FORMULA RENAULT 2.0

USER MANUAL

B. Chassis

RENAULT SPORT

RENAULT

CONTENTS

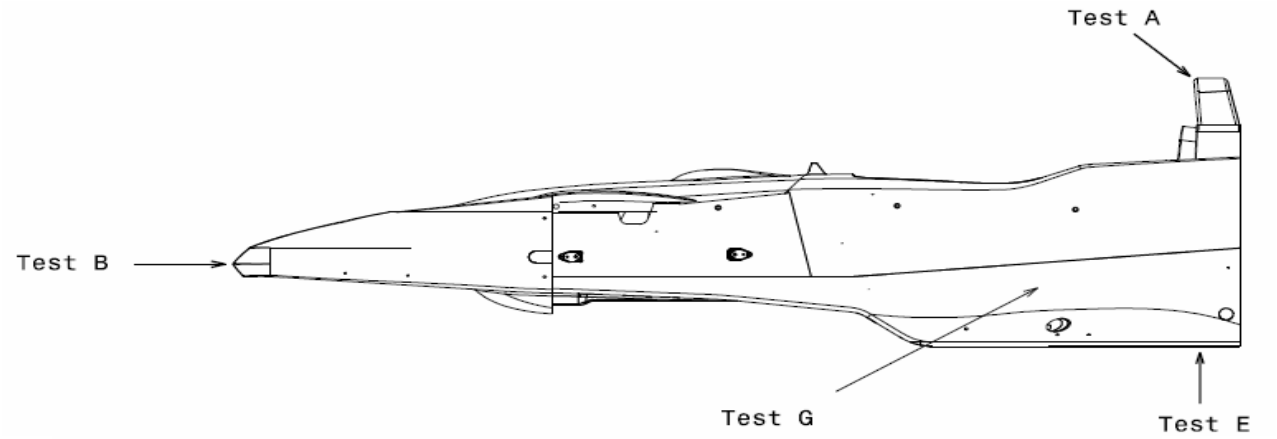
1. CHASSIS

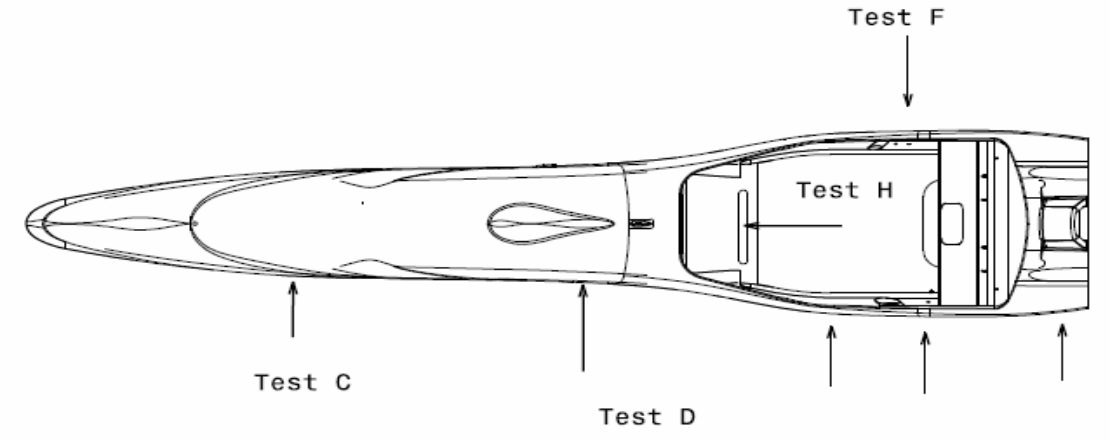
1.1. Safety

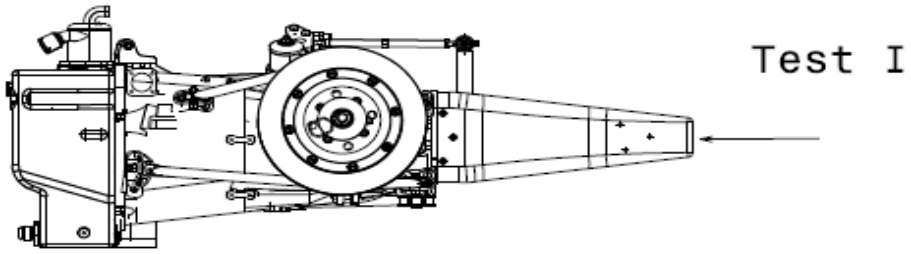
1.1.1. Safety tests

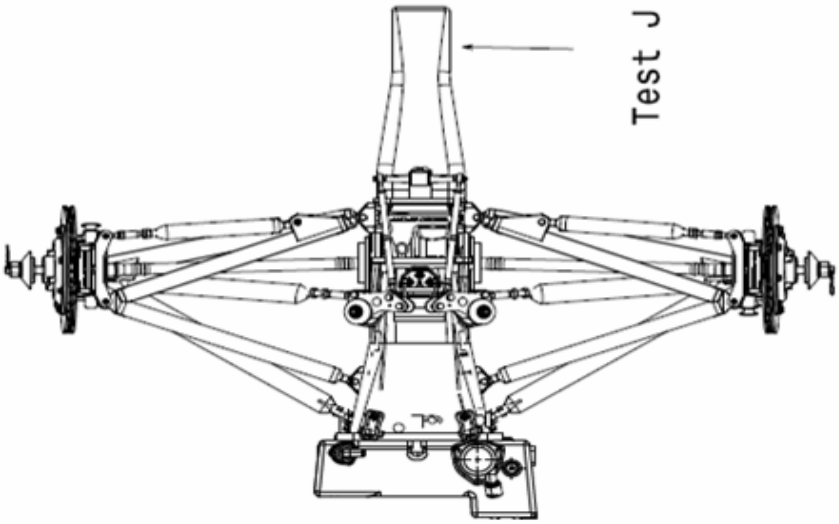
All tests are performed in accordance with the standard 2011 FIA F3 safety norms.

	Tests	Conditions
A	Safety roll bar crash test (art 275-15.2.4)	Resistance to: 13.2 kN vertical, 49.5 kN longitudinal and 66kN vertical
B	Frontal impact crash test (art 275-15.3.6)	Speed: 12m/s, 650 Kg, deceleration: 5g for the 150 first mm and structure deceleration <25g
C	Crash box fastening crash test (art 275-15.3.7)	3 tests of static load, 20 kN for 30s, maxi deformation 20 mm (test1), permanent <1mm
D	"Survival cell" crash test (art 275-15.3.8)	Static load, 30 kN for 30 sec, no deformation of the structure and fastenings
E	Underneath fuel tank crash test (art 275-15.3.9)	Static load, 10 kN for 30 s, permanent deformation<0.5 mm
F	Cockpit opening crash test (art 275-15.3.10)	2 static load tests, 10 kN for 30 s, maxi deformation 10 mm, permanent deformation<1mm
G	Lateral load crash test (art 275-15.4)	Thrust speed: 2mm/s up to 150 mm of displacement, the load should not exceed 150 kN for the first 100 mm, the energy absorbed should be 6000 J minimum
H	Steering crash test (art 275-10.5)	Mass of 8kg, speed 7m/s, maximum deceleration 80g for 3ms
I	Rear structure crash test (art 275-15.5)	Speed 10m/s, object 560kg object deceleration <25g, lower structure deceleration< 60g for 3ms
J	Rear push off	Lateral load 30 kN for 30 seconds at a distance of 475 mm from the back of the gearbox.


Test A
Test B
Test G
Test E


Test F
Test H
Test C
Test D


Test I


Test J

1.1.2. Safety wheel tethers

Front tethers - Wheel side

Front tethers - Chassis side

Rear Tethers – Wheel side

Rear Tethers – Chassis side

Wheel tether must imperatively be changed every 12 months

Wheel side installation:

Front and rear: Eyelet trapped around the brake calliper bosses.

Chassis side installation:

Front: Eyelet trapped around lower wishbone front leg central bracket

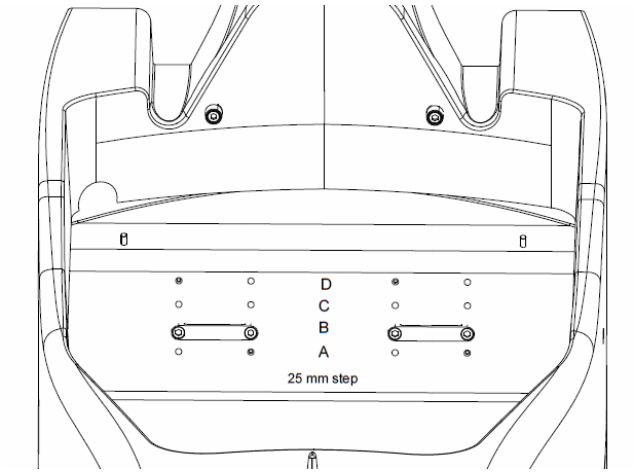
Rear: Eyelet trapped around lower wishbone rear leg bracket (the tightening torque is 23 Nm for the wheel tether support screws)

1.1.3. HANS® system

The car must only be used with a HANS device.

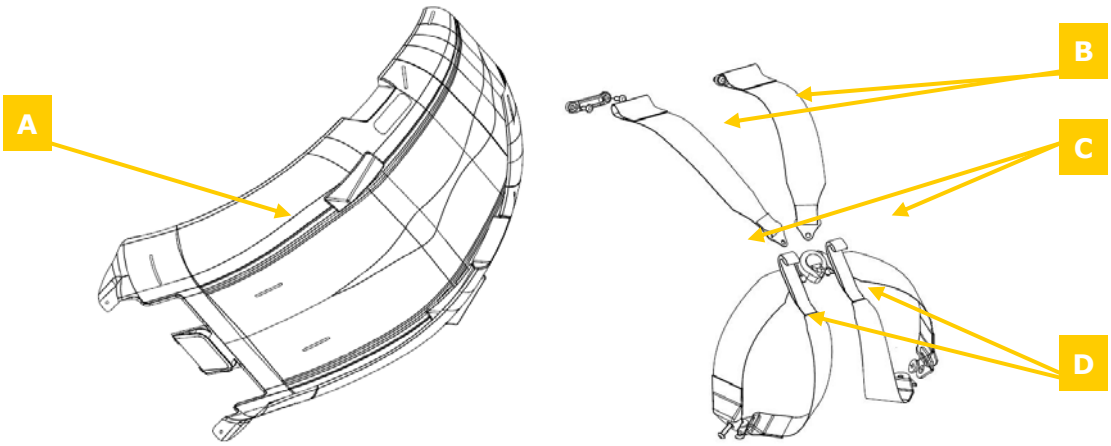
1.1.4. The installation instructions of the safety belts support

It is possible to adjust the position of the safety belts. There are four different positions.



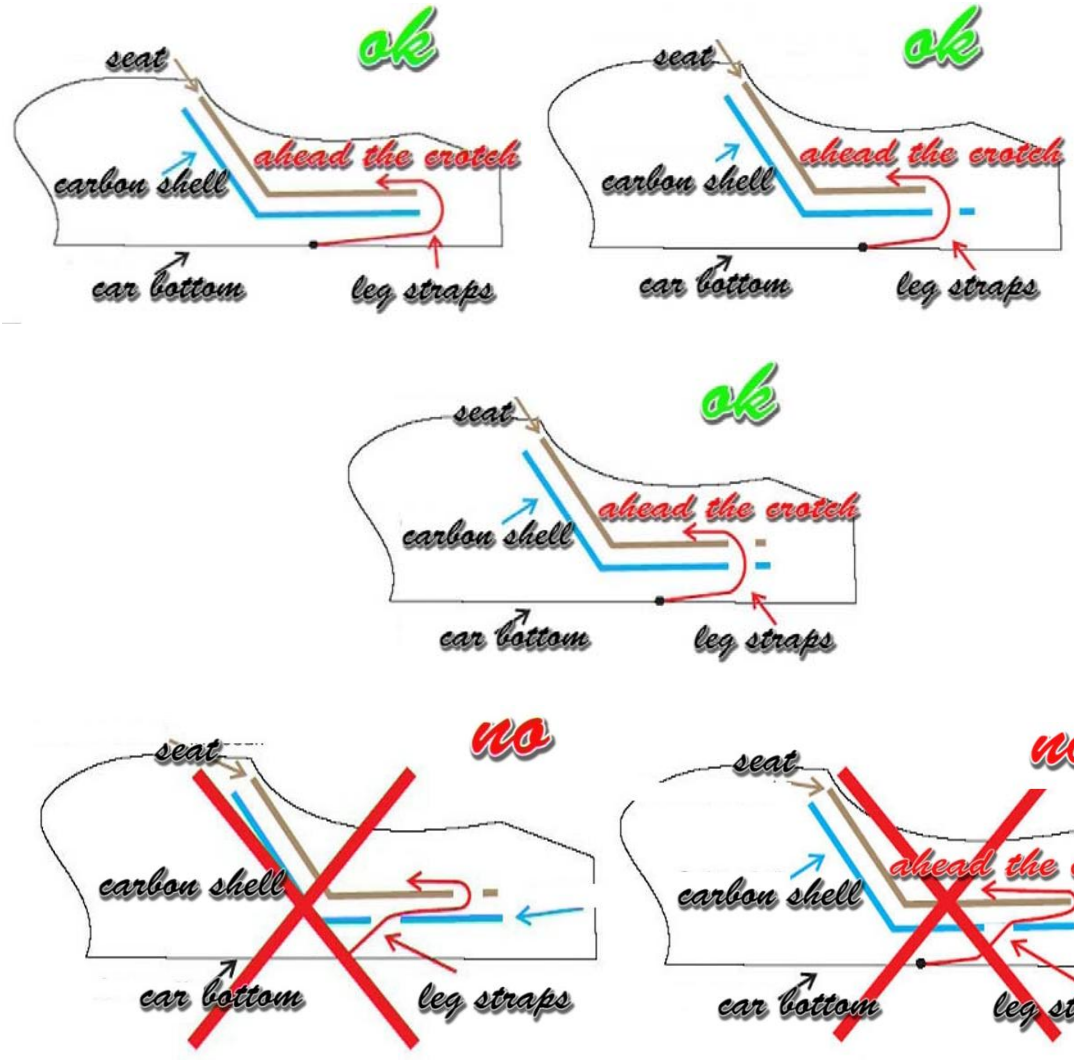
1.1.5. Extractable seat

Please keep in mind that, in case of important crash, the driver should be extracted with no harm and no difficulties. On this purpose you should be sure that the following points are respected when you make your driver's seat.



- Make sure that the seat is correctly fitted in the carbon shell
- Make sure that the holes for the leg straps in the carbon shell and in the seat are in front of each others.
- Make sure that the leg straps are exiting in front of the driver's crotch
- Make sure that, the driver does not sit on the leg straps when he is sitting in the car

Here are some illustrations of these points (*sources: F.I.A.*):



The hole made in the driver seat to pass the lower seat belts must be large enough. Some tape can be added on the lower belt in order to avoid any friction during the extraction.

The non respect of this rule will be considered as a non conformity.

1.1.6. Driver seat dimension

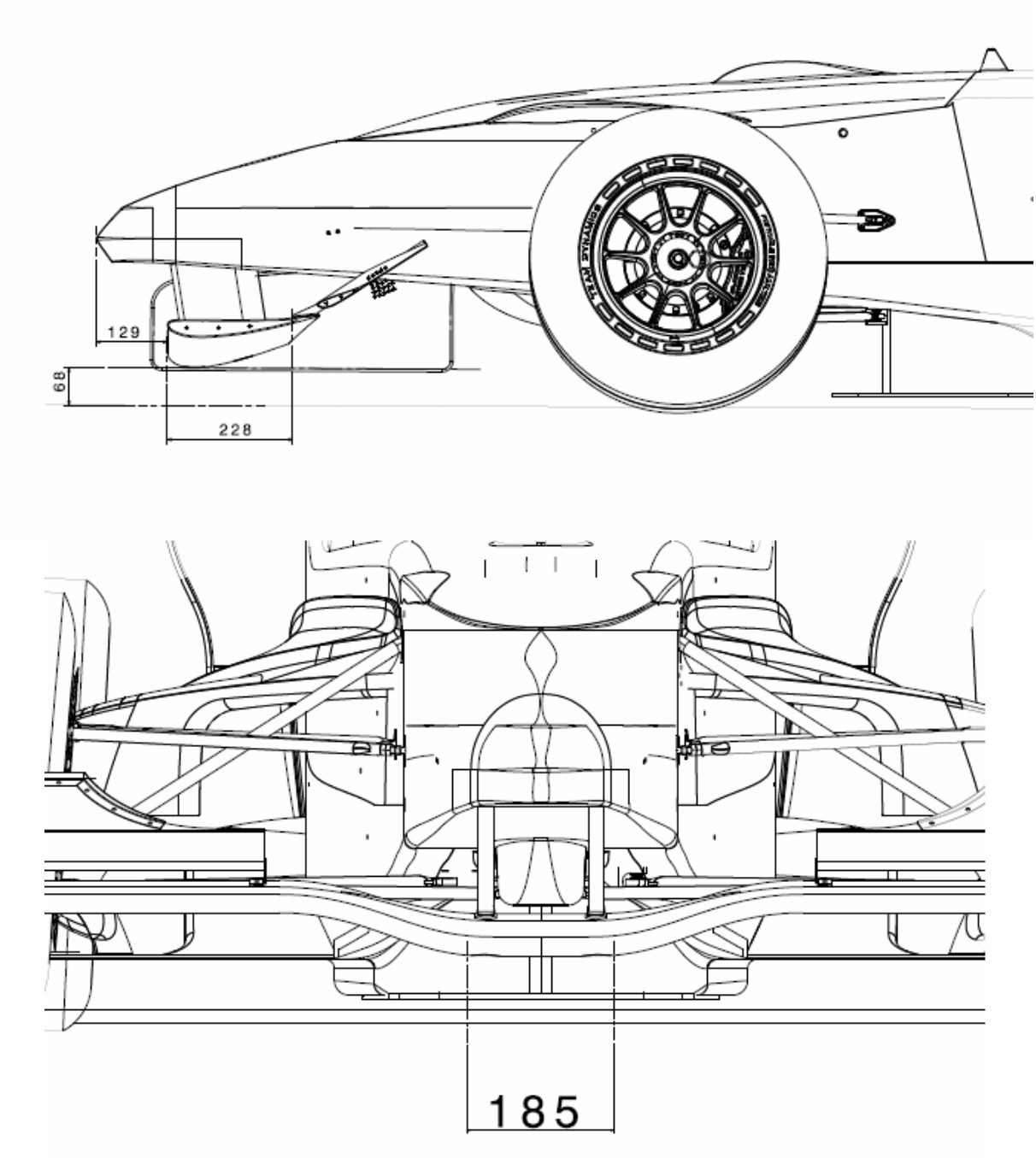
The driver seat must not exceed the carbon shell length and width.

1.1.7. Head padding

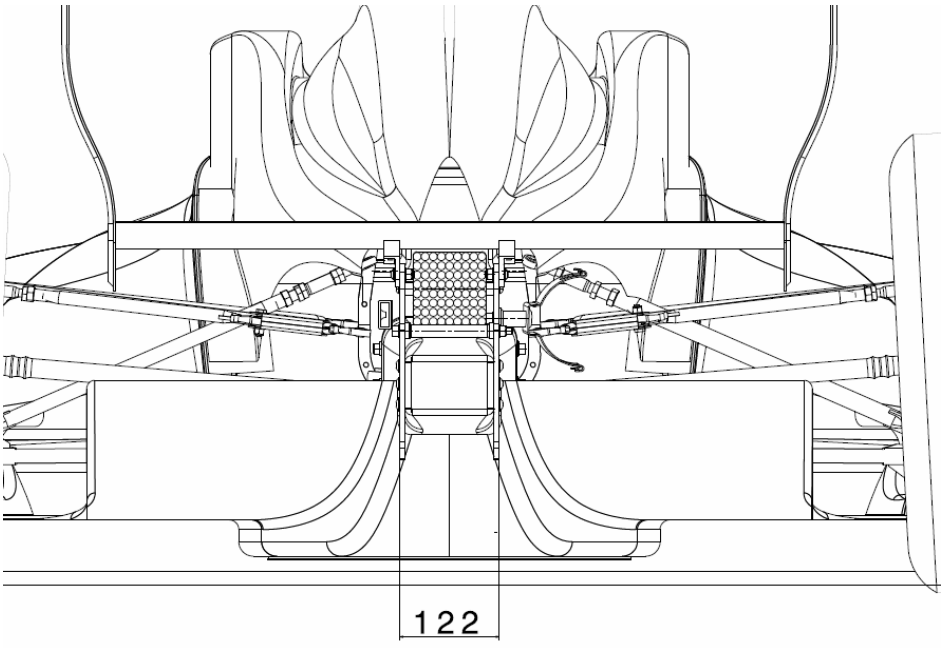
No structural modification is allowed; please refer to the technical regulations.

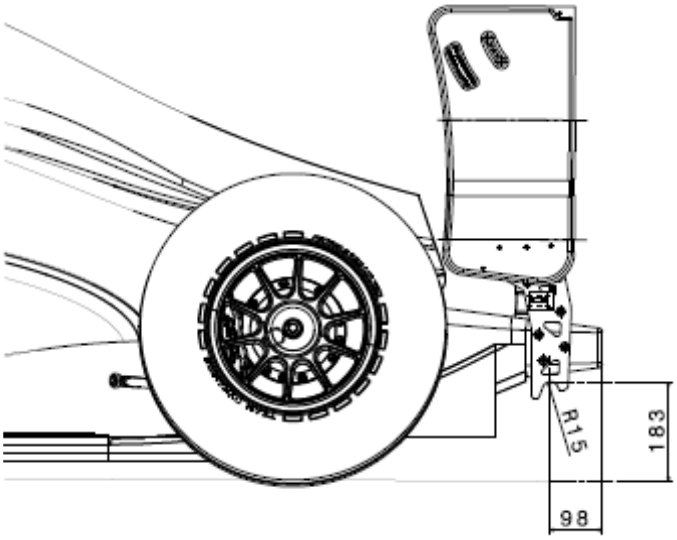
1.2. Lifting points

1.2.1. Front



1.2.2. Rear





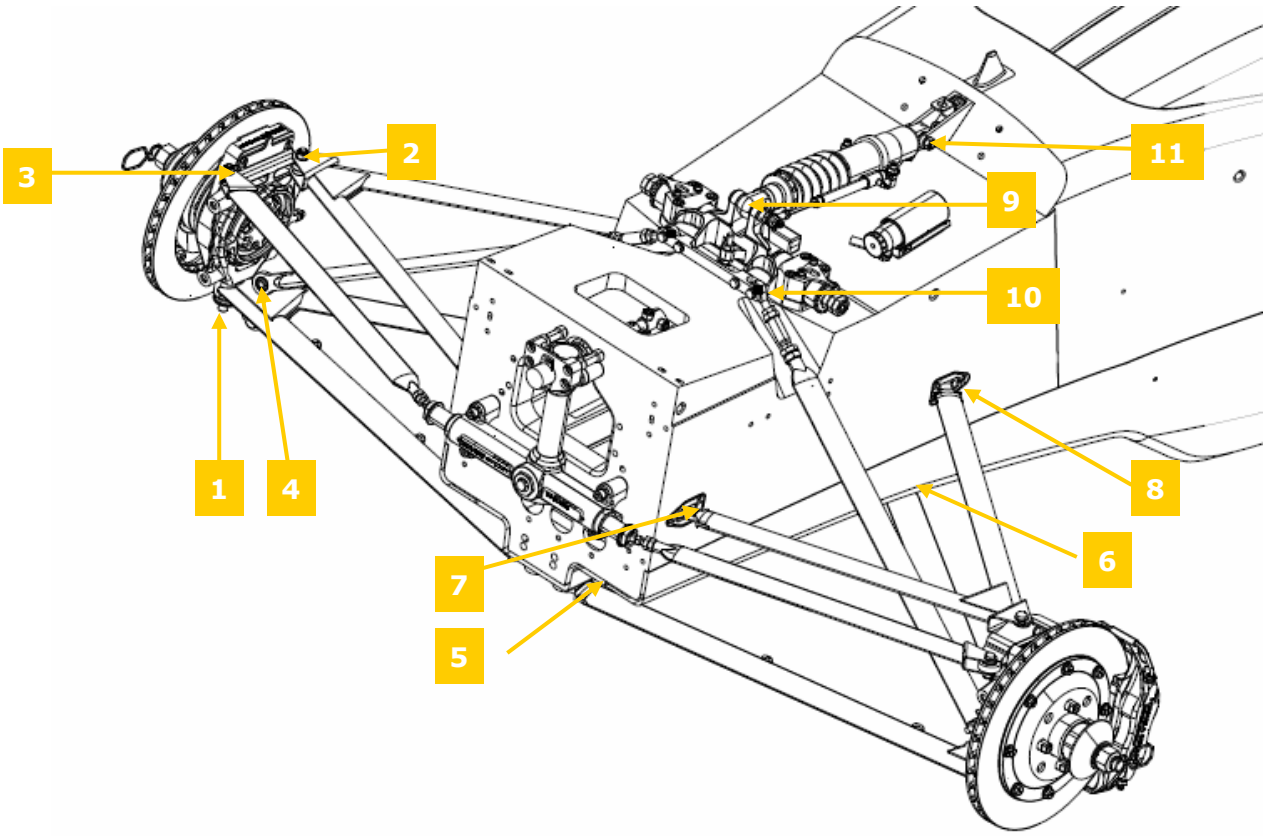
2. SUSPENSION

2.1. Suspension fastening points

2.1.1. Front axle assembly

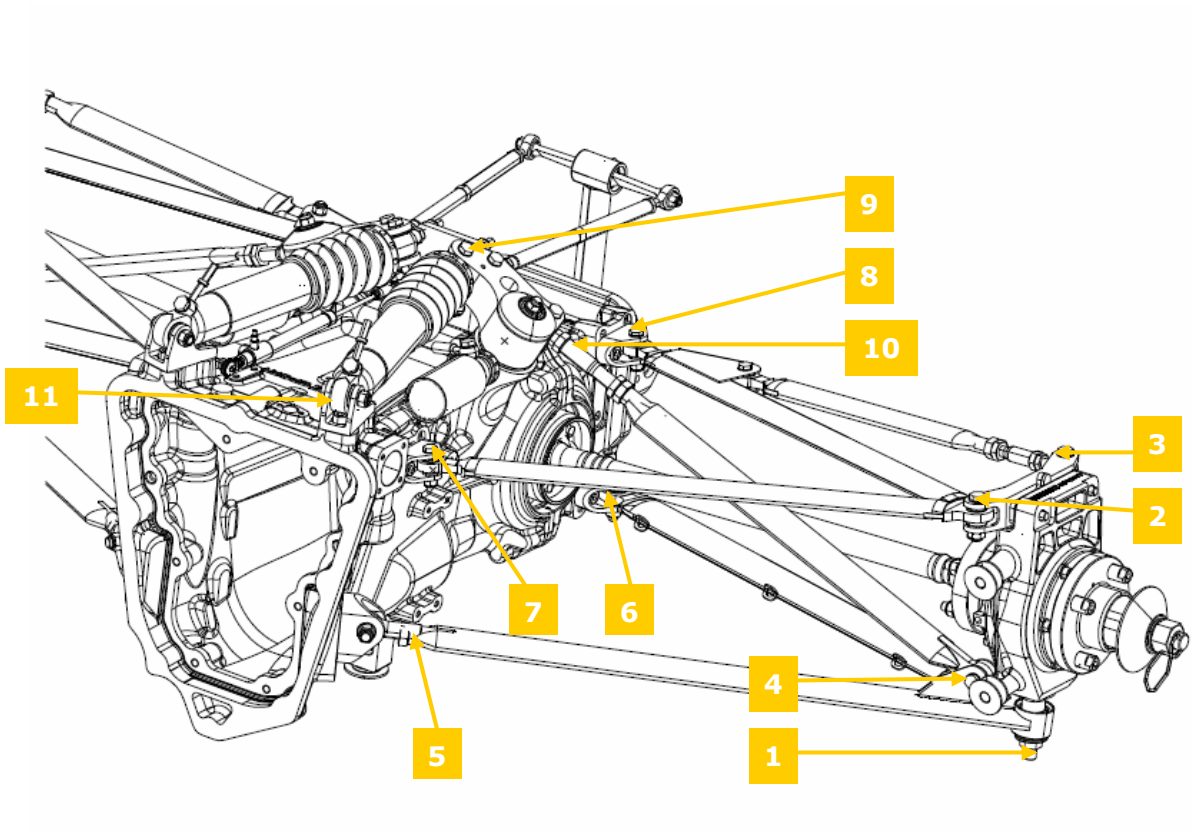
	Point	Torque
Lower arm wheel side	1	50 Nm
Upper arm wheel side	2	25 Nm
Steering rod wheel side	3	23 Nm
Push rod wheel side	4	25 Nm
Lower arm chassis side forward point	5	23 Nm
Lower arm chassis side rearward point	6	23 Nm
Upper arm chassis side forward point	7	12 Nm
Upper arm chassis side rearward point	8	12 Nm
Damper rocker side	9	22 Nm
Push rod rocker side	10	12 Nm
Damper chassis side	11	22 Nm

	Tightening torque
Front rocker on chassis	23 Nm
Upper wishbone bracket	12 Nm
Rear lower wishbone bracket	23 Nm
Front lower wishbone bracket	M8 @23 Nm M10@46 Nm



2.1.2. Rear axle assembly

	Point	Torque
Lower arm wheel side	1	50 Nm
Upper arm wheel side	2	25 Nm
Toe rod wheel side	3	25 Nm
Push rod wheel side	4	25 Nm
Lower arm gearbox side forward point	5	35 Nm
Lower arm gearbox side rearward point	6	22 Nm
Upper arm gearbox side forward point	7	12 Nm
Upper arm gearbox side rearward point	8	12 Nm
Damper rocker side	9	22 Nm
Push rod rocker side	10	22 Nm
Damper chassis side	11	22 Nm



2.2. Adjustment

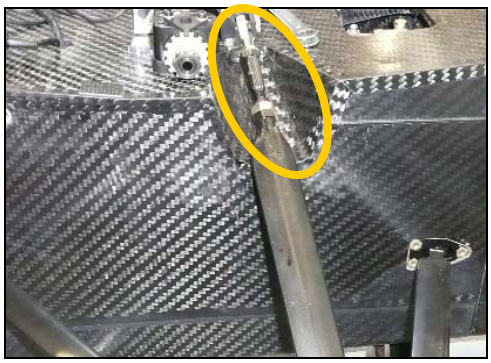
2.2.1. Adjustment table

POSITIVE CHANGE IN:	MEANS:
Ride Height	car moves up
Toe	toe-out
Camber	upper part of rim outward

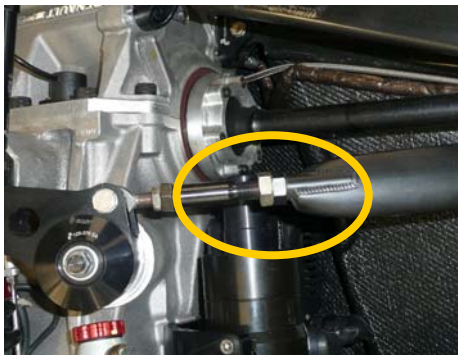
		FRONT	REAR
PUSHROD ADJUSTER			
+1 barrel TURN	**Ride Height change**	**3.75 mm**	**5.5 mm**
	Camber change (deg)	**0.07°**	**0.18°**
	Thread size	**1.27+1.06**	**1.27+1.06**
TOE ADJUSTER (PER WHEEL)			
	toe change	**3.5 mm** (per turn)	**1.1 mm** (per turn)
	thread step	**3/8UNF-24**	**1mm-1.06mm**
CAMBER SHIM	**+1mm**	**0.28°**	**0.28°**
	toe change (deg)	**0°**	**0°**
SPRING PLATFORM			
+1TURN	thread step (mm)	**1.5**	**1.5**
	height change (mm)	**1.6**	**1.3**
RATIOS			
WHEEL/SPRING RATIO (vertical)		**0.94**	**1.14**
WHEEL/BELLEVILLE RATIO (lateral)		**1.51**	----
WHEEL/DROP LINK RATIO (roll)		--	**1.73**

At the front, because of the “mono” geometry, when **the axle** moves **vertically** by 1mm, the vertical spring is compressed by 1/0.94 mm. When the **difference in wheel vertical movement**, from side to side, is 2 mm, the Belleville stack is compressed by 1/1.51 mm.

2.2.2. Ride height



Front

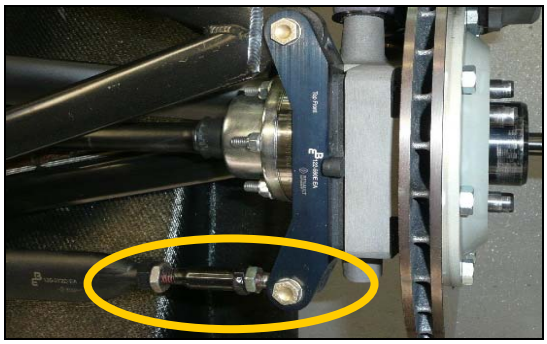


Rear

The ride height is adjusted by screwing or unscrewing the register of the push rods.

2.2.3. Toe

Front



Rear

The toe is adjusted by means of the steering rod on the front axle and the toe rod on the rear.

2.2.4. Camber

The camber is adjusted by means of shims inserted between the Ackermann and the upright. To put or remove the shims, untighten the two screws shown below.

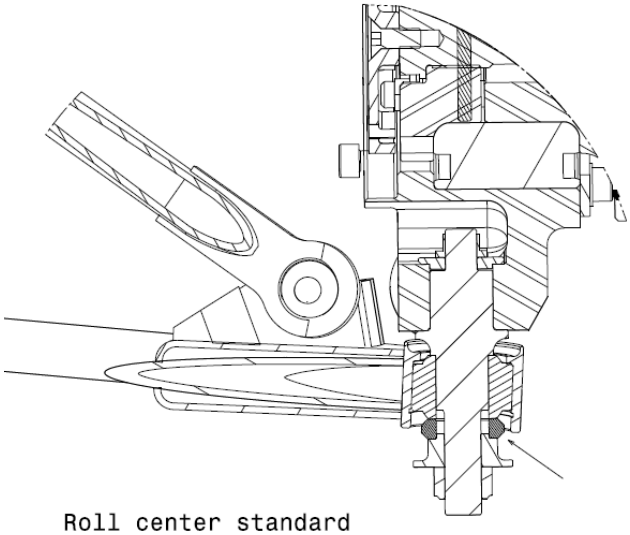
The shim thicknesses available are :

- 1 mm
- 1.5 mm
- 2 mm
- 3 mm
- 5 mm

2.3. Front roll centre height setting

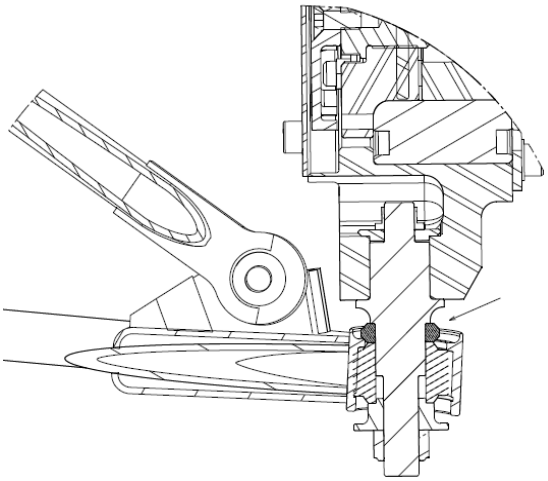
There are two different heights for the front roll centre.

Option		Roll centre height	Δ RC height/std
1	Standard	23.4	Std
2	High RC	29	+5.6



Roll center standard

Spacer (Optionnal part) under whisbone



Roll center High

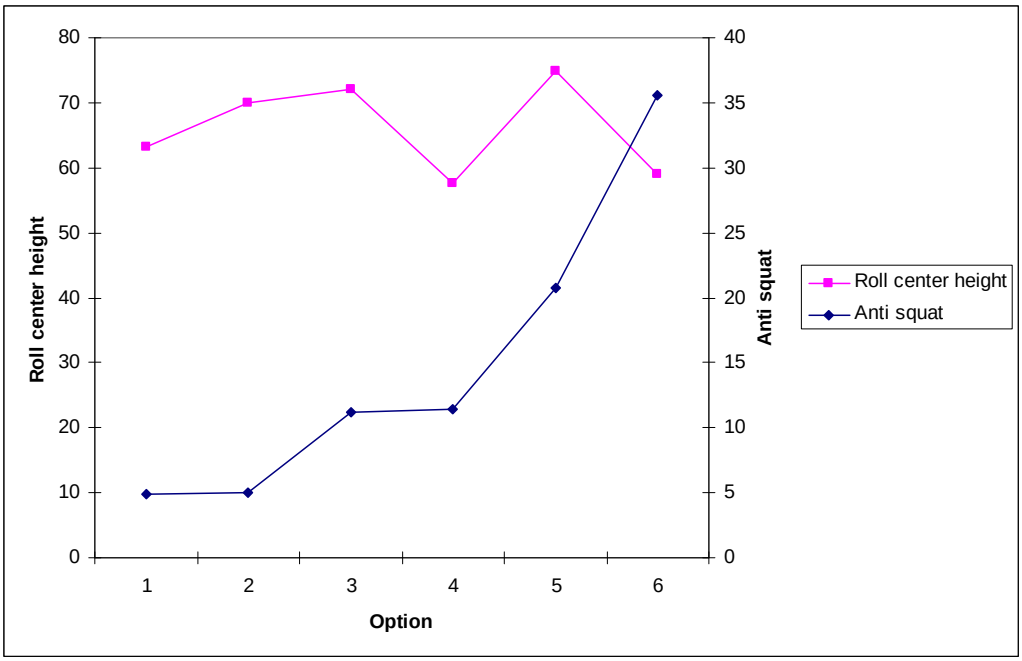
Spacer (optionnal part) on top

2.4. Rear roll centre height and anti squat setting

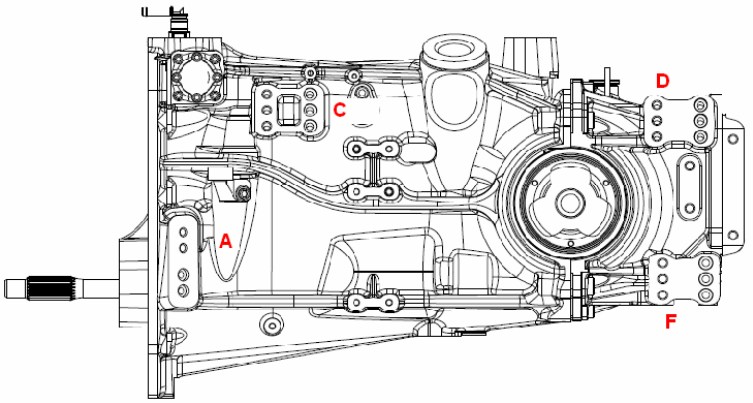
The only combinations allowed are:

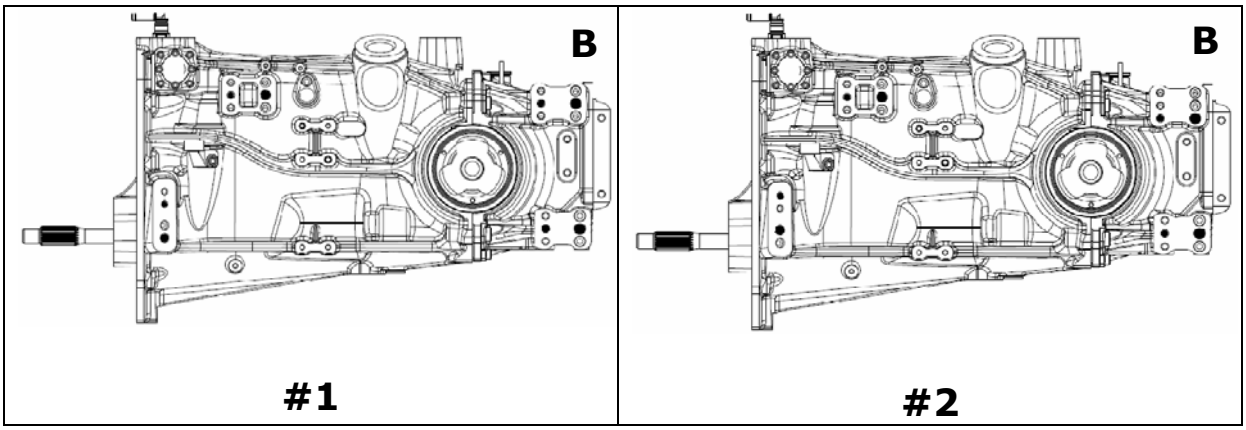
Option	A	B	C	D	F	Roll centre height	Δ RC height/std	Δ camber/ 10 mm	Anti squat
						mm	-	°	%
1	A2	B	C2	D2	F2	63.2	STD	0.30°	4.9
2	A1	B	C2	D3	F2	70	6.8		5.0
3	A1	B	C2	D2	F2	72.1	8.9	0.32°	11.2
4	A1	B	C2	D1	F1	57.7	-5.5	0.28°	11.4
5	A1	B2	C2	D1	F2	74.9	11.7	0.32°	20.7
6	A1	B2	C3	D1	F3	59.1	-4.1	0.28°	35.6

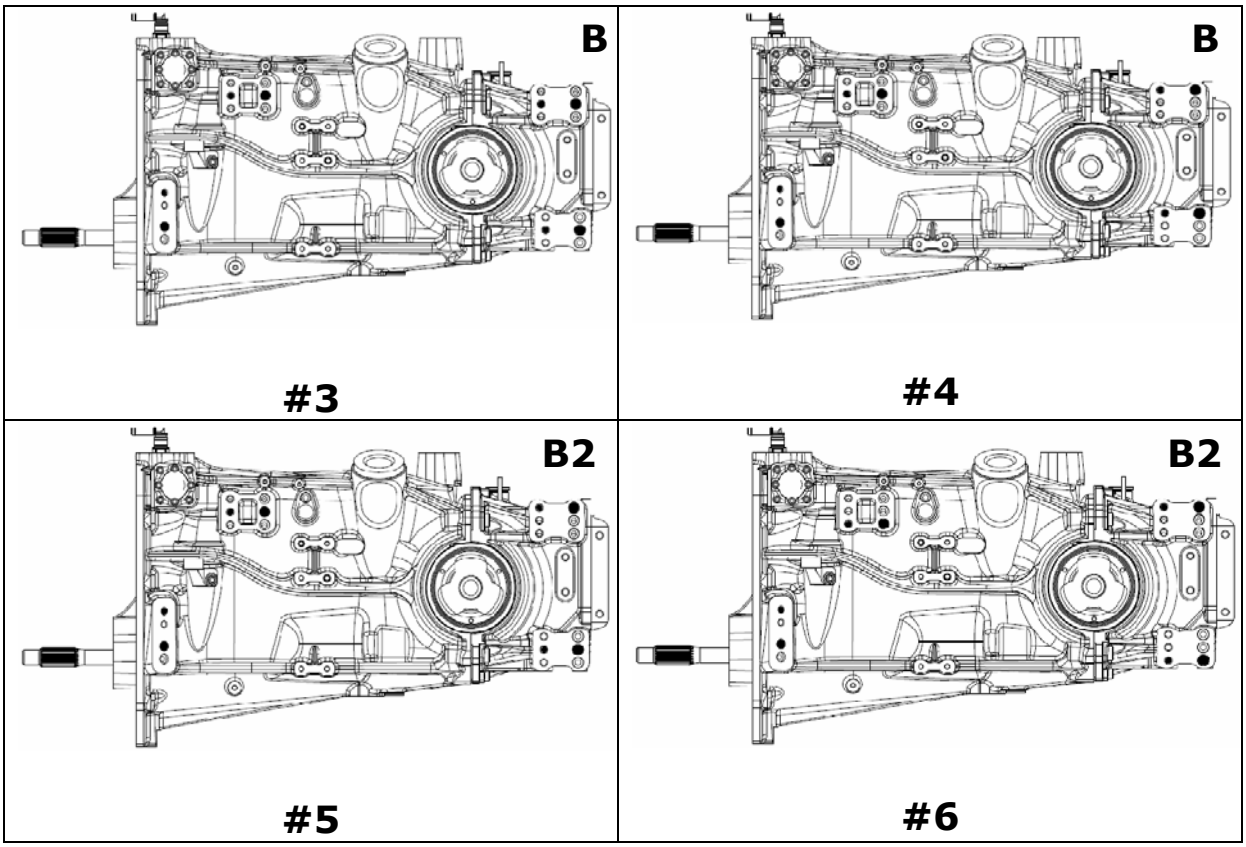
Anti-squat and Roll centre height chart:



Combinations gearbox side:



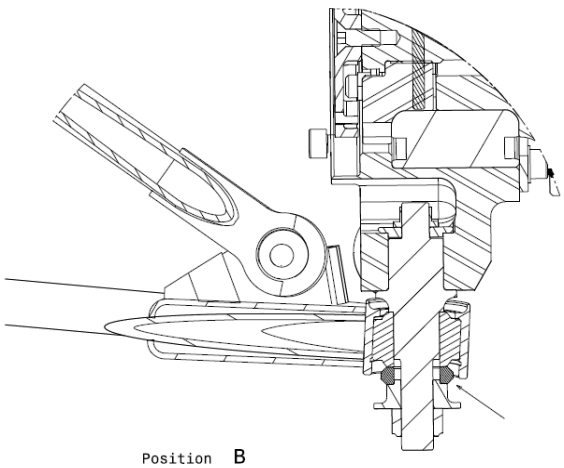




For the A position, there are 3 different possible configurations, depending on the bracket position. To use A1 and A2 positions, the bracket must be mounted towards the top.

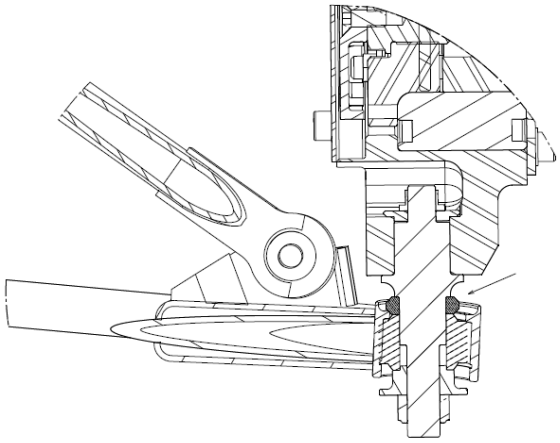
Combinations wheel side:

There are two positions on this side: B and B2.



Position B

Spacer (Optionnal part) under whisbone



Position B2

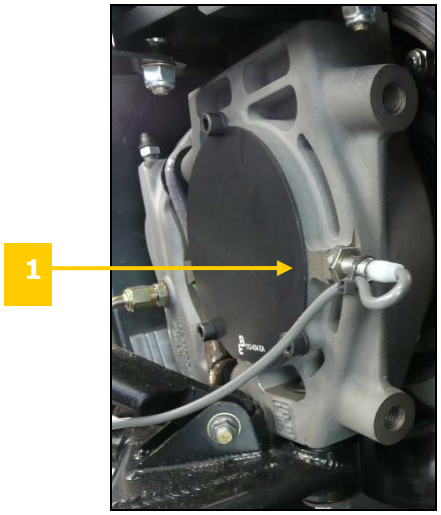
Spacer (optionnal part) on top

2.5. Upright

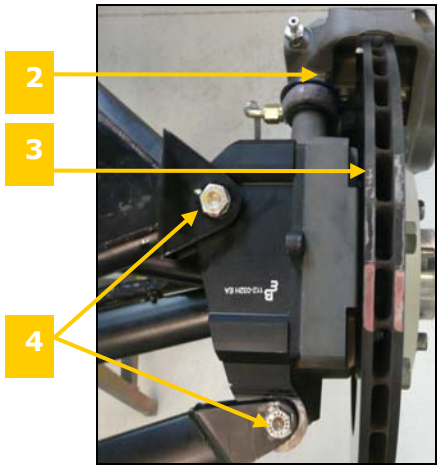
2.5.1. Removal

To remove front upright:

- disconnect wheel speed sensor (1)



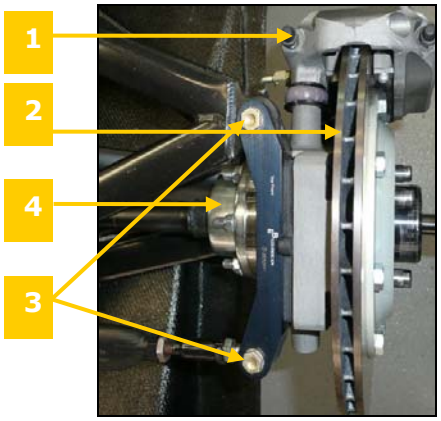
- remove callipers (2)
- remove brake discs (3)
- remove the two screws between upright and upper wishbone (4), and toe link.
- remove the nut between upright and lower wishbone



- take out the upright

To remove rear upright:

- remove callipers (1)
- remove brake discs (2)
- remove the two screws between upright and upper wishbone (3)
- remove the nut between upright and lower wishbone
- take out the drive shaft (4)



- take out the upright

2.5.2. Installation

Follow removal steps in reverse order.

	Tightening torque
Ackermann	23 Nm
Caliper	44 Nm
Upright / lower arm	50 Nm

2.6. Wheel hub and bearing

2.6.1. Hub disassembly

Available in the next release.

2.6.2. Bearing removal

Available in the next release.

2.7. Spring-damper set

2.7.1. Front

The front suspension is by means of push rod (1) and one damper (2). Compression and rebound can be adjusted.

2.7.2. Rear

The rear suspension is by means of two dampers. Compression and rebound can be adjusted.

2.7.3. Adjustment

Rebound

Rebound setting located on the piston rod (1).

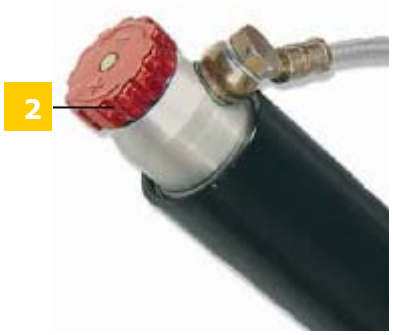
The shock absorbers come with a basic setting. This is identified by a yellow mark at the setting screw. This setting is by 1 turn from the close position.

Turn the screw in the clockwise direction:
Hard rebound
Turn the screw in the counter clockwise direction:
Softer rebound.

Setting range: 2 turns from complete close.

Bump

Bump absorption may be adjusted by index notches at the compensation reservoir.

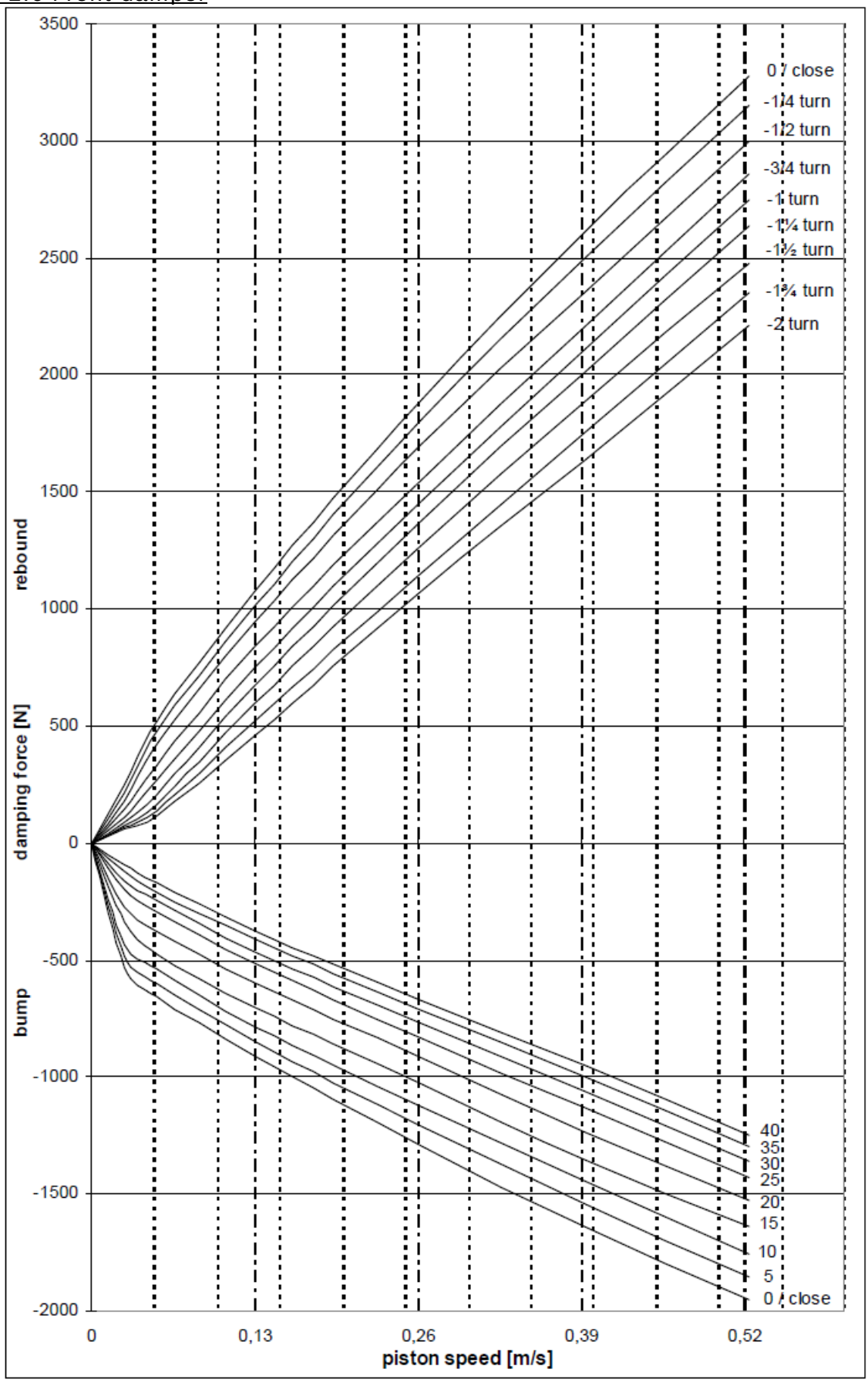


The shock absorbers come with a basic setting: 20R clicks from the close position (yellow mark) too.

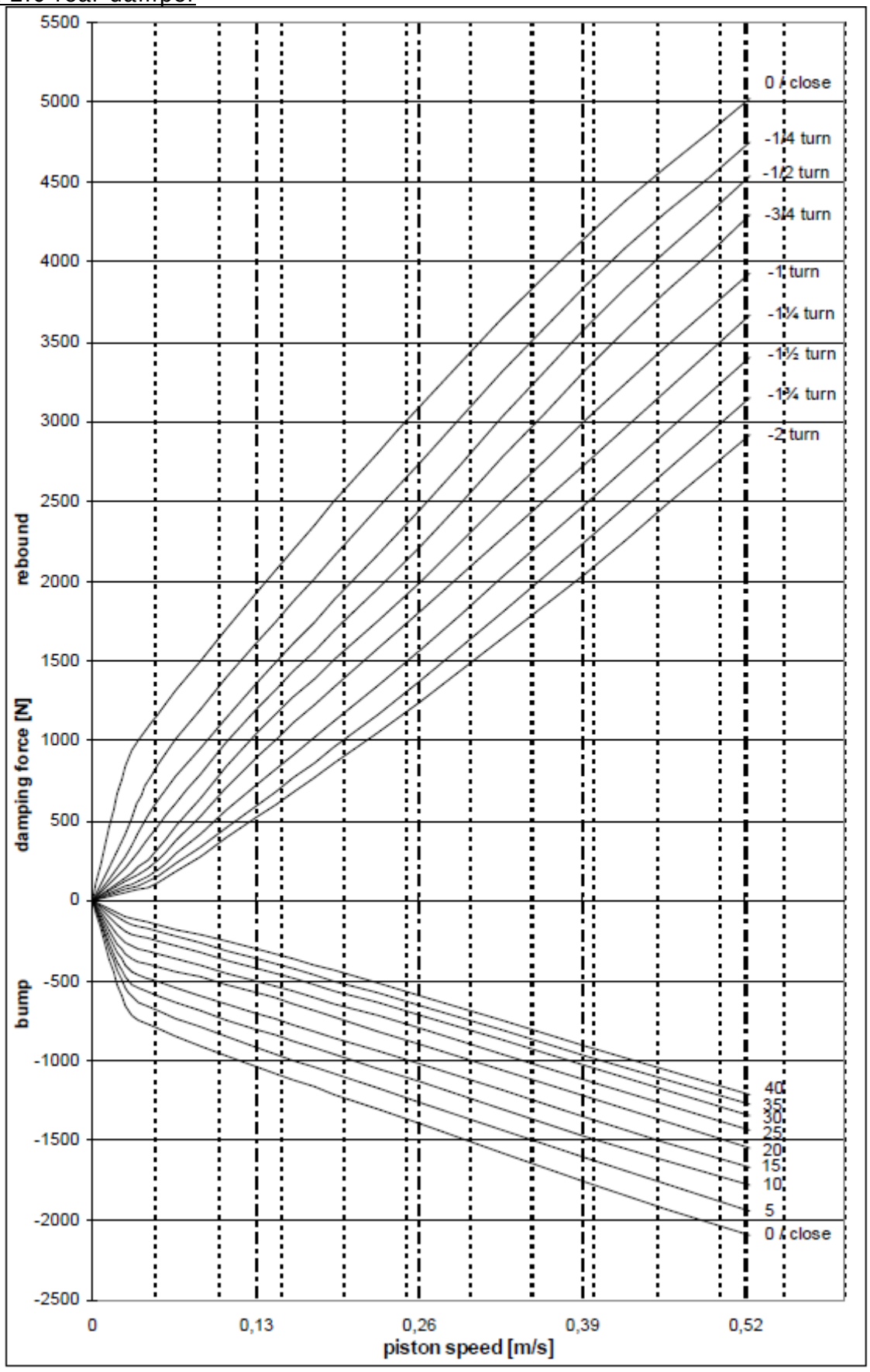
Turn in the clockwise direction:
Harder compression.
Turn in the counter clockwise direction:
Softer compression.

Setting range : 40 notches from complete close

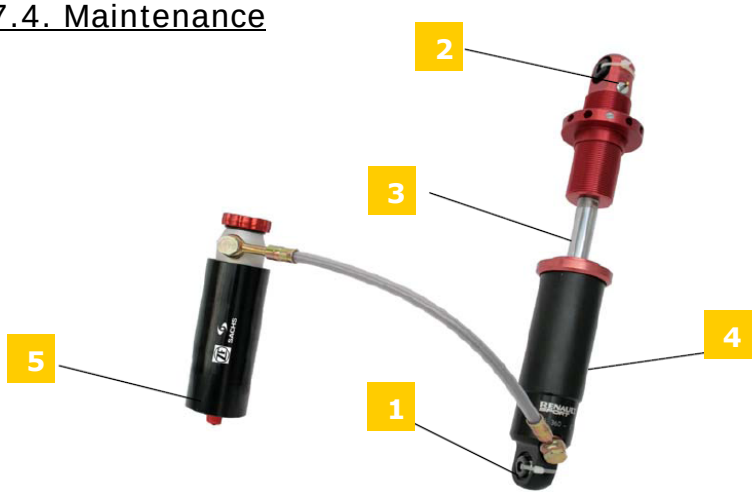
FR 2.0 Front damper



FR 2.0 rear damper



2.7.4. Maintenance



Inspection points:

1. Check the lower uniball joint for clearance
2. Check the upper uniball joint for clearance
3. Check the surface of the piston rod for scratches, dirt and oil leackage
4. Check the damper body for any damage or leackage
5. Gas pressure 15 bar ± 1 bar. The shock absorbers are nitrogen charged to ensure instantly responsive damping under the toughest racing conditions. Checking the gas pressure shall be done at 20 °C and with fully extended piston rod.

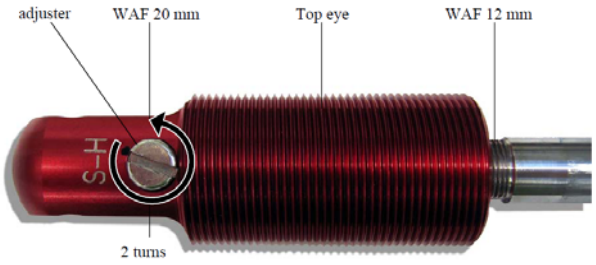
Do not use detergent, like brake cleaner or thinner for cleaning the shock absorber!

Sachs Racing Dampers:
Dampers out of the Sachs Racing line are developed for motorsport applications only and are not allowed to be used on public roads.

Service information:
We recommend a damper service check at least once per racing season (or appr. after 5 000 km of mileage). Parts to be serviced can be shipped directly to ZF SRE or to our authorised service partners.

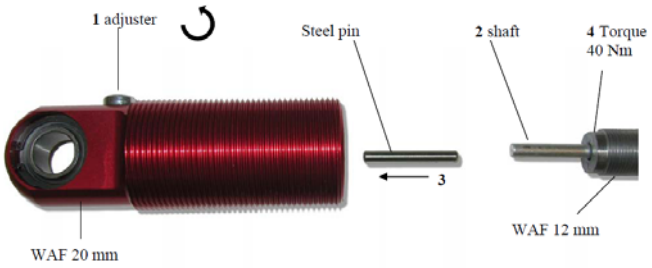
2.7.5. Demounting of the top eyes

- Unscrew the adjuster at 2 turns from the close position (counter clockwise)
- Disassemble the top eye using a 20 mm and a 12 mm spanners



2.7.6. Installation of the top eyes

- Make sure that the adjuster is set at 2 turns from the close position
- Make sure that the adjusting shaft is set into the piston rod
- Insert the steel pin into the top eye
- Afterwards please torque the top eye with the piston rod with 40 Nm.



2.7.7. Damper service

ZF Sachs Engineering subsidiary and service partners

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Germany Galladé Technologiezentrum am Nurburgring Rudolf Diesel Strabe 11-13 53520 Meuspath Phone: +49 2691 9338-54 Fax: +49 2691 9338-50 www.gallade.de	**UK** Competition Braking Products Catering Garrison North Yorkshire DL9 4GA Phone: +44 1748 831200 Fax: +44 1748 831222	**Austria** Dullinger Fahwerkstechnik Kasten 3 4091 Vichtenstein Phone: +43 676 6850371 www.dullunger.co.at
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	Italy VPS Workshop srl Via Garibaldi, 28 24031 Almenno San Salvatore BG Phone: +39 356 33000 Fax: +39 356 320514	**USA** ZF Sachs Race Engineering NA 15811 Centennial Drive Northville, MI, 48168 Phone: +1 734 416 6200 Fax: +1 734 416 1948 www.sachsracing.com

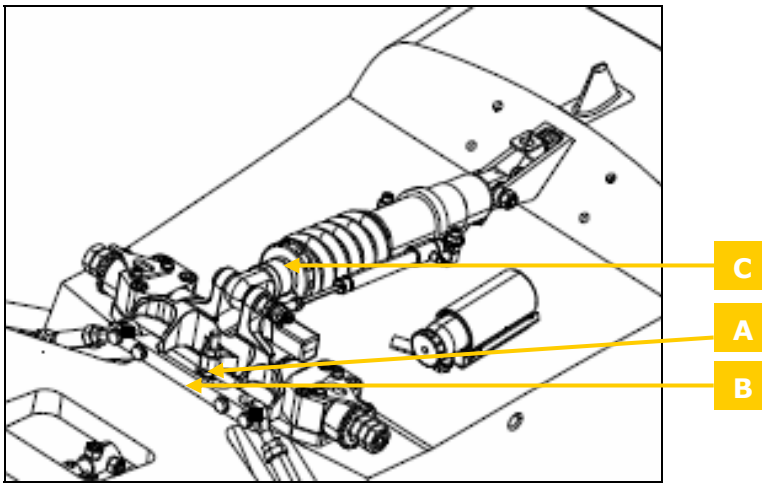
2.7.8. Front springs

There are three different springs available for the front

Stiffness in lb/in	Stiffness in kg/mm
700	12.40
800	14.17
900	15.49

2.7.9. Front spring preload setting

- Mount the spring with the spring platform C just in contact with the spring.
- Mount the damper-spring assembly on the car and put the car with the driver seated on the set-up floor.
- Bounce the car a few times to settle it down.
- Be sure that the droop-stop A is not in contact with the plate B.
- Set the desired ride height with the pushrod adjusters.
- Turn the droop-stop A in contact with plate B and tighten with its counter-nut.
- You need to screw out the 3 plastic bolts for 2 – 3 mm. Then you should use a 5mm pin for spinning the upper spring seat.
  1 turn around of the spring seat, changes the spring preload for 1.5 mm. For exact adjustment of the spring preload you should make a mark on the spring seat, in order to change the preload for the exact value.



2.7.10. Rear Springs

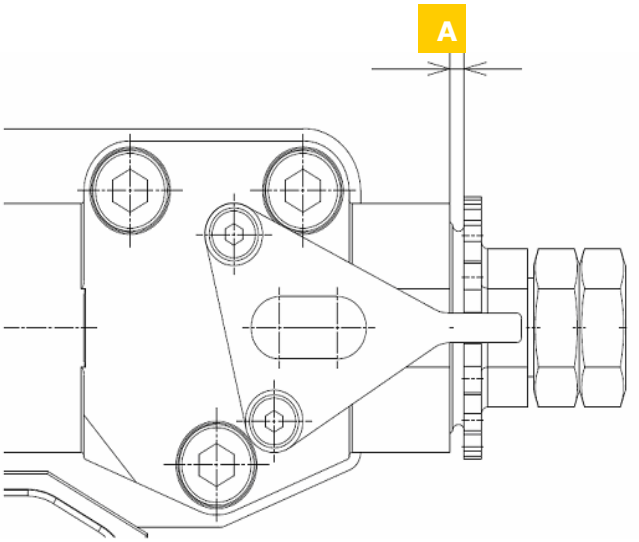
There are three different springs available for the rear

Stiffness in lb/in	Stiffness in kg/mm
800	14.17
900	15.49
1000	17.72

2.7.11. Front Anti Roll

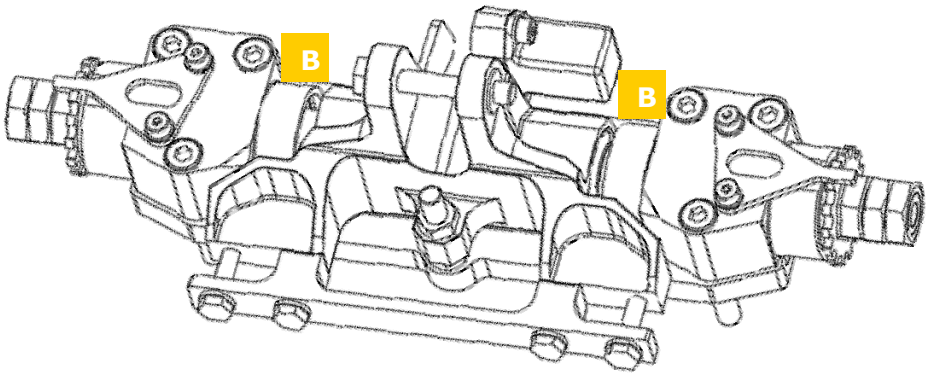
The front anti roll is made by the means of Belleville springs placed on both side of the front rocker.

The configuration of the stack will determinate the rigidity of the front anti-roll.



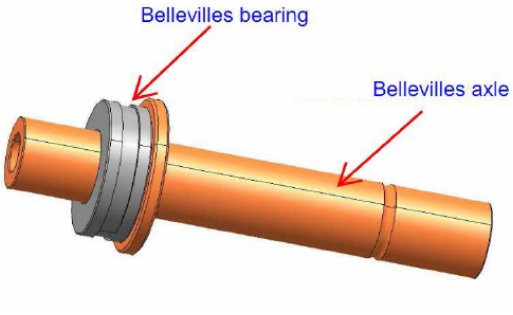
Pay attention to the following:

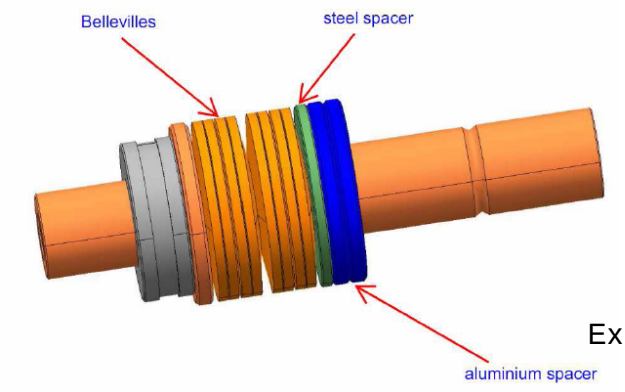
- Total length of the combined stack should never be more than 27mm.
- The clearance between the platform and the rocker (A) should not be more than 5mm when the platform just touches the Belleville stack, with no pre-load.
- Both left and right packs must be symmetrical.
- For any Belleville stack, in running conditions, the total of the rocker lateral displacement plus the chosen pre-load must never reach the "Maximum Deflection" (see Table below), to avoid the side of the rocker to “bottom-out” suddenly.
- To set-up the anti roll you must maintain the rocker in the middle of its support by the mean of spacers (B).
- The platform thread step is 1.5 mm. There are 15 notches per turn, hence 0.1 mm preload per notch
- Belleville thickness is 2.0 mm



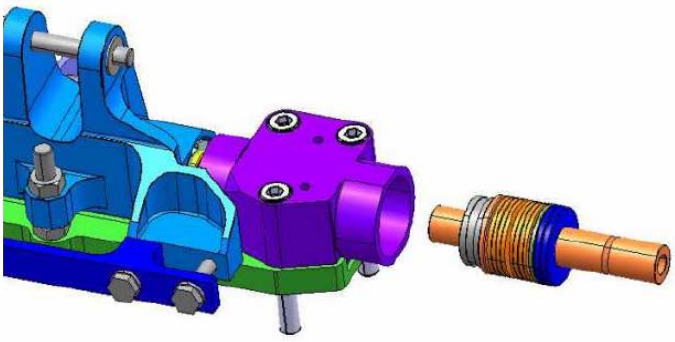
Example of configuration or setting

Configuration	Max clearance (mm)	Stacking thickness (mm)	Rigidity (kg/mm)	Min preload	Max preload	Max deflection (mm)	Stack length (mm)
<<<>>>	1.125	13.5	1796	1	5.5	1.12	13.50
<<<>>><<<	1.6875	20.5	1197	2	5.5	1.69	20.25
<<>><<	1.6875	14.25	751	3	5.5	1.69	14.25
<<>><<>>	2.25	19	571	3.5	6.5	2.25	19.00
<<>><<>><<	2.8125	23.75	457	4	8.5	2.81	23.75
<><	1.6875	8.25	362	4	5.5	1.69	8.25
<><>	2.25	11	272	5	6.5	2.25	11.00
<><><	2.8125	13.75	218	6	8.5	2.81	13.75
<><><	3.375	16.5	181	6.5	10	3.37	16.50





Example <<>><<>>



2.7.12. Front anti-roll preload setting

There are three different ways of setting the front anti-roll Belleville washers:

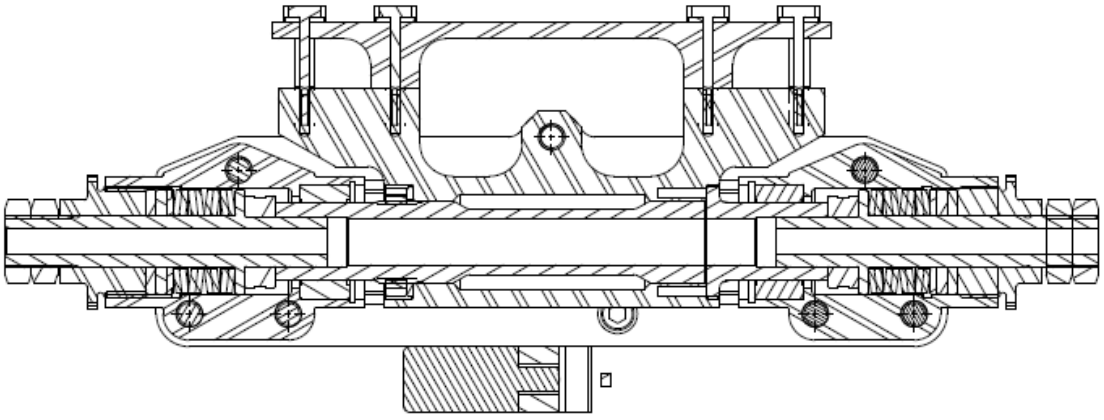
[1] Select a stack configuration and turn the platforms (both sides) until **just in contact** with the stack. In this configuration there is **no pre-load** and the roll stiffness is the nominal stack stiffness.
For example: the configuration **<<>><<** gives 761kg/mm stack stiffness.

[2] By turning both platforms (use notches as a reference) you preload the system. The roll stiffness below the **pre-load threshold is twice the nominal stack stiffness**. The roll stiffness above the pre-load threshold is the nominal stack stiffness.
For example:" >><<>> + 5 notches " has 0.5mm of roll preload and, up to 0.5 mm of side rocker movement, the stack stiffness is 761x2=1522kg/mm.

[3] By turning both platforms (use notches as reference) and **by locking the two extra locknuts** the system is **infinitely stiff**, this means the rocker will not move as long as the force is lower than the pre-load. Once the side force overcomes the pre-load, the stiffness is the **nominal stack stiffness**.

Above the pre-load, the stiffness gets back to the nominal stack stiffness.

Set accurately the transition point of 'pre-load / no pre-load' since the consequently stiffness variation is sudden and reflects immediately on the balance.

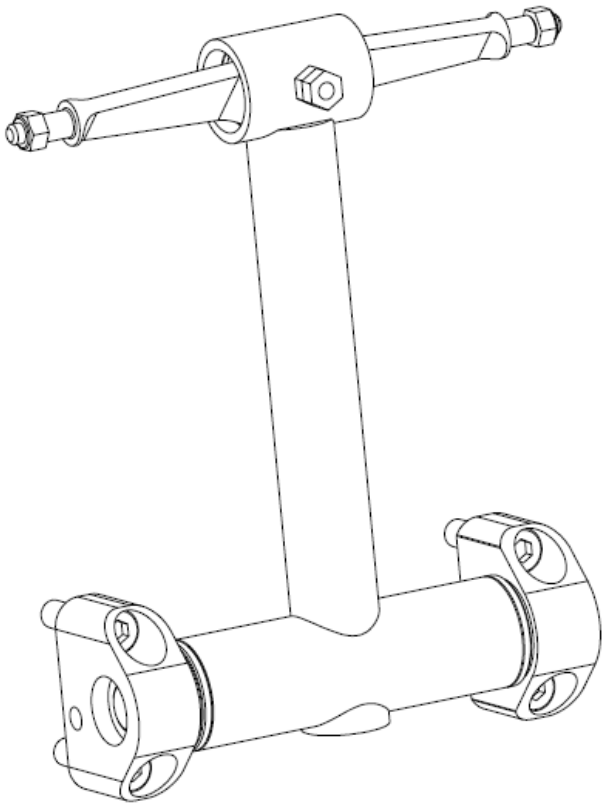


2.7.13. Rear Anti Roll Bar

There is one anti roll bar available and two blades. There are five different positions for each blade.

At full soft (position 1), the blade is vertical.
At full stiff (position 5), the blade is horizontal.

Blade	Position	Rigidity kg/mm
5 mm	P1	18.5
	P2	34.3
	P3	57.9
	P4	95.5
	P5	145.8
7 mm	P1	59.6
	P2	74
	P3	94.5
	P4	140.4
	P5	220.6



2.8. Front suspension pick up points

Available in the next release.

2.9. Rear suspension pick up points

Available in the next release.

3. SUGGESTED SET UP

The set up considers the complete car, with all liquids (water, oil), driver and 30 Kg of fuel, ready to race.

		FRONT		REAR	
Ride height	*mm*	23		37.5	
Camber	*deg*	-4.00°	-4.00°	-3.60°	-3.60°
Toe	*deg*	20'° OUT		10' IN	
Springs	*Lb/in*	800		900	
Spring vertical pre-load		contact		3 faces	
Damper bump/rebound	*Nber of clicks*	10	2	20	0.5
Droop	*mm*	0		max	
Roll centre setting		STD		3	
Anti Roll setting		<<>><<>>		Soft P3	
Front anti-roll pre-load	*notches*	2		-	

4. WHEELS AND TYRES

4.1. Wheels

Material: Aluminium
Attachment: Central nut
Wheel nut tightening torque: 162 Nm

	Type of wheel	Width	Weight
Front wheel	FR 2.0	9’	4.8 Kg
Rear wheel	FR 2.0	10.5’	5.2 Kg

4.2. Tyres

		Slick	Rain
Type	Front	RST 2.0	RST 2.0R
	Rear	RST 2.0	RST 2.0R
Size	Front	20x54x13	20x54x13
	Rear	24x57x13	24x57x13
Hot inflating pressure	Front	1.5	2.0
	Rear	1.5	2.0

To have more details about the tyres, refer to the tyres manual (F).

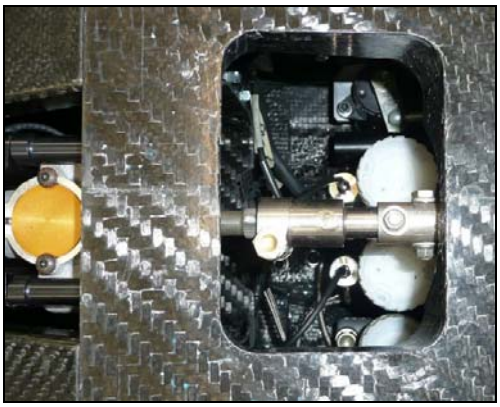
5. STEERING ASSEMBLY

5.1. Tightening torques

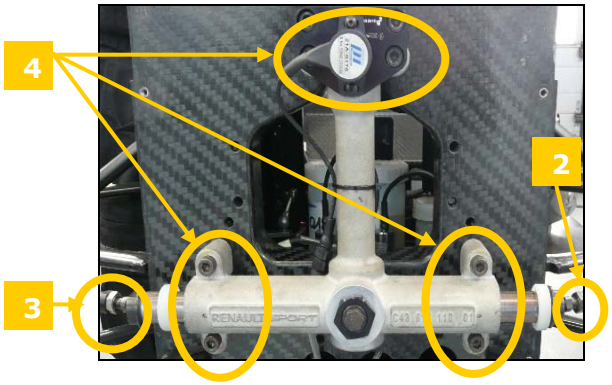
	Tightening torque
Steering rack screws	23 Nm

5.2. Replacement

- Unscrew the screw on the steering column

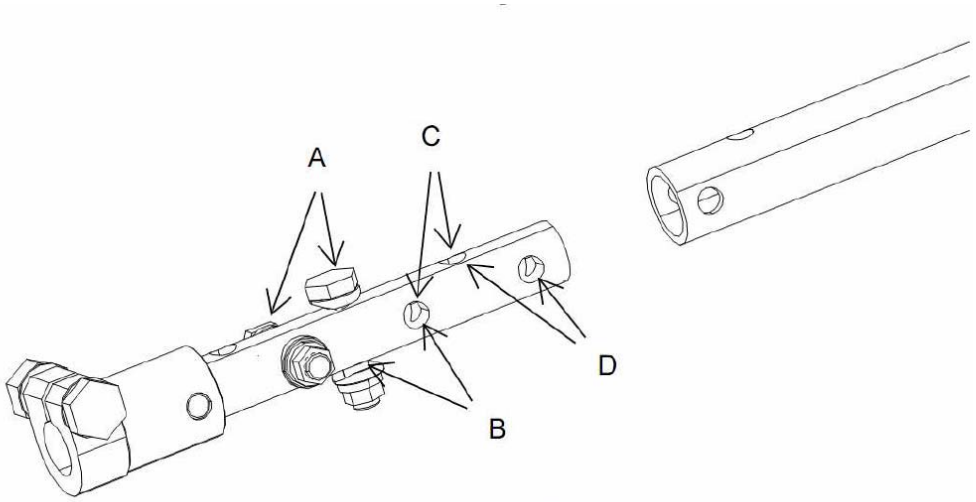


- Disconnect the left (2) and right (3) ball joints
- Disconnect the steering potentiometer
- Remove the six screws (4)
- Take out the rack



5.3. Steering column position

There are 4 different positions to adjust the length of the steering column and move the steering wheel along the X axis.

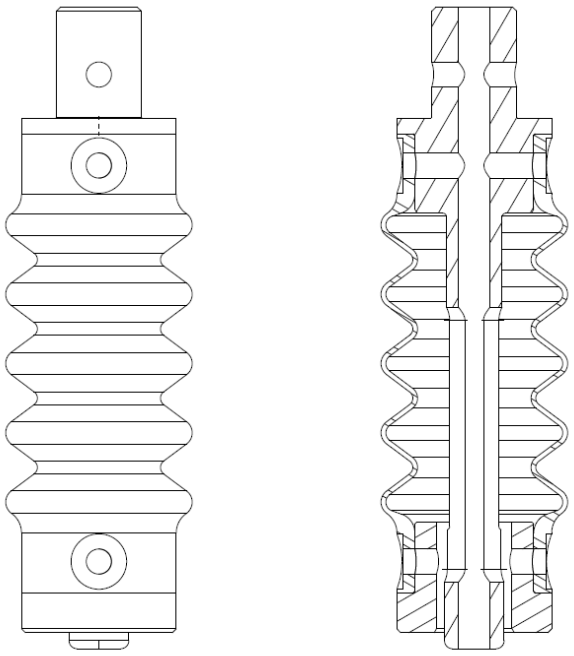


4 settings positions, 15mm step (total=45mm)

Mandatory to use the 2 fixing bolts

5.4. Collapsable structure

The state of the collapsable structure must be controlled on a regular basis to ensure the security level of the car.



5.5. Shimming of Bevel Gears

5.5.1. Removal

1. Clamp rack in a vice.

2. Remove countersunk screws.
3. Remove flange.
4. Remove any shims.

5. Remove button head screws.
6. Remove crinkle washers.
7. Remove potentiometer-blanking plate.
8. Tap bronze bush back with a draught so it is recessed into the housing. The bevel gears should now be loose. (**Do not push the bush, bearing, input shaft and bevel gear out of the housing.**)

5.5.2. Installation

1. Replace the potentiometer-blanking plate.
2. Replace the crinkle washers.
3. Replace the cap head screws.

4. Increase or decrease the overall thickness of the shims according to how the rack feels.
5. Place the shims in the flange ready for reassembly.

6. Replace the flange.
7. Replace the countersunk screws.
8. You will feel the bearing and bevel gear being pushed back into place as the countersunk screws are tightened.
9. Repeat entire process until bevel gears have no play in them and run smoothly.

You have reassembled your rack.

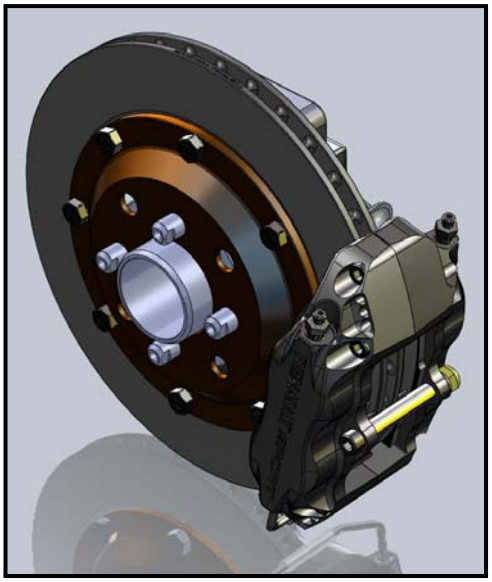
5.6. Adjustment of backstop shoe

1. Loosen lock nut.
2. Tighten or loosen backstop adjuster until rack runs smoothly.
3. Loosen backstop adjuster 1/16th of a turn.
4. Re-tighten lock nut whilst keeping backstop adjuster in the same place.

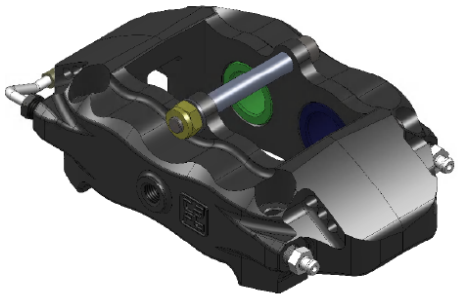
5.7. Steering rack information

Ratio of Rack	8T x 12DP
Rack movement per turn of the pinion	57.3mm/2.25”
Distance between end joint ball centres	322mm
Total travel	60mm
Spline detail on input shaft	9/16” 36 serrations
End joint thread	3/8” x 24UNF

6. BRAKES



The braking system is provided by Caparo AP Braking.



6.1. Introduction

6.1.1. Cautions, Warnings, Notes, etc

Within this manual are specifically labeled comments intended to bring special attention to a general procedure or detailed steps. Be aware of, and understand, the meaning of these labels.

Warning	**:**	**Means that there is the possibility of personal injury to yourself or to others.**
Caution	**:**	**Means that there is the possibility of damaging the brake or the vehicle.**

6.1.2. Glossary

To help you become familiar with some of the terms associated with disc brakes, and in particular the CAPB Disc Brake, we provide the following glossary.

Burnish	:	The bedding-in period of a disc brake system until the brake achieves full power.
Bleed	:	Removing the air from a full hydraulic system.
Full Hydraulic	:	A Hydraulic system where pressure is generated directly through activation of the pedal.
Master Cylinder	:	The part on the CAPB Disc Brake system that generates pressure in the full hydraulic system. The master cylinder is activated through the pedal.
Caliper	:	The part of the CAPB Disc Brake system that holds the brake pads, and clamps on the disc to slow the wheel.

6.1.3. Recommended Fluids and Lubricants

Use only “FR 2.0 Caparo 600” brake fluid.

Caution : Do not use any petroleum-based lubricants, as this will cause the rubber parts to swell.

Clean the disc and pads only with isopropyl alcohol.

6.1.4. Safety Info

This brake has been designed for use on a single seater racing vehicle. The use on any other vehicle or device will void the warranty and can cause serious injury.

As a serious driver you are probably well aware of the need to practice safety in all aspects of the sport. This includes service and maintenance practices as well as driving practices.

Warning : Before each drive, always check your brakes for proper function and the brake pads and discs for wear.

Maximum working pressure: 120 bar

6.2. General Information

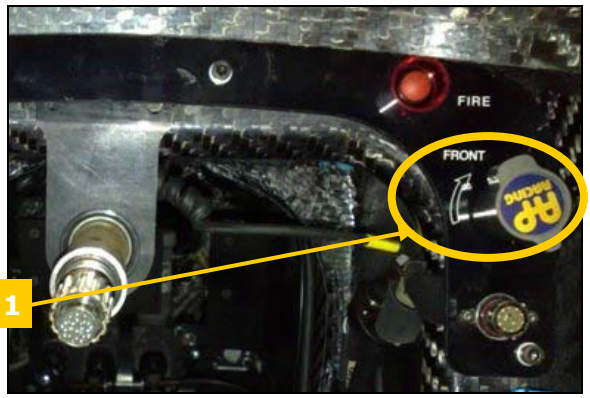
Master cylinder diameters available	0.625’ / 0.7’/0.75’
Brake Fluid	FR 2.0 Caparo 600 brake fluid
Brake pads type	FR 2.0 brake pads
Contact Area	18.08 cm²
Brake pads nominal thickness	16 mm
Brake pads minimal thickness	7.5 mm
Brake discs type	FR 2.0 floating discs
Brake discs nominal thickness	18 mm
Brake discs minimal thickness	17 mm

6.3. Brake balance device

The driver can adjust the brake balance device from inside the cockpit.

Turn control (1) clockwise to increase braking on front and decrease it on rear.

Turn control (1) counter clockwise to decrease braking on front and increase it on rear.



Note:

- The percentage of change per turn will depend on the combination of master cylinder you are using.
- To check the brake balance from the cockpit a dashboard page is available. Refer to the electronics manual (E) for more information.

6.4. Brake tightening torques

	Tightening torque
Pad retaining nut	11 – 13.5 Nm
Bleed screw	14 Nm hot / 17Nm Cold
Fluid inlet	22 – 25 Nm
Bobins	14 – 17 Nm
Caliper fitting screws	44 Nm

6.5. Maintenance

6.5.1. Disc/Pad bedding procedure

To achieve optimum performance from any brake pads it is essential to bed them in properly. The aim of the bedding procedure is to achieve 100% mating of the friction surfaces and thermally condition both disc and pads by gradually increasing temperature without creating any thermal shock or hot spots. A small investment of time to follow the recommended bedding procedure will enhance performance and improve the life of both pads and discs.

Warning : Please follow the procedure below

1. While vehicle is stationary, pump brakes to bring pads into contact with the disc and ensure a firm pedal.
2. Use light braking for 2 or 3 laps (5 Km) using 50% of normal race pedal pressure to obtain full (over 80%) contact between disc & pad. Do not drag the brakes against the engine.

3. Gradually increase speed and braking pressure for another 2 or 3 laps until full racing speeds are reached to progressively build up temperature in the Discs & Pads.
4. Cool the brakes by driving the vehicle for another lap with minimal brake use and then return to the pits.
5. Allow the brakes to cool. The pads should now be ready to race.
6. If time permits it is recommended that the pads are removed and inspected after bedding. The full surface of the pad should show evidence of contact with the disc but without glazing. If this has not been achieved further bedding applications should be carried out.
7. If possible avoid bedding new pads on new, unbedded discs; use a previously bedded disc which has a smooth flat friction surface.

Note : During this period some noise may occur.

6.5.2. Replacing Pads

Brake pads should be regularly inspected for wear. Brake pads must have at least 2.5 mm of friction material above the metal backing plate and be reasonably flat. Excessively worn brake pads must be replaced as an axle set, preferably vehicle set.

Warning : Please follow the procedure below

1. While vehicle is stationary, remove the pad retaining bolt and sleeve from the caliper assembly.
2. Remove the worn pads and replace with new
3. Replace the bolt and sleeve taking care to check both pads are free to move. The nut should be torqued to 11 – 14 Nm.

6.5.3. Bleeding Brake system

Why bleed brakes?

Fresh brake fluid has a significantly higher boiling point than old fluid, allowing harder braking without fade. This is because brake fluid is hygroscopic and readily absorbs moisture. The more moisture in the fluid, the lower the boiling point.

That same moisture promotes corrosion. Frequent bleeding with fresh fluid allows brake components to last longer. A well maintained brake system can help you avoid ever having to replace calipers or master cylinders

The bleeding process, done properly, removes air bubbles from the hydraulic system, resulting in firmer brake pedal feel and more linear, responsive braking performance. Too much air in the system can be dangerous and result in the pedal sinking all the way to the floor. Air is compressible, brake fluid is not.

How often should you bleed your brakes?

You should bleed the brakes before each track event and, if the pedal becomes soft during an event, it may even be necessary to bleed between sessions. If you find yourself bleeding the car between sessions, then you should look for any loose connections or other sources of leaks.

Supplies Required

You will need the following tools:

- ✓ Box-end wrench suitable for your car's bleeder screws. An offset head design usually works best.
- ✓ Extra FR 2.0 Caparo 600 brake fluid (about 1 x ½ litre bottle if you are just bleeding, about 4 if you are completely replacing).
- ✓ 12-inch long section of clear plastic tubing, ID sized to fit snugly over your car's bleeder screws.
- ✓ Disposable bottle for waste fluid.
- ✓ One can of brake cleaner.
- ✓ One assistant (to pump the brake pedal).

Vehicle preparation and support

1. Loosen the nut of the wheels and place the entire vehicle on jackstands. Be sure that the car is firmly supported before going ANY further with this procedure!
2. Remove all wheels.
3. Check the level of the brake fluid reservoir. Add fluid as necessary to ensure that the level is at the MAX marking of the reservoir. Do not let the reservoir become empty at any time during the bleeding process!

Warning : Bleeding Procedure

1. Begin at the corner furthest from the driver and proceed in order toward the driver. (Right rear, left rear, right front, left front.). While the actual sequence is not critical to the bleed performance it is easy to remember the sequence as the farthest to the closest. This will also allow the system to be bled in such a way as to minimize the amount of potential cross-contamination between the new and old fluid.
2. Locate the bleeder screw at the rear of the caliper body.
3. Place the box-end wrench over the bleeder screw. An offset wrench works best since it allows the most room for movement.
4. Place one end of the clear plastic hose over the nipple of the bleeder screw.
5. Place the other end of the hose into the disposable bottle.
6. Place the bottle for waste fluid on top of the caliper body or drum assembly. Hold the bottle with one hand and grasp the wrench with the other hand.

7. Instruct the assistant to "apply." The assistant should pump the brake pedal three times, hold the pedal down firmly, and respond with "applied." Instruct the assistant not to release the brakes until told to do so.
8. Loosen the bleeder screw with a brief ¼ turn to release fluid into the waste line. The screw only needs to be open for one second or less. (The brake pedal will "fall" to the floor as the bleeder screw is opened. Instruct the assistant in advance not to release the brakes until instructed to do so.)
9. Close the bleeder screw by tightening it gently. Note that one does not need to pull on the wrench with ridiculous force. Usually just a quick tug will do.
10. Instruct the assistant to "release" the brakes. Note: do NOT release the brake pedal while the bleeder screw is open, as this will suck air back into the system!
11. The assistant should respond with "released."
12. Inspect the fluid within the waste line for air bubbles.
13. Continue the bleeding process (steps 11 through 16) until air bubbles are no longer present. Be sure to check the brake fluid level in the reservoir after bleeding each wheel! Add fluid as necessary to keep the level at the MAX marking. (Typically, one repeats this process 5-10 times per wheel when doing a standard' bleed.).
14. Move systematically toward the driver right rear, left rear, right front, left front - repeating the bleeding process at each corner. Be sure to keep a watchful eye on the brake fluid reservoir! Keep it full!
15. When all four corners have been bled, torque each bleedscrew to 14 – 17 Nm and spray (and any other parts that were moistened with spilled or dripped brake fluid) with brake cleaner and wipe dry with a clean rag. (Leaving the area clean and dry will make it easier to spot leaks through visual inspection later!). Try to avoid spraying the brake cleaner DIRECTLY on any parts made of rubber or plastic, as the cleaner can make these parts brittle after repeated exposure.
16. Test the brake pedal for a firm feel. (Bleeding the brakes will not necessarily cure a "soft" or "mushy" pedal since pad taper and compliance elsewhere within the system can contribute to a soft pedal. But the pedal should not be any worse than it was prior to the bleeding procedure!)
17. Be sure to inspect the bleeder screws and other fittings for signs of leakage. Correct as necessary.
18. Properly dispose of the used waste fluid as you would dispose of used motor oil. Important: used brake fluid should NEVER be poured back into the master cylinder reservoir!

Vehicle completion and test

1. Re-install all wheels.
2. Raise the entire vehicle and remove jackstands. Torque the lug nuts to the manufacturer's recommended limit.
3. With the vehicle on level ground and with the car NOT running, apply and release the brake pedal several times until all clearances are taken up in

the system. During this time, the brake pedal feel may improve slightly, but the brake pedal should be at least as firm as it was prior to the bleeding process.

4. Test the vehicle to confirm proper function of the brakes.

Caution : The first time you drive your car after modification; ensure proper function of all vehicle systems.

6.5.4. Replacing Disc and Bell assemblies

The disc system is designed with a “float” mechanism which reduces the distortion caused by severe thermal abuse encountered in racing. It also reduces the weight and the corresponding inertia resulting in improved vehicle handling.
Discs and bells should be regularly inspected for wear. Discs must be greater than 17.0 mm thick and excessively worn discs must be replaced as an axle set, preferably vehicle set.

Warning : Please follow the procedure below

1. Remove the disc from the assembly by removing each of the 8 bobbins and nuts. Check the wear on the bobbin drive surfaces of the bell and replace if any witness marks are visible
2. Remove the worn discs and replace with new
3. Replace the bobbin and nuts in sequence using a torque of 14 – 17 Nm.

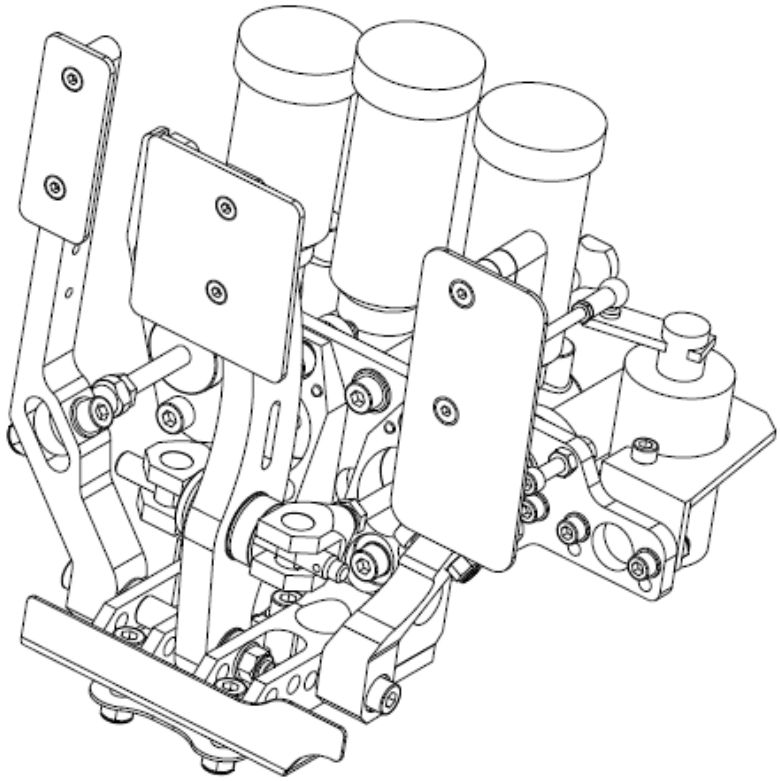
Caution : Care must be used to hold the head of the bobbin bolt whilst torquing the nut. Once the torque has been achieved the head should be rotated in the contra-direction to relieve the pressure. Check that the disc is free to move on each bobbin.

4. The float on each bobbin should be 0.35 mm
5. Re-fit the disc and bell assemblies to the vehicle.

7. PEDAL BOX

7.1. Setting up the pedal box

7.1.1. Overview



The pedal box is an all in one device containing the 3 pedals, the 3 master cylinders and the throttle potentiometer. It can be taken out of the cockpit to set it up outside.

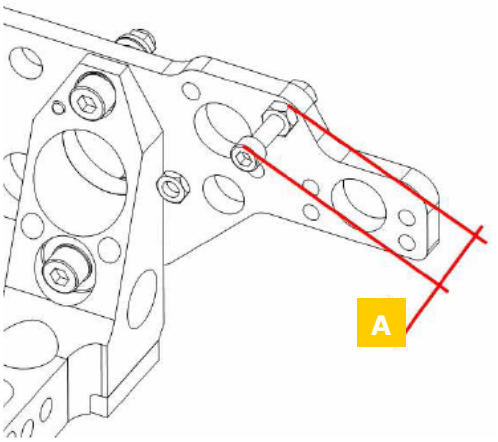
7.1.2. Throttle potentiometer set-up

The position of the throttle pedal is defined and cannot be changed.

The shape of the pads can be changed. Please refer to the technical regulations.

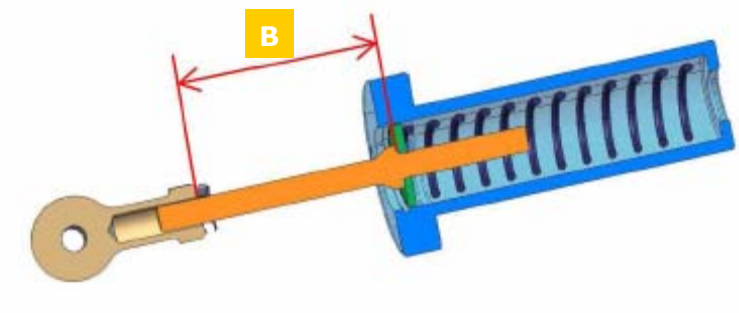
The following lengths must be respected:

Throttle pedal stop:



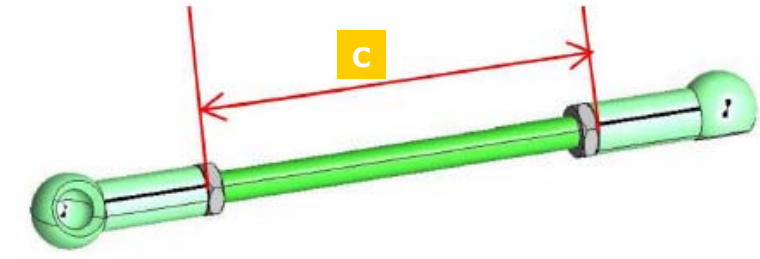
The length A must be 33 mm

Damper spring:



The length B must be 47 mm.

Throttle link:



The length C should be adjusted to 66mm.

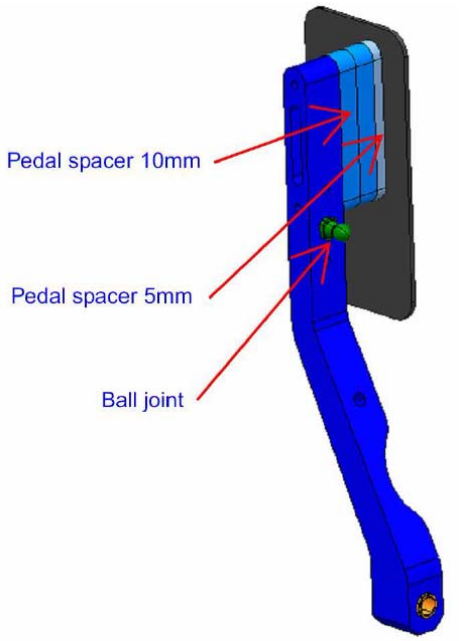
Validate the axial position of the arm on the sensor with the following electrical values:

State	PPS1 reading
Off throttle	< 0.601 mV
Full throttle	> 1.400 mV

After each change in the Throttle pedal setting, a sensor zero must be operated. Please refer to the electronics manual (throttle pedal learning process).

7.1.3. Throttle pedal

As mentioned above, the position of the throttle pedal is defined and cannot be adjusted. The position of the pad can be adjusted by the means of 5 or 10 mm spacers.



7.1.4. Brake pedal

The position of the brake pedal can be adjusted by modifying the length of the rod connecting the pedal to the master cylinders. Make sure that both rods have the same length.

The shape of the pads can be changed. Please refer to the technical regulations.

Master cylinder diameters available	0.625' / 0.7'/0.75'

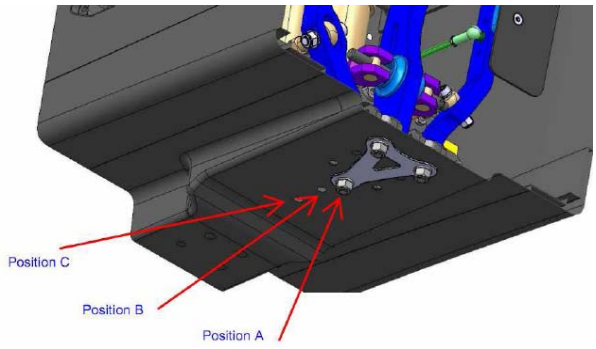
7.1.5. Clutch Pedal

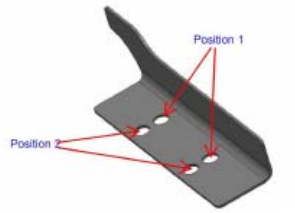
Clutch Master cylinder diameter	14 mm

7.2. Positioning the pedal box

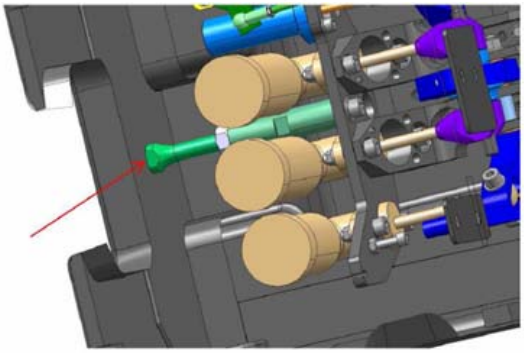
There are 3 possible positions for the pedal box: A, B and C.

- Install the pedal box in the chassis
- Fit the pedal box in the chosen position
- Slightly screw the front fastening nut (@ 12 Nm)
- Insert the heel rest, position 1 or 2 between the pedal box and the chassis
- Screw the two remaining fastening nuts (@ 12 Nm)



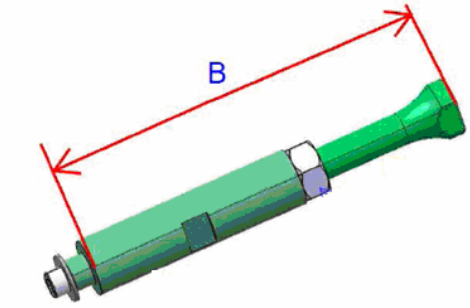


Once the pedal box is fitted, a rigidity rod must be placed between the chassis front bulkhead and the pedal box.



Set the approximate length of the rod according to the chart below.

Adjust once fitted to ensure a perfect rigidity of the pedal box.

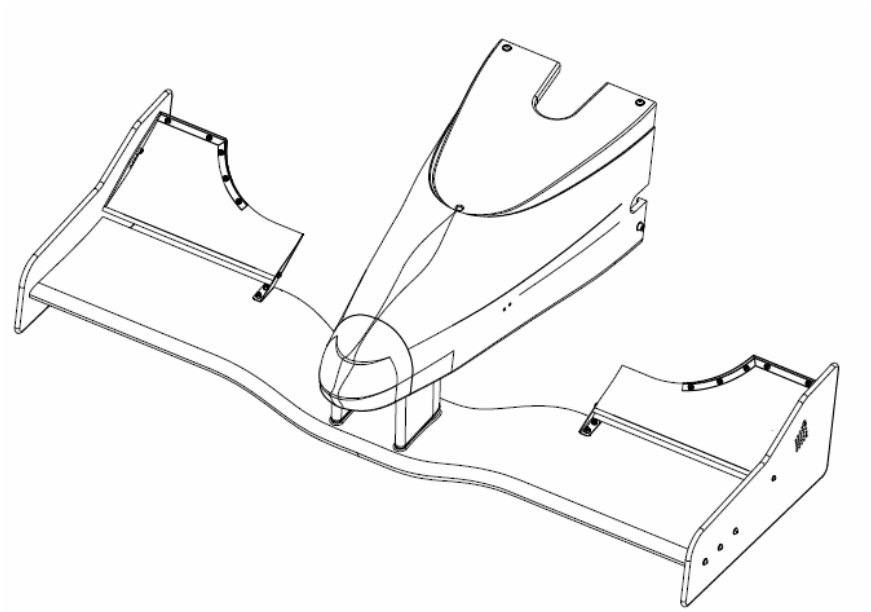


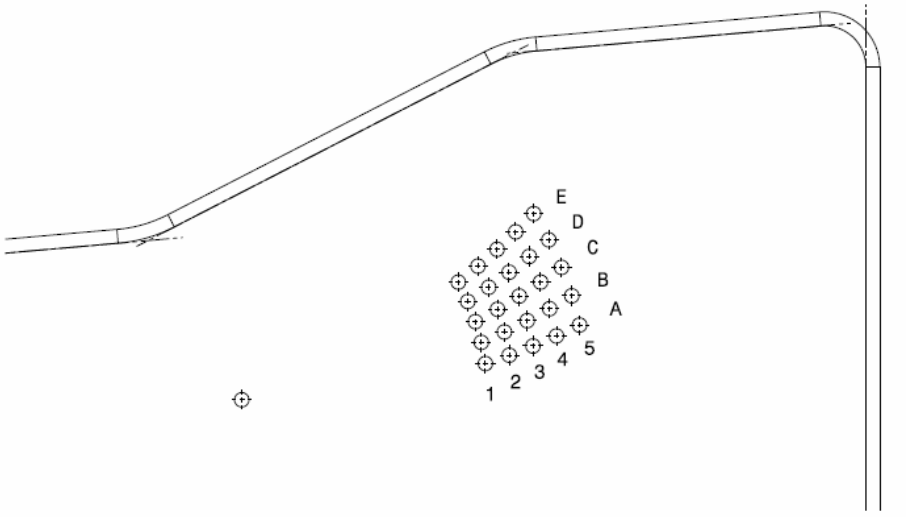
Pedal box position	Approximate Length "B"
A	140 mm
B	110 mm
C	80 mm

8. AERODYNAMICS

8.1. Wings

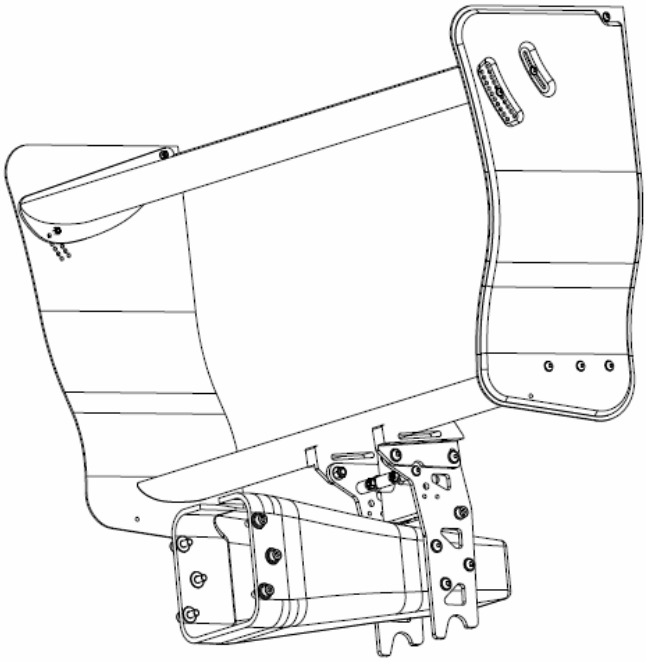
8.1.1. Front wing

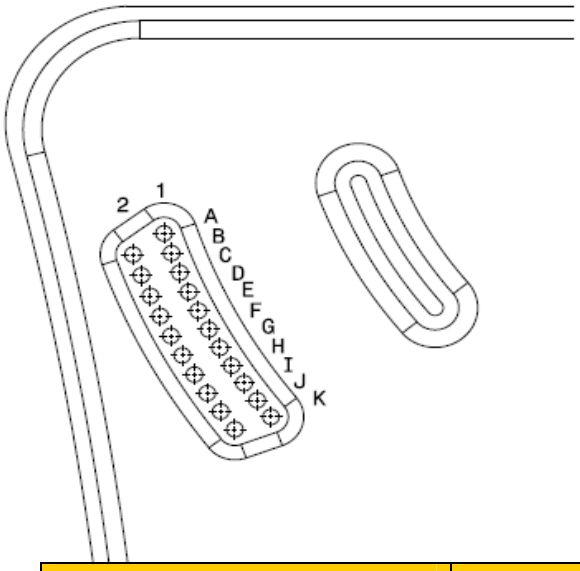




	1	2	3	4	5
A	5°	6°	7°	8°	9°
B	10°	11°	12°	13°	14°
C	15°	16°	17°	18°	19°
D	20°	21°	22°	23°	24°
E	25°	26°	27°	28°	29°

8.1.2. Rear wing





	1	2
A	5	6°
B	7	8°
C	9°	10°
D	11°	12°
E	13°	14°
F	15°	16°
G	17°	18°
H	19°	20°
I	21°	22°
J	23°	24°
K	25°	26°

8.2. Influence of the ride heights

Available in the next release.

8.3. Wing settings influence

Available in the next release.

8.4. Polar curve

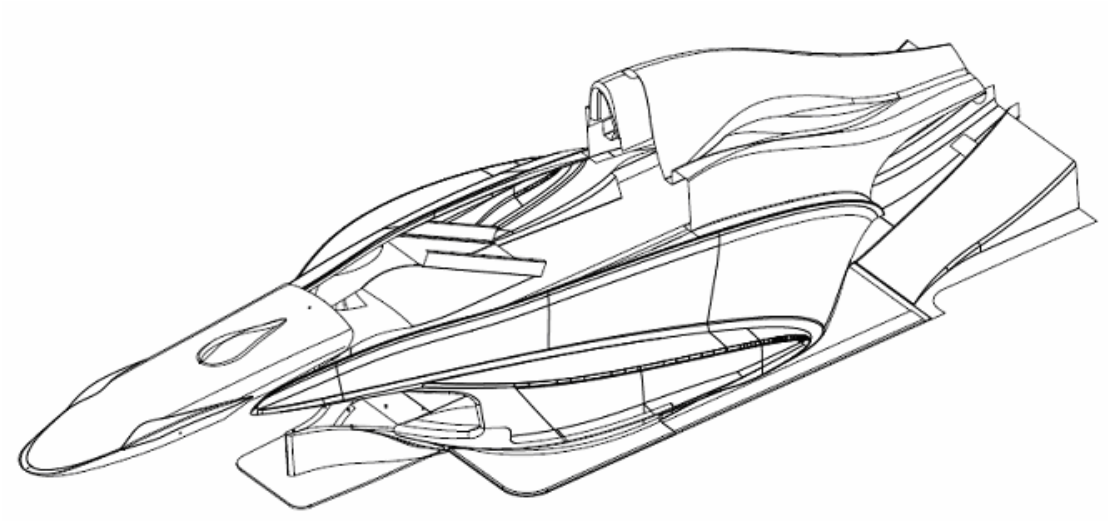
Available in the next release.

8.5. Aero Maps

Available in the next release.

9. BODYWORK

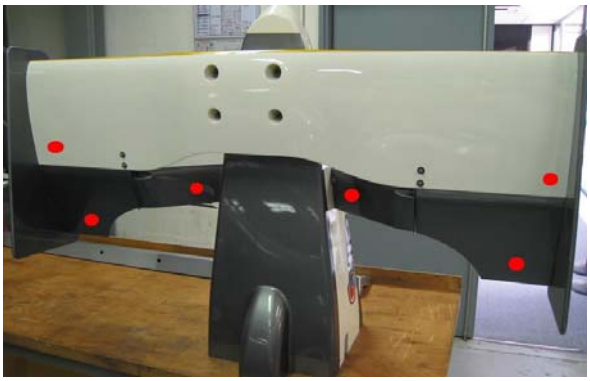
9.1. Overall view



9.2. Renault Sport marking

All parts making up the bodywork, wings and bow are marked with hologram discs. It is compulsory to keep them present and visible on the car. Contestants are responsible for the condition of these hologram discs.

Near the front damper



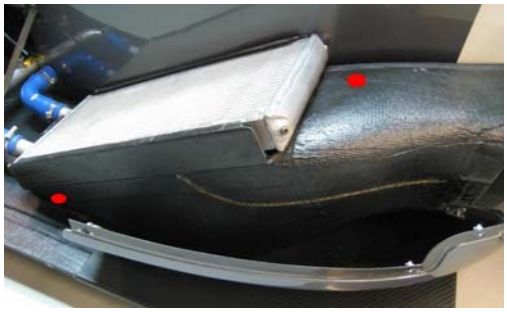
On the front wing: one hologram on left and right sides near the edge , on the flap: one hologram on left and right

Front wing endplate: inside rear part

One hologram on the crash box under the front cover

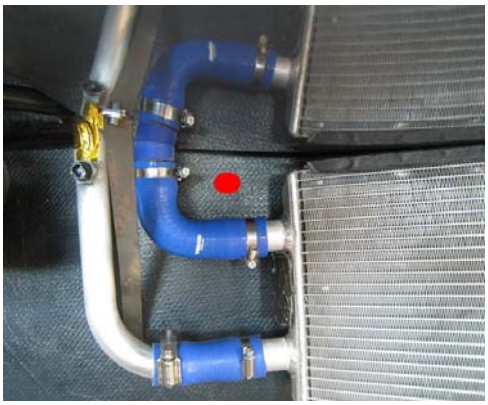
One hologram inside the crash box, on the nose

One hologram inside the front cover in the damper lump

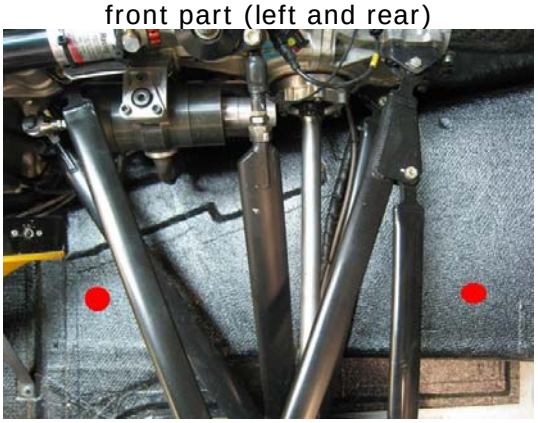


Two holograms outside the radiator duct

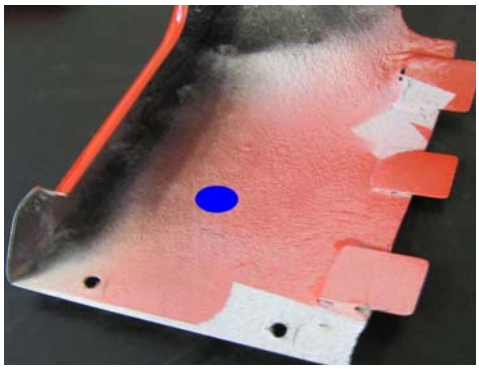
Two holograms inside the front floor, in the front part (left and rear)



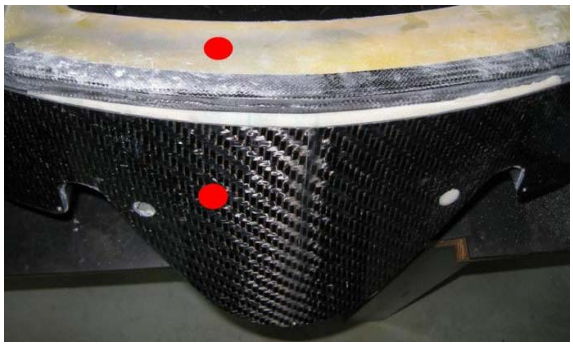
Two holograms inside the front floor rear part (left and right)



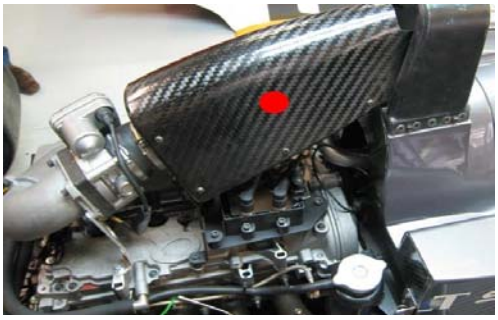
4 holograms inside the rear floor rear part (two on each side)



One hologram inside the roll hoop



Head padding: one hologram underneath on the rear part and one hologram rear part of the sump



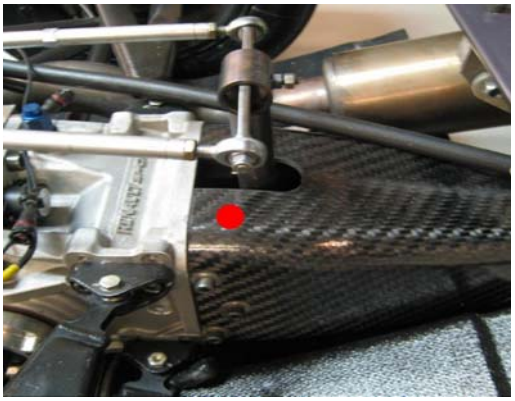
One hologram outside the airbox

One hologram underneath the airbox

One hologram inside the engine cover, on the rear middle part

One hologram inside the side pod rear part

Rear wing:
Lower part: two holograms underneath (left and right)
Upper part: two holograms underneath (left and right)
Upper flap: two holograms underneath (left and right)
Endplate: one hologram inside, near the rear bottom



One hologram outside the rear crash box on the upper part

10. CHASSIS AND CRASH STRUCTURES

10.1. Chassis repair

Available in the next release.

10.2. Front crash box repair

Available in the next release.

10.3. Rear crash box repair

Available in the next release.

11. TIGHTENING TORQUES

Dimensions		Torque (Nm)
NAS	04	12
NAS	05	22
NAS	06	35

Quality	8.8	10.9	12.9
Dimension	Tightening torques (Nm)		
M5	5.7	8	9.7
M6	9.8	14	17
M7	24	33	40
M8	47	65	79
M9	81	114	136

Description	Torque (Nm)
Front rocker on chassis	23 Nm
Upper wishbone bracket	12 Nm
Rear lower wishbone bracket	23 Nm
Wheel tethers support	23 Nm
Wheel nut	162 Nm
Steering rack	23 Nm
Pedal box screws	12 Nm
Lower arm wheel side (front)	50 Nm
Upper arm wheel side (front)	25 Nm
Steering rod wheel side (front)	23 Nm
Push rod wheel side (front)	25 Nm
Lower arm chassis side forward point (front)	23 Nm
Lower arm chassis side rearward point (front)	23 Nm
Upper arm chassis side forward point (front)	12 Nm
Upper arm chassis side rearward point (front)	12 Nm
Damper rocker side (front)	22 Nm
Push rod rocker side (front)	12 Nm
Damper chassis side (front)	22 Nm
Lower arm wheel side (rear)	50 Nm
Upper arm wheel side (rear)	25 Nm
Toe rod wheel side (rear)	25 Nm
Push rod wheel side (rear)	25 Nm
Lower arm gearbox side forward point (rear)	35 Nm
Lower arm gearbox side rearward point (rear)	22 Nm
Upper arm gearbox side forward point (rear)	12 Nm
Upper arm gearbox side rearward point (rear)	12 Nm
Damper rocker side	22 Nm
Push rod rocker side	22 Nm
Damper chassis side	22 Nm
Ackermann	23 Nm

Upright/lower arm	50 Nm
Brake pad retaining nut	11 – 13.5 Nm
Brake caliper bleed screw	14 Nm hot / 17Nm Cold
Brake caliper fluid inlet	22 – 25 Nm
Disc bobbins	14 – 17 Nm
Caliper fitting screws	44 Nm