ФОРМУЛА СТУДЕНТ

СЕЗОН 2018/2019

bauman racing team

Движение в России

1. FDR Moscow - Московский Политех
2. Polytech North Capital Motorsport - СПбПУ
3. Формула Студент РУДН
4. Формула Студент МАДИ
5. Formula Electric MADI
6. Togliatti Racing Team
7. SHUKHOV RACING TEAM
8. NEFTEGAZ Engineering
9. Формула студент Магнитогорск DS-Garage

Раскол

До 2017 года был единый регламент от SAE (ассоциации автомобильных инженеров). В 2017 году организаторы немецкого этапа предложили свою версию регламента, которая стала основной на большинстве европейских этапов.

FS-Rules (formulastudent.de - Германия):

- Германия
- Австрия
- Англия
- Чехия
- Венгрия
- Испания
- Голландия

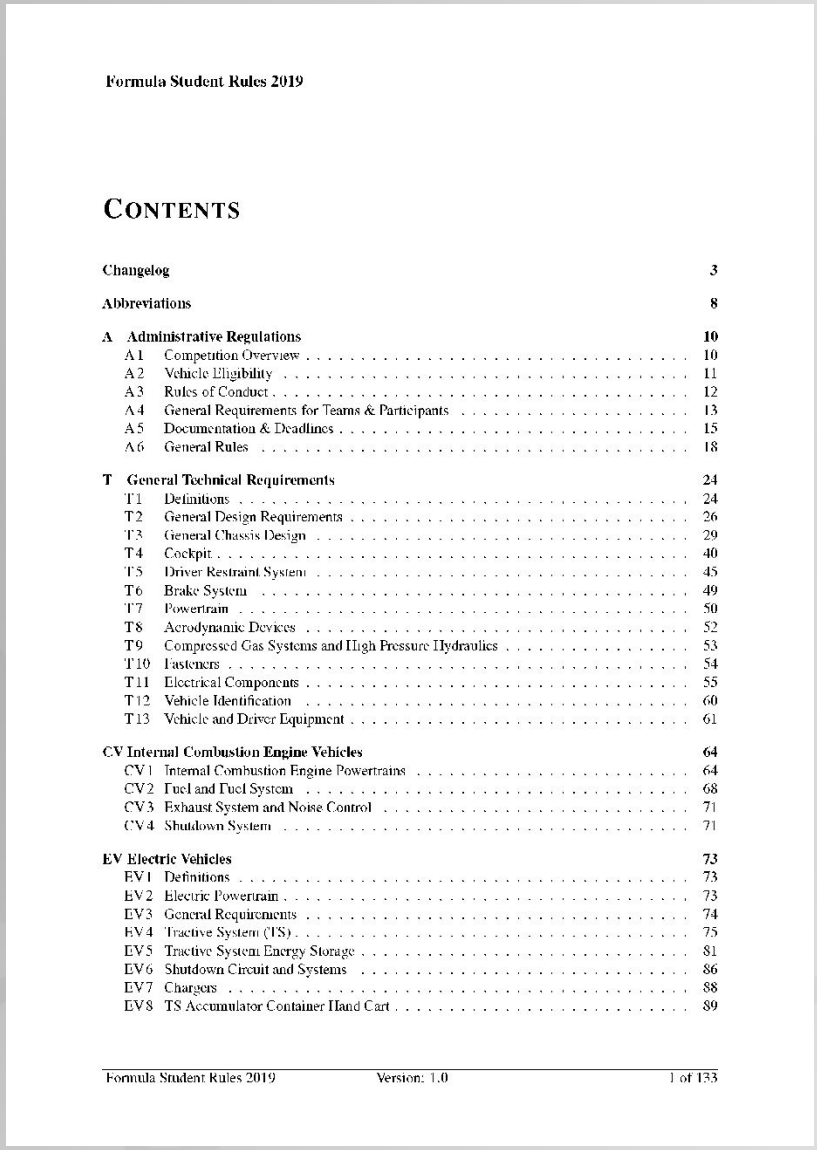
Formula SAE Rules (fsaeonline.com - США):

- США (2 этапа)
- Италия

Структура регламента

133 страницы
8 разделов:

A - Administrative Regulations
T - General Technical Requirements
CV - Internal Combustion Engine Vehicles
EV - Electric Vehicles
DV - Driverless Vehicles
IN - Technical Inspections
S - Static Events
D - Dynamic Events



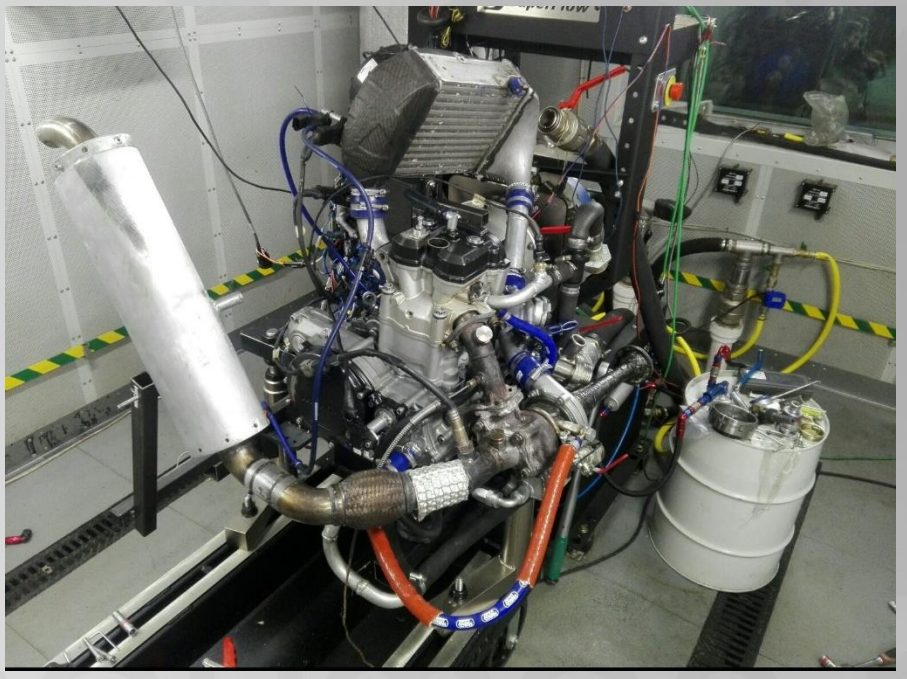
Formula Student Rules 2019

CONTENTS

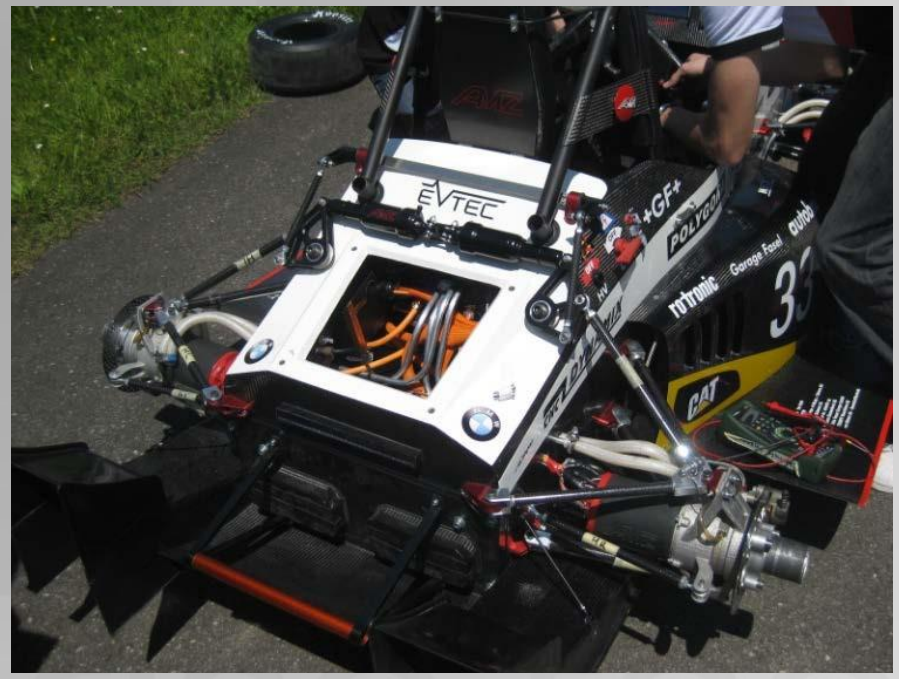
Классы автомобилей

A1.2.1 The competition is split into the following classes:

- Internal Combustion Engine Vehicle (CV)
- Electric Vehicle (EV)
- Driverless Vehicle (DV) (which are either CV or EV)



CV. It’s our, you know



EV. AMZ Racing Zurich(Швейцария)

Испытания

Техническая инспекция

Статика:

- ✔ Business Plan Presentation
- ✔ Cost and Manufacturing
- ✔ Engineering Design Event

Динамика:

- ✔ Skidpad
- ✔ Acceleration
- ✔ Autocross
- ✔ Endurance
- ✔ Efficiency

Разделы регламента T,S,D

	CV & EV	DV
Static Events:		
Business Plan Presentation	75 points	75 points
Cost and Manufacturing	100 points	100 points
Engineering Design	150 points	300 points
Dynamic Events:		
Skid Pad	75 points	75 points
Acceleration	75 points	75 points
Autocross	100 points	100 points
Endurance	325 points	-
Efficiency	100 points	75 points
Trackdrive	-	200 points
Overall	1000 points	1000 points

Table 3: Maximum points awarded

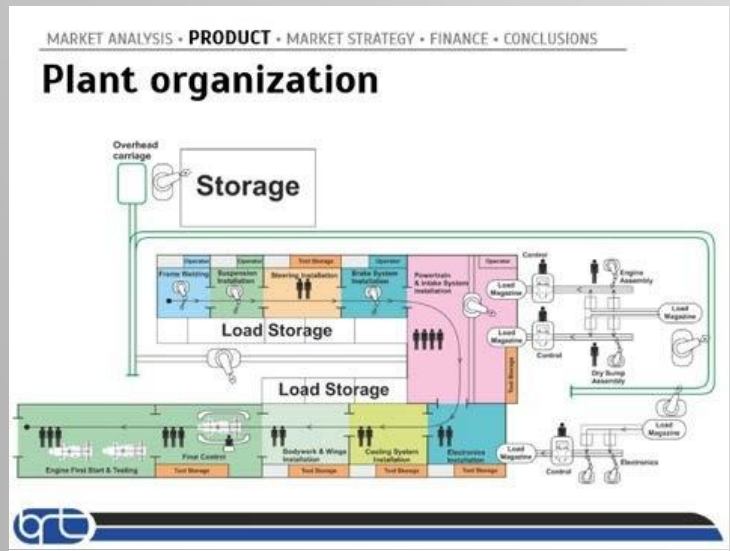
Техническая инспекция

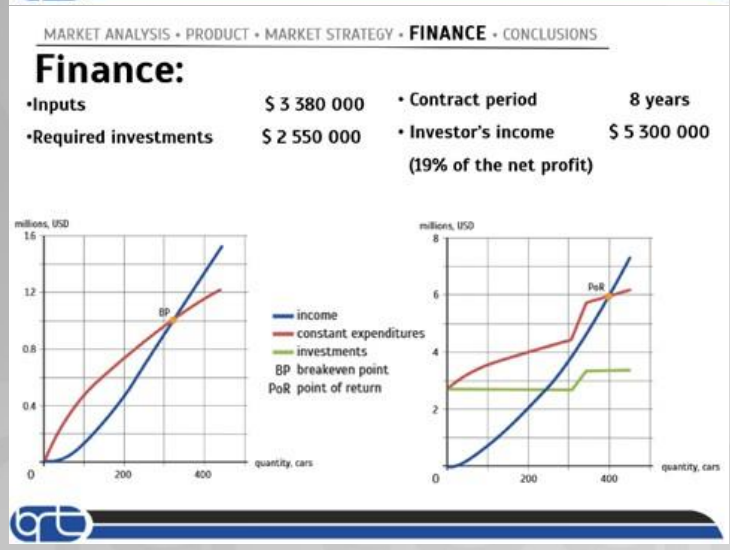
IN1.1.1 The technical inspection is divided into the following parts:

- Pre-Inspection
- [EV ONLY] Accumulator Inspection
- [EV ONLY] Electrical Inspection
- Mechanical Inspection (scrutineering)
- [DV ONLY] Driverless Inspection
- Tilt Test
- Vehicle Weighing
- [CV ONLY] Noise Test
- [EV ONLY] Rain Test
- Brake Test
- [DV ONLY] EBS Test

Business Plan Presentation

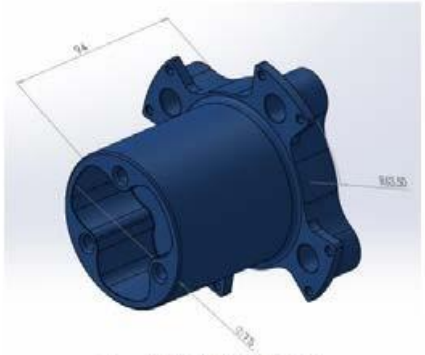
Презентация на 10 минут с бизнес планом производства и продажи автомобилей



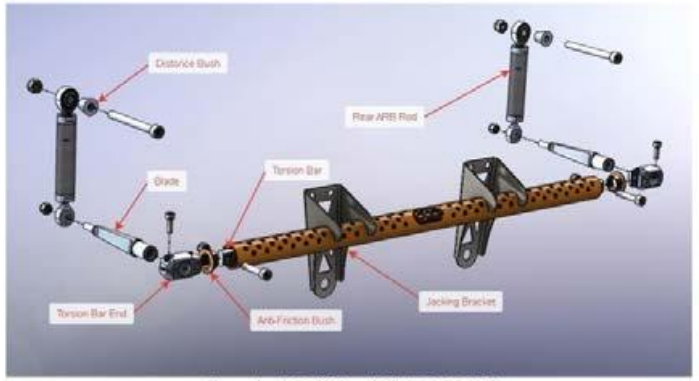


Расчет стоимости операций изготовления и сборки деталей, описание этих процессов

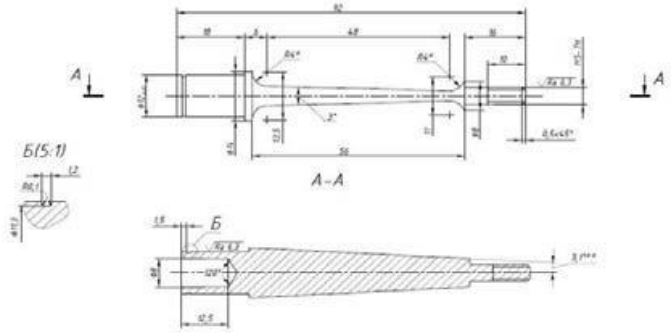
Rear Hubs (431-WT-A0003)



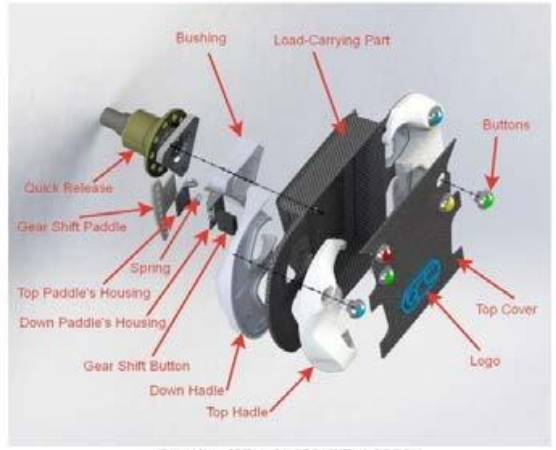
Rear Hub (431-WT-00016)



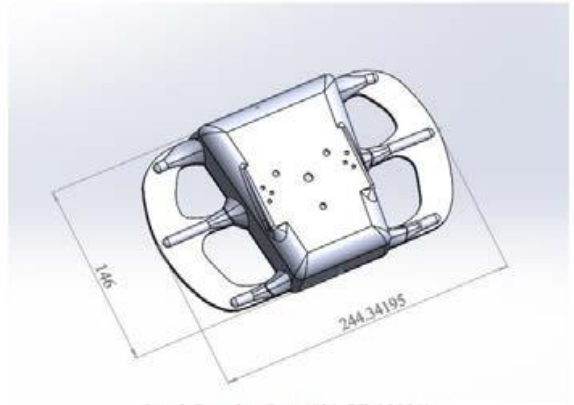
Rear Anti Roll Bar 431-SU-A0007



Blade 431-SU-00044



Steering Wheel (431-ST-A0001)



Load-Carrying Part (431-ST-00001)

Общение с судьями в течение часа – защита конструкционных решений и расчетов.

Acceleration

D5.1.1 The acceleration course is a straight line with a length of 75m from starting line to finish line…

Skidpad

D4.1.1 The skidpad course consists of two pairs of concentric circles in a figure of eight pattern.

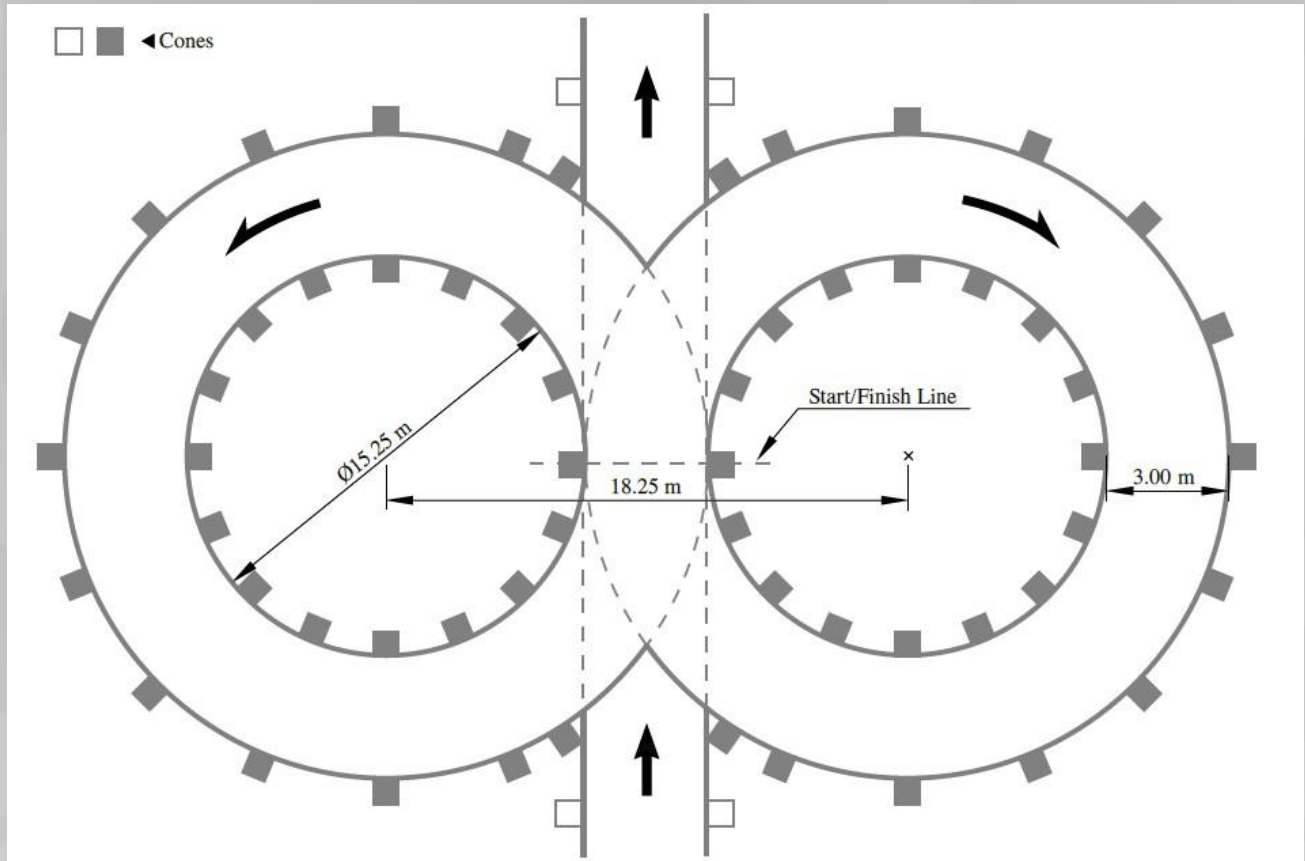


Figure 21: Skidpad Track Layout

Autocross

D6.1.1 The autocross track layout is a handling track built to the following guidelines:

- Straights: No longer than 80m
- Constant Turns: up to 50m diameter
- Hairpin Turns: Minimum of 9m outside diameter (of the turn)
- Slaloms: Cones in a straight line with 7:5m to 12m spacing
- Miscellaneous: Chicanes, multiple turns, decreasing radius turns, etc. The minimum

track width is 3 m.

D6.1.2 The length of the autocross track is less than 1:5 km.

Endurance (Efficiency)

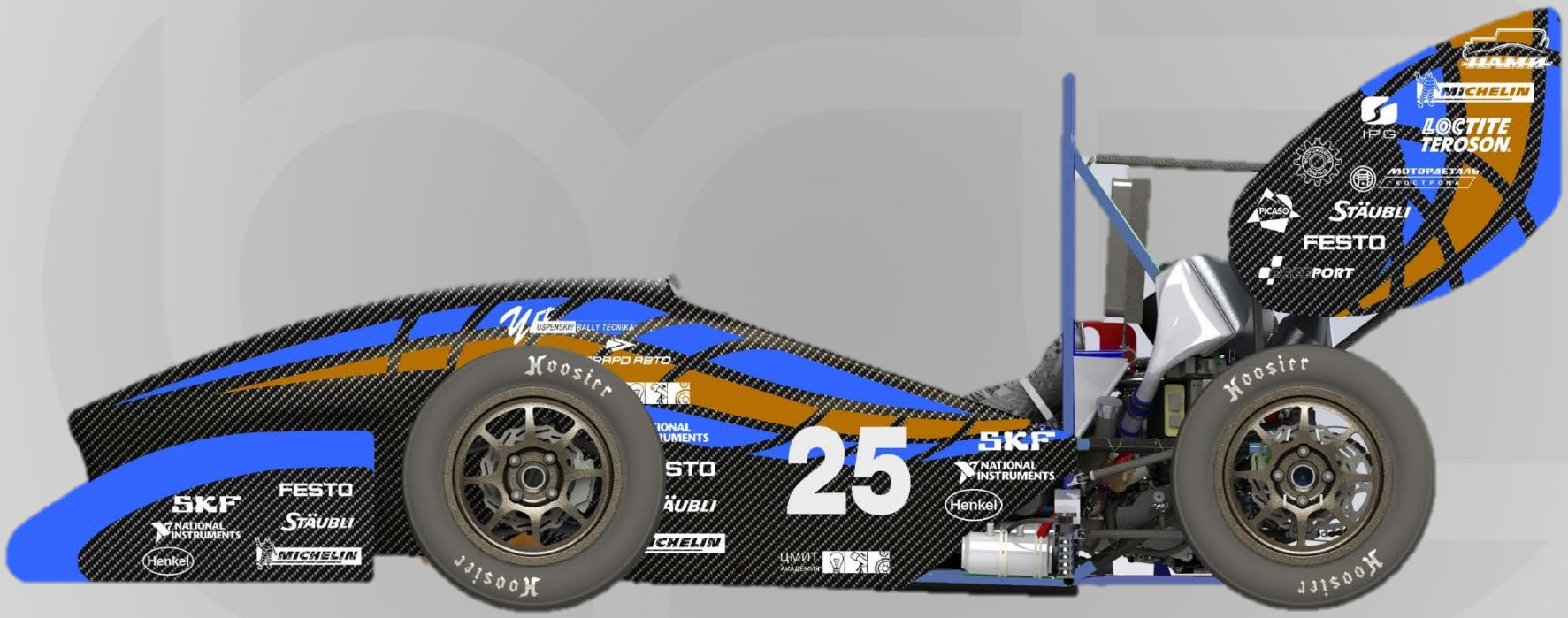
D7.1.1 The endurance track layout is a closed lap circuit built with the following guidelines:

- *Straights:* No longer than 80m
- *Constant Turns:* up to 50m diameter
- *Hairpin Turns:* Minimum of 9m outside diameter (of the turn)
- *Slaloms:* Cones in a straight line with 9m to 15m spacing
- *Miscellaneous:* Chicanes, multiple turns, decreasing radius turns, etc.
- The minimum track width is 3m

D7.1.2 The length of one lap of the endurance track is approximately 1 km.

D7.1.3 The length of the complete endurance is approximately 22 km.

Главные требования



Автомобиль с открытыми колесами

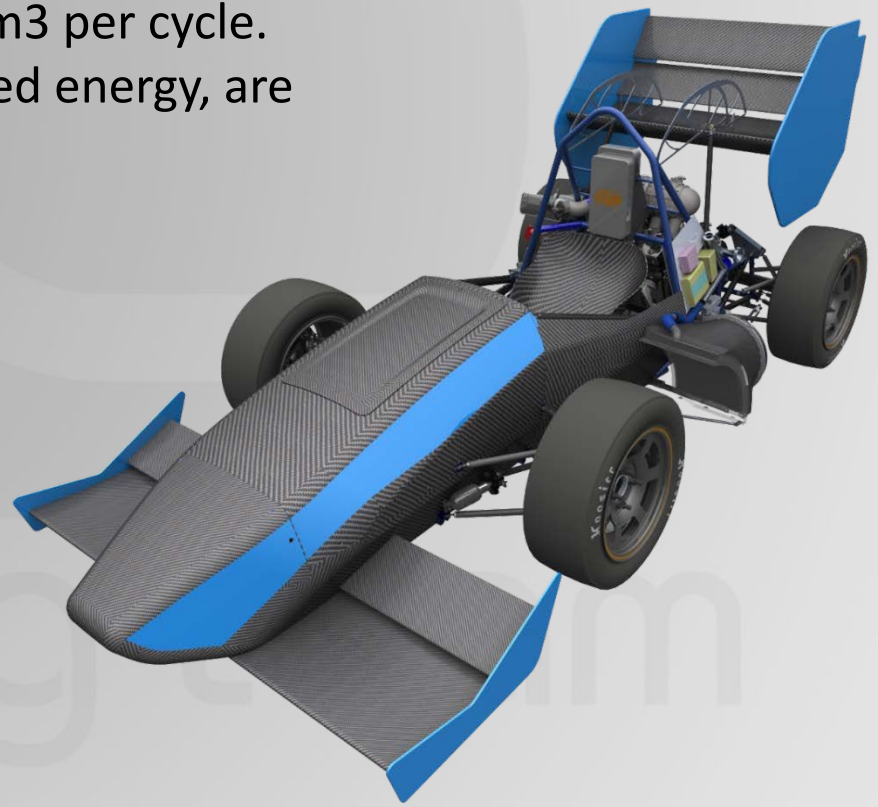
T2.1.2 The vehicle must be open-wheeled, single seat and open cockpit (a formula style body) with four wheels that are not in a straight line.

Объем двигателя не более 710 см^3

CV1.1.1 The engine(s) used to power the vehicle must be piston engine(s) using a four-stroke primary heat cycle with a displacement not exceeding 710 cm3 per cycle. Hybrid powertrains, such as those using electric motors running off stored energy, are prohibited.

Минимальный ход подвески 50 мм

T2.3.1 The vehicle must be equipped with fully operational front and rear suspension systems including shock absorbers and a usable wheel travel of at least 50mm …



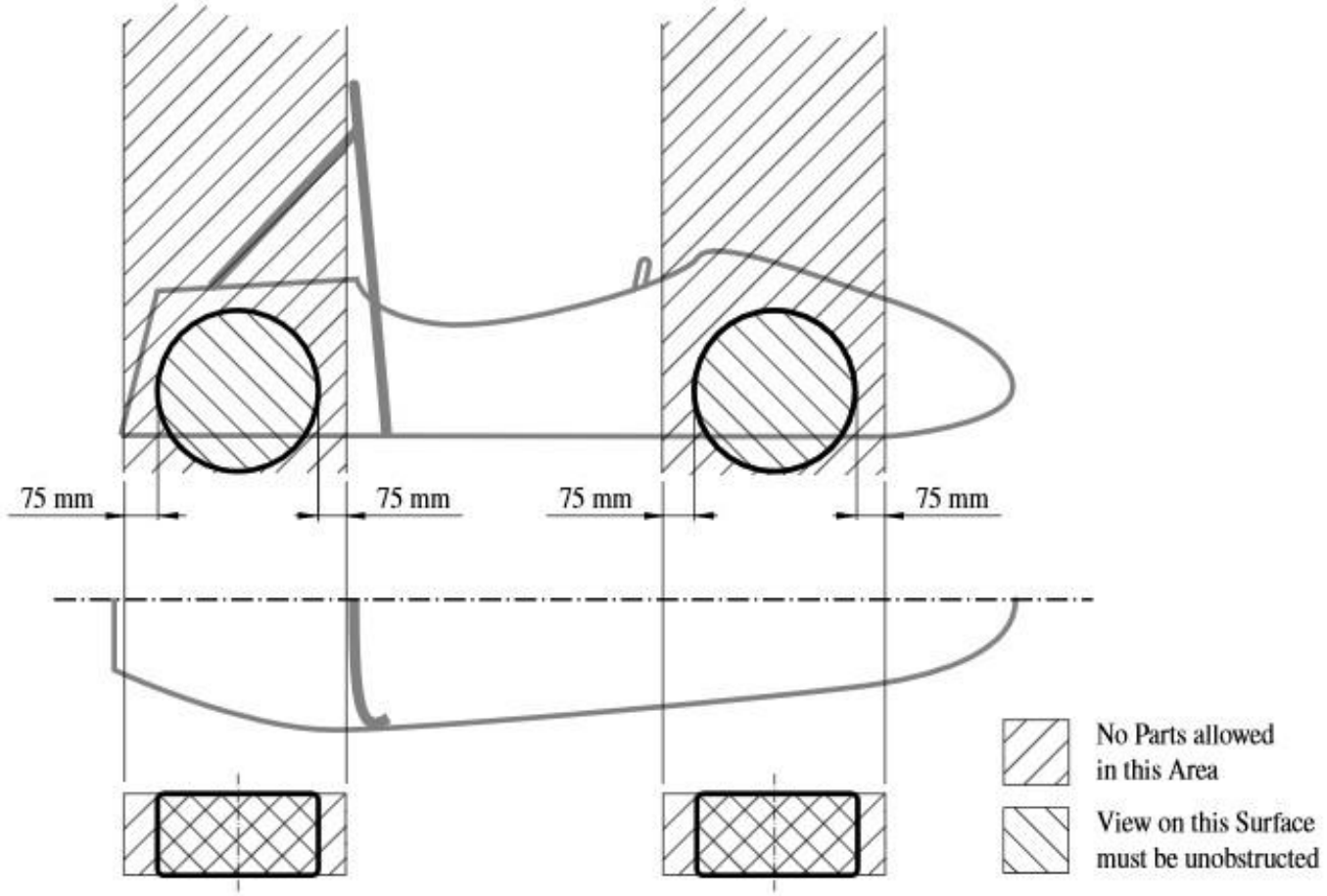


Figure 1: Keep-out-zones for the definition of an open-wheeled vehicle.

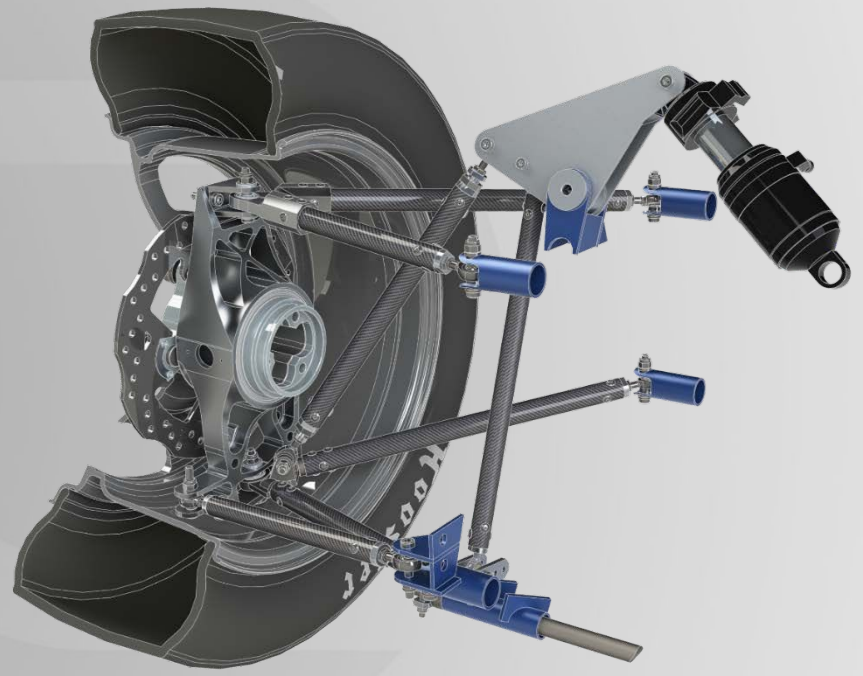
Подвеска

- Любой тип
- Ход не меньше 50 мм
- Обязательно 4 колеса
- База не меньше 1525мм

T 2.7.1 The vehicle must have a wheelbase of at least 1525 mm.

Чаще всего:

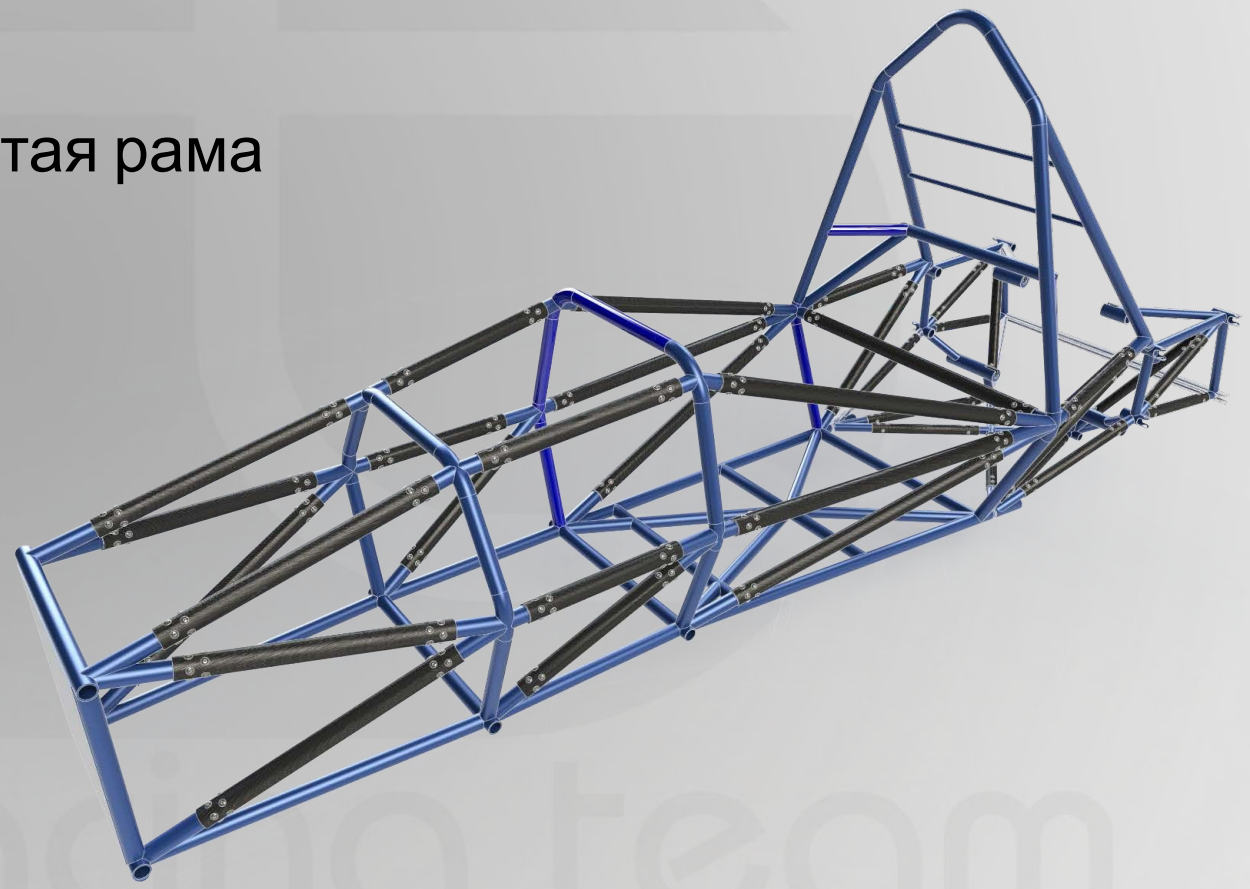
- Двухрычажная подвеска спереди и сзади
- Амортизаторы от велосипеда



Рама

Несущая система может быть любой.
Чаще всего:

- Стальная пространственная трубчатая рама
- Карбоновый монокок
- Алюминиевый монокок
- Композитная трубчатая рама



Рама

Рама включает в себя следующие элементы:

Main Hoop - A roll bar located alongside or just behind the driver’s torso.

Front Hoop - A roll bar located above the driver’s legs, in proximity to the steering wheel.

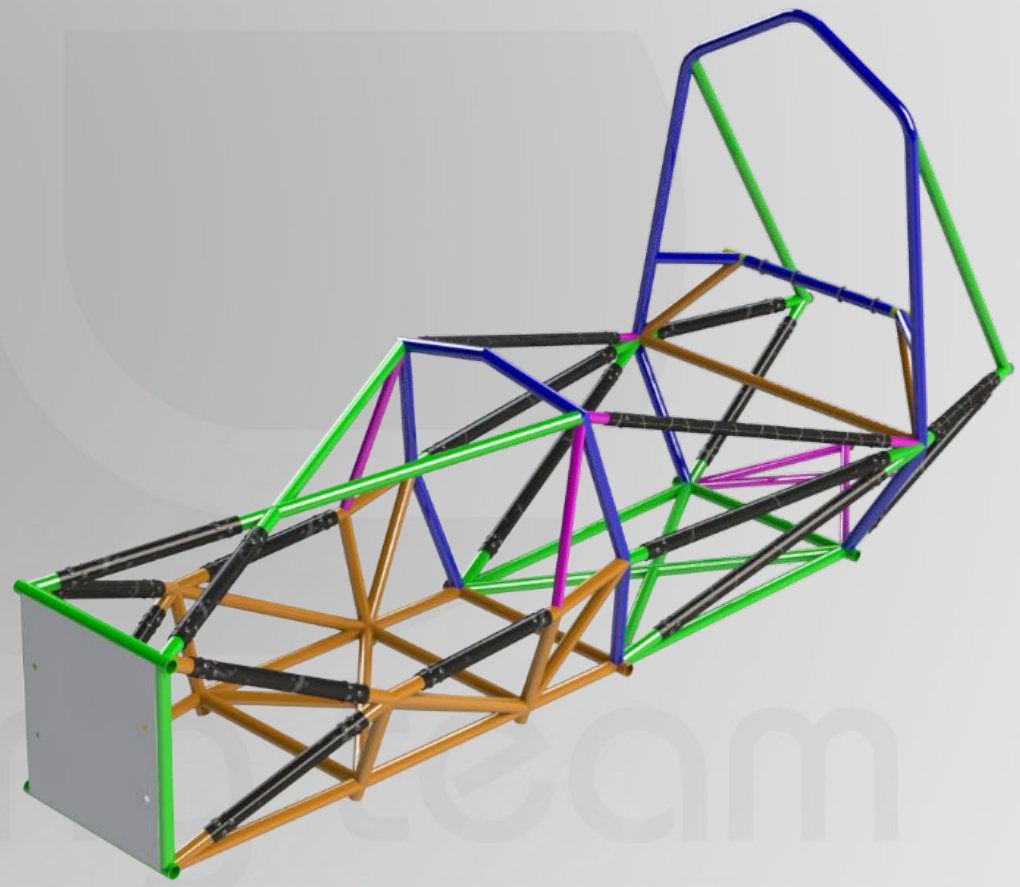
Roll Hoops – Both the Front Hoop and the Main Hoop are classified as “Roll Hoops”

Roll Hoop Bracing Supports – The structure from the lower end of the Roll Hoop Bracing back to the Roll Hoop(s).

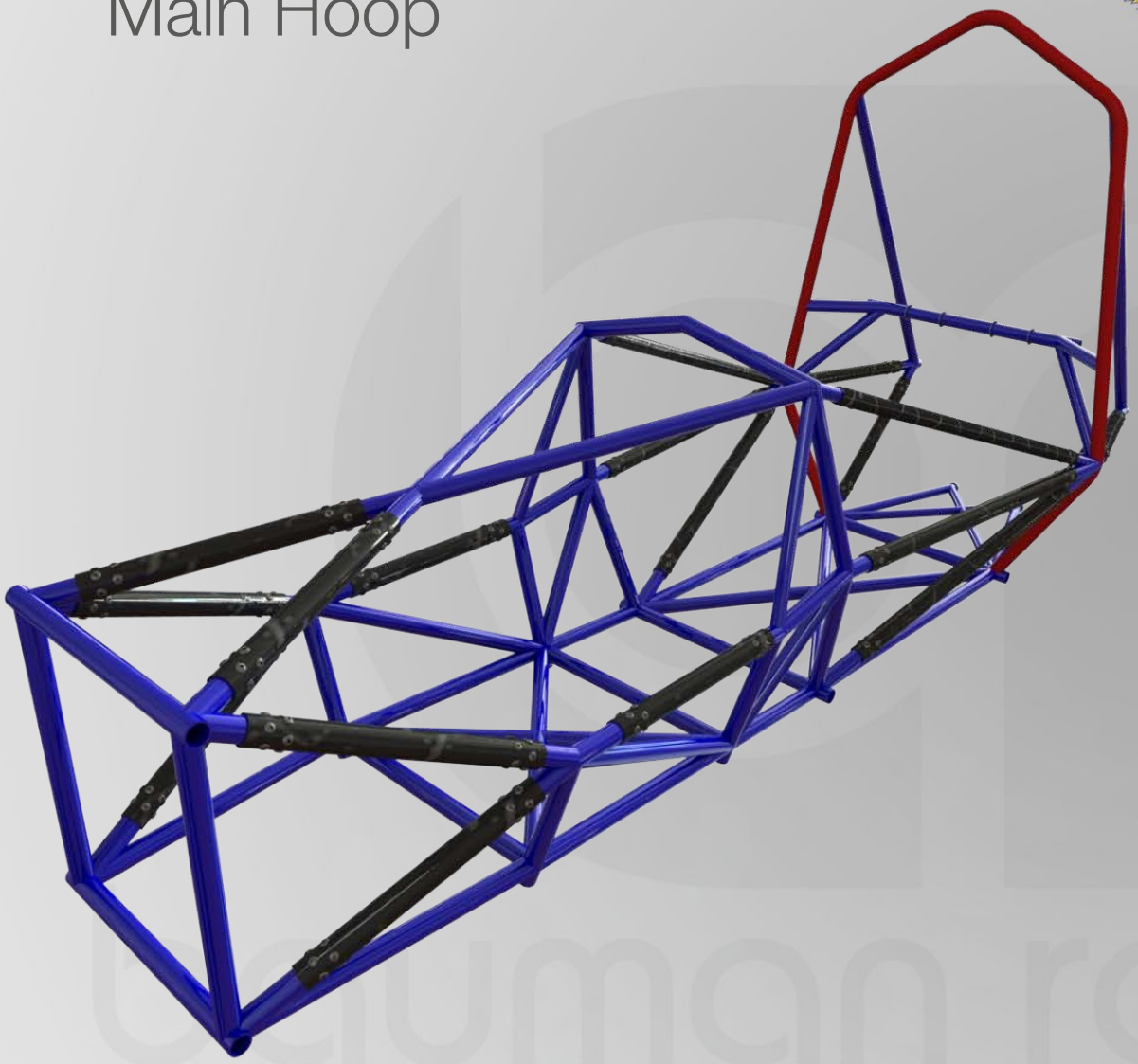
Front Bulkhead – A planar structure that defines the forward plane of the Major Structure of the Frame and functions to provide protection for the driver’s feet.

Impact Attenuator – A deformable, energy absorbing device located forward of the Front Bulkhead.

Side impact structure – The area of the side of the chassis between the front hoop and the main hoop and from the chassis floor to the height as required in T3.15 above the lowest inside chassis point between front hoop and main hoop.



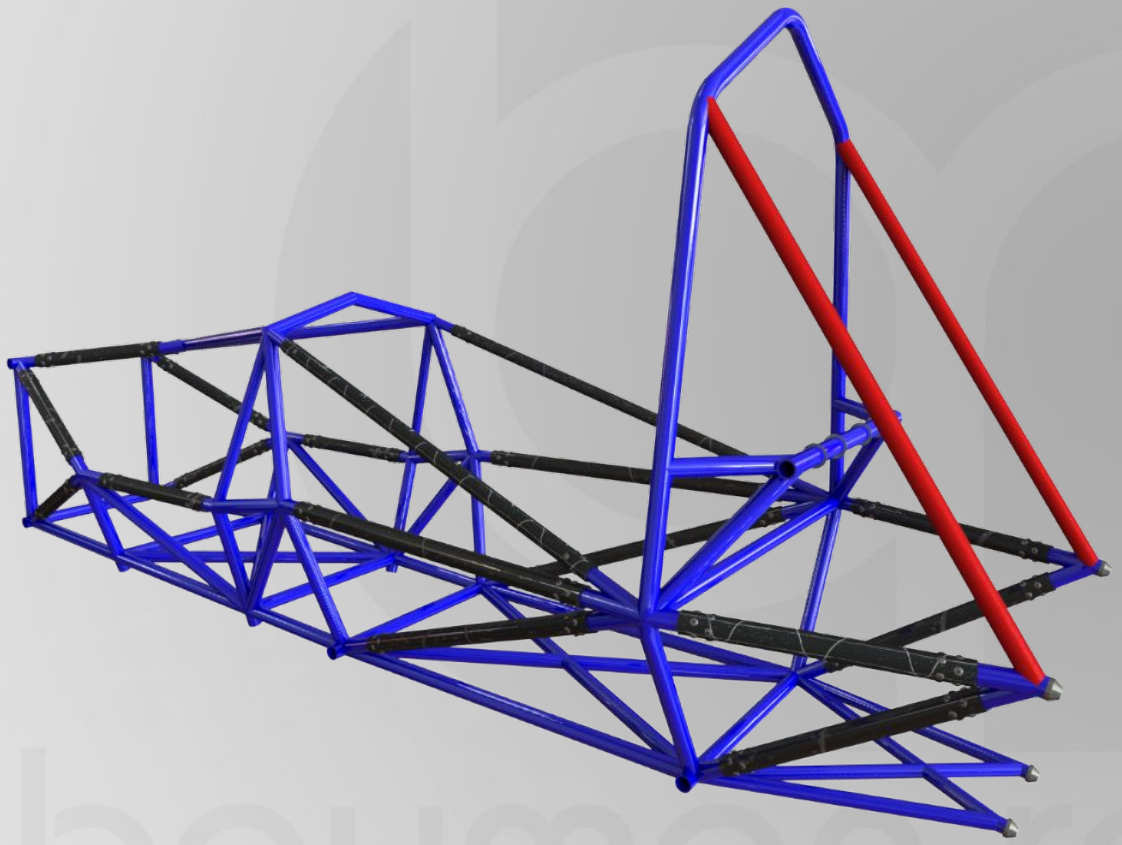
Main Hoop



T 2.9.1

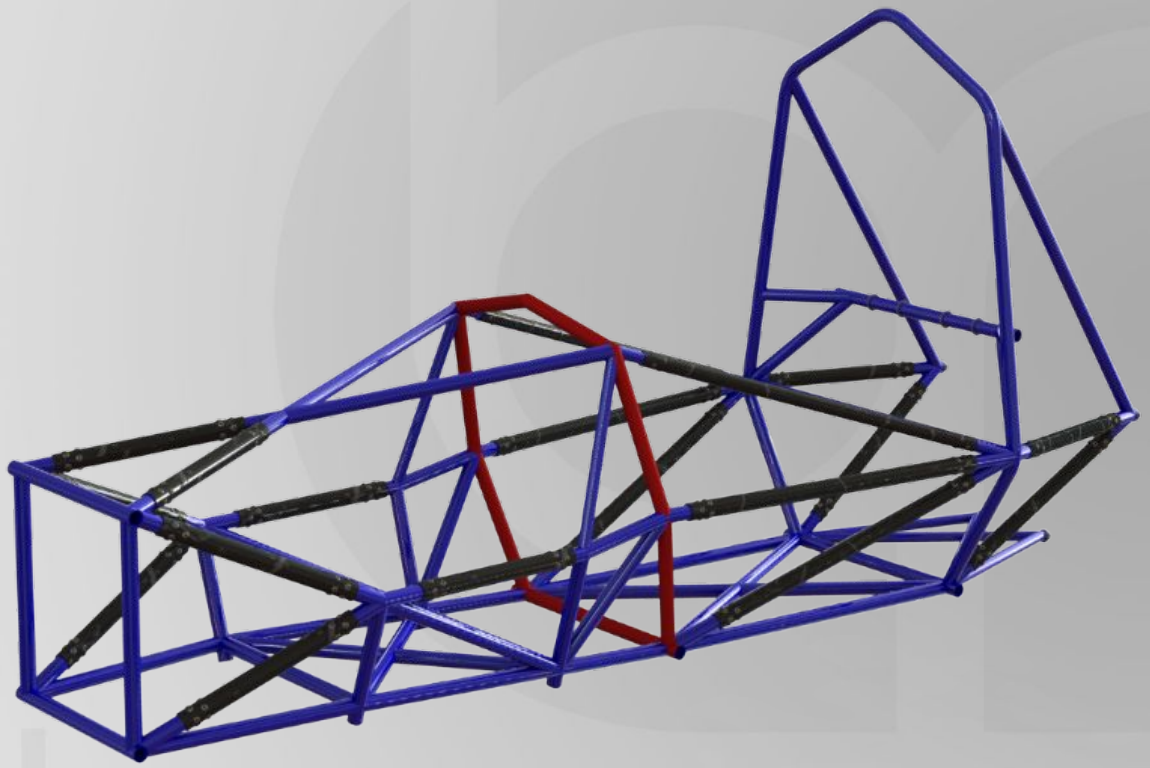
The main hoop must be constructed of a single piece of uncut, continuous, closed section steel tubing.

Main hoop bracing



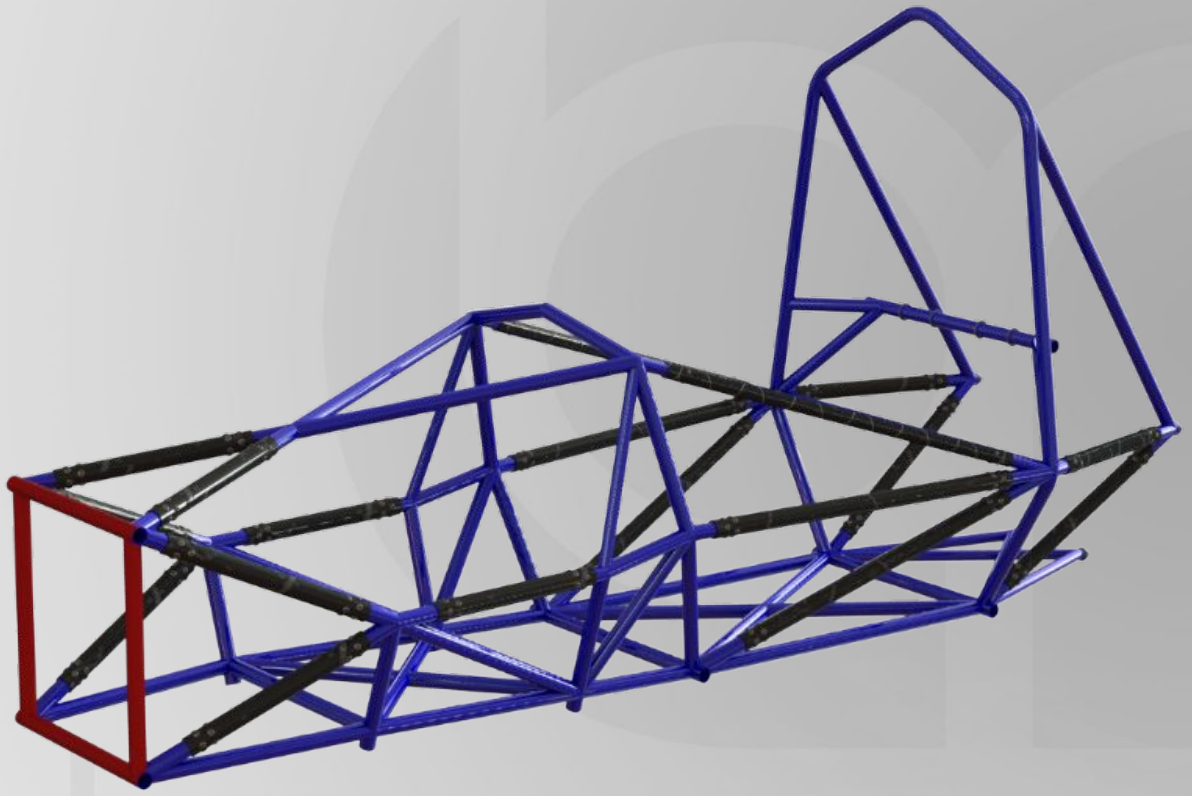
T 2.11
Main Hoop Bracing
T 2.11.1
The main hoop must be supported by two bracings extending on both sides of the main hoop to the front or the rear.
T 2.11.2
In side view the main hoop and the main hoop bracings must not lie on the same side of the vertical line through the top of the main hoop.

Front hoop



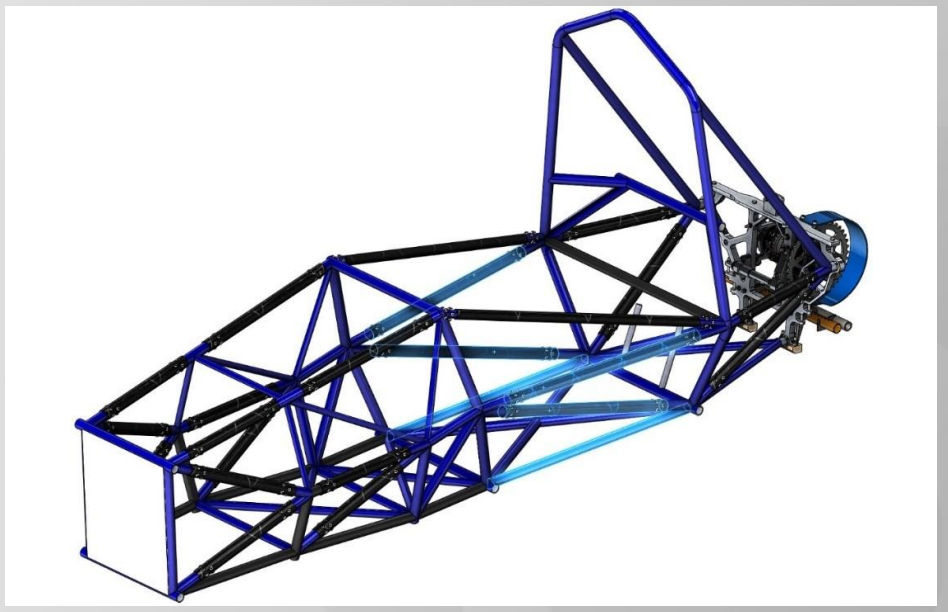
T 2.10
Front Hoop
T 2.10.1
If the front hoop is made from more than one piece it must be supported by node-to-node triangulation or an equivalent construction.
T 2.10.2
In side view, no part of the front hoop can be inclined more than 20° from vertical.

Front Bulkhead



T 2.14
Front Bulkhead
T 2.14.1
The rear plane of the front bulkhead must be located forward of all non-crushable objects.
T 2.14.2
The soles of the driver's feet/shoes must be rearward of the rear bulkhead plane when touching but not applying the pedals for all pedal box adjustments.
T 2.14.3
Any alternative material used for the front bulkhead must have a perimeter shear strength
equivalent to a 1.5 mm thick steel plate.

Side impact structure



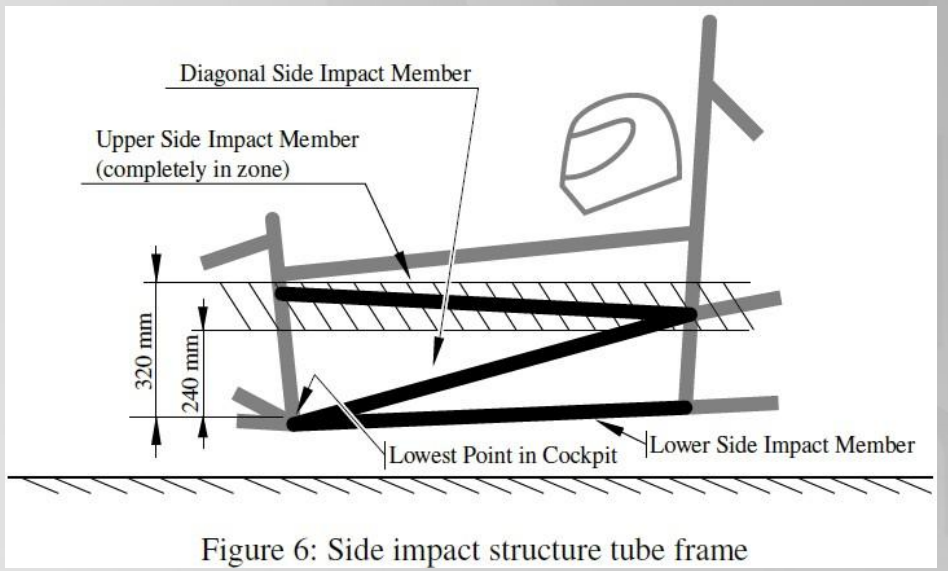


Figure 6: Side impact structure tube frame

T 3.15
Side Impact Structure
T 3.15.1
The side impact structure must consist of at least three steel tubes (see T 3.2) at each side of the cockpit (see Figure 8).

- The upper member must connect the main hoop and the front hoop. It must be at a height between 240 mm and 320 mm above the lowest inside chassis point between the front and main hoop.
- The lower member must connect the bottom of the main hoop and the bottom of the front hoop.
- The diagonal member must triangulate the upper and lower member between the roll hoops node-to-node.

T 3.1.1 The size of the cockpit opening needs to be sufficient for the template shown on the left in Figure 9 to pass vertically from the opening below the top bar of the side impact structure whilst being held horizontally. The template may be moved fore and aft.

T 3.2.1 The cockpit must provide a free internal cross section sufficient for the template shown on the right in Figure 9 to pass from the rear of the front hoop to a point 100 mm rearwards of the face of the rearmost pedal in inoperative position. The template may be moved up and down. Adjustable pedals have to be put in their most forward position.

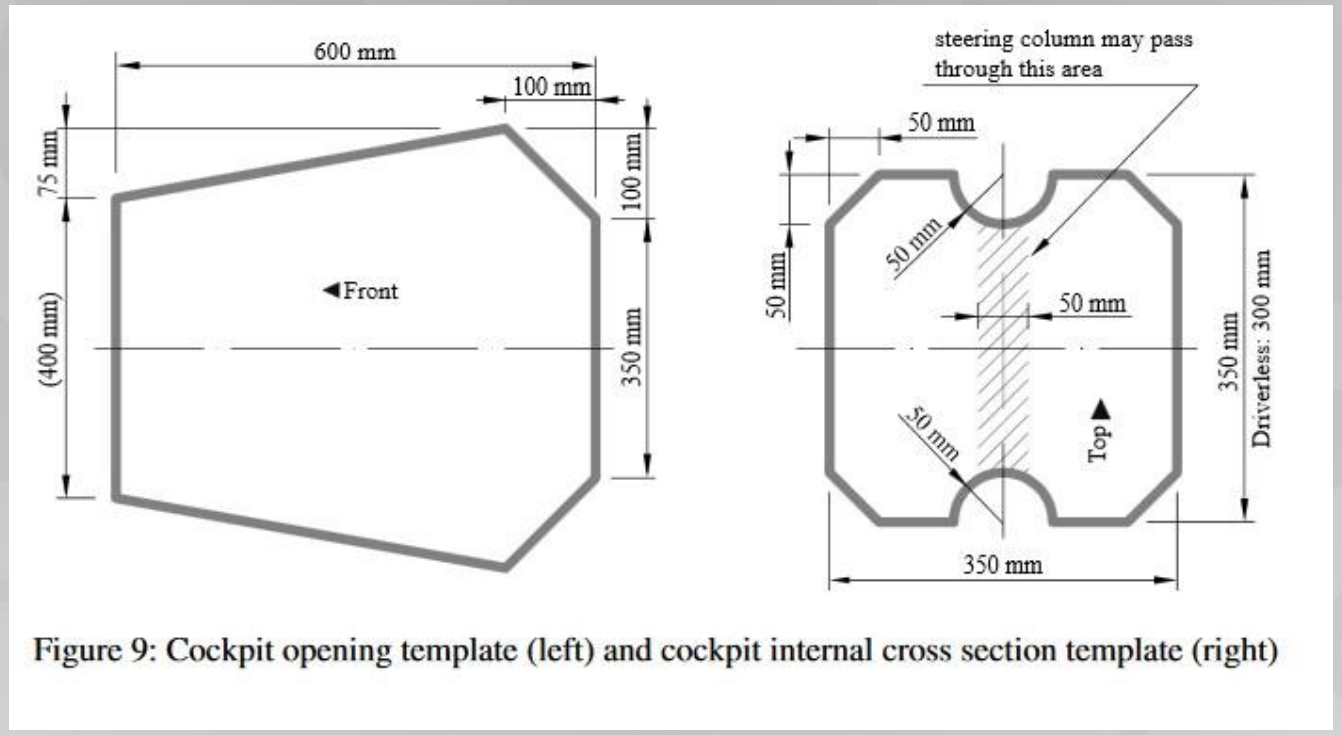


Figure 9: Cockpit opening template (left) and cockpit internal cross section template (right)

T 3.3.1

When seated normally and restrained by the driver's restraint system, the helmet of a 95th percentile male and all of the team's drivers must:

(a) Be a minimum of 50 mm away from the straight line drawn from the top of the main hoop to the top of the front hoop.

b) Be a minimum of 50 mm away from the straight line drawn from the top of the main hoop to the lower end of the main hoop bracing if the bracing extends rearwards.

(c) Be no further rearwards than the rear surface of the main hoop if the main hoop bracing extends forwards.

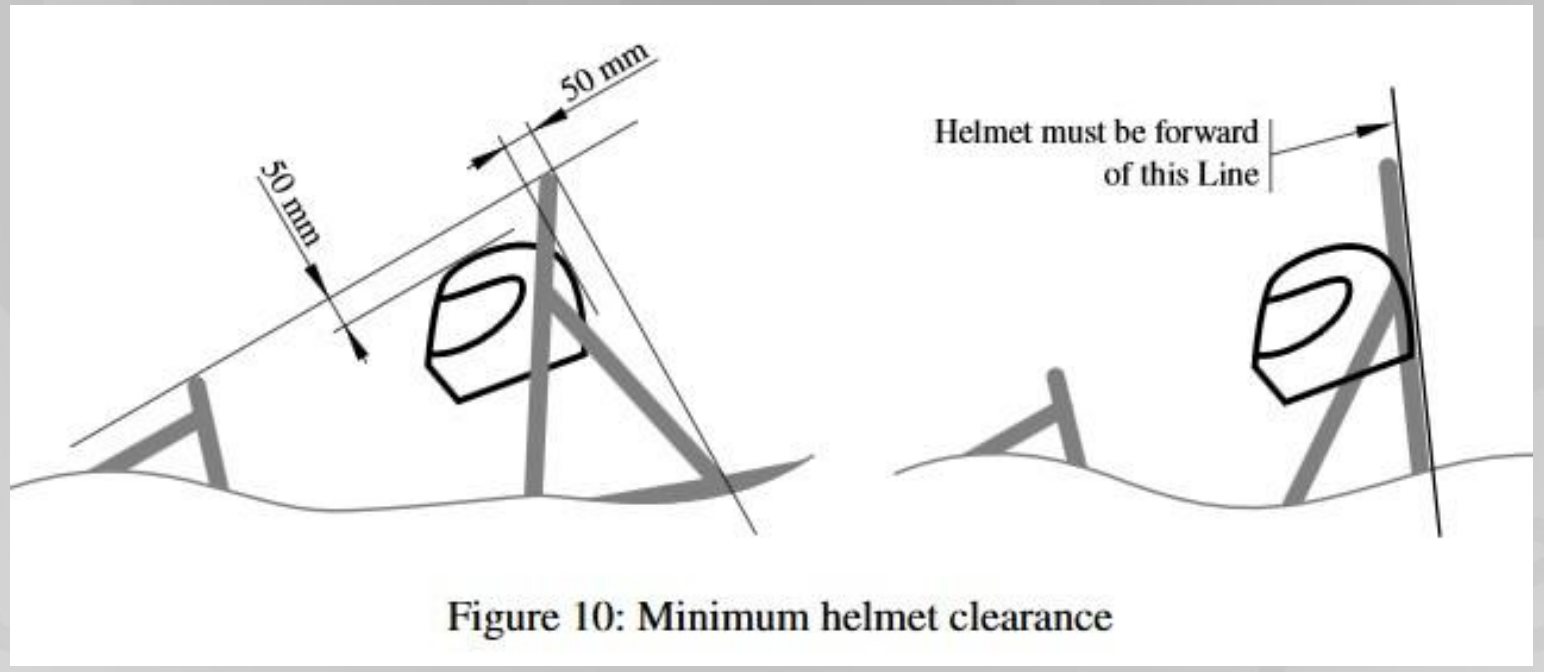


Figure 10: Minimum helmet clearance

T 3.3.2
The 95th percentile male is represented by a two dimensional figure consisting of two circles of 200 mm diameter (one representing the hips and buttocks and one representing the shoulder region) and one circle of 300 mm (representing the head with helmet).

T 3.3.3
The two 200 mm circles are connected by a straight line measuring 490 mm. The 300 mm circle is connected by a straight line measuring 280 mm with the upper 200 mm circle.

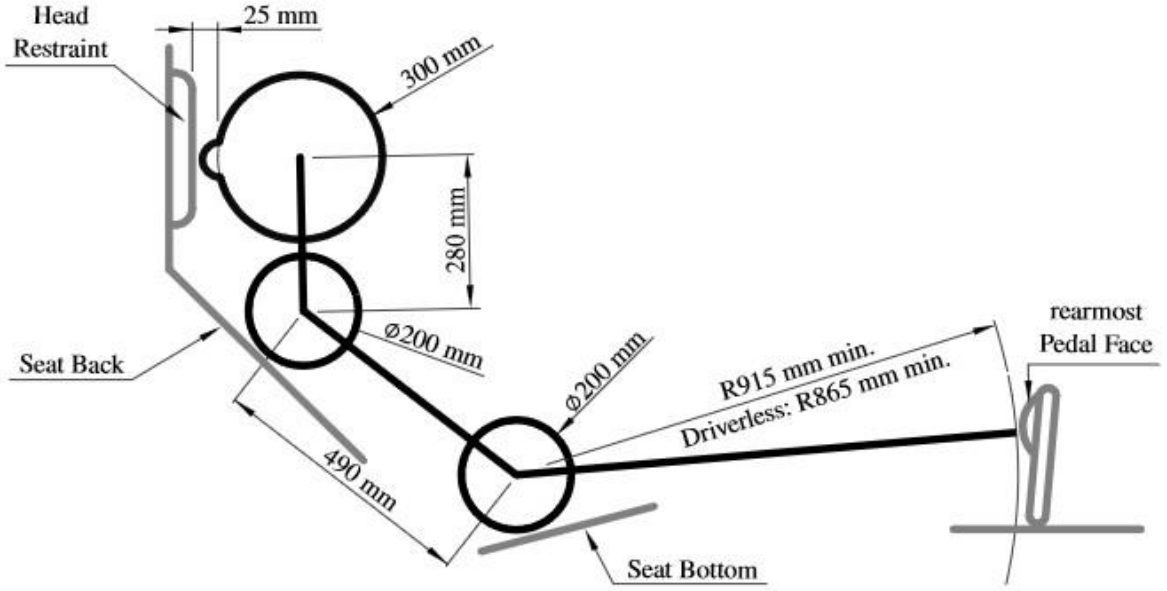


Figure 11: Percy placement

Engine

CV1.1.1 The engine(s) used to power the vehicle must be **piston** engine(s) using a **four-stroke** primary heat cycle with a displacement not exceeding **710** cm^3 per cycle...

- Четырехтактный
- Поршневой
- До **710** $см^3$

CV1.7.2 In order to limit the power capability from the engine, a single circular **restrictor** must be placed in the intake system and all engine airflow must pass through the restrictor…

CV1.7.3 … (a) Gasoline fueled vehicles - **20mm**, (b) E-85 fueled vehicles - **19mm**

Весь воздух, попадающий в двигатель, должен проходить через **рестриктор** - отверстие **20 мм** (для бензиновых машин) или **19 мм** (для машин на этаноле E-85)

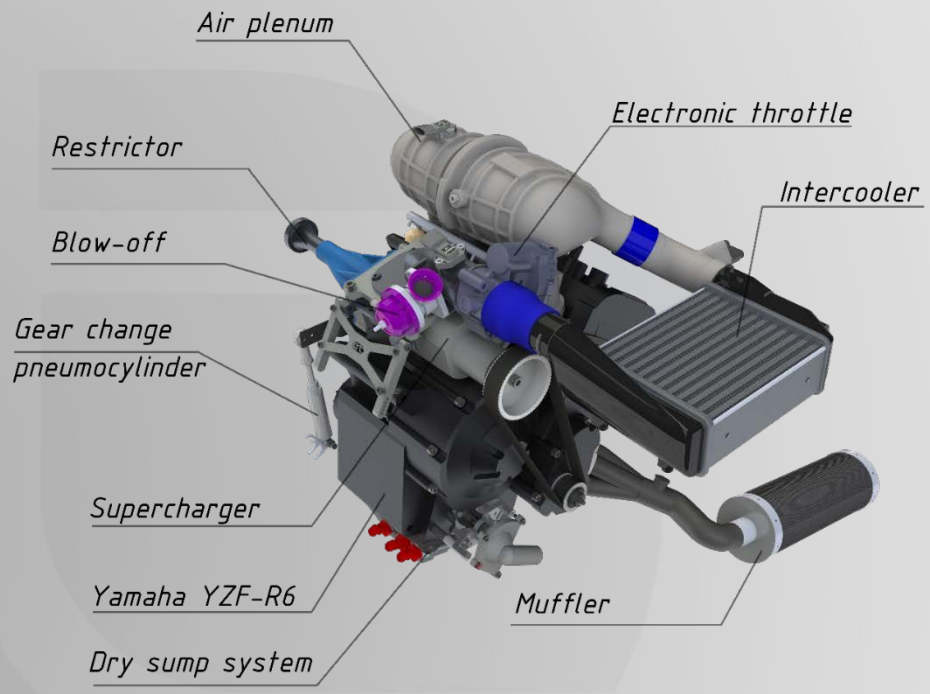
- **Наддув** разрешен
- Топливо: **Бензин** или этанол **E-85**

Engine

710 см^3 разрешены только с 2017 года (раньше 610 см^3)

Чаще всего двигатель от мотоцикла

- Рядная четверка (Honda CBR600, Yamaha YZF-R6, Kawasaki 600, Suzuki GSX-R600)
- Одноцилиндровые 450см^3 и 500см^3, (а теперь и 690 см^3). KTM 500 EXC, Yamaha WR 450 F.
- Двухцилиндровые: Aprilia sxv 550

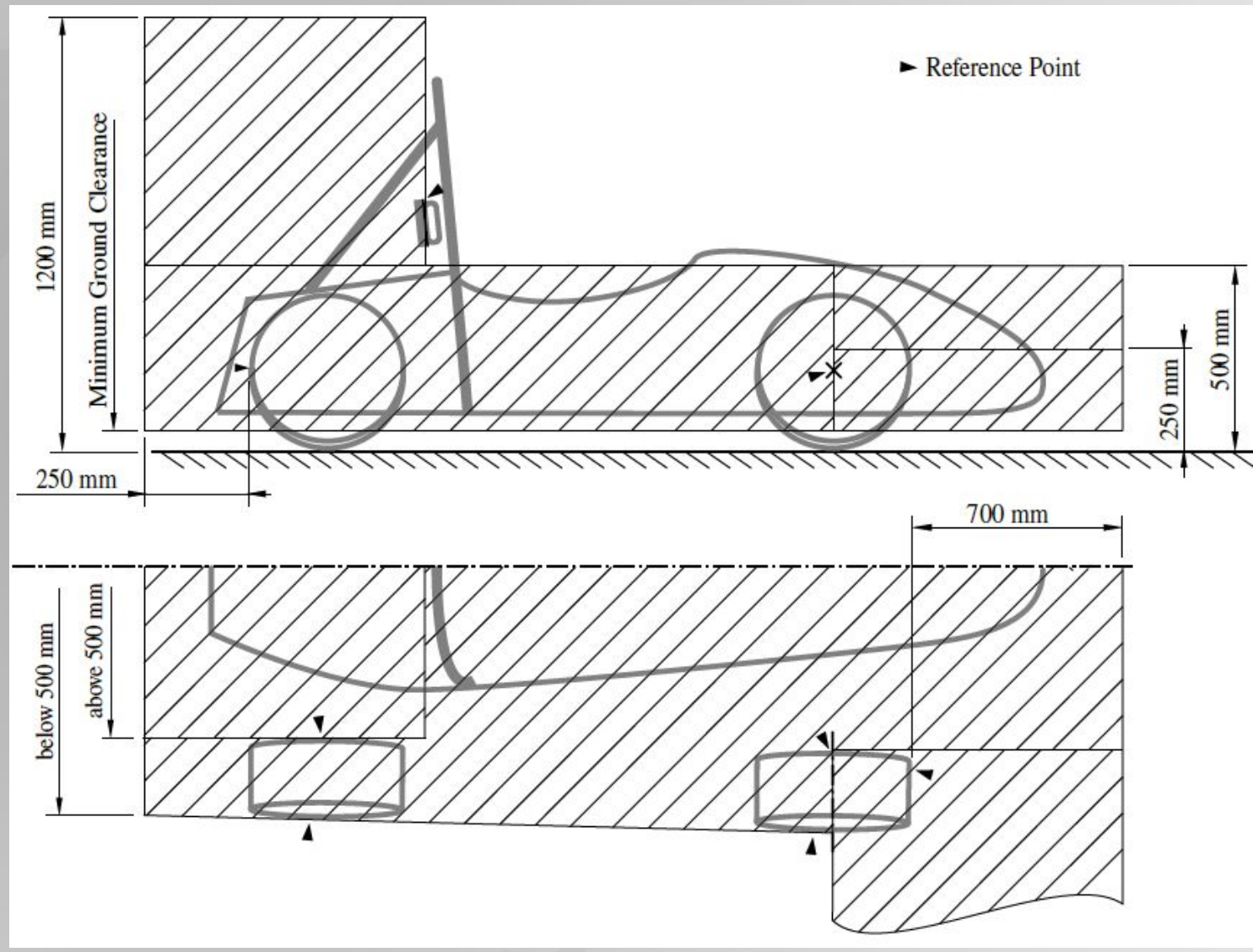


Наш двигатель (BRT-4,5,(6))

- Yamaha WR 450 F с турбонаддувом
- Объем: 450 $см^3$
- Турбокомрессор: Garrett gt12
- Блок управления: Motec M400
- Крышка собственной разработки с увеличенным генератором 350Вт

Аэродинамика

T7.2.1 Power ground effects are prohibited. No power device may be used to move or remove air from under the vehicle except fans designed exclusively for cooling.



Заднее крыло
- не выше 1200 мм;
- не шире внутренней кромки задних шин;
- на дальше 250 мм назад;

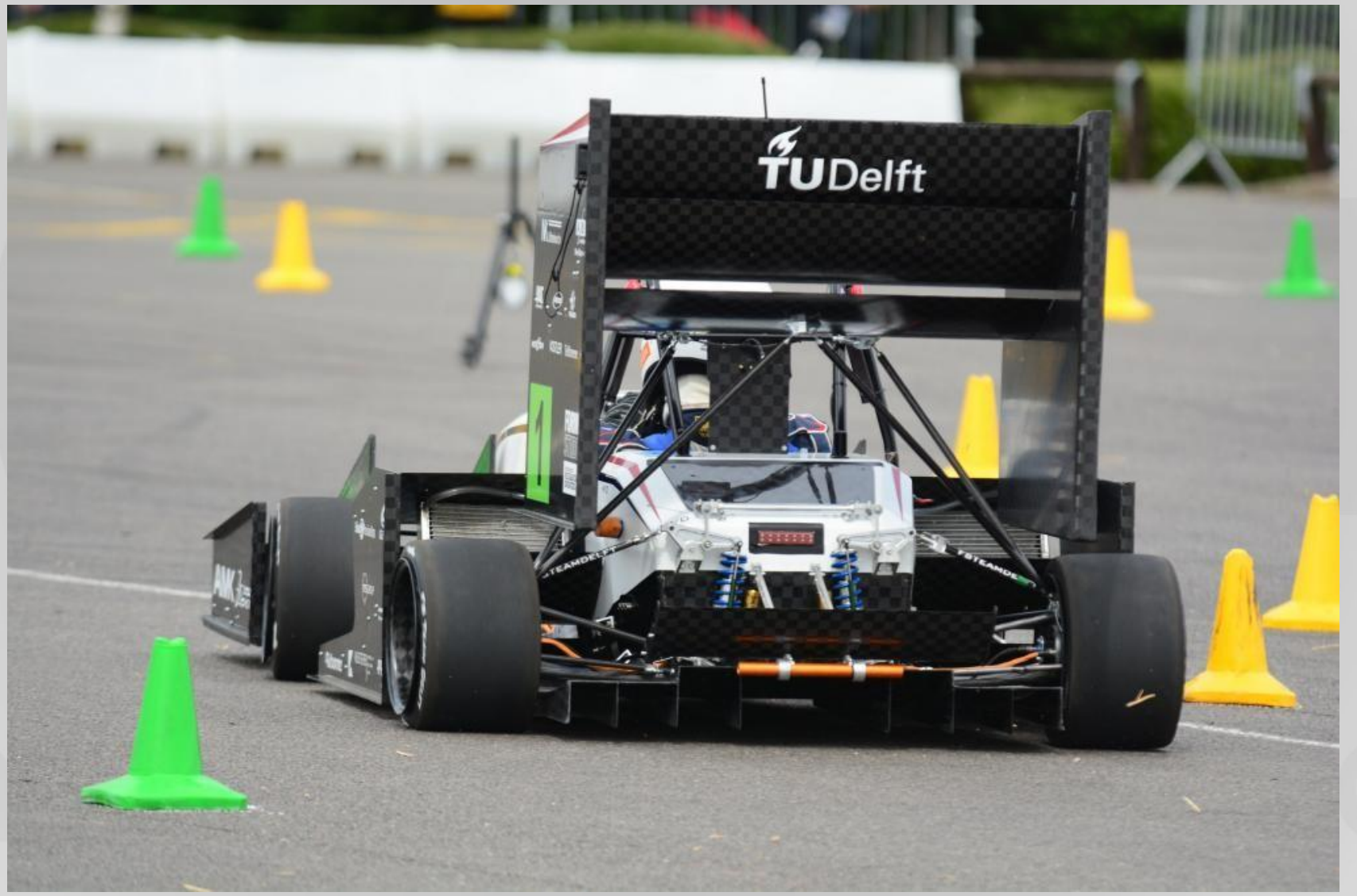
Переднее крыло
- не выше 500 мм;
- не дальше 700 мм от колес вперед

Средние крылья
- не выше 500 мм;
- не шире наружных кромок шин;

Диффузор
- не шире наружных кромок шин;

Аэродинамика

Аэродинамика



«ФОРМУЛА СТУДЕНТ»

BRT-1
СЕЗОН 2012/2013

BRT-2
СЕЗОН 2013/2014

BRT-3
СЕЗОН 2014/2015

BRT-4
СЕЗОН 2015/2016

BRT-5
СЕЗОН 2016/2017

BRT-6
СЕЗОН 2017/2018

Задания:

- Какие классы автомобилей существуют в соревнованиях “Формула студент”
- Из чего состоит техническая инспекция
- За что начисляются баллы на соревнованиях, какие 3 испытания входят в статическую часть и какие 5 в динамическую части.
- Названия основных элементов рамы (что такое Main hoop, Front hoop, Side impact structure)
- Основные ограничения на двигатель (объем, тип, топливо, тактность, прочитать правило про обязательный рестриктор и его размеры, наддув).
- Основные ограничения на аэродинамику

Прочитать разделы: A1,
A2.
T1-T4; T7
CV 1.1.1, CV 1.7.
IN 1.1, IN 1.2.1
S1.1.1-1.2; S2.1-S2.2.7.
D4-D7.