

Lenovo

 **in Schools**  
UNITED KINGDOM

# DEV CLASS

TECHNICAL REGULATIONS



**2022/23**





## Welcome to F1 in Schools™ Development Class!

Welcome to the F1 in Schools Development Class, the proving ground of the world's leading STEM competition! Development Class is where we uncover the National and World Champions of the future. Development Class teams meet first at the UK Regional Finals, competing for a place at the UK National Finals. Here, teams battle for the chance to be crowned UK Development Class National Champions and compete at the spectacular F1 in Schools World Finals.

By choosing to enter this class, you're about to go head-to-head with some of the best emerging teams in the UK, so make sure you read this document carefully. **The teams who understand the rules most clearly will have the best chance to create a winning car!** We want teams to show creativity and risk taking in their designs; this is how the fastest cars and the most unique ideas are born. Playing safe will never get you to the front of the grid, or the top step of the podium!

*Please use this document alongside the corresponding F1 in Schools UK Competition Regulations.*



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## Rule revisions from the previous season



Just like in the real world of Formula 1®, at the end of each season we reflect on our rules and make any changes we think are important. If you see the ‘NEW!’ symbol next to any rule, we’ve made changes to it for the new season so make sure you read it extra carefully.

# How to use the Technical Regulations booklet

In this booklet you will find all the technical rules and regulations for designing and making your car. These rules must be followed to avoid penalty points in scrutineering. Pay special attention to any Proportional Penalties (illustrated by the **PP+** symbol), or **PERFORMANCE rules, highlighted in yellow**, as breaking these means you cannot win the Fastest Car or Best Engineered car award. Some phrases we use are advanced engineering terms, but don't worry – we've added some *explanations in green* just to make things easier to understand. All minimum and maximum dimensions are also highlighted in **bold blue**, so keep an eye out for these throughout the booklet.

You will see that all the rules have been grouped into different areas of the car, as listed in the contents. We recommend you use this booklet in stages, as and when you need to find out about particular aspects of the car. Challenge yourself to learn the requirements for designing the front wing for example, then test yourself on them before getting creative with pens, modelling materials and CAD.

## The bright red car

The diagrams in this booklet use an example car to show you how to design to certain rules. This car is NOT a winning car and has been created just to show you how to make sure your car is legal. We're sure you can do better, so get creative and show us how much more imaginative you can be with your own designs...

## What to do next:

### READ THE RULES!



- Read the technical regulations carefully one section at a time, so your design complies.
- Pay EXTRA SPECIAL attention to any **Proportional Penalties, which are explained on p11**.

### Follow the sketching tutorial on the F1 in Schools™ website

- Have a go at the IsoSketch® tutorial, which shows you how to sketch the chassis of your F1 in Schools car. Then, you can either trace or photocopy this sketch to give you loads of chassis templates to start designing onto!

### Get designing!

- Design the body of your F1 in Schools racing car over the chassis sketch you have done. The more concepts your team comes up with, the better! F1® designers all need time to think creatively before sitting down at a computer, so do lots and lots of rough sketches and models to begin with.

### Make sure you have a suitable 3D CAD package

- We recommend you download and install the **FREE** Autodesk Fusion 360 software onto your school computers (this can also be used at home). This is available from Autodesk through the F1 in Schools website. Your 3D CAD package should be able to output **.stl** files (these are used to manufacture parts using CAM).

### Download the following CAD files from the F1 in Schools™ website:

- There are **5** Development Class CAD models that can be downloaded to help you build your Development Class car. These are: **F1® model block, body 'no-go-zone', standard wheel, axle** and the **CO<sub>2</sub> cartridge**.

### Get your Development Class Starter kit from DenfordWebshop.com

- The Development Class starter kit contains all the standard components needed to design and make your F1 in Schools Development Class car. Apart from your wheels, which can be 3D printed, all Development Class cars must be manufactured using this kit. Get manufacturing your car and put everything you've learned into practise!

### ATTEND YOUR NEAREST REGIONAL FINAL, READY TO RACE...



# DEVELOPMENT CLASS: THE RULES

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## ARTICLE D1 - DEFINITIONS (a useful glossary of terms)

F1 in Schools™ can sound very technical sometimes, but it's really pretty simple. Here's a glossary of common terms, explaining what everything means:

### D1.1 F1 in Schools™ car

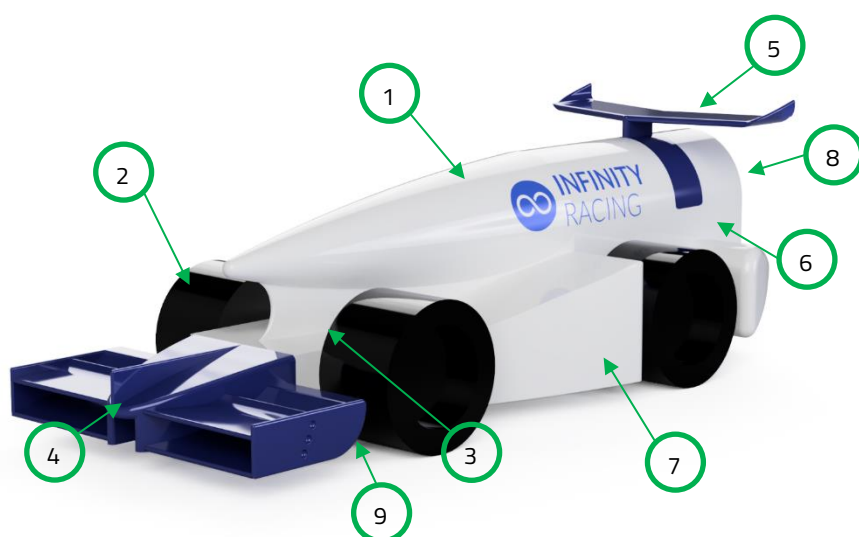
**In simple terms:** All the individual parts that make up an F1 in Schools Development Class car.

**In technical terms:** This is also referred to as 'the car'. Designed and manufactured according to these regulations for the purpose of participating in races on the F1 in Schools track at the UK Regional and National Finals events, powered only by a single compressed air cartridge containing 8 grams of pressurised CO<sub>2</sub>. F1 in Schools cars are designed to travel the 20 metre race distance as quickly as possible, whilst withstanding the forces of launch acceleration, track traversing and physical deceleration after crossing the finishing line.

Your F1 in Schools car assembly must **only** consist of the following components:

- A body (manufactured from Official F1® Model Block – available from [denfordwebshop.com](https://www.denfordwebshop.com))
- 4 x standard design wheels
- 2 x axles / axle guide tubes / 4 x axle bushes
- Front wing assembly
- Rear wing assembly
- Surface finishing (e.g. paint) and decals / graphics
- F1 in Schools logo decals
- A CO<sub>2</sub> cartridge chamber
- Tether line guides

Adhesives with no dimensional impact (e.g. superglue) are allowed for joining components.



1. Body
2. 4 x standard design wheels
3. Axles / guide tubes / bushes
4. Front wing assembly
5. Rear wing assembly
6. Surface finishing
7. F1 in Schools logo decals
8. CO<sub>2</sub> cartridge chamber
9. Tether line guides

## D1.2 Fully assembled car

**In simple terms:** Your completed car, ready to race.

**In technical terms:** An F1 in Schools car, without a CO<sub>2</sub> cartridge inserted, presented ready for racing, resting on the track surface, free of any external force other than gravity.

## D1.3 Body

**In simple terms:** The main part of your car, made from F1® Model Block.

**In technical terms:** The body is a solid uninterrupted piece of F1® Model Block Material existing rear of the front axle centre line and encompassing both the virtual cargo and CO<sub>2</sub> cartridge chamber. For dimensional purposes the body also includes any attached decals and surface finishes. Any F1® Model Block forward of the front axle centre line is not defined as car body.

## D1.4 Official F1® Model Block

**In simple terms:** The material you **must** use to make your car body. (Included in the F1 Development Class starter kit, available from [denfordwebshop.com](https://denfordwebshop.com))

**In technical terms:** The official F1® Model Block is a rigid, closed cell foam block processed to the dimensional features as shown by diagrams in **Appendix ii** of this document. **IMPORTANT:** all cars entered into the UK season **must** be manufactured from F1® Model Blocks.

A universal 3D CAD part of the official model block can be downloaded from:



[www.f1inschools.co.uk/downloads](https://www.f1inschools.co.uk/downloads)

## D1.5 'No-go-zone'

**In simple terms:** The area you **CANNOT** design inside – the minimum size of your body.

**In technical terms:** The no-go-zone is a defined area within the official F1® Model Block, set by F1 in Schools™ to provide a minimum safe working shape for the body of an F1 in Schools™ Development Class car.

A universal 3D CAD part of the no-go-zone can be downloaded from:



[www.f1inschools.co.uk/downloads](https://www.f1inschools.co.uk/downloads)

## D1.6 CO<sub>2</sub> cartridge chamber

**In simple terms:** The hole for the CO<sub>2</sub> gas cartridge

**In technical terms:** The CO<sub>2</sub> cartridge chamber is a cylindrical clear space bounded around its inner circumference and one end by car body only. This is where the CO<sub>2</sub> gas cartridge is placed for racing.

## D1.7 Wheels

**In simple terms:** The standard wheel design you **must** use (available to download as a 3D part, or as included in the F1 Development Class starter kit available from [denfordwebshop.com](https://denfordwebshop.com))

**In technical terms:** A wheel is a single part, cylindrical in form, with its maximum circumference contacting the track surface, enabling forward motion of the car through rotation. All material existing within the volume of the extreme diameter and width is considered to be part of the wheel. **IMPORTANT:** all Development Class cars entered into the UK season **must** use the standard wheel design, which is included in the Development Class starter kit.

A universal 3D CAD part of the standard wheel can be downloaded and 3D printed from:



[www.f1inschools.co.uk/downloads](https://www.f1inschools.co.uk/downloads)

## D1.8 Axles

**In simple terms:** The standard axles you **must** use (Included in the F1 Development Class starter kit available from [denfordwebshop.com](https://denfordwebshop.com))

**In technical terms:** Axles are single parts that connect a wheel to any other part of the car. **IMPORTANT:** all Development Class cars entered into the UK season **must** use the standard axles, which are included in the



Development Class starter kit. These are supplied with 2 (two) plastic axle bushes and guide tubes per axle and must not be substituted with any other parts. Axles may only be modified in length (please refer to D6.1).



A universal 3D CAD part of the standard wheel can be downloaded from: [www.f1inschools.co.uk/downloads](http://www.f1inschools.co.uk/downloads)

### D1.9 Tether line guides

**In simple terms:** 2 screw eyes attached to the underside of your car, to keep it on the track. (Included in the official starter kit available from [denfordwebshop.com](http://denfordwebshop.com))

**In technical terms:** A tether line guide is a key safety component which completely surrounds the track tether line so as to safely connect the car to the tether line during races. A tether line guide can be a component sourced from a supplier or manufactured wholly or in part by the team.

### D1.10 Front / rear wing assembly

**In simple terms:** Wings mounted on the front and rear of your car, designed to control airflow.

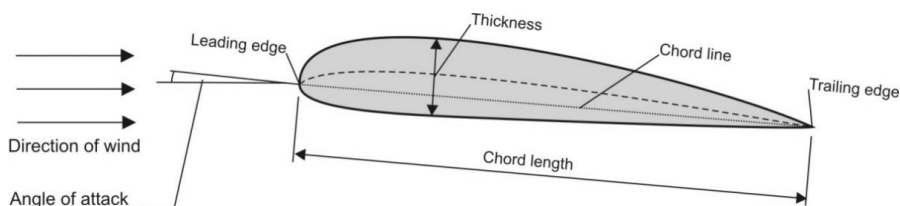
**In technical terms:** A wing on an F1 in Schools Development Class car is an aerodynamic feature that permits airflow around ALL of its surfaces including its features of a leading and trailing edge. The measurements used to calculate the dimensions of an F1 in Schools car wing are the maximum and minimum span, chord and thickness. The vertical cross-sectional shape of the wing, parallel to the direction of car travel, is referred to as an aerofoil.

Definition of wing terminology:

- A **leading edge** is the edge of the wing that cuts through the air first.
- The **trailing edge** is the edge that the air touches last as it leaves the wing.
- Wing **span** is just like the arm span of a human, or the wing span of a bird or plane. It is the total width of the wing across the body of the car.
- Wing **chord** is the widest point of the wing's cross section, between the leading and trailing edges.
- Wing **thickness** is the deepest point of the wing across its cross section.

These terms are all shown on the diagram below, make sure you understand what they all mean!

Wing cross-section diagram:



### D1.11 Surface finish and decals

**In simple terms:** A fancy paint job and sponsor stickers.

**In technical terms:** A surface finish on an F1 in Schools car is considered to be any applied visible surface covering, of uniform thickness over the profile of a car component. A decal is material adhered to a component or surface finish. To be defined as a decal, 100% of the area of the adhering side must be attached to a surface. Surface finishes and decals are included when measuring the dimensions of any components they feature on.

### D1.12 Hand finishing

**In simple terms:** Filing, sanding and polishing.

**In technical terms:** Hand finishing is defined as use of a hand powered device (e.g. needle files, abrasive paper, lacquer) for removing only the irregularities that may remain on a CNC machined surface of the car body. These irregularities are often referred to as 'scalloping marks'.

### D1.13 F1 in Schools™ logo decals

**In simple terms:** A white or black F1 in Schools™ sticker which must be stuck to each of your cars.

**In technical terms:** This consists of the F1 in Schools logo graphic printed on a black or a white adhesive vinyl with a 1mm contrast keyline border, with a horizontal dimension of 30mm and vertical dimension of 15mm.

Teams must use a decal to identify Car A and Car B. The official decals are supplied by F1 in Schools Ltd at event registration. A team can manufacture and fit their own decals, provided they use the official F1 in

Schools logo decal artwork which can be downloaded from the F1 in Schools website:



[www.f1inschools.co.uk/downloads](http://www.f1inschools.co.uk/downloads)

**Decal designs:**



### D1.14 Engineering drawings

**In simple terms:** Orthographic and/or isometric drawings of your finished car, showing dimensions.

**In technical terms:** Engineering drawings are freehand or CAD produced drawings which should be such that they could theoretically be used to manufacture the fully assembled car by a third party. Such drawings must include all relevant dimensions, tolerances and material information. F1 in Schools engineering drawings must include detail to specifically identify and prove compliance for wing surfaces (refer to D7.2).

Engineering drawings can include: orthographic projection, auxiliary projection, section views, isometric projection, oblique projection, perspective and annotated renderings.

It is recommended to label the relevant technical regulations where appropriate throughout your Engineering drawings (**e.g. D7.8.1: 65mm**); this makes the job of the scrutineer much easier in identifying the different features of your car.

### D1.15 Renderings

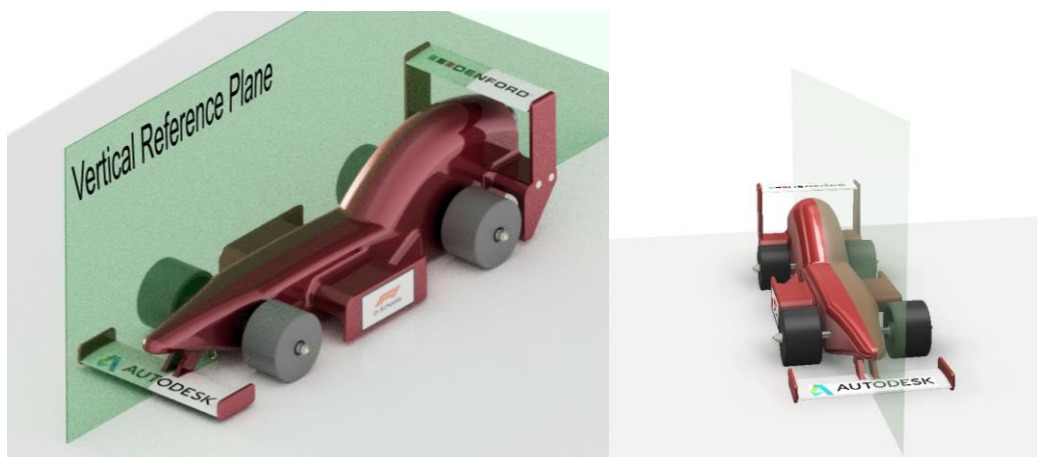
**In simple terms:** Freehand or CAD presentation images of your finished car

**In technical terms:** Renderings are images intended to illustrate the three dimensional form of an object. These can be generated in isometric projection, oblique projection or perspective.

### D1.16 Vertical reference plane

**In simple terms:** An imaginary slice through the centre of your car, used to describe measurements

**In technical terms:** To assist with describing dimensions, it is assumed that a two dimensional invisible plane exists along the length of the CO<sub>2</sub> cartridge chamber centre axis and perpendicular to the track surface. This is known as the vertical reference plane.



**D1.17 Normal**

**In simple terms:** At right angles to another object

**In technical terms:** The term 'normal' is used in geometry to describe a line or object that is perpendicular or at 90 degrees to another given object. When referring to the term normal in these regulations it is considered to mean:

- a. Being at right angles; perpendicular.
- b. Perpendicular to the direction of a tangent line of a curve or a tangent plane to a surface.

**D1.18 Additional Components**

Any component other than those listed in D1.1 will be considered an additional component. Please refer to P11 and also the corresponding UK Competition Regulations.

**P1.19 Full 8 gram CO<sub>2</sub> cartridge**

A metallic cartridge which contains a compressed 8 gram charge of CO<sub>2</sub>. For weights and dimensions refer to appendix iv. Official CO<sub>2</sub> cartridge dimensions.

# ARTICLE D2 - GENERAL PRINCIPLES *(the smallprint!)*

## D2.1 Regulations documents

**D2.1.1** F1 in Schools Ltd. issues the regulations, their revisions and amendments made.

**D2.1.2** Technical Regulations - this document. The Development Class Technical Regulations document is mainly concerned with those regulations that are directly related to F1 in Schools car design and manufacture. Development Class Technical regulation article numbers have a 'D' prefix.

**D2.1.3** Competition Regulations – a document separate to this one which is mainly concerned with regulations and procedures directly related to judging and the competition event. Competition Regulation article numbers have a 'C' prefix.

## D2.2 Interpretation of the regulations

**D2.2.1** The final text of these regulations is in English should any dispute arise over their interpretation. The text of a regulation, diagrams and any related definitions should be considered together for the purpose of interpretation.

**D2.2.2** Text clarification - any questions received that are deemed by F1 in Schools Ltd. to be related to regulation text needing clarification will be answered by F1 in Schools Ltd. The question received, along with the clarification provided by F1 in Schools Ltd., will be published online at the same time.

## D2.3 Amendments to the regulations

Any amendments will be announced and released by F1 in Schools Ltd. on the official UK website: [www.f1inschools.co.uk](http://www.f1inschools.co.uk). Any amended text will be indicated **thus** (using red underlined text).

## D2.4 Classification of regulations

**D2.4.1** The technical regulations are classified as either: GENERAL, SAFETY, PERFORMANCE.

GENERAL	SAFETY	PERFORMANCE
Regulations that shape the way the car fundamentally looks and works, vital to the style of an F1 in Schools car.	Mandatory rules that govern the safe running of the car. Cars must meet these rules to be considered 'safe to race'.	Rules that have a direct impact on the performance of the vehicle, these typically carry the heaviest penalties.

**D2.4.2** If a race car is judged as being NON-COMPLIANT with any Performance regulation they will be INELIGIBLE for the awards of: 'Fastest Car' and 'Best Engineered Car'. All Performance regulations are highlighted in yellow throughout this document.

## D2.5 Compliance with regulations

**D2.5.1** Points are deducted for non-compliance with the technical regulations as per the specification judging score card. Both race cars are scrutineered and points will be deducted for any infringements on either car. These penalties are only applied once, per infringement, per car.

**D2.5.2** Proportional penalties will be applied to regulations showing the PP+ symbol. The penalty applied increases proportionally as the margin of non-compliance with the absolute minimum/maximum dimension increases, by rounding up the non-compliance to the next complete unit of measure (1.0mm or 1.0g). The penalty is applied once for every complete unit outside of the absolute minimum/maximum dimension. E.g.

Regulation example	Measurement	Pass/Fail	Margin of fail	Penalty
<b>D3.5 Total weight – [PERFORMANCE   Penalty – 10pts]</b> Absolute Min: 60.0g	59.9g – 59.0g	FAIL	0.1g-1.0g	10pts
	58.9g – 58.0g	FAIL	1.1g-2.0g	20pts
	57.9g – 57.0g	FAIL	2.1g-3.0g	30pts

## D2.7 Design ideas and regulation compliance questions

Teams are not permitted to seek a ruling from F1 in Schools Ltd. or any competition officials or judges before the event as to whether a design idea complies with these regulations. Rulings will only be made by the judges at the Regional and National Finals events. Design compliance to the regulations forms part of the competition.

As in Formula 1, innovation is encouraged and F1 in Schools teams may also find ways of creating design features that push the boundaries of the regulations in order to get an extra competitive edge.

## D2.7 Measurements

**D2.7.1** All dimensions and weights are presented as absolute minimum or maximum, unless stated otherwise. For example:

MIN Weight Absolute Min: 60.0g	MIN Dimension Absolute Min: 170.0mm	MAX Dimension Absolute Max: 210.0mm
60.0g - <b>PASS</b>	170.0mm - <b>PASS</b>	210.0mm - <b>PASS</b>
59.9g - <b>FAIL</b>	169.9mm - <b>FAIL</b>	210.1mm - <b>FAIL</b>

**D2.7.2** Dimensional measures - all car component dimensions are inclusive of any applied paint finish or decal. A series of specially manufactured gauges will be used to broadly verify dimensional compliance. Accurate measuring tools, such as vernier calipers, will then be used to closely inspect any dimensions found to be close to the dimensional limits per the initial gauge inspection. **IMPORTANT:** Some regulations are assessed with a full 8.0g race cartridge fully inserted into the cartridge chamber. In these regulations, the car must be capable of resting equally on all four (4) wheels without any outside assistance.

**D2.7.3** Weight measures – all weight measurements will be made using the F1 in Schools Ltd. calibrated electronic competition scales.

## D2.8 Benefit of doubt

The chair of judges will, where appropriate, seek to use 'benefit of doubt' when the assessment of compliance is marginal or unclear. In this situation, teams will be given the benefit of doubt rather than a firm penalty if a penalty cannot be clearly measured or identified.

## D2.9 Spirit of the competition

Teams are expected to act in the spirit of the competition, both before and during any F1 in Schools events. Any team deemed by the chair of judges to be acting outside of the spirit of the competition, can be removed from certain or all aspects of the competition. For example, a team attempting to abuse the technical regulations to their advantage may, at the discretion of the chair of judges, be removed from racing and receive no points for this activity. A team deemed to be acting in an unsportsmanlike manner towards another team or other persons may be removed from some or all judging areas.

The spirit of the competition is simple; embrace and respect the rules and regulations, do your very best to compete legally and fairly, while contributing positively to F1 in Schools. Make friends, create positive relationships, network professionally and enjoy yourselves.

## D2.10 Plagiarism

F1 in Schools LTD views cases of plagiarism very seriously. Competing teams at all levels of the competition that intentionally plagiarise any part of their assessed work, undermines the credibility and integrity of the F1 in Schools challenge and the spirit of the competition. F1 in Schools will be implementing various plagiarism detection methodologies. Further details will be available in the corresponding UK Competition Regulations.

**Please make sure you have also read the  
corresponding F1 in Schools UK Competition Regulations**

# **CAR DESIGN**

## **COMPLIANCE AND PENALTIES**

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<b>Article 8: Tether Line Guides</b>	<b>26</b>







# ARTICLE 3:

## FULLY ASSEMBLED CAR



## ARTICLE D3 - FULLY ASSEMBLED CAR

### D3.1 Design and manufacture - [GENERAL | Penalty - 5pts each]

**D3.1.1** All F1 in Schools cars must be designed and engineered using CAD (Computer Aided Design) software and CAM (Computer Aided Manufacture) technology. CAD software used should provide for 3D part modelling, assembly and 3D realistic rendering. The CAM package should allow students to simulate CNC machining processes so they can show evidence of these in their portfolio. We recommend the use of Denford QuickCAM PRO software.

**D3.1.2** The body of all F1 in Schools cars must be manufactured via material removal using a CNC router/milling machine. We recommend all teams use a Denford CNC router. This manufacturing process should occur at your school/college or at a designated manufacturing centre/partner site.

**D3.1.3** An official F1 in Schools holographic sticker from the official F1® Model Block for each car must be submitted on the project element submission sheet at registration at the Regional and National Finals events.

**D3.1.4** The race cars must have identically designed components.

### T3.2 Safe Construction [SAFETY | Penalty - 10pts each]

**D3.2.1** Specification judging - all submitted cars will be inspected closely to ensure that they are engineered and constructed safely for the purpose of racing. If the judges rule an aspect of either race car to be unsafe for racing, the team will be required to carry out repairs / modifications to the car(s). Any such repair work will result in a penalty of 10 points per unsafe car.

**D3.2.2** During racing – the race officials will routinely inspect cars for safety during scheduled races. If the officials rule a car to be unsafe, a penalty of 10 points will be imposed at the discretion of the Chair of Judges. The team may repair the car as per the Competition Regulations – C10 Car Repairs and Servicing.

### D3.3 Undefined features - [PERFORMANCE | Penalty - 20pts]

The car assembly must only consist of components listed in ARTICLE D1.1.

### D3.4 Total length - [GENERAL | Penalty - 5pts per millimetre]

Total length is measured between the front and rear extremities of the assembled car, parallel to the track surface and vertical reference plane. (See diagram below for example)

**Absolute Min: 170mm / Absolute Max: 210mm**

### D3.5 Total width - [GENERAL | Penalty - 5pts per millimetre]

Width is the maximum assembled car width, measured normal to the vertical reference plane, between the outer edges of the widest feature of the car assembly. (See diagram below for example)

**Absolute Max: 90mm**

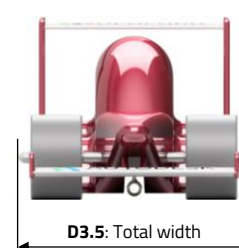
### D3.6 Total weight - [PERFORMANCE | Penalty - 10pts per gram]

Total weight is the weight of the car excluding a CO<sub>2</sub> gas cartridge. If ruled underweight, ballast will be added before racing, at 0.2g for every 0.1g underweight.

**Absolute Min: 60.0g**

### D3.7 Additional Components - [GENERAL | Penalty - 5pts]

The car assembly must be designed so that no items other than those listed in D1.1, or CO<sub>2</sub> cartridges are removed, replaced or added to the assembly during scheduled race events.



# ARTICLE 4:

## BODY



## ARTICLE D4 - BODY

### D4.1 Body construction - [GENERAL | Penalty - 20pts]

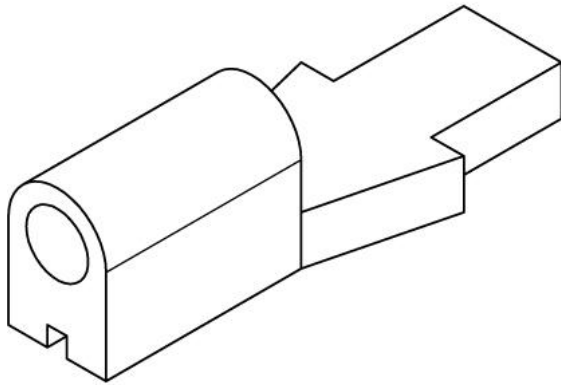
A single continuous piece of CNC manufactured F1® Model Block material must exist rear of the front axle centre line, encompassing both the virtual cargo and CO<sub>2</sub> cartridge chamber.

### D4.2 No-go-zone - [PERFORMANCE | Penalty - 25pts]

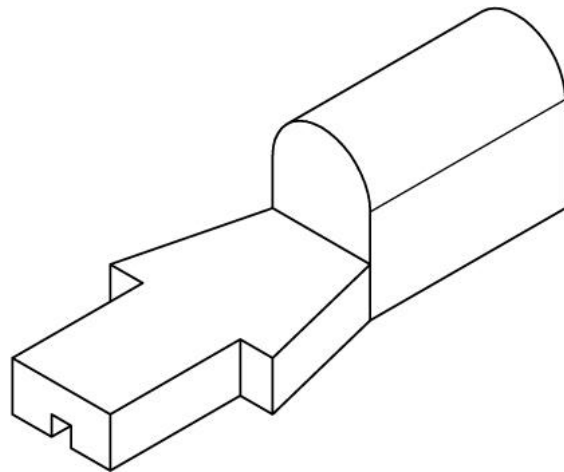
The no-go-zone is a specific area, defined by F1 in Schools Ltd that must be preserved in your finished design. As such, no part of the body design is permitted to fall inside the no-go-zone. The only permitted modification to the no-go-zone is the placement of two (2) axle holes. **Please see Appendix iii** for no-go-zone diagram and download the official no-go-zone .ipt part from [www.f1inschools.co.uk/downloads](http://www.f1inschools.co.uk/downloads)

**No-go-zone isometric views:**

**Rear isometric view:**



**Front isometric view:**



### D4.3 F1 in Schools™ logo decal location - [GENERAL | Penalty - 5pts]

An F1 in Schools logo decal (refer to ARTICLE D1.13) must be wholly adhered to each **side** of the car, positioned between the front and rear wheels and being clearly legible in the respective side view. Teams may manufacture their own decals but must use the artwork supplied by F1 in Schools Ltd.



**D4.3:** F1 in Schools™ logo decal location

# ARTICLE 5:

## CO<sub>2</sub> CARTRIDGE CHAMBER



# ARTICLE D5 - CO2 CARTRIDGE CHAMBER

## D5.1 Distance from track surface - [GENERAL | Penalty - 5pts per millimetre]



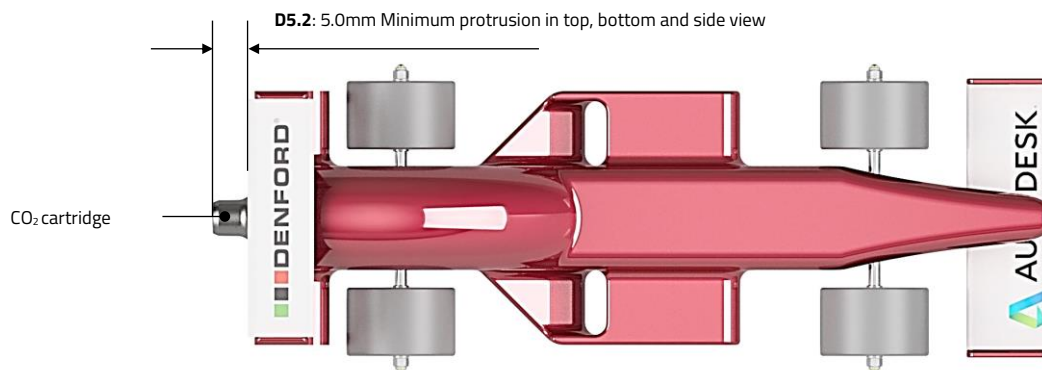
This is the lowest point of the chamber opening to the track surface, measured normal to the track surface.

**Absolute Min: 20mm / Absolute Max: 30mm**

## D5.2 CO<sub>2</sub> cartridge visibility - [PERFORMANCE | Penalty - 10pts per millimetre]



There must be no obstructions to the cartridge chamber from the rear view. The cartridge chamber must be free and clear of any objects that the judges could deem obstructive to fully inserting a CO<sub>2</sub> cartridge. *Take extra care to ensure that screw eyes (tether line guides) and axles DO NOT pass through the cartridge chamber.*





# ARTICLE 6:

## WHEELS



# ARTICLE D6 - WHEELS

## D6.1 Number and location - [GENERAL | Penalty - 25pts]

The car assembly must use the official F1 in Schools Development Class standard wheel design (as supplied in the Development Class starter kit, available from [denfordwebshop.com](http://denfordwebshop.com)). Please refer to appendices v and vi and download the 3D .ipt parts to use as part of your CAD assembly.

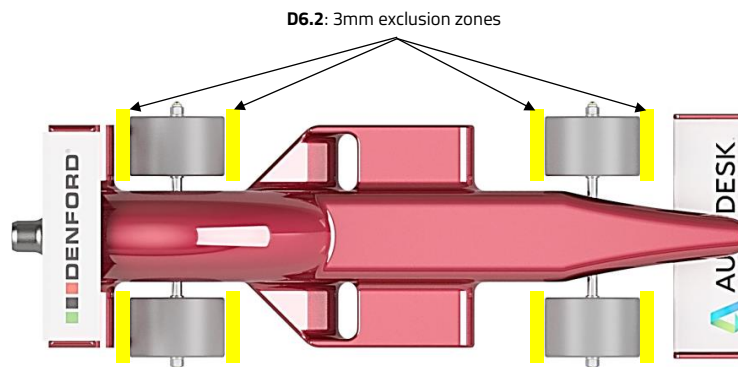
- Four standard design wheels, unmodified in geometry (supplied or 3D printed)
- Four axle bushes (as supplied with Development Class starter kit)
- Two continuous axles and guide tubes as supplied, length only can be modified
- The axle guide holes may be machined by a hand or a CNC process

**Note:** 3D printed wheels **are** permitted, provided the geometry remains unchanged from the standard design wheel. No other modifications to the wheels or axles systems are allowed, all parts must be those supplied in the official Development Class starter kit.

## D6.2 Visibility - [PERFORMANCE | Penalty - 25pts]

View of all wheels must not be obscured by any component of the car in the car's top, side and bottom elevation views. A 3mm exclusion zone must exist to the front and rear of all wheels in the plan and bottom views.

**Absolute Min: 3mm**

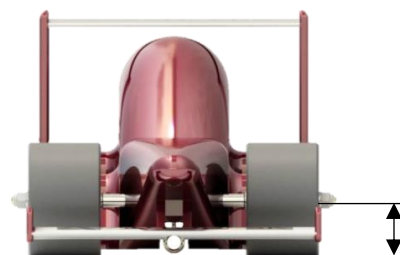


*View of wheels not obstructed in top, bottom or side views*

## D6.3 Visibility in front view - [PERFORMANCE | Penalty - 10pts per millimetre]

The visibility of the front wheels in the car's front view may only be obstructed to a height of 20mm from the track surface.

**Absolute Max obstruction: 20mm**



**D6.3:** Visibility of front wheels obstructed up to a maximum of 20mm

## D6.4 Race track contact - [PERFORMANCE | Penalty - 2.5pts per wheel]

All four (4) wheels must touch the racing surface at the same time across the full width of the wheel.

## D6.5 Rotation - [GENERAL | Penalty - 5pts]

The track contact surface of all four (4) wheels must rotate freely about their own centre axis to facilitate forward motion of the car during racing. The scrutineering judge must be able to validate this with reasonably minimal effort.



# ARTICLE 7:

## WINGS



# ARTICLE D7 - WINGS

## D7.1 Description and placement - [PERFORMANCE | Penalty - 25pts]

The design of the car should resemble an actual F1 car through the inclusion of a wing on the nose of the car and a wing at the rear of the car. Each wing must have a leading edge and a trailing edge. Refer to the definitions in D1.10.

## D7.2 Wing identification - [GENERAL | Penalty - 5pts]

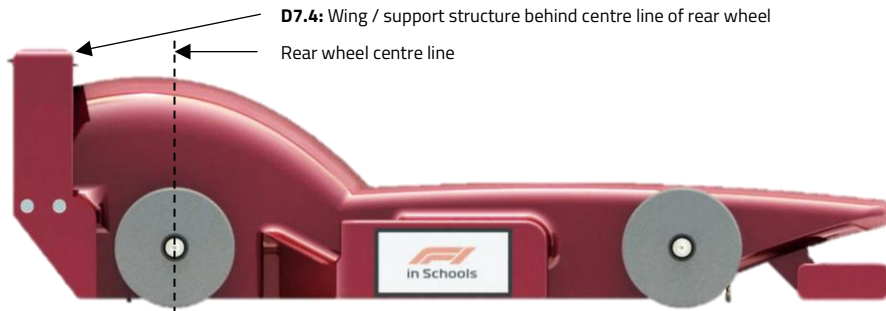
The span, chord and thicknesses of both the front and rear wings MUST be identified clearly within the engineering drawings submitted for scrutineering judging.

## D7.3 Construction and rigidity - [SAFETY | Penalty - 5pts]

The front wing, rear wing and any support structures may be manufactured directly from the model block, or from any separate materials, including laser cut and 3D printed materials. The wing shape must remain unchanged during races, i.e. wings must be rigid, ruled at the judge's discretion.

## D7.4 Rear wing location - [PERFORMANCE | Penalty - 10pts]

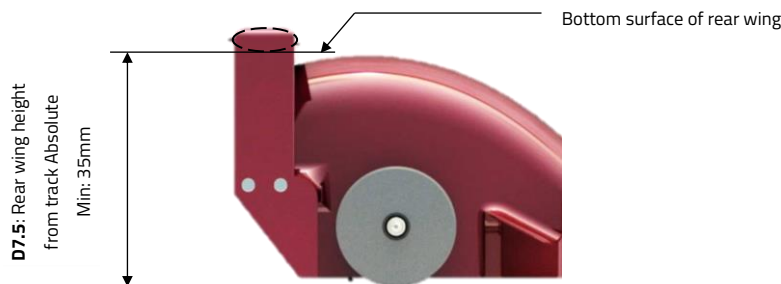
The whole of the rear wing and any support structure must be behind the centre line of the rear wheel when viewed in the side elevation.



## D7.5 Rear wing height - [PERFORMANCE | Penalty - 10pts]

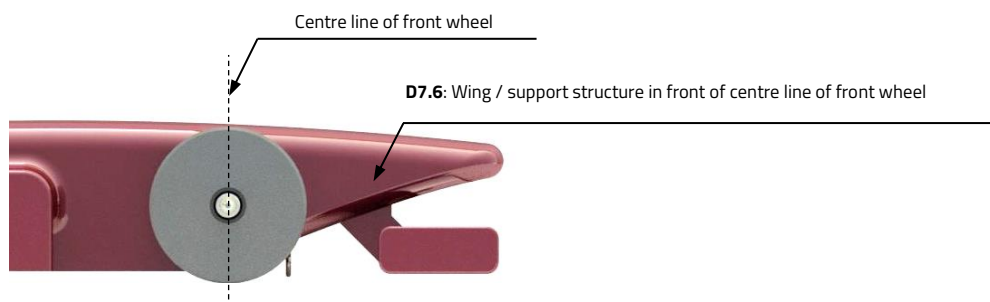
The bottom surface of the rear wing must be higher than 35mm when measured from and normal to the track surface.

**Absolute Min: 35mm**



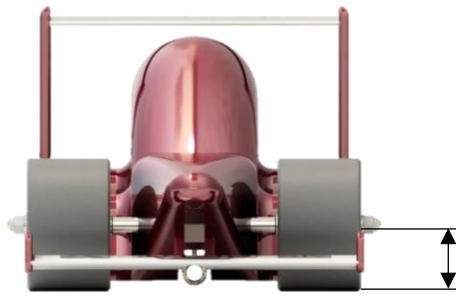
## D7.6 Front wing location - [PERFORMANCE | Penalty - 10pts]

The whole of the front wing and any support structure must be in front of the centre line of the front wheel when viewed in the side elevation.



**D7.7 Visibility of front wing - [PERFORMANCE | Penalty - 15pts]**

Visibility of the front wing must not be obstructed by any other component when viewed in the front elevation.



D7.7: Visibility of front wing not obstructed in this view

**D7.8 Front and rear wing span - [GENERAL | Penalty - 5pts each per millimetre]**

The wing span is measured on the top or bottom surface of the wing, whichever is shortest, parallel to the track surface and normal to the vertical reference plane. *(See illustration below)*

D7.8.1 Front wing span – **Absolute Min: 60mm**

D7.8.2 Rear wing span – **Absolute Min: 60mm**

**D7.9 Front and rear wing chord - [GENERAL | Penalty - 5pts each]**

The wing chord minimum and maximum dimensions must exist throughout the wing span. Chord is measured parallel to the vertical reference plane. *(See illustration below)*

D7.9.1 Front wing chord – **Absolute Min: 15mm / Absolute Max: 30mm**

D7.9.2 Rear wing chord – **Absolute Min: 15mm / Absolute Max: 30mm**

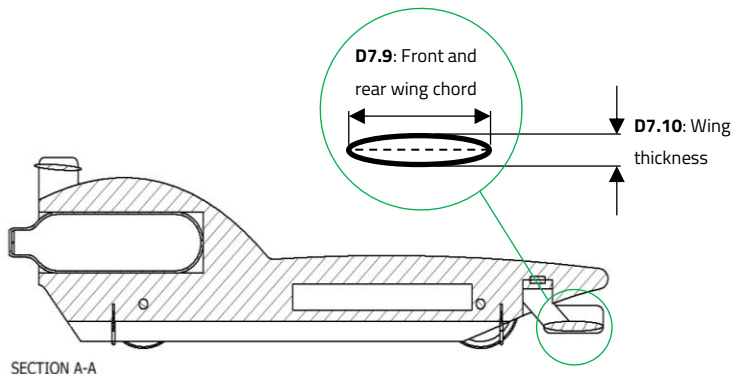
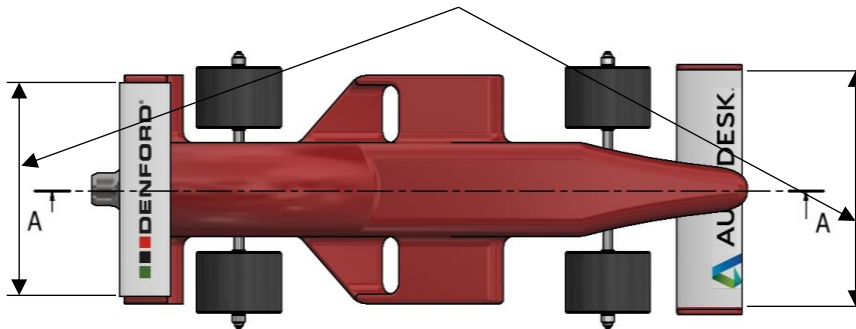
**D7.10 Front and rear wing thickness - [GENERAL | Penalty - 5pts each]**

The wing thickness minimum dimension must exist throughout the wing’s minimum span, measured perpendicular *(at 90° to)* the chord line. *(See illustration below)*

D7.10.1 Front wing thickness – **Absolute Min: 5mm / Absolute Max: 15mm**

D7.10.2 Rear wing thickness – **Absolute Min: 5mm / Absolute Max: 15mm**

D7.8: Front and rear wing span





# ARTICLE 8:

## TETHER LINE GUIDES

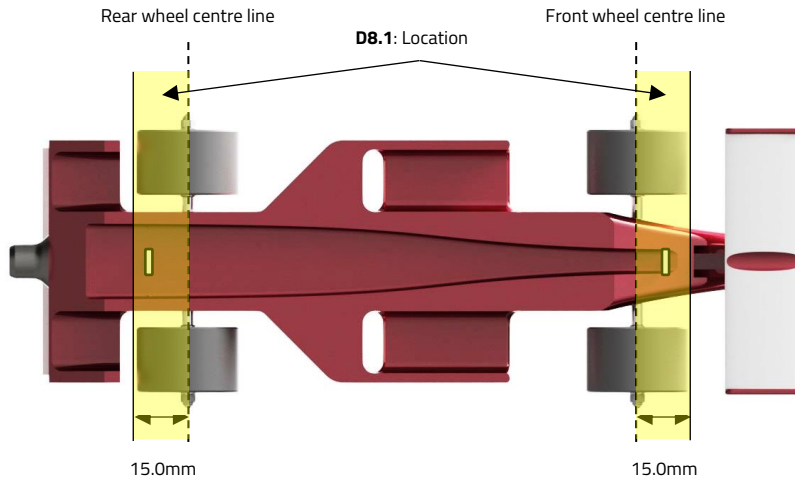




# ARTICLE D8 - TETHER LINE GUIDES

## D8.1 Location - [SAFETY | Penalty - 10pts]

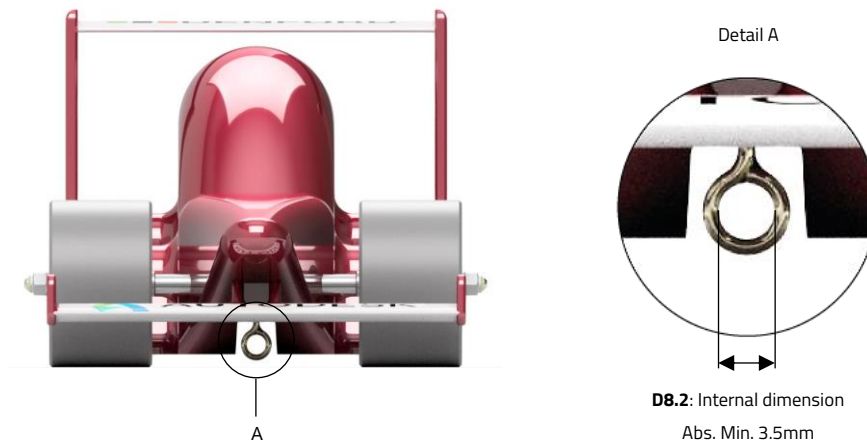
Each car must have only two (2) firmly secured tether line guides, one on or up to 15.0mm in front of the front axle centre line and one on or up to 15.0mm behind the rear axle centre line of the car. The track tether line must only pass through both tether line guides during racing. *This means the tether CANNOT pass through an enclosed gap in your front or rear wing before passing through the tether guide.*



## D8.2 Internal dimension - [SAFETY | Penalty - 5pts]

The internal measurement of the opening within the guide which the tether line passes through.

**Absolute Min: 3.5mm / Absolute Max: 6mm**



# APPENDIX

<b>Appendix i:</b>	<b>Launch Pod/Finish Gate</b>	<b>28</b>
<b>Appendix ii:</b>	<b>Official F1® model block</b>	<b>28</b>
<b>Appendix iii:</b>	<b>No-go-zone</b>	<b>29</b>
<b>Appendix iv:</b>	<b>Standard wheels</b>	<b>30</b>
<b>Appendix v:</b>	<b>Standard axles</b>	<b>31</b>



### Appendix i. Start Box and Finish Line

The Start Boxes are designed to sit centrally within each lane of the track

The distance from the emitter centre line to the race track surface on both lanes is ~7mm

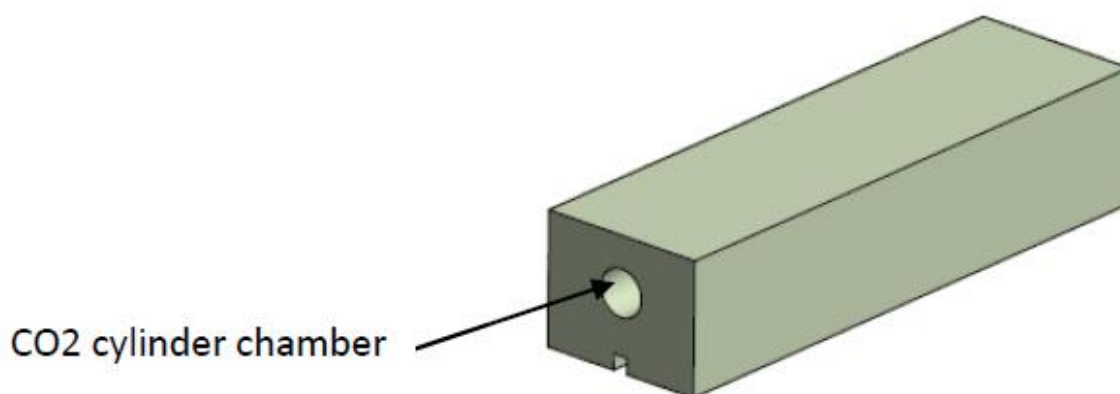
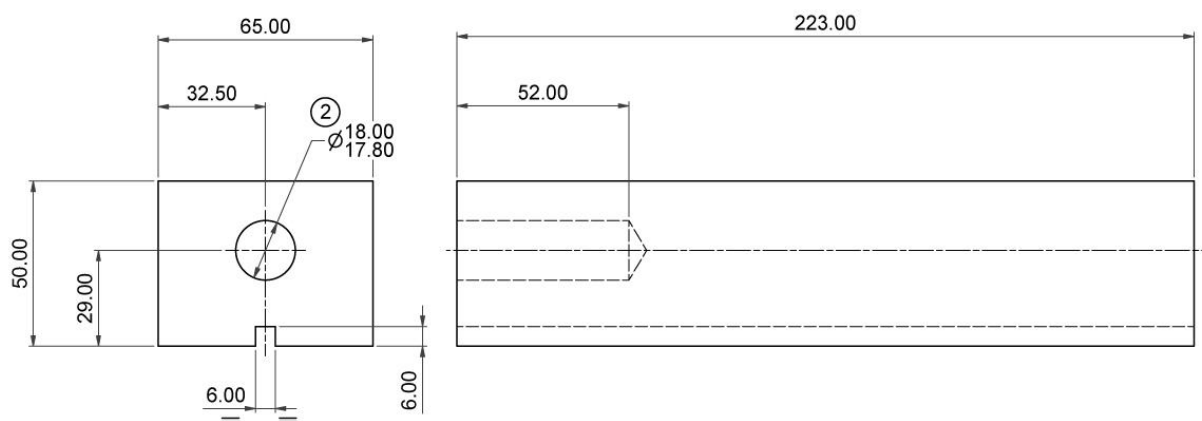
### Appendix ii. Official F1® Model Block Dimensions

Below: orthographic projection of F1® Model Block. All dimensions shown in millimetres



This component is available to download FREE as a universal 3D CAD part from the F1 in Schools website. For this part and more, please visit: [www.f1inschools.co.uk/downloads](http://www.f1inschools.co.uk/downloads)

From July 2017 the F1 Model Block was supplied with a reduced diameter CO<sub>2</sub> power pack chamber bore of 18mm. Please see diagram below.



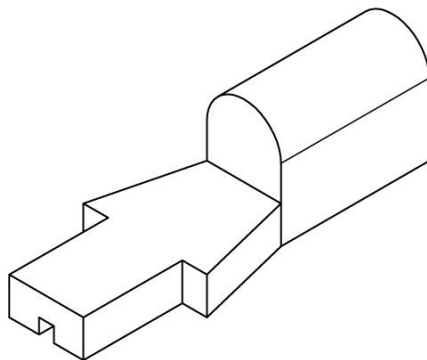
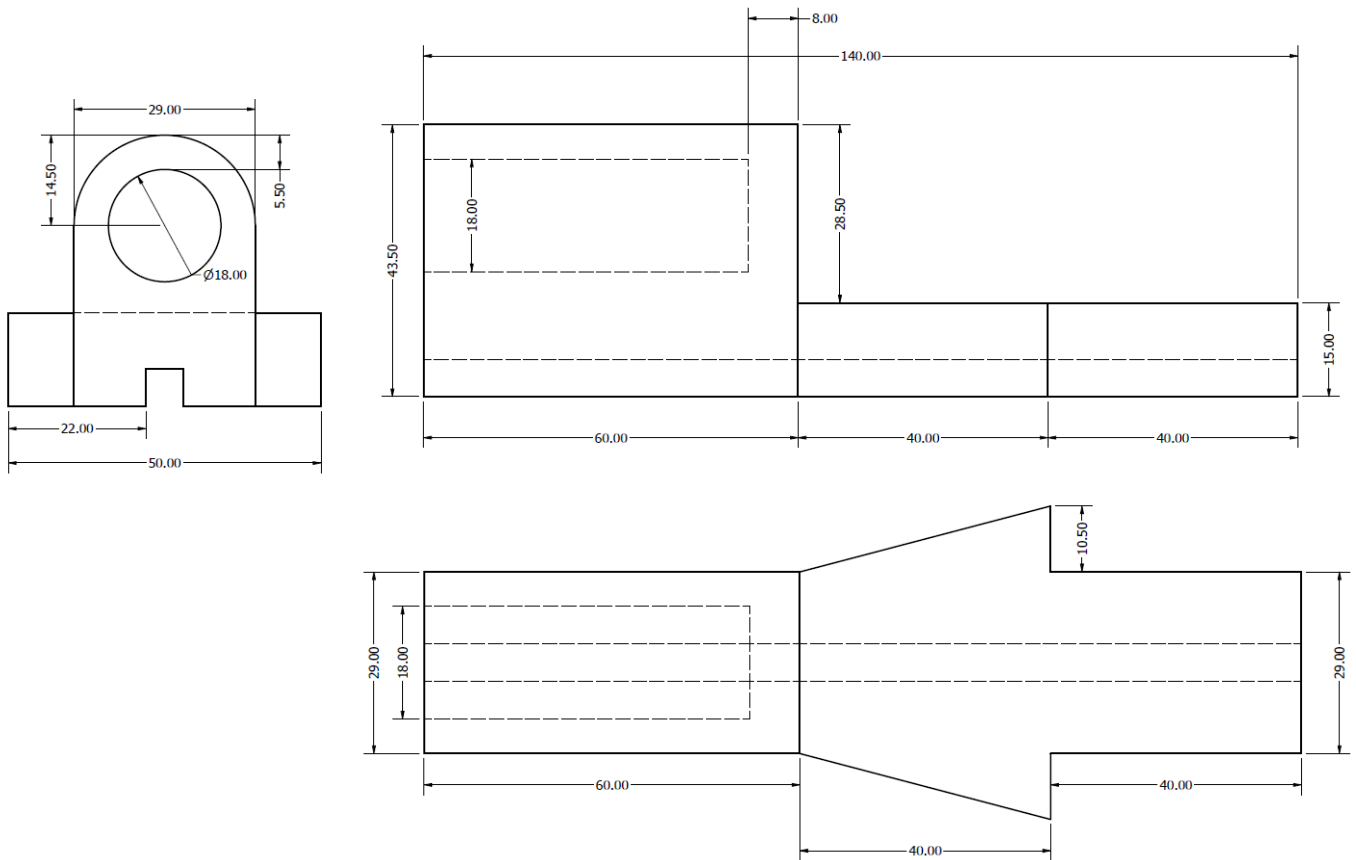
### Appendix iii. Development Class 'no-go-zone'



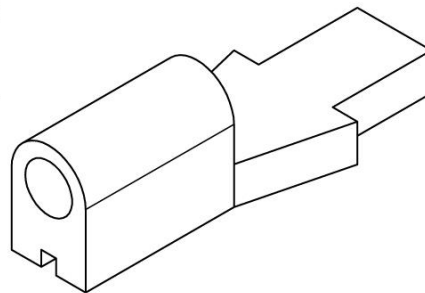
The Scrutineers will measure your car body to check the minimum dimensions of the no-go-zone are present, as one continuous piece of model block. We would strongly recommend starting your 3D CAD model using the official F1 in Schools no-go-zone 3D part. This component is available to download FREE as a universal 3D CAD part from the F1 in Schools website. For this part and more, please visit:

[www.f1inschools.co.uk/downloads](http://www.f1inschools.co.uk/downloads)

#### Orthographic projection:



Front view

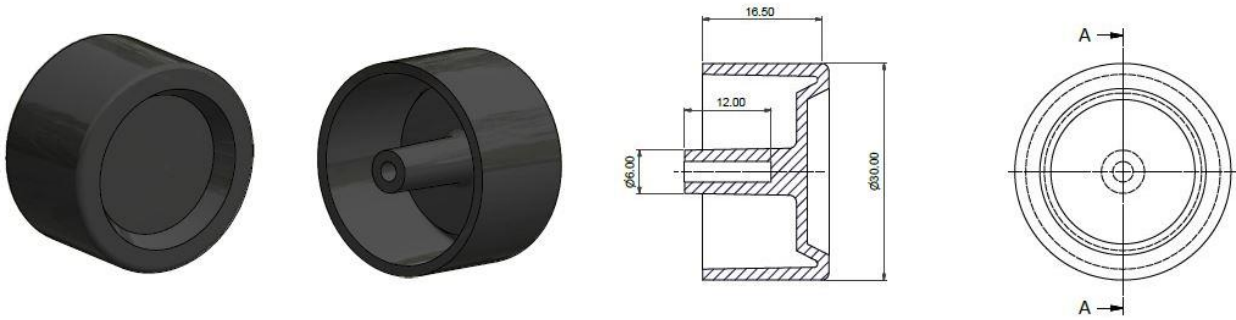


Rear view

### Appendix iv. Development Class standard wheel design



This component is available to download FREE as a universal 3D CAD part from the F1 in Schools website. For this part and more, please visit: [www.f1inschools.co.uk/downloads](http://www.f1inschools.co.uk/downloads)

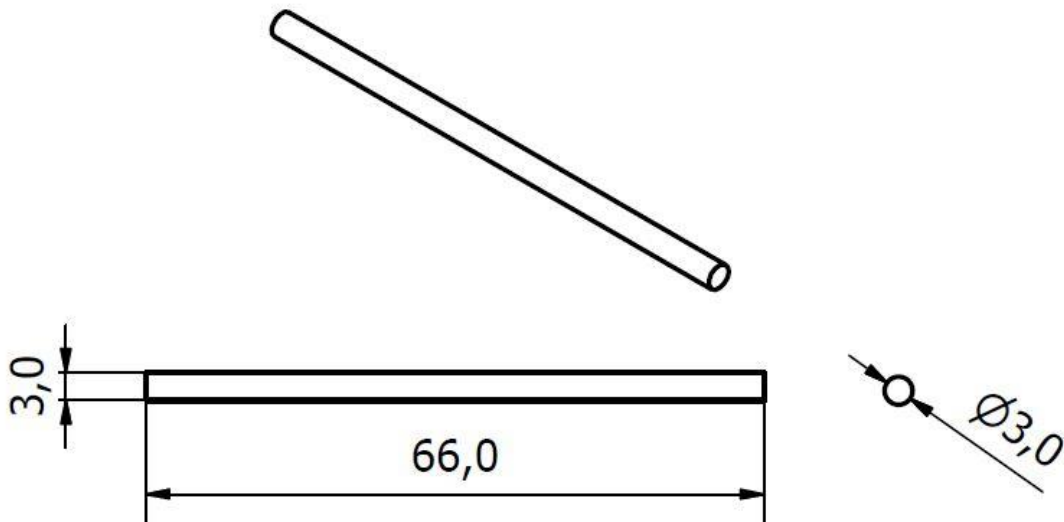


Individual wheel weight: 3.5-3.8g

### Appendix v. Development Class standard axle



This component is available to download FREE as a universal 3D CAD part from the F1 in Schools website. For this part and more, please visit: [www.f1inschools.co.uk/downloads](http://www.f1inschools.co.uk/downloads)



Individual axle weight: 4g



**Please make sure you have also read the  
corresponding F1 in Schools UK Competition Regulations**

# **Work hard, see you on the track!**

If you need any help at all, just get in touch with us:

## **F1 in Schools™ STEM Challenge**

Engineering in Motion

T: 020 7344 8444  
E: [contactus@f1inschools.co.uk](mailto:contactus@f1inschools.co.uk)  
W: [www.f1inschools.co.uk](http://www.f1inschools.co.uk)

