FORTIS SAXONIA

Technical Report

15. April 2021

Virtual technical inspection documentation 2021

Content:

Vehicle Dimensions

With min and max according to Article 45 of Chapter I		**min**	**max**	**actual**	**unit**
a)	Total vehicle height	1000	1300	1125	[mm]
b)	Total vehicle width	1200	1300	1215	[mm]
c)	Total vehicle length	2200	3500	3000	[mm]
d)	Track width (front)	1000	-	1080	[mm]
	Track width (rear)	800	-	950	[mm]
e)	Wheelbase	1200	-	1895	[mm]
f)	Driver's compartment height	880	-		[mm]
	Driver's compartment width	700	-		[mm]
g)	Ground clearance	100	-		[mm]
h)	Vehicle weight	-	225	160*	[kg]

* The vehicle weight was measured during Shell Eco-marathon Netherlands 2019. Unfortunately there were no ideal measuring conditions in our workshop but the vehicle weight should not have changed more than +/-10kg.

Braking System description

The Vehicle is equipped with a hydraulic braking system, which contains the following components as shown in the braking system diagram below (see Figure 3):

- **Brake pedal** (light red in diagram, see also Figure 1): The pedal is a single brake pedal with a surface area of about 5692mm². The operating force of the driver is applied as indicated by the red arrow and is transferred to the braking cylinder by a rigid mechanical link (see Figure 2).
- **Single master braking cylinder** (yellow in diagram, see also Figure 2) The braking cylinder is a single master cylinder, it comes from a commercial vehicle application which supports two circuits.
- **2 hydraulic circuits** (black): There are two separate hydraulic brake circuits where one operates on the two front axles and the other one on the rear axles. Both are connected to the same single master two circuit braking cylinder. The lines consist of professionally customised braided stainless steel brake lines or plastic brake lines.
- **Braking discs and callipers** (blue, see also Figure 4): Each of the four wheels has its own braking disk with calliper which are as unit taken from a commercial quad bike application.

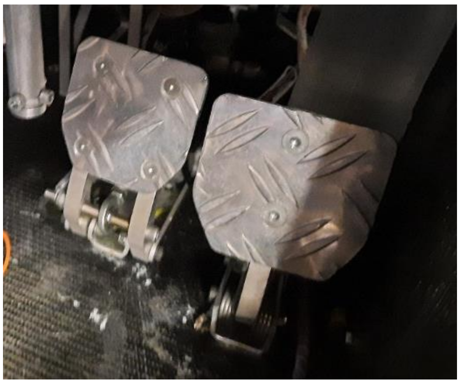


Figure 1: brake pedal (left)

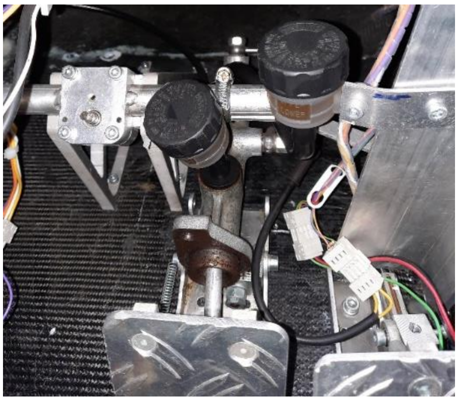


Figure 2: single master two circuit brake cylinder

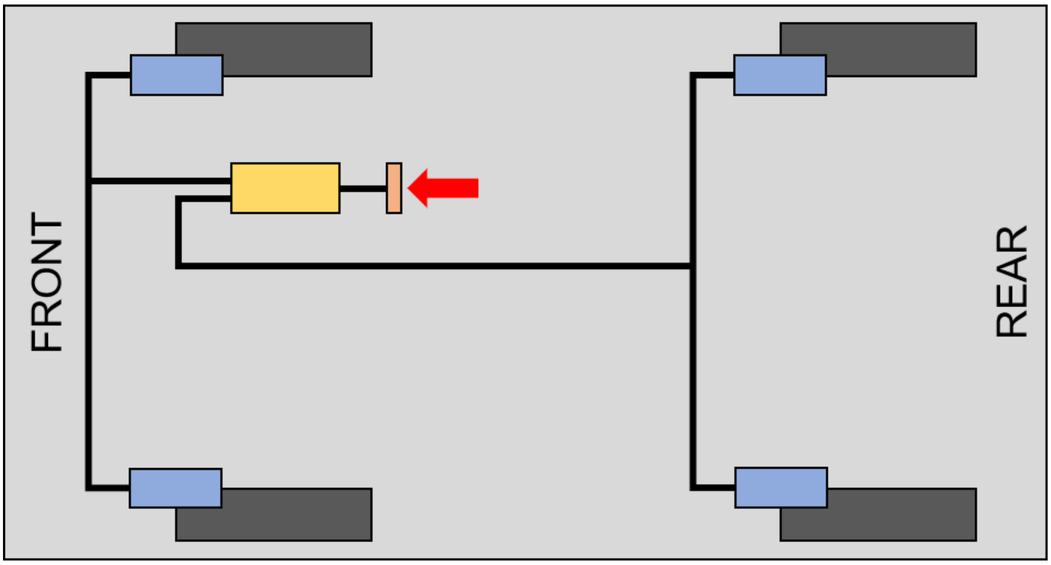


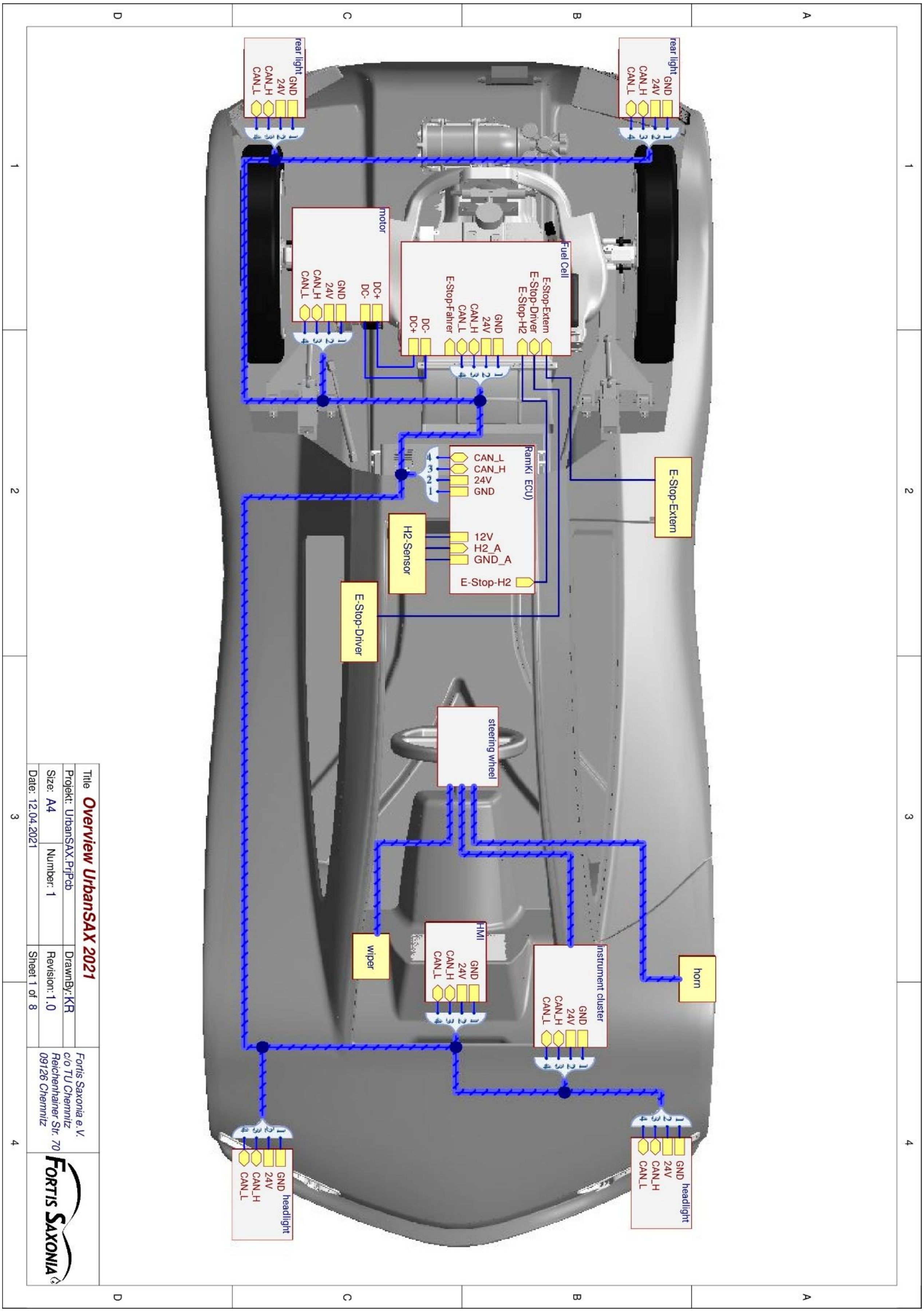
Figure 3: Braking system diagram of UrbanSAX

As the components applied near the wheels are commercial components from quad bikes / all-terrain vehicles, the wet weather capability of the system is considered as given.

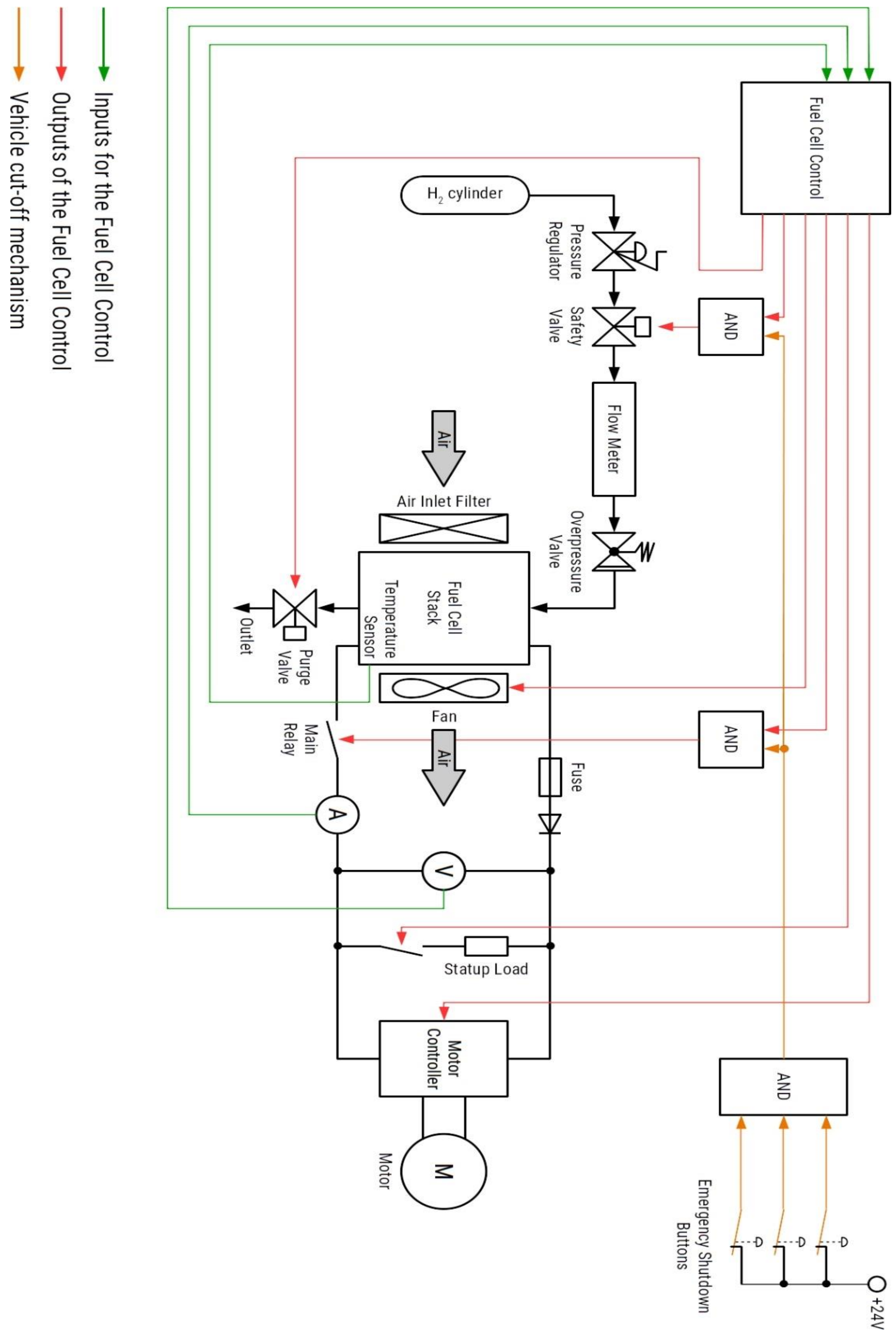
Plus, there were no changes to the 2019 braking system, which passed the technical inspection of Shell Eco-marathon Netherlands in Berghem.

Figure 4: Brake disc and calliper assembly. From top left to bottom right: Front left, front right, rear left, rear right

Vehicle level electric schematic



Energy supply diagram



Fuel cell description

Our vehicle uses a hydrogen fuel cell system for the delivery of the needed propulsion energy. The used fuel cell stack has the following properties.

- cell count 46
- voltage range 23 V – 46 V
- current range 0 A – 65 A
- rated power 2 kW

This fuel cell stack is embedded into a housing that was specially constructed by and manufactured for us. During the design it was taken care that the temperature inside would be equally distributed to ensure a stable and reliable operation that leads to a maximum performance. The tubing that is used to deliver hydrogen to and purge from the fuel cell is made from PTFE.

The electrical control of the fuel cell is done by an electrical control unit (ECU) that was also specially developed for this system. It can operate the hydrogen fuel cell independently of the vehicle. This makes it possible to test the system extensively without needing a real vehicle. The ECU itself monitors all relevant data of the fuel cell, including voltage, drawn current, cell temperature and hydrogen pressure. Based on these values, the actuators (valves, relays and the air fan) are controlled.

To ensure a safe operation, the vehicle cut-off mechanism is realised in hardware. The used emergency stop signal is low-active, meaning it has a voltage of 0V if any emergency switch is pressed. In this case a partial power outage is also be treated as an emergency by default. This emergency signal is used with logical AND gates before each valve and relay, ensuring that none of them is opened if any emergency switch is active. This guarantees the safety of the whole system, even if the used software might fail. Furthermore, it makes it impossible to bypass this security mechanism by any intended or unintended software means.

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