



# PROFESSIONAL CLASS



# TECHNICAL REGULATIONS 2019/20





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## GENERAL INFORMATION

### PREFACE – SUMMARY OF REVISIONS

The following changes have been made from the 2018/19 Season Technical Regulations Revision 1:

- T2.8**            **New Regulation added: Benefit of doubt**
- T2.9**            **New Regulation added: Spirit of the competition**
- T7.4**            **Renamed: Autonomous Features**

### HOW TO USE THIS DOCUMENT



Use of 'NEW!' symbol denotes where dimensional limits have changed, or a new rule has been created. Please read all text carefully to fully understand the rules and do not assume any previous knowledge of this booklet.

### PLAGIARISM

Land Rover 4x4 in Schools views cases of plagiarism very seriously. Competing teams at all levels of the competition that intentionally plagiarise any part of their assessed work, undermines the credibility and integrity of the Land Rover 4x4 in Schools challenge and the spirit of the competition. Examples of plagiarism will be dealt with individually, on a case-by-case basis. Points penalties may be given at the discretion of the chair of judges.

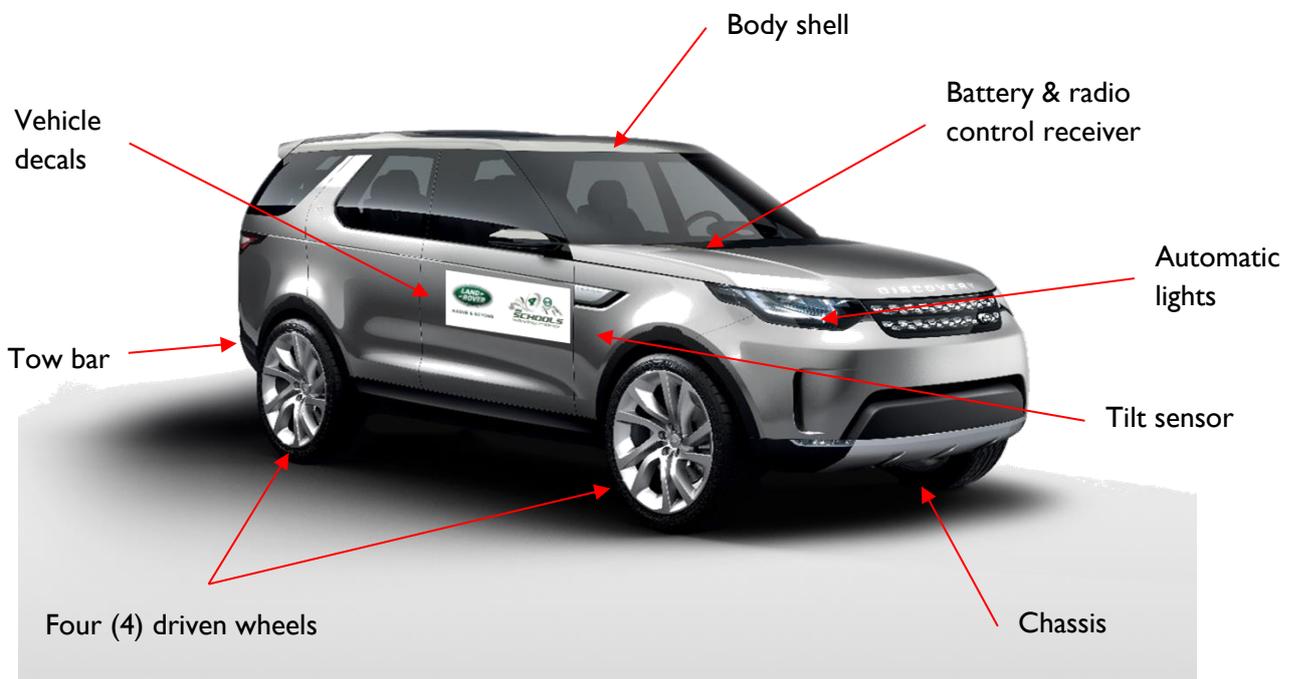
## T1.0 Definitions

### T1.1 Land Rover 4x4 in Schools Vehicle

Each team is required to produce a working remote-controlled vehicle that satisfies the Land Rover 4x4 in Schools vehicle Technical Regulations (this document). The vehicle must be manufactured as much as possible by the team members and judges may ask teams to prove how the vehicle has been produced. Any work done on the vehicle not by a team member must be listed as an outsourced item and must have engineering drawings, product descriptions and design briefs along with information of the manufacturer. The vehicle must be battery powered.

A Land Rover 4x4 in Schools vehicle assembly ('the vehicle') must consist of the following components:

- A body shell
- Four (4) driven wheels
- Vehicle drive battery
- Radio control receiver
- Vehicle chassis including spring / damper assembly
- Automatic lights
- Tilt sensor
- Tow bar
- Vehicle decals



### T1.2 Chassis

A chassis consists of an internal vehicle frame that supports a manmade object in its construction and use. An example of a chassis is the underpart of a motor vehicle, consisting of the frame, axles and suspension (onto which the body is mounted).

### **T1.3 Axle Track**

The axle track is the distance between the centreline of two wheels on the same axle.

### **T1.4 Wheelbase**

The wheelbase of the vehicle is the distance between the rotational centres of the front and rear wheels as viewed in the side view.

### **T1.5 Tolerance**

The permissible range of variation in a dimension of an object.

### **T1.6 Tank / skid steer**

By operating the left and right wheel pairs at different speeds, the vehicle turns by skidding, or dragging its fixed-orientation wheels across the ground.

### **T1.7 Land Rover 4x4 in Schools logo decal**

This consists of the Land Rover 4x4 in Schools logo graphic printed with a horizontal dimension of 55mm and vertical dimension of 20mm. The official decals are supplied by Land Rover 4x4 in Schools at event registration or a team can manufacture and fit their own decals, provided they use the official Land Rover 4x4 in Schools logo decal artwork which can be downloaded from [www.4x4inschools.co.uk](http://www.4x4inschools.co.uk).

### **1.8 Team number decal**

This consists of the Land Rover 4x4 in Schools team number decal printed with a horizontal dimension of 30mm and vertical dimension of 30mm. The official team number decals are supplied by Land Rover 4x4 in Schools at event registration.

### **T1.9 Vehicle drive battery**

This is the battery used primarily to provide power to the vehicle's wheels through one or more electric motors for drive (Such as Nickel-Cadmium (NiCad), Nickel Metal Hydride (NiMH) cells and LiPo). This is supplied as standard with the Land Rover 4x4 in Schools Starter kit, available through Land Rover 4x4 in Schools. Additional batteries may be used to power control circuits, please see T8.0 for more information.

### **T1.10 Body Shell**

The body shell is the aesthetic outer shell of a Land Rover 4x4 in Schools car. This can be a one-piece construction or a combination of different components, designed to protect and cover the vehicle chassis and electronics. The body shell should be securely fixed to the chassis and can be finished using paint, decals and other components.

### **T1.11 Spring / damper assembly**

The spring / damper assembly is an integral part of the suspension system of a vehicle. This comprises the assembly of components directly responsible for absorbing and damping wheel movements. The spring / damper assembly does not include any secondary linkages or control arms.

## T2.0 General Principles

### T2.1 Regulations Documents

**T2.1.1** Engineering in Motion Ltd issues the regulations, their revisions and amendments made.

**T2.1.2** Technical Regulations (this document). The Technical Regulations document is mainly concerned with those regulations that are directly related to Land Rover 4x4 in Schools vehicle design and manufacture. Technical regulation article numbers have a 'T' prefix.

**T2.1.3** Competition Regulations – a separate document which is mainly concerned with regulations and procedures directly related to judging and the competition event. Competition Regulation article numbers have a 'C' prefix.

### T2.2 Interpretation of the regulations

**T2.2.1** 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.

**T2.2.2** Text clarification - any questions received that are deemed by Engineering in Motion Ltd to be related to regulation text needing clarification will be answered by Engineering in Motion Ltd. The question received, along with the clarification provided by Engineering in Motion Ltd., will be published to all competing teams at the same time.

### T2.3 Amendments to the regulations

Any amendments will be announced and released by Engineering in Motion Ltd. on the official UK website: [www.4x4inschools.com](http://www.4x4inschools.com). Any amended text will be indicated thus (**using red underlined text**).

### T2.4 Compliance with regulations

Points are deducted for non-compliance with the technical regulations as per the specification judging scorecard. The vehicle is scrutineered and points will be deducted for any infringements. Several regulations have been identified as '**critical regulations**'.



### T2.5 Critical Regulations – identified with a hazard symbol

**IMPORTANT:** The below scrutineering rules are classified as critical regulations, which carry much heavier penalties than non-critical regulations. If a team breaks any one or more of these critical regulations, they will not be eligible to win the Best Engineered Vehicle and Best Track Performance awards so **please take extra time to check your car doesn't break any of the below critical Technical Regulations:**

- **T3.1** – Overall length
- **T3.2** – Overall width
- **T3.3** – Overall height
- **T4.1.1** – Powered by electric motor(s)
- **T4.1.2** – Caterpillar track
- **T4.2.1** – Four wheels only
- **T5.1** – Vehicle weight
- **T6.1.1** – All wheels/tyres covered by body shell in plan view
- **T9.1** – Fixed tow bar
- **T9.2** – Tow bar suitable for use

## T2.6 Design ideas and regulation compliance questions

Teams are not permitted to seek a ruling from Land Rover 4x4 in Schools or any competition officials or judges before the event as to whether a design idea complies with these regulations. Rulings will only be made by the judges at Land Rover 4x4 in Schools events. Design compliance with the regulations forms part of the competition. As in many competitions, innovation is encouraged and Land Rover 4x4 in Schools teams may also find ways of creating design features that push the boundaries of the regulations in order to get an extra competitive edge.

### T2.7 Measurements

**T2.7.1** All units of measure in this document unless otherwise stated for dimensions and weight are in millimetres (mm), kilograms (kg) and degrees (°). Conversion calculations are the responsibility of the team.

**T2.7.2** Tolerance when measuring all dimensions is +/- 1(one) millimetres (mm) unless otherwise stated.

**T2.7.3** Tolerance when measuring weight is +/- 0.001 kilogram (kg) unless otherwise stated.

**T2.7.4** Tolerance when measuring angles is +/- 2(°) unless otherwise stated.

**T2.7.5** Tolerance when measuring light is +/- 5(lux) unless otherwise stated.

**T2.7.6** 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. Measurements will be taken with the vehicle in a ready to compete state.

**T2.7.7** Weight measures – all weight measurements will be made using the Land Rover 4x4 in Schools electronic competition scales which are accurately calibrated to +/- 1(one)g.



### T2.8 Benefit of doubt

The chair of judges will, where appropriate, seek to use 'benefit of doubt' when the assessment of compliance is marginal or unclear. In this situation, teams will be given the benefit of doubt rather than a firm penalty if a penalty cannot be clearly measured or identified.



### T2.9 Spirit of the competition

Teams are expected to act in the spirit of the competition, both before and during any Land Rover 4x4 in Schools event. Any team deemed by the chair of judges to be acting outside of the spirit of the competition, can be removed from certain or all aspects of the competition. For example, a team attempting to abuse the technical regulations to their advantage may, at the discretion of the chair of judges, be removed from track activity and receive no points for this activity. A team deemed to be acting in an unsportsmanlike manner towards another team or other persons may be removed from some or all judging areas.

The spirit of the competition is simple; embrace and respect the rules and regulations, do your very best to compete legally and fairly, while contributing positively to the Land Rover 4x4 in Schools Technology Challenge. Most importantly; learn as much as you can, make friends, create positive relationships, network professionally and enjoy yourselves.

## T3.0 Vehicle Dimensions

NEW!



### T3.1 Total length - [Critical regulation | Penalty -25pts]

Measured from the longest points on the vehicle and including the fixed tow bar.

Min: 200mm / Max: 375mm



NEW!



### T3.2 Total width - [Critical regulation | Penalty -25pts]

Measured from the widest points on the vehicle and including features such as side mirrors.

Min: 160mm / Max: 215mm





**T3.3 Total height - [Critical regulation | Penalty -25pts]**

Measured from the track surface to the highest point on the vehicle including aerials.

**Min: 100mm / Max: 200mm**



**T3.4 Ground clearance - [Penalty -5pts]**

Measured from the track surface to the lowest point under the vehicle including the fixed tow bar.

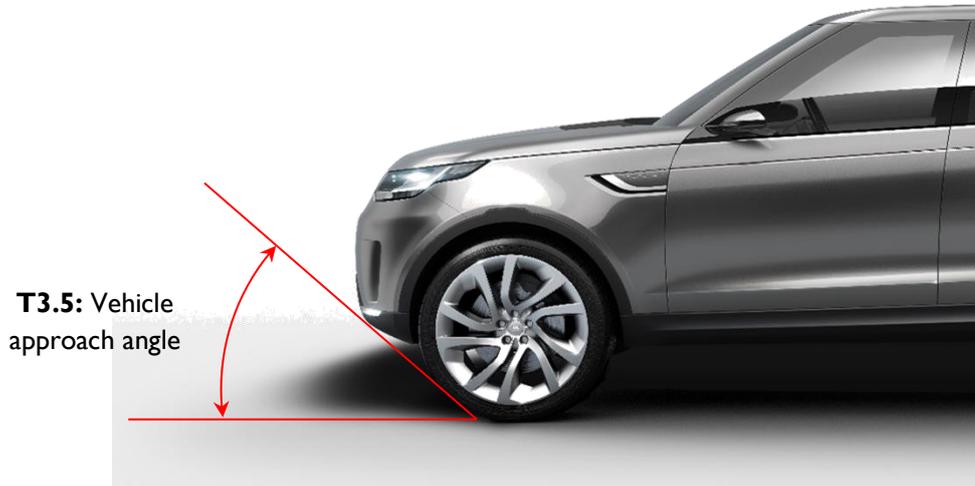
**Min: 20mm**



### T3.5 Approach angle - [Penalty -5pts]

From the front of the vehicle.

**Min: 25°**



### T3.6 Departure Angle - [Penalty -5pts]

From the back of the vehicle.

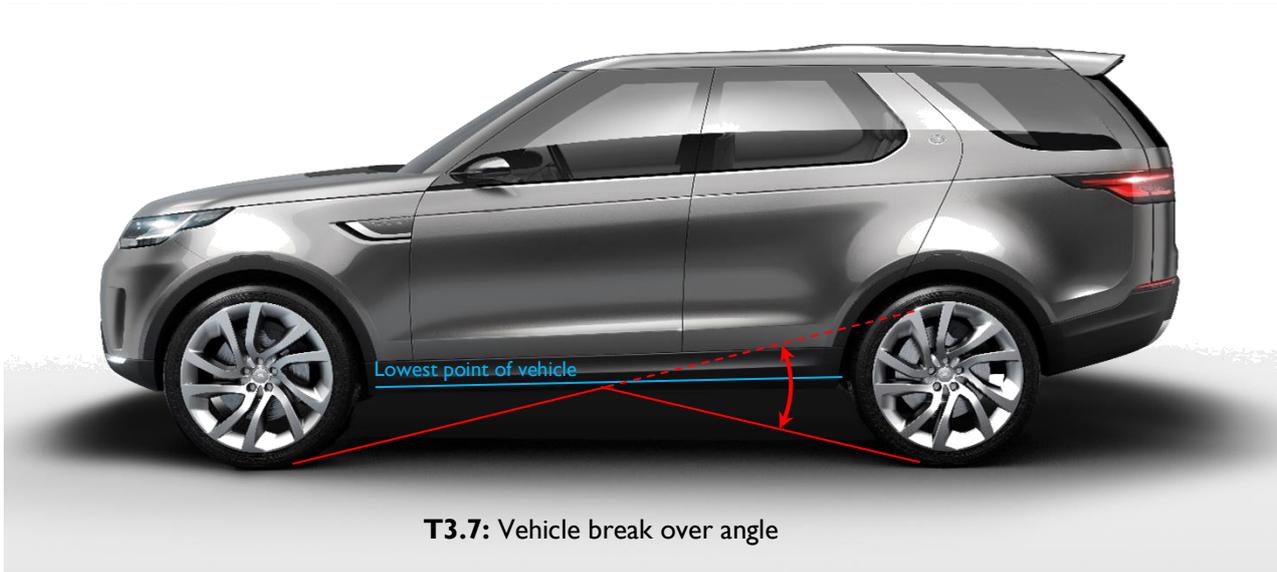
**Min: 25°**



### T3.7 Break over angle - [Penalty -5pts]

Centred between the wheels to the lowest point of the vehicle.

**Min: 40°**



**IMPORTANT:** The dimensions above are set as a minimum for the vehicles. Certain elements of the test track will exceed these dimensions to test the vehicles overall capability.

## T4.0 Drive and wheels

- T4.1 Drive - [Critical regulations | If failed, cannot be track assessed]**
  - T4.1.1** The vehicle must be powered by an electric motor or motors.
  - T4.1.2** Caterpillar tracks are not permitted.
  - T4.1.3** All wheels must be driven. [Non-critical | Penalty -5pts]

- T4.2 Wheels - [Critical regulation | If failed, cannot be track assessed]**  
The vehicle must have four (4) wheels only.

## T5.0 Vehicle weight

- T5.1 Maximum weight - [Critical regulation | Penalty -5pts for each 50g overweight]**  
The vehicle must not exceed 2.0kg in weight. Any vehicle that exceeds 2.0kg will incur in (-5) points per 50g over 2.0kg. Therefore: 2.005kg = 5-point penalty, 2.055g = 10 points penalty.  
**Max: 2.0kg**

## T6.0 Vehicle body shell



### T6.1 Body shell cover

The vehicle's body shell must cover the following:

**T6.1.1** All four (4) wheels and tyres from plan view (above). **[Critical regulation | Penalty -25pts]**

**T6.1.2** The vehicle's battery. **[Penalty -5pts]**

**T6.1.3** All motors and receivers. **[Penalty -5pts]**



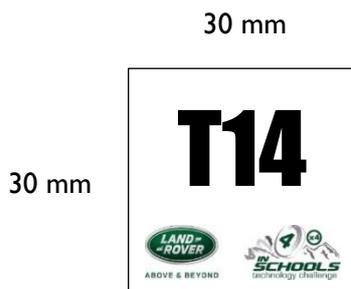
### T6.2 Challenge logo - [Penalty -5pt]

The vehicle must display the challenge logo, as shown below. This file is available to download from <http://www.4x4inschools.co.uk/downloads/> titled: 'Land Rover 4x4 in Schools Logo CAR.jpg'



### T6.3 Team number decal - [Penalty -5pt]

The vehicle body shell must have available space to display two (2) team number decals on a minimum of two panels of the vehicle. The stickers will be provided by Land Rover 4x4 in Schools during registration.



## T7.0 Vehicle electronics

### T7.1 Tilt sensor – [Penalty –10pts]

The vehicle must have a lateral (centre to left and centre to right) tilt detection system to trigger lights or a buzzer on the vehicle when the angle of tilt is greater than 25°.

**This will be assessed on track on the Slide Slope element (tolerance  $\pm 5^\circ$ )**

### T7.2 Automatic lights – [Penalty –10pts]

The vehicle must have an automated system to turn the vehicle lights on when the light level drops to below 25 lux.

**This will be assessed on track on the Tunnel element (tolerance  $\pm 5$  lux)**

### T7.3 Cable Management – [Penalty –5pts]

Cables and wiring should be protected by the body shell where possible. Cables should be tied together neatly and routed in a logical manner, so as not to catch on any external element or pose a safety risk.



### T7.4 Autonomous Features (optional)

Teams have the option to add a programmable computer such as an Arduino, Raspberry Pi, BBC Microbit or similar to their vehicle, allowing them to code autonomous functions such as hazard avoidance, parking sensors, automatic lights and GPS. These must use a power source with a maximum nominal voltage of 9v. Points are awarded for the use of coding, for detailed scoring information please refer to the Competition Regulations. **Not sure where to start?** Learn the basics of coding using Scratch, a fantastic FREE platform developed by MIT. Find out more and try out loads of helpful tutorials at: <https://scratch.mit.edu/>.

## T8.0 Vehicle control equipment

The following vehicle control equipment is needed to participate in the Land Rover 4x4 in Schools Technology Challenge:

### T8.1 Radio control equipment – [Penalty –2pts]

A digital speed controller must be used to control the vehicle.

### T8.2 Drive Battery Pack – [Penalty –5pts]

Battery pack(s) with a combined nominal maximum voltage of 7.4v must be used.

### T8.3 Additional Battery Packs (optional)

Additional batteries can be used to power non-drive control circuits (e.g. programmable computer, light sensor, buzzer), these must have a maximum nominal voltage of 9v.

## T9.0 Tow bar (assessed on track during the Trailer Test)

All vehicles must be fitted with a fixed tow bar which must be carried by the vehicle throughout the competition. The tow bar will be used to tow a trailer by all vehicles through a set course laid out on the day of the competition by Land Rover 4x4 in Schools. Details of the trailer can be found in Appendix i at the end of this document. Failing to have a tow bar stops the team from participating in the Trailer Test.



### T9.1 Fixed [Critical regulation | If failed, cannot be track assessed]

The vehicle must have a fixed tow bar which must be carried by the vehicle throughout the competition.



### T9.2 Suitable for use [Critical regulation | If failed, cannot be track assessed]

The tow bar must be suitable for use with the tow eye on the supplied trailer.

**Outer diameter of tow bar hitch pin: Max: 5mm**

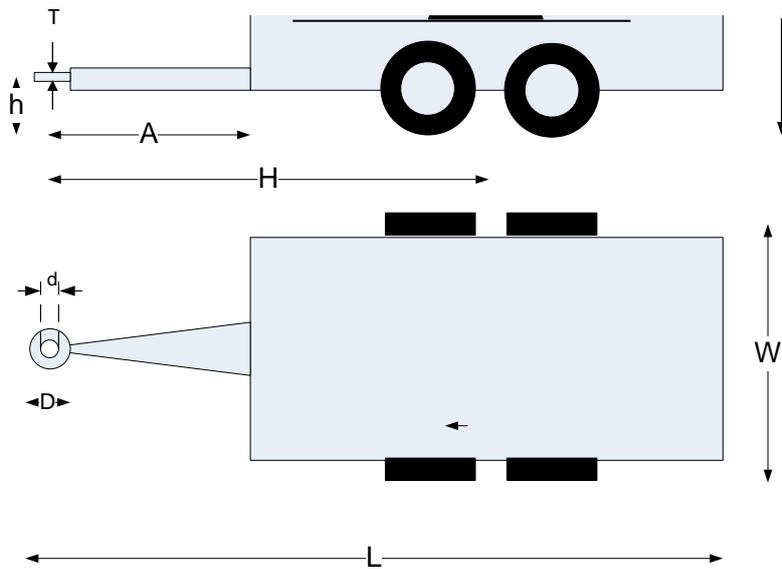
### T9.3 Retract, fold or pivot (optional)

It is permissible to retract, fold or pivot the tow bar providing this is done without the use of tools.

**NEXT... Appendix – Additional Information**

## Appendix i – Trailer

- i.1** Land Rover 4x4 in Schools will provide the trailer on the day of the competition.
- i.2** The trailer has no brakes.
- i.3** The trailer or towed object will have 2 or more wheels.
- i.4** The towing eye on the trailer is rigidly fixed to the trailer – there is no rotational movement.
- i.5** The towing eye is a ring type.



Dimension	Label	Value
Trailer max width	W	200mm
Trailer max length including tow eye	L	350mm
Towing eye height	h	35mm
Hitch length (see diagram)	H	210mm
Drawbar length	A	70mm
Tow eye inner diameter	d	5mm
Tow eye outer diameter	D	15mm
Tow eye thickness	T	3mm



Please make sure you have also read the Competition Regulations

**GOOD LUCK, SEE  
YOU ON THE TEST  
TRACK!**

**Land Rover 4x4 in Schools Technology Challenge**

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