s) by registering for a Regional Final on the STEM Racing website. T&C's can be found online.

TURN UP ON COMPETITION DAY!

- Attend your nearest **STEM Racing** Regional Final ready to race.

What do you need to produce?

Development Class – please also refer to the submission checklist on P50

D

2 x 5 Page Portfolios (p33-36)

A4 Engineering Drawings (p19, 24-25)

A4 Car Renderings (p19, 24-25)

Spain National Finals Electronic version of Portfolios / Engineering Drawings

1 x 5 minute Verbal Presentation (p37-38)

Spain National Finals: 10 minute Verbal Presentation

1 x Development Class Race Car (p26-28)

Spain National Finals: 2 x Identical Race Cars

1 x Pit Display (p39-40)

Professional Class – please also refer to the submission checklist on P51

P

2 x 10 Page Portfolios (p33-36)

A4 Engineering Drawings (p19, 24-25)

A4 Car Renderings (p19, 24-25)

Spain National Finals: Electronic version of Portfolios / Engineering Drawings

1 x 5 minute Verbal Presentation (p37-38)

Spain National Finals: 10 minute Verbal Presentation

1 x Professional Class Race Car (p29-32)

Spain National Finals: 2 x Identical Race Cars

1 x Pit Display (p39-40)

First stop - Regional Finals

Multiple Regional Finals will be held across SPAIN, where student teams will compete against each other to win a place at the SPAIN National Finals. The SPAIN National Finals will determine who will be crowned the SPAIN National Champions and invited to compete at the STEM Racing World Finals.

After registering, teams will be invited to participate in their nearest regional competition on a first-come, first-served basis. If the local regional competition is already full, we will contact the team directly and make every effort to secure them a place in another regional event.

STEM Racing Regional Finals are 1-day events, beginning with an official welcome and culminating in our awards ceremony.

Please note that the timings provided for the Awards and Close of Event may vary between each event, we will aim to provide a more accurate end time ahead of each Regional Final.

The Registration Process

Registration is simply the process of sending us your team details so we know you're actively competing in the competition, which is completed online at https://stemracing.es/inscribete/. Each Development and Professional Class team competing in the STEM Racing STEM Challenge will be required pay a registration fee for their Regional Final. The key here is to try NOT to pay this yourself! Businesses will happily sponsor young, ambitious teams with the right approach; or if you know your way round a packet of cake mix, why not raise the money with an F1-inspired bake sale?!

We strongly suggest trying to raise your registration fee through either sponsorship or fundraising. This is your first chance to practise raising money ahead of the bigger task of attracting team sponsorship later in the project! Get your thinking caps on and work out how to raise your portion of the team registration fee, which ensures your team can take part in your nearest Regional Final.

This registration fee is non-refundable and must be paid in full before your chosen Regional Final to STEM Racing.

Next steps – Spain National and World Finals

The Spain National Finals is the ultimate stage of the competition in Spain. The event is held at the end of the regional season, usually in June, with the very best teams from the Regional Finals competing for the crown of National Champions. After two days of fierce competition, a select group of deserving teams will earn their passes through to the season finale, the spectacular STEM Racing World Finals

The Spain National Final Fee is subject to change and will be confirmed on a teams invite to the final.

National Champions from over 73 countries around the world are then invited to compete at the World Finals where they will go head-to-head to become the STEM Racing World Champions and lift the STEM Racing World Champions Trophy. The following winning teams from the Spain National Finals will be invited to compete in the next World Finals…

Who is invited to compete at the World Finals?

Professional Class

1st Place Professional Class (Spain National Champions)

2nd Place Professional Class

3rd Place Professional Class

Depending on number of teams in attendance and number of invites the Sspain gets allocated, extra teams may be invited.

The Challenge

You are the Formula One Team commissioned to design, make, and race the fastest F1® car of the future, driven by compact, compressed air power units.

In order to enter the championship, you must allocate job roles to the members of your group.

Ideally, one role should be allocated to each person. However, you may have to double up on your role and responsibilities, depending on the number of people you have available. The following job roles are examples of what could be covered by the members of your team:

Project Manager (maximum 1 person)

This person is responsible for managing the team, project management of all key deliverables and ensuring that all race cars are ready for the competition. The team manager works closely with all members of the team, offering assistance where necessary.

Finance Manager

This person organises budgets and resources needed for designing and making the car(s) and team project work. They might keep track of all expenses and income generated, allocating certain funds to certain areas of the project, for example Car, Pit Display, Portfolio, team uniforms.

Manufacturing Engineer

This person is responsible for advising team members on the manufacture of the car and the constraints of the machining process. Manufacturing engineers will need to liaise with the design engineers to report and help solve any problems with the construction of the car.

Design Engineer

This role is responsible for the styling and aerodynamic performance of the car design. Design engineers will need to liaise with the manufacturing engineers to ensure their ideas can be realised.

Graphic Designer

This person could be responsible for producing the colour schemes applied to the vehicle, including any special sponsorship decals, together with the final graphic renderings and any additional team marketing materials. The graphic designer will need to liaise with the design engineer to ensure any schemes will fit the shape of the vehicle and the resources manager for additional marketing development.

Sponsorship & Marketing Manager

This person could be responsible for generating sponsorship proposals for potential sponsors, contacting firms and marketing the team through different media. They may be tasked with creating and managing the team's social media accounts as well as thinking up ways to generate interest and income for the team through marketing events.

IMPORTANT - Please register your teams online at https://stemracing.es/inscribete/ to attend Spain Regional Final as soon as you have allocated your job roles.

There are so many tasks that must be mastered, in order to design, manufacture, prepare and finally, enter a car for racing. Teamwork and project management throughout the team will be vital to your success. A real F1 team succeeds because all the people learn to work together and support each other. Remember, no one person is more important than other members in the team.

PLEASE ENSURE YOU READ AND CHECK THE TECHNICAL REGULATIONS VERY THOROUGHLY BEFORE BEGINNING THE DESIGN AND CONSTRUCTION OF YOUR STEM RACING CAR.

Design Considerations

Design Preparation

Before beginning to design your car, you will need:

- A 3D CAD solid modelling software package at your school/college. We strongly recommend the use of Autodesk Fusion 360, which can be obtained **free of charge** through the STEM Racing website at: https://stemracing.es/software/.
- Our 3D CAD file of the official STEM Racing Model Block. This can be downloaded from https://stemracing.es/software/.
- The dimensions of the STEM Racing Model Block are also available in the appendix of the Technical Regulations
- Hopefully, an endless supply of ideas!

Training

CAD packages will help you draw and develop your ideas in 3D. Of course, as with most drawing packages, it takes time to learn how to use them. Your technology teacher should be able to show you how the software works, but members of your team will need to spend some time exploring the software, so you can see what it can do and how it can help you design your F1 car. A wealth of Autodesk tutorial videos specific to the STEM Racing competition are available via our website.

Research

Investigate existing F1 car designs. Your teacher may be able to help you use the internet to find out the latest developments occurring in the world of F1 design. Concentrate your research on areas that could help your team, for example, aerodynamics and car body designs and then try to apply the principles to your own ideas.

Testing

Your team may want to consider testing a variety of car designs, or car parts, in a wind and/or smoke tunnel to evaluate their aerodynamic performance. Our partners, Ansys, are a world-class simulation software and learning tool. Students can test, refine, and optimise their car designs before race day. Ansys enables teams to determine the feasibility of ideas, analyse the aerodynamics of their design, and, ultimately, increase their car's performance, Ansys software is an invaluable tool for all competing in STEM Racing and available to download free of charge at https://stemracing.es/software/.

Manufacturing Considerations

If you choose to purchase a STEM Racing Starter Kit you will receive an Official STEM Racing Model Block, a set of 4 wheels, 4 axle bushes, 2 axles and 2 tether line guides, this is the minimum that you will need to enter the challenge.

Please note that your car design template must be at least 10mm shorter at one end, compared to the actual STEM Racing Model Block. You will not be able to machine to the extreme ends of the official STEM Racing Model Block since they are sometimes used for attaching the CNC machine fixtures. Damage could occur if the cutting tool hits any of these fixtures.

The fixture is used to stop the official STEM Racing Model Block moving whilst being machined. It also allows the block to be accurately repositioned. Please note however, that some machines will process with only one cut, others may require two or more cuts and therefore you will need to take this into account when you are designing your car.

Once machined, you can smooth down the official STEM Racing Model Block design and finish with primer and paint.

Note that only a limited amount of hand finishing to the body is allowed. You could also decorate the car body with any sponsorship stickers, decals, advertising or colour schemes.

Essential Equipment

Madcup stocks and distributes all the software, hardware, consumables and design tools (including the official STEM Racing Model Block) needed to complete the challenge.

To purchase Starter Kits for your team(s) or any equipment for the challenge please contact:

T: +34 647 934 597

E: tienda@madcup.es

E: contacto@stemracing.es

W: https://stemracing.es/material/

Consumables

Consumables for the challenge can be purchased fromhttps://stemracing.es/material/.

CAD Software

Autodesk and STEM Racing partnered to offer design tools to help prepare next-generation designers. Students and schools participating in STEM Racing now have access to an extensive portfolio of Autodesk® 3D design software free of charge. Please request this via our website: https://stemracing.es/software/.

Manufacturing Centres, Test Centres and Race Centres

STEM Racing has a number of Official Manufacturing Centres, providing a service to teams who do not have the capability of manufacturing their own car or components. These are typically schools or organisations with years of competition experience, who provide a service for the good of the competition. There may be a small cost to cover the materials, costs and time required, but these are capped at no more than £75 per car and are usually much less. Certain Manufacturing Centres also have test and race facilities, which could be crucial in the build up to a Regional, National or World Finals event. All details of accredited manufacturing, test and race centres are posted on the useful links page of the STEM Racing website https://stemracing.es/centrosdefabricacion/.

Enquiries and Questions

If in doubt, just ask. All questions and queries about the STEM Racing STEM Challenge should be emailed to: contacto@stemracing.es**.**

Competition

Explanations and definitions

ARTICLE C1 – DEFINITIONS

C1.1 Article

Each section in all documentation will be referred to as an Article which brings STEM Racing documents in line with the Fédération Internationale de l'Automobile (FIA) documentation.

C1.2 Parc Ferme

A secure area where all race cars are held to prevent unauthorised handling but to allow technical inspections to be conducted by the Judges. (Literal meaning in French of 'closed park').

C1.3 Competition Schedule

The competition program will detail the schedule of judging activities for all teams.

C1.4 Key performance indicators (KPI's)

These are portions of text that feature on the scorecards within a corresponding points range. The KPI's describe the type of evidence the Judges are looking for in order to score the team appropriately.

C1.5 Car race time value

A 'car race time' value is the actual time taken for a STEM Racing™ car to travel the track from start to finish, measured from the instant the launch pod fires to when the car breaks the finish line timing beam. In the case of reaction races, the 'car race time' value is calculated as the 'total race time' value displayed on the electronic start gate minus the 'reaction time' value displayed for that race.

C1.6 Total race time value

The 'total race time' value is displayed in the total time field on the electronic start gate at the conclusion of every race. This time is the sum of the 'car race time' value and any 'reaction time' value displayed on the electronic start gate.

C1.7 Reaction time value

A 'reaction time' value is the time recorded from the instant the five (5) start lights extinguish to the instant the start trigger is activated by the driver. This value is displayed in the reaction time field on the start gate.

C1.8 Project elements

These are any materials and resources that the team presents as part of its entry for any judging activity.

C1.9 Engineering Drawings

Hand drawn or CAD produced drawings, which along with relevant machinery and/or CAM programs, could theoretically be used to manufacture the fully assembled car by a third party. Such drawings include all relevant dimensions, tolerances and material information. STEM Racing engineering drawings include detail to specifically identify and prove compliance for the virtual cargo and wing surfaces.

C1.10 Renderings

Renderings are images intended to illustrate the three-dimensional form of an object. These can be hand drawn or CAD generated in isometric projection, oblique projection or perspective.

ARTICLE C2 – GENERAL INFORMATION

C2.1 Competing teams

- **C2.1.1** Each team must consist of a minimum of 3 students to a maximum of 6, between the ages of 11-19. Team members competing at a Regional and / or Sapin National Finals must be those registered to compete on the official online registration form. If for any reason, a team member cannot travel to an event and is to be replaced by another individual, this must be brought to the attention of STEM Racing prior to the event.

- **C2.1.2** Only the registered team members of any official competing team (maximum 6) are permitted to wear the team's uniform.
- **C2.1.3** During the competition, only the official core team members (maximum of 6) can represent the team at registration, Pit Display set up, Scrutineering review, Verbal Presentation, Design & Engineering judging and Enterprise judging, racing, on-stage presentations and any direct communication with the Chair of Judges or Event/Competition Directors.

C2.2 Team responsibilities

- **C2.2.1** Teams must read the Spain **Technical Regulations** carefully to ensure their car(s) comply with those regulations.
- **C2.2.2** Teams must read the Spain **Competition Regulations (this document)** carefully to ensure that all project elements satisfy these regulations and that they understand the requirements and procedures for all aspects of the competition and judging.
- **C2.2.3** During the competition it's the team's responsibility to ensure that team members are present at the correct time and location for all scheduled activities.
- **C2.2.4** Security of the pit display and its elements is the team's responsibility during competition.

C2.3 Role and responsibility of supervising teacher / adult.

- **C2.3.1** All supervising teachers / adults should explain all relevant information to their students.
- **C2.3.2** It is the primary responsibility of any supervising teacher/adult to ensure duty of care/well-being for all their student team members. Any concerns arising during the event in relation to this should be brought to the attention of STEM Racing immediately.
- **C2.3.3** The supervising teacher/adult is permitted to be present during any judging activity with their team but, must not interact in any way with the student team, judges or judging process. Any incident considered inappropriate will be brought to the attention of the Chair of Judges and penalty points may be applied.

C2.4 Regulations documents

- **C2.4.1** STEM Racing issues the regulations, their revisions and any amendments made.
- **C2.4.2** Competition Regulations - (this document). The Competition Regulations document is mainly concerned with regulations and procedures directly related to judging and the competition event. Competition Regulation articles have a 'C' prefix.
- **C2.4.3** Technical Regulations – a separate document which is mainly concerned with regulations that are directly related to STEM Racing™ car design and manufacture. Technical Regulation articles have a 'D' prefix for Development Class and a 'P' prefix for Professional Class.

C2.5 Interpretation of the regulations

- **C2.5.1** The final text of these regulations is in English, should any dispute arise over their interpretation, the regulation text, diagrams and any related definitions should be considered together for the purpose of interpretation.
- **C2.5.2** Text clarification - any frequently asked questions that are deemed by STEM Racing to be related to text needing clarification will be answered. The question and the clarification will be published to all teams at the same time.

C2.6 Supplementary competition regulations

Other documents may be issued by STEM Racing that provide teams with further logistic and important event information. Any supplementary regulations will be issued to all lead teachers and team managers, where the team manager has supplied STEM Racing with a contact email address.

C2.7 Design ideas and regulation compliance queries

Teams are not permitted to seek a ruling from STEM Racing, any competition official or judge before the event as to whether a design idea complies with the regulations. Rulings will only be made by the Judges at an event. Design compliance to the regulation's forms part of the competition. As in Formula 1, innovation is encouraged and STEM Racing

teams may also find, sometimes controversial ways, of creating design features by pushing the boundaries in order to get an extra competitive edge.

C2.8 Team partnerships

- **C2.8.1** STEM Racing teams are encouraged to develop mentoring partnerships with businesses, industry or higher education organisations throughout their project.
- **C2.8.2** All design work, text and scripting for all project elements presented for assessment must be wholly undertaken and created by the team. This includes all CAD and CAM data, electronic portfolio and graphic content.
- **C2.8.3** All aspects of any partnerships should also be represented in the team's portfolio. For project elements produced utilising some outside assistance, teams should be able to demonstrate to the judges a high level of understanding of, and justification for, any of the processes used.
- **C2.8.4** 'Common sense' will prevail for project elements or components that a team has purchased from a supplier. E.g. bearings, screw eye, display hardware. Teams should be able to explain and justify why a specific component was selected / purchased over other similar available components.

C2.9 Mandatory project elements for Regional and Spain National Finals entry

The following is a summary of the mandatory elements required for judging:

Regional Finals:

- One (1) STEM Racing car including all optional replacement components
- One (1) A3 or similar Design & Engineering Portfolio
- One (1) A3 or similar Enterprise Portfolio
- A 5-minute Verbal Presentation with laptop
- A Pit Display
- A4 Engineering Drawings of your completed race car
- A4 Renderings of your finished race car

Spain National Finals:

- Two (2) identical STEM Racing cars and replacement components
- One (1) A3 or similar Design & Engineering Portfolio
- One (1) A3 or similar Enterprise Portfolio
- A Pit Display
- A 10-Minute Verbal Presentation with laptop
- A4 Engineering Drawings of your completed race car
- A4 Renderings of your finished race car
- Electronic version of both portfolios, Engineering Drawings and Renders submitted to STEM Racing
- A Project Elements Submission Checklist which must include the official STEM Racing Model Block holographic sticker if applicable (see p51/52).

- **C2.9.1** Car(s) - each team must produce a minimum of one (1) race car for Regionals and two (2) identical race cars for the Spain National Finals.
- **C2.9.2** Portfolios – each team must produce the following:

D

Development Class:

- One (1) 'hard copy' 5-page maximum Design & Engineering Portfolio
- One (1) 'hard copy' 5-page maximum Enterprise Portfolio.

P

Professional Class:

- One (1) 'hard copy' 10-page maximum Design & Engineering Portfolio
- One (1) 'hard copy' 10-page maximum Enterprise Portfolio.

Portfolios (excluding front and/or back covers) presented in an A3 (or similar) sized format for exhibition within the teams' pit display. Refer to ARTICLE C5 & C6 of these regulations along with the Design & Engineering and Enterprise judging scorecard for portfolio specification and content requirements.

- **C2.9.3** Pit Display - each team will be provided with a dedicated exhibition style space for set-up of their pit display elements. The specific style and size of this space will be announced in supplementary event competition regulations. Refer to ARTICLE C8 for further pit display specifications and content requirements.
- **C2.9.4** Verbal Presentation - teams will be required to deliver a Verbal Presentation in relation to their project to the Judges. The presentation must not last longer than **5 minutes** (**10 minutes** at the Spain Nationals). Teams must bring their own laptop with any slide show or other multimedia files that need to be shown as part of their Verbal Presentation.
- **C2.9.5** Project Element Submission Checklist – teams must complete the checklist (please refer to Appendix iii) and attach their official STEM Racing Model Block holographic sticker (if applicable) for submission at the event.

C2.10 Team registration at the event

- **C2.10.1** Teams will be required to register with STEM Racing once arriving for the event. At this registration, teams will be issued with a detailed event welcome pack. The student team manager and supervising teacher for each team should attend.
- **C2.10.2** The Regional or National accreditation material issued will include the official STEM Racing 30x15mm car decals, for teams that have not manufactured their own. These decals must be fitted to each car by the team following registration and prior to the submission of their project elements.

C2.11 Submission of STEM Racing car(s)

Once race-ready car(s) have been submitted, they are considered as being in Parc Fermé.

A4 Engineering drawings and Renders MUST be handed into Parc Fermé with your ready to race car.

C2.12 Project elements to be retained by STEM Racing (Spain National Finals Only)

It is a condition of the STEM Racing Spain National Finals entry that each team permits STEM Racing to retain 1 x race car and 1 x copy of both Enterprise and Design & Engineering portfolios. This can be submitted electronically if the team wishes to keep the printed version.

C2.13 Team names

No teams participating in the challenge are permitted to use any of the Formula One Word Marks (shown below) in their team name, logo, domain name, and/or any social media handle. For example, "Infinity F1" is not allowed and should be changed to something similar such as "Infinity" or "Team Infinity". No team will be permitted to use any of the prohibited word marks within their team name when participating in STEM Racing from 2017 onwards.

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C2.14 Benefit of doubt

The chair of judges will, where appropriate, seek to use 'benefit of doubt' when the assessment of compliance is marginal or unclear. In this situation, teams will be given the benefit of doubt rather than a firm penalty if a penalty cannot be clearly measured or identified.

C2.15 Spirit of the competition

Teams are expected to act in the spirit of the competition, both before and during any STEM Racing events. Any team deemed by the chair of judges to be acting outside of the spirit of the competition, can be removed from certain or all aspects of the competition. Judges reserve the right to penalize the team from 20 to 50 points.

Any team can file a protest, *You must request the official form.* If a team summits a false protest they will be subject for the same penalties at discretion of the judges.

The spirit of the competition is simple; embrace and respect the rules and regulations, do your very best to compete legally and fairly, while contributing positively to STEM Racing. Make friends, create positive relationships, network professionally and enjoy yourselves.

ARTICLE C3 – COMPETITION AND JUDGING FORMAT

C3.1 Competition program

- **C3.1.1** Each team will be judged as per the competition program. The competition program will be formulated by STEM Racing to best and fairly accommodate all judging and other competition activities. Teams will rotate around judging activities as per this program, with each rotation usually of 15 minutes in duration.
- **C3.1.2** Judging Streams – the competition program will normally be divided into two parallel judging streams (Stream A and Stream B), to help ensure quality judging time intervals within the event time constraints. A number of strategies are implemented within the judging process, including judge briefings and judge reviews for cross-moderation to ensure there is consistency across the judging streams.

C3.2 Judging categories

There are six (6) main judging categories, each with its own team of judges and specified judging activities as detailed in further articles.

- Specification and Scrutineering Judging
- Design and Engineering Judging
- Enterprise Judging
- Verbal Presentation Judging
- Brand Identity Judging
- Racing

C3.3 Judging scorecards

The STEM Racing judging scorecards provide detailed information in relation to what the Judges will be looking for. They include key performance indicators which are referred to by the judges in awarding points during judging activities. The judging scorecards can be found from p24 of this document, alongside guidance for the corresponding judging category. Reading the scorecards carefully is important. They provide critical information for teams as to what needs to be presented for each judging category.

The judging scorecards are not to be viewed as assessment criteria but are for the purpose of ranking teams at STEM Racing events. Marks given may differ between events, so scores should not be used exclusively to determine the strengths and weaknesses of a team.

C3.4 Spain Regional and National Champions

The STEM Racing Spain Regional and National Champions trophies will be awarded to the team with the highest total score, sum of all judging categories (ARTICLE C3.5). In the case of a tied points score, the team with the highest racing score will be determined the winner.

C3.5 Point allocations

Points will be awarded to teams across six (6) categories in both Development **and** Professional Class, with maximum possible scores as detailed in the following table:

Specification and Scrutineering Judging (170 points)	
Specifications	110 points
Engineering Drawings	20 points
Renderings	20 points
Quality of Finish and Assembly	20 points
Design and Engineering Judging (180 points)	
Design & Engineering Portfolio	180 points
Enterprise Judging (160 points)	
Project Management	80 points
Sponsorship & Marketing	80 points
Brand Identity Judging (100 points)	
Corporate Identity	40 points
Pit Display	60 points
Verbal Presentation Judging (140 points)	
Technique	40 points
Composition	40 points
Subject Matter	60 points
Racing (220 points)	
Time Trials	110 points
Reaction Racing	110 points
TOTAL	**970 points**

C3.6 Classification of Technical Regulations

- **C3.6.1** The technical regulations are classified as either: **GENERAL**, **SAFETY**, **PERFORMANCE**. Please refer to the Technical Regulations for more information on compliance and penalties.

GENERAL	SAFETY	PERFORMANCE
Regulations that shape the way the car fundamentally looks and works, vital to the style of an STEM Racing car.	Mandatory rules that govern the safe running of the car. Cars must meet these rules to be considered 'safe to race'.	Rules that have a direct impact on the performance of the vehicle, these typically carry the heaviest penalties.

- **P3.6.2** If a race car is judged as being NON-COMPLIANT with any Performance Regulation they will be INELIGIBLE for the awards of: 'Fastest Car' and 'Best Engineered Car'. All Performance regulations are highlighted in yellow throughout the Technical Regulations document for each class.

Judging

Criteria and the scorecards

ARTICLE C4 – SPECIFICATION & SCRUTINEERING JUDGING (170 points)

C4.1 What will be judged?

Scrutineering judging is a detailed inspection process where all race cars plus any optional replacement components are assessed for compliance with the STEM Racing Technical Regulations. The A4 Engineering Drawings, A4 Renderings and quality of finish & assembly will also be assessed. **Refer to the scrutineering and specification judging scorecards for scoring details.**

- **C4.1.1** Optional replacement components must be identical to those fitted to all race cars and must be submitted with the car. Only the following replacement components are permitted:
    - Rear wing/support structure – maximum of three (3)
    - Front wing/support structure and / or nose cone – maximum of three (3)
    - Wheel/wheel support system – maximum of three (3) car sets

  Submitted replacement components that are determined by the judges to not be identical to that which is fitted to the car will not be allowed to be used. Submitted components will remain in Parc Fermé and only be handed back to the team if needed during racing and / or car servicing.

C4.2 Team preparation

Teams must ensure that their car(s), A4 engineering drawings, A4 renders and any optional replacement components are complete and ready for specification judging and racing before they are submitted. At the UK National Finals, teams must also submit an electronic copy of all specified project data such as scrutineering engineering drawings, which may all be referenced. *For more information, refer to ARTICLE C2.9 and C3.6.*

C4.3 Who needs to attend?

Specification & Scrutineering judging is a closed activity that no team member or supervising teacher may attend. At Spain National Finals, for selected teams there will be a specification review session scheduled that must be attended by the team manager, team design and manufacturing engineers as a minimum.

C4.4 Judging process / procedure

Teams begin specification judging with a full allocation of 110 points. Any infringements of the Technical Regulation articles, on either car, will result in points being deducted as detailed in the Technical Regulations.

There are two (2) parts to the specification judging process.

A. **Specifications** – this is conducted within the confines of Parc Fermé, where the specification Judges will scrutineer all cars submitted and optional replacement components for compliance to the Technical Regulations. A series of specially manufactured gauges will be used to broadly check compliance. Accurate measuring tools, such as Vernier callipers will then be used to closely inspect any dimensions found to be near to dimensional limits per the initial gauge inspection. Scrutineering commences immediately, as soon as cars, engineering drawings, renders and optional replacement components are submitted.

B. **A4 Engineering Drawings & Renderings –** these documents are used along with the car(s) to assess Engineering Drawings, Rendering and Quality of Finish & Assembly as on the Scrutineering Judging scorecard - this is conducted within the confines of Parc Fermé, where the specification Judges will assess both cars as per the Scrutineering scorecard.

The specific areas to be assessed are described on the scorecard and specifications sheets on the following pages. **Please note: Development and Professional Class have separate specification sheets.**

C4.5 Safe/Fit to race fix

At Spain National Finals, a special 20-minute car service time will commence prior to the start of racing, for any teams judged during initial scrutineering to have incurred a regulation failure from the list below. Cars must meet these rules to be considered 'Safe/Fit to race. If during this service time the car can be modified to comply with the failed regulation(s), the team will then only incur half the penalty points for that infringement, without being classified as having incurred a **SAFETY** infringement.

Scrutineering Judging Scorecard

Team Number:
Team Name:
School:

Scrutineering

	Developing	Secure	Strong	Exceptional	SCORE
Engineering Drawings	Little or no detail, Little or no annotation. No table of contents. No regulation compliance was shown.	Basic views included. Some dimensions are included but not sufficient annotations. Insufficient regulation compliance was shown. A basic table of contents.	Multiple views including First or Third-angle orthographic projection matching the final car. Some parts or materials are represented. Some Regulation compliance shown. Good table of contents	First or Third-angle orthographic projection matching the final car and unrendered isometric view or similar. Additional views to show sufficient detail. Parts list/bill of materials. Excellent regulation compliance shown. Complete and ordered table of contents.	
	0 1 2 3 4 5	5 6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
Rendering	Basic use of colour and 3D to show finished car.	Multiple views. Some inconsistencies matching the final car.	Multiple views. Good match to the final car Good render technique.	Multiple views. Perfect match to the final car including branding. Realistic environment and lighting High-end render technique	
	0 1 2 3 4 5	5 6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
Quality of Finish and Assembly	Poor surface finish with visible defects such as scratches, glue marks, gaps, or misaligned parts. Assembly is weak or inconsistent.	Reasonable overall finish with minor imperfections or alignment issues. Assembly is generally secure but lacks refinement. Small differences between the two cars may be visible	Clean and consistent finish across components. Parts are accurately aligned and securely assembled. Branding is neatly applied. The two cars are highly similar in quality and construction.	Exceptional, professional-quality finish with no visible defects. Precision assembly with seamless fit of all parts. Branding perfectly applied. The two cars are virtually identical in finish and build quality.	
	0 1 2 3 4 5	5 6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	

Scrutineering Total =	/60

Notes:

D

Development Class Specifications Score Card

Please enter ✓ for a pass and **F** for a fail

(8g Pack) – measured with full 8g race power pack cartridges

Team Number:
Team Name:
School:

Reg	Regulation Overview		Min/Max Quick Guide	Penalty per car	Car A	Car B	Notes
					Initial Scrutineering		
ARTICLE D3 – FULLY ASSEMBLED CAR							
D3.1.1	Designed and engineered using CAD / CAM		Check Portfolio	-5			
D3.1.2	Body manufactured using CNC only		Check Portfolio	-5			
D3.1.3	STEM Racing holographic sticker		Check submission	-5			
D3.1.4	Both Cars Identical (National Finals)		Visual Check	-5			
D3.2.1	Safe Construction – Specification judging		Safe to race at Scrutineering	-10			
D3.3	Undefined features		Check D1.1	-20			
D3.4	Total length	PP+	Min: **170mm** Max: **210mm**	-5	mm	mm	
D3.5	Total Width	PP+	Max: **90mm**	-5	mm	mm	
D3.6	Total weight	PP+	Min: **60.0g**	-10	g	g	
D3.7	Status during racing		Nothing removed	-5			
D3.8	Replacement components		Check list	-5			
ARTICLE D4 – BODY							
D4.1	Body construction		STEM Racing Model Block	-20			
D4.2	No-go-zone		Check Eng. Drawing	-25			
D4.3.1	STEM Racing Halo		Halo exits with dimensional changes	-5			
D4.3.2	STEM Racing Halo Visibility Front, Side and Plan view		Check views	-5			
D4.3.3	STEM Racing Halo Circular notch height		34.0mm (±1.0mm)	-5			
D4.3.4	STEM Racing Halo Safety Test		Load test	-5			
D4.4	STEM Racing Helmet		inlcuded	-5			
D4.5	STEM Racing logo decal location		Check size and location	-5			
				Assessed by: (Initials)			
				Checked by: (Initials)			

Page 1 Notes

D

Development Class Specifications Score Card

Please enter ✓ for a pass and **F** for a fail

(8g Pack) – measured with full 8g race power pack cartridges

Team Number:
Team Name:
School:

Reg	Regulation Overview		Min/Max Quick Guide	Penalty per car	Car A	Car B	Notes
					Initial Scrutineering		
ARTICLE D5 - POWER UNIT CARTRIDGE CHAMBER							
D5.1	Distance from track surface	PP +	Min: **30mm** Max: **40mm**	-5	mm	mm	
D5.2	Power unit cartridge visibility **(8g)**	PP +	No obstructions in rear view	-10			
ARTICLE D6 – WHEELS							
D6.1	Number and location		**4, 2 x 2** / standard design	-25			
D6.2	Visibility (top, side and bottom views)		Not obscured	-25			
D6.3	Visibility in the front view	PP +	Only obscured below **20mm**	-10	mm	mm	
D6.4	Race track contact		All 4 wheels touching track	-2.5 PW	FL:	FL:	
					FR:	FR:	
					RL:	RL:	
					RR:	RR:	
D6.5	Rotation		Reasonably minimal effort	-5			
				Assessed by: (Initials)			
				Checked by: (Initials)			

Page 2 Notes:

D

Development Class Specifications Score Card

Please enter ✓ for a pass and **F** for a fail

(8g Pack) – measured with full 8g race power pack cartridges

Team Number:
Team Name:
School:

Reg	Regulation Overview	Min/Max Quick Guide	Penalty per car	Car A (Initial Scrutineering)	Car B (Initial Scrutineering)	Notes
ARTICLE D7 – FRONT WING						
D7.1	Description and placement	Refer D1.10	-25			
D7.2	Wing identification	Check Eng Drawing	-5			
D7.3	Construction and Rigidity	Span constant during racing + rigid	-5			
D7.4	Front wing location	In Front of FW CL	-10			
D7.5	Visibility of front wing	Visible from Front	-15			
D7.6.1	Front wing span PP+	Min: **60mm**	-5	mm	mm	
D7.6.2	Front wing chord	Min: **15mm** Max: **30mm**	-5	mm	mm	
D7.6.3	Front wing thickness	Min: **5mm** Max: **15mm**	-5	mm	mm	
ARTICLE D8 – REAR WING						
D8.1	Description and placement	F & R & Height (D1.10)	-25			
D8.2	Wing identification	Check Eng Drawing	-5			
D8.3	Construction and Rigidity	Span constant during racing + rigid	-5			
D8.4	Rear wing location	In Front of FW CL	-10			
D8.5	Rear wing height	Min: 35mm	-10			
D8.6.1	Rear wing span PP+	Min: **60mm**	-5	mm	mm	
D8.6.2	Rear wing chord	Min: **15mm** Max: **30mm**	-5	mm	mm	
D8.6.3	Rear wing thickness	Min: **5mm** Max: **15mm**	-5	mm	mm	
ARTICLE D9 – Tether Line Guides						
D9.1	Location	2 guides, **15mm** fore/aft CL's	-10			
D9.2	Internal dimension	Min: **3.5mm** Max: **6mm**	-5	mm	mm	
D9.3	Tether line guide safety	**200g test**	-10			
			Assessed by: (Initials)			
			Checked by: (Initials)			

Page 3 Notes:

Professional Class Specifications Scorecard

For clarification on individual regulations, refer to the Professional Class Technical Regulations.
Please enter for a pass and **F** for a fail
(8g Pack) – measured with full 8g race power pack cartridges

Team Number:
Team Name:
School:

Reg	Regulation Overview	Min/Max Quick Guide	Penalty Per Car	Initial Scrutineering			Post Safety Fix			Post Review Interview			Remarks
				Car A	Car B	CoJ CS	Car A	Car B	CoJ CS	Car A	Car B	CoJ CS	
ARTICLE T3 – FULLY ASSEMBLED CAR													
T3.1.1	Designed and engineered using CAD / CAM		-5										
T3.1.2	Body manufactured using CNC only	Check unfinished body	-5										
T3.1.3	STEM Racing holographic sticker	Must be supplied	-5										
T3.1.4	Race cars identical geometry (National Finals)	Visual check	-5										
T3.2.1	Safe Construction – Specification judging	Check T3.2.1	-10										
T3.3	Undefined features	Check T1.1	-20										
T3.4	Total width PP+	Min: 65 Max: 85	-5	mm	mm								
T3.5	Total height (8g Pack) PP+	Max: 65	-5	mm	mm								
T3.6	Total weight PP+	Min: 48.0g	-10	g	g								
T3.7	Track clearance (8g Pack) PP+	Min: 1.5	-10	mm	mm								
T3.8	Status during racing	Nothing removed	-5										
T3.9	Replacement Components	Identical to fitted											
	Nose Cone & Front Wing Assembly	Max: 2	-5										Supplied:
	Rear Wing Assembly	Max: 2	-5										Supplied:
	Front Wheels	Max: 4	-5										Supplied:
	Front Wheel Support Structure	Max: 2	-5										Supplied:
	Rear Wheels	Max: 4	-5										Supplied:
	Rear Wheel Support Structure	Max: 2	-5										Supplied:
	Front tether line guide	Max: 2	-5										
	Rear tether line guide	Max: 2	-5										
			Assessed by: (Initials)										
			Checked by: (Initials)										

Page 1 Notes:

Professional Class Specifications Scorecard

For clarification on individual regulations, refer to the Professional Class Technical Regulations.
Please enter for a pass and **F** for a fail
(8g Pack) – measured with full 8g race power pack cartridges

Team Number:
Team Name:
School:

Reg	Regulation Overview	Min/Max Quick Guide	Penalty Per Car	Initial Scrutineering			Post Safety Fix			Post Review Interview			Remarks
				Car A	Car B	CoJ CS	Car A	Car B	CoJ CS	Car A	Car B	CoJ CS	
ARTICLE T4 – BODY													
T4.1	Body construction	SR Model Block only	-20										
T4.2	Virtual cargo – See T4.2 for dims	Between axles	-25										
T4.3	Virtual cargo identification	Check Eng. drawing	-5										
T4.4.1	Halo	Halo exists	-10										
T4.4.2	Halo visibility front and side views	Side & front view	-10										
T4.4.3	Halo visibility	Refer to Article T4.4.3	-10										
T4.4.4	Halo circular notch height	34.0 (±1.0)	-5	mm	mm								
T4.4.5	Halo safety test	1kg test, safe to race	-5										
T4.4.5	Halo safety test	300g static load	-5										
T4.5	Helmet	Included	-5										
T4.6	STEM Racing logo decal location	Between Front & Rear wheels 100% Visible	-5										
T4.7	Team Number (Nationals Only)	Min: 4.0	-2	mm	mm								
T4.8	Decal Thickness	Max: 0.5	-5										
ARTICLE T5 – RACE POWER PACK CARTRIDGE CHAMBER													
T5.1	Diameter	Min: 18 Max: 18.5	-5	mm	mm								
T5.2	Distance from track surface (8g Pack) PP+	Min: 30 Max: 40	-5	mm	mm								
T5.3	Depth	Min: 45 Max: 58	-5	mm	mm								
T5.4	Max angle of chamber (8g Pack)	Min: -3° Max: 3°	-5	°	°								
T5.5	Chamber safety zone (8g Pack)	Min: 3	-10										
T5.6	Power unit cartridge visibility (8g Pack) PP+	Min: 5mm top view	-10	mm	mm								
ARTICLE T6 – TETHER LINE GUIDES													
T6.1	Location	10mm in front / front axle 10mm behind / rear axle	-10										
T6.2	Internal diameter	Min: 3.5 Max: 6	-5										
T6.3	Tether line guide safety	300g test, safe to race	-10										
			Assessed by: (Initials)										
			Checked by: (Initials)										

Page 2 Notes:

Professional Class Specifications Scorecard

For clarification on individual regulations, refer to the Professional Class Technical Regulations.
Please enter for a pass and **F** for a fail
(8g Pack) – measured with full 8g race power pack cartridges

Team Number:
Team Name:
School:

Reg	Regulation Overview	Min/Max Quick Guide	Penalty Per Car	Initial Scrutineering Car A	Initial Scrutineering Car B	Initial Scrutineering CoJ CS	Post Safety Fix Car A	Post Safety Fix Car B	Post Safety Fix CoJ CS	Post Review Interview Car A	Post Review Interview Car B	Post Review Interview CoJ CS	Remarks
ARTICLE T7 – WHEELS AND WHEEL SUPPORT STRUCTURES													
T7.1	Number and location	4, 2 x 2	-25										
T7.2	Distance between opposing wheels PP+	Front Min: 38 Rear Min: 30	-2.5	F: mm R: mm	F: mm R: mm								
T7.3	Wheelbase PP+	Min: 120 Max: 140	-5	mm	mm								
T7.4	Track contact width PP+	Front Min: 12 Rear Min: 15 exc. chamfer/fillet	-2.5 per wheel	FL: mm FR: mm RL: mm RR: mm	FL: mm FR: mm RL: mm RR: mm								
T7.5	Diameter PP+	Min: 28 Max: 32	-2.5 per wheel	FL: mm FR: mm RL: mm RR: mm	FL: mm FR: mm RL: mm RR: mm								
T7.6	Racetrack contact (8g Pack)	All 4 in contact	-2.5 per wheel	FL: FR: RL: RR:	FL: FR: RL: RR:								
T7.7	Rolling surface	Consistent, no tread	-2.5 per wheel	FL: FR: RL: RR:	FL: FR: RL: RR:								
T7.8	Rotation	Abs. Min rolling incline: 3°	-5 per wheel	FL: FR: RL: RR:	FL: FR: RL: RR:								
T7.9	Visibility in top and bottom views	In front of front wheels Min: 5mm	-2.5	mm	mm								
		Behind front wheels Min: 15mm	-5	mm	mm								
		In front of rear wheels Min: 5mm	-5	mm	mm								
		Behind rear wheels Min: 5mm	-2.5	mm	mm								
T7.10	Visibility in side views	Side views	-10										
T7.11	Visibility in front view (8g Pack) PP+	Max obscured 20mm	-10	mm	mm								
T7.12.1	Wheel support systems	Cylindrical volume	-5										
T7.12.2	Wheel support systems identification	Check Eng. drawing	-5										
T7.13	Wheel Safety Test	300g test per wheel	-2.5										
			Assessed by: (Initials)										
			Checked by: (Initials)										

Page 3 Notes:

Professional Class Specifications Scorecard

For clarification on individual regulations, refer to the Professional Class Technical Regulations.
Please enter for a pass and **F** for a fail
(8g Pack) – measured with full 8g race power pack cartridges

Team Number:
Team Name:
School:

Reg	Regulation Overview	Min/Max Quick Guide	Penalty Per Car	Initial Scrutineering			Post Safety Fix			Post Review Interview			Remarks
				Car A	Car B	CoJ CS	Car A	Car B	CoJ CS	Car A	Car B	CoJ CS	
ARTICLE T8 – NOSE, FRONT WING AND WING SUPPORT STRUCTURES													
T8.1	Nose, front wing & wing support structure identification	Check Eng. drawing	-5										
T8.2	Nose cone assembly dimension	Max: 40	-5	mm	mm								
T8.3	Front wing(s) description and placement	Wings exist	-5										
T8.4	Front wing(s) construction and rigidity	Span constant during racing + rigid	-5										
T8.5.1	Front wing and wing support structure location	In front of Reference Plane A & below 25mm	-10										
T8.5.2	Front wing location	In front of Reference Plane A & below 20mm	-10										
T8.5.3	Front wing and end plate location	Outside the minimum legal span	-10										
T8.6.1	Front wing span PP +	Min: 50	-2	mm	mm								
T8.6.2	Front wing chord PP +	Min: 15 Max: 25	-1	mm	mm								
T8.6.3	Front wing thickness PP +	Min: 2 Max: 6	-1	mm	mm								
T8.7	Front wing clear airflow	5mm clear 'air' space	-5	mm	mm								
T8.8	Front wing visibility	Visible and not obstructed in front view	-10										
ARTICLE T9 – REAR WING AND WING SUPPORT STRUCTURES													
T9.1	Rear wing and wing support structure identification	Check Eng drawing	-5										
T9.2	Rear wing(s) description and placement	Wings exist	-5										
T9.3	Rear wing(s) construction and rigidity	Span constant during racing + rigid	-5										
T9.4.1	Rear wing and wing support structure location	Wing + Support rear of reference plane B	-10										
T9.4.2	Rear overhang length	Max: 40	-5										
T9.4.3	Rear overhang height	Max: 65	-5										
T9.5.1	Rear wing span PP +	Min: 50	-2	mm	mm								
T9.5.2	Rear wing chord PP +	Min: 15 Max: 25	-1	mm	mm								
T9.5.3	Rear wing thickness PP +	Min: 2 Max: 6	-1	mm	mm								
T9.5.4	Rear wing height deviation PP +	Max: 15	-1	mm	mm								
T9.6	Rear wing clear airflow	Min: 5	-5	mm	mm								
T9.7	Rear wing visibility	Visible and not obstructed in front view	-10										
			Assessed by: (Initials)										
			Checked by: (Initials)										

Page 4 Notes:

ARTICLE C5 – DESIGN & ENGINEERING JUDGING (180 points)

C5.1 What will be judged?

The Design & Engineering judges will mark your 5-page or 10-page Design & Engineering Portfolio so that they can assess the team's car design and use of CAD/CAM technologies along with the quality of manufacture of all race cars submitted.

C5.2 Team preparation

A laptop can be taken to Design & Engineering judging along with any other items which may help the team explain any Engineering or manufacturing concepts. The Design & Engineering judges will **not** have access to the car(s) submitted in Parc fermé so bring your pit display car, or any other car you deem helpful. Preparation should include careful reading of the scorecard. The key performance indicators for the design process, application of CAD / CAM, analysis and associated data organisation, describe what the judges will be looking for.

C5.3 Who needs to attend?

This judging session must be attended by the team manager and team design and manufacturing engineers as a minimum.

C5.4 Judging process / procedure

Teams will be awarded points as per the key performance indicators shown on the Design & Engineering scorecard. Judges will review the Design & Engineering portfolio in a 'closed to teams' session programmed before the commencement of scheduled judging sessions. The scheduled Design & Engineering judging interview session will focus on the overall Engineering and Design of the car. This is an informal interview where Judges will ask the team to demonstrate their CAD / CAM work and query teams on what they have done. The quality of car manufacture and car assembly will be judged during a separate 'closed to teams' session. *Please note: The Best Engineered Car award takes into account any penalties occurred through damage during racing (please refer to C10.1.3 for more details).*

C5.5 Design & Engineering Portfolio requirements

The Design & Engineering portfolio must be in a printed 'hard copy' format or saved as a PDF of A3 or similar size. **Spain National Finals:** teams must also provide an electronic copy of their Enterprise and Design and Engineering portfolio to STEM Racing. Submission details will be provided to teams prior to the event.

Development Class: The portfolio is limited to **5 pages** of content, which **does not** include the front and back covers. This should be 5 single sided sheets. If a portfolio comprises more than 5 pages, the Judges will only assess the first 5 PRINTED pages after the front cover.

Professional Class: The portfolio is limited to **10 pages** of content, which **does not** include the front and back covers. This can be 10 single sided or 5 double sided sheets. If a portfolio comprises more than 10 pages, the Judges will only assess the first 10 PRINTED pages after the front cover.

There MUST be content related to the use of CAM and CNC manufacturing included in the portfolio and this will be referenced by the Engineering Judges. An orthographic drawing and 3D render must also be included in the portfolio, refer ARTICLE C2.10. Content related to the car, design ideas, design development, research, testing and evaluation are commonly presented within the portfolio.

Please note: Front and back covers do not contribute towards the portfolio assessment in any way, these are purely presentation items.

The specific areas to be assessed are described on the scorecard on the following page.

Design & Engineering Scorecard

Team Number:
Team Name:
School:

	Developing	Secure	Strong	Exceptional	SCORE
Design & Engineering Portfolio Only Assessment					
Design Concepts	Single or minimal concepts for car components with no links to research. No relevance to final car	Basic concepts of car components with limited links to research. Limited relevance to final car.	Good technically inspired ideas that are relevant for different car components linked to research.	Excellent technically inspired ideas for multiple car components with research-detailed. Relevance of the concept strongly justified.	
	1 2 3 4 5	5 6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
3D Modelling	Minimal application of 3D modelling techniques. Only final design 3D modelled.	Basic use of 3D modelling tools and techniques. More than 1 design included with different iterations.	Good use of advanced 3D modelling tools, showcasing skill and technique. Dimensional constraints of the STEM RACING model block considered. Design approach explained. Design for manufacture considerations noted. (ie fillets, tolerance of machining).	Expert use of a wide range of complex 3D modelling techniques, demonstrating exceptional skill and innovation. Design for manufacture directs process. (ie machining tool availability, fit clearances). Quality of CAD surfaces analysed.	
	1 2 3 4 5	5 6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
Application of Computer Aided Analysis	Poor choice and no justification of simulation parameters. Weak analysis with poorly presented/no results. No design choices made based on FEA/CFD study.	Limited choice and justification of simulation parameters. Limited analysis and results. Little to no design choices made based on FEA/CFD study.	Well-justified choice and understanding of simulation Good analysis with clear, wellpresented results. Some design choices made based on FEA/CFD study.	Excellent choice & understanding of simulation parameters. Detailed analysis with clear, wellpresented results. Proven design improvements made based on FEA/CFD study	
	1 2 3 4 5	5 6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
Use of CAM/CNC	No or minimal evidence of CAM/CNC understanding or manufacturing.	Basic evidence of CAM/CNC processes and manufacturing.	Good use and understanding of CAM/CNC processes to achieve manufacturing goals. Manufacturing issues noted with limited problem solving.	Evidence of excellent understanding of CAM/CNC technologies. Appropriate techniques and processes used to achieve manufacturing goals. Manufacturing issues discussed with innovative problem-solving solutions.	
	1 2 3 4 5	5 6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
Other Manufacturing & Assembly	No or minimal manufacturing presented. No or minimal consideration of quality assurance and workplace safety documented. No or minimal justification of outsourcing.	The manufacturing process is mentioned without detail. Basic consideration of quality assurance and workplace safety documented. Basic justification of outsourcing.	Good manufacturing process and stages described. Good consideration of quality assurance and workplace safety documented. Appropriate use of manufacturing resources documented (i.e. tools, finishes, jigs, fixtures). Outsourcing clearly explained and justified.	Details all manufacturing stages and processes. Quality assurance and workplace safety considerations evident. Appropriate outsourcing justified with make vs buy analysis.	
	1 2 3 4 5	5 6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
Research & Development	No or limited evidence of R&D.	Basic evidence of R&D with some principles considered.	Some scientific & mathematical theories and principles considered. Logical research based design developments explained and justified.	Relevant R&D throughout the entire product design & development cycle. Design concept developments refined and justified from research & test findings.	
	1 2 3 4 5	5 6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
Testing	No or little evidence of testing on the fully assembled car and individual components.	Limited testing. Some evidence of method and outcomes on the fully assembled car and individual components.	Good testing. Different evidence of method and outcomes. Some evidence of virtual and physical testing on the fully assembled car and individual components.	Appropriate testing with excellent methods and outcomes documented. Comprehensive evidence of virtual and physical testing on the fully assembled car and individual components.	
	1 2 3 4 5	5 6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
Design Process Evaluation	No or limited Ideas or process evaluations at different stages. No or limited documentation of evaluation-linked improvement actions.	Basic Ideas or process evaluations at different stages. Basic documentation of evaluation-linked improvement actions.	Multiple Ideas or process evaluations at different stages. Good documentation of evaluation-linked improvement actions.	Excellent ongoing idea evaluations linked to improvement actions. Comprehensive documentation of evaluation-linked improvement actions.	
	1 2 3 4 5	5 6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
Document Presentation	Difficult to follow with basic presentation standard.	Basic organisation.	Good and clear structure, well organised.	High impact and professional throughout. Consistent and clear organisation.	
	1 2 3 4 5	5 6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
				Design & Engineering Portfolio Only Assessment Total =	/180

Notes:

ARTICLE C6 – ENTERPRISE JUDGING (160 points)

C6.1 What will be judged?

The Enterprise judges will mark your 5-page or 10-page Enterprise Portfolio. Judges will be looking for the following:

- Project Management (how your team has planned and carried out all the work required, following processes and working together as a team to complete your objectives)
- Sponsorship & Marketing (the activities you have carried out to raise awareness, support and finance to help your team function in order to complete the project)

C6.2 Team preparation

Each team must prepare an Enterprise Portfolio as per ARTICLE C2.9. Most importantly, teams need to read the Enterprise judging scorecard carefully to ensure they have met all the areas to be assessed. It is each team's decision how and where these areas are presented. Teams should be mindful of the time constraints of judging when making these decisions.

C6.3 Who needs to attend?

All team members must be present during the Enterprise judging session.

C6.4 Judging process / procedure

Teams will be awarded points as per the key performance indicators shown on the Enterprise scorecard. Judges will review the Enterprise portfolio in a 'closed to teams' session programmed before the commencement of scheduled judging sessions. The scheduled Enterprise judging interview session will focus on the overall Project management and Sponsorship & Marketing activities conducted by the team. This is an informal interview where Judges will ask the team to demonstrate their processes and query teams on what they have done.

C6.5 Enterprise Portfolio requirements

The Enterprise portfolio must be in a printed 'hard copy' format or saved as a PDF of A3 or similar size. **SPAIN National Finals:** teams must also provide an electronic copy of their Enterprise and Design and Engineering portfolios to STEM Racing. Submission details will be provided to teams prior to the event.

Development Class: The portfolio is limited to **5 pages** of content, which **does not** include front and/or back covers. This should be 5 single sided sheets. If a portfolio comprises more than 5 pages, the Judges will only assess the first 5 PRINTED pages excluding the front cover.

Professional Class: The portfolio is limited to **10 pages** of content, which **does not** include front and/or back covers. This can be 10 single sided or 5 double sided sheets. If a portfolio comprises more than 10 pages, the Judges will only assess the first 10 PRINTED pages excluding the front cover.

C6.6 Project Management Guidebook

As mentioned previously in this document, STEM Racing has produced a guidebook in partnership with Project Management Institute Educational Foundation (PMIEF), to help equip teams with industry-level terminology and techniques to employ in their project work. Using the correct terminology is important, but just as crucial is understanding the meaning of these phrases and words. Teams are advised to learn the basics of professional Project Management through the guide, to increase their chances of successfully achieving the higher KPI's in the Enterprise scorecard. Using the guide is not mandatory, nor is it a comprehensive guide to all the activities your teams may undertake, but we have created a document that can add to your teams understanding of much of the Project Management work they already do, while giving a few ideas to help them improve further. STEM Racing would like to acknowledge the detailed and professional work of PMIEF in helping us create this document.

The STEM Racing Project Management Guidebook can be downloaded directly from: https://stemracing.es/descargas/.

The specific areas to be assessed are described on the scorecard on the following page.

Enterprise Scorecard

Team Number:
Team Name:
School:

	Developing	Secure	Strong	Exceptional	SCORE
Project Management					
Scoping and Project schedule	No or limited evidence of tasks to be completed.	Evidence of a project schedule, showing a breakdown of time required to complete essential tasks.	Clear evidence of a project schedule and Work Breakdown Structure. Detailed Gantt chart created to identify all tasks, dependencies, and time estimations. Resource allocation is included for major project phases.	Comprehensive project schedule with detailed Work Breakdown Structure and Gantt chart. All tasks, dependencies, and time estimations are clearly identified. Key dependencies are identified, and critical path analysis is included (with evidence the team monitored critical tasks and took action when they slipped).	
	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
Roles and Responsibilities	No or limited evidence of clear roles and responsibilities within team.	Team roles and responsibilities identified, with some evidence of task and/or activity breakdown.	Team members identified and a structured team created with defined job functions and appropriate responsibilities. Evidence of a basic Responsibility Assignment ('RACI') Matrix.	Highly structured team with clearly defined job functions, skill requirements, and detailed responsibilities. Comprehensive RACI Matrix covering all project activities and key decisions. Evidence of team development (skills planning/onboarding) and strategies for managing team dynamics.	
	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
Budget and Risk Management	No or limited evidence of strategies to manage budget and/or resources.	Some evidence of resources required and how they are to be acquired and managed. Some evidence of budgeting.	Clear evidence of budgeting and use of basic accounting methods to track expenditure. Identification of where, when, and how resources are to be acquired and used. Initial cost estimates for major project components.	Comprehensive budgeting with detailed cost breakdown and methods for tracking expenditure (baseline vs. actual). Thorough resource management plan, including procurement strategies, resource allocation, and utilization forecasts. Cost–benefit rationale documented for key project decisions.	
	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
Communication, Monitoring & Controlling	No or limited or isolated project evaluation.	Ongoing evaluation of most areas. Documented evidence of problems identified and suggested solutions.	Regular 'Status Reports', documenting tasks signed off and highlighting areas of concern. Scope creep identified with a clear action plan for tasks that overrun. Key performance indicators (KPIs) tracked and reported.	Regular and detailed tracking processes consistently applied. Comprehensive status reports include: analysis of work completed versus resources used, comparison of planned versus actual progress, KPI trends, forecasting/predictions of future performance, and clear procedures for managing project changes (formal change control) with modifications documented in a change/issue log.	
	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
				Project Management Total	/80
Sponsorship & Marketing					
Marketing	Lack of coherent marketing strategy, poorly developed marketing materials, and minimal content relevance.	Partially coherent marketing strategy, average quality marketing materials, needs enhancement in content relevance.	Good marketing strategy, reasonably developed marketing materials, and satisfactory content relevance.	Well-defined marketing strategy, high-quality marketing materials, and highly relevant content.	
	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
Sponsorship	No or incomplete Sponsor/partner hierarchy. Limited understanding of sponsorship. No evidence of ROI.	Basic Sponsor/partner hierarchy and benefits included. Partial understanding of sponsorship. Some evidence of return of investment (ROI) to relevant sponsors.	A range of sponsor/partner hierarchy and benefits identified. Good understanding of sponsorship, reasonable investment, and satisfactory ROI to relevant sponsors.	Sponsor/partner hierarchy and benefits detailed and justified. Range of relevant sponsors/partners showing mutually beneficial relationships. Creative activities linked to return of investment (ROI).	
	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
Community & Social Impact	No or limited evidence of community or social engagement. No documented activity beyond the team's own project. No consideration of impact on others.	Basic evidence of community or social engagement. Some activities documented, with limited planning. Minimal consideration of reach or benefit to others.	Good evidence of planned community or social engagement. Activities purposeful and documented. Reasonable consideration of how the team's work inspires or benefits others, with some evidence of reach.	Strong evidence of meaningful community or social engagement, well-planned and documented. Clear intent to inspire others, with well-evidenced impact and lasting benefit beyond the competition season.	
	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
Document Presentation	Poor formatting, lack of structure. Minimal visual appeal in the document.	Average formatting with some structure. Needs improvement in the document visual appeal.	Good formatting, structured document. Satisfactory document visual appeal. Good organisation.	Excellent formatting, well-structured document, and highly appealing visually. High impact and professional throughout. Consistent and clear organisation.	
	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
				Sponsorship & Marketing Total	/80
				Initiating + Planning + Executing + Monitoring and Controlling = Project Management Total =	/160

ARTICLE C7 – VERBAL PRESENTATION JUDGING (140 points)

C7.1 What will be judged?

- Presentation technique (how your team comes across during the presentation)
- Presentation composition (how well you structure your presentation)
- Subject Matter (the topics which need to be talked about)

C7.2 Team preparation

Each team is required to prepare a **5-minute (Regional) and 10-minute (Spain National Finals)** Verbal Presentation as per the requirements at ARTICLE C2.9.4. Any multimedia content, slides etc. must be saved on and shown, using the team's own laptop. Teams must have all presentation resources tested and ready with them for Verbal Presentation judging. Most importantly, teams should read the Verbal Presentation judging scorecard carefully to ensure their verbal presentation features all elements and content that the judges will be looking for.

C7.3 Who needs to attend?

All team members must be present during the Verbal Presentation judging session.

C7.4 Judging process / procedure

Verbal Presentation judging is scheduled for the same duration of other judging sessions, usually 15 minutes. Teams will be given an opportunity at the start of their time to set-up and test their laptop and any other presentation technologies and resources. The team will inform the judges when they are ready to begin. The judges start timing the 5-minute/10-minute duration and will provide a discreet time warning signal when one minute of presentation time remains. The team will be asked to cease presenting when the time limit has been reached. At the conclusion of the team's presentation time, the judges may choose to provide some feedback and / or ask any clarifying questions they feel necessary.

C7.5 Verbal presentation judging provisions

STEM Racing will provide a dedicated private space, such as a small meeting room, where each team will deliver their presentation to the judges. This space will include a data projector, screen and multimedia sound system. These will be in fixed positions but usually with sufficient cable length to allow teams some freedom for choosing where they wish to locate their laptop. A single table will also be made available with its use and location in the presentation space being optional.

C7.6 Verbal presentation video recordings

The Verbal Presentations of all teams may be video recorded by STEM Racing for the purpose of judging review and/or post event publicity and promotional purposes by STEM Racing™.

The specific areas to be assessed are described on the scorecard on the following page.

Verbal Presentation Scorecard

Team Number:
Team Name:
School:

	Developing	Secure	Strong	Exceptional	SCORE
Technique					
Engagement & Presentation Dynamics	Monotonous presentation, lack of visual aids, and minimal interaction with audience. Poor delivery technique.	Limited team dynamics, some visual aids. Limited delivery technique and interaction with the audience.	Good team dynamics, effective visual aids, Good delivery and interaction with the audience.	Excellent engagement, captivating and highly interactive delivery, and strong audience connection. Exceptional team dynamics, and impactful visual aids.	
	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
Team Contribution	Single team member taking the lead in presentation.	Minimal team participation during the presentation.	Good contributions from most team members.	Excellent teamwork with all members participating effectively.	
	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
				Technique Total	/40
Composition					
Content Quality, Relevance & Subject Understanding	Irrelevant or outdated content, lack of depth, and poor relevance. Unclear explanations.	Partially relevant content, some depth, needs improvement in quality and explanations.	Relevant content, good depth, and reasonably high-quality information. Clear explanations.	Highly relevant content, profound depth, and exceptional quality information with articulate explanations.	
	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
Time, Clarity and structure of content	Severe time management issues, with significant rushing or excessive time taken. Less than 3 minutes or more than 7 minutes. Incoherent structure, unclear message, and disorganised content.	Time management issues are evident, with noticeable rushing or excessive time taken. Less than 4 minutes or more than 6 minutes. Partially clear structure, some coherence, needs better content organisation.	Good flow and time management of each topic with minimal rushing or excessive time taken. Clear structure, coherent flow, and organised content.	Excellent time management and balance of each topic without exceeding the time limit. Excellent structure, crystal-clear message (concept), and highly organized content. Excellent attention to detail.	
	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
				Composition Total	/40
Subject					
Innovation	Little project innovation presented with no justifications.	Average project innovations are described but with no justification.	Good project innovations are described and justified and connected to competition elements.	Excellent innovations related to competition elements, or other aspects with high positive project impact.	
	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
Collaboration	None or Little collaboration with industry or higher education mentioned.	Some collaboration with industry or higher education is mentioned.	Good description of collaboration with industry and higher education.	Excellent justification of collaborations with industry and higher education. Links to learning and project outcomes.	
	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
STEM Racing™ learning journey	No or limited real reflections discussed.	Basic explanation of some learning outcomes for some team members.	Good explanation of some learning outcomes for all team members.	A range of personal, life-long learning and career skills acquired and identified as project outcomes for all team members.	
	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
				Subject Total	/60
				Technique Total + Composition Total + Subject Total = Verbal Presentation Total =	/140

Notes:

ARTICLE C8 – BRAND IDENTITY JUDGING (100 points)

C8.1 What will be judged?

The Brand Identity judges will assess each teams' Pit Display and overall Corporate Identity, through all project elements.

C8.2 Team Preparation

Each team must prepare a Pit Display as per ARTICLE C2.9. Most importantly, teams need to read the Brand Identity judging scorecard carefully to ensure that all areas to be assessed are included within the design of their Pit Display and/or additional competition project elements. The judges will assess each teams' Corporate identity through the Pit Display and all other project elements, so it's important to have a continuous theme throughout all your work.

C8.3 Who needs to attend?

All team members must be present during the Pit Display judging session.

C8.4 Judging process / procedure

The Brand Identity judging will take place at each teams Pit Display. The Judges will usually introduce themselves then ask the team to stand clear of their display so the Judges can conduct assessments, while asking further questions about the work. Outside judging slots, the Judges will also be given some time to conduct pre-judging and review of each team's Pit Display and other competition elements, in order to accurately assess Corporate Identity.

C8.5 Pit Display setup and parameters

- **C8.5.1** At Regional Finals, teams will be given a classroom style table (no bigger than 2m x 1m) to present their pit display. At Spain National Finals, STEM Racing will provide each team with an exhibition style display booth approximately 2m wide x 1m deep.
- **C8.5.2** At Spain National Finals, no part of the teams completed Pit Display is allowed to protrude beyond the physical dimensions of their allocated pit space. This includes anything that might protrude above the pit space highest point e.g. flags.
- **C8.5.3** **ONLY** student team members are permitted to set-up their pit displays. There must be no supervising teacher / adult or other outside assistance, unless deemed by STEM Racing to be a health and safety issue.

IMPORTANT HEALTH & SAFETY: Please ensure that Health and Safety measures are considered when working on all aspects of your Pit Display. STEM Racing reserves the right to apply a penalty of **up to 50 points** at the discretion of the Chair of Judges for unsafe activity.

- **C8.5.5** STEM Racing and / or the Chair of Judges may instruct a team to take action to reduce noise or remove display inclusions deemed to be inappropriate. STEM Racing will instruct teams to remove or alter any display inclusions considered to be a safety hazard.
- **C8.5.6** Any electrical appliance connected to the power supply must be PAT tested and approved. Please note, at Regional Finals there may be no availability of power for teams, so it is advisable not to rely on this assumption for your display.

The specific areas to be assessed are described on the scorecard on the following page.

Brand Identity Scorecard

Team Number:
Team Name:
School:

	Developing	Secure	Strong	Exceptional	SCORE
Pit Display					
Sustainability	No or limited understanding and implementation of sustainable practices. No or minimal awareness of environmental impact.	Partial understanding and inconsistent implementation of sustainable practices. Needs improvement in awareness of environmental impact. Some evidence of implementation.	Good understanding and moderate implementation of sustainable practices. Some awareness of environmental impact. Implementation documented considering different factors such as economic, environmental, and social.	Strong understanding and effective implementation of sustainable practices. High awareness of environmental impact and active involvement in sustainability initiatives considering economic, environmental, and social factors.	
	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
Visual appearance	Limited, relevant graphics or advertising methods employed	Attractive display, including relevant graphic elements and implementation of some advertising methods	Professional looking display, incorporating highly effective graphics, use of ambient advertising and use of lighting to enhance display	Outstanding visual appearance demonstrated through exceptional professionalism, highly effective use of layout, colour and lighting, excellent build quality, strong branding consistency and an innovative pit display with high visual impact.	
	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
Pit Display Content	Limited or unclear pit display content with minimal relevant project information or supporting evidence.	Basic project information evident with some use of supporting content, multimedia or interactive elements.	Effective pit display content demonstrated through relevant technical and promotional information, clear communication, appropriate multimedia integration and interactive elements that support visitor understanding.	Outstanding pit display content demonstrated through comprehensive and highly relevant project information, excellent use of multimedia and interactive elements, strong educational value and highly effective communication of technical, commercial and project development content to visitors and judges.	
	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
				Pit Display Total	/60
Corporate Identity					
Graphic Identity	Inconsistent, unclear or limited graphic identity with minimal evidence of branding consistency across project elements.	Basic graphic identity evident with some consistency in logo usage, colours, typography and branding across project outputs.	Effective graphic identity demonstrated through consistent branding, professional implementation of visual elements and clear integration across project outputs including the car, uniforms, portfolio and pit display.	Outstanding graphic identity demonstrated through exceptional visual consistency, highly professional implementation of branding elements, strong brand recognition and seamless integration of logo, typography, colour palette and graphic styling across all team outputs and project materials.	
	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
Team Identity	Inconsistent, limited or obscure identity through project elements. Weak team cohesion, lack of shared identity.	Partial team cohesion, and inconsistent shared identity through project elements.	Good team identity is consistent through various project components e.g. car matches team uniform.	Excellent and highly effective team identity. Team 'brand' consistently applied through all project elements (portfolios, pit display, uniforms and cars), including compliant use of the official STEM Racing™ logo on team uniforms.	
	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	
				Corporate Identity Total	/40
				Pit Display Total + Corporate Identity Total = Brand Identity Total =	/100

Notes:

Racing

How it works

ARTICLE C9 – RACING (220 points)

C9.1 What races will be conducted?

At Regional and Spain National Finals, the STEM Racing points will be awarded through the staging of one (1) type of race event:

Reaction Racing – manual / driver launch mode, two races in each lane.

Reaction racing will be split over one (1) sessions of two races each race consists in 2 launches **(Spain National Finals two (2) sessions of four races)**. The average 'car race time' value from all reaction races will determine the Fastest Car Award (refer to C9.6). Refer to ARTICLE C3.5 and further information following for details on how points are calculated and awarded.

Please note: at Regional Finals, 1 car will be required to race. At Spain National Finals, 2 identical cars will be required to race. Refer to ARTICLE C3.5 and further information following for details on how points are calculated and awarded.

C9.2 Team preparation

- **C9.2.1** Teams should be familiar with the operation of the STEM Racing Race System. There may be a section demonstration track within the venue where teams can practice race starts during free time prior to their scheduled races.
- **C9.2.2** Manual / driver starts - one or more team members (driver/s) must be appointed for launching of the teams' car using the manual launch method. The driver must stand within the dedicated starting area.
- **C9.2.3** Finish line management - at least one member of the team must be appointed as responsible for managing their own deceleration system (refer C9.10.2) and return of car along the track to the start, accompanied by a member of the organization.
- **C9.2.4** Start line car staging – one team member may be appointed as being responsible for 'aligning' the car. This team member is only permitted to set the alignment of the car behind the start line, with respect to the launch pod and track under close supervision from the racetrack Judges. Team members are NOT permitted to interfere in any way with the CO_2 cartridge or vertical alignment of the launch pod. This process must be completed within a time limit of 30 seconds. Appointment of this team member is optional. All four wheels must be in contact with the track surface after completion of the car staging time. The race Judges can assist or perform this task for the team.
- **C9.2.5** Teams must ensure that both cars are race ready, a car service session will be provided before the next race event (refer C10.2). If a teams' car is damaged beyond achievable repair, then teams will forfeit any races that the car would have been used for.

All team members must be present during their scheduled racing sessions and should assemble at the track start for briefing by the racetrack judges at their scheduled time.

C9.4 Reaction race procedure (Regional and Spain National Finals)

Cars are launched in manual (driver launched) mode with four (4) races total per team, two (2) races in each lane. The TOTAL RACE TIME displayed, and the REACTION TIME displayed for each race is recorded. The reaction races will be conducted as follows:

1. Teams race in order as shown in the competition program. To begin racing, the lowest team number will start in lane 1.
2. One team member to track finish for deceleration system control
3. Judge arms launch pod - SAFETY ON – makes initial launch pod adjustments
4. Race 1 (Car A) - Judge sets cars on track / tether line and inserts CO_2 cartridge
5. A team member is then allowed 30 seconds to 'fine tune' the alignment of their car, please see C9.2.4 for more detail
6. Driver and team stand trackside with corresponding lane start trigger
7. Judge checks deceleration system is ready, track is clear for racing, switches launch pod - SAFETY OFF
8. Judge presses the start system reset button – cars are launched by driver pressing start trigger
9. Judge records TOTAL RACE TIME and REACTION TIME displayed on start gate

10. Team member at finish moves car into storage zone at the end of the track
11. Race 2 (Car B) conducted in same lane as above, driver can be inter-changed as nominated
12. Team member at finish control returns car and empty CO_2 cartridge along track to the start with minimum handling
13. Judges remove cars from tether line and change lanes
14. Race 3 (Car A) and Race 4 (Car B), driver can be inter-changed as nominated
15. Cars removed from track and returned to Parc Fermé

C9.5 Reaction race scoring

All four (4) 'total race times' recorded from the reaction races are considered. The fastest of these four (4) times is used in the following formulae to calculate the points awarded:

- Fastest 'total race time' = 110 pts
- 2nd fastest 'total race time' = 105 pts
- 3rd fastest 'total race time' = 100 pts
- Slowest 'total race time' = 5 pts
- Base Time = 120% of 3rd fastest 'total race time'
- 4th fastest and all other teams score points using the following formula:
- Team Points = 5 + (95 / (Base Time – fastest 'total race time')) x (Base Time – teams fastest 'total race time')
- Any team with a best 'total race time' that is slower than the base time will score 5 points. To further discriminate between any teams scoring 5 points, a deduction of 1 point will be made for any did not finish (DNF) reaction race result

C9.6 Time Trial race scoring

The four (4) 'car race times' recorded during the reaction races will be considered. From these four (4) races, the team's 2nd and 3rd best **'car race times'** will be averaged. This average time is used in the following formulae to calculate the points awarded:

- Fastest average (avg.) time = 110 pts
- Second fastest avg. time = 105 pts
- Third fastest avg. time = 100 pts.
- 'Base Time' = 115% of the third fastest avg. time of all teams avg. times.
- Fourth (4th) to slowest avg. time score points using the following formula:

Team Points = 20 + (80/(Base Time – 3rd fastest avg.)) x (Base Time – teams avg.)

- Any team that has an average slower than the base time will score 20 points. To further discriminate between these teams, a deduction will be made of 5 points for any did not finish (DNF) time trial result
- If after discarding a team's fastest time there remains less than two (2) times from races finished, due to DNF's, the slowest time recorded is again input to the average equation until there are a total of four (4) times to average

C9.7 DNF (Did not Finish) race results

Damage or part separation occurring during a race, before the car crosses the finish line, (e.g. wheel or any other part of the car separating), or car not crossing the finish line at all, effects in a DNF race result. The Judges may refer to video evidence to verify a DNF result.

C9.8 False starts

- **C9.8.1** A false start (jump start) occurs when the driver presses the trigger button before the five (5) start gate lights have extinguished. This will be signalled with the outer red light above the lanes illuminating.
- **C9.8.2** All reaction false starts will incur a 2.5-point penalty and by default, forfeit that race. This penalty does not apply to knock-out racing.
- **C9.8.3** During knock-out racing – if one team false starts (jump starts), the other team should continue to race as normal. The team who false started forfeits that race, scoring a DNF and the other team's time is recorded. If both teams false start, the race counts as one of the two (2) runs.

- **C9.8.4** During any manual / driver starts, if a driver false starts and distracts the other driver the race will be re-run and the driver who caused the distraction will forfeit their race.
- **C9.8.5** Distractions outside of the race start area will be assessed by the lead track judge and track officials to determine if the race should be re-run. Spectators must keep noise down to a minimum and not use flash photography.

C9.9 Track, tether line and timing system information

- **C9.9.1** The STEM Racing Elevated Racetrack, supplied by Denford Ltd will be used. The official length of the track, from start line to finish is 20 metres. A monofilament tether line of diameter 0.6mm, fixed at the finish end, passes down the centre of each lane. At the start end the line passes through 90 degrees over a single pulley then attached to a 1.0kg mass suspended above the floor.
- **IMPORTANT: Teams are not permitted to add anything to the racetrack until 250mm after the finish line/gate.**
- **C9.9.2** Launch/Timing - The STEM Racing Launch/Timing System will be used for launching cars and timing races and driver reaction times to 1/1000th of a second.

C9.10 Secondary Car Deceleration system

- **C9.10.1** The Car Deceleration System acts to bring cars to rest once crossing the finish line. STEM Racing will provide the standard secondary Car Deceleration System, consisting of tapered brushes positioned behind the finish line of each lane.

- **C9.10.2** Teams may supply their own secondary deceleration system, and the team will be responsible for its management. Any system supplied by a team must be simple to setup within 1 minute and must not impede the opposing track lane, race car or the race schedule in any way. The judges, at their discretion, can rule any system supplied by a team to be inappropriate and revert to use of the standard deceleration system.
- **C9.10.3** Deceleration systems must be located a minimum of 250mm after the finish line.

C9.11 CO_2 Race cartridges

CO_2 cartridges to be used for all competition races will be supplied by STEM Racing. Each CO_2 cartridge will be separately weighed before competition to ensure that all CO_2 cartridges used for races are within a weight range of 0.5 grams. All race cartridges will be kept in a temperature-controlled environment of 21 degrees Celsius.

C9.12 Car weight checks

Cars will have their weight checked at the racetrack prior to commencing a race event. This is done to ensure each car remains at a legal weight during all races. If a car is judged to have gone under weight whilst stored in Parc Fermé, the judges will add ballast to return the car weight to what it was when first submitted to Parc Fermé, without penalty.

C9.13 Judges handling cars

The race Judges will not be required to comply with any special car handling requests made of them by teams. This includes use of any special gloves or tools.

Details

Things to be aware of

ARTICLE C10 – CAR REPAIRS AND CAR SERVICING

C10.1 Car repairs

- **C10.1.1** All damage issues and related repair work during racing is at the Judge's discretion and may be referred to the scrutineering Judges and/or Chair of Judges for a final decision.
- **C10.1.2** No items can be removed or added to a car during racing, other than CO_2 cartridges, except in the case of a repair.
- **C10.1.3** If any race car sustains damage during racing and this damage is ruled to be related to engineering deficiencies, the damage can be repaired using any of the defined replacement components. Any repairs using replacement components that can be **safely** performed in under 30 seconds will not incur any race penalty points. A timer will start when the race official places the damaged car on the official repair table. If the repair takes longer than 30 seconds, doesn't use the defined replacement components or the car is not race ready, then **a 5-point penalty will be applied**. A repair time limit of 120 seconds (2 minutes) will be applied, if the car is not race ready at the end of this time then any further repairs must take place in the next service session This may include but not be limited to car body, wings & wheels being damaged as part of racing including damage occurring within the deceleration area. ***Please note**: The Best Engineered Car award is calculated using several scores from the competition, including penalty points incurred through damage during racing. Please see the Awards Matrix in the appendix of this document for more information.*
- **C10.1.4** Engineering deficiencies may include but not limited to damage to car body, wings & wheels as part of racing including damage occurring within the deceleration area.
- **C10.1.5** Curing time for adhesives must be included in 30 second repairs.
- **C10.1.6** Tool kits are allowed to be taken racing. Teams must supply all of their own tools and other necessary resources. Judges will not be able to assist teams with any additional resource requirements
- **C10.1.7** If the Judges rule that damaged sustained was not due to engineering deficiencies, immediate repairs will be permitted without penalty.
- **C10.1.8** No penalty is applied for damage incurred during knock-out racing or a car's final race of any race event.

ARTICLE C11 – PROTESTS

C11.1 Submitting a protest

Any protest issues must be submitted by the team manager to an Event Director, no more than 10 minutes after the conclusion of the final scheduled race event. This will be registered and immediately lodged with the Chair of Judges. Any protest or appeals submitted after this time may be disregarded. All protests must be lodged in writing via the official protest form available from the Event Directors. The Chair of Judges decision related to any protest is final.

C11.2 Unsuccessful protests

Teams should carefully consider their grounds for submitting a protest or appeal. Any protest or appeal that is unsuccessful, with the Judges initial decision remaining unchanged, will result in the team having a **15-point penalty** applied against their total score.

ARTICLE C12 – JUDGES

C12.1 Overview

At Regional Finals, there will be a minimum of five (5) teams of judges plus officials that form the entire judging panel. At Spain National Finals this increases to allow for the greater number of teams. Each judging team will have one (1) judge appointed as the Stream Lead Judge. Judges are education and industry experts invited by STEM Racing. All judges sign a 'declaration' to ensure there are no conflicts of interest with respect to judges and the teams they are judging.

C12.2 Chair of Judges (Spain National Finals only)

This is an independent authority appointed by STEM Racing who oversees all judging procedures. The Chair of Judges will determine the final judging decision where a protest has been submitted or other judging issue needs resolution. The Chair of Judges will also preside over a meeting of all Lead Judges to ratify the final results along with nominations and winners for relevant awards. At Regional Finals, STEM Racing will nominate one lead official to act as Chair of Judges for any resolutions.

C12.3 The Judging teams

- **C12.3.1** Specification and Scrutineering Judges - will assess all race cars as per the Specification and Scrutineering scorecards.
- **C12.3.2** Design and Engineering Judges - will assess each team as per the Design & Engineering scorecard.
- **C12.3.3** Verbal Presentation Judges – will assess each team as per the Verbal Presentation scorecard.
- **C12.3.4** Enterprise Judges **–** will assess each team as per the Enterprise scorecard.
- **C12.3.5** Race Judges – will oversee and rule on all race events and any incidents.
- **C12.3.6** Car servicing officials – will oversee all car service activities and rule on any infringements that may occur.
- **C12.3.7** Marketing Judges **(Spain National Finals only)** – will assess each team's use of marketing and social media.

C12.4 Judging Decisions

THE DECISION OF THE JUDGES AND OFFICIALS IS FINAL.

ARTICLE C13 - AWARDS

C13.1 Awards Celebration

The Regional and Spain National Finals awards will be presented at the Awards Ceremony at the end of the competition.

C13.2 Participation Recognition

All students will receive an official participation certificate from STEM Racing.

C13.3 List of awards to be presented

A full list of awards to be presented will be announced before the Regional or Spain National Finals event. All awards will be presented to the team that achieves the highest score in each category taken from the scorecards unless otherwise stated below.

Achievement Awards (decided by individual team points scores by class):

Entry Class	Development Class	Professional Class
1st Place Entry Class	1st Place Development Class	1st Place Professional Class
2nd Place Entry Class	2nd Place Development Class	2nd Place Professional Class
3rd Place Entry Class	3rd Place Development Class	3rd Place Professional Class
Best Engineered Car Entry Class	Best Engineered Car Development Class	Best Engineered Car Professional Class
Fastest Car Entry Class	Fastest Car Development Class	Fastest Car Professional Class

Star Quality Awards (decided by judges' nomination, covering all classes):

Team Identity

Sponsorship & Marketing

Research & Development

Portfolio

Verbal

Pit Display

Judges Choice

Lightning Reaction time

(Spain National Finals) awards will also be given for:

Scrutineering Award

Project Management

Girls in STEM Leadership Award

Digital Media

Appendix:

1. Scoring matrix
2. Project Submission Checklist (DEV CLASS)
3. Project Submission Checklist (PRO CLASS)

APPENDIX i: Scoring Matrix

Please find below how each award is calculated and which judging categories contribute to each award.

NF = Spain National Finals Only

Judges	Heading	Subheading	Regional / National Champions	2nd Place	3rd Place	Fastest Car Award	Best Engineered Car	Sponsorship & Marketing Award	Team Identity Award	Pit Display	Verbal Presentation	Research & Development	Judges Choice	Lightning Reaction Time	Project management NF	Digital Media Award NF	Team Sportsmanship NF	Girls in STEM Leadership Award NF	Knockout Racing NF	Scrutineering Award NF
Scrutineering	Scrutineering	Specifications	●	●	●	●	●						●				●	●		●
		Engineering Drawings	●	●	●		●						●				●	●		●
		Rendering	●	●	●		●						●				●	●		●
		Quality of Finish and Assembly	●	●	●		●						●				●	●		●
Design & Engineering	Design & Engineering Portfolio	Design Concepts	●	●	●		●					●	●				●	●		
		3D Modelling	●	●	●		●					●	●				●	●		
		Application of CAA	●	●	●		●					●	●				●	●		
		Use of CAM/CNC	●	●	●		●						●				●	●		
		Other Manufacturing & Assembly	●	●	●		●						●				●	●		
		Research & Development	●	●	●		●					●	●				●	●		
		Testing	●	●	●		●					●	●				●	●		
		Design Process Evaluation	●	●	●		●						●				●	●		
		Quality & Clarity	●	●	●		●						●				●	●		
Enterprise	Project Management	Scoping and Project schedule	●	●	●								●		●		●	●		
		Roles and Responsibilities	●	●	●								●		●		●	●		
		Budget and Risk Management	●	●	●								●		●		●	●		
		Communication, Monitoring & Control	●	●	●								●		●		●	●		
	Sponsorship & Marketing	Marketing	●	●	●			●					●				●	●		
		Sponsorship	●	●	●			●					●				●	●		
		Community and Social Impact	●	●	●			●					●			●	●	●		
		Document Presentation	●	●	●			●					●			●	●	●		
Brand Identity	Pit Display	Sustainability	●	●	●					●			●				●	●		
		Visual Appearance	●	●	●					●			●				●	●		
		Pit Display Content	●	●	●					●			●				●	●		
	Corporate Identity	Team Identity	●	●	●			●	●				●				●	●		
		Graphic Identity	●	●	●			●	●				●				●	●		
Verbal Presentation	Technique	Visuals	●	●	●						●		●				●	●		
		Team Contribution	●	●	●						●		●				●	●		
		Energy / Engagement	●	●	●						●		●				●	●		
	Composition	Concept Clarification	●	●	●						●		●				●	●		
		Time / Presentation	●	●	●						●		●				●	●		
	Subject	Innovation	●	●	●						●		●				●	●		
		Collaboration	●	●	●						●		●				●	●		
		STEM Racing Learning Experiences	●	●	●						●		●				●	●		
Racing	Racing	Time Trials	●	●	●	●							●				●	●		
		Reaction	●	●	●	●							●	●			●	●		
		Knockout																	●	
		Damage During Racing Penalties	●	●	●		●						●				●	●		

D	**Key:** Grey fill and **(NF)** denotes item only mandatory for Spain National Finals. Green fill indicates those project elements that should also be submitted digitally prior to the event.

Team Number:	
Team Name:	
School:	

Project Element	PRE-EVENT: (Team members)	AT EVENT: (STEM Racing Staff)	COMMENTS: (Completed by STEM Racing Officials only)	
1 x 5 Page Design & Engineering Portfolio	TICK DIGITAL SUBMISSION	TICK		
1 x 5 Page Enterprise Portfolio	TICK DIGITAL SUBMISSION	TICK		
A4 Engineering drawings	TICK DIGITAL SUBMISSION	TICK		
A4 Car renderings	TICK DIGITAL SUBMISSION	TICK		
Pit Display	TICK	TICK		
Verbal Presentation	TICK	TICK		
1 x Car A (Green dot applied by SR)	TICK	TICK	Weight: g	
1 x Car B (Red dot applied by SR) **(NF)**	TICK	TICK	Weight: g	
Rear Wing / Support Structure (Optional)	TICK	TICK	Max: 3 sets Number Submitted:	
Front Wing / Support Structure (Optional)	TICK	TICK	Max: 3 sets Number Submitted:	
Wheel / Wheel Support System (Optional)	TICK	TICK	Max: 3 car sets Number Submitted:	
2 x Official STEM Racing Model Block Holographic Stickers (if applicable)	TICK	TICK	Car A sticker here	Car B sticker here (NF)

Sign-off by	Name	Signature
Team Manager:		
STEM Racing Official:		

P	**Key:** Grey fill and **(NF)** denotes item only mandatory for Spain National Finals**.** Green fill indicates those project elements that should also be submitted digitally prior to the event.

Team Number:	
Team Name:	
School:	

Project Element	PRE-EVENT: (Team members)	AT EVENT: (STEM Racing Staff)	COMMENTS: (Completed by STEM Racing Officials only)	
1 x 10 Page Design & Engineering Portfolio	TICK DIGITAL SUBMISSION	TICK		
1 x 10 Page Enterprise Portfolio	TICK DIGITAL SUBMISSION	TICK		
A4 Engineering drawings	TICK DIGITAL SUBMISSION	TICK		
A4 Car renderings	TICK DIGITAL SUBMISSION	TICK		
Pit Display	TICK	TICK		
Verbal Presentation	TICK	TICK		
1 x Car A (Green dot applied by SR)	TICK	TICK	Weight: g	
1 x Car B (Red dot applied by SR) **(NF)**	TICK	TICK	Weight: g	
Rear Wing / Support Structure (Optional)	TICK	TICK	Max: 3 sets Number Submitted:	
Front Wing / Support Structure (Optional)	TICK	TICK	Max: 3 sets Number Submitted:	
Wheel / Wheel Support System (Optional)	TICK	TICK	Max: 3 car sets Number Submitted:	
2 x Official STEM Racing Model Block Holographic Stickers (if applicable)	TICK	TICK	Car A sticker here	Car B sticker here (NF)

Sign-off by	Name	Signature
Team Manager:		
STEM Racing Official:		

APPENDIX iv: Nose Cone replacement Challenge

The replaceable nose cone assembly challenge is an optional challenge and consists of a team being able to completely remove and replace the car's nose cone assembly in under 60 seconds. This will need to be demonstrated on one of the two cars and recorded by STEM Racing during car submission. The fastest nose changes will be nominated for the Fastest Nose Change Award.

Instructions and procedures to participate:

1. **WHEN** - This optional challenge will be available during your registration
2. **WHO** – Team needs to select one team member to perform the challenge.
3. **CHALLENGE PREPARATION** – Preparation and participation will not exceed 10 minutes.
4. **CHALLENGE DURATION** - You will have a maximum time of 60 seconds from start to finish to change the nose cone.
5. **MATERIALS** - You will need to select one of your two competition cars to perform the challenge. You will also require a spare nose cone assembly. Please refer to T3.9.1 of our technical regulations.
6. **WORKSPACE** – A special table will be prepared with designated areas to place your car and components.
7. **RECORDING & TIMING** – The challenge will be recorded and timed from start to finish.
8. **INSTRUCTIONS:**
   a. Selected team member places chosen car and spare component in designated space.
   b. STEM Racing Staff gives instructions on how to start and finish the challenge.
   c. Challenge starts:
      i. Selected team member presses start button.
      ii. Team member removes the car nose cone assembly and places the part in the allocated area.
      iii. Team member collects spare part from allocated area.
      iv. Team member inserts spare nose cone assembly back into car.
      v. Team member presses finish button.
   d. When challenge is finished, cars and components are returned to the team to finalise submission process to specification judging.
9. **EVALUATION** – The winner will be selected from the fastest recorded assembly that followed the instructions provided.
10. **IMPORTANT** – Teams need to be careful participating in the challenge avoiding any breakages to their components as no repair time is available before car submission.

Please make sure you have also read the corresponding STEM Racing Spain Technical Regulations

Work hard, see you on the track!

If you need any help at all, just get in touch with us:

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Engineering in Motion

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