STEM RACING™ AUSTRALIA

Propulsion

Charles Campbell College, SA

2023 F1® in Schools World Finals

- 2nd Place Overall

- Best Engineered Car

2025 Technical Regulations

Development & Professional Classes

Version 1.0

Managed by

Re-Engineering Australia™ Foundation

Propulsion – Charles Campbell College, SA – 2023 STEM Racing World Finals - Singapore
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ENQUIRIES

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ACKNOWLEDGEMENT

In preparing the STEM Racing Technical Rules, certain wording and images have been adopted from the World Final Technical Regulations.

REPRODUCTION

ALTERATIONS

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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 2024 State Finals and the 2025 National Final.

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 2023/2024 Season

The following summary provides an overview of all technical related regulations that have been revised from the 2023/2024 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 Version 1.0 and last season are identified within the document by using red underlined text.

Changes made between Version 1.0 and this version are identified within the document by using green underlined text.

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Nil changes

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Nil changes

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Nil changes

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Nil changes

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Nil changes

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Nil changes

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 regulations **SHOULD** remain constant. REA Foundation Ltd reserves the right to update / revise the regulations 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 regulations.

T1.3 Language Used

The language of the regulations 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 0.02, 0.05 or 0.10 second to every run/lap for every critical regulation violated up to a maximum of 0.5 seconds.

T1.4.3 Eligibility

Teams need to meet certain safety criteria. Failure to comply with certain criteria **MAY** lead to disqualification from racing. [Eligibility].

T1.5 Competition Classes

There are four competition classes in the Australian STEM Racing competiton: 3DP, Cadet, Development and Professional.

This document is only relevant for the Development and Professional Classes ONLY.

Please note: Due to the Development and Professional Class regulations being separated from other competition classes and to maintain regulation numbering consistency, some regulations will not appear as sequential. These 'missing' numbers will be present in other competition class regulations.

For more information please refer to the current Australian Competition Regulations which can be downloaded from the Learning Space on the REA website.

T1.6 F1® in Schools Cars

These are Car A and Car B, 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 STEM Racing track at a State or National Final event, powered only by a single gas cylinder containing 8 grams of pressurised CO2. STEM Racing 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 STEM Racing car assembly **MUST** only consist of the following **mandatory** components and/or features:

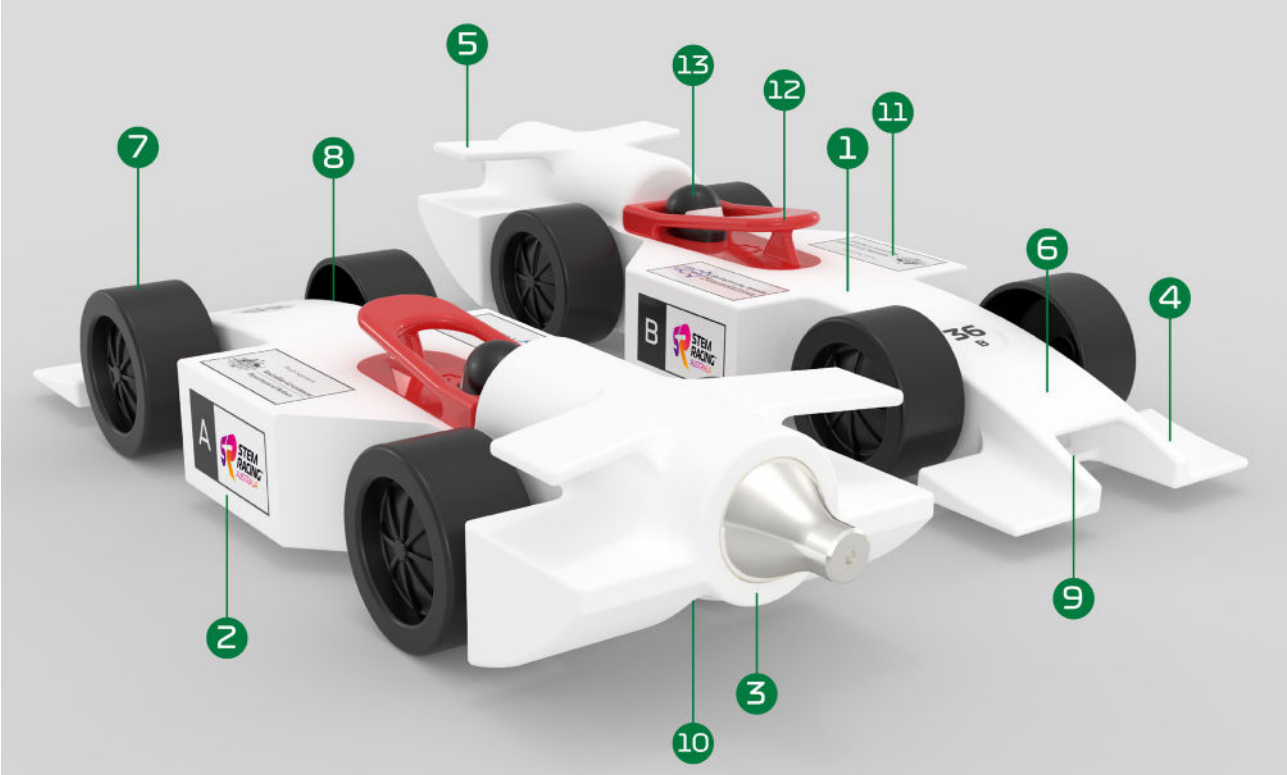
1. A body
2. Side pods
3. CO2 cylinder chamber
4. Front wing
5. Rear wing
6. Nosecone
7. Wheels
8. Wheel support systems
9. Tether line guide support system
10. Tether line guides
11. Decals
12. Halo
13. Drivers Helmet

Each STEM Racing car assembly **MAY** include the following optional components and/or features:

14. Wing support structures
15. Surface finishing
16. Ballast screws

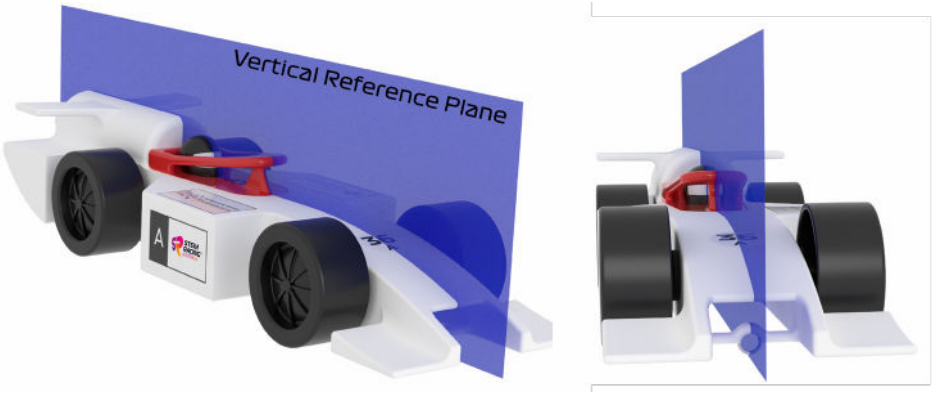
Adhesives are permissible for joining components.

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 CO2 cylinder chamber centre axis and perpendicular to the track surface. This is known as the vertical reference plane.



Fully Assembled Cars

Two x STEM Racing cars, without a CO2 cylinder inserted, presented ready for racing, resting on the track surface, free of any external force other than gravity.

T1.8 Body

The body is defined as the primary connective structure of the car. It is a **solid, uninterrupted** piece of balsa wood 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 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.

T1.9 Side Pod

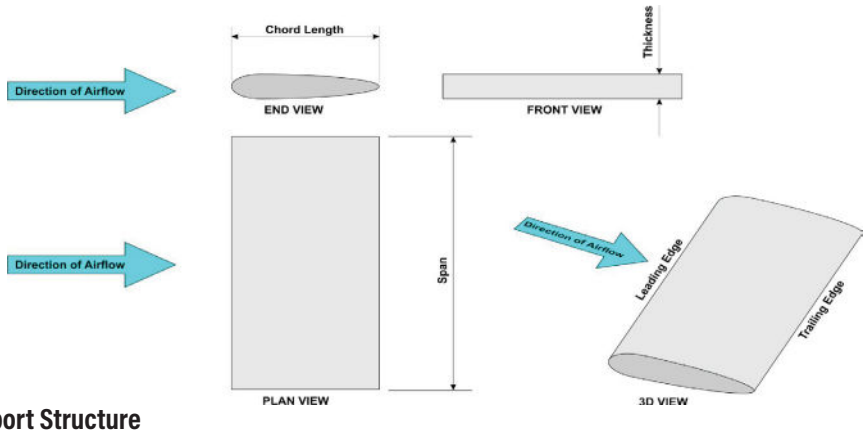
Defined as a feature of the car body between the front and rear wheels satisfying the side pod dimensional regulations.

T1.10 CO2 Cylinder Chamber

A circular cylinder of clear space bounded along its side and one end by car body only. This is where the CO2 gas cylinder is placed for racing. Extreme violations of ARTICLE T10 regulations **MAY** lead to cars being deemed ineligible to race due to safety concerns or starting pod incompatibility resulting in zero points for racing.

T1.11 Wing

A wing on an STEM Racing 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.



T1.12 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.

T1.13 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.

T1.14 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.

T1.15 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.

T1.16 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 material that continues forward of the front axle centre line, or any other legal materials.

T1.17 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.

T1.18 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.

T1.19 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 regulations over the full range of possible motion. Components intended to be "rigid" but exhibiting minor flexure will not be classified as "moving components".

T1.20 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 block and this **MAY** be incorporated into the car's design as part of the tether guide support system.

T1.21 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.

T1.22 Surface Finish & Decals

A surface finish on an STEM Racing 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.

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 STEM Racing or REA Corporate Partner car sticker decals.

T1.22.1 STEM Racing Logo Car Sticker Decals

This consists of the 'A STEM Racing decal' for Car A, the 'B STEM Racing' decal for Car B and the non-alpha STEM Racing decal for a team's display car. The STEM Racing logo graphics are printed with a horizontal dimension of 30mm and vertical dimension of 15mm. Teams will be provided with the white **ONLY** 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.

T1.22.2 REA Corporate Partner Car Sticker Decals

This consists of the REA Foundation Ltd logo text and globe graphic, and a potential sponsor logo, printed with a horizontal dimension of 30mm and vertical dimension of 15mm. Teams will be provided with the white **ONLY** 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.

T1.23 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'.

T1.24 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. Note that use of the **STEM Racing Model Foam Block** is no longer permitted for the Australian National competition but **MUST** be used for the World Final competition.

T1.25 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. STEM Racing engineering drawings **MUST** include detail to specifically identify and prove compliance for the virtual cargo and wing surfaces.

T1.26 Launch Energy Recovery System (LERS)

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 STEM Racing competition including Regional Finals. Car alignment devices are permitted provided they are removed from the track and starting mechanism prior to a run.

T1.27 Ballast Screws

Metal screws are permissible for mass ballast, these are only to be used to ballast the car up to the minimum weight.

ARTICLE T2 - GENERAL PRINCIPLES

T2.1 Regulations Documents

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

T2.1.1 Technical Regulations

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

T2.1.2 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.

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).

[Eligibility | 10 Pt Penalty]

T2.4 Safe Construction

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 Penalties for Critical Regulations

Some of the more critical regulations **WILL** attract both a Point Penalty and Time Penalty as per ARTICLE T1.4. The critical regulations are:

Penalty = 4 Pts and 0.05s Time Penalty

T3.5 / T3.9.1 / T4.2 / T4.3 / T4.4 / T5.1 / T5.2 / T6.1 / T7.14 / T7.15 / T8.1 / T8.2.1 / T8.7 / T9.3 / T11.7

Penalty = 4 Pts and 0.02s or 0.05s Tiered Time Penalty

T3.6 / T4.5 / T5.5 / T7.3.1 / T7.3.2 / T7.8.1/ T7.8.2 / T7.13 / T8.3/ T8.4/ T8.8 / T8.9 / T10.5 / T11.4

Penalty = 20 Pts and 0.1s Time Penalty

T7.1.1 / T7.1.2

T2.5.2 Tiered Time Penalties

Dimensional critical regulations will be measured and violations less than 1mm will attract a time penalty of 0.02 seconds. Violations of 1mm or more will attract a time penalty of 0.05 seconds.

T2.6 Rectification of Critical Regulation Infringements

Teams whose race cars have been deemed by Scrutineers to have infringed a regulation attracting a Time Penalty, **MAY** be given an opportunity to rectify this (time permitting) 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 Unless Stated

No tolerance will be applied for dimensions unless otherwise stated.

T2.7.2 No Tolerance for Mass

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 Scrutineering of Finished Product

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 with CO2 Cylinder Inserted

Scrutineering of cars will be conducted with a charged CO2 cylinder inserted into the chamber. The mass of the cylinder will be 29g with a tolerance of +/- 0.5g.

T2.7.7 Scrutineering Throughout all Configurations

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 CAD & CAM Software Required

All STEM Racing 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 CNC Requirement

The body of all STEM Racing 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 Identical Components

The race cars **MUST** have identically designed components and features.

T3.1.4 Machining Requirements - Development Class

Development Class teams **MUST** only machine from both sides and top (for halo pocket) OR top and bottom when manufacturing their cars on a CNC machine using only a 6mm diameter cutter.

T3.1.5 Hand Machining - Development Class

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

T3.2 Leading Features Minimum Width

[Eligibility | 10 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 Forward Most Extremity

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

T3.2.2 6mm Back from Forward Most Extremity

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 Car Finishing Declaration

[Eligibility | 10 Pt Penalty]

All team cars **MUST** be assembled, painted and finished by team members only. A signed Car Finishing Declaration Form **MUST** be submitted as per ARTICLES C2.7.2 and C2.4.1.5 in the Australian Competition Regulations

T3.3.3 Hand Finishing

[10 Pt 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

[10 Pt 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 Team Number Decals

[Advice]

Each team will receive a unique Team Number and a corresponding Team Number Decal, which includes the Team Number followed by either an "A" or "B" to identify their race car. This decal is required to be affixed to the race car's body, positioned specifically between the leading edge of the halo and the leading edge of the front tires. The decal **MUST** be clearly visible in the plan view. While teams have the option to create and apply their own Team Number Decals to their vehicles before the event, decals will also be made available at the time of event registration for those who need them.

Decal Diameter: 15.0mm

Decal Font: Formula 1 Font

Font Weight for Number: 18pt

Font Weight for A/B: 9pt

T3.4.2 REA Foundation Ltd. Corporate Partner Logos

[2 Pt 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 T1.23 for more information. Each decal infringement attracts a 2pt penalty.

T3.4.3 Minimum Dimensions & Positioning

[2 Pt Penalty each]

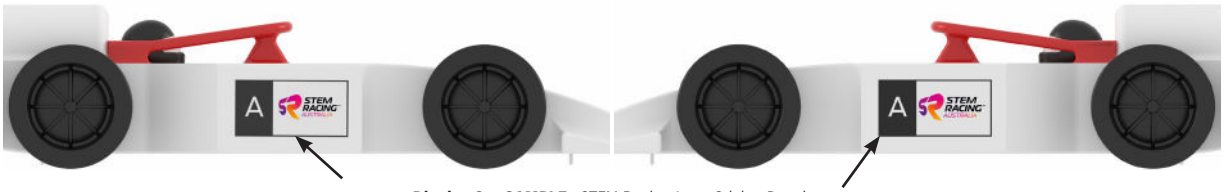
T3.4.3.1 Minimum Dimensions

The REA Foundation Ltd., Department of Defence and STEM Racing 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

[2 Pt Penalty each]

The 'A' STEM Racing decals are to be applied to Car A's sidepods and the 'B' STEM Racing' decals are to be applied to Car B's sidepods. Refer to ARTICLE T1.23. Each decal infringement attracts a 2pt penalty. Picture following example only.



Display Car SAMPLE: STEM Racing Logo Sticker Decal

T3.4.3.3 Positioning of Other Corporate Sticker Decals

[2 Pt 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 ☒4 Pt Penalty]

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

T3.6 Overall Length

[0.02 or 0.05 Time Penalty ☒4 Pt 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 CO2 cylinder, **MUST** be a minimum of 170mm and a maximum of 210mm.

[Eligibility]

T3.7 Minimum Mass

The minimum mass of the complete car product, without the CO2 cylinder fitted **MUST** be:

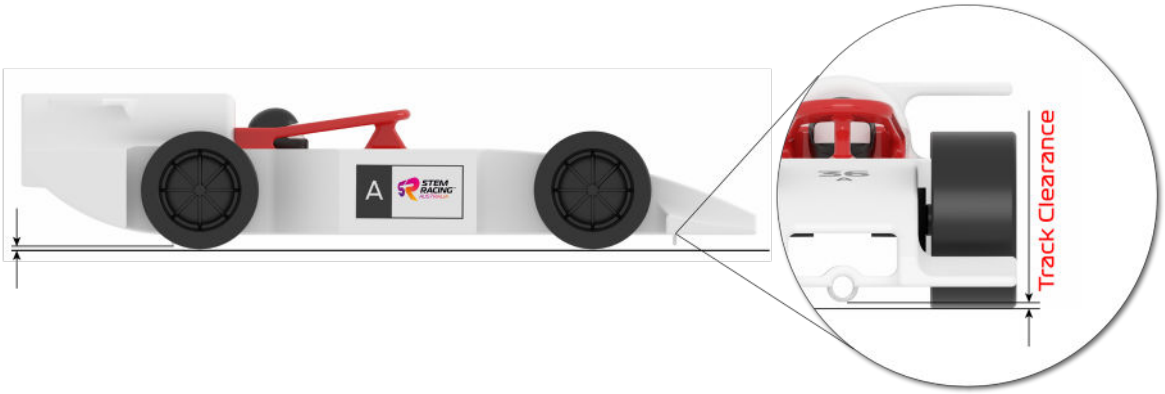
T3.7.3 Development Class: 50 grams

T3.7.4 Professional Class: 50 grams

T3.8 Track Clearance

[4 Pt 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.



T3.9 Balsa Wood Components

All balsa wood components for a completed car **MUST** be made from an REA supplied single standard balsa wood as defined in these regulations.

T3.9.1 Default Material

[0.05 Time Penalty ☒4 Pt Penalty]

Balsa wood 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.

T3.9.2 Thickness

[1 Pt Penalty]

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

T3.10 Status During Racing

[2 Pt Penalty]

The car assembly **MUST** be designed so that no items other than CO2 cylinders are removed, replaced or added to the assembly during scheduled race events.

ARTICLE T4 - HALO

T4.1 Halo Description [Advice]

The halo is a driver crash-protection system used in open-wheel racing series which consists of a curved bar placed to protect the driver's head. The Halo is being introduced to STEM Racing not only to echo real F1 car design but also as a component of a new car deceleration system. The Halo is available to download as a universal 3D part from the REA Learning Space website. For this part and more free downloads, please visit https://learning.rea.org.au/c/REA_Standard_Car_Parts.The Halo **MUST** be included in the final car design.

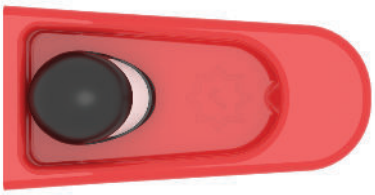
The Halo **MUST** be well adhered to the body of the car To achieve this requires a recess or pocket to match the underside of the Halo in the car body. It has been designed so the required recess or pocket can be manufactured using a 6.35mm (1/4") or smaller ball nose cutter. The Halo and the Helmet are mandatory items and can be made from any material.

FRONT VIEW

REAR VIEW

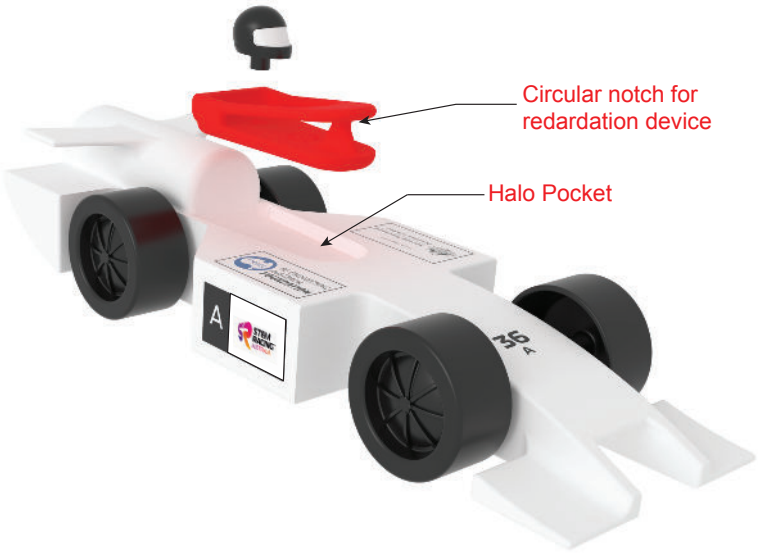
SIDE VIEW

TOP VIEW



ISOMETRIC VIEW - TOP

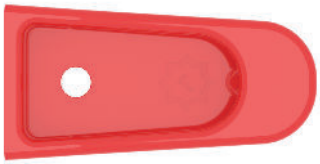
ISOMETRIC VIEW - BOTTOM



HELMET

T4.2 Inclusion of Halo **[0.05 Time Penalty | 4 Pt Penalty]**

The Halo **MUST** be included in the car design without any dimensional changes. The file can be downloaded from https://learning.rea.org.au/c/REA_Standard_Car_Parts Please see appendix T4.8 for detailed dimensions.



T4.3 Halo visibility front and side views **[0.05 Time Penalty | 4 Pt Penalty]**

Visibility of the Halo **MUST** not be physically obstructed by any other component when viewed in the front or side views.

SIDE VIEW

When viewed from the side everything inside the black outline **MUST** be visible.

FRONT VIEW

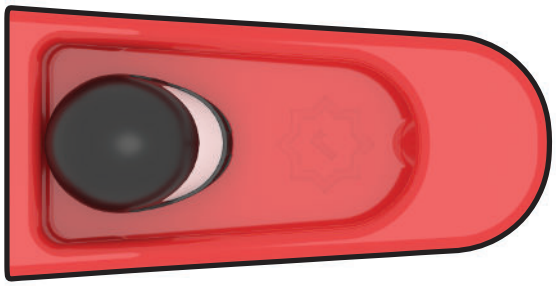
When viewed from the front everything inside the black outline **MUST** be visible.

T4.4 Halo visibility top view **[0.05 Time Penalty | 4 Pt Penalty]**

The Halo **MUST NOT** be physically obstructed in the plan view except by the helmet.

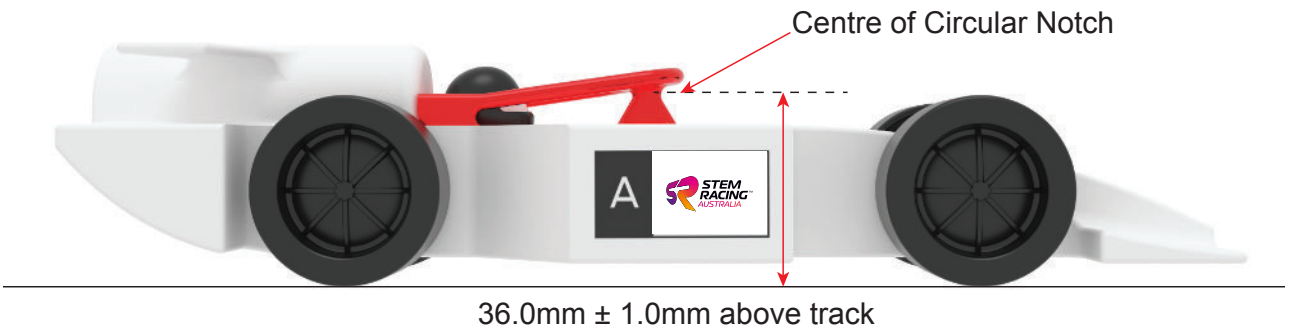
TOP VIEW

When viewed from the top everything inside the black outline **MUST** be visible.



T4.5 Halo circular notch height [0.02 or 0.05 Time Penalty | 4 Pt Penalty]

To be effective the centre of the Circular Notch **MUST** be 36.0mm (±1.0mm) above the track surface. To achieve this the bottom of the halo pocket must be 26.0mm above the track in the assembled car.



T4.6 Halo Safety Test [Eligibility | 4 Pt Penalty]

T4.6.1 Frontal Halo Load Test

With the car supported on a power unit cartridge a 1kg load will be suspended to give a loading of 2kg at point of contact on the Halo circular notch.

T4.6.2 Inverted Halo Load Test

[Eligibility | 4 Pt Penalty]

When the car is positioned horizontally on a power unit cartridge with the halo oriented downward, a load weighing 400 grams will be hung from the halo.

T4.7 Helmet

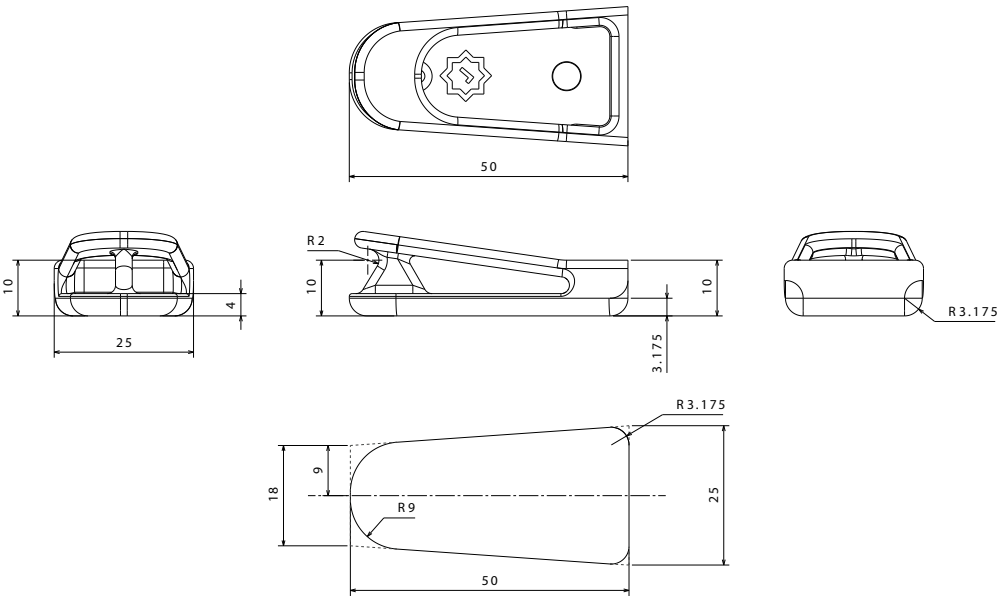
[4 Pt Penalty]

The Helmet is a standard part designed by STEM Racing that **MUST** be included in the car design without any dimensional changes. The Helmet is available to download as a universal 3D part from the STEM Racing website. For this part and more free downloads, please visit https://learning.rea.org.au/c/REA_Standard_Car_Parts. The helmet may be manufactured out of any material.

T4.8 Halo Drawings

[Advice]

To accommodate the 'Halo', your car will require a pocket cut to the dimensions in the drawing below using a 6.35mm (1/4") or smaller ball nose tool to a depth of 3.175mm. The centre of the Halo 'Circular notch' for the retardation device is exactly 10.0 mm above the bottom of the pocket. To be effective the centre of the Circular Notch must be 36.0mm ±1.0mm above the track surface. To achieve this, the bottom of the pocket **MUST** be 26.0mm above the track in the assembled car. Use the dimensions on the diagrams below to check you have manufactured your Halo correctly.



ARTICLE T5 - BODY & SIDE POD REGULATIONS

T5.1 Body Construction [0.05 Time Penalty ☒4 Pt Penalty]

A **single, continuous** piece of CNC manufactured balsa wood, 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 CO2 cylinder chamber.

T5.2 Implants, Foreign Objects or Voids [0.05 Time Penalty ☒4 Pt Penalty]

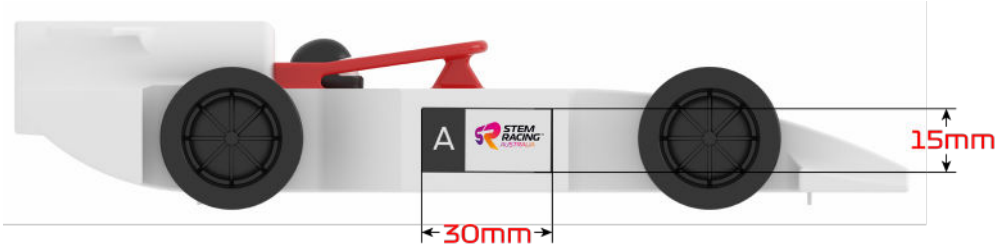
Implants, foreign objects or voids in or on the car body and side pods **MUST NOT** be incorporated.

T5.3 Width of Side Pod [2 Pt Penalty]

The overall width of the side pods measured transversely between the side-pod extremities MUST be a minimum of 40mm. Any part having a width less than 40mm is not considered a side pod.

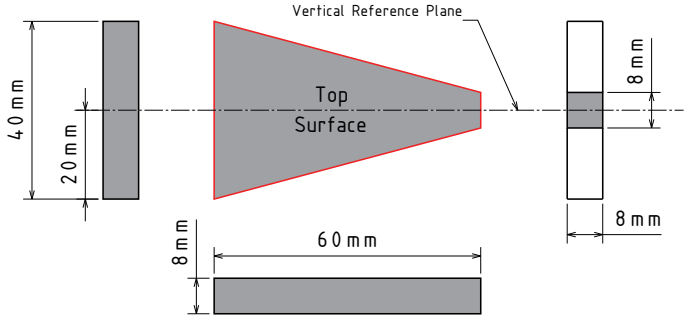
T5.4 Side Pod Projected Surface [2 Pt Penalty]

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



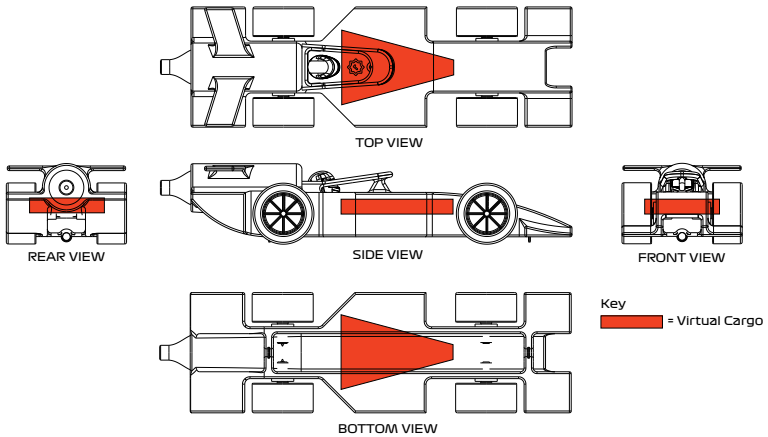
T5.5 Virtual Cargo [0.02 or 0.05 Time Penalty ☒4 Pt Penalty]

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



T5.6 Virtual Cargo Identification [1 Pt Penalty]

The virtual cargo location and compliance **MUST** be clearly dimensioned and identified by hatching, shading or block colour within the engineering drawings submitted for scrutineering judging. Refer to the example diagram following.



ARTICLE T6 - NOSECONE REGULATIONS

T6.1 Construction Material [0.05 Time Penalty ☒4 Pt Penalty]

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

T6.2 Positioning [1 Pt Penalty]

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

ARTICLE T7 - WING REGULATIONS

T7.1 Wings

T7.1.1 Car has a Front Wing [0.10 Time Penalty ☒20 Pt Penalty]

Car must have a Front Wing. If the car fails this regulation then skip without penalties all subsequent T6 Front Wing Regulations.

T7.1.2 Car has a Rear Wing [0.10 Time Penalty ☒20 Pt Penalty]

Car must have a Rear Wing. If the car fails this regulation then skip without penalties all subsequent T6 Rear Wing Regulations.

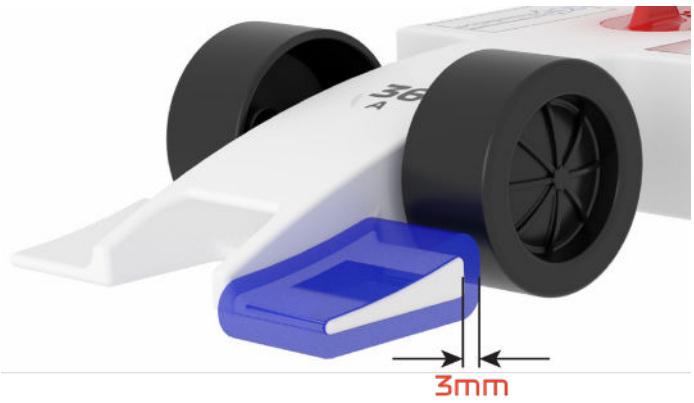
T7.2 Wing Identification [1 Pt Penalty]

The surfaces defining both the front and rear wings **MUST** be identified clearly within the engineering drawings submitted by teams at event check-in.

T7.3 Clear Airspace

T7.3.1 Front Wing [0.02 or 0.05 Time Penalty ☒4 Pt 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 front wing's upper, lower, leading edge and trailing edge surfaces. Each individual element of a multi-element wing **MUST** comply with the minimum air space regulation.

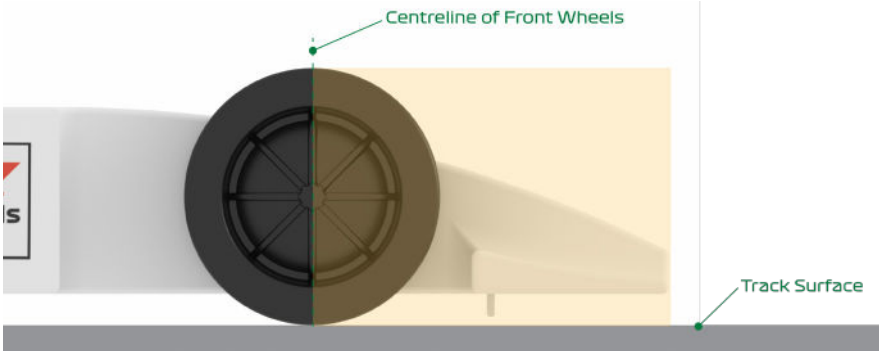


T7.3.2 Rear Wing [0.02 or 0.05 Time Penalty ☒4 Pt Penalty]

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 rear wing's upper, lower, leading edge and trailing edge surfaces. Each individual element of a multi-element wing **MUST** comply with the minimum air space regulation.

T7.4 Front Wing Positioning [1 Pt 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.



T7.5 Construction & Rigidity [2 Pt Penalty]

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

T7.6 Front Wing Construction Material [Eligibility | 10 Pt 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.

T7.7 Connection with Nosecone [1 Pt Penalty]

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

T7.8 Span [Advice]

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. Refer to T11.7 for a number of examples.

T7.8.1 Front wing span [0.02 or 0.05 Time Penalty ☒4 Pt Penalty]

- **T7.8.1.1** If made from balsa wood: Min. 34mm
- **T7.8.1.2** If made from alternative material: Min. 40mm

T7.8.2 Rear wing span [0.02 or 0.05 Time Penalty ☒4 Pt Penalty]

- **T7.8.2.1** If made from balsa wood: Min. 34mm
- **T7.8.2.2** If made from alternative material: Min. 40mm

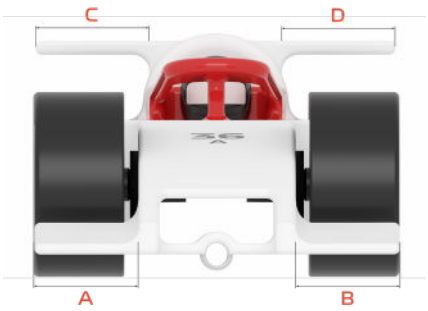
T7.9 Span Segments [Advice]

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: 10mm

Wing and Span Calculations Explained

To be included in the judge's wing span calculation, a wing segment **MUST** be at least 10mm in span. If **ANY** of the segments A, B, C, D were less than 10mm, they would not qualify as wing segments, but would instead be treated as wing support structures.



T7.10 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. Each individual element of a multi-element wing **MUST** satisfy the minimum chord requirement.

T7.10.1 Front wing chord - Min: 15mm [2 Pt Penalty]

T7.10.2 Rear wing chord - Min: 15mm [2 Pt Penalty]

T7.11 Front & Rear Wing Thickness

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

T7.11.1 Front wing thickness [2 Pt Penalty]

- **T7.11.1.1** If made from balsa wood: Min: 3.5mm / Max: 9mm
- **T7.11.1.2** If made from alternative material: Min: 1.5mm / Max: 9mm

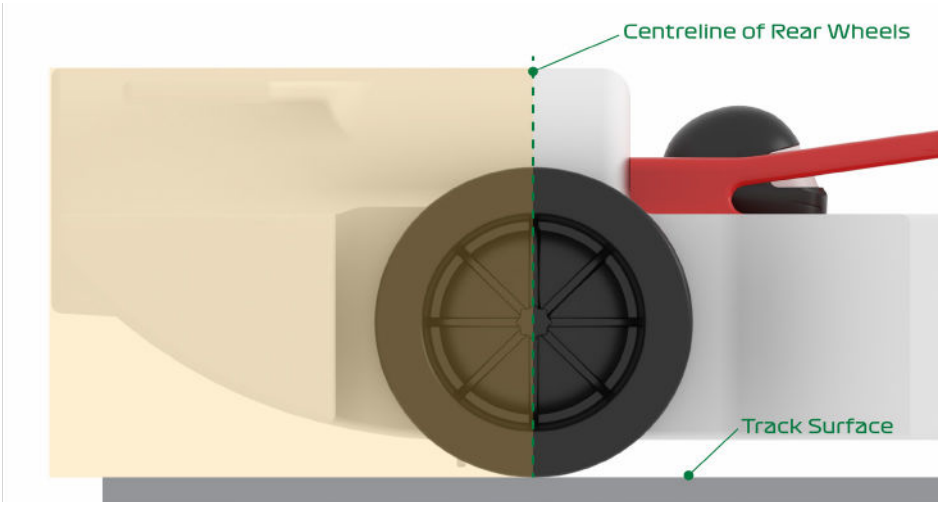
T7.11.2 Rear wing thickness [2 Pt Penalty]

- **T7.11.2.1** If made from balsa wood: Min: 3.5mm / Max: 9mm
- **T7.11.2.2** If made from alternative material: Min: 1.5mm / Max: 9mm

T7.12 Rear Wing Positioning [1 Pt Penalty]

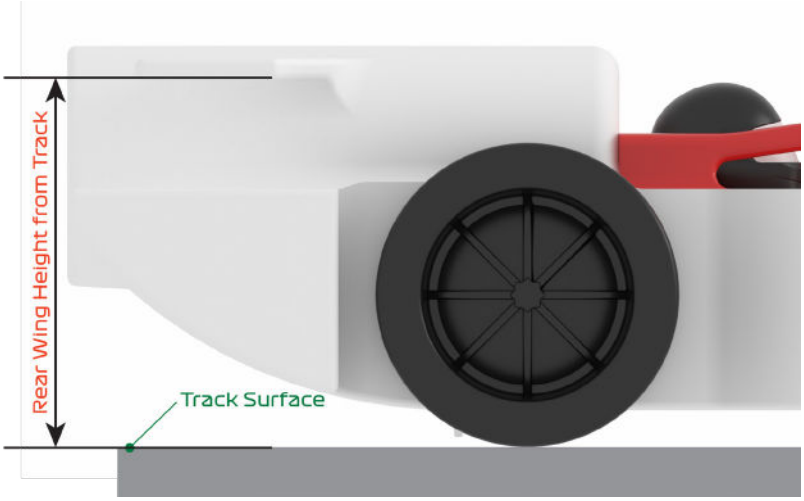
The whole of the rear wing when viewed from the side **MUST** be behind the centre line of the rear axle.

track surface.



T7.13 Rear Wing Height [0.02 or 0.05 Time Penalty ☒4 Pt Penalty]

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



T7.14 Rear Wing Construction Material [0.05 Time Penalty ☒4 Pt Penalty]

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

T7.15 Rear Wing Support Structure [0.05 Time Penalty ☒4 Pt 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 T8 - WHEEL REGULATIONS

T8.1 Number and location [0.05 Time Penalty ☒4 Pt 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.

T8.2 REA Standard Wheels

T8.2.1 Development Class Teams [0.05 Time Penalty ☒4 Pt Penalty]

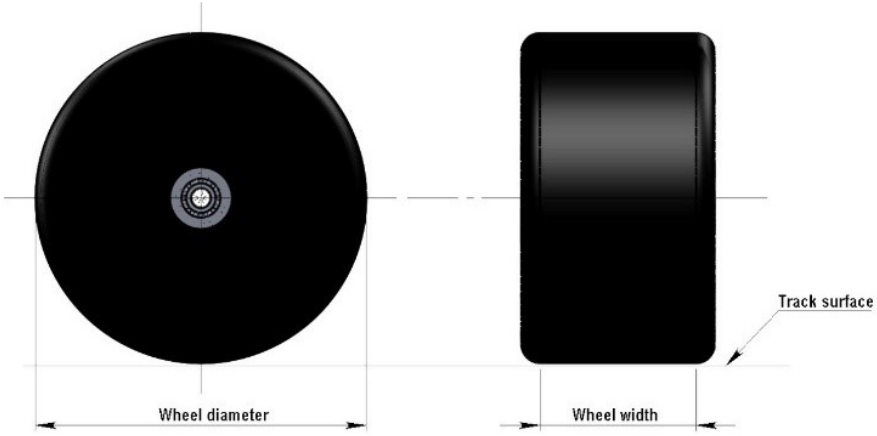
Development Class Teams **MUST** use any combination of four (4) unmodified REA standard wheels. No other parts can be added to the wheels. Removal of the sprue remnant is acceptable.

T8.2.2 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.)

T8.3 Diameter [0.02 or **0.05 Time Penalty ☒4 Pt Penalty**]

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



T8.4 Track Contact Width

[0.02 or **0.05 Time Penalty ☒4 Pt Penalty**]

The wheel track contact width for "team manufactured wheels" as measured between the extreme outer edges along the contiguous contact line of each wheel.

T8.4.1 Front Wheels: Min: 12.0mm

T8.4.2 Rear Wheels: Min: 15.0mm

T8.5 Full Contact Width

[2 Pt Penalty]

With a CO2 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.).

T8.6 No Tyre Tread

[2 Pt Penalty]

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

T8.7 Freely Rotating Wheels

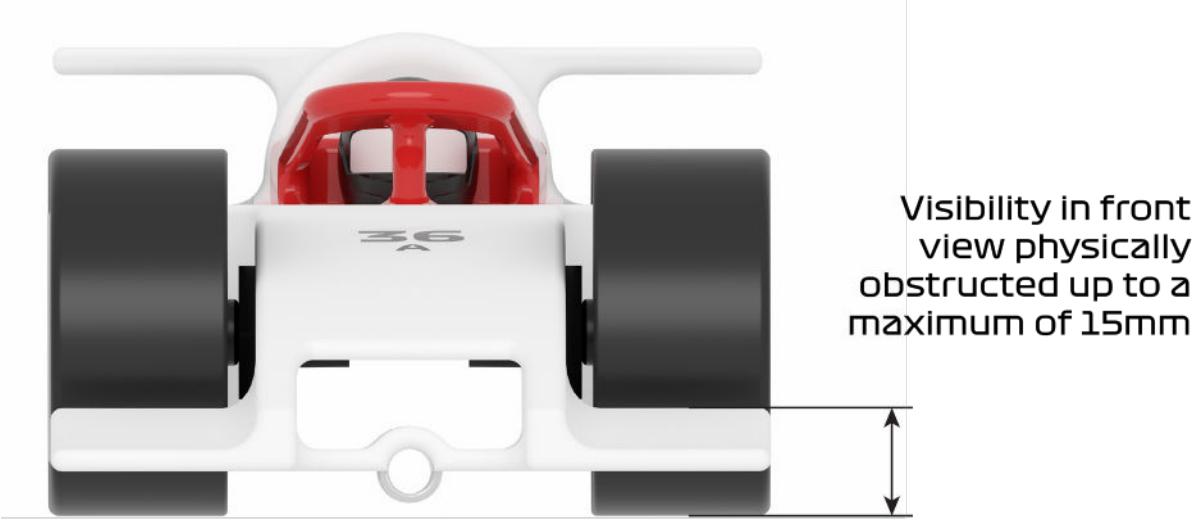
[0.05 Time Penalty ☒4 Pt Penalty]

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.

T8.8 Visibility in Front View

[0.02 or 0.05 Time Penalty ☒4 Pt 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.



T8.9 Visibility from Top, Bottom & Side

[0.02 or 0.05 Time Penalty ☒4 Pt Penalty]

The visibility of all wheels must not be physically obscured by any component of the car in the car's top and bottom elevation views. Car body or any other components must not exist within the dimensions illustrated below. These dimensions must exist from the inside edges of each wheels' track contact width to the extreme width of the car assembly and a height from track surface of 65.0mm. This is measured, parallel to the vertical reference plane and track surface.

T8.9.1 In front of front wheels

Min: 1.0mm

T8.9.2 Behind front wheels

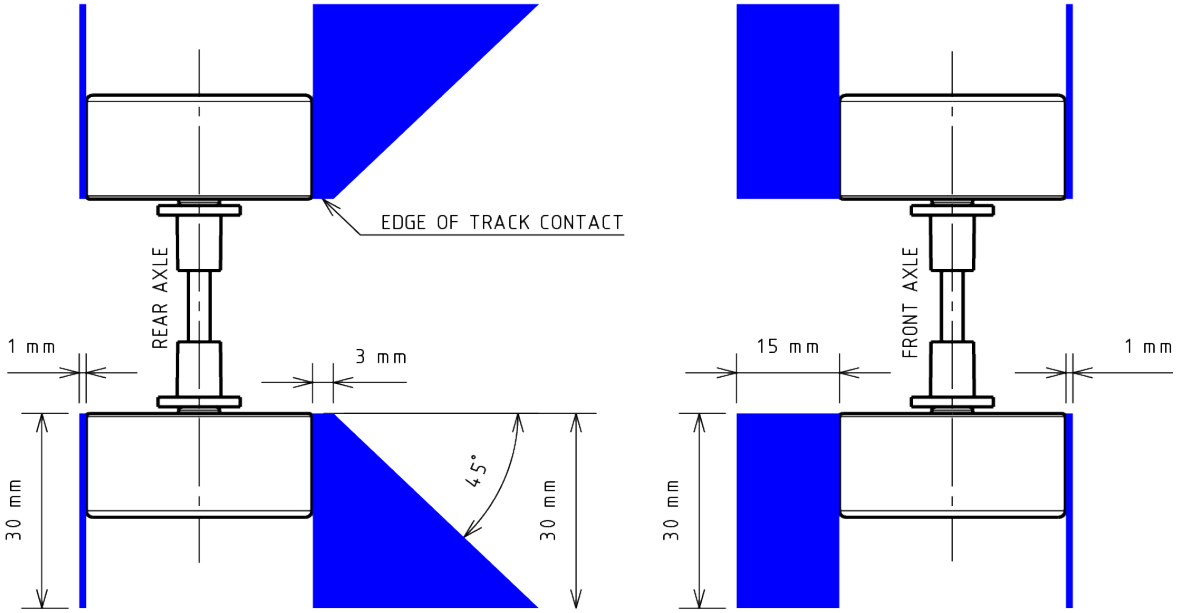
Min: 15.0mm

T8.9.3 In front of rear wheels

Minimum dimensions on diagram below

T8.9.4 Behind rear wheels

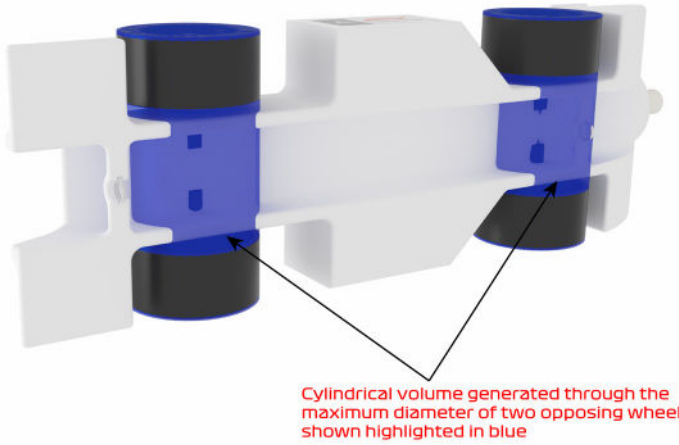
Min: 1.0mm



ARTICLE T9 - WHEEL SUPPORT REGULATIONS

T9.1 Projected Cylinder Volume [2 Pt 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).



T9.2 Integration with Wing Support Systems [2 Pt Penalty]

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

T9.3 REA Standard Grommets [0.05 Time Penalty ☒4 Pt Penalty]

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

T9.4 REA Standard Axles

T9.4.1 Development Class Teams [2 Pt Penalty]

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

T9.5 Modifications

T9.5.1 Development Class Teams [2 Pt Penalty]

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

T9.5.2 Professional Class Teams [Advice]

Teams **MAY** manufacture their own wheel support system and the wheel support system materials are unrestricted.

T9.6 Integration with Wing Support Systems [2 Pt Penalty]

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

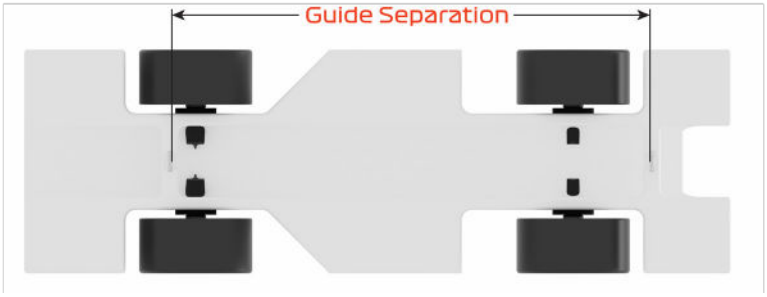
ARTICLE T10 - TETHER LINE GUIDE REGULATIONS

T10.1 Location [Eligibility | 10 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.

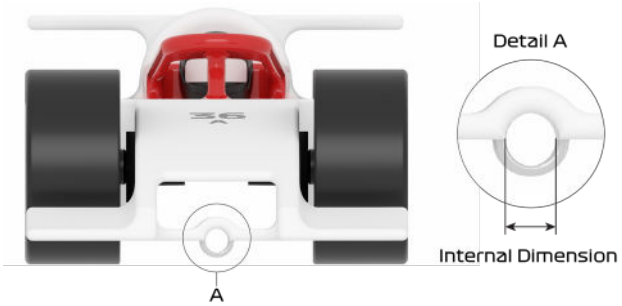
T10.2 Separation [1 Pt Penalty]

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



T10.3 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



T10.4 Safety

T10.4.1 Closed Guides [Eligibility ☒4 Pt Penalty]

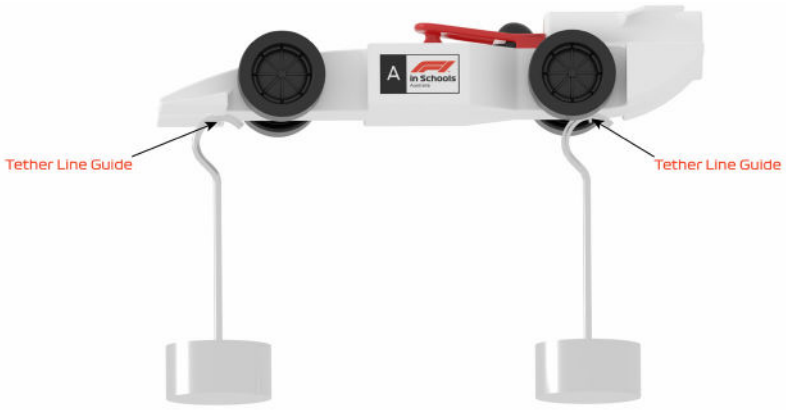
The tether line guides **MUST** be closed to prevent the tether line from coming out of the tether line guide. This is considered a safety issue. Cars **WILL** be ineligible to race if unresolved.

T10.4.2 Sharp Edges [Eligibility ☒4 Pt Penalty]

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

T10.4.3 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.



T10.5 Separate Tether Guide Support System [0.02 or 0.05 Time Penalty ☒4 Pt Penalty]

If a tether guide support system at either the front or the rear of the car is comprised of a separate component that connects a tether guide to any one of or a combination of the car body, front wing, wing support, wheel support or nose cone, then:

T10.5.1 A tether guide support system must be connected to one and only one tether guide.

T10.5.2 Material of tether guide support system must be non-metallic.

T10.5.3 No part of the front tether guide support system may exist rearward of the front tether guide by more than 10 mm.

T10.5.4 No part of the rear tether guide support system may exist forward of the rear tether guide by more than 10 mm.

T10.5.5 A tether guide support system must be one continuous component, and not an assembly of separate components.

T10.5.6 A tether guide support system must not exist simultaneously both in front of and behind a wheel support.

ARTICLE T11 - POWER PLANT PROVISIONS

T11.1 Interfacing with Launch Pod [Eligibility ☒20 Pt Penalty]

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

T11.2 Diameter [1 Pt Penalty]

The CO2 cylinder chamber diameter **MUST** be 19mm (+/- 0.5mm)

T11.3 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 45mm and maximum 60mm.

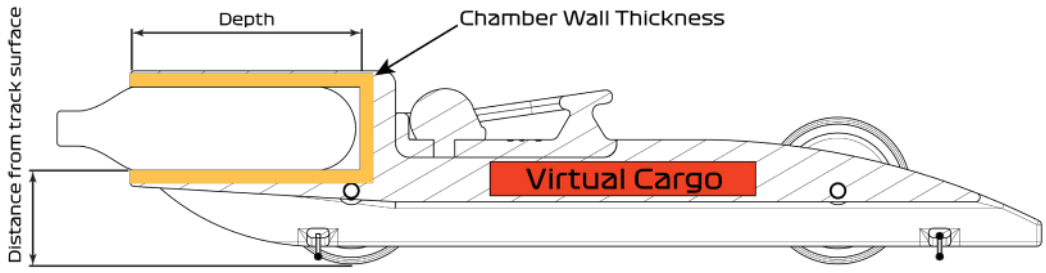
T11.4 Distance from Track Surface [0.02 or 0.05 Time Penalty ☒4 Pt Penalty]

The vertical height of the lowest point of the CO2 cylinder chamber above the race track surface **MUST** be a minimum of 20mm for both Development and Professional Classes.

T11.5 Chamber Wall Thickness [Eligibility ☒4 Pt Penalty]

The CO2 cylinder chamber **MUST** be completely surrounded by a minimum 3mm thickness of material. The chamber surrounds and connection to the car body will be assessed 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



T11.6 Finishing of Chamber Surrounds [1 Pt Penalty]

Paint and other foreign materials **MUST NOT** be present inside the CO2 cylinder chamber. This is considered a measure of manufacturing quality control.

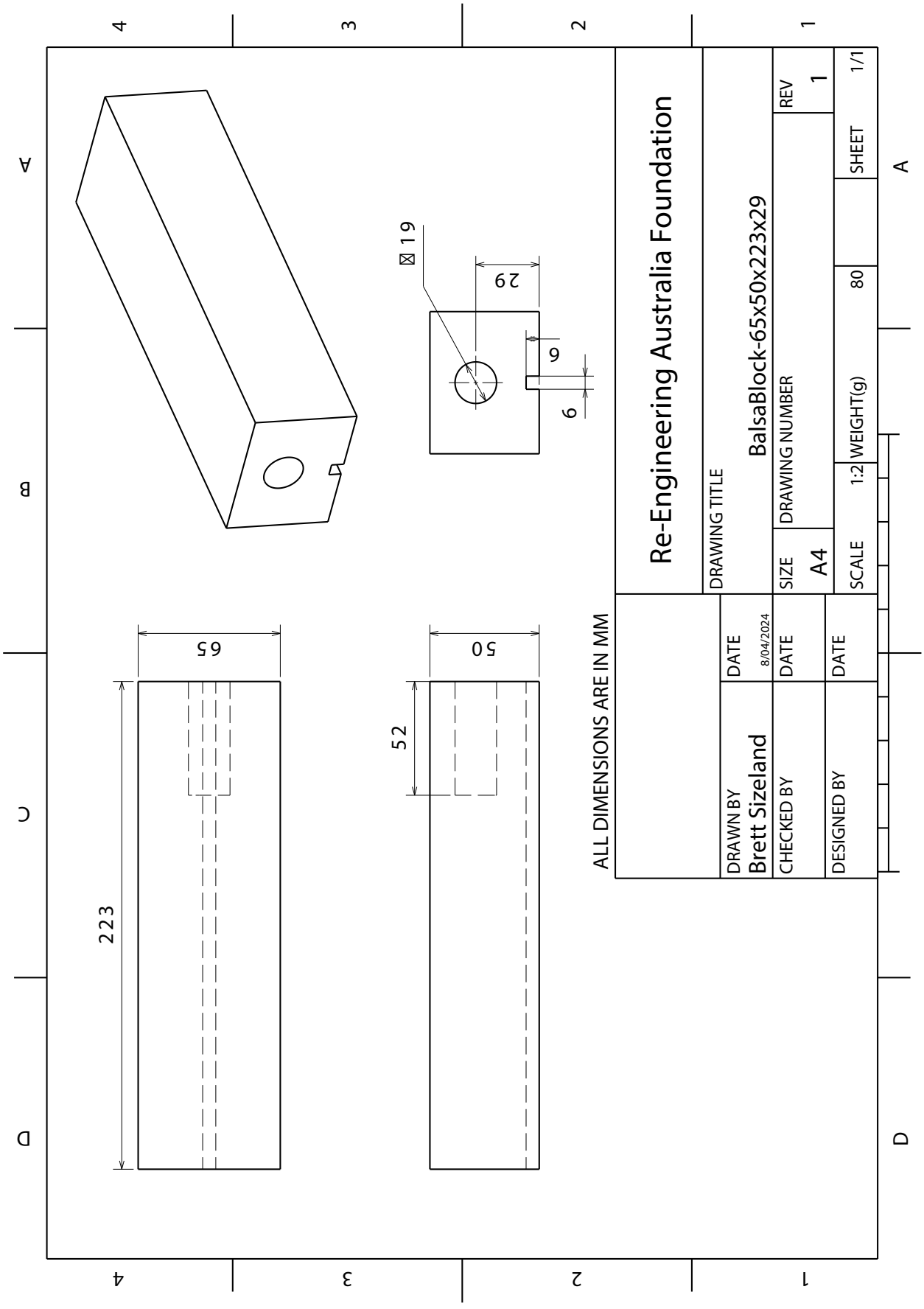
T11.7 Interaction with Cylinder [0.05 Time Penalty ☒4 Pt Penalty]

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

ARTICLE T12 - APPENDICES

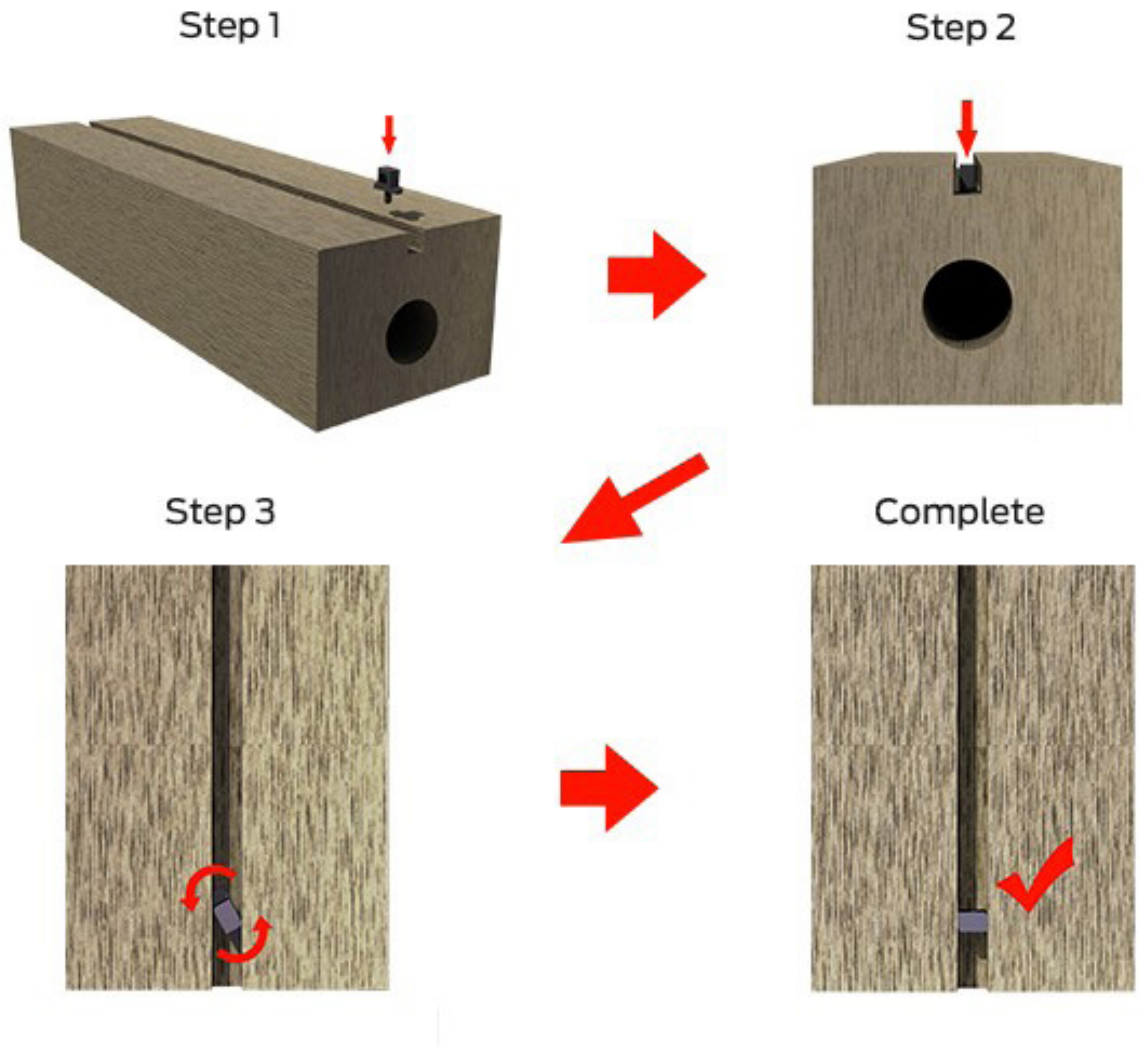
T12.1 Official REA Balsa Block Dimensions

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

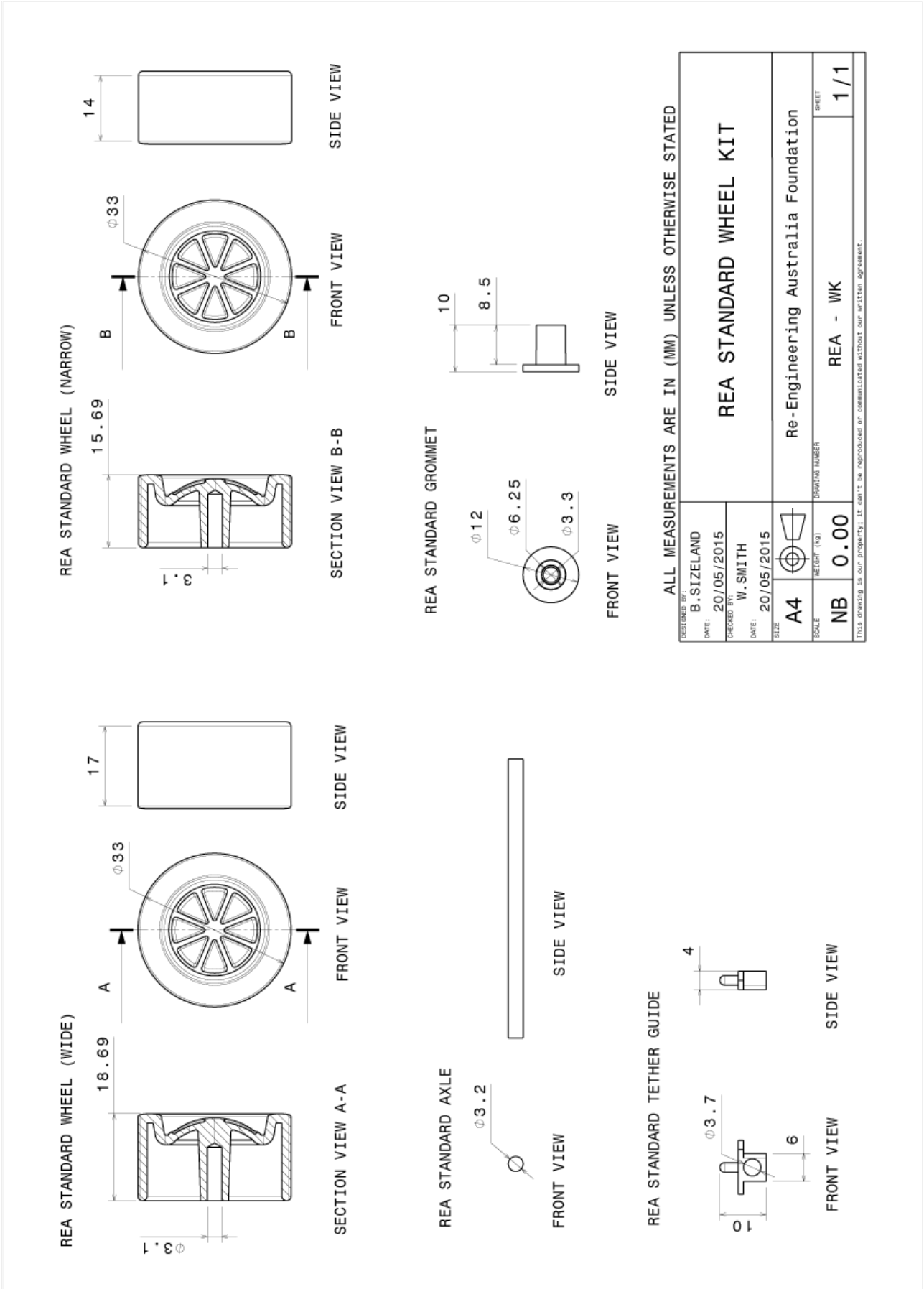


T12.2 REA Standard Tether Guide Insertion Instructions

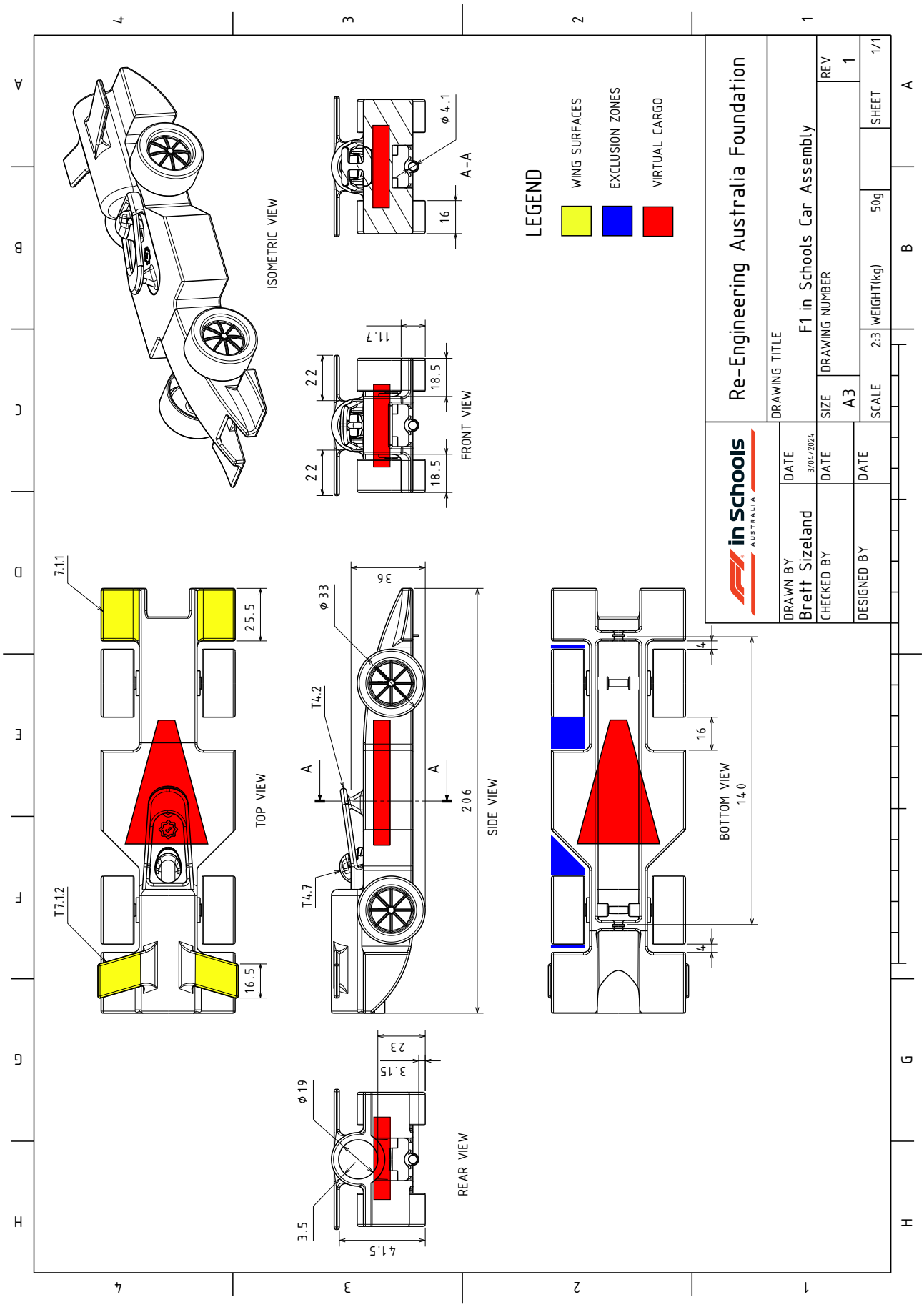
Can be used in balsa wood blocks.



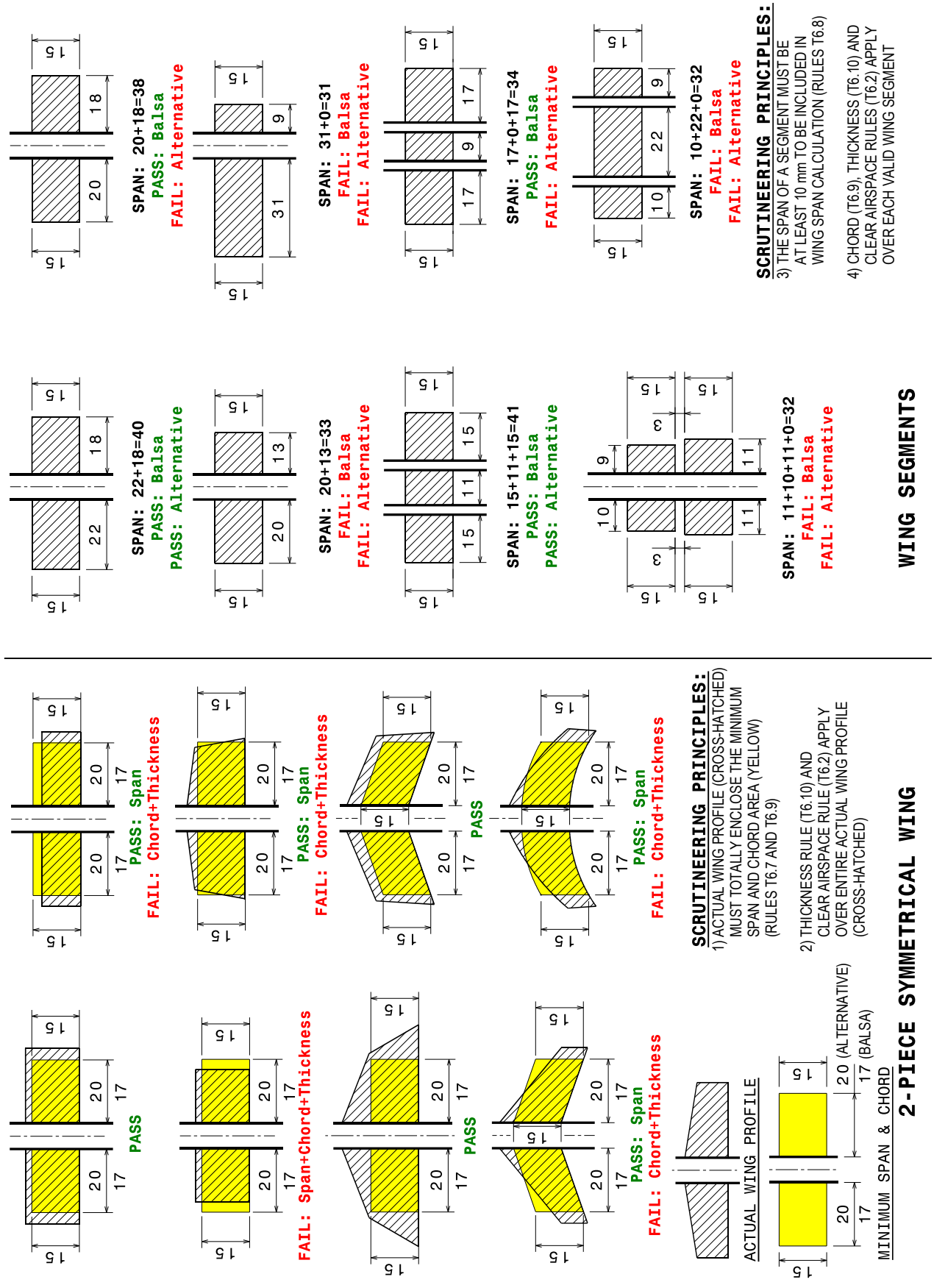
T12.3 Official REA Standard Wheel Kit



T12.4 Example Orthogonal Drawing



T12.5 Wing Span Diagram



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