

18. ROLL CAGES

These general specifications are for all automobiles. Roll cages are required in all automobiles.

Roll cages may be of two (2) designs, low front hoop (top of steering wheel) or high front hoop (top of windshield). Specific installations are subject to approval by the Technical and Safety Inspectors at each event.

The Technical Staff of Club Racing shall have the responsibility to ensure specification compliance with SCCA safety standards. To that end, the Technical Staff of Club Racing may or may not accept alternate construction standards from any source that significantly vary from SCCA standards of protection.

18.1. BASIC DESIGN CONSIDERATIONS

1. The basic purpose of the roll cage is to protect the driver if the car turns over, runs into an obstacle such as a guardrail or catch fence, or is struck by another car. It shall be designed to withstand compression forces from the weight of the car coming down on the rollover structure and to take fore/aft and lateral loads resulting from the car skidding along on its rollover structure.
2. A system of head restraint to prevent whiplash and rebound, and also to prevent the driver's head from striking the underside of the main hoop shall be installed on all vehicles. Racing seats with integral headrests shall also meet this requirement and have a support to the main hoop. *FIA homologated seats need not have seat back attached to roll structure if seat manufacturer recommends, within their mounting instructions, that seat back remain unattached to roll structure. Competitors shall have manufacturer recommendation in writing.* The head restraint on non-integral seats shall have a minimum area of thirty-six (36) square inches and be padded with a non-resilient material such as Ethafoam® or Ensolite® or other similar material with a minimum thickness of one (1) inch. The head restraint shall be capable of withstanding a force of two-hundred (200) lbs., in a rearward direction. The head restraint support shall be such that it continues rearward or upward from the top edge in a way that the driver's helmet can not hook over the pad. The padded surface shall touch the helmet; it shall not be under fiberglass or other hard material.
3. Forward braces and portions of the main hoop subject to contact by the driver's helmet (as seated normally and restrained by seat

belt/shoulder harness) shall be padded with non-resilient material such as Ethafoam or Ensolite or other similar material with a minimum thickness of one-half (1/2) inch.

4. No portion of the safety roll cage shall have an aerodynamic effect by creating a vertical thrust.
5. Roll cage or chassis design shall prevent engine intrusion into the driver compartment.
6. Material:
 - A. Seamless, or DOM (Drawn Over Mandrel) mild steel tubing (SAE 1010, 1020, 1025) or equivalent, or alloy steel tubing (SAE, 4130) shall be used for all roll cage structures. Proof of use of alloy steel is the responsibility of the entrant.
 - B. Minimum tubing sizes (all Formula, Sports Racing, GT, and Production Category automobiles, and all automobiles registered prior to June 1, 1994) for all required roll cage elements (All dimensions in inches):

Vehicle Weight Without Driver	Material	
	Mild Steel	Alloy Steel
Up to 1500 lbs.	1.375 x .095	1.375 x .080
1500-2500 lbs.	1.50 x .095	1.375 x .095
Over 2500 lbs.	1.50 x .120	1.50 x .095
	1.625 x .120	
	or 1.75 x .095	

- C. Minimum tubing sizes for (all Showroom Stock, Touring and Improved Touring Category automobiles registered after June 1, 1994) for all required roll cage elements (All dimensions in inches):

Up to 1500 lbs	1.375 x .095 DOM / Seamless / Alloy
1501-2200 lbs	1.500 x .095 DOM / Seamless / Alloy
	or 1.500 x .120 ERW
2201-3000 lbs	1.500 x .120 DOM / Seamless / Alloy
	1.625 x .120 DOM / Seamless / Alloy
	1.750 x .095 DOM / Seamless / Alloy
	or 1.750 x .120 ERW

(American Sedans may construct to these specifications regardless of weight.)

3001-4000 lbs 1.750 x .120 DOM / Seamless / Alloy - No ERW

Over 4000 lbs 2.000 x .120 DOM / Seamless / Alloy - No ERW

Main hoop: 4 bends maximum, totaling 180 degrees \pm 10 degrees.

Front hoop: 4 bends maximum or Front downtubes: 2 bends maximum.

Rear hoop supports: No bends.

If any of the above bend requirements cannot be met, all components of the roll cage shall be fabricated from the tubing size(s) listed for the next heavier category of automobiles.

- D. For purposes of determining tubing sizes, the vehicle weight is as raced without fuel and driver. The minus tolerance for wall thickness should not be less than .010" below the nominal thickness. Improved Touring roll cage tubing sizes are to be calculated based on the published vehicle weight minus 180 lbs.
- E. An inspection hole at least 3/16 inch diameter shall be drilled in a non-critical area of all tubes with a specified size to facilitate verification of wall thickness.

7. General Construction

- A. One (1) continuous length of tubing shall be used for the main hoop member with smooth continuous bends and no evidence of crimping or wall failure. The radius of bends in the roll cage hoop (measured at centerline of tubing) shall not be less than three (3) times the diameter of the tubing.

Whenever possible, the roll cage hoop should start from the floor of the car, and, in the case of tube frame construction, be attached to the chassis tubes by means of gussets or sheet metal webs with support tubes beneath the joints to distribute the loads. It is recommended that gussets be used at all joints.

- B. Welding shall conform to American Welding Society D1.1, Structural Welding Code, Chapter 10, Tubular Structures. Welds shall be continuous around the entire tubular structure.

All welds shall be visually inspected and shall be acceptable if the following conditions are satisfied:

- 1. The weld shall have no cracks.
 - 2. Thorough fusion shall exist between weld metal and base metal.
 - 3. All craters shall be filled to the cross section of the weld.
 - 4. Undercut shall be no more than 0.01 inch deep.
- C. Aluminum bronze or silicon bronze welding technique is permitted, but extreme care shall be used in preparation of parts before bronze welding and in the design of the attaching joints.

18.2. SHOWROOM STOCK/TOURING ROLL CAGE

- 1. Full width roll cages are required in all Showroom Stock/Touring automobiles. Roll cages installed in Showroom Stock/Touring automobiles are for driver safety and shall be contained entirely within the driver/passenger compartment without removing any panel or accessory not specifically authorized in these rules. The carpet/padding may be cut around the mounting base plates.
 - A. The cage need not be removable. It shall be bolted and/or welded to the car.
 - B. It shall attach to the car at no more than eight (8) points, consisting of the basic cage with six (6) points and two optional braces.
 - C. The forward part of the cage shall be mounted to the floor of the vehicle. In addition, if the two optional braces referred to in 18.2.1.B are utilized they shall be mounted, one on either side, from the forward section of the cage to the firewall or front fender wells (see GCR Section 18.2., Figure 1). No braces shall pass through the front firewall.
- 2. Removable roll cages and braces shall be very carefully designed and constructed to be at least as strong as a permanent installation.

and, in the case of tube frame construction, be attached to the tubes by means of gussets or metal webs in order to distribute the loads. On automobiles of frameless construction, consideration should be given to using a vertical roll hoop of 360 degrees completely around the inside of the automobile and attached with suitable mounting plates.

18.3.2. Bracing

All required bracing shall be the same diameter and wall thickness as listed in 18.1.6., Material. (Main and Front Hoops)

All main hoops shall incorporate a diagonal brace (same diameter and wall thickness as main hoop) to prevent lateral distortion of the main hoop.

A. Main Hoop Bracing:

Main hoops shall have two (2) braces extending to the rear, attaching to the frame or chassis. Braces shall be attached as near as possible to the top of the main hoop (not more than six (6) inches below the top) and at an included angle of at least thirty (30) degrees. Open cars with a low front hoop shall have (**Effective 1/1/99**) two braces extending from the main hoop to the low front hoop. These braces shall be mounted no lower than six inches below the top of the main hoop as illustrated in Figure 7.

B. Removable Bracing:

Removable bracing shall incorporate connectors of the double lug, tapered, or muff-type as shown in Figures 9, 10, and 11. The double-lug type shall include a doubler, gusset, or capping arrangement so as to avoid distortion or excessive strain caused by welding.

C. Front Hoop Bracing:

There shall be two (2) braces extending forward from the front hoop to protect the driver's legs. It is recommended that this bracing extend to the bulkhead in front of the driver's feet; but, in any case, it shall be integrated into the frame or chassis to provide substantial support for the front hoop.

18.3.3. Side Protection - Open and Closed Automobiles

- A. The minimum side protection shall consist of a side tube connecting the front and rear hoops across both the door openings. Additionally, there shall also be either a diagonal tube from the front hoop to the rear hoop bisecting the door opening below the horizontal side tube, or not less than two (2) horizontal side tubes. Additional tubing may be added. NASCAR-style door bars are recommended.
- B. In automobiles with full roll cage installations including side bars, interior door panels may be altered, replaced, or removed. When door panels are removed, all sharp edges or projections shall be protected.

18.3.4. Mounting Plates:

The thickness of mounting plates bolted to the structure of the car shall not be less than the thickness of the roll hoop or brace that they attach and shall be backed-up with a plate of equal dimensions on the opposite side of the panel, with the plates through-bolted together. A minimum of three (3) bolts per mounting plate is required for bolted mounting plates. All hardware (bolts) shall be Grade 5 or better with 5/16" diameter minimum. Mounting plates welded to the structure of the car shall not be less than .080" thick. Whenever possible the mounting plates should extend onto a vertical section of the structure (such as door pillar).

18.3.5. Driver's Seat

The driver's seat shall be firmly mounted to the structure of the car. In cars where the seat is upright, the back of the seat shall be firmly attached to the main roll hoop, or its cross bracing. *FIA homologated seats need not have seat back attached to the roll structure if the seat manufacturer recommends, within their mounting instructions, that the seat back remain unattached to the roll structure. Competitors shall have manufacturer recommendation in writing.* Bulkheads, firewalls, rear decks, or similar structures of suitable strength may be used as a substitute for the main roll hoop or cross bracing to provide the required seat back support.

18.4. ROLL CAGES, FORMULA AND SPORTS RACING AUTOMOBILES

All Formula and Sports Racing automobiles are required to have full roll cages. Cage may be of two designs, low front hoop (top of steering

wheel) or high front hoop (equal to rear hoop) but with no diagonal brace. Two (2) seat Sports Racers shall have full cockpit width cages per Figure 7. All tube frame automobiles shall have both front and rear hoops formed of tubing per 18.1.6. On automobiles of full monocoque construction, a fabricated sheet metal front hoop structure may be approved upon specific application to the SCCA. All Formula Car and Sports Racing roll cage tubing specifications must meet the current GCR specifications, effective 1/1/98.

18.4.1. Main Hoop

The main hoop shall be constructed of tubing per 18.1.6. The minimum bend radius shall not be less than three (3) times the tube diameter measured from the tube centerline. The main hoop shall not be less than two (2) inches above the driver's helmet, seated normally and restrained by seat belt/shoulder harness. A straight line drawn from the top of the main hoop to the top of the front hoop shall pass over the driver's helmet. On Formula cars and single seat Sports Racers the vertical members of the main hoop shall not be less than fifteen (15) inches apart (inside dimension) at their attachment to the chassis. If the hoop does not go to the belly pan, proper gussets and tube triangulation shall be used under its attachment. On monocoque chassis the main hoop shall be welded to mounting plates not less than .080" thick. It is important that these plates be attached to the chassis in such a way as to spread the loads over a wide area. There shall be a plate of equal thickness on the inside of the monocoque with solid rivets or bolts (5/16" minimum bolt diameter) through the non-ferrous material.

18.4.2. Front Hoop

Low front hoops must be no lower than the top of the steering wheel. It is recommended the hoop extend to the belly pan. If not, it shall be attached to the chassis with gussets and triangulation in order to spread the loads. In automobiles of full height (top of the steering wheel) monocoque or composite construction, a steel cap plate, not less than .080" thick must be attached as a rub block.

18.4.3. Roll Cage Bracing

- A. The main hoop must have two forward braces extending from the hoop and attached to the frame, monocoque, or front hoop. Braces must be attached as near as possible to the top of the hoop but must not be more than six (6) inches below the top and at an included angle of at least thirty (30) degrees. If these braces do not extend to the front hoop, an additional brace or gusset (14

gauge - .078" minimum thickness) must be installed between the lower frame rail and the upper frame rail at the point of attachment of the forward hoop brace. If these braces do not extend to the front hoop, an additional brace or gusset must be installed at the point of attachment to the main rear hoop or lower frame rail or other major frame member in such a manner as to reinforce the attachment point to help prevent collapse of the frame rail at the point of attachment. These tubes shall be 1" x .080" minimum and gussets shall be 14 gauge - .078" minimum thickness.

Two seat Sports Racers with full width main hoops must incorporate a lateral brace to prevent lateral distortion of the hoop (See Figure 7). All bracing on full width cages must be the same diameter and wall thickness as the main hoop. Formula and single seat Sports Racers under 1500 lbs., may use bracing with a minimum dimension of 1.0" diameter by .080" wall thickness. Braces attached to monocoque chassis must be welded to plates not less than .080" thick and backed up on the inner side by plates of equal thickness using bolts of Grade 5 or better with 5/16" minimum diameter.

- B. The front hoop must have two (2) braces near its top extending forward to protect the driver's legs. It is recommended that this bracing extend to the bulkhead in front of the driver's feet; but in any case it must be integrated into the chassis to provide substantial support for the front hoop. Full width front hoop bracing shall be a minimum dimension of 1.0" diameter by .080" wall thickness tubing.

Formula and single seat Sports Racers under 1500 lbs., may use tubing with a minimum dimension of 1.0" diameter by .080" wall thickness. When monocoque construction is used as bracing for the front hoop, it must be approved on an individual basis. If a high front hoop is used, it must be similar in shape to the rear hoop and have two horizontal tubes connecting the top of the front hoop to the top of the main hoop. The bracing for the main hoop remains the same.

- C. Removable bracing must incorporate connectors of the double-lug, tapered, or muff-type as shown in Figures 9, 10, and 11. The double-lug type must include a doubler, gusset, or capping arrangement so as to avoid distortion or excessive strain caused by welding.

18.4.4. Composite Chassis Safety Structures

- A. The basic purpose of safety structures is to protect the driver. This purpose is the primary design consideration.
- B. All cars must have at least two (2) roll over structures, but the use of titanium is prohibited.

The first roll over structure must be in front of the steering wheel, not more than 25cm forward of the steering wheel rim, and at least as high as the top of the steering wheel rim.

The second roll over structure must not be less than 50cm behind the first. It must be high enough for a line extending from the top of the front structure to the top of the rear structure to pass over the driver's helmet when he is seated normally in the car with his helmet on and the seat belt fastened. This second structure behind the seat must be symmetrical about the lengthwise centerline of the car and comply with the following dimensions: The top of the roll bar must be at least two (2) inches (5cm) above the driver's helmet when the driver is seated in a normal driving position. No second roll structure on a composite chassis will be considered unless it contains a main hoop having a minimum tubing size of 1.375" x .080" wall thickness. Supplemental braces must have a minimum tubing size of 1.00" x .080" wall thickness.

The roll bar must be capable of withstanding the following stress loading applied simultaneously to the top of the roll bar:

- 1.5 (X) laterally
 - 5.5 (X) longitudinally in either direction.
 - 7.5 (X) vertically
- where (X) = the minimum weight of the car.

The induced loads must be carried over into the primary structure of the chassis.

The ability of the roll bar to bear and distribute the load through the chassis must be demonstrated satisfactorily in test conditions to the SCCA. In conjunction with SCCA, manufacturers of cars utilizing carbon fiber composite survival cell construction will be required to designate repair locations capable of proper evaluation and damage repair. In the event of damage to the chassis, repairs can only be made at these locations.

Proper documentation must be made in the vehicle logbook. No car will be allowed to compete after damage without following this procedure.