

FORMULA STUDENT UK 2020 SUPPLEMENTARY RULES

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INTRODUCTION

Formula Student UK (FS) is an educational challenge organised by the Institution of Mechanical Engineers (IMechE) for the purpose of educating and preparing students of engineering and other disciplines for their future careers.

The competition is governed and executed in line with four key principles:

1. Safety – to maintain the highest standards of safety throughout the event.
2. Education – to focus on providing the best educational experience for all those involved, including competitors, volunteers and visitors.
3. Openness – to be open to collaboration with other competitions and parties, to embrace new ideas and to allow different vehicle concepts to compete together within a common rule set.
4. Inclusiveness – to deliver an event that allows all teams to be at their best: new or established, elite or amateur, domestic or international.

The IMechE is supported by volunteers from Industry and Academia that together form the Formula Student Organising Committee (the Committee). The Committee includes the IMechE Formula Student Project Manager and Project Executive and volunteers: Chairmen, Chief Judge, Clerk of the Course, Head Judges, Chief Scrutineer(s), Dynamic Events Captain(s) and other volunteers representing key functional areas. The Committee is supported by sub-committees for Scrutineering, Dynamic Events and FS-AI. The base ruleset for the competition, along with the Formula Student UK supplementary rules are continuously reviewed by the Committee and are updated at least once a year with the aim of providing the best educational experience for students and volunteers whilst maintaining the highest standards for safety.

FS operates under a permit from the national motorsport governing body, Motorsport UK. The dynamic events are overseen by a licensed Clerk of the Course, supported by nationally registered marshals and officials as well as volunteers with industry and/or Formula Student experience.

The static events are judged by a mix of experienced engineering industry professionals (from backgrounds including motorsport, automotive, aerospace and supply chain partners) as well as recent graduates and some learned academic authorities.

The Competition is composed of three classes:

- Formula Student (formerly Class 1)
- FS-AI (Formula Student Artificial Intelligence)
- Concept Class (formerly Class 2)

The Formula Student Rule consist of four documents:

- 2020 Formula Student Rules (FSG Rules)
- Formula Student UK 2020 Supplementary Rules (this document)
- Formula Student AI 2020 Rules (driverless vehicle regulations for the UK)
- Formula Student Concept Class 2020 Rules

This set of regulations deals with 'Formula Student' class and is written using the "2020 Formula Student Rules" as the base ruleset. To avoid confusion this rulebook only contains amendments or new rules specific to the UK event, all of which take precedence over the equivalent regulation in "2020 Formula Student Rules".

The 'Formula Student' class permits vehicles designed to the "2020 Formula Student Rules" and the "Formula Student UK 2020 Supplementary Rules" under the CV and EV vehicle types. Vehicles built to the Formula SAE Rules (FSAE) are also eligible but must conform to all relevant Formula Student Rules as defined above.

FS-AI rules (Driverless Vehicles) define the regulations for the two driverless classes where teams use their own vehicle (Autonomous Driving System Class - ADS) or where the IMechE commissioned ADS-DV (Autonomous Driving System – Dedicated Vehicle) is used (Dynamic Driving Task Class - DDT).

- ADS class follows the DV vehicle type rules in "2020 Formula Student Rules" except where there are specific changes in this document and the "Formula Student AI 2020 Rules" document which take precedence.
- For DDT class all technical, inspection, static and dynamic regulations are covered by the document "Formula Student AI 2020 Rules" in addition to some changes to the Administrative regulations where the FS-AI rules take precedent.

The Formula Student AI 2020 Rules can be found on the Formula Student website.

Vehicles which are in the design process can compete in Formula Student Concept Class. Concept Class entries are assumed to be focused on ultimately providing a Formula Student (running vehicle) entry in a future competition year. The Concept Class regulations can be found on the Formula Student website.

A - ADMINISTRATIVE RULES

A1 COMPETITION OVERVIEW

As per 2020 Formula Student Rules except:

A1.2 Competition Procedure

A1.2.1 The competition accepts entries for the following vehicle types:

- Internal Combustion Engine Vehicle (CV)
- Electric Vehicles (EV)
- Alternative Fuel Vehicles (AFV)
- Driverless Vehicles (DV)

A1.2.2 All vehicles must meet the requirements defined in Chapters T and either CV, EV or AFV, depending on their powertrain type.

A1.2.6 Maximum points for Formula Student class are awarded as described in Table 1.

A1.2.7 The CV, EV or AFV team with the most overall points will win the FSUK competition.

Static Events:

Business Plan Presentation	120
Cost and Manufacturing	120
Engineering Design	160

Dynamic Events:

Skid Pad	75
Acceleration	75
Autocross / Sprint	100
Efficiency	100
Endurance	250

Total Points	1000
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Table 1: Maximum Points Awarded

A2 VEHICLE ELIGIBILITY

As per 2020 Formula Student Rules except:

A2.2 First Year Vehicles

A2.2.1 A vehicle may only be used for one competition year, counting from the first day onsite at its first competition. A vehicle may not compete in the same event (e.g. Formula Student UK) the following season, even if two events occur within a one-year period.

A2.2.3 Teams may apply to reuse a previous year's chassis if they are making substantive changes to other areas of the vehicle which require a similar or greater level of engineering effort, e.g. changing powertrain type.

Requests must via the [Formula Student Question Database \(FSQD\) portal via your team account](#) before the Structural Equivalency Spreadsheet (SES) deadline.

Requests received before the deadline will be reviewed by the Chief Technical Scrutineer for consideration, their decision will be final.

A3 RULES OF CONDUCT

As per 2020 Formula Student Rules except:

A3.6 Questions about the Rules

A3.6.4 Questions must be submitted to the Formula Student Questions Database (FSQD) which can be accessed here: <http://teams.formulastudent.com/faq/FAQ.aspx>

A3.6.5 Clarifications issued in response to questions about the rules may only be valid for one competition year. If you are submitting a question to reconfirm a previous clarification the ID number of the original question should be referenced in the new question.

A3.6.6 Clarifications issued by other events may not be valid at Formula Student, if you are entering multiple events then ensure you check the legality of your design with all event organisers.

A3.7 Protests

A3.7.4 Protests concerning any aspect of the competition must be filed within the protest period announced by the competition organisers in the Team Handbook, or within 30 minutes of the scores of the event to which the event relates being posted.

A3.7.5 The decision of the officials regarding any formal protest will be in written form and final.

A3.8 Advertising Regulations

A3.8.1 To ensure full compliance with UK and European legislation, teams are not permitted to display any form of tobacco or cigarette advertising on their vehicles or display areas. The organisers also reserve the right to instruct teams to remove or cover any other vehicle or display area markings that may be illegal or likely to cause offence.

A3.9 Car Covering

A3.9.1 Covering or obscuring any competing car or any part of a competing car is considered unsportsmanlike conduct. Teams could receive up to 50 penalty points for car covering, at the discretion of the Chief Judge.

A3.9.2 During the entire Competition, except as permitted below, no screen, cover or other obstruction which in any way obscures any part of a car will be allowed at any time in the paddock, garages, pit lane or grid. The following are permitted:

- A cover over the car in the garage or paddock overnight.
- A cover over the car in pit lane or on the grid if it is raining.
- Covers on the tyres to prevent debris pick-up.
- Covers over severely damaged cars or components.

A3.9.3 Any car part (e.g. bodywork) stored in front of the car will be considered as an obstruction unless it is stored flat on the ground and does not hide totally or partially the car. Anybody standing in front of the car is considered as an obstruction to the visibility unless they have to work on the car. A line of people in front of the car is strictly prohibited.

A4 GENERAL REQUIREMENTS FOR TEAMS & PARTICIPANTS

As per 2020 Formula Student Rules except:

A4.1 Teams per University for Formula Student

A4.1.1 For Formula Student Class and Formula Student Concept Class a university may register two teams for each class as long as they use different power-train types (i.e. CV, EV or AFV) . For FS-AI Class a university may enter one ADS and one DDT entry which will be considered separately.

A4.1.2 Registration for Formula Student in the UK may be restricted to one (1) vehicle per class, per university, regardless of powertrain or vehicle type, depending on available space.

A4.3 Student Status

A4.3.2 Students seeking a post graduate degree or equivalent are eligible to compete.

A4.3.3 Drivers who have driven for a professional racing team in a national or international series at any time may not drive in any competition event.

A “professional racing team” is defined as a team that provides racing cars and enables drivers to compete in national or international racing series and employs full time staff in order to achieve this.

A4.3.4 Students studying at a UK university must be a member of the Institution of Mechanical Engineers to compete at Formula Student.

International students with a ‘home FS competition’ may be a member of the engineering organisation that organises their home event (i.e. we will accept German students who are VDI members). If you do not have one of these home events in your country: SAE International, SAE Australasia, SAE Brazil, VDI, VDE, or ATA, your team must become IMechE members.

Student Affiliate membership is FREE to all Formula Student team members, regardless of discipline. To apply for Student Affiliate Membership, follow these easy steps:

- Complete the [online registration form](#) to setup an account
- Once logged into your account click on the link ‘Student Affiliate Form’
- Fill in your personal details and follow the prompts to submit your application

Team Leaders need to ensure that all team members become IMechE members as defined in the Key Dates Document which can be found at:

<https://www.imeche.org/events/formula-student/team-information/key-dates>

All membership numbers need to be quoted in the Team Member Details section of your account prior to the event. Faculty Advisor membership of an engineering institution is optional.

A4.3.5 Students who became an IMechE affiliate member in a previous competition year do not need to apply again, but must inform membership@imeche.org that they are continuing to compete in Formula Student in this competition year.

A4.5 Driver's Licence

A4.5.1 Team members who will drive a competition vehicle at any time during the competition must hold a valid, government issued, photographic driver's licence for passenger cars, or a recognised National Sporting Authority (ASN) approved karting or car motorsport licence.

A4.6 Insurance

A4.6.1 Faculty Advisors are required to confirm that adequate insurance is in place, including but not limited to personal accident insurance for all drivers and public liability insurance (minimum £15m) for the team. Declaration that cover is in place must be made via the liability waiver which must be submitted in advance of the competition as per the Key Dates documents. Teams will not be permitted to participate without this confirmation.

A4.6.2 Teams from outside of the EU or Switzerland are required to present evidence of medical insurance covering participation in a motorsport event. This must be provided with the liability waiver. Teams will not be permitted to participate without evidence of cover.

A4.7 Liability Waiver

A4.7.1 The Team Leader and all drivers must sign a liability waiver. This must be submitted in advance of the competition via your Team Account as per the Key Dates document.

A4.8 Faculty Advisor

A4.8.1 Each team is expected to have a Faculty Advisor appointed by the university.

A4.8.2 The Faculty Advisor is expected to accompany the team to the competition and will be considered by the competition officials to the official representative of the university and be responsible for the behaviour of all team members during the event.

The Faculty Advisor is expected to ensure that wherever possible the regulations are followed and at all times their university's Health and Safety protocols are followed.

A4.8.3 Faculty Advisors may advise their teams on general engineering and engineering project management theory.

A4.8.4 Faculty Advisors may not design build or repair any part of the competition vehicle or directly participate in the development of any documentation or presentation.

A4.9 Electrical System Officer (ESO) – EV ONLY

A4.9.1 Every participating team has to appoint at least one electrical system officer (ESO) for the event. This person is responsible for all electrical operations of the vehicle during the event.

A4.9.2 The ESO is responsible for every kind of work on the car during the event.

A4.9.3 The ESO is the only person in the team that is allowed to declare the car electrically safe, so that work on any system of the car may be performed by the team.

A4.9.4 The ESO must be a valid team member, which means that they must have student status, see A4.3.

- A4.9.5 The ESO must be contactable by telephone at all times during the event.
- A4.9.6 The ESO must accompany the car whenever it is operated or moved around at the event site.
- A4.9.7 The ESO is not allowed to be a driver, unless a second ESO is named by the team who is not a driver. If the second ESO is also a driver then they cannot compete in the same dynamic event as the first driver, or a third ESO is required.
- A4.9.8 The ESO must be properly qualified. The ESO must be certified or must have received appropriate practical training whether formal or informal for working with high voltage systems in automotive vehicles. Details of the training must be provided to the organizers on the ESO/ESA form for approval.

A4.10 Electrical System Advisor (ESA) – EV ONLY

- A4.10.1 The ESA must be a professionally competent person(s), nominated by the team, who can advise on the electrical and control systems that will be integrated into the vehicle. It is acceptable for the Faculty Advisor to be the ESA if all the requirements below are met.
- A4.10.2 The ESA must supply details of their experience of electrical and/or control systems engineering as employed in the car on the ESO/ESA form for approval by the organisers. It is likely that the ESA will be a Chartered Engineer or someone of equivalent status.
- A4.10.3 The ESA must have significant experience of the technology that is being developed and its implementation into vehicles or other safety critical systems such that they are adequately qualified to advise the team on their proposed electrical and control system designs.

Note: It may be necessary to have more than one ESA to achieve this requirement.

- A4.10.4 The ESA must advise the team such that the merits of any relevant engineering solutions can be discussed, questioned and approved before being implemented into the final vehicle design.
- A4.10.5 The ESA should advise the students on the required training so that they are competent to work with the systems on the vehicle.
- A4.10.6 The ESA must review and sign the Electrical System Form and FMEA documents to confirm that in principle the vehicle has been designed using good engineering practices.
- A4.10.7 The ESA must ensure that the team discusses any unusual aspects of the design with the rules committee to reduce the risk of exclusion or significant changes being required to pass technical inspection.
- A4.10.8 All EV team members are required to have basic electrical safety training to ensure they are aware of the risks and know how to respond in the event of an incident. Details of this training should be documented in the ESO/ESA form.

A4.11 Autonomous System Responsible (ASR) – DV ONLY

As per 2020 Formula Student Rules A4.9 for ADS Class and as per “Formula Student AI V1.0” rules for DDT Class.

A4.12 Registration

- A4.12.1 Registration for Formula Student must be completed online. Online registration must be performed by the Team Leader and official Faculty Advisor connected with the registering university.
- A4.12.2 Registration for Formula Student UK is limited to a fixed number of competing cars. There is no limit to how many teams may be on the reserve list. A reserve team will be notified when a registration slot becomes available.
- A4.12.3 Registration for Formula Student will open and close at the dates and times posted on the competition website. There are no exceptions to this registration policy.
- A4.12.4 Registration fees must be paid to the Institution of Mechanical Engineers by the deadline specified on the Formula Student website.
- A4.12.5 Registration fees are not refundable and may not be transferred to a subsequent year's competition.
- A4.12.6 Formula Student teams may request to change their entry to Concept Class but only up until the date published in the Key Dates document. This will be subject to capacity in Concept Class.

A4.13 Team Member Registration Requirements

- A4.13.1 Team Leaders must ensure that every participants name, including the Faculty Advisors, is listed in the Manage Members section of their Team Account. It is the Team Leader's responsibility to ensure that all team members have their own individual accounts. The following is also required:
- Driver's licence numbers must be listed for participants who intend to drive a competition vehicle.
 - IMechE Membership Number (where required by A4.3.4)
 - Emergency Contact Details for each team member and the Faculty Advisor must be submitted online by the deadline specified in the Key Dates document.
- A4.13.2 All drivers, Team Leaders and Faculty Advisors must attend onsite registration.
- All team members who intend to drive a competition vehicle must bring their Driver's Licence which conforms to the requirements of A4.5.
 - All non-EU team members who intend to drive a competition vehicle must bring their Medical Insurance card or documentation.

A4.14 Withdrawals

- A4.14.1 Registered teams that find that they will not be able to attend the competition are requested to officially withdraw by contacting the officials at formulastudent@imeche.org no later than one (1) week before the event.
- A4.14.2 If a team withdraws from the competition their car is only eligible to be entered in the following year's competition if it complies with Rule A2.
- A4.14.3 An official withdrawal acknowledgement will be sent via email by a Formula Student official to the Team Leader.

A4.14.4 Teams which do not officially withdraw but then do not attend the competition may be refused entry to the competition in future years.

A4.15 Newcomer Registration

A4.15.1 Teams who will be competing in their first season of the FSAE/FS calendar with a running vehicle and have not won a major award at a previous competition, and teams that have been absent from FSAE/FS for at least 5 years will be eligible for the Newcomer Award. Eligible teams should email fs@imeche.org to advise organisers of their Newcomer status.

A4.16 Vehicle Shipping

A4.16.1 Vehicle shipments by commercial carrier must comply with the laws and regulations of nations from which, and to which, the car is being sent. Teams are advised to consult with their shipping company or freight forwarder to be sure their shipment fully complies with all relevant, customs, import/export and aviation shipping requirements.

Shipments must be sent with the sending team or university listed as the receiving party. Neither the competition organisers nor the competition sites can be listed as the receiving party. The Institution of Mechanical Engineers will not take responsibility for any shipments or any associated charges. Full [shipping guidance](#) can be found on the Formula Student website.

A5 DOCUMENTATION & DEADLINES

As per 2020 Formula Student Rules except:

A5.1 Required Documents and Forms

A5.1.1 The following documents must be submitted in the format and by the method and deadlines defined in the Key Dates document published on the Formula Student website:

- Alternative Fuel Report (AFR) [AFV teams only]
- Autonomous Design Report (ADR) [DV teams only]
- Autonomous System Form (ASF) [DV teams only]
- Autonomous System Responsible (ASR) [DV teams only]
- Design Concept Specification (DCS)
- Cost Report Documentation (CRD)
- Design Spec Sheet (DSS)
- Electrical System Form (ESF) [EV & AFV teams only]
- Emergency Contact Details
- Engineering Design Report (EDR) [AFV, CV & EV teams only]
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- ESO/ESA Form [DV-ADS Class, EV & AFV teams only]
- ETC Notice of Intent [IC Teams with Electronic Throttle Control only]
- ETC FMEA [IC Teams with Electronic Throttle Control only]
- EV FMEA [DV-ADS Class & EV Teams Only]
- Final Team Member Details
- Impact Attenuator Data (IAD)
- Structural Equivalency Spreadsheet (SES)

A5.1.2 Where applicable, templates for the required submissions can be found here:

<https://www.imeche.org/events/formula-student/team-information/forms-and-documents>

A5.1.3 Documents submitted in the wrong format, or with an incorrect filename, will be considered “Not Submitted”.

A5.2 Submission

A5.2.1 Team Leaders are responsible for ensuring that all their team's submissions are uploaded or sent before the published deadline. Account creation for online document submission is explained on the FS website.

A5.2.2 The format, method of submission, initial deadline and final deadline are all defined in the Key Dates document published here:

<https://www.imeche.org/events/formula-student/team-information/key-dates>

A5.2.3 Uploaded documents can only be viewed by:

- Team Leaders
- Deputy Team Leaders
- Faculty Advisors
- Authorised Judges, Officials and Technical Inspectors
- IMechE Staff

A5.2.4 By submitting documents via the competition website, the team agrees that they may be reproduced and distributed by the officials, in both complete and edited versions, for educational purposes.

A5.2.5 Documents which are largely incomplete or not readable will be considered as "Not Submitted."

A5.2.6 SES and IAD submissions are reviewed in the order that they are received. Teams are strongly encouraged to submit these well before the submission deadline.

A5.2.7 All documents submitted online through your Team Account will generate a confirmation email stating the date and time of your upload. This will be sent to your primary team contact, as defined in your registration form.

You are strongly advised to print and retain this confirmation email for the final version of each submission.

If the primary contact email changes you must inform formulastudent@imeche.org

A5.3 Late Submission or Non-Submission

A5.3.1 Volunteer judges evaluate all the required submissions and it is essential that they have enough time to complete their work. There are no exceptions to the document submission deadlines and late submissions will incur penalties.

A5.3.2 The penalties for submitting documents later than the initial and final deadlines are defined in the Key Dates document on the Formula Student website.

A5.3.3 Any penalty for late submission or non-submission of documents required for the Static Events will be deducted from the related event score, not the overall competition score.

A5.4 Correction Requests and Resubmissions

A5.4.1 Judges and officials may request that you resubmit amended versions of the following document types:

- AFR
- ASF
- ESF
- EV FMEA
- ETC FMEA
- IAD
- SES

- A5.4.2 Amended documents must be submitted no more than 14 days after the request is sent.
- A5.4.3 Teams have the option to replace any uploaded documents with a new file at any time before the “No Submissions Accepted After” date.
- A5.4.4 Between the “Submission Due Date” (document deadline before lateness applies) and the “No Submissions Accepted After” date replacement documents are classified as late submissions and the appropriate lateness penalties will be applied, unless you were asked to resubmit by the judge reviewing your submission.

A5.5 De-registration – NOT APPLICABLE

A5.6 Vehicle Status Video (VSV) – NOT APPLICABLE

A5.7 SES Approval (SESA) – NOT APPLICABLE

A5.8 Design Concept Specification

- A5.8.1 All teams must submit a Design Concept Specification (DCS) by way of application to compete in the 2020 competition. Teams will be selected for a place in the competition by the Committee based on their DCS document. Submission of the DCS is via your Team Account and is as per the Key Dates document.

A6 GENERAL RULES

As per 2020 Formula Student Rules except:

A6.3 Team Briefings

- A6.3.1 All drivers for a particular day must attend the team briefing for that day.

A6.4 Testing and Work Safety

- A6.4.1 Teams are reminded that cars built according to the Formula Student and Formula SAE rules are not designed or intended for racing or use at high speed, or in confined areas where they might impact with solid objects, including safety barriers. Teams are advised to develop and run their vehicles on large, substantially open areas, and to do so only under similar speed and cornering conditions as they would face at official FSAE or FS events.

It is further advised that all cars are checked by an Motorsport UK safety scrutineer - please email fs@imeche.org to arrange this.

Testing Guidelines can be found on the Formula Student Website at:

<https://www.imeche.org/docs/default-source/1-oscar/Get-involved/operation-and-testing-recommendations.pdf?sfvrsn=0>

A6.4.2 The organisers hereby reserve the right to deduct points, or exclude individuals or teams from future competitions, if they act in such a way, at any time, as to actually or potentially bring the Formula Student name into disrepute. Teams or individuals associated with them, displaying and/or running their vehicles at any events organised by themselves or others, who use the Formula Student name while doing so, and act irresponsibly or recklessly, may, at the organiser's sole discretion, be deemed to have acted in breach of this rule.

A6.6 Alcohol and Illegal Material

A6.6.1 Drivers should not consume alcohol at least 24 hours before any event they are competing in and may be subject to random breathalyser checks.

A6.7 Vehicle Movement

A6.7.5 Vehicles must be pushed at a normal **walking pace** by means of a "push bar", see T13.1, and with a team member in the cockpit wearing the required driver equipment as defined in T13.3 except for helmet, arm restraints and balaclava.

A6.7.9 Any team found 'running with the car' may have their tech sticker removed and will have their car confiscated and quarantined by the Chief Technical Scrutineer for a minimum of one hour. The one hour will start and end at the discretion of the Chief Technical Scrutineer.

A6.9 Fuelling and Oil

A6.9.3 Waste fuel and oil should be disposed of at the location specified in the Event Handbook.

A6.13 Team Radios

A6.13.1 Any team radios must comply with PMR446:

https://www.ofcom.org.uk/data/assets/pdf_file/0025/85156/ir_2009_analogue_and_digital1.pdf

A6.13.2 Operating on any other frequencies, or with transmission powers greater than 0.5W requires a licence from OFCOM.

A6.14 Official Event Schedule

A6.14.1 The master version of the Event Schedule will be posted at Race Control.

In the event of any differences between the master version and any version published elsewhere, then the timings published in the master version prevail.

A6.15 Static Event Judging Schedule

A6.15.1 Any team which is unable to attend any of their scheduled times for static event judging must report in person to the location specified in the Team Handbook at the earliest possible opportunity.

A6.15.2 In exceptional circumstances teams may be offered an alternative scheduled time, but this cannot be guaranteed and teams must make their best efforts to attend at their original allocated judging time and location.

A6.16 Team Radio Communication

A6.16.1 All team telemetry must be transmitted on 2.4GHz frequency. Team must not transmit on a 5GHz frequency.

T - GENERAL TECHNICAL REQUIREMENTS

As per 2020 Formula Student Rules except:

T1 CHASSIS DEFINITIONS

As per 2020 Formula Student Rules except:

T1.1.14 Rollover protection envelope – A volume enclosed by multiple planes, each of which are tangent to the outermost surface of the primary structure and any additional structures fixed to the primary structure which meet the minimum specification defined in T 3.2 or equivalent.

T1.1.15 Surface envelope – A volume enclosed by multiple planes, each of which are tangent to the outermost surface of the primary structure and the outside edges of the four tires.

T2 GENERAL DESIGN REQUIREMENTS

As per 2020 Formula Student Rules except:

T2.4 Wheels

T2.4.1 Any wheel mounting system that uses a single retaining nut must incorporate a device to retain the nut and the wheel in the event that the nut loosens. A second nut (“jam nut”) does not meet these requirements

T2.4.4 Extended or composite wheel studs are prohibited.

T2.4.5 Wheel spacers are permitted. Laminated or multiple spacers per wheel are not permitted.

T2.6 Steering

T2.6.3 The steering system must have positive steering stops that prevent the steering linkages from locking up and must prevent the tires and rims from contacting any other parts.

T3 GENERAL CHASSIS DESIGN

As per 2020 Formula Student Rules except:

T3.2 Minimum Material Requirements

T3.2.2 The Primary Structure of the car must be constructed of:

- a) Round, mild or alloy steel (minimum 0.1% carbon) of the minimum dimensions specified in T3.2.1
- b) Approved ‘Alternative Materials’ as per T3.3.
- c) Approved ‘Composite Structure’ as per T3.4.

T3.6 Structural Documentation

T3.6.1 All teams must submit a Structural Equivalency Spreadsheet (SES).

T3.6.2 Teams must use the latest FSUK SES Template from the FSUK website.

T3.6.3 Not applicable to Formula Student UK.

T3.6.6 As part of the SES submission, a comparison describing the physical differences between the submitted Primary Structure design with that of the most recent previous entry will be required.

Photographic evidence demonstrating a 'new chassis' will be required for Chassis Scrutineering as per Rule IN 15.1.1.

SES demonstrating minimal change in design between old and new chassis will be passed to the Design Judges for consideration of penalty points under Rule S3.8.2.

Teams who fail to satisfy rule A2.2.2 will not pass scrutineering.

T3.6.7 SES submission will be graded based on the completeness and quality of information provided in SES. It will not be an appraisal of the quality of design. Grades will range from A to F based on the following definitions:

- A. Completed to a high standard with clear graphics, notes and engineering justification.
- B. Completed to a good standard with clear graphics and notes.
- C. Completed to a minimum acceptable standard.
- D. Notes and graphics difficult to read and/or poorly presented.
- E. Repeat of the same errors for the same or similar design as in a previous year's original submission.
- F. Late submission, incorrect SES template or major sections missing such that SES is deemed a 'non-submission'.

A '+' will be attached to a grade for an SES that is approved on its original submission. Only grades A to C can 'pass first time'. Grades will be published online and shared with Design Judges. No points will be awarded for grades A-E. An F grade will carry 10 to 50 penalty points.

SES demonstrating minimal change in design will be passed to the Design Judges for consideration of penalty points under Rule S3.8.2.

T3.7 Roll Hoops

T3.6.2 The minimum radius of any bend, measured at the tube centreline, must be at least three times the tube outside diameter. Bends must be smooth and continuous with no evidence of crimping or wall failure.

T3.6.4 Roll hoops attached to a composite primary structure must be mechanically attached at the top and bottom of both sides of the structure and at intermediate locations if needed to show equivalency.

T3.11 Front Hoop Bracing

T3.11.0 The front hoop bracing consists of two single, straight tubes (one each side of the front hoop) which connect to the front hoop and the structure forward of the driver's feet (e.g. front bulkhead). The front hoop braces may cross. Rule T 3.2.6 cannot be applied to the roll hoop braces.

T3.11.3 Not applicable at Formula Student UK.

T3.14 Front Bulkhead Support

T3.14.2 If the front bulkhead support is part of a composite structure, it must have equivalent EI to the sum of the EI of the six baseline steel tubes that it replaces.

T3.18 Impact Attenuator (IA) Data Requirement

T3.18.1 All teams must submit an IA Data report using the Impact Attenuator Data (IAD) template provided on the Formula Student UK Website.

If a report does not use this template, it will automatically incur a 10 point design penalty. **Templates from other Formula Student/FSAE competitions are not unacceptable.** It will still be assessed to ensure that the IA meets the rules requirements and to allow the team to compete. Minor violations in report layout will be dealt with via the downgrading process outlined in rule T3.18.5.

T3.18.2 Reports submitted late will incur lateness penalties as described in the Key Dates document published on the Formula Student website. However, these reports will still be assessed in order to ensure that the IA meets the rules requirements and to allow the team to compete.

T3.18.3 Reports submitted on time but which do not contain the required information (e.g. a “placeholder report” submitted to avoid penalties but without the required test data) will be treated as a non-submission and dealt with according to Rule T3.18.2.

T3.18.4 Reports will be assessed by a team of judges using a common approach. A selection of reports will be moderated by the Lead IAD Judge to ensure consistency.

T3.18.5 Reports will be assessed according to the following process, in order to grade them from A to F:

- i) Reports are initially assigned a grade according to the type of testing carried out. Dynamic tests are initially assigned a ‘B’ grade; Quasi-static (crush) tests a ‘C’ grade; and teams using a Standard IA an ‘E’ grade.
- ii) The report is then assessed to ensure that the IA meets the rules requirements for energy absorption, deceleration levels, dimensions, mounting arrangements etc. Impact Attenuators which do not meet these requirements will automatically incur a 10 point penalty, and the team will be contacted by the Judges to determine appropriate modifications or re-design to allow them to compete.
- iii) If the IA design meets the rules, the report will then be assessed for quality. Minor items of missing information or poor explanation or presentation may lead to the report being downgraded by up to two grades. Teams will be contacted and asked to supply missing information, but the downgrade will remain. A high quality report may be upgraded by up to two grades.
- iv) IA reports for the standard FSAE IA may be upgraded by up to two grades if they include additional analysis or testing – for example finite element simulation, or testing of material samples.

T3.18.6 Once the report has been graded, the grade will be converted into design penalty points as follows:

A = 0 points; B = 0 points; C = 1 point; D = 4 points; E = 8 points; F = 10 points.

These penalties will be forwarded to the Head Design Judge for inclusion in the overall design score.

T3 COCKPIT

As per 2020 Formula Student Rules except:

T3.8 Firewall

T3.8.1 All A firewall must separate the driver compartment from all components of the fuel supply system, **the engine oil, the liquid cooling systems**, the low voltage battery and any TS component, see EV 1.1.1.

T3.8.2 [EV ONLY] TS parts outside of the Rollover Protection Envelope that meet the requirements of EV 4.4.3 do not need a firewall.

T5 DRIVER RESTRAINT SYSTEM

As per 2020 Formula Student Rules except:

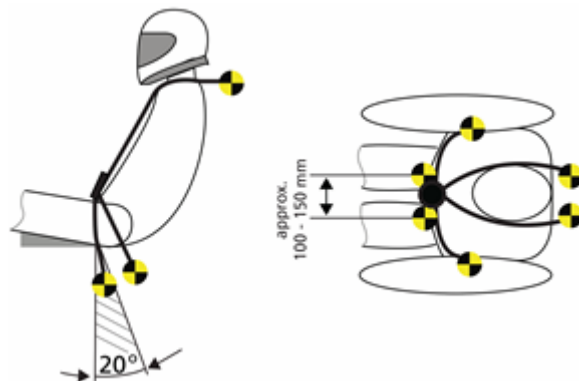
T5.5 Shoulder Harness

T5.5.6 Any bracket used to mount the shoulder harness must not be able to contact the driver in the event of an impact.

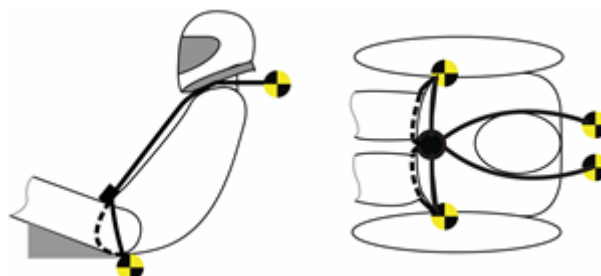
T5.6 Anti-Submarine Belt Mounting

T5.6.1 The anti-submarine belts of a 6-point or 7-point harness must be mounted either:

- a) With the belts going vertically down from the groin, or angled up to twenty degrees (20°) rearwards. The anchorage points should be approximately 100 mm (4 inches) apart.



- b) With the anchorage points on the Primary Structure at or near the lap belt anchorages, the driver sitting on the anti-submarine belts, and the belts coming up around the groin to the release buckle.



T5.6.2 All anti-submarine belts must be installed so that they go in a straight line from the anchorage point(s) the first point where the belts touch the driver's body for the 6-point or 7-point mounting, without touching any hole in the seat or any other intermediate structure.

T5.7 Head Restraint

T5.7.2 The Head Restraint padding must:

- a) Be vertical or near vertical in side view.
- b) Be an energy absorbing material that meets SFI Spec 45.2, or is listed in the FIA Technical List No. 17 as a "Type B Material for single seater cars": CONFOR M foam CF-42 (pink) or CF-42M (pink). CF-42AC (pink) is acceptable.
- c) Have a minimum thickness of 38 mm.
- d) Have a **minimum** width of 15 cm and **minimum** height of 15 cm.
- e) Be covered with a thin, flexible material that contains a ~20 mm diameter inspection hole in a surface other than the front surface.

For all drivers, the Head Restraint must be located and adjusted so that:

- a) The Head Restraint is no more than 25 mm away from the back of the driver's helmet, with the driver in their normal driving position.
- b) The contact point of the back of the driver's helmet on the Head Restraint is no less than 50 mm from any edge of the Head Restraint.
- c) All material and structure of the Head Restraint is within the Rollover Protection Envelope (see T1.1.14).

T6 BRAKE SYSTEM

As per 2020 Formula Student Rules except:

T6.1 Brake System General

T6.1.11 All brake fluid reservoirs must be shielded from the driver with an impermeable barrier which has a thickness of at least 0.5mm.

T8 AERODYNAMIC DEVICES

As per 2020 Formula Student Rules except:

T8.1 Aerodynamic Devices Stability and Strength

T8.1.2 No power device (e.g. fan) may be used to move or remove air from under the vehicle.

T8.4 Aerodynamic Devices Stability and Strength

T8.4.3 A lower force may be applied, e.g. 100N instead of 200N. The allowable deflections will be scaled by the ratio of the applied load/200N for T8.5.1 or applied load/50N for T8.4.2.

T8.4.4 If any vehicle on track is observed to have large, uncontrolled movements of aerodynamic devices, then officials may Black with Orange Circle Flag the car for inspection and the car may be excluded from that run and prevented from further running until any issue identified is rectified.

T9 COMPRESSED GAS SYSTEMS AND HIGH PRESSURE HYDRAULICS

As per 2020 Formula Student Rules except:

T9.3 Gaseous Fuel Systems

T9.3.1 Any gas system on the vehicle that is used as a means of propulsion or energy source (e.g. to charge a battery through a fuel cell) must comply with the following requirements:

- a) Working Gas - The working gas may be flammable, but only if it is to be burned or used for the sole means of propulsion of the vehicle.
- b) Cylinder Certification - The gas cylinder/tank must be of proprietary manufacture, designed and built for the pressure being used, certified by an accredited testing laboratory in the country of its origin, and labelled or stamped appropriately. The following standard for composite cylinders applies: ISO11439 for hydrogen containers or NGV1 or ECE-R110 for natural gas, methane or similar gases. In accordance to cylinder standards, cylinders found to have external defects such as abrasions or chemical corrosion must not be used.
- c) Pressure Regulation - Where cylinders are interchangeable the pressure regulator must be mounted directly onto the gas cylinder/tank. If the vehicle is to be refuelled with the cylinder on-board the vehicle, the cylinder must be fitted with an internal solenoid, supplied by Dynetek or Teleflex GFI, this must be followed by an excess flow valve prior to fitting of a regulator. The inlet to the solenoid must be directly coupled to a check valve, with a cracking pressure no greater than 1 psi to ensure gas flow may only flow out of the cylinder via the regulator.
- d) Protection - The gas cylinder/tank and lines must be protected from rollover, collision from any direction, or from damage resulting from the failure of rotating equipment. It is advised ECE-R110 documents are consulted for recommendations regarding the safe installation of gas systems.
- e) Cylinder Location- The gas cylinder/tank and the pressure regulator must be located either rearward of the Main Roll Hoop and within the Primary Structure envelope, or in a structural side-pod that meets the requirements of T2.16. It must not be located in the cockpit.
- f) Cylinder Mounting - The gas cylinder/tank must be securely mounted to the Frame, engine or transmission.
- g) Cylinder Axis - The axis of the gas cylinder/tank must not point at the driver.
- h) Insulation - The gas cylinder/tank must be insulated from any heat sources, e.g. the exhaust system.
- i) Lines and Fittings - The gas lines and fittings must be appropriate for the maximum possible operating pressure of the system and must be assembled according to manufacturer's recommendations. As part of the safety form and FMEA, for gas systems teams must:
 - Provide gas system diagrams.

- Provide details of all components used in the system so that they can be approved by the rules committee. (These can be approved prior to submission of the safety documents if required)
 - Provide details of proof testing for pressurisation of the whole system to working pressure in addition to a leak test on all fittings. (If the testing is not conducted before the safety documentation is submitted then this information must be available at scrutineering).
 - Demonstrate single failure tolerant design; other than the tank and gas lines, the system must be capable of containing the gas in the event that any failure occurs in any one component. Where reasonably possible a component failure should cause the fuel solenoid to close. Teams must be able to demonstrate how to identify whether a component functions correctly or not.
- j) The maximum allowable storage pressure is 350 bar.
- k) All gas cylinders, regulators, solenoid valves and other equipment exposed to pressurized gas must be appropriately certified for use with the gas being used and the pressure that they are being used at.
- l) Where vehicle refuelling is to be carried out onsite the following cylinder connections are to be used:
- 350 bar hydrogen: SAE J2600-H35 and ISO 17268
 - 200 bar CNG: ISO 14469
- m) Ventilation - any leaked gas should be able to freely dissipate without pockets of gas accumulating. Gas detection systems must be placed in the most likely escape paths for gas, but should not create an obstacle to the escaping gas.

T10 FASTENERS

As per 2020 Formula Student Rules except:

T10.1.3 All threaded critical fasteners must meet or exceed metric grade 8.8, SAE Grade 5 or equivalent

T11 ELECTRICAL COMPONENTS

As per 2020 Formula Student Rules except:

T11.7 Low Voltage Batteries

T11.7.8 All batteries must be separated from the driver and sources of heat by a firewall as specified in T4.8.

T11.7.9 All batteries that are less than 350 mm above the ground must be shielded from front, side and rear impact collisions, by a fully triangulated structure meeting T3.2 or equivalent.

T11.7.10 All batteries using chemistries other than lead acid must be:

- a) Identified with the symbol below (minimum height 75mm) and showing the appropriate battery chemistry on each side of the car at the approximate fore-and-aft position of the battery and clearly showing how the battery is accessed in case of fire.



- b) Presented at technical inspection with markings identifying it for comparison to a datasheet or other documentation proving the pack and supporting electronics meet all rules requirements

T11.7.11 Battery packs based on Lithium Chemistry must:

- a) Have overcurrent protection that trips at or below the maximum specified discharge current of the cells within the times specified on the datasheet for the battery. For example, if the datasheet specifies a continuous discharge current of 70A, a 10 second discharge pulse current of 120A and a 1 second discharge pulse current of 150A the overcurrent protection must not allow any of these requirements to be exceeded.
- b) Have a rigid, sturdy and fire-retardant casing to UL94-V0, FAR25 or equivalent.
- c) Be separated from the driver and sources of heat by a firewall as specified in T4.8. The battery pack casing cannot act as the firewall.
- d) Be directly accessible with a fire extinguisher nozzle of 35mm diameter x 150mm long, without removing body panels and with the driver seated normally in the vehicle (clearly marked covers which can be easily "punched through" are acceptable). If an access hole is required it must be identified using the symbol below. The battery chemistry symbol (T11.7.9a) must be adjacent to the access hole.



- e) If the battery is positioned greater than 50mm inboard of the access hole then a tube of at least 35mm diameter must be present to direct the discharge from the extinguisher towards the battery. The tube must be no more than 750mm in length. Any access tube must be separated from the driver by a firewall as specified in T4.8.

Note: A tube routed from an engine bay opening to the battery packs could be acceptable if compliant with the rules. The access hole in all cases must be clearly identified and visible.

T11.8 Accelerator Pedal Position Sensor (APPS)

T11.8.13 When any kind of digital data transmission is used to transmit the APPS signal, the FMEA study must contain a detailed description of all the potential failure modes that can occur, the strategy that is used to detect these failures and the tests that have been conducted to prove that the detection strategy works. The failures to be considered must include but are not limited to the failure of the APPS, APPS signals being out of range, corruption of the message and loss of messages and the associated time outs.

T11.8.14 Any algorithm or electronic control unit that can manipulate the APPS signal, for example for vehicle dynamic functions such as traction control, may only lower the total driver requested torque and must never increase torque unless it is exceeded during a gearshift. Thus the drive torque which is requested by the driver may never be exceeded.

T11.9 System Critical Signals (SCSs)

T11.9.5 The FMEA must contain a detailed description of all the potential failure modes that can occur for each SCS, the strategy that is used to detect these failures and the tests that have been conducted to prove that the detection strategy works. The failures to be considered must include but are not limited to the failure of sensors and actuators, signals being out of range, corruption of the message and loss of messages and the associated time outs.

T12 VEHICLE IDENTIFICATION

As per 2020 Formula Student Rules except:

T12.1 Vehicle Number

T12.1.1 Each team will select an available number at the time of its entry into Formula Student. Vehicle numbers 1-10 are reserved for the top 10 overall finishers at last year's Formula Student competition.

T12.1.3 Any car which uses electrical energy as a means of propulsion must use a light green background for the numbers. Note: it is not necessary, but is permissible, to have a letter E before the number.

T12.1.4 Any car which uses a gaseous fuel must use an orange background for the numbers.

T12.3 Timing Equipment

T12.3.2 The transponder mounting requirements are:

- a) Orientation – The transponder must be mounted vertically and orientated so the number can be read “right-side up”.
- b) Location – The transponder must be mounted on the driver's right side of the car forward of the front roll hoop. The transponder must be no more than 60 cm (24 in) above the track.
- c) Obstructions – There must be an open, unobstructed line between the antenna on the bottom of the transponder and the ground. Metal and carbon fibre may interrupt the transponder signal. The signal will normally transmit through fiberglass and plastic. If the signal will be obstructed by metal or carbon fibre, a 10.2 cm (4 in) diameter opening may be cut, the transponder mounted flush with the opening, and the opening covered with a material transparent to the signal.
- d) Protection – Mount the transponder where it will be protected from being hit by cones.

T12.4 Formula Student Logo

T12.4.1 Each car will be required to append three (3) Formula Student logos, 20 cm x 15 cm. One (1) marking to the front end of the nose of the car and one (1) on each side panel, ideally above the race number plate or within the top third of the side panels, (these will be supplied by the organisers). No sponsor or other markings will be permitted to encroach on these areas. A document showing the requirements can be found here:

<https://www.imeche.org/events/formula-student/team-information/logo-usage>

Alternatively, teams may incorporate the Formula Student logo into their own colour/graphics schemes, in any of the permitted colour options, providing the logo meets the size and location requirements above and does not breach the Institution Brand Guidelines – see the Formula Student Website. The logo is available in various formats on the Use of Logos webpage.

T13 VEHICLE AND DRIVER EQUIPMENT

As per 2020 Formula Student Rules except:

T13.2 Quick Jack and Stands

T13.2.5 In addition to a quick jack, each team must have a set of jack stands, trestles or similar, that will safely support the complete car for inspections during scrutineering while not presenting a tripping hazard to the scrutineers and team members.

The stands/trestles must:

- a) Support the car with all four wheels a minimum of 100 mms off the ground.
- b) When in place, be completely within the plan profile of the car.

T12.8 Driver Equipment

T12.8.1 A well-fitting, closed face helmet that meets one of the following certifications and is labelled as such:

- Snell SA2005, SA2010, SA2015, SAH2010, SAH2015
- FIA 8860-2004, FIA 8860-2010, FIA 8859-2015
- SFI Foundation 31.1A, 31.2A

Any kart standard helmets, including but not limited to Snell K, CMR or CMS standards are not permitted for use at Formula Student.

Non-UK teams may also use helmets that comply with their own sanctioning body, but these helmets must also be permitted by the FSAE Rules. Approval for use of alternative helmets to those listed above must be sought from formulastudent@imeche.org. Note: the reference number in the helmet must be included.

Open faced helmets are prohibited.

All helmets to be used in the competition must be presented during Technical Inspection where approved helmets will be stickered. The organiser reserves the right to impound all non-approved helmets until the end of the competition.

The use of a Frontal Head Restraint (FHR) is not mandatory at Formula Student but is strongly recommended. If an FHR is used then:

- a) The combination of helmet and FHR standards must comply with the table published on the Motorsport UK website here: <https://www.motorsportuk.org/assets/helmetfhrstandards.pdf>
- b) The FHR and shoulder harnesses must be properly adjusted as per the manufacturer's recommendations. Guidance notes published by the FIA can be found here: https://www.fia.com/file/2059/download/8993?token=JZgU_uNN
- c) From the driver's shoulders rearwards to the mounting point or structural guide, the shoulder harness must be between zero degrees (0°) above the horizontal and twenty

degrees (20°) below the horizontal. This supersedes the requirements of T4.5.5 in the 2020 Formula Student Rules.

d) Any driver using a FHR must wear the FHR during their driver egress test.

T12.8.4 The driver's suit must comply with FIA 8856-2000. Non-UK teams may also use driver's suits that comply with their own sanctioning body, but these driver suits must also be permitted by the 2020 Formula Student Rules. Approval to use alternative driver's suits to those listed above must be sought from formulastudent@imeche.org

Note: a scan of the suit label must be supplied with the submission.

T13.3.13 A second complete set of driver equipment (e.g. balaclava, suit, underwear, socks, shoes and gloves), except arm restraints and helmet, are required and must be presented at technical inspection. Exchange of driver equipment between drivers at driver change is prohibited, except for arm restraints and helmet.

T12.5 Camera Mounts

T12.5.1 The mounts for video/photographic cameras must be of a safe and secure design:

- All camera installations must be approved and sealed at technical inspection.
- Helmet mounted cameras are prohibited.
- The body of any camera or recording unit that weighs more than 0.25kg must be secured at a minimum of two points on different sides of the camera body. If a tether is used to restrain the camera, the tether length must be limited so that the camera cannot contact the driver.

[DV ONLY] Cameras used as input sensors for driverless vehicles are exempted and must follow DV 4 instead.

CV - INTERNAL COMBUSTION ENGINE VEHICLES

As per 2020 Formula Student Rules except:

CV1 INTERNAL COMBUSTION ENGINE POWERTRAINS

As per 2020 Formula Student Rules except:

CV1.3 Air Intake System

CV 1.3.5 An Air Filter must be installed at the entry of the Intake System that will protect the powertrain from the ingress of dirt and debris.

CV1.6 Electronic Throttle Control (ETC)

CV1.6.4 The ETC system must be equipped with at least the following sensors:

- Accelerator Pedal Position Sensors (APPSs) as defined in T11.8.
- Two Throttle Position Sensors (TPSs) to measure the throttle position.
- One Brake System Encoder (BSE) to measure brake system pressure to check for plausibility.

CV1.6.12 Teams must submit a detailed description of their ETC system not later than the deadline specified in the competition handbook. The document must follow the template layout for the ETC FMEA which is available on the competition website. Late submission of the FMEA will require the team to revert to a mechanical throttle arrangement.

CV1.6.13 Notice of Intent - Teams planning to build an electronically controlled throttle complying with CV1.6 for entry into Formula Student must notify the organisers of their intent by the date specified in the action deadlines for the competition.

- Include a short paragraph detailing your team's outline design and showing that you have the capability to design the electronic systems. The "Notice of Intent" must include the email addresses and phone numbers of team members who can answer any questions the organisers may have about your proposal.
- Failure to submit a notice of intent by the due date will mean that you may only compete with a mechanical throttle.
- Formula Student may choose to apply limits to the number of ETC entries that they allow and therefore the Notice of Intent may be used to screen which teams are accepted to build an ETC to the appropriate regulations.

CV1.6.14 An ETC system that is commercially available, but does not comply with CV1.6, may be used, only if it does comply with the intent of the rules and is approved by the officials. To obtain approval, the team must:

- Submit a rules question to ask the event organizers if that ETC system may be used.
- Include the specific ETC rule(s) that the commercial system deviates from.
- Include sufficient technical details of these deviations to allow the acceptability of the commercial system to be determined.

CV2 FUEL AND FUEL SYSTEM

As per 2020 Formula Student Rules except:

CV2.1 Fuel

CV2.1.1 The basic fuels available at Formula Student are unleaded gasoline (99RON) and E85. Information on these fuels can be viewed at:

<https://www.imeche.org/events/formula-student/team-information/general-information>

The basic fuel types may be changed at the discretion of the event organisers. Other fuels may be available at the discretion of the organising body.

CV2.2 Fuel System Location Requirements

CV2.2.2 Any portion of the Fuel System, except for the fuel tank filler neck and sight tube (as defined in CV2.6), must be located within the Rollover Protection Envelope.

CV2.2.4 Any portion of the Fuel System that is less than 350 mm above the ground must be shielded from front, side and rear impact collisions, by a fully triangulated structure meeting T3.2 or equivalent.

CV3 EXHAUST SYSTEM AND NOISE CONTROL

As per 2020 Formula Student Rules except:

CV3.1 Exhaust System General

CV3.1.1 The use of rubber mounts directly between the exhaust and exhaust clamp is prohibited for both the exhaust and silencer.

CV4 SHUTDOWN SYSTEM

As per 2020 Formula Student Rules except:

CV4.1 Shutdown Circuit

CV4.1.5 The shutdown circuit directly controls all electrical power to the ignition, fuel injectors and all fuel pumps. It must act through a minimum of two mechanical relays (**or equivalent solid-state switching devices**). One relay for the fuel pump and at least one relay for injection and ignition.

An explanatory schematic of the required shutdown circuit, is shown in Figure 19.

EV - ELECTRIC VEHICLES

EV2 ELECTRIC POWERTRAIN

As per 2020 Formula Student Rules except:

EV2.2 Power Limitation

EV2.2.1 As per 2020 Formula Student Rules: The TS power at the outlet of the TS accumulator container must not exceed 80 kW.

EV2.2.3 Supplying power to the motor(s) such that the car is driven in reverse is prohibited.

EV4 TRACTIVE SYSTEM (TS)

As per 2020 Formula Student Rules except:

EV4.1 General Requirements

EV4.1.4 The maximum permitted voltage that may occur between any two electrical connections is 600VDC and for motor controller/inverters internal low energy control signals 620VDC.

EV4.3 Separation of Traction System and Grounded Low Voltage System

EV4.3.1 Teams must be prepared to demonstrate spacing on team-built equipment. For inaccessible circuitry, spare boards must be available. These do not have to be fully assembled.

EV4.4 Positioning of Tractive System Parts

EV4.4.2 All parts belonging to the Tractive System, except parts permitted according to EV4.4.3, that are less than 350 mm above the ground must be shielded from front, side and rear impact collisions, by a fully triangulated structure meeting T3.2 or equivalent.

EV4.5 Tractive System Energy Storage – Mechanical Configuration

EV4.5.13 All electrical connections (including bolts, nuts and other fasteners) in the high current path of the TS must be secured from unintentional loosening using positive locking mechanisms that are suitable for high temperatures, for example prevailing torque nuts, see T10.2.

Components, e.g. inverters, certified for automotive use might be allowed without positive locking feature, if connections are completed as recommended by the manufacturer's datasheet and no positive locking is possible.

The team must be able to demonstrate that they have assessed the risk of loosening of these connections and describe this and the control methods applied in their FMEA.

EV4.6 Data Logger

EV4.6.2 The data logger must be in an easily accessible location so that it is possible for the officials to check its operation and insert/remove the memory stick at any time.

EV4.10 Tractive System Active Light (TSAL)

EV4.10.5 The TSAL itself must:

- Be red in colour and flash continuously with a frequency between 2Hz and 5Hz if and only if the TS is active, see EV4.10.2.
- Be green in colour and continuously illuminated if and only if the TS is deactivated.
- Be powered from an independent power supply which complies with T11.7.
- Always be powered when the LVS is switched on and remain powered for at least 15 minutes after the LVS is switched off. It is permissible for the team to deactivate the TSAL when the LVS is switched off and the TS is confirmed to be deactivated. The driver must not be able to deactivate the TSAL
- Comply with all requirements of T11.1 but must not be de-activated by opening the LVMS (see T11.1.3).

EV4.12 Ready to Drive Sound

EV4.12.2 The sound level must be a minimum of 90dB(A), fast weighting. The sound level will be measured with a free-field microphone placed free from obstructions in a radius of 2m around the vehicle.

EV5 TRACTIVE SYSTEM ENERGY STORAGE

As per 2020 Formula Student Rules except:

EV4.3 Tractive System Accumulator – General Requirements

EV5.3.8 All TS accumulators using chemistries other than lead acid must be Identified with the symbol below (minimum height 75mm) and showing the appropriate battery chemistry on each side of the car at the approximate fore-and-aft position of the battery and clearly showing how the battery is accessed in case of fire.



EV5.3.9 Each TS accumulator container must be directly accessible with a fire extinguisher nozzle of 35mm diameter x 150mm long, without removing body panels and with the driver seated normally in the vehicle (clearly marked covers which can be easily "punched through" are

acceptable). The access hole and the first 50mm of any tubing should be angled between horizontal and 45degrees downwards from the horizontal.

EV5.3.10 If the battery is positioned greater than 50mm inboard of the access hole then a tube of at least 35mm diameter must be present to direct the discharge from the extinguisher towards the battery. The tube must be no more than 750mm in length.

EV5.3.11 If an access hole is required it must be identified using the symbol below. The battery chemistry symbol (EV5.3.8) must be adjacent to the access hole.



EV4.5 Tractive System Accumulator – Mechanical Configuration

EV4.5.6 The floor and walls of the accumulator container must be joined by welds, bonding and/or fasteners.

- Fastened connections between the floor and any vertical wall of each section must have at least 2 fasteners.
- Fastened connections between internal vertical walls and external vertical walls must be located in the top half of the internal vertical wall.
- Sections containing 8 kg (18 lbs) or less must have a minimum of 2 fasteners connecting any two vertical walls.
- Sections containing between 8 kg (18 lbs.) and 12 kg (26.5 lbs.) must have a minimum of 3 fasteners connecting any two vertical walls.

Folding or bending plate material to create flanges or to eliminate joints between walls is acceptable.

EV9 ELECTRICAL SYSTEM FORM (ESF) AND FMEA

As per 2020 Formula Student Rules except:

EV9.1 Electrical System Form (ESF) and FMEA

EV9.1.2 The ESF must follow the template provided on the Formula Student website, must not exceed one hundred (100) pages and be submitted in pdf format. Submissions that do not meet these requirements may be rejected by the judges and considered as a non-submission.

- EV9.1.3 Teams must submit a complete failure modes and effects analysis (FMEA) of the tractive system by the deadline published in the Key Dates document on the Formula Student website.
- EV9.1.4 A template including required failures to be described will be made available online – see the Formula Student website for details. Do not change the format of the template. Pictures, schematics and data sheets referenced in the FMEA must be included in the FMEA on additional table pages.
- EV9.1.5 Datasheet values and manufacturer recommendations must be adhered to for all items in the ESF, unless prior permission is sought and approved by submitting a rules question to the Formula Student Question Database.

AFV - ALTERNATIVE FUEL VEHICLES

AFV1 ALTERNATIVE FUEL VEHICLES

AFV1.1 Alternative Fuels and Powertrains Overview

Formula Student would like to promote alternative powertrains and fuels such that vehicles built with alternative powertrains can compete fairly at the competition.

If a team wishes to use an alternative fuel, then the process in AFV 1.2 must be followed.

There are additional rules for alternative fuels. It will be necessary to work with the Formula Student Technical Committee to develop a satisfactory design; some of the additional rules are presented in AFV1.3 to AFV1.5.

During the endurance event the fuel efficiency of all vehicles will be measured in terms of the production of CO₂ measured in kg. The quantity of CO₂ released to the atmosphere by the consumption of each allowable fuel is specified in rule D7.8.2 and is intended to represent the UK average number for the type of fuel under consideration.

AFV1.2 Alternative Fuel Report

AFV1.2.1 Any team intending to submit an alternative fuel entry must submit a short report (5 A4 pages maximum) by the date defined by the Key Dates Document outlining the fuel or combination of fuels that the team intends to use, how the fuel will be transported and stored at the event, details of how the powertrain will work and any possible risks and how these might be mitigated. Subsequent discussions with the Formula Student Technical Committee will determine whether an entry can be accepted and what additional regulations the entry must respect.

AFV1.2.2 Once an alternatively fuelled vehicle's entry is accepted, the team must complete reports equivalent to those required by EVs, namely the FMEA and ESF before the vehicle will be allowed to run at the competition.

AFV1.3 Fuel

AFV1.3.1 The allowable forms of power in addition those covered by the Formula Student rules (Petrol, E85 and Electric) are specified as Diesel, Hydrogen, Hydrogen fuel cell and combinations of all the above forms of power to create a hybrid but the organising committee will consider requests for other fuels such as Liquid Petroleum Gas (LPG) and Compressed Natural Gas (CNG) to be added to this list.

AFV1.3.2 For alternative powertrains, in addition to the fuel that is available for cars built to the CV rules, the organisers will seek to secure the supply of appropriate fuels to support alternative powertrains but this cannot currently be guaranteed.

AFV1.3.3 Entrants requiring alternative fuels should have a back-up plan in mind for fuel supply.

AFV1.4 Location of Fuel System

AFV1.4.1 Any fuel, compressed gasses, other energy storage media must be contained within the Primary Structure Envelope and when located less than 350mm from the ground must be protected from side or rear impacts with a structure built to T2.16.

AFV1.5 Powertrain Limitations

- AFV1.5.1 Any alternatively fuelled combustion engine, whether the sole prime mover or part of a hybrid powertrain, must use a reciprocating 4 stroke cycle internal combustion engine with a maximum capacity of 710cc.
- AFV1.5.2 The engine can be modified within the restrictions of the rules.
- AFV1.5.3 If more than one engine is used, the total displacement cannot exceed the maximum displacement described in AFV1.3.1 and the air for all engines must pass through a single air intake restrictor (see CV1.7, "Intake System Restrictor.")
- AFV1.5.4 Hybrid powertrains utilizing on-board energy storage are allowed.
- AFV1.5.5 Electric only or hybrid vehicles which use Electric as their prime means of propulsion e.g. electric / hydraulic and series hybrids as well as parallel hybrids are allowed.
- AFV1.5.6 Any electric hybrid vehicles must follow the EV regulations for the Electrical System unless a change is agreed with the Formula Student Technical Committee.
- AFV1.5.7 Any car using a diesel engine with mechanical fuel injection must incorporate a throttle which is mechanically closed when the throttle pedal is released. Diesel engines with electronic fuel injection do not require a throttle if the team follows the principles of the electronic throttle control rules to control and monitor the supply of fuel to the engine and satisfies the technical inspection team that their design is safe.

DV - DRIVERLESS VEHICLES

Please see the separate document “Formula Student AI 2020 Rules” which can be found on the Formula Student website at: <https://www.imeche.org/events/formula-student/team-information/rules>

IN - TECHNICAL INSPECTIONS

IN1 GENERAL

As per 2019 Formula Student Technical Rules V1.1 except:

IN1.1 Technical Inspection Process

IN1.1.1 The technical inspection is divided into the following parts:

- Motorsport UK Safety Inspection (SAFETY)
- Mechanical Inspection (CHASSIS and TECH)
- Accumulator Inspection [EV Only] (EV BATTERY)
- Electrical Inspection [EV Only] (EV VEHICLE)
- Rain Test [EV Only]
- Noise Test (NOISE)
- Tilt Test (TILT)
- Brake Test (BRAKE)
- Vehicle Weighing
- Driver Egress Tests
- Driverless Inspection [DV Only]
- EBS Test [DV Only]

IN1.2 General Rules

IN1.2.13 The event organisers reserve the right to re-inspect the vehicle at any time during the event after passing technical inspection. If any non-compliances are identified, then the team may be disqualified from the run in the dynamic event that immediately preceded the re-inspection.

IN1.3 Technical Inspection Sticker

IN1.3.1 Technical inspection stickers will be placed on the upper nose of the vehicle. Cars must have a clear and unobstructed area at least 125 mm diameter on the upper front surface of the nose along the vehicle centreline, which will be used to record the car weight and identify the sections of scrutineering that have been completed.

IN1.3.3 Each car will be required to append a sticker on the car 8cm x 8cm, which identifies which drivers have completed which event. The location of the sticker must be on the left-hand side of the car above 350mm from the ground such that the marshals can record the driver's letter on the sticker at each event.

IN2 MOTORSPORT UK SAFETY INSPECTION

IN2.1 Motorsport UK Safety Inspection Objective

IN2.1.1 At the Motorsport UK Safety Inspection the driver's equipment and various aspects of the vehicle are checked for compliance with the rules.

IN2.2 MotorsportUK Safety Inspection Required Items

IN2.2.1 The following items must be presented:

- All helmets
- All driver's equipment and other safety gear
- Two unused and in date fire extinguishers
- The vehicle

IN3 [EV ONLY] ACCUMULATOR INSPECTION

As per 2020 Formula Student Rules except:

IN3.1 Accumulator Inspection Objective

IN3.1.1 Not applicable at FSUK.

IN3.1.2 The accumulator charger and the accumulator will be inspected and sealed. If either are disassembled and the seals broken or removed they must be reinspected and resealed before they can be used again.

IN4 [EV ONLY] ELECTRICAL INSPECTION

As per 2020 Formula Student Rules except:

IN4.2 Electrical Inspection Required Items

IN4.2.1 The following items must be presented at electrical inspection:

- One ESO
- Vehicle with the TS Accumulator removed
- Quick jack, stands and push bar
- Samples of self-designed PCBs which are part of the tractive system
- Tools needed for the BSPD check, see T11.6.9
- Datasheets for all parts used in the tractive system
- Tools needed for the disassembly of parts for electrical inspection
- Printouts of any relevant rules questions

IN5 MECHANICAL INSPECTION

As per 2020 Formula Student Rules except:

IN5.1 Mechanical Inspection Required Items

IN5.1.1 The following items must be presented at mechanical inspection:

- The vehicle fitted with tyres for **dry conditions**
- Quick jack, stands and push bar
- The tallest driver of the team with their helmet
- Copy of SES
- Copy of IAD report
- Printouts of any relevant rules questions
- Impact attenuator test piece (except for teams with "standard" IA)
- Teams with a monocoque: laminate test specimen(s)
- Only tools needed for the (dis)assembly of parts for mechanical inspection
- Set of tyres on rims for wet conditions
- Data sheets for the headrest foam, LV Battery(s) and any other item with a material specification required by the rules
- Photographic evidence demonstrating that the chassis is new for the year of entry

IN8 VEHICLE WEIGHING

As per 2020 Formula Student Rules except:

IN8.1 Vehicle Weighing Procedure

All oil and coolant circuits must be at their maximum fill level. The fuel tank(s) must be empty [CV & AFR Only].

IN11 BRAKE TEST

As per 2020 Formula Student Rules except:

IN11.1 Brake Test Procedure

IN11.1.1 Lock all four wheels and stop the vehicle in a straight line at the end of an acceleration run specified by the officials.

Whilst at some point during the run all 4 wheels must be locked at the same time, it is acceptable for the front wheels to lock before the rear wheels.

IN12 DRIVER EGRESS TEST

IN12.1.4 Not applicable to Formula Student UK.

IN12.1.7 Not applicable to Formula Student UK.

IN13 DRIVER EGRESS TEST**IN13.1 Driver Egress Test Objectives**

IN13.1.1 All of the drivers will be tested to prove they meet the requirements of:

- T4.3.1 – Minimum Helmet Clearance
- T5 – Driver Restraint System

IN13.2 Driver Egress Test Procedure

IN13.2.1 The vehicle must have passed SAFETY, CHASSIS, TECH, [EV ONLY] EV BATTERY, [EV ONLY] EV VEHICLE and [EV ONLY] RAIN TEST before attempting the Driver Egress Test.

IN13.2.2 A Driver Egress Test will be completed for the tallest driver only at first to allow the vehicle to attempt the later stages of Inspection.

IN13.2.3 When all other aspects of Inspection are passed the remaining drivers can be tested.

IN13.2.4 The following vehicle and driver with helmet, gloves and shoes must be presented at the Driver Egress Test.

IN13.2.5 The three other team members allowed in the Inspection Area must strap the driver in to the car in the normal driving position and make any required adjustments to the Driver Restraint System (harnesses and head restraint).

IN13.2.6 If there are any non-compliances these will be noted and must be corrected before the driver is allowed to attempt the Driver Egress Test.

IN13.2.7 All drivers must be able to exit to the side of the vehicle in no more than 5 seconds. Egress time begins with the driver in the fully seated position, hands in driving position on the connected steering wheel and wearing the required driver equipment. Egress time will stop when the driver has both feet on the ground.

S - STATIC EVENTS

As per 2020 Formula Student Rules except:

S0 Any team that fails to complete a static event will receive -100 points per static event missed.

S1 BUSINESS PLAN PRESENTATION (BPP)

Complete replacement of 2020 Formula Student Rules with:

S1.1 Business Plan Presentation Objective

S1.1.1 The objective of the BPP is to evaluate the team's ability to develop and deliver a comprehensive business model which demonstrates their product – a prototype race car for the amateur weekend racer – could become a rewarding business opportunity.

S1.1.2 The BPP event is a role play and teams should present themselves as employees of a company rather than as students.

S1.1.3 The judges should be treated as if they were potential investors or partners for the presented business model. Teams should assume that the “executives” represent different areas of a corporate organisation, including engineering, production, marketing and finance, and thus may not all be engineers.

S1.1.4 The business plan must relate to the specific prototype race car entered in the competition. The quality of the actual prototype will not be considered as part of the BPP judging.

S1.1.5 The Business presentations must take into account a “special condition” set prior to the event. Details of the special condition will be published via the Formula Student website usually within one month of the Learn To Win event.

S1.1.6 Unless specifically stated otherwise within the special condition, teams are free to suggest their own manufacturing volume / production rate targets, within their Business Presentations.

S1.2 Business Presentation Schedule

S1.2.1 The Business Plan Presentation Judging will take place in two parts:

- Initial judging of all teams
- Final judging of up to the 5 top teams

S1.2.2 Initial judging of Business Plan Presentations will be made on the static events days. Teams will be assigned a presentation judging time at registration. Teams are reminded that the BPP judging will be held in the BPP judging rooms, NOT at your display area.

S1.2.3 Teams arriving more than eleven (11) minutes late to their assigned BPP judging slot will be deemed to have missed their assigned time period and will receive zero (0) points for the event.

S1.2.4 Final judging of up to the 5 top teams will take place during the BPP Final. Qualifying teams will be notified of their allocated times in advance of the final.

S1.3 Business Presentation Format

S1.3.1 One or more team members will give the presentation to the judges.

- S1.3.2 All team members who will give any part of the presentation, or who will respond to the judges' questions, must be in the podium area when the presentation starts and must be introduced to the judges. Team members who are part of this "presentation group" may answer the judge's questions even if they did not speak during the presentation itself.
- S1.3.3 Presentations are limited to a maximum of ten (10) minutes. Penalties will be imposed if the presentation is less than nine (9) minutes or exceeds eleven (11) minutes. Teams will be asked to rapidly conclude their presentation and may be stopped by the judges if they significantly overrun.
- S1.3.4 The presentation itself will not be interrupted by questions. Immediately following the presentation there will be a question and answer session of up to five (5) minutes.
- S1.3.5 Only judges may ask questions. Only team members who are part of the "presentation group" may answer the judges' questions.
- S1.3.6 Teams giving a PowerPoint or similar style presentation are required to provide an electronic copy of their slides using a USB drive provided by the judges at the time of the presentation.
- S1.3.7 The format of the final judging will be the same as for the initial judging including Questions & Answers. The "presentation group" for the final must consist of the same team members as the initial judging.
- S1.3.8 Access to an internet connection during the initial or final judging cannot be guaranteed.
- S1.3.9 Both the initial and final judging sessions may be filmed by BPP judges.
- S1.4 Data Projection Equipment**
- S1.4.1 LCD / Plasma TV-style screens or video projectors will be provided by the organisers, but teams should bring their own laptop computers and may use their own projectors if they wish. The screens/projectors will have HDMI and VGA Input Connectors. Teams are responsible for the compatibility of their computer equipment and setting up of the screens. Overseas teams should ensure they have UK compatible power leads/adaptors.
- S1.5 Evaluation Criteria**
- S1.5.1 The presentation will be evaluated against the following categories:
- Content
 - Visual Aids
 - Delivery
 - Q&A
- S1.5.2 The criteria are applied only to the team's presentation itself. The team that makes the best presentation, regardless of the quality of their car, will win the event.
- S1.5.3 Content marks will only be awarded for the information presented to the judges. Printed material to support this is allowable but must:
- Be referred to within the presentation

- Be limited to a maximum of eight (8) sides of A4 paper. Decorative covers are excluded from this page count.

S1.6 Scoring Formula

S1.6.1 To ensure judging allows an acceptable separation between teams, the BPP event is marked out of 470 marks - please note: this number may change due to modification of the marking scheme between these rules being published and the competition taking place but is consistent for all teams. A team’s mark out of 470 will be converted into a maximum of one hundred and twenty (120) points that count towards the Formula Student competition as described below.

S1.6.2 Up to 5 teams will be invited to participate in the BPP final. The number of teams invited to participate in the final is at the discretion of the BPP Event Captain and will not be eligible for appeal.

Points will be allocated to top six teams will be as shown in Table 2 below.

Teams in Final	Points assigned					
	1st	2nd	3rd	4th	5th	6th
2	120	110	105*	pro-rata	pro-rata	pro-rata
3			105	103*	pro-rata	pro-rata
4			105	103	101*	pro-rata
5			105	103	101	100*

Table 2 - BPP Finalist Scores

S1.6.3 The BPP scores for non-finalists will be normalised and awarded on a pro-rata basis using the following formula:

$$\text{BUSINESS PLAN PRESENTATION SCORE} = \text{HNFS} \times \text{Pyour} / \text{Pmax}$$

Where:

- “HNFS” is the highest non-finalist score (as indicated with a *) shown in Table 2
- “Pmax” is the mark achieved out of 470 by the highest non-finalist
- “Pyour” is the mark achieved out of 470 by your team

S1.6.4 The BPP Event Captain may at his/her discretion; normalise the scores of different judging teams.

S1.7 Business Plan Presentations without a Completed Car

S1.7.1 Given the quality of the competitor’s car isn’t considered within the BPP event, Formula Student and Concept Class teams compete directly against each other.

S1.7.2 Formula Student Teams that are unable to bring a vehicle to the competition may participate in the BPP event and will receive a score for that event.

S1.7.3 Participating in the BPP event without bringing a vehicle to the competition will not affect vehicle eligibility as per Rule A2.

S2 COST AND MANUFACTURING EVENT

As per 2020 Formula Student Rules except:

S2.3 Cost Report Documents (CRD)

S2.3.1 The CRD consists of the following documents using templates published on the Formula Student website:

- The Bill of Material file (BOM) uploaded as a PDF in A4 landscape format
- The Supporting Material file uploaded as a PDF in A4 portrait format
- The Cost Explanation file uploaded as a PDF in A4 portrait format

S2.3.4 All CRD must be brought as a hard copy to the event and must match exactly the submitted documents.

S2.4 Bill of Material (BOM)

S2.4.9 All eight systems must have a DBOM e.g. list all parts/assembly, materials, processes and fasteners. (See S2.5)

S2.4.10 Two systems must have a CBOM (DBOM) e.g. list all parts/assembly, materials, processes and fasteners. (See S2.6)

S 2.6 Costed Bill of Material (CBOM)

S 2.6.3 The cost calculations MAY consider research, development and capital expenditures for real estates (e.g. plant or development hours of the team) so that a real-world learning experience can be achieved and to enhance discussions with Cost Judges at the event. Equally if a team's wishes to omit these elements that should be made clear in the Cost Explanation file and the judges will focus conversations on only the elements included. All cost should be realistic and measured and points will be award for an enhanced and real-world understanding.

S2.9 Cost and Manufacturing Scoring

S2.9.2 If items are missing from the BOM, points are deducted and reported up to a maximum - 100 points.

<u>Missing Item</u>	<u>Points</u>
Assembly	-5
Part	-3
Process / Material	-1

The judges may not evaluate any vehicle that is presented at the cost and manufacturing event, in what they consider to be an unfinished state and may apply a penalty in line with standard tariff (e.g not attending Cost Judging session or a documentation fault)

S2.10.1 The cost and manufacturing event will be evaluated on the categories specified in the following table:

<u>Category</u>	<u>Points</u>
Format and Accuracy of Documents	5
Knowledge of Documents and Vehicle	5
Content and Completeness of the BOM	20
	(2x10)
Realism of the CBOM	30
Discussion Part 2 "Cost Understanding"	50
Cost Final	10
Total	120

- S2.9.3 The maximum penalty for the Cost and Manufacturing Event is capped at -100points.
- S2.9.4 Teams that submit incorrectly formatted documentation, completed not as prescribed or one of the three required pieces of documentation is missing from the upload/submission will be subject to a penalty of 30 points per failed document on top of any late penalties incurred.
- S2.9.5 Teams which submit their Cost Report Documents after the Final Deadline published in the Key Dates document are expected to attend the Cost event with the correct documentation for judging. Failure to supply documentation at your cost judging slot will result in penalties in line with S 2.9.2 in addition to those received for missing the Final Deadline.
- S2.9.6 The scoring for the non-finalist is calculated as followed:
- $$\text{COST SCORE} = 110(P_{\text{team}}/P_{\text{max}})$$
- P_{team} is the score awarded to the team
 P_{max} is the highest score awarded to any team not participating in the finals
- S2.10.5 The scoring of the cost and manufacturing finalists will vary from 120 to 110 points

S3 ENGINEERING DESIGN EVENT

As per 2020 Formula Student Rules except:

S3.2 Engineering Design Report (EDR)

- S3.2.2 The EDR must not exceed eight pages, consisting of not more than five pages of content (text, which may include pictures and graphs) and three pages of drawings. TIP: Do not use newspaper style twin columns of text or wrap text around images or graphs as reading and evaluating such Reports is hard for Judges using a laptop.

The EDR shall be used to sort the teams into appropriate design queues based on the quality of the information and understanding of the event objective contained in the Report.

S3.6 Engineering Design Vehicle Condition

- S3.6.2 The judges may not evaluate any vehicle that is presented at the design event in what they consider to be an unfinished state and may, at their sole discretion, award zero points for the entire design event.

S3.7 Engineering Design Judging Criteria

- S3.7.2 The judges shall inspect the vehicle and discuss the vehicle design with the team to determine if the design concepts are adequate and appropriate for the application (relative to the objectives set forth in the rules). The judges may sit in the vehicle to ascertain the ergonomics and the driver environment.

S3.8 Engineering Design Scoring

- S3.8.1 The overall engineering design event maximum scoring is 160 points for AFV/CV/EV and 250 points for DV.
- S3.8.2 Up to 50 penalty points may be given to team that demonstrate a lack of engineering knowledge and are unable to provide justification for their designs, including the use of 'carry-over parts' from previous competition vehicles.

The Design Judging Score Sheet for AFV/CV and EV teams will be available at:
<http://www.formulastudent.com/formula-student/Teams/forms>

D - DYNAMIC EVENTS

As per 2020 Formula Student Rules except:

D4 SKIDPAD EVENT

As per 2020 Formula Student Rules except:

D4.1 Skidpad Procedure

D4.1.6 Two separate skidpad locations may exist. If there are two (2) skidpads, one driver must make both their runs on one skidpad and the other driver must make both their runs on the other skidpad.

D4.4 Skidpad Scoring

D4.4.2 5 points are awarded to every team that finishes at least one run without DNF or DQ.

D4.4.3 If a team's run time including penalties is below T_{max} , additional points based on the following formula are given:

$$SKIDPADSCORE = 70 \left(\frac{\left(\frac{T_{max}}{T_{team}} \right)^2 - 1}{\left(\frac{T_{max}}{T_{min}} \right)^2 - 1} \right)$$

T_{team} is the team's best run time including penalties.

T_{min} is the fastest vehicle run time including penalties.

T_{max} is 125% of the fastest vehicle time including penalties.

D5 ACCELERATION EVENT

As per 2020 Formula Student Rules except:

D5.2 Acceleration Event Heats and Top 6 Runoff Procedure

D5.2.1 There will be two (2) heats. Each heat must have a different driver and each driver can have two (2) runs.

D5.2.6 The six (6) fastest cars in the heats qualify to compete in the "Top Six Runoff". The runoff will be run as an additional heat for the fastest driver from each qualifying team.

D5.2.7 The driver can have two (2) runs, these additional runs do not count as competing in another dynamic event.

D5.2.8 The starting order will be reversed from the fastest times in the heats, i.e. the slowest team runs first and the fastest team runs last.

D5.4 Acceleration Scoring

D5.4.1 5 points are awarded to every team that finishes at least one run without DNF or DQ.

D5.4.2 If a team's best time including penalties is below T_{max} additional points based on the following formula are given:

$$ACCELERATION SCORE = 65 \left(\frac{\frac{T_{max}}{T_{team}} - 1}{\frac{T_{max}}{T_{min}} - 1} \right)$$

T_{team} is the team's best time including penalties.

T_{min} is the fastest vehicle time.

T_{max} is 150% of the fastest vehicle time.

D5.4.4 The score for the Top Six Runoff is spread between zero (0) and five (5) based upon the elapsed time, additional points will be awarded as per the below:

Top Six Runoff Placing	Points
First	5
Second	4
Third	3
Fourth	2
Fifth	1
Sixth	0

D6 AUTOCROSS / SPRINT EVENT

As per 2020 Formula Student Rules except:

D6.1 Autocross Track Layout

D6.1.3 The organisers reserve the right to deviate from the parameters specified, when they determine it is appropriate given the characteristics of the particular competition site.

D6.2 Autocross / Sprint Event Procedure

D6.2.6 If a stalled or broken-down vehicle is blocking the track then all other vehicles on track will be shown the red flag and allowed another run.

D6.4 Autocross / Sprint Event Scoring

D6.4.1 5 points are awarded to every team that finishes at least one run without DNF or DQ.

D6.4.2 If a team's corrected elapsed time is below T_{max} additional points based on the following formula are given

$$SPRINT SCORE = 95 \left(\frac{\frac{T_{max}}{T_{team}} - 1}{\frac{T_{max}}{T_{min}} - 1} \right)$$

T_{team} is the team's best time including penalties.

T_{min} is the fastest vehicle time including penalties.

T_{max} is 145% of the fastest vehicle time including penalties.

D7 ENDURANCE AND EFFICIENCY EVENT

As per 2020 Formula Student Rules except:

D7.1 Endurance Track Layout

D7.1.4 The organisers reserve the right to deviate from the parameters specified, when they determine it is appropriate given the characteristics of the particular competition site.

D7.3 Passing

D7.3.4 The passing zone procedure will be as follows:

- A slower leading vehicle will be shown a blue flag and/or blue flashing lights and must drive into the slow lane and decelerate
- The following faster vehicle will continue in the slow lane to pass the slow vehicle

- The vehicle that has been overtaken may re-enter the track when the track marshal who is in charge of the passing zone shows the green flag

D7.6 Endurance Specific Regulations

- D7.6.9 If a vehicle is unable to maintain lap times within one hundred forty-five percent (145%) of the fastest lap time for the course, then it must exit immediately.
- D7.6.10 Disqualification for failure to maintain the minimum speed will be made at the discretion of the Dynamic Event Captain / Clerk of the Course.

D7.7 Endurance Scoring

- D7.7.4 If a team's corrected elapsed time is below T_{max} additional points based on the following formula are given:

$$ENDURANCE\ SCORE = 225 \left(\frac{\frac{T_{max}}{T_{team}} - 1}{\frac{T_{max}}{T_{min}} - 1} \right)$$

T_{team} is the team's best time including penalties.

T_{min} is the fastest vehicle time including penalties.

T_{max} is 145% of the fastest vehicle time including penalties.

- D7.7.5 If a team DNFs then:

$$ENDURANCE\ SCORE = \text{Number of Laps Completed}$$

- D7.7.6 If a driver's run is interrupted by a red flag, the recorded laptime for their red-flagged lap will be replaced by the average lap time from their preceding laps. The number of laps used for the averaging will be at the discretion of the Dynamic Event Captain.

D7.8 Efficiency Scoring

- D7.8.1 The Efficiency is based on a metric of the amount of fuel consumed or energy used and the lap time on the endurance course, averaged over the length of the event. Teams are advised that the Efficiency score is based only on the distance cars run on the course during the Endurance event. Although the starting line, exit line and the driver change zone increase the actual distance a car must drive during the event, those distances are not factored into the fuel calculations. Additionally, fuel consumption adjustments will not be made for engine running in the entry/exit lines, during driver change, in the penalty box or for any on-course incidents. The organizer may use either the corrected Endurance laptimes or the scored Endurance laptimes for the Efficiency event.
- D7.8.2 The mass of CO₂ released to the atmosphere will be assessed by using the conversion factors below from quantity of fuel used to CO₂ released. The factors are intended to represent the average supply of the appropriate commodity and the organizers will not take account of where the actual fuel used came from.

Fuel Type	Conversion Factor
Unleaded petrol	2.31kg CO ₂ per litre
Electric	0.65kg CO ₂ per kWh
E85	1.65kg CO ₂ per litre

The conversion factor for Alternative Fuels will be determined by the organisers upon receipt and review of the Alternative Fuel Report.

D7.8.3 Full credit will be given for energy recovered through regenerative braking.

D7.8.4 Efficiency will be scored using the following formulas:

$$EFFICIENCY\ SCORE = 100 \frac{(Efficiency\ Factor_{min}/Efficiency\ Factor_{team}) - 1}{(Efficiency\ Factor_{min}/Efficiency\ Factor_{max}) - 1}$$

Where:

$$EFFICIENCY\ FACTOR = \frac{T_{min}/LapTotal_{Tmin}}{T_{team}/Laps_{team}} * \frac{CO_{2min}/LapTotal_{CO2min}}{CO_{2team}/Laps_{team}}$$

CO_{2min} is the smallest mass of CO_2 used by any competitor whose endurance time T_{team} is less than 145% of the average laptime of the fastest team that completes the endurance event.

CO_{2team} is the mass of CO_2 used by the team being scored.

T_{min} is the lowest Endurance time of the fastest team whose fuel consumption does not exceed 26 litres/100km or energy equivalent of 60.06 kg CO_2 /100km.

T_{team} is the combined Endurance times of the drivers in your heat.

$Laps_{team}$ is the number of laps driven by the team being scored.

$LapTotal_{Tmin}$ and $LapTotal_{CO2min}$ are the number of laps completed by the teams which set T_{min} and CO_{2min} respectively.

$EfficiencyFactor_{min}$ is calculated using CO_{2team} equivalent to 60.06kg CO_2 /100km and T_{team} set to 145% of the average laptime of the fastest team that completes the Endurance event.

D7.8.5 Vehicles whose average Endurance laptime exceeds 1.45 times the average Endurance laptime of the fastest team that completes the Endurance event, will receive zero (0) points for efficiency.

D7.8.6 Vehicles whose corrected average fuel consumption per lap exceeds 26 litres/100 km or energy equivalent of 60.06 kg CO_2 /100 km, will receive zero (0) points for Efficiency.

D7.8.7 The minimum Efficiency Factor is determined from the maximum allowable CO_2 /100km and 145% of the corrected average Endurance laptime of the fastest team that completes the Endurance event.

D7.8.8 Efficiency scores can range from zero points (0) to positive one hundred (100) points.

D7.8.9 Vehicles which cross the start line following driver change are eligible for Efficiency points. Other vehicles will receive a score of zero points (0) for Efficiency.

D7.8.10 Should the fuel level change after refuelling due to effects such as described in CV2.7.1 then the difference in fuel level will be measured and twice the amount will be added to the official fuel consumption figure.