ALRC Roll-Cage Regulations

NOTE: Road Taxed Vehicle Trials vehicles do not require roll-over protection. These regulations relate to Cross Country Vehicles trials vehicles only. For all other classes, see the Motorsport UK current Yearbook Section K, Safety.
Vehicles with a chassis should follow these regulations; monocoque vehicles should follow Motorsport UK roll-cage designs.
Each paragraph and drawing is identified by a number as an aid to identification and subsequent amendment.
If you need any further clarification, please contact any members of the Scrutineering and Off-Road Committee members; list inside front cover.

INDEX of TOPICS

1 Roll-Cages

1.1. Introduction

1.1.1. Cross Country Vehicles are likely to overturn during a fiercely competitive event. There is, therefore, a basic requirement to protect the driver from injury should this happen The roll-cage should be able to withstand reasonable impact without deformation, unlike designs used in other branches of motor sport where a crushable, energy absorbing structure working in conjunction with the monocoque structure of the vehicle is used.

1.1.2. When is a roll-cage needed?

Event	Open / Soft top vehicle	Hard-top vehicle
RTV	Not applicable	NO
CCVT	CAGE (with centre bar)	CAGE

Comp Safari, Timed Trial, Team Recovery, Point to Point, see the current Motorsport UK Yearbook for regulations.

1.2. General Points and Advice

1.2.1. If you are buying a second-hand roll-cage from a 'friend', examine it yourself, don't rely on his assurance that it *"has been over thousands of times and is still all right"*. Rolling over gently at a trial is different from the bone-breaking jars of a Competitive Safari roll. Your 'friend' may not have even stressed the cage if the vehicle has only fallen on its side.

1.2.2. Is the design to an ALRC pattern? If not, you will not be allowed to compete in ALRC events that require a roll-cage.

1.2.3. CHECK, and check carefully, scrape / wire brush paint from all welds and ensure that they are welds and not just blobs of metal ground away to look reasonable with a layer of paint on top.

1.2.4. If the metal is pitted, this will have been caused by rust, if it is pitted on the outside think what it will be like on the inside. You do not want that cage.

1.2.5. A second-hand cage can be a very dangerous thing to buy without fully knowing its history. If a second-hand car breaks down, it's unlikely to harm you, if a second-hand roll-cage breaks down it will do so because there is nearly 2 tons on top of it with you as the meat in the sandwich; not very healthy.

1.2.6. Making a roll-cage yourself can also be a very trying experience with a tube bender being a simple looking device which is not so simple to use. Inexperience with one leads to bends not being in the same plane, not allowing for the 'spring' in the material and getting the bends in the wrong place; all good fun!

1.2.7. Don't forget, as well, when welding it up after careful bending/cutting the tube will distort, expert welding will minimise distortion and knowledge built up in the fabrication trade will assist. Without it, you are in for disappointment.

1.2.8. If using galvanised tube ensure that you grind the zinc coating off first. Failure to do so will result in poor welds and breathing problems caused by the toxic gasses given off by the welding process.

1.2.9. Some dangers of 'home' building have been highlighted as have some of the second-hand buying pitfalls. With care they can be avoided, seek expert advice before stepping out into the roll-cage field.

1.2.10. A roll-cage is probably the second dearest thing you will have to get when competing in cross country events. Indeed, it may even be dearer than the vehicle you compete in.

1.2.11. It is well worth buying one that is sound and solid. If you have any doubts about the ability of the manufacturer, the answer is simple, don't get it. It may be the advice is "don't make it yourself". You know your capabilities, it is your life you are dealing with and that of your navigator. Please do not treat it lightly.

1.2.12. If you can't make the roll-cage yourself and no-one you know personally can make one for you, then your best bet will be to buy one from one of the many companies making, selling and / or installing roll-cages built to ALRC specifications. It's still your responsibility to ensure that it really does comply with the following regulations.

1.2.13. Never forget that the basic purpose of a roll-cage is to protect the driver / passenger should the vehicle roll over or have a serious accident. No matter what the 'car' rally man may say, due to the nature of the ground that we cross this sport is potentially the most dangerous, the forces involved in a 30 mph Land Rover roll roughly equate to rolling at 100 mph in a Formula One car (if one relates purely to weight differences). More if one considers that a Formula One vehicle normally scrapes across flat ground, CCV competitors do not.

1.2.14. Roll-cages must be able to withstand these three loads simultaneously:- 1.5g lateral, 5.5g fore and aft, 7.5g vertical.

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2. DESIGN.

2.1. The drawing below gives a very simple general idea of the position and size of a basic roll-cage.
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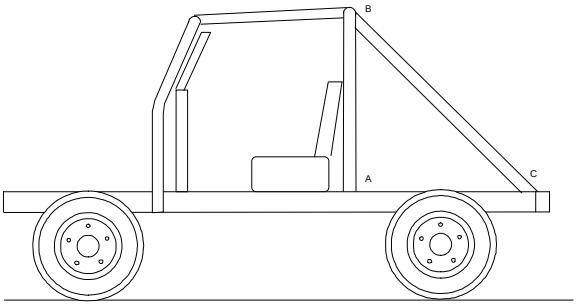
2.2. (DRAWING)



A Foot of main hoop in front of load space, close behind driver's seat.
B Top of bar inside roof or 2"/50mm above driver's head/helmet. SJK
C As far aft as possible in the load area.

2.3. The main hoop and the windscreen or front hoop will run across the width of the vehicle. Its height will be determined by the requirement for there to be a distance of at least 50mm / 2" from the top of the driver's head (when crash-helmeted as applicable) to the top of the bar and be as wide as possible within the vehicle's body.

2.4. The main hoop, behind the driver, should be vertical. It should be as close as possible to the back of the driver's seat.

3. Materials and Components.

3.1. The minimum material specification for all tubing will be **nominal** 38mm / 1½" bore steel "blue band" tubing to BS 1387. (This will actually be nearer 42mm / $1^5/_8$") This has a minimum wall thickness of 3.2mm / $^1/_8$" and a minimum outside diameter of 48.3mm / $1^7/_8$". See table below for practical imperial and metric stock sizes. Tensile strength will be between 320 - 416 N/mm^2. Yield strength will be at least 195N/mm^2. Tubing which exceeds this specification is recommended where the outside diameter at least matches the above type and a minimum nominal wall thickness of 2.5mm where the quality and origin can be traced."

3.2. All hoops (main and front) and the diagonal shall each be made of one continuous piece of tube. Bracing bars, both rear and diagonal, may be made detachable or jointed as specified later.

3.3. Materials pitted with rust are not permitted.

3.4. Hoop corners must not be separate sections and clamps or angled corners are prohibited. Corners where the tube has flattened or is showing signs of 'crimping' are not allowed, neither are tube ends flattened or crimped for ease of welding. The ratio of minimum diameter to major diameter is 0.9 or greater. Tube ends should be correctly shaped to fit the bar they are joined to. Bend radius must be at least three times the tube diameter.

3.5. Any plugs inserted into the tubing for the purposes of preventing crushing or in the making of joints (see later) will be made from EN8 or equivalent (or better) material.

Below is the table showing the dimensions of permitted materials:-

3.6. (TABLE)	BS1387*		CDS	
ITEM	Imperial size (inch)	Metric size, (mm)	Metric size, (mm)	*Practical Metric size*
Diameter for all tube including bracing / supporting bars.	$1^7/_8$" o/d	48 to 48.8 o/d	47.6 o/d	-

Tube wall thickness	$^1/_8$	3.2	2.5	-
Roll-bar base-plate thickness	$^1/_8$	3.2	3.2	-
Any other plate / bracket thickness.	$^1/_4$"	6.4	-	*6*
Mounting bolt sizes (HTS)	$^3/_8$"	9.6	-	*10*

*1387 tube is sold by it's nominal bore, which is known as 40mm / 1½".

3.7. All of the above are minimum sizes and may be exceeded.

3.8. **Welding**

3.8.1. Welding should be carried out to the highest standards.

3.8.2. Welds should be cleaned, but **not ground or filed** after completion.

3.9. **Inspection Holes**

3.9.1. An inspection hole $^3/_{16}$" / 5mm diameter must be drilled through every section of tube used. It should be drilled in a straight length at least 100mm / 4" from a bend and in a position so as to minimise water entry and where it can be seen easily.

3.9.2. The only permitted drilled hole is a hole of 3/16" diameter for inspection purposes on roll cages and fabricated bulkheads unless current regulations allow. Grandfather rights can be given to vehicles with existing holes for the roof panels but these vehicles can only be used for CCVT and not speed events. All new builds must comply with the rule. Vehicles with drilled holes for wings or attachments for doors - With relation to bulkheads where the front cage is a bulkhead it can be used until the next re-log booking when it needs to be altered to a bulkhead with no holes.

3.10. **Nuts and Bolts**

3.10.1. All nuts and bolts used in securing a roll-cage should be made from high tensile steel.

3.10.2. Plated or corrosion protected / treated nuts and bolts are recommended. Where possible use plated nuts and bolts, the best quality high tensile steel bolt will still rust unless treated. There is no substitute for getting them with a finish that will not rust; self coloured or black ones come with only a covering of light oil that will soon go and the corrosion problems begin.

3.10.3. All high tensile bolts must have appropriate markings on the head; if it has only manufacturer's markings or it has a plain head do not use it. The markings can consist of either letters (UNC, UNF and Whit. threaded bolts) or numbers (Metric or ISO Metric). The letter to look for is 'S' or a higher letter or the number 8.8 or higher. (For the technically minded, the 8.8 designation is two separate numbers. The first '8' is the tensile strength, i.e. the load at which the material begins to fail, given in units of 100MPa or MN/mm^2, giving 800 MN/mm^2 or 800,000,000N/m^2. Convert this to kg by dividing by gravity (9.81m/s^2) say 10, to give 80,000,000kg/m^2, and then divide by 10^4 to convert to cm^2 which gives 8000kg/cm^2 or 8 tonnes/cm^2. The second part of the designation '.8' is then used to generate a decimal fraction of the first part, i.e. 8 x 0.8 = 6.4 or 640Mpa, 6.4 tonnes/cm^2. This is the yield strength, i.e. the load at which plastic deformation of the material occurs.) Stainless Steel bolts usually have a tensile strength of 5 Tonnes/cm^2, 33 tons/in^2 (marked A2 for Stainless Steel and 'M' for the strength) so be warned! Some bolts may be marked in Newtons per square centimetre, in which case high-tensile means over 80N/cm^2. Do not get confused with the manufacturer's name code, e.g. GKN, SN, BP, etc. High tensile bolts must always be fitted with high tensile nuts, and these will also have appropriate markings. Usually, there will be a marking on the face (not the flat) of the nut and this may be out of sight when fitted depending which way up you screw it on. Nyloc nuts are often plated but should still show this mark; you don't have the option which way up this type of nut goes and this mark will not be visible on assembly. A figure 8 will equate to a grade 8 specification and must be used with a grade 8 bolt. Nuts may also have a "clock code". There may be a dot and a stroke. With the dot at the top (12 o'clock position) look to see where the stroke is. A stroke at the 8 o'clock position indicates a grade 8 nut. You must be able to prove to a scrutineer that the nuts and bolts used meet these specifications. If in doubt, ask the supplier for a chart that shows the meaning of the markings.

3.10.4. Plain nuts must always have lock nuts or they must be self locking types. There are several of these ranging from 'Nyloc' to 'split ring' types. Alternatively, use castellated nuts and split pins or tab washers. You must always use a washers under the nuts and these should be suitable for the type of nut.

3.10.5. Also remember, a set screw with the thread running from tip to the head is not a bolt (which has the thread running from the tip to the shank - approx. $^{2}/_{3}$ the length of the bolt) and is not designed to bear a shear load. The plain shank is designed to do that, a thread is designed to use the nut on. Drill the holes to fit your bolts (or buy your bolts to fit the holes!) and do not have any gaps round them.

3.10.6. Bolt (and other material) sizes shown in this book are given in Imperial and Metric sizes. For nuts and bolts, you may not be able to get 9.6mm, ($^{3}/_{8}$"), for example - always get the next largest 'whole' number size, e.g. 9.6mm = 10mm.

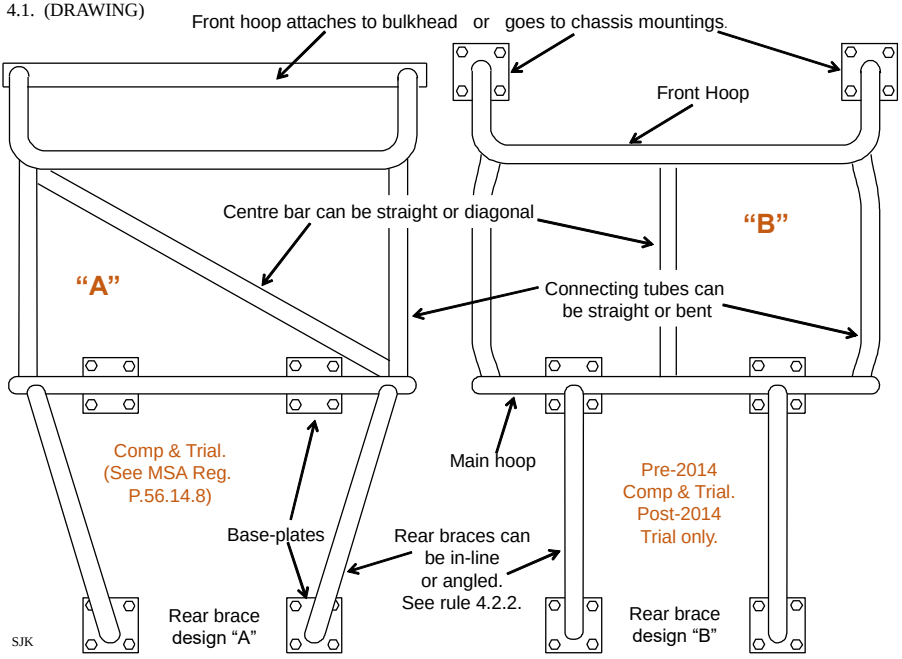
3.10.7. The following table may be helpful.

Imperial (inch)	Metric (mm)	ITEM
$^{1}/_{8}$	3	Tube wall thickness
$^{3}/_{16}$	5	Bolts
$^{1}/_{8}$	3	Bolts & Plates
$^{1}/_{4}$	6	"
$^{5}/_{16}$	8	"
$^{3}/_{8}$	10	"
$^{1}/_{2}$	13	"
$^{9}/_{16}$	15	"
$1^{7}/_{8}$	48	Roll-cage tube
2	50	"
12	305	1 foot
36	915	3 feet / 1 yard.

The following information on roll-cages, outriggers, mountings, seat-belts etc. represents minimum specifications which may be added to as required.

4. CONFIGURATIONS

4.1. (DRAWING)



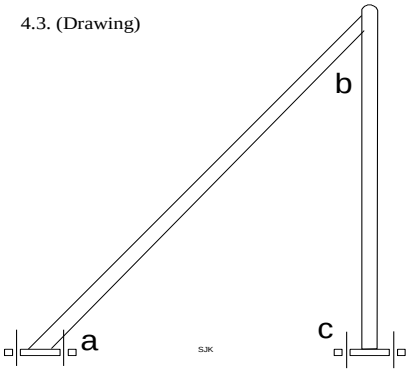
4.2. These two plan-view drawings show:-

4.2.1. Alternative types of tube connecting the main hoop to the front hoop. Straight or bent ones may be used subject to the limits shown on the next page.

4.2.2. Alternative positions for the rear braces where they join the main hoop. See drawing 4.1. Rear brace design "A" may be used for any events but is mandatory for Competitive Safari and Point-to-point. Rear brace design "B" may be used for any events other than Competitive Safari and Point-to-point, and be fitted in the area between the two positions shown.

4.2.3. Alternative positions for centre-bar or diagonal which is required for open vehicles only. If two or more centre bars are fitted, they should be evenly spaced.

4.3. (Drawing)

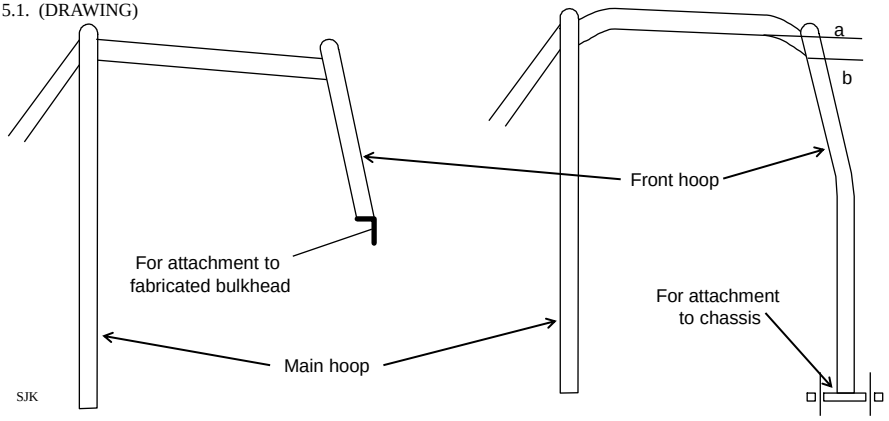


4.4. The feet spacing 'a' to 'c' should be as far apart as possible within the load area. The smaller the angle abc at the top, the less effective are the bracing bars.

4.5. Read on for methods of attachment to chassis.

5. Front hoop mounting and attachment methods.

5.1. (DRAWING)



5.2. The front hoop should run across the width of the vehicle and the top part must not lean back any further than the angle of the windscreen. Bends may be used on the connecting bars between the front and rear hoops but should not have more than 4" / 100mm between 'a' and 'b' as shown above. The angle of the windscreen should be that of a 90/110 for any Series or Defender vehicles (The front hoop on any Series vehicle or 90 / 110 / Defender vehicles may lean back by an angle of no more than 33º from the vertical) or the actual angle on other types; even if a windscreen or its pillars are not fitted.

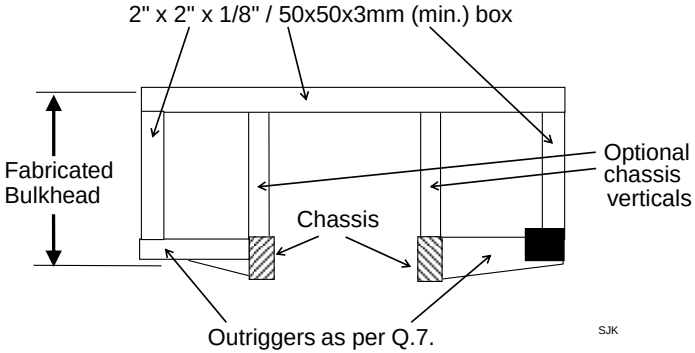
5.2.1. If a bulkhead fabricated from tube and angle is used, the front hoop may be welded or bolted to the top edge box material.

5.2.2. If the front hoop continues down to become a part of the fabricated bulkhead structure, then the mounting must be as shown in "Integrated front-hoop/bulkhead assembly" diagram. See para. 7.6.

5.2.3. Where a standard / original bulkhead is used, the front hoop must bear down onto the chassis or suitably strengthened or fabricated outriggers as shown in para. 7.1.

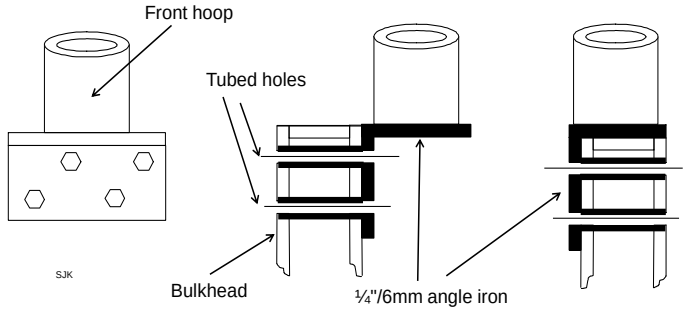
5.3. Fabricated bulkheads
and various methods of bolting or welding the front hoop to a bulkhead fabricated from box-section.

5.3.1. (DRAWING)

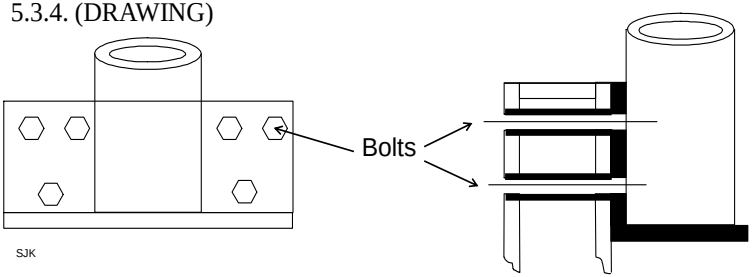


5.3.2. The item shown as "bulkhead" in the following drawings refers to a bulkhead fabricated from box-section or roll-cage grade tube.

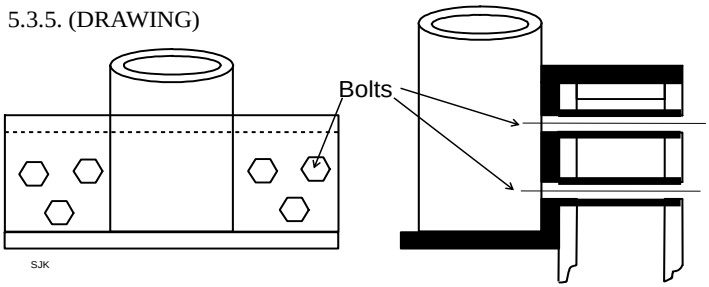
5.3.3. (DRAWING)



5.3.4. (DRAWING)

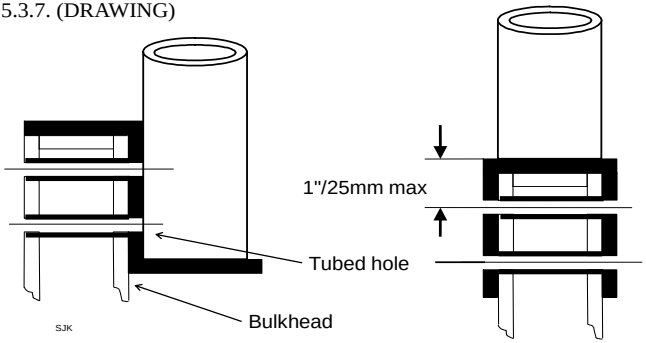


5.3.5. (DRAWING)

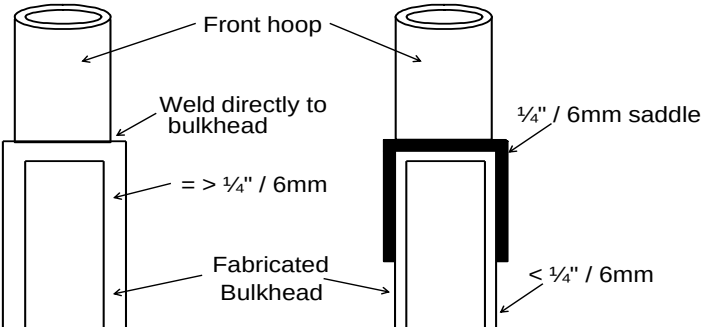


5.3.6. Note that the hoop always rests on top of the angle iron to facilitate welding and to prevent load being taken entirely on the weld. All bolts are to be a minimum of $^{3}/_{8}$" / 10mm high tensile steel.

5.3.7. (DRAWING)



5.3.8. (DRAWING)



5.3.9. (left above) Where the tube material is equal to or greater than ¼" / 6mm, then the hoop may be welded directly on top.

5.3.10. (right above) Where the tube material is less than ¼" / 6mm, then a saddle of at least ¼" / 6mm steel must be used as shown.

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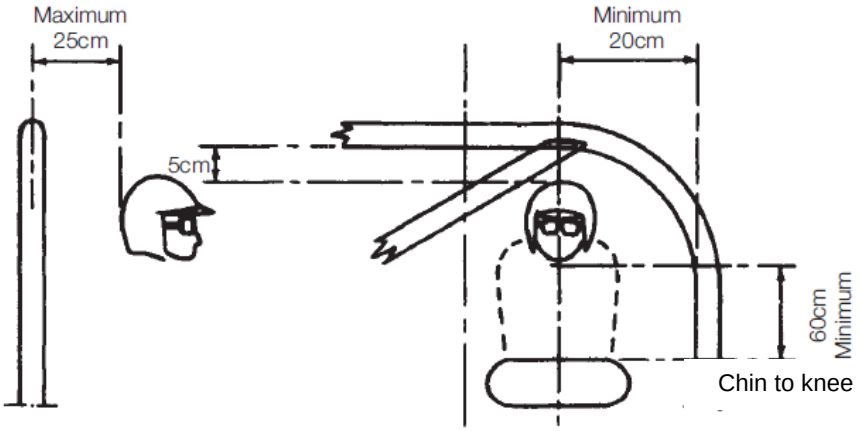
6. Internal Main hoop with external Front Hoop

6.1. The diagram below shows the general requirements for the fore/aft, left/right, and up/down dimensions between the occupants and the roll-cage.

6.2. (DRAWING. Motorsport UK Section K drawing 31)

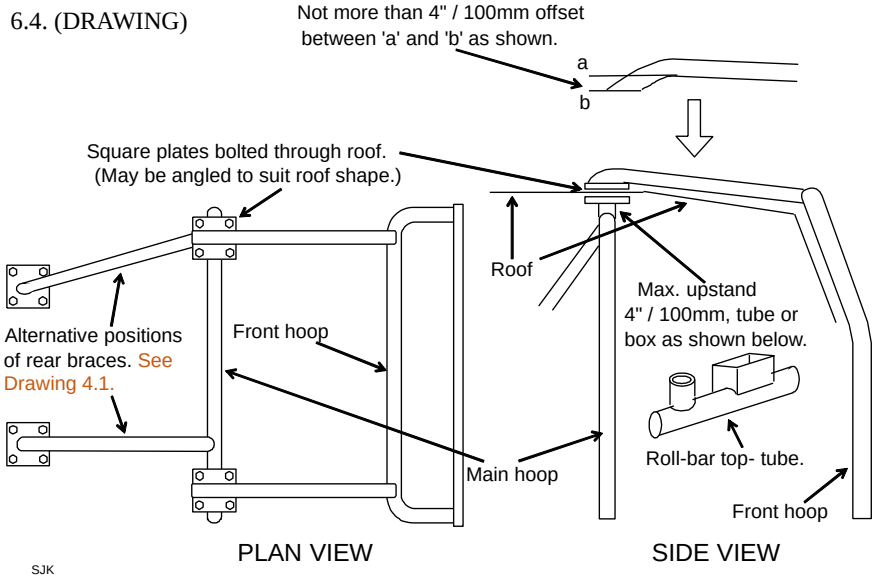


Drawing No. 31

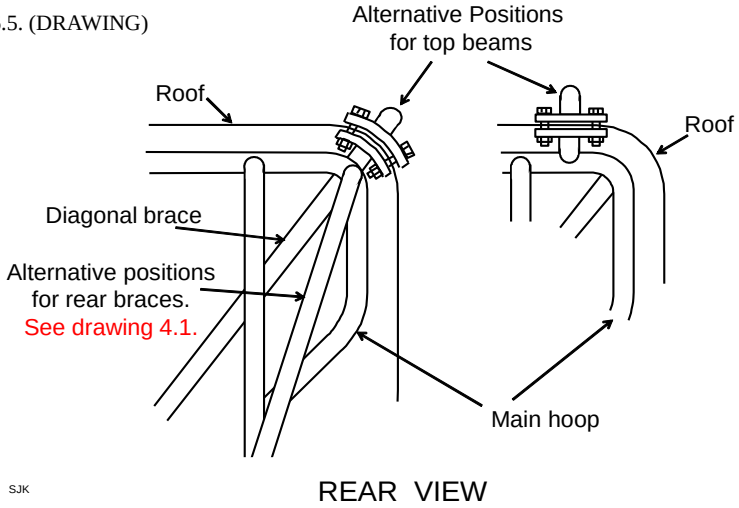
6.2. If you need to have the front hoop on the outside of a hard-top or soft-top with the main hoop inside, the following design may help. The square plates that sandwich the roof panel are of standard design defined elsewhere. The plates may be level or angled to suit the shape of the roof. There must be no more than 4" / 100mm between the top of the roll-cage top tube and the inside of the roof. The difference may be made up with round tube as used for the roll-cage, or by box section at least 2" / 50mm square by $^{1}/_{8}$" / 3mm wall. On soft-top installations, the main hoop may replace the first tilt-frame with only the bolt holes perforating the material.

6.3. The joint shown in drawing 8.2.14. could be used to make an adjustable upstand, if inverted from the way it is drawn.

6.4. (DRAWING)



6.5. (DRAWING)

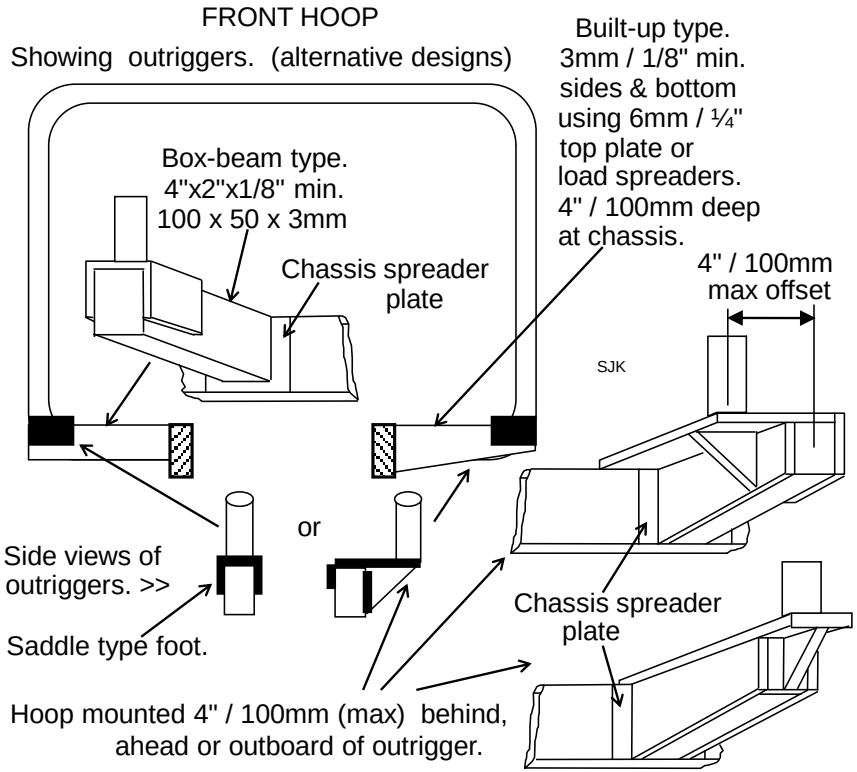


7. Front Hoop Designs and Attachments to Chassis

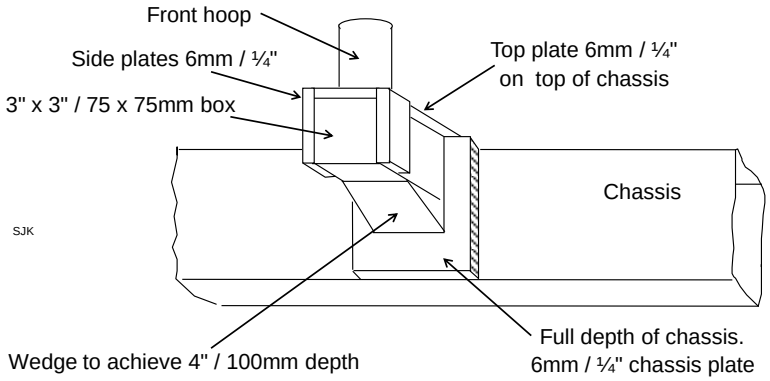
7.1. The drawing 7.3. shows details on how to attach a front hoop to existing outriggers or to fabricated ones. All types of outrigger should be at least 4" / 100mm deep at the chassis, but on coil-sprung vehicles, the outrigger must be as deep as possible but still provide clearance for the front suspension radius arms.

7.2. If it is not possible to bring the front hoop leg straight down onto an existing outrigger, the mount may be offset by up to 4" / 100mm ahead, behind or outboard as shown bottom right of drawing 7.3.

7.3. (DRAWING)



7.4.(DRAWING)



7.5. The drawing above shows how the 4" / 100mm depth at the chassis can be achieved. The wedge must be at least half the span of the outrigger.

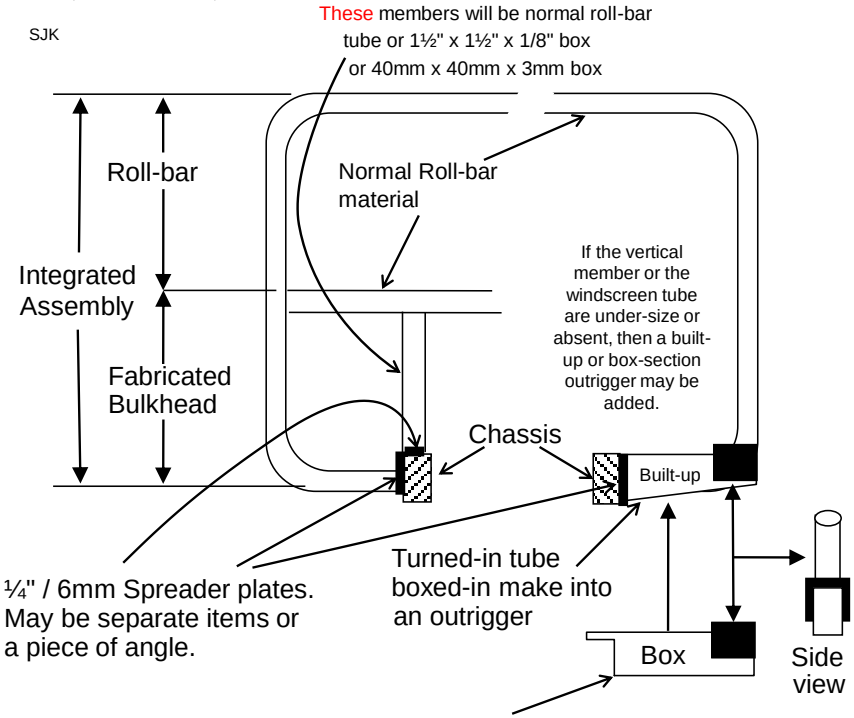
7.6. Integrated front hoop / bulkhead assembly

7.6.1. In this variation, the front hoop side pieces turn in and are welded to the side of the chassis. This is permissible where the front hoop forms part of an integrated front-hoop / bulkhead assembly. The front hoop is neither cut nor welded where it changes from being the front hoop to being a part of the bulkhead. See drawing 7.6.4.

7.6.2. This type of structure is acceptable so long as all the provisions detailed in the drawing are adhered to. Otherwise, box-section outriggers should be used to support the ends of the front hoop. If the all-round hoop has been fitted but is **not** part of the integrated assembly, then boxing in the existing turned-in tube is acceptable.

7.6.3. If the spreader plates are not present on the chassis or additional members are under the size shown or are absent, then an outrigger must be fitted. This can either be built up around the turned in tube as shown using $^{1}/_{8}$" / 3mm plate or a box-section outrigger fitted as shown. Don't forget the ¼" / 6mm spreader plate on the chassis or make the top plate of the outrigger from this thickness material.

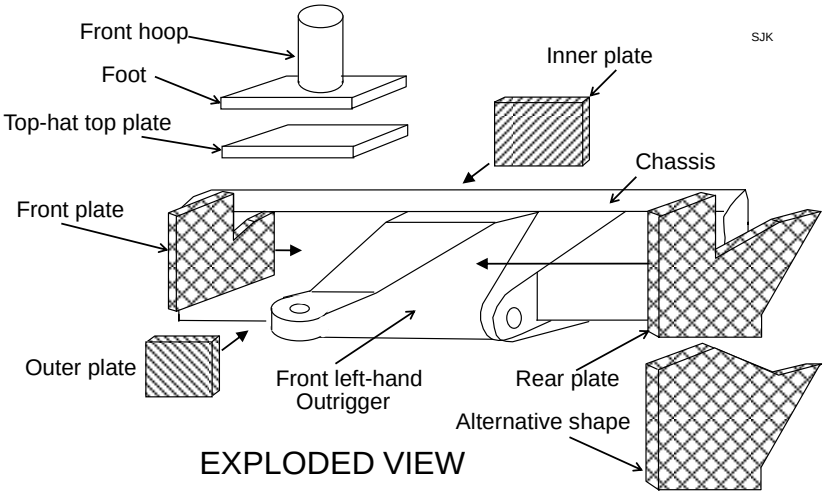
7.6.4. (DRAWING)



7.7. Range Rover / Discovery mounting to front Outrigger.

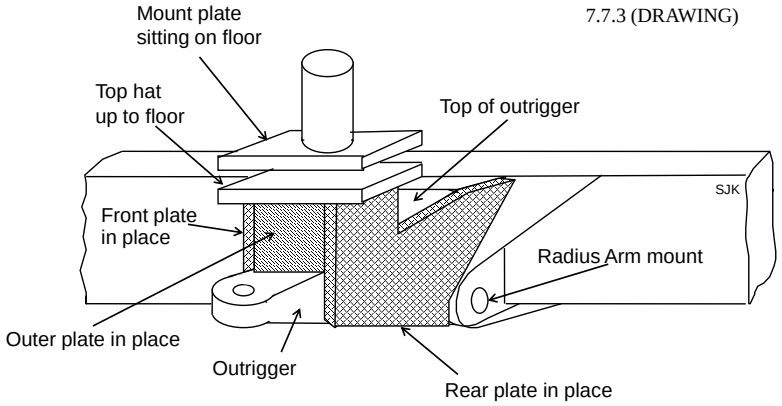
7.7.1. Mounting the front hoop in a Range Rover or Discovery can be difficult but the following "top-hat" guidelines might help. This uses a standard ¼" / 6mm foot sitting on the floor and bolted through to the "top-hat" underneath. The principle is the same as the rear-brace mount shown in 9.2.3. for the 90 where a box-section upstand with a flat plate on top in used. As far as reinforcing the outrigger is concerned, add ¼" / 6mm plates to the outrigger. These should extend inwards to the chassis. The rule-book states that they should be 4" / 100mm deep at that point but the front radius-arm mounts and the shallow front-face of the outrigger itself make these dimensions hard to achieve in practice. The side-plates and the parts of the "top-hat" could possibly be cut as shown to simplify matters. Plate over the inside and outside of the "top-hat" box as shown.

7.7.2. (DRAWING)



EXPLODED VIEW

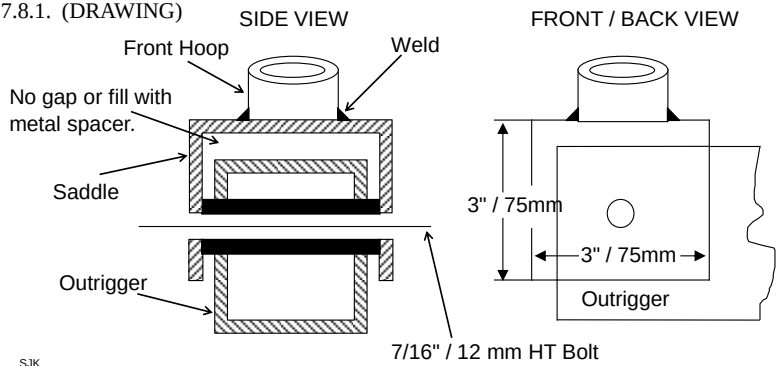
7.7.3 (DRAWING)



ASSEMBLY

7.8. Front Hoop Mounting to Outrigger on SI - III & 90 / 110 etc.

7.8.1. (DRAWING)



7.8.2. The hoop is welded to the saddle, and the saddle is attached to the outrigger with the high tensile outrigger / bulkhead bolt (which also secures the bulkhead).

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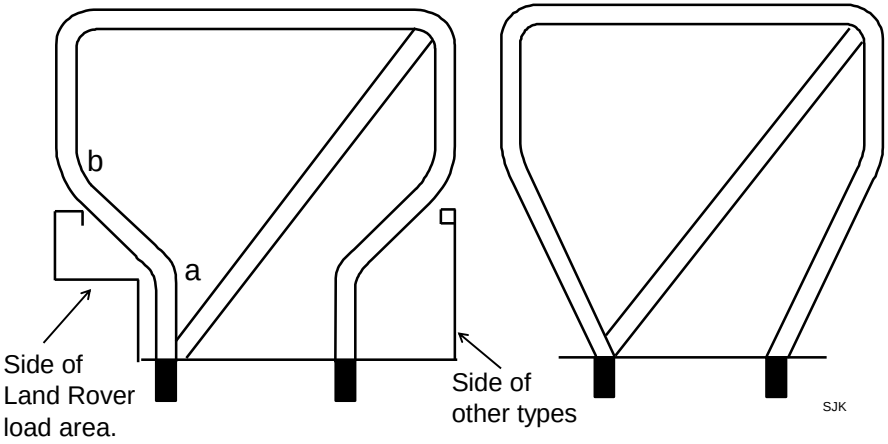
8. Main Hoops

8.1. Standard Design

8.1.1. All diagonals will go to the top of the driver's side.

8.1.2. (DRAWING)

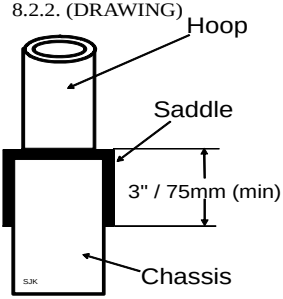


8.1.3. Above left shows the basic design. The less the amount of bend at points ‘a’ and ‘b’ will proportionately increase the strength of the bar. The bend at ‘a’ can effectively be reduced to a straight tube as shown above right.

8.2. Methods of Securing Roll Cages to Chassis

8.2.1. In the following drawings, the rectangle identified as "Chassis" can also be taken to be an outrigger. The attachment principles are the same.

8.2.2. (DRAWING)

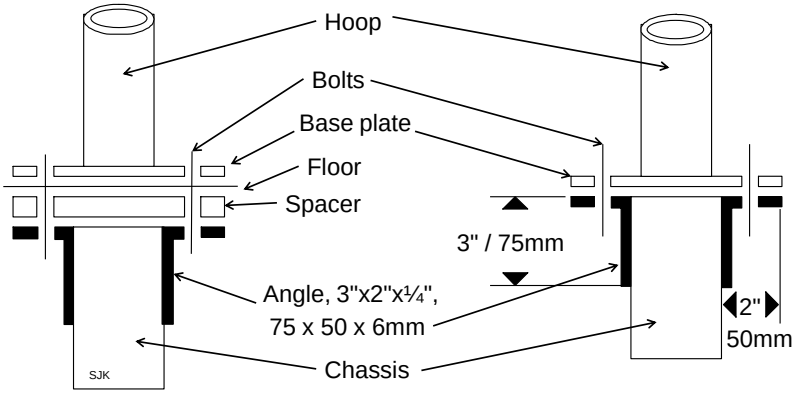


8.2.3. The drawing (8.2.2.) shows the basic principle of a "U"-shaped channel welded over the chassis. There must be no gaps between the channel and the chassis.

8.2.4. The "saddle" shown may be an inverted "U" channel, two lengths of angle or three flat plates. The objective is to spread the load over a large area of chassis rather than concentrate the loads on a 2" / 50mm (or thereabouts) diameter spot.

8.2.5. Roll-cages can be made detachable as shown in the following drawings. The ”U”-shaped saddle is replaced with lengths of angle and a base-plate is fitted to the roll-cage tube. The assembly is then bolted as shown.

8.2.6. (DRAWING)



8.2.7. Above left:- Bolting through a floor. The angle iron is welded to the chassis and a spacer / packing piece will almost certainly be needed to fill the gap.

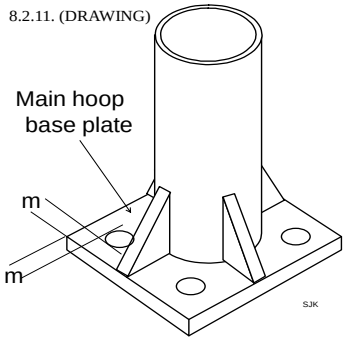
8.2.8. Above right:- Cut-away or no floor panel. As before but the plate sits directly on the chassis and the spacer is not required.

8.2.9. In many of the foregoing drawings, a packing-piece / spacer is shown fitted between the floor of the load area and the chassis. Close fitting pieces of metal or ‘Tufnol’ or similar material (but not wood) the same size and shape as the foot / base-plate must be used to pack the gap between the chassis and the floor. It may be necessary to taper this packing due to the varying gap. The aluminium floor will not take the strain imposed by the legs / feet of the roll-cage.

8.2.10. The base-plate / feet shall be at least 5" x 5" x ¼" / 125mm x 125mm x 6mm steel plate. Bolt holes shall have at least 1½ x bolt-diameter edge margin, i.e. edge of bolt-hole to

edge of plate, angle or bracket shall be at least 1½ times the diameter of the bolt. (See 8.2.11.)

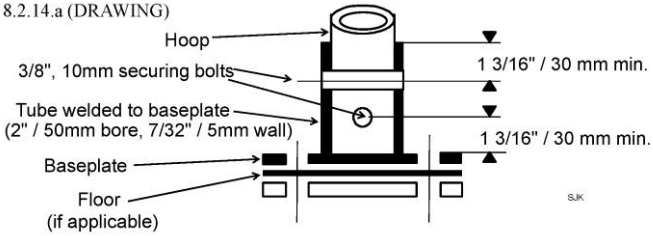
8.2.11. (DRAWING)



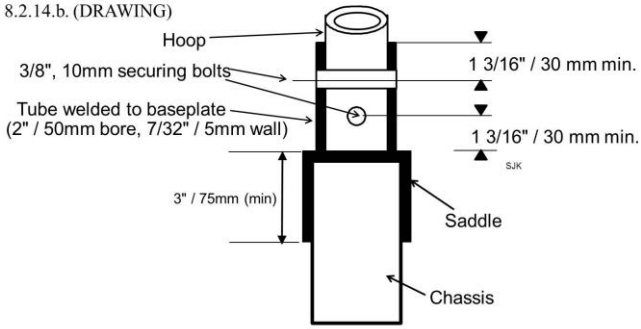
8.2.12. The use of flitch plates or webs around the base of the bars and bracing will greatly increase the strength. All base-plates shall be at least 125mm x 125mm x 6mm / 5" x 5" x ¼" thick mild steel.

8.2.13. Hole edge margin "m" shown on sketch 8.2.11 shall be at least 1½ x hole diameter. This applies to other brackets and plates.

8.2.14.a (DRAWING)

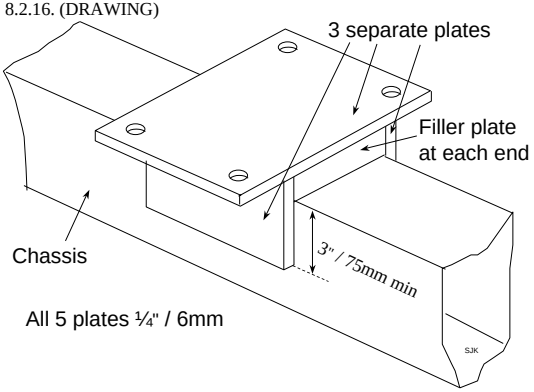


8.2.14.b. (DRAWING)



8.2.15. Above is a type of mounting enabling the roll-cage to be removed leaving only the socket in situ in the vehicle. This is suitable for either the front or back hoop as a base foot mounting.

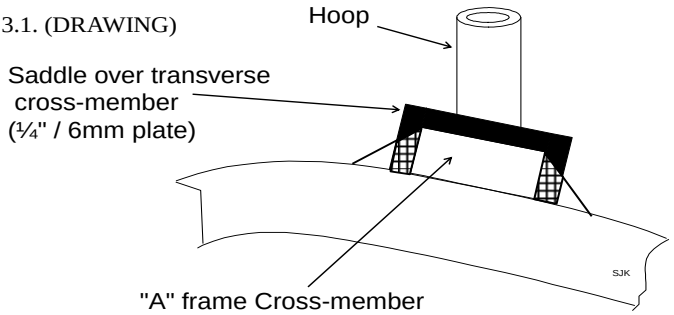
8.2.16. (DRAWING)



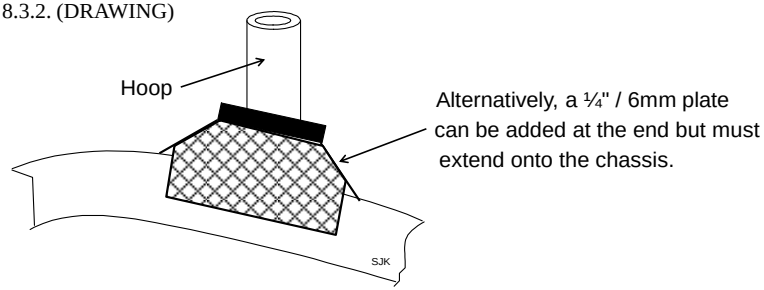
8.2.17. Above is a type of mounting that fills the gap between the chassis and the floor, enabling the roll-cage to be removed easily. The height of the top plate above the chassis can be varied to suit the vehicle.

8.3. Standard Shape Hoop Mounting onto "A"-Frame Cross-Member.

8.3.1. (DRAWING)



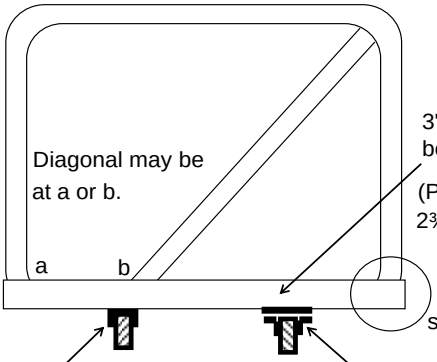
8.3.2. (DRAWING)



8.4. Main Hoop Design and Installation for Range Rover / Discovery and other Long Wheelbase Station Wagons.

8.4.1. The following design has been devised to give access to the rear seats in all long wheelbase vehicles. It is a "D" hoop mounted on a substantial box-beam. The methods of attaching the hoop to the beam and the beam to the chassis are shown in detail. The diagonal can go in either the "a" or the "b" position. The diagonal and the rear braces can be made detachable using methods shown later. On a Range Rover, the rear braces just clear the top of the back seats.

8.4.2.(DRAWING)



3" x 3" x 1/8" / 75mm x 75mm x 3mm box beam or channel (nominal size.)

(Practical available stock sizes:- 2¾" x 2¾" x ¼" or 76.2mm x 76.2mm x 3.25mm)

see next drawing

SJK

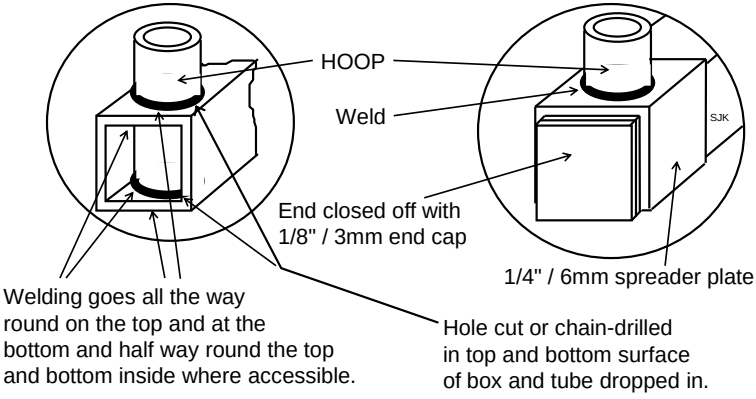
Weld to the chassis with appropriate channel-type load spreader or....

...use the baseplate and angles method of securing.

8.4.3. The design shown above is for use in Range Rover, Discovery and any other Long Wheelbase station-wagon vehicles. They give a more stable base due to the extra width of these vehicles and give back seat accessibility

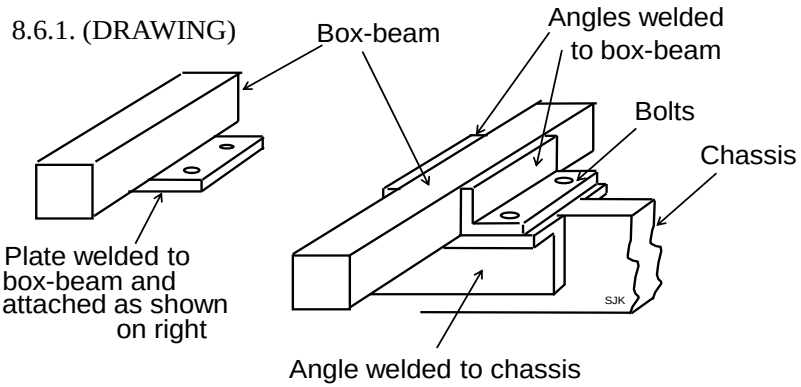
8.5. Methods of attaching the hoop to the box-beam

8.5.1. (DRAWING)



8.6. Methods of attaching the box-beam to the chassis.

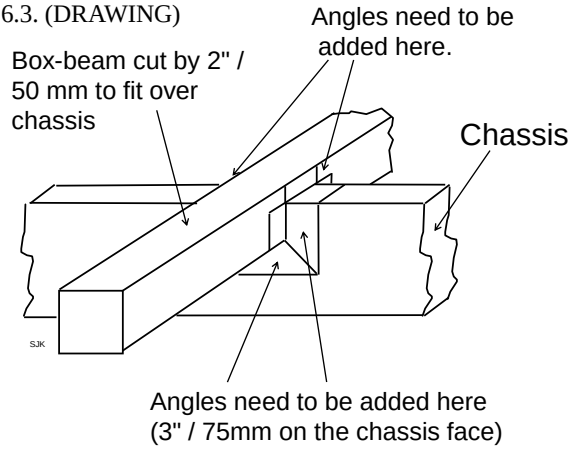
8.6.1. (DRAWING)



All angles to be 3" / 75mm deep with 2" / 50mm flange x ¼" / 6mm thick, min.

8.6.2. On early Range Rovers, the rear floor can easily be removed and new panelling fitted round this assembly after installation.

8.6.3. (DRAWING)



8.6.4. On Discoveries and later Range Rovers, the floor panels are welded in. The method shown at left can be used to mount the box-beam below floor level by cutting the beam by 2" to fit over the chassis. Angles welded at the joints should adequately restore the area to full strength.

8.6.5. This method is stronger than reinforcing existing outriggers or adding fabricated ones.

8.6.6. Spreader plates are not required where the roll-cage tube is welded on to ¼" / 6mm wall thickness box material.

8.7. Roll-cages on 101" Wheelbase Forward Control Land Rovers

8.7.1. The major problem with this vehicle is that the roll-cage needs to straddle the engine making it impossible to run the requisite diagonal from the top corner of the hoop down to the chassis in the normal way. This particular vehicle type was not considered when the original roll-cage regulations were drawn up. The following design has been passed by the ALRC Council and the Scrutineering Committee for use on this vehicle type only.

8.7.2. The outriggers can easily be re-inforced if necessary with the addition of a 6mm / ¼" top plate extending onto the top of the chassis. The cab can sit on top of this too. There are usually some shims between the cab feet and the top of the outrigger (typically 3mm / $^{1}/_{8}$") but the addition of the reinforcing plate would raise the rear of the cab by a maximum of 6mm / ¼". This shouldn't cause a problem as the cab is a large unit.

8.7.3. Additional side plates can be added to the front face of the outrigger. There are usually some shims (typically 3 to 6mm / $^{1}/_{8}$" to $^{1}/_{4}$") between the rear face of the outrigger and the front face of the back body unit. Building this up to 6mm / ¼" shouldn't be a problem as, at worst, the back body will be pushed back by this amount. (maximum)

8.7.4. If the fuel tank is to be left in its original position, then the petrol filler pipe will need to be re-routed. The rubber filler hose goes from the filler point, into the void behind the front seat and then down through the top surface of the outrigger and then out of the aft face of the outrigger and into the tank. A new pipe to the tank could easily be made from a combination of metal pipe and rubber hose. A route similar to the original could be used or alternatively, it could easily be made to pass downwards from the aforementioned void to a point ahead of the outrigger and then go rearwards right through the outrigger and into the tank.

8.7.5. On the left hand side, the air filter will need to be moved.

8.7.6. The hoop will be attached to the top of the re-inforced outrigger 55mm / 2¼" in from the end as the cab mount frame bolts through right at the extreme outboard end. The hoop will be adequately wide at this position. If needed, the hoop width could step out to full vehicle width once clear of the cab structure.

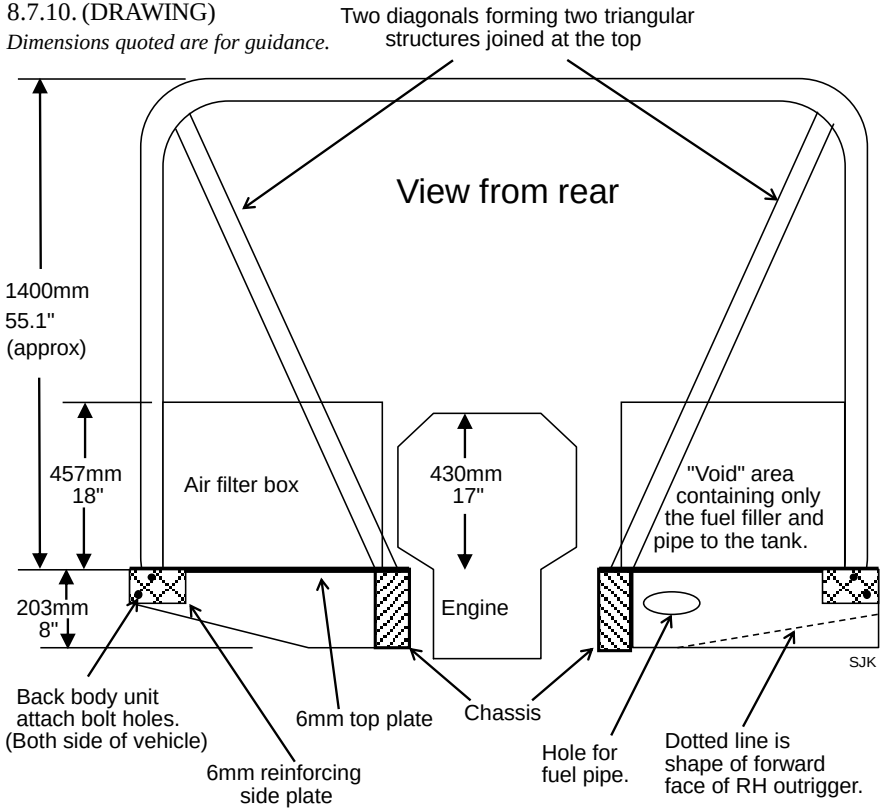
8.7.7. The two diagonals would go from the upper corner bends to the top of the chassis giving a base width of 500mm / 20". The left-hand diagonal can now tuck in under the overhanging manifold and attach to the top of the chassis.

8.7.8. Details on materials, fixings, welding, mount types, front-hoops, rear braces, etc. can be found earlier on in this set of regulations.

8.7.9. The drawing 8.7.10. shows the relevant design and dimensional details of the hoop.

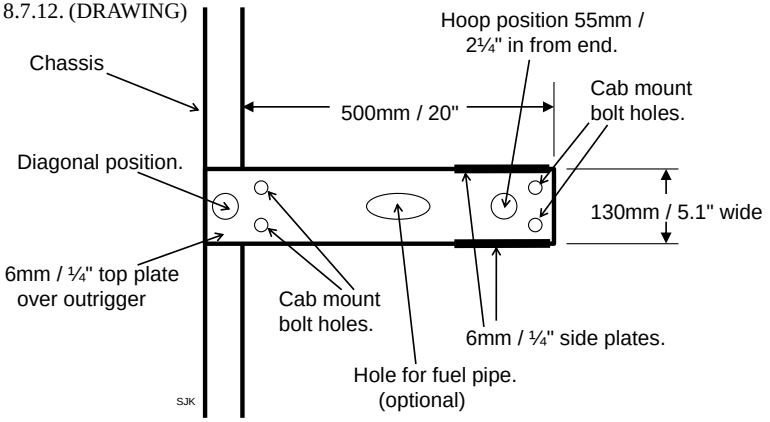
8.7.10. (DRAWING)

Dimensions quoted are for guidance.



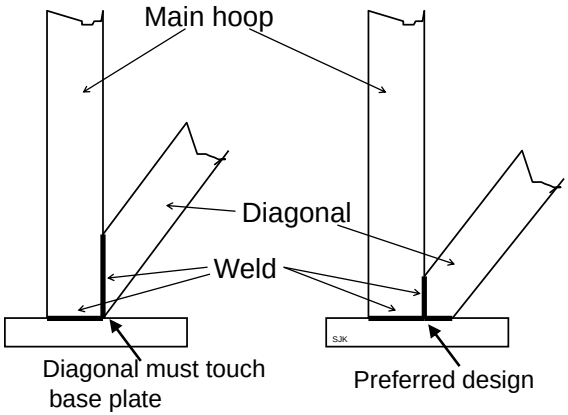
8.7.11. The drawing 8.7.12. shows a plan view of the outrigger.

8.7.12. (DRAWING)



8.8. Diagonal Braces for Main Hoops

8.8.1. (DRAWING)



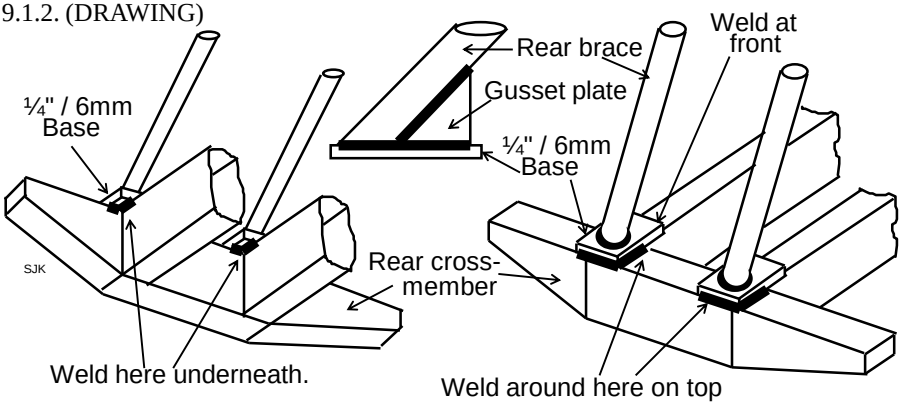
8.8.2. The diagonal shall touch the base-plate, if only by its tip. See drawing.

9. REAR BRACING BARS.

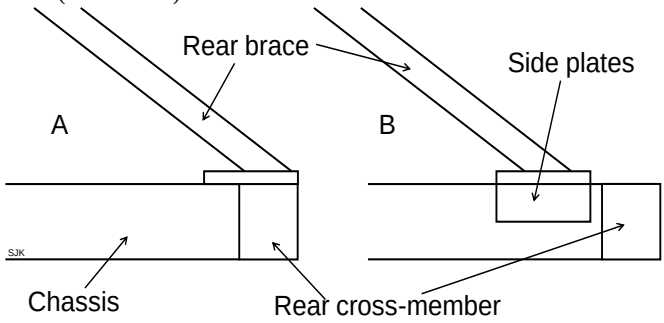
9.1. GENERAL

9.1.1. The further back they are the better and these may join the chassis on top of the rear cross-member. Here, it will not be easy to fit the required material down the sides of the chassis as shown previously. In this case only, the side plates may be dispensed with so long as the welding goes all round the plate on the top and underneath as shown below. A gusset plate is advisable and, **preferably,** leave the base-plate rectangular as shown and not trimmed to a T shape. The reason for this design being acceptable is that this is a very strong part of the chassis.

9.1.2. (DRAWING)



9.1.3. (DRAWING)



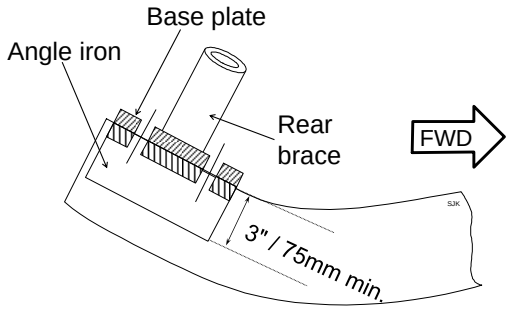
9.1.4. "A" shows the rear brace on top of the rear cross-member. No chassis side plates can be fitted, so a flat plate over the rear cross-member and overlapping on to the chassis is acceptable.

9.1.5. "B" shows the rear brace still well back but not on top of the rear cross-member. Here, side plates or angles will need to be used per previous drawings.

9.2. Rear Braces on Range Rover, Discovery, 90, 110 Defender etc.

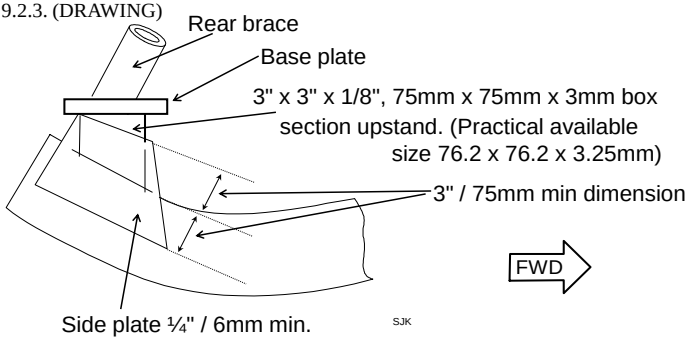
9.2.1. The awkward shape of the chassis on the coil sprung vehicles can lead to mounting problems. The following sketches may help. Remember, outriggers and cross members should be treated the same way as the main chassis rails.

9.2.2. (DRAWING)



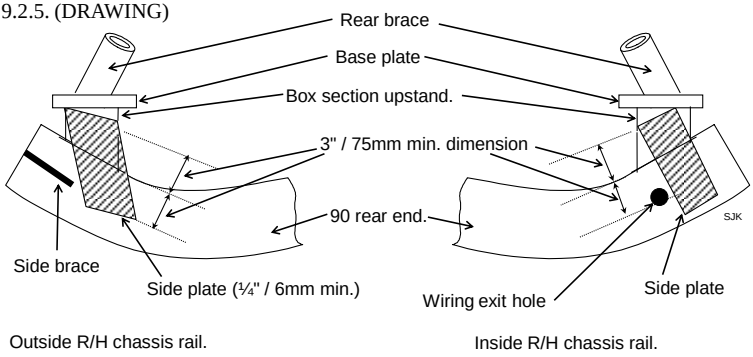
REAR END of Defender Chassis

9.2.3. (DRAWING)



9.2.4. The sketch 9.2.3. above may not always work out exactly as shown due to braces between the chassis and the rear cross-member, and the point on the inner face of the chassis rail where the wiring loom emerges. The sketch below (adapted from the above drawing) shows the pattern of side plates that could be added to a 90 that has been fitted with a roll-cage in the way that some commercial manufacturers do. The box-section upstands are to be securely welded to the chassis first and the ¼" / 6mm reinforcing side-plates added afterwards.

9.2.5. (DRAWING)



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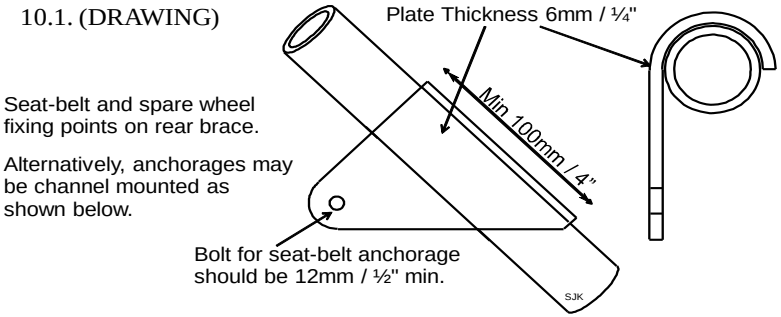
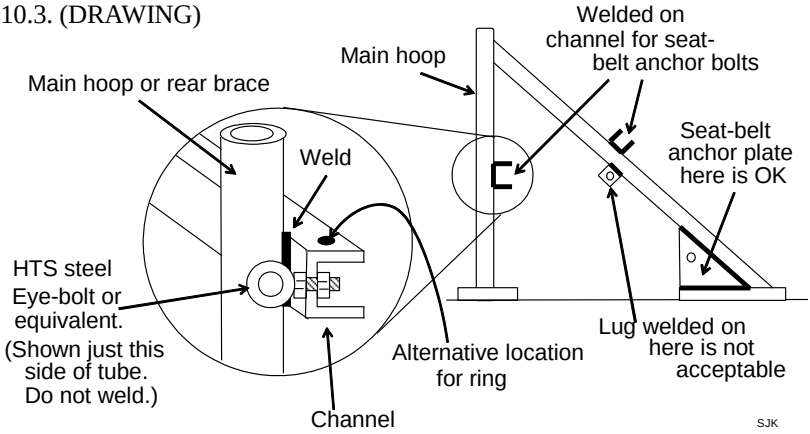
10. SEAT BELT ATTACHMENTS

10.1. (DRAWING)



10.2. Seat belts may be fixed to the roll cage but the fixing method should not cause any weaknesses. An 'eye' tapped into the bar or just welded on is insufficient, use a load spreading method.

10.3. (DRAWING)

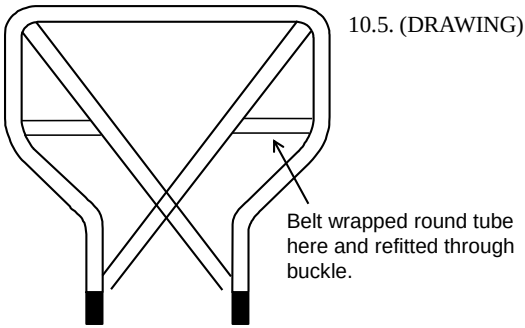


2" x 2" x ¼" / 50 x 50 x 6 mm min.

(Practical stock sizes would be:- 76 x 38 x 5.1mm or 76 x 51 x 6.4 mm)

10.4. The seat belts that pass over the occupants' shoulders can be lead over a structural tube where indicated in the drawing 10.5. and fixed at floor level, or wrapped around a structural tube and refitted using the buckle. The belt itself must not be altered. This cannot be done with all types of belt; only those that have an adjusting buckle that can be unthreaded.

10.5. (DRAWING)



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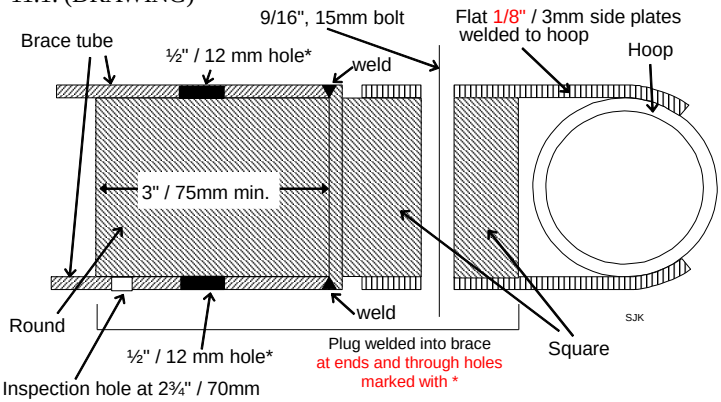
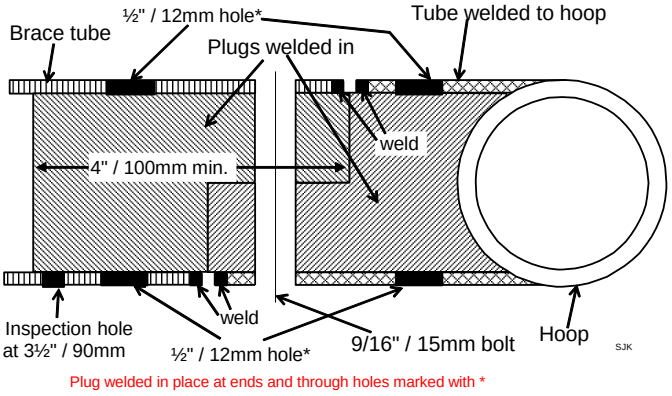
11. JOINTS VARIOUS

11.1. (DRAWING)



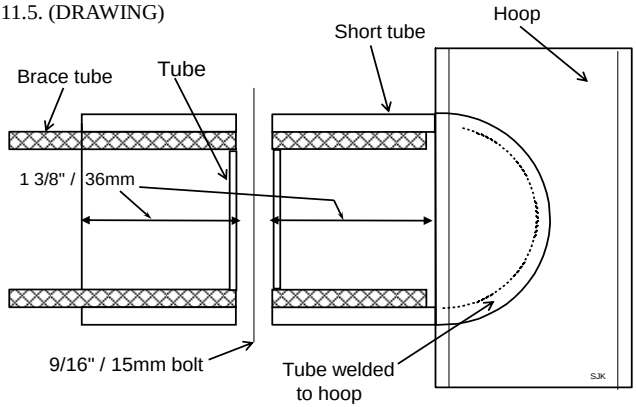
11.2. Method of attaching rear brace. Note that the plug is round where it fits into the tube and square where the flat plates are bolted.

11.3. (DRAWING)



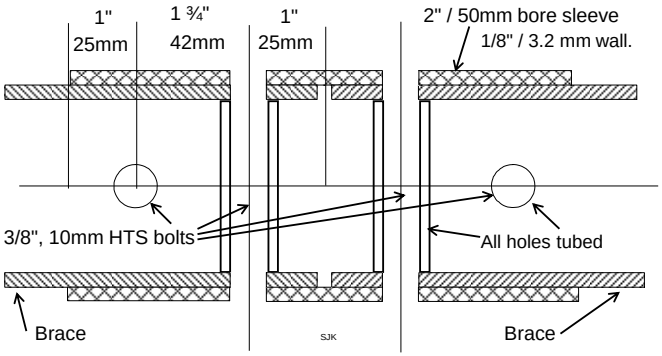
11.4. Method of attaching rear brace in which two mirror-image plugs are welded into the tubes and held with a high tensile nut and bolt.

11.5. (DRAWING)



11.6. Socket type connection of rear brace to main hoop.

11.7. (DRAWING)



11.8. Method of making a brace joiner. The bolts must be no less than 1¾" / 42mm apart and no less than $^{7}/_{8}$", 20mm from the end of the tubes.

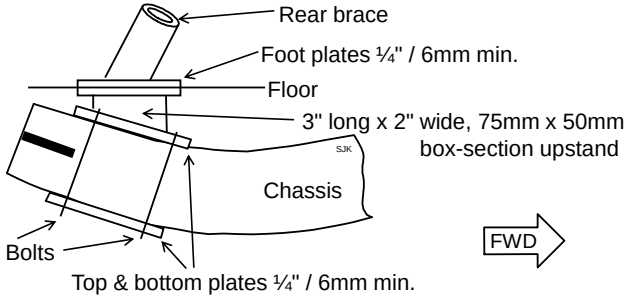
11.9. * References on the "joints" pages to a **½" / 12mm hole*** indicates where a hole of that size is drilled prior to insertion of the plug. The edges of the hole are then to be welded to the plug that appears through it.

12. EXEMPTIONS

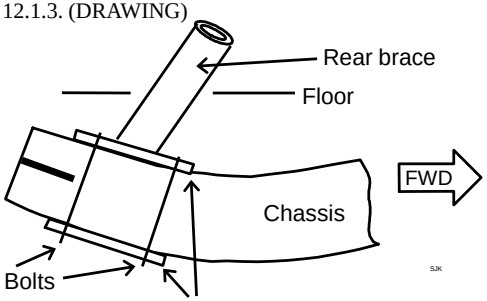
12.1. Non-UK Registered & Resident Vehicles

12.1.1. In some countries the law forbids welding to the chassis of road-going vehicles. (Germany, France, Denmark, for example). Competitors from such countries may be required to prove that a welded assembly is not permitted. For vehicles registered and normally resident in such countries, a bolted-on roll-cage mount is allowed. The rear brace mount is like this:-

12.1.2. (DRAWING)

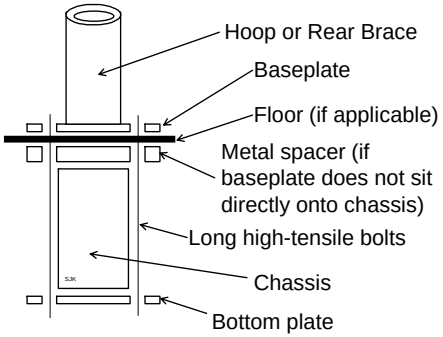


12.1.3. (DRAWING)



12.1.4. The main hoop mount is the same as the “old” bolted design and attachment is by the usual $^{3}/_{8}$" / 10mm HT mounting bolts.

12.1.5. (DRAWING)



12.1.6. All plates are to be 6mm / ¼" and nuts and bolts to be $^{3}/_{8}$" / 10mm high tensile as elsewhere.

Please direct any enquiries to the ALRC Scrutineering & Off-Road Committee.