Quantum VICTORIA

A Centre of Excellence & Innovation in Science & Mathematics

PrintACar Challenge

Field Guide

2025

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Overview

The Quantum Victoria PrintACar Challenge is a statewide competition providing Primary and Secondary Students with an authentic STEM project. It combines design thinking, teamwork, 3D printing technologies, and friendly competition to foster creativity, critical thinking, and a passion for STEM education.

Students have a chance to test their 3D printed creations against those of other teams. This aspect encourages students to refine their designs, optimise performance, and apply principles of physics and engineering to achieve the best results.

This field guide outlines all requirements for entry into the 2025 PrintACar Challenge.

Objective

The Quantum Victoria PrintACar Challenge aims to provide an authentic application of a design process and engage students in the processes of 3D modelling and printing.

Eligibility Criteria

A school may enter a maximum of

- Two teams from primary year levels (3-6) AND
- Two teams from secondary year levels (7-12).

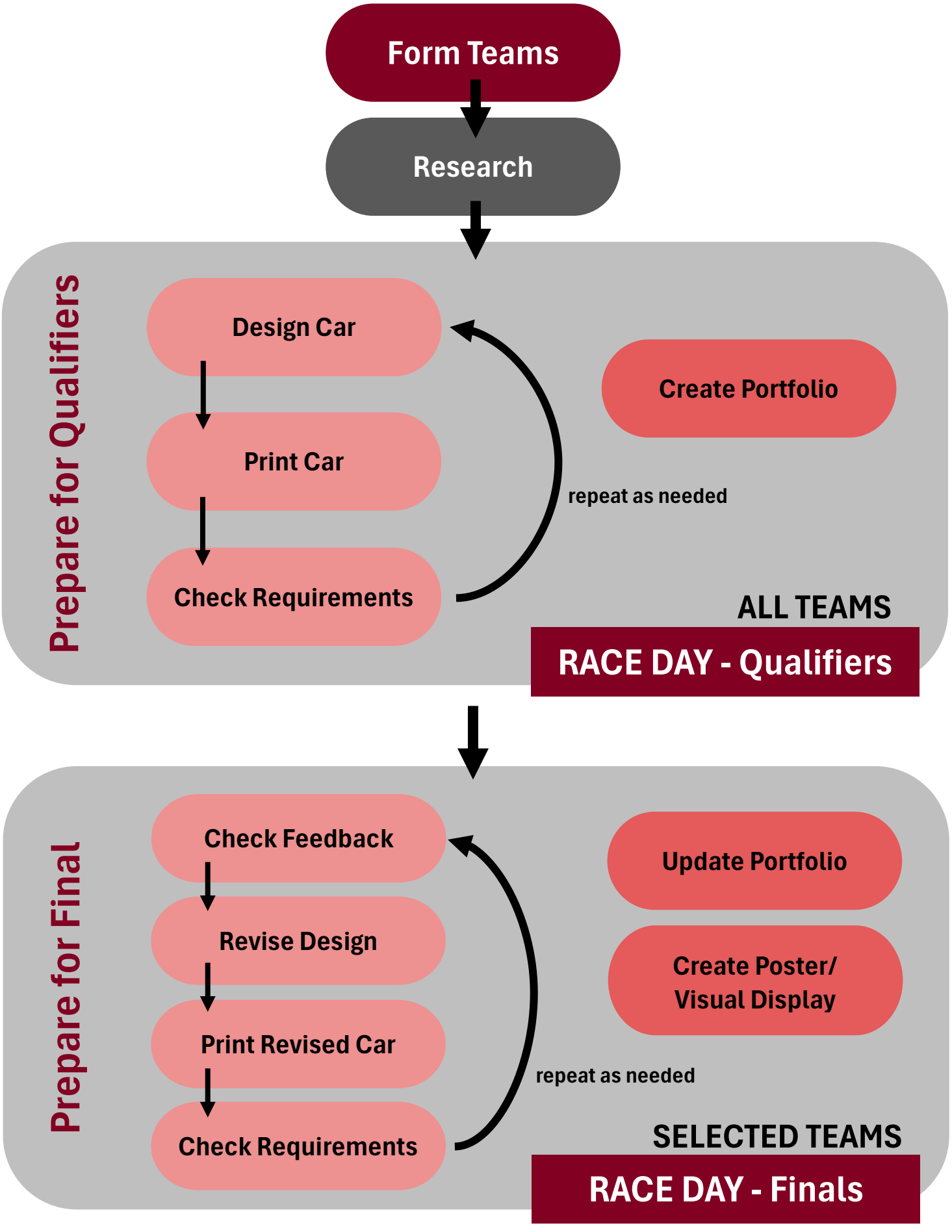
Individual students may compete in no more than two years of PrintACar in primary year levels and two years in secondary year levels.

Teams must be available to attend the Finals Day onsite at Quantum Victoria.

Please also note that a school **cannot** be awarded an Overall Winner prize two years in a row.

If you have any questions regarding the contents of this field guide, please contact admin@quantumvictoria.vic.edu.au.

PrintACar Challenge Process



Challenge Description & Race Days

Categories

Primary teams and secondary teams compete in separate categories. The Challenge consists of two stages of racing: Qualifiers and Finals. All teams compete in the Qualifiers stage. The top 10 teams in each category are then invited to compete in the Finals stage. This is determined according to the criteria outlined in this document.

Qualifiers Race Day

The Qualifiers will be held on Thursday 21st August and Friday 22nd August 2025 at Quantum Victoria. There will be four sessions over the two days (morning 9:30am – 11:30am and afternoon 1:00pm and 3:00pm). Teams will be asked to nominate their session preference. Schools will be advised of session allocation at least two weeks prior to the day.

We strongly encourage teams to attend onsite if practical. However, if this is not possible, you have the option of watching our livestream online.

Finals Race Day

Finals Race Day will be held on Friday 28th November 2025 from 9:15am to 2:15pm at Quantum Victoria. Teams are required to attend the Finals in person.

2025 Updates

Every year Quantum Victoria makes changes to the specifications for the Challenge. This ensures originality of designs and allows students to compete more than one year. Teams should read through all requirements closely.

This year, the following changes have been made:

- The weight requirements and the wheel & axle specifications.
- Minor modifications to other car specifications.
- The penalty system has been clarified to ensure transparency of decisions, and rubrics have been provided for your reference.
- For the Finals Day, all posters/visual displays must be a physical resource.

Racing Safety

Quantum Victoria retains the right to refuse the racing of any car.

Cars that are judged by the Quantum Victoria (QV) team to be unsafe to race or likely to cause damage to the track will not be raced. This includes the situation where a car becomes unsafe during racing. In the event that a car is deemed unsafe at the time of submission, the Quantum Victoria team may endeavour to modify the car to ensure safe racing. However, if this occurs, the car may still incur a disqualification.

2025 Key Dates

Mid-February *Term 1 Week 4*	Expressions of Interest Open
Mid-March *Term 1 Week 6*	Field Guide Published Team Registrations Open
Friday 6th June *Term 2 Week 7*	Team Registrations Close
Friday 25th July *Term 3 Week 1*	Optional Car Feedback Close
Wednesday 6th August *Term 3 Week 3*	Qualifiers Car/s DUE – Delivered to Quantum Victoria Qualifiers Paperwork DUE: • Portfolio • Model Files • Self-Assessment • Recording Consent (if attending onsite)
Thursday 21st August *Term 3 Week 5*	Qualifiers Race Day 1
Friday 22nd August *Term 3 Week 5*	Qualifiers Race Day 2
Friday 14th November *Term 4 Week 6*	Finals Paperwork DUE: • Portfolio • Model Files
Friday 28th November *Term 4 Week 8*	Finals Race Day Finals Submissions DUE: • Finals Car • Poster/Visual Display • Self-Assessment

PrintACar Challenge Specifications
QUALIFIERS

Judging Overview

Judging of the Qualifiers stage is based on the assessment of a portfolio, the racing results, the car construction and a self-assessment.

2025 Qualifiers Judging	Point Distribution
Portfolio	**50%**
Racing Results	**35%**
Car Construction	**10%**
Self-Assessment	**5%**

Portfolio – 50%

Overview

Each team must produce a portfolio that outlines the design process undertaken. The document should demonstrate the development of the 3D-printed car, from concept to racing.

Submission & Assessment

Portfolios must be saved as an Adobe PDF document (.pdf) and be submitted electronically via the QV Google Drive link provided. Other file types will not be accepted or marked.

Portfolios will be assessed by the QV Team according to the requirements below and using the Portfolio Rubric (Appendix A).

Section 1 – Team Profile **3 Points**

- ☐ Name of school
- ☐ Name of team (displayed in addition to logo)
- ☐ Team logo
- ☐ Names of team members
- ☐ Roles of team members
- ☐ Individual photos of each team member OR a group photo of the team

Section 2 – Design Process — 29 Points

☐ State the 3D modelling software used and why it was used.

☐ Provide images of what inspired your design with notes/labels/comments explaining why it motivated you. Highlight which features you chose to include in your car design.

☐ Discuss how the shape and at least two additional features of your car will affect the speed. Include the relevant physics concepts in your discussion of **each** feature.

☐ Discuss how the wheel design will affect the speed of the car. Include the relevant physics concepts in your discussion.

☐ Include at least three images of your car design throughout the 3D Modelling process**.** All images should be labelled to show features and changes that have occurred.

- Images from the **beginning** (e.g. hand-drawn sketches)
- Images from the **middle** (e.g. screenshots from design software during the modelling phase)
- Images of the **completed initial car design** (e.g. screenshots from design software when the car design is ready to print)

☐ List the modifications that the team wanted to make to the initial prototype.

☐ Explain which modifications were made and why. Which modifications did you not include and why?

☐ Describe and reflect on the steps you took in each stage of the design process to get to your final design. Include research, brainstorming, concept sketches, prototyping and iterations.

☐ Include at least six images and/or screenshots of the final car (either in the modelling software or of the printed car), showing each listed feature below and showing exact **measurements** in millimetres.

☐ Car Body - *three images (one side, other side and front/back)*
- length (side view)
- width/depth (front or back view)
- height (side view)

☐ Cylinder Hole – *one or two images*
- diameter
- depth
- width of material around the hole

☐ Eyelets - *one or two images*
- distance between each eyelet
- depth of each eyelet
- width of material around the hole

☐ Wheels - *one or two images*
- diameter

Section 3 – Printing Process — 15 Points

☐ What brand and model printer did you use?

☐ What type of material did you use? List the manufacturer, material type and colour.

☐ Discuss the properties of this material and how it affected the printing of your model (e.g. strength, durability, flexibility and ease of printing).

☐ What printing/slicing (not 3D modelling) software did you use?

☐ Provide two or more pictures of any **printed** prototype cars.

☐ What printing challenges did you encounter when you printed your prototype and your final car? How did you solve these challenges?
For example:

- Print quality challenges
- Software challenges

☐ Provide two or more pictures from different angles of the final car/s on the print bed - before being removed from the print bed.

Section 4 – Reflection (paragraph) — 3 Points

☐ Describe the team's experience of preparing for the PrintACar Challenge. Include responses to the following questions:

- ☐ What was the best part of the PrintACar Challenge?
- ☐ What was the most difficult part of the PrintACar Challenge?
- ☐ How well did you work as a team?
- ☐ What would you do differently next time?

Racing Results – 35%

Car Submission

Number of Cars

Each team must submit one car (and optionally a second car) to participate in the Qualifiers Race Day. This means that each team may submit a maximum of two cars.

Each car must be of an ORIGINAL design. The car should be designed by the participating team and the car design must not have been submitted to Quantum Victoria for any previous PrintACar Challenge.

Submission

Cars must be delivered to Quantum Victoria (235 Kingsbury Dr, Macleod VIC 3085) prior to the Qualifiers Race Day. See the Key Dates on page 6 for appropriate deadline.

This allows the cars to be assessed and checked for safety before the Qualifiers Race Day. Cars will be assessed by the QV Team according to the requirements below and using the Car Rubric (Appendix B).

If the school chooses to send the car via a post/parcel delivery service, this is to occur at the school's expense. Tracking details should be provided to Quantum Victoria within one business day of dispatch to ensure safe receipt of the car.

Self-Assessment

A self-assessment (Appendix D) must be completed for each car. This should be submitted at the same time as the car and portfolio. See Self-Assessment section below (page 16) for more detail.

Additional Feedback Option

Teams may submit their car/s early to the QV Team for feedback. Cars will be checked against the disqualification and race-ability criteria. This option allows the team to make changes before the submission date and resubmit.

Schools who would like their cars returned will need to arrange for return postage/pick up.

Please see the Key Dates on page 6 for the Optional Car Feedback closing date.

Points & Penalties

Racing and Ranking

Each car will race three times and will receive a final Race Time which will be based on their average time. Any time penalties incurred for breaches to car design specifications will be added to these times and used in the calculation of the Race Time.

Race Times will be used to rank the cars in order of speed. The team with the fastest car in each category will receive 100% of the available points. Cars will then be allocated points proportional to their rank.

Exceptions

Any car that does not make it all the way down the track will receive a time of 10.00s.

Any car that has been disqualified but is being raced down the track will receive a time of 20.00s. A disqualified car receives zero racing points.

Penalties

The Car Design Specifications contribute to the Racing Results portion of the Judging.
Cars are marked according to the specifications below and using the Car Rubric (Appendix B).

Any specification not met will incur the penalty indicated next to the individual specification.
Penalties are cumulative and applied to the car as a whole.

Types of Penalties

Time penalty

- Indicated by a number of seconds (e.g. +2.0s).
- This type of penalty is applied where the specification is designed to ensure fair and equitable competition.
- **The specified time penalty is added to the car's race time.**

Disqualification

- Indicated by the word "DISQUALIFICATION" or "DQ".
- This type of penalty is applied where the specification is designed to ensure safety of the participants and prevent damage to the track.
- **A disqualified car receives no racing points.**

Both penalties

For a specification that lists both types of penalty, the time penalty will be applied if the car is deemed safe to race. If the car cannot be deemed safe to race, then the car will be disqualified.

Manufacturing & Assembly Specifications		Penalty
1	**Manufacturing:** All components of the car must be manufactured using 3D Fused Deposition Modelling (FDM) printing technology with ABS or PLA filaments. Exceptions: • Axles: we recommend the use of brass rod. • Adhesives: used to stick wheels to axles or parts of the car together. Please refer to the FAQ (Appendix F) for acceptable adhesives. • (For Finals Day only) Paints, sealants and stickers (paints and sealants must be dry and any stickers must not fall off).	**DISQUALIFICATION**
2	**Axles:** The axles must freely rotate within the car; wheels may be fixed or rotate on the axle.	**+2.0s**
3	**Assembly:** Car must be fully assembled. This includes: • any gluing of pieces • wheel attachment • (For Finals Day only) painting	**+1.0s** **OR** **DISQUALIFICATION**
Dimension Specifications		**Penalty**
4	**Weight:** Car must have a mass of **110g or more**. *Car will be weighed fully assembled without the CO_2 canister.*	**+2.0s**
5	**Length:** Car must have a length between **95mm - 140mm**. *Car will be measured fully assembled from front-most point to rear-most point.*	**+0.2s**
6	**Height:** Car must have a height between **55mm - 90mm**. *Car will be measured fully assembled from the resting surface to the highest point.*	**+0.2s**
7	**Width:** Car must have a width of between **55mm - 90mm**. *Car will be measured fully assembled at the widest point.*	**+0.2s**
8	**Wheels:** **a.** Wheels must have a diameter of between **20mm - 50mm.**	**+0.2s**
	b. The number of wheels must be even (e.g. 2 or 4) and aligned forward (pointing towards the front).	**DISQUALIFICATION**

Cylinder Hole Specifications		Penalty
Cars are propelled down the track using carbon dioxide canisters. These will be provided and managed by Quantum Victoria. **Each car must have a cylindrical hole or opening for the safe placement of the canister.**		
9	**Cylinder Hole:** **a. Alignment:** The hole must be aligned to the centre of the car and the length should be parallel to the ground.	**+0.2s** **OR** **DISQUALIFICATION**
	b. Diameter: The hole must have a diameter between **19mm - 20mm**.	**+0.2s** **OR** **DISQUALIFICATION**
	c. Depth: The hole must have a depth between **50mm - 52mm**.	**+0.1s** **OR** **DISQUALIFICATION**
	d. Material surrounding the hole: The material surrounding the hole must measure **no less than 3mm** in any direction around the hole. The only opening to the hole must be at the rear of the car.	**DISQUALIFICATION**
	e. Circular shape: The hole must be a circular shape (not oval). i.e. the diameter should be the same in all orientations	**+0.2s**
	f. Inner End: The inner end of the cylinder hole must be flat (not curved).	**+0.2s**
10	**Cylinder Hole Location:** To facilitate safe and fair launching, the entrance to the cylinder hole must be located as follows. **a.** Be the rearmost point of the car. No part of the car, including wheels, should stick out behind the canister entrance point.	**+0.2s**
	b. The lowest point must be between **20mm - 35mm** from the ground. *This is measured with the car fully assembled.*	**+0.5s** **OR** **DISQUALIFICATION**

Eyelet Specifications		Penalty
The car will race along a guide-wire; therefore eyelets must be included in the printed car so that it can be threaded onto the guide-wire. **Any car that is unable to be threaded onto the guide-wire will not be raceable.** **See page 15 for a visual guide of the eyelet specifications.**		
11	**a. Number:** The car must have exactly two eyelets.	**+1.0s OR DISQUALIFICATION**
	b. Distance: The eyelets must be **at least 50mm apart**. *This is measured from the rearmost point of the front eyelet and the foremost point of the back eyelet.*	**+0.2s OR DISQUALIFICATION**
	c. Alignment: The eyelets must be in line with the centre of the car.	**+0.1s**
	d. Diameter: Each eyelet must have a hole between **4mm - 6mm**. Holes <4mm in diameter will not be able to be raced.	**+0.2s OR DISQUALIFICATION**
	e. Height from ground: The bottom of each eyelet must be between **2mm - 8mm** from the ground. *This is measured with the car fully assembled.*	**+2.0s OR DISQUALIFICATION**
	f. Length of eyelet: The depth/length of the eyelet must be between **5mm - 7mm**. *This is measured along the direction of the hole.* Holes <3mm in length will not be able to be raced.	**+0.2s OR DISQUALIFICATION**
	g. Material surrounding the hole: The material surrounding the hole must measure **no less than 3mm** in any direction around the hole. Material thickness <1.5mm will not be able to be raced.	**+0.1s OR DISQUALIFICATION**
	h. Clear Path: There must be a clear path between the eyelet holes and the front and back of the car. Axles must not impede the path of the guide-wire.	**DISQUALIFICATION**
Safety Considerations		**Penalty**
12	**Minimum Clearance:** No part of the car (except the wheels) can be closer than 2mm from the ground. *This is measured with the car fully assembled.*	**+1.0s OR DISQUALIFICATION**
13	**Damage to the Track:** The car must not have the potential to cause damage to any person or object, and/or breakage to any part of the track.	**DISQUALIFICATION**

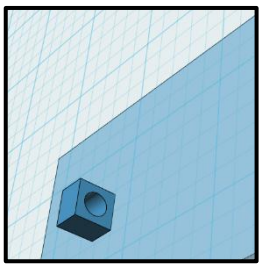
Visual Guides

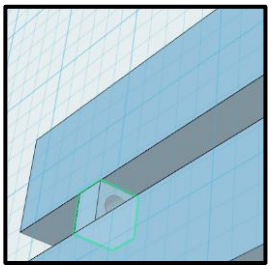
Eyelet examples

The diagrams to the right show two different designs for eyelets.

The first has an eyelet protruding from the bottom of the car (left) and the second shows an eyelet embedded into the car (right).

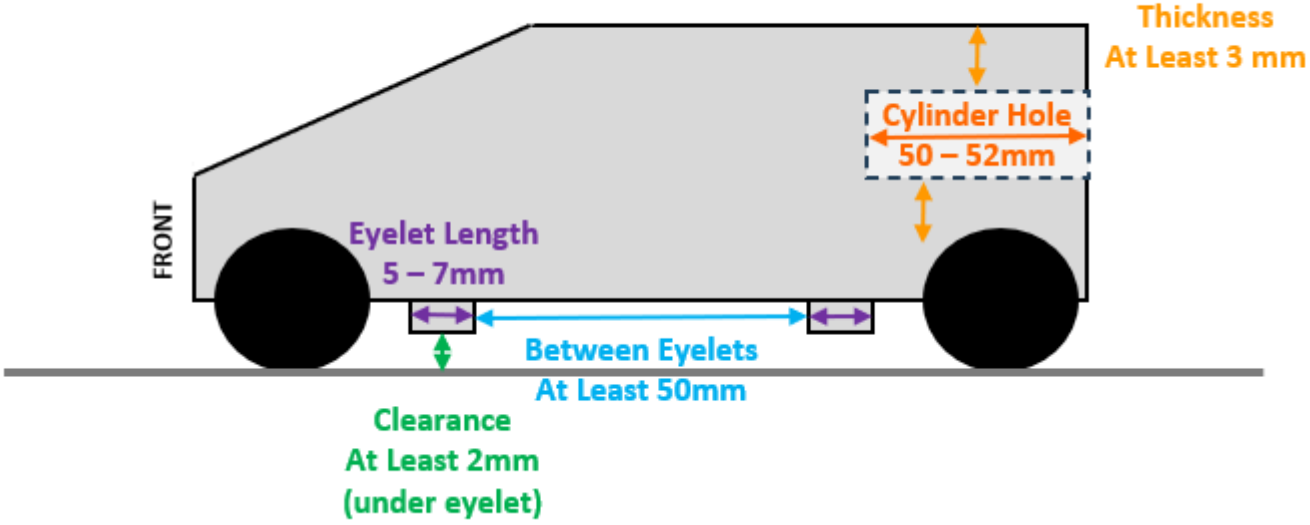
Note: The images only show one eyelet; your design must have two.



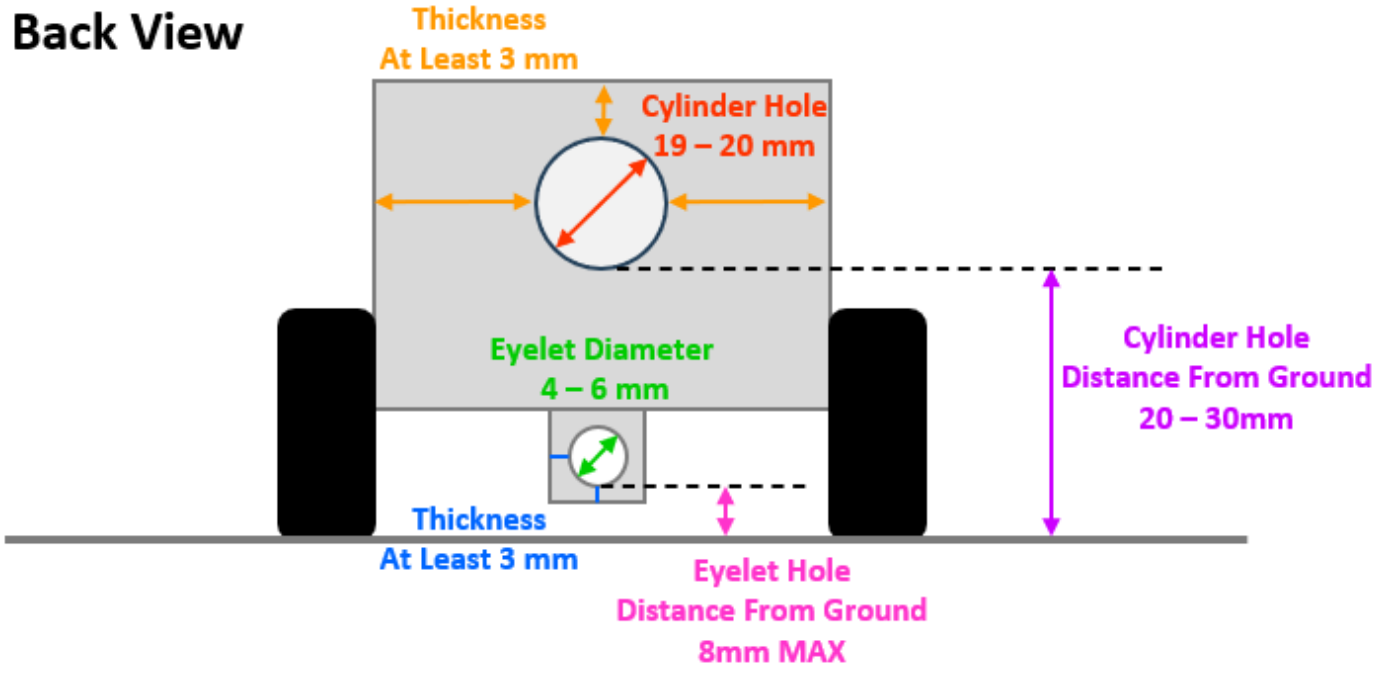


Eyelet & Cylinder Hole Specifications

Side View



Back View



Car Construction – 10%

Each car will be assessed based on the quality of 3D printing, finishing, and assembly.
Cars are marked according to the specifications below and using the Car Construction Rubric (Appendix C).

Support Material

- All support material should be removed.

Large Surface Finish

- This applies to external surfaces such as the main body of the car, wheels and spoilers.
- Surfaces should be smooth to the touch without rough bits noticeable.
- This can be achieved through print settings and large-scale finishing techniques such as sanding.
- Paint and fillers cannot be used.

Fine Detail Finish

- This applies to smaller printed details and internal printed surfaces such as eyelet holes, cylinder holes, axle holes and spoiler under-hangs.
- The outermost printed layer should be intact and smooth.
- No little holes or voids should be present in the plastic around any holes (e.g. cylinder, eyelets).
- This can be achieved through advanced print settings or print orientation and small-scale finishing techniques such as the use of pliers, tweezers, drills, or files and rasps.

Car Assembly

- All car parts are attached securely.
- Any glue used is set/dry.

Self-Assessment – 5%

Each car submitted must be accompanied by a completed self-assessment (Appendix D).

Self-Assessments must be submitted electronically via the Google Drive link. Scans of printed Self-Assessments are acceptable.

Points will be allocated as follows:

Self-Assessment Degree of Completion	Points
Fully completed, with all measurements	**5**
Fully completed, no measurements	**4**
Partially completed *Marks will be allocated proportional to completion*	**1-3**
Not completed or not submitted.	**0**

PrintACar Challenge Specifications
FINALS

Finals Selection

Ten teams from each category (Primary and Secondary) will be selected to compete in the Finals stage of the PrintACar Challenge.

The team with the fastest Race Time and the team with the best portfolio from each category will automatically proceed to the Finals. For the remaining places, the teams with the highest overall scores will proceed to the Finals.

Teams will be notified of their selection for the Finals within five working days of the Qualifiers Race Day.

Feedback will be provided on request.

Finals Judging Overview

Judging of the Finals stage is based on the assessment of a portfolio and a poster/visual display, the racing results, the car construction and a self-assessment.

2025 Qualifiers Judging	Point Distribution
Portfolio	45%
Poster/Visual Display	15%
Racing Results	25%
Car Construction	10%
Self-Assessment	5%

Finals Portfolio – 45%

Overview

All sections from the Qualifiers Portfolio should be re-submitted to show the complete process and growth across the whole PrintACar Challenge.

Each team must then add Section 5 (outlined below) to their portfolio to demonstrate all changes and updates to the car design and outline their approach to large surface and fine detail finishes.

Submission & Assessment

Portfolios must be saved as an Adobe PDF document (.pdf) and be submitted electronically via the QV Google Drive link provided. Other file types will not be accepted or marked.

Portfolios will be assessed by the QV Team according to the requirements below and using the Portfolio Rubric (Appendix A).

Section 5 – Improvements from Qualifiers **40 Points**

- ☐ What changes did you make to your car design from Qualifiers Race Day?
  - ☐ How and why did you change it?
  - ☐ If you didn't change your design, why didn't you change it?
  - ☐ What new challenges did you encounter when you made the changes?
- ☐ Discuss the finishes applied to your car and why this is beneficial.
- ☐ What did you do to improve print quality?
- ☐ Include pictures of any printed prototype cars and the final car straight from the printer (before any finishes are applied).

Poster/Visual Display – 15%

Overview

The purpose of your poster/visual display is to promote your team and your car. Suitable mediums for this section could be a poster, diorama, or similar. If a poster is chosen, then it should be A2 size.

Submission & Assessment

Teams will be awarded marks for their poster/visual display based on the inclusion of the required information, the level of detail, the clarity of communication of information and the visual appeal of the display.

Poster/visual displays will be assessed by the QV Team according to the requirements below and using the Poster/Visual Display Rubric (Appendix E).

Note: This year, video/electronic visual displays will not be accepted.

Poster/Visual Display Requirements **15 Points**

- ☐ Team Information
  - ☐ Name of school
  - ☐ Name of team (displayed in addition to logo)
  - ☐ Team logo
  - ☐ Names of team members
  - ☐ Roles of team members
  - ☐ Individual photos of each team member OR a group photo of the team
  - ☐ Year level/s of team members
- ☐ Photos of your car
- ☐ Brief summary of unique/important features of your car
- ☐ Clear explanations of why the identified features are unique/important
- ☐ Visual appeal

Finals Racing Results – 25%

Car Submission

Cars for Finals
Each selected team must submit one car to participate in the Finals Race Day.

Teams are expected to improve their design between Qualifiers and Finals.

If a team has chosen not to make changes to their car design after Qualifiers, they must still re-print their car. Due to wear and tear on the car, the same physical car cannot be raced at both Qualifiers and Finals.

Submission
Teams must bring their car with them to Quantum Victoria (235 Kingsbury Dr, Macleod VIC 3085) on the Finals Race Day.

Cars will be assessed by the QV Team according to the requirements outlined in the Qualifiers section (pages 12-14) and using the Car Rubric (Appendix B) prior to racing.

Self-Assessment
A self-assessment (Appendix D) must be completed for the car. This should be submitted along with the car when the team arrives on Finals Race Day. See Self-Assessment section below (page 21) for more detail.

Points & Penalties

Racing and Ranking
Each car will race four times and will receive a final Race Time which will be based on their average time. Any time penalties incurred for breaches to car design specifications will be added to these times and used in the calculation of the Race Time.

Race Times will be used to rank the cars in order of speed. The team with the fastest car in each category will receive 100% of the available points. Cars will then be allocated points proportional to their rank.

Exceptions
Any car that does not make it all the way down the track receives a time of 10.00s.

Any car that has been disqualified but is being raced down the track will receive a time of 20.00s. A disqualified car receives zero racing points.

Penalties
Penalties are applied as per the guidelines and specifications for Qualifiers. See page 11 for further information about penalties and how they are applied.

Car Construction – 10%

Each car will be assessed based on the quality of 3D printing, finishing, and assembly.
Cars are marked according to the specifications below and using the Car Construction Rubric (Appendix C).

Support Material

- All support material should be removed.

Large Surface Finish

- This applies to external surfaces such as the main body of the car, wheels and spoilers.
- Surfaces should be smooth to the touch without rough bits noticeable.
- Edges of wheels should be smoothed.
- This can be achieved through print settings and large-scale finishing techniques such as sanding, as well as filling and painting in the Finals.

Fine Detail Finish

- This applies to smaller printed details and internal printed surfaces such as eyelet holes, cylinder holes, axle holes and spoiler under-hangs.
- The outermost printed layer should be intact and smooth.
- No little holes or voids should be present in the plastic around any holes (e.g. cylinder, eyelets).
- This can be achieved through advanced print settings or print orientation and small-scale finishing techniques such as the use of pliers, tweezers, drills, or files and rasps.

Car Assembly

- All car parts are attached securely.
- Any glue used is set/dry.

Decoration

- Cars should painted/coloured or decorated to enhance appearance and exhibit team colours or branding.
- Decorations should be purposefully placed to enhance appearance.
- Any paint or decals should be applied evenly and securely.

Self-Assessment – 5%

Each car submitted must be accompanied by a completed Self-Assessment (Appendix D).

Self-Assessments must be submitted along with the car on Finals Race Day.

Points will be allocated as per the specification in the Qualifiers section (page 16).

Awards

Overall Winner

There will be one **Overall Winner (Primary)** and one **Overall Winner (Secondary)**. The winning teams will have the **highest total scores** and will receive a **prize and trophy** for their school.

Challenge Awards

In addition to the Overall Winner award, the following awards will be presented to one team in each category (Primary and Secondary):

- Best Portfolio
- Best Poster/Visual Display
- Fastest Penalty Adjusted Race Time for the day
- Fastest Reaction Time for the day
- Most Original Design
- Flair and Effort for Portfolio or Poster/Visual Display.

Award Eligibility

A school **cannot** be awarded an overall winner prize two years in a row.

Teams will only be eligible for one of the Challenge Awards; however, they will still be eligible for the Overall Winner prize.

As a condition of entry into the PrintACar competition, any prizes/awards will only be awarded to schools, not individual students. Quantum Victoria reserves the right to reclaim the prize should any requirement be compromised. Quantum Victoria's decision is final, and no correspondence will be entered into.

Appendix A – Portfolio Rubric

	CRITERIA	HIGH/ YES	MEDIUM	LOW	NOT SHOWN	MARKS
Team Profile (5 *marks*)	**Name of school**	Present			Not shown	
	Name of team	Present			Not shown	
	Team Logo	Present			Not shown	
	Names	Present			Not shown	
	Roles	Present			Not shown	
	Photos	Present			Not shown	/3
Design Process (25 *marks*)	**State the 3D modelling software used and why it was used.**	The description clearly states the name of the 3D modelling software used, and provides a well-thought-out explanation for why this particular software was chosen.	The name of the 3D modelling software is provided, but the explanation for why this software was chosen may lack some detail or clarity e.g. "We were told to" or "We used it in class"		Not shown	/2
	Provide images of what inspired your design with notes/labels/comments explaining why it motivated you. Highlight which features you chose to include in your car design.	2 or more images show where the idea for the design came from. Each image has comments to explain how specific features influence the design choices of the car. Including how each element improves the car's function and appearance. The features of the car design are connected to the original inspiration, and it is explicitly detailed in how they connect.	At least 2 images show where the idea for the design came from. Each image has a comment to briefly mention how features influence the design choices of the car. Some features of the car design are connected to the original inspiration, but it is not explicitly detailed in how they connect.	Less than 2 images are provided. No comments or explanations as to why the images are chosen to motivate them. The car design does not show any influence from the inspiration images.	Not shown	/3
	Discuss how the shape and at least 2 additional features of your car will affect the speed. Include the relevant physics concepts in your discussion of <u>each</u> feature.	The discussion provides clear and detailed explanations of how the shape of the car and two additional features influence speed, using relevant physics principles such as Newton's laws of motion, aerodynamics, weight, and friction to explain each design choice	The discussion explains how the shape of the car and at least one additional feature influence speed, referencing some relevant physics principles. However, explanations may be general, lacking depth, or missing clear connections between design choices and their impact on speed.	The discussion mentions one design feature describing in some detail how it affects speed OR only features are listed but not discussed. There is minimal or unclear links to physics principles	Not shown	/3
	Discuss how the wheel design will affect the speed of the car. Include the relevant physics concepts in your discussion.	The discussion explains how wheel size, shape, and material can affect the speed of the car. It mentions specific physics principles such as resistance and improving grip.	The discussion talks about basic wheel features like size and shape and how they might affect speed. There are no specific explanations linked to physics concepts.	The discussion only talks about one feature of wheel design. There is minimal mention of physics concepts.	Not shown	/3
	Include at least 3 images of your car design throughout the 3D modelling process. All images should be labelled to show features and changes that have occurred. • **BEGINNING** • **MIDDLE** • **PROTOTYPE**	At least 3 images of the design process are provided, including 1 from each of the beginning, middle and end of the process. All images are annotated to highlight features and changes.	At least 3 images of the design process are provided, including 1 from each of the beginning, middle and end of the process. BUT images do not highlight features or changes. OR 1-2 images are provided. All images are annotated to highlight features and changes.	1-2 images of the design process are provided, BUT images do not highlight features or changes.	Not shown	/5
	List the modifications that the team wanted to make to the initial prototype.	A detailed list has been provided of what changes the team would like to make to the initial prototype.	A simple list has been provided however it lacks detail.		Not shown	/2
	Explain which modifications were made and why? Which modifications did you not include and why?	The description thoroughly explains specific modifications made after the initial prototype, providing clear reasons for each change, such as addressing functional defects or improving performance. Also includes a rationale for the modifications not included with clear justification for each decision.	The description outlines general modifications after the initial prototype, mentioning some changes and providing reasons, but lacks depth. Mentions modifications not included but may provide general or partial reasons for their exclusion.	The description offers minimal detail on modifications made after the initial prototype, providing only a vague overview with unclear or missing reasons for the changes. Does not discuss modifications not included or gives unclear/missing justification for their exclusion.	Not shown	/3
	Describe and reflect on the steps you took in each stage of the design process to get to your	Provides a detailed and thoughtful description of each step in the design process (research, brainstorming,	The description outlines the general steps, such as research, brainstorming, and prototyping. Reflects on the impact of each step	The description provides minimal detail, offering only a vague overview of the process, and lacks clarity in explaining	Not shown	/3

	final design. Include research, brainstorming, concept sketches, prototyping and iterations.	concept sketches, prototyping, and iterations). Reflects deeply on how each stage contributed to the final design, demonstrating a clear understanding of how these steps influenced decision-making and improved the design.	on the final design, though the reflection may lack depth or clarity in some areas.	the design journey. There is minimal refection on the impact of each step on the final design.		
	At least 6 images and/or screenshots of FINAL CAR, showing each feature below and showing exact measurements in mm. **Car Body - 3 images (side, side, front/back)** • **length (side view)** • **width/depth** • **height** **Cylinder Hole - 1-2 images** • **diameter** • **depth** • **width of material** **Eyelets - 1-2 images** • **distance between** • **Depth of each** • **Width of material** **Wheels - 1-2 images** • **diameter**	Six or more images and/or screenshots of the FINAL CAR, showing each listed feature below and showing exact measurements in millimeters. Car Body - 3 images (side, side and front/back) • length (side view) • width/depth (front or back view) • height (side view) Cylinder Hole - 1-2 images • diameter • depth • width of material around hole Eyelets - 1-2 images • distance between each eyelet • Depth of each eyelet • Width of material around hole Wheels - 1-2 images • diameter	Six images showing measurements of the car and some of its features. Images of the final car are provided, but they may lack clarity or detail in showcasing its design or measurements	Less than six images showing some car measurements or some measurements of key features. Poor-quality images of the final car are provided, or they fail to effectively showcase its design or measurements, detracting from the overall presentation	Not shown	**/5**
The Printing Process	**What model of 3D printer did you use?**	Present			Not shown	**/1**
	What type of material did you use?	The manufacturer, material type and colour are listed.	Only some details of the material are given		Not shown	**/2**
	Discuss the properties of this material and how it affected the printing of your model (e.g. strength, durability, flexibility and ease of printing).	The discussion thoroughly explains the material's properties such as strength, flexibility, durability, and printability, and described how they affected the printing of the model.	The discussion mentions some properties of the material and their effects on the printing process but lacks depth or detail.	The description provides minimal detail on how the material affected the printing the model.	Not shown	**/3**
	What printing/slicing (not 3D modelling) software did you use?	Present			Not shown	**/1**
	Provide 2 or more pictures of any printed prototype cars.	Two or more pictures of prototype cars are included.	1-2 pictures of prototype cars.		Not shown	**/2**
	What printing challenges did you encounter when printing prototype and your final car? How did you solve these?	The description provides detailed accounts of at least three challenges encountered during printing, along with clear strategies for overcoming each challenge.	The description outlines general challenges encountered during printing, mentioning at least two issues, but lacks detailed explanations or strategies for resolution.	The description offers minimal detail on the encountered challenges, mentioning one or fewer issues without clear explanations or strategies for resolution.	Not shown	**/3**
	2 or more pictures from different angles of the final car(s) on the print bed	Two or more pictures of the final car, from multiple angles, are included and any supports are shown.	One picture of the final car is included, straight from the printer.		Not shown	**/2**
Reflection	**Describe your experience of preparing for the PrintACar Challenge. Include answers to the following questions.** • **What was the best part of PrintACar?** • **What was the worst part of PrintACar?** • **How well did you work as a team?** • **What would you do differently next time?**	Provides a detailed reflection, addressing all four questions thoroughly. Describes the best and worst parts of the challenge with clear explanations and personal insights. Demonstrates thoughtful evaluation of teamwork, with specific examples of collaboration. Suggests practical and well-reasoned improvements for future participation.	Addresses most of the questions with some detail. Describes the best and worst parts of the challenge but with limited explanation. Mentions teamwork with general comments but fewer specific examples. Suggest improvements, though they may lack detail or practicality.	Only some of the questions are answered and show minimal reflection and/or detail.	Not shown	**/3**

THE FOLLOWING SECTION IS FOR FINALS PORTFOLIOS ONLY. This is additional to the portfolio submitted in the Qualifying.						
Improvements from Qualifying	**What changes did you make to your car design from Qualifying Day?** • **How and why did you change it?** • **If you didn't change your design from qualifying day, why didn't you change it?** • **What new challenges did you encounter when you made the changes?**	A detailed reflection is provided, discussing more than one design change with detailed explanations of each change, rationale, challenges encountered, and reasons for retaining any original elements.	Only one change was outlined. Discussion included: how it was changed and the reasoning behind the changes. OR Detailed discussion of reasons behind keeping all features the same. More than one feature was discussed.	Changes were mentioned, but not detailed. OR Reasons behind changes were not included. OR Design Challenges were not discussed.	Not shown	**/20**
	Discuss the finishing applied to your car and why this is beneficial	Clearly identifies the finishing techniques and materials used AND clearly explains the benefits of each to the performance of the car.	Identifies and explains the finishing techniques and materials used.	Lists or mentions the finishing techniques used but does not provide any explanation or context.	Not shown	**/6**
	After re-printing your car, what did you do to improve print quality after Qualifying Day? What improvements did you notice?	Clearly outlines steps taken to improve print quality and describes expected improvements to the performance of the car.	Lists improvements to print quality but does not link it to expected improvements to performance of the car.	Mentions that they made improvements but does not provide detail about what.	Not shown	**/6**
	Pictures of any printed prototype cars and the final car straight from the printer (before any finishing).	Two or more pictures of the car that has been re-printed for the finals. Pictures are shown straight from the printer, multiple angles are included, supports are shown.			Not present	**/8**

Appendix B – Car Rubric

	Manufacturing & Assembly Specifications	Tolerance	mm	Y/N	Penalty
1	**Manufacturing:** All components of the car must be manufactured using 3D FDM with ABS or PLA filaments.				DQ
2	**Axles:** The axles must freely rotate within the car; wheels may be fixed or rotate on the axle.				+2.0s
3	**Assembly:** Car must be fully assembled.				+1.0s OR DQ
	Dimension Specifications				Penalty
4	**Weight:** Car must have a mass of **110g or more**.	+/- 1.0g			+2.0s
5	**Length:** Car must have a length between **95mm - 140mm**.	+/- 1.0mm			+0.2s
6	**Height:** Car must have a height between **55mm - 90mm**.	+/- 1.0mm			+0.2s
7	**Width:** Car must have a width of between **55mm - 90mm**.	+/- 1.0mm			+0.2s
8	**Wheels: a.** Must have a diameter between **20mm - 50mm.**	+/- 1.0mm			+0.2s
	b. Number must be even (e.g. 2 or 4) and aligned forward.				DQ
	Cylinder Hole Specifications				Penalty
9	**a. Alignment**: The hole must be aligned to the centre of the car and the length parallel to the ground.				+0.2s OR DQ
	b. Diameter: The hole must have a diameter between **19mm - 20mm**.	+/- 0.1mm			+0.2s OR DQ
	c. Depth: The hole must have a depth between **50mm - 52mm**.	+/- 0.1mm			+0.1s OR DQ
	d. Material surrounding the hole: Must measure **no less than 3mm** in any direction. Only opening must be at the rear.	+/- 0.1mm			DQ
	e. Circular shape: The hole must be a circular shape (not oval).	+/- 0.2mm			+0.2s
	f. Inner End: The inner end of the cylinder hole must be flat (not curved).				+0.2s
10	**Location: a.** Be the **rearmost point** of the car.				+0.2s
	b. The **lowest point** must be between **20mm - 35mm** from the ground.	+/- 1.0mm			+0.5s OR DQ
	Eyelet Specifications				Penalty
11	**a. Number**: The car must have exactly two eyelets.				+1.0s OR DQ
	b. Distance: The eyelets must be **at least 50mm apart**.	+/- 1.0mm			+0.2s OR DQ
	c. Alignment: The eyelets must be in line with the centre of the car.				+0.1s
	d. Diameter: Each eyelet must have a hole between **4mm - 6mm**. Holes <4mm in diameter = disqualification.	+/- 0.1mm			+0.2s OR DQ
	e. Height from ground: The bottom of each eyelet must be between **2mm - 8mm** from the ground.	+/- 0.1mm			+2.0s OR DQ
	f. Length of eyelet: The depth/length of the eyelet must be between **5mm - 7mm**. Holes <3mm = disqualification.	+/- 0.1mm			+0.2s OR DQ
	g. Material surrounding the hole: Must be **no less than 3mm** in any direction around the hole. <1.5mm = disqualification.	+/- 0.1mm			+0.1s OR DQ
	h. Clear Path: There must be a clear path between the eyelet holes and the front and back of the car.				DQ
	Safety Considerations				Penalty
12	**Minimum Clearance:** No part of the car (except the wheels) can be closer than 2mm from the ground.	+/- 0.1mm			+1.0s OR DQ
13	**Damage to the Track:** No potential to cause damage to any person, object or track.				DQ

Appendix C – Car Construction Rubric

QUALIFIERS

Criteria	High	Medium	Low	Marks
Support Material	All traces of support material have been removed.	Traces of hard-to-reach support material still visible.	Easily removable support material still visible.	/3
Large Surface Finish	Main body and wheel surfaces are smooth to the touch. No rough bits are noticeable.	Some components or parts of components have a rough surface.	Most components have a rough surface.	/2
Fine Detail Finish	No evidence of holes or voids in or adjacent to small features. Feature surfaces are smooth and outermost layer is intact.	Some evidence of holes or voids in the features OR features are rough OR the outermost layer is compromised.	No attempt to smooth features or remove printing voids.	/3
Car Assembly	All parts are securely attached and/or glued.	Parts are loose or not well connected and may fall off or break.	Parts have fallen off or broken.	/2

FINALS

Criteria	High	Medium	Low	Marks
Support Material	All traces of support material have been removed.	Traces of hard-to-reach support material still visible.	Easily removable support material still visible.	/2
Large Surface Finish	Main body surfaces are smooth to the touch. Wheel sides and edges are smooth. No rough bits are noticeable.	Some components or parts of components have a rough surface.	Most components have a rough surface.	/2
Fine Detail Finish	No evidence of holes or voids in or adjacent to small features. Feature surfaces are smooth and outermost layer is intact.	Some evidence of holes or voids in the features OR features are rough OR the outermost layer is compromised.	No attempt to smooth features or remove printing voids.	/2
Car Assembly	All parts are securely attached and/or glued.	Parts are loose or not well connected and may fall off or break.	Parts have fallen off or broken.	/2
Decoration	Decorations adhere well to the surface and are placed in a way that improves the visual appearance of the car.	Decorations are not well applied and/or do not improve the visual appearance of the car.	Very little attention to the surface smoothness and little or no improvements have been made to the visual appearance of the car.	/2

Appendix D – Self-Assessment

Team: _____ **PRIMARY**

School: _____ **SECONDARY**

Read each specification and answer Yes (Y) or No (N). Include measurements where requested.
If you list a No or N for any specification, check the penalty applicable and, if possible, make changes.

	Manufacturing & Assembly Specifications	Measurement	Y/N
1	**Manufacturing:** All components of the car must be manufactured using 3D FDM with ABS or PLA filaments.		
2	**Axles:** The axles must freely rotate within the car; wheels may be fixed or rotate on the axle.		
3	**Assembly:** Car must be fully assembled.		
	Dimension Specifications		
4	**Weight:** Car must have a mass of **110g or more**.		
5	**Length:** Car must have a length between **95mm - 140mm**.		
6	**Height:** Car must have a height between **55mm - 90mm**.		
7	**Width:** Car must have a width of between **55mm - 90mm**.		
8	**Wheels: a.** Must have a diameter between **20mm - 50mm.**		
	b. Number must be even (e.g. 2 or 4) and aligned forward.		
	Cylinder Hole Specifications		
9	**a. Alignment**: The hole must be aligned to the centre of the car and the length parallel to the ground.		
	b. Diameter: The hole must have a diameter between **19mm - 20mm**.		
	c. Depth: The hole must have a depth between **50mm - 52mm**.		
	d. Material surrounding the hole: Must measure **no less than 3mm** in any direction. Only opening must be at the rear.		
	e. Circular shape: The hole must be a circular shape (not oval).		
	f. Inner End: The inner end of the cylinder hole must be flat (not curved).		
10	**Location: a.** Be the **rearmost point** of the car.		
	b. The **lowest point** must be between **20mm - 35mm** from the ground.		
	Eyelet Specifications		
11	**a. Number**: The car must have exactly two eyelets.		
	b. Distance: The eyelets must be **at least 50mm apart**.		
	c. Alignment: The eyelets must be in line with the centre of the car.		
	d. Diameter: Each eyelet must have a hole between **4mm - 6mm**. Holes <4mm in diameter = disqualification.		
	e. Height from ground: The bottom of each eyelet must be between **2mm - 8mm** from the ground.		
	f. Length of eyelet: The depth/length of the eyelet must be between **5mm - 7mm**. Holes <3mm = disqualification.		
	g. Material surrounding the hole: Must be **no less than 3mm** in any direction around the hole. <1.5mm = disqualification.		
	h. Clear Path: There must be a clear path between the eyelet holes and the front and back of the car.		
	Safety Considerations		
12	**Minimum Clearance:** No part of the car (except the wheels) can be closer than 2mm from the ground.		

Appendix E – Poster/Visual Display Rubric

Criteria	High/Yes	Medium	Low	Not shown	Marks
Poster/visual display provided	Poster: A2 size Other medium: able to be displayed either on display board or table, on Finals Day			Not shown	**/1**
Team Information • **Name of School** • **Year Level(s) of team members** • **Name of team (displayed separately to the logo)** • **Team Logo** • **Names of team members** • **Roles of team members** • **Individual Photos of each team member or a group photo of the team**	All required information provided	At least 4 aspects of team information as listed are provided	1 – 3 aspects of team information as listed are provided	Not shown	**/3**
Photos of your car	Present			Not shown	**/1**
Summary of unique/important features of your car	The summary identifies at least 3 unique/important features of the car.	The summary identifies 2 unique/important features of the car.	The summary identifies 1 unique/important feature of the car.	Not shown	**/3**
Clarity of Communication	All features are well-explained, and reference is made as to why these features are unique/important.	There is some explanation of the features and brief reference as to why they are unique/important.	There is limited explanation of the features and no reference as to why the features are unique/important.	Not shown	**/3**
Visual Appeal	Overall, visually appealing. Colours, fonts and graphics enhance the poster/visual display. Content arranged clearly and is easy to follow.	Overall, visually appealing. Colours, fonts and graphics support the readability of the poster/visual display. Content arranged so it is fairly easy to follow.	Colours, fonts and graphics affect the readability of the poster/visual display. Layout of information is somewhat confusing and difficult to follow.	Layout difficult to follow and informatio n difficult to read.	**/4**

Appendix F – Frequently Asked Questions

Q. What glue can I use to assemble my car?
A. You should research the best glue to use for the material you have chosen (this might be a good thing to add to your portfolio).
You must not use hot melt glue to attach eyelets to your car or wheels to the axles.
Below we have provided some suggestions.

Body of Car	• PVA • Super glue (Cyano acrylate) • UV curable resin
Wheels	• 5-minute epoxy resin e.g. araldite • UV curable resin

Q. Are we allowed to use lubricant on the axles?
A. No.

Q. If my car breaks during racing, can I fix it?
A. This will depend on how much the car breaking affects its safety. We will allow you (or a Quantum Victoria staff member) to repair your car if it is safe to do so. However, if the car breaks in the same way again, it will not be allowed to race further on that day. If the break is a result of something you have assembled coming loose (e.g. wheel/s falling off), then this will affect the mark you will receive for the Car Construction section.

Q. How much teacher input is allowed, if any?
A. We want teachers to act as a guide to their teams. Teachers can discuss and clarify the requirements as listed in this field guide and also teach skills students need to complete the tasks required. However, students must design and create their cars, portfolio and poster/visual display themselves. Teachers can provide access to the use of the 3D printer, but the students must print their designs themselves. You need to show evidence of this in your portfolio.

Q. Do we have to use our school printer to print our car?
A. If you do not have access to a printer at your school or your printer is unable to print anything of reasonable quality, please contact us to discuss alternative options.

Q. Does it have to be printed with a specific type of 3D printer? If so, what type?
A. Students can use any 3D printer that uses filament. Note that only one of ABS or PLA filament can be used.

Q. Do the wheels need to be printed?
A. Yes, the wheels need to be printed.

Q. What are the tolerances for printed shapes?
Tolerance refers to the difference between the 3D model in the modelling software and the printed product.
A. Tolerances will vary depending on your printer and materials used. Some trial and error might be needed. Judging will use the tolerances given in the Car Rubric (Appendix B).

Q. How does the car launch?
A. A carbon dioxide (CO_2) canister is inserted into the canister hole at the back of the car. A launch pod is placed behind the car, then a firing pin is triggered to puncture the CO_2 canister. The release of the CO_2 from the canister accelerates the car.

Q. Does the portfolio and/or poster/visual display need to be printed, or can it be handwritten?
A: Teams can choose whether to handwrite or create their portfolio digitally. Regardless of the chosen medium, a digital copy must be uploaded to the Google Drive folder by the due date.
A physical copy of the poster/visual display needs to be submitted on Finals Race Day. Again, these can be handwritten or created digitally.

Q. Do I need to remove any 3D printed support material?
A. Yes, you need to remove all support material (including in the eyelet holes and the canister hole).

Q. My school is in Melbourne close to Quantum Victoria. Do I have to send my car/s by courier or can I hand deliver it?
A. You can hand deliver your car as long as it is delivered and handed in to Quantum Victoria by the date mentioned in Key Dates (page 6).

Q. How can we learn more about how to use 3D Design and Printing?
A. Teachers can book their classes into one of our 3D Modelling and Printing programs to upskill their students (subject to availability for onsite and synchronous programs). Visit https://www.quantumvictoria.vic.edu.au/programs?features%5B%5D=3d-modelling for more information on the primary and secondary 3D Printing programs.