RE-ENGINEERING AUSTRALIA
FOUNDATION

National Sponsor
Australian Government
Department of Defence

THE FORMULA 1® STEM CHALLENGE
IN SCHOOLS™

TECHNICAL REGULATIONS
(AUSTRALIA)

2017/2018 Season
Version 1.1

Infinitude - Australia
St Bede's College, VIC & Brighton Secondary School, SA
2016 World Finals - 2nd Outright
Fastest Car 0.916s - New World Record

www.rea.org.au

ACKNOWLEDGEMENT

In preparing the F1 in Schools™ Australian Technical Rules, certain wording and images have been adopted from the World Final Technical Regulations.

ALTERATIONS

Re-Engineering Australia Foundation Ltd. reserves the right to alter any specifications and documentation associated with the 'Challenge' without prior notice.

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PREFACE

This document only contains 'Technical Regulations'. A separate document encompasses the 'Competition Regulations'.

These regulations will be valid for all 2017 State Finals and the 2018 National Final. Some changes may only be valid for National Finals.

Car diagrams and images used in this document are an illustrative representation only and do not necessarily constitute a 'legal' design.

Summary of Main Revisions from Review of 2016/2017 Season

The following summary provides an overview of all technical related regulations that have been revised from the 2016/2017 season's regulations.

It is each team's responsibility to thoroughly read this document in order to identify wording changes and to understand any impact this may have on their project.

All changes between this season and last season are identified within the document by using red underlined text. All changes made since the release of this season's V1.0 in green underlined text.

ARTICLE T1 – DEFINITIONS
T1.6 F1 in Schools™ Cars: Wording update to reflect the labelling of Car A and Car B.
T1.8 Fully Assembled Cars: Wording update to reflect new racing arrangements for both cars.
T1.21 Replacement Components: Inclusion of Tether Line Guides as optional Replacement Parts
T1.24 Surface Finish & Decals: New arrangements for Car Decal Stickers. Incorporates T1.24.1 and T1.24.2.
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ARTICLE T2 – GENERAL PRINCIPLES
T2.4 Safe Construction: Wording update. Points penalty reduced.
T2.6 Rectification of Critical Regulation Infringements: Minor wording update.

ARTICLE T3 – GENERAL CAR REGULATIONS
T3.1 Design, Manufacture & Construction: Points penalty reduced.
T3.2 Leading Features Minimum Width: *New regulation* governing sharp/pointed leading features.
T3.3 Finishing & Assembly: Hand Finishing now includes a 3mm maximum variation to CAD model v's finished product. Hand Created Features not permitted. Incorporates T3.2.1 and T3.2.2. Points penalty reduced.
T3.4 Car Decals: New arrangements for Entry Number Stickers, Minimum Dimensions and Positioning. Picture updated.
T3.9 Minimum Mass: Updated for Professional and Development Class Teams in light of LERS abolition. Wording update from 'Weight' to 'Mass'– June edition. Also updated in Articles 2.7.
T3.13 Replacement Components: Updated to include Tether Line Guides. Updated – June edition.

ARTICLE T4 – BODY & SIDE POD RULES
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ARTICLE T5 – NOSECONE RULES
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ARTICLE T6 – WING RULES
T6.3 Clear Airspace: Picture updated.

ARTICLE T7 – WHEEL RULES
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ARTICLE T8 – WHEEL SUPPORT RULES
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ARTICLE T9 – TETHER GUIDE RULES
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ARTICLE T10 – POWER PLANT PROVISIONS
No Changes

ARTICLE T11 – APPENDICES
T11.8 LERS Operating Zone Drawing removed.

ARTICLE T1 - DEFINITIONS

T1.1 Australian Competition Season

The standard sequence of Australian competitions runs across two calendar years. The State Finals held Sept/Oct/Nov in one year will feed to the National Final in February/March/April of the following year. This encompasses a complete season, for which the rules **SHOULD** remain constant. REA Foundation Ltd reserves the right to update / revise the rules if deemed appropriate.

T1.2 World Final Competition

The Australian National Final will feed into a World Final which is usually held anywhere from September through November each year depending on the country hosting this competition. For teams aspiring to represent Australia at the World Final, please be aware that the world final rules are different to the Australian rules.

T1.3 Language Used

The language of the rules is tiered. Those clauses expressed as **"MUST" or "WILL"** are mandatory and failure to comply will attract objective penalties - points and/or racing and/or in the extreme, disqualification. Those expressed as **"SHOULD"** or **"MAY"** reflect some level of discretion and choice.

Some clauses will be satisfied through team registration processes or declarations signed as complied with as part of the Challenge Terms and Conditions, whilst others will be tested through a variety of objective and subjective judging.

T1.4 Penalties

A range of penalties will be applied for non-compliance with identified regulations. These penalties include:

T1.4.1 Point Penalty: Invoked from non-compliance with technical regulations and some competition regulations governing portfolio or trade booth restrictions. These are identified as [Point Penalty].

T1.4.2 Time Penalty: Invoked from non-compliance with Technical Regulations which are identified as critical through the use of the danger symbol at left and listed in ARTICLE T2.5. These will be identified as [Time Penalty] and will be applied as 0.05 second to every run/lap for every critical regulation violated up to a maximum of 0.5 second.

T1.4.3 Ballast Penalty: 2 grams applied for every gram underweight or part thereof (rounded up) and applied to each car submitted. E.g. 2.1g underweight equals 3g x 2, totalling 6g of ballast. These will be identified as [Ballast Penalty].

T1.4.4 Eligibility: Teams need to meet certain eligibility criteria to compete at a State or National Final. Failure to comply with certain eligibility criteria **MAY** lead to disqualification from the competition, a judging element or a class of competition [Eligibility].

T1.5 Competition Classes

There are three competition classes in the Australian F1 in Schools™ competition:

T1.5.1 Cadet Class (Years 5 – 12)

A simplified project with restricted pathway to state level competitions and no pathway to the world final. **Students may only participate in this class once.** Maximum 1 – 3 team members

T1.5.1.1 Junior: Years 5 – 9 only

T1.5.1.2 Senior: Years 10 – 12

T1.5.2 Development Class (Years 5 – 9)

For first time entering students or those who have only participated in the Cadet Class previously. **Students may only participate in this class once.** This class provides a collaboration team pathway to the World Final. Maximum 3 – 5 team members.

T1.5.2.1 Junior: Years 5 – 9 only

T1.5.3 Professional Class (Years 5 – 12)

Open to all students but usually only entered by students in Years 5-9 who have competed in the Cadet or Development classes previously. The National Champion Professional Class team will represent Australia at the World Final. Maximum 3 – 5 team members.

T1.5.3.1 Junior: Years 5 – 9 only

T1.5.3.2 Senior: Years 10 – 12

T1.6 F1 in Schools™ Cars

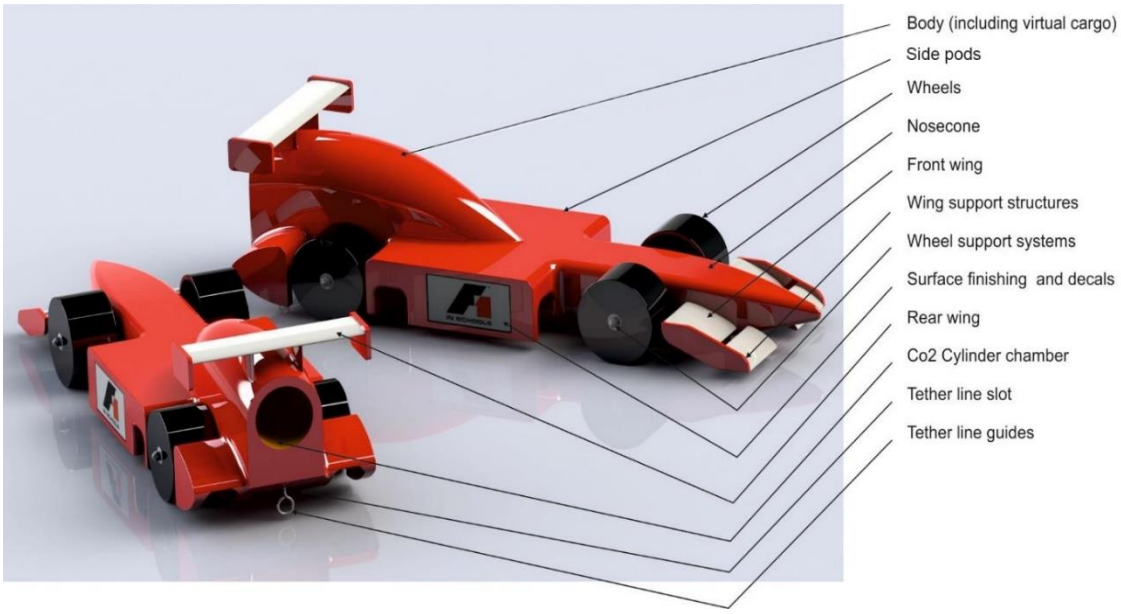
These are Car A and Car B[1], also referred to as 'the cars', and **MUST** be designed and manufactured according to these regulations for the purpose of participating in races on the F1 in Schools™ track at a State or National Final event, powered only by a single gas cylinder containing 8 grams of pressurised CO_2. 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.

Each F1 in Schools™ car assembly **MUST** only consist of the following **mandatory** components and/or features:

- A body
- Side pods
- CO_2 cylinder chamber
- Front wing
- Rear wing
- Wing support structures (optional)
- Nosecone
- Wheels
- Wheel support systems
- Tether line guide support system (Cadet Class must comply with ARTICLE T9.5.1)
- Tether line guides
- Surface finishing and decals

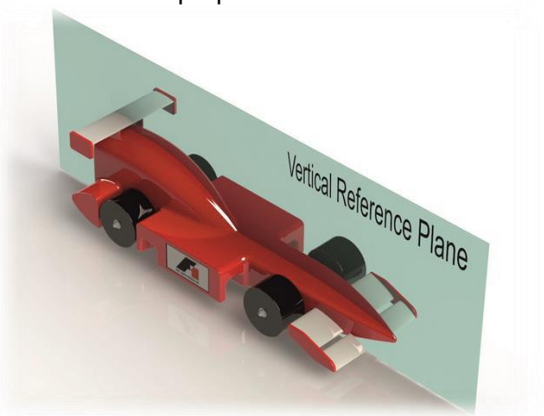
Adhesives are permissible for joining components.

Failure to have any of the listed mandatory components or features **WILL** result in all relevant penalties being applied.



T1.7 Vertical Reference Plane

To assist with describing dimensions, it is assumed that a two dimensional invisible plane exists along the length of the CO_2 cylinder chamber centre axis and perpendicular to the track surface. This is known as the vertical reference plane.



[1] Car B not applicable to the Cadet Class

T1.8 Fully Assembled Cars

Two[2] F1 in Schools™ cars, without a CO_2 cylinder inserted, presented ready for racing, resting on the track surface, free of any external force other than gravity.

T1.9 Body

The body is defined as the primary connective structure of the car. It is a **solid, uninterrupted** piece of balsa wood or model foam which begins at either the front axle centre line or at the boundary of the front wheel support, and extends rearward. For dimensional purposes the body also includes any attached decals and surface finishes. Any balsa wood or model foam forward of the front axle centre line is not defined as car body. The body can be thought of as the monocoque car chassis with which all other legal components are integrated.

T1.10 Side Pod

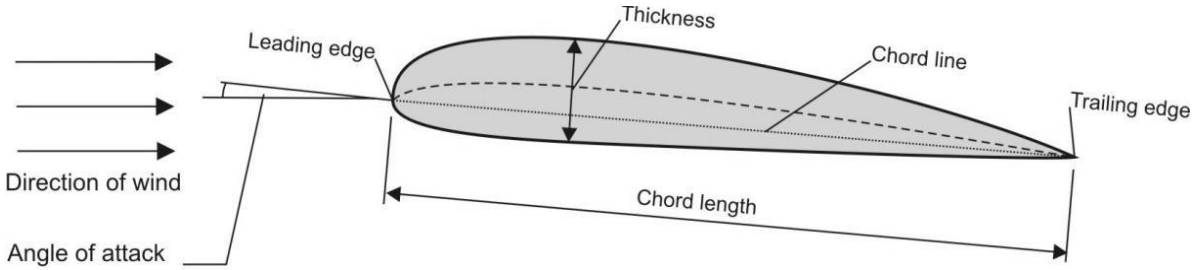
Defined as a feature of the car body between the front and rear wheels satisfying the side pod dimensional rules.

T1.11 CO_2 Cylinder Chamber

A circular cylinder of clear space bounded along its side and one end by car body only. This is where the CO_2 gas cylinder is placed for racing. Extreme violations of ARTICLE T10 rules **MAY** lead to cars being deemed ineligible to race due to safety concerns or starting pod incompatibility resulting in zero points for racing.

T1.12 Wing

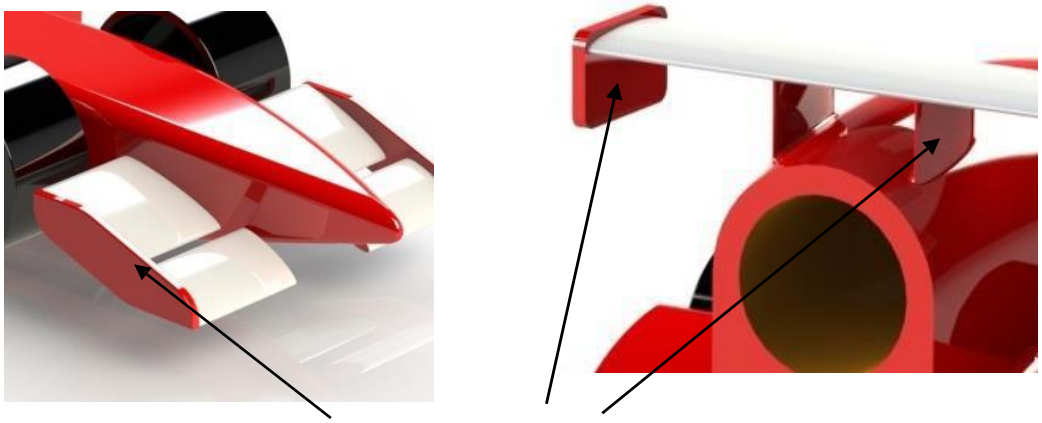
A wing on an F1 in Schools™ car is an aerodynamic feature that permits airflow around **ALL** of its cross sectional boundary. It includes features of a leading and trailing edge. A wing is dimensionally defined by the minimum dimensions of span and chord, and maximum dimensions of thickness.



Wing cross-section / wing nomenclature

T1.13 Wing Support Structure

Is a feature, other than wing, car body or nosecone that joins a wing surface to another component of the car assembly. Wing end plates will only be classified as wing support structure if they are not required to comply with minimum span dimensions, else wing end plates will be considered to be wing.



Wing Support Structure Examples

[2] One car only for the Cadet Class

T1.14 Span

Measurement of a wing span is made parallel to the track surface, on the top or bottom surface of the wing (in the 'y' direction), whichever produces the shortest dimension. Intersecting the wing with other car parts including the body, nosecone or supporting structure reduces the effective span to the sum of the clear airspace envelope segments. An undersized span will lead to deeming the existence of an undersized chord and thickness.

T1.15 Chord

A wing's chord is measured along the chord line from leading edge to trailing edge. Supporting structures are not included in the measurement. The wing chord minimum dimensions **MUST** be satisfied across the minimum dimensions that define the wing span. An undersized chord **WILL** lead to deeming the existence of an undersized thickness.

T1.16 Thickness

The thickness of a wing is measured perpendicular to the chord line. Supporting structures are not included in the measurement. The wing thickness min/max dimensions **MUST** be satisfied across the minimum dimensions that define the wing span.

T1.17 Nosecone

The nosecone is a component of the car, other than wheel, wheel support system, wing or wing support structure, that exists forward of the front axle centre line. This includes any balsa wood or model foam material that continues forward of the front axle centre line, or any other legal materials.

T1.18 Wheel

A wheel is a single part or assembly of components, cylindrical in form, with its maximum circumference contacting the track surface, enabling motion of the car through its rotation. All material existing within the volume of the extreme diameter and width is considered to be part of the wheel.

T1.19 Wheel Support System

The wheel support system is defined as the collection of components that connect the wheels to the car body. Legal components include items such as shafts, bushings, and bearings. Wheel support systems are single parts or an assembly of components that connect a wheel to any other part of the car. These may consist of a combination of manufactured or commercially available parts.

T1.20 Moving Components

Moving components are permitted on a car. A moving component is defined as any part or assembly of parts that is attached to another part of the car via either sliding, rotational or flexible joints and is not prevented from moving by some locking feature. The range of motion of a moving component is defined as the full motion between features on the car which limit the motion of the moving component. The specific force required to move a moving component shall not be considered in determining the range of motion. A car must remain legal over the entire range of motion of any moving components. During scrutineering a car will be measured with moving components positioned at the extents of their range of motion and at any other location within their range of motion required to determine the compliance with rules over the full range of possible motion. Components intended to be "rigid" but exhibiting minor flexure will not be classified as "moving components".

T1.21 Replacement Components

Replacement components **MUST** be designed to be interchanged with existing components within 30 seconds. These replacement components are optional spares that have the ability to be switched with the equivalent fitted part. Teams will be required to prove the capability of the replacement components at the point of Project Element Submission.

They are limited to:

- rear wing / support structure
- front wing / support structure and / or nosecone
- wheel / wheel support system
- tether line guides

T1.22 Tether Guide Support System

A tether guide support system is a feature, other than tether guides, car body or nosecone that joins a tether guide to another component of the car assembly. An example of this is a tether line slot which is a rectangular prism of clear space (6mm x 6mm) that is bounded by solid material on three sides of its length. This slot features on the official REA balsa wood or model foam block and this **MAY** be incorporated into the car's design as part of the tether guide support system. For security, the slot, must remain between the guides for Cadet Class teams. Refer to ARTICLE T9.5.1.

T1.23 Tether Line Guide

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.

T1.24 Surface Finish & Decals

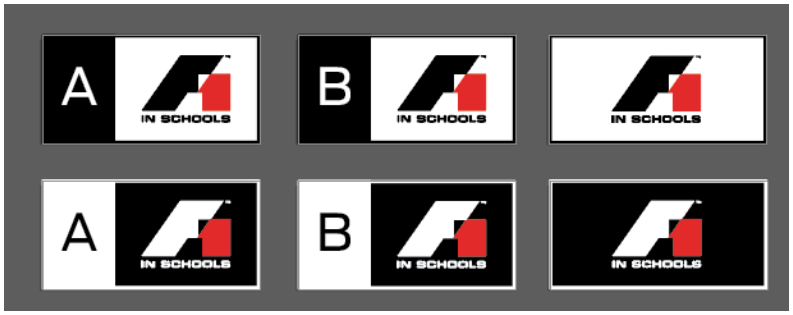
A surface finish on an F1 in Schools™ car is considered to be any applied visible surface covering, of uniform thickness over the profile of a car component. A decal is material adhered to a component or surface finish. To be defined as a decal, it must be a maximum 2mm in thickness and 100% of the area 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. Refer to the Competition Regulations for more information.

From 2017, teams **MUST** use the **REA supplied** sidepod and corporate logo car sticker decals. These car sticker decals will be provided at the point of event registration and teams will be given 15 minutes to apply them before submitting Cars A & B for Specifications Judging.

Teams are **NOT** permitted to create their own F1 in Schools™ or REA Corporate car sticker decals.

T1.24.1 F1 in Schools™ Logo Car Sticker Decals

This consists of the 'A F1 in Schools™' decal' for Car A, the 'B F1 in Schools™' decal for Car B and the non-alpha F1 in Schools decal for a team's display car. The F1 in Schools™ logo graphics are printed on either black or white with a horizontal dimension of 30mm and vertical dimension of 15mm. Teams will be provided with the black or the white background sticker decal so as to provide **maximum contrast** with the colour of the surface the sticker decal is being adhered to. Official car sticker decals are supplied by REA Foundation Ltd at event registration. Refer to the Competition Regulations for more information.



T1.24.2 REA Corporate Car Sticker Decals

This consists of the REA Foundation Ltd logo text and globe graphic, Australian Government Department of Defence logo text and coat of arms graphic, Autodesk logo and text graphic and Jetta logo and text graphic, printed on either black or white with a horizontal dimension of 30mm and vertical dimension of 15mm. Teams will be provided with either the black or the white background sticker decal so as to provide **maximum contrast** with the colour of the surface the sticker decal is being adhered to. Official car sticker decals are supplied by REA Foundation Ltd at event registration.

T1.25 Hand Finishing

Hand finishing is defined as use of a hand powered device (e.g. abrasive paper) 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'.

T1.26 REA Official Balsa Wood Block

The REA official balsa wood block is a homogenous piece of forested balsa wood, processed to the dimensional features as shown by diagrams in the appendix of this document.

T1.27 Official Denford F1® Model Block

The official Denford F1® Model Block is a rigid, closed cell foam block processed to the dimensional features as shown by diagrams in the appendix of this document. Use of the Official F1® Model Block is **optional** for teams at State and National Finals. The official F1® Model Block can be sourced directly from Re-Engineering Australia Foundation - an official Denford Ltd distributor.

For the purpose of these Regulations, the term 'model foam' will used to describe the Official F1® Model Block.

T1.28 Engineering Drawings

CAD produced drawings which should be such that, along with relevant CAM programs, could theoretically be used to manufacture the fully assembled car by a third party. Such drawings **SHOULD** include all relevant dimensions, tolerances and material information. F1 in Schools™ engineering drawings **MUST** include detail to specifically identify and prove compliance for the **virtual cargo** and **wing surfaces.**

T1.29 Launch Energy Recovery System (LERS)

Commencing from the 2017/2018 Season, it will not be permitted to attach any device, including a LERS device, to the track or starting mechanism or car, or modify the track or starting mechanism in any way for ANY race event within the Australian F1 in Schools competition including Regional Finals. Car alignment devices are permitted provided they are removed from the track and starting mechanism prior to a run.

ARTICLE T2 - GENERAL PRINCIPLES

T2.1 Regulations Documents

REA Foundation Ltd. issues the regulations, their revisions and amendments made.

Technical Regulations - This document. The Technical Regulations document is mainly concerned with those regulations that are directly related to F1 in Schools™ car design and manufacture. Technical Regulation article numbers have a 'T' prefix.

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.

T2.2 Interpretation of the Regulations

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.

Text Clarification - Any questions received that are deemed by REA Foundation Ltd. to be related to regulation text needing clarification will be answered by REA Foundation Ltd. The question received, along with the clarification provided by REA Foundation Ltd., will be published to all competing teams at the same time.

T2.3 Amendments to the Regulations

Any amendments will be announced and released by REA Foundation Ltd. by email notification to all teachers nominated in the school registration, as well as the updated revision being uploaded to the website at http://rea.org.au/f1-in-schools/. Any amended text will be indicated thus (using red underlined text).

T2.4 Safe Construction [Eligibility | 10 Pt Penalty]

All submitted cars will be inspected closely to ensure that they are engineered and constructed safely for the purpose of racing. High importance is placed on ensuring that tether line guides are robust and secure. If the Judges rule any aspect of a team's race cars to be unsafe for racing, the team will be required to make, repairs / modifications. Any such repair work **WILL** result in a penalty being applied. Teams are advised to check both the Technical and Competition Regulations for further advice.

T2.5 Compliance with Critical Regulations

Points are deducted for non-compliance with the technical regulations. Both Car A and Car B are scrutinised and points will be deducted for any infringements on either car. These penalties are only imposed once, per infringement

T2.5.1 Some of the more **critical** regulations **WILL** attract both a **4 Point Penalty** and a **0.05 second Time Penalty** as per ARTICLE T1.4. The critical regulations are:
T3.4 / T3.5 / T3.6 / T3.7 / T3.10.1 / T4.1 / T4.2 / T4.5 / T4.7 / T6.3 / T6.9 / T6.14 / T6.15 / T6.16 / T7.1 / T7.2.1 / T7.3 / T7.4 / T7.7 / T7.8 / T7.9 / T10.4 / T10.7

T2.6 Rectification of Critical Regulation Infringements

Any team whose race cars have been deemed by Scrutineers to have infringed a regulation attracting a Time Penalty, will be given an opportunity to rectify this prior to racing with the effect of removing the time penalty. The original point penalty will stand. Teams unable to rectify at this time should refer to the Competition Regulations for more information.

T2.7 Measurements

T2.7.1 No tolerance will be applied for dimensions unless otherwise stated.

T2.7.2 No tolerance will be applied when measuring mass.

T2.7.3 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.

T2.7.4 Whilst your CAD design **MAY** comply with dimensional regulations, the process of machining, finishing and assembly **WILL** individually impact on the final dimensions of the finished product submitted for scrutineering. It is the actual product that is measured in scrutineering. It is not the design intent that is judged in scrutineering.

T2.7.5 Mass measurements – all mass measurements will be made using the REA Foundation Ltd. electronic competition scales which are accurately calibrated to +/- 0.1g.

T2.7.6 Scrutineering of cars will be conducted with a charged CO_2 cylinder inserted into the chamber. The mass of the cylinder will be 29g with a tolerance of +/- 0.5g.

T2.7.7 Scrutineering of cars will be conducted by examining cars throughout all possible configurations. Refer to ARTICLE T1.20.

ARTICLE T3 - GENERAL CAR REGULATIONS

T3.1 Design, Manufacture & Construction [Eligibility | 10 Pt Penalty]

T3.1.1 All F1 in Schools™ cars **MUST** be designed and engineered using CAD (Computer Aided Design) 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.

T3.1.2 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.

T3.1.3 The race cars[3] **MUST** have identically designed components and features.

[3] Does not apply to the Cadet Class

T3.1.4 Development Class Teams have two options as follows when manufacturing their cars on a CNC machine using only a 6mm diameter cutter.

T3.1.4.1 Side Machining: 1 x mirrored NC code, executed twice; OR

T3.1.4.2 Top/Bottom Machining: 2 x NC codes executed once each.

T3.1.5 Cadet Class Teams **MUST** manufacture their car on a CNC machine using only a side machining process with 1 x mirrored NC code and a 6mm diameter cutter.

T3.1.6 Development Class and Cadet Class Teams **MAY** machine axle and/or axle grommet holes by an additional hand or CNC process.

T3.1.7 For Cadet Class Teams, no balsa wood or model foam parts are to be separately formed and glued to the main body.

T3.1.8 Cadet Class Teams **MUST** use balsa or model foam as the default material for all non-rotating components of the car including the body, side pods and wings. No other materials are permitted.

T3.2 Leading Features Minimum Width [Eligibility | 4 Pt Penalty]

The minimum width of any pointed feature of the car assembly **MAY** vary over the first 6mm of its length from its forward most extremity. Teams are advised to check ARTICLE T2.4 for further advice.

T3.2.1 Minimum width at forward most extremity: 3mm or R1.5mm

T3.2.2 Minimum width at 6mm back from forward most extremity: 6mm

T3.3 Finishing & Assembly

T3.3.1 Post Machining Processes [Advice]

All cars are expected to be finished to a high standard and **MUST** reflect the features of the documented CAD design. Features of the machined car other than machining scallops **SHOULD NOT** be removed.

T3.3.2 Signed Declaration [10pt Penalty]

All team cars **MUST** be assembled, painted and finished by team members only. Documented supporting evidence must be submitted with signed declaration. See also C2.4.1.5 in the Australian Competition Regulations

T3.3.3 Hand Finishing [10pt Penalty]

Hand finishing of the car assembly is permitted. Refer ARTICLE T1.25. Maximum variation to CAD model - including Critical Regulation Rectification processes - is 3mm.

T3.3.4 Hand Created Features [10pt Penalty]

No feature of the car body, side pods and wings is to be created solely by a hand process.

T3.4 Car Decals

T3.4.1 Entry Number Sticker [Advice]

When teams submit Car A and B at event registration, a small, round, numbered and colour coded sticker will be applied to the underside of each car. This number will be unique for each team and colour coded for each class of the competition. Teams are **NOT** permitted to design and apply their own entry number stickers.

T3.4.2 REA Foundation Ltd. Corporate Logos [2pt Penalty each]

These sticker decals **MUST** be displayed on all cars at State and National Finals and will be supplied by REA at event check-in. Refer to T1.24 for more information. Each decal infringement attracts a 2pt penalty.

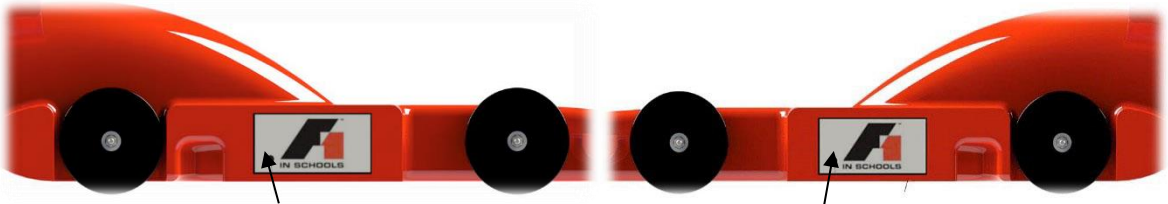
T3.4.3 Minimum Dimensions & Positioning

T3.4.3.1 Minimum Dimensions [2pt Penalty each]

The REA Foundation Ltd., Department of Defence, Autodesk, Jetta Express and F1 in Schools™ sticker decals **MUST** maintain minimum dimensions of 30mm long and 15mm wide. Any trimming of decals will result in a 2pt penalty for each infringement.

T3.4.3.2 Positioning of F1 in Schools Sticker Decals [2pt Penalty each]

The 'A' F1 in Schools™ decals are to be applied to Car A's sidepods and the 'B' F1 in Schools™' decals are to be applied to Car B's sidepods. Refer to ARTICLE T1.24. Each decal infringement attracts a 2pt penalty. Picture following example only.



Display Car SAMPLE: F1 in Schools™ Logo Sticker Decal

T3.4.3.3 Positioning of Other Corporate Sticker Decals **[2pt Penalty each]**

All remaining REA supplied corporate sticker decals **MUST** be clearly visible in the top or side view of the car.

T3.4.4 Regional Sponsors **[Advice]**

If your region is supported by a sponsor, corresponding sponsor recognition **MUST** be included in displays, portfolio and on the car.

T3.5 Undefined Features **[0.05 Time Penalty | 4pt Penalty]**

The car assembly **MUST** only consist of components listed in ARTICLE T1.6.

T3.6 Centre of Gravity **[0.05 Time Penalty | 4pt Penalty]**

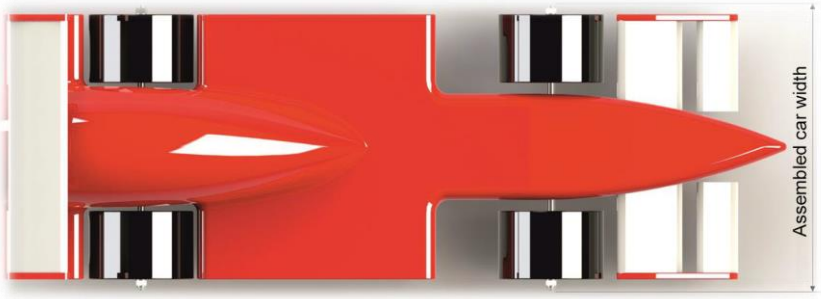
The centre of gravity **MUST** remain between the axles with the canister inserted.

T3.7 Overall Length **[0.05 Time Penalty | 4pt Penalty]**

The overall length of the complete car measured between the front and rear extremes of the car product, including all components with the exception of the CO_2 cylinder, **MUST** be a minimum of 170mm and a maximum of 210mm.

T3.8 Overall Width **[0.05 Time Penalty | 4pt Penalty]**

The overall width of the complete car product including all components **MUST** be a minimum of 60mm.



T3.9 Minimum Mass **[Ballast Penalty | 4pt Penalty]**

The minimum mass of the complete car product, without the CO_2 cylinder fitted **MUST** be:

T3.9.1 Cadet Class: 55 grams

T3.9.2 Development Class: 52 grams

T3.9.3 Professional Class: 52 grams

T3.10 Track Clearance [4pt Penalty]

The track clearance measured normal from the track surface to the lowest point of the car product (excluding the wheel volumes) **MUST** be a minimum of 2mm including the tether line guides. Cars with unsafe arrangements will be ineligible to race if unresolved.

T3.11 Balsa Wood & Model Foam Components

All balsa wood and model foam components for a completed car **MUST** be made from an REA supplied single standard balsa wood or model foam block as defined in these rules.

T3.11.1 Default Material

T3.11.1.1 Cadet Class **[0.05 Time Penalty | 4pt Penalty]**

Balsa wood or model foam is the default material for all non-rotating components of the car including the body and side pods. Other materials can only be used as explicitly specified.

T3.11.1.2 Development & Professional Classes **[0.05 Time Penalty | 4pt Penalty]**

Balsa wood or model foam is the default material for all non-rotating components of the car including the body and side pods. Other materials can only be used as explicitly specified.

T3.11.2 Thickness **[1pt Penalty]**

Balsa wood and model foam components **MUST** be a minimum of 3mm thick.

T3.12 Status During Racing [2pt Penalty]

The car assembly **MUST** be designed so that no items other than those listed in ARTICLE T3.13, or CO_2 cylinders are removed, replaced or added to the assembly during scheduled race events.

T3.13 Replacement Components [Eligibility]

Any spare / replacement components **MUST** be identical to those fitted to the car and **MUST** be submitted with the car. Only the following spare / replacement components are permitted:

- rear wing / support structure – maximum of one (1) (Professional Class only)
- front wing / support structure and / or nose cone – maximum of one (1)
- wheel / wheel support system – maximum of two (2) wheels and components
- tether line guides – maximum of one (1) car set (2 front and 2 rear if different)

Replacement components must be identical in design and finish, and weigh no less than the race/back up car's original component, whichever is heaviest.

Submitted replacement components that are determined by the judges to not be identical to that which is fitted to the car will not be allowed to be used.

ARTICLE T4 - BODY & SIDE POD REGULATIONS

T4.1 Body Construction [0.05 Time Penalty | 4pt Penalty]

A **single, continuous** piece of CNC manufactured balsa wood OR model foam material, deemed the body, **MUST** exist rear of the front axle centre line. The body begins at either the front axle centre line or at the boundary of the front wheel support and extends rearward. The body, encompasses the side pods, virtual cargo and CO_2 cylinder chamber.

T4.2 Implants, Foreign Objects or Voids [0.05 Time Penalty | 4pt Penalty]

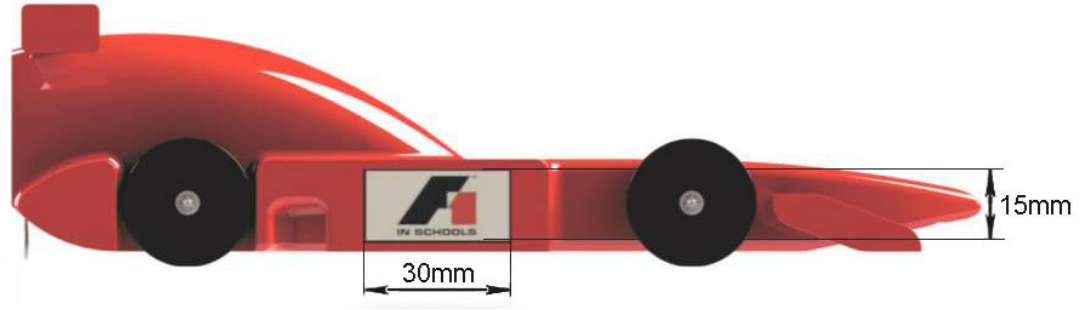
Implants, foreign objects or voids in or on the car body and side pods **MUST NOT** be incorporated

T4.3 Width of Side Pod [1pt Penalty]

The overall width of the side pods measured transversely between the side-pod extremities **MUST** be a minimum of 50mm. Any part having a width less than 50mm is not considered a side pod.

T4.4 Side Pod Projected Surface [1pt Penalty]

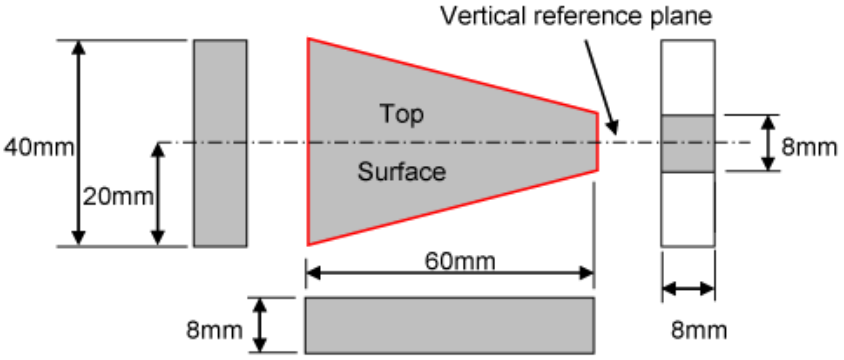
Each side pod **MUST** present a complete rectangular projected surface when viewed from the side measuring not less than 30mm wide x 15mm high.



T4.5 Virtual Cargo [0.05 Time Penalty | 4pt Penalty]

A virtual cargo **MUST** be completely encompassed by the body and be wholly positioned between the front and rear wheel centre lines. The virtual cargo **MUST** have minimum dimensions as shown below, with its top surface split symmetrical by the vertical reference plane of the car body. The virtual cargo **MUST NOT** be intersected by the FRONT wheel support system but **MAY** share common faces with the car body

.

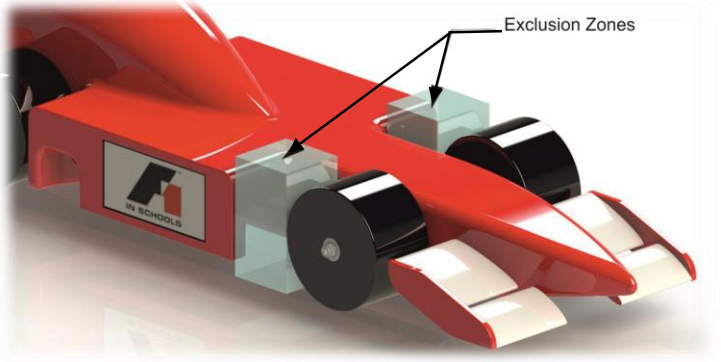


T4.6 Virtual Cargo Identification [1pt Penalty]

The virtual cargo location and compliance **MUST** be clearly identified within the engineering drawings submitted for scrutineering judging

T4.7 Exclusion Zones [0.05 Time Penalty | 4pt Penalty]

When viewed from the top, car body **MUST NOT** exist within a volume 15mm immediately rear of either front wheel. The volume width is equal to the wheel width, and height from track surface is equal to the wheel diameter. This is measured in the top view, parallel to the vertical reference plane and track surface.



ARTICLE T5 - NOSECONE REGULATIONS

T5.1 Construction Material [Eligibility | 10pt Penalty]

Professional Class and Development Class teams **MAY** manufacture the nosecone or parts thereof from separate, non-metallic materials.

T5.2 Positioning [1pt Penalty]

Alternative non-metallic materials forming the nosecone **MUST NOT** be present behind the centre line of the front axle.

ARTICLE T6 - WING REGULATIONS

T6.1 Visibility of Top Surfaces [1pt Penalty]

Both wing top surfaces **MUST** be 100% visible from the car top view.

T6.2 Wing Identification [1pt Penalty]

The surfaces defining both the front and rear wings **MUST** be identified clearly within the engineering drawings submitted for scrutineering judging.

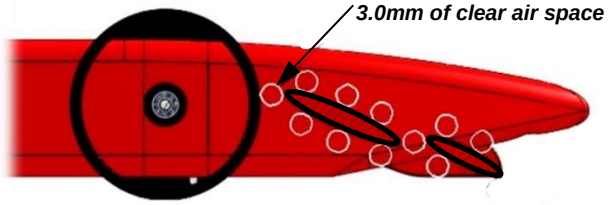
T6.3 Clear Airspace

T6.3.1 Front Wing [0.05 Time Penalty | 4pt Penalty]

For a front wing to be deemed to exist, the wing surface **MUST** have a minimum of 3mm of clear 'air' space, to any other part of the car and track surface, measured normal from any part of the wing's surface.

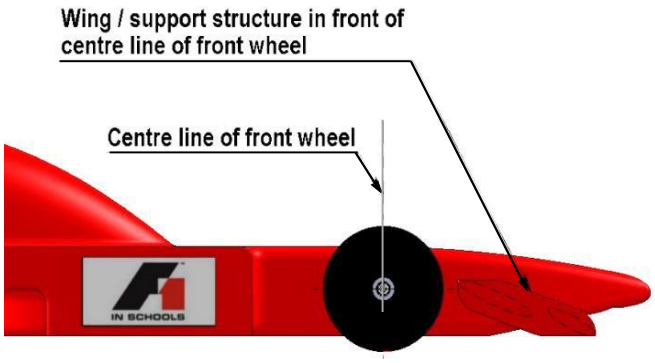
T6.3.2 Rear Wing [0.05 Time Penalty | 4pt Penalty]

For a rear wing to be deemed to exist, the wing surface **MUST** have a minimum of 3mm of clear 'air' space, to any other part of the car and track surface, measured normal from any part of the wing's surface.



T6.4 Front Wing Positioning [1pt Penalty]

The whole of the front wing and support structure when viewed from the side **MUST** be in front of the centre line of the front axle.

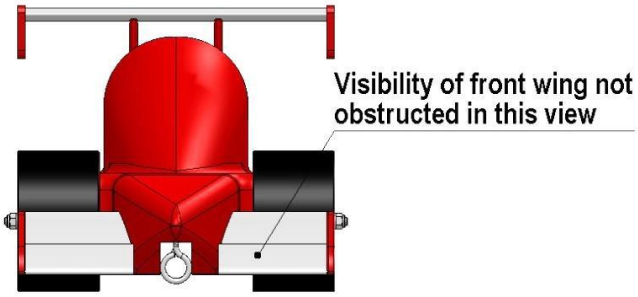


T6.5 Construction & Rigidity [2pt Penalty]

The wing span dimension **MUST** remain unchanged during races, i.e. wings must be rigid – ruled at the judge's discretion.

T6.6 Visibility [1pt Penalty]

Visibility of the front wing **MUST NOT** be obstructed by any other component when viewed in the front elevation.



FRONT ELEVATION

T6.7 Front Wing Construction Material [Eligibility | 10pt Penalty]

Professional Class and Development Class Teams **MAY** manufacture the front wing and any supporting structure connecting it to the nosecone from separate, non-metallic materials.

T6.8 Connection with Nosecone [1pt Penalty]

The front wing or its support structure **MUST** be connected only to the nosecone.

T6.9 Front & Rear Wing span

Where the wing span is intersected by another part of the car, the total span is the sum of each segment. The wing span is measured on the top or bottom surface of the wing, whichever is shortest, parallel to track surface and normal to the vertical reference plane.

T6.9.1 Front wing span [0.05 Time Penalty | 4pt Penalty]

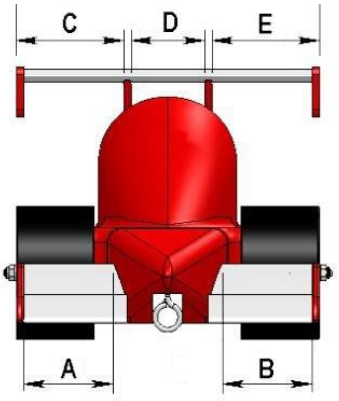
- **T6.9.1.1** Made from balsa wood or model foam: Min. 34mm
- **T6.9.1.2** Made from alternative material: Min. 40mm

T6.9.2 Rear wing span [0.05 Time Penalty | 4pt Penalty]

- **T6.9.2.1** Made from balsa wood or model foam: Min. 34mm
- **T6.9.2.2** Made from alternative material: Min. 40mm

T6.10 Span Segments [Advice]

The span of a wing can be intersected by the car body, nosecone or wing support structure to form span segments. All span segments **MUST** conform to the wing chord and thickness regulations. If intersected, at least two (2) of the front wing segments and two (2) of the rear wing segments must be no less than the minimum size in span.
Minimum segment span: 17mm



Wing and Span Calculations Explained

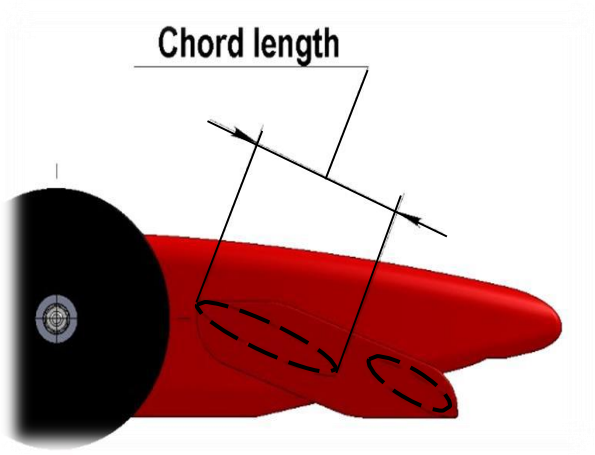
To be included in the judge's wing span calculation, a wing segment **MUST** be at least 17mm in span. If ANY of the segments A, B, C, D & E were less than 17mm, they would not qualify as wing segments, but would instead be treated as wing support structures.

T6.11 Front & Rear Wing Chord

The wing chord requirements **MUST** be satisfied throughout the wing's minimum span. The chord is the distance between the leading edge and trailing edge measured parallel to the vertical reference plane.

T6.11.1 Front wing chord - Min: 15mm **[2pt Penalty]**

T6.11.2 Rear wing chord - Min: 15mm **[2pt Penalty]**



T6.12 Front & Rear Wing Thickness

The wing thickness requirements **MUST** be satisfied throughout the wing's minimum span, measured perpendicular to the chord line.

T6.12.1 Front wing thickness **[2pt Penalty]**

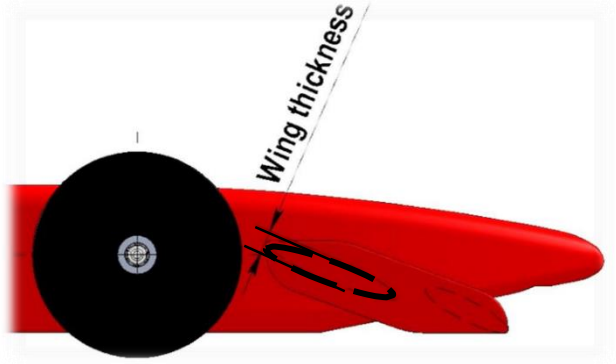
T6.12.1.1 Made from balsa wood or model foam: Min: 3.5mm / Max: 9mm

T6.12.1.2 Made from alternative material: Min: 1.5mm / Max: 9mm

T6.12.2 Rear wing thickness **[2pt Penalty]**

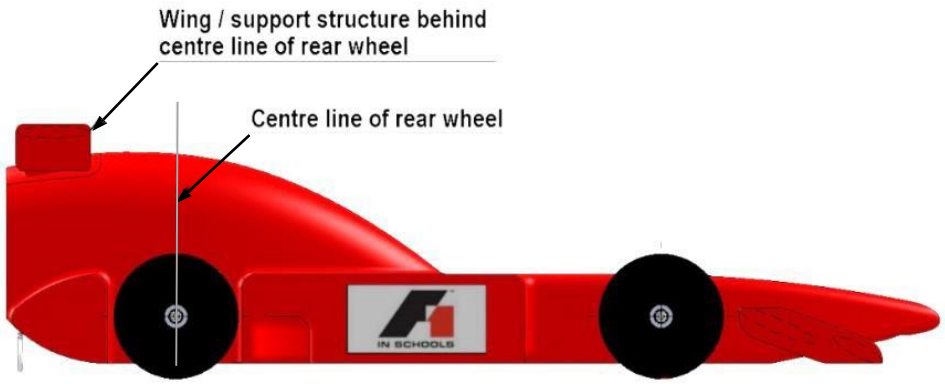
T6.12.2.1 Made from balsa wood or model foam: Min: 3.5mm / Max: 9mm

T6.12.2.2 Made from alternative material: Min: 1.5mm / Max: 9mm



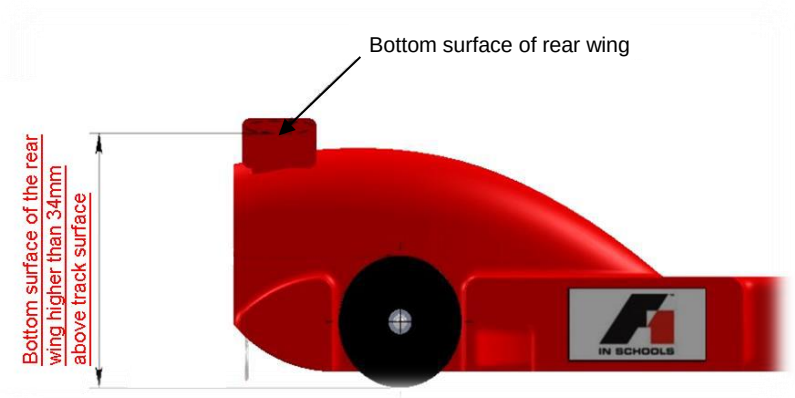
T6.13 Rear Wing Positioning **[1pt Penalty]**

The whole of the rear wing when viewed from the side **MUST** be behind the centre line of the rear axle.



T6.14 Rear Wing Height [0.05 Time Penalty | 4pt Penalty]

The bottom surface of the rear wing **MUST** be higher than 34mm when measured from and normal to the track surface.



T6.15 Rear Wing Construction Material [0.05 Time Penalty | 4pt Penalty]

Development Class teams **MUST** manufacture the rear wing and any supporting structure from balsa wood or model foam.

T6.16 Rear Wing Support Structure [0.05 Time Penalty | 4pt Penalty]

If Professional Class teams manufacture the rear wing and any supporting structure from separate, non-metallic materials, these materials **MUST** be completely contained behind the rear axle centre line.

ARTICLE T7 - WHEEL REGULATIONS

T7.1 Number and location [0.05 Time Penalty | 4pt Penalty]

The car assembly **MUST** include 4 cylindrical wheels, two at the front and two at the rear. The two front wheels **MUST** share a common centerline. The two back wheels **MUST** share a common centerline.

T7.2 REA Standard Wheels

T7.2.1 Cadet & Development Class Teams [0.05 Time Penalty | 4pt Penalty]

Development and Cadet Class Teams **MUST** use any combination of four (4) unmodified REA standard wheels. No other parts can be added to the wheels. Removal of the sprue remnant is acceptable.

T7.2.2 Professional Class Teams [Advice]

Professional Class Teams **MAY** use any combination of four (4) unmodified REA standard wheels or manufacture their own. The wheel material used is unrestricted. (NOTE: Modified REA Standard Wheels are classified team manufactured.)

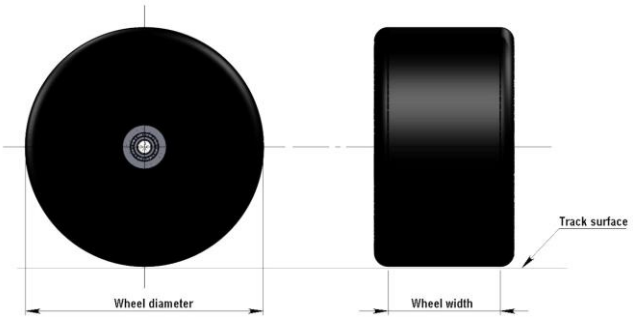
T7.3 Diameter

T7.3.1 Front Wheel [0.05 Time Penalty | 4pt Penalty]

The front wheel diameter for “team manufactured wheels” as measured to the extreme outer edges of each wheel **MUST** be a minimum of 26mm.

T7.3.2 Rear Wheel [0.05 Time Penalty | 4pt Penalty]

The rear wheel diameter for “team manufactured wheels” as measured to the extreme outer edges of each wheel **MUST** be a minimum of 26mm.



T7.4 Track Contact Width

T7.4.1 Front Wheel [0.05 Time Penalty | 4pt Penalty]

The front wheel track contact width for "team manufactured wheels" as measured between the extreme outer edges along the contiguous contact line of each wheel **MUST** be a minimum of 15mm.

T7.4.2 Rear Wheel [0.05 Time Penalty | 4pt Penalty]

The rear wheel track contact width for "team manufactured wheels" as measured between the extreme outer edges along the contiguous contact line of each wheel **MUST** be a minimum of 15mm.

T7.5 Full Contact Width [2pt Penalty]

With a CO_2 cylinder loaded, all 4 wheels **MUST** touch the racing surface at the same time across the full contact width of the wheel (zero tolerance). That is, there **MUST** be no "camber". (Tested using the thickness of a strip of 80gsm paper on a flat surface.).

[2pt Penalty]

T7.6 No Tyre Tread

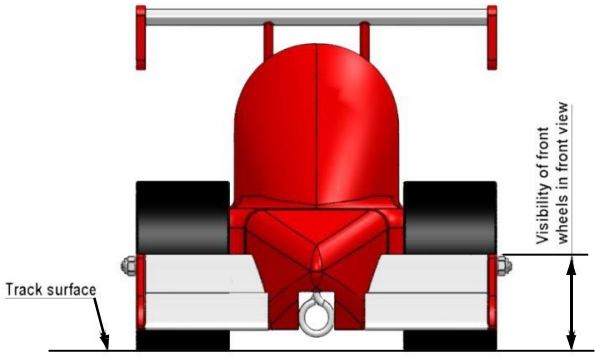
Wheel dimensions **MUST** be consistent in diameter and circumference across the contact width of the wheel (i.e., "tyre tread" is not allowed)

T7.7 Freely Rotating Wheels [0.05 Time Penalty | 4pt Penalty]

The track contact surface of all four wheels **MUST** rotate freely about their own centre axis to facilitate motion of the car during racing. A car must be able to roll unassisted from a standing start down a straight ramp surface angled at 10 degrees from the horizontal for a minimum distance of 500 mm. Sliding or skidding motion of any wheel is not permitted and ALL wheels must freely rotate for the full distance.

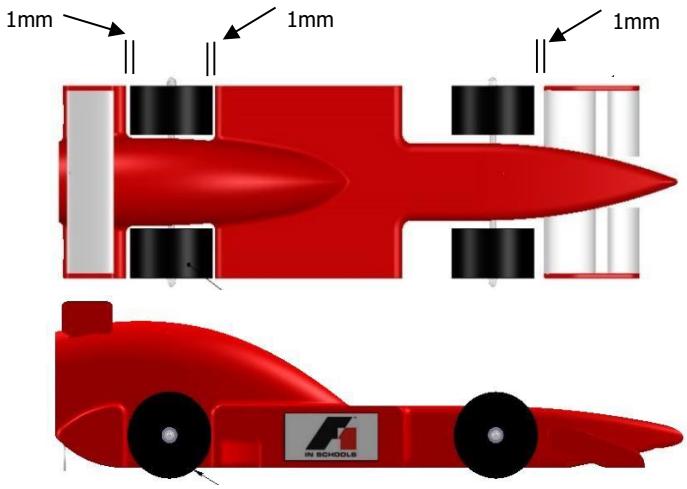
T7.8 Visibility in Front View [0.05 Time Penalty | 4pt Penalty]

Visibility of the front wheels in the car's front view **MUST** only be obstructed to a height of 15mm from the track surface.



T7.9 Visibility from Top, Bottom & Side [0.05 Time Penalty | 4pt Penalty]

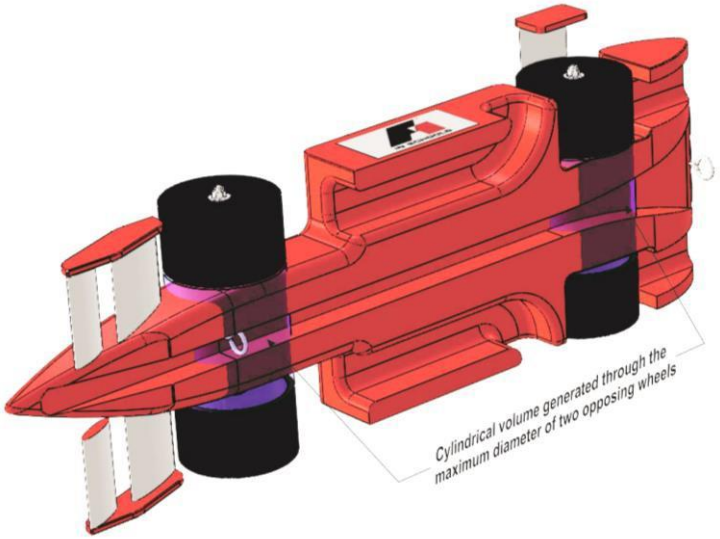
The view of the wheels **MUST NOT** be obscured in any way, by any component of the car, in the car's top, bottom and side elevation views. A minimum of a 1mm vertical exclusion zone **MUST** be present in front of each wheel and behind each rear wheel and in the top view, the track surface **MUST** be visible immediately in front and behind the wheel width.



ARTICLE T8 - WHEEL SUPPORT REGULATIONS

T8.1 Projected Cylinder Volume [2pt Penalty]

The wheel support system **MUST** be fully contained within the volume of the cylinder formed by the projection of the wheel circumference (from the side view).



T8.2 Integration with Wing Support Systems [2pt Penalty]

Wheel support systems **MUST** not be integrated with wing support systems.

T8.3 REA Standard Grommets [2pt Penalty]

Development and Cadet Class Teams **MUST** use four (4) unmodified REA axle grommets.

T8.4 REA Standard Axles

T8.4.1 Development Class Teams [2pt Penalty]

Development Class Teams **MUST** use two (2) REA standard axles (3.175mm) **OR** axles from a different material with a minimum 3mm diameter.

T8.4.2 Cadet Class Teams [2pt Penalty]

Cadet Class Teams **MUST** use two (2) standard brass axles (3.175mm) supplied by REA. No other axle material can be used.

T8.5 Modifications

T8.5.1 Development and Cadet Class Teams [2pt Penalty]

Development and Cadet Class Teams **MUST NOT** use any other parts or make any other modifications to the wheel support system.

T8.5.2 Professional Class Teams [Advice]

Professional Class teams **MAY** manufacture their own wheel support system and the wheel support system materials are unrestricted.

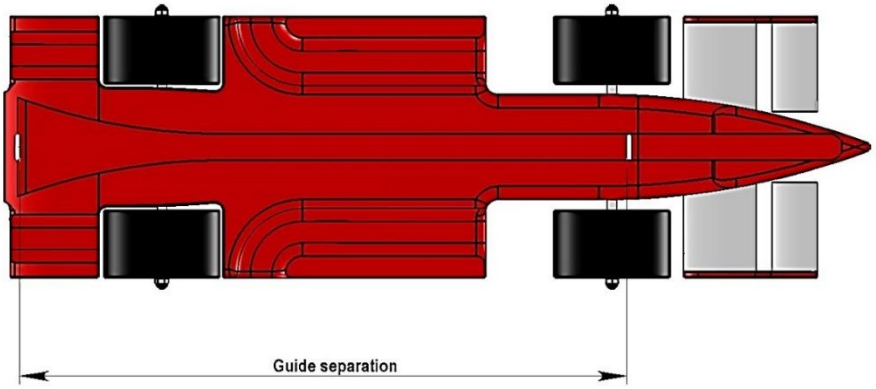
ARTICLE T9 - TETHER LINE GUIDE REGULATIONS

T9.1 Location [1 Pt Penalty]

Each car **MUST** have 2 (essentially circular) tether line guides firmly secured toward the front and rear of the car, located on the underside along the car body centre line. The track tether line passes through these two tether line guides. An adhesive **MAY** be used to help secure the tether line guides.

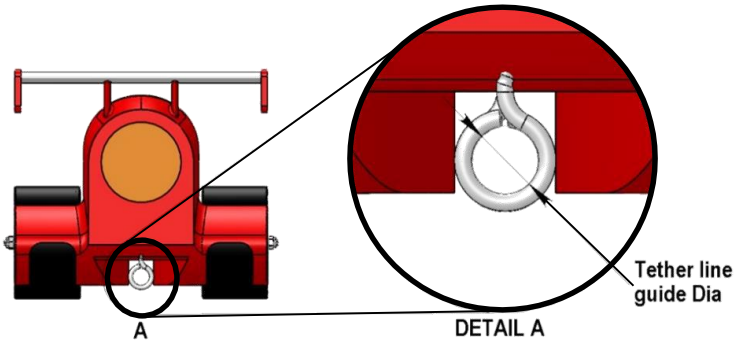
T9.2 Separation [1 Pt Penalty]

The longitudinal separation of the tether line guides as measured between the outside edges of the guides **MUST** be a minimum of 120mm.



T9.3 Inside Diameter [2 Pt Penalty]

The inside diameter of the tether line guide (referring to the size of the hole) **MUST** be a minimum of 3mm



T9.4 Safety

T9.4.1 Closed Guides [Eligibility | 4 Pt Penalty]

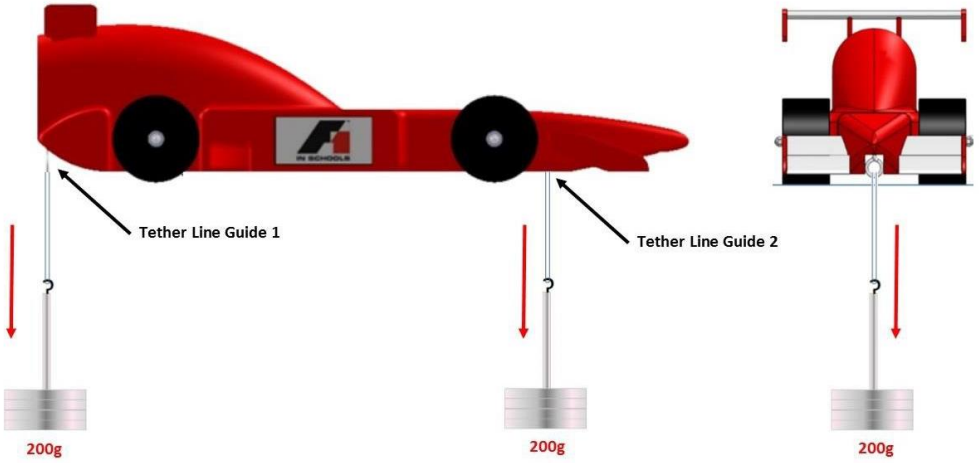
The tether line guides **MUST** be closed to prevent the tether line from coming out of the tether line guide. This is considered a safety issue. Cars **WILL** be ineligible to race if unresolved.

T9.4.2 Sharp Edges [Eligibility | 4 Pt Penalty]

Tether guide arrangements with sharp edges **WILL** be prevented from racing.

T9.4.3 Strength & Fixing [Eligibility | 4 Pt Penalty]

Adequate strength and fixing of the tether line guides **MUST** be considered a safety issue and cars with unsafe arrangements will be ineligible to race if unresolved. The guides must be robust so as to prevent the diameter or shape changing during racing. A tether line guide test will be conducted during scrutineering using a 200g mass (2.0N max) to check the guides are securely fitted to the car and safe to race.



T9.5 Cadet Class Restrictions

T9.5.1 REA Standard Tether Line Guides **[1 Pt Penalty]**

Cadet Class Teams **MUST** use the REA supplied Tether Line Guides.

T9.5.2 Positioning of REA Standard Tether Line Guides **[1 Pt Penalty]**

Cadet Class Teams **MUST** place Tether Line Guides within the 6mm x 6mm tether slot feature on the standard balsa or model foam block.

ARTICLE T10 - POWER PLANT PROVISIONS

T10.1 Interfacing with Launch Pod **[Eligibility | 20 Pt Penalty]**

The cylinders provide the car propulsion and all cars **MUST** interface directly with the standard track starting pod mechanism without the use of additional launch equipment.

T10.2 Diameter **[1 Pt Penalty]**

The CO_2 cylinder chamber diameter **MUST** be 19mm (+/- 0.5mm)

T10.3 Depth **[1 Pt Penalty]**

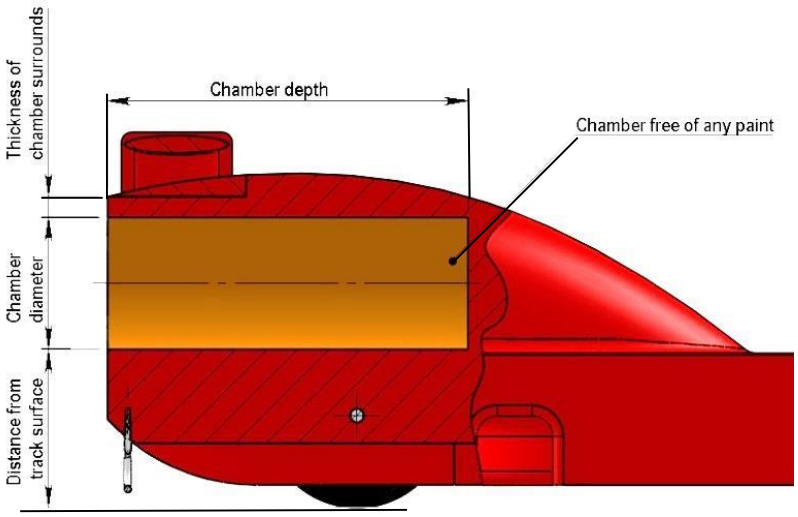
Depth of chamber measured parallel to the vertical reference plane anywhere around the chamber circumference from opening to chamber end **MUST** be a minimum 50mm and maximum 60mm.

T10.4 Distance from Track Surface **[0.05 Time Penalty | 4pt Penalty]**

The vertical height of the lowest point of the CO_2 cylinder chamber above the race track surface **MUST** be a minimum of 22mm for the Cadet Class and 20mm for Development and Professional Classes.

T10.5 Chamber Wall Thickness **[Eligibility | 4 Pt Penalty]**

The CO_2 cylinder chamber **MUST** be completely surrounded by balsa or model foam car body only. The chamber surrounds and connection to the car body will be accessed and if determined below the minimum thickness, may be considered a safety issue at the judge's discretion. Minimum thickness is measured through any line of the chamber radius. **IMPORTANT:** The entire circumference and length of the cylinder chamber must not be punctured by any object. Min: 3mm



T10.6 Finishing of Chamber Surrounds [1 Pt Penalty]

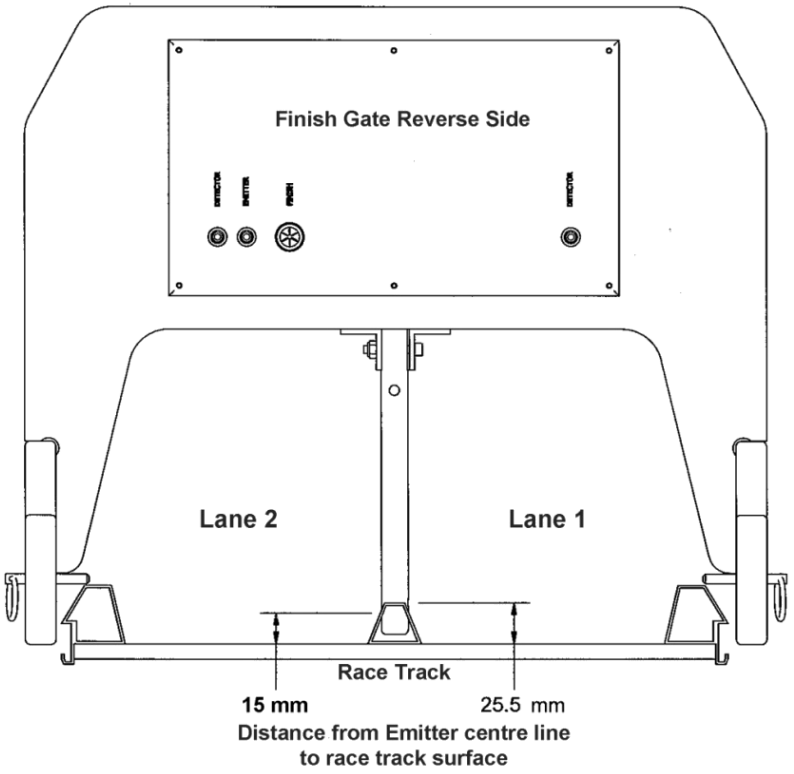
Paint and other foreign materials **MUST NOT** be present inside the CO_2 cylinder chamber. This is considered a measure of manufacturing quality control.

T10.7 Interaction with Cylinder [0.05 Time Penalty | 4pt Penalty]

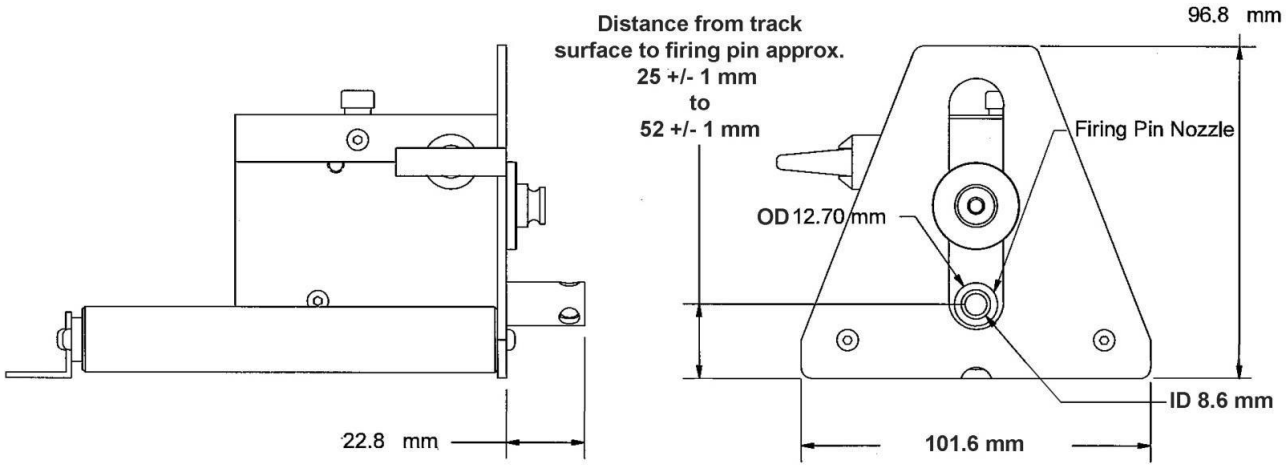
The cylinder **MUST** be able to be inserted and withdrawn without removal and replacement of car parts.

ARTICLE T11 - APPENDICES

T11.1 Finish Gate and Race Track Section View from Rear

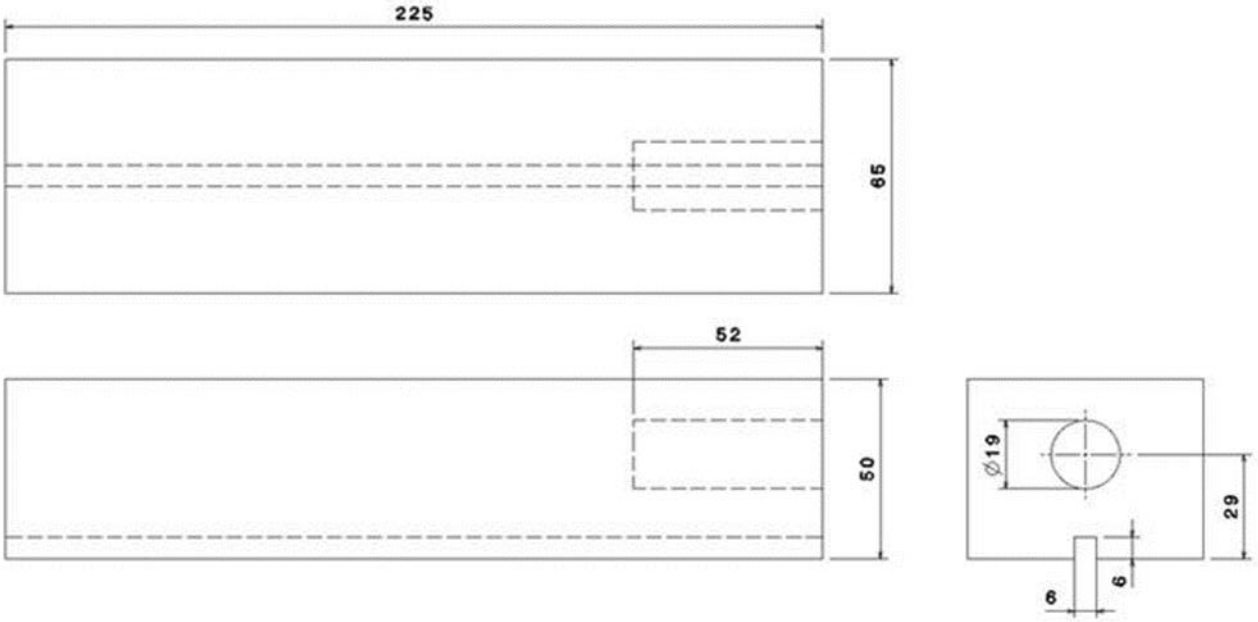


T11.2 Launch Pod Side and Front Views

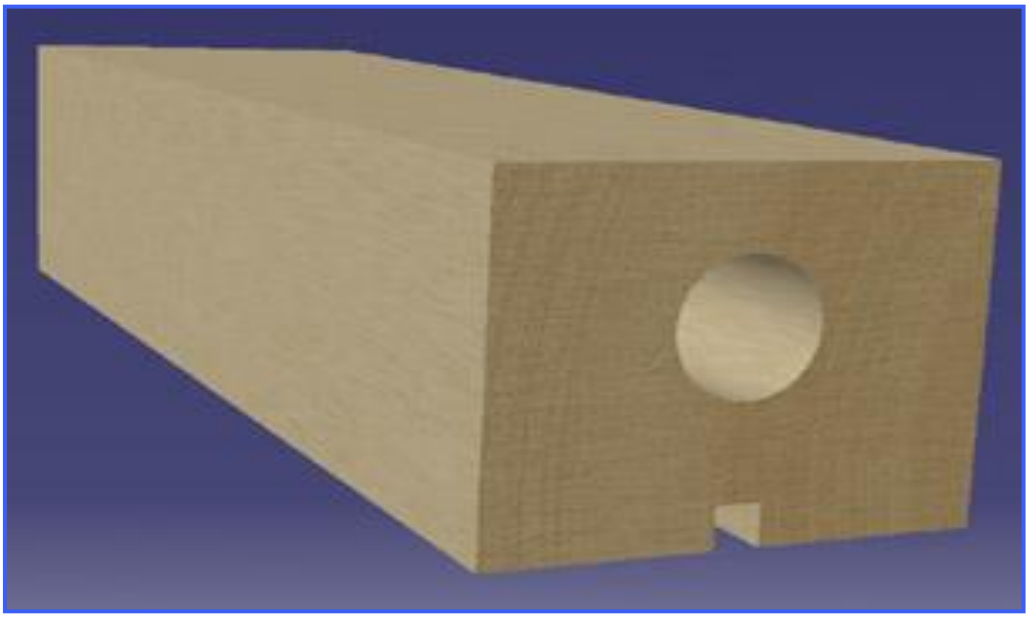


T11.3 Official REA Balsa Block Dimensions

Below: Orthographic projection of REA Standard Balsa Wood Block. All dimensions shown in millimetres. Not drawn to scale.

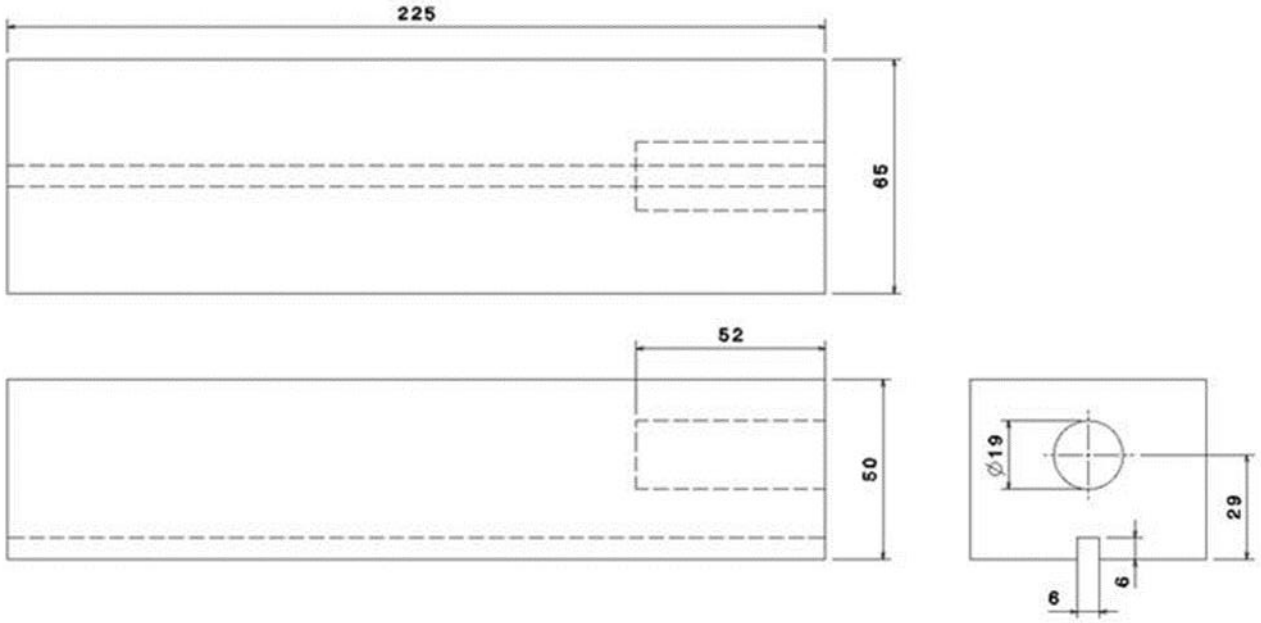


rick 23/02/2004	R-Type Balsa Blank (65x50x225 version)	
XXX XXX		
A3	REA	
1:1	98.5	R-Type Blank 1/1



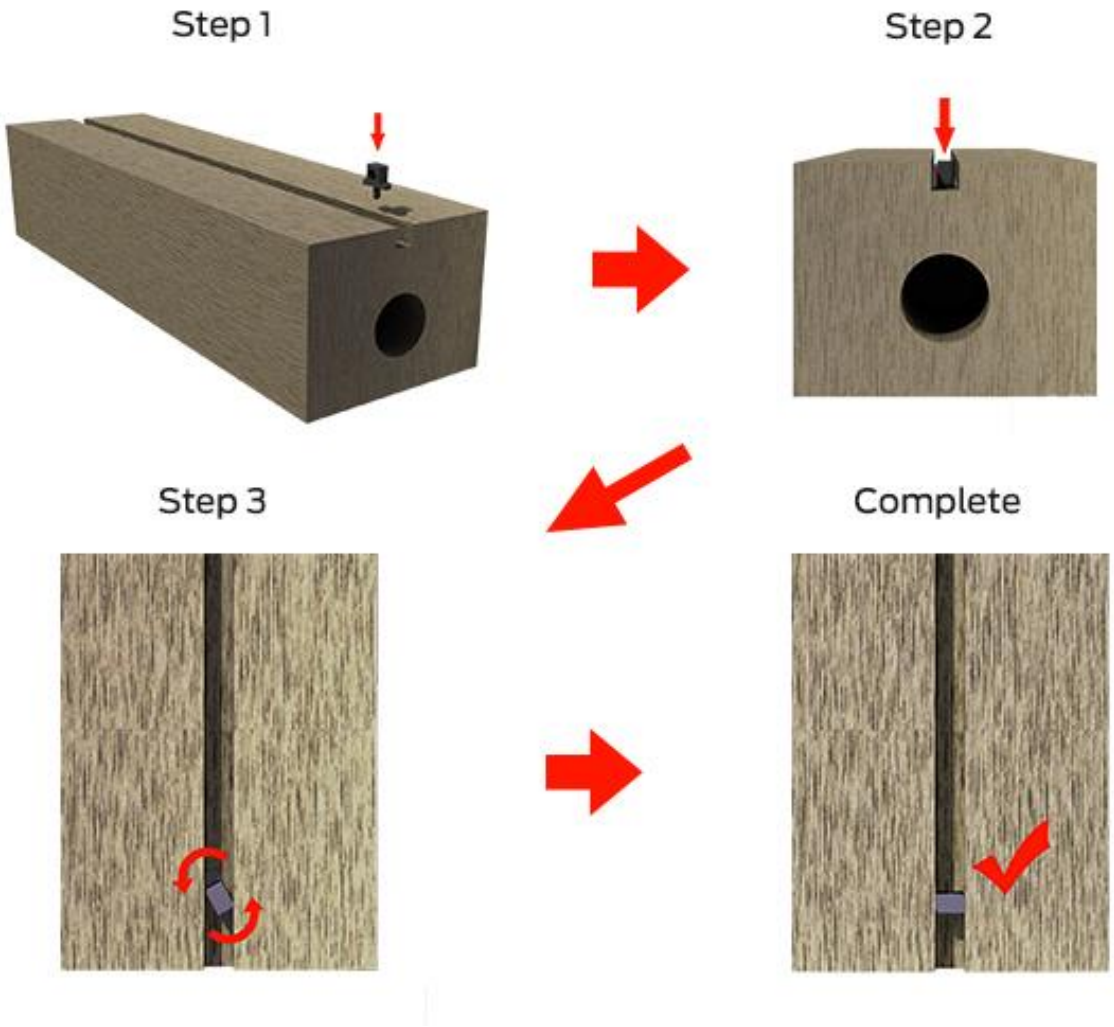
T11.4 Official F1® Model Foam Block Dimensions

Below: Orthographic projection of F1® Model Foam Block. All dimensions shown in millimetres. Not drawn to scale.

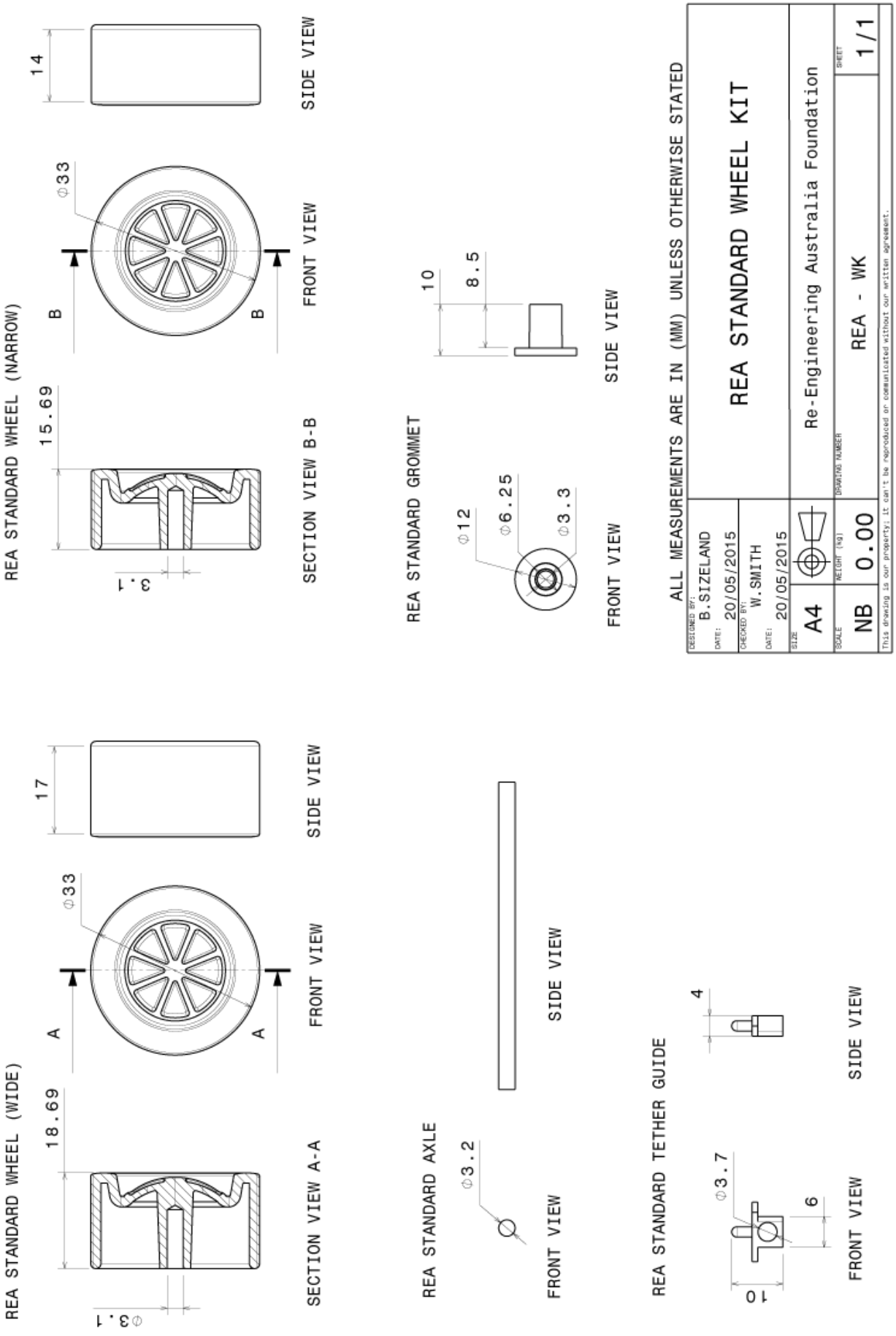


T11.5 REA Standard Tether Guide Insertion Instructions

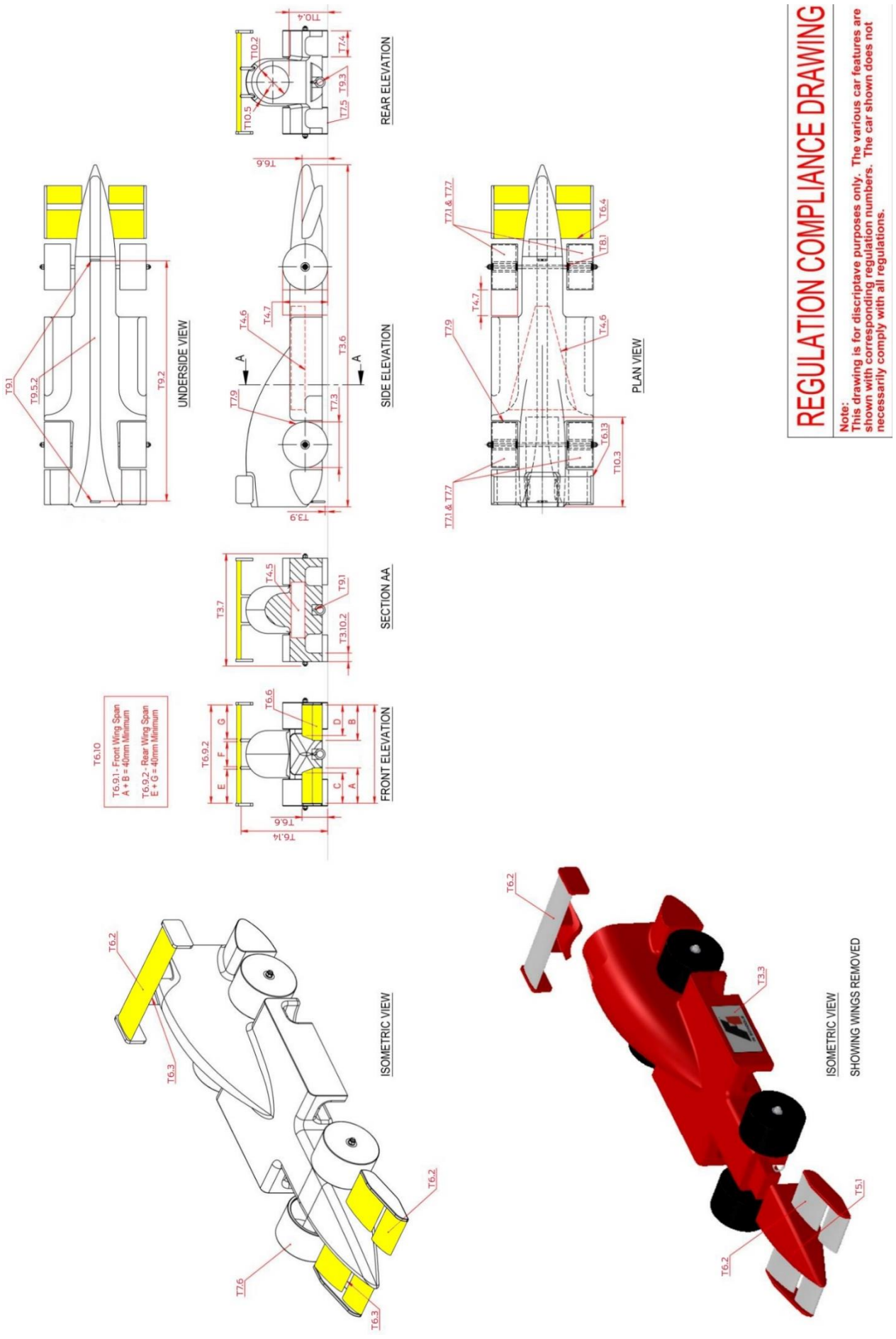
Can be used in balsa wood or model foam blocks.



T11.6 Official REA Standard Wheel Kit



T11.7 Example Orthogonal Drawing



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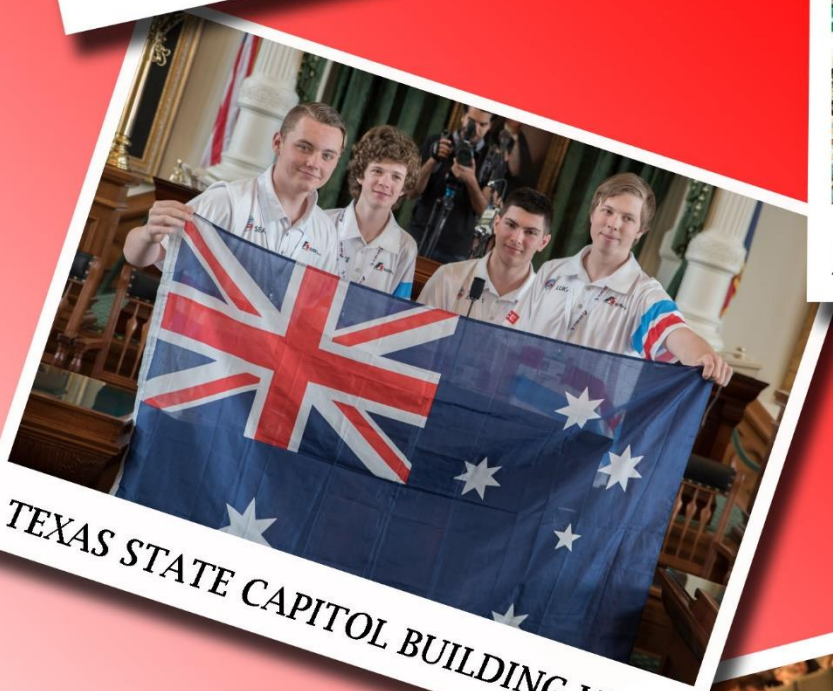

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