

## Appendix E – Rollover Protection

Note that all diagrams within this section are prefaced with the number 3.6.2 indicating their original placement within section 3.6.2 of the GRRs.

# Table of Contents

Appendix E – Rollover Protection.....	1
1 Rollover Protection.....	3
2 Definitions.....	3
2.1 Roll cage (safety cage).....	3
2.2 Rollbar.....	4
2.3 Main Rollbar .....	4
2.4 Front Rollbar .....	4
2.5 Lateral Rollbar.....	4
2.6 Lateral Half Rollbar.....	4
2.7 Longitudinal Member.....	4
2.8 Transverse Member.....	4
2.9 Diagonal Member.....	5
2.10 Roof reinforcement.....	5
2.11 Reinforcement Plate.....	5
2.12 Mounting Foot.....	5
2.13 Removable Members.....	5
2.14 Gusset.....	5
2.15 Sill bar.....	5
2.16 Door bar.....	5
2.17 Backstays.....	5
3 Rollover Protection General Requirements.....	5
3.1 Grandfathering of cages, and variances from rules .....	6
3.2 Allowed Roll Cage Structural Framework.....	7
3.3 Required front upper corner bracing or gusseting	8
3.4 Backstays.....	8
3.5 Diagonal Members.....	8
3.5.1 Diagonals in the plane of the main rollbar or the plane of the rear legs of lateral roll bars.....	8
3.5.2 Diagonal Members between the Backstays.	10

3.5.3	Alternate compliance for two diagonals for previously logbooked cars.....	11
3.6	Sill bars.....	11
3.7	Door Bars.....	12
3.7.1	Door Bars: X Configuration.....	12
3.7.2	Door Bars: V Configurations.....	13
3.7.3	Door Bars: Configuration with single straight bar with sill bar.....	13
3.7.4	Door Bars: Stock-car style configuration bar .....	13
4	Protective Padding.....	14
4.1	Required Padding.....	14
4.2	Recommended Padding.....	14
5	Optional Reinforcement of the Roll cage.....	15
5.1	Roof Reinforcement.....	15
5.2	A-pillar reinforcement.....	15
5.3	Reinforcement of Bends and Junctions.....	16
5.4	Reinforcement to A and B Pillars.....	17
5.5	Other Optional Reinforcing Members.....	17
5.6	Reinforcements in front of and behind the roll cage.....	18
5.7.1	Front core support reinforcement.....	18
5.7	Trunk area reinforcement.....	19
6	Detailed Construction Specifications.....	19
6.1	Formation and fitting of Main, Front, Lateral and Half Lateral Rollbars.....	19
6.2	Mounting of Roll cages to the Body shell.....	20
6.2.1	Welded Connections.....	20
6.2.2	Bolted Connections.....	20
6.2.3	Reinforcement plates.....	21
6.3	Gusset construction.....	21
6.4	Removable Members.....	21
6.5	Guidance on Welding.....	22
6.6	Material Specifications .....	22

## **1 Rollover Protection**

Specific roll over protection is subject to the approval of the Scrutineer at each event. Approval is under the guidance provided in these rules, with the condition that the roll cage is presented in a condition of adequate and acceptable structural integrity.

Note that roll cages must be inspected after the cage is installed, repaired, upgraded, or modified.

1. For newly assembled rally cars, a logbook will be issued for the specific combination of car and cage.
2. For a car with an existing logbook, for modified or repaired cages, or for a new cage, a log book notation denoting acceptable condition will be made.

Roll cages are mandatory for all vehicles. Three specifications for rollcages may be used:

1. An FIA approved roll cage (with either FIA homologation certificates or ASN homologation certificates). The homologation of any such rollcage must be current with the date of logbook issue.
2. Non-FIA homologated rollcages to FIA specifications, as set forth in Appendix J to the International Sporting Code, Article 253, and associated figures.
3. Cages built to the specifications listed below. These specifications are based upon FIA specifications, as set forth in Appendix J to the International Sporting Code, Article 253. These specifications are not intended for cars completing in classes homologated under FIA Rally rules; cages for cars competing in FIA rally classes must use a homologated cage correct for the FIA class.

Articles 2 to 6 below inclusive concern rollbars manufactured without a FIA homologation certificate or without an ASN homologation certificate.

## **2 Definitions**

### **2.1 Roll cage (safety cage)**

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

## **2.2 Rollbar**

A structural frame or hoop with mounting points.

## **2.3 Main Rollbar**

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

## **2.4 Front Rollbar**

Similar to main rollbar but in the front of the passenger compartment. Its shape follows the A-pillars and front door pillars, and the top edge of the windshield opening. The front leg must be as close to the A-pillar and the door pillar as practical so that it does not impeded driver a driver's exit from the vehicle. Each front leg may have only one bend.

## **2.5 Lateral Rollbar**

Structure consisting of a near-vertical frame or hoop located along the right or left side of the vehicle. The rear legs of a lateral rollbar must be vertical and just behind the front seats (and would be in the same location as the vertical portions of a main rollbar.) The front leg must be as close to the the A-pillar and the door pillar as practical so that it does not impeded a driver's exit from the vehicle. Each front leg may have only one bend.

## **2.6 Lateral Half Rollbar**

A lateral half roll bar is similar to a lateral rollbar, but without the rear vertical portion. Lateral half rollbars are used in conjunction with a main roll bar. A lateral half rollbar joins to a main rollbar at the roof level. The front leg must be as close to the A-pillar and the door pillar as practical so that it does not impede a driver's exit from the vehicle. Each front leg may have only one bend.

## **2.7 Longitudinal Member**

Longitudinal tube which is not a part of the main, front, or lateral rollbars or lateral half rollbars, nor their roof connecting members. Longitudinal members link portions of the main cage or link the backstays, and lie horizontally in a fore/aft direction. An example of longitudinal members is doorbars.

## **2.8 Transverse Member**

Transverse tube which is not a part of the main, front or lateral rollbar, nor their roof connecting members. Transverse members link portions of the main cage, or link the backstays and lie horizontally across the main axis of the car.

## **2.9 Diagonal Member**

A tube between a top corner of the main rollbar or upper end of a backstay, and a lower mounting point on the other side of the main rollbar or the opposite backstay.

## **2.10 Roof reinforcement**

Tubes in the roof plane of the main cage. The connecting tubes for the main cage structure are not defined as roof reinforcement.

## **2.11 Reinforcement Plate**

Metal plate fixed to the body shell or chassis structure to spread load into the structure.

## **2.12 Mounting Foot**

Plate welded to the end of a rollbar or diagonal member tube to permit its bolting or welding to a reinforcement plate.

## **2.13 Removable Members**

Structural members of a safety cage which can be removed by removing bolts at tubing joints.

## **2.14 Gusset**

A plate or tube that is welded to the connection of 2 roll cage tubes that provides reinforcement of the connection. Refer to 6.3 for detailed information.

## **2.15 Sill bar**

Longitudinal members at each side of the vehicle connecting the vertical portions of the main roll cage between the base of the A and B pillar, and mounted immediately above or beside the car's door sills in both the driver and co driver doorways.

## **2.16 Door bar**

One or more longitudinal members at each side of the vehicle connecting the vertical portions of the main roll cage in the door openings of the cage.

## **2.17 Backstays**

Tubes that connect to the top corners of the main hoop, or back, upper corners of lateral roll bars, and slope back to the rear floor or strut towers. These are used to stabilize the cage structure in the longitudinal direction.

## **3 Rollover Protection General Requirements**

A roll cage must be designed and made so that, when correctly installed, it substantially reduces body shell deformation and so reduces the risk of injury to occupants.

The essential features of roll cages are sound construction, designed to suit the particular vehicle and the drivers' physical statures, adequate mountings, adequate padding, and a close fit to the body shell.

Tubes must not carry fluids.

The roll cage must not unduly impede the entry or exit of the driver and co-driver.

Members may intrude into the occupant's space in passing through the dashboard and front side-trim, as well as through the rear side-trim and rear seats.

Longitudinally, the roll cage must be entirely contained between the mounting points of the front and rear suspension elements carrying the vertical loads (springs and shock absorbers).

NOTE: Any modification to a homologated safety cage is forbidden

### **3.1 Grandfathering of cages, and variances from rules**

Previously logbooked cars (including those with NASA, SCCA, CARS, and Rally America logbooks) will be allowed to compete as is for 2008 if:

1. The cage must have at least 1 diagonal in the plane of the main hoop (or rear legs of lateral roll bars) and 1 diagonal in the plane of the rear backstays, OR, alternately, comply with the diagonal requirements of sections 3.5.1 plus 3.5.2.
2. The roof level connections of bolt-in cages are welded per NASA RallySport scrutineer guidance; this must be inspected, accepted, and noted in the vehicle logbook at the next event.

#### **Starting July 1, 2008:**

1. All cars will be required to have sill bars as in 3.6 plus at least one front door bar per side.
2. The front upper joints in the roll cage must have gussets per 3.3, or roof reinforcement per 5.1.

Note that these 2 requirements do not apply to homologated cages per section 1.

Previously accepted roll cage tubing sizes accepted under SCCA rally rules will be accepted for cars with SCCA logbooks issued prior to Jan 1 2005, for the foreseeable future.

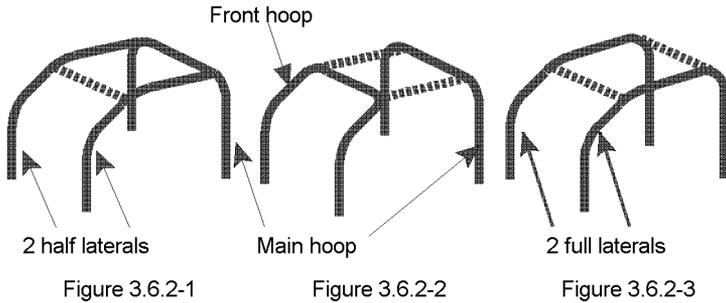
Other variations on roll cage designs outside these rules may be accepted at the discretion of the Chief Scrutineer of an event. However, acceptance by the Chief Scrutineer of a non-compliant roll cage at one event does not guarantee continued acceptance at that or any other event, and not to be construed to allow a path for continued acceptance of a non-compliant cage. It is strongly recommended that any cage that is given discretionary acceptance for one event be upgraded to be in compliance with these rules rather than have the owner/entrant continue to seek discretionary acceptance at each event.

If a roll cage is found to be not in compliance with rules at an event, but is allowed to compete at the discretion of the Chief Scrutineer at an event, this must be noted in the vehicle logbook. Any corrections required prior to the next event by this logbook notation must be completed or the vehicle will be rejected at the next event.

### **3.2 Allowed Roll Cage Structural Framework**

The roll cage structural framework must be made to one of the following configurations:

1. A main rollbar, 2 lateral half rollbars, their connecting members, diagonal members, doorbars, backstays and mounting points. Refer to figure 3.6.2-1 (2007 FIA figure 253-3).
2. A main rollbar and a front rollbar and their connecting members, diagonal members, backstays, doorbars, and mounting points. Refer to figure 3.6.2-2 (2007 FIA figure 253-1).
3. Two lateral rollbars, their connecting members, diagonal members, backstays, doorbars, and mounting points. Refer to figure 3.6.2-3 (2007 FIA figure 253-2).



### 3.3 Required front upper corner bracing or gusseting

The intersection of the tube over the windshield with the lateral or half-lateral roll bars, or the connecting tubes at roof level between main and front rollbars at the top of the A pillar, must be reinforced. The preferred, and strongly recommended method is with roof reinforcement tubes as described in section 5.1. If roof reinforcement tubes are not used, then gussets are required at these joints. These may be of any of the allowed gusset types in 6.2. There must be one gusset on each end of the tube across the windshield; these 2 gussets may be in front of, or behind, the tube across the windshield.

### 3.4 Backstays

These are compulsory and must be attached near the roofline and near the top outer bends of the main rollbar or lateral rollbars, on both sides of the car.

They must make an angle of at least 30° relative to a vertical plane, must run rearwards, must be straight, and be placed as close as practical to the interior side panels of the body shell.

### 3.5 Diagonal Members

#### 3.5.1 Diagonals in the plane of the main rollbar or the plane of the rear legs of lateral roll bars.

The fitting of at least two diagonal or horizontal members in the plane of the main rollbar, or in the plane of the rear legs of lateral roll bars, is required. They shall be in one of the following configurations:

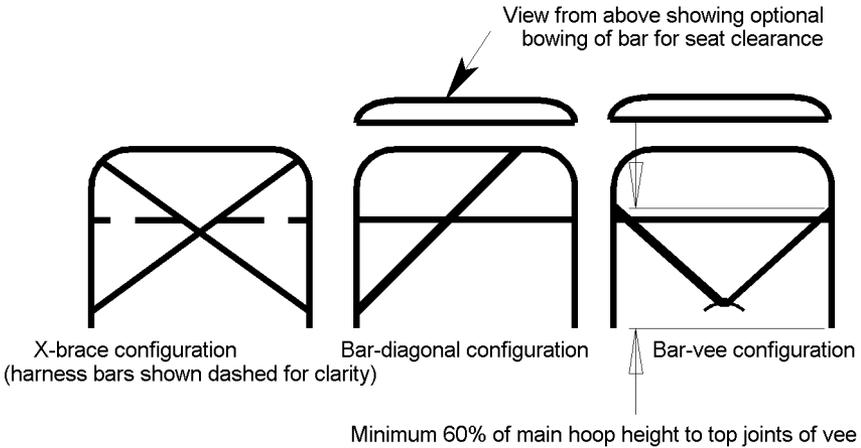
1. An X-configuration, per figure 3.6.2-4 (2007 FIA figure 253-7)

2. A bar-diagonal configuration as shown in figure 3.6.2-5
3. A V-configuration, per figure 3.6.2-6, with a horizontal bar. For this configuration:
  1. The two halves of the V must be attached to each other and to one continuous reinforcement plate, which is welded on the top of a floor tunnel (not separately to opposite sides of a floor tunnel). A continuous tube is preferred.
  2. The level at which each half of the V connects to the main roll bar must be at least 60% of the vertical height of the main rollbar up from the floor plates
  3. The horizontal bar shall be one tube and connected to the main hoop at each side.

The diagonal members for the X- and bar-diagonal configurations, and each half of the V-configuration, must be straight, not curved. A smooth bend at the attachment of the V-configuration to the floor is allowed if this diagonal is made from one continuous tube.

For the 'X' configuration, one of the two cross-members of the 'X' must be a single, continuous tube, with the other cross-member being formed from two half tubes. The joint must have two gussets on opposite sides of the joint to prevent separation of the tubes.

The attachment points of the diagonal members must be located to prevent injuries. (This is particularly important so as to avoid introducing potential for head injuries.) The upper end of any diagonal in the plane of the main rollbar, or in the plane of the rear legs of lateral rollbars, must join the main rollbar(s) not further than 4 inches from the junction of the backstay joint, and be as close to the roof level as practical. The lower end of a diagonal for the X- or bar-diagonal configuration must join the main rollbar or lateral roll bars no further than 4 inches from the mounting foot.



X-brace configuration  
(harness bars shown dashed for clarity)

Figure 3.6.2-4

Bar-diagonal configuration

Figure 3.6.2-5

Bar-vee configuration

Figure 3.6.2-6

Minimum 60% of main hoop height to top joints of vee

### 3.5.2 Diagonal Members between the Backstays

A minimum of one diagonal shall be placed between the backstays. See figure 3.6.2-7.

Two diagonals may be placed between the backstays in an X-configuration (as in 2007 FIA figure 253-21). It is required that one such diagonal in an X-configuration in the plane of the backstays be of one continuous tube, and that the junction be gusseted.

Two diagonals may be placed in the plane of the backstays in a V configuration as in figure 3.6.2-8 (based in FIA figure 253-22) if a V configured roof reinforcement as in figure 3.6.2-8 is also used.

The upper end of any diagonal between the backstays must join the upper end of a backstay no more than 4 inches from its junction with the main rollbar or with the rear leg of a lateral roll bar. The connection of the lower end of any such diagonal shall be to the opposite backstay at a point no more than 4 inches from its connection to the vehicle structure. Optionally, for vehicles with non-strut tower rear suspensions, the lower end of the backstay diagonal may connect directly the vehicle body within 6" of the opposite backstay's lower connection to the vehicle. Any such direct connection of a backstay diagonal to the vehicle body must

have a reinforcement plate, plus a mounting foot if it is bolted to the reinforcement plate.

### 3.5.3 Alternate compliance for two diagonals for previously logbooked cars

NOTE: This section is applicable for cars logbooked prior to 1-1-2008.

Two diagonal members are required for competition. These may be per any of the configurations above in paragraph 3.5.1. (describing diagonals in the plane of the main rollbar). Alternately, this requirement may be met by one diagonal in the plane of the main hoop, plus one diagonal between the backstays.

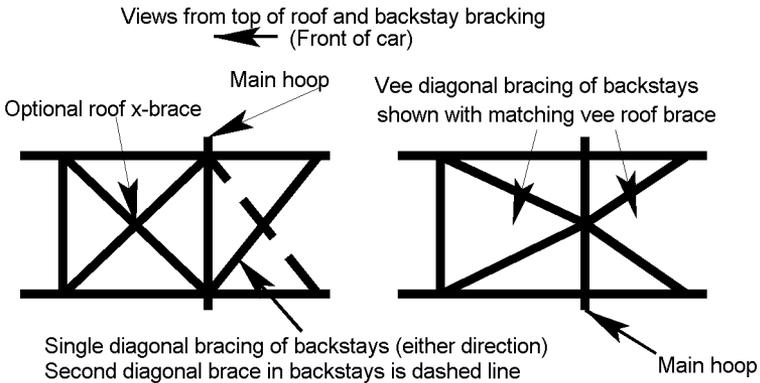


Figure 3.6.2-7

Figure 3.6.2-8

### 3.6 Sill bars

Sill Bars will be required in all newly logbooked cars as of Jan 1, 2008, and will be required in ALL cars starting July 1, 2008. (Refer to the lower longitudinal bars in figure 3.6.2-9 (FIA 2007 figure 253-8) for general reference). Sill bars must be welded in place to the main hoop legs and the forward legs of the cage.

Sill bars must be as straight as possible. Bends in the sill bars are often necessary for safe clearance to seats and occupants. Any such bends in the door bars must be completed within 6" of the forward or rear connections of the door bars, so that the majority of

the length of the sill bars is straight. It is permitted that the sill bar be welded to the car's door sill.

Sill bars should be not more than 4" above the car's door sill as measured to the bottom of the sill bar tubing.

### 3.7 Door Bars

One or more longitudinal members must be fitted at each side of the vehicle in the door openings of the cage. See:

1. Figure 3.6.2-9 (2007 FIA figure 253-9); sill bar required.
2. Figure 3.6.2-10 (2007 FIA figure 253-10); sill bar required.
3. Figure 3.6.2-11 (2007 FIA figure 253-11); sill bar not required IF lower bar is installed as a sill bar.

Door bars may be removable, **but this is strongly discouraged.**

They must be as straight as possible. Any bends in the door bars to allow safe clearance for seat mounts or occupants must be complete within 6" of the forward or rear connections of the door bars, so that the majority of the length of the door bars is straight.

Any attachment point of a door bar to a vertical member of the roll cage must not be higher than half the height of the door opening measured from its base. If these attachment points are located in front of or behind the door opening, this height limitation applies at intersection of the strut and the door opening.

#### 3.7.1 Door Bars: X Configuration

In the case of door bars in the form of an "X" (figure 3.6.2-9), there are 2 allowed configurations:

1. It is recommended that the two tubes in an 'X' configuration be formed from two continuous tubes. The upper is formed in the shape of a shallow 'U', and the lower is formed in the shape of an inverted shallow 'U'. The connection between these tubes must be welded and have gussets in both the forward and rearward corners of the junction to prevent separation.
2. Alternately, one of the two cross-members of the 'X' should must be a single, continuous tube, with the other cross-member being formed from two half tubes. The connection between these tubes must be welded and have gussets in

both the forward and rearward corners of the joint to prevent separation.

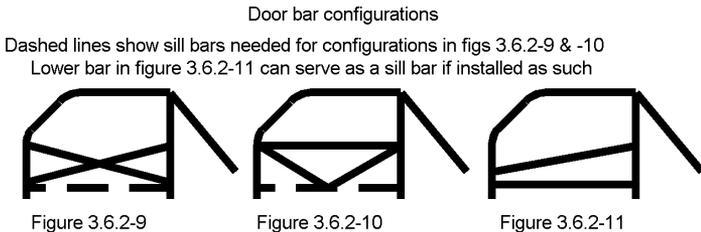
3. It is recommended that the lower attachment points of the 'X' be fixed directly to the intersection of the sill bar and the vertical tubes to which it is connected.

### 3.7.2 Door Bars: V Configurations

Note that the vee-with-bar door-bar configuration of figure 3.6.2-10 still requires a sill bar as part of the roll cage. The vee bar should be made from one continuous tube. The upper connections of the vee ends to the vertical tubes should be at the joint with the upper horizontal bar.

### 3.7.3 Door Bars: Configuration with single straight bar with sill bar

A single door bar as is allowed; this is illustrated as the upper bar in figure 3.6.2-11. These may be sloped downward from rear to front to improve exiting from the vehicle.



### 3.7.4 Door Bars: Stock-car style configuration bar

This type of door bar is only allowed in certain circumstances and must be specifically approved by a NASA scrutineer and that approval note in the logbook. There is no guarantee of approval if this is built prior to scrutineer approval.

In cases where the door bar is bent out far enough such that the inner face of the door bar tubing is more than 4" outside of the plane formed by the vertical sections of the main and lateral (or half lateral) roll bars at the A and B pillars, then the door bar tube sizing must meet the requirements set forth below, and 3 braces between the door bar and the sill bar must be included. These braces must be equally spaced in the longitudinal direction

between the main hoop and half lateral or front hoop vertical legs (or between the vertical legs if a lateral roll bar design is used). Refer to figure 3.6.2-12.

The tubing for the door bar and the 3 vertical braces must be either 1.5' dia x .120" wall, or 1.75" x .095" wall. (Note that the tubing diameter for door bar and braces used should not exceed the diameter of any tube to which it connects. Thus the 1.75 diameter option can only be used if all the surrounding tubes are 1.75" diameter also.)

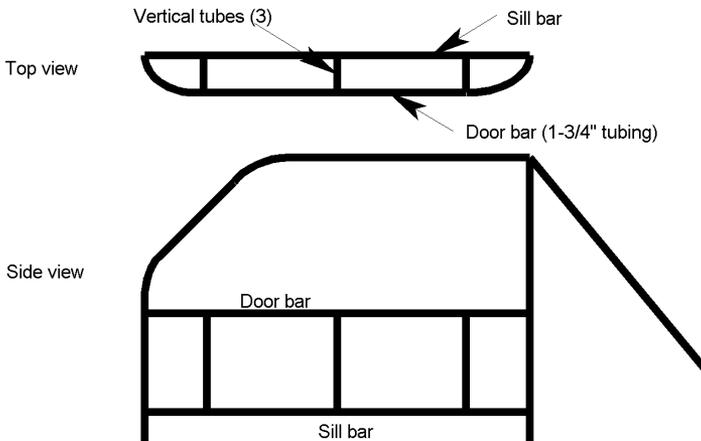


Figure 3.6.2-12

## 4 Protective Padding

### 4.1 Required Padding

Where the occupants helmets could come into contact with the safety cage, padding to FIA specification 8857-2001, types A or B, or to SFI specification 45.1, must be installed.

### 4.2 Recommended Padding

Where the occupants bodies could come into contact with the safety cage, padding should be provided for protection. This is particularly important around the areas where the lower legs can contact the cage elements

## 5 Optional Reinforcement of the Roll cage

The diameter, thickness and material of reinforcements must be as defined in 6.6. They shall be either welded in position or installed by means of dismantable joints. Dismountable joist are not recommended.

### 5.1 Roof Reinforcement

The following section is strongly recommended and will become mandatory for new cages logbooked after 1-1-2009.

Reinforcing the upper part of the roll cage by adding members as shown in figures 253-12 through 253-14 is permitted. If roof reinforcement of figure 253-14 is used, it is permitted that the arrangement of backstay reinforcing diagonals of figure 3.6.2-8 be used.

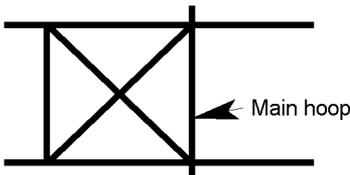


Fig 253-12 Roof X-brace

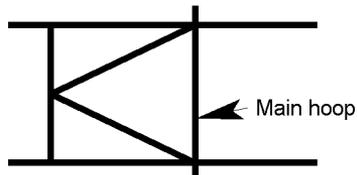


Figure 253-13 Roof vee-brace

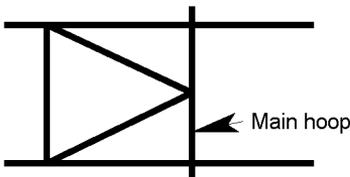


Figure 253-14 Roof vee brace (alt)

Optional roof reinforcement types  
(shown from top view)

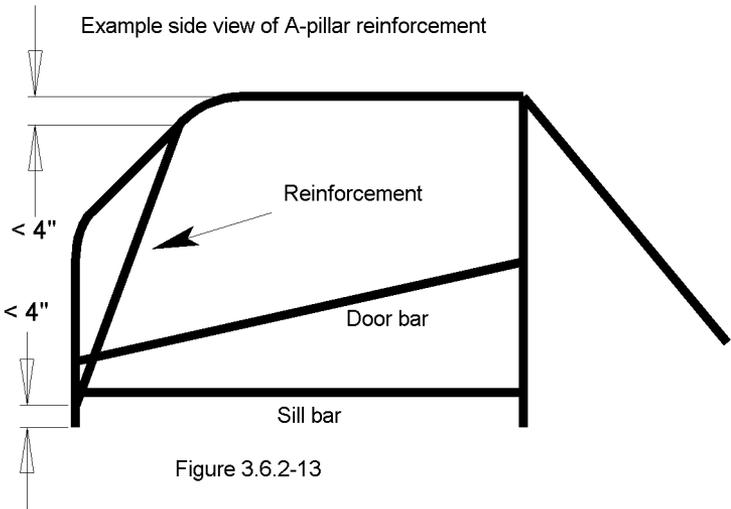


### 5.2 A-pillar reinforcement

The following section is strongly recommended and will become mandatory for new cages logbooked after 1-1-2009.

A reinforcement of the A-pillar area of the roll cage as shown in figure 3.6.2-13 (Based on 2007 FIA figure 253-15) may be added between the upper corner of the A-pillar area and the base of the

vertical portion of the roll cage. This reinforcement may be bent only if it remains straight from a frontal view and the angle of the bend does not exceed 20 degrees. Junctions with the lower mounting point and the upper junction of the lateral half roll bars and transverse member over the windshield, or the front hoop and longitudinal members over the doors, must be less than 4°.



### 5.3 Reinforcement of Bends and Junctions

The following section is strongly recommended:

It is permitted to reinforce the junction of the main rollbar or the front rollbar with the longitudinal struts (figures 3.6.2-14 and 3.6.2-15), as well as the top rear bends of the lateral rollbars and the junction between the main rollbar and the backstays. The upper, rearmost reinforcements (between main hoop and longitudinal connectors over the doors) shown in figure 3.6.2-14 are highly recommended.

The ends of these reinforcing tubes must not be more than half way down or along the members to which they are attached, except for those of the junction of the front rollbar, which may join the junction of the door bar and the front leg of the front rollbar, lateral rollbar, or half lateral rollbar.

The transverse member (dash bracing) fixed to the front rollbar, or between the front legs of lateral rollbars or half rollbars, must not encroach upon the space reserved for the occupants. It must be placed as high as possible but its lower edge must not be higher than the top of the dashboard.

#### 5.4 Reinforcement to A and B Pillars

The following section is strongly recommended:

Welded reinforcement of the roll cage to the A and B pillars is allowed. Use of welded plates as part of this connection is allowed.

#### 5.5 Other Optional Reinforcing Members

Each type of reinforcement shown in figures 253-16, -17, -18, -20, and 253-23 through 253-33 in Appendix J to the FIA's International Sporting Code, Article 253, are allowed. Refer to that document for those figures. Typical bracing is shown in figure 3.6.2.-14 and -15 below.

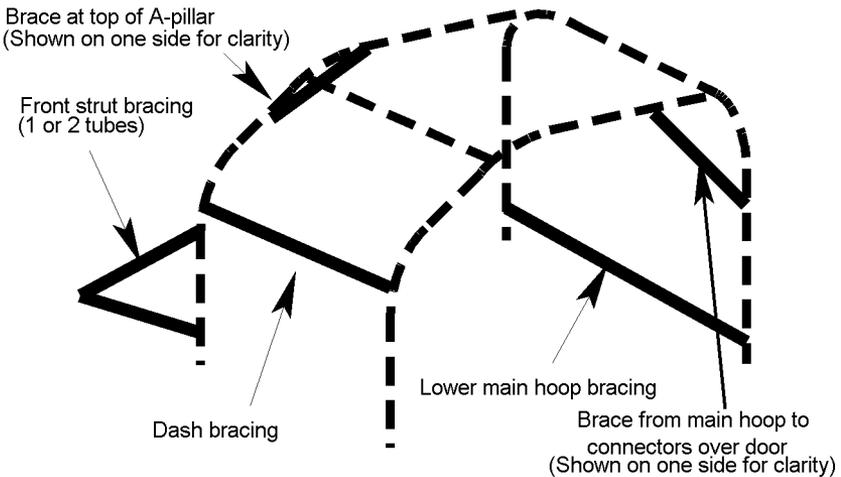


Figure 3.6.2-14 Optional bracing common in main cage area

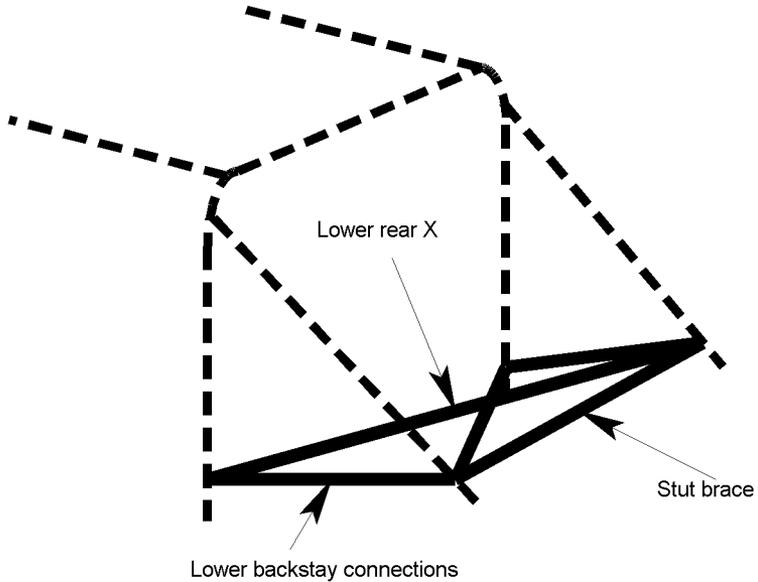


Figure 3.6.2-15 Common rear cage bracing

## 5.6 Reinforcements in front of and behind the roll cage

Longitudinally, the roll cage must be entirely contained between the mounting points of the front and rear suspension elements carrying the vertical loads (springs and shock absorbers). Supplementary reinforcements exceeding these limits are authorized in front of and behind the roll cage as follows:

### 5.7.1 Front core support reinforcement

Reinforcement to the front core support is allowed if:

1. For cars without McPherson strut front suspensions, a single tube may be added on each side from the lateral or half lateral roll bar or front roll bar to the core support that :
  1. Is no larger than 1.5" diameter and .095" wall thickness,
  2. has a downward bend of at least 30 degrees in the tube to allow for bending in a frontal impact
  3. has a downwardly turned portion in front of at least 8" long

4. shall be joined to the lateral or half lateral roll bar below the base of the windshield
2. For car with strut front suspensions, one or 2 tubes tube may be extended forward from the front strut tower on each side to the core support that is no larger in diameter than 1" and .095 wall thickness. This may be bent or straight.

## **5.7 Trunk area reinforcement**

Reinforcement of the rear trunk floor is allowed to better protect trunk mounted fuel cells. Tubing for this reinforcement must be no larger in diameter than 1" and .095 wall thickness. This tubing shall connect to the backstays or their reinforcing plates on the floor, or to the rear strut tower.

Reinforcement of rear sway bar anchorage points is also permitted. Each of these anchorage points may be connected to the safety cage by a single tube with dimensions of not to exceed 1 inch diameter and .065 inch wall thickness.

## **6 Detailed Construction Specifications**

### **6.1 Formation and fitting of Main, Front, Lateral and Half Lateral Rollbars**

These rollbars must be made in one piece without joints. Their construction must be smooth and even, without ripples or cracks.

The tubing must be bent by a cold working process and the centerline bend radius must be at least 3 times the tube diameter. If tubing is ovalised during bending, the ratio of minor to major diameter must be 0.9 or greater.

The vertical part of the main rollbar, or rear legs of a lateral roll bar, must be as straight as possible and as close as possible to the interior contour of the body shell.

The front portions of a front rollbar, or of a lateral rollbar or lateral half rollbar, must follow the A pillars. The portion from the base of the windshield opening to the floor must be vertical.

To achieve an efficient mounting to the body shell, the original interior trim may be modified around the safety cages and their mountings by cutting it away or by distorting it. However, this modification does not permit the removal of complete parts of

upholstery or trim that are not allowed in a particular competition class.

Where necessary, the fuse box may be moved to enable a roll cage to be fitted. This applies to all NASA Rally Sport classes. For FIA classes, refer to FIA class rules to determine if this allowed.

## **6.2 Mounting of Roll cages to the Body shell**

Minimum mountings are at 6 points:

1. 1 one each side at the base of the front legs of the front rollbar or of each lateral or lateral half rollbar
2. 1 for each side at the base of the legs of the main rollbar or each of the rear legs of each of the lateral rollbars
3. 1 for the rear mounting point of each backstay

### **6.2.1 Welded Connections**

Roll cage tubing may be welded directly to the reinforcement plate. This is the preferred and recommended mounting method.

### **6.2.2 Bolted Connections**

The following method of attachment is required:

1. Each mounting foot of the front, main, lateral, and half-lateral rollbars, and of the backstays, must include a mounting foot at least 1/8<sup>th</sup> inch thick, and a minimum of 3 inches wide and 4 inches long.
2. Each mounting foot must be attached by at least three bolts on a steel reinforcement plate at least .120" thick and of at least 18 square inches in area which is welded to the body shell.
3. Examples of mounting feet and reinforcement plates are shown in figures 253-18 to 253-24 of the FIA rules.
4. Bolts must be of at least M10 or 3/8<sup>th</sup> inch size. Bolts may be either of ISO Standard 8.8 or Metric Standard 10.9, or SAE grades 5 or 8.
5. Fasteners must be self-locking or fitted with double nuts. Only flat washers may be used.

Neither rollbar tubes nor rollbar mounting feet may be welded directly to the body shell without a reinforcement plate.

### **6.2.3 Reinforcement plates**

These are plates welded to the bodyshell used for attachment of the cage, either by direct welding or via mounting feet.

Reinforcement plates must be a minimum of 1/8" thick, and have an area of 12 to 100 square inches, with a minimum dimension on any side of 2.5" and a maximum dimension on any side of 12".

### **6.3 Gusset construction**

Refer to figure 253-16A in the FIA rules for a typical gusset made from sheet metal. Gussets are required to be made as follows:

1. U-shaped sheet metal (taco shell). Refer to figure 253-16A in the FIA rules for a typical gusset made from sheet metal. Minimum thickness is .040" (1 mm). Minimum length along the unwelded side of the gusset is 3 times the tubing diameter.
2. Round tubing. Minimum length of the longest dimensions is 3 times the tubing diameter. Minimum tubing diameter is 1" with minimum wall thickness of .083". Maximum diameter and wall thickness is per the materials in table of section 6.6.
3. One or 2 triangular plate steel gussets with combined thickness equal to the tubing which is being gusseted. Minimum length along the unwelded side of the triangular gusset is 3 times the tubing diameter.

Any plate or u-shaped gusset that is welded into a joint location where it can block the view of the welds between the tubes being reinforced must have the corner cut back to enable visual inspection of the tube joint. This is illustrated in figure 253-16A and typically looks like a 'bite' out of the corner of the gusset.

### **6.4 Removable Members**

Should removable members be used in the construction of a roll cage, the dismountable joints used must comply with a type approved by the FIA. (See FIA International Sporting Code Appendix J, figures 253-37 through 253-47.)

The nuts, bolts, and washers must be of at least M8 or 5/16<sup>th</sup> inch size, and of ISO Standard 8.8 or Metric Standard 10.9, or SAE grades 5 or 8. Self-locking nuts or double nuts are required to secure nuts. Only flat washers are allowed.

Dismountable joints must not be used for joining the roof level connections between main, front, lateral, or half lateral rollbars because they act as hinges in the principal structure and allow deformation. Their use is solely for attaching diagonal and reinforcing members to the rollbars.

**6.5 Guidance on Welding**

All welding must be of the highest possible quality with full penetration and preferably using a gas-shielded arc.

The welds must be continuous around the whole perimeter of the tube at each joint.

The external appearance of a good weld does not necessarily guarantee its quality. However, evidence of poor quality welds by appearance is usually a basis for rejection.

When using head-treated steel the special instructions of the manufacturers must be followed (special electrodes, gas protected welding). It must be emphasized that the use of heat-treated or high carbon steels may cause problems and that bad fabrication may result in a decrease in strength (caused by brittle heat-affected zones), inadequate ductility and internal stress. Use of heat-treated or high carbon steels is not allowed after 3/1/2005.

**6.6 Material Specifications**

Material: All cages built after 3/1/2005 shall be constructed of either CDS (Cold Drawn Seamless) or DOM (Drawn Over Mandrel) unalloyed carbon steel tubing containing a maximum of 0.3% of carbon and with a maximum content of additives of 1% for manganese and 0.5% for other elements. It is required that mild steel be used after 3/1/2005.

The tubing must be bent by a cold working process and the centerline bend radius must be at least 3 times the tube diameter. If tubing is ovalised during bending, the ratio of minor to major diameter must be 0.9 or greater.

The minimum size of tubing to be used shall be as follows:

**Tubing size configuration 1: Allowed for all cars**

Dimension (in)	Dimensi on (mm)	Use
-------------------	--------------------	-----

1.75" x 0.095" or 2.0" x 0.083"	45 x 2.5 or 50 x 2.0	Main rollbar (figure 253-39) Lateral rollbars and their connections (figure 253-40)
1.5" x 0.095" or 1.6" x 0.083"	38 x 2.5 or 40 x 2.0	Front rollbar and lateral half roll bars, and all other connecting and reinforcement members

**tubing size configuration 2:** Allowed for cars weighing 2650 lbs or less, in full rally configuration (with full fuel but without drivers).

Dimension (in)	Dimension (mm)	Use
1.5" x 0.120"	38 x 3.0	Must be used for all portions of the main cage structure including: Main rollbar, front rollbar, lateral rollbars, and lateral half roll bars, and all connecting members at the roof level.
1.5" x 0.095"	38 x 2.5	All other connecting and reinforcement members