

Appendices

Appendix X: Safety Fuel Tanks

1. Capacity

There shall be no restriction of fuel capacity or dimension when installing safety fuel tanks. The installation of more than one tank is permitted.

2. Location

Location of the safety fuel tank shall be as close as possible to the location of the standard tank(s) except when safety aspects or dimensional limitations make this unfeasible or impossible. In no case shall the location of the safety tank in the automobile be more than 12" from the standard tank(s), nor shall the tank be located in the driver/passenger compartment.

3. Installation, Fittings, Lines

Internal body panels may be modified to accommodate the installation of safety fuel tanks as long as such modification serves no other purpose. All openings created by removal or modification of panels must be replaced with materials of the same type and gauge as those removed.

Filler caps, fuel pick-up openings and lines, breather vents and fuel filler lines shall be so designed and installed that if the car is partially or totally inverted, fuel shall not escape. If the fuel filler cap is located directly on the fuel tank, a check valve shall not be required provided the filler cap is of a positive locking type and does not incorporate an unchecked breather opening. If the fuel filler cap is not located directly on the fuel tank, a check valve must be incorporated in the fuel tank to prevent fuel escaping if the cap or filler neck is torn from the tank.

Fuel tank breathers must vent outside the car. The addition of a bulkhead between the driver/passenger compartment and the fuel cell is required. It is recommended that all lines and filler openings be incorporated in a single fitting located at the top of the fuel tank.

4. Recommended Safety Fuel Cell Specifications

4.1 Cells must be securely mounted. A fuel cell will consist of a fuel bladder in a fully enclosed container.

4.1.1 Fuel Bladder

4.1.1.1 Materials

Bladders shall be constructed and certified in accordance with FIA FT-3 or higher or SFI 28.3.

4.1.2 Container

4.1.2.1 GT and Production Category

The bladder must be installed in a container of a minimum of 20 gauge steel, .059 inch aluminum or .125 inch Marlex (HDPE) and be fully enclosed.

4.1.2.2 Sports Racing Category and Formula Cars

The bladder shall be completely enclosed in a container (which may be part of the structure of the chassis) securely mounted and having a minimum of 20-gauge steel, .059 aluminum or .125 Marlex (HDPE) for protection.

Appendix Z: Roll Bar Requirements

These specifications are mandatory and represent minimum requirements. Specific installations are subject to approval by the Chief Technical Inspector.

Acknowledgment is made to the California Sports Car Club Region of the SCCA for their work in developing much of the material, and to NASCAR, Inc. for their development of roll bar structures for closed cars.

Reference has also been made to the roll bar specifications published by the United States Auto Club, Canadian Automobile Sports Club, and the National Hot Rod Association.

1. Basic Design Considerations

- 1.1 The basic purpose of the roll bar is to protect the driver if the car turns over or is involved in a serious accident. This purpose should not be forgotten.
- 1.2 The top of the roll bar must be a minimum of 2 inches above the top of the driver's helmet when the driver is sitting in normal driving position (as near the roof as possible on closed cars) and shall not be more than 6 inches behind the driver.
- 1.3 The roll bar must be designed to withstand compression forces resulting from the weight of the car coming down on the roll structure, and to take fore-and-aft loads resulting from the car skidding along the ground on the roll structure.
The roll bar must be able to withstand three simultaneously applied loads:
1.5 G Lateral 5.5 Fore-and-aft 7.5 G Vertical
The induced loads being carried over into the primary structure.
- 1.4 The two vertical members forming the sides of the hoop shall not be less than 15 inches apart inside dimension. It is recommended that the roll bar extend the full width of the cockpit to provide maximum bearing area. The roll bar vertical members on Formula cars must be not less than 15 inches apart, inside dimension, at their attachment points to the uppermost main chassis member.
- 1.5 A system of head restraint, to prevent the driver's head from striking the underside of the roll bar hoop must be installed on all automobiles. This may be incorporated into the roll bar or cage. The head restraint must be padded with 1" thick high density foam.
- 1.6 No portion of the roll bar/ roll cage shall have an aerodynamic effect by creating a vertical thrust.

2. Material

- 2.1 The roll bar hoop and all braces must be of seamless DOM mild steel tubing or chrome molybdenum alloy steel such as SAE 4125 or SAE 4130. It is recommended that mild steel tubing be used as chromium alloys present difficulties in welding and must be normalized to relieve stress. Proof of the use of alloy steel will be the responsibility of the entrant
- 2.2 The size of the tubing shall be determined by the weight of the car. Minimum size requirements are:

| Vehicle Race Weight | Mild Steel | Alloy Steel |
|---------------------|----------------------------------|----------------|
| Under 1700lbs | 1.50" x .095" or 1.625" x 0.080" | 1.375" x .080" |
| 1701 to 2700lbs | 1.50" x .095" | 1.500" x .095" |
| Over 2700lbs | 1.50" x .120" | 1.625" x .095" |

An inspection hole of at least 3/16" diameter (0.1875") must be drilled in a non-critical area of the roll bar hoop to facilitate verification of wall thickness.

Where bolts and nuts are used, the bolts shall be at least 3/8" diameter SAE Grade 5 or equivalent aircraft quality.

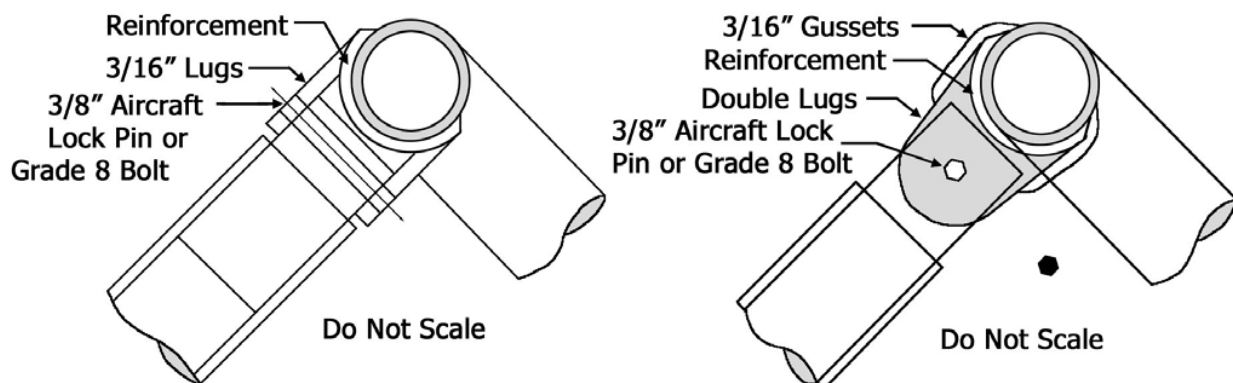
3. Fabrication

- 3.1 One continuous length of tubing must be used for the hoop member with smooth continuous bends and no evidence of crimping or wall failure. It is recommended that the radius of the roll bar hoop be such that the minimum outside width measured at a point 4 inches below its uppermost point is 12 inches. Whenever possible the roll bar 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 in order to distribute the loads.
- 3.2 All welding must be of the highest possible quality with full penetration. Arc welding, particularly heliarc, should be used wherever possible. The welds should be inspected by magnaflux or dye penetrant after fabrication. Alloy steel must be normalized after welding.

4. Bracing

- 4.1 Full cockpit width roll bar hoops must have two fore and two aft braces, one on each side of the hoop, of tubing with dimensions at least equal to the minimum dimensions required for the main roll bar hoop. All roll bars must include a transverse brace from the top of the hoop on one side to the bottom of the hoop on the other side, or alternatively, to the bottom of a rearward brace required above.
- 4.2 Roll bar hoops on Formula cars and cars with partial width hoops may have either one fore/aft brace with a minimum dimension equal to the tubing required for the main hoop, or two fore/aft braces with a minimum dimension of 1.0" x .090" mild steel or .750" x .090" alloy steel.
- 4.3 The bracing must be attached as near as practical to the top of the roll bar hoop, but not more than 6" below the top of the hoop, and at an angle of at least 30° from vertical. If a single brace is used, it must be attached to the top of the main hoop.
- 4.4 If the fore/aft bracing must be removable, the connection between the roll bar hoop and the brace-rod must be of the double lug type fabricated from material at least 3/16" thickness and welded through a doubler or gusset arrangement

Removeable Roll Bar Brace Attachment Details



to avoid distortion or excessive strains caused by welding. (See diagram above.) It is recommended that the fore/aft brace be attached to a rear chassis member through a double lug connection. If attached to the engine, it must mount to a major component such as a head stud or combination of head studs.

5. Mounting Plates

- 5.1 Roll bars and braces must be attached to the frame of the car whenever possible. Mounting plates must be a minimum of 12 square inches. Mounting plates, regardless of whether welded or bolted to the frame, must be at least 3/16" thick.
- 5.2 In case of cars with unitized or frameless construction, or cars with frames where frame-mounting of the roll bar is impractical, mounting plates must be used to secure the roll bar structure to the floor of the car. Mounting plates shall be a minimum of 12 square inches. It is recommended that they have a minimum area of 1.5 square inches per each 100lbs. vehicle weight: The important consideration is that the load be distributed over as large an area as possible. Mounting plates bolted to the structure shall not be less than the minimum required wall thickness of the hoop with a backup plate of equal size and thickness on the opposite side of the panel with plates bolted together with a minimum of three each 3/8" grade 5 bolts.

6. Removable Roll Bars

Removable roll bars and braces must be very carefully designed and constructed to be at least as strong as a permanent installation. If one tube fits inside another tube to facilitate removal, the removable portion must fit tightly and must bottom on the permanent mounting, and at least two bolts must be used to secure each such joint. The telescope section must be at least 8" in length.

7. Installation on Cars of Space Frame and Frameless Design

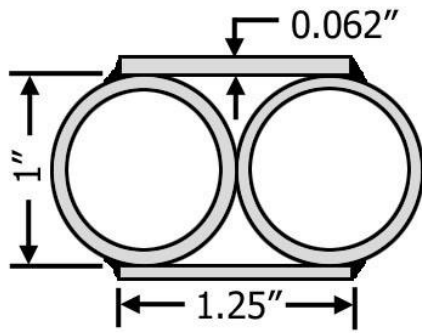
- 7.1 It is important that roll bar structures be attached to cars in such a way as to spread the loads over a wide area. It is not sufficient to simply attach the roll bar to a single tube or junction of tubes. The roll bar must be designed in such a way as to be an extension of the frame itself, not simply an attachment to the frame. Considerable care must be used to add as necessary to the frame structure itself in such a way as to properly distribute the loads. It is not true that a roll bar can only be as strong as any single tube in the frame.
- 7.2 On cars of frameless construction, consideration should be given to using a vertical roll bar hoop of 360° completely around the inside of the car, and attached with suitable mounting plates. This type of roll bar then becomes a substitute for the frame.

8. Roll Cages

It is highly recommended that all cars employ a roll cage as stated in [Appendix ZZ](#)

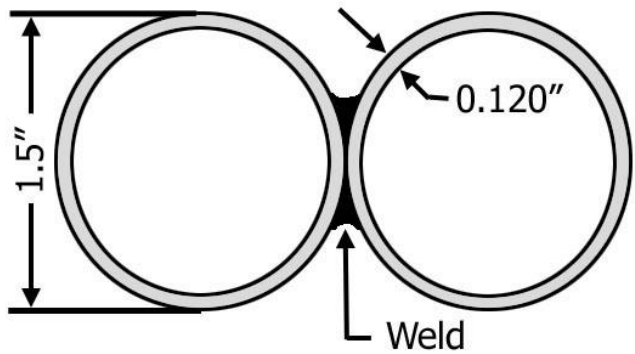
Drawings of Cross-Sectional Top View of One Leg

Figure 1



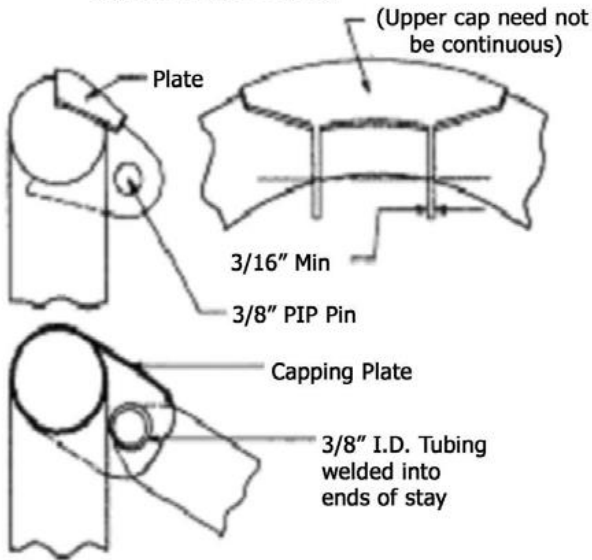
Front / Rear

Figure 2

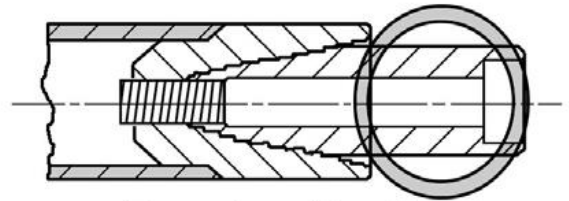


Front / Rear

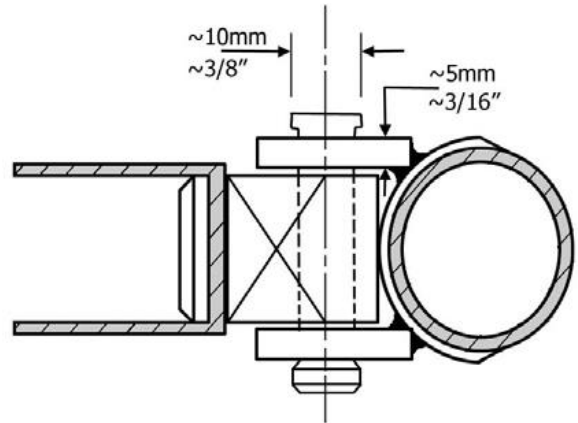
**Removable Roll Bar Braces
Attachment Details**



Drawing No. 1

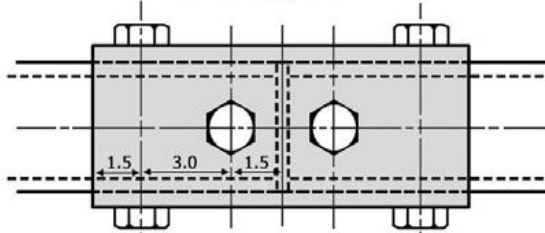


Drawing No. 2



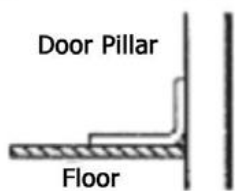
Drawing No. 3

Drawing No 4

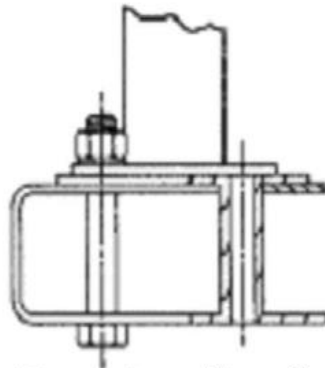


- 12mm (tube < 40 dia. ext.)
- 14mm (tube > 40mm < 50mm dia. ext.)
- 18mm (tube > 80mm dia. ext.)

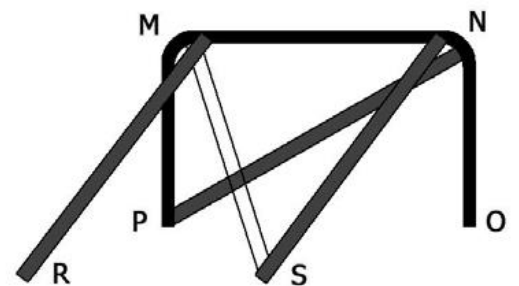
**Roll Bar Attachment to
Integral Chassis Type of Car**



Drawing No. 5



Drawing No. 6



The Lateral brace must be fitted either from M-O, from N-P, M-S, or N-R

Drawing No. 7

Appendix ZZ: Roll Cage Recommendations

It is HIGHLY RECOMMENDED that full roll cages be installed in all cars where satisfactory installation can be achieved without major structural modifications. (SCCA Roll Cage Requirements)
Specific installations are subject to approval by the Chief Technical Inspector.

1. Basic Design Considerations

- 1.1 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 must be designed to withstand compression forces from the weight of the coming down on the roll-over structure and to take fore and aft and lateral loads resulting from the car skidding along the ground on its roll-over structure.
- 1.2 A system of head restraint to prevent whiplash and prevent the driver's head from striking the underside of the roll bar must be installed on all vehicles. The head restraint must have a minimum area of 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 1". The head restraint must be capable of withstanding a force of 200lbs in a rearward direction.
- 1.3 Forward braces and portions of the roll bar hoop subject to contact by the driver's helmet (as seated normally and restrained by his/her restraint system) must be padded with a protective padding of non-resilient material such as Ethafoam or Ensolite or other similar mater with a minimum thickness of ½".
- 1.4 No portion of the safety roll cage shall have an aerodynamic effect by creating a vertical thrust.

2. Material

- 2.1 Seamless or DOM (drawn over mandrel) mild steel tubing (SAE 1010, 1020, 1025) or equivalent or alloy steel tubing (SAE 4125, 4130) (T-45). Alloy steels (proof of which is the responsibility of the entrant) must be normalized to relieve stress after welding.
- 2.2 An inspection hole of at least 3/16" diameter must be drilled in a non-critical area of the roll bar hoop to facilitate verification of wall thickness. All bolts and quick release pins must be of minimum diameter of 3/8" SAE Grade 5 or equivalent aircraft quality.

3. General Construction

- 3.1 One continuous length of tubing must be used for the hoop member with smooth continuous bends and no evidence of crimping or wall failure. The radius of bends in the roll bar hoop (measured at centerline of tubing) shall not be less than 3 times the diameter of the tubing. Whenever possible, the roll bar 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 to distribute the loads. It is recommended that gussets be used at all joints.
- 3.2 All welding must be of the highest possible quality with full penetration and must be done according to A.S.T.M specifications for the material used. Arc welding, particularly heliarc, should be used wherever possible. Welds should be inspected by magnaflux or dye penetrant after fabrication. Alloy steel must be normalized after welding.
- 3.3 Aluminum bronze or silicon bronze welding technique is permitted, but extreme care must be used in preparation of parts before bronze welding in the design of the attaching joints.

4. Formula and Sports Racing Cars

4.1 Main Hoop (behind driver)

- 4.1.1 Tubing size (minimum)

| | |
|----------------|-------------|
| 1.375" x .080" | Alloy Steel |
| 1.50" x .120" | Mild Steel |
- 4.1.2 Vertical members must not be less than 15" apart (inside dimensions) at their attachment to the uppermost main chassis member.
- 4.1.3 In sports racing cars the main hoop (behind the driver) may be of either full cockpit width or partial cockpit width (behind the driver only). If full cockpit width, it must incorporate a lateral brace of equal dimension tubing to the main hoop. (See drawing No. 7 for alternate bracing location.)

4.2 Front hoop may be low hoop near dashboard, but at least as high as the top of the steering wheel rim OR a high front hoop, similar to the rear hoop, but without lateral brace.

- 4.2.1 Tubing size (minimum)

| | |
|----------------|-------------|
| 1.375" x .080" | Alloy Steel |
| 1.50" x .120" | Mild Steel |
- 4.2.2 A fabricated sheet metal structure or cars of full monocoque construction may be approved upon specific application.
- 4.2.3 Height – A straight line drawn from the top of the main roll bar hoop to the top of the forward hoop or structure must pass at least 2" over the driver's helmet when the driver is seated in normal driving position.

4.3 Bracing

- 4.3.1 **Front Hoop** – There must be two braces extending forward from the front hoop so as to protect the driver's legs. It is recommended that this bracing extend forward to the bulkhead in front of the driver's feet, but in all cases must be integrated into the frame or monocoque so as to provide substantial support for the front hoop. The tubing for these braces must not be smaller than 1.0" diameter x .080" wall thickness alloy steel or 1.375" x .080" mild steel.
- 4.3.2 **Rear Hoop – Partial cockpit width Sports Racer or single seat Formula or Sports Racing Cars.** There must be two braces extending forward (not smaller than 1.0" diameter x .080" wall thickness alloy steel or 1.375" x .080" mild steel) attaching to the frame, monocoque or front hoop. In addition, there must be either one brace (not smaller than 1.375" x .080" alloy steel or 1.50" x .120" mild steel) extending rearward and attaching to the frame, cross member of other substantial chassis component.

4.3.3 Rear Hoop – Full cockpit width Sports Racer. There must be two braces extending forward (not smaller than 1.0" x .080" alloy steel or 1.375" x .120" mild steel) attaching to the frame, monocoque or front hoop. In addition, there must be two braces extending rearward (not smaller than 1.375" x .080" alloy steel or 1.50" x .120" mild steel) attaching to the frame, cross member or other substantial chassis component.

4.3.4 Forward and rear facing bracing must be attached as near as possible to the top of the main hoop (not more than 6" below the top) and at an included angle of at least 30°.

4.3.5 Removable bracing must incorporate connectors of the double lug type or tapered connections or muff connections as shown in the accompanying drawings. The double lug type must include a doubler, gusset, or capping arrangement so as to avoid distortion or excess strain caused by welding (see drawings 1, 2, and 3 on prior page).

4.4 Mounting Plates: The thickness of mounting plates bolted, riveted, or welded to the structure of the car shall not be less than the thickness of the roll hoop or brace they attach.

5. Open Production Cars

5.1 Minimum tubing sizes for front and main hoops and all required bracing:

| Vehicle Race Weight | Mild Steel | Alloy Steel |
|---------------------|----------------------------------|----------------|
| Under 1700lbs | 1.50" x .095" or 1.625" x 0.080" | 1.375" x .080" |
| 1701 to 2700lbs | 1.50" x .095" | 1.500" x .095" |
| Over 2700lbs | 1.50" x .120" | 1.625" x .095" |

For purpose of determining tubing sizes, the vehicle race weight is as raced without fuel and driver.

5.2 The front hoop may be either a low hoop (below the driver's eye level) near the dashboard or a high front hoop (similar to the rear hoop) but without lateral brace.

5.3 The main hoop (behind the driver) may be either the full width of the cockpit or a partial cockpit (only behind the driver).

5.4 Height of the two hoops must be so that an imaginary straight line drawn from the top of the main roll bar hoop to the top of the front hoop passes at least 2" over the driver's helmet when the driver is seated in normal driving position.

5.5 Bracing

5.5.1 Cars with a low front hoop must have two braces extending forward so as 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, must be integrated into the frame or monocoque so as to provide substantial support for the front hoop.

5.5.2 Cars with a high front hoop (above driver's eye level) must have two braces connecting the front and rear hoops together at each side of the tops of the roll hoops or alternatively use two side hoops following the line of the front door pillars extending upwards above the driver's eye level then bending horizontally to the rear and attaching to the main hoop. These two side hoops must be connected together over the top of the windshield by a tube above the driver's eye level.

5.5.3 The main roll hoop of full cockpit width must incorporate a diagonal lateral brace to prevent lateral distortion of the hoop (see drawing No.7 on prior page).

5.5.4 The main roll hoop, either full cockpit width or partial cockpit width, must have two braces extending forward attaching to the front hoop and two braces extending to the rear attaching to the frame of the chassis.

5.5.5 All braces must be attached as near as possible to the top of the main hoop (not more than 6" below the top and at an included angle of at least 30°).

5.5.6 Removable Bracing – Any removable bracing must incorporate connectors of the double lug type, tapered connection or muff connection as shown in the accompanying drawings. The double lug type must include a doubler, gusset, or capping arrangement so as to avoid distortion or excessive strains caused by welding.

5.6 Mounting Plates: Mounting plates bolted to the structure of the car shall not be less than .1875 (3/16) inch thick with a backup plate of equal size and thickness on the opposite side of the panel with the plates through bolted together. There must be a minimum of 3 bolts per mounting plate. All hardware must be Grade 5 or better. Mounting plates welded to the structure of the car shall not be less than .080" thick. Whenever possible, the mounting plate shall extend onto a vertical section of the structure such as a door pillar.

5.7 Side Protection: The minimum side protection must consist of a horizontal tube not less than 1.50" x .095" connecting the front and rear hoops across the driver's door opening. Additionally, there must also be either a diagonal tube from the front hoop bisecting the door opening below the horizontal side tube, or not less than 2 horizontal side tubes not less than 1.50" in diameter x .095" wall thickness. Additional tubing may be added.

6. Closed Cars

6.1 Minimum tubing sizes for front and main hoops and all required bracing:

| Vehicle Race Weight | Mild Steel | Alloy Steel |
|---------------------|----------------------------------|----------------|
| Under 1700lbs | 1.50" x .095" or 1.625" x 0.080" | 1.375" x .080" |
| 1701 to 2700lbs | 1.50" x .095" | 1.500" x .095" |
| Over 2700lbs | 1.50" x .120" | 1.625" x .095" |

6.2 Main roll hoop (behind the driver) must extend the full width of the driver/passenger compartment and must be as near the roof as possible. It must incorporate a diagonal lateral brace to prevent lateral distortion of the hoop (see drawing No. 7).

6.3 The front hoop must follow the line of the front pillars and be connected by horizontal bars to the main hoop at each side of the top. Alternately, two side hoops following the line of the front top of the windshield (as close to the roof as possible) then horizontally to the rear attaching to the main hoop. These two side hoops are to be connected together by a tube over the top of the windshield.

6.4 The minimum side protection must consist of a horizontal side tube not less than 1.50" x .095" connecting the front and rear hoops across the driver's door opening. Additionally, there must also be either a diagonal tube from the front hoop bisecting the

door opening below the horizontal side tube, or not less than 2 horizontal side tubes not less than 1.50" x .095". Additional tubing may be added.

6.5 Bracing

6.5.1 The main roll hoop must have two braces extending forward to the front hoop or forming the uprights of the front hoop and two braces extending to the rear attaching to the frame and chassis.

6.5.2 All braces must be attached as near as possible to the top of the main roll hoop (not more than 6" below the top and at an included angle of at least 30°).

6.6 Mounting Plates: Mounting plates bolted to the structure of the car shall not be less than .1875 (3/16) inch thick with a backup plate of equal size and thickness on the opposite side of the panel with the plates through bolted together. There must be a minimum of 3 bolts per mounting plate. All hardware must be Grade 5 or better. Mounting plates welded to the structure of the car shall not be less than .080" thick. Whenever possible, the mounting plate should extend onto a vertical section of the structure such as a door pillar.

7. Removable Roll Cages

7.1 Removable roll cages and braces must be very carefully designed and constructed to be at least as strong as a permanent installation. If one tube fits inside another tube to facilitate removal, the removable portion must fit tightly and must bottom by design, on the permanent mounted tube, and at least two bolts must be used to secure each such joint. The telescope section must be at least 18" in length (see drawing No. 4). Removable bracing sections (compression loading only) may use 3 bolts flange (min 3/16").

8. Installation on Cars of Space frame and Frameless Design

8.1 It is important that roll cage structures be attached to cars in such a way as to spread the loads over a wide area. It is not sufficient to simply attach the roll cage to a single tube or junction of tubes. The roll cage must be designed in such a way as to be an extension of the frame itself, not simply an attachment to the frame. Considerable care must be used to add necessary strength to the frame structure itself in such a way as to properly distribute the loads. It is not true that a roll cage can only be as strong as any single tube in the frame.

8.2 On cars of frameless construction, consideration should be given to using a vertical roll hoop of 360° completely around the inside of the car, and attached with suitable mounting plates. This type of roll hoop then becomes a substitute for the frame.

9. Other Roll Cage Designs

Roll cages of alternate material or design may be accepted upon presentation of data verifying the installation is able to withstand three simultaneously applied loads:

1.5 G Lateral, 5.5 G Fore and Aft, 7.5 G Vertical

However, tubing sizes for front and rear hoops of less than 1.375" x .080" alloy steel or 1.50" x .095" mild steel will not be accepted.

10. Driver's Seat

The driver's seat must be firmly mounted to the structure of the car. In cars where the seat back is upright (most common in sedans and production cars) the back of the seat must be firmly attached to the main roll hoop, or its cross bracing, so as to provide both fore/aft lateral support.