REGULATIONS AND SPECIFICATIONS FOR THE 2019 KWAZULU NATAL LOTUS CLUB CHAMPIONSHIP (161650/144)

These regulations apply for the calendar year 2019. As we are affiliated to KZN road racing, the KZN road racing rules supersede these rules in sports and GT, as such any rule from KZN road racing which conflicts with these is taken to be the correct rule with regards to Sport and GT.

CONTROLLERS OF THE CHAMPIONSHIP

The controllers of the championship shall be the MSA Kwa Zulu Natal Regions Motor sport Committee, which may delegate certain authorities and responsibilities to the Seven Car Club of Natal. In these regulations, any reference to "Committee" shall mean the Racing Committee (RC) of the Seven Car Club of Natal (SCCN) and/or a member of the Racing Committee as applicable.

DOMICILE

The Championship is open to all holders of a valid MSA competition license. (Club status)

THE KWAZULU NATAL LOTUS RACING CHAMPIONSHIP SERIES

INTRODUCTION

The **KWAZULU NATAL LOTUS RACING REGIONAL CHAMPIONSHIP** is a series of race events aimed at attracting wide participation by owners of Lotus 7 type cars and replicas. Previous race experience is not a requirement and new competitors will take part in at least three time attack races before being allowed to join the main races. All seven drives are most welcome. Track day experience or new entrants in a lotus is strongly recommended to ensure the safety of the new entrant, as well as the rest of the competitors.

1. OBJECTIVE

1.1 **Scratch**

The objective is to drive as fast as possible so as to have the lowest race time.

2. CHAMPIONSHIPS & TROPHIES

2.1 The Kwa Zulu Natal Region & Lotus Racing Champion will be the overall winner rom classes A, B or X based on accumulated scratch points from the respective class. Should there be a tie, then the greater number of class wins followed by second positions and, if required, third positions etc., will be considered in order to break the tie.

2.2 Class winner badges and subsidiary championship trophies will be awarded to drivers accumulating the most points within:

2.2.1 Class A

2.2.2 Class B

2.3 There will be one SCCN Club Championship which does not have trophy status

2.3.1 Class X or cars as detailed later on in these Regulations.

2.4 Any competitor may be awarded trophies at individual race meetings but has to be a member or affiliate member of the SCCN or alternatively, have paid the prescribed MSA levy of R350.00 to the SCCN.

2.5 Points per heat in respect of all Classes shall be awarded as follows:

No. of Participants in class

	>5	**5**	**4**	**3**	**<3**
1st	14	12	10	8	6
2nd	12	10	8	6	5
3rd	10	8	6	5	
4th	8	6	5		
5th	6	5			
6th	5				

7th 4

8th 3

9th 2

10th 1

The Number of participants in a Class shall be determined as the total number of cars in that class participating in any of Qualifying heats 1 or 2. Drivers sharing a car at the same race meeting will be counted as one car only. Individual points scored will not be affected. Points earned in one class may not be carried over into another class but all points earned will be reflected in the Kwa Zulu Natal Region Championship.

2.6 All Races will be championship races, competitors are allowed to discard points scored at one race meeting. Individual heats may not be discarded; the whole race meeting's points must be discarded. Any points lost due to exclusion as a result of any infringements may not be discarded.

2.7 Subject to the number o competitors exceeding the minima stipulated in the organiser's regulations or the day, the trophies shall be awarded per event as follows:

2.7.1 Class A - 1st 2nd 3rd

2.7.2 Class B - 1st 2nd 3rd

2.7.3 Class C - 1st 2nd

2.8 Awards per event shall be determined as follows:
Classes, A, B and X- The highest number of laps at the lowest total race time across the two heats will determine the winner and subsequent positions in each class(subject, however, to relevant regulations regarding cut-off time that may be applicable within any class).

2.9 All Championship race heats to be a minimum of 2kms in length.

2.10 For purposes of these regulations a 'racing event' is classified as qualifying or race heats.

3. CONDUCT OF SERIES & EVENTS

3.1 Competition Licenses

Competitors require, as a minimum, a "Club l" level circuit racing competition license for all classes, which is obtainable rom Motorsport South Africa.

3.2 Scrutineering & eligibility compete

3.2.1 All competitor vehicles must be presented to, and approved by, the circuit Scrutineers prior to participation in any race session.

3.2.2 Should a class change be required, the vehicle must be inspected or conformity in the new class prior to any racing event.

3.2.3 All vehicles must comply too the specifications stipulated herein, as well as the annual safety inspection sheet.

3.2.4 All vehicles must comply in full with the stipulated specifications of the class in which they are entered, save that:

3.2.4.1 In the event that any non-compliance that by the agreement of all competitors in that class together with a member of the RC, is deemed immaterial to the performance or safety of the non-compliant vehicle, that vehicle shall be permitted to compete in that class or that race meeting only and shall be eligible for inclusion in the results of the event and championship points; and

3.2.4.2 In the event that no agreement is reached according to the foregoing, a RC member may permit the vehicle to compete "by invitation" but be excluded from the event results and the earning of championship points for that class.

3.2.5 Vehicles must be made available for technical inspections at any time during race day. Should a participant's vehicle be found non-compliant with the technical regulations of the class in which they are competing, that participant will be excluded from the day's results and subject to disciplinary action which could result in further penalties being applied.

3.2.6 Decals indicating the positioning of fire extinguishers, cut-off switches and towing points must be fitted per MSA regulations.

3.2.7 Prior to participating in its first event for the season and after any contact incident or material modification, a competitor vehicle must be presented for, and pass, a series inspection conducted by the series compliance officer or RC.

3.2.8 The Race Committee may from time-to-time develop for adoption additional monitoring standards, guidelines, requirements, and/or procedures which it will then apply at its sole discretion.

3.3 Starting Grid Positions

3.3.1 The fastest o the recorded qualifying times will determine the grid positions for Heat 1.

3.3.2 The finishing positions for Heat 1 will determine the grid positions or Heat 2.

3.3.3 Where no representative time is established in Qualifying, the competitor concerned will be allocated a starting position or the next heat behind the last car of the class he is competing in. Should more than one competitor in a class be affected, the order will be determined by current championship points standing.

3.3.4 Competitors that switch classes during a racing event, after qualifying, must comply fully with that class's eligibility requirement and will be required to stat rom behind the slowest competitor of that relevant class. (Refer 3.2.2)

3.4 **Driver Conduct**

3.4.1 It is incumbent upon all competitors to refrain from reckless and dangerous driving which might constitute a danger to themselves and/or other competitors.

3.4.2 All on track incidents must be referred to the clerk of course (C o C) in writing on an incident report and Stewards of the day for investigation and establishment of any penalties applicable.

3.5 **New Competitors**

3.5.1 New competitors will be required to identify themselves by attachment of a ribbon trailing behind the car. The Ribbon will be red, white or yellow, 3mm wide and 1 meter in length and be supplied by the competitor.

3.5.2 This is a requirement or the first 2 race meetings or any new competitors and will be reviewed thereafter by the Race Committee

3.5.3 Prior to competing in their first event, competitors must

3.5.3.1 Present their vehicle to the series compliance officer for inspection.

3.5.3.2 Complete the rookie questionnaire

3.5.3.3 Be a paid up member o SCCN or alternatively have paid the prescribed MSA affiliation fee.

3.5.3.4 Have a valid MSA competition license

3.5.3.5 Complete and handover to the RC a signed copy of the SCCN indemnity form.

3.6 **Disputes**

3.6.1 Competitor attention is drawn to part IX and X o the MSA General Competition Rules & Appendixes in respect of Protests and Appeals

3.7 **Race Committee and Technical Consultant (RC)(TC)**

3.7.1 It is a requirement that, as per the SCCN Constitution, a Race Committee (RC) be announced or the duration of the Race Season.

3.7.2 A technical Consultant (TC) may be appointed at the sole discretion of the Racing Representative at any time during the racing season The TC compensation must be agreed with the racers at large as well as the funding model.

3.7.3 The TC/RC shall get to know and operate within the bounds of the MSA General Competition Rules and circuit racing rule books.

3.7.3.1 Represent the SCCN and act as a liaison between competitors and race officials

3.7.3.2 Ensure that the rules of the class are applied and adhered to by all competitors.

3.7.3.3 Act as a consultant to the clerk of course and Stewards of the day.

3.7.3.4 Where rules are transgressed, it is the duty of the TC/RC to report these to the C o C for a ruling.

3.7.3.5 Perform eligibility checks as appropriate.

4. VEHICLE ELIGIBILITY, ALL CLASSES

4.1 **General**

4.1.1 It is recorded that only lotus seven-type vehicles are eligible to race in the Lotus Championship, and the Race Committee may, from time to time at its discretion or by amendment to these regulations, or by Bulletin, permit departures from vehicle Eligibility to the extent that such departures serve not to present a safety risk

4.1.2 If requested, all electronic data (Data logger and/or video footage) must be made available to officials for investigation purposes.

4.2 **Seven Meter Rule**

4.2.1 All vehicles must conform to the Seven meter rule i.e. vehicles must appear as fair representations of the models upon which they are based when viewed from a distance of 7 meters.

4.2.2 The placement of the engine, gearbox and differential must be consistent with the original design concept of the vehicle upon which it is based.

4.3 **Vehicle Dimensions**

4.3.1 The maximum track permissible for a “lotus 7” derivative vehicle competing in any class is 1780mm measured at the outside edge of the tyre including the bulge made where the tyre contacts the ground. Class L vehicle requirements are listed in the class L vehicle eligibility section of these regulations.

4.3.2 The maximum length for these vehicles is 3400mm

4.3.3 No part of the power unit may protrude outside of the normal engine by other than necessitated by certain types of carburettors and/or air filters

4.4 **Body Work**

4.4.1 Except in respect of components clearly stipulated in these regulations, aerodynamic aids designed to promote down-force or constitutes an aerodynamic advantage, are not permitted on Lotus Sevens or derivatives

4.4.2 Cladding is permitted on the underside of the vehicles

4.4.3 On Lotus Sevens or derivatives, nothing is permitted on the underside of the vehicle that, as may be determined by the committee, serves as a splitter, diffuser, or similar aerodynamic aid.

4.4.4 The area above the petrol tank must be completely covered, to prevent fuel spillage in the event of an accident. The use of material shall be subject to the approval of the Race Committee. Should fuel tanks be positioned within passenger compartment, they will be isolated from the driver by means of a firewall or be enclosed within a separate metal container which will prevent fuel spillage onto the driver or into the driver’s compartment, a drain hole of at least 12mm must be made in the floor as far away from the exhaust as practically possible.

4.4.5 When fuel cells are fitted behind the rear passenger compartment firewall they may be fitted above, in front of, or

behind the rear axle. Any tank fitted behind the rear axle must comply with the manufacturer's specification.

4.4.6 The fuel tank must be fitted with an appropriate breather pipe.

4.4.7 No Air boxes that protrude beyond the bodywork are permitted.

4.4.8 Air intake scoops (that supply air for combustion purposes) that are positioned on the nose or bonnet must be of similar shape and no greater size than detailed in Appendix B. Any other option used must comply with the inlet dimensions of Appendix B.

4.4.9 NACA type intakes are permitted but must comply with the inlet dimensions of Appendix B

4.4.10 The passenger compartment may be covered from scuttle rearwards

4.4.11 All wheels must be covered. Cycle fenders are permitted on front wheels. Should a cycle fender mounting bracket break during an event, the damaged one may be removed for the remainder of the event, but must be repaired by the following race meeting.

4.4.12 Rear fenders must cover the area from the chassis bodywork to the outer edge of the rear tyre and must attach to the chassis cladding directly.

4.4.13 No elements may be removed from any part of the chassis or bodywork if deemed to be detrimental to the structural integrity of the vehicle.

4.4.14 If no tail lights are fitted, a minimum of one red rain light must be fitted. The driver must be able to witch the rain light on when strapped to the seat. The light must be positioned above the lowest point of the rear body work or rear fender and not higher than the drivers shoulders.

4.5 **Engines**

4.5.1 Only reciprocating 4-cylinder engines are permitted

4.5.2 Engine capacity limitations are detailed in each individual class's specifications.

4.5.3 With the exception of Class X, no forced induction is permitted. The use of nitrous oxide is NOT permitted.

4.6 **Drive-train**

4.6.1 No four-wheel drive is permitted

4.6.2 No anti-lock braking systems are permitted

4.6.3 No traction control or similar system of electronic intervention is permitted

4.6.4 Gearbox:- "Paddle shift" mechanisms are not allowed

4.6.5 See class eligibility requirements

4.7 **Suspension**

4.7.1 All cars shall have a double wishbone front suspension

4.7.2 Any rear suspension design is permitted

4.7.3 All spherical bearings used between wishbones and uprights in single shear must have captive washer to ensure the joint is not lost in the event of a spherical joint failure.

4.7.4 All rod ends must have a locking nut or physical fixing

4.7.5 Rod ends may not be bent o deformed in anyway

4.7.6 Rod ends/spherical bearings may not have free play

4.7.7 Shock absorbers are limited as follows in general. Additional Class specifications are defined later in these regulations.

4.7.7.1 Shock absorber damping shall be by conventional gas/hydraulic means only. Remote canisters are permitted. Permitted adjustability shall be only by manual means and limited to spring platform height and bump and rebound control (Maximum 2 way adjustable only per damper).

4.8 **Racing Numbers & Logos**

4.8.1 All vehicles will carry Lotus Championship backing decals and numbers and class identification colour strips as designated for the series. A minimum of 3 numbers must be placed on the vehicle, 1 on either side of the bonnet, and 1 on the nosecone. Placing one on the rear of the vehicle is recommended, but optional.

4.8.2 The Committee or race organisers may, from time to time, determine the positioning, size and quantity of series sponsor logos.

4.8.3 Transgressions may result in a loss of points for the event concerned and the withholding of sponsor product.

4.8.4 If Race numbers have not been used for 1 season, that number will become free for any other competitor to use. Each competitor has the right to reserve his current number for another season, by requesting this in writing to RC.

4.9 **Roll cage and side impact beams**

4.9.1 All vehicles must be fitted with an approved Rollover Cage.

4.9.2 Unless equipped with a roll cage approved and certified by the FIA for use on that type of vehicle, vehicles must conform to minimum specification detailed in Appendix C.

4.9.3 Minimum roll cage requirement or SCCN racing is as follows in SCCN roll cage Specification sheet.

4.10 **Other**

4.10.1 Use of Tyre warmers is not permitted.

4.10.2 All vehicles are required to be fitted with a silencer that will ensure that the noise generated will be compliant with MSA noise regulations.

4.10.3 Particular attention must be paid to the construction and assembly quality of the exhaust system and its fixings. Adequate supporting structures must be in place and all welds must be of good quality.

4.10.4 All vehicles must be fitted with an approved fire extinguisher of 1kg. Plastic mounting brackets are not allowed. The use

of approved plumbed in extinguisher systems is recommended. Fire stryker units are not allowed but not as the primary fire extinguisher.

4.10.5 Only unleaded pump fuel with a maximum octane rating of 95 may be used in Classes A and B.

4.10.6 The use of water injection is not allowed

4.10.7 The use of any form of intake air cooling inside or in front of the air intake system is NOT allowed. E.g. dry ice in air box

4.10.8 Only body panels and non- structural components may be manufactured from composite materials e.g. carbon fiber and fiber glass (Wheels are considered to be structural component).

4.10.9 The use of titanium and other exotic materials is forbidden.

4.10.10 Competitors need to inform the committee in advance of any changes to their equipment or to alert them if they require their services

Appendix C

Roll over protection

1) Roll cage specification applicable to all classes

All cars must be equipped with a roll-cage consisting, at a minimum, of a structural framework made up of:

1) A main roll-bar, and
2) A front roll-bar, and
3) Their connecting members, and
4) One diagonal member, and
5) Backstays, and
6) A minimum of 6 mounting points, and
7) All general configured in accordance with figure 1

Unless fitted with an FIA certified and approved Roll Cage (minimum 6 mounting points) for use on that type of vehicle **(The original identification plate must be attached)**, the following minimum specification detailed below is applicable to **ALL.** Roll cages supplied by Caterham U.K. Birkin S.A. and Locost S.A. are acceptable.

Main roll-cage structure: (Refer to figure 1 below)

Two safety rollover structures (front and rear) are mandatory.

The rear structure tubing must be straight and vertical when viewed from the side, front or rear of the car. When fitted to an enclosed car (e.g. Exige), it must follow the internal contour o the body-shell as close as possible. It must have at least 1 diagonal brace, left to right, lowest point at the base plate on the passenger side of the vehicle.

The front structure must be separated by a minimum of 600mm from the rear structure, measured at its nearest point. It should loosely follow the profile of a standard windscreen as fitted to a road going “seven” or internal body-shell if fitted to an enclosed car. The vertical tubes must be straight and can have a maximum of 1 bend on their lowest part.

The front structure must be connected to the rear structure by tubes attached near the top outer bends of the forward and rear main structures on both sides of the car.

At least 1 diagonal member must connect the front & rear rollover structures, its front connection must be at the driver’s side. These connections must be at the same location as the side tube joints this member may be replaced by two curved tubes (U-shaped) the legs of each “U” must attach at the attachment points of the side tubes connecting the front and rear roll structures and the base of the “U” must meet on the longitudinal centreline of the roll structure.

Two backstays may be omitted with the approval of the race committee and circuit Scrutineers. The rear of these stys must locate on the factory mounting points for Sevens.

The base plates for the main rollover structures must be made from at least 3mm steel plate. Mount plates for the backstays must be at least 2mm.

If not forming part of the seat construction, a head restraint must be fitted to the roll cage, of minimum dimensions 100x100mm and positioned so that the drivers head cannot move past it under rearward forces or get trapped between the roll-bar and head restraint. The drivers head should be within 50mm of it when normally seated.

The fwd & rear safety rollover structures must be symmetrical about the lengthwise centre-line of the car.

The fwd & rear structures must have at least one 5mm hole drilled though to enable tubing wall thickness to be verified.

The forward and rear rollover safety structures must be made in one piece without joints. Their construction must be smooth and even, without ripples or cracks. The centreline bend radius must be a minimum of 3 times the tube Dia.

The areas within the roll cage structure shall remain entirely open and shall not, when viewed from any angle, be covered with or supplemented by, any additional material which, as might be determined by the race committee, might serve, or be intended to serve, as an aerodynamic aid.

The top of the driver's helmet may not be less than 50mm below the top edges of the two roll over structures. Any extension added to the main structure to facilitate this, may not be higher than 100mm above the main roll hoop.

It is recommended that roll-cage tubes within 150mm of the driver's helmet are covered with a suitable energy absorbing material.

The tubes may not carry fluids.

Tubing specifications

1. All compulsory elements of the roll-cage structures shall be – Cold drawn unalloyed carbon steel
2. Minimum dia. 38mm
3. Minimum wall thickness x 2mm
   All bolts securing the roll-cage must be at least grade 8.8"

Optional reinforcing members may be fitted (shaded items fig.1) but none may extend forward of the front roll hoop although an additional diagonal brace within the top of the roll-cage is recommended;
Side-intrusion bars may be fitted external to the chassis and/or incorporated into the roll-cage structure but may not extend further forward than the front of the driver foot well.

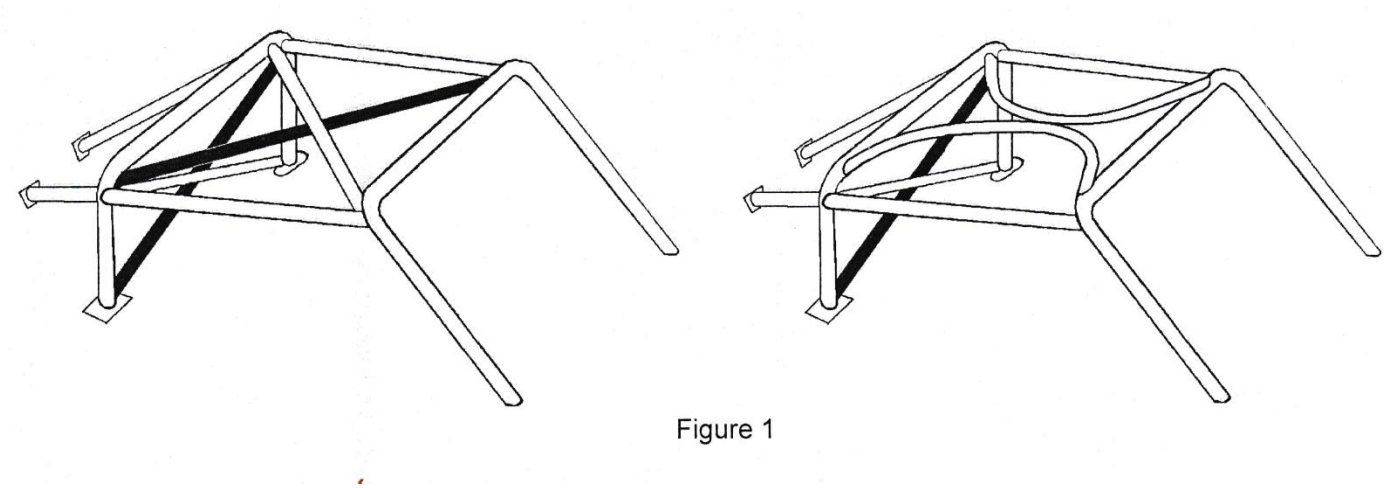


Figure 1

FOR ALL ROAD GOING SEVENS WISHING TO RACE, ALL MINIMUM REQUIREMENTS ARE SHOWN IN RED IN APPENDIX E.

Appendix D
Side impact protection
Side impact specification, applicable to all lotus 7 type vehicles
All Lotus 7 type cars must be equipped with externally mounted side impact protection bars consisting of a structure mounted on the outside and, at minimum, to the driver's side of the vehicle and generally configured in accordance with figure 1. Although option 2 is the preferred and recommended configuration, the utilisation of one, or a combination of, options 1, 2 or 3 is permitted. This requirement is in addition to any existing internally fitted side impact protection.

Main Structure: (Refer to figure 1 below)

One tubular side impact bar mounted to the chassis frame at a minimum of three points along the side of the vehicle. Two of these points may be attached to existing roll-cage structure. Tubing to be cold drawn unalloyed steel. Minimum of 31mm diameter and 2mm wall thickness. Spacing between the tubing and chassis/ cladding to be either 0 to 30mm or 200-300mm. The structure may be removable.

Mounting points to be, from rear to front:

A. Rear rollover hoop maximum 150mm above base mount (a mount point can be sandwiched between the vehicle chassis and the rear roll hoop mount base plate). Minimum fastener size 10mm.

B. **<u>This is an optional point and does not have to be included in the structure.</u>** Located about 50mm below the point where the angled trailing arm mount tube, the cockpit side rail "elbow rail" and curved tube from the backrest/shock mount point are joined. Recommended minimum fastener size 8mm.

C. At the down tube which links the dashboard frame tubing to the lower chassis longer on tube. A minimum of 150mm and a maximum of 300mm from the bottom of the lower chassis longer on tube. Or, on roll-cages that mount to chassis in this area, the lower mounting point of the forward roll hoop. Minimum fastener size 8mm.

D. At the furthermost forward foot well/ cockpit bulkhead vertical tube, a maximum of 100mm from the bottom of the lower chassis longer on tube. Minimum fastener size 10mm.

E. An Additional tube from point C to a point in the area where the lower trailing arm is mounted to the chassis is permitted.

Car fitted with side impact bars that form an integral part of the roll-cage structure (e.g. Caterham), need only install a foot well side impact bar, utilising mounting points C&D as shown in option 3 of figure 1 below.

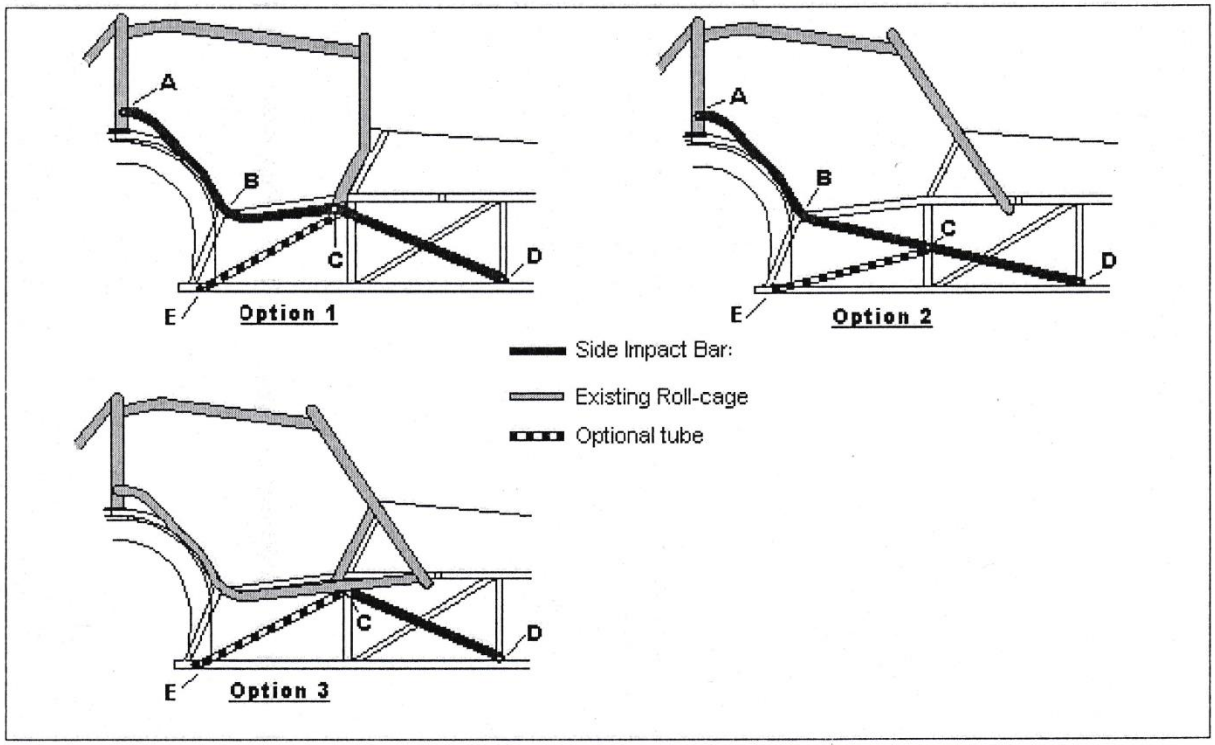
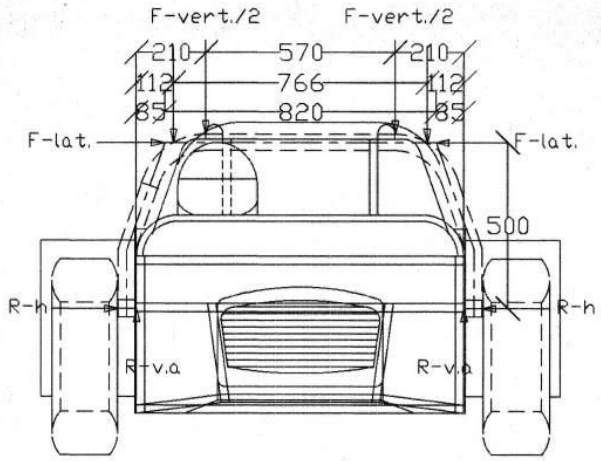


Figure 1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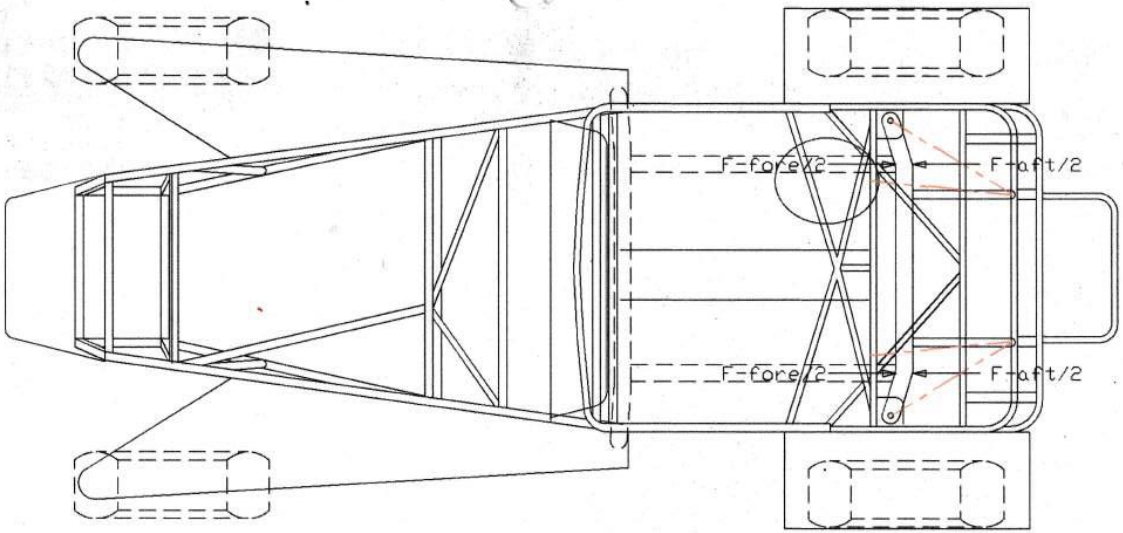
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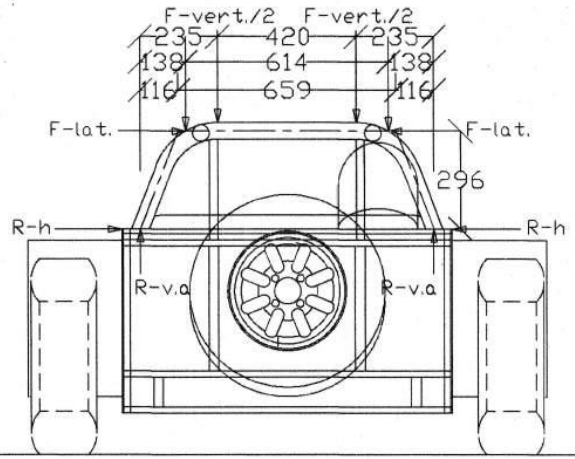
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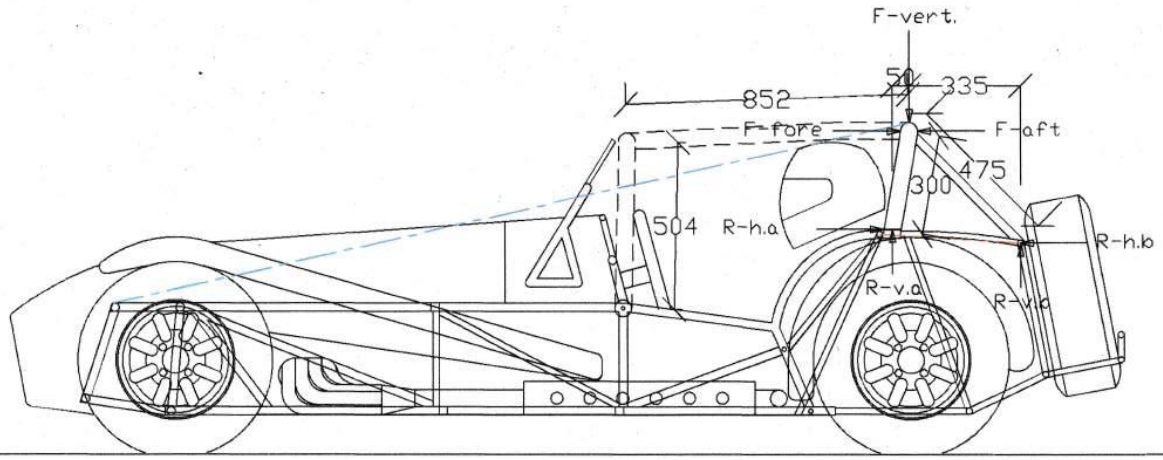
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Description	Symbol/Formula	Unit	Value	Remarks
Car data				
Car Weight	Wc	kg	550	Birkin 7 with Ford Kent engine
Vehicle Weight	W=Wc +150	kg	700	
Roll cage loads & forces				
Lateral Load	Ll=1,5 W	kg	1050	
Fore & Aft Load	Lfa=5,5W	kg	3850	
Vertical Load	Lv=7,5W	kg	5250	
Lateral Force	$F_{l=}$ Ll * .00981	kN	10,3	
Fore & Aft Force	F_{fa} = Lfa * .00981	kN	37,8	
Vertical Force	$F_{v=}$ Lv * .00981	kN	51,5	
Rollcage materials				
Rollbar Tube diameter	TD1	mm	50,8	
Tube wall thicknesss	TT1	mm	2,0	
Sectional area of tube	AT1=PI/4*(TD1^2-(TD1-2*TT1)^2)/1000	m^2 x 1e-3	0,3066	
Moment of inertia of tube	IT1=PI/64*(TD1^4-(TD1-2*TT1)^4)/1000000	m^4 x 1e-6	0,0914	
Section modulus of tube	Z1 = IT1/TD1*2000	m^3 x 1e-6	3,5995	
Radius of gyration of tube	RT1=(IT1/AT1*1000)^{0,5}	mm	17,3	
Rear tie Tube diameter	TD2	mm	25,4	
Tube wall thicknesss	TT2	mm	1,6	
Sectional area of tube	AT2=PI/4*(TD2^2-(TD2-2*TT2)^2)/1000	m^2 x 1e-3	0,1196	
Moment of inertia of tube	IT2=PI/64*(TD2^4-(TD2-2*TT2)^4)/1000000	m^4 x 1e-6	0,0085	
Section modulus of tube	Z2 = IT2/TD2*2000	m^3 x 1e-6	0,6700	
Radius of gyration of tube	RT2=(IT2/AT2*1000)^{0,5}	mm	8,4	
Lateral load Reactions, forces & moments on rear rollcage				
Lateral Force	$F_{l=}$ L_l * .00981	kN	10,3	
height of rollbar above base	h	mm	300	
width of rollbar at base	wb	mm	944	
width of rollbar at top	wt	mm	636	
horizontal reaction at rollbar bases	Rh = Fl/2	kN	5,2	
vertical reaction at rollbar bases	Rv = Fl/2*h/w	kN	1,6	
horizontal reaction at rollbar top	Rht = wt/w*Fl	kN	6,9	
bending moment in rollbar	M = Rht*h/2/1000	kNm	1,04	
Section modulus of tube	Z1 = IT1/TD1*2000	m^3 x 1e-6	3,5995	
bending stress in rollbar	σ = M/Z1*1000	Mpa	289,2	exceeds yield strength by 16%
Fore & aft load Reactions, forces & moments on rear rollcage				
Fore & Aft Force	F_{fa} = Lfa * .00981	kN	37,8	
height of rollbar above base	h	mm	296	
distance rollbar base to tie base	wf	mm	385	
distance rollbar top to tie base	wa	mm	335	
length of ties	lt	mm	475	
vertical reaction at tiebar ends	Rv = Ffa/2*h/wf	kN	14,5	
compressive force in ties	Ft=Rv*lt/h	kN	23,3	
horizontal reaction at tiebar ends	Rh=Rv*wa/h	kN	16,4	beyond chassis capacity, needs strut
Sectional area of tube	AT2=PI/4*(TD2^2-(TD2-2*TT2)^2)/1000	m^2 x 1e-3	0,1196	
compressive stress in ties	σ = Ft/AT2*1000	Mpa	194,8	below yield strength
Radius of gyration of tube	RT2=(IT2/AT2*1000)^{0,5}	mm	8,4	
slenderness ratio	sr=lt/RT2		56,3	buckling not a factor
Vertical load Reactions, forces & moments on rear rollcage				
Vertical Force	$F_{v=}$ Lv * .00981	kN	51,5	
height of rollbar above base	h	mm	300	
width of rollbar at base	wb	mm	890	
width of rollbar at top intersections	wta	mm	660	
distance between contact points on rollbar before deformation	wtb	mm	420	
distance between contact points on rollbar after 25mm deformation	wtb	mm	614	
distance rollbar base to tiebar ends	wf	mm	385	
distance rollbar top to tiebar ends	wa	mm	335	
vertical reaction at rollbar bases	Rvf = Fv/2*wa/wf	kN	22,4	
vertical reaction at tiebar ends	Rva = Fv/2-Rvf	kN	3,3	
moment arm to contact points before deformation	da=(wb-wtb)2	mm	235	
moment arm to contact points after 25mm deformation	db=(wb-wtb)2	mm	138	
moment arm to intersection	dc=(wb-wta)2	mm	115	
bending moment in rollbar before deformation	M1 = Rv*(da-dc)	kNm	2,7	
bending moment in rollbar after 25mm deformation	M2 = Rv*(db-dc)	kNm	0,5	
Section modulus of tube	Z1 = IT1/TD1*2000	m^3 x 1e-6	3,5995	
bending stress in rollbar before deformation	σ1 = M1/Z1*1000	Mpa	747	exceeds yield strength by 200%
bending stress in rollbar after 25mm deformation	σ2 = M2/Z1*1000	Mpa	140	below yield strength
length of sides to intersection	ls=(h^2+db^2)^,5/h	mm	321	
compressive force in sides	Ft=Rvf*ls/h	kN	24,0	
Sectional area of tube	AT1=PI/4*(TD1^2-(TD1-2*TT1)^2)/1000	m^2 x 1e-3	0,3066	
compressive stress in ties	σ = Ft/AT2*1000	Mpa	78,3	below yield strength

Description	Symbol/Formula	Unit	Value	Remarks
Lateral load Reactions, forces & moments on front rollbar				
Lateral Force	$F_{l=}L_l$ * .00981	kN	10,3	
height of rollbar above base	h	mm	500	
width of rollbar at base	wb	mm	990	
width of rollbar at top	wt	mm	820	
horizontal reaction at rollbar bases	Rh = Fl/2	kN	5,2	
vertical reaction at rollbar bases	Rv = Fl/2*h/w	kN	2,6	
horizontal reaction at rollbar top	Rht = wt/w*Fl	kN	8,5	
bending moment in rollbar	M = Rht*h/2/1000	kNm	2,13	
Section modulus of tube	Z1 = IT1/TD1*2000	m^3 x 1e-6	3,5995	
bending stress in rollbar	σ = M/Z1*1000	Mpa	592,6	exceeds yield strength by 118%
Fore & aft load Reactions, forces & moments on front rollbar				
Fore & Aft Force	F_{fa} = Lfa * .00981	kN	37,8	
compressive force in struts	Ft=Ffa/2	kN	18,9	
Sectional area of tube	AT1=PI/4*(TD1^2-(TD1-2*TT1)^2)/1000	m^2 x 1e-3	0,3066	
compressive stress in struts	σ = Ft/AT2*1000	Mpa	61,6	below yield strength
Radius of gyration of tube	RT1=(IT1/AT1*1000)$^{0.5}$	mm	17,3	
length of struts	ls	mm	852	
slenderness ratio	sr=ls/RT1		49,3	buckling not a factor
height of rear rollbar above base	h	mm	296	
distance rear rollbar base to tie base	wf	mm	385	
distance rearrollbar top to tie base	wa	mm	335	
length of ties	lt	mm	475	
vertical reaction at tiebar ends	Rv = Ffa/2*h/wf	kN	14,5	
compressive force in ties	Ft=Rv*lt/h	kN	23,3	
horizontal reaction at tiebar ends	Rh=Rv*wa/h	kN	16,4	beyond chassis capacity, needs strut
Sectional area of tube	AT2=PI/4*(TD2^2-(TD2-2*TT2)^2)/1000	m^2 x 1e-3	0,1196	
compressive stress in ties	σ = Ft/AT2*1000	Mpa	194,8	below yield strength
Radius of gyration of tube	RT2=(IT2/AT2*1000)$^{0.5}$	mm	8,4	
slenderness ratio	sr=lt/RT2		56,3	buckling not a factor
Vertical load Reactions, forces & moments on front rollbar				
Vertical Force	$F_{v=}$Lv * .00981	kN	51,5	
height of rollbar above base	h	mm	500	
width of rollbar at base	wb	mm	990	
width of rollbar at top intersections	wta	mm	820	
distance between contact points on rollbar before deformation	wtb1	mm	570	
distance between contact points on rollbar after 25mm deformation	wtb2	mm	766	
vertical reaction at rollbar bases	Rvf = Fv/2	kN	25,8	
moment arm to contact points before deformation	da=(wb-wtb1)2	mm	235	
moment arm to contact points after 25mm deformation	db=(wb-wtb2)2	mm	112	
moment arm to intersection	dc=(wb-wta)2	mm	85	
bending moment in rollbar before deformation	M1 = Rvf*(da-dc)/1000	kNm	3,9	
bending moment in rollbar after 25mm deformation	M2 = Rvf*(db-dc)/1000	kNm	0,7	
Section modulus of tube	Z1 = IT1/TD1*2000	m^3 x 1e-6	3,5995	
bending stress in rollbar before deformation	σ1 = M1/Z1*1000	Mpa	1073	exceeds yield strength by 330%
bending stress in rollbar after 25mm deformation	σ2 = M2/Z1*1000	Mpa	193	below yield strength
length of sides to intersection	ls=(h^2+db^2)^,5/h	mm	507	
compressive force in sides	Ft=Rvf*ls/h	kN	26,1	
Sectional area of tube	AT1=PI/4*(TD1^2-(TD1-2*TT1)^2)/1000	m^2 x 1e-3	0,3066	
compressive stress in sides	σ3= Ft/AT2*1000	Mpa	85,2	below yield strength
offset in sides	dc=(wb-wta)2	mm	85	
bending moment in rollbar sides after 25mm deformation	M3 = Rv*dc/1000	kNm	2,2	
Section modulus of tube	Z1 = IT1/TD1*2000	m^3 x 1e-6	3,5995	
bending stress in rollbar sides after 25mm deformation	σ4 = M1/Z1*1000	Mpa	608	exceeds yield strength by 240%
combined stress in rollbar sides after 25mm deformation	σ5 = σ3 + σ4	Mpa	693	exceeds yield strength by 280%