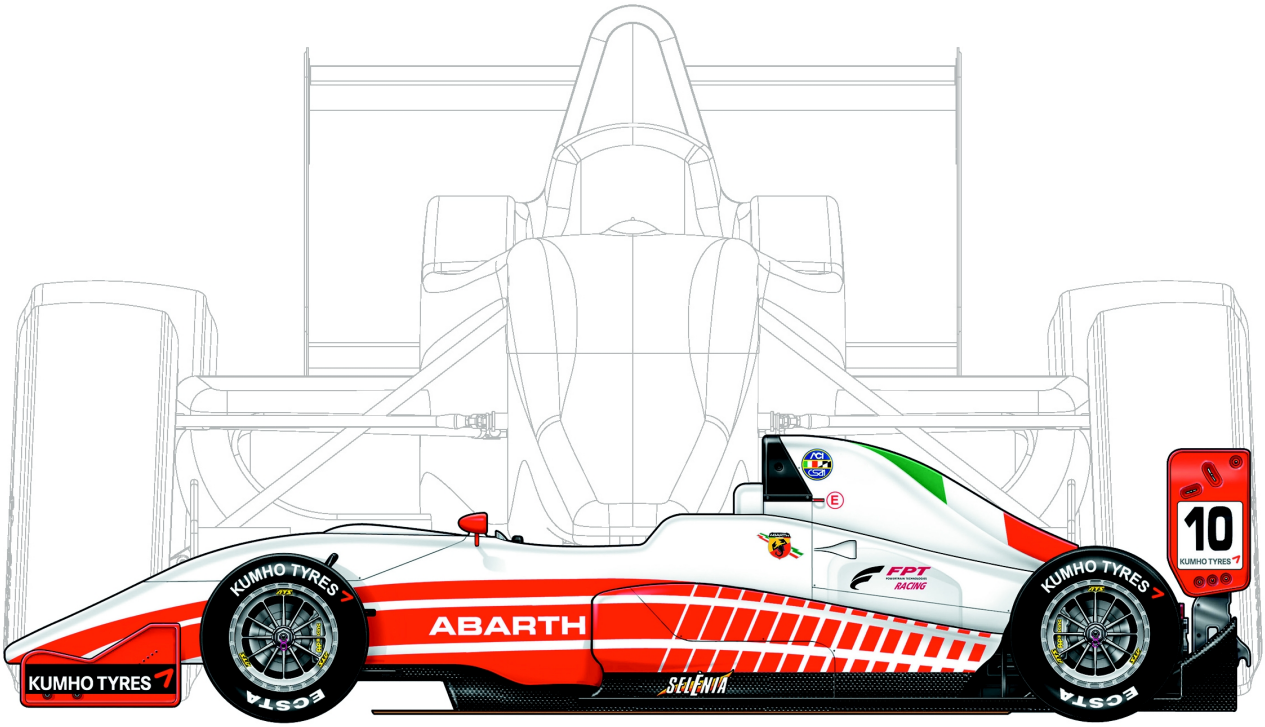


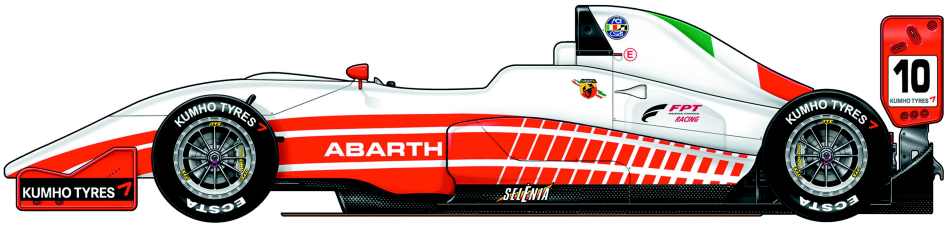
FA010

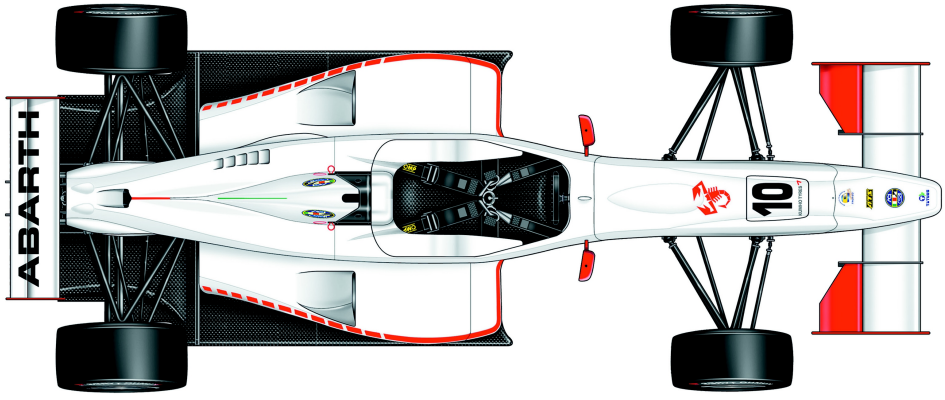
2010 WORKSHOP MANUAL

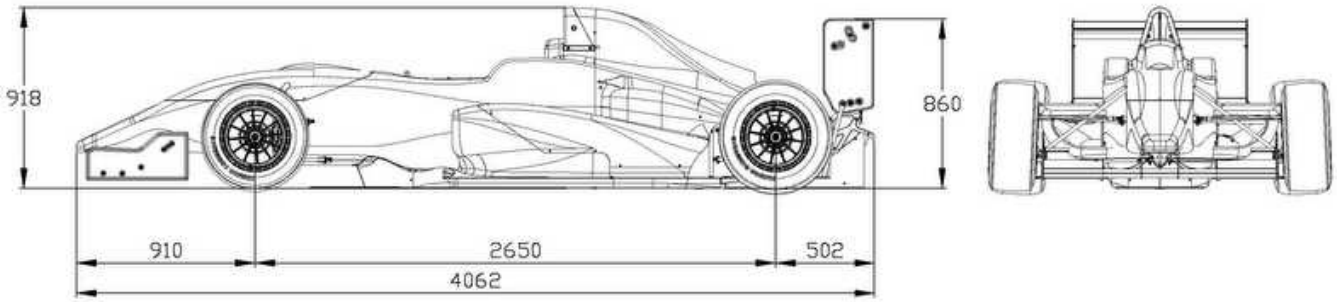
Release 2.3 (15/05/10)

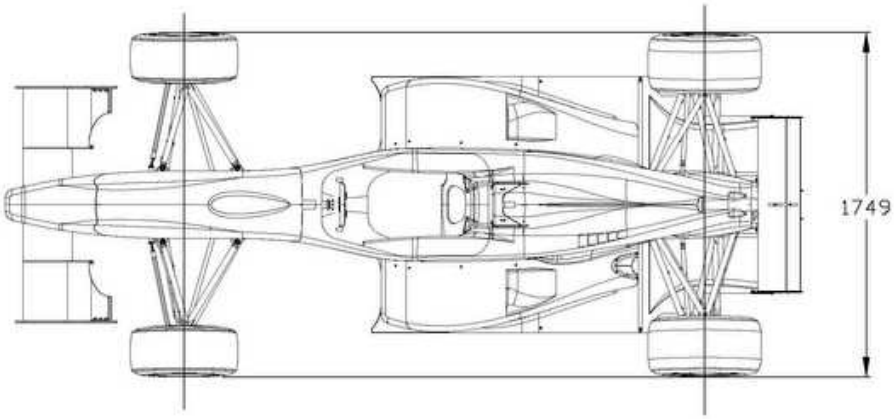
1 GENERAL INFORMATION

1.1 OVERVIEW









Front track	1515 mm
Rear track	1460 mm
Wheelbase	2650 mm
Overall length	4062 mm
Overall width	1749 mm
Overall Height	918 mm (from reference plane)

Weight	525 kg (with driver)
Chassis	Composite Carbon fibre sandwich with Al/Nomex honeycomb, FIA F3/2008 homologated
Bodywork	Carbon fibre
Front suspension	Push-rod mono damper coil spring
Rear suspension	Push-rod twin dampers coil spring
Springs	EIBACH 36mm ID
Dampers	ORAM bump and rebound adjustable
Brakes	AP calliper and disc, Ferodo pads
Tires	Kumho 180/550R13 Front – 240/570R13 Rear
Wheels	ATS 13”x9” front – 13”x10.5” rear
Engine	FPT 414TF
Electronics	ECU Magneti Marelli SRA – Logger Magneti Marelli RDL
Power system	Electronic Powerbox Next Solution
Clutch	AP twin plates 115mm
Gearbox	SADEV SL75 sequential 6 ratios, LSD
Steering wheel	AIM
Battery	DEKA
Fuel cell	PREMIER FT3
Seat	Carbon fibre extractable shell, FIA approved.
Seat belts	OMP 6-points, 3” shoulder and lap straps, HANS compatible
Lubricants	SELENIA

1.2 Technical Contacts

1.2.1 Chassis

Tatuus Racing Srl
Via G. Verga, 12
20049 Concorezzo (MI) - Italy
Contact: Corrado Casiraghi
Tel: +39 039 6040828
Fax: +39 039 6041764
e-mail: corrado.casiraghi@tatuus.it
Web: www.tatuus.it

1.2.2 Engine

FIAT POWERTRAIN TECHNOLOGIES SpA
Strada del Drosso 145
10135 Torino – Italy
Contact: Eugenio Bizzocchi
Tel: +39 335 5301073
E-mail: eugenio.bizzocchi@fptpowertrain.com
www.fptpowertrain.com

FIAT POWERTRAIN TECHNOLOGIES SpA
Strada del Drosso 145
10135 Torino – Italy
Contact: Daniele Ciavarella
Tel: +39 334 6266597
E-mail: daniele.ciavarella@fptpowertrain.com
www.fptpowertrain.com

1.2.3 Gearbox

Factory address:
SADEV
6, rue des Grand'Montains
85110 SAINT PROUANT
France
Tél.: (+33) 2 51 66 42 68
Fax: (+33) 2 51 66 49 60
E-Mail: sadev@sadev-tm.com

Postal address:
SADEV
BP 1
85 111 CHANTONNAY
France

1.2.4 Tires

RS&TA
via C. Cattaneo, 88/L
20035 Lissone (MI) – Italy
Contact: Emilio Colzani
Tel. +39 039 463761
Fax. +39 039 2542999
E-mail: mailto:emilio.colzani@rseta.it

1.2.5 Dampers

ORAM
V.le Rasori, 2
20145 Milano – Italy
Contact: Andrea Pezzotta
Tel. +39 024989884
Fax. +39 0248003052
E-mail: mailto:info@oramitalia.com

1.2.6 Electronic

Magneti Marelli Holding Spa Motorsport
via A. Borletti, 61/63
20011 Corbetta (MI) -Italy
Tel: +39 02 97227000
Fax: +39 02 97227570

Next Solution Snc
Via Belfiore, 31/D
23900 Lecco (Italy)
Contact: Giuseppe Corti
Tel. +39 0341 289072
Fax +39 0341 370057
E-mail mail@nextsolution.it

1.2.7 Brakes

AP Racing
Wheler Road
CV3 4LB Coventry
Contact: Ian Nash
Tel: +44 (0)24 7688 3311
E-mail: ian.nash@apracing.co.uk

Federal Mogul Operation Italy Srl
Racing & Motorcycle Division
C.so Inghilterra, 2
12084 Mondovì (CN) Italy
Tel. +39 0174 560514
sergio.bonfanti@federalmogul.com

1.2.8 Fuel

Panta Racing Fuel
Contact: Luca Perani
Tel. +39 0373 235137
Fax. +39 0373 235123
Mob. +39 3351003058
E-mail: racingfuel@panta.it

1.2.9 Seat belts – Fire Extinguisher

OMP Racing
via Bazzano, 5
16019 Ronco Scrivia (Ge)
Italy
Tel. +39 01096501
Fax. +39 010935698

1.3 Releases

Modifications from previous release are in red

1.3.1 Release list:

Version	Release Date	Author	Notes
0.5	20/02/10	Tatuus	Preview version
1.0	03/03/10	Tatuus	First release
'2.0	30/03/10	Tatuus	Updated contacts (FPT, AP). New gearbox release. Front and rear suspension motion ratio. Front and rear suspension tables. Electric/wiring loom update. New Electronic and software release.
2.3	15/05/10	Tatuus	Reference and step plane definition and tolerances. Engine information updated.

2 SAFETY

2.1 Homologated Safety Devices

2.1.1 Extractable seat

The seat must be removable without the need to cut any of the seat belts or remove the harness buckle.

The shoulder and lap belts must fall away over the seat edges as it is withdrawn and the crotch straps must pass freely through the seat bottom hole or holes, which must be located in front of the driver's crotch.

Any seat liner must have the same holes as the seat shell, identical and perfectly aligned with them in order to prevent the harness straps being trapped.
However, if the lap straps have to pass through holes in the seat, it is necessary to fit the car with a harness having the buckle attached to a shoulder belt, given that the buckle will not pass between the driver's body and the side of the seat.

2.1.2 Wheel tethers

Cortex zylon 2kJ/2006-C

2.1.3 Fuel cell

Premier FT3-1999
No rubber bladders should be used more than 5 years after the date of manufacture, unless inspected and recertified by the manufacturer for a period of up to another 2 years.

2.1.4 Seat belts

OMP FIA D – 255 T/98

2.1.5 Fuel coupling

Staubli SPT08.3655/L/JV
SPT08.7655/L/JV

2.1.6 Rain light

Melectronics SLC2 LED (RED)

2.1.7 Fire extinguisher system

OMP CB/364

Anti-tampering seal and manometer pointer remaining in green area guarantee the compliance of the system. In ideal conditions, the system is perfectly able to extinguish the fire on a car. Nevertheless the aim cannot be reached in all cases because of the unavoidable events due, for example, to an accident.

To avoid electrolytic corrosion phenomena from occurring inside the bottle, the vehicle's electrical system must be tested to ensure that there is no electrical leakage. We strongly suggest testing the vehicle body with an insulation resistance Ohm meter. OMP does not accept any liability for cases in which the bottle has been damaged by corrosion as a result of electrolytic phenomena or other external causes.

As regards the extinguishing liquid, we recommend to avoid the contact with eyes and a long-lasting repeated contact with skin. If it happens wash the affected body part immediately with abundant water; if irritation persists contact a doctor. In case of inhalation take the person to open air, if symptoms persist consult a doctor. In case of ingestion do not provoke vomit but drink two glasses of water and consult a doctor.

The control box (installed under the safety seat) is provided with a red push button for the activation of the system and the test switch with related green pilot light.

Indication labels must be sticked near external and internal activators.

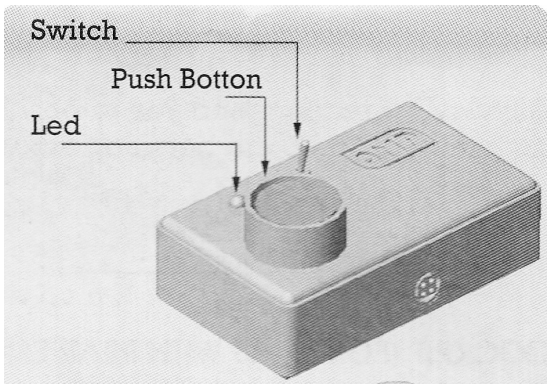
After operating one of the push/pull buttons with the switch in "ON" position, the release of the liquid is immediate and there is no possibility to block it.

It is necessary to leave the switch in "OFF" position and move it to the "ON" position only during the competition.

CHECKING OF THE WORKING CONDITION OF THE CONTROL BOX

When the switch is in "OFF" position and one of the push/pull buttons is activated, the current intensity at the ends of the plugs must be about 0 Amp, the pilot LED light must be on thus indicating correct connection of the circuit.

When the switch is in "ON" position and one of the buttons is operated, there must be a voltage of about 9V.



WARNING: we recommend to replace batteries (high alkaline capacity) before every competition.

MAINTENANCE

- Regularly check manometer pointer (it must remain in the green area);
- Regularly clean the system:
  - disconnect the valves from the fittings and fittings from the tube.
  - Blow pressurized air into the tube, fitting and valves.
- Check the integrity of the tubes and the coupling of connections to avoid any possible leak.
- Carry out the control box test at regular intervals.
- Overhaul have to be carried out every two (2) years (FIA rules) by OMP (or any other company authorized by OMP) starting from the date printed on the bottle sticker.
- In case of accident without neither fire nor activation of the system, it is anyway advisable to carry out the above mentioned tests.
- In case of activation of the system without fire, it is advisable to carry out the above mentioned tests and to let the the system refilled by OMP (or any other company authorized by OMP).
- In case of activation of the system with fire it is necessary to let the system be refilled by OMP (or any other company authorized by OMP) replacing fittings, valves and, if necessary, tubes.

3 CHASSIS

3.1 Chassis and impact structures

3.1.1 Chassis

Chassis is the main safety and structural component of the car and it has been approved by the FIA, great attention must be done in checking for structural failure not later than two years after delivery from Tatuus factory, and after each major accident. Chassis must be checked and repaired by a centre authorized by Tatuus.

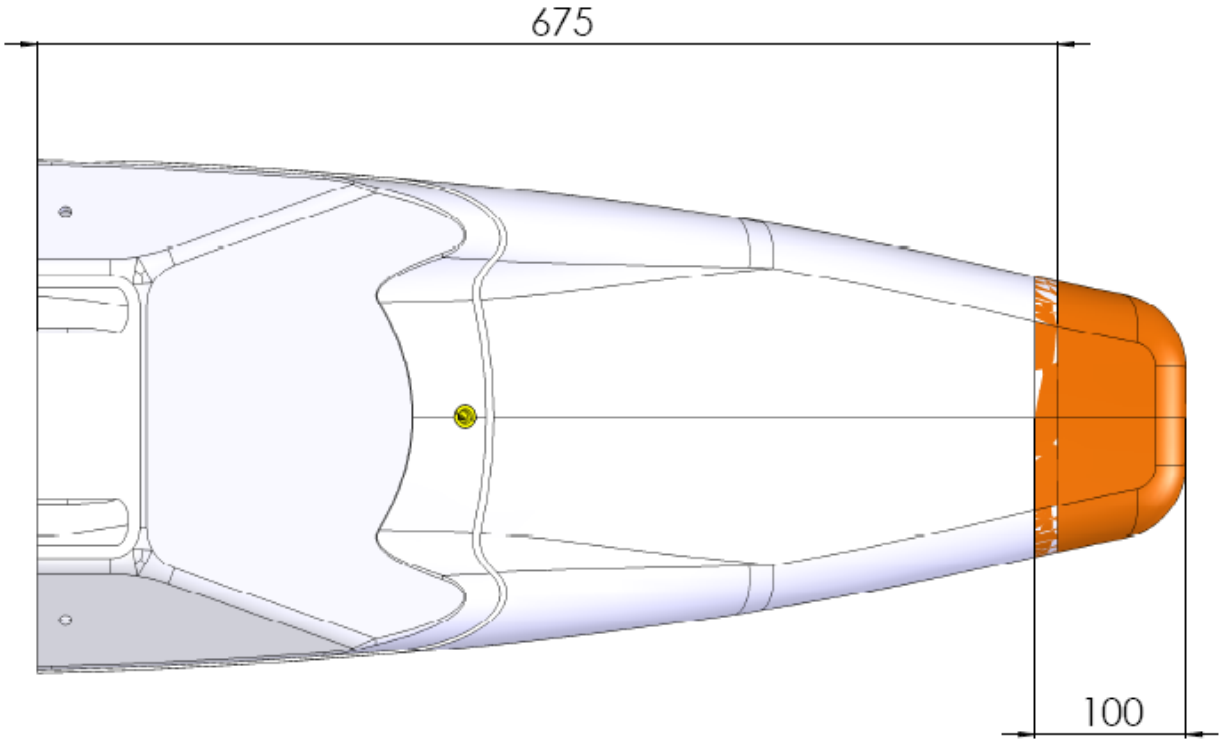
3.1.2 Front impact structure

Front impact structure is a safety and structural component of the car (approved by FIA crash test), great attention must be done in checking for structural failure not later than two years after delivery from Tatuus factory, and after each accident. Front nose must be checked and repaired by a centre authorized by Tatuus except for the following specified exceptions

3.1.2.1 Front nose repair specification and procedure

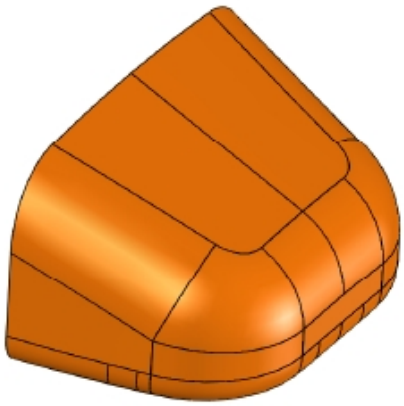
Applicable requirements

The following procedure is applicable only when the damage is contained in the first 100mm from the nose tip (675mm from the chassis bulkhead), all the other damages must be inspected by the manufacturer.

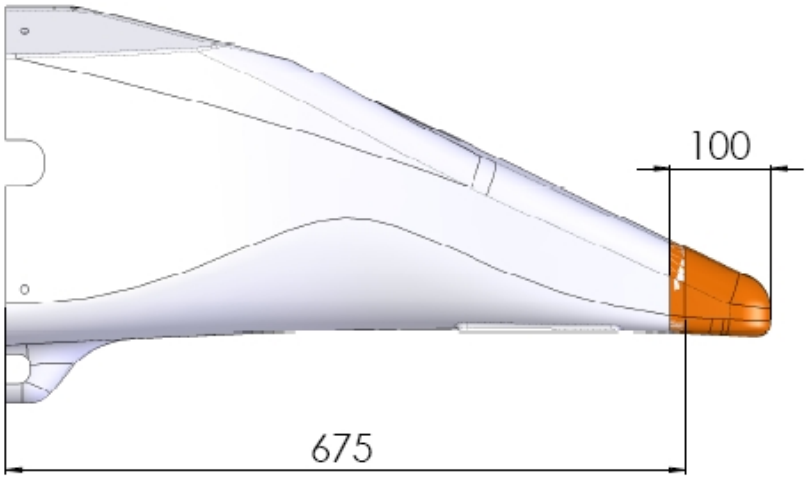


Replacement procedure

1. The specific spare part is available:

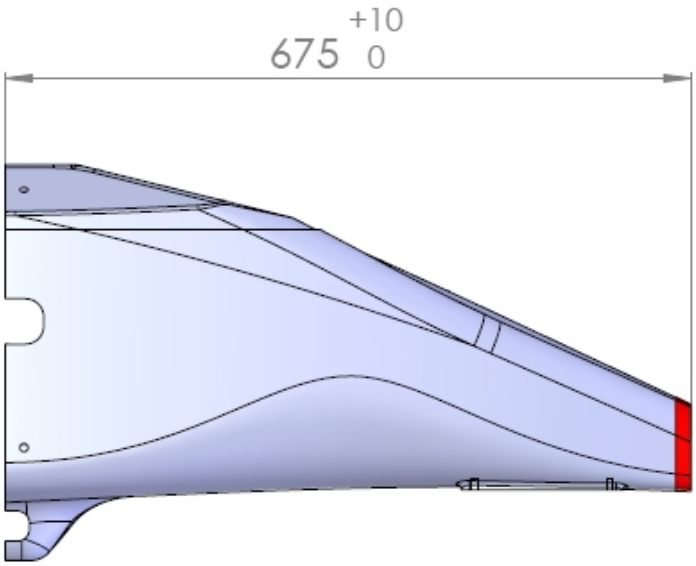


2. Trace a line parallel to the chassis bulkhead 675 mm from the bulkhead, you should find the line 25 mm from the old nose tip junction.

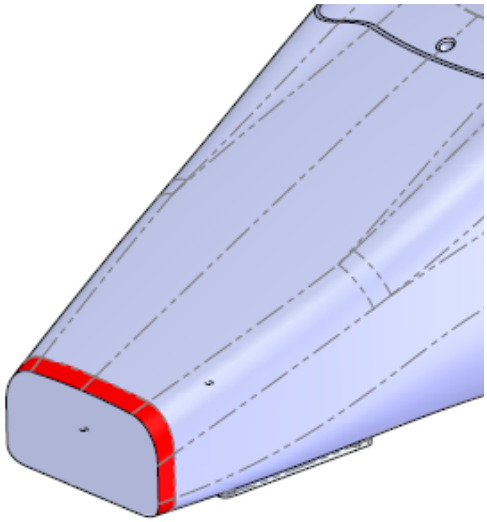


Detail "B"

3. Cut off the nose tip forward the traced line:

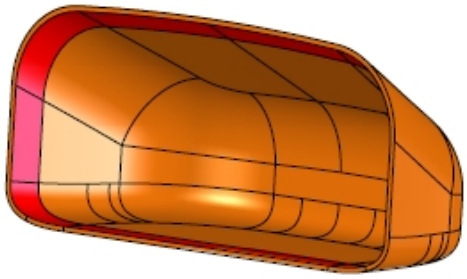


4. Using sandpaper on the outer surface, reduce the thickness of the crashbox by about 1mm for a length of 20-40mm (red area).

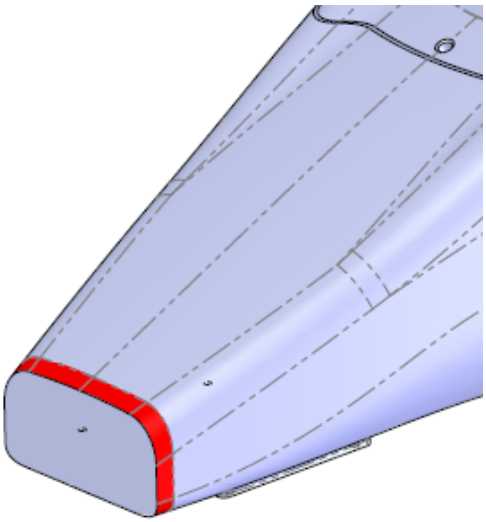


Attention must be paid to sandpaper the outer surface, at the depth of 1 mm you should find the resin between first and second ply.

5. Use sandpaper on the new nose tip inner surface to produce a rough surface that will match the outer surface of the crashbox.



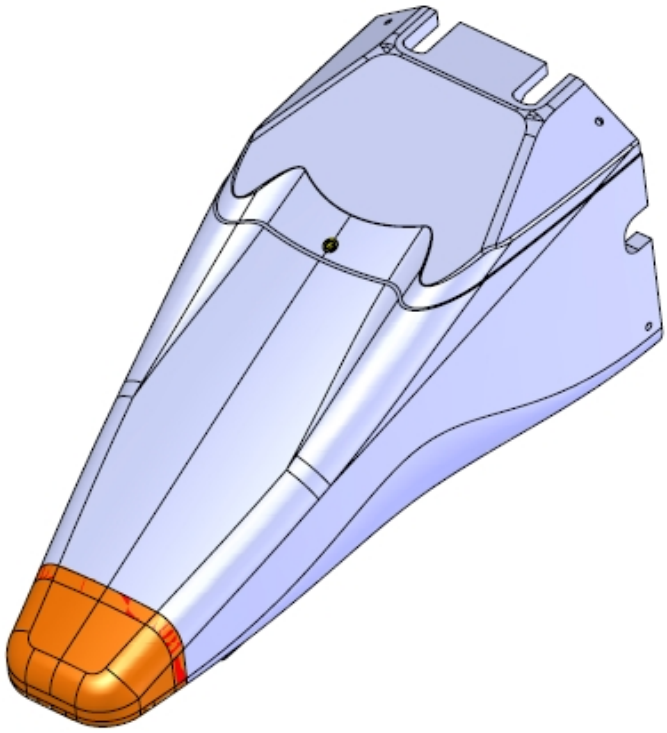
6. Spread specific resin 3M 9323 over the junction surface, carefully respect the percentage between resin and catalyst



3M 9323 Mixing specification:

	Resin	Catalyst
Weight ratio	100 g	27 g
Volume ratio	100 g	31 g

7. Position the new nose tip cleaning the excess of resin; new nose tip can be hold in postion with hight temperature tape.



8. Cure the assembly on the oven following the specific temperature cycle for 3M 9323: 2 hours at 60°C.

3.2 Reference plane

All sprung parts of the car situated more than 280mm behind the front wheel centre line and more than 280mm forward of the rear wheel centre line, and which are visible from underneath, must form surfaces which lie on one of two parallel planes, the reference plane or the step plane. This does not apply to any parts of rear view mirrors which are visible, provided each of these areas does not exceed 9000mm² when projected to a horizontal plane above the car. The step plane must be 50mm above the reference plane.
Additionally, the surface formed by all parts lying on the reference plane must :

- extend from a point lying 280mm behind the front wheel centre line to a point lying 280mm forward of the rear wheel centre line;
- have minimum and maximum widths of 300mm and 500mm respectively;
- be symmetrical about the car centre line ;
- be made of wood nominally 5mm thick.

All parts lying on the reference and step planes, in addition to the transition between the two planes, must produce uniform, solid, hard, continuous, rigid (no degree of freedom in relation to the body/chassis unit), impervious surfaces under all circumstances.

The peripheries of the surfaces formed by the parts lying on the reference and step planes may be curved upwards with maximum radii of 25 and 50mm respectively. The surface formed by the parts lying on the reference plane must be connected at its extremities vertically to the parts lying on the step plane and any radius which forms the transition between the two planes may have a maximum radius of 25mm.

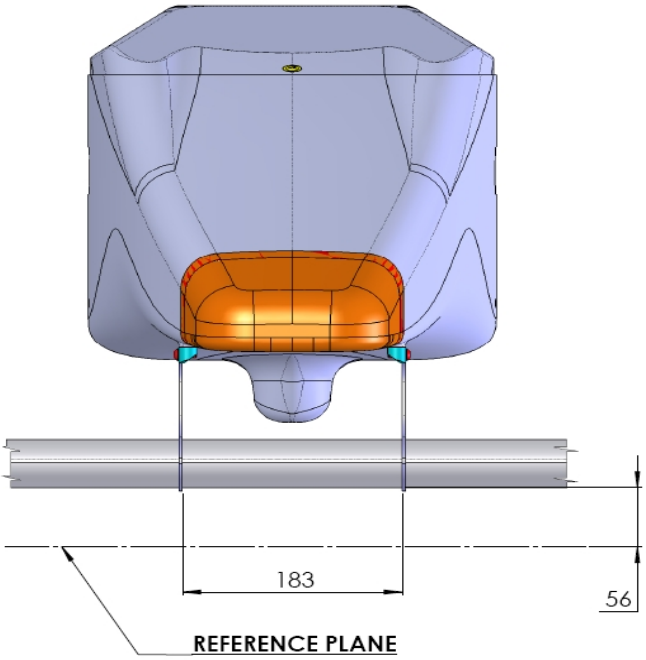
To help overcome any possible manufacturing problems, a tolerance of ± 5mm is permissible across these surfaces.
All sprung parts of the car situated behind a point lying 280mm forward of the rear wheel centre line, which are visible from underneath and more than 150mm from the car centre line, must be at least 50mm above the reference plane.

3.3 JACKING

The vehicle can be jacked with suitable jacking equipment by the specific points:

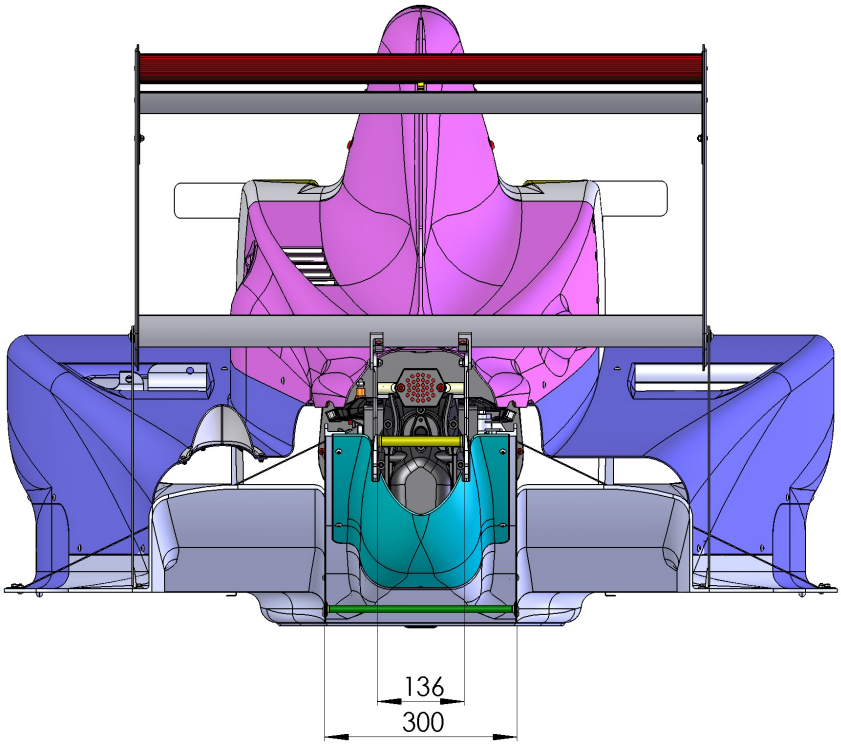
3.3.1 Front Jacking

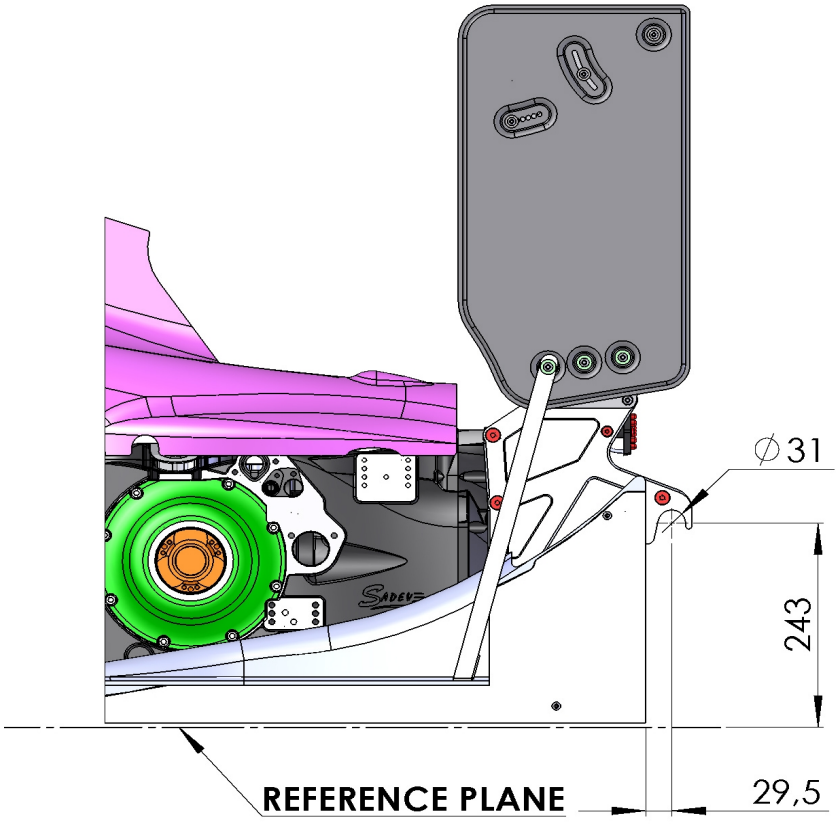
The highlighted area is suitable to carry the weight of the car, the jack plate should fit as better as possible the underwing surface.



3.3.2 Rear Jacking

The highlighted jacking points are suitable to carry the weight of the car.





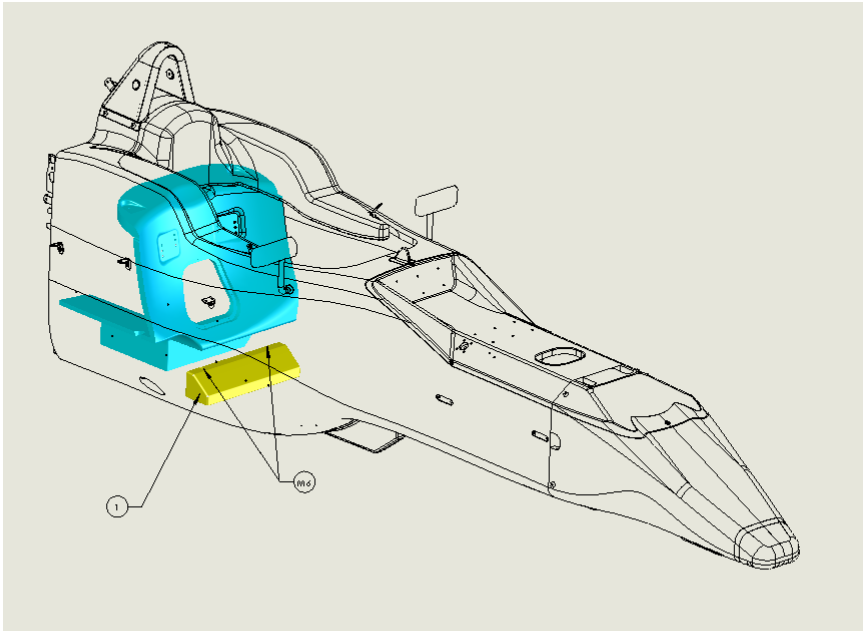
3.4 Standard Set-up

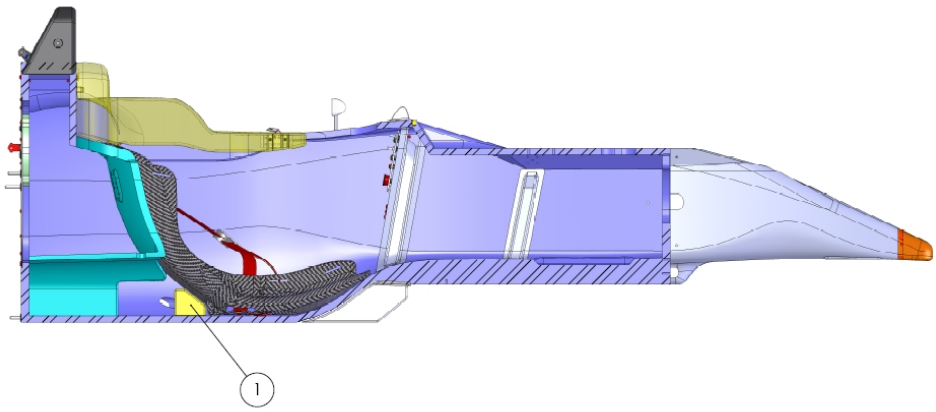
Here below the standard set-up sheet, refer to specific chapter for details:

		FRONT	REAR
GEOMETRY	Ride Height [mm]	20	35
	Camber [deg]	-3°	-2°
	Toe (Total) [deg]	15' (out)	10' (in)
	Rear Suspension position	AD14	
SUSPENSION	Springs [lb/in]	1000	1200
	Spring preload [mm]	6	0
	Anti-roll	<<>>	13mm
	Anti-roll preload [notches]	4	---
	Damper bump [clicks from full closed]	9	9
	Damper rebound [clicks from full closed]	9	9
AERO	Wing position	C6	C6
	Gurney [mm]	15	
BRAKE	Brake type	DS3000	DS3000
GEAR / DIFF	Gear set	14/37-18/35-18/28-21/27-20/22-27/26	
	Diff Ramp on power	50	
	Diff Ramp off power	50	
	Diff plates config	RBFDFDF	
TIRE	Tire pressure (hot) [bar]	1.5	1.5

3.5 Weight and ballast

In order to achieve the minimum racing weight of the car a specific it is possible to add a lead ballast provided it is fitted in the specific place for this purpose (see pictures below) and it is fixed in such a way that tools are required for its removal.





3.6 COCKPIT

3.6.1 Commands and procedures

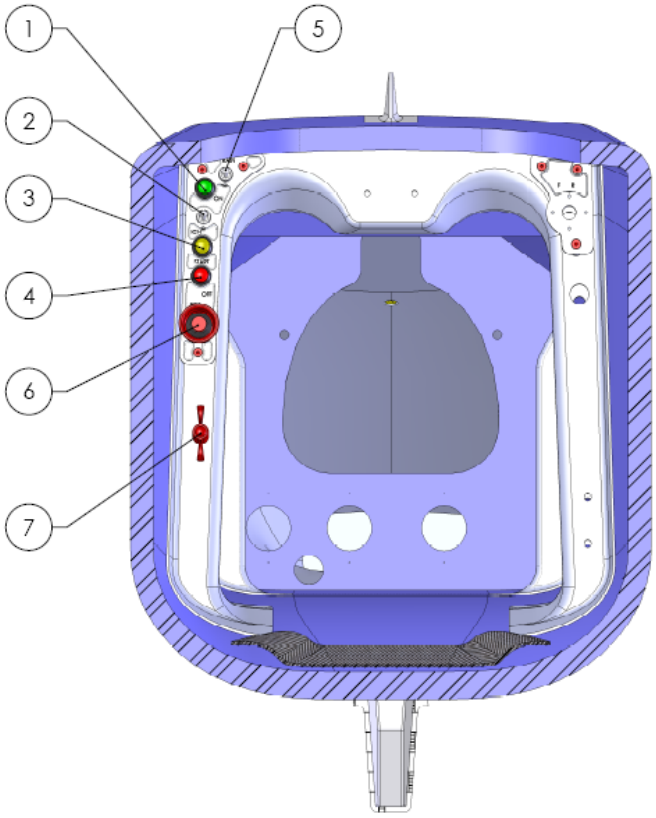
On the cockpit panels you can find:

- [1] Push button ON (GREEN): master switch is on, electrical system is powered;
- [2] Ignition switch: ignition coils, injectors and alternator are powered;
- [3] Starter button (YELLOW): starter motor is cranking (starter is working with Ignition off to cranck the engine and raise oil pressure);
- [4] Push button OFF (RED): master switch off, all the electrical circuit is switched off.
- [5] Rain light switch.
- [6] Fire extinguisher button;
- [7] Gearbox lock: pull the knob to engage first gear, reverse and neutral.

Before the start is strongly suggested to crank the engine and raise the oil pressure, for further details refer to engine chapter.

To start the engine check to be in neutral gear, then push master switch ON [1], switch ON ignition [2], press starter button [3].

To switch off the engine it is strongly suggested to turn ignition switch off [2], cutting the main power switch can cause transmission problem due to power cut on valves.



3.6.2 Steering

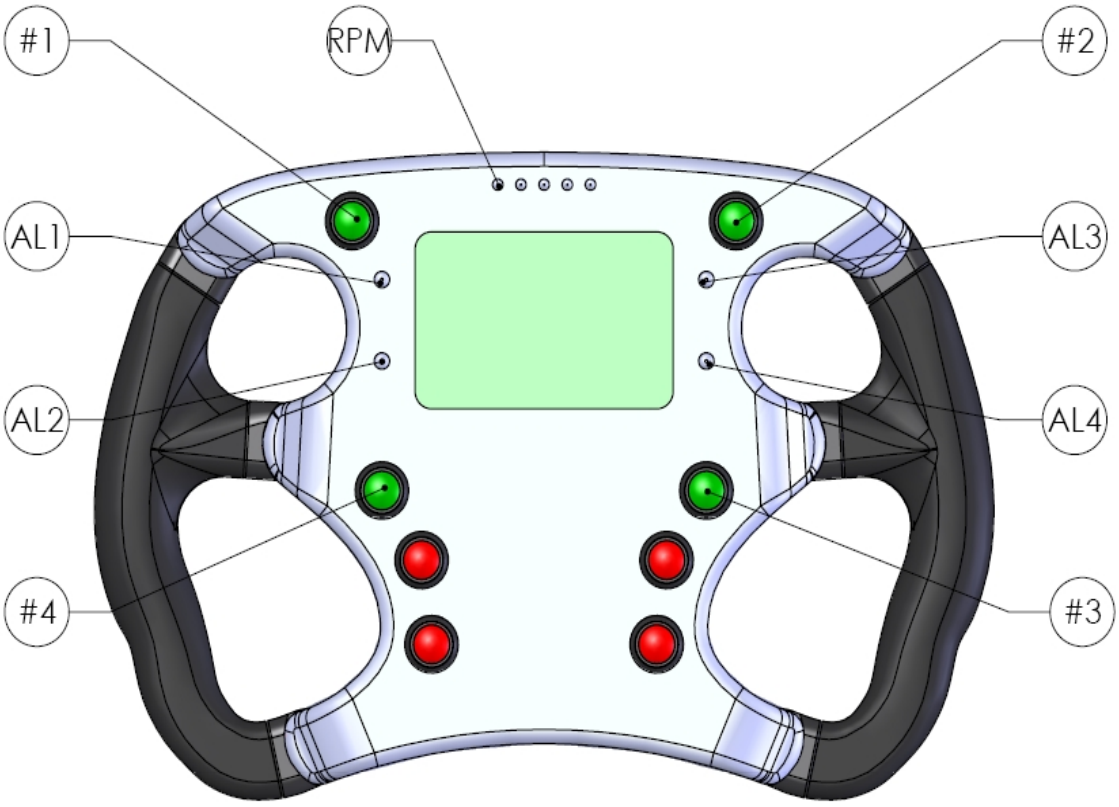
The AIM steering software can be edited through the AIM CAN box located under the driver's seat, the communication cable have been delivered with the car, (visit http://www.aim-sportline.it/pagine/download/sezione_download.htm for latest release)

Alarms lights:

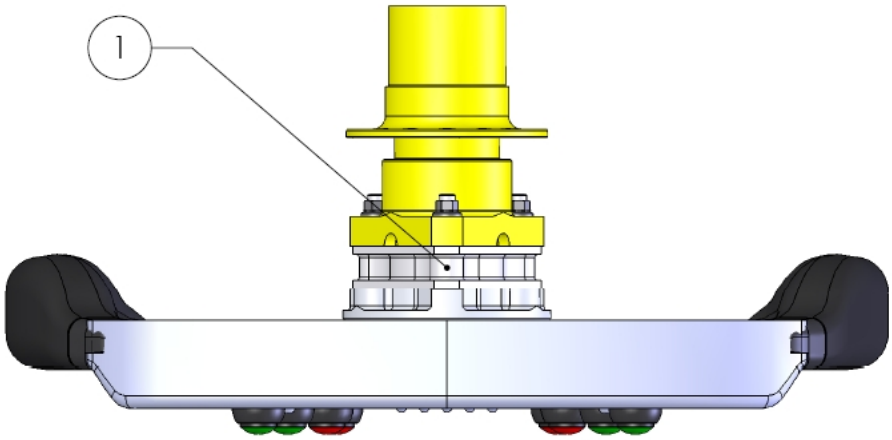
- Rev lights (default): 1 [6200] 2[6300] 3[6400] 4[6400] 5[6500]
- Alarm 1 (default): Oil pressure [min 2.0 bar – max 8.0 bar]
- Alarm 2 (default): Water Temperature [min 60°C – max 95°C]
- Alarm 3 (default): Oil Temperature [min 70°C – max 140°C]
- Alarm 4 (default): Battery Voltage [min 10.5V – max 15V]

Buttons:

- Button #1: Brake pressure reset;
- Button #2: throttle reset (see electronic chapter for details);
- Button #3: Pit Limiter (Push the button to limit vehicle speed under 60km/h in 1st,2nd and 3rd gear);
- Button #4: PTT;

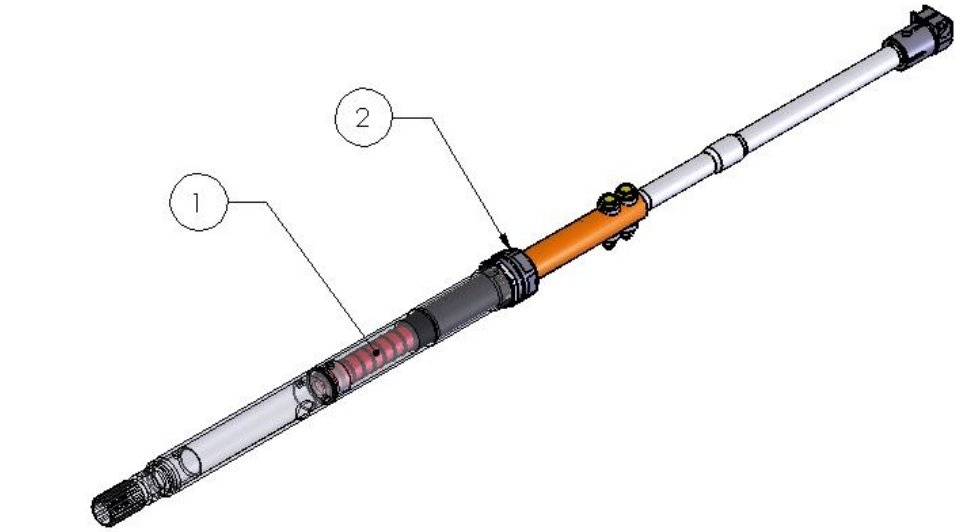


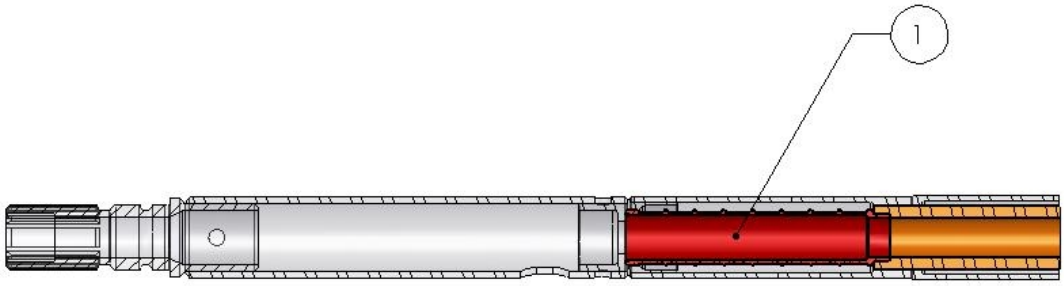
The spacers [12] allow the adjustment of driver position, each spacer add 13mm and you can stack maximum three of them.



Steering column is integrating the crashbox [1] to absorb impact energy, extreme attention must be paid on this part to avoid any damage or overload.

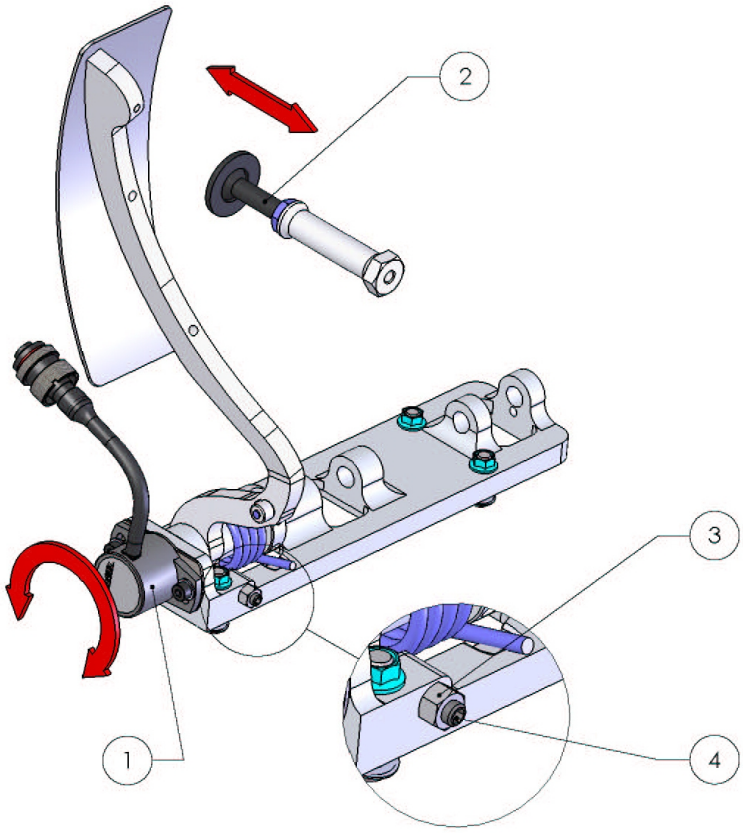
IMPORTANT: in case of impact the aluminium crashbox must be replaced and column carefully inspected.





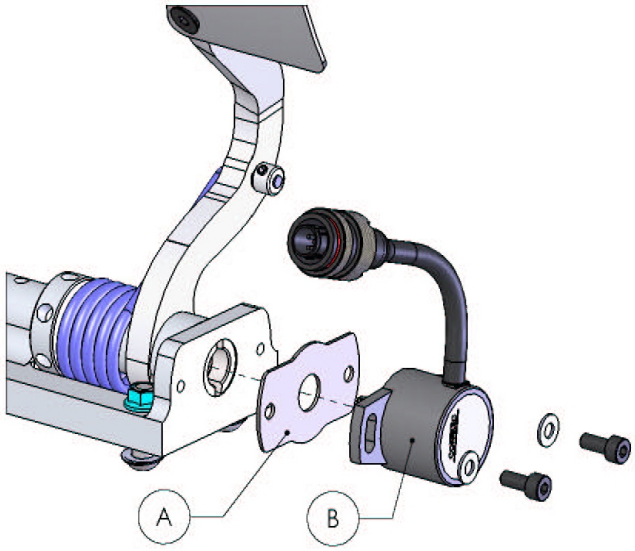
3.6.3 Pedals

Pedal position can be adjusted in depth within a range: the chassis allows different installation of the bracket along the rake (40mmm step). The new position will require the adjustment of the master cylinders studs and the pedal stop [2].



Throttle pedal rest position can be adjusted by the bolt [3,4].

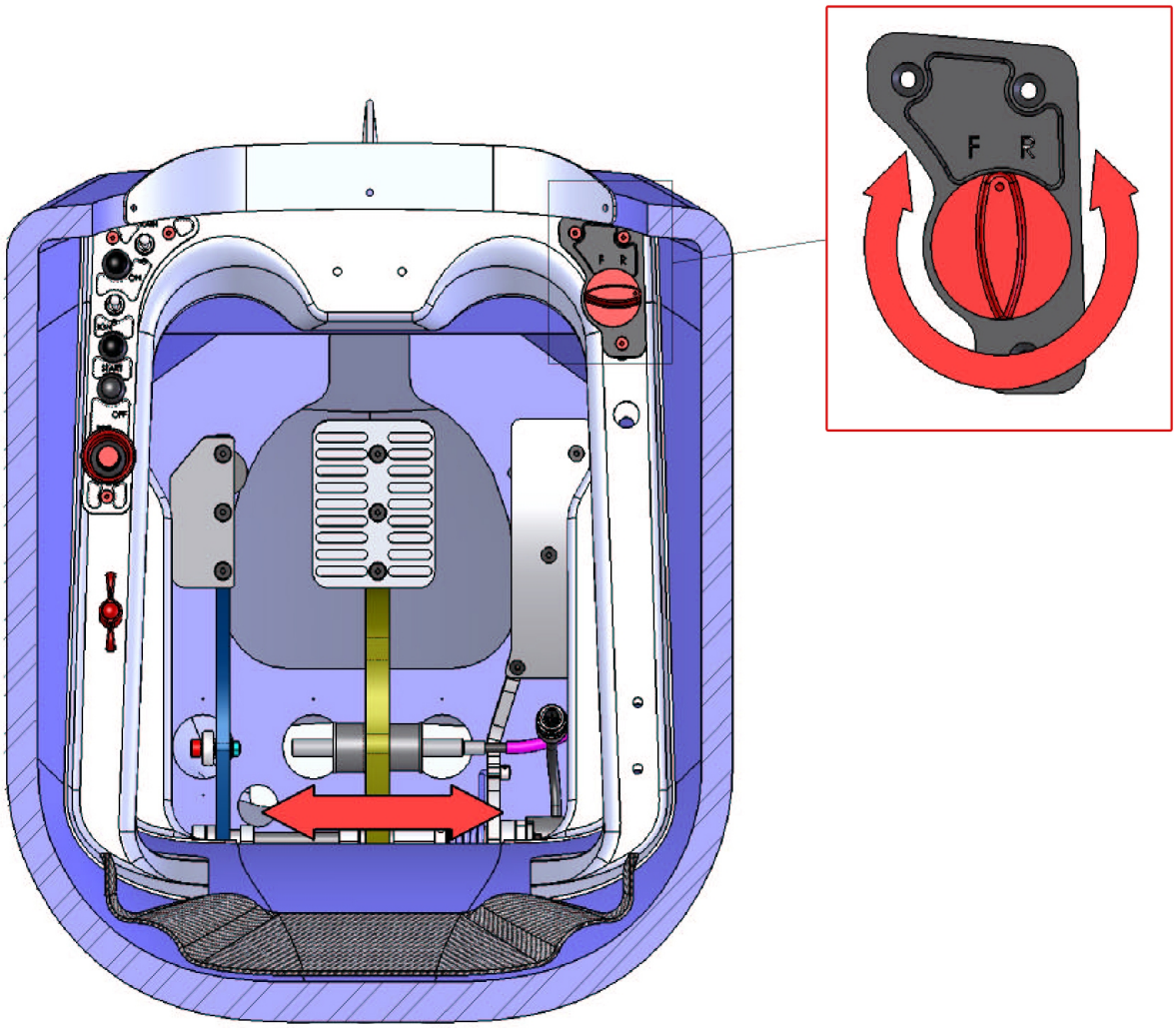
Maintenance procedure requires a frequent inspection of the throttle sensor [B] and the tightening check of its mounting bolts. Beware to install the spacer [A] between sensor and pedals bracket.



After any intervention on the throttle pedal reset the electronic pedal position (refer to electronic chapter).

3.6.4 Brake bias

Brake bias can be adjusted by driver turning knob [4], clockwise turn move the brake balance to rear axle.

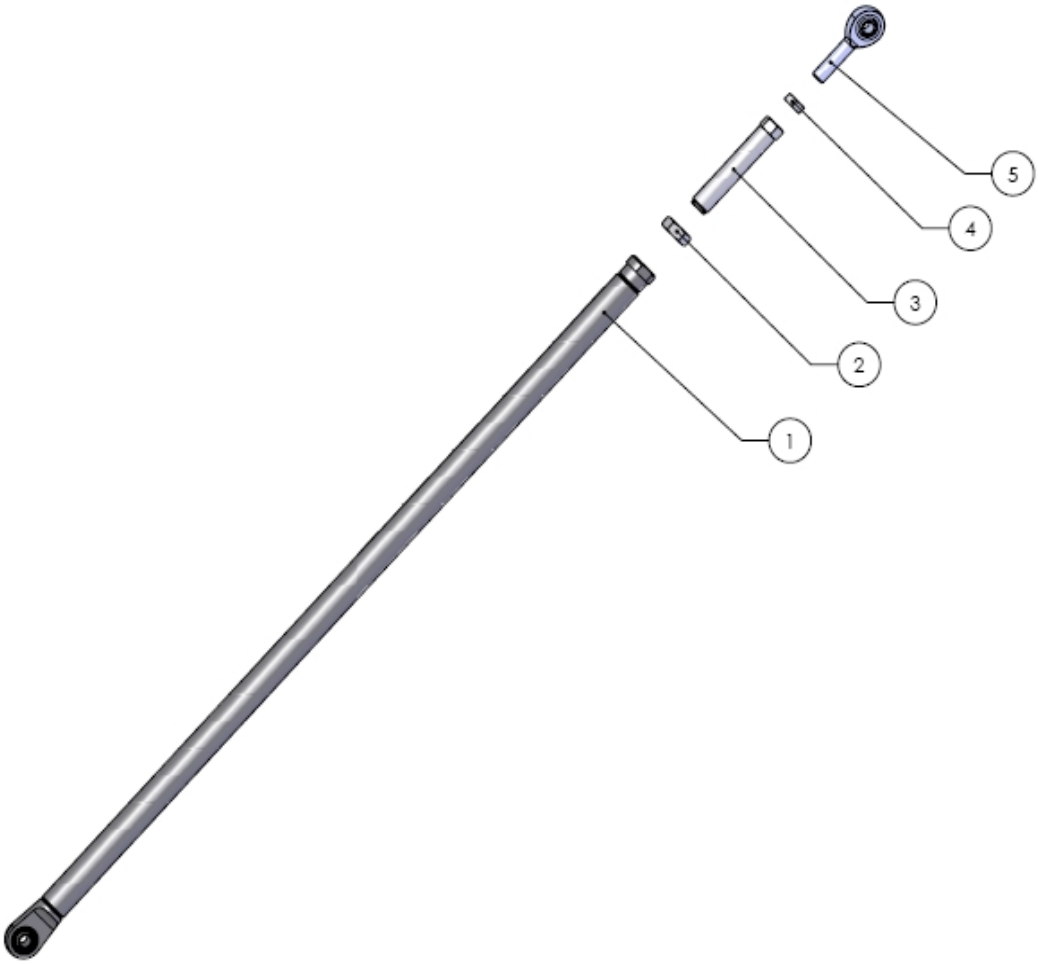


3.7 Front Axle

3.7.1 Setup Adjustments

3.7.1.1 Ride Height

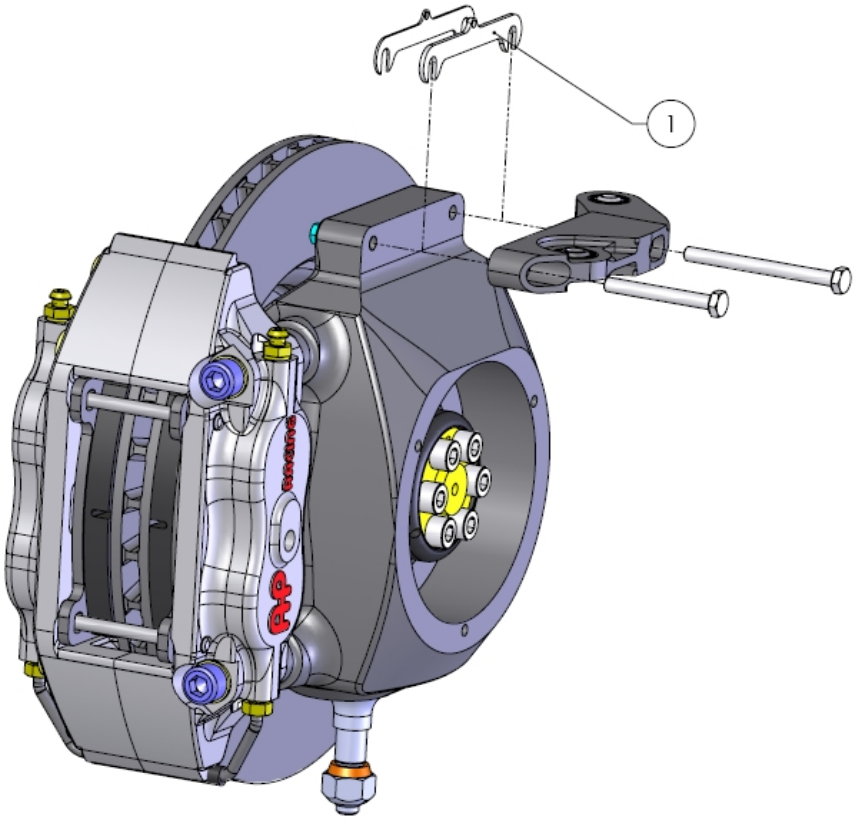
Front ride height is increased turning the adjuster [3] of the front push-rod:



RIDE HEIGHT	+1 Turn push adj.	
	Push	+2.25 mm
	RH	+4.2 mm

3.7.1.2 Camber

Front camber is set changing the shims stack [1] between ackerman and upright, the following table represents the available size and its respective effect:



	mm	deg
CAMBER	0	-5
	1	-4.72
	2	-4.44
	3	-4.17
	4	-3.89
	5	-3.61
	6	-3.33
	7	-3.06
	8	-2.78
	9	-2.5
	10	-2.22
	11	-1.94
	12	-1.67
	13	-1.39
	14	-1.11
	15	-0.83

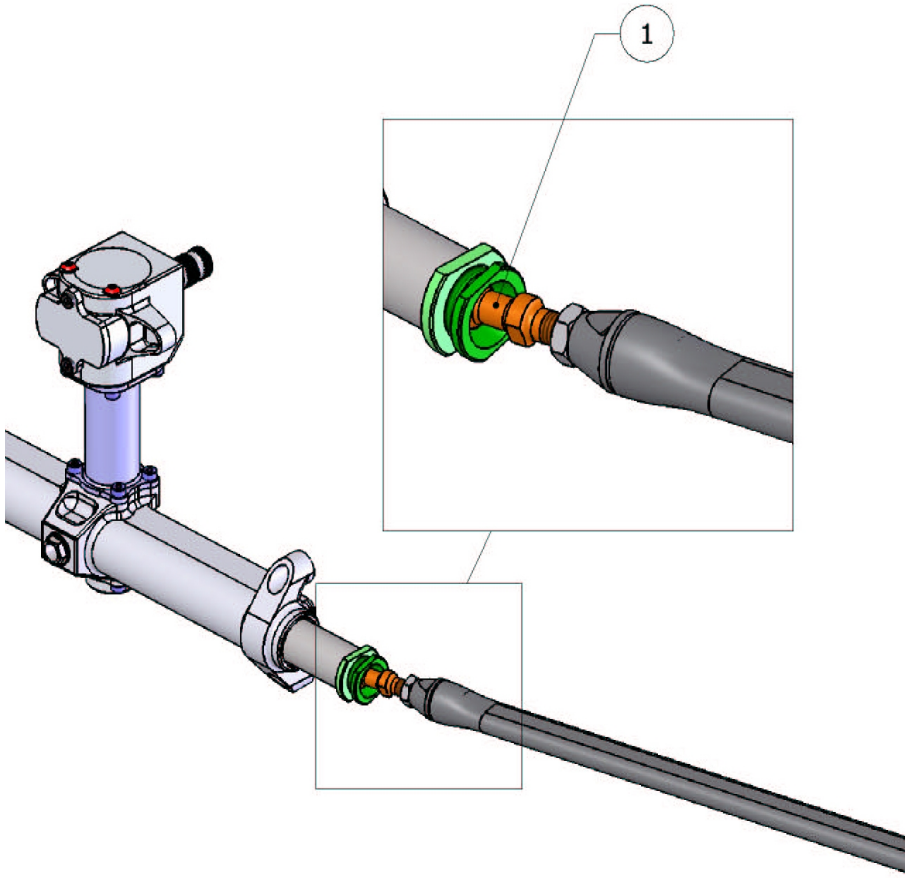
3.7.1.3 Caster

Front caster is not adjustable.

3.7.1.4 Toe

Front Toe can be adjusted by the steering arm length:

	Side [mm]	Total [deg]	Rim [mm]
TOE	0	0	0
	0.18	0.21	0.63
	0.35	0.41	1.23
	0.53	0.63	1.86
	0.7	0.83	2.45
	0.88	1.04	3.08
	1	1.18	3.5
	2	1.18	7



3.7.1.5 Vertical spring

A range of springs is available to set the vertical stiffness of the car:

K_{spring} [lb/in]	700	800	900	1,000	1,100	1,200	1,300
K_{wheel} [kgf/mm]	11.5	13.2	14.8	16.5	18.1	19.7	21.4

Motion ratio: Wheel/Spring 1.04
Spring/Wheel 0.96

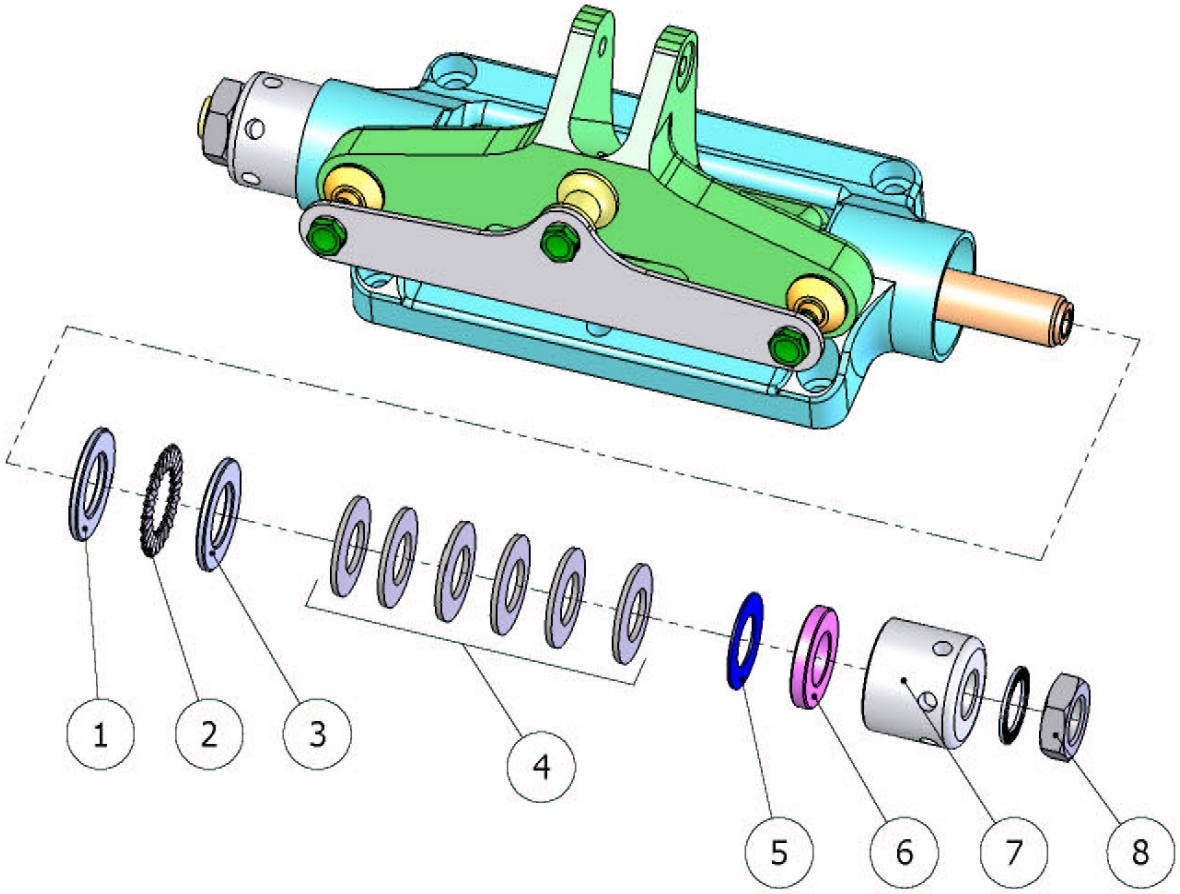
Spring preload can be set acting on the spring platform (thread step 2mm), remember that acting on the preload you change the ride height.

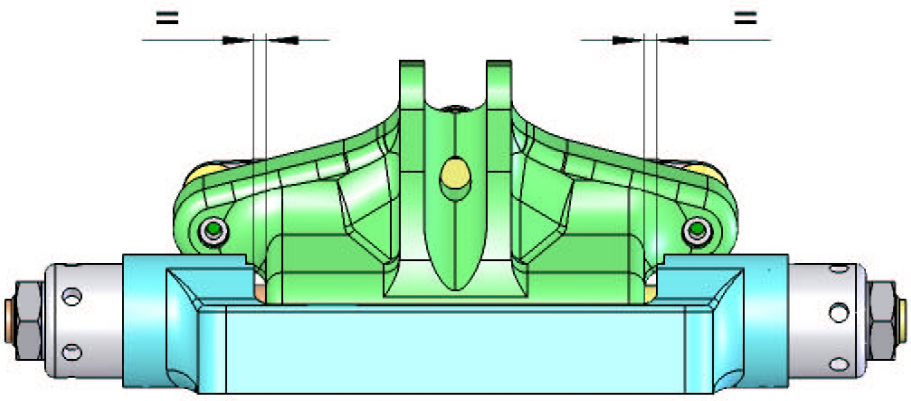
Preload [daN] = Stiffness [daN/mm] x Turns (of spring platform) x 2 [mm]

3.7.1.6 Antiroll device

The front antiroll stiffness is controlled by the Belleville washer (2.0 mm thickness) stack [4].

In the next page some belleville stack are enlisted with their relevant stiffness, once the bellevile are installed turn both platforms [7] until they are in contact with the washers [6], then check that the shuttle is centred.





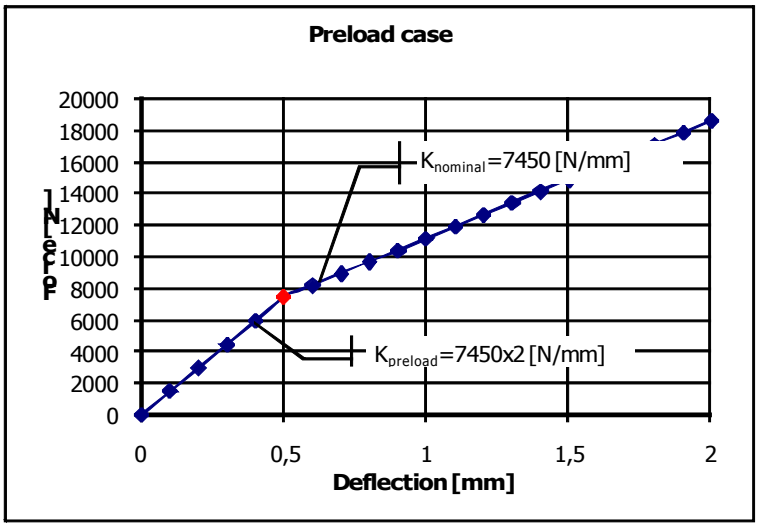
When the platform [7] is just in contact with the stack the stiffness is the the nominal stack stiffness (see table).

To add preload to the antiroll stack urn both platform [7] of the same amount of notches, the thread step is 1.5mm with 6 notches, hence 0.25mm preload per notch.

When preload is added the roll stiffness is twice the nominal stack stiffness until the preload threshold is overcome

The roll stiffness below the preload threshold (the Belleville compression in mm) is twice the nominal stack stiffness; above this threshold the roll stiffness remains the nominal.

The following diagram shows an example of preload of 0.5mm (4 notches) applied to the stack [<<>><<]: the preloaded stiffness is 7450x2=14900 N/mm until the threshold of 0.5mm is reached and the fall to the nominal 7450 N/mm.



Motion ratio: Wheel displacement / mono-shuttle displacement: 1.45

The following table reports the stack options, with their respective stiffness.

Stack configuration	Stack Stiffness [N/mm]	Stack lenght [mm]	Max deflection [mm]
<><><><><	1242	24.75	6.75
<><><>	1863	16.5	4.5
<><><	2235	13.75	3.75
<><>	2794	11	3
<><	3725	8.25	2.25
<>	5588	5.5	1.5
<<>><<>>	5588	19	3
<<>><<	7450	14.25	2.25
<<>>	11175	9.5	1.5
<<<>>>	16763	13.5	1.5
<<<<>>>>	22351	17.5	1.5
<<<<<>>>>>	27938	21.5	1.5

Caution:

- The lateral displacement of the rocker plus the preload must never reach the 'Max Deflection' reported in the table.
- The total length of the stack [A] should never be more than 25mm

3.7.2 Steering assembly

Steering ratio is 10.5:1 [steering wheel/wheel].

3.7.3 Front Damper

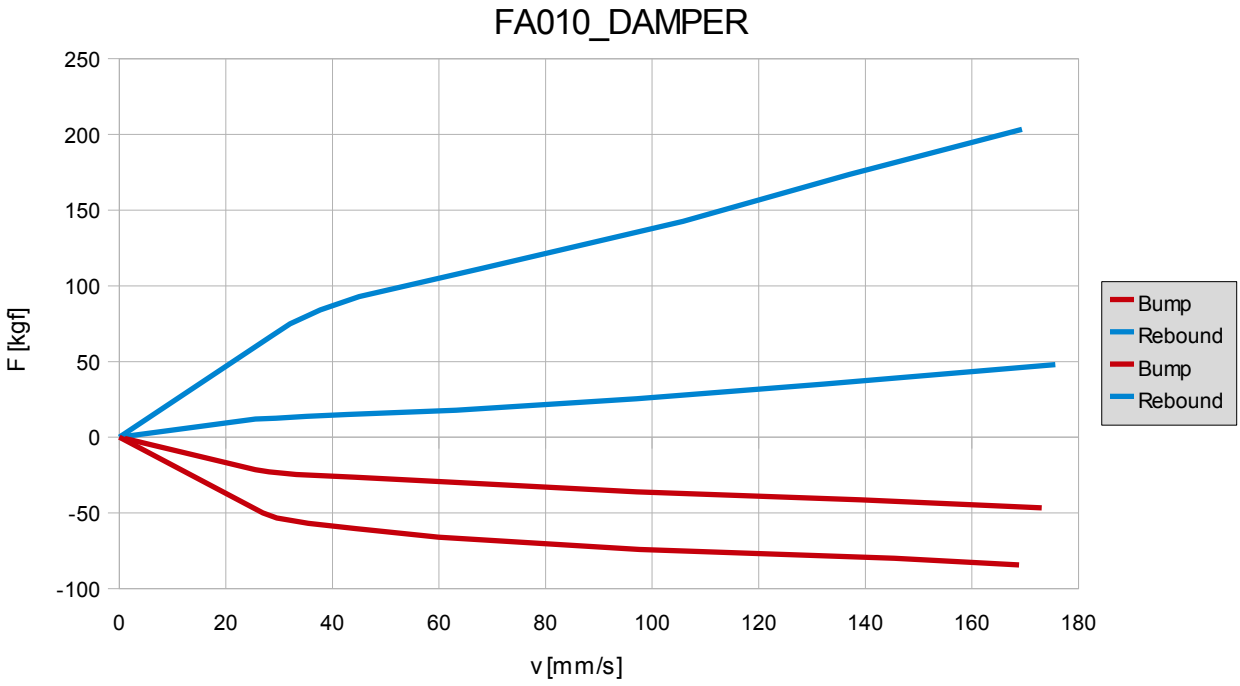
The standard front damper is ORAM, full open length is 320mm and maximum stroke is 39mm.

The dampers are adjustable in bump and rebound, the disc located in the top eye adjust the rebound, the knob on the body adjust the bump damping.

Both adjustments have a range of 18 clicks, for the maximum damping full tight the adjuster.

The dampers setting is the same for front and rear axle, for the installation ratio refers to the stiffness chapter.

The following diagram represents the force/speed of the standard front damper.



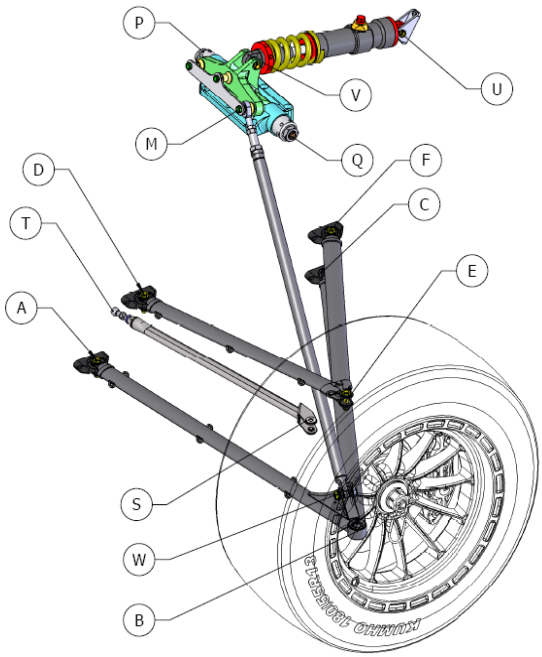
3.7.4 Front suspension geometry

3.7.4.1 Pickup points

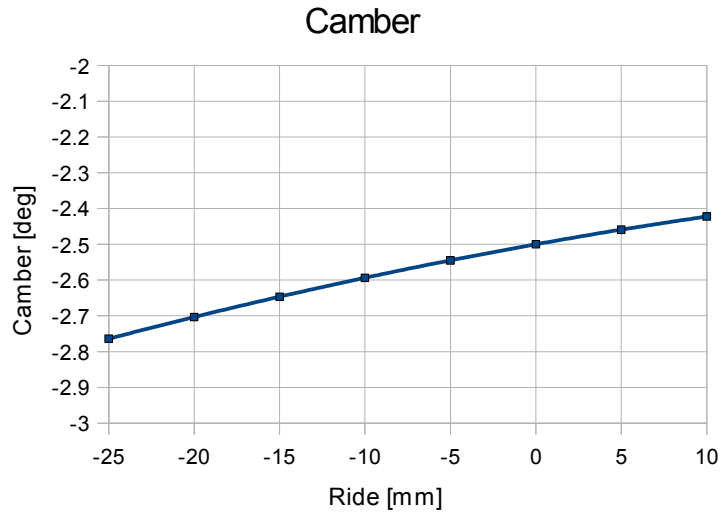
The front suspension geometry is fixed, the following table resume the coordinates based on reference system:

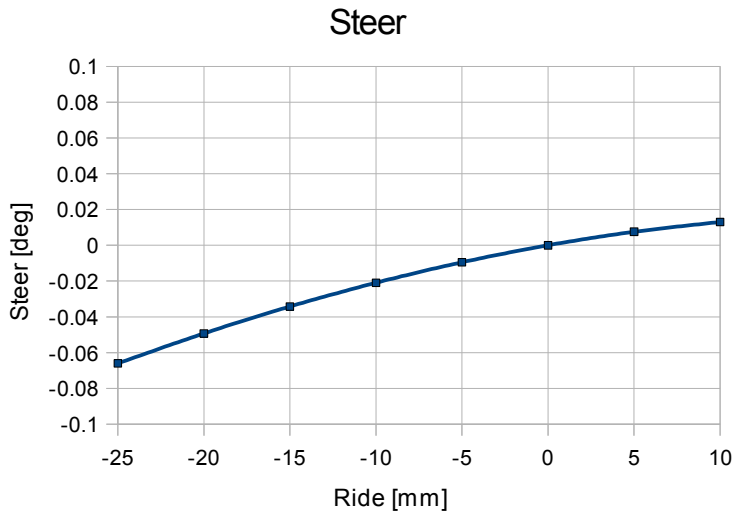
x_0: front wheel axis
y_0: vehicle axis
z_0: Reference plane (bottom of the wooden skid).

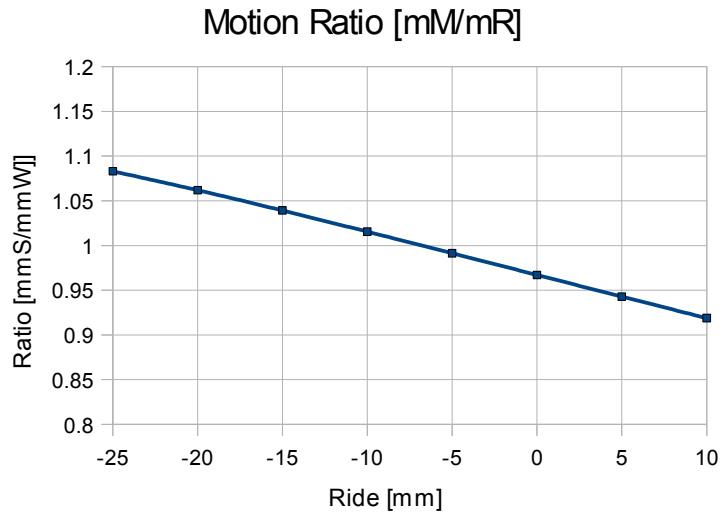
		FRONT		
		x	y	z
	Centre of Tire Contact Patch	0	757.5	-15
	Centre of Wheel	0.00	757.5	275
A	Lower Wishbone Inner Front pickup	115	50	142.3
B	Lower Wishbone Outer pickup	6.7	692	140
C	Lower Wishbone Inner Rear pickup	-335	52	146.2
D	Upper Wishbone Inner Front pickup	110	190.3	353.6
E	Upper Wishbone Outer pickup	-10.8	632.5	361.9
F	Upper Wishbone Inner Rear pickup	-270	191.3	336.5
S	Outboard Trackrod pickup	83.6	666.5	363.8
T	Inboard Trackrod pickup	168	189	353.6
V	Shock Absorber Pickup on Chassis	-532.8	0.00	611.5
U	Shock Absorber Pickup on Rocker	-232.5	0.00	548
Q	Rocker Pivot Point_1 on Chassis	-224	100	533
P	Rocker Pivot Point_2 on Chassis	-224	0	533
M	Inboard Push-rod pickup on Rocker	-172	77.4	569.1
W	Outboard Push-rod pickup	-13.1	624.3	165.2
	CG Location	1060	0	255



The following diagrams represent the variation of the relevant parameters for the standard suspension configuration, ride measurement are relative to the standard design configuration (in this case the tabled ride are offset by 15mm):







3.7.4.2 Anti-effects

Roll centre height is measured from the ground.

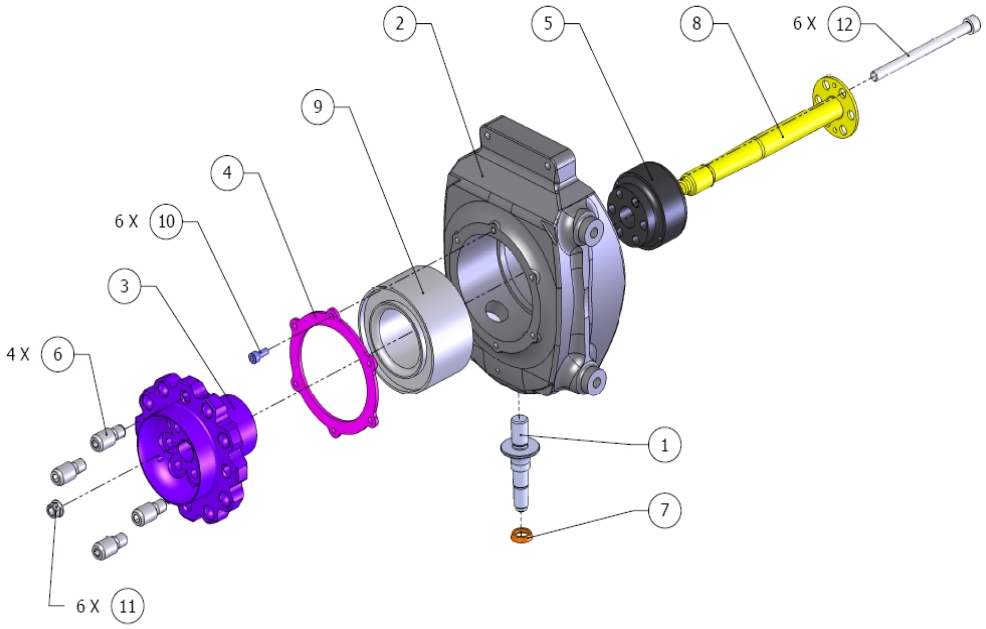
	Roll Centre	Anti-dive
Pos	RC_z [mm]	AD [%]
Std	21.6	25.0

3.7.5 Front axle maintenance

3.7.5.1 Wheel upright

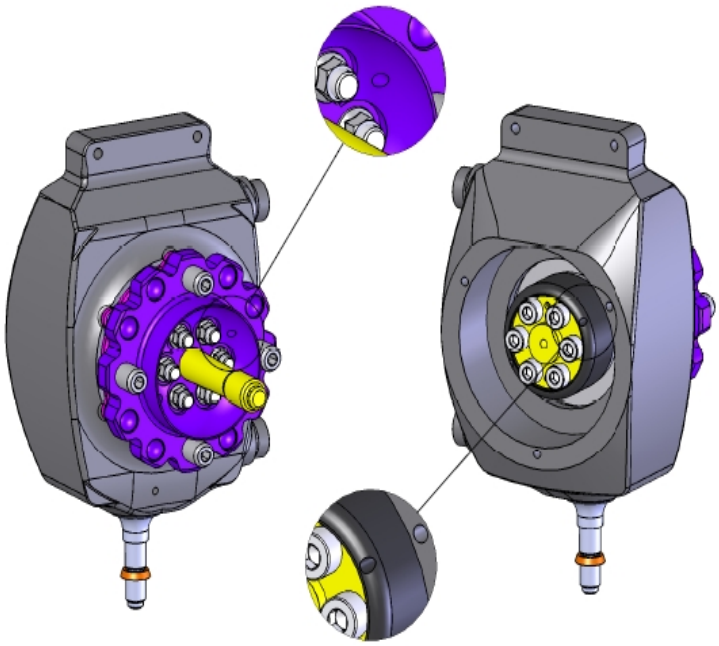
Disassembly

1. Remove nuts and bolts [12, 6];
2. Remove the wheel spindle [8] tapping it if necessary with a plastic mallet;
3. Remove the outer hub [3] from the upright using a 4 mm pin drift through the proper hole in the inner hub (Drawing 1:2);
4. Remove the inner hub [5];
5. Remove the bearing retainer [4];
6. Warm the upright [7-9] to 120 °C, the bearing should come out without the help of any tools;



Assembly

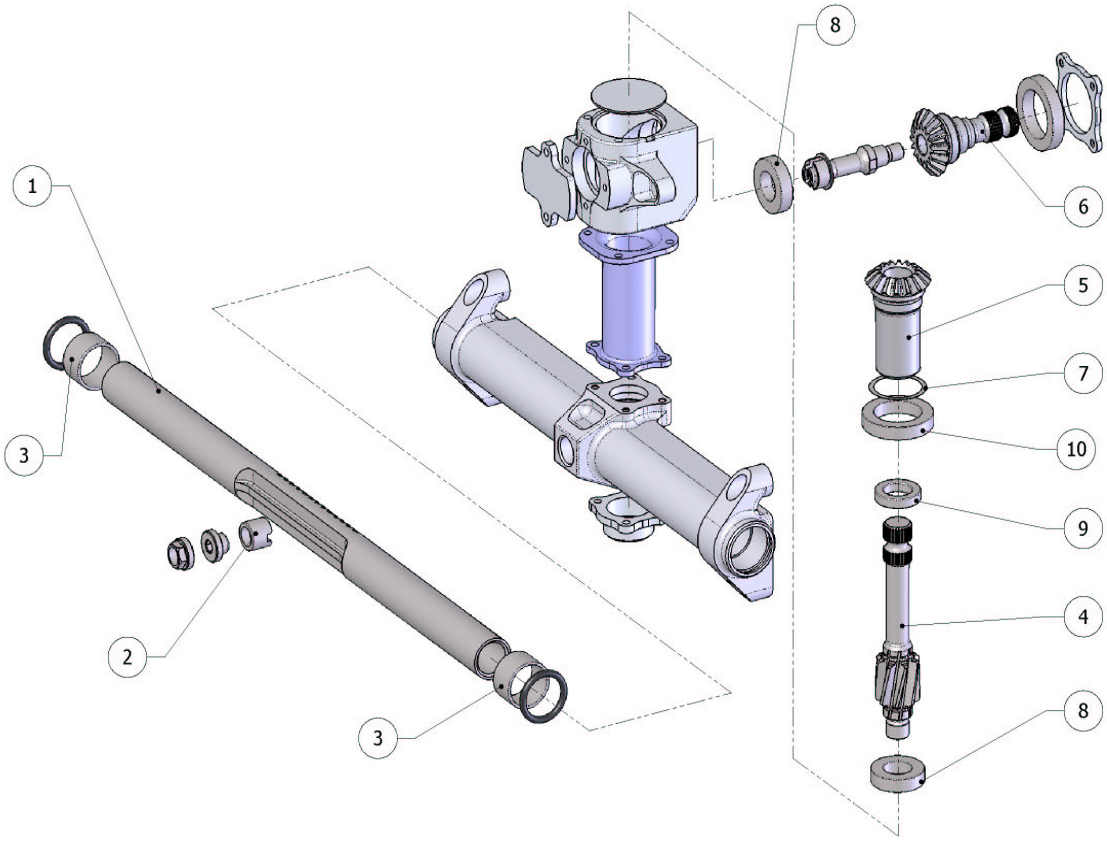
1. Warm the upright [7-9] to 120 °C, the bearing should come in without the help of any tools;
2. Fasten the bearing retainer [4] with Loctite 243, tightening torque 6.0 Nm;
3. Using a press drive the outer hub [3] in the bearing, then the inner hub [5];
4. Install the wheel spindle [8];
5. Replace the spindle bolts [12, 6] (tightening torque 25 Nm).



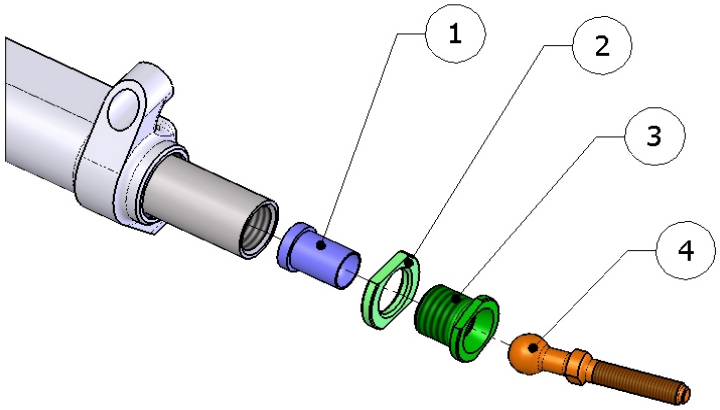
3.7.5.2 Steering rack

The steering rack must be periodically inspected:

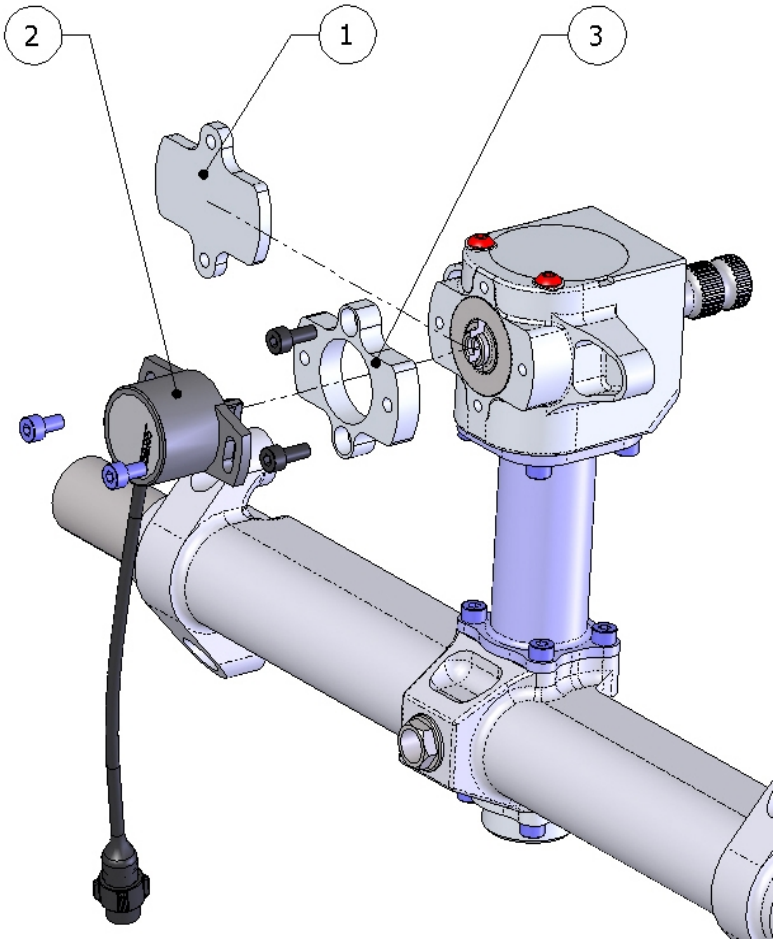
- rack [1]: the preload can be set acting on the item [2], its position should be regularly inspected to follow system wearing, periodically inspect bush [3];
- pinion [4]: regularly inspect and lubricate;
- bevel gear pair [5-6]: to set the gear coupling you can add shim [7];
- bearings [8-9-10];



- Rack end assy [4]: allow some preload [2-3] to avoid any freeplay during the setting up, periodically change the bush [1].



- Steering potentiometer [2]: to install the standard sensor replace the bearing cover [1] with the sensor bracket [3]. To set the correct electrical position align the wheels, set the output voltage to 2.5 V, then install the potentiometer with the shaft in the pinion slot. When reassembling the steering rack the pinion slot must be as vertical as possible, to respect this position centre the rack, then align pinion [4] and bevel gear [5] so that the shaft slot is vertical.



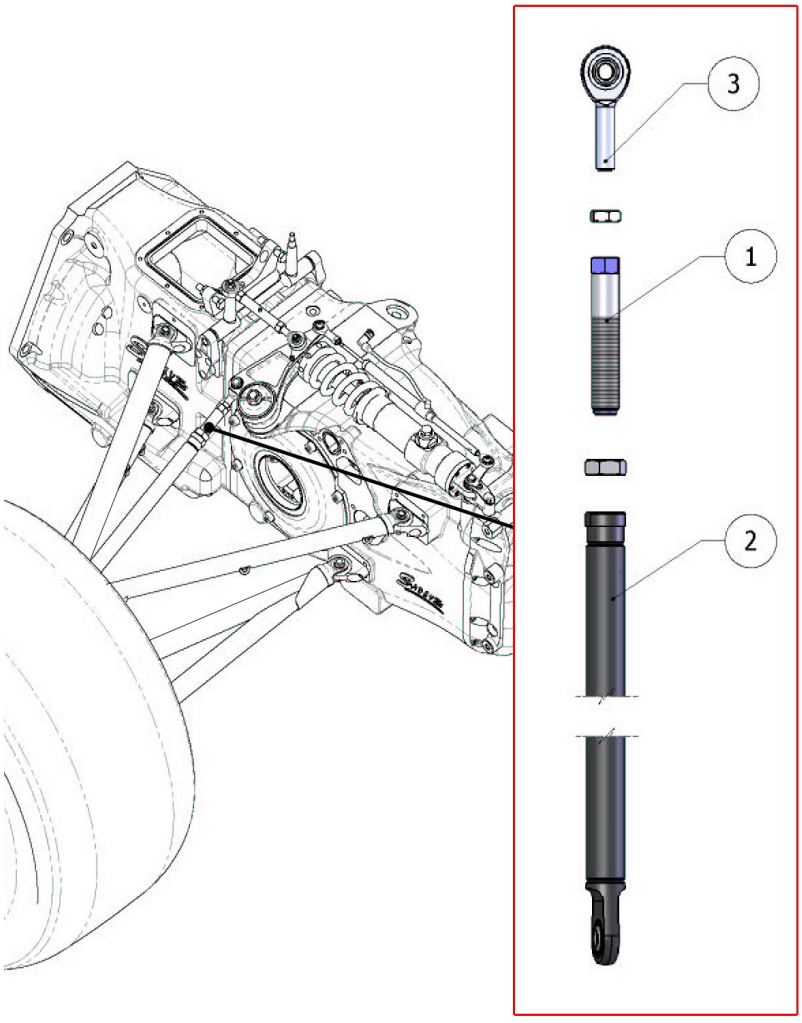
3.8 Rear Axle

3.8.1 Setup Adjustment

3.8.1.1 Ride Height

Ride height is measured from the road surface to the lower surface of the wooden skid underneath the rear axle.

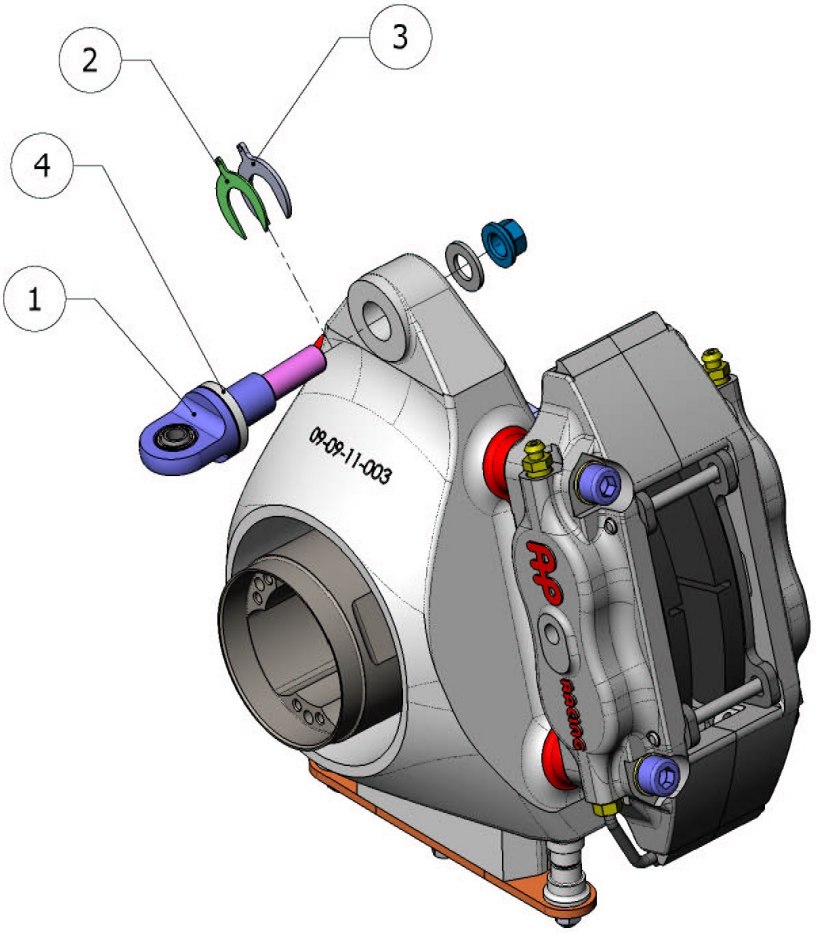
Rear ride height is raised acting on the barrel [2], the thread is 1.25mm + 24 UNF



RIDE HEIGHT	+1 Turn push adj.	
	Push	+2.25 mm
	RH	+6.8 mm

3.8.1.2 Camber

Rear Camber can be adjusted adding shims [2,3].
Important: don't remove the spacer [4].

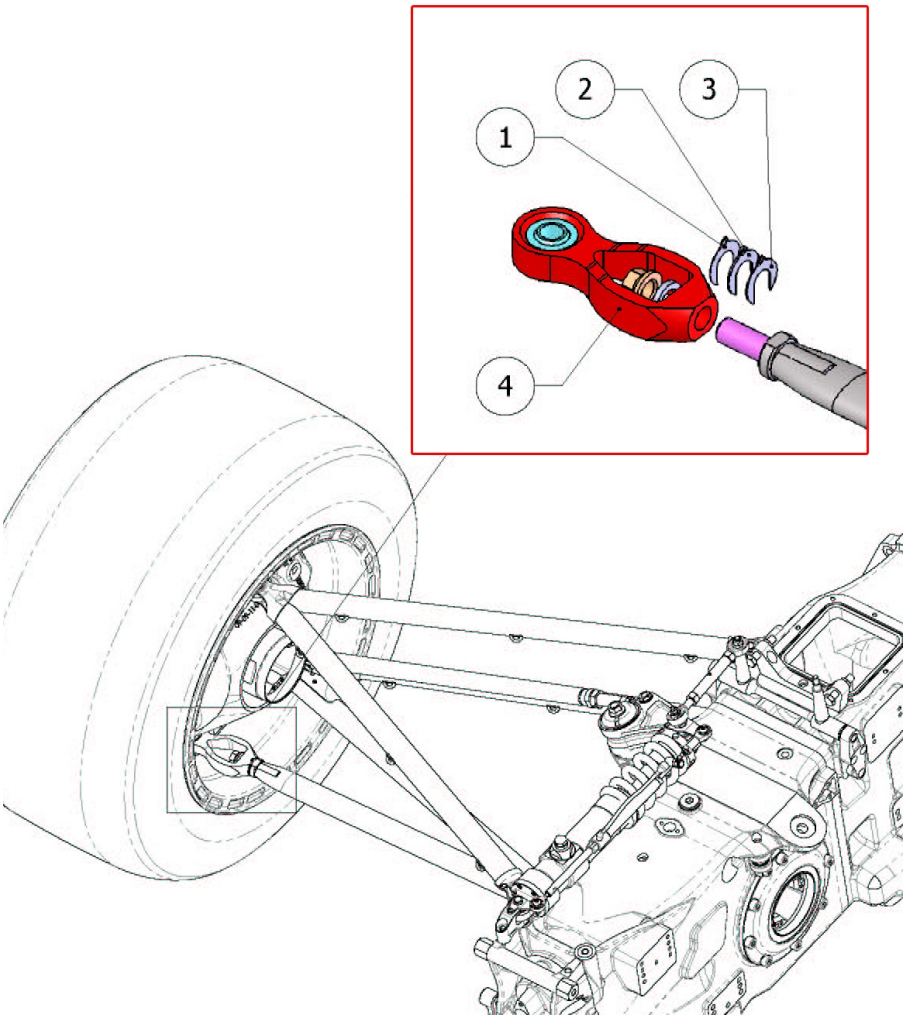


The following table represents the available size and its respective effect:

	mm	deg
CAMBER	0	-3.5
	1	-3.26
	2	-3.02
	3	-2.79
	4	-2.55
	5	-2.31
	6	-2.07
	7	-1.83
	8	-1.6
	9	-1.36
	10	-1.12

3.8.1.3 Toe

The rear toe is adjustable with shims [1,2,3]



	Side [mm]	Total [deg]	Total [°,']	Rim [mm]
TOE	0	0	0	0
	0.1	-0.08	-0.05	0.23
	0.2	-0.16	-0.09	0.46
	0.3	-0.23	-0.14	0.69
	0.4	-0.31	-0.19	0.92
	0.5	-0.39	-0.23	1.16
	0.6	-0.47	-0.28	1.39
	0.7	-0.55	-0.33	1.62
	0.8	-0.62	-0.37	1.85
	0.9	-0.7	-0.42	2.08
	1	-0.78	-0.47	2.31

3.8.1.4 Vertical spring

A range of springs is available to setting the vertical stiffness of the car:

K_{spring} [lb/in]	700	800	900	1.000	1.100	1.200	1.300
K_{wheel} [kgf/mm]	7,4	8,4	9,5	10,5	11,6	12,6	13,7

Motion ratio: Wheel/Spring 1.30
Spring/Wheel 0.77

Spring preload can be set acting on the spring platform (thread step 2mm), remember that acting on the preload you change the ride height.

Preload [daN] = Stiffness [daN/mm] x Turns (of spring platform) x 2 [mm]

3.8.1.5 Antiroll

Rear roll is controlled by antiroll bar, different diameter are available to adjust stiffness:

D_{ext} [mm]	13	11.4	9.6
$K_{T\_AR\ bar}$ [Nm/rad]	2784	1647	828

Motion ratio: Wheel displacement / Drop link displacement: 1.3

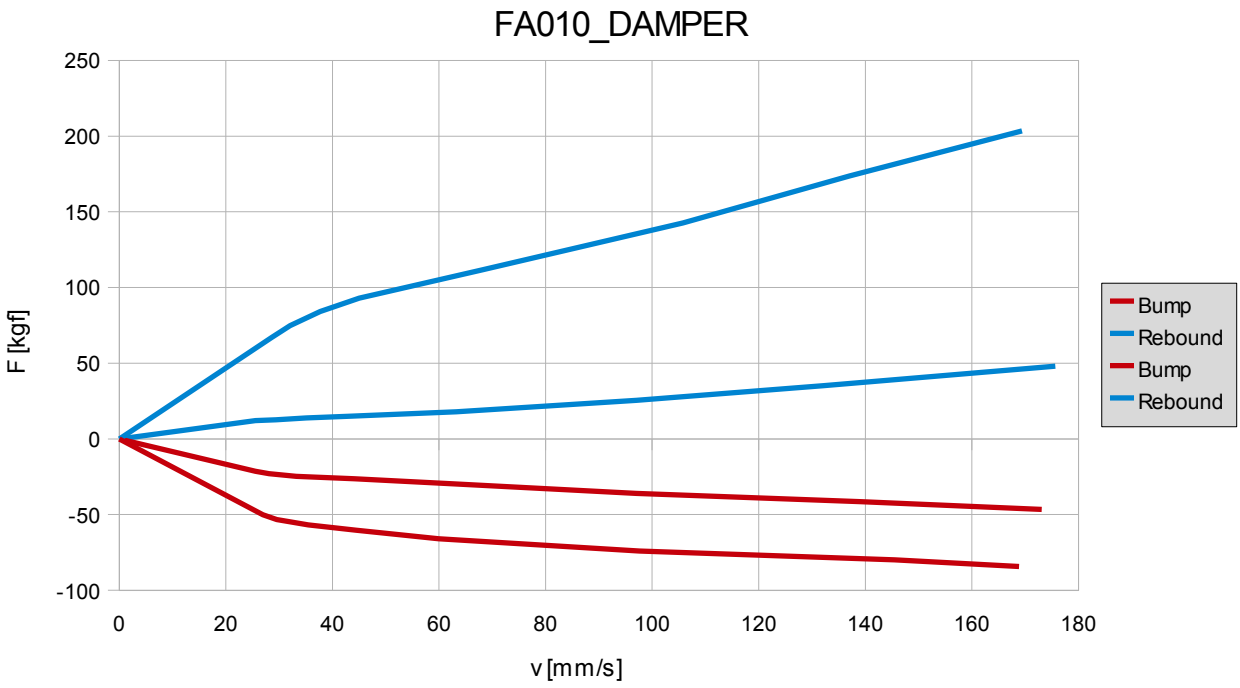
3.8.2 Rear Dampers

The standard front damper is ORAM, full open length is 320mm and maximum stroke is 39mm.

The dampers are adjustable in bump and rebound, the disc located in the top eye adjust the rebound, the knob on the body adjust the bump damping.

Both adjustments have a range of 18 clicks, for the maximum damping full tight the adjuster.

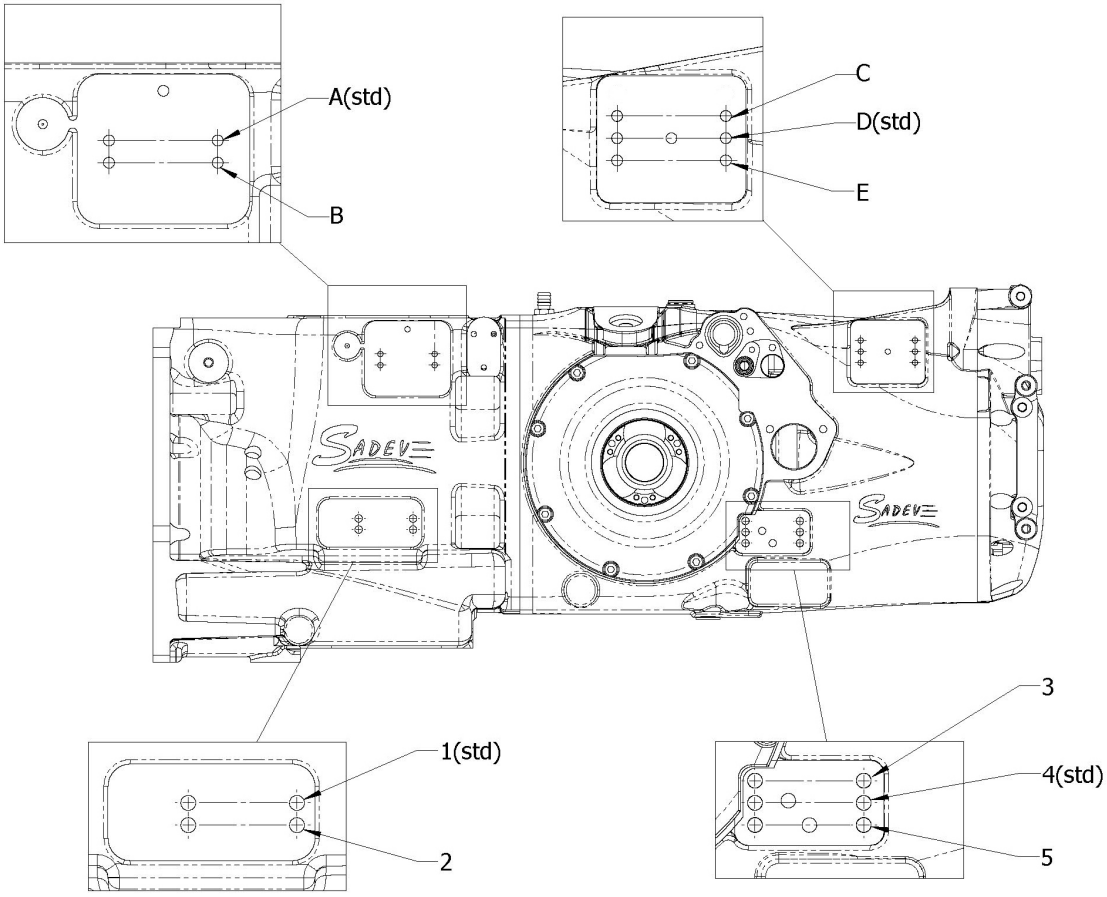
The dampers setting is the same for front and rear axle, for the installation ratio refers to the stiffness chapter.



3.8.3 Rear suspension geometry

3.8.3.1 Pickup

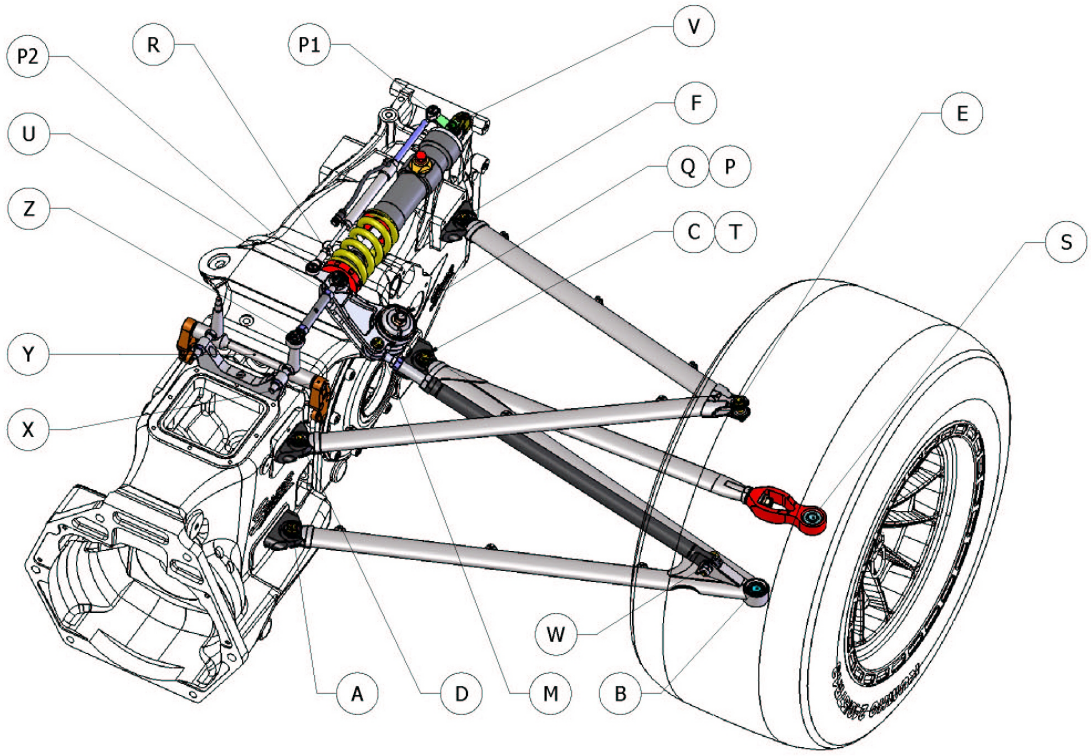
The rear suspension geometry is adjustable, car is delivered in standard wishbone position (see coordinates table), three pickup points can be moved in different positions (see fig. X), the displacement step is 10mm.



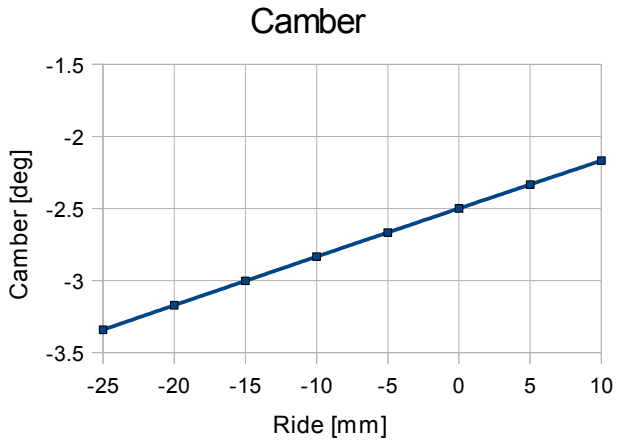
The following table resume the coordinates of the standard pickup points, based on reference system:

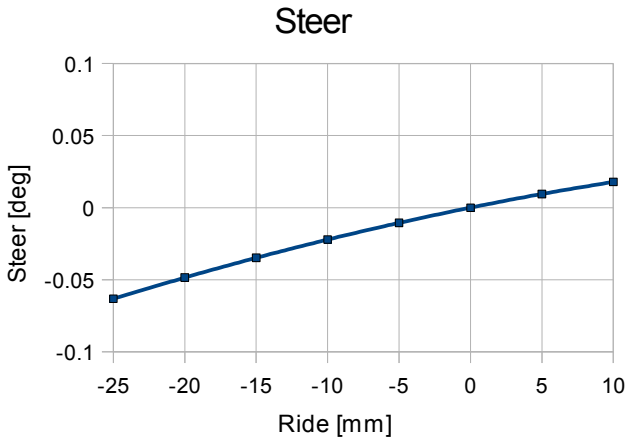
x_0: front wheel axis
y_0: vehicle axis
z_0: Reference plane (bottom of the wooden skid).

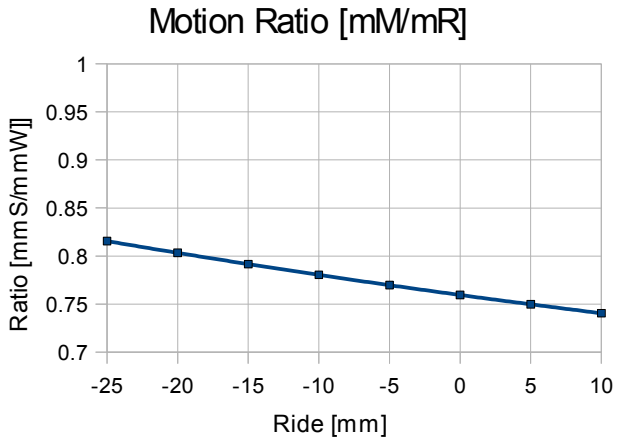
		REAR		
		x	y	z
	Centre of Tire Contact Patch	2650	730	-30
	Centre of Wheel	2650	730	285
A	Bottom Wishbone Inner Front pickup	2356.9	112	147.5
B	Bottom Wishbone Outer pickup	2572.8	671	154.2
C	Bottom Wishbone Inner Rear pickup	2705.5	112	135.3
D	Top Wishbone Inner Front pickup	2376.4	106.5	300
E	Top Wishbone Outer pickup	2654.7	592	386.6
F	Top Wishbone Inner Rear pickup	2809.3	106.5	302.2
S	Outboard Trackrod pickup	2720	671.3	149.1
T	Inboard Trackrod pickup	2705.5	112	135.3
V	Shock Absorber Pickup on Chassis	2565.4	43.2	374.4
U	Shock Absorber Pickup on Rocker	2877.4	46	373.4
Q	Rocker Pivot Point_1 on Chassis	2573.1	121.6	320.9
P	Rocker Pivot Point_2 on Chassis	2573.1	129.6	343
M	Inboard Push-rod pickup on Rocker	2532.3	125.7	344.4
W	Outboard Push-rod pickup	2567.9	605.1	177.2
	CG Location	1014	0	255



The following diagrams represent the variation of the relevant parameters for the standard suspension configuration (AD14), ride measurements are relative to the standard design configuration (in this case the tabled ride are offset by 30mm):





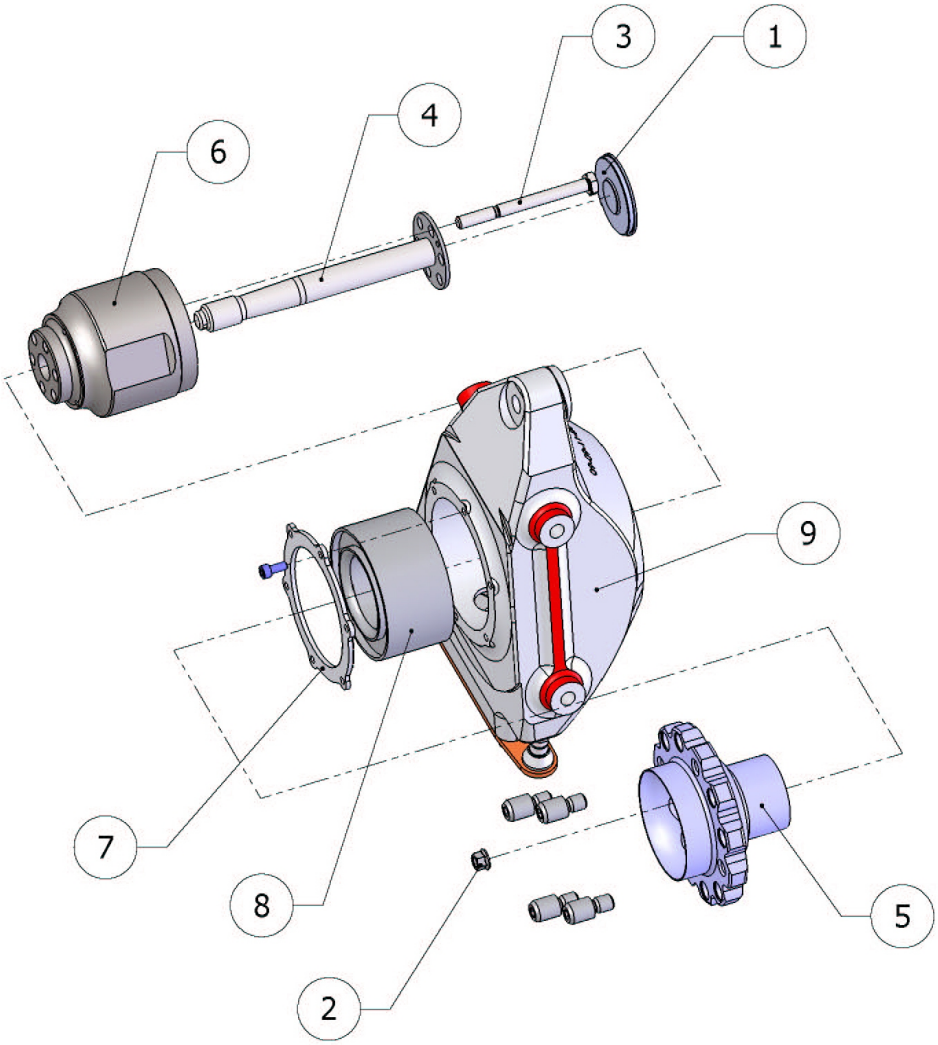


3.8.3.2 Anti-effects

Roll centre height is measured from the ground.

		Roll Center	Anti-squat		Anti-lift	
Pos		RC_z [mm]	AS [%]	[deg]	AL [%]	[deg]
AC13	13	71.5	-9.9	-0.6	13.4	1.8
AC14	14	53.1	9.2	0.6	34.4	4.6
AC24	24	49.7	-10.0	-0.6	13.5	1.8
AC25	25	31.1	9.4	0.6	34.6	4.6
AD13	13	77.7	-1.1	-0.1	6.1	0.8
AD14	**14**	**59.4**	**18.0**	**1.1**	**27.2**	**3.7**
AD24	24	56.1	-1.2	-0.1	6.1	0.8
AD25	25	37.6	18.1	1.1	27.3	3.7
BD13	13	81.2	-9.5	-0.6	13.3	1.8
BD14	14	63.0	9.5	0.6	34.2	4.6
BD24	24	59.7	-9.6	-0.6	13.4	1.8
BD25	25	41.2	9.6	0.6	34.4	4.6
BE13	13	87.3	-0.8	0.0	6.1	0.8
BE14	14	69.2	18.2	1.1	27.1	3.6
BE24	24	65.8	-1.0	-0.1	6.1	0.8
BE25	25	47.6	18.3	1.1	27.2	3.7

3.8.4 Rear axle maintenance



Drawing 1-1

Disassembly

1. Remove the upright from suspension and drive shaft;
2. Remove nuts and bolts [18];
3. Remove the wheel spindle [17] tapping it if necessary with a plastic mallet (pay attention to avoid thread damages);
4. Remove the outer hub [3] from the upright using a 4 mm pin drift through the proper hole in the inner hub [9];
5. Remove the inner hub [9];
6. Remove the bearing retainer [4];
7. Warm the upright [8] to about 120 °C, be careful to warm just the casting upright, the bearing should come out without the help of any tools;

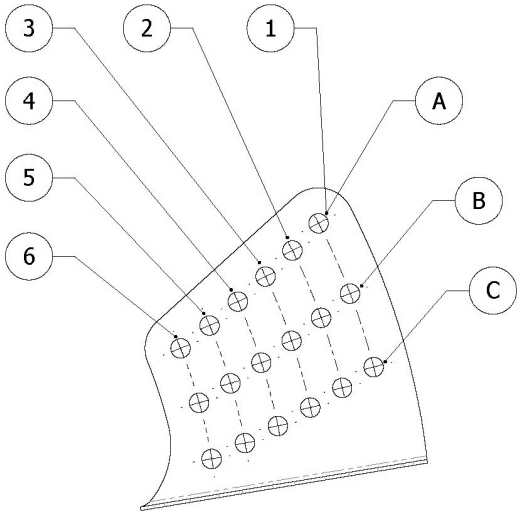
Assembly

1. Warm the upright [8] to about 120 °C, be careful to warm just the casting upright, the bearing should come in without the help of any tools;
2. Fasten the bearing retainer [4] with Loctite 243, tightening torque 6.0 Nm;
3. Using a press drive the outer hub [3] in the bearing, then the inner hub [9];
4. Install the wheel spindle [17];
5. Replace the spindle bolts [18] (tightening torque 25 Nm).

4 AERODYNAMIC

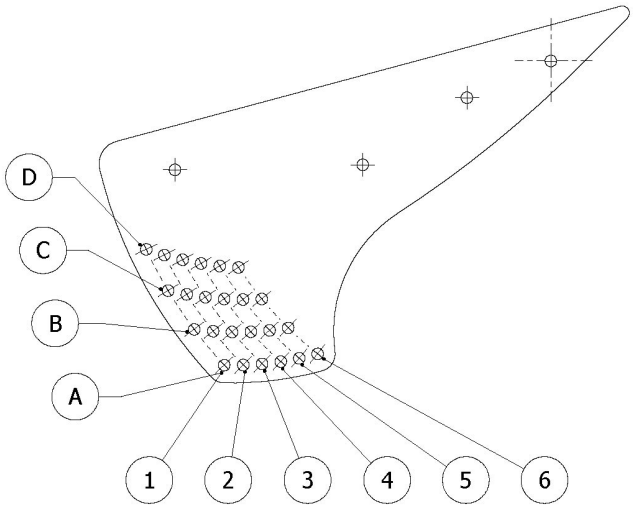
4.1 FRONT WING SETTING

The front downforce is adjustable with the front flap incidence: the front flap angle range is (step 1°)



4.2 REAR WING SETTING

The front downforce is adjustable with the front flap incidence: the front flap angle range is (step 1°)



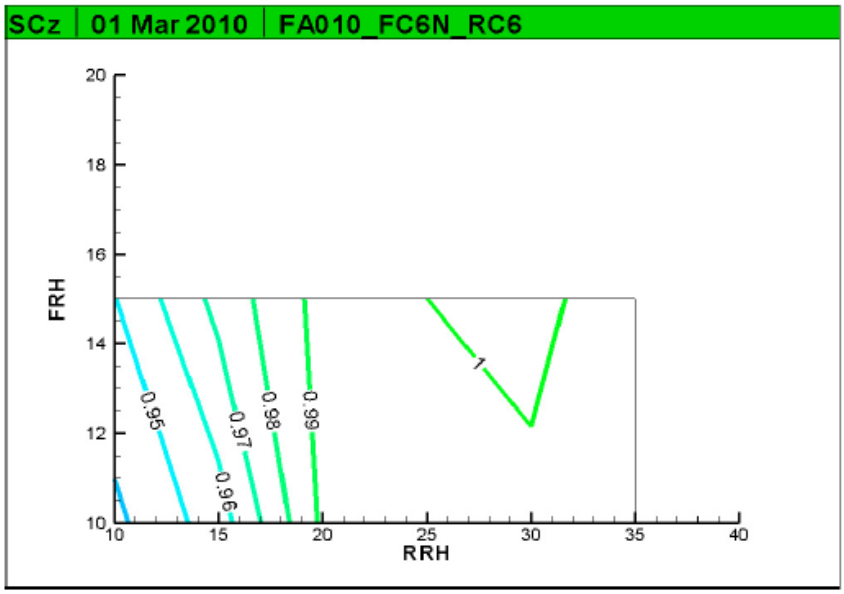
4.3 AERODYNAMIC SETUP

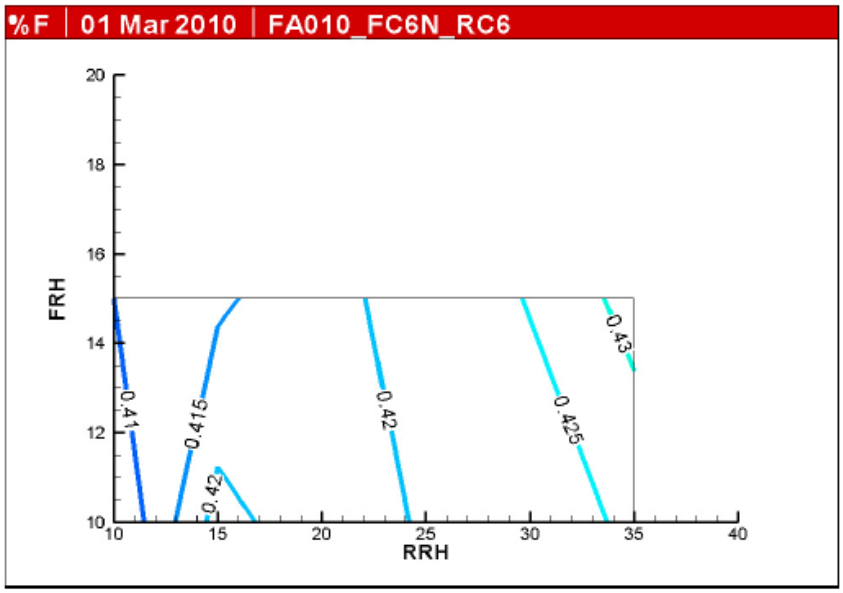
The standard aerodynamic setup is:

Front flap position: C6
Front gurney: 15mm
Front ride height: 1 5mm

Rear Flap position: C6
Rear ride height: 25mm

The following diagram represent a preview of the balanced aeromap for the standard wing setup:





4.4 Wing proportionality

In order to maintain the aero balance the flap angle can be increased by the same amount on the front and rear wings.

5 BRAKE SYSTEM

5.1 CALIPERS

5.1.1 Caliper technical details

FRONT CALIPER TYPE &/OR PART NO.....CP...7606-12/13S0 RH & LH Trailing
REAR CALIPER TYPE &/OR PART NO.....CP..7606-14/15S0 RH & LH Leading
FRONT DISC TYPE &/OR PART NO.....Ø272 x 18 One Piece
REAR DISC TYPE &/OR PART NO.....Ø272 x 18 One Piece

5.1.2 Caliper service

Because race Brake Calipers are sometimes subjected to very high and unpredictable operating temperatures, they must be examined and seals must be replaced on a regular basis to maintain efficiency and safety. Seal life is governed by time at temperature which should therefore be kept as low as possible by provision of cooling airflow. For guidance only AP Racing offer the following recommendations (temperatures measured on outside of Caliper adjacent to logo):

- Calipers that regularly run at up to 200°C – Re-seal every other event.
- Calipers that run intermittently from 200°C to 220°C and above – Re-seal as soon as possible
- Reduce "soak" temperatures after the car has come to rest where possible (e.g. do not leave foot on brake pedal when stationary with hot brakes) as this can cause excessive Caliper temperatures

- Regular examination and maintenance of brake calipers is essential to maintain safety and efficiency of operation.
- AP Racing recommend that brake calipers should be cleaned with soapy water only, as this will not damage any of the seals.
- A complete reconditioning service is available:
  - Seal repair kits and other spare parts e.g. pistons, bleed bolts etc, are also available and can be identified by referring to the individual caliper information.
  - Other spare parts e.g. pistons, bleed bolts, pad retainers are also available by referring to individual caliper details
- Replacement seals should be soaked in brake fluid for 30 minutes prior to fitment.
- For more information please contact AP Racing.

5.2 Master Cylinders

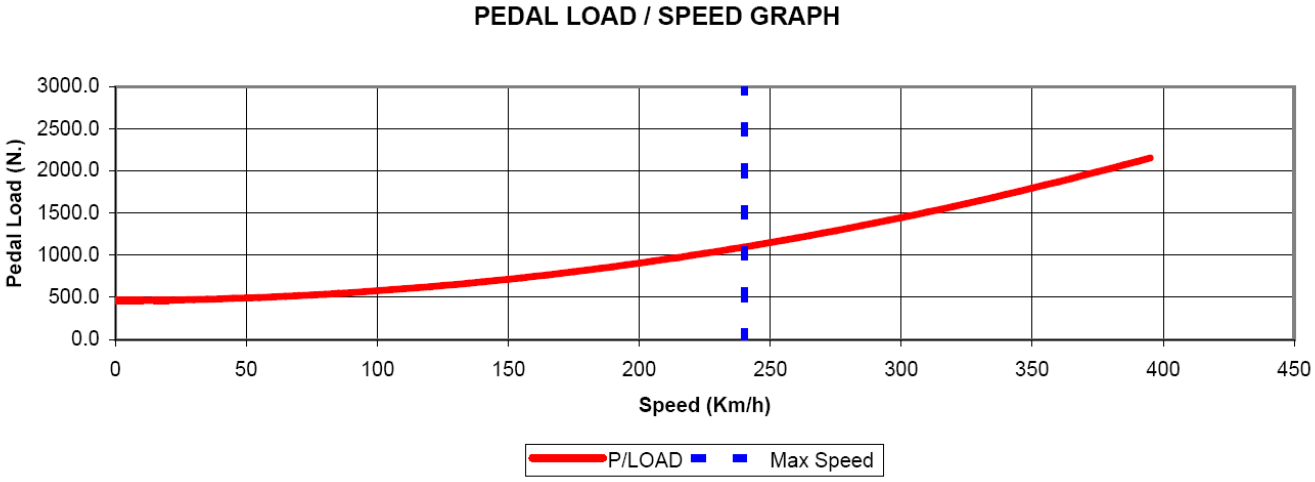
The FA010 chassis is equipped AP Racing master cylinders,here below standard installation layout:

Front brake	17.78 mm (0.70”)
Rear brake	20.64 mm (13/16”)
Clutch	5/8”

It is allowed the mix of the master cylinder.

PEDAL LOAD IN N..*.....851.271

	FRONT	REAR
RETARDING FORCE IN N..*	8971.930	6748.070
BRAKE SPLIT %..*	57.020	42.887
WHEEL R.R. IN M.M.	270.000	279.000
BRAKE TORQUE IN N.M..*	2422.421	1882.711
BRAKE TORQUE/WHEEL IN N.M..*	1211.211	941.356
DISC/CALIPER EFF.RAD. IN M.M.	112.950	112.950
PAD MU	0.390	0.390
FORCE NORMAL TO DISC FACE IN N..*	13747.978	10684.961
PISTON AREA/DISC FACE IN SQ.M.M.	2280.184	2280.184
LINE PRESSURE IN N./SQ.M.M..*	6.029	4.686
LINE PRESSURE IN BAR..*	. 60.293	46.860
MASTER CYL. DIA. IN M.M.	17.780 (.70")	20.638 (13/16")
RECOMMENDED SIZE WAS IN M.M..*	17.780 (.70")	20.638 (13/16")
MASTER CYL. AREA IN SQ.M.M.	248.286	334.522
PUSH ROD LOAD IN N..*	1497.001	1567.573
BALANCE BAR SETTING %..*	48.849	51.151



5.3 PADS

5.3.1 Brake pads options

Ferodo DS3000 brake pads is the only available pad compound.

5.3.2 Pads maintenance

5.3.2.1 Bedding-in:

To achieve the optimum performance from brake pads follow the procedure:
Perform 25 to 30 trial brake applications, each of approximately 4 seconds, using around 50% of normal race pedal pressure.
Inspect the surface of the brake pads of the two more stressed wheels, there should be evidence of contact over the full pad area but without glazing. Pads are now ready to race.

If time does not allow inspection, brake system must cool down for a short time before the pads are ready to race.

IMPORTANT: to optimize the performance and the life of brake pads and discs, during the bedding-in heat in the braking system should be built up progressively.

5.3.2.2 Pad wear

Brake pads must have at least 2mm of friction material.

Thermal paint temperature check: if none of the three paints has changed appearance discs are too cool, if all three paints have changed discs are too warm.

6 TIRES

The following table resumes the 2010 Italian F3 Race KUMHO Tyre Technical Data

SLICK TIRE

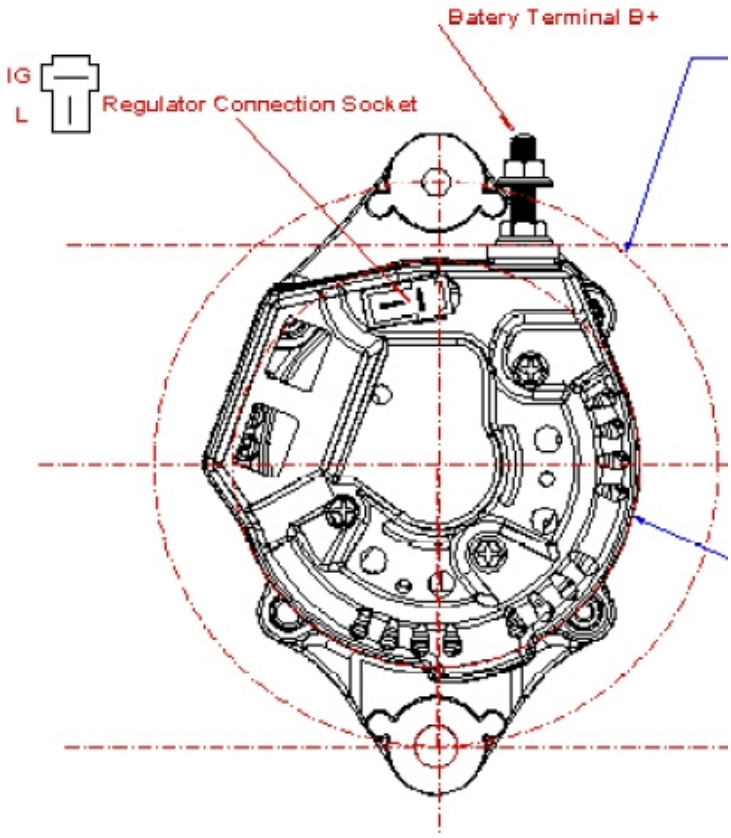
Tire Size		180/550R13	240/570R13
Permitted Rim		8.5 ~ 9.5	10.0 ~ 11.0
Optimum Rim (Measuring)		9.0 * 13	10.0 * 13
Section Width		237 mm	287 mm
Overall Diameter		550 mm	576 mm
Overall Circumference		1727 mm	1809 mm
Revolutions/Mile at 100MPH		931	889
Vertical Spring Rate (Road: 300Kg)	17Psi(1.15bar)	18.18Kgf/mm	23.84Kgf/mm
	23Psi(1.55bar)	22.86Kgf/mm	30.05Kgf/mm
Lateral Spring Rate (Road: 300Kg)	17Psi(1.15bar)	16.43Kgf/mm	17.57Kgf/mm
	23Psi(1.55bar)	19.10Kgf/mm	20.42Kgf/mm
Recommended Inflation Pressure	Cold	16~17Psi (1.10~1.15bar)	16~17Psi (1.10~1.15bar)
	Hot	22~23Psi (1.50~1.55bar)	22~23Psi (1.50~1.55bar)
Recommended Camber		3.15˚~ 3.65˚Negative	2.05˚~ 2.55˚Negative
Recommended Toe		1.5mm ~ 3.0 mm toe - out	0.5mm ~ 2.0 mm toe - in

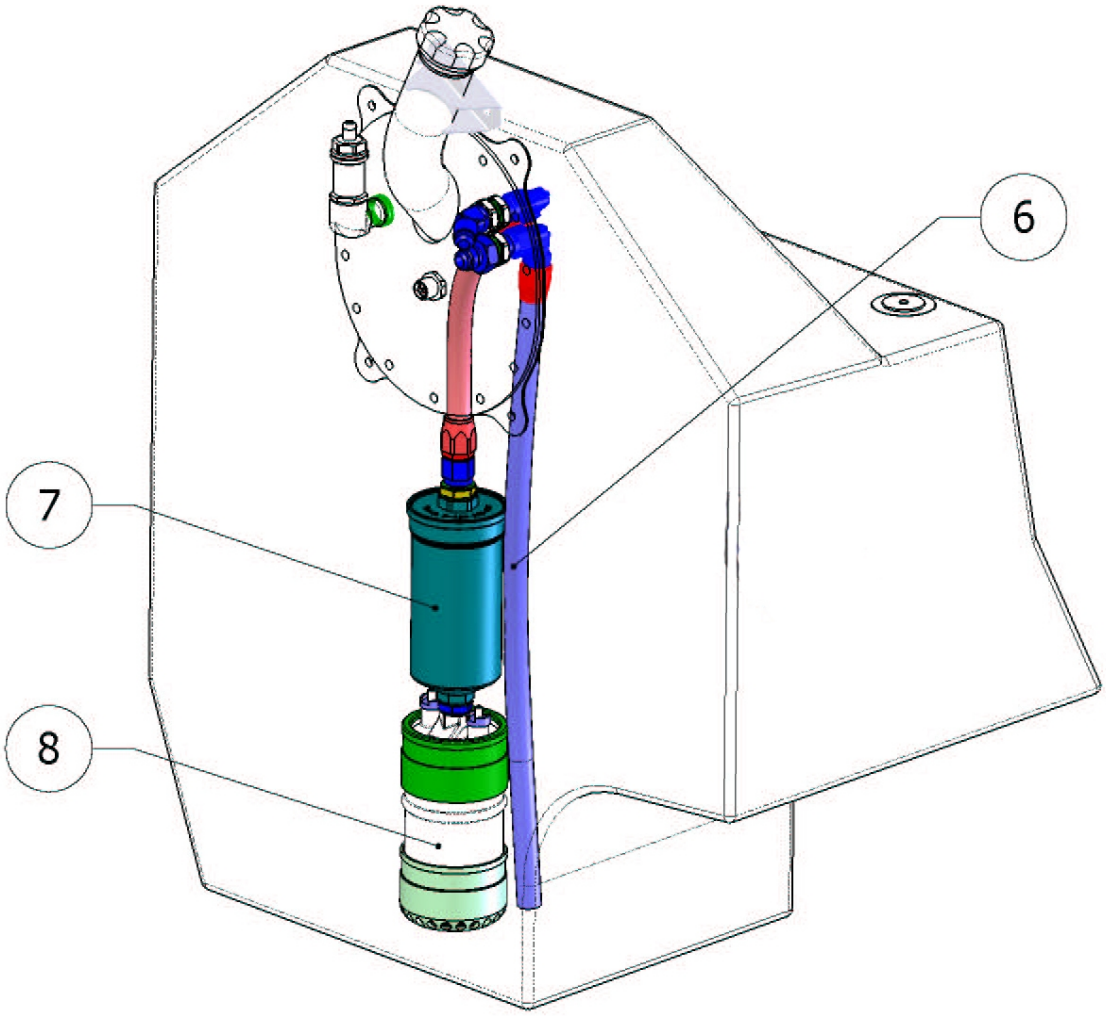
WET TIRE

Tire Size		180/550R13	240/570R13
Permitted Rim		8.5 ~ 9.5	10.0 ~ 11.0
Optimum Rim (Measuring)		9.0 * 13	10.0 * 13
Section Width		237 mm	287 mm
Overall Diameter		550 mm	576 mm
Overall Circumference		1727 mm	1809 mm
Revolutions/Mile at 100MPH		931	889
Vertical Spring Rate		15.90Kgf/mm at 300Kg,17Psi	17.65Kgf/mm at 300Kg,17Psi
Lateral Spring Rate		12.25Kgf/mm at 300Kg,17Psi	15.24Kgf/mm at 300Kg,17Psi
Recommended Inflation Pressure	Cold	18~20Psi (1.25~1.40bar)	18~20Psi (1.25~1.40bar)
	Hot	22~23Psi (1.50~1.55bar)	22~23Psi (1.50~1.55bar)

7 FUEL SYSTEM

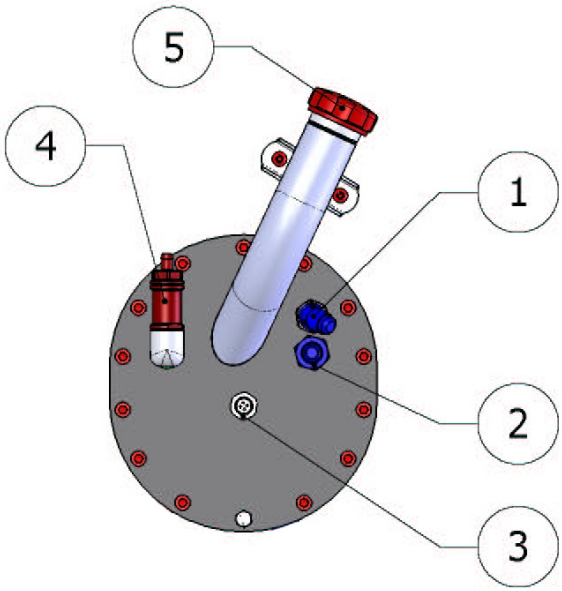
The fuel system include the high pressure main pump [8], and the high pressure fuel filter [7].



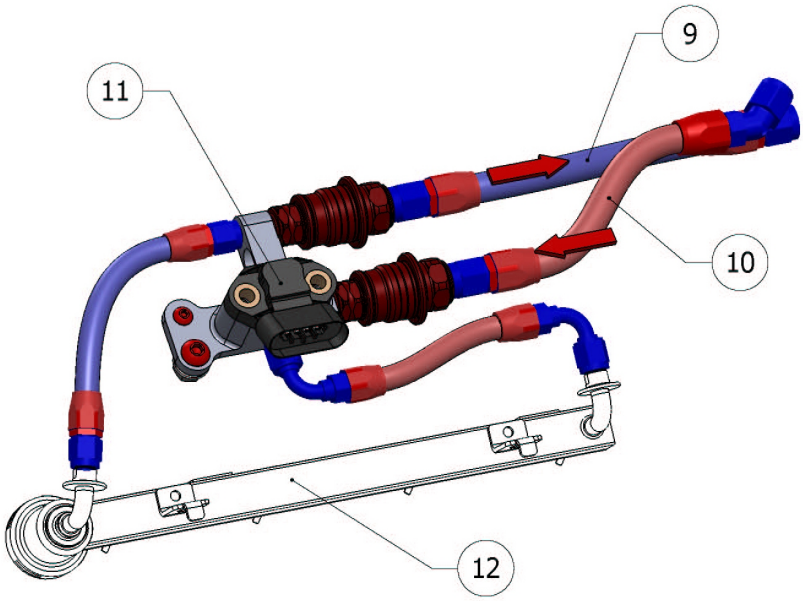

6
7
8

The fuel tank can be refilled trough the cap [5], breathing port [4] must be checked and installed in order that the flap valve lock the fuel flow when vehicle roll over.

The fuel line from the pump to the engine have to be connected to port [1], port [2] has to be connected to the return line.



In order to drain the fuel tank disconnect return line [10] from the quick release and plug a line to an external fuel pump, the fuel will be sucked by the return pipe [6].

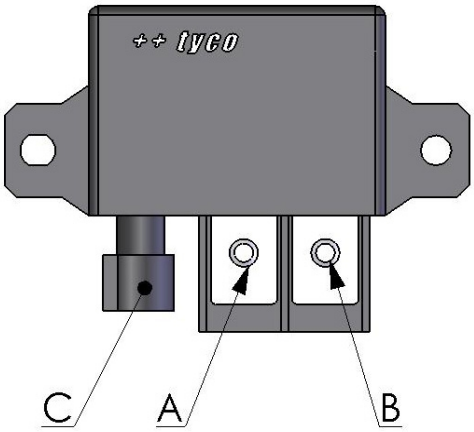


8 ELECTRIC SYSTEM

8.1 MAIN SWITCH

Master switch is actuated by the cockpit panel and emergency switches, it includes three plugs where you have to connect the following wiring:

- A: 12V Generator, PowerBox;
- B: 12V Battery, Main switch couil supply (Jump battery);
- C: engine loom connector.



8.2 POWERBOX

The powerbox protect the electrical system from overcurrent.

Electric system is separated in five section, each one protected by a different circuit breaker, here below the details of different sections:

1	Pin 3A, 3B, 3C grey connector	Rain light
2	Pin 4A, 4B, 4C grey connector	Ignition coils 1, 2, 3, 4 – Injectors 1, 2, 3,4
3	Pin 5A, 5B, 5C grey connector	Magneti Marelli ECU (SRA), Magneti Marelli Logger (RDL), Steering wheel dashboard
4	Pin 6A, 6B, 6C grey connector	Pin 1 RDL Aux Channels Pin 1 AIM CAN Interface Pin 1 PTT Interface Pin 1 Front CAN Extension Pin 1 Front Right, Left Wheel Speed Sensors Pin 1 Dump Valve Control Solenoid Pin 2 Waste Gate Control Solenoid Pin 4 Lambda Sonde Pin 1 Rear CAN Extension Pin 1 Lap Trigger Receiver
5	Pin 7A, 7B, 7C grey connector	Fuel pump

User devices connected to customer available connections (Front/Rear CAN extension, RDL Aux Channels, PTT Interface) **must not** exceed 5A in total and 2A per power supply pin.

Power lines failures can be detected through the power box diagnostic lines available on the connector *Power Lines Status*. The diagnostic lines are driven to battery GND whenever a failure condition has been detected by the power box.

Power Lines Status Connector Pinout:

1. Battery Power
2. Line 5 – Fuel Pump Line Status
3. Line 4 – Auxiliary Power Line Status
4. Line 3 – SRA, RDL, Dashboard Line Status
5. Line 2 – Ignition Coils, Injectors Line Status
6. Line 1 – Rain Light Line Status
7. Battery Ground

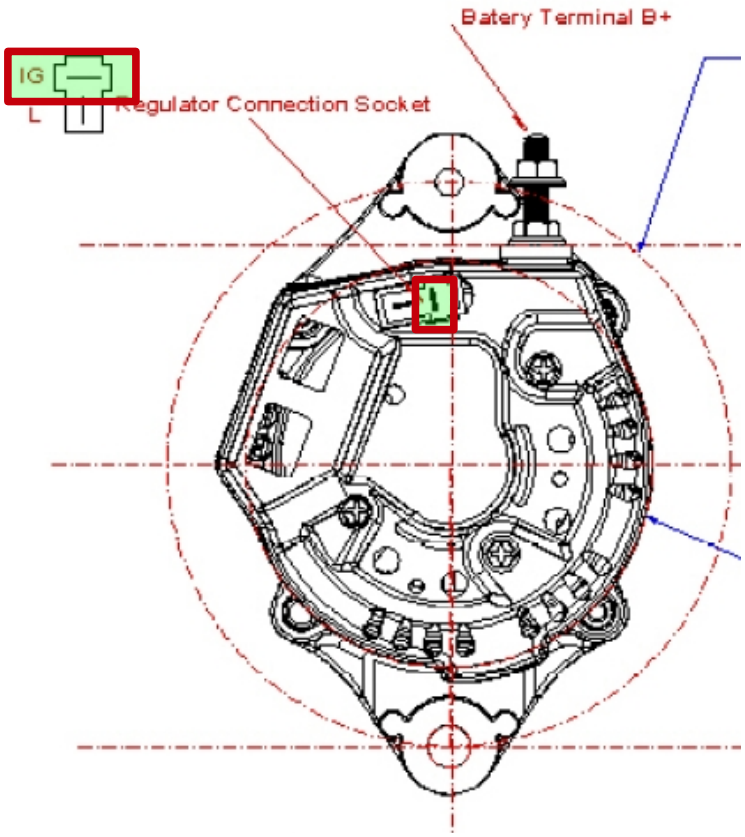
A LED display is available to help user to detect which line caused the failure.

Power lines current and diagnostic informations are collected in the RDL data logger, here below relevant channel list:

Channel	Info	Description
I_Rain	[value]	Current [A]
I_Inj_Coil	[value]	Current [A]
I_SRA_RDL_Dash	[value]	Current [A]
I_Aux	[value]	Current [A]
I_Fuel_Pump	[value]	Current [A]
PWRBOX_6	Hex	Diagnostic
PWRBOX_7	1	Line 1 (Rain) Alarm
	2	Line 2 (Ign-Inj) Alarm
	4	Line 3 (SRA_RDL_Dash) Alarm
	8	Line 4 (Aux) Alarm
	16	Line 5 (Fuel_Pump) Alarm
PWRBOX_8	Hex	Diganostic

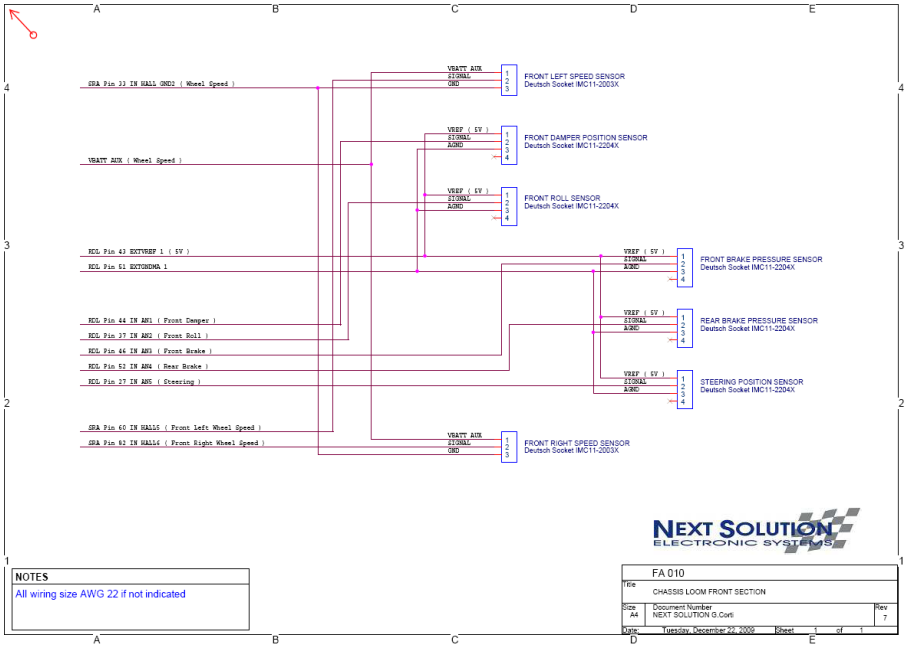
8.3 BATTERY AND GENERATOR

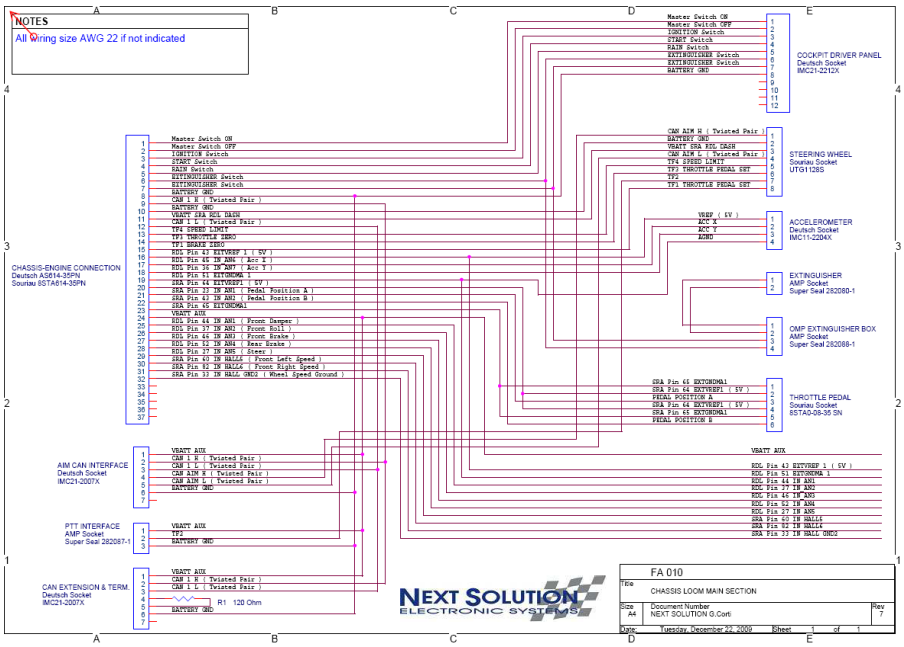
Engine loom red isolated Faston socket must be connected to **IG** terminal (Regulator Connection Socket).



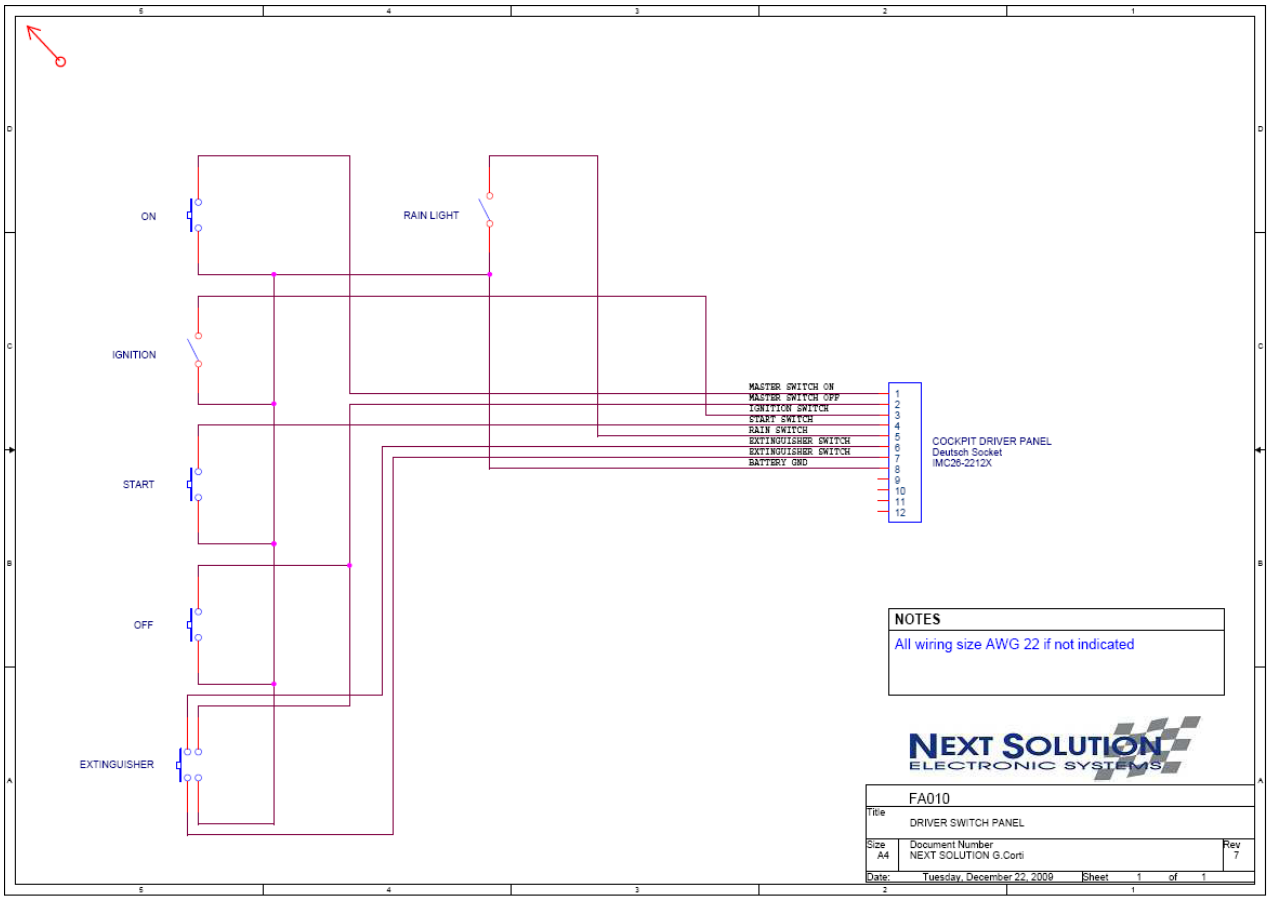
8.4 WIRING LOOM

8.4.1 Chassis loom

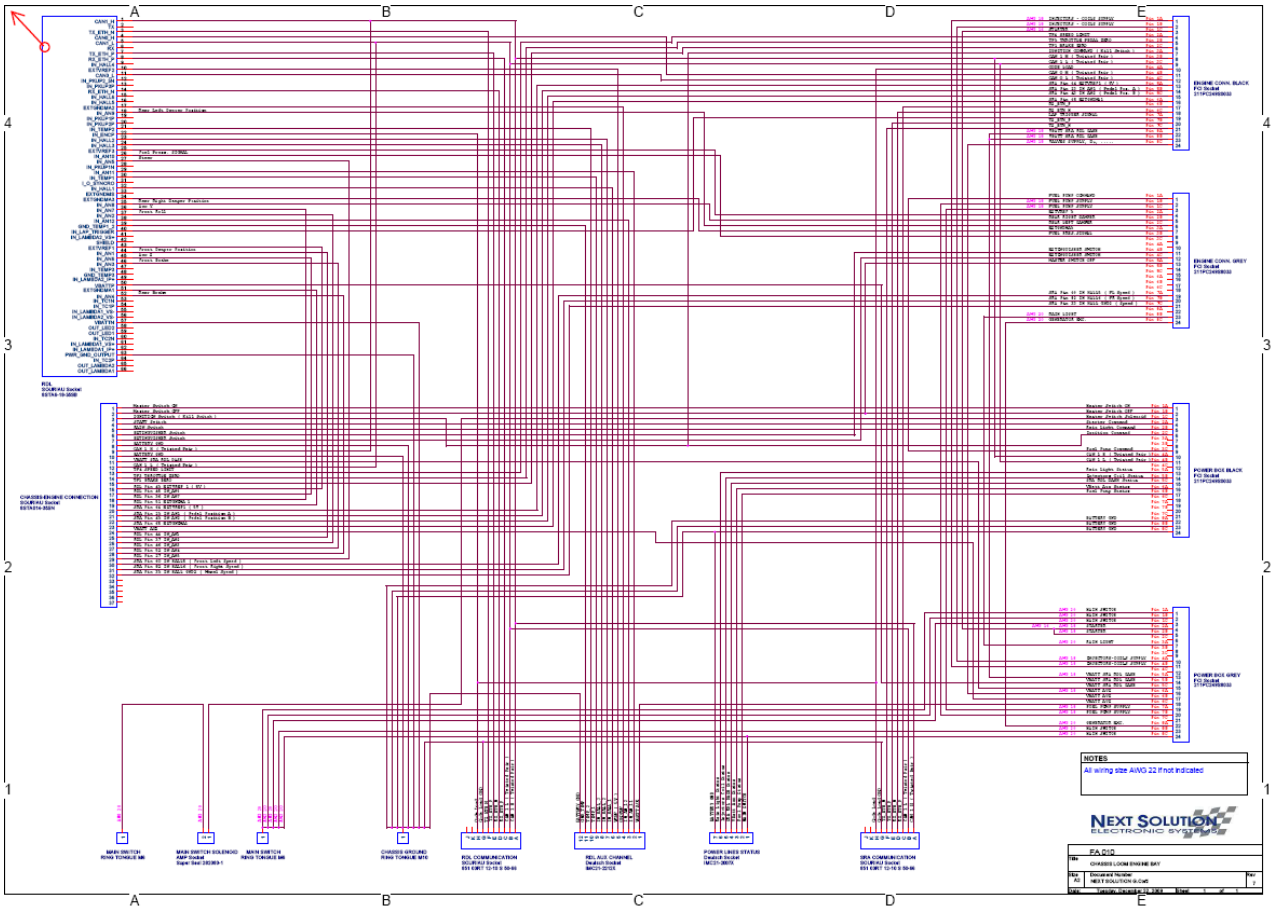




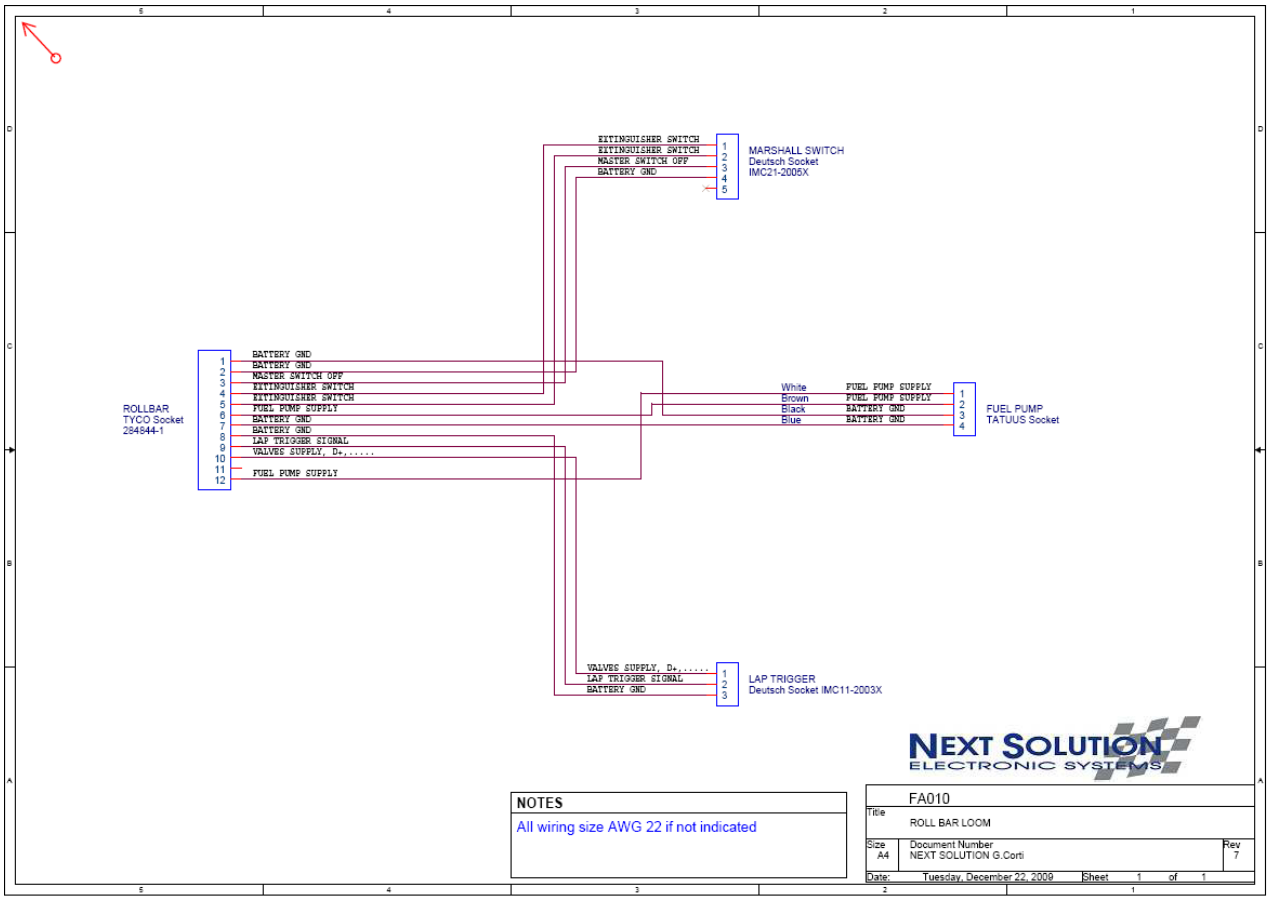
8.4.2 Switch panel



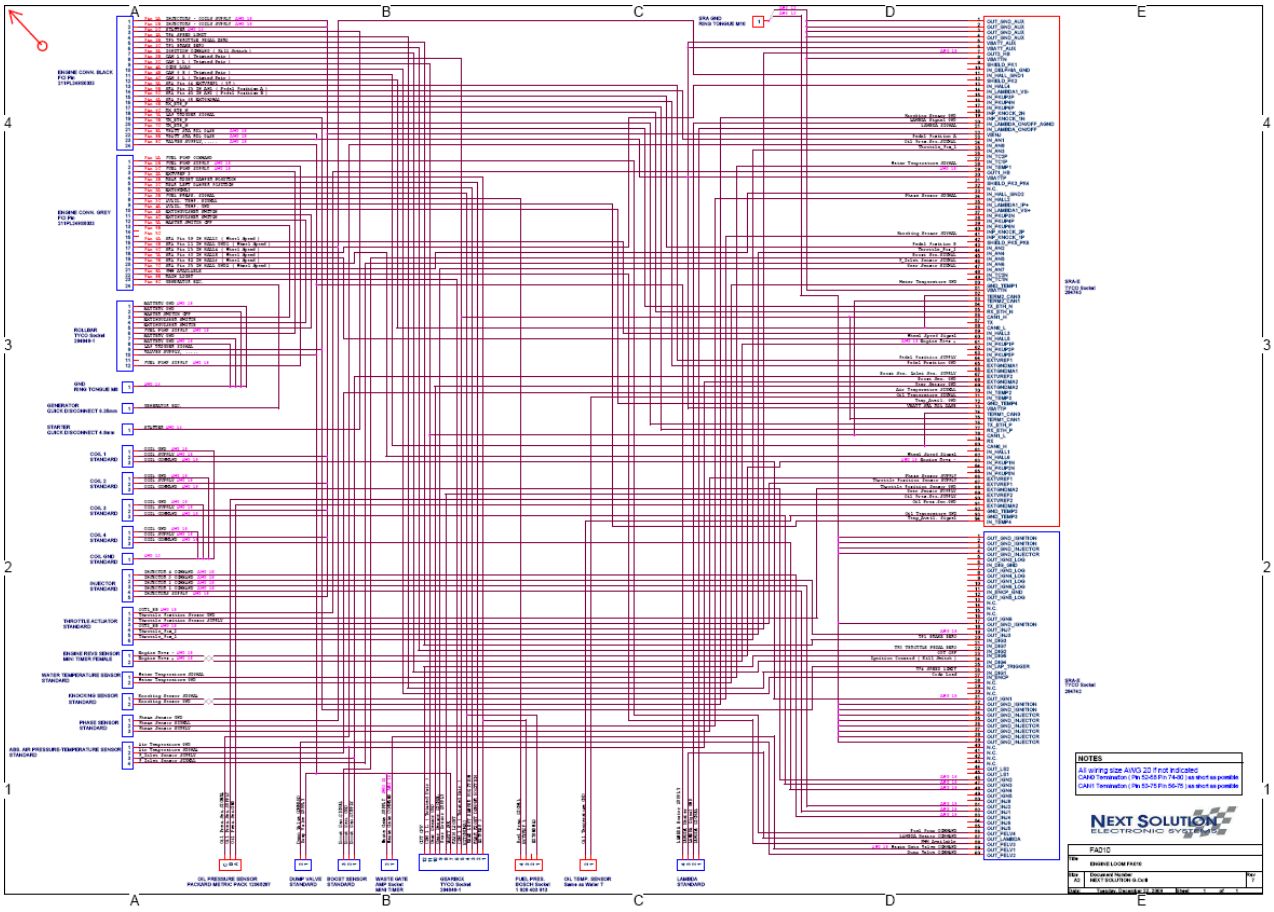
8.4.3 Chassis engine bay loom



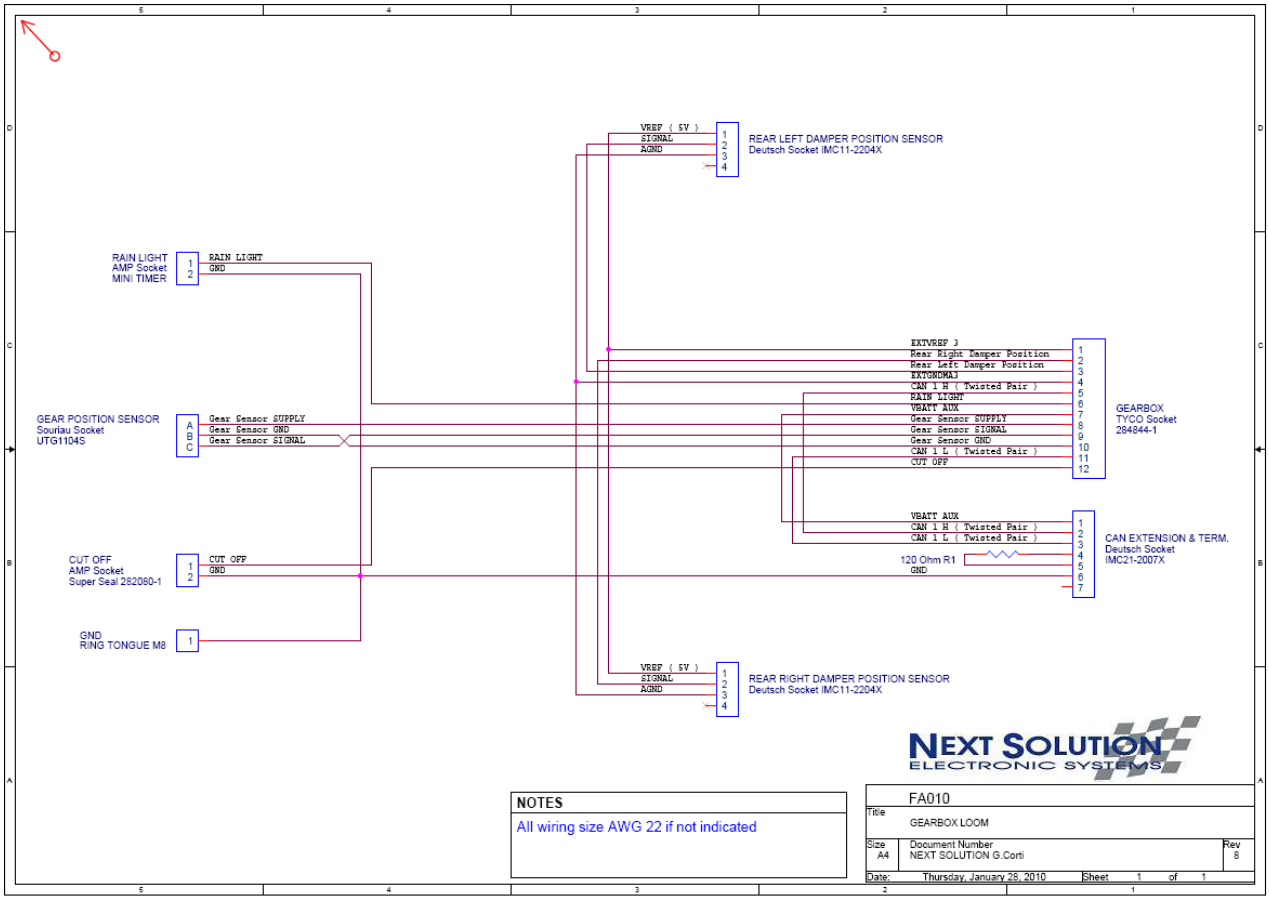
8.4.4 Rollbar loom



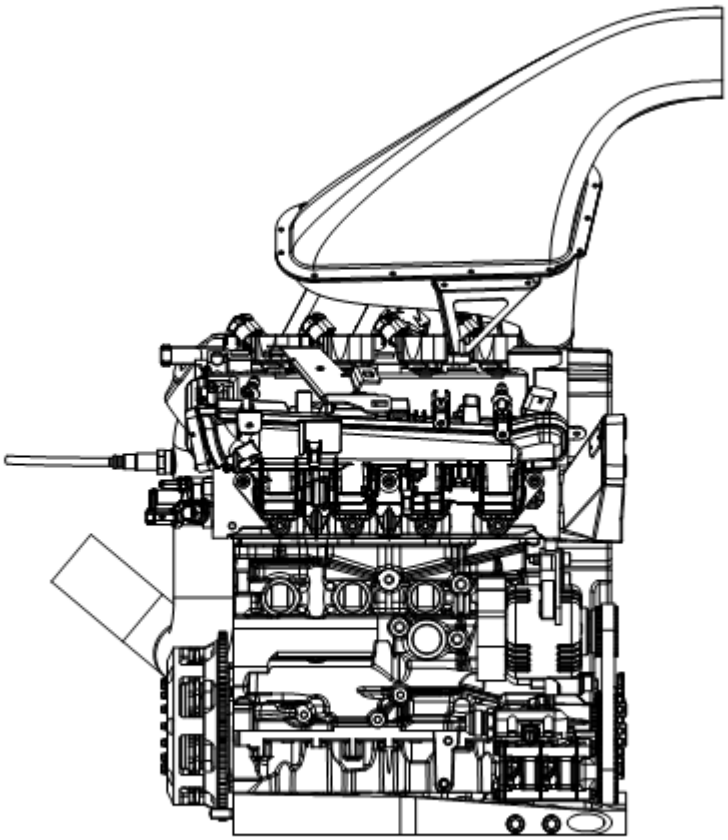
8.4.5 Engine loom



8.4.6 Gearbox loom



9 ENGINE



Il manuale tecnico del motore 414TF rappresenta lo strumento indispensabile per la gestione e manutenzione del motore. A tale scopo nel presente manuale sono forniti tutti i dati necessari. Per facilità di consultazione esso è suddiviso in 2 capitoli:

- DATI TECNICI
- PROCEDURE DI UTILIZZO E MANUTENZIONE

9.1 Dati Tecnici

9.1.1 Caratteristiche generali

Alesaggio	72	mm
Corsa	84	mm
Cilindrata totale	1368	cm^3
Rapporto di compressione	9.8 : 1	
Potenza massima DIN (a 6000 giri/min)	180/132	cv/kW
Coppia massima DIN (a 3000 giri/min)	280	Nm
Combustibile prescritto	Benzina 100RON	

9.1.2 Sistema di distribuzione

	Asp [mm]	Sca [mm]
Diametro condotti nella testa lato camera combustione	22.7	18.8
Diametro riferimento valvole	25.48	22.8
Alzata su asse valvola senza gioco	7.5	7
Fasatura	-2/34	27/-2

9.1.3 Sistema di formazione della miscela

Corpo farfallato Bosch DVE5		
Iniettori Bosch		
Pressione impianto alimentazione	3.65+pressione sovralimentazione	bar
Candele NGK IKR9F8		
Ordine di accensione	1-3-4-2	
Centralina iniezione	ECU MAGNETI MARELLI SRA-EDL8	

9.1.4 Sistema di lubrificazione

Olio motore da impiegare	Selenia Abarth 10W50	
Temperatura di esercizio olio motore	100 ÷ 130	°C
Temperatura massima	140	°C
Pressione olio media a temperatura regimata (6000rpm)	4.5 ÷ 5	bar
Pressione olio al regime minimo a temperatura regimata	2.5 ÷ 3	bar

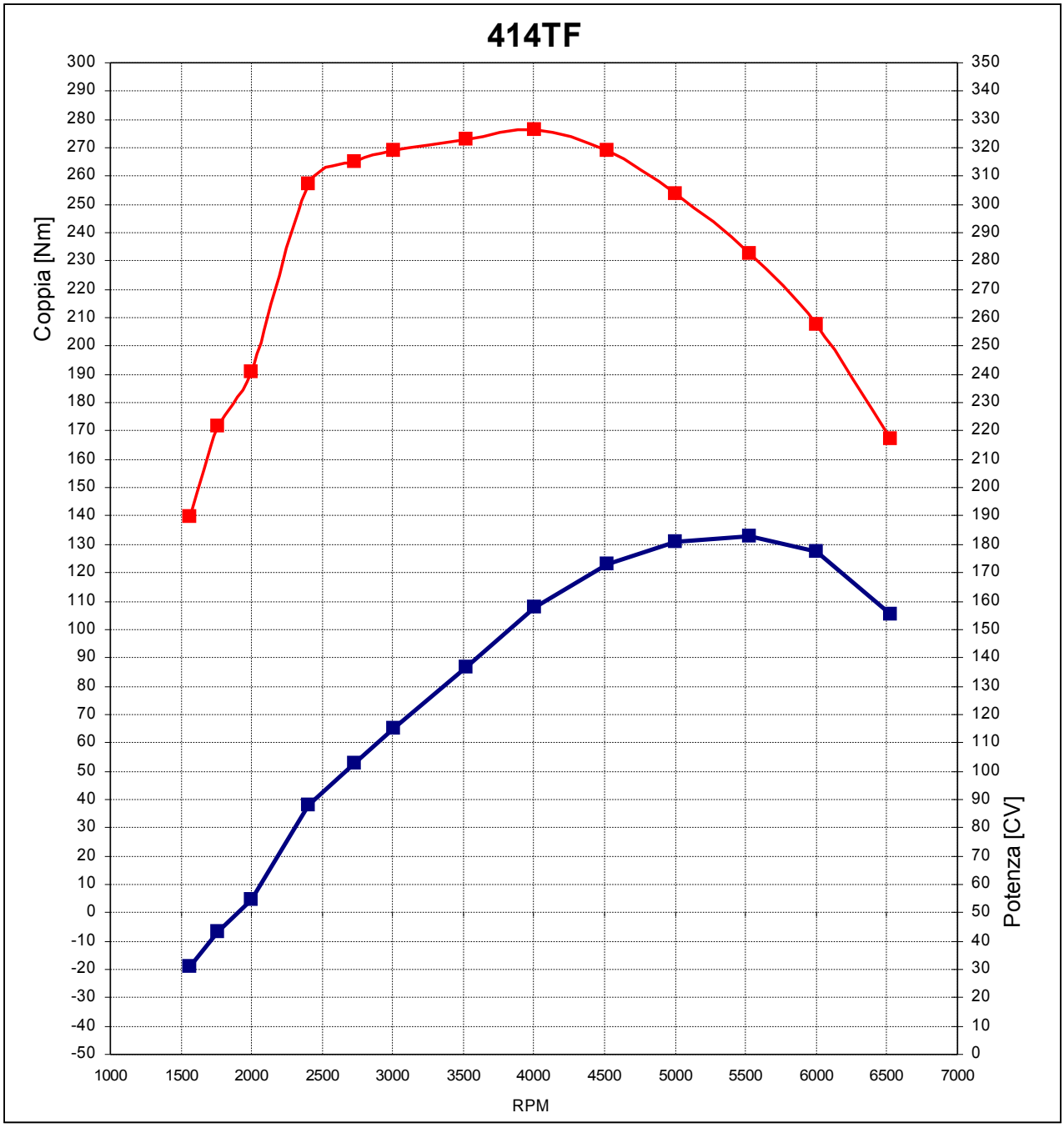
9.1.5 Sistema di raffreddamento

Pompa centrifuga comandata da cinghia distribuzione		
Liquido refrigerante	Acqua + Paraflù al 30%	
Temperatura di esercizio ottimale	80 ÷ 85	°C
Temperatura massima in esercizio	100	°C
Pressione di apertura tappo espansione	1.2	bar

9.1.6 Sistema di sovralimentazione

Turbocompressore a gas di scarico Garrett		
Pressione di sovralimentazione (6000rpm)	1000	mbar

9.1.7 Prestazioni



9.2 Procedure di Utilizzo e Manutenzione Motore 414TF

9.2.1 Controlli preliminari

PROCEDURA WARM-UP		NOTE
1	Verifica livello liquido raffreddamento	
2	Verifica livello olio	Capacità dell'impianto circa 4.5 litri
3	Controllo linearizzazione pedale acceleratore	Linearizzazione pedale: 1) Attivare unicamente pulsante ON 2) premere a fondo l'acceleratore 3) premere il pulsante switch user 2 per circa 3 secondi 4) rilasciare il pulsante 5) rilasciare il pedale 6) assicurarsi che la farfalla compia automaticamente una corsa completa 7) controllare tramite Axon che l'operazione sia andata a buon fine: pedale rilasciato: canale PDL=1 pedale a fondo : canale PDL=100. Non preoccuparsi se a pedale rilasciato il canale TPS (farfalla) assume valori compresi tra 5% e 35% in quanto è attiva una strategia farfalla per gli avviamenti a freddo. Al termine della procedura di linearizzazione farfalla spegnere e riaccendere il quadro generale prima di andare in moto.
4	Attivare unicamente pulsante ON (quadro generale)	
5	Messa in pressione dell'impianto di lubrificazione	Trascinare il motore tramite pulsante START e verificare in AXON che il canale P_OIL superi il valore di 2 bar.
6	Attivare interruttore IGNITION	
7	Messa in moto tramite pulsante START.	E' indispensabile servirsi di batteria ausiliaria. Potrebbe essere necessario dare pressione al pedale acceleratore durante la messa in moto
8	Verifica circolazione fluido di raffreddamento in impianto	Spurgare l'impianto tramite sfiati radiatori. Una volta verificata la circolazione del fluido e il riempimento dell'impianto, serrare il tappo vaschetta.
9	Warm up	Nel corso della fase di warm up mentenere il regime di rotazione motore compreso tra 1500rpm e 2500rpm. Non preoccuparsi se a pedale rilasciato il regime motore tende automaticamente a oscillare in quanto durante la fase di warm up è presente una strategia farfalla per il mantenimento del regime di minimo a freddo.

10	Regime di minimo	A temperatura acqua regimata il regime di minimo è pari a 1000± 100rpm. Non preoccuparsi se nella fase di warm up il regime di minimo assume valori superiori in quanto è presente una strategia farfalla per il mantenimento del regime di minimo a freddo.
11	Spegnimento tramite interruttore IGNITION	La fase di warm up deve durare almeno fino al raggiungimento della temperatura acqua di 75°C.
12	Verifica livello olio	Inserire un misuratore di livello nella bocchetta di riempimento e verificare che il pelo libero si trovi ad una distanza di 20mm dal fondo.

9.2.2 Controlli generali

COMPONENTE		NOTE
1	Distribuzione	Il limitatore è impostato a 6500rpm. In caso di superamento del regime di rotazione di 7200rpm contattare personale FPT Racing.
2	Alternatore	L'alternatore funziona correttamente se al superamento del regime di 2700rpm la tensione batteria è prossima a 13.5V
3	Impianto lubrificazione	Effettuare la sostituzione dell'olio motore e del filtro olio al termine di ogni weekend di gara e comunque ogni 500km. E' vietato utilizzare oli differenti da quello prescritto.
4	Filtro aria	Al termine di ogni evento controllare integrità del filtro aria e pulizia. Nel caso di anomalia controllare l'integrità delle palette compressore.
5	Turbocompressore	Per garantire l'integrità del turbocompressore si consiglia di effettuare al termine di ogni run un giro di rientro a basso carico motore. Inoltre al rientro della vettura ai box è necessario non spegnere immediatamente il motore ma mantenere il regime di minimo per almeno 30 secondi (controllare comunque che la temperatura acqua non superi i 95°C). Il ritrovamento di tracce di olio di modesta entità nel gruppo aspirazione a valle compressore è tollerata.
6	Cinghia ausiliari	Al termine di ogni evento controllare l'integrità della cinghia ausiliari.
7	Fasatura delle valvole	Dopo ogni uscita di pista effettuare un controllo della fasatura valvole mediante la seguente procedura: collegarsi in RDL tramite Axon, trascinare il motore senza avviare e controllare che nel corso del trascinamento il canale CamReal si stabilizzi su un valore compreso tra -15 e -25

9.2.3 Allarmi dashboard

N° allarme	Descrizione	Soglia inf.	Soglia sup.
1	Pressione olio	2	8
2	Temp. acqua	60	95
3	Temp. olio	70	140
4	Tensione batteria	10.5	15

9.2.4 Volano

La coppia di serraggio delle viti M9x1.25 è pari a 45Nm.

9.2.5 Frizione

La coppia di serraggio dei dadi K-Lock M8x1.0 è pari a 19Nm.

9.2.6 Tensionamento cinghia ausiliari

Per effettuare il tensionamento della cinghia ausiliari è necessario allentare i 4 dadi del supporto alternatore. Successivamente ruotare l'alternatore attorno al perno M8 fino al raggiungimento di una tensione di 130Hz sul ramo pompe recupero-alternatore. Serrare quindi il dado M8 con coppia 30Nm e i 3 dadi M10 con coppia 50Nm. Infine ricontrollare il tensionamento sullo stesso ramo.

9.2.7 Diagnostci motore

MOTORSPORT MAGNETI MARELLI

6.1.1 HBridge Diagnostic

A diagnostic function test the Hbridge driver. This information are read in the Hbridge driver and write in ***DiagHB***

DiagHB			
Bit 3	**Bit 2**	**Bit 1**	**Bit 0**
CO_HB	**Warning**	**PreWarning**	**Error_Flag**
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**
PowerSupply	**1**	**CC_Vbatt**	**CC_Gnd**

- **Error_Flag** = **1** One default is present.
- **PreWarning** = **1 :** High temperature pre-alarm of the driver..
- **Warning** = **1 :** High temperature alarm of the driver.
- **PreWarning+ Warning = 1 :** Very High temperature for the driver .(for internal protection the motor supply is cutoff by the driver)
- **CO_HB** = **1** : Motor open circuit .
- **CC_Gnd** = **1** : Ground short circuit upon one of the motor alimentation .
- **CC_ Vbatt** = **1** : Vbatt short circuit upon one of the motor alimentation, short circuit across the motor.
- **PowerSupply** = **1 :** Lower alimentation for the motor .(for internal protection the motor supply is cutoff by the driver)
- **Bit 6 is always read to 1** (if no error, DiagHB = 40 hexa)

NOTE: , In case of fault present in EtatPap or DiagHB , speed limiters are applied for injections (EE.Pmot.LimInjPmotand ignitions (EE.Pmot.LimAllPmot) (See Limiters.doc for more details).

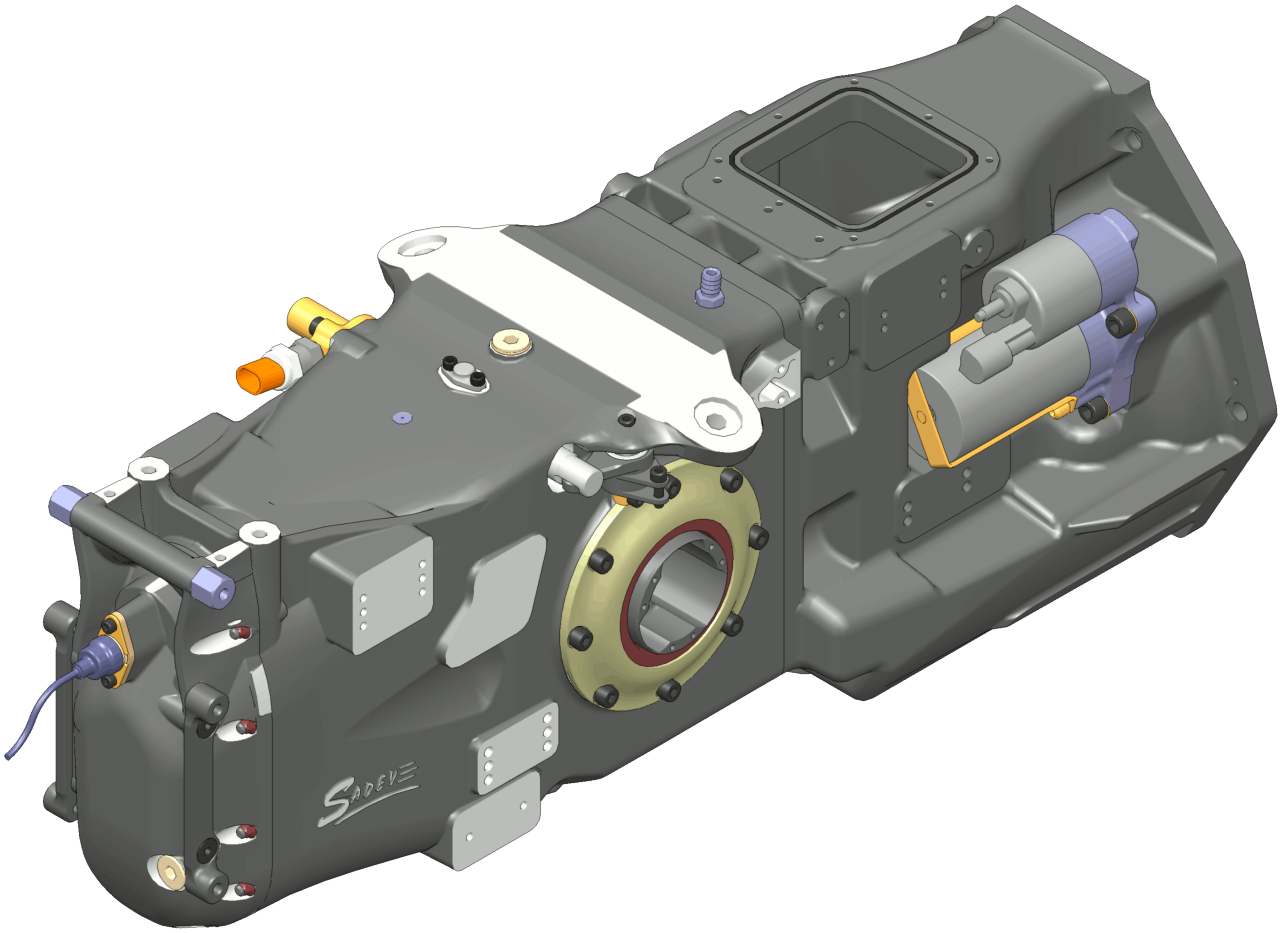
Diagnostics SRAE

CC: Court circuit, **CO**: Circuit Ouvert, **OUT**: Valeur Out of Range

	bit 16	bit 15	bit 14	bit 13	bit 12	bit 11	bit 10	bit 9	bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1
Hexa Val	0x8000	0x4000	0x2000	0x1000	0x0800	0x0400	0x0200	0x0100	0x0080	0x0040	0x0020	0x0010	0x0008	0x0004	0x0002	0x0001
DiagHB_VVT	HB Under Voltage		HB CC VBAT	HB CC GND	HB CO	Over T°C HB	Warning T°C HB	Def Mot Pap								VVT Def Asserv
VRSDiags							CAM not PHASED	WRONG CAM	SYNCLOST by GAP	Virtual TOOTH	SYNCLOST by SMOT	SMOT recovery	CAM Out of window	NOISE	No CAM	No SMOT
EtatPap										Pap: Def 3 Regul	Pap: Def 2 Regul	Pap: Def 1 Regul	Def Pap cohérence	Def Elec sur 2 Pap	Def Pdl cohérence	Def Elec sur 2 Pdl
DiagAcqAna0																CHTPAP Changt piste
DiagAcqAna1	PESS CC	PESS CO	POIL CC	POIL CO		PADM OUT	PATM CC	PATM CO	PDL2 CC	PDL2 CO	PDL1 CC	PDL1 CO	PAP2 CC	PAP2 CO	PAP1 CC	PAP1 CO
DiagAcqAna2	BARREL OUT	LBDA OUT	ROTLIMDEP	VBAT T OUT	NTURBO OUT	TCK2 OUT	ROT FINLIMDEP	TCK1 OUT	TFUEL CC	TFUEL CO	TOIL CC	TOIL CO	TAIR CC	TAIR CO	TEAU CC	TEAU CO
DiagAcqAna3														ROT TCTRLLVL	FBRAKEP CC	FBRAKEP CO
DiagWheels													Def RR	Def RL	Def FR	Def FL
FlagInjCO									INJ8 CO	INJ7 CO	INJ6 CO	INJ5 CO	INJ4 CO	INJ3 CO	INJ2 CO	INJ1 CO
FlagInjCC									INJ8 CC	INJ7 CC	INJ6 CC	INJ5 CC	INJ4 CC	INJ3 CC	INJ2 CC	INJ1 CC
FlagOutCO					LS7 CO	LS6 CO	LS5 CO	LS4 CO	LS3 CO	LS2 CO	LS1 CO	Heat LBD1 CO	ELV4 CO	ELV3 CO	ELV2 CO	ELV1 CO
FlagOutCC					LS7 CC	LS6 CC	LS5 CC	LS4 CC	LS3 CC	LS2 CC	LS1 CC	Heat LBD1 CC	ELV4 CC	ELV3 CC	ELV2 CC	ELV1 CC
FlagBobCO									BOB8 CO	BOB7 CO	BOB6 CO	BOB5 CO	BOB4 CO	BOB3 CO	BOB2 CO	BOB1 CO
FlagBobCC									BOB8 CC	BOB7 CC	BOB6 CC	BOB5 CC	BOB4 CC	BOB3 CC	BOB2 CC	BOB1 CC

10 TRANSMISSION

The gearbox is the **SADEV SL75-14** type.



10.1 Main Features

10.1.1 General details

The sequential gearbox type SADEV SL75-14 FORMULA ABARTH, is composed of 6 front gears and one reverse gear. Its weight is approximately 45 kg (without bell housing).
It is equipped with a self-locking differential with friction discs and pressing plates with ramps.

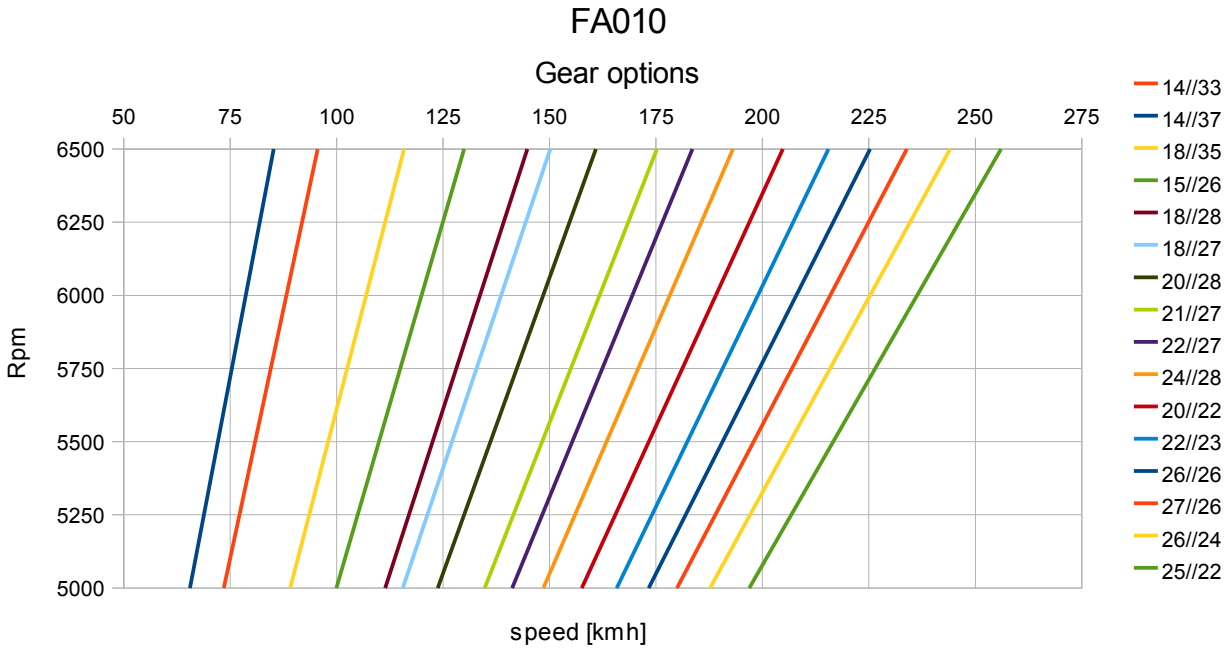
10.1.2 Ratio chart

Here below the option ratio:

Gear	Ratio
14//37	2.64
14//33	2.36
18//35	1.94
15//26	1.73
18//28	1.56
18//27	1.50
20//28	1.40
21//27	1.29
22//27	1.23
24//28	1.17
20//22	1.10
22//23	1.05
26//26	1.00
27//26	0.96
26//24	0.92
25//22	0.88

Final drive Ref.CPLE10X31855	
Secondary shaft	10
Crown wheel	31

Reverse gear	
Primary shaft	14
Reverse gear	18
Secondary shaft	40



10.1.3 Differential technical data

ZF type self-locking differential with triple friction discs and pressing plates with ramps acting symmetrically or not, for driving or braking condition.

BELLEVILLE WASHER	
Washer Travelling	Part. number
1,2mm (thick. 2.0mm)	F0085914
1,2mm (thick. 1.6mm)	F0085922

Pressing plates	
Ramps	Reference
50°/50° & 45°/90°	F0085920

Note : *A fell of preload from approximately 15% after (60 kilometers running-in) will be note.*
Note : *The cold measured preload (workshop) is approximately 15% higher than that measured hot.*

10.1.4 Lubrication

Oil capacity : 1.5 L

1rst drain	Drain frequency	Viscosity
After a 50Km running-in	Each meeting	75W90

PARTICULAR PRECAUTIONS

No additives should be added to the oil. The resulting consequences are not in any circumstances covered by the SADEV supplier.
When topping up the gearbox oil, do not mix any other oil with that already in the box.

STORAGE AND USE

Be particularly careful with any bottles which are open when used:
- Close the bottle again properly after use to prevent the introduction of water or dirt.
- Store bottles horizontally, protected from severe weather.
- Do not store bottles close to a washing station.
- Do not decant the oil into larger containers.

WASHING UNDER PRESSURE

When the gearbox is removed, seal all openings correctly to prevent the ingress of water into the gearbox.

10.2 ASSEMBLY INFORMATIONS

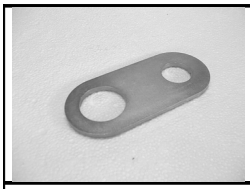
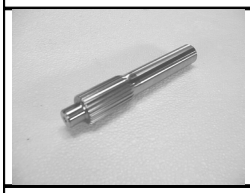
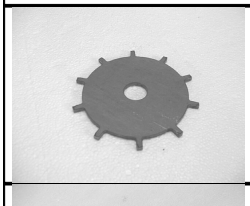
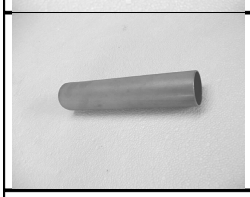
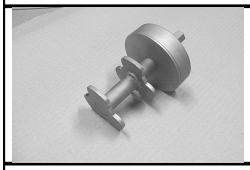
10.2.1 Glue components

Glue components and tightening torque are shown in the 3D exploded view.

WARNING: Glue components have been chosen during tests sessions. Only 'Loctite' brand components must be used.

Consequences of wrong glue choice can't be ensured by Sadev.

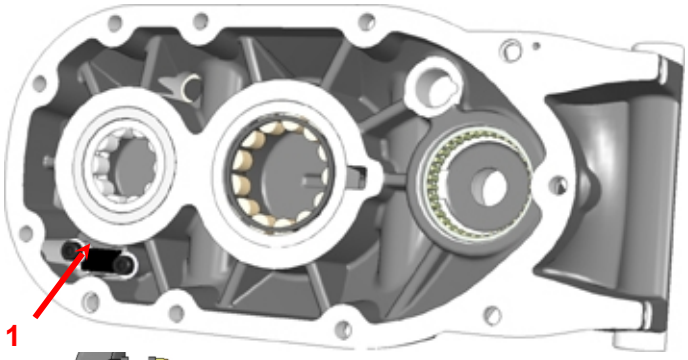
10.3 SPECIAL TOOLS

	Ref. SADEV	OUT 0085001	Locking plate
	Ref. SADEV	OUT 1908001	Priamary geartrain tool
	Ref. SADEV	OUT 0085017	Clutch plate centring pin
	Ref. SADEV	OUT 0085012	Fork repositioning tool
	Ref. SADEV	OUT 0085004	Play adjuster
	Ref. SADEV	OUT 0085005	Spacer
	Ref. SADEV	OUT 9024007	LSD preload tester
	Ref. SADEV	OUT 9024010	LSD bearings preload tester
	Ref. FACOM	U.49D6	Bearing extractor
	Ref. FACOM	U.306G2 U.306M	Inertia extractor

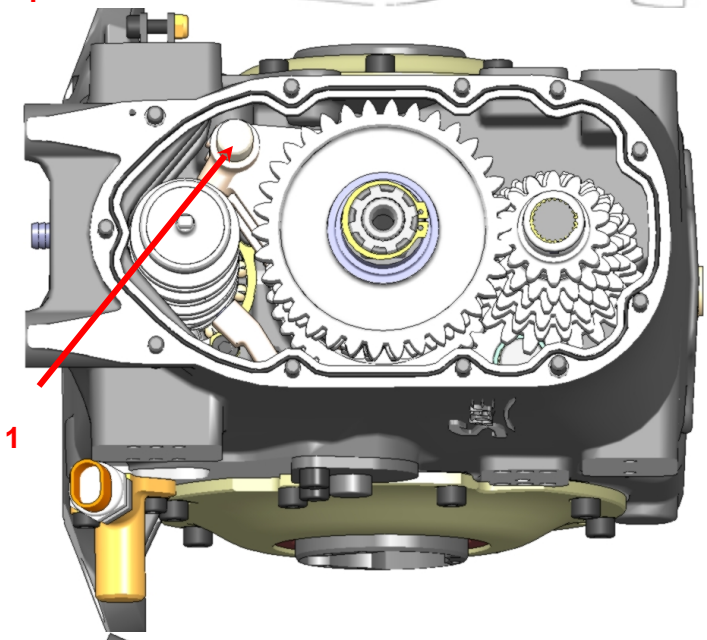
10.4 Gearbox rebuild

10.4.1 Gears

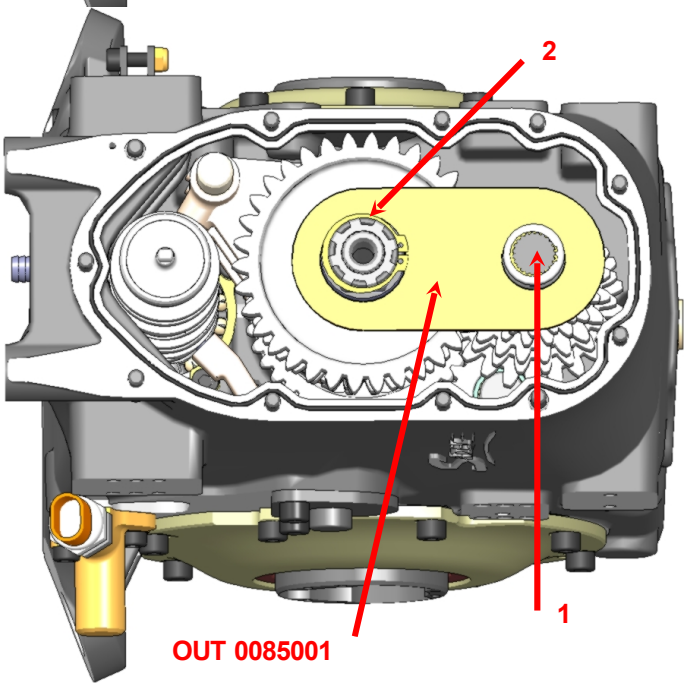
- Engage reverse gear.
- Drain gearbox through lower drain plug.
- Disconnect potentiometer.
- Remove rear casing and clean magnet **(1)**.



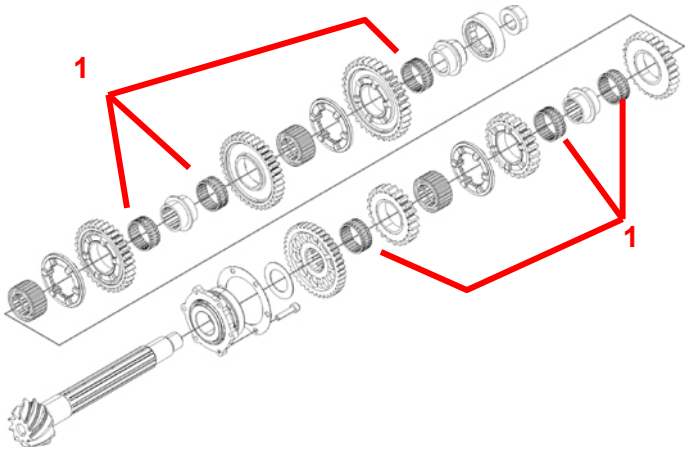
- Remove fork shaft **(1)** and swing forks to release barrel slope control fingers.

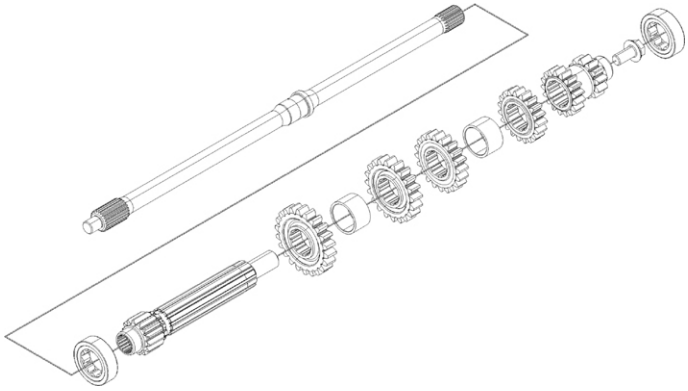


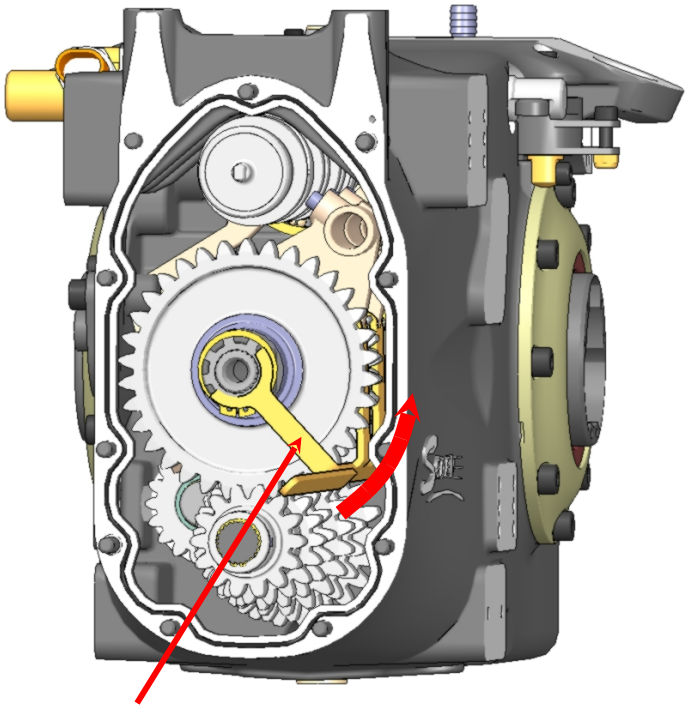
- Engage 2nd gear.
- Fit primary and secondary shaft lock plate **OUT 0085001**.
- Remove the unlocking part either for primary & secondary shafts (circlips & splined washers).
- Remove primary shaft bolt (right-hand thread & **FOUT1908001** tool) **(1)** and secondary shaft nut (left-hand thread) **(2)** .
- Remove gears one after the other marking installation direction.



- Do not invert the gears so as to ensure their initial rotation direction: risk of breaking teeth.
- Clean and check condition of parts.
- If you need to change the secondary shaft or the head bearing, then see chapter *V* to adjust clearances.
- Lightly lubricate the needle roller bearing cages using gearbox oil **(1)**.
- Replace gears one after the other in the reverse order from removal.
- Engage 2nd gear to prevent gearbox turning.
- Mount the primary/secondary lock plate **OUT 0085001**.
- Clean and degrease threads on shafts and bolts.
- Coat primary shaft bolt and thread of secondary shaft with coppered grease and tighten to torques :
  - Primary shaft bolt : 10 daN.m (tool **FOUT1908001**)
  - Secondary shaft nut : 18 daN.m
- Reinstall the unlocking part either for primary & secondary shafts (circlips & splined washers).
- Replace forks in initial locations using the fork repositioning tool **OUT 0085012**.
- Clean the joint face of the rear casing.
- Refit rear casing.
- Connect potentiometer ensuring that its coupling is still correct:.
- The gear display must indicate reverse.
- Top up gearbox oil to level stop.

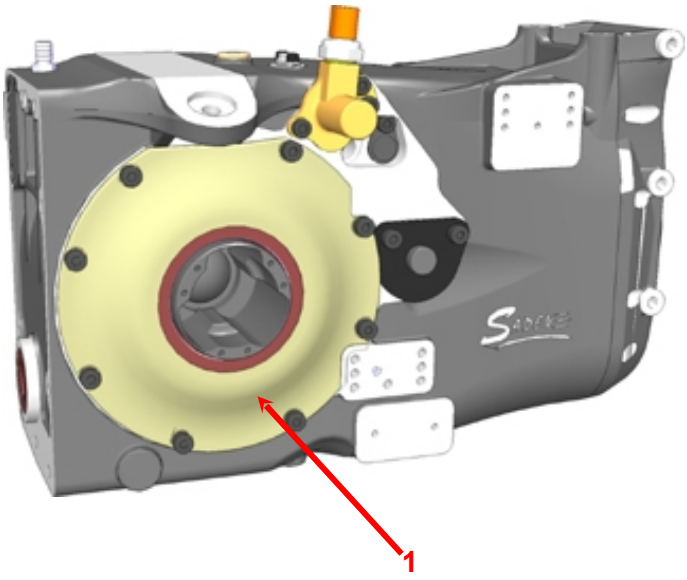






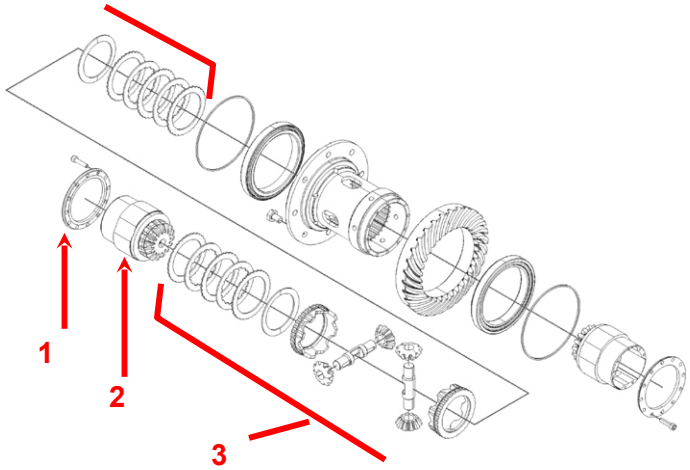
10.4.2 Differential

- Drain the box through the lower drain plug.
- Remove left-hand plate **(1)**.
- Extract the SLD assembly.



Dismantling the SLD elements :

- Remove the bevel gear stopping plate **(1)**.
- The bolts are glued and a hot air gun must be used.
- Remove bevel gear **(2)**.
- Remove the SLD elements **(3)** one after the other, noting the refitting sequence.
- Check condition of the various parts and housing. Replace faulty parts.



Refitting the SLD elements :

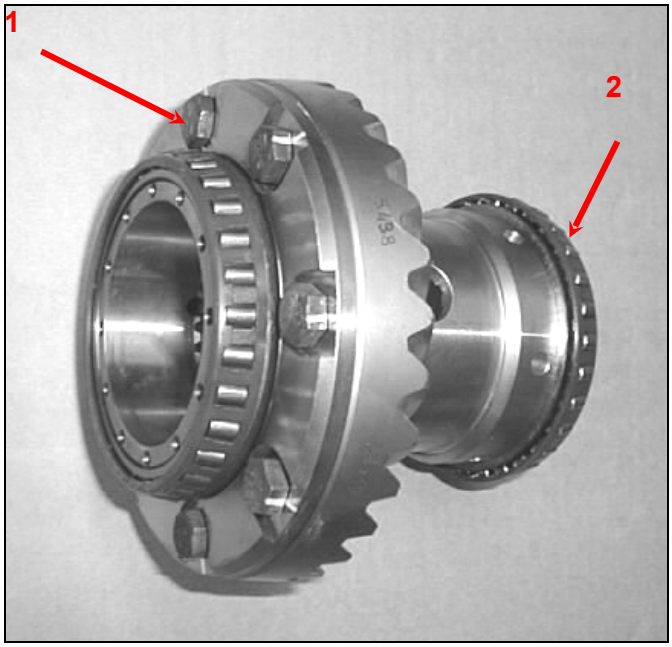
- Clean parts.
- Using an M6 x 100 tap, clean and degrease the threads on the casing and bolts.
- Replace parts in the reverse order of installation, lubricating each part with gearbox oil just before installation. Maintain order of parts as noted during dismantling.
- Fix the bevel gear bearing on the housing using bolts coated with a few drops of Loctite normal threadlock 243, tighten bolts to 1.5 daN.m.
- Check good function of SLD.
- Check preload on SLD: fit tool **OUT 9024010** on one of the two hollow bevel gears in order to prevent the diff. from turning. Then use a torque wrench and tool **OUT 9024007** positioned on the second bevel gear to check the preload.

The preload can be changed using different Belleville washers.

Remove the spiral gear crown :

- Remove the right-hand bevel gear bearing.
- Remove right-hand tapered roller bearings **(2).**
- Remove crown wheel fixing bolts **(1)**.

The bolts are glued and a hot air gun must be used.



Re-assemble the spiral gear crown :

- Using an M10 x 100 tap, clean and degrease gearbox and bolt threads.
- Attach the crown wheel to the housing using bolts coated with a few drops of Loctite blockpress 648. Tighten bolts to 9 daN.m.
- Replace right hand bevel gear bearing.
- Adjust the various clearances : bearing preload, check toothing clearance (see corresponding paragraphs on removing secondary shaft).

Re-fitting :

- Clean joint face on left-hand plate.
- Using an M8 x 125 tap, clean and degrease for housing and bolt threads.
- Check condition of O-ring.
- Attach left-hand plate to gearbox using bolts covered with a few drops of Loctite low-strength threadlock 222. Tighten bolts to 2.5 daN.m, while turning the differential in order to position the tapered roller bearings properly.
- Using an M5 x 80 tap, clean and degrease gearbox and bolts of the oil seal plate.
- Attach oil seal plates to the casing using bolts coated with a few drops of Loctite low-strength threadlock 222. Tighten bolts to 0.6 daN.m.
- Check condition of O-ring and lip seal.

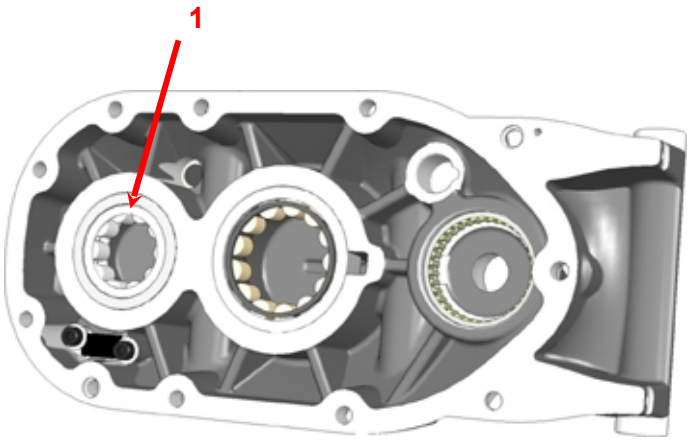
10.4.3 Bearing replacement and adjustment

10.4.3.1 Primary shaft bearing

Removal of primary shaft bearing

Rear casing side :

- Drain oil through the lower drainage plug.
- Disconnect potentiometer and remove assembly from support.
- Remove rear casing.
- Heat rear casing to 120° (first remove lip seal from potentiometer).
- Fit a FACOM type extractor (ref. U.49D6) on the primary shaft bearing **(1)** and extract using an inertia extractor.



Check that the bearing housing has not been damaged on dismantling.

Differential side :

- Drain the box through the lower drain plug.
- Disconnect potentiometer and remove assembly from its support.
- Remove rear casing.
- Remove gears (see paragraph 10.4.1).
- Remove primary shaft.
- Remove SLD assembly (ref paragraph 10.4.2).
- Remove bearing by tapping from the inside of the differential casing.
-

Check that the bearing housing has not been damaged on dismantling.

Refitting :

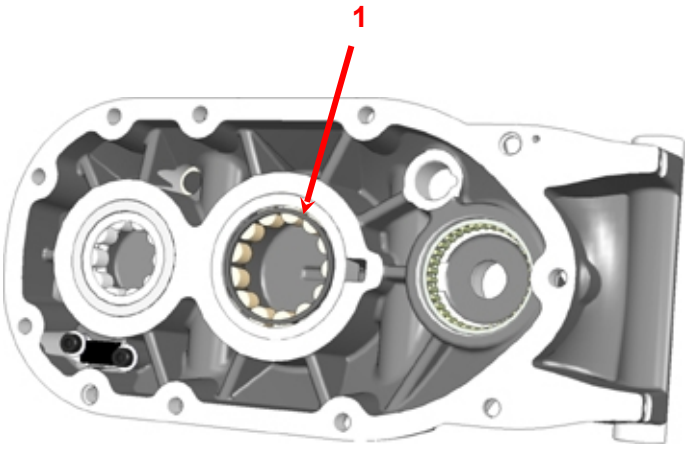
- Apply a small quantity of Loctite "fixing product " 603 on the outer bearing cage.
- Press fit the bearing of the rear casing taking care to seat this well at the bottom of its housing.
- For the other bearing use the same glue but do not press fit.

10.4.3.2 Secondary shaft bearing

Removal of secondary shaft bearing

- Heat the rear casing to 120° (first remove the potentiometer lip seal).
- Turn casing and position on a flat surface, then tap with a mallet on the back of the secondary shaft bearing housing until the bearing is removed from its position.

Check that the bearing housing have not been damaged on dismantling.



Refitting :

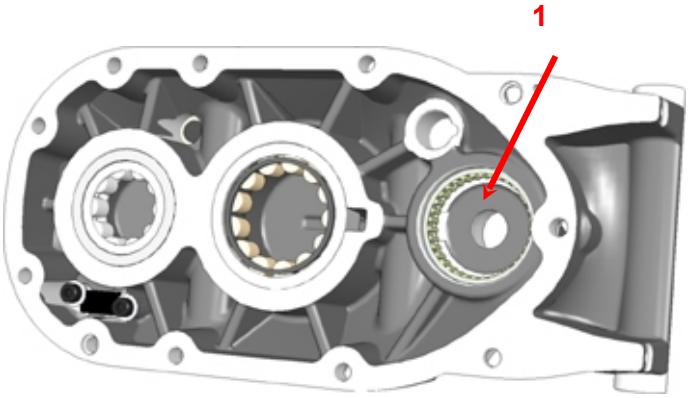
- Apply a small quantity of Loctite "fixing product" 603 on the outer bearing cage.
- Press fit bearing **(1)** on the rear casing ensuring this is well seated at the bottom of its housing.
- To change the bearings on the differential side see paragraph ***V I***).

10.4.3.3 Barrell shaft bearing

Removing the barrel bearing :

Rear casing side :

- Heat the casing to 120° (first remove the potentiometer lip seal).
- Position the **FACOM** extractor ref U.306G2 in the recesses on the housing and extract the bearing **(1)** using the inertia extractor.



Check that the bearing housing has not been damaged on dismantling.

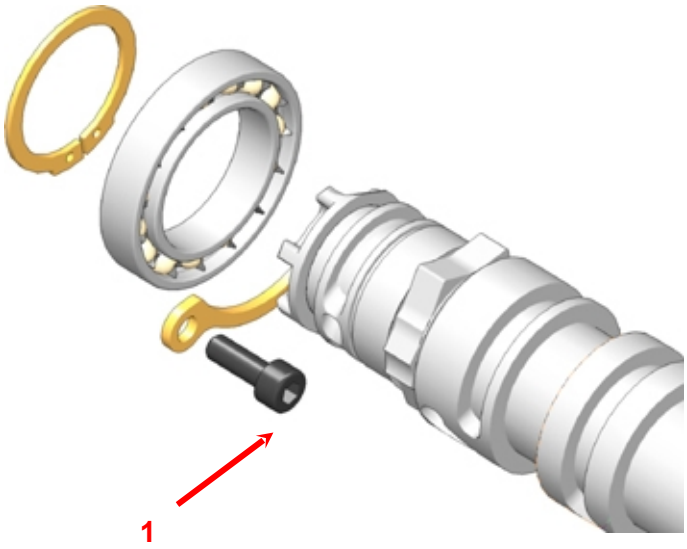
Refitting :

- Apply a small quantity of Loctite "fixing product" 603 on the outer bearing cage.
- Press fit the bearing on the rear casing ensuring this is properly seated at the base of its housing.

After refitting, ensure that the needle roller cage has not been crushed (rotate the needles).

Differential side :

- Drain the box through the lower drain plug.
- Disconnect potentiometer and remove from support.
- Remove rear housing.
- Remove gears (see paragraph 10.4.1).
- Remove reverse rocker (see paragraph 10.4.8).
- Remove indexer guide.
- Remove the two bolts **(1)** on the barrel bearing retainer and extract the barrel.
- Remove barrel circlips.
- Remove press bearing (do not damage barrel).
-



Check that the bearing housing has not been damaged on dismantling.

Refitting :

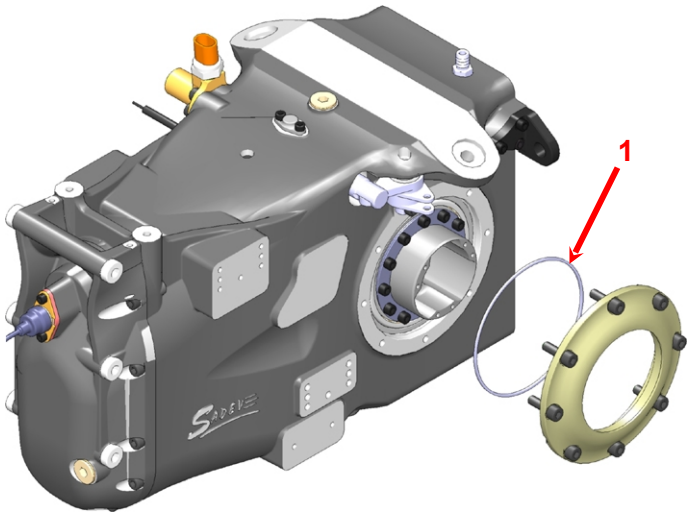
- Apply a small quantity of Loctite "fixing product" 603 on the inner bearing cage.
- Press fit the bearing on the barrel & refit circlips.
- Refit barrel (see paragraph 10.4.7).

10.4.3.4 Differential bearing

- Extract the SLD assembly (see paragraph 10.4.2).
- Remove left-hand and right-hand bevel gear and the other SLD.
- Remove right-hand and left-hand bevel gear stopping plates.
- Separate bearing shells and shims from the right-hand and left-hand plates & the main housing.
- Remove secondary shaft (see paragraph 10.4.5.1).

Refitting :

- Press fit the tapered roller bearings on the SLD casing.
- Refit the bearing shells and shims on the left-hand and right-hand plates.
- Refit the SLD assembly (see paragraph 10.4.2).
- Check preload on differential bearings :
- Refit right-hand and left-hand plates without glue and tighten bolts to 2.5daN.m.
- Check the preload on the SLD bearings using a torque wrench and a tool **OUT 9024007** to measure the load necessary for rotation. This must be between 3.5 kg and 6 kg for new bearings and between 0.2 kg and 1.6 kg for used bearings.
- If the preload obtained is not in this range, remove the right-hand plate and adjust the thickness of the shim **(1)**.



After refitting the plates, make sure the right hand bearing shell is in contact with its shim acting on the diff from the left with a mallet.

Rotate the differential before checking the preload to position bevel gear stopping plates correctly.

- Once the correct preload has been obtained, check the thickness of the two shims.
- Refit secondary shaft (see paragraph 10.4.5.2), and adjust the final drive operating clearance (see paragraph10.4.4).

10.4.4 Final Drive Operating Clearance

- Drain the box via the lower drain plug.
- Remove gears (see paragraph 10.4.1).
- Fit tool **OUT 0085004** and **OUT 0085005** on the secondary shaft and tighten the secondary shaft nut to 18 daN.m.
- Check the inter-tooth play using a comparator placed on tool **OUT 0085004** (clearance indicator).
- Check the play for each tooth on the gear (10 teeth) by rocking the secondary shaft from left to right. The play must be between 0.1 mm and 0.2 mm.
- If the inter-tooth play is incorrect, remove the left and right hand plates and remove the bearing shell from the right hand plate.
- Remove the shims behind the bearing shells and proceed as follows:
  - If the play is excessive : move the crown wheel closer to the pinion by increasing the thickness of the left-hand shim and reducing the thickness of the right-hand shim accordingly.
  - If the play is insufficient : move the crown wheel away from the pinion by reducing the thickness of the left-hand shim and increasing the thickness of the right-hand shim accordingly.

After refitting the plates, make sure the bearing shells are in contact with their shims acting on the diff from the left and from the right with a mallet.

Always keep the total thickness of the two shims constant so as not to affect the preload on the bearings.

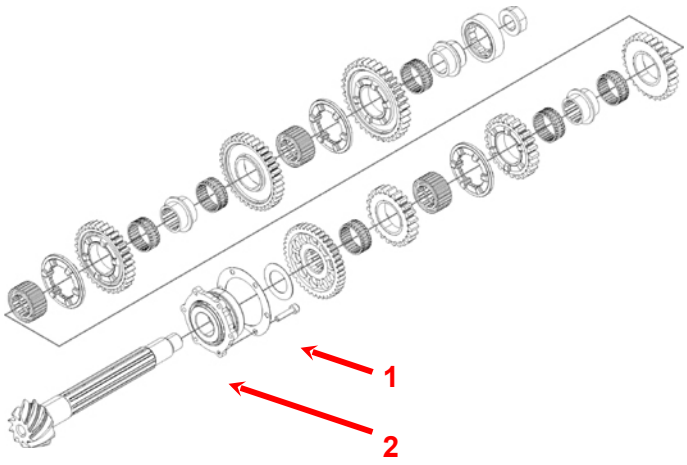
- Recheck clearance after each operation.
- Once the clearance has been checked, refit the SLD (see paragraph 10.4.2)
- Refit gears (see paragraph 10.4.1)

10.4.5 Secondary Shaft

10.4.5.1 Removal & calculation :

Removal :

- Drain the box through the lower drain plug.
- Remove gears (see paragraph 10.4.1).
- Remove LSD (see paragraph 10.4.2).
- Remove secondary shaft fixing bolts **(1)**.
- Remove secondary shaft by tapping the end with a mallet (do not damage the thread) and withdrawing this through the differential housing.
- Disassemble the twin head-bearing **(2)**.
- Remove bearing cage by heating the casing uniformly to 120° around the zone concerned.

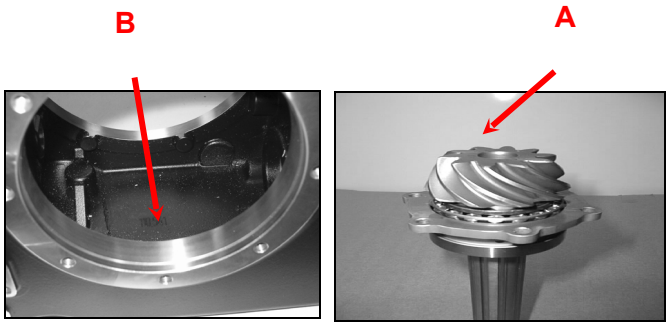


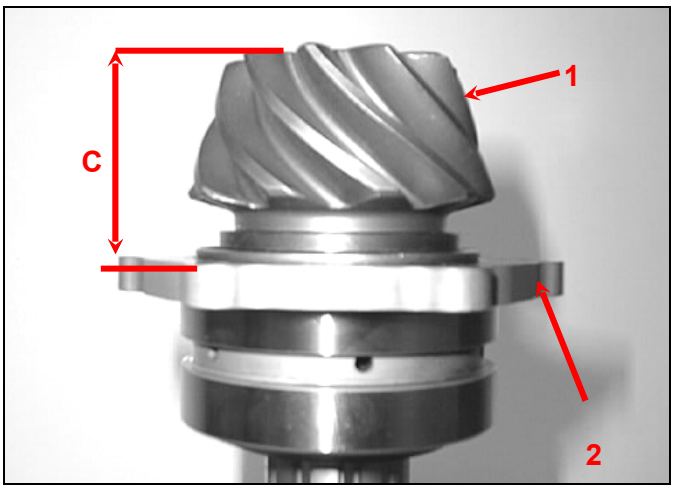
Check that the bearing housing has not been damaged on dismantling.

Calculation :

- Press fit the twin head-bearing assembly on the secondary shaft. Fit **OUT 0085005** and tighten the secondary shaft nut to 18 daN.m.
- Note the value engraved on the top of the secondary shaft pinion **(A)**, and that on the bottom inside of the SLD casing **(B)**.
- Measure dimension **(C)** between the upper face of the secondary shaft pinion **(1)** and the lower face of the bearing cage **(2)**.
- Perform the following operation:

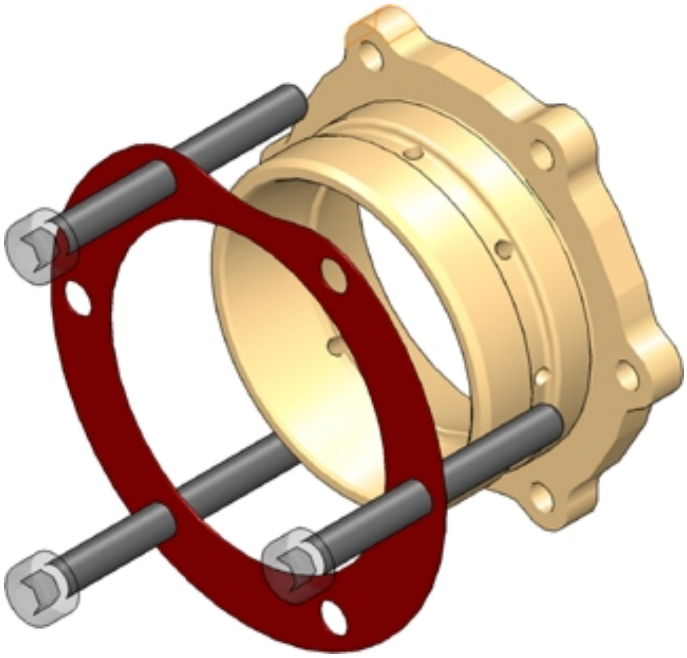
E = B - (A + C)





10.4.5.2 Secondary shaft refitting

- Using an M7 x 100 tap, clean and degrease the bearing cage threads and bolts.
- Clean the joint faces of the left-hand and right-hand plates.
- Using an M8 x 125 tap, clean and degrease the casing threads and bolts.
- Remove cage and bearing from the secondary shaft.
- Heat the gearbox casing until the temperature of the roller cage housing is 120°.
- Fit shim thickness **E** on the roller cage (see calculation in previous paragraph).
- Position the cage on the centring pins so that its bores coincide with those on the shim and casing. (Cut the head of 3 M7x65 bolts and use them as centring pins)
- Refit it using a mallet.
- Fit 3 secondary shaft fixing bolts so that the casing bores align perfectly opposite the cage threads.
- Hold this fixing until the temperature of the casing returns to normal.
- Remove the 3 temporary fixing bolts.
- Refit the secondary shaft fixing bolts coated with a few drops of Loctite block press 648 & tightened to 3 daN.m.

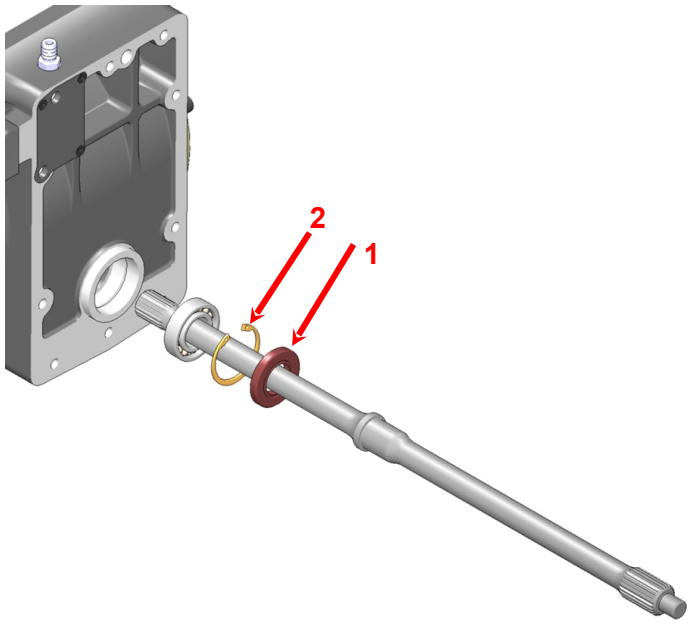


- Refit secondary shaft preload brace and bearing on the cage.
  Ensure that the two tapered roller bearings are in contact with the cage.
- Refit SLD & gears.
- Check the operating play of the conical pair (see paragraph 10.4.4).
- Top up the gearbox oil to the level.

10.4.6 Input Shaft

Removing

- Destroy lip seal **(1)** to remove.
- Remove circlip **(2)**.
- Remove input shaft.
- Remove input shaft bearing.
- If the clutch shaft is seized in the primary shaft, remove the rear casing and bolt on the primary shaft, then insert a shaft ☐ 10 inside the primary shaft and tap the clutch shaft to release.



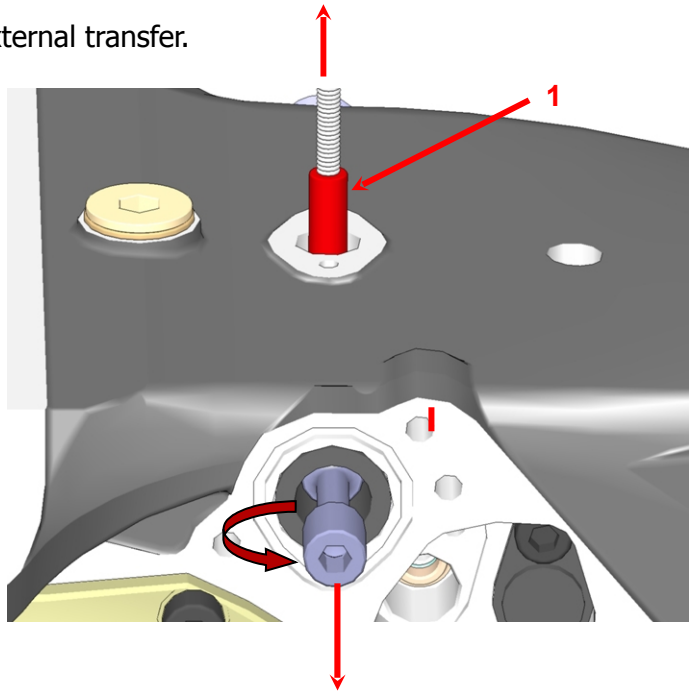
Refitting :

- Clean and check state of shaft (splines and bearing surface) and housing of lip seal.
- Change faulty parts.
- Lubricate the bearing surface and shaft splines.
- Fit the ball bearing on the clutch shaft.
- Fit the clutch shaft in the primary shaft and attach circlips.
- Fit the new lip seal taking care of not damaging it on the splines.

10.4.7 Selection

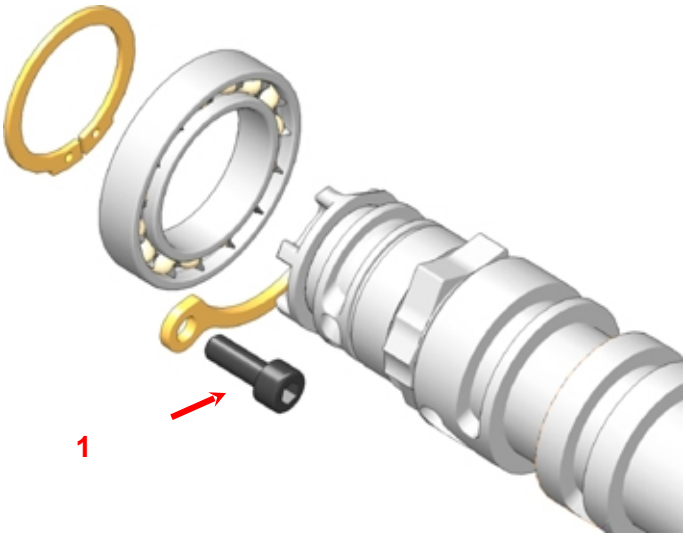
Removing the control lever:

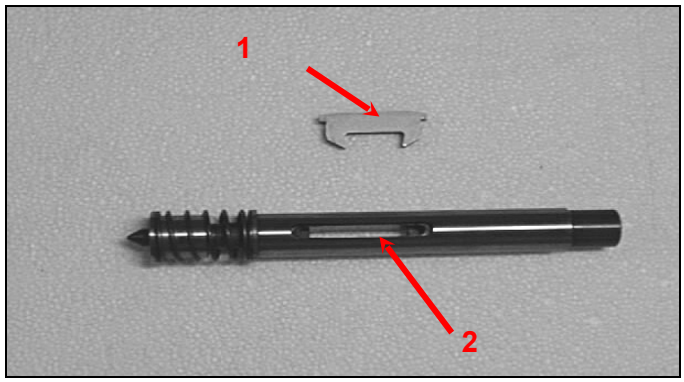
- Remove the push-pull cable of the external transfer.
- Remove the two fixing bolts of the external transfer and release from the control lever.
- Remove the reverse gear locking cable.
- Engage reverse gear using the control lever.
- Remove control closing block.
- Remove pusher guide.
- Pass a round magnet **(1)** type FACOM (ref. 827.1) through the opening of the pusher guide and support the double clip.
- While holding the clip raised, pivot the control shaft one-quarter of a turn only and extract from the control closing block side.



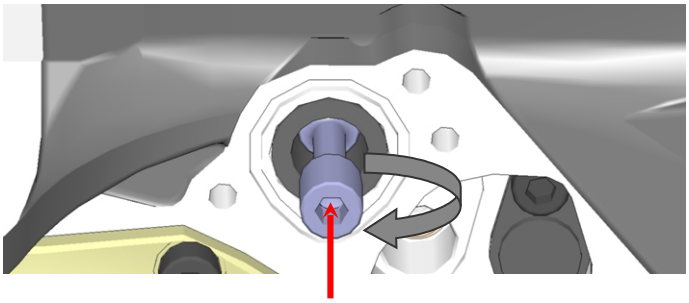
Removing the selector barrel :

- Remove all gears (see paragraph 10.4.1).
- Remove reverse gear rocker (see paragraph 10.4.8).
- Remove indexer guide.
- Remove the three bolts **(1)** of the barrel retainer bearing and extract barrel.
- Refit selection barrel :
- Proceed in the reverse order from removal.
- Clean and degrease the three fixing bolts of the retainer and the reverse gear rocker bolt.
- Apply a few drops of Loctite normal threadlock 243 on the bearing retainer bolt and Loctite high-strength threadlock 270 on the reverse gear rocker bolt. Tighten as follows:
  - Bearing retainer bolt : 2.2 daN.m
  - Reverse gear rocker bolt : 5.5 daN.m
- Refit indexer guide and tighten bolts to 1.3 daN.m, after coating with a few drops of Loctite low-strength threadlock 222.



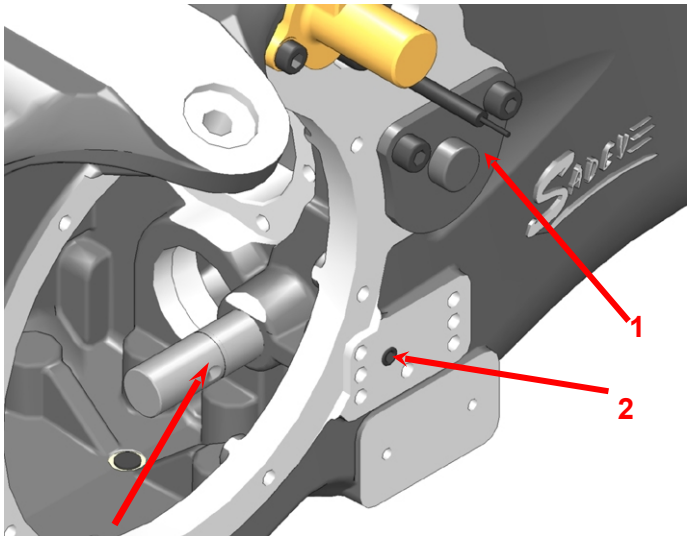


- Clean the joint face of the control closing block.
- Put the barrel in reverse gear position.
- Check the condition of the double clip **(1)** and control shaft **(2)**.
- Check the good condition of the various O-rings and lip seals.
- Refit the double clip on the control lever.
- Insert control lever in casing having first made a quarter turn anti-clockwise. Once the shaft is in place, turn this back a quarter turn clockwise.
- Using an M5 x 80 tap, clean and degrease the casing threads and bolts on the pusher guide and control closing block.
- Refit pusher guide. Coat threads with Loctite low-strength threadlock 222 and tighten to 0.6 daN.m.
- Apply a few drops of Loctite low-strength threadlock 222 on the bolts of the control closing block and refit block. Tighten bolts to 0.6 daN.m.



- Refit reverse gear locking cable on gearbox. Clean bolts, coat threads with Loctite sealant 577 and tighten bolts moderately.
- Check proper function of gate on selector lever.
- Using an M7x100 tap, clean and degrease the casing threads and bolts of the external transfer lever.
- Apply a few drops of Loctite normal threadlock 243 and tighten the bolts on the external transfer lever to 2.2 daN.m.
- Refit push-pull cable on external transfer.

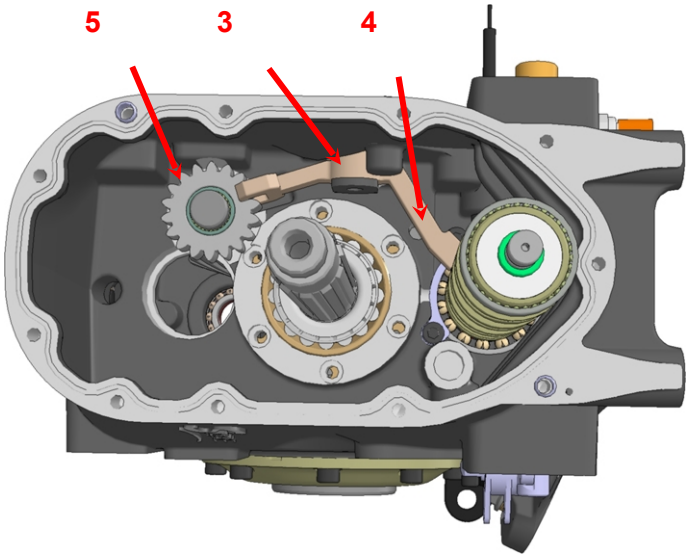
10.4.8 Reverse Gear



Remove

- Remove all gears (see paragraph 10.4.1).
- Withdraw primary shaft.
- Withdraw cover on rocker bolt **(1)**.
- Using an open-ended wrench, stop the reverse rocker nut turning **(3)** and release rocker bolt.
- Withdraw rocker **(4)** and reverse transfer pinion **(5).**
- Remove SLD (see paragraph 10.4.2).
- Remove anti-rotation bolt of reverse pin **(2)**.
- Heat the casing to 120°C around the reverse pin.
- Remove the pin from the SLD casing side by tapping with a mallet.
-

Check that the bore of the casing has not been damaged.



Refit :

- Check condition of all parts and using an M8 x 125 tap, clean the anti-rotation bolts of the reverse pin and the threads.
- Heat casing to 120°C around the reverse pin.
- Install (in its original direction) the reverse pin so that the centre point on the reverse pin corresponds with the axis of the anti-rotation bolts **(A)**.
- Refit shaft by tapping with a mallet in the opposite direction to removal.
- Apply Loctite sealant 577 to anti-rotation bolts and refit in their initial positions checking that the bolt with the pointed end is positioned in the centring point of the pin. Tighten bolts to 2.2 daN.m.
- Refit SLD assembly.
- Clean and check condition of parts.
- Fit the reverse transfer pinion in the fork of the reverse gear rocker.
- Insert the rocker control finger in the barrel groove.
- Using an M10x150 tap, clean and degrease the reverse gear bolt and nut.
- Change the copper washer after each removal.
- Apply a few drops of Loctite high-strength threadlock 270 to the rocker bolt. Tighten the bolt to 5.5 daN.m while stopping the reverse nut from turning with an open-ended spanner.
- Refit the bolt head cap.

11 ELECTRONIC & SOFTWARE

11.1 ELECTRONIC SYSTEM

The F. Abarth electronic system is based on three units:

- Engine Control Unit (ECU): Magneti Marelli SRA-E located on the left side of the engine.
- Steering dashboard: AIM integrated on the steering wheel and interfaced to the electronic system throug the AIM ECU Bridge located behind the driver's seat;
- Data logger (optional): Magneti Marelli RDL installed on the right-hand cooling duct.

The three units have their communication port:

- SRA-E: it is possible to communicate to the unit with the Ethernet cable plugged on the communication port printed "SRA Com" located on the bracket on the rear chassis bulkhead;
- AIM ECU Bridge: it is possible to communicate to the unit with the USB cable plugged on the communication port of the unit;
- RDL: it is possible to communicate to the unit with the Ethernet cable plugged on the communication port printed "RDL Com" located on the bracket on the rear chassis bulkhead;

Please note that SRA-E and RDL plug are inter-changeable on their bracket and the Ethernet communication loom can operate on both of them.

11.2 Software

To operate with the car the following software are provided:

- Magneti Marelli Axon Lite allows to:
  - program hardware devices sending tables,
  - view Dataloggers data (realtime channels values),
  - send Zeros to Dataloggers.

- Magneti Marelli Wintax: Data Acquisition and Analysis.

- AIM Race Studio allows the programming of the dashboard (display, alarms and rev lights).

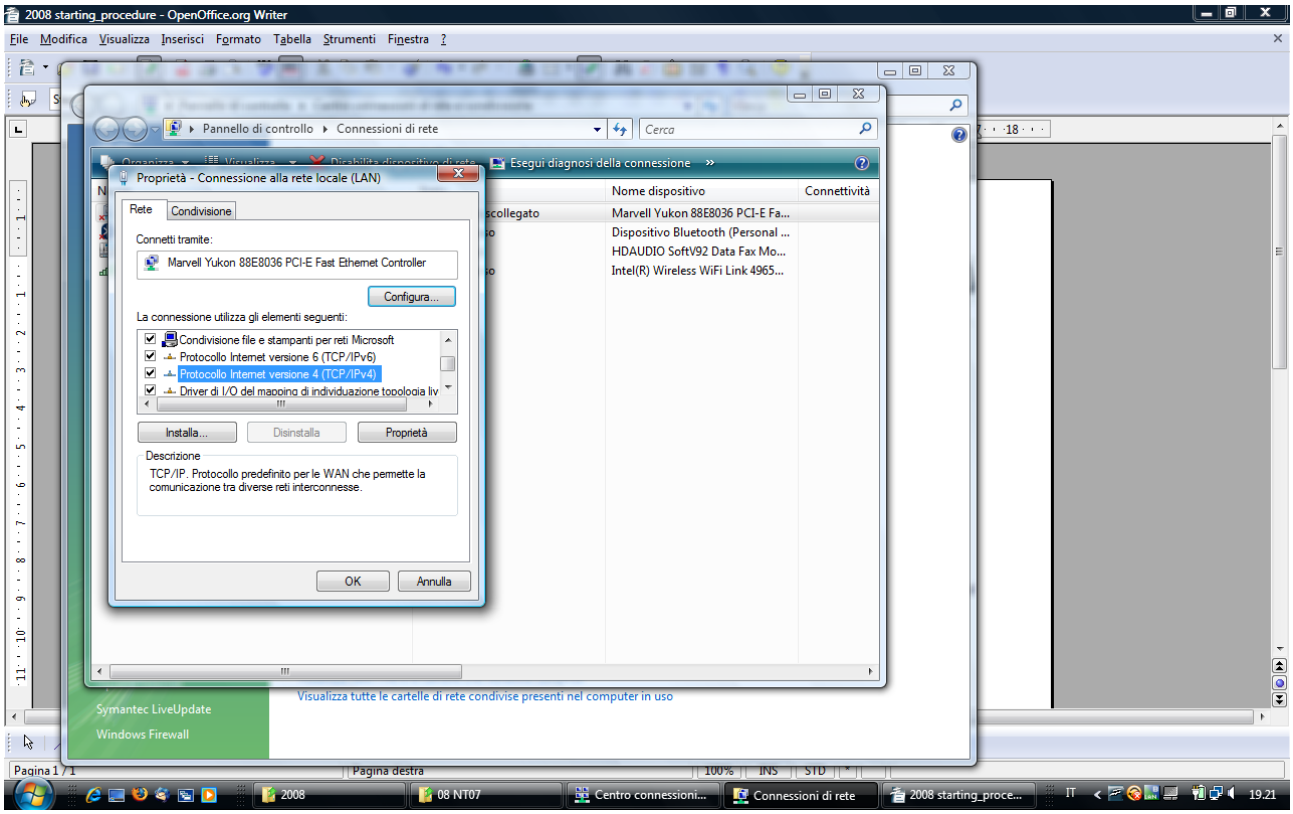
The data analysis and communication software are available on the Magneti Marelli download website: http://motorsport.magnetimarelli.com/
login: `fabarth`
pwd: `fabarth`

The AIM software are available on the following website:
http://www.aim-sportline.it/pagine/download/sezione_software.php?lang=ita

11.3 COMMUNICATION

The communication with the SRA-E and RDL is done by the communication Ethernet cable, the IP address of the ECU is fixed and you must set the IP of your laptop to have a correct communication.

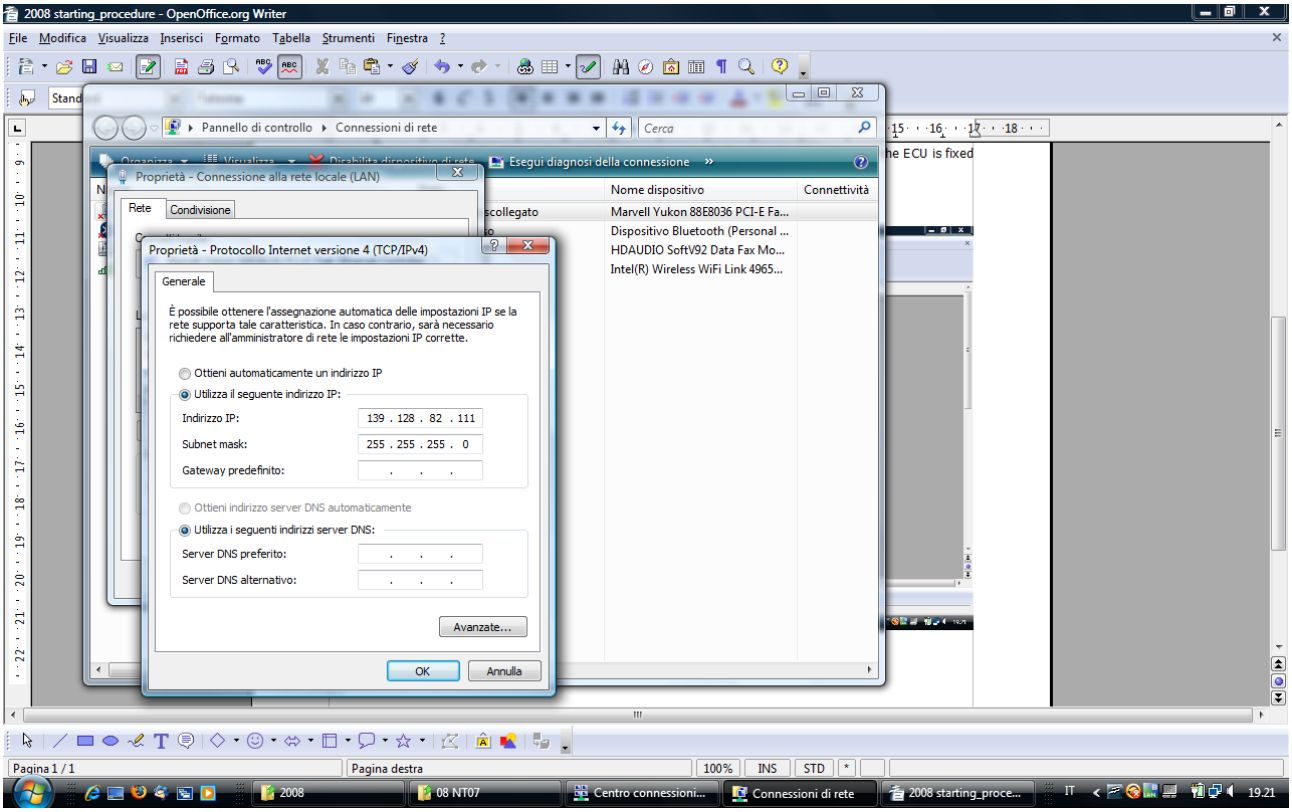
To set it, connect the loom to the car, switch on and set the LAN as follows (Control Panel, Ethernet connection, property):



Set the TCP/IP properties:

IP address: `192.168.1.111`

Subnet mask: `255.255.255.0`



11.3.1 Visualize Datalogger data (channel values) in DLView window

DLView window shows instantaneous values for all channels (configured in datalogger table) as they are logged and their names in table format.

This utility is useful to check sensor measurement during warmup and if datalogger runs correctly

1. Run Axon Lite and connect to a datalogger.
2. Open DLView window with command *View/DLView* from main menu.
3. Connect DLView window with command *DLView/Connect*.

11.4 Setting Procedures

This chapter resume the setting procedures:

- the flyby wire throttle require pedal stroke setting;
- barrel potentiometer have to be set to get the right gear information;
- sensor can be linearized and reset
- shift light and alarm displayed on the steering dashboard

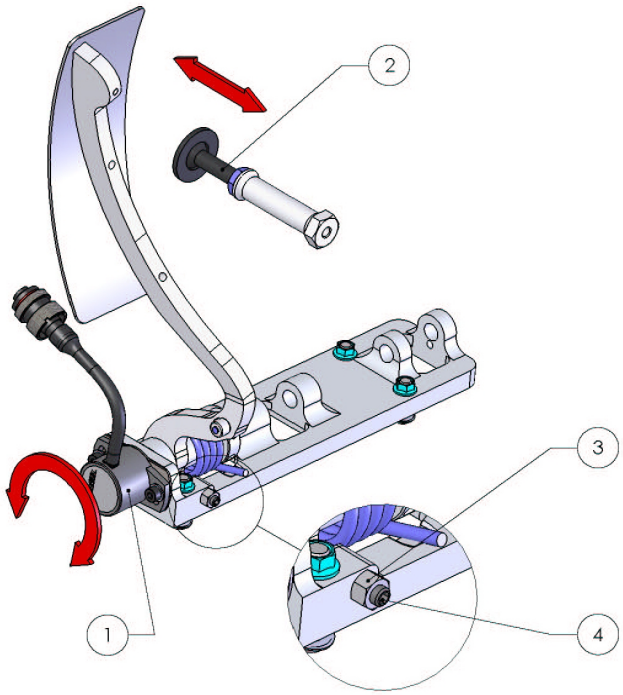
IMPORTANT: All the reset procedures must be undertaken with vehicle stopped, engine off, gearbox in neutral and steering wheel in position.

11.4.1 Throttle setting

This procedure reset pedal and throttle body, some preliminary setting have to be done in order to get a proper learning process.
It is recommended to check and reset pedal and throttle position every day.

The reset procedure can be started only if the ignition switch is set to off.
Launch Axon, open DLView window to check channels AN1_corr, AN2_corr.

The throttle pedal potentiometer have to be set in order that when pedal is idle or full opened the following range are respected:



AN1_corr must be less than 1.2 V and AN2_corr must be less than 4.2 V with throttle pedal resting,
AN1_corr must be more than 2.0 V and AN2_corr must be more than 1.0 V when throttle pedal is full stroke.

	Pedal released	Full stroke
AN1_corr	<1.2 V	>2.0 V
AN2_corr	<4.2 V	>1.0 V

Learning procedure can then be started:

1. Switch ignition OFF
2. Set the pedal to full throttle (100%) position;
3. Push button #2 on the steering wheel for 3 seconds;
4. Release button #2, then release pedal;
5. Check the TPS channel with Axon DLView, you will see TPS moving 0% to 100%.

You can now check the correct percentage of pedal and throttle bodies, please note that the pre-opening of 25-30% is normal for a cold starting.

11.4.2 Barrel position setting

Mechanically engage first gear in your gearbox and mechanically disconnect the barrel position sensor.
Launch Axon, open DLView window and turn the barrel sensor until the Barrel channel indicates 820 +/- 10mV, then lock the barrel brackets.

In case of gear case disconnect, replace sensor etc. this procedure must be repeated.

11.4.3 Sensors setting

Run Axon Lite and connect to the car with communication cable on the RDL plug.

Zero function allows applying an offset to some channels and forces channels to assume a specified value (i.e.: useful to set accelerometers to 0 when vehicle is steady).

1. Run Axon Lite and load a table file.
2. Select item Zeros in the tree on left hand of table window.
3. Run command *Edit/Insert/Zero*.
4. Configure Zero properties in window Zero.

Channel	Select a channel from table or use button on the left.
Offset	This value will be added to elaboration during table transmission.
Target	Value automatically set when running command *Network/Zeros*.

1. Repeat points 1 to 4 for setting Zero for other channels.
2. Save the table and send it to datalogger.
3. When datalogger is connected, run command *Network/Zeros* to set Zero values on data logger.

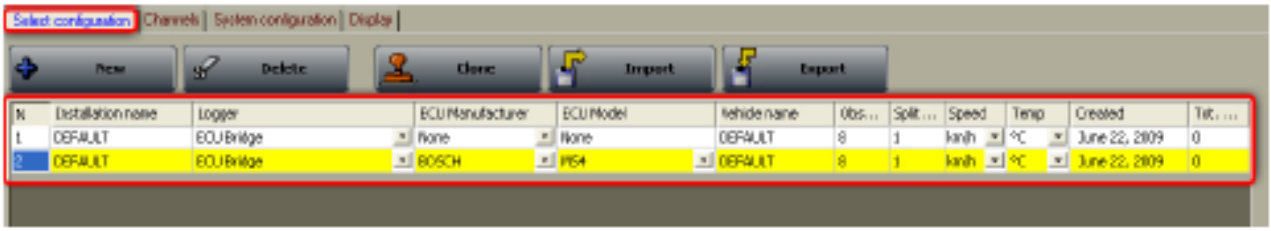
For any further information refer to the Axon help documentation.

11.4.4 Dashboard

To correctly configure ECU Bridge, use a PC and Race Studio 2 software, hhis interface module can only be configured via software.
Before starting the configuration, install Race Studio 2 and the USB driver, launch Race Studio 2.

Click on the icon AIM system manager, then on the icon ECU Bridge, system manager window will open.

In the Select configuration layer (shown here below) is possible to:



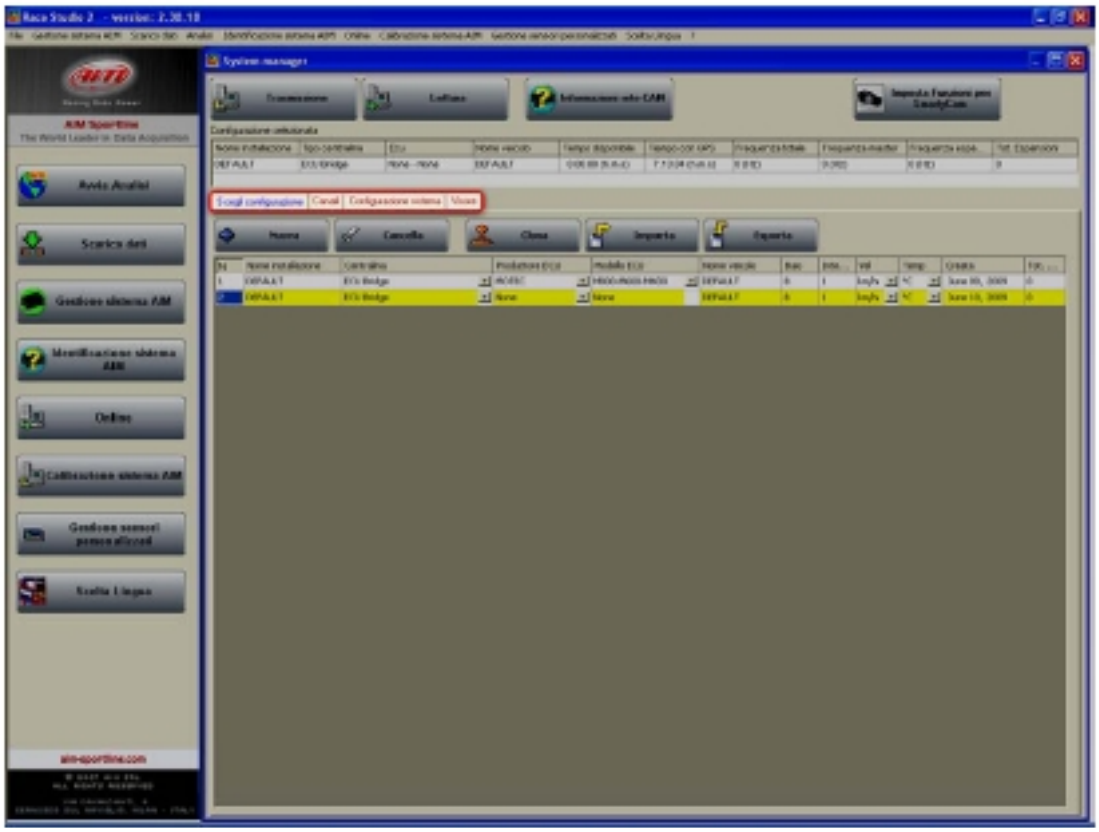
- New: creates a new configuration;
- Delete: deletes a configuration;
- Clone: clones a configuration;
- Import: imports a configuration from a file;
- Export: exports a configuration to a file.

Click on New icon to create F. Abarth configuration:

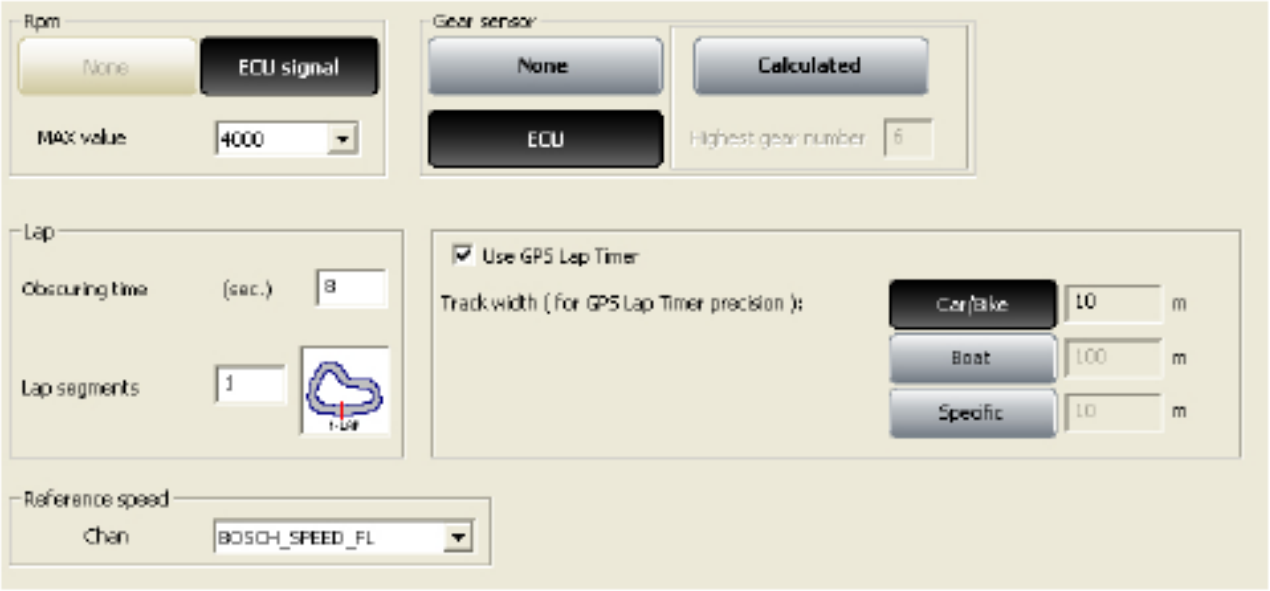
then select

- ECU Manufacturer: `MARELLI`
- ECU Model: `FORMULA_ABARTH`
- New configuration name: fill in the new configuration name.
- Vehicle name: fill in the vehicle name.
- Speeds unit of measure: km/h.
- Temperatures unit of measure:°C.
- Pressures unit of measure: Bar.

Current Configuration Table: shows the current configuration loaded.



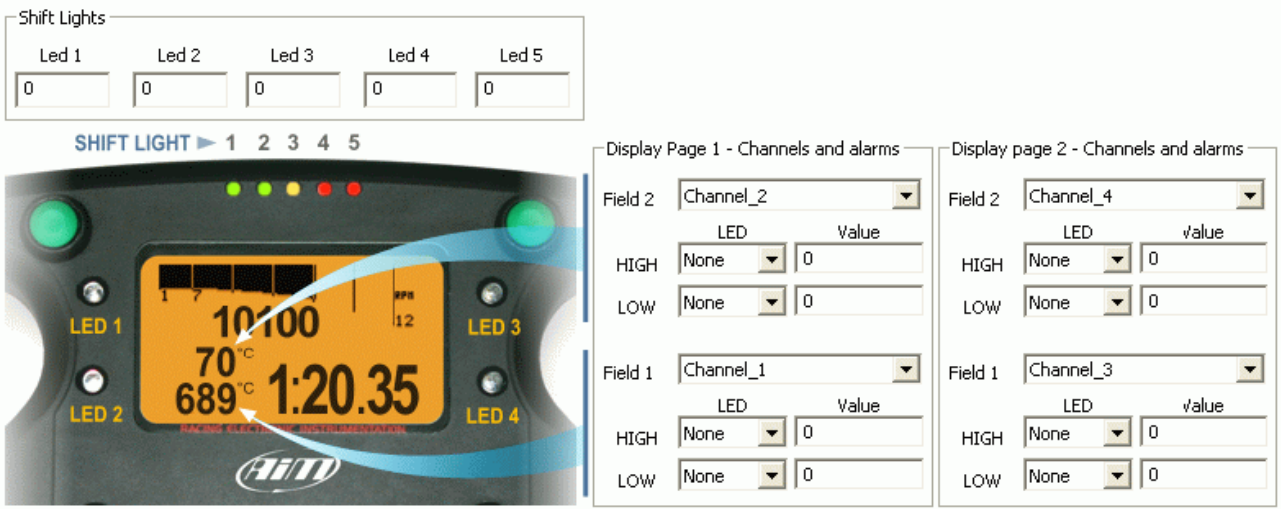
Click on System configuration layer:



- RPM box: set ECU signal, RPM Max 8000.
- Gear sensor: ECU.

Click on Display layer:

Selecting "Formula Steering Wheel":



Alarms lights default:
Led 1 [6200], Led 2[6300], Led 3[6400], Led 4[6400], Led 5[6500]

These boxes allow to set the displayed channels connecting them to one of the four alarm led of the dashboard (refer to picture for numbering).

Default set is:
Page 1 - Field 2:
FA_OIL_PRESSURE
High: Led 2 – Value 8.0 (bar)
Low: Led 2 – Value 2.0 (bar)
Page 1 – Field 1:
FA_WATER_TEMP
High: Led 1 – Value 100 (°C)
Low: Led 1 – Value 60 (°C)
Page 2 - Field 2:
FA_OIL_TEMP
High: Led 4 – Value 140 (°C)
Low: Led 4 – Value 70 (°C)
Page 2 - Field 1:
FA_V_BATT
High: Led 3 – Value 15.0 (V)
Low: Led 3 – Value 10.0 (V)

11.5 Data logger

Datalogger system is available as optional for the car, the following sensors are provided and ready to be plugged on the loom.

- X-y accelerometer;
- Steering angle;
- Front damper displacement;
- Rear dampers displacement;
- Front roll sensor;
- Front brake pressure;
- Rear brake pressure.

Two extra analogue input are available on the AUX-RDL plug, together with two extra digital and two temperatures (refer to Wiring loom for details).

In order to manage logger tables (gain, zero, log frequencies) refer to Axon information chapters and help.
In order to download and analyse logged data refer to Wintax information chapters and help;

11.5.1 Logger tables

Axon software allow the logger tables management.

After the Axon installation, browse to the installation directory and copy in the Tables sub-directory the following files (provided with the car information pack or downloaded from the Magneti Marelli website):

- `custom.lps`
- `*.tjx`

Table files (*.tjx) store the logging table and logger set-up parameters, a list of channels with sampling rates, linearizations etc. for logging.
Usually, vendor provides these files together with datalogger firmware.

In order to transmit the logger table to the system follow this procedure:

1. Run Axon Lite.
2. Load a valid table with command *File/Load* from main menu.
3. Run command *Network/Select Datalogger* from main menu, and select a datalogger from the pop up window list.
4. Connect to datalogger with command *Network/Ping*.
5. Transmit table to datalogger with command *Network/Tx Table...*.

11.5.2 Data download and analysis

In order to download data and set the post-processing diagram and reports install Wintax4 and refer to its online help feature.

Indice generale