

2008 FORMULA ONE TECHNICAL REGULATIONS

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ARTICLE 1: DEFINITIONS

1.1 Formula One Car :

An automobile designed solely for speed races on circuits or closed courses.

1.2 Automobile :

A land vehicle running on at least four non-aligned complete wheels, of which at least two are used for steering and at least two for propulsion.

1.3 Land vehicle

A locomotive device propelled by its own means, moving by constantly taking real support on the earth's surface, of which the propulsion and steering are under the control of a driver aboard the vehicle.

1.4 Bodywork :

All entirely sprung parts of the car in contact with the external air stream, except cameras and the parts definitely associated with the mechanical functioning of the engine, transmission and running gear. Airboxes, radiators and engine exhausts are considered to be part of the bodywork.

1.5 Wheel :

Flange and rim.

1.6 Complete wheel :

Wheel and inflated tyre. The complete wheel is considered part of the suspension system.

1.7 Automobile Make :

In the case of Formula racing cars, an automobile make is a complete car. When the car manufacturer fits an engine which it does not manufacture, the car shall be considered a hybrid and the name of the engine manufacturer shall be associated with that of the car manufacturer. The name of the car manufacturer must always precede that of the engine manufacturer. Should a hybrid car win a Championship Title, Cup or Trophy, this will be awarded to the manufacturer of the car.

1.8 Event :

Any event entered into the FIA F1 Championship Calendar for any year commencing at the scheduled time for scrutineering and sporting checks and including all practice and the race itself and ending at the later of the time for the lodging of a protest under the terms of the Sporting Code and the time when a technical or sporting verification has been carried out under the terms of that Code.

1.9 Weight :

Is the weight of the car with the driver, wearing his complete racing apparel, at all times during the event.

1.10 Cubic capacity :

The volume swept in the cylinders of the engine by the movement of the pistons. This volume shall be expressed in cubic centimetres. In calculating engine cubic capacity, the number Pi shall be 3.1416.

1.11 Supercharging :

Increasing the weight of the charge of the fuel/air mixture in the combustion chamber (over the weight induced by normal atmospheric pressure, ram effect and dynamic effects in the intake and/or exhaust system) by any means whatsoever. The injection of fuel under pressure is not considered to be supercharging.

1.12 Cockpit :

The volume which accommodates the driver.

1.13 Sprung suspension :

The means whereby all complete wheels are suspended from the body/chassis unit by a spring medium.

1.14 Survival cell :

A continuous closed structure containing the fuel tank and the cockpit.

1.15 Camera :

Television cameras the dimensions of which are defined in Drawing 6.

1.16 Camera housing :

A device which is identical in shape and weight to a camera and which is supplied by the relevant Competitor for fitting to his car in lieu of a camera.

1.17 Cockpit padding :

Non-structural parts placed within the cockpit for the sole purpose of improving driver comfort and safety. All such material must be quickly removable without the use of tools.

1.18 Brake caliper :

All parts of the braking system outside the survival cell, other than brake discs, brake pads, caliper pistons, brake hoses and fittings, which are stressed when subjected to the braking pressure. Bolts or studs which are used for attachment are not considered to be part of the braking system.

1.19 Electronically controlled :

Any command system or process that utilises semi-conductor or thermionic technology.

ARTICLE 2 : GENERAL PRINCIPLES

2.1 Role of the FIA :

The following technical regulations for Formula One cars are issued by the FIA.

2.2 Amendments to the regulations :

Amendments to these regulations for 2008 and 2009 will be made in accordance with Clause 8.10 of the 1998 Concorde agreement.

Thereafter changes to these or to the sporting regulations which, in the opinion of the FIA Technical Department, involve significant change to the design of a car, will be announced no later than 30 June to come into force for the next season but one. Changes needed for safety reasons may be introduced with shorter notice in consultation with the currently competing teams.

2.3 Dangerous construction :

The stewards of the meeting may exclude a vehicle whose construction is deemed to be dangerous.

2.4 Compliance with the regulations :

Automobiles must comply with these regulations in their entirety at all times during an Event.

Should a competitor feel that any aspect of these regulations is unclear, clarification may be sought from the FIA Formula One Technical Department. If clarification relates to any new design or system, correspondence must include :

- a full description of the design or system ;
- drawings or schematics where appropriate ;
- the Competitor's opinion concerning the immediate implications on other parts of the car of any proposed new design ;
- the Competitor's opinion concerning any possible long term consequences or new developments which may come from using any such new designs or systems ;
- the precise way or ways in which the Competitor feels the new design or system will enhance the performance of the car.

2.5 New systems or technologies

Any new system, procedure or technology not specifically covered by these regulations, but which is deemed permissible by the FIA Formula One Technical Department, will only be admitted until the end of the Championship during which it is introduced. Following this the Formula One Commission will be asked to review the technology concerned and, if they feel it adds no value to Formula One in general, it will be specifically prohibited.

Any team whose technology is prohibited in this way will then be required to publish full technical details of the relevant system or procedure.

2.6 Measurements :

All measurements must be made while the car is stationary on a flat horizontal surface.

2.7 Duty of Competitor :

It is the duty of each Competitor to satisfy the FIA technical delegate and the Stewards of the Meeting that his automobile complies with these regulations in their entirety at all times during an Event.

The design of the car, its components and systems shall, with the exception of safety features, demonstrate their compliance with these regulations by means of physical inspection of hardware or materials. No mechanical design may rely upon software inspection as a means of ensuring its compliance.

ARTICLE 3 : BODYWORK AND DIMENSIONS

For illustrations refer to drawings 1A-5A in the Appendix to these regulations.

3.1 Wheel centre line :

The centre line of any wheel shall be deemed to be half way between two straight edges, perpendicular to the surface on which the car is standing, placed against opposite sides of the complete wheel at the centre of the tyre tread.

3.2 Height measurements :

All height measurements will be taken normal to and from the reference plane.

3.3 Overall width :

The overall width of the car, including complete wheels, must not exceed 1800mm with the steered wheels in the straight ahead position. Overall width will be measured when the car is fitted with tyres inflated to 1.4 bar.

3.4 Width ahead of the rear wheel centre line :

3.4.1 Bodywork width ahead of the rear wheel centre line must not exceed 1400mm.

3.4.2 In order to prevent tyre damage to other cars, the top and forward edges of the lateral extremities of any bodywork forward of the front wheels must be at least 10mm thick with a radius of at least 5mm. Providing it is inclined at an angle less than 60° to the car centre line, the forward edge of any horizontal part of the bodywork in these areas need not comply with these requirements.

3.4.3 In order to avoid the spread of debris on the track following an accident, the outer skins of the front wing endplates and any turning vanes in the vicinity of the front wheels (and any similarly vulnerable bodywork parts in this area), must be made predominantly from materials which are included for the specific purpose of containing debris.

The FIA must be satisfied that all such parts are constructed in order to achieve the stated objective.

3.5 Width behind the rear wheel centre line :

Bodywork width behind the rear wheel centre line must not exceed 1000mm.

3.6 Overall height :

No part of the bodywork may be more than 950mm above the reference plane.

3.7 Front bodywork height :

3.7.1 All bodywork situated forward of a point lying 330mm behind the front wheel centre line, and more than 250mm from the centre line of the car, must be no less than 150mm and no more than 350mm above the reference plane.

3.7.2 All bodywork situated forward of a point lying 330mm behind the front wheel centre line must be no less than 50mm above the reference plane.

3.8 Bodywork in front of the rear wheels :

3.8.1 Other than the rear view mirrors, each with a maximum area in plan view of 12000mm², no bodywork situated more than 330mm behind the front wheel centre line and more than 330mm forward of the rear wheel centre line, which is more than 600mm above the reference plane, may be more than 300mm from the centre line of the car.

3.8.2 No bodywork between the rear wheel centre line and a line 800mm forward of the rear wheel centre line, which is more than 500mm from the centre line of the car, may be more than 500mm above the reference plane.

3.8.3 No bodywork between the rear wheel centre line and a line 400mm forward of the rear wheel centre line, which is more than 500mm from the centre line of the car, may be more than 300mm above the reference plane.

3.8.4 With the rear wheels removed and when viewed from above, no bodywork more than 500mm from the car centre line may lie between the rear wheel centre line and a point 400mm forward of it. Any bodywork forming the forward inner corner of these areas may have a radius no greater than 140mm.

3.9 Bodywork between the rear wheels :

3.9.1 No bodywork situated between the rear wheel centre line and a point lying 330mm forward of it, and which is more than 100mm from the car centre line, may be more than 600mm above the reference plane.

3.9.2 No bodywork situated between the rear wheel centre line and a point lying 150mm behind it, and which is between 75mm and 480mm from the car centre line, may be located between 375mm and 600mm above the reference plane.

3.10 Height behind the rear wheel centre line :

3.10.1 No part of the car behind the rear wheel centre line may be more than 800mm above the reference plane.

3.10.2 No bodywork behind the rear wheel centre line, and more than 150mm each side of the car centre line, may be less than 300mm above the reference plane.

3.10.3 Any bodywork more than 150mm behind the rear wheel centre line which is between 300mm and 600mm above the reference plane, and between 75mm and 480mm from the car centre line, must lie in an area when viewed from the side of the car that is situated between 300mm and 375mm above the reference plane. When viewed from the side of the car no longitudinal cross section may have more than one closed section in this area.

3.10.4 Any bodywork behind the rear wheel centre line which is more than 600mm above the reference plane, and between 75mm and 480mm from the car centre line, must lie in an area when viewed from the side of the car that is situated between the rear wheel centre line and a point 350mm behind it. When viewed from the side of the car, no longitudinal cross section may have more than two closed sections in this area.

Furthermore, the distance between adjacent sections at any longitudinal plane must not exceed 15mm at their closest position.

3.10.5 In order to ensure that the relationship between the two upper aerofoil elements cannot change whilst the car is in motion they must be bridged by means of rigid impervious supports (including any adjustment mechanism) arranged such that no part of the trailing edge of the forward section may be more than 250mm laterally from a support. These rigid supports must :

- fully enclose the two complete sections such that their inner profile matches that of the two sections. Their outer profile must be offset from the inner profile by between 8 and 30mm and may not incorporate any radius smaller than 10mm ('gurney' type trim tabs may however be fitted between the supports) ;
- not be recessed into the wing profiles ;
- be arranged so that any curvature occurs only in a horizontal plane ;
- be between 2 and 3mm thick ;
- be rigidly fixed to the two sections. Some form of adjustment mechanism between the sections may be incorporated for the sole purpose of allowing adjustment of the sections relative to one another whilst the car is in the pits ;
- be constructed from a material with modulus greater than 50GPa.

These supports will be ignored when assessing whether the car is in compliance with Articles 3.9.1, 3.9.2, 3.10.1, 3.10.4 and 3.10.6.

- 3.10.6 No part of the car between 75mm and 480mm from the car centre line may be more than 500mm behind the rear wheel centre line. Any parts of the car less than 75mm from the car centre line and more than 500mm behind the rear wheel centre line must be situated between 200mm and 400mm above the reference plane.
- 3.10.7 In side view, the projected area of any bodywork lying between 300mm and 800mm above the reference plane and between the rear wheel centre line and a point 600mm behind it must be greater than 230000mm².

3.11 Bodywork around the front wheels :

With the exception of brake cooling ducts, in plan view, there must be no bodywork in the area formed by two longitudinal lines parallel to and 400mm and 900mm from the car centre line and two transversal lines, one 350mm forward of and one 800mm behind the front wheel centre line.

3.12 Bodywork facing the ground :

- 3.12.1 All sprung parts of the car situated more than 330mm behind the front wheel centre line and more than 330mm forward of the rear wheel centre line, and which are visible from underneath, must form surfaces which lie on one of two parallel planes, the reference plane or the step plane. This does not apply to any parts of rear view mirrors which are visible, provided each of these areas does not exceed 12000mm² when projected to a horizontal plane above the car, or to any parts of the panels referred to in Article 15.4.7.

The step plane must be 50mm above the reference plane.

- 3.12.2 Additionally, the surface formed by all parts lying on the reference plane must :

- extend from a point lying 330mm behind the front wheel centre line to the centre line of the rear wheels;
- have minimum and maximum widths of 300mm and 500mm respectively ;
- be symmetrical about the centre line of the car ;
- have a 50mm radius (+/-2mm) on each front corner when viewed from directly beneath the car, this being applied after the surface has been defined.

- 3.12.3 The surface lying on the reference plane must be joined around its periphery to the surfaces lying on the step plane by a vertical transition. If there is no surface visible on the step plane vertically above any point around the periphery of the reference plane, this transition is not necessary.

- 3.12.4 The peripheries of the surfaces lying on the reference and step planes may be curved upwards with maximum radii of 25 and 50mm respectively. Where the vertical transition meets the surfaces on the step plane a radius, no greater than 25mm, is permitted.

A radius in this context will be considered as an arc applied perpendicular to the periphery and tangential to both surfaces.

The surface lying on the reference plane, the surfaces lying on the step plane, the vertical transitions between them and any surfaces rearward of the surfaces lying on the reference or step planes, must first be fully defined before any radius can be applied or the skid block fitted. Any radius applied is still considered part of the relevant surface.

- 3.12.5 All parts lying on the reference and step planes, in addition to the transition between the two planes, must produce uniform, solid, hard, continuous, rigid (no degree of freedom in relation to the body/chassis unit), impervious surfaces under all circumstances.

Fully enclosed holes are permitted in the surfaces lying on the reference and step planes provided no part of the car is visible through them when viewed from directly below.

- 3.12.6 To help overcome any possible manufacturing problems, and not to permit any design which may contravene any part of these regulations, dimensional tolerances are permitted on bodywork situated between a point lying 330mm behind the front wheel centre line and the rear wheel centre line. A vertical tolerance of +/- 5mm is permissible across the surfaces lying on the reference and step planes and a horizontal tolerance of 5mm is permitted when assessing whether a surface is visible from beneath the car.
- 3.12.7 No bodywork more than 150mm from the car centre line, which is visible from beneath the car and which lies between the rear wheel centre line and a point 330mm forward of it may be more than 125mm above the reference plane. Any intersection of the surfaces in this area with a lateral or longitudinal vertical plane should form one continuous line which is visible from beneath the car.

Additionally, any bodywork in this area must produce uniform, solid, hard, continuous, rigid (no degree of freedom in relation to the body/chassis unit), impervious surfaces under all circumstances.

- 3.12.8 All sprung parts of the car situated behind a point lying 330mm forward of the rear wheel centre line, which are visible from underneath and are more than 250mm from the centre line of the car, must be at least 50mm above the reference plane.

3.13 Skid block :

- 3.13.1 Beneath the surface formed by all parts lying on the reference plane, a rectangular skid block, with a 50mm radius (+/-2mm) on each front corner, must be fitted. This skid block may comprise more than one piece but must :

- a) extend longitudinally from a point lying 330mm behind the front wheel centre line to the centre line of the rear wheels.
- b) be made from an homogeneous material with a specific gravity between 1.3 and 1.45.
- c) have a width of 300mm with a tolerance of +/- 2mm.
- d) have a thickness of 10mm with a tolerance of +/- 1mm.
- e) have a uniform thickness when new.
- f) have no holes or cut outs other than those necessary to fit the fasteners permitted by 3.13.2 or those holes specifically mentioned in g) below.
- g) have seven precisely placed holes the positions of which are detailed in Drawing 1. In order to establish the conformity of the skid block after use, its thickness will only be measured in the four 50mm diameter holes and the two forward 80mm diameter holes.

Four further 10mm diameter holes are permitted provided their sole purpose is to allow access to the bolts which secure the Accident Data Recorder to the survival cell.

- h) be fixed symmetrically about the centre line of the car in such a way that no air may pass between it and the surface formed by the parts lying on the reference plane.
- 3.13.2 Fasteners used to attach the skid block to the car must :
- a) have a total area no greater than 40000mm² when viewed from directly beneath the car ;
 - b) be no greater than 2000mm² in area individually when viewed from directly beneath the car ;
 - c) be fitted in order that their entire lower surfaces are visible from directly beneath the car.

When the skid block is new, ten of the fasteners may be flush with its lower surface but the remainder may be no more than 8mm below the reference plane.

3.13.3 The lower edge of the periphery of the skid block may be chamfered at an angle of 30° to a depth of 8mm, the trailing edge however may be chamfered over a distance of 200mm to a depth of 8mm.

3.14 Overhangs :

3.14.1 No part of the car may be more than 600mm behind the rear wheel centre line or more than 1200mm in front of the front wheel centre line.

3.14.2 No part of the bodywork more than 200mm from the car centre line may be more than 900mm in front of the front wheel centre line.

3.14.3 All overhang measurements will be taken parallel to the reference plane.

3.15 Aerodynamic influence :

With the exception of the cover described in Article 6.5.2 (when used in the pit lane) and the ducts described in Article 11.4, any specific part of the car influencing its aerodynamic performance :

- Must comply with the rules relating to bodywork.
- Must be rigidly secured to the entirely sprung part of the car (rigidly secured means not having any degree of freedom).
- Must remain immobile in relation to the sprung part of the car.

Any device or construction that is designed to bridge the gap between the sprung part of the car and the ground is prohibited under all circumstances.

No part having an aerodynamic influence and no part of the bodywork, with the exception of the skid block in 3.13 above, may under any circumstances be located below the reference plane.

3.16 Upper bodywork :

3.16.1 With the exception of the opening described in Article 3.16.3, when viewed from the side, the car must have bodywork in the area bounded by four lines. One vertical 1330mm forward of the rear wheel centre line, one horizontal 550mm above the reference plane, one horizontal 925mm above the reference plane and one diagonal which intersects the 925mm horizontal at a point 1000mm forward of the rear wheel centreline and the 550mm horizontal at the rear wheel centreline.

Bodywork within this area must be arranged symmetrically about the car centre line and, when measured 200mm vertically below the diagonal boundary line, must have minimum widths of 150mm and 50mm respectively at points lying 1000mm forward of the rear wheel centre line and at the rear wheel centre line. This bodywork must lie on or outside the boundary defined by a linear taper between these minimum widths.

3.16.2 Bodywork lying vertically above the upper boundary as defined in 3.16.1 may be no wider than 125mm and must be arranged symmetrically about the car centreline.

3.16.3 In order that a car may be lifted quickly in the event of it stopping on the circuit, the principal rollover structure must incorporate a clearly visible unobstructed opening designed to permit a strap, whose section measures 60mm x 30mm, to pass through it.

3.17 Bodywork flexibility :

3.17.1 Bodywork may deflect no more than 5mm vertically when a 500N load is applied vertically to it 700mm forward of the front wheel centre line and 625mm from the car centre line. The load will be applied in a downward direction using a 50mm diameter ram and an adapter 300mm long and 150mm wide. Teams must supply the latter when such a test is deemed necessary.

- 3.17.2 Bodywork may deflect no more than 10mm vertically when a 500N load is applied vertically to it 450mm forward of the rear wheel centre line and 650mm from the car centre line. The load will be applied in a downward direction using a 50mm diameter ram and an adapter of the same size. Teams must supply the latter when such a test is deemed necessary.
- 3.17.3 Bodywork may deflect by no more than one degree horizontally when a load of 1000N is applied simultaneously to its extremities in a rearward direction 780mm above the reference plane and 20mm forward of the rear wheel centre line.
- 3.17.4 Bodywork may deflect no more than 5mm vertically when a 2000N load is applied vertically to it at a point which lies on the car centre line and 380mm rearward of the front wheel centre line. The load will be applied in an upward direction using a 50mm diameter ram.
- 3.17.5 The uppermost aerofoil element-lying behind the rear wheel centre line may deflect no more than 5mm horizontally when a 500N load is applied horizontally. The load will be applied 800mm above the reference plane at three separate points which lie on the car centre line and 250mm either side of it. The loads will be applied in a rearward direction using a suitable 25mm wide adapter which must be supplied by the relevant team.
- 3.17.6 The forward-most aerofoil element lying behind the rear wheel centre line and which lies more than 600mm above the reference plane may deflect no more than 2mm vertically when a 200N load is applied vertically. The load will be applied in line with the trailing edge of the element at any point across its width. The loads will be applied using a suitable adapter, supplied by the relevant team, which :
- may be no more than 50mm wide ;
 - which extends no more than 10mm forward of the trailing edge ;
 - incorporates an 8mm female thread in the underside.
- 3.17.7 Bodywork may deflect no more than 2mm vertically when a 500N load is applied simultaneously to each side of it 200mm behind the rear wheel centre line, 450mm from the car centre line and 820mm above the reference plane. The deflection will be measured at the outer extremities of the bodywork at a point 345mm behind the rear wheel centre line.
- The load will be applied in a downward direction through pads measuring 200mm x 100mm which conform to the shape of the bodywork beneath them, and with their uppermost horizontal surface 820mm above the reference plane. The load will be applied to the centre of area of the pads. Teams must supply the latter when such a test is deemed necessary.
- 3.17.8 In order to ensure that the requirements of Article 3.15 are respected, the FIA reserves the right to introduce further load/deflection tests on any part of the bodywork which appears to be (or is suspected of), moving whilst the car is in motion.

ARTICLE 4 : WEIGHT

4.1 Minimum weight :

The weight of the car must not be less than 605kg at all times during the Event.

4.2 Ballast :

Ballast can be used provided it is secured in such a way that tools are required for its removal. It must be possible to fix seals if deemed necessary by the FIA technical delegate.

4.3 Adding during the race :

With the exception of fuel and compressed gases, no substance may be added to the car during the race. If it becomes necessary to replace any part of the car during the race, the new part must not weigh any more than the original part.

ARTICLE 5 : ENGINES

5.1 Engine specification :

- 5.1.1 Only 4-stroke engines with reciprocating pistons are permitted.
- 5.1.2 Engine capacity must not exceed 2400 cc.
- 5.1.3 Crankshaft rotational speed must not exceed 19,000rpm.
- 5.1.4 Supercharging is forbidden.
- 5.1.5 All engines must have 8 cylinders arranged in a 90° "V" configuration and the normal section of each cylinder must be circular.
- 5.1.6 Engines must have two inlet and two exhaust valves per cylinder.
Only reciprocating poppet valves are permitted.
The sealing interface between the moving valve component and the stationary engine component must be circular.

5.2 Other means of propulsion :

- 5.2.1 The use of any device, other than the 2.4 litre, four stroke engine described in 5.1 above, to power the car, is not permitted.
- 5.2.2 The total amount of recoverable energy stored on the car must not exceed 300kJ. Any which may be recovered at a rate greater than 2kW must not exceed 20kJ.

5.3 Engine dimensions :

- 5.3.1 Cylinder bore diameter may not exceed 98mm.
- 5.3.2 Cylinder spacing must be fixed at 106.5mm (+/- 0.2mm).
- 5.3.3 The crankshaft centreline must not be less than 58mm above the reference plane.

5.4 Weight and centre of gravity :

- 5.4.1 The overall weight of the engine must be a minimum of 95kg.
- 5.4.2 The centre of gravity of the engine may not lie less than 165mm above the reference plane.
- 5.4.3 The longitudinal and lateral position of the centre of gravity of the engine must fall within a region that is the geometric centre of the engine, +/- 50mm. The geometric centre of the engine in a lateral sense will be considered to lie on the centre of the crankshaft and at the mid point between the centres of the forward and rear most cylinder bores longitudinally.
- 5.4.4 When establishing conformity with Articles 5.4.1, 5.4.2, 5.4.3 and Appendix 6 of the 2008 F1 Sporting Regulations, the homologated engine will include the intake system up to and including the air filter, fuel rail and injectors, ignition coils, engine mounted sensors and wiring, alternator, coolant pumps and oil pumps.
- 5.4.5 When establishing conformity with Article 5.4, the engine will not include :
 - clutch and clutch actuation system ;
 - flywheel ;
 - electronic control units or any associated devices containing programmable semiconductors ;
 - the alternator regulator ;
 - liquids ;

- exhaust manifolds ;
- heat shields ;
- oil tanks, catch tanks or any breather system connected to them ;
- studs used to mount the engine to the chassis or gearbox ;
- water system accumulators ;
- heat exchangers ;
- hydraulic system (e.g. pumps, accumulators, manifolds, servo-valves, solenoids, actuators) except servo-valve and actuator for engine throttle control ;
- fuel pumps nor any component not mounted on the engine when fitted to the car ;
- any ancillary equipment associated with the engine valve air system, such as hoses, regulators, reservoirs or compressors ;

Furthermore, any parts which are not ordinarily part of an engine will not be included when assessing its weight. Examples of this could be, but are not limited to :

- Wiring harnesses having only a partial association with engine actuators or sensors ;
- A bell housing designed to be integral with the engine crankcase ;
- Top engine mountings designed higher than necessary with integral webs or struts. The centre of any engine mounting which is part of a cam cover should not be any more than 100mm above a line between the camshaft centres, when measured parallel to it. Any webs integral with the cam cover should not extend further back than the centre of the second cylinder bore ;
- Ballast. This is permitted on the engine (subject to the requirements of Article 4.2) but any in excess of 2kg will be removed from the engine before measuring engine weight or centre of gravity height.

5.5 Engine throttles :

- 5.5.1 The only means by which the driver may control the engine throttle positions is via a single chassis mounted foot pedal.
- 5.5.2 Designs which allow specific points along the pedal travel range to be identified by the driver or assist him to hold a position are not permitted.
- 5.5.3 The minimum and maximum throttle pedal travel positions must correspond to the engine throttle minimum (nominal idle) and maximum open positions.

5.6 Variable geometry systems :

- 5.6.1 Variable geometry inlet systems are not permitted.
- 5.6.2 Variable geometry exhaust systems are not permitted.
- 5.6.3 Variable valve timing and variable valve lift systems are not permitted.

5.7 Fuel systems

- 5.7.1 The pressure of the fuel supplied to the injectors may not exceed 100 bar. Sensors must be fitted which directly measure the pressure of the fuel supplied to the injectors, these signals must be supplied to the FIA data logger.
- 5.7.2 Only one fuel injector per cylinder is permitted which must inject directly into the side or the top of the inlet port.

5.8 Electrical systems :

5.8.1 Ignition is only permitted by means of a single ignition coil and single spark plug per cylinder. The use of plasma, laser or other high frequency ignition techniques is forbidden.

5.8.2 Only conventional spark plugs that function by high tension electrical discharge across an exposed gap are permitted.

Spark plugs are not subject to the materials restrictions described in Articles 5.13 and 5.14.

5.8.3 The primary regulated voltage on the car must not exceed 17.0V DC. This voltage is defined as the stabilised output from the on-car charging system.

With the exception of capacitor circuitry or coils being used solely to provide ignition, any device with a current requirement greater than 50mA or a power requirement greater than 1W may only be supplied at or below the primary regulated voltage.

Only capacitor discharge ignition systems (those which generate a spark by means of closing a switch which then discharges a capacitor through the primary side of the ignition coil) , are permitted to provide a voltage higher than the primary regulated voltage to an ignition coil.

Other than any parts being used to supply a higher voltage to devices such as those described in the previous paragraphs, no device may step up or increase the primary regulated voltage.

5.9 Engine actuators :

With the following exceptions hydraulic, pneumatic or electronic actuation is forbidden :

- a) Electronic solenoids uniquely for the control of engine fluids ;
- b) Components providing controlled pressure air for a pneumatic valve system ;
- c) A single actuator to operate the throttle system of the engine.

5.10 Engine auxiliaries :

With the exception of electrical fuel pumps engine auxiliaries must be mechanically driven directly from the engine with a fixed speed ratio to the crankshaft.

5.11 Engine intake air :

5.11.1 Other than injection of fuel for the normal purpose of combustion in the engine, any device, system, procedure, construction or design the purpose or effect of which is any decrease in the temperature of the engine intake air is forbidden.

5.11.2 Other than engine sump breather gases and fuel for the normal purpose of combustion in the engine, the spraying of any substance into the engine intake air is forbidden.

5.12 Materials and Construction - Definitions

5.12.1 X Based Alloy (e.g. Ni based alloy) – X must be the most abundant element in the alloy on a %w/w basis. The minimum possible weight percent of the element X must always be greater than the maximum possible of each of the other individual elements present in the alloy.

5.12.2 X-Y Based Alloy (e.g. Al-Cu based alloy) – X must be the most abundant element as in 5.12.1 above. In addition element Y must be the second highest constituent (%w/w), after X in the alloy. The mean content of Y and all other alloying elements must be used to determine the second highest alloying element (Y).

5.12.3 Intermetallic Materials (e.g. TiAl, NiAl, FeAl, Cu₃Au, NiCo) – These are materials where the material is based upon intermetallic phases, i.e. the matrix of the material consists of greater than 50%v/v intermetallic phase(s). An intermetallic phase is a solid solution between two or more metals exhibiting either partly ionic or covalent, or metallic bonding with a long range order, in a narrow range of composition around the stoichiometric proportion.

- 5.12.4 Composite Materials – These are materials where a matrix material is reinforced by either a continuous or discontinuous phase. The matrix can be metallic, ceramic, polymeric or glass based. The reinforcement can be present as long fibres (continuous reinforcement); or short fibres, whiskers and particles (discontinuous reinforcement).
- 5.12.5 Metal Matrix Composites (MMC's) – These are composite materials with a metallic matrix containing a phase of greater than 2%v/v which is not soluble in the liquid phase of the metallic matrix.
- 5.12.6 Ceramic Materials (e.g. Al₂O₃, SiC, B₄C, Ti₅Si₃, SiO₂, Si₃N₄) – These are inorganic, non metallic solids.

5.13 Materials and construction – General

- 5.13.1 Unless explicitly permitted for a specific engine component, the following materials may not be used anywhere on the engine :
- Magnesium based alloys
 - Metal Matrix Composites (MMC's)
 - Intermetallic materials
 - Alloys containing more than 5% by weight of Beryllium, Iridium or Rhenium.
- 5.13.2 Coatings are free provided the total coating thickness does not exceed 25% of the section thickness of the underlying base material in all axes. In all cases the relevant coating must not exceed 0.8mm.

5.14 Materials and construction – Components

- 5.14.1 Pistons must be manufactured from an aluminium alloy which is either Al-Si ; Al-Cu ; Al-Mg or Al-Zn based.
- 5.14.2 Piston pins must be manufactured from an iron based alloy and must be machined from a single piece of material.
- 5.14.3 Connecting rods must be manufactured from iron or titanium based alloys and must be machined from a single piece of material with no welded or joined assemblies (other than a bolted big end cap or an interfered small end bush).
- 5.14.4 Crankshafts must be manufactured from an iron based alloy.
- No welding is permitted between the front and rear main bearing journals.
- No material with a density exceeding 19,000kg/m³ may be assembled to the crankshaft.
- 5.14.5 Camshafts must be manufactured from an iron based alloy.
- Each camshaft and lobes must be machined from a single piece of material.
- No welding is allowed between the front and rear bearing journals.
- 5.14.6 Valves must be manufactured from alloys based on Iron, Nickel, Cobalt or Titanium.
- Hollow structures cooled by sodium, lithium or similar are permitted.
- 5.14.7 Reciprocating and rotating components :
- Reciprocating and rotating components must not be manufactured from graphitic matrix, metal matrix composites or ceramic materials, this restriction does not apply to the clutch and any seals. Ceramic bearings are not permitted in ancillaries which are included when assessing the weight of the engine, e.g. alternator, coolant pumps and oil pumps ;
 - Rolling elements of rolling element bearings must be manufactured from an iron based alloy ;
 - Timing gears between the crankshaft and camshafts (including hubs) must be manufactured from an iron based alloy.

5.14.8 Static components :

- a) Engine crankcases and cylinder heads must be manufactured from cast or wrought aluminium alloys.
No composite materials or metal matrix composites are permitted either for the whole component or locally.
- b) Any metallic structure whose primary or secondary function is to retain lubricant or coolant within the engine must be manufactured from an iron based alloy or an aluminium alloy of the Al-Si, Al-Cu, Al-Zn or Al-Mg alloying systems.
- c) All threaded fasteners must be manufactured from an alloy based on Cobalt, Iron or Nickel.
Composite materials are not permitted.
- d) Valve seat inserts, valve guides and any other bearing component may be manufactured from metallic infiltrated pre-forms with other phases which are not used for reinforcement.

5.15 Starting the engine :

A supplementary device temporarily connected to the car may be used to start the engine both on the grid and in the pits.

5.16 Stall prevention systems :

If a car is equipped with a stall prevention system, and in order to avoid the possibility of a car involved in an accident being left with the engine running, all such systems must be configured to stop the engine no more than ten seconds after activation.

5.17 Replacing engine parts

The parts in lists A and B below may be changed without incurring a penalty under Article 28.4 of the 2008 F1 Sporting Regulations. If changing any of these parts involves breaking a seal this may be done but must be carried out under FIA supervision. The parts in List B may only be replaced by identical homologated parts in accordance with Appendix 6 of the 2008 F1 Sporting Regulations.

List A

- Clutch
- Clutch basket
- Hydraulic pumps
- Engine electronic boxes (ECU's, power modules, control boxes)
- Fuel filters
- Fuel pumps
- Oil filters
- Oil tank systems
- Pneumatic bottles, regulators, pumps and pipes for valve actuation
- Exhaust systems
- Supports and brackets related to the auxiliaries, mentioned above
- Screws, nuts, dowels or washers related to the auxiliaries, mentioned above
- Cables, tubes or hoses related to the auxiliaries, mentioned above
- Oil or air seals related to the auxiliaries, mentioned above
- Spark plugs

List B

- Throttle system (including but not limited to throttle device, linkage, actuator, hydraulics)
- Intake system external to cylinder head (including but not limited to trumpets, trumpet tray, air box, air filter)
- Ignition coils
- Injection system
- Alternators
- Oil scavenging pumps
- Oil supply pumps
- Oil air separators
- Water pumps
- Electric and electronic sensors

ARTICLE 6 : FUEL SYSTEM

6.1 Fuel tanks :

- 6.1.1 The fuel tank must be a single rubber bladder conforming to or exceeding the specifications of FIA/FT5-1999, the fitting of foam within the tank however is not mandatory. A list of approved materials may be found in the Appendix to these regulations.
- 6.1.2 All the fuel stored on board the car must be situated between the front face of the engine and the driver's back when viewed in lateral projection. When establishing the front face of the engine, no parts of the fuel, oil, water or electrical systems will be considered.

Furthermore, no fuel can be stored more than 300mm forward of the highest point at which the driver's back makes contact with his seat. However, a maximum of 2 litres of fuel may be kept outside the survival cell, but only that which is necessary for the normal running of the engine.

- 6.1.3 Fuel must not be stored more than 400mm from the longitudinal axis of the car.
- 6.1.4 All rubber bladders must be made by manufacturers recognised by the FIA. In order to obtain the agreement of the FIA, the manufacturer must prove the compliance of his product with the specifications approved by the FIA. These manufacturers must undertake to deliver to their customers exclusively tanks complying to the approved standards.
- A list of approved manufacturers may be found in the Appendix to these regulations.
- 6.1.5 All rubber bladders shall be printed with the name of the manufacturer, the specifications to which the tank has been manufactured and the date of manufacture.
- 6.1.6 No rubber bladders shall be used more than 5 years after the date of manufacture.

6.2 Fittings and piping :

- 6.2.1 All apertures in the fuel tank must be closed by hatches or fittings which are secured to metallic or composite bolt rings bonded to the inside of the bladder. The total area of any such hatches or fittings which are in contact with the fuel may not exceed 30000mm².
- Bolt hole edges must be no less than 5mm from the edge of the bolt ring, hatch or fitting.
- 6.2.2 All fuel lines between the fuel tank and the engine must have a self sealing breakaway valve. This valve must separate at less than 50% of the load required to break the fuel line fitting or to pull it out of the fuel tank.
- 6.2.3 No lines containing fuel may pass through the cockpit.
- 6.2.4 All lines must be fitted in such a way that any leakage cannot result in the accumulation of fuel in the cockpit.

6.3 Crushable structure :

The fuel tank must be completely surrounded by a crushable structure, which is an integral part of the survival cell and must be able to withstand the loads required by the tests in Articles 18.2.1 and 18.3.

6.4 Fuel tank fillers :

Fuel tank fillers must not protrude beyond the bodywork. Any breather pipe connecting the fuel tank to the atmosphere must be designed to avoid liquid leakage when the car is running and its outlet must not be less than 250mm from the cockpit opening.

All fuel tank fillers and breathers must be designed to ensure an efficient locking action which reduces the risk of an accidental opening following a crash impact or incomplete locking after refuelling.

6.5 Refuelling :

- 6.5.1 All refuelling during the race must be carried out at a rate no greater than 12.1 litres per second and by using equipment which has been supplied by the FIA designated manufacturer, details concerning the manufacturer may be found in the Appendix to these regulations. This manufacturer will be required to supply identical refuelling systems, the complete specification of which will be available from the FIA no later than one month prior to the first Championship Event.

Any modifications to the manufacturer's specification may only be made following written consent from the FIA.

- 6.5.2 A cover must be fitted over the car connector at all times when the car is running on the track. The cover and its attachments must be sufficiently strong to avoid accidental opening in the event of an accident.

- 6.5.3 Before refuelling commences, the car connector must be connected electrically to earth.

All metal parts of the refuelling system from the coupling to the supply tank must also be connected to earth.

- 6.5.4 No fuel intended for immediate use in a car may be more than ten degrees centigrade below ambient temperature. When assessing compliance the ambient temperature will be that recorded one hour before any practice session or the race by the FIA appointed weather service provider. This information will also be displayed on the timing monitors.

The temperature of fuel intended for use in a car must be measured via an FIA approved and sealed sensor.

- 6.5.5 The use of any device on board the car to decrease the temperature of the fuel is forbidden.

6.6 Fuel draining and sampling :

- 6.6.1 Competitors must provide a means of removing all fuel from the car.

- 6.6.2 Competitors must ensure that a one litre sample of fuel may be taken from the car at any time during the Event.

- 6.6.3 All cars must be fitted with a -2 'Symetrics' male fitting in order to facilitate fuel sampling. If an electric pump on board the car cannot be used to remove the fuel an externally connected one may be used provided it is evident that a representative fuel sample is being taken. If an external pump is used it must be possible to connect the FIA sampling hose to it and any hose between the car and pump must be -3 in diameter and not exceed 2m in length. Details of the fuel sampling hose may be found in the Appendix to these regulations.

- 6.6.4 The sampling procedure must not necessitate starting the engine or the removal of bodywork (other than the cover over the refuelling connector).

ARTICLE 7 : OIL AND COOLANT SYSTEMS

7.1 Location of oil tanks :

All oil storage tanks must be situated between the front wheel axis and the rearmost gearbox casing longitudinally, and must be no further than the lateral extremities of the survival cell are from the longitudinal axis of the car.

7.2 Longitudinal location of oil system :

No other part of the car containing oil may be situated behind the complete rear wheels.

7.3 Catch tank :

In order to avoid the possibility of oil being deposited on the track, the engine sump breather must vent into the main engine air intake system.

7.4 Transversal location of oil system :

No part of the car containing oil may be more than 700mm from the longitudinal centre line of the car.

7.5 Coolant header tank :

The coolant header tank on the car must be fitted with an FIA approved pressure relief valve which is set to a maximum of 3.75 bar gauge pressure, details of the relief valve may be found in the Appendix to these regulations. If the car is not fitted with a header tank, an alternative position must be approved by the FIA.

7.6 Cooling systems :

The cooling systems of the engine must not intentionally make use of the latent heat of vaporisation of any fluid.

7.7 Oil and coolant lines :

7.7.1 No lines containing coolant or lubricating oil may pass through the cockpit.

7.7.2 All lines must be fitted in such a way that any leakage cannot result in the accumulation of fluid in the cockpit.

7.7.3 No hydraulic fluid lines may have removable connectors inside the cockpit.

ARTICLE 8 : ELECTRICAL SYSTEMS

8.1 Software and electronics inspection :

8.1.1 Prior to the start of each season the complete electrical system on the car must be examined and all on board and communications software must be inspected by the FIA Technical Department.

The FIA must be notified of any changes prior to the Event at which such changes are intended to be implemented.

8.1.2 All re-programmable microprocessors must have a mechanism that allows the FIA to accurately identify the software version loaded.

8.1.3 All electronic units containing a programmable device, and which are intended for use at an Event, must be presented to the FIA before each Event in order that they can be identified.

8.1.4 All on-car software versions must be registered with the FIA before use.

8.1.5 The FIA must be able to test the operation of any compulsory electronic safety systems at any time during an Event.

8.2 Control electronics :

8.2.1 All components of the engine and gearbox, including clutch, differential and all associated actuators must be controlled by an Electronic Control Unit (ECU) which has been manufactured by an FIA designated supplier to a specification determined by the FIA.

The ECU may only be used with FIA approved software and may only be connected to the control system wiring loom, sensors and actuators in a manner specified by the FIA.

8.2.2 All control sensors, actuators and FIA monitoring sensors will be specified and homologated by the FIA.

Each and every component of the control system will be sealed and uniquely identified and their identities tracked through their life cycle.

These components and units may not be disassembled or modified in any way and seals and identifiers must remain intact and legible.

8.2.3 The control system wiring loom connectivity will be specified by the FIA.

8.2.4 Pneumatic valve pressure may only be controlled via a passive mechanical regulator or from the ECU and its operation will be monitored by the ECU.

8.2.5 The car hydraulic system will be monitored by the ECU.

8.2.6 The ECU will be designed to run from a car system supply voltage of 12V nominal provided by a homologated voltage regulator.

8.3 Start systems :

Any system, the purpose and/or effect of which is to detect when a race start signal is given, is not permitted.

8.4 Data acquisition :

Any data acquisition system, telemetry system or associated sensors additional to those provided by the ECU and ADR must be physically separate and completely isolated from any control electronics with the exception of the primary regulated voltage supply, car system ground and a single communication link to the ECU and ADR.

8.5 Telemetry :

8.5.1 Telemetry systems must operate at frequencies which have been approved by the FIA.

8.5.2 Pit to car telemetry is prohibited.

8.6 Driver controls and displays :

Any electronic modules used for driver information displays and switch inputs must be supplied by an FIA designated supplier to a specification determined by the FIA and be suitably housed by each team.

8.7 Driver radio :

Other than authorised connections to the FIA ECU, any voice radio communication system between car and pits must be stand-alone and must not transmit or receive other data. All such communications must be open and accessible to both the FIA and, where appropriate, broadcasters.

8.8 Accident data recorders (ADR) :

8.8.1 The recorder must be fitted and operated :

- in accordance with the instructions of the FIA ;
- symmetrically about the car centre line and with its top facing upwards ;
- with each of its 12 edges parallel to an axis of the car ;
- less than 50mm above the reference plane ;
- in a position within the cockpit which is readily accessible at all times from within the cockpit without the need to remove skid block or floor;
- in order that the entire unit lies between 40% and 60% of the wheelbase of the car ;
- via anti-vibration mountings giving a clearance of 5mm to all other objects ;
- with its connectors facing forwards ;
- in order that its status light is visible when the driver is seated normally ;
- in order that the download connector is easily accessible when the driver is seated normally and without the need to remove bodywork.

8.8.2 The recorder must be connected to two external 500g accelerometers which are solidly bolted to the survival cell, on the car centre line, using four 4mm bolts. One must be as close to the nominal car centre of gravity as practical and the other as far forward as possible inside the survival cell. The forward accelerometer may be mounted to the underside of the top surface provided it is solidly bolted to a structural part of the survival cell.

8.8.3 The recorder must be powered from a nominally 12V supply such that its internal battery can be recharged at all times when the car's electronic systems are powered and when the car systems are switched off, but a jump battery or umbilical is connected.

8.8.4 An ADR and two accelerometers must be fitted to every car at all times during an Event and at all tests attended by more than one team.

8.9 Track signal information display :

All cars must be fitted with red, blue and yellow cockpit lights the purpose of which are to give drivers information concerning track signals or conditions. The lights must be LEDs each with a minimum diameter of 5mm and which are fitted in order that they are directly in the driver's normal line of sight.

Details of the light control system, which must be fitted to every car, may be found in the Appendix to these regulations.

8.10 Medical warning system

In order to give rescue crews an immediate indication of accident severity each car must be fitted with a warning light which is connected to the FIA data logger.

The light must face upwards and be recessed into the top of the survival cell no more than 150mm from the car centre line and the front of the cockpit opening and as near to the clutch disengagement system, as described in Article 9.4, as is practical.

Details of the light and its control system may be found in the Appendix to these regulations.

ARTICLE 9 : TRANSMISSION SYSTEM

9.1 Transmission types :

No transmission system may permit more than two wheels to be driven.

9.2 Clutch control :

9.2.1 If multiple clutch operating devices are used, they must all have the same mechanical travel characteristics and be mapped identically.

9.2.2 Designs which allow specific points along the travel range of the clutch operating device to be identified by the driver or assist him to hold a position are not permitted.

9.2.3 The minimum and maximum travel positions of the clutch operating device must correspond to the clutch fully engaged normal rest position and fully disengaged (incapable of transmitting any useable torque) positions respectively.

9.2.4 Designs or systems which in addition to typical inherent hydraulic and mechanical properties are designed to, or have the effect of, adjusting or otherwise influencing the amount, or rate, of engagement being demanded by the FIA ECU, are not permitted.

9.3 Traction control

No car may be equipped with a system or device which is capable of preventing the driven wheels from spinning under power or of compensating for excessive throttle demand by the driver.

Any device or system which notifies the driver of the onset of wheel spin is not permitted.

9.4 Clutch disengagement :

All cars must be fitted with a means of disengaging the clutch for a minimum of fifteen minutes in the event of the car coming to rest with the engine stopped. This system must be in working order throughout the Event even if the main hydraulic, pneumatic or electrical systems on the car have failed.

In order that the driver or a marshal may activate the system in less than five seconds, the switch or button which operates it must :

- face upwards and be recessed into the top of the survival cell no more than 150mm from the car centre line ;
- be designed in order that a marshal is unable to accidentally re-engage the clutch ;
- be less than 150mm from the front of the cockpit opening ;
- be marked with a letter "N" in red inside a white circle of at least 50mm diameter with a red edge.

9.5 Gearboxes

9.5.1 A gearbox is defined as all the parts in the drive line which transfer torque from the engine crankshaft to the drive shafts (the drive shafts being defined as those components which transfer drive torque from the sprung mass to the un-sprung mass). It includes all components whose primary purpose is for the transmission of power or mechanical selection of gears, bearings associated with these components and the casing in which they are housed.

9.5.2 In this context the following parts are not considered part of the gearbox and may be changed without incurring a penalty under the F1 Sporting Regulations. If changing any of these parts involves breaking an FIA applied seal this may be done but must be carried out under FIA supervision :

- the clutch assembly and any shaft connecting the clutch to the crankshaft or first motion shaft of the gearbox, provided this is located prior to any mechanical speed reduction from the engine ;

- the clutch actuator and clutch release bearing(s) ;
- inboard driveshaft joints and seals but not their housing if that housing is integral with the gearbox output shaft and therefore part of the sprung mass ;
- the hydraulic system prior to the point at which it produces direct mechanical movement of the gear selection mechanism by means of hydraulic actuator(s) ;
- oil, oil pumps, oil filters, oil seals, oil coolers and any associated hoses or pipes ;
- electrical sensors, actuators, servo valves and wiring ;
- any parts associated with the suspension or functioning of the sprung suspension that are attached to the gearbox casing ;
- the rear impact structure provided it can be separated from any gearbox casing ;
- any other component mounted to the casing whose primary purpose is unconnected with the transmission of power or selection of gears.

9.6 Gear ratios :

9.6.1 The maximum number of forward gear ratios is 7.

9.6.2 No forward gear ratio pair may be :

- less than 12mm wide when measured across the gear tooth at the root diameter or any point 1mm above or below the root diameter. Above this area each side of the gear teeth may be chamfered by a maximum of 10°. In addition, a chamfer or radius not exceeding 2.0mm may be applied to the sides and the tip of the teeth ;
- less than 85mm between centres ;
- less than 600g in weight (excluding any integral shaft or collar). If an integral shaft or collar is to be excluded the mass of this may be shown by calculation assuming the gear to be 12mm wide and the shaft geometry to be the same as that where slide on gears are used.

9.6.3 Gear ratios must be made from steel.

9.6.4 Continuously variable transmission systems are not permitted to transmit the power of the engine defined in Article 5.1.

9.7 Reverse gear :

All cars must have a reverse gear operable any time during the Event by the driver when the engine is running.

9.8 Torque transfer systems :

9.8.1 Any system or device the design of which is capable of transferring or diverting torque from a slower to a faster rotating wheel is not permitted.

9.8.2 Any device which is capable of transferring torque between the principal axes of rotation of the two front wheels is prohibited.

ARTICLE 10 : SUSPENSION AND STEERING SYSTEMS

10.1 Sprung suspension:

- 10.1.1 Cars must be fitted with sprung suspension.
- 10.1.2 The suspension system must be so arranged that its response results only from changes in load applied to the wheels.

10.2 Suspension geometry:

- 10.2.1 With the steering wheel fixed, the position of each wheel centre and the orientation of its rotation axis must be completely and uniquely defined by a function of its principally vertical suspension travel, save only for the effects of reasonable compliance which does not intentionally provide further degrees of freedom.
- 10.2.2 Any powered device which is capable of altering the configuration or affecting the performance of any part of the suspension system is forbidden.
- 10.2.3 No adjustment may be made to the suspension system while the car is in motion.

10.3 Suspension members :

- 10.3.1 The cross-sections of each member of every suspension component must have an aspect ratio no greater than 3.5:1 and be symmetrical about its major axis. All suspension components may however have sections with an aspect ratio greater than 3.5:1, and be non-symmetrical, provided these are adjacent to their inner and outer attachments and form no more than 25% of the total distance between the attachments of the relevant member.

All measurements will be made perpendicular to a line drawn between the inner and outer attachments of the relevant member.

- 10.3.2 No major axis of a cross section of a suspension member may subtend an angle greater than 5° to the reference plane when measured parallel to the centre line of the car.
- 10.3.3 Non-structural parts of suspension members are considered bodywork.
- 10.3.4 In order to help prevent a wheel becoming separated in the event of all suspension members connecting it to the car failing provision must be made to accommodate flexible cables, each with a cross sectional area greater than 110mm², the purpose of which is to connect each wheel/upright assembly to the main structure of the car. The cables and their attachments must also be designed in order to help prevent a wheel making contact with the driver's head during an accident.

Each cable must have its own separate attachment which :

- is able to withstand a tensile force of 70kN ;
- is able to accommodate a cable end fitting with a minimum inside diameter of 15mm.

Each wheel may be fitted with one or two cables, dependent upon their performance when tested under FIA Test Procedure 03/07. If one cable is fitted it must exceed the requirements of 3.1.1 of Test Procedure 03/07 and if two are fitted each must exceed the requirements of 3.1.2.

Each cable must exceed 450mm in length and must utilise end fittings which result in a tether bend radius greater than 7.5mm.

10.4 Steering :

- 10.4.1 Any steering system which permits the re-alignment of more than two wheels is not permitted.
- 10.4.2 Power assisted steering systems may not be electronically controlled or electrically powered. No such system may carry out any function other than reduce the physical effort required to steer the car.
- 10.4.3 No part of the steering wheel or column, nor any part fitted to them, may be closer to the driver than a plane formed by the entire rear edge of the steering wheel rim. All parts fixed to the steering wheel must be fitted in such a way as to minimise the risk of injury in the event of a driver's head making contact with any part of the wheel assembly.
- 10.4.4 The steering wheel, steering column and steering rack assembly must pass an impact test, details of the test procedure may be found in Article 16.5.

ARTICLE 11 : BRAKE SYSTEM

11.1 Brake circuits and pressure distribution :

- 11.1.1 All cars must be equipped with only one brake system. This system must comprise solely of two separate hydraulic circuits operated by one pedal, one circuit operating on the two front wheels and the other on the two rear wheels. This system must be designed so that if a failure occurs in one circuit the pedal will still operate the brakes in the other.
- 11.1.2 The brake system must be designed in order that the force exerted on the brake pads within each circuit are the same at all times.
- 11.1.3 Any powered device which is capable of altering the configuration or affecting the performance of any part of the brake system is forbidden.
- 11.1.4 Any change to, or modulation of, the brake system whilst the car is moving must be made by the driver's direct physical input, may not be pre-set and must be under his complete control at all times.

11.2 Brake calipers :

- 11.2.1 All brake calipers must be made from aluminium materials with a modulus of elasticity no greater than 80Gpa.
- 11.2.2 No more than two attachments may be used to secure each brake caliper to the car.
- 11.2.3 No more than one caliper, with a maximum of six pistons, is permitted on each wheel.
- 11.2.4 The section of each caliper piston must be circular.

11.3 Brake discs and pads :

- 11.3.1 No more than one brake disc is permitted on each wheel.
- 11.3.2 All discs must have a maximum thickness of 28mm and a maximum outside diameter of 278mm.
- 11.3.3 No more than two brake pads are permitted on each wheel.

11.4 Air ducts :

Air ducts around the front and rear brakes will be considered part of the braking system and shall not protrude beyond :

- a plane parallel to the ground situated at a distance of 160mm above the horizontal centre line of the wheel ;
- a plane parallel to the ground situated at a distance of 160mm below the horizontal centre line of the wheel ;
- a vertical plane parallel to the inner face of the wheel rim and displaced from it by 120mm toward the centre line of the car.

Furthermore, when viewed from the side the ducts must not protrude forwards beyond a radius of 330mm from the centre of the wheel or backwards beyond a radius of 180mm from the centre of the wheel.

All measurements will be made with the wheel held in a vertical position.

11.5 Brake pressure modulation :

- 11.5.1 No braking system may be designed to prevent wheels from locking when the driver applies pressure to the brake pedal.
- 11.5.2 No braking system may be designed to increase the pressure in the brake calipers above that achievable by the driver applying pressure to the pedal under static conditions.

11.6 Liquid cooling :

Liquid cooling of the brakes is forbidden.

ARTICLE 12 : WHEELS AND TYRES

12.1 Location :

Wheels must be external to the bodywork in plan view, with the rear aerodynamic device removed.

12.2 Number of wheels :

The number of wheels is fixed at four.

12.3 Wheel material :

All wheels must be made from an homogeneous metallic material.

12.4 Wheel dimensions :

12.4.1 Complete wheel width must lie between 305 and 355mm when fitted to the front of the car and between 365 and 380mm when fitted to the rear.

12.4.2 Complete wheel diameter must not exceed 660mm when fitted with dry-weather tyres or 670mm when fitted with wet-weather tyres.

12.4.3 Complete wheel width and diameter will be measured horizontally at axle height, with the wheel held in a vertical position and when fitted with new tyres inflated to 1.4 bar.

12.4.4 Wheel bead diameter must lie between 328 and 332mm.

12.5 Supply of tyres :

12.5.1 All tyres must be used as supplied by the manufacturer, any modification or treatment such as cutting, grooving or the application of solvents or softeners is prohibited. This applies to dry, wet and extreme-weather tyres.

12.5.2 If, in the opinion of the appointed tyre supplier and FIA technical delegate, the nominated tyre specification proves to be technically unsuitable, the stewards may authorise the use of additional tyres to a different specification.

12.5.3 If, in the interests of maintaining current levels of circuit safety, the FIA deems it necessary to reduce tyre grip, it shall introduce such rules as the tyre supplier may advise or, in the absence of advice which achieves the FIA's objectives, specify the maximum permissible contact areas for front and rear tyres.

12.6 Specification of tyres :

12.6.1 All dry-weather tyres must incorporate circumferential grooves square to the wheel axis and around the entire circumference of the contact surface of each tyre.

12.6.2 Each front dry-weather tyre, when new, must incorporate 4 grooves which are :

- arranged symmetrically about the centre of the tyre tread ;
- at least 14mm wide at the contact surface and which taper uniformly to a minimum of 10mm at the lower surface ;
- at least 2.5mm deep across the whole lower surface ;
- 50mm (+/- 1.0mm) between centres.

Furthermore, the tread width of the front tyres must not exceed 270mm.

12.6.3 Each rear dry-weather tyre, when new, must incorporate 4 grooves which are :

- arranged symmetrically about the centre of the tyre tread ;
- at least 14mm wide at the contact surface and which taper uniformly to a minimum of 10mm at the lower surface ;

- at least 2.5mm deep across the whole lower surface ;
- 50mm (+/- 1.0mm) between centres.

The measurements referred to in b) and c) above will be taken when the tyre is fitted to a wheel and inflated to 1.4 bar.

12.6.4 A wet-weather tyre is one which has been designed for use on a wet or damp track.

All wet-weather tyres must, when new, have a contact area which does not exceed 280cm² when fitted to the front of the car and 440cm² when fitted to the rear. Contact areas will be measured over any square section of the tyre which is normal to and symmetrical about the tyre centre line and which measures 200mm x 200mm when fitted to the front of the car and 250mm x 250mm when fitted to the rear. For the purposes of establishing conformity, void areas which are less than 2.5mm in depth will be deemed to be contact areas.

12.6.5 An extreme-weather tyre is one which has been designed for use on a wet track.

All extreme-weather tyres must, when new, have a contact area which does not exceed 240cm² when fitted to the front of the car and 375cm² when fitted to the rear. Contact areas will be measured over any square section of the tyre which is normal to and symmetrical about the tyre centre line and which measures 200mm x 200mm when fitted to the front of the car and 250mm x 250mm when fitted to the rear. For the purposes of establishing conformity, void areas which are less than 5.0mm in depth will be deemed to be contact areas.

12.6.6 Tyre specifications will be determined by the FIA no later than 1 September of the previous season. Once determined in this way, the specification of the tyres will not be changed during the Championship season without the agreement of all competing teams.

12.7 Tyre Gases :

Tyres may only be inflated with air, nitrogen or CO₂.

ARTICLE 13 : COCKPIT

13.1 Cockpit opening :

13.1.1 In order to ensure that the opening giving access to the cockpit is of adequate size, the template shown in Drawing 2 will be inserted into the survival cell and bodywork.

During this test the steering wheel, steering column, seat and all padding required by Articles 14.6.1-6 (including fixings), may be removed and :

- the template must be held horizontal and lowered vertically from above the car until its lower edge is 525mm above the reference plane ;
- referring to Drawing 2, the edge of the template which lies on the line d-e must be no less than 1800mm behind the line A-A shown in Drawing 5.

Any measurements made from the cockpit entry template (when referred to in Articles 13.1.3, 14.3.3, 15.2.2, 15.4.5, 15.4.6, 15.5.4, 16.3 and 18.4), must also be made whilst the template is held in this position.

13.1.2 The forward extremity of the cockpit opening, even if structural and part of the survival cell, must be at least 50mm in front of the steering wheel.

13.1.3 The driver must be able to enter and get out of the cockpit without it being necessary to open a door or remove any part of the car other than the steering wheel. When seated normally, the driver must be facing forwards and the rearmost part of his crash helmet may be no more than 125mm forward of the rear edge of the cockpit entry template.

13.1.4 From his normal seating position, with all seat belts fastened and whilst wearing his usual driving equipment, the driver must be able to remove the steering wheel and get out of the car within 5 seconds and then replace the steering wheel in a total of 10 seconds.

For this test, the position of the steered wheels will be determined by the FIA technical delegate and after the steering wheel has been replaced steering control must be maintained.

13.2 Steering wheel :

The steering wheel must be fitted with a quick release mechanism operated by pulling a concentric flange installed on the steering column behind the wheel.

13.3 Internal cross section :

13.3.1 A free vertical cross section, which allows the outer template shown in Drawing 3 to be passed vertically through the cockpit to a point 100mm behind the face of the rearmost pedal when in the inoperative position, must be maintained over its entire length.

The only things which may encroach on this area are the steering wheel and any padding that is required by Article 14.6.7.

13.3.2 A free vertical cross section, which allows the inner template shown in Drawing 3 to be passed vertically through the cockpit to a point 100mm behind the face of rearmost pedal when in the inoperative position, must be maintained over its entire length.

The only thing which may encroach on this area is the steering wheel.

13.3.3 The driver, seated normally with his seat belts fastened and with the steering wheel removed must be able to raise both legs together so that his knees are past the plane of the steering wheel in the rearward direction. This action must not be prevented by any part of the car.

13.4 Position of the driver's feet :

- 13.4.1 The survival cell must extend from behind the fuel tank in a rearward direction to a point at least 300mm in front of the driver's feet, with his feet resting on the pedals and the pedals in the inoperative position.
- 13.4.2 When he is seated normally, the soles of the driver's feet, resting on the pedals in the inoperative position, must not be situated forward of the front wheel centre line.

ARTICLE 14 : SAFETY EQUIPMENT

14.1 Fire extinguishers :

- 14.1.1 All cars must be fitted with a fire extinguishing system which will discharge into the cockpit and into the engine compartment.
- 14.1.2 Any extinguishant listed in the Appendix to the regulations is permitted.
- 14.1.3 The quantity of extinguishant may vary according to the type of extinguishant used, a list of quantities may be found in the Appendix to these regulations.
- 14.1.4 When operated, the fire extinguishing system must discharge 95% of its contents at a constant pressure in no less than 10 seconds and no more than 30 seconds.
- If more than one container with extinguishant is fitted, they must be released simultaneously.
- 14.1.5 Each pressure vessel must be equipped with a means of checking its pressure which may vary according to the type of extinguishant used. A list of pressures may be found in the Appendix to the regulations.
- 14.1.6 The following information must be visible on each container with extinguishant :
- Type of extinguishant
 - Weight or volume of the extinguishant
 - Date the container must be checked which must be no more than two years after the date of filling.
- 14.1.7 All parts of the extinguishing system must be situated within the survival cell and all extinguishing equipment must withstand fire.
- 14.1.8 Any triggering system having its own source of energy is permitted, provided it is possible to operate all extinguishers should the main electrical circuits of the car fail.
- The driver must be able to trigger the extinguishing system manually when seated normally with his safety belts fastened and the steering wheel in place.
- Furthermore, a means of triggering from the outside must be combined with the circuit breaker switch described in Article 14.2.2. It must be marked with a letter "E" in red inside a white circle of at least 100mm diameter with a red edge.
- 14.1.9 The system must work in any position, even when the car is inverted.
- 14.1.10 All extinguisher nozzles must be suitable for the extinguishant and be installed in such a way that they are not directly pointed at the driver.

14.2 Master switch :

- 14.2.1 The driver, when seated normally with the safety belts fastened and the steering wheel in place, must be able to cut off the electrical circuits to the ignition, all fuel pumps and the rear light by means of a spark proof circuit breaker switch.
- This switch must be located on the dashboard and must be clearly marked by a symbol showing a red spark in a white edged blue triangle.
- 14.2.2 There must also be an exterior switch, with a horizontal handle, which is capable of being operated from a distance by a hook. This switch must be situated at the base of the main roll over structure on the right hand side.

14.3 Rear view mirrors :

- 14.3.1 All cars must have at least two mirrors mounted so that the driver has visibility to the rear and both sides of the car.

14.3.2 The reflective surface of each mirror must be at least 150mm wide, this being maintained over a height of at least 50mm. Additionally, each corner may have a radius no greater than 10mm.

14.3.3 No part of the reflective surface may be less than 250mm from the car centre line or more than 750mm from the rear of the cockpit entry template.

14.3.4 The FIA technical delegate must be satisfied by a practical demonstration that the driver, when seated normally, can clearly define following vehicles.

For this purpose, the driver shall be required to identify any letter or number, 150mm high and 100mm wide, placed anywhere on boards behind the car, the positions of which are detailed below :

Height : From 400mm to 1000mm from the ground.

Width : 4000mm either side of the centre line of the car.

Position : 10m behind the rear axle line of the car.

14.4 Safety belts :

It is mandatory to wear two shoulder straps, one abdominal strap and two straps between the legs. These straps must be securely fixed to the car and must comply with FIA standard 8853/98.

14.5 Rear light :

All cars must have a red light in working order throughout the Event which :

- has been supplied by an FIA designated manufacturer ;
- faces rearwards at 90° to the car centre line and the reference plane ;
- is clearly visible from the rear ;
- is mounted nominally on the car centre line ;
- is mounted 300mm (+/-5mm) above the reference plane ;
- is no less than 595mm behind the rear wheel centre line measured parallel to the reference plane ;
- can be switched on by the driver when seated normally in the car.

The two measurements above will be taken to the centre of the rear face of the light unit.

14.6 Headrests and head protection :

14.6.1 All cars must be equipped with three areas of padding for the driver's head which :

- are so arranged that they can be removed from the car as one part ;
- are located by two horizontal pegs behind the driver's head and two fixings, which are clearly indicated and easily removable without tools, at the front corners ;
- are made from a material which is suitable for the relevant ambient air temperature, details of approved materials and the temperature bands in which they should be used may be found in the Appendix to these regulations ;
- are covered, in all areas where the driver's head is likely to make contact, with two plies of Aramid fibre/epoxy resin composite pre-preg material in plain weave 60gsm fabric with a cured resin content of 50% (+/-5%) by weight ;
- are positioned so as to be the first point of contact for the driver's helmet in the event of an impact projecting his head towards them during an accident.

14.6.2 The first area of padding for the driver's head must be positioned behind him and be between 75mm and 90mm thick over an area of at least 40000mm². If necessary, and only for driver comfort, an additional piece of padding no greater than 10mm thick may be attached to this headrest provided it is made from a similar material which incorporates a low friction surface.

14.6.3 Whilst he is seated normally the two further areas of padding for the driver's head must be positioned in an area bounded by two vertical lines and one horizontal line through the front, rear and lower extremities of the driver's helmet (on the vehicle centre line), and the upper surface of the survival cell.

Each of these must cover an area greater than 33000mm² when viewed from the side of the car and be no less than 95mm thick, this minimum thickness being maintained to the upper edges of the survival cell and over their entire length. The minimum thickness will be assessed perpendicular to the car centre line but a radius no greater than 10mm may be applied along their upper inboard edges.

If necessary, and only for driver comfort, an additional piece of padding no greater than 10mm thick may be attached to these headrests provided they are made from a similar material which incorporates a low friction surface.

14.6.4 Forward of the side areas of padding further cockpit padding must be provided on each side of the cockpit rim. The purpose of the additional padding is to afford protection to the driver's head in the event of an oblique frontal impact and must therefore be made from the same material as the other three areas of padding.

These extensions must :

- be symmetrically positioned about the car centre line and a continuation of the side areas of padding;
- be positioned with their upper surfaces at least as high as the survival cell over their entire length;
- have a radius on their upper inboard edge no greater than 10mm ;
- be positioned in order that the distance between the two is no less than 320mm ;
- be as high as practicable within the constraints of driver comfort.

14.6.5 All of the padding described above must be so installed that if movement of the driver's head, in any expected trajectory during an accident, were to compress the foam fully at any point, his helmet would not make contact with any structural part of the car.

Furthermore, for the benefit of rescue crews all of the padding described above must be installed using the system described in the Appendix to these regulations. The method of removal must also be clearly indicated.

14.6.6 No part of the padding described above may obscure sight of any part of the driver's helmet when he is seated normally and viewed from directly above the car.

14.6.7 In order to minimise the risk of leg injury during an accident, additional areas of padding must be fitted each side of, and above, the driver's legs.

These areas of padding must :

- be made from a material described in the Appendix to these regulations ;
- be no less than 25mm thick over their entire area ;
- cover the area situated between points lying 50mm behind the centre of the point at which the second roll structure test is carried out and 100mm behind the face of the rearmost pedal when in the inoperative position, as shown in Drawing 4 ;
- cover the area above the line A-A shown in Drawing 3.

14.7 Wheel retention :

All cars, whilst under their own power, must be fitted with devices which will retain any wheel in the event of it coming loose.

After the wheel nut is fastened, these devices must be manually fitted in a separate action to that of securing the wheel nut.

14.8 Seat fixing and removal :

14.8.1 In order that an injured driver may be removed from the car in his seat following an accident, all cars must be fitted with a seat which, if it is secured, must be done so with no more than two bolts. If bolts are used they must :

- be clearly indicated and easily accessible to rescue crews ;
- be fitted vertically ;
- be removable with the same tool for all Teams and which is issued to all rescue crews.

14.8.2 The seat must be equipped with receptacles which permit the fitting of belts to secure the driver and one which will permit the fitting of a head stabilisation device.

14.8.3 The seat must be removable without the need to cut or remove any of the seat belts.

14.8.4 Details of the tool referred to above, the belt receptacles and the head stabilisation device may be found in the Appendix to these regulations.

14.9 Head and neck supports :

No head and neck support worn by the driver may be less than 25mm from any structural part of the car when he is seated in his normal driving position.

ARTICLE 15 : CAR CONSTRUCTION

15.1 Permitted materials :

15.1.2 A list of permitted materials may be found in the Appendix to these regulations.

15.1.2 No parts of the car may be made from metallic materials which have a specific modulus of elasticity greater than 40 GPa / (g/cm³). Tests to establish conformity will be carried out in accordance with FIA Test Procedure 03/02, a copy of which may be found in the Appendix to these regulations.

15.2 Roll structures :

15.2.1 All cars must have two roll structures which are designed to help prevent injury to the driver in the event of the car becoming inverted.

The principal structure must be at least 940mm above the reference plane at a point 30mm behind the cockpit entry template. The second structure must be in front of the steering wheel but no more than 250mm forward of the top of the steering wheel rim in any position.

The two roll structures must be of sufficient height to ensure the driver's helmet and his steering wheel are at least 70mm and 50mm respectively below a line drawn between their highest points at all times.

15.2.2 The principal structure must pass a static load test details of which may be found in Article 17.2. Furthermore, each Team must supply detailed calculations which clearly show that it is capable of withstanding the same load when the longitudinal component is applied in a forward direction.

15.2.3 The second structure must pass a static load test details of which may be found in Article 17.3.

15.2.4 Both roll structures must have minimum structural cross sections of 10000mm², in vertical projection, across a horizontal plane 50mm below the their highest points.

15.3 Structure behind the driver :

The parts of the survival cell immediately behind the driver which separate the cockpit from the car's fuel tank, and which lie less than 150mm from the centre line of the car, may be situated no further forward than the line a-b-c-d-e shown in Drawing 2.

15.4 Survival cell specifications :

15.4.1 Every survival cell must incorporate three FIA supplied transponders for identification purposes. These transponders must be a permanent part of the survival cell, be positioned in accordance with Drawing 6 and must be accessible for verification at any time.

15.4.2 The survival cell must have an opening for the driver, the minimum dimensions of which are given in Article 13.1. Any other openings in the survival cell must be of the minimum size to allow access to mechanical components.

15.4.3 An impact absorbing structure must be fitted in front of the survival cell. This structure need not be an integral part of the survival cell but must be solidly attached to it.

Furthermore, it must have a minimum external cross section, in horizontal projection, of 9000mm² at a point 50mm behind its forward-most point.

15.4.4 Referring to Drawing 5 :

The external width of the survival cell between the lines B-B and C-C must be no less than 450mm and must be at least 60mm per side wider than the cockpit opening when measured normal to the inside of the cockpit aperture. These minimum dimensions must be maintained over a height of at least 350mm.

The width of the survival cell may taper forward of the line B-B but, if this is the case, the outer surface must not lie closer to the centre line of the car than a plane which has a linear taper to a minimum width of 300mm at the line A-A.

Between the lines A-A and B-B the width of the survival cell must be greater than the width defined by the two lines a-b. This minimum width must be arranged symmetrically about the car centre line, must be maintained over a height of at least 400mm at the line B-B and 275mm at the line A-A. The height at any point between A-A and B-B must not be less than the height defined by a linear taper between these two sections. When assessing the minimum external cross-sections of the survival cell, radii of 50mm at the line B-B, and reducing at a linear rate to 25mm at the line A-A, will be permitted.

The minimum height of the survival cell between the lines A-A and B-B need not be arranged symmetrically about the horizontal centre line of the relevant section but must be maintained over its entire width.

The minimum height of the survival cell between the lines B-B and C-C is 550mm.

- 15.4.5 When the test referred to in Article 13.1.1 is carried out and the template is in position with its lower edge 525mm above the reference plane, the shape of the survival cell must be such that no part of it is visible when viewed from either side of the car. The parts of the survival cell which are situated each side of the driver's head must be no more than 550mm apart.

In order to ensure that the driver's head is not unduly exposed and for him to maintain good lateral visibility he must, when seated normally and looking straight ahead with his head as far back as possible, have his eye visible when viewed from the side. The centre of gravity of his head must lie below the top of the survival cell at this position. When viewed from the side of the car, the centre of gravity of the driver's head will be deemed to be the intersection of a vertical line passing through the centre of his ear and a horizontal line passing through the centre of his eye.

- 15.4.6 In order to give additional protection to the driver in the event of a side impact a flat test panel of uniform construction, which is designed and constructed in order to represent a section of the survival cell sides, must pass a strength test. Details of the test procedure may be found in Article 18.6.

Referring to Drawing 5, with the exception of local re-enforcement and/or inserts, all parts of the survival cell which are as wide or wider than the minimum widths stipulated in Article 15.4.4, including any radii applied, must be manufactured to the same specification as a single panel which satisfies the requirements of Article 18.6. Furthermore, parts to this tested specification must cover an area which:

- begins at least 250mm high at line A-A ;
- tapers at a linear rate to at least 400mm high at line B-B and which remains at this height to the rear of the survival cell ;
- is no less than 100mm above the reference plane between the line B-B and the rear of the survival cell.

- 15.4.7 Once the requirements of Articles 15.4.4, 15.4.6, 15.5.1, 15.5.2, 15.5.4, 15.5.5, 16.1, 16.2, 16.3, 17.1, 17.2, 17.3, 18.1, 18.2, 18.3, 18.4, 18.5, 18.6 and 18.8 have been met, panels no less than 6.2mm thick must then be permanently attached to the survival cell sides. These panels must :

- in a longitudinal sense, cover the area lying between two vertical planes, one 125mm forward of the cockpit entry template and one 50mm to the rear of the template. A 50mm horizontal linear taper may be included at both ends ;
- in a vertical sense, cover an area which has been constructed in accordance with Articles 15.4.6 and 18.6. This will not apply where any radius permitted by Article 15.4.4 falls inside the minimum permitted chassis width ;
- be constructed from 16 plies of Zylon and two plies of carbon, precise lay-up details must be followed and may be found in the Appendix to these regulations ;

- be permanently attached to the survival cell with an appropriate adhesive which has been applied over their entire surface.

Cut-outs in these panels totalling 35000mm² per side will be permitted for fitting around side impact structures, wiring loom holes and essential fixings.

15.5 Survival cell safety requirements :

15.5.1 The survival cell and frontal absorbing structure must pass an impact test against a solid vertical barrier placed at right angles to the centre line of the car. Details of the test procedure may be found in Article 16.2.

15.5.2 Between the front and rear roll structures, on each side of the survival cell, impact absorbing structures must be fitted and must be solidly attached to it. The purpose of these structures is to protect the driver in the event of a lateral impact and, in order to ensure this is the case, a lateral strength test in the vicinity of the driver's seating position must be carried out successfully. Details of the test procedure may be found in Article 18.2.2.

The survival cell and one of these impact absorbing structures must pass an impact test, details of the test procedure may be found in Article 16.3. If these structures are not designed and fitted symmetrically about the car centre line a successful impact test must be carried out on them both.

15.5.3 An impact absorbing structure must be fitted behind the gearbox symmetrically about the car centre line with the centre of area of its rearmost face 300mm (+/-5mm) above the reference plane and no less than 575mm behind the rear wheel centre line.

The rearmost face of the impact structure must be a rectangular section no less than 100mm wide, this minimum width must be maintained over a height of at least 130mm and each corner may incorporate a radius no greater than 10mm. Between the rear face and the rear wheel centre line no dimension of the area thus defined may diminish nor may any part of the structure or gearbox which is visible from below, other than the permitted radii, be higher than the lower edge of the rear face.

This structure must pass an impact test and must be constructed from materials which will not be substantially affected by the temperatures it is likely to be subjected to during use. Details of the test procedure may be found in Article 16.4.

Only those parts of the structure which genuinely contribute to its performance during the impact test, and which are designed and fitted for that sole purpose, will be considered when assessing compliance with any of the above.

15.5.4 The survival cell must also be subjected to five separate static load tests :

- 1) on a vertical plane passing through the centre of the fuel tank ;
- 2) on a vertical plane passing through the rearmost point at which the outer end of the forward-most front wheel tether would make contact with the survival cell when swung about the inner attachment;
- 3) on a vertical plane 375mm forward of the rear edge of the cockpit entry template ;
- 4) from beneath the fuel tank ;
- 5) on each side of the cockpit opening.

Details of the test procedures may be found in Article 18.2.

15.5.5 To test the attachments of the frontal, side and rear impact absorbing structures static side load tests must be carried out. Details of these test procedures may be found in Articles 18.5, 18.7 and 18.8.2.

ARTICLE 16 : IMPACT TESTING

16.1 Conditions applicable to all impact tests :

- 16.1.1 All tests must be carried out in accordance with FIA Test Procedure 01/00, in the presence of an FIA technical delegate and by using measuring equipment which has been calibrated to the satisfaction of the FIA technical delegate. A copy of the test procedure may be found in the Appendix to these regulations.
- 16.1.2 Any significant modification introduced into any of the structures tested shall require that part to pass a further test.
- 16.1.3 The reference survival cell must have passed every static load test described in Articles 15.2, 15.5.4 and 15.5.5 before being subjected to any impact test.

16.2 Frontal test :

All parts which could materially affect the outcome of the test must be fitted to the test structure which must be solidly fixed to the trolley through its engine mounting points but not in such a way as to increase its impact resistance.

The fuel tank must be fitted and must be full of water.

A dummy weighing at least 75kg must be fitted with safety belts described in Article 14.4 fastened. However, with the safety belts unfastened, the dummy must be able to move forwards freely in the cockpit.

The extinguishers, as described in Article 14.1 must also be fitted.

For the purposes of this test, the total weight of the trolley and test structure shall be 780kg (+1%/-0) and the velocity of impact not less than 15 metres/second.

The resistance of the test structure must be such that during the impact :

- the peak deceleration over the first 150mm of deformation does not exceed 10g ;
- the peak deceleration over the first 60kJ energy absorption does not exceed 20g ;
- the average deceleration of the trolley does not exceed 40g ;
- the peak deceleration in the chest of the dummy does not exceed 60g for more than a cumulative 3ms, this being the resultant of data from three axes.

Furthermore, there must be no damage to the survival cell or to the mountings of the safety belts or fire extinguishers.

This test must be carried out on the survival cell subjected to the higher loads in the tests described in Articles 18.2-4, and on the frontal impact absorbing structure which was subjected to the test described in Article 18.5.

16.3 Side test :

All parts which could materially affect the outcome of the test must be fitted to the test structure which must be solidly fixed to the ground and a solid object, having a mass of 780kg (+1%/-0) and travelling at a velocity of not less than 10 metres/second, will be projected into it.

The object used for this test must :

- incorporate an impactor assembly, the specification of which may be found in the Appendix to these regulations ;
- be positioned in order that its centre of area strikes the structure 300mm (+/-25mm) above the reference plane and at a point 500mm (+/-3mm) forward of the rear edge of the cockpit opening template.

During the test the striking object may not pivot in any axis and the survival cell may be supported in any way provided this does not increase the impact resistance of the parts being tested. The impact axis must be perpendicular to the car centre line and parallel to the ground.

The resistance of the test structure must be such that during the impact :

- the average deceleration of the object, measured in the direction of impact, does not exceed 20g ;
- the force applied to any one of the four impactor segments does not exceed 80kN for more than a cumulative 3ms ;
- the energy absorbed by each of the four impactor segments must be between 15% and 35% of the total energy absorption.

Furthermore, all structural damage must be contained within the impact absorbing structure.

This test must be carried out on the survival cell subjected to the higher loads in the tests described in Articles 18.2-4 and on the side impact absorbing structure(s) which were subjected to the test described in Article 18.8.

16.4 Rear test :

All parts which will be fitted behind the rear face of the engine and which could materially affect the outcome of the test must be fitted to the test structure. If suspension members are to be mounted on the structure they must be fitted for the test. The structure and the gearbox must be solidly fixed to the ground and a solid object, having a mass of 780kg (+1%/-0) and travelling at a velocity of not less than 11 metres/second, will be projected into it.

The object used for this test must be flat, measure 450mm (+/-3mm) wide by 550mm (+/-3mm) high and may have a 10mm radius on all edges. Its lower edge must be at the same level as the car reference plane (+/-3mm) and must be so arranged to strike the structure vertically and at 90° to the car centre line.

During the test, the striking object may not pivot in any axis and the crash structure may be supported in any way provided this does not increase the impact resistance of the parts being tested.

The resistance of the test structure must be such that during the impact :

- the peak deceleration over the first 225mm of deformation does not exceed 20g ;
- the maximum deceleration does not exceed 20g for more than a cumulative 15ms, this being measured only in the direction of impact.

Furthermore, all structural damage must be contained within the area behind the rear wheel centre line.

This test must be carried out on the rear impact absorbing structure which was subjected to the test described in Article 18.7.

16.5 Steering column test :

The parts referred to in Article 10.4.4 must be fitted to a representative test structure, any other parts which could materially affect the outcome of the test must also be fitted. The test structure must be solidly fixed to the ground and a solid object, having a mass of 8kg (+1%/-0) and travelling at a velocity of not less than 7metres/second, will be projected into it.

The object used for this test must be hemispherical with a diameter of 165mm (+/-1mm).

For the test, the centre of the hemisphere must strike the structure at the centre of the steering wheel along the same axis as the main part of the steering column.

During the test the striking object may not pivot in any axis and the test structure may be supported in any way provided this does not increase the impact resistance of the parts being tested.

The resistance of the test structure must be such that during the impact the peak deceleration of the object does not exceed 80g for more than a cumulative 3ms, this being measured only in the direction of impact.

After the test, all substantial deformation must be within the steering column and the steering wheel quick release mechanism must still function normally.

ARTICLE 17 : ROLL STRUCTURE TESTING

17.1 Conditions applicable to both roll structure tests :

- 17.1.1 Rubber 3mm thick may be used between the load pads and the roll structure.
- 17.1.2 Both peak loads must be applied in less than three minutes and be maintained for 10 seconds.
- 17.1.3 Under the load, deformation must be less than 50mm, measured along the loading axis and any structural failure limited to 100mm below the top of the rollover structure when measured vertically.
- 17.1.4 Any significant modification introduced into any of the structures tested shall require that part to pass a further test.

17.2 Principal roll structure :

A load equivalent to 50kN laterally, 60kN longitudinally in a rearward direction and 90kN vertically, must be applied to the top of the structure through a rigid flat pad which is 200mm in diameter and perpendicular to the loading axis.

During the test, the roll structure must be attached to the survival cell which is supported on its underside on a flat plate, fixed to it through its engine mounting points and wedged laterally by any of the static load test pads described in Article 18.2.

17.3 Second roll structure :

A vertical load of 75kN must be applied to the top of the structure through a rigid flat pad which is 100mm in diameter and perpendicular to the loading axis.

During the test, the rollover structure must be attached to the survival cell which is fixed to a flat horizontal plate.

ARTICLE 18 : STATIC LOAD TESTING

18.1 Conditions applicable to all static load tests :

- 18.1.1 The tests described in Articles 18.2, 18.3, 18.4, 18.5 and 18.8.2 must be carried out on the survival cell which will be subjected to the impact tests described in Article 16.
- 18.1.2 Every subsequent survival cell produced must also be subjected to the tests described in Articles 18.2, 18.3 and 18.4.
- However, the tests described in Articles 18.2.1, 18.3 and 18.4 may be carried out on subsequent survival cells with peak loads reduced by 20%. During these tests (on deflections greater than 3.0mm), the deflection across the inner surfaces must not exceed 120% of the deflection obtained at 80% of the peak load during the first test.
- 18.1.3 Deflections and deformations will be measured at the centre of area of circular load pads and at the top of rectangular pads.
- 18.1.4 All peak loads must be applied in less than three minutes, through a ball jointed junction at the centre of area of the pad, and maintained for 30 seconds.
- 18.1.5 Following the tests described in 18.2, 18.3 and 18.4, permanent deformation must be less than 1.0mm (0.5mm in 18.3) after the load has been released for 1 minute.
- 18.1.6 All tests must be carried out by using measuring equipment which has been calibrated to the satisfaction of the FIA technical delegate.
- 18.1.7 A radius of 3mm is permissible on the edges of all load pads and rubber 3mm thick may be placed between them and the test structure.
- 18.1.8 For the tests described in 18.2, 18.3 and 18.4, the survival cells must always be produced in an identical condition in order that their weights may be compared. If the weight differs by more than 5% from the one subjected to the impact tests described in Articles 16.2 and 16.3 further frontal and side impact tests and roll structure tests must be carried out.
- 18.1.9 Any significant modification introduced into any of the structures tested shall require that part to pass a further test.

18.2 Survival cell side tests :

- 18.2.1 For test 1, referred to in Article 15.5.4, pads 100mm long and 300mm high, which conform to the shape of the survival cell, must be placed against the outermost sides of the survival cell with the lower edge of the pad at the lowest part of the survival cell at that section.

A constant transverse horizontal load of 25.0kN will be applied and, under the load, there must be no structural failure of the inner or outer surfaces of the survival.

- 18.2.2 For test 2), referred to in Article 15.5.4, pads 200mm in diameter which conform to the shape of the survival cell, must be placed against the outermost sides of the survival cell.

The centre of the pads must pass through the plane mentioned above and the mid point of the height of the structure at that section.

A constant transverse horizontal load of 30.0kN will be applied to the pads and, under the load, there must be no structural failure of the inner or outer surfaces of the survival cell and the total deflection must not exceed 15mm.

- 18.2.3 For test 3), referred to in Article 15.5.4, pads 200mm in diameter which conform to the shape of the survival cell, must be placed against the outermost sides of the survival cell.

The centre of the pads must be located 350mm above the reference plane and on the vertical plane mentioned in Article 15.5.4.

A constant transverse horizontal load of 30.0kN will be applied to the pads and, under the load, there must be no structural failure of the inner or outer surfaces of the survival cell and the total deflection must not exceed 15mm.

18.3 Fuel tank floor test :

A pad of 200mm diameter must be placed in the centre of area of the fuel tank floor and a vertical upwards load of 12.5kN applied.

Under the load, there must be no structural failure of the inner or outer surfaces of the survival cell.

18.4 Cockpit rim test :

Two pads, each of which is 100mm in diameter, must be placed on both sides of the cockpit rim with their upper edges at the same height as the top of the cockpit side with their centres at a point 250mm forward of the rear edge of the cockpit opening template longitudinally.

A constant transverse horizontal load of 10.0kN will then be applied at 90° to the car centre line and, under the load, there must be no structural failure of the inner or outer surfaces of the survival cell and the total deflection must not exceed 20mm.

18.5 Nose push off test :

During the test the survival cell must be resting on a flat plate and secured to it solidly but not in a way that could increase the strength of the attachments being tested.

A constant transversal horizontal load of 40.0kN must then be applied to one side of the impact absorbing structure, using a pad identical to the ones used in the lateral tests in Article 18.2.1, at a point 550mm from the front wheel axis.

The centre of area of the pad must pass through the plane mentioned above and the mid point of the height of the structure at the relevant section. After 30 seconds of application, there must be no failure of the structure or of any attachment between the structure and the survival cell.

18.6 Side intrusion test

18.6.1 The test must be carried out in accordance with FIA Test Procedure 02/05, in the presence of an FIA technical delegate and by using measuring equipment which has been calibrated to the satisfaction of the FIA technical delegate. A copy of the test procedure may be found in the Appendix to these regulations.

18.6.2 The test panel must be 500mm x 500mm and will be tested by forcing a rigid truncated cone through the centre of the panel at a rate of 2mm (+/-1mm) per second until the displacement exceeds 150mm.

During the first 100mm of displacement the load must exceed 250kN and the energy absorption must exceed 6000J. There must be no systematic damage to the border or damage to the fixture before these requirements have been met.

18.7 Rear impact structure push off test :

During the test the gearbox and the structure must be solidly fixed to the ground but not in a way that could increase the strength of the attachments being tested.

A constant transversal horizontal load of 40kN must then be applied to one side of the impact absorbing structure, using a pad identical to the ones used in the lateral tests in Article 18.2.1, at a point 400mm behind the rear wheel axis.

The centre of area of the pad must pass through the plane mentioned above and the mid point of the height of the structure at the relevant section. After 30 seconds of application, there must be no failure of the structure or of any attachment between the structure and the gearbox.

18.8 Side impact structure push off test :

18.8.1 Each team must supply detailed calculations which clearly show that the structure(s) are capable of withstanding :

- horizontal loads of 20kN applied separately in a forward and a rearward direction by a ball-jointed pad, which may conform to the shape of the structure(s), measuring 550mm high x 100mm wide and whose centre of area lies 600mm from the car centre line and 300mm above the reference plane ;
- a vertical load of 10kN applied in an upward or downward direction by a ball-jointed pad, which may conform to the shape of the structure(s), measuring 400mm long x 100mm wide whose centre of area lies 600mm from the car centre line and 500mm forward of the rear edge of the cockpit entry template.

In all cases the calculations should show that there will be no structural failure of the parts. It should be assumed that ball-jointed pads are used, the joint lying at the centre of area of the pad.

If multiple impact structures are fitted to the car only those in contact with the pads need have the load applied to them.

18.8.2 During the push off test the survival cell must be resting on a flat plate and secured to it solidly but not in a way that could increase the strength of the attachments being tested.

A constant rearward horizontal load of 20.0kN must then be applied to the impact absorbing structure(s) using a ball-jointed pad 550mm high and 100mm wide, which may conform to the shape of the structure(s), at a point 600mm from the car centre line.

The centre of area of the pad must lie 300mm above the reference plane and there must be no failure of any structure or of any attachment between the structure(s) and the survival cell.

If multiple impact structures are fitted to the car only those in contact with the pads will be tested.

ARTICLE 19 : FUEL

19.1 Purpose of Article 19:

- 19.1.1 The purpose of this Article is to ensure that the fuel used in Formula One is petrol as this term is generally understood.
- 19.1.2 The detailed requirements of this Article are intended to ensure the use of fuels that are composed of compounds normally found in commercial fuels and to prohibit the use of specific power-boosting chemical compounds. Acceptable compounds and compound classes are defined in 19.2 and 19.4.4. In addition, to cover the presence of low level impurities, the sum of components lying outside the 19.2 and 19.4.4 definitions are limited to 1% max m/m of the total fuel.
- 19.1.3 Any petrol, which appears to have been formulated in order to subvert the purpose of this regulation, will be deemed to be outside it.

19.2 Definitions:

- Paraffins - straight chain and branched alkanes.
- Olefins - straight chain and branched mono-olefins and di-olefins.
- monocyclic mono-olefins (with five or more carbon atoms in the ring) with or without paraffinic side chains.
- Di-olefins - straight chain or branched or monocyclic or bicyclic or tricyclic hydrocarbons (with five or more carbon atoms in any ring) with or without paraffinic side chains, containing two double bonds per molecule.
- Naphthenes - monocyclic alkanes (with five or more carbon atoms in the ring) with or without paraffinic side chains.
- Aromatics - monocyclic and bicyclic aromatic rings with or without paraffinic or olefinic side chains and/or fused naphthenic rings. Only one double bond may be present outside the aromatic ring. Fused naphthenic rings must meet the naphthene definition above.
- Oxygenates - organic compounds containing oxygen.

19.3 Properties:

The only fuel permitted is petrol having the following characteristics:

<u>Property</u>	<u>Units</u>	<u>Min</u>	<u>Max</u>	<u>Test Method</u>
RON		95.0	102.0	ASTM D 2699-86
MON		85.0		ASTM D 2700-86
Oxygen	%m/m		3.7	Elemental Analysis
Nitrogen	mg/kg		500	ASTM D 4629
Benzene	%v/v		1.0	EN 238
RVP	hPa	450	600 ⁽¹⁾	ASTM D 323
Lead	g/l		0.005	ASTM D 3237
Density at 15°C	kg/m ³	720.0	775.0	ASTM D 4052
Oxidation Stability	minutes	360		ASTM D 525
Existent gum	mg/100ml		5.0	EN 26246
Sulphur	mg/kg		10	ASTM D 5453
Copper corrosion	rating		C1	ISO 2160
Electrical conductivity	pS/m	200		ASTM D 2624

- (1) The maximum RVP may rise to 680hPa if a minimum of 2% bio-methanol and/or bio-ethanol are included in the fuel.

Distillation characteristics:

At E70°C	%v/v	20.0	50.0	ISO 3405
At E100°C	%v/v	46.0	72.5	ISO 3405
At E150°C	%v/v	75.0		ISO 3405
Final Boiling Point	°C		210	ISO 3405
Residue	%v/v		2.0	ISO 3405

The fuel will be accepted or rejected according to ASTM D 3244 with a confidence limit of 95%.

19.4 Composition of the fuel:

- 19.4.1 The composition of the petrol must comply with the specifications detailed below:

Component	Units	Min	Max	Test Method
Aromatics	%v/v		35*	GCMS
Olefins	%v/v		18*	GCMS
Total di-olefins	%m/m		1	GCMS
Total styrene and alkyl derivatives	%m/m		1	GCMS

* Values corrected for fuel oxygen content.

In addition, the fuel must contain no substance which is capable of exothermic reaction in the absence of external oxygen.

- 19.4.2 The total of individual hydrocarbon components present at concentrations of less than 5% m/m of the total fuel must be at least 30% m/m of the hydrocarbon component of the fuel.

- 19.4.3 The total concentration of each hydrocarbon group in the total fuel sample (defined by carbon number and hydrocarbon type), must not exceed the limits given in the table below:

% m/m	C4	C5	C6	C7	C8	C9+	Non PONA*	Unassigned
Paraffins	10	30	25	25	55	20	-	-
Naphthenes	-	5	10	10	10	10	-	-
Olefins	5	20	20	15	10	10	-	-
Aromatics	-	-	1.2	35	35	30	-	-
Maximum	15	40	45	50	60	45	1	5

* Non PONA are components not meeting definitions in 19.2 and 19.4.4

For the purposes of this table, a gas chromatographic technique must be employed which can classify hydrocarbons in the total fuel sample such that all those identified are allocated to the appropriate cell of the table. Compounds present at concentrations below 0.1% by mass may be deemed unassigned, except that it is the responsibility of the fuel approval laboratory to ensure that components representing at least 95% by mass of the total fuel are assigned. The sum of the non PONA and unassigned hydrocarbons must not exceed 5% by mass of the total fuel sample.

- 19.4.4 The only oxygenates permitted are paraffinic mono-alcohols and paraffinic mono-ethers with a final boiling point below 210°C.
- 19.4.5 A minimum of 5.75% (m/m) of the fuel must comprise oxygenates derived from biological sources. The percentage that each component is considered to originate from a biological source is calculated from the relative proportion of the molecular weight contributed by the biological starting material.
- 19.4.6 Synthetic hydrocarbons or mixtures of synthetic hydrocarbons, which have been produced from biomass, will be considered for future inclusion into Formula One fuel, provided that a suitable analytical procedure is available to verify their biological origin.
- 19.4.7 Manganese based additives are not permitted.

19.5 Air:

Only ambient air may be mixed with the fuel as an oxidant.

19.6 Safety:

- 19.6.1 All competitors must be in possession of a Material Safety Data Sheet for each type of petrol used. This sheet must be made out in accordance with EC Directive 93/112/EEC and all information contained therein strictly adhered to.

19.7 Fuel approval:

- 19.7.1 Before any fuel may be used in an Event, two separate five litre samples, in suitable containers, must be submitted to the FIA for analysis and approval.
- 19.7.2 No fuel may be used in an Event without prior written approval of the FIA.

19.8 Sampling and testing at an Event:

- 19.8.1 All samples will be taken in accordance with FIA Formula One fuel sampling procedure, a copy of which may be found in the Appendix to these regulations.
- 19.8.2 Fuel samples taken during an Event will be checked for conformity by using a gas chromatographic technique, which will compare the sample taken with an approved fuel. Samples which differ from the approved fuel in a manner consistent with evaporative loss, will be considered to conform. However, the FIA retains the right to subject the fuel sample to further testing at an FIA approved laboratory.
- 19.8.3 GC peak areas of the sample will be compared with those obtained from the reference fuel. Increases in any given peak area (relative to its adjacent peak areas) which are greater than 12%, or an absolute amount greater than 0.1% for compounds present at concentrations below 0.8%, will be deemed not to comply.

If a peak is detected in a fuel sample that was absent in the corresponding reference fuel, and its peak area represents more than 0.10% of the summed peak areas of the fuel, the fuel will be deemed not to comply.

If the deviations observed (above) by GC indicate that they are due to mixing with another Formula One fuel, which has been approved by the FIA for use by the team, the fuel sample will be deemed to comply, provided that the adulterant fuel is present at no more than 10% in the sample.

ARTICLE 20 : TELEVISION CAMERAS AND TIMING TRANSPONDERS

20.1 Presence of cameras and camera housings :

All cars must be fitted with either two cameras, two camera housings or one of each at all times throughout the Event.

20.2 Location of camera housings :

Camera housings, when used, must be fitted in the same location as cameras. Details concerning the size and weight of all camera housings may be found in the Appendix to these regulations.

20.3 Location and fitting of camera equipment :

20.3.1 All cars must be equipped with five positions in which cameras or camera housings can be fitted. Referring to Drawing 6, all cars must carry a camera or camera housing in position 4, the position of the remaining camera or camera housing will be determined by the FIA after consultation with the relevant Competitor.

Once positions are determined in the above manner, any decision as to whether a camera or camera housing is fitted in those positions will rest solely with the relevant Competitor.

20.3.2 Any camera or dummy camera fitted in positions 2, 3 or 4 shown in Drawing 6 must be mounted in order that its major axis does not subtend an angle greater than 5° to the reference plane.

20.4 Transponders :

All cars must be fitted with a timing transponder supplied by the officially appointed timekeepers. This transponder must be fitted in strict accordance with the instructions detailed in the Appendix to these regulations.

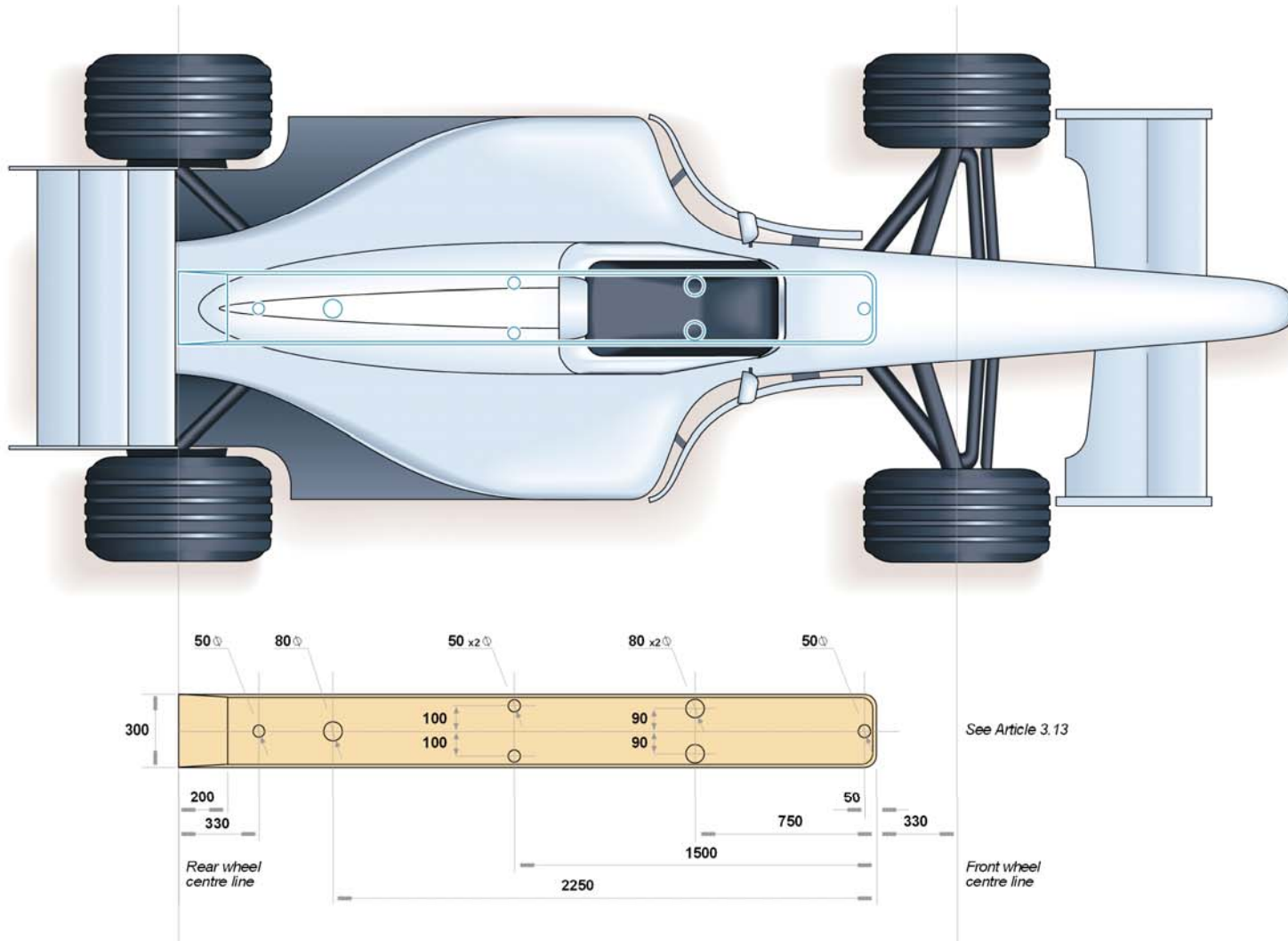
ARTICLE 21 : FINAL TEXT

The final text for these regulations shall be the English version should any dispute arise over their interpretation.

Drawing 1



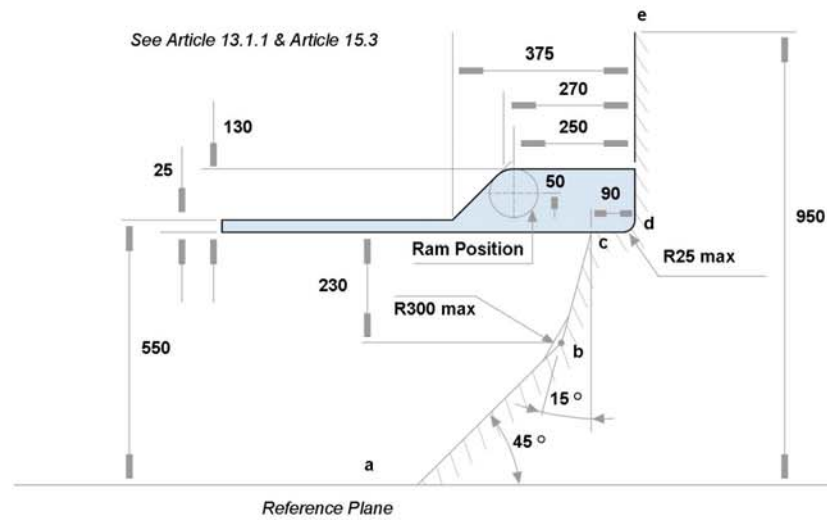
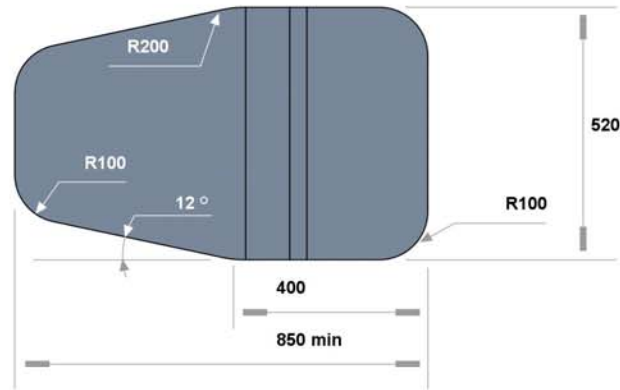
Skid Block Dimensions



Drawing 2



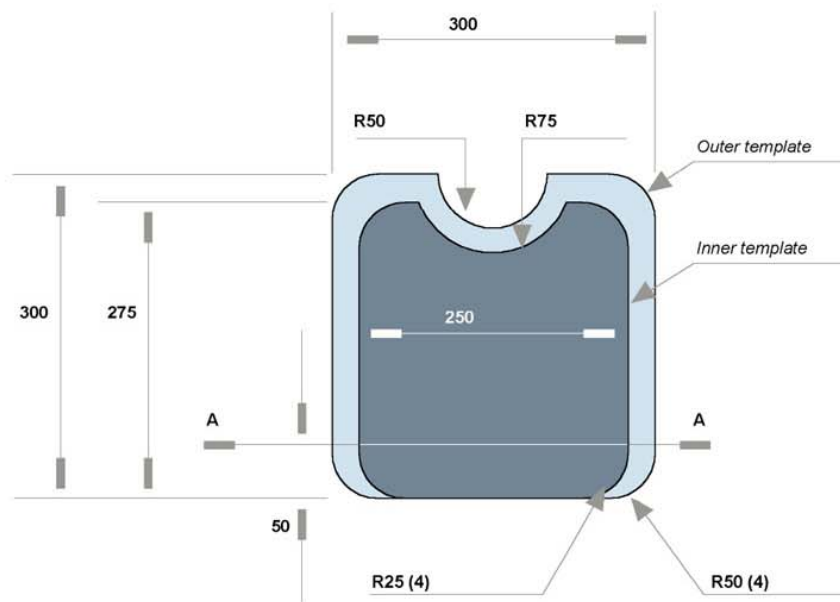
Cockpit Entry Templates



Drawing 3



Cockpit Cross Section Template

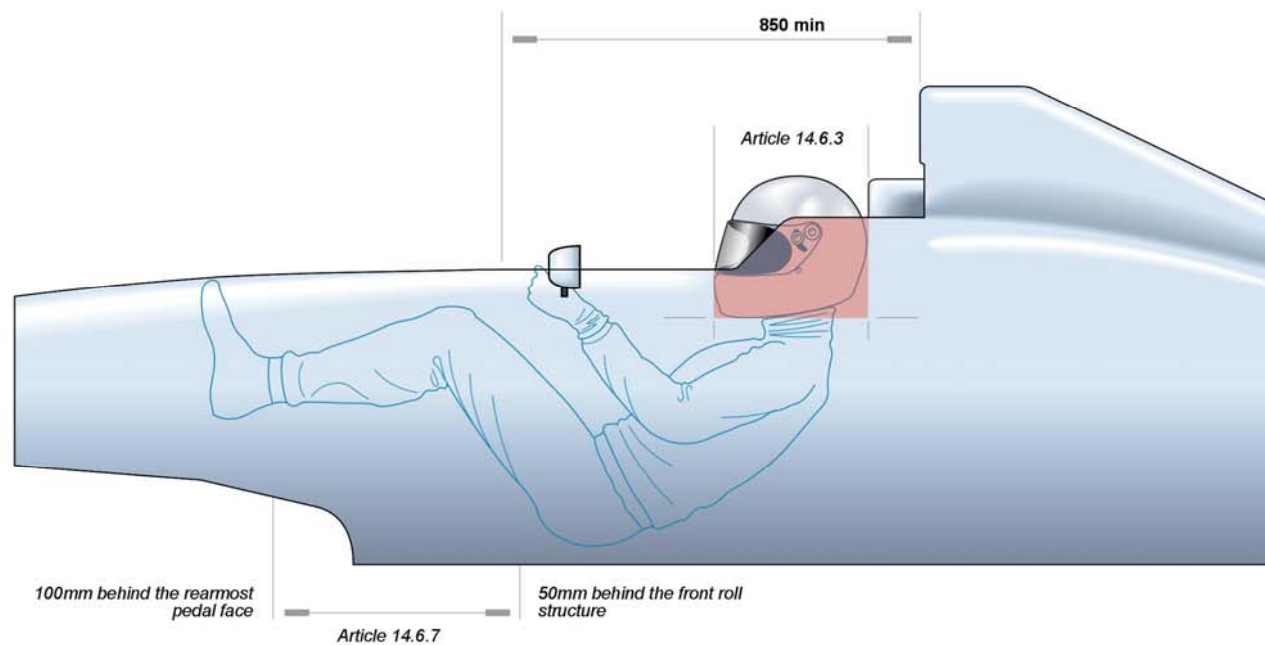


See Article 13.3.1 & Article 14.6.7

Drawing 4



Cockpit Padding

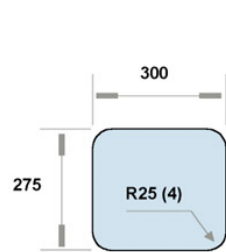
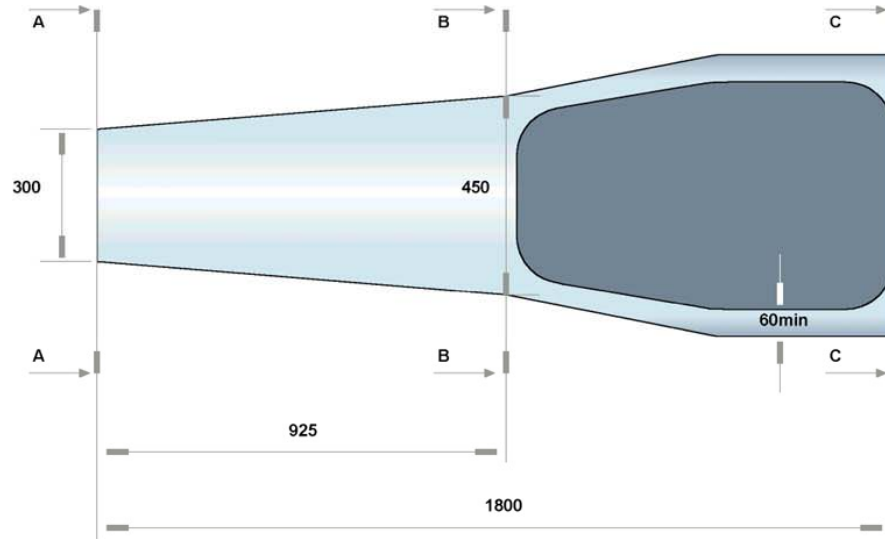


Drawing 5

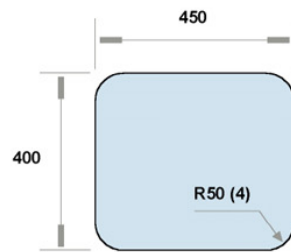


Survival Cell Dimensions

See Article 13.1.1, Article 15.4.4, Article 15.4.6



Minimum external dimensions at the section A-A



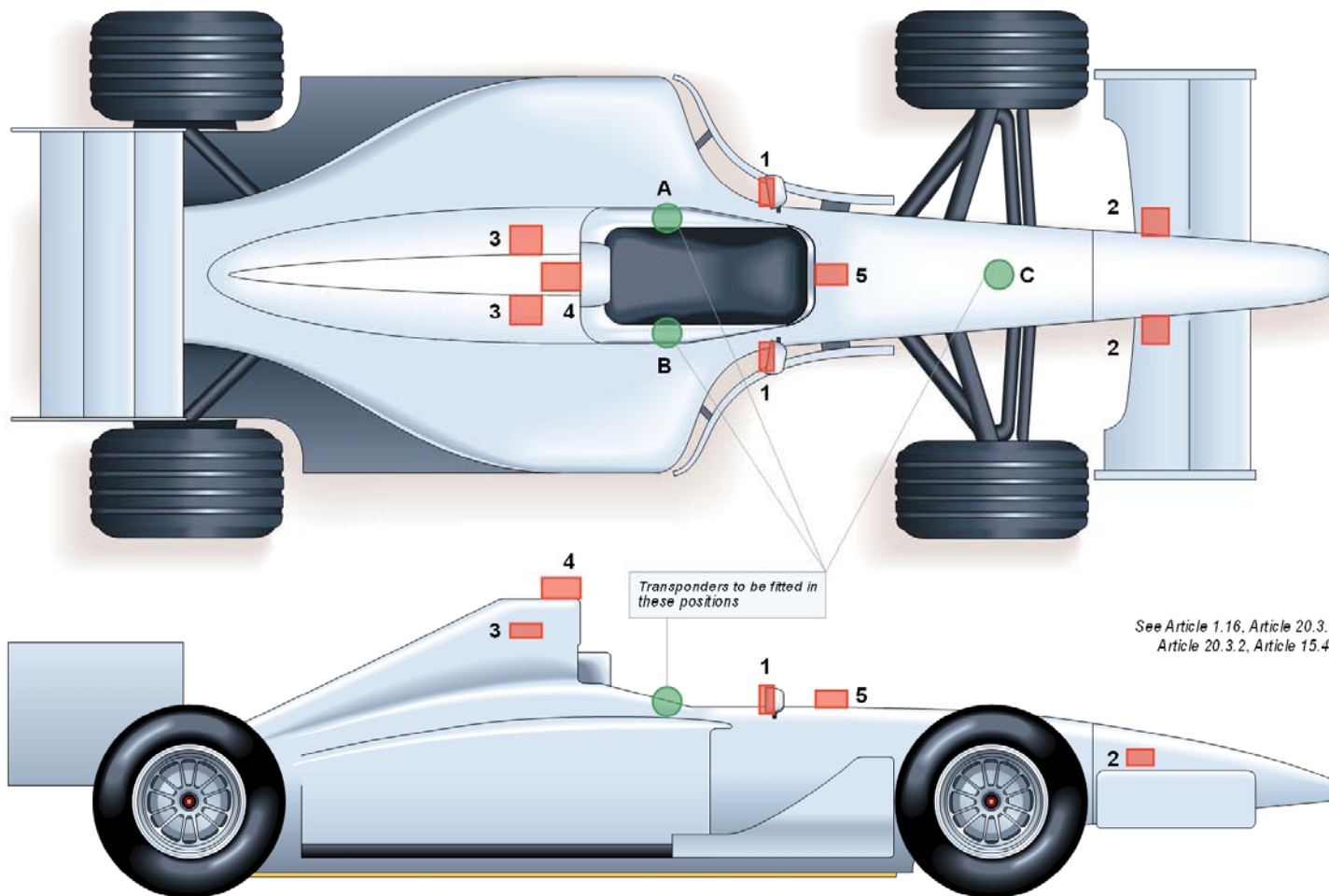
Minimum external dimensions at the section B-B

Drawing 6



Cameras and Transponders

- Camera locations
- Transponder locations



See Article 1.16, Article 20.3.1,
Article 20.3.2, Article 15.4.1