



FORMULA STUDENT ALPE ADRIA



FS CV Hybrid Rules Extension 2023

2023





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Version: 1.2

Version	Date	Modification	Rule
1.0	Sept. 26th, 2022	Initial release	-
1.1	November 23rd, 2022	Updated references to FS Rules v1.1; AIR regulated with EV 5.6.3	Introduction; Rule 5.4
1.2	December 21st, 2022	New rule 2.5: Voltage up to 75 V allowed for internal low power control signals	Rule 2.5

Introduction

The European Formula Student competitions FSA, FSEast, FSN, FSCzech, FSAA and FSPT will continue (or start) to offer the Hybrid Class for the 2023 season as extension for the Combustion Vehicle Class. The above-mentioned competitions plan on making the Hybrid Class a permanent installment and it is possible that further competitions will also offer this Hybrid Class.

This document is based on **FS Rules 2023 V1.1** ([link](#)) and it is applicable for CV class teams intending to design Formula Student cars with a hybrid powertrain system consisting of an internal combustion engine and an electric tractive system. The rules listed below are specific rule changes and additions to the FS Rules 2023. In case of a conflict between the FS Rules 2023 and the FS CV Hybrid Rules Extension 2023, the FS CV Hybrid Rules Extension 2023 supersedes the FS Rules 2023.

Concept outline

These rules allow hybrid systems with **low-voltage solutions (<60 V)** and an electrical energy storage with a maximum of **3 kg** of “active material” meaning the battery cells, supercapacitors or similar electrical storage solutions. The hybrid storage container, fuse, insulation relays and other parts of the HSC will not be included any more within the weight limit.

These rules aim for a capacity of around **500 Wh** and a maximum average power of **5 kW**. The electrical characteristics are open, only the maximum weight of the HSC active material will be checked during inspection. The teams are free to determine where and how to apply the energy, as well as how to recuperate the energy.

Abbreviations:

HSC: Hybrid Storage Container
HMS: Hybrid Monitoring System
HSD: Hybrid System Description



1. Eligibility

- 1.1. The FS Hybrid class is an extension of the CV class.
- 1.2. Hybrid vehicles will compete against / together with “regular” CV cars.
- 1.3. Unmodified FS-CV Vehicles are still eligible to run under FS hybrid rules.

2. Definitions

- 2.1. The hybrid system must be a low voltage system, T11 is applied for all system components.
- 2.2. If there is a conflict between T11 and the hybrid rules, the hybrid rules apply.
- 2.3. Energy must be stored only in purely electrical energy storage systems such as batteries or supercapacitors. Other solutions, such as flywheels or compressed air energy storage are prohibited.
- 2.4. The HSC is defined as the energy storage system as per 2.3 (including the AIR and overcurrent protection) that can be used to introduce energy into the powertrain.
- 2.5. Exception from Rule T11.1.3: The maximum permitted voltage for motor controller/inverters internal low power control signals is 75 VDC

3. Additional technical rules

- 3.1. A firewall must be present between the low voltage battery and the fuel tank.
- 3.2. Hybrid cars have to be identified by an additional marking next to all three vehicle numbers with the capital letters “HY” in Roman Sans-Serif characters at least 75 mm high in white on a red background.
- 3.3. Hybrid components other than the LV battery must be positioned in the surface envelope see T1.1.17.
- 3.4. Rule T6.1.11 applies to hybrid vehicles as well.
- 3.5. Rule T7.2.2 applies to hybrid components as well.

4. Additional CV rules

- 4.1. The entirety of the CV - rules from the FS Rules 2023 apply.
- 4.2. The hybrid system will be incorporated into the CV shutdown circuit (CV 4.1).
- 4.3. The HSC AIR must be part of the shutdown circuit in such a way that one side of the relay coil is directly incorporated into the shutdown circuit and the other side is supplied by the hybrid control system.
- 4.4. Precharge circuits are allowed.
- 4.5. EV 2.1 applies also for hybrid vehicles.
- 4.6. The hybrid system may only be deployed if the combustion engine is running or when the starter button is pushed.



5. Energy Storage Container

- 5.1. The HSC must comply with T11.7 rules.
- 5.2. The HSC must comply with T11.7.7 regardless of chemistry type.
- 5.3. The HSC must include overcurrent protection that trips at or below the maximum specified charge current of the cells.
- 5.4. The disconnection mechanism must be designed as an AIR internal to the HSC, disconnecting the positive pole of the HSC. The AIR must be compliant with EV 5.6.3 - solid state relays are not allowed.
- 5.5. A fuse rated for the maximum specified discharge current of the cells must be implemented as required in T11.7.7.
- 5.6. The active material within the HSC is defined as the elements that store the electrical energy e.g.: battery cells or supercapacitors including all casings and tabs that are integral to them.
- 5.7. The maximum weight of the active material within the HSC is 3 kg.
- 5.8. If multiple HSCs are used, the total weight of the contained active material is limited to 3 kg.
- 5.9. The HSC must be removable to be inspected at scrutineering.
- 5.10. All electrical parts of the hybrid system must be IPxxB compliant when energized.
- 5.11. Moving energy into the HSC from a different electrical storage system is prohibited.

6. Technical Documentation

- 6.1. The team has to submit a Hybrid System Description, which contains the
 - Hybrid system wiring diagram;
 - Energy storage electrical and mechanical configuration;
 - Used electrical actuators placement and mechanical drawings, power and rpm limits.
- 6.2. **The HSD is subject to approval.** The deadline is the same as for the ESF documents of the respective competitions.

7. Additional inspection rules

- 7.1. Hybrid cars will follow the respective applicable CV procedure.
- 7.2. Hybrid cars will have an additional HSC and HSD inspection during the CV scrutineering procedure.
- 7.3. The HSC will be inspected and sealed, only sealed HSC must be used during the dynamic events.
- 7.4. It must be possible to easily determine the weight of the active material within the HSC during inspection. For example: one battery cell has to be provided for weighing and it must be possible to determine the number of cells in the HSC.