

## Cover Sheet

The Cover Sheet must contain the following:

- **Heading “Hydrogen System Form 2025”**
- **University Name and Team Name**
- **Contact details of an Hydrogen Safety Officer, team leader or other person responsible for this document**

Feel free to add your team logo, car picture, and the like to the cover page

- 1. Requirements (delete this section after you have read and understood it):**
2. Complete all sections and tables of the H2SF. If a section is not applicable to your design state that in the document, do not delete any sections.
3. Remove instructions (orange) from the document as you complete the sections.
4. Provide hyperlinks to all datasheets.
5. If you are unsure concerning the reviewer's feedback, do not hesitate to ask questions at: [hydrogen@fs-world.org](mailto:hydrogen@fs-world.org)
6. Parts of the H2SF that are changed because of reviewer's feedback **must be marked in red.**
7. Following these guidelines will guarantee a swift review process.

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## 1 System Overview

### 1.1 Short description

Include a brief description of the vehicle (1 paragraph).

### 1.2 Renderings from the whole car

Include renderings from all both side views, top view, front view and back view which shows the whole car. To make some parts of the bodywork transparent to make other parts better visible is allowed.

### 1.3 Renderings from the drivetrain and hydrogen related parts

Include renderings from the drivetrain and all hydrogen related parts, so that the officials can see how your system looks like.

### 1.4 Block diagram

Insert a large (full page) system overview block diagram showing all major hydrogen components and system interaction. No part mentioned in the Hydrogen Rules and installed in the car may be missing.

## 2 Fuel

Complete the information in the table below.

Which kind/grade of hydrogen do you need?	ISO 14687: 2019
How much hydrogen do you need for one endurance?	500g
How much hydrogen do you need at the whole event?	800g
maximum fuel pressure	350 bar
Do you bring your own hydrogen?	no

Table 2-0 - Fuel Specifications

## 3 Hydrogen tank

### 3.1 Description and safety

Include a description of the hydrogen tank and the manufacturer. If it is a self made or customized hydrogen tank, please tell us how it is designed, manufactured, tested and why it is a safe system.

Please add some pictures of the tank, so that officials can see that there are no visible defects.

### 3.2 General informations

Complete the information in the table below.

Tank manufacturer	xxx
Model/name of the tank	xxx
Type of tank	xxx
Maximum hydrogen pressure	350 bar
Tank volume	1 kg
Certification according to	xxx
accredited by	xxx

Table 3-2 - Hydrogen Tank Specifications

### 3.3 Hydrogen tank links

Please add the following links:

Datasheet of the hydrogen tank

Datasheet of the certification of the hydrogen tank

### 3.4 Refueling hydrogen tank

Please explain how the refueling of your tank is working?

## 4 On Tank Device (OTD)

### 4.1 General informations

Please explain how all the functions of the OTD are solved in your construction. If several parts build together the OTD, please explain how they are mounted to each other.

Please add pictures of the whole assembly and how it is attached to the hydrogen tank.

All OTD or the parts of the OTD must be certified according to ISO 19881, UN GTR No.13 or UN regulation No. 134.

Complete the information in the table below.

Model OTD	xxx
Manufacturer OTD	xxx
Model OTV	xxx
Manufacturer OTV	xxx
Model TPRD	xxx
Manufacturer TPRD	xxx

Table 4-1 - ON Tank Device Specifications

#### 4.2 On Tank Valve (OTV)

Please show detailed pictures and a datasheet for the OTV.

#### 4.3 Thermal activated pressure relief device (TPRD)

Please show detailed pictures and a datasheet for the TPRD.

### 5 Pressure regulator

#### 5.1 General informations

Complete the information in the table below.

Model pressure regulator	xxx
Manufacturer	xxx
Model OTV	xxx
rated for max. high pressure	350 bar
used low pressure	10 bar

Table 5-1 - Pressure regulator Specifications

#### 5.2 Picture and Datasheet

Please show detailed pictures and a datasheet for the pressure regulator.

#### 5.3 Mounting of the pressure regulator

Please explain how to attach the pressure regulator to the OTD and the quick connector.

### 6 Connectors, fittings and lines

#### 6.1 Quick Connector

Please show detailed pictures and a datasheet for the connector which is prescribed in F3.1.6 of the Hydrogen Rules. Please explain which steps are necessary to remove the tank assembly from the car for refueling and to reassemble it. How long will it take?

#### 6.2 Refueling connector an refuelling protocol

Which connectors do you have that we can connect the hydrogen tank to the refueling infrastructure? Please show that your tank nipples H35 (normal flow or designed for maximum mass flows of 60g/s) is specified in accordance with ISO 17268 - Gaseous hydrogen land vehicle refuelling connection devices. Please add pictures and if available a datasheet of the connector.

Please show that you fulfill the requirements for the refueling protocol from the following link: <https://cleanenergypartnership.de/wp-content/uploads/2022/03/CEP-Requirements-for-Refuelling-at-Ambient-Temperatures18022020-min.pdf>

### 6.3 Connectors and fittings

Please show detailed pictures and a datasheets for all hydrogen containing parts. See F4.1.1 and F4.1.2 of the Hydrogen Rules.

### 6.4 Lines

Which kind of lines or tubings do you use? Please add datasheets.

## 7 Structural

### 7.1 Attachment hydrogen tank to the chassis

Insert a large image of the complete hydrogen tank assembly without cover and show the attachment points to the chassis.

Please show with pictures and calculations that your design fulfills F2.1.1 and F3.1.3 of Hydrogen Rules and can withstand all the forces of T9.3 of the FS Rules.

Please add a link to the Installation guidelines of the hydrogen tank.

### 7.2 Lowest point of any part of the hydrogen system

Please show with a rendering or picture that your design is rules conform to F2.1.8 of the Hydrogen Rules.

### 7.3 Structural sidepods

If a structural side box is used to accommodate hydrogen tanks and other hydrogen-containing parts, it must be comply with T3.2 of the FS Rules and must protect against front, side and rear impacts. Please show that you are rulesconform.

Please show how you attach the structural sidepods to the chassis and show the necessary calculations.

Prove that you have considered F2.1.4 of Hydrogen Rules when designing the housing and firewall.

### 7.4 H2CV only: Engine mounting

Insert a large image of the engine without cover and show the attachment points to the chassis.

Please show that you are using good engineering practices to fulfill F2.1.1 of Hydrogen Rules and can withstand all the forces of T9.3 of the FS Rules.

### 7.5 H2HY only: Hybrid Storage Container Attachments

Insert calculations showing that the following criteria are being met: The HSC itself, the mounting of the HSC to the chassis, and the mounting of each cell to the HSC must be designed to withstand the following forces of T9.3 of the FS Rules.

### 7.6 FCEV only: Fuel cell mounting

Insert a large image of the fuel without cover and show the attachment points to the Fuel Cell System Container (FCSC).

Please show with pictures and calculations that your design fulfills E12.1.1 and E.12.1.2 of Hydrogen Rules and can withstand all the forces of T9.3 of the FS Rules.

### 7.7 FCEV only: Fuel Cell System Container Attachments

Insert a large image of the FCSC and show the attachment points to the chassis.

Please show with pictures and calculations that your design fulfills E12.1.3 to E12.1.11 of Hydrogen Rules and can withstand all the forces of T9.3 of the FS Rules.

### 7.8 FCEV only: Tractive System Accumulator Container Attachments

Insert large images of the Tractive System Accumulator Container (TSAC) and show the attachment points to the chassis.

Insert calculations showing that the following criteria are being met: The TSAC itself, the mounting of the TSAC to the chassis, and the mounting of each cell to the TSAC must be designed to withstand all the accelerations of T9.3 of the FS Rules. Please show pictures.

### 7.9 FCEV only: Positioning of Hydrogen System Parts

Please show that all parts of the Hydrogen System fulfil E3.1.1 and E3.1.1.2 of the Hydrogen Rules.

## 8 Firewall

### 8.1 Firewall specifications

Complete the information in the table below.

Aluminum layer thickness:	0.2mm
Insulating layer thickness:	2mm
Insulating Material Make / Model:	Conductive Co. FLDPDCT
Insulating Material Datasheet:	<a href="#">Datasheet</a>
Insulating layer side:	Driver

Table 8-1 - Firewall Specifications



## 8.2 Firewall pictures

Provide CAD rendering(s) or photographs showing the firewall components. Mark the parts that the firewall is protecting from (Hydrogen, oil, and cooling system components) in the pictures, if necessary. Show that you are rules conform to F2.1.2, F2.1.4 and E12.1.1 of the Hydrogen Rules.

## 9 H2CV / H2HY only

### 9.1 General informations about engine

Complete the information in the table below.

Model of the engine	xxx
Manufacturer of the engine	xxx
Displacement	1600cc
Horsepower	95PS
Number of cylinders	4

Table 9-1 - Engine Specifications

### 9.2 General informations about injection

Complete the information in the table below.

Model of the injector(s)	xxx
Manufacturer of the injector(s)	xxx
Rated to/norm	xxx
Injections pressure	25 bar
Kind of injection	xxx

Table 9-2 - Injection Specifications

### 9.3 Modification of the engine

Please explain which kind of modification you have done to make the engine running on hydrogen. Please add pictures of the modifications.

### 9.4 Parts of the injection system

Please explain all parts of the injection system and show all datasheets and norms that your design is rules conform with C1.1.5 of the Hydrogen Rules.

If your injector(s) is/are not rated to one of the hydrogen norms, explain why that should be a safe solution. Please add pictures of the injector.

### 9.4 Pressure relief device and flame arrestor

Show through text and images that you fulfill C1.1.6 of the Hydrogen Rules. Please add the datasheet of both parts.

### 9.5 Air intake system

Please make a short description of your air intake system and show how you attach it to the car. Show the officials that you are using good engineering practice. Add some pictures.

### 9.6 Forced air induction system (if applicable)

Please make a short description of your air induction system and show how you attach it to the car. Add some pictures.

### 9.7 Water injection system (if applicable)

Please make a short description of your water injection system and show how you attach it to the car. Add some pictures.

### 9.7 Heat management

Explain how you do the heat management and how you fulfill F2.1.5 and F2.1.6 from the Hydrogen Rules. Please show renderings and datasheets of the used material/construction.

## 10 FCEV only

### 10.1 General requirements

Please explain how you want to fulfill the general requirements of the whole chapter E2 of the Hydrogen Rules. Show necessary datasheets and/or pictures.

### 10.2 Insulation and cabling of the hydrogen system

Please show that you fulfill the rule E4.1.1 of the Hydrogen Rules for Insulation and cabling of the hydrogen system.

### 10.3 Discharge Circuit

Explain how you design the discharge circuit(s) and how you fulfill the rules from the chapter E7 from the Hydrogen Rules. Please show circuit diagrams and datasheets of the used material/construction.

### 10.4 Tractive System Active Light

Please show a picture of your Tractive System Active Light. Please show how you manage that the Tractive System Active Light shall be active if there is HV live on the vehicle (either on the TS side, or on the FC side of the HS DCDC).

### 10.5 General informations about fuel cell

Complete the information in the table below.

Model of the fuel cell	xxx
Manufacturer of the fuel cell	xxx
Output Voltage	xxxV
Output Current	xxxA
Max. Power	20kW
Size	500x450x300mm
Weight	15kg

Table 10-5 - Fuel Cell Specifications

### 10.6 Fuel cell

Please explain and show pictures how you mount the fuel cell system to the Fuel Cell System Container with flexible mounts to prevent stresses introduced by e.g. chassis deformation or vibration. Check E12.1.2 from the Hydrogen Rules.

Please add the following links:

Datasheet of the fuel cell

Installation guidelines of the fuel cell

Datasheet of the Dedicated fuel cell coolant

### 10.7 Fuel Cell System Container – Electrical Configuration

Please explain how you fulfill rule E10.1.2 from the Hydrogen Rules and show the necessary ventilation holes.

Please show that your electrical layout is rules conform with the whole chapter E11 from the Hydrogen Rules. Add all necessary pictures, circuit diagrams or datasheets.

### 10.8 Fuel Cell Isolation Relays (FCIR)

Please explain how you want to fulfill rule E14.1.1 from the Hydrogen Rules. Please add circuit diagrams and a datasheet of the used FCIR(s).

### 10.9 General informations about HV battery

Complete the information in the table below.

Model of the battery cells	xxx
Manufacturer of the cells	xxx
Output Voltage	xxxV
Output Current	xxxA
Max. Power	20kW
Size	500x450x300mm
Weight	15kg

Table 10-9 - HV-battery Specifications

### 10.10 Power distribution

Please explain how you want to fulfill rule E5.1.4 to E5.1.7. Please add circuit diagrams and/or programming.

### 10.11 General informations about TSAC

Complete the information in the table below.

Number and grade of bolts	xxx
Material	xxx
Wall Thickness	2mm
Size	500x400x300mm
Weight including battery	20kg

Table 10-11 - HV-battery Specifications

### 10.12 TSAC – Electrical Configuration

Insert a large image (top or nearly top view) of the complete tractive system accumulator container (TSAC) assembly without cover.

Figure must include the following:

- Electronics for the cell monitoring (at least one PCB mock-up)
- AIR
- Overcurrent protection device (typically: fuses)
- All electrical connections for the high current path
- Main power connector

(additional images may be needed to provide clear views of all elements)

### 10.13 Heat management

Explain how you do the heat management and how you fulfill F2.1.5 and F2.1.6 from the Hydrogen Rules. Please show renderings and datasheets of the used material/construction.

### 10.14 Air intake system

Please make a short description of your air intake system and show how you attach it to the car. Show the officials that you are using good engineering practice. Add some pictures.

### 10.15 Fuel Cell Control Unit (FCCU)

Please explain how your FCCU is working. Please add circuit diagrams and/or programming.

Please explain how you want to fulfill rule E7.1.6 and the whole chapter E16 of the Hydrogen Rules.

## 11 Shutdown Circuit and Hydrogen System Master Switch

### 11.1 Shutdown Circuit Schematic H2CV / H2HY

Insert a large (full page) schematic of the shutdown circuit. Check for working on this topic chapter S3 of the Hydrogen Rules.

The schematic must include the following:

- All shutdown circuit switches/devices (indicate Normally Open or Closed)
- Hydrogen control system connection to shutdown circuit
- BSPD connection to shutdown circuit
- BOTS
- Inertia switch
- AIR coils
- Pre-charge relay coil (if used)
- GLV battery
- Overcurrent protection(s)
- Wire size (AWG or mm<sup>2</sup>)

Explain how you meet the following requirement: The hydrogen system may only be activated when the combustion engine is running or during engine start.

### 11.2 Shutdown Circuit Schematic FCEV

Insert a large (full page) schematic of the shutdown circuit. Check for working on this topic chapter S4 of the Hydrogen Rules.

The schematic must include the following:

- All shutdown circuit switches/devices (indicate Normally Open or Closed)
- Hydrogen control system connection to shutdown circuit
- BSPD connection to shutdown circuit
- BOTS
- Inertia switch
- AIR coils
- Pre-charge relay coil (if used)
- GLV battery
- Overcurrent protection(s)
- Wire size (AWG or mm<sup>2</sup>)

Explain how you meet the following requirements:

- chapter E9 from the Hydrogen Rules
- The hydrogen system may only be activated when the fuel cell is running.

### 11.3 Hydrogen System Master Switch

Show through text and images that you fulfill S2 of the Hydrogen Rules.

## 12 Hand cart

### 12.2 Hydrogen leak detection

Show through text and images that you fulfill S7.1.3 of the Hydrogen Rules. Please add the datasheet of your measuring tools.

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### 12.2 Hand cart

Show through text and images that you fulfill S8.1.5 and S8.1.6 of the Hydrogen Rules.