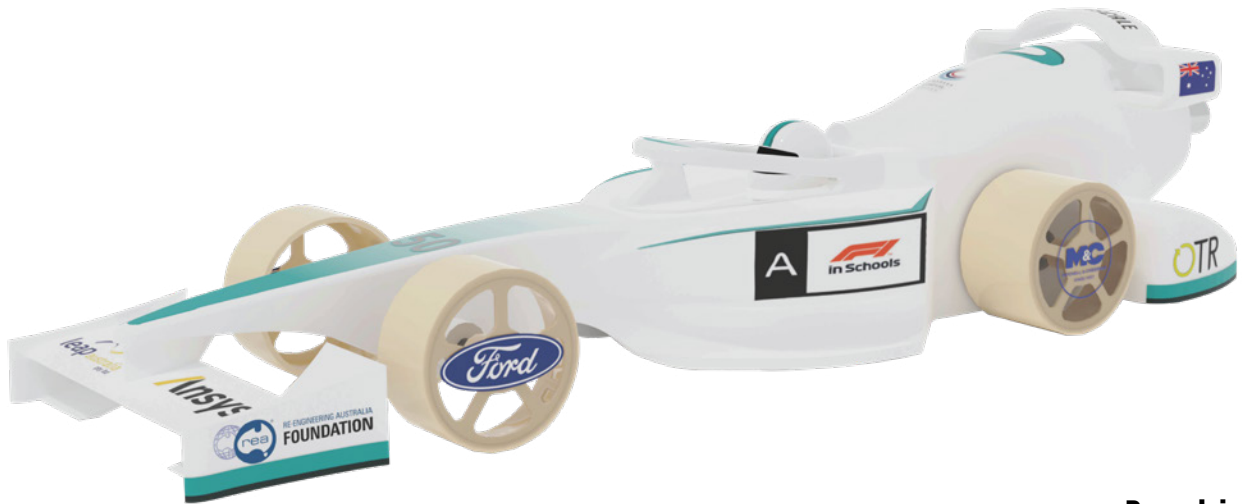




Propulsion

*Charles Campbell College, SA
2023 F1 in Schools World Finals
- 2nd Place Overall
- Best Engineered Car*

2025

Victorian State Finals Technical Regulations Professional Class

Version 1.3

Managed by

**WYNDHAM
TECH
SCHOOL**



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

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

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ALTERATIONS

Wyndham Tech School. 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 2025 and 2026 Victorian State 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 2024 National and state regulations are identified within the document by using red underlined text.

ARTICLE T1 - DEFINITIONS

T1.6 Revision of mandatory components of an STEM Racing car

T1.27 Revised definition and permissible location of legal ballast

ARTICLE T2 - GENERAL PRINCIPLES

Nil changes

ARTICLE T3 - GENERAL CAR REGULATIONS

T3.1.7 Inclusion of sub assembly manufacturing requirements

T3.4 Revision of car decals

T3.5 Revision of overall dimensions

T3.8 Revision of default material

HALO

ARTICLE T4 - Nil changes

ARTICLE T5 - BODY & SIDE POD REGULATIONS

T5.3 Revision of width of side-pod

T5.5 Revision of virtual Cargo

ARTICLE T6 - NOSECONE REGULATIONS

Nil changes

ARTICLE T7 - WING REGULATIONS

T7.3 Revision of clear airspace

T7.8 Revision of wing span

T7.10 Revision of wing chord

T7.11 Revision of wing thickness

ARTICLE T8 - WHEEL REGULATIONS

T8.1 Introduction of distance between opposing wheels

T8.4 Revision of wheel contact width

T8.8 Revision of front visibility

T8.9 Revision of top and side visibility

WHEEL SUPPORT REGULATIONS

Nil changes

ARTICLE T9 - TETHER LINE GUIDE REGULATIONS

T10.3 Revision of inside diameter

ARTICLE T10 - POWER PLANT PROVISIONS

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. Wyndham Tech School 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 **Three** competition classes in the Victorian STEM Racing competition: Cadet, Development and Professional.

This document is **ONLY** relevant for the Professional Class.

Please note: Due to the 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 Victorian Competition Regulations which can be downloaded from the Learning Space on the REA website.

T1.6 STEM Racing 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.

T1.6.1 Components and Subassembly manufacturing

Each STEM Racing car assembly MUST only consist of the following mandatory components (labeled numerically, eg. 1.) and/or features (labeled alphabetically, eg. A.):

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

C. Decals

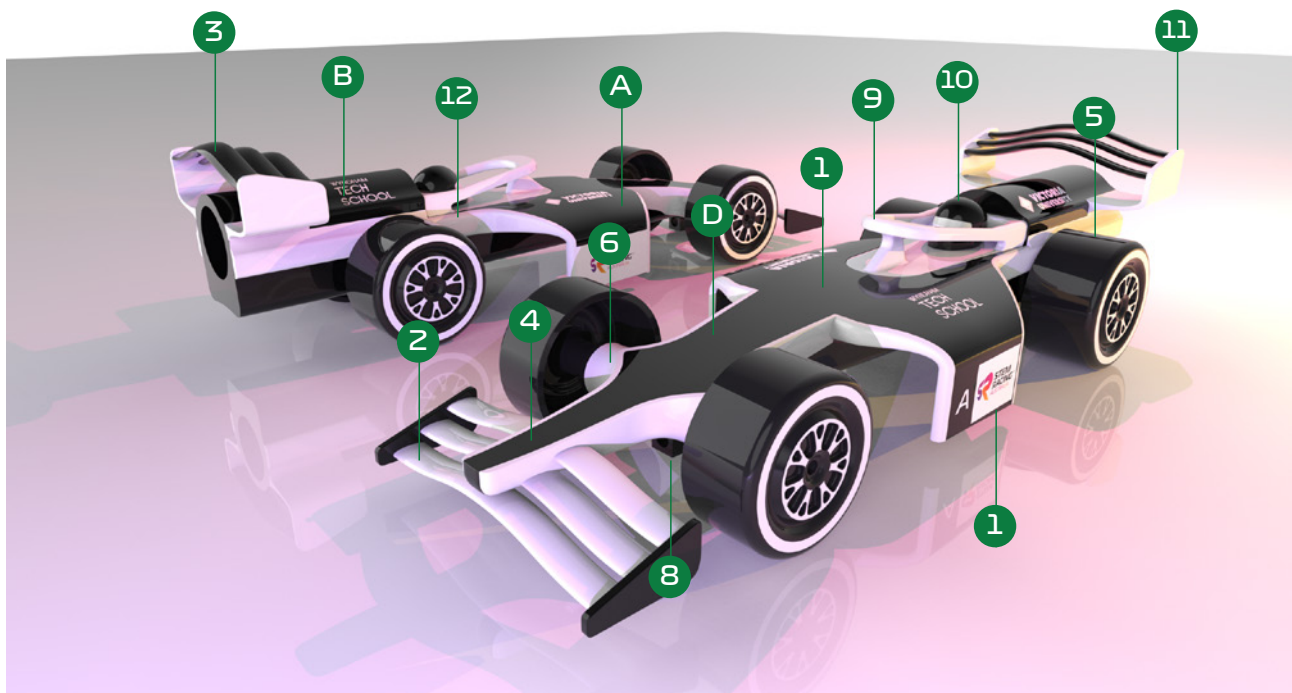
Each STEM Racing car assembly **MAY** include the following optional components and/or features:

11. Wing support structures
12. Ballast

D. Surface finishing

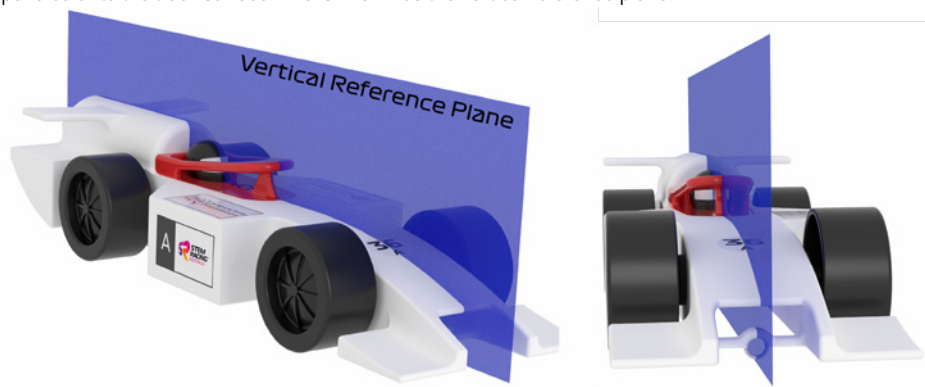
Adhesives are permissible for joining components.

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

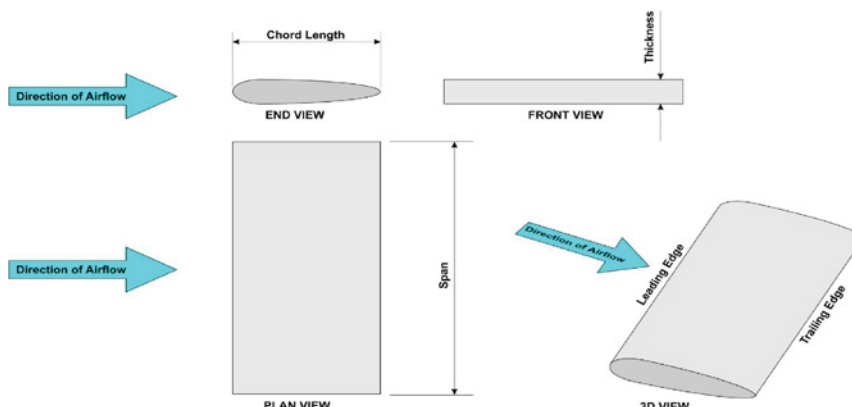
Defined as a feature of the car body between the front and rear wheels satisfying the side pod dimensional regulations.

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 T11 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 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 **Wyndham Tech School supplied** side-pod 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 Wyndham Tech School 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 Wyndham Tech School Corporate Partner Car Sticker Decals

This consists of the Wyndham Tech School logo text and globe graphic, printed with a horizontal dimension of 30mm and vertical dimension of 15mm. Teams will be provided with the black **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 Wyndham Tech School 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 Official Balsa Wood Block

The official balsa wood block is a homogeneous 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 Victorian 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 Victorian 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 Legal Ballast

Legal ballast **MAY** be added to achieve the minimum weight. Legal ballast may **ONLY** be added to the container under the halo, accessible through the halo/helmet aperture (hole). This is the **ONLY** permissible location for ballast. Ballast may consist of heavy materials such as fishing weights or similar.

ARTICLE T2 - GENERAL PRINCIPLES

T2.1 Regulations Documents

Wyndham Tech School. 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 'R' 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 Wyndham Tech School. to be related to regulation text needing clarification will be answered by Wyndham Tech School.

T2.3 Amendments to the Regulations

Any amendments will be announced and released by Wyndham Tech School. by email notification to all teachers nominated in the school registration, as well as the updated revision being uploaded to the website at <https://www.wyndhamtechschool.vic.edu.au/vicstemracing>. 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

T3.1.7 / T3.5.1 / T3.5.2 / T2.5.3 / T3.8.1 / T4.2 / T4.3 / T4.4 / T5.1 / T5.2 / T6.1 / T7.1.4 / T7.1.5 / T8.1 / T8.2.1 / T8.4.1 / T8.4.2 / 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 / T7.1.3 / 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 Wyndham Tech School. 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..

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 modeling, 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 Identical Components

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

T3.1.4 CNC Requirement

The body of all Professional Class 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.

T3.1.8 Component and Sub Assembly Manufacturing

[10 Pt Penalty]

For a component to be deemed to exist it must be designed, manufactured and presented as a discrete part. They **MUST NOT** be digitally merged in CAD software and manufactured as a single part. Certain components are considered functional sub-assemblies and **MAY** be manufactured either as separate parts or as a single integrated part, provided their grouping is explicitly allowed below:

Nose Cone Assembly

2. Front Wing

4. Nose Cone

11. Wing Support Structures

Tether Guide Assembly

7. Tether line guide support system

8. Tether line guides

Halo Assembly

9. Halo

10. Drivers Helmet

Rear Wing Assembly

3. Rear Wing

11. Wing Support Structures

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 R2.4.1.3 in the Victorian Competition Regulations

T3.3.3 Hand Finishing

[10 Pt Penalty]

Hand finishing of the car assembly is permitted. Refer ARTICLE T1.23. Maximum variation to CAD model - including Critical Regulation Rectification processes - is 3mm.

T3.3.4 Hand Created Features

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

[Advice]

Each team will receive a unique Team Number. This must be displayed on the race car's body, positioned specifically between the leading edge of the halo and the leading edge of the front tires. The team number **MUST** be clearly visible in the plan view. Teams **MUST** create and apply their own Team Number to their vehicles before the event.

18
A

Decal Font: Formula 1 Font

Minimum Font Height for Number: 8mm

Minimum Font Height for: 8mm

T3.4.2 Wyndham Tech School. 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 Wyndham Tech School 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 Wyndham Tech School 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 STEM Racing 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 T1.22. 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 Wyndham Tech School 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.

[0.05 Time Penalty | 4 Pt Penalty]



T3.5 Undefined Features

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



T3.6 Overall Dimensions

T3.6.1 Overall Length

[0.02 or 0.05 Time Penalty | 4 Pt Penalty]

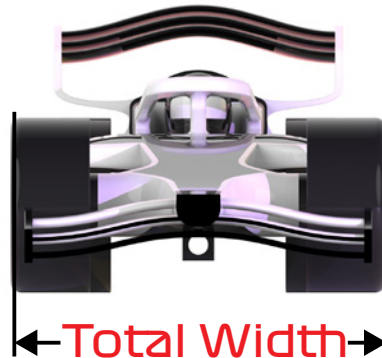
The overall length of the complete car measured between the front and rear extremes of the car product, including all components with the exception of the CO2 cylinder, **MUST** be a minimum of 170mm and a maximum of 210mm.



T3.6.2 Overall Width

[0.02 or 0.05 Time Penalty | 4 Pt Penalty]

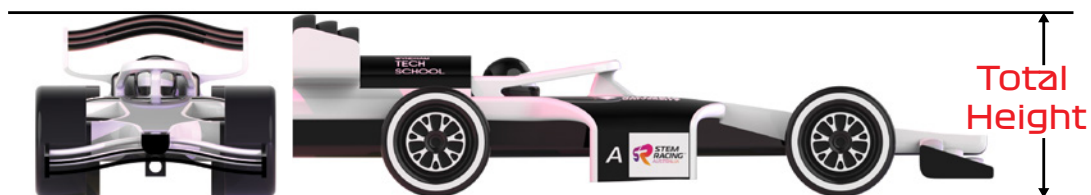
The overall width of the complete car measured normal to the vertical reference plane, between the outer edges of the widest feature of the car assembly **MUST** be a minimum of 65.0mm and a maximum of 85.0mm.



T3.6.3 Overall Height

[0.02 or 0.05 Time Penalty | 4 Pt Penalty]

The overall height of the complete car measured between the track surface and the highest feature of the car assembly, **MUST** be a maximum of 65.0mm.



T3.7 Minimum Mass

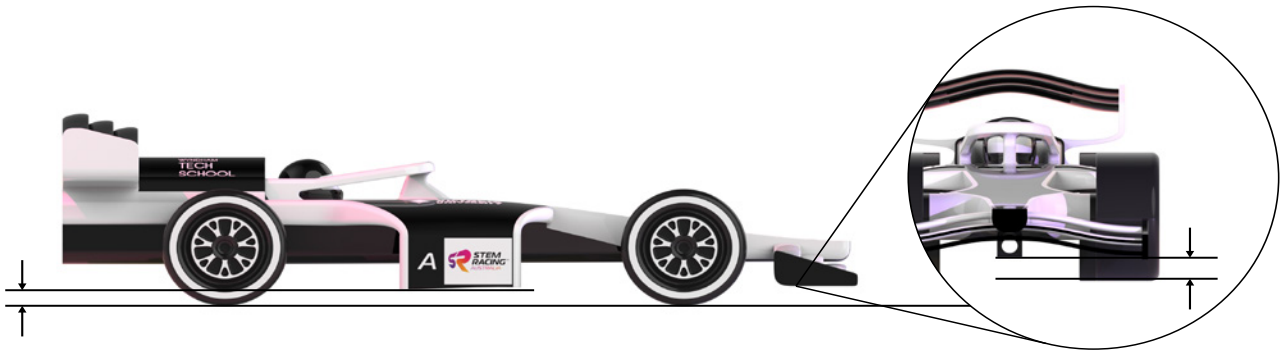
[Eligibility]

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

T3.7.1 Professional Class: 50 grams

T3.8 Track Clearance

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 Default Material Components

All components for a completed car **MUST** be made from a single default material as defined in these regulations. The default material must be clearly identified in all submitted engineering drawings.



T3.9.1 Default Material

[0.05 Time Penalty | 4 Pt Penalty]

T3.9.1.3 Professional Class

Balsa wood is the default material for the body of the car. Other materials can only be used as explicitly specified.

T3.9.2 Thickness

[1 Pt Penalty]

Default material 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 WTS website. For this part and more free downloads, please visit www.wyndhamtechschool.vic.edu.au/vicstemracing. 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



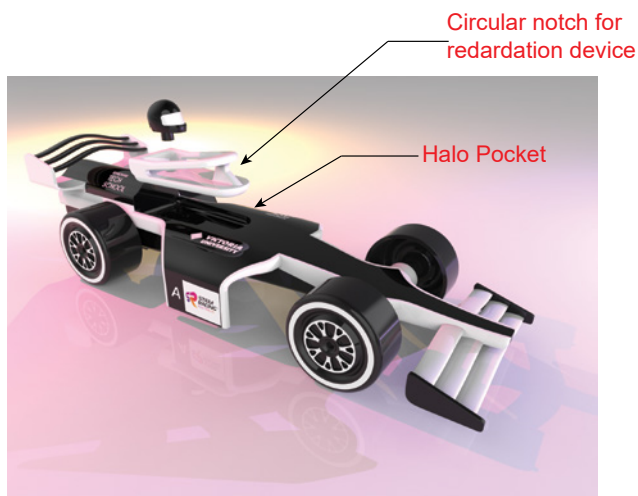
TOP VIEW



ISOMETRIC VIEW - TOP

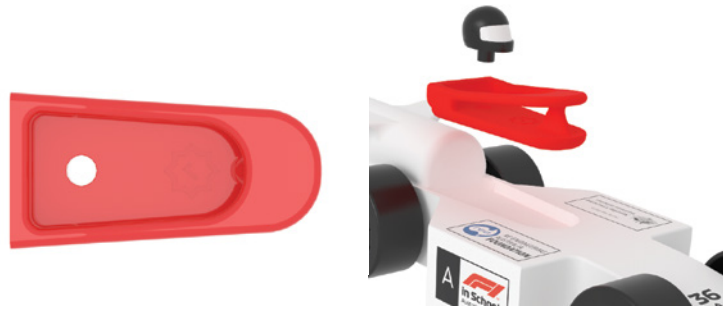


ISOMETRIC VIEW - BOTTOM



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 www.wyndhamtechschool.vic.edu.au/vicstemracing. 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.



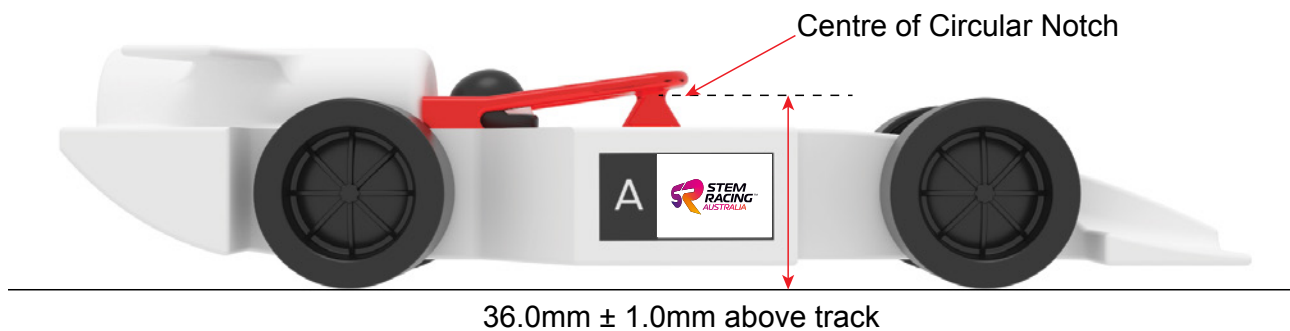
- T4.4 Halo visibility top view** [0.05 Time Penalty | 4 Pt Penalty]
- The Halo **MUST NOT** be physically obstructed in the plan view except by the helmet.

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 (± 1.0 mm) 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]**

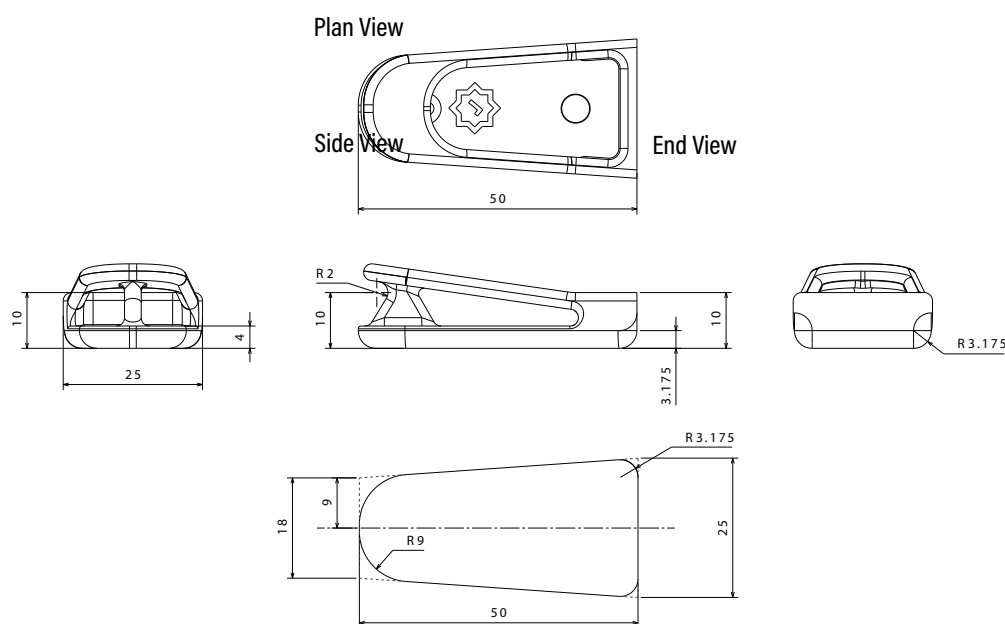
When the car is positioned horizontally on a power unit cartridge with the halo oriented downward, a load weighing 400 grams will be hung from the halo.

**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 www.wyndhamtechschool.vic.edu.au/vicstemracing. 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 $\pm$ 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 **55mm**. Any part having a width less than **55mm** is not considered a side pod.

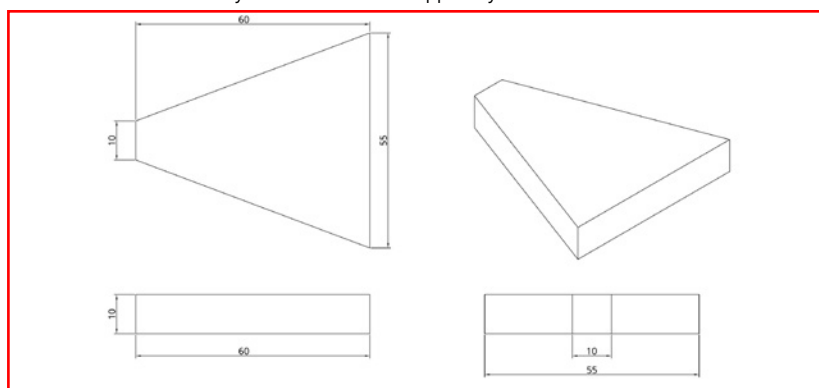
T5.4 Side Pod Projected Surface [2 Pt Penalty]

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



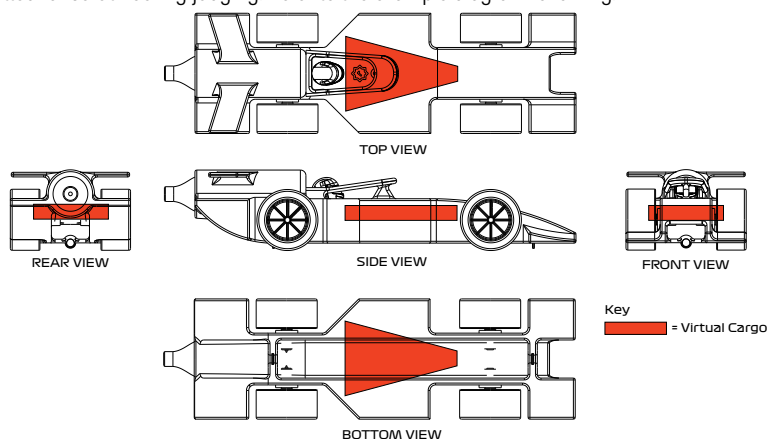
T5.5 Virtual Cargo [0.02 or 0.05 Time Penalty | 4 Pt Penalty]

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 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.

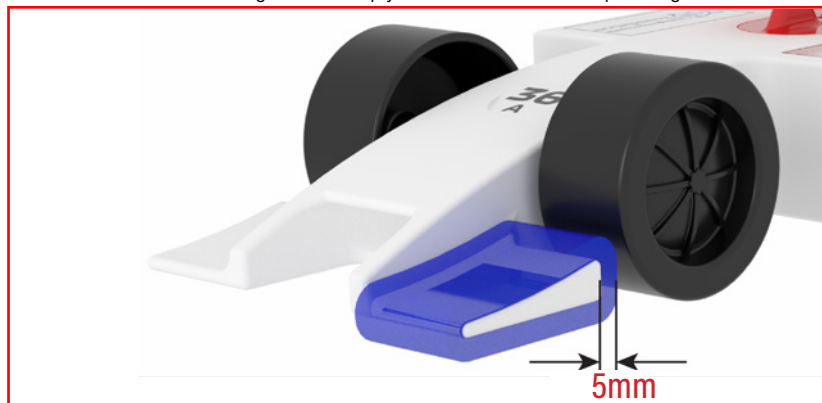
ARTICLE T7 - WING REGULATIONS

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.

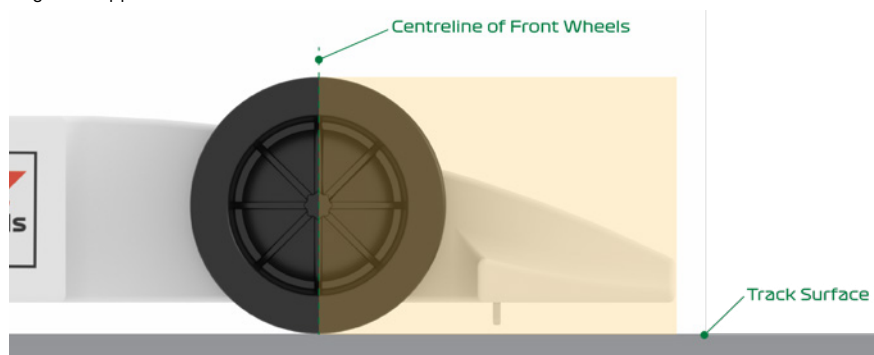
T7.3 Clear Airspace
T7.3.1 Front Wing [0.02 or 0.05 Time Penalty | 4 Pt Penalty]
 For a front wing to be deemed to exist, the wing surface **MUST** have a minimum of 5mm of clear 'air' space, to any other part of the car and track surface, measured normal from any part of the front wing's upper, lower, 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 5mm 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

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 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 Min. 50mm



T7.8.2 Rear wing span

[0.02 or 0.05 Time Penalty | 4 Pt Penalty]

T7.8.2.1 Min. 50mm

T7.9 Span Segments

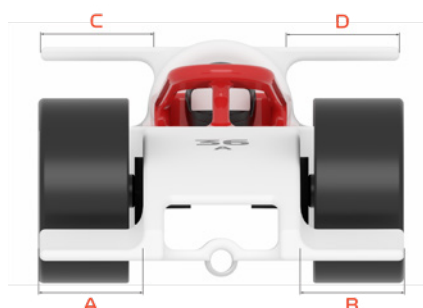
[Advice]

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

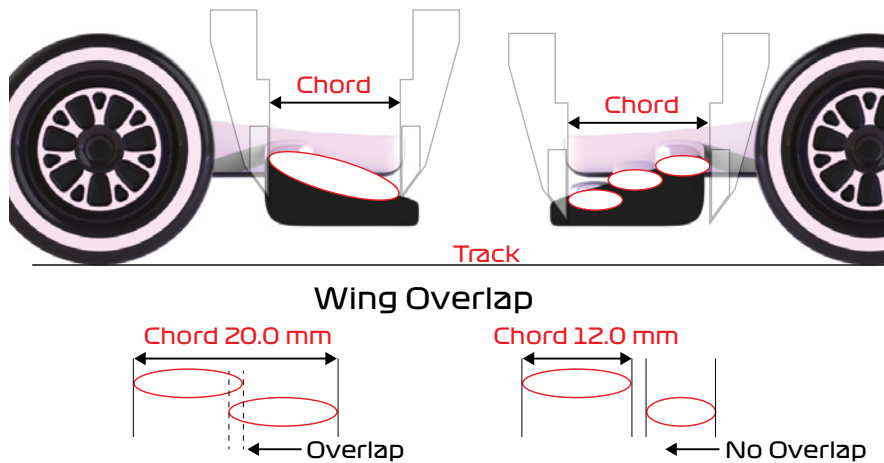
The wing chord requirements **MUST** be satisfied throughout the wing's minimum span. The chord is the distance between the leading edge and trailing edge measured parallel to the vertical reference plane. Multi vane wings **MUST** Overlap.

T7.10.1 Front wing chord - Min: 15mm / Max: 25mm

[2 Pt Penalty]

T7.10.2 Rear wing chord - Min: 15mm / Max: 25mm

[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 Min: 2mm / Max: 6mm

[2 Pt Penalty]

T7.11.2 Rear wing thickness Min: 2mm / Max: 6mm

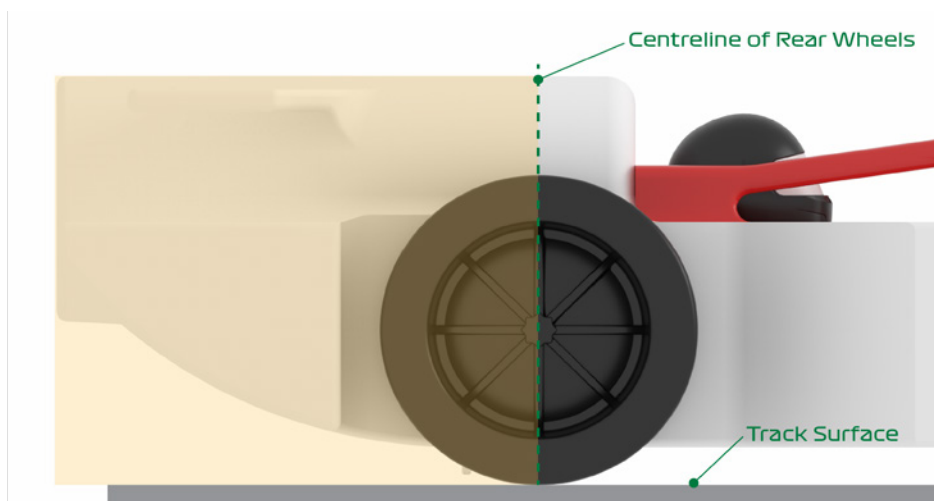
[2 Pt Penalty]



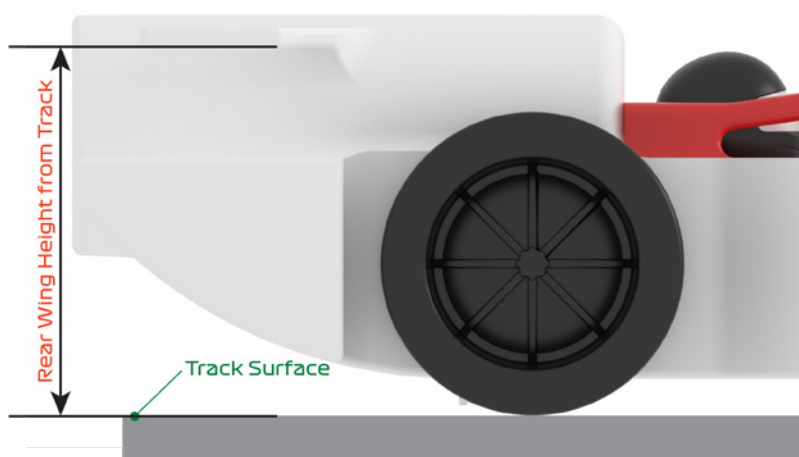
T7.12 Rear Wing Positioning

[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.



- T7.15 Rear Wing & Support Structure Construction Material** [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.

T8.1.1 Distance between Opposing Wheels

This is measured as the innermost distance between the rotating wheel components of two opposing wheels measured parallel to the track surface

T8.1.2 Front Axle Min. 38mm

[0.05 Time Penalty | 4 Pt Penalty]

T8.1.3 Rear Axle Min. 30mm

[0.05 Time Penalty | 4 Pt Penalty]

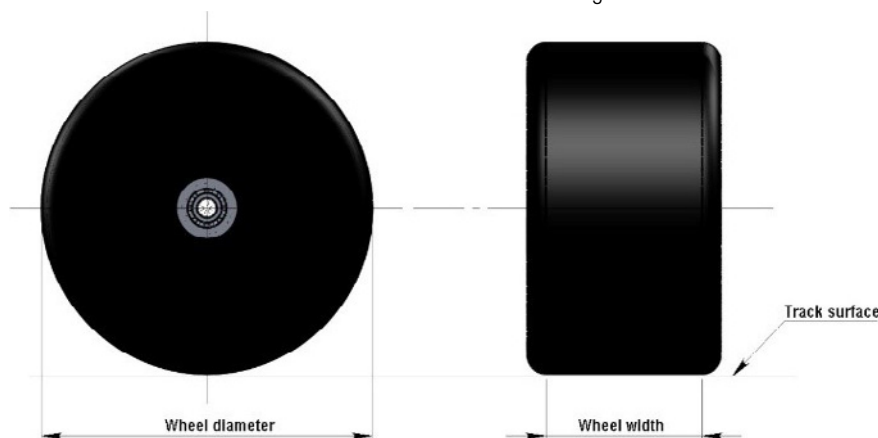
T8.2 Standard Wheels

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 28mm.



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: 13.0mm [0.05 Time Penalty | 4 Pt Penalty]

T8.4.2 Rear Wheels: Min: 17.0mm [0.05 Time Penalty | 4 Pt Penalty]

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]

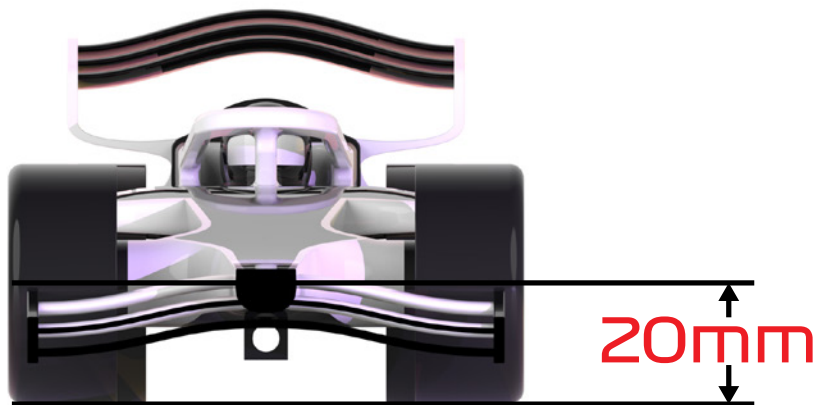
Wheel dimensions **MUST** be consistent in diameter and circumference across the contact width of the wheel (i.e., “tyre tread” is not allowed)

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 20mm 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: 5.0mm

T8.9.2 Behind front wheels

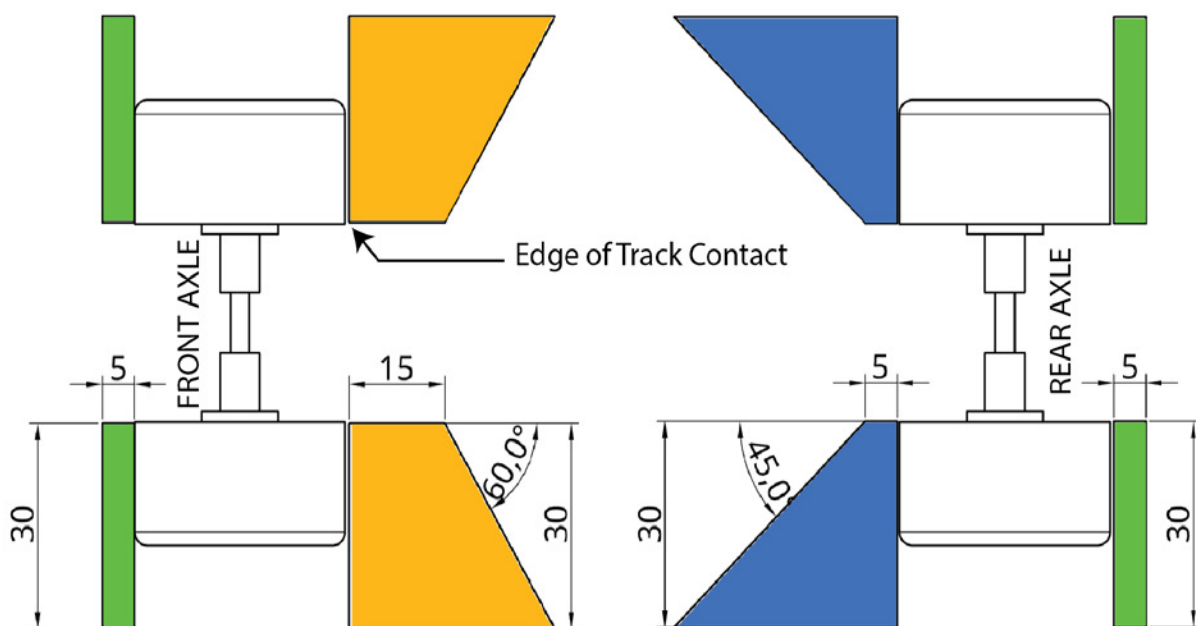
Minimum dimensions on diagram below

T8.9.3 In front of rear wheels

Minimum dimensions on diagram below

T8.9.4 Behind rear wheels

Min: 5.0mm

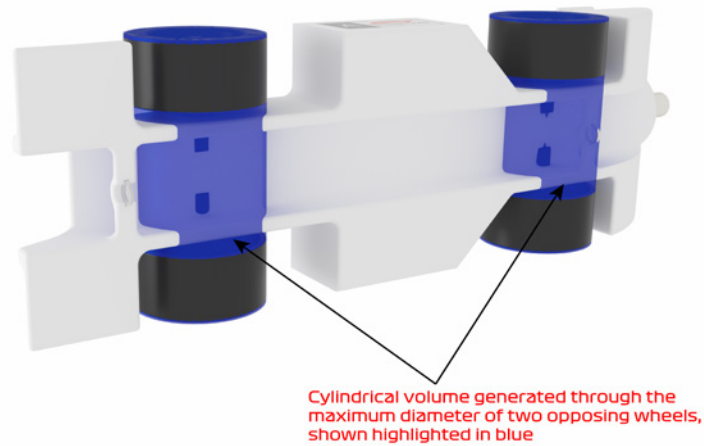


ARTICLE T9 - WHEEL SUPPORT REGULATIONS

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.

T9.5 Modifications

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

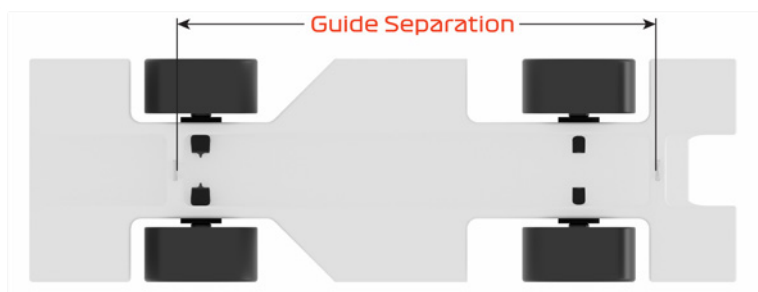
[Eligibility | 10 Pt Penalty]

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]

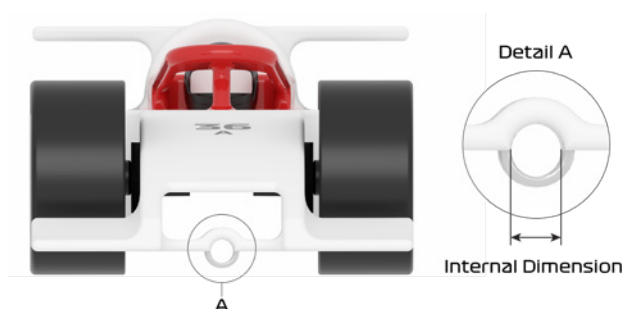
The longitudinal separation of the tether line guides as measured between the inside edges of the guides **MUST** be a minimum of 120mm.



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 3.5mm / Maximum of 6.0mm



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

- T10.6 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:
- T10.6.1** A tether guide support system must be connected to one and only one tether guide.
 - T10.6.2** Material of tether guide support system must be non-metallic.
 - T10.6.3** No part of the front tether guide support system may exist rearward of the front tether guide by more than 10 mm.
 - T10.6.4** No part of the rear tether guide support system may exist forward of the rear tether guide by more than 10 mm.
 - T10.6.5** A tether guide support system must be one continuous component, and not an assembly of separate components.
 - T10.6.6** A tether guide support system must not exist simultaneously both in front of and behind a wheel support.

ARTICLE T11 - POWER PLANT PROVISIONS

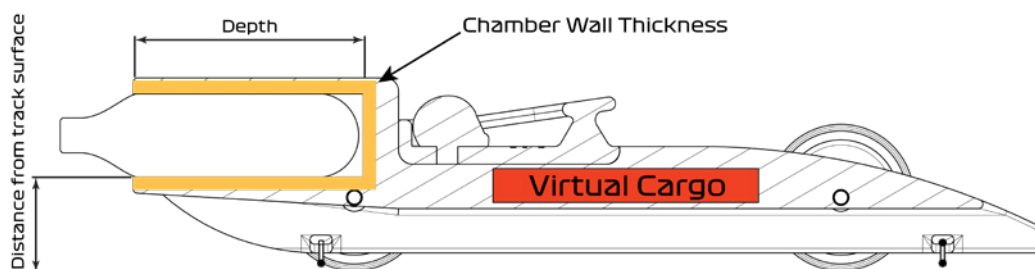
- T11.1 Interfacing with Launch Pod** [Eligibility | 20 Pt Penalty]
- The cylinders provide the car propulsion and when fully inserted, all cars **MUST** interface directly with the standard track starting pod mechanism without the use of additional launch equipment.

- 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 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



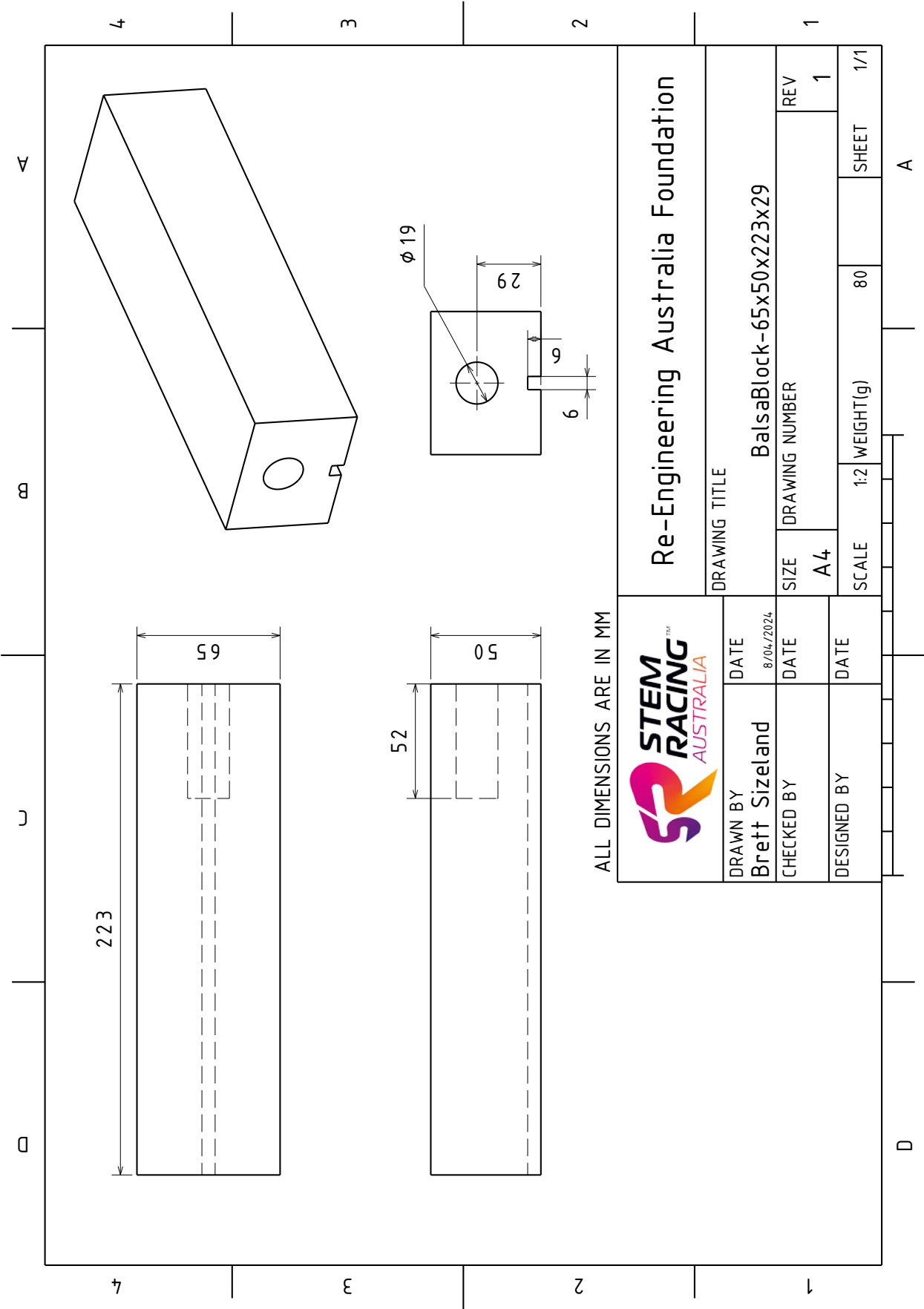
- T11.6 Finishing of Chamber Surrounds** [1 Pt Penalty]
- Paint and other foreign materials **MUST NOT** be present inside the CO2 cylinder chamber. This is considered a measure of manufacturing quality control.

- 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

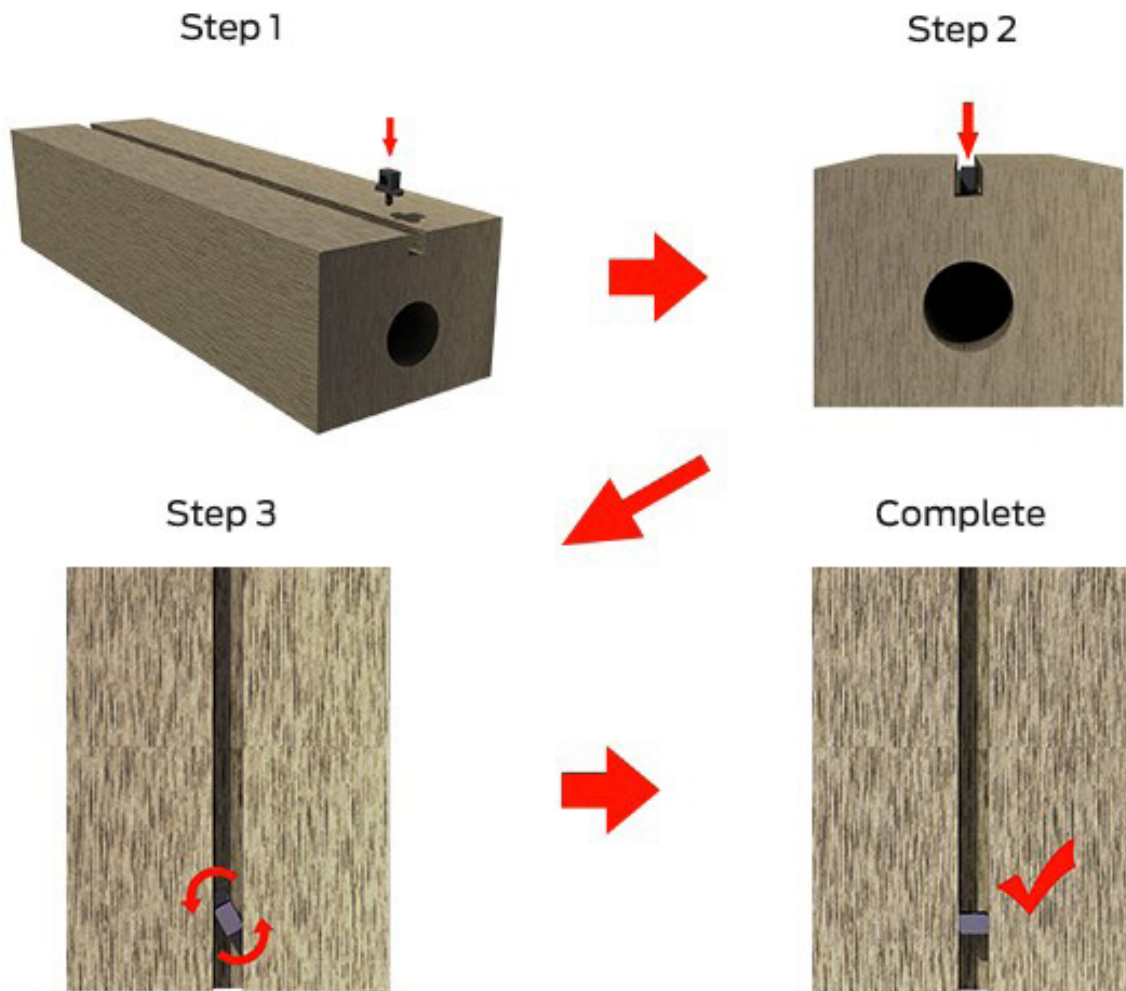
T12.1 Official REA Balsa Block Dimensions

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

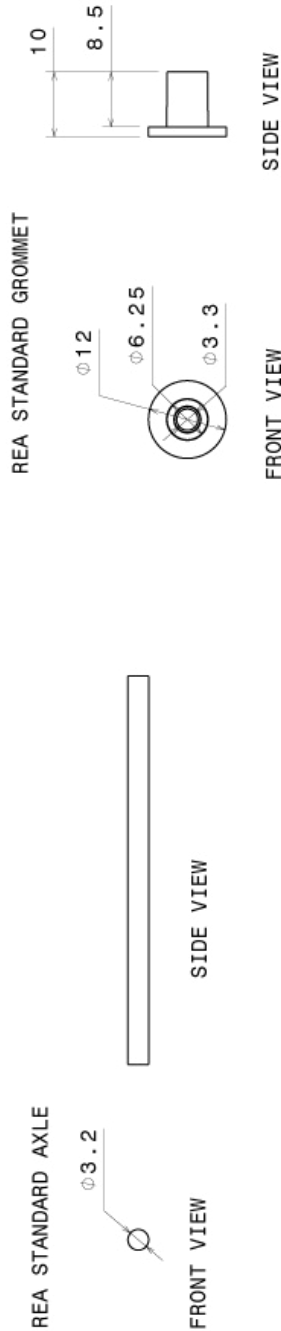
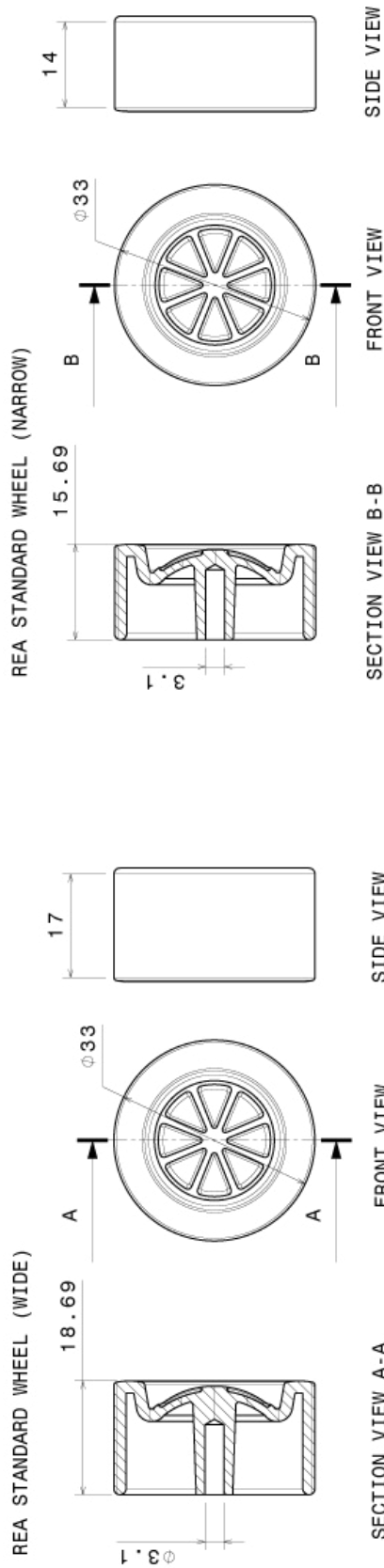


T12.2 REA Standard Tether Guide Insertion Instructions

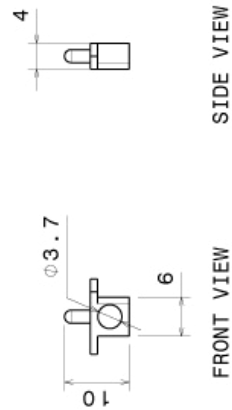
Can be used in balsa wood blocks.



T12.3 Official REA Standard Wheel Kit



REA STANDARD TETHER GUIDE

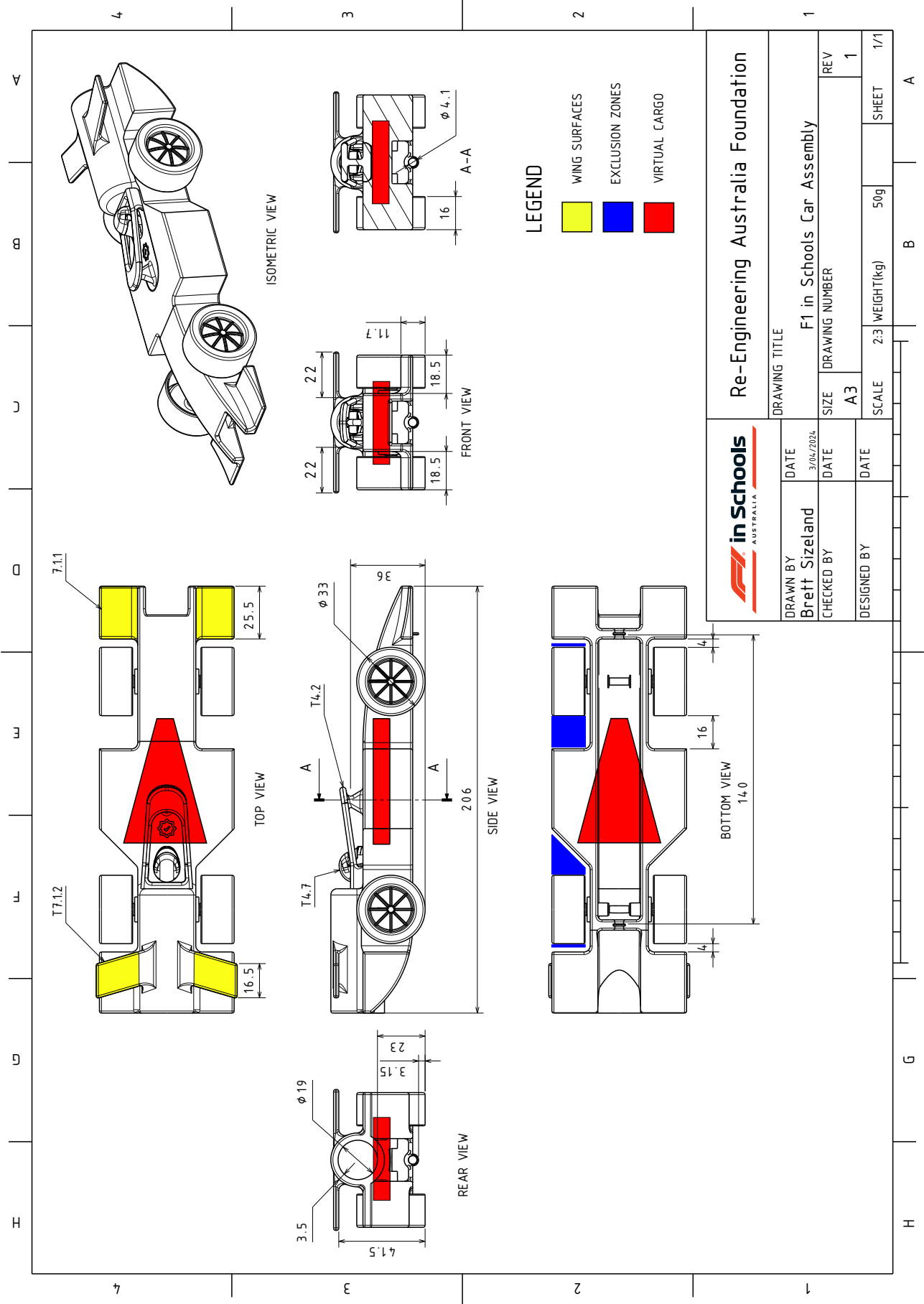


ALL MEASUREMENTS ARE IN (MM) UNLESS OTHERWISE STATED

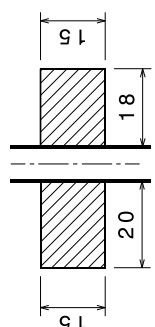
DESIGNED BY: B. SIZELAND	REA STANDARD WHEEL KIT		
DATE: 20/05/2015			
CHECKED BY: W. SMITH			
DATE: 20/05/2015			
SIZE: A4	Re-Engineering Australia Foundation		
SCALE: NB 0.00	RETURN (N)	REAR - WK	SHEET 1/1

This drawing is our property. It can't be reproduced or communicated without our written agreement.

T12.4 Example Orthogonal Drawing

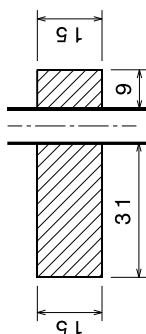


T12.5 Wing Span Diagram



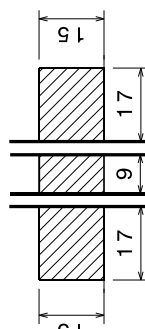
SPAN: 20+18=38

PASS: Balsa
FAIL: Alternative



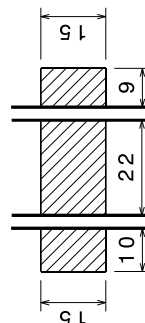
SPAN: 31+0=31

FAIL: Balsa
FAIL: Alternative



SPAN: 17+0+17=34

PASS: Balsa
FAIL: Alternative



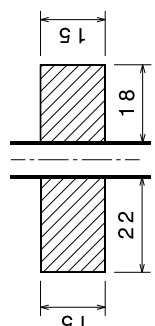
SPAN: 10+22+0=32

FAIL: Balsa
FAIL: Alternative

SCRUTINEERING PRINCIPLES:

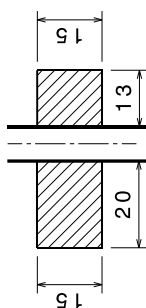
3) THE SPAN OF A SEGMENT MUST BE AT LEAST 10 mm TO BE INCLUDED IN WING SPAN CALCULATION (RULES T6.8)

4) CHORD (T6.9), THICKNESS (T6.10) AND CLEAR AIRSPACE RULES (T6.2) APPLY OVER EACH VALID WING SEGMENT



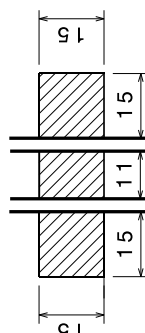
SPAN: 22+18=40

PASS: Balsa
PASS: Alternative



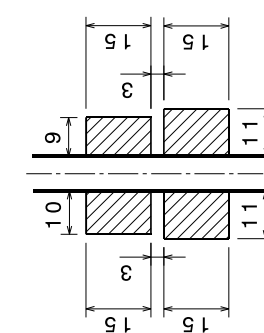
SPAN: 20+13=33

FAIL: Balsa
FAIL: Alternative



SPAN: 15+11+15=41

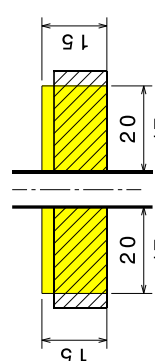
PASS: Balsa
PASS: Alternative



SPAN: 11+10+11+0=32

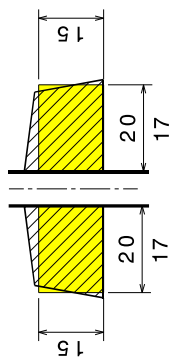
FAIL: Balsa
FAIL: Alternative

WING SEGMENTS



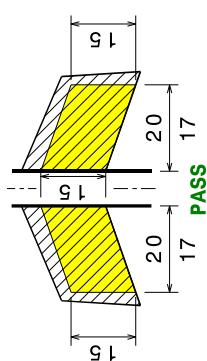
PASS: Span

FAIL: Chord+Thickness

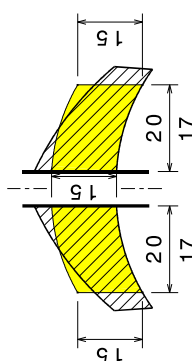


PASS: Span

FAIL: Chord+Thickness



PASS



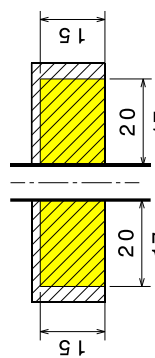
PASS: Span

FAIL: Chord+Thickness

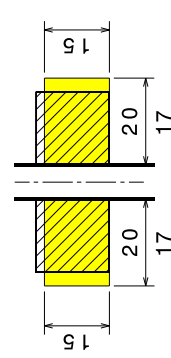
SCRUTINEERING PRINCIPLES:

1) ACTUAL WING PROFILE (CROSS-HATCHED) MUST TOTALLY ENCLOSE THE MINIMUM SPAN AND CHORD AREA (YELLOW) (RULES T6.7 AND T6.9)

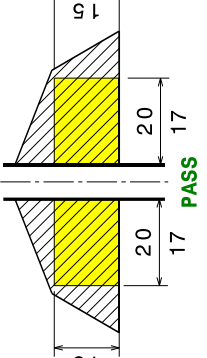
2) THICKNESS RULE (T6.10) AND CLEAR AIRSPACE RULE (T6.2) APPLY OVER ENTIRE ACTUAL WING PROFILE (CROSS-HATCHED)



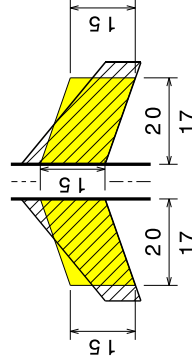
PASS



FAIL: Span+Chord+Thickness

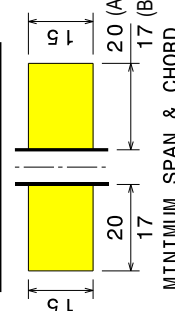
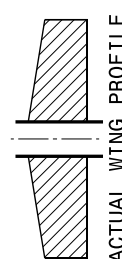


PASS



PASS: Span

FAIL: Chord+Thickness



MINIMUM SPAN & CHORD

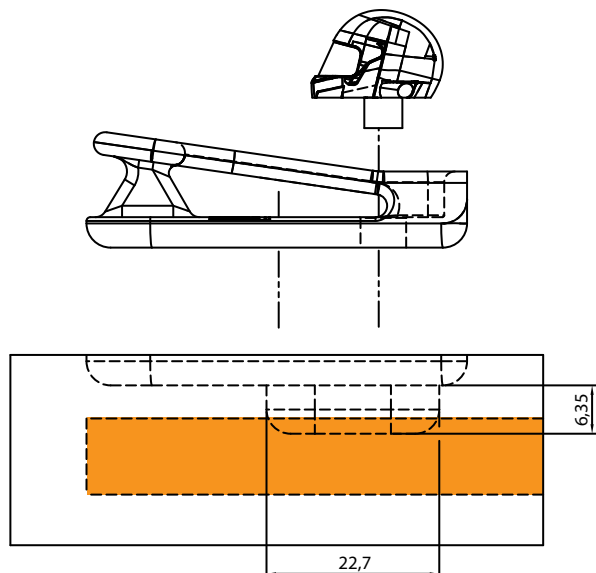
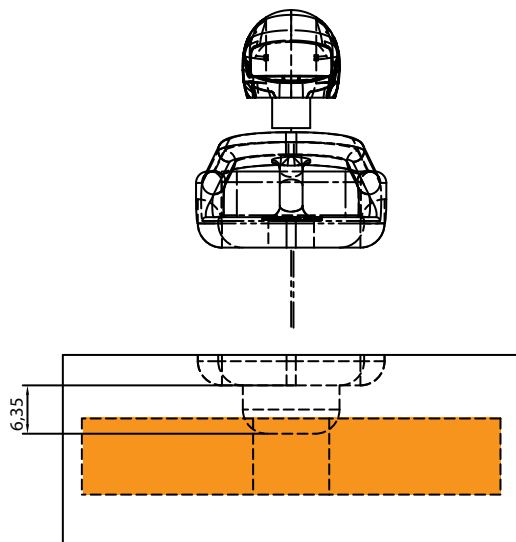
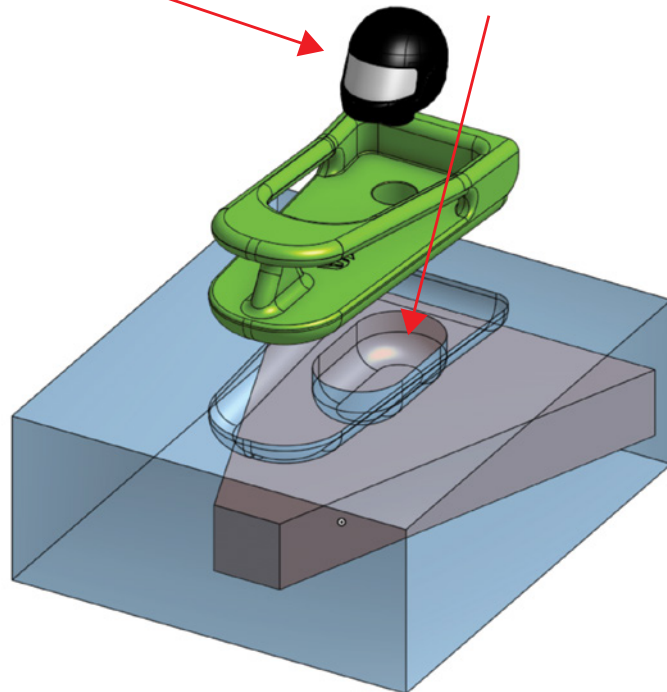
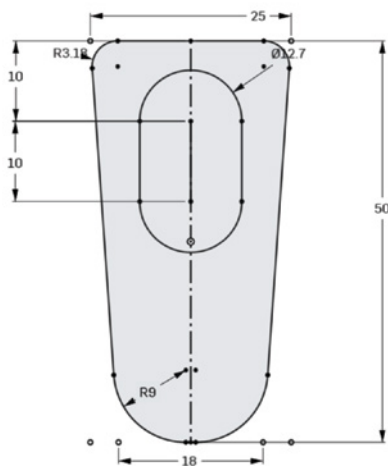
2-PIECE SYMMETRICAL WING

T12.6 Legal Ballast Pocket

The helmet must be removable to be able to add ballast

Legal Ballast may only be inserted into the ballast container

Halo Pocket & Ballast Container Drawing



The Virtual Cargo MAY coincide with the Ballast container but not the Halo pocket

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