

MANUAL OF 4WD MOTOR SPORT
SECTION 5 – ROLLOVER PROTECTION



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5 ROLLOVER PROTECTION

5.1 APPLICATION

Rollover protection is required as specified in the CCDA Class Specifications and Event Supplementary Rules.

5.2 DEFINITIONS

5.2.1 ROPS (ROLL OVER PROTECTION SYSTEM)

A structural framework designed to prevent serious body shell deformation in the event of a collision or the vehicle turning over.

5.2.2 MAIN ROLL BAR (MAIN HOOP)

Structure consisting of a near vertical frame or hoop located across the vehicle just behind the front seats.

5.2.3 FRONT ROLL BAR

A longitudinal bar - its shape following the roofline and A pillars connecting the main hoop to the floor at the base of the A pillar.

5.2.4 LOWER FLOOR SIDE BAR

A single longitudinal bar linking the bottom section of the Main hoop to the bottom section of the Front roll bar following the floor line.

5.2.5 DIAGONAL MEMBER

A transverse tube between a top corner of the main hoop and a lower mounting point on the other side of the roll bar.

5.2.6 A-PILLAR STRUT

A single bar joining the upper corner of the front roll bar to the lower point of the front roll bar, straight when viewed from the side of the vehicle.

5.2.7 FRAMEWORK REINFORCEMENT

A reinforcing member fixed to the roll cage to improve its structural efficiency.

5.2.8 REINFORCEMENT PLATE

A metal plate fixed to the body shell or chassis structure under a roll bar mounting foot to spread load into the structure.

5.2.9 MOUNTING FOOT

A plate welded to a roll bar tube to provide for bolting or welding to the body shell or chassis structure, usually onto a reinforcement plate.

5.2.10 REMOVABLE MEMBER

A structural member of a safety cage which is able to be removed.

5.3 SPECIFICATIONS

5.3.1 GENERAL COMMENTS

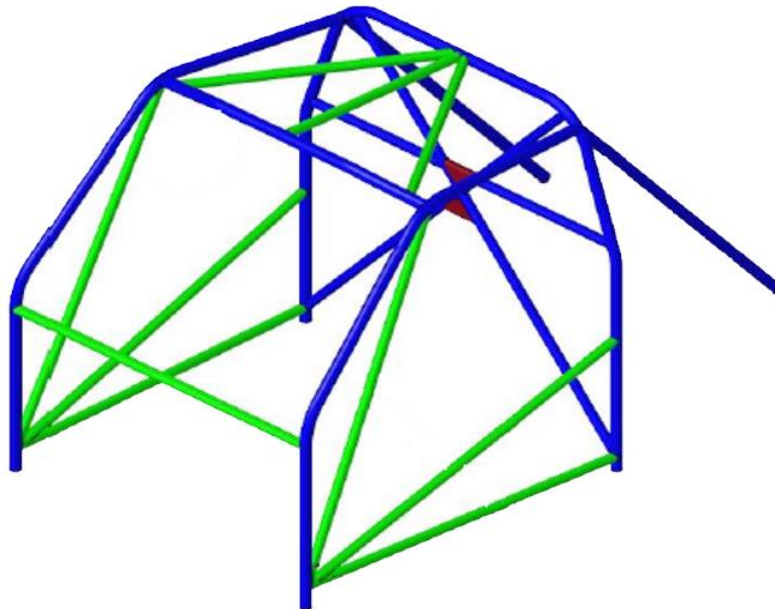
Safety cages shall be designed and made so that, when correctly installed, they substantially reduce body shell deformation and so reduce the risk of injury to occupants. The essential features of safety cages are sound construction designed to suit the particular vehicle, adequate fixings and a close fit to the body shell. Tubes shall not carry fluids or compressed air or be used as a pressure vessel. The safety cage shall be designed and fitted to minimise impact on ingress and egress of the crew.

5.3.2 TECHNICAL SPECIFICATIONS

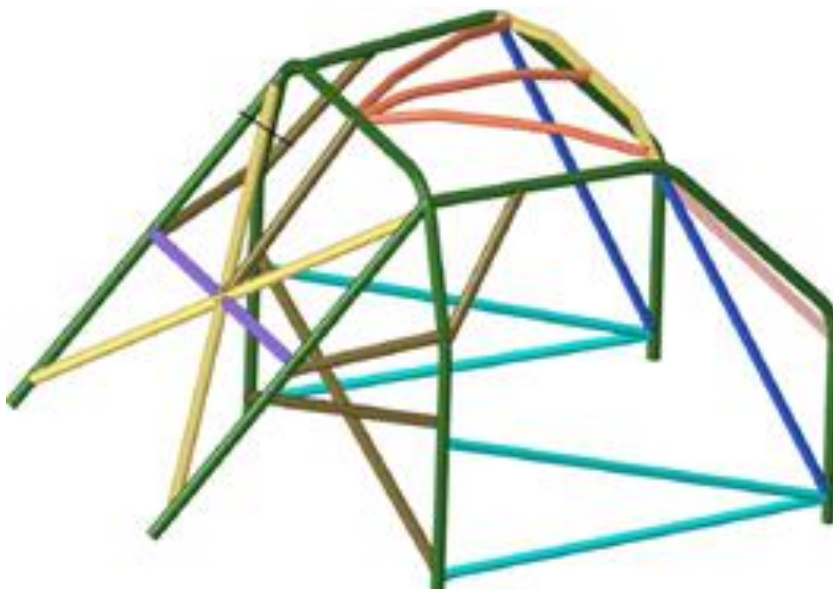
5.4 COMPLETE ROPS STRUCTURE OVERVIEW:

These rules allow for two options when building your ROPS cage. Cage specifications are predominantly the same, differences are noted below.

OPTION 1:



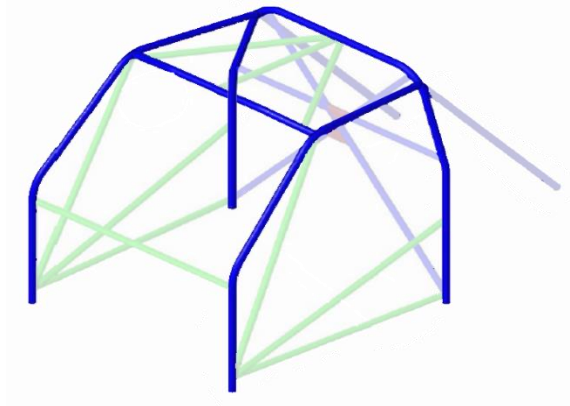
OPTION 2:



5.4.1.1 MAIN CAGE STRUCTURE:

Definition:

The basic cage structure, consisting of main hoop, front hoops and upper transverse (windscreen spreader) bar.

**Minimum Material Specifications:**

Diameter: 44.45mm

Wall thickness 2.5mm

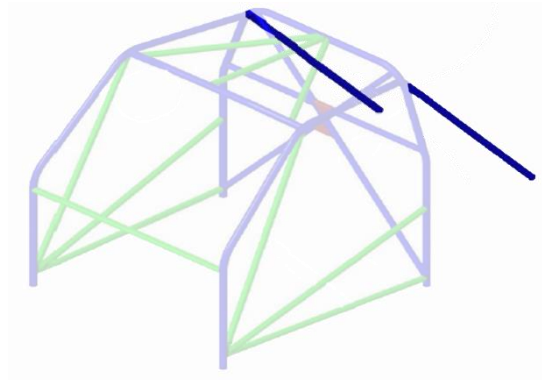
Notes:

- Main & front hoops shall be made in one piece without joints with smooth and even construction without ripples or cracks. The vertical part of the main hoop shall be parallel to the interior contour or the body shell where possible.
- The front leg of a front roll bar or of a lateral roll bar shall be straight, or shall follow the windscreen pillars and have only one bend with its lower vertical part.
- To achieve an efficient fixing to the body shell, the original interior trim may be modified around the safety cages and their fixings by cutting it away or by removing it.
- No part of the interior trim/ roof lining etc. should compromise the positioning of the ROPS.
- The roll bar shall be a minimum of 50 mm above any occupant's head in all vehicles. In conjunction with the vehicle's structure the roll cage should not leave unprotected any part of an occupant's shoulders when viewed from front or rear.
- The main hoop shall not overhang but shall be within 150mm of any occupant's head.
- An occupant's helmet shall be prevented from passing between the bars to the extent that the helmet is visible at the rear of the hoop when viewed from the side.
- No holes may be drilled in the main cage structure.

5.4.1.2 BACK STAYS:

Definition:

Straight reinforcing bars to support the main cage structure.

**Minimum Material Specifications:**

Diameter: 44.45mm

Wall thickness 2.5mm

Notes:

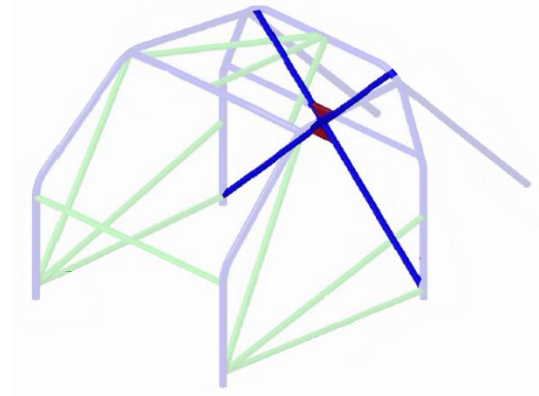
- Backstays shall be attached to the main hoop near the roofline and near the top outer bends of the main hoop on both sides of the vehicle. Backstays shall be attached to the main hoop within 100mm of the intersection of the diagonal cross brace. They shall be at angle of at least 30 degrees with the vertical, shall run rearwards and be straight and as close as possible to the interior side panels of the body shell.
- Their fixings shall be reinforced by plates. Each backstay should be secured by bolts having a cumulative section area at least two thirds of that recommended for each roll bar leg mounting, and with identical reinforcement plates of at least 6,000mm² area.
- A single bolt in double shear is permitted, provided it is of adequate section and strength and provided that a bush is welded into the backstay.
- No holes may be drilled in the backstays.
-

5.4.1.3 DIAGONAL CROSS BRACING:

OPTION 1

Definition:

Straight diagonal intersecting members reinforcing the main hoop.

**Minimum Material Specifications:**

Diameter: 44.45mm

Wall thickness 2.5mm

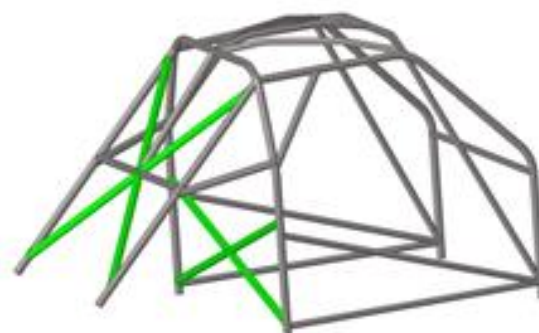
Notes:

- At least two diagonal members shall be fitted and shall be straight. The lower end of the diagonal shall join the main hoop or the backstay not further than 100mm from the fixing foot. The upper end must join the main hoop not further than 100mm from the junction of the backstay joint.
- Gussets shall be fitted on the upper and lower sections of the intersection from minimum 2mm Mild steel, roller along the horizontal profile and welded into the mid-point of the tube.

OPTION 2

Definition:

Straight diagonal intersecting members reinforcing the main hoop intersecting with the junction of the upper side bar on the main hoop. Plus a second cross brace in the backstays. The cross brace in the backstays also includes the straight bar from the top centre of the main hoop to the centre of the cross braces in the backstays.



Minimum Material Specifications:

Diameter: 44.45mm

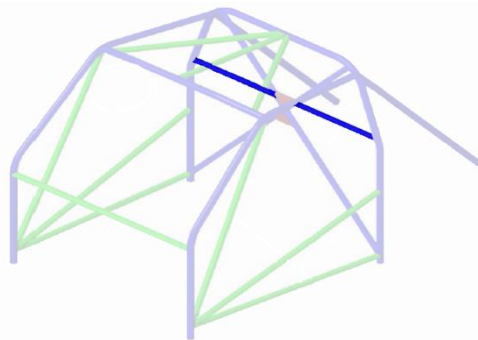
Wall thickness 2.5mm

Notes:

- At least two diagonal members shall be fitted in the lower section of the main hoop and shall be straight. The lower end of the diagonals shall join the main hoop not further than 100mm from the fixing foot. The upper end must join the main hoop not further than 100mm from the junction of the side intrusion bar.
- At least two diagonal members shall be fitted in the backstays and shall be straight. The lower end of the diagonals shall join the backstay not further than 100mm from the fixing foot. The upper end of the diagonals must join the backstay bar not further than 100mm from the junction of the main hoop.
- Gussets shall be fitted on the upper and lower sections of the intersection from minimum 2mm Mild steel, rolled along the horizontal profile and welded into the mid-point of the tube.

5.4.1.4 HARNESS BARS:**OPTION 1****Definition:**

Horizontal bar joining the main hoop to the diagonal cross braces to support the main hoop and retain the harness vertically.

**Minimum Material Specifications:**

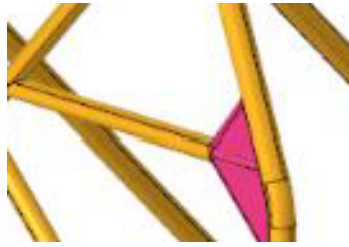
Diameter: 44.45mm

Wall thickness 2.5mm

Notes:

- The harness bar must be placed level with or within 50mm above the shoulder height of the occupant allowing the harness to pass over the bar and forward in a near horizontal plane before contacting the shoulders.

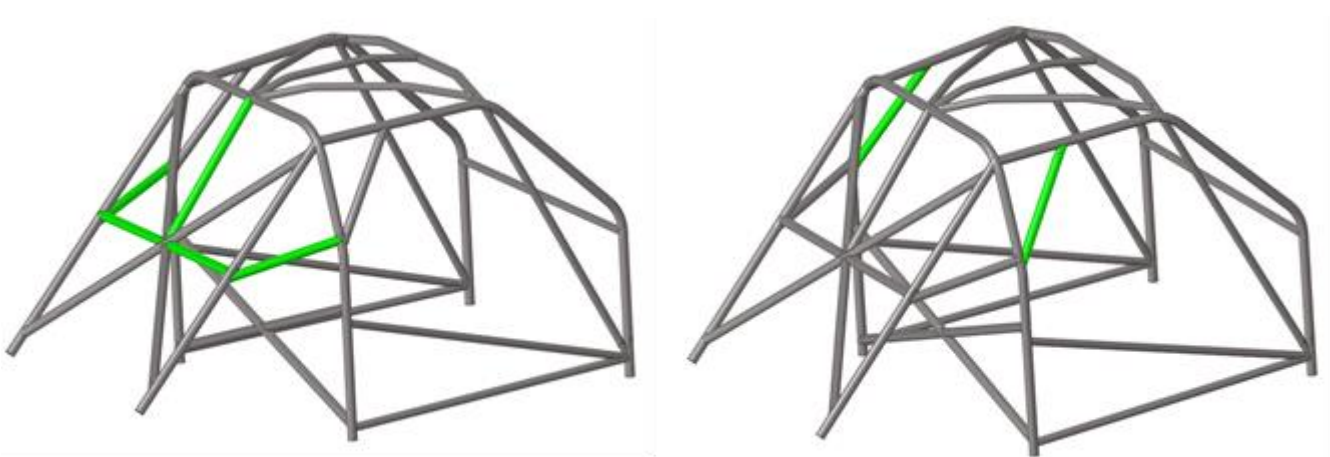
- Optional gusseting of the harness bar to the main hoop (as shown below) is recommended to further improve side impact load strength.



OPTION 2

Definition:

Horizontal bar joining the main hoop to the diagonal cross braces to support the main hoop and retain the harness vertically.



Minimum Material Specifications:

Diameter: 44.45mm

Wall thickness 2.5mm

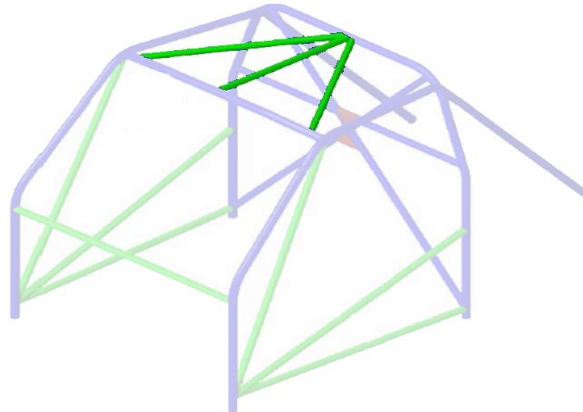
Notes:

- The harness bar must be placed level with or within 50mm above the shoulder height of the occupant allowing the harness to pass over the bar and forward in a near horizontal plane before contacting the shoulders. The harness bar is mounted to the backstays of the main cage structure to allow clearance inside the cabin.
- Optional gusseting of the harness bar to the main hoop is recommended to further improve side impact load strength.

5.4.1.5 ROOF REINFORCEMENT:

Definition:

Reinforcing bars to support the roof section and upper front hoop corners.

**Minimum Material Specifications:**

Diameter: 38mm

Wall thickness 2.5mm

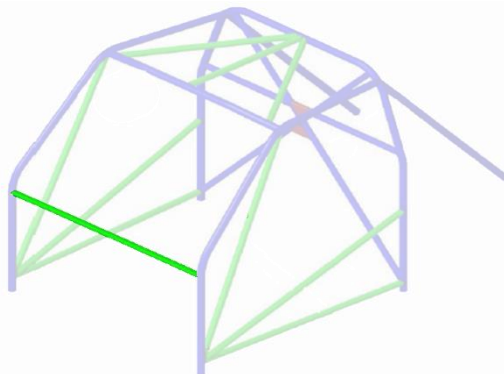
Notes:

- Roof reinforcement shall consist of:
 - At least one longitudinal bar down the centre joining the upper windscreen spreader bar to the main hoop
 - Two diagonal members joining the outer front corners of the upper windscreen spreader bar to the centre of the main hoop roof bar.
- These members may have bends up to 20 degrees to allow bars to fit closer to the roof line maximising occupant headroom. Each member must be fitted so they appear straight when viewed from above.

5.4.1.6 LOWER WINDSCREEN SPREADER BAR:

Definition:

Straight horizontal member to support front hoops.



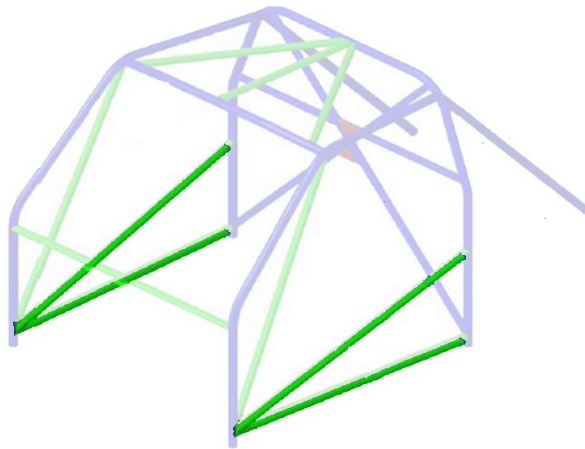
Minimum Material Specifications:

Diameter: 38mm

Wall thickness 2.5mm

Notes:

- The lower windscreen spreader bar shall join the two front hoops. The member shall be straight and attached to the front hoops within 150mm above or below the lower most bend.

5.4.1.7 SIDE INTRUSION AND LOWER FLOOR SIDE BAR:**Definition:**

Straight reinforcing bars to support the main hoop and provide side intrusion protection. These members also provide significant “Punch Through” strength adding to the main and front hoop foot plates. The lower floor side bar also provides strength into the lower front hoop in the event of contact with a tree or other immovable object in the lower firewall section of the vehicle.

Minimum Material Specifications:

Diameter: 38mm

Wall thickness 2.5mm

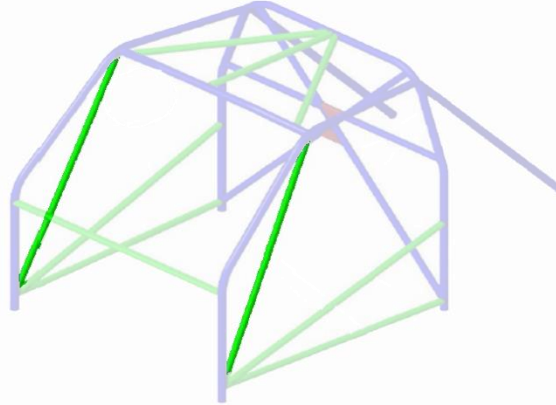
Notes:

- Lower Floor Side Bar – the lower floor side bar shall be fundamentally straight, attached to the main hoop and front hoop within 150mm of the foot plate. This bar may be bent up to 20 degrees at one or both ends to allow fitment however the majority of the member shall follow the floor.
- Side intrusion bar – the side intrusion bar shall be joined to the main hoop and front hoop above the lower floor bar. It may be either straight or bent to follow the seat line. If bent the side intrusion bar must have a reinforcing member to the lower floor bar in the centre third of the bar. The rear attachment must be at the centre or above of the lower vertical section of the main hoop. The side intrusion bar shall be mounted as low as possible to the front hoop to minimise impact on occupant access.

5.4.1.8 FRONT HOOP SUPPORT:

Definition:

Primary reinforcement to add rollover capacity to the upper corners of the A pillar and front hoop.

**Minimum Material Specifications:**

Diameter: 38mm

Wall thickness 2.5mm

Notes:

- The front hoop reinforcement member shall be fitted to both sides, attached to the horizontal section of the front hoop within 100mm of the upper windscreen spreader bar. The lower section attached to the lower most section of the front hoop generally at the junction of the lower floor bar or foot plate or both. If the front hoop support intersects the side intrusion bar it must be sectioned and straight when viewed from the side. The member may be bent by up to 20 degrees however must be fitted so the bar appears straight when viewed from the side.

5.4.2 OPTIONAL REINFORCEMENT OF THE ROLL CAGE

Recommended optional members consist of reinforcing gussets on the harness bar to main hoop junctions and a single vertical strut from the centre of the diagonal cross brace to the centre of the main hoop horizontal section. These members/gussets provide additional support and are especially recommended in vehicles over 3200kg

Other optional reinforcing members are allowed however must be manufactured out of 44.45 or 38mm tube as per the specifications contained in this schedule and shall be fitted in a way to minimise impact on occupant access and/or injury risk.

5.4.3 REINFORCEMENT OF BENDS AND JUNCTIONS

The junction of the main hoop or the front roll bar, the top rear bends of the lateral roll bars and the junction between the main hoop and the backstays may be reinforced with longitudinal struts.

The ends of these reinforcing struts shall not be more than half way down or along the members to which they are attached, except for those at the junction of the front roll bar, which may join the junction of the door strut/front roll bar.

5.5 FIXING OF ROLL CAGES TO THE BODY SHELL

Roll cages shall be fixed to the vehicle by one of the following three options:

5.5.1 OPTION 1

As a minimum, fixings shall comprise:

- One for each leg of the main or lateral roll bar;
- One for each of the front roll bar;
- One for each backstay.

Fixing may be by bolting or welding to the body shell.

Each fixing plate of the front, main and lateral roll bars shall include a reinforcement plate 3mm thick, or the gauge of the tube onto which it is welded, whichever is the greatest.

If bolted to the body shell each fixing plate shall be attached by a minimum of three bolts on a steel reinforcement plate at least 3mm thick and of at least 15,000mm² area which is welded to the body shell. This area can be made up of a single plate or by adding a third dimension (i.e. angle) to its profile. Minimum Base Plate to be at least 10,000mm² with a 100mm single dimension.

Bolts shall be either M8 size to ISO standard 8.8, hexagon head high tensile fasteners to AS2465 or capscrews to AS14201 with nuts to AS1112 or better. Pins for removable connections shall be the same strength specifications as the bolts.

Fasteners shall be self-locking or fitted with lock washers. Additional fasteners may be used however all fasteners shall meet these requirements.

If welded to the body shell roll bar legs shall be welded to reinforcement plates. Roll bar feet shall not be welded directly to the body shell without a reinforcement plate.

5.5.2 OPTION 2

Alternatively all the attachment points of the roll cage may be fitted with a base plate and lower plate complying with the table below. The base plate, complying with the area requirements shown in the table below, may be welded to the body shell, in which case the use of bolts and the lower plate is not required.

Application	Minimum Area	Minimum single dimension
Upper (base) plate Over 1151kg	15,000mm ² Min Baseplate of 10,000mm ²	100mm
Lower plate	4,500mm ²	Proportional to upper plate

5.5.3 OPTION 3

Where Event Group regulations permit, the roll bar protection may be an integral part of a space frame tubular chassis. The roll cage shall comply with these regulations from a point above where the predominately vertical portion of the roll cage meets a predominately horizontal portion of the chassis. Parts of the roll cage may extend below this horizontal plane and become integral with the chassis. Vertical components shall be braced from the chassis.

5.6 PROTECTIVE PADDING

All sections of the roll cage that could come into contact with occupant's bodies or helmets shall be provide with non-flammable padding for protection.

5.7 REMOVABLE MEMBERS

Demountable joints are not recommended in any members, any demountable joints must carry certification of a level higher than this schedule and we recommend you discuss your plans with the chief scrutineer prior to purchasing/fitting any demountable joints.

Demountable joints shall not be used as part of the main, front or lateral roll bar, or the junction of the backstays to the main hoop.

5.8 GUIDANCE ON WELDING

All welding shall be of the highest possible quality with full penetration and preferably using a gas shielded arc, and shall demonstrate good workmanship.

When using heat-treated steel the special instructions of the manufacturers shall be followed

5.9 MATERIAL SPECIFICATIONS

All tubing used in roll bar protection structures shall be circular section cold drawn steel tube (CDS) with properties as shown in the following table:

Composition	Property Specification
Carbon content	0.3% max.
Manganese content	1.0% max.
Other alloy content	0.5% max.
Tensile strength	350 MPa min.

These figures represent the minimum permitted specification. In selecting the steel, attention shall be paid to obtaining good elongation properties and adequate weldability. The tubing shall be bent by a cold working process and the centreline bend radius shall be at least three times the tube diameter. Where the tubing is distorted during bending, the ratio of major to minor diameter shall be 0.9 or greater.

5.10 FLEXIBLE JOINTS

The use of flexible mounts shall be only permitted on the backstay lower mounting point provided the following minimum specifications are met:

5.10.1 OUTER SLEEVE

The material shall be that used for the rear brace or of a higher specification and shall be welded to end of rear brace.

The wall thickness shall be 2.5mm minimum

The minimum outside diameter shall be that used for the rear brace and the maximum outside diameter shall be 25% larger than that used for the rear brace.

The minimum length shall be equal to the outside diameter of the rear brace.

5.10.2 BUSHING MATERIAL

Bushings may be rubber, urethane, nylon or similar flexible material

Bushing outside diameter shall be no greater than three and a half times the outside diameter of the inner sleeve.

The minimum length of bushings shall be equal to the length of the outer sleeve.

5.10.3 INNER SLEEVE/SPACER TUBE

Inner sleeves shall be steel of minimum thickness of 1.0mm.

The inside diameter of inner sleeves shall equal the outside diameter of the cross bolt.

Inner sleeve length shall be no greater than the length of the bushing material, and at least 200mm longer than outer sleeve.

5.10.4 CROSS BOLT

Cross bolts shall be 11mm or 7/16 inch, minimum diameter and at least 8.0 Grade steel.

5.10.5 FIXING LUGS

Fixing lugs shall be steel with a minimum thickness of 5mm and a minimum length no less than the outside diameter of the bushing material.