

# **UK Hacky Racers Build Rules**

**2023**

**V1.1 Draft**

**Based on the US PRS Rules**

# Table of Contents

<b>1. Car Construction Rules</b>	<b>4</b>
1.1. Car Theme	4
1.2. Drivers	4
1.3. Car Egress	4
1.4. Car Chassis	4
1.5. Wheels and Tyres	4
1.6. Steering	5
1.7. Motor Propulsion	5
1.8. Battery	5
1.9. Controller	6
1.10. Transponder	6
1.11. Required Safety Systems	6
1.11.1. Bumpers	7
1.11.2. Driver Protection	7
1.11.3. Brakes	7
1.11.4. Battery Retention	8
1.11.5. Reverse	8
1.11.6. Kill Switch	8
1.11.7. Fuse	8
1.12. Optional Safety Systems	9
1.12.1. Lights	9
1.12.3. Horn	9
1.13. Budget	9
1.13.1. Bill of Materials (BOM)	10
1.13.2. Excluded Items	10
1.13.3. Battery Exemption	11
1.13.4. Budget Enforcement and Penalties	11
1.14. Car Decorations and Modifications	11
1.15. Moxie Label	12
1.16. Team Secrets	12
<b>2. Driver Rules</b>	<b>12</b>
2.1. General Driver Rules	12
2.2. Helmets	12
2.3. Other Attire	12
<b>3. General Event Rules</b>	<b>13</b>

3.1. Event Structure	13
3.1.1. Scrutineering	13
3.1.2. Qualifying Round	13
3.1.2.1. Qualifying	13
3.1.2.2. Brake Test	14
3.1.2.3 Practice Laps	14
3.1.3. Races	14
3.1.4. Battery Charging	14

# 1. Car Construction Rules

## 1.1. Car Theme

Each car should have a theme that's whacky and entertaining. The crazier the better! You score points for entertainment value as well as speed, so go all out and come up with something completely mad. Bodywork is highly recommended, but not mandatory as long as the car has a strong theme without.

## 1.2. Drivers

Each car shall be controlled only by one human driver seated in or on the car.

## 1.3. Car Egress

Each car shall be constructed such that an uninjured driver can exit the car unassisted in 5 seconds or less.

## 1.4. Car Chassis

Each car shall not be longer than 1600mm

Each car shall not be wider than 900mm

Each car, including the driver seated and dressed per the rules, shall not be taller than 1800mm

The chassis may be either based on a donor vehicle of some kind, or it may be a scratch build.

## 1.5. Wheels and Tyres

With the exception of treaded tanks and walking/shuffling carts, Each car must have a minimum of three wheels that support the weight of the car. Any wheel driven by a motor shall not be allowed to swivel like a caster wheel. Exceptions considered upon a 1 month notice to the organisers prior to the event.

The minimum wheel track (wheel-to-wheel width) allowed is 300mm.

The minimum wheelbase (axle-to-axle length) allowed is 450mm.

Each wheel that supports the weight of the car must have a tyre mounted to it.

With the exception of treaded tanks and walking/shuffling carts, all forces to drive the car during the race must be transmitted through one or more tyres.

As long as wheels and tyres meet budget requirements, any type of tread pattern or lack of therefore is allowed.

Be aware that Hacky Racer events can be held on tarmac or on grass, so be prepared for either.

**Hovercraft are allowed.**

## 1.6. Steering

No car may be steered by remote control or by anyone besides the driver(s) onboard at any time.

Cars must have a mechanical connection between their wheel/handlebars/other steering implement and their steering wheels.

## 1.7. Motor Propulsion

Each car shall be propelled by one or more electric motors. Each motor must have a maximum RMS input voltage not greater than 48V from the motor controller.

No other form of motive power besides an electric motor is allowed. That include no pedals (unless the vehicle is sufficiently slow that it will make no difference either way)

## 1.8. Battery

Each car shall have at least one battery with a nominal voltage less than or equal to 48V that supplies traction current to the controller and motor Each battery in the car shall be of one of the following chemistries:

- SLA: Sealed Lead-Acid
- AGM: Absorbed Glass Mat Lead-Acid
- Ni-Cd: Nickel-Cadmium
- Ni-MH: Nickel-Metal Hydride
- LiFePO4: Lithium Iron Phosphate (14s max)
- LiPO/Li-Ion Lithium Polymer/Ion\* (12s max)

\*WARNING: Teams running any lithium chemistry other than LiFePO4 (IE aircraft or EV type batteries) will need to demonstrate safe handling and charging procedures, and have batteries stored safely in a padded durable metal container

on the vehicle. (EV batteries that are already in a metal enclosure do not require an additional containment). The organisers must approve each car's implementation of Lithium batteries. Do not be the "this is why we can't have nice things" dude. Do not mess this up, cut corners, or be the amateurs who "think" they know how this works. This is dangerous, you've been warned. See Dunning-Kruger Effect if you believe you are perfectly competent without peer review.

No more than 1000Wh (eg 12S 20Ah) of soft case LiPo is allowed in a racer during a race due to the risk of fire.

Fire extinguishers will be available on site. Please make sure you are aware of their location, and inform the organisers if you believe there are any problems with your batteries.

Capacitor banks (100,000uF or more of parallel capacitance) are not considered batteries and are not allowed. No switched capacitor system whose purpose is to supplement the battery power or capture braking energy is permitted. Advanced power storage systems can be considered by the organisers with prior notice. They also can be vetoed by other teams under safety premises.

## **1.9. Controller**

Each car shall have a throttle-controlled motor controller to transfer power from the battery or batteries to the motor(s). Contactors and other forms of on-off control are banned, as they are liable to weld shut, and are a pain for everyone while trying to line up for the grid.

## **1.10. Transponder**

Each car must have an approved transponder affixed to it for timing and scoring purposes. These will be supplied by the organisers at the event.

The transponder system is I-Laps compatible, such as

<https://www.dronebit.co.uk/ilaps-fpv-drone-transponder.html>

Transponders must face upward and have a clear line-of-sight. There will be a timing gate vehicles must pass underneath

## **1.11. Required Safety Systems**

The following features of your car are required for safety purposes, and the implementation costs of these systems do not count toward your £500 budget

### **1.11.1. Bumpers**

Bumpers are required safety systems

Each car shall have bumper-like structures in the front and rear of the car.

Each bumper must cover at least 90% of the width of the car

Each bumper must cover at least 75mm of height within the vertical space of 100-150mm from the ground

Each bumper must be flat perpendicular to the ground. No round bumpers.

Each bumper shall be sturdy enough to survive the kind of accidental impacts that are expected in racing, and should be made of a shock absorbent material such as a non-brittle plastic or wood.

Metal may be used for bumper support, but must not be the primary structure (IE a bumper may not be metal bar wrapped in pipe insulation).

They should be attached securely to the chassis with bolts or similar sturdy fixings. Wood screws and other sharp fixings are not allowed as if a bumper does detach we don't want a spike board present on track.

### **1.11.2. Driver Protection**

The car must extend beyond the driver in every direction when viewed from directly above. This protection shall be sufficient to prevent direct contact between the driver and another car/barriers during an impact from any direction.

This protection especially applies to feet, which may not dangle off the car.

Occupants may not use the bumpers as a footrest. In the event of impact, drivers should not be the first point of contact with any outside intrusion of any other vehicle.

### **1.11.3. Brakes**

Brakes are required safety systems.

Each car shall have mechanical brakes capable of stopping the car in full per Rule 3.1.1.2

Brakes that apply braking force directly to the tyre of a car are not allowed to be the only source of mechanical braking.

Brakes that apply braking force to the ground are not allowed.

Motor braking is allowed only if there is a mechanical braking system also in place, as a fuse blowing may impact the function of any electronic braking system.

We recommend bringing spare pads for your brakes to race events and encourage replacing them as they fade.

#### **1.11.4. Battery Retention**

Battery Retention is a required safety system

Each battery must be secured so that it remains in its position relative to the rest of the car during normal operation and during a tip or rollover.

Lithium based batteries must be retained in a suitable metal container (eg. ammo box / cash box). These must be ventilated in some capacity so that pressure cannot build up in case a battery starts to burn.

#### **1.11.5. Reverse**

It is required that you have some method of reversing without exiting the vehicle and without pushing yourself backwards with your hands or feet. This is so that in the case of a crash into a barrier or with another vehicle, drivers can get back into the race quickly without having people on the track to move carts.

#### **1.11.6. Kill Switch**

The kill switch is a required safety system.

Each car must have a kill switch or removable link that stops all current flow from the battery or all batteries to the motor(s).

This kill switch must be visible and accessible from the outside of your car. The kill switch should be yellow and/or red in colour so someone other than you can shut your kart off in an emergency.

The kill switch may not be your throttle.

The kill switch should not disable any required safety systems.

Any obvious e-stop or isolator switches (Large/red/prominent) must act as such a kill switch even if another is present, a marshall using these switches would expect them to be kill switches.

#### **1.11.7. Fuse**

The fuse is a required safety system

Each car must have one regulation fuse in series with the battery or batteries such that all current coming from the battery or batteries passes through the fuse before reaching any traction motor or traction motor controller.

It is recommended that the Fuse be located as close to the battery or batteries as possible.

Each car may not have regulation fuses stored on the car or driver beyond the one required to be in the circuit. Regulation fuses may not be actively cooled.

'Active Cooling' is defined as cooling where energy (electrical, chemical, gravitational, dark, nuclear, thermal, temporal, etc) is expended in order to obtain



some reduction in the temperature or rate of temperature rise of the fuse element.

Should you blow a fuse on race day, the timing and scoring booth's fuse dispenser will be the only allowed source of replacement regulation fuses. The regulation fuse that each car is required to run varies based on the car's nominal battery output voltage as follows, and must be unmodified from its purchase condition:

Each car which makes use of walking mechanisms instead of wheels for propulsion is allowed to use a fuse with a current limit higher than the standard regulation fuse for that car's battery voltage.

Manufacturer part numbers are provided next to each fuse:

- 48v = 30A (10S - 12S Lipo) MPN: 0498030.M
- 36v = 40A (8S - 9S Lipo) MPN: 0498040.M
- 28.8v = 50A (7S Lipo) MPN: 0498050.M
- 24v = 60A (5S - 6S Lipo) MPN: 0498060.M
- 18v = 80A (4S Lipo) MPN: 0498080.M
- 12v = 125A (3S Lipo) MPN: 0498125.M

If your nominal voltage is between ratings, you must use whichever current limit is lesser.

Devices such as cameras, lights or other aesthetic elements may have their own small batteries as long as they do not contribute to the race performance of the vehicle in any way.

## 1.12. Optional Safety Systems

The following features of your car are optional safety features. They are not required, but the implementation costs of these systems do not count toward your £500 budget

### 1.12.1. Lights

Lights are optional safety systems for daytime races

Front lights are required for night-time races. Rear lights are recommended but not mandatory.

### 1.12.3. Horn

A horn (or similar noise-producing device) is an optional safety system.

## 1.13. Budget

Each car has an allowable budget of £500.

This budget covers only items that are a part of the car as it sits on the grid of any race, and does not include the cost of spare parts or development costs (except where those development costs are also part of the price of car components as it sits on the grid)

Each component of the car must be totaled in the budget according to the components' Fair Market Value. Fair Market Value is the cost someone could reasonably expect to pay for that item in similar condition elsewhere without a relationship to the seller/donor. The FMV of a used part worth £100 new and £25 used, that you got for £10 because your buddy owns a shop is £25. The FMV of a used part worth £100 new and £25 used, that your hackerspace got for free is £25. The FMV of a part bought on ebay (etc) from a seller who is not giving you preferential treatment is whatever you got it for, since anybody could have bought that part.

Cars that use shuffling and/or walking mechanisms for movement will be given a 500% increase in budget.

### **1.13.1. Bill of Materials (BOM)**

Each car is required to have a BOM submitted at the beginning of each race weekend that includes the costs of parts on the car which count toward the budget.

The minimum items to be included in the BOM are:

- Chassis or donor vehicle
- Motor(s)
- Motor Controller(s)
- Wheels
- Tyres
- Other drivetrain components
- Any items which increase your race performance

Full BOM submissions are highly encouraged

Race points may be awarded for exceptionally well-documented BOMs, subject to TBD determinations made by TBD judges at TBD times.

### **1.13.2. Excluded Items**

The following items are excluded from the budget:

- Brakes
- Batteries
- Physical throttle components and linkage

- Machining/ labour costs
- Shipping costs, and custom fees for parts/hardware/materials

### **1.13.3. Battery Exemption**

Batteries will be exempt from the BOM. This is to help discourage the use of cheap batteries as doing so could be a potential fire risk.

### **1.13.4. Budget Enforcement and Penalties**

In the event that a Hacky Racers official or a majority of teams believe a team has greatly exceeded the £500 limit, they will be deemed suspect and are at risk of a buyout. Hacky Racers officials, consisting of our team-submitted volunteers and event organisers will determine if teams have exceeded the budget and hold all rights to purchase a team's car for £500. By entering into an event, a team consents that their car could potentially be bought out at the end of the event for £500. A team may redeem their car and re-enter in the next event if they agree to remove the suspected over-budget component(s).

If the organisers determine the car to infringe on certain rules or bend said rules to a position that is beyond "the spirit of the series," then a completely arbitrary, painful, and time consuming penalty will be administered. If we get enough referrals from other teams for "breaking budget" and our tech inspector agrees, the organisers have complete freedom to severely limit the car's performance, administer embarrassing penalties, or outright strip points to satisfy the masses. This penalty will most likely be made up on the spot, will cost you considerable ire and outrage and lifting this penalty will require considerable bribery.

## **1.14. Car Decorations and Modifications**

Teams are encouraged to decorate and modify their cars in imaginative ways as long as the decorations and/or modifications do not present a risk of danger or injury to other participants or spectators above and beyond the risks and dangers inherent to the sport.

Vehicular weaponry is banned.

The organisers reserve the right to examine your car and prevent your car from competing if they feel it poses a danger to you, the other competitors, or the spectators.

## **1.15. Moxie Label**

Each car shall have a label for the moxie board, and its size shall be 150mm across by 45mm high. DO NOT IGNORE THIS. It's the only way the audience

knows you exist. Vague labels that are not iconic or in alignment with your design will totally screw you over. If you are the red Ferrari car, for example, your label could simply be a red label stating "Ferrari." Simple is good. Flashy is better. Remember most people have no idea who you are. Clueless in-jokes will not work, random numbers scribbled on paper will not work effectively. Do not half-ass this. Use full ass.

The label should contain the car or team name and the car number.

## **1.16. Team Secrets**

To avoid the issue of race-day disqualifications, please contact the race organiser in advance to inquire if your modifications are legal. Modifications that are "team secrets" will be kept in confidence and will not be shared with other teams.

# **2. Driver Rules**

## **2.1. General Driver Rules**

Drivers should be over 18 and possess a driver's licence. Drivers must possess an RS clubman licence (Available for free from Motorsport UK).

## **2.2. Helmets**

Each driver shall wear an approved helmet whenever they are on track to race or to practise. Helmets shall be subject to inspection and approval by race officials.

An approved helmet shall be a  $\frac{3}{4}$  or full-face motorcycle, motocross, or automotive racing helmet that meets or exceeds DOT, SNELL, or ECE standards.

Drivers who wear helmets that do not cover the eyes are required to wear DOT approved eye protection.

## **2.3. Other Attire**

Each driver is required to wear closed-toe shoes. Gloves are strongly recommended.

It is recommended that each individual on the track (driver, pit crew, marshalls) wear abrasion-resistant gloves and full-body clothing including long trousers and a long shirt. Bring your own safety gear for use in the pits, such as safety

glasses, and wear them when you should. Be adults about this. It's not our fault that you are irresponsible.

## **3. General Event Rules**

### **3.1. Event Structure**

The event structure for Hacky Racers will change between events, but will roughly consist of scrutineering and qualifying, followed by 5 minute circuit races every 60 or 90 minutes throughout the day.

#### **3.1.1. Scrutineering**

Each car will be checked by a scrutineer for adherence to the build rules to ensure that the races are safe and fair. For minor rule infringements the scrutineer will give an advisory which must be fixed by next event. For major infringements your vehicle may be barred from competing until the issue has been fixed.

A car is not allowed to compete until it has been passed by a scrutineer.

#### **3.1.2. Qualifying Round**

Once a car has passed scrutineering it can move on to qualifying. Qualifying consists of at least two laps of the track plus a brake test. Race organisers will call on cars one at a time to perform their qualifying laps and brake test. A car must have completed qualifying and a brake test before it can compete in any races.

##### **3.1.2.1. Qualifying**

To start qualifying, you will take your car on a warm-up lap of the track.

This warm-up lap allows the organisers to verify that your car's transponder is working.

You may then perform one or more qualifying laps.

An organiser will then indicate for you to perform a brake test to demonstrate your brakes function correctly.

Provided your car passes the brake test, its qualifying time is the fastest lap from the qualifying laps.

### **3.1.2.2. Brake and Reverse Test**

At the end of qualifying, your car will have to come to a complete stop within 6m of when its transponder crossed the start/finish line.

You will then be asked to demonstrate your car can reverse without needing to push it or get out of the vehicle.

Deliberately skidding, swerving, or spinning out in order to stop is not an acceptable method of braking for the brake test.

Impacting the barriers is not an acceptable method of braking for the brake test (or ever).

If you fail the brake test, you may line up at the end of pit row and attempt to re-qualify if there is time.

Cars that do not pass the brake test are not allowed to race.

### **3.1.2.3 Practice Laps**

If the track is clear and it is safe to do so, drivers may perform practice laps before or between races. Just remember to have batteries charged by the next race.

## **3.1.3. Races**

The event will then be made up of a series of races which will be approximately 5 or 10 minutes, though this may change depending on the event. The race winner is the one who does the most laps in that time. Cars will start this race in their qualifying order (or reverse order if we're feeling chaotic).

The race ends when all cars cross the Start/Finish line after the first car crosses the Start/Finish line after time is up.

## **3.1.4. Battery Charging**

As described in 1.8, builders must be familiar with the safe handling procedures for their batteries. For lithium Polymer, this means batteries mustn't be allowed to over discharge, charging must be in a 'Lipo safe' bag/box with an auto cutoff charger, and charging must be supervised at all times. No unattended charging, as it's a serious fire risk.

Chargers must be in good working order and wired safely to minimise the risk of shock.

There will usually be an hour or so between races, depending on race lengths. If possible, you should be able to charge your battery to full in around an hour in order to make every race.