



**RENAULT
SPORT**

FORMULA RENAULT **2000**



MAINTENANCE MANUAL

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English Issue

5th issue

"The repair procedures prescribed by the manufacturer in this manual have been written in compliance with the technical specifications in force at publication issuing date.

They are subject to modifications in case of changes made by the manufacturer to the production of the various components and accessories of his brand name vehicles".

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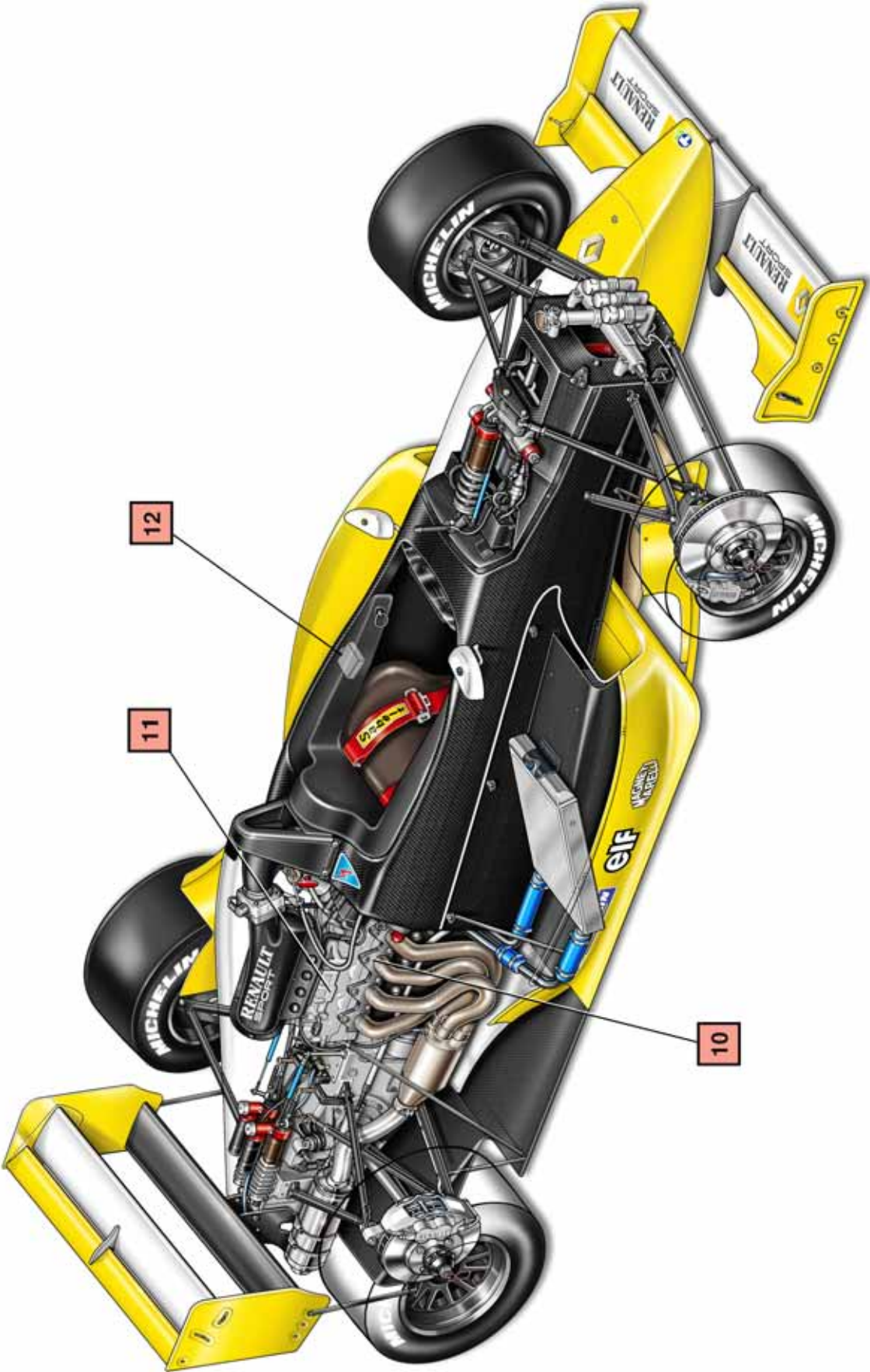
ENGINE

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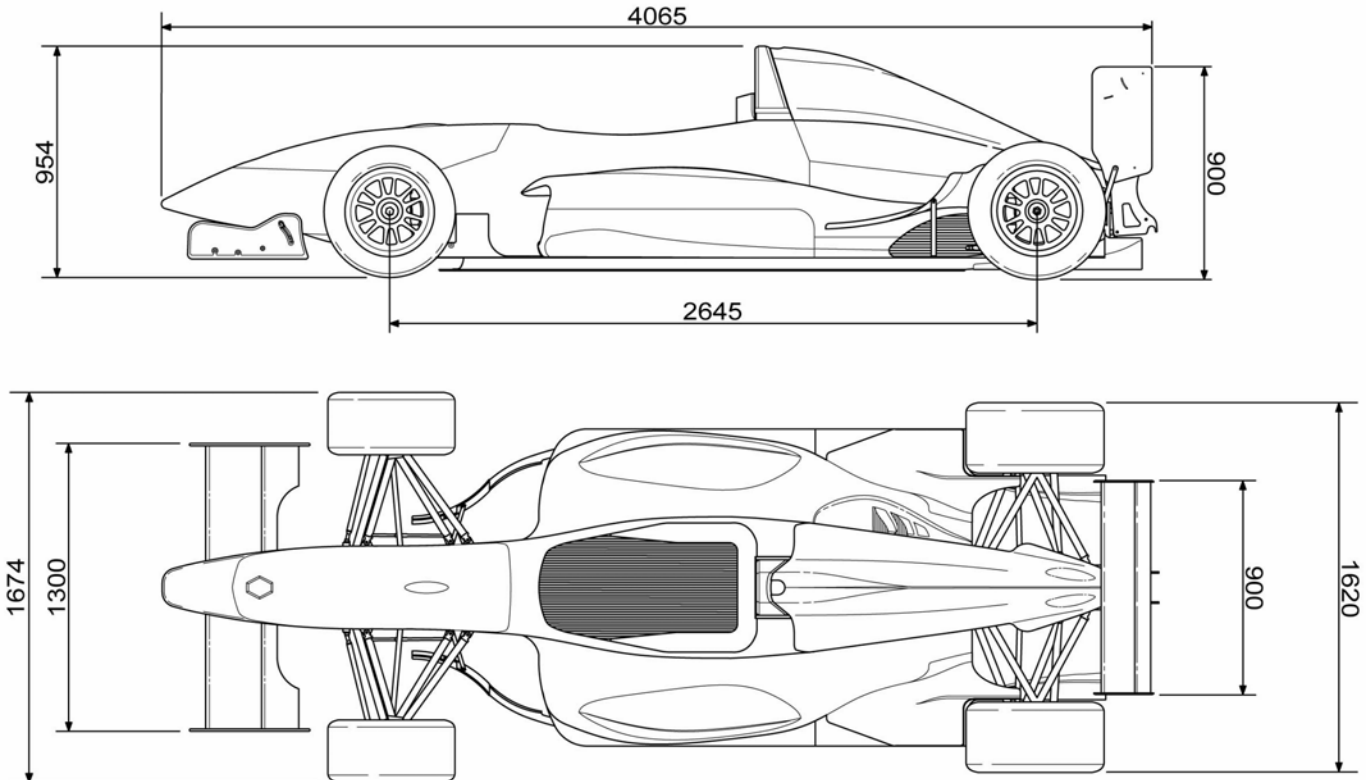
ENGINE

Exploded view

1



DIMENSIONS



FR0101_1

WEIGHT (without petrol) 490 kg.

Capacities

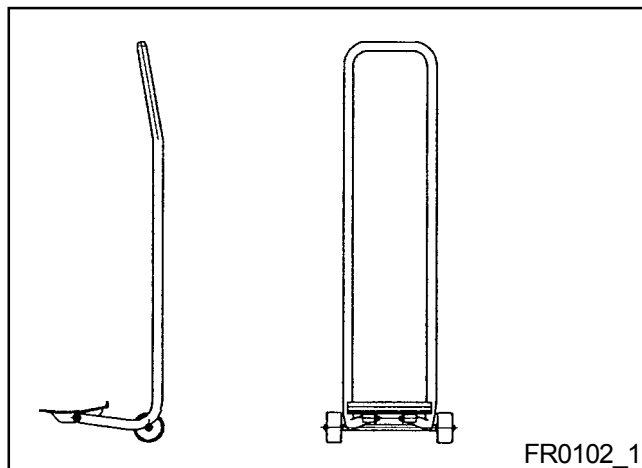
PRODUCTS	QUANTITY	CHARACTERISTICS
Petrol	39 l	98 without lead
Oil engine	6 l	ELF HTX 802 15W50
Gear box oil	1.7 l	ELF HTX 752 SAE 80W140
Coolant	7 l	
Front brake fluid	0.25 l	Dot 5
Rear brake fluid	0.25 l	Dot 5
Clutch fluid	0.25 l	Dot 5

Handling

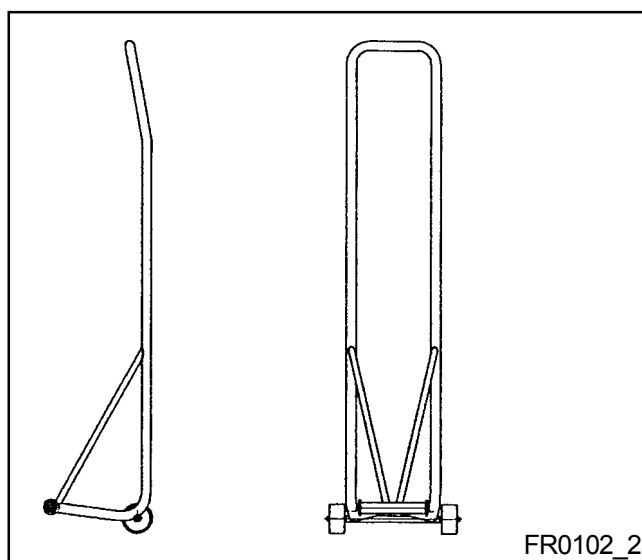
JACKING VEHICLE

The vehicle is jacked using the following equipment:

- front quick jack.

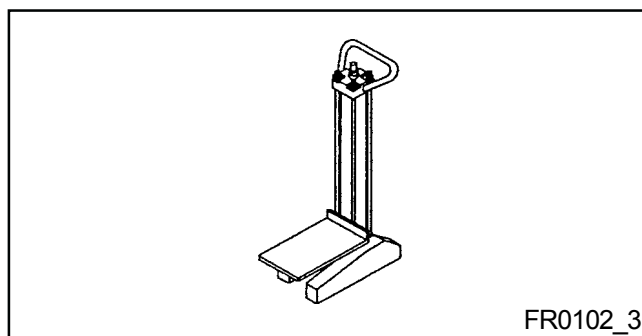


- rear quick jack.

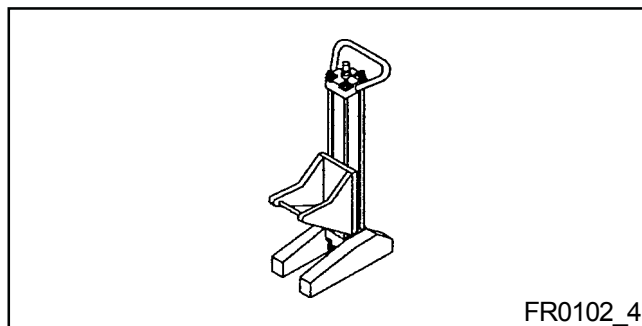


NOTE: *The following are available on the pneumatic model:*

- front quick jack.

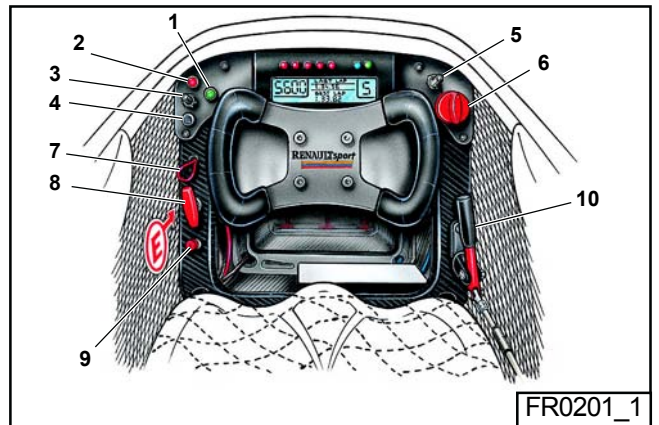


- rear quick jack.



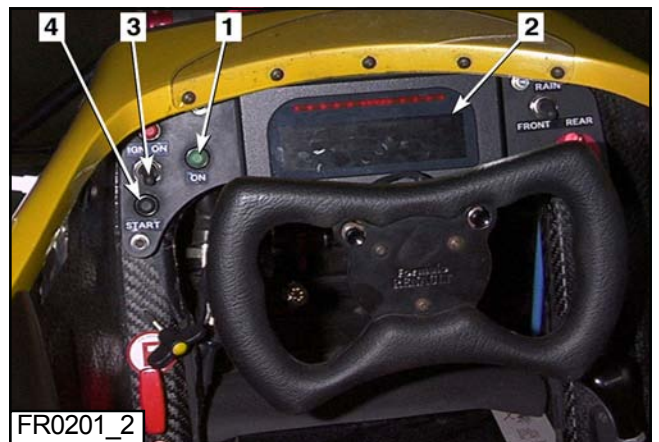
GAUGES AND SWITCHGEARS

- 1 Master switch ON.
- 2 Master switch OFF.
- 3 Ignition switch.
- 4 Starter switch.
- 5 Rain light switch.
- 6 Brake balance bar.
- 7 Reverse locking cable.
- 8 Fire extinguisher control switch.
- 9 Fire extinguisher nozzle.
- 10 Gear selector.

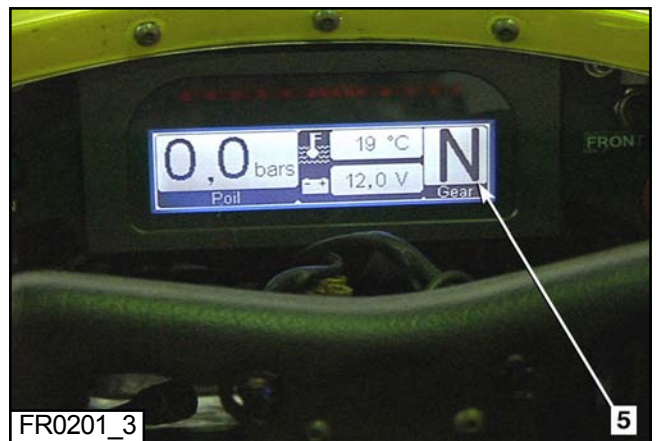


STARTING PROCEDURE

- Press the "ON" (1) push-button.
 - A readout is displayed on the dashboard (2).
 - Lower "IGNITION" switch (3).
-
- Check that no speeds are engaged (the letter N is displayed in the "Gear" window (5)) and press the "START" button (4).



TB 08



TB 12

PARTICULAR INSTRUCTIONS

If the engine does not start:

- Press the red push-button (6).
- Repeat the starting procedure.



TB 09

GEAR SHIFTING PROCEDURE

- Actuate the gear-shift lever (2) to engage the desired gear ratio:
 - push lever to drop gear ratios,
 - pull lever to increase gear ratios.
- Check that the desired gear ratio is displayed on the dashboard (1).

- Changing from 1st gear to neutral:

- pull release handle (4),

NOTE : This black handle is located just above the red extinguisher handle (3),

- push gearshift lever (2),
- check that "N" is displayed on the dashboard (1).
- Changing from neutral to reverse:
 - pull release handle (4),
 - push gearshift lever (2),
 - check that "R" is displayed on the dashboard (1).
- Changing from reverse to neutral:
 - pull release handle (4),
 - push gearshift lever (2),
 - check that "N" is displayed on the dashboard (1).



TB 2

SWITCHING OFF ENGINE

- Flip "IGNITION" switch (3) towards the top.
- Press red "OFF" button (1), the dashboard (2) goes out.



TB 10

In order to improve the quality of its racing cars, Renault Sport Technologies asks competitors in the Formula Renault 2.0 championships to follow these procedures.

ENGINE FAILURE

In case of an engine failure, competitors are asked to respect the following points, in order to allow an identification of the incident and its efficient treatment.

If the following points are respected, the engine-builder will be able to lend a new engine or a revised one (with invoicing detailed below), until the causes of the incident are established.

- The external accessories, which are not damaged, can be demounted and kept by the competitor except for:
 - The oil pump, the dry sump, the oil-water exchanger and its brackets, and the oil filter for the Formula Renault 2.0 engine.
 - The air filter, the nozzle holder's shim, the admission distributor, the injection ramp with the injectors, the calculator.

- **Each engine, which will be sent to the engine-builder for rebuilding must always be sent with the following sheet completed.**

ENGINE ASSEMBLY

General

Engine sheet

<i>IDENTIFICATION</i>			
Engine type (F4R 730, 732, 736 ou 738)		Ow	ner
Engine number		Driver(s)	
ECU N°		Championship (FR2.0 or Cup, country)	

<i>Engine History</i>			
Date of purchase		Mileage	
	Dates	Operations	Reasons
Details of previous work			
Diverse (went off circuit, emergency repairs, etc.)			

<i>INCIDENT DETAILS</i>	
Date	
Usage	practice/ race / engine test bench / others :
Track (if track incident)	
Meteorological conditions (T°ext, ...)	
Dashboard information (oil pressure alarm etc...)	
Lubricant (type and make) Sample number	
Cooling liquid (type and make)	
Number of incident of the same type occurring on the same vehicle or on the other cars of the team.	
Diverse	

- The engine must absolutely be sent with the following elements:
 - a sample of 1L of fuel, taken in the presence of technical scrutineers,
 - a sample of 250 mL of engine oil, taken in the presence of technical scrutineers,
 - a sample of 250 mL of cooling liquid,
 - the calculator (Renault Sport can lend one),
 - the data (AIM/DRACK) registered during the incident (when this occurred during track running); this file should be supplied on a CD or a USB.
- The responsibility for the engine failure will be established in a maximum of two weeks after receiving the engine, except if complementary analysis in a laboratory is required: In this case, the decision will be made within 5 weeks. After this time, the parts which are not damaged will be sent to the competitor. But the damaged parts will be still kept for one month, and after this, if the competitor makes an express request, he can recover the parts.
- After the analysis of the engine, if the competitor is declared to be at fault, the costs for the rebuilding of the loan engine must be paid, in proportion to the kilometres covered (on the basis of 2809 • every 5000 km for the season 2004).
The competitor will have to give back the loan engine, and pay the transport to the engine-builder. Conversely, if the engine-builder is at fault (or Renault Sport Technologies), the competitor will keep the loan engine with nothing to pay for the loan.

Summary of the different responsibilities:

TEAM	<i>ENGINE-BUILDER/ RENAULT SPORT TECHNOLOGIES</i>
<ul style="list-style-type: none"> - Taking of fuel, oil and cooling liquid. - Demounting engine from the car. - Recuperation of non-essential parts. - Pictures of demounted parts. - «Engine sheet» completed. - Sending the engine with the «engine sheet», the samples of fuel, oil, cooling liquid, the calculator, the data file.... - Payment for rebuilding the loan engine (if the responsibility of the competitor is declared). 	<ul style="list-style-type: none"> - Loan of new engine or revised one. - Demounting and analysis of the faulty engine. - Supplying analysis report. - Determination of the responsibilities (with a Renault Sport Technologies expert). - Determination of cost of rebuilding the loan engine (depending on the kilometres covered). - Payment for rebuilding the loan engine (if the responsibility of Renault Sport is declared).

SENDING ENGINE FOR REBUILDING

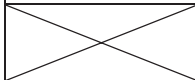
In order to improve the control of engines, each competitor must **absolutely** send an «engine sheet» each time that the competitor sends its engine to the engine-builder for rebuilding, even if the rebuilding doesn't occur after a problem or a failure.

FAILURE OF OTHER PARTS

- For the other parts, apart from the engine, the same type of procedure must be respected (even for bolts and fixings).
- The defective component, or the parts of the broken one, must be sent back to Renault Sport Technologies, with the following sheet.

Component sheet

<i>IDENTIFICATION</i>			
Engine type (F4R 730, 732, 736 ou 738)	Ow	ner	
Engine number		Driver(s)	
ECU N°		Championship (FR2.0 or Cup, country)	

<i>Component History</i>			
Date of purchase		Mileage	
	Dates	Operations	Reasons
Details of previous work			
Diverse (went off circuit, emergency repairs, etc.)			

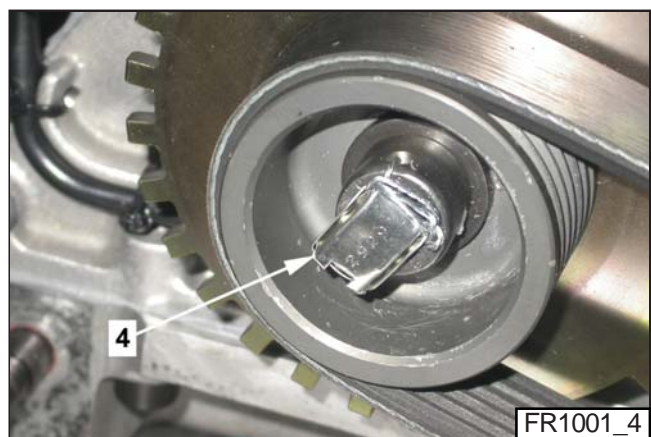
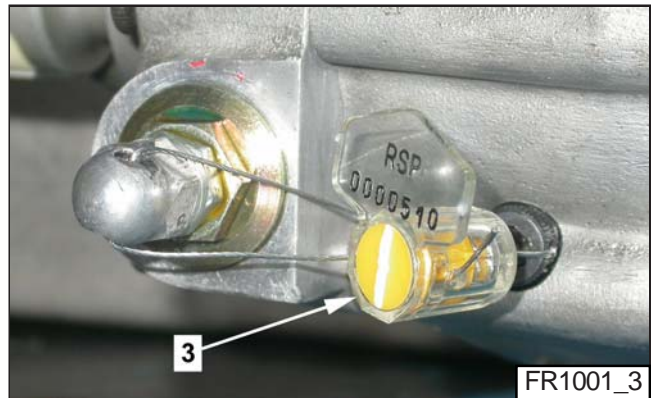
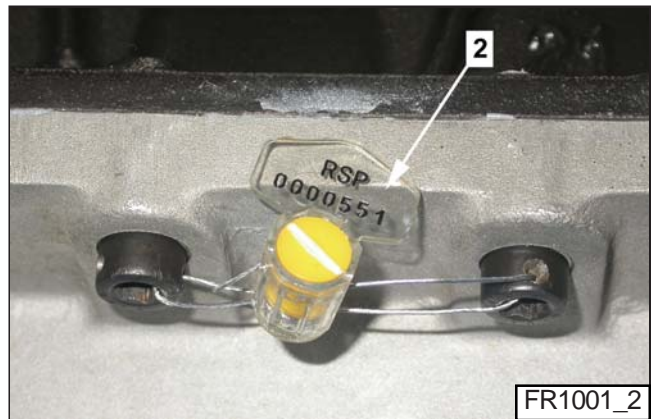
<i>INCIDENT DETAILS</i>	
Date	
Usage	practice/ race / engine test bench / others :
Track (if track incident)	
Meteorological conditions (T°ext, ...)	
Dashboard information (oil pressure alarm etc...)	
Lubricant (type and make) Sample number	
Cooling liquid (type and make)	
Number of incident of the same type occurring on the same vehicle or on the other cars of the team.	
Diverse	

SEALED

IMPORTANT: *The engine is sealed off. It is forbidden to carry out any interventions on the engine. It is compulsory that these be carried out by Renault Sport representatives.*

The following are sealed:

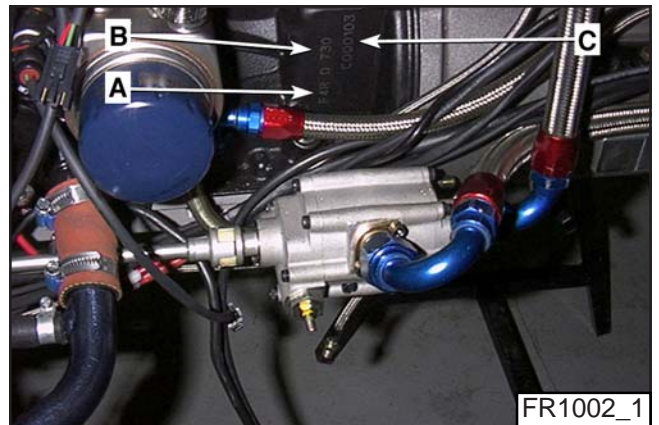
- cylinder head and camshaft plugs (1),
- bottom case (2),
- oil pump (3).
- the distribution pulley and the ignition target (4).



The engine is identified by an engraving on the engine-gearbox unit.

It includes the following:

- at **A**: engine type and certification letter,
- at **B**: Renault identification and engine index,
- at **C**: engine production number.



Characteristics

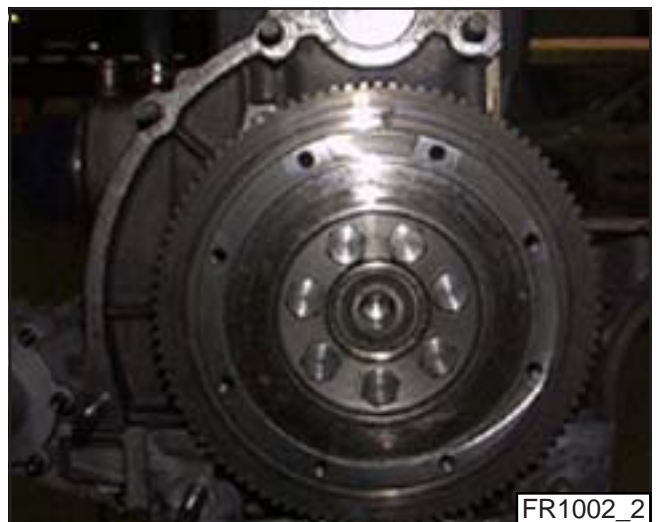
ENGINE

- Type: F4R
- Number of cylinders: 4.
- Number of valves: 16.
- Bore: 82.7 mm.
- Stroke: 93 mm.
- Engine displacement: 1,998 cm³.
- Gear ratio: 11.2:1.
- Max. power: 190 ch DIN at 7,250 rpm.
- Max. torque: 216 Nm DIN at 5,000 rpm.
- Control: electronic, Magneti Marelli MF4L competition.
- Type of crankcase: dry (comes from Renault Sport F3 engine).
- Oil: 15W50 compulsory
- Exhaust: catalytic and silencer (complies with FIA standards).

FLYWHEEL

- Diameter: 212 mm.
- Weight: 2050 g minimum.

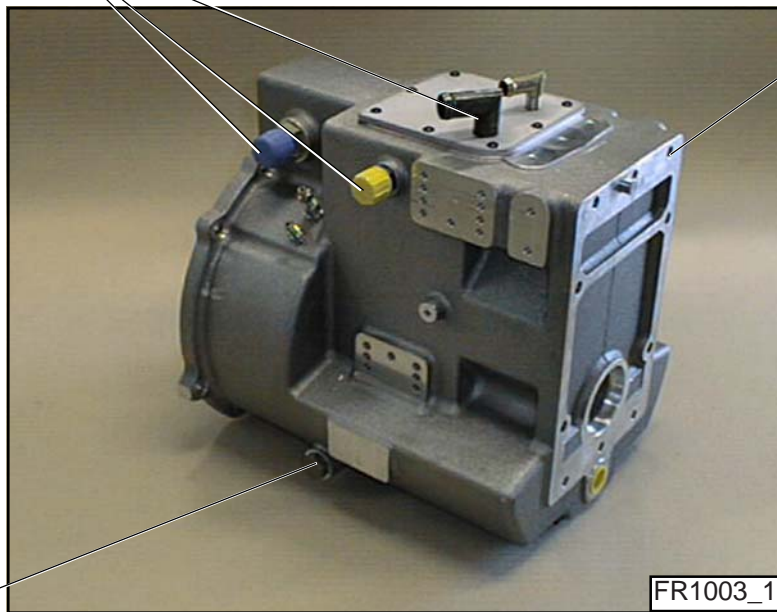
WARNING: *It is forbidden to change the flywheel.*



Type	Use
Loctite low-strength Screwlock 222	Tarpaulin fastening screw
Loctite 518 sealant	Case/tarpaulin mating plane

Drain plug
Loctite 577 pipe sealant

Case/tarpaulin mating plane
Loctite 518 sealant



Connectors
Loctite 577 pipe sealant

ENGINE ASSEMBLY

Removal - Installation

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TORQUES

Grade 8.8 nuts and bolts are used except:

- studs and raised head screws and bolts: grade 10.9,
- screws and bolts with the grade engraved on the head.

Torques are indicated in N.m.

Screw	Grade		
	8.8	10.9	12.9
M4	2.8	3.9	4.7
M5	5.5	7.7	9.2
M6	9.4	13.2	15.9
M8	22.7	32.0	38.4
M10	44.9	63.1	75.7

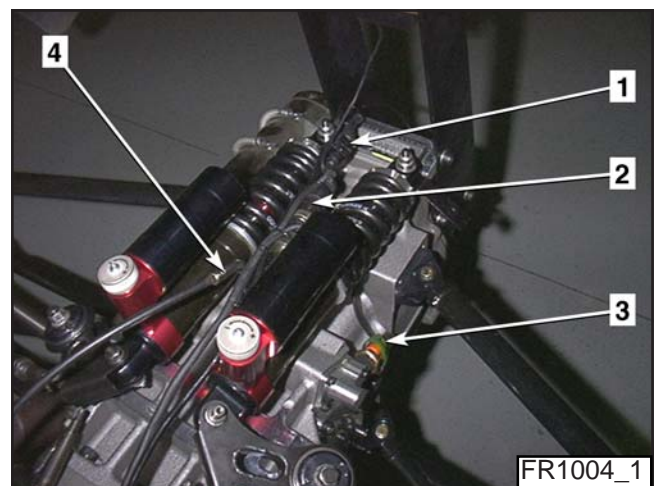
Screw	UNF
1/4"	13.5
5/16"	26.5
3/8"	46.0

ENGINE-GEARBOX UNIT

Removal

- Disconnect battery.
- Remove left and right bridges, engine bonnet, and floorboard.
- Disconnect the following connectors:
 - rain light (1),
 - gearbox potentiometer (2),
 - cut-off switch (3),
 - gearbox release cable (4).
- Remove wing.

- Disconnect the following:
 - intake air pressure sending unit (1),
 - camshaft phase shift solenoid valve (2),

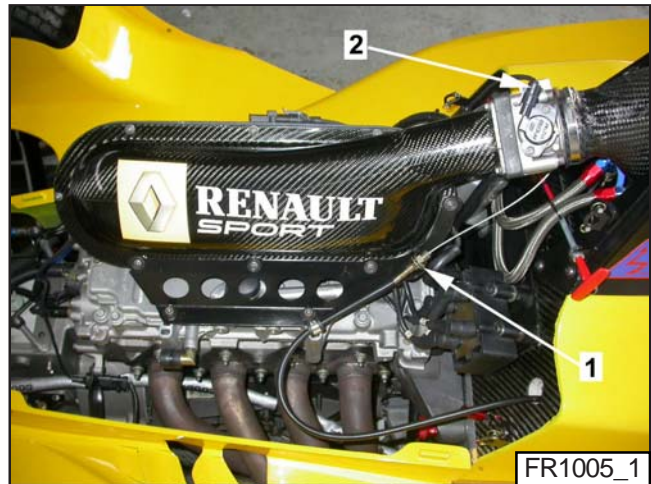


ENGINE ASSEMBLY

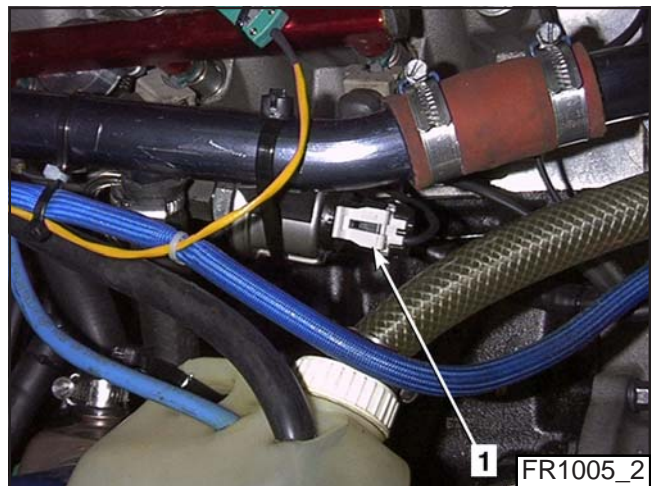
Removal - Installation

10

- intake air temperature sending unit (2),
- accelerator control cable (1),

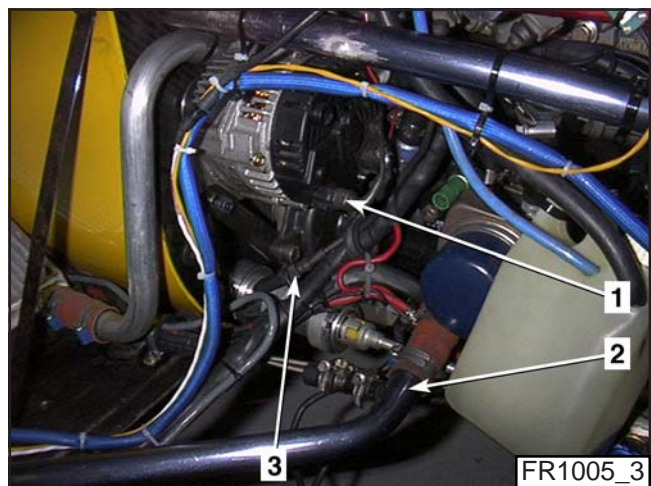


- oil pressure sending unit (1),

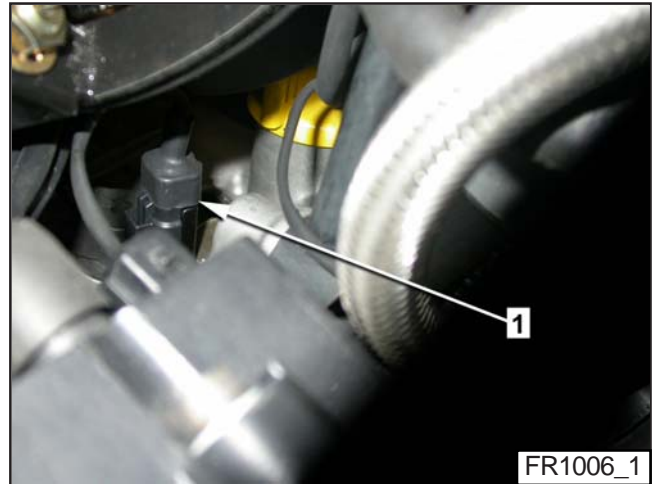


- TDC sensor connector (3),
- alternator wiring (1),
- water pump cooling system lines (2).

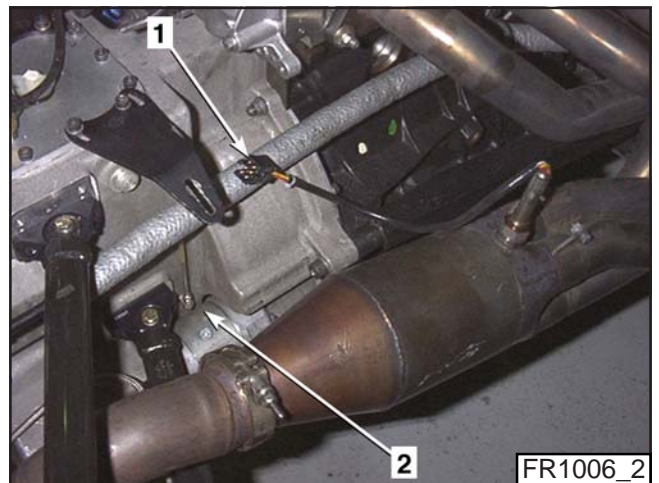
NOTE: Provide for coolant flow.



- butterfly valve position sending unit (1),



- oxygen probe connector (1),
- starter wiring (2),



- Disconnect coil (1).

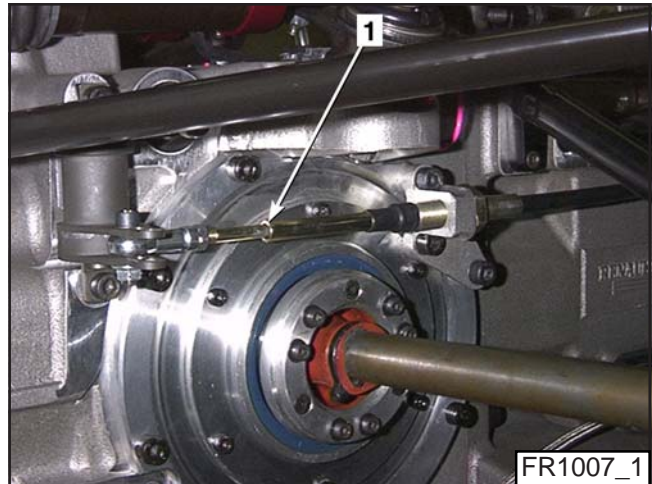


ENGINE ASSEMBLY

Removal - Installation

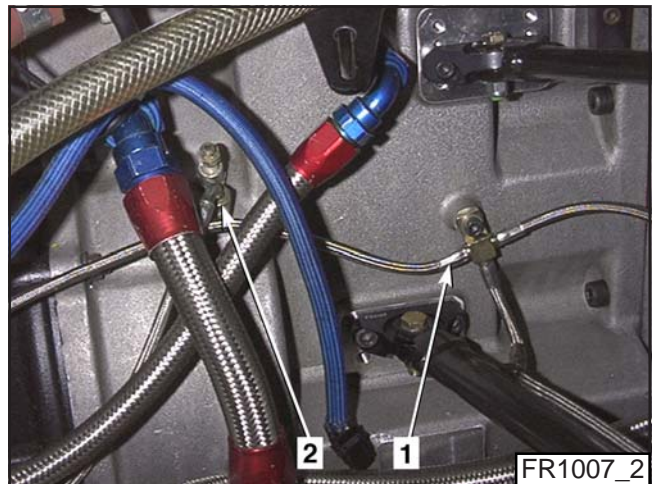
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- Disconnect push-pull cable,



- Disconnect hydraulic system lines:
 - clutch lines (2),
 - rear brakes on Tee (1).

NOTE: Provide for hydraulic fluid flow.



- Disconnect the following:
 - fuel supply coupler (1),
 - fuel return connector to tank.

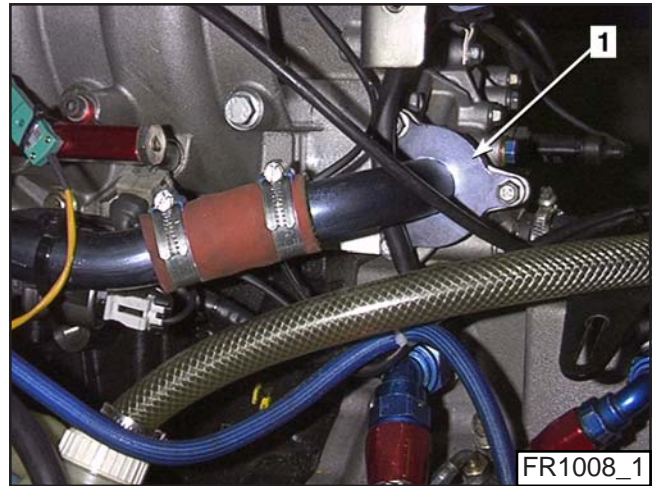


ENGINE ASSEMBLY

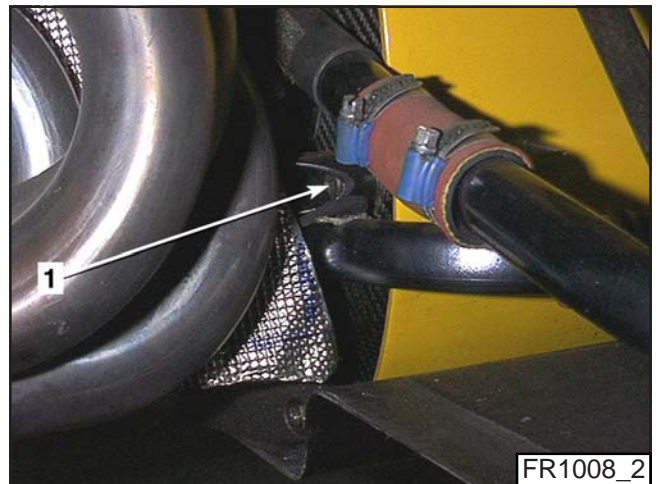
Removal - Installation

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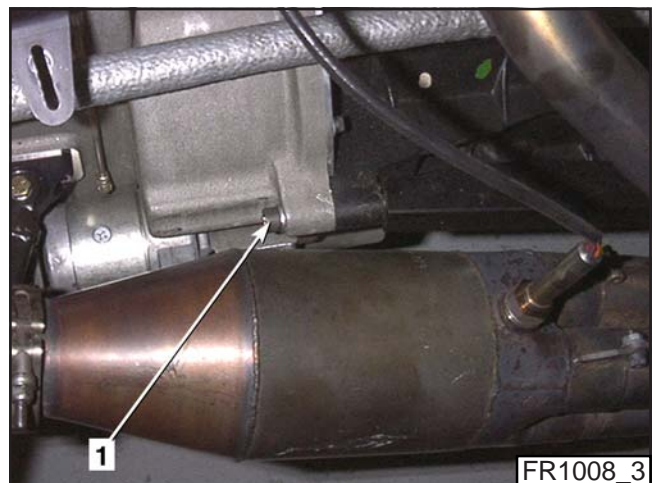
- Remove the three bolts fastening the water line clamp **(1)** to the thermostat casing.



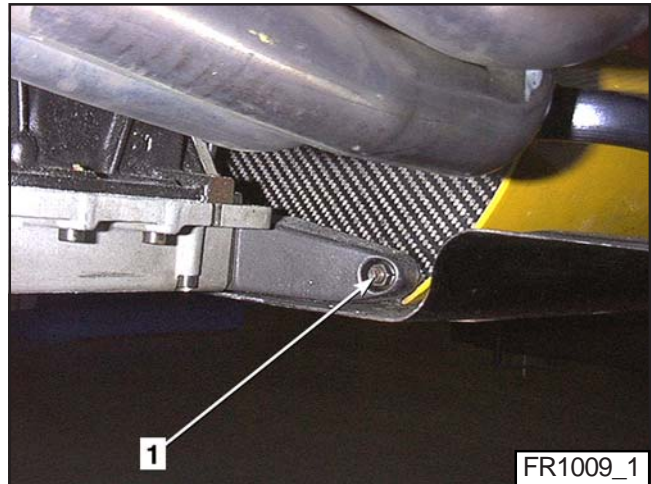
- Install shell on stand and prop up engine with a lifting device (see section covering this).
- Loosen bolt **(1)** fastening through-bolt to shell.



- Remove bolt **(1)** fastening through-bolt to clutch case.

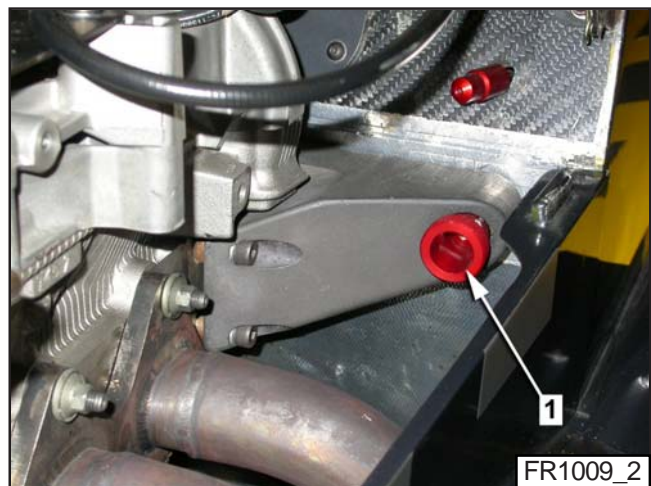


- Remove the two nuts (1) fastening the bottom mounting to the shell.



- Remove the two nuts (1) fastening the top mounting to the shell.
- Disengage gearbox-engine unit.

NOTE: Two top-mounting references are available :
the 77 11 154 676 is a reinforced one.



Installation

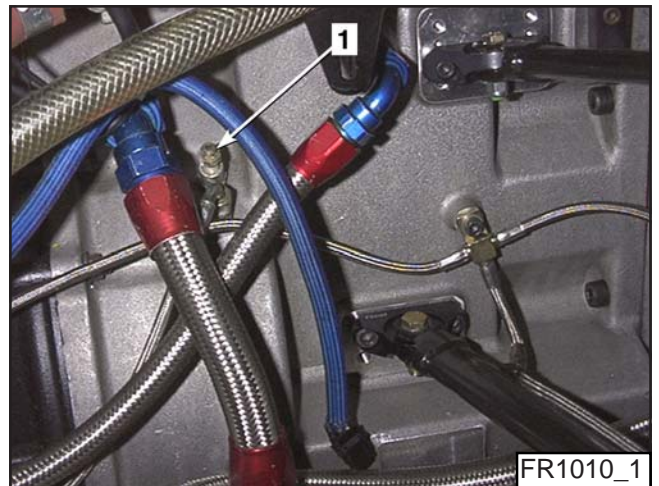
- Carry out the above steps in the reverse order.
- Observe torques.

CAUTION: *When attaching the pull-rod to the shell, adjust using washers so that the tightening of the screw does not entail strain in the pull-rod.*

- Bleed the following:
 - Brakes (1),



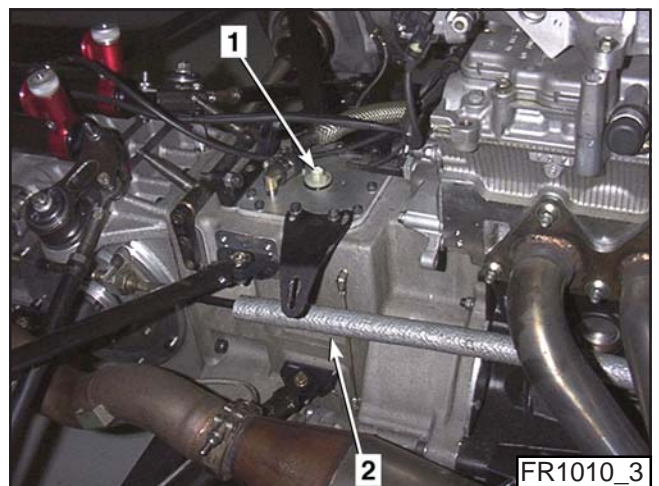
- clutch (1),



- radiators (1).

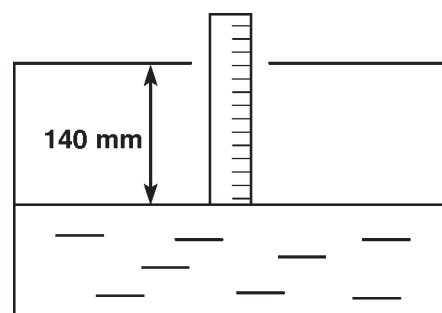


- **Adjust the levels of the following:**
 - engine oil [filler cap (1) and level gauge (2)],

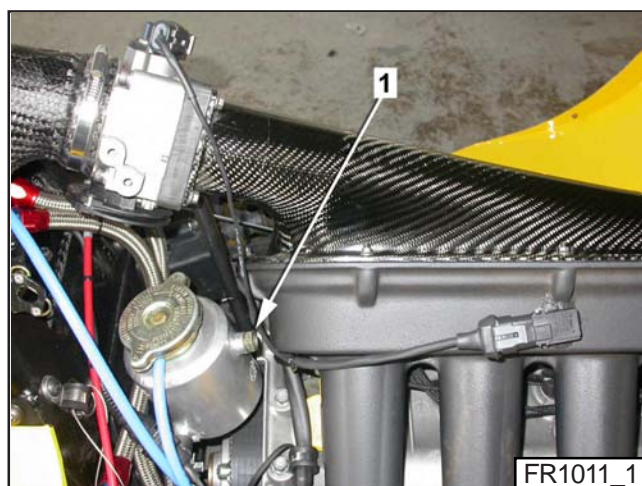


NOTE: The oil level is adjusted following the following steps :

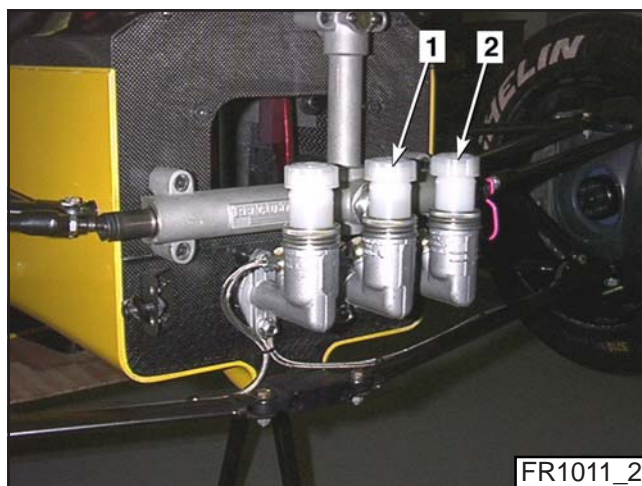
- Run the engine for 2 or 3 minutes.
- Use a rule plunged into the tarpaulin to check that the level between the surface of the oil and the filler hole is 140 mm.



- cooling system (1),



- clutch system (2),
- rear brake fluid (1).



ALTERNATOR BELT AND OIL PUMP

Adjustment of the tension

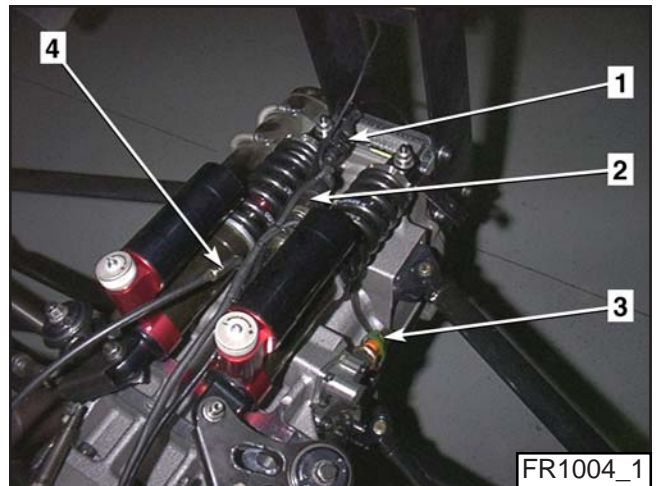
- Regularly, it must be checked with hot engine.
- It is correct when it is possible to turn of quarter turn (90°) the belt strand located between the alternator pulley and the oil pump pulley.



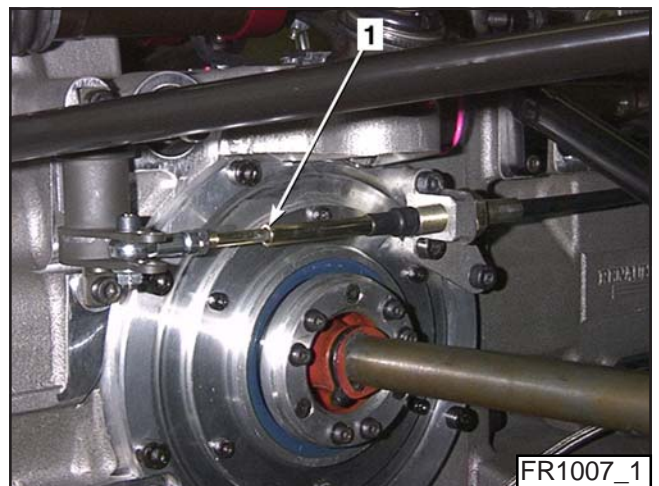
TARPAULIN/GEARBOX ASSEMBLY

Removal

- Disconnect battery.
- Remove left and right bridges, engine bonnet, and floorboard.
- Disconnect the following connectors:
 - rain light (1),
 - gearbox potentiometer (2),
 - cut-off switch (3),
 - gearbox release cable (4).
- Remove wing.
- Remove starter.

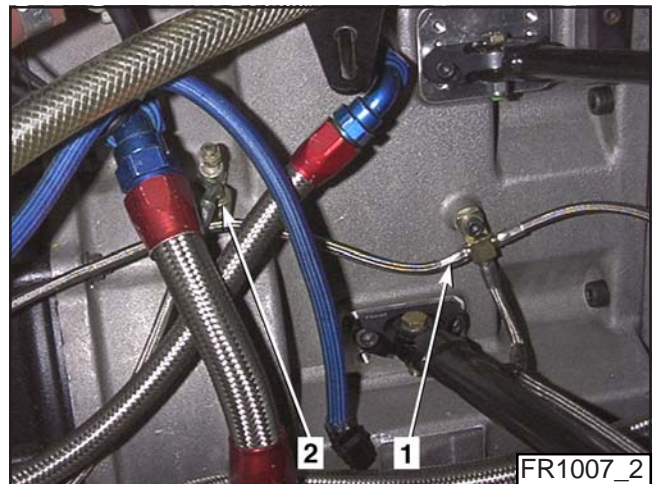


- Disconnect push-pull cable (1).



- Disconnect hydraulic system lines:
 - clutch lines (2),
 - rear brakes on Tee (1).

NOTE: Provide for hydraulic fluid flow.

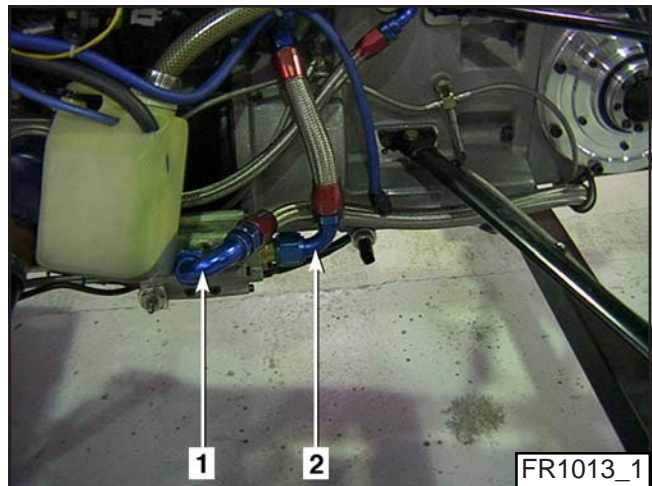


ENGINE ASSEMBLY

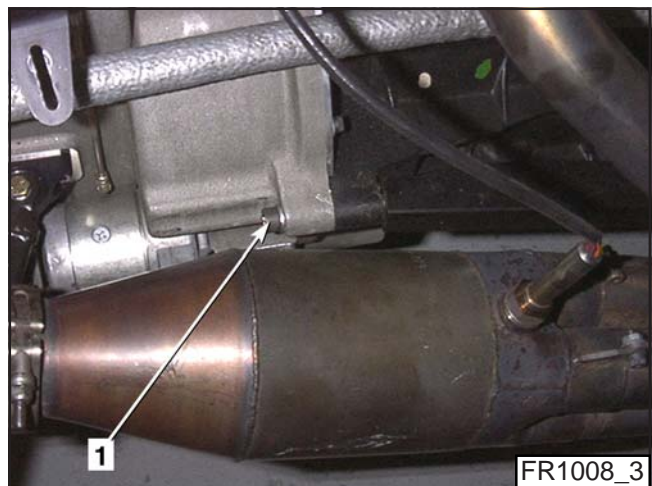
Removal - Installation

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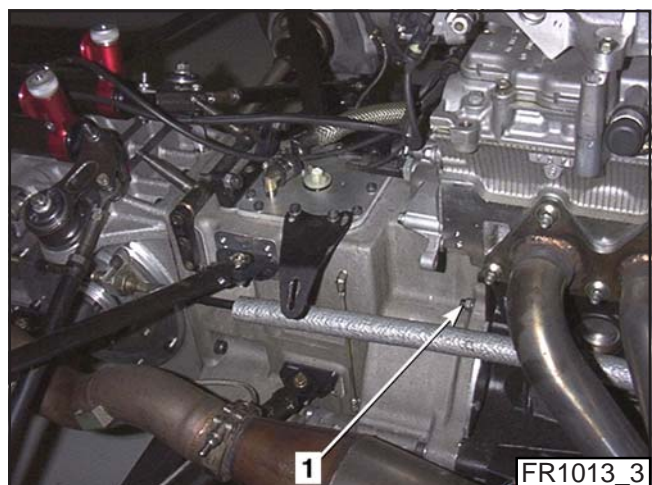
- Disconnect oil lines **(1)** and **(2)** on oil pump.
- Remove muffler.
- Place engine/shell assembly on stand and prop up tarpaulin/gearbox assembly with a lifting device.



- Remove bolt **(1)** fastening engine strut to clutch housing.

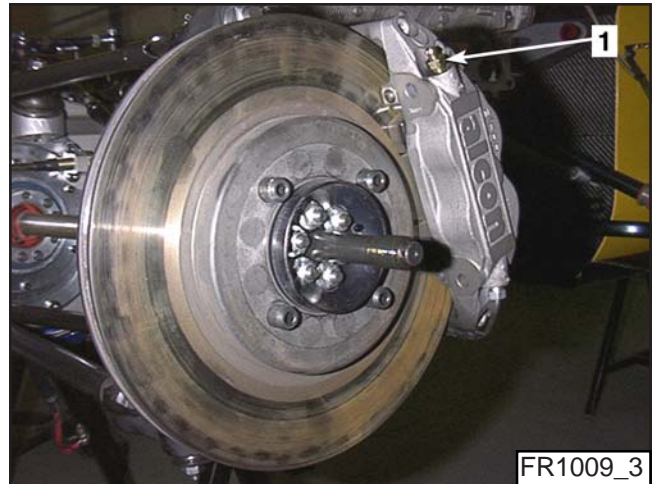


- Remove nuts **(1)** fastening clutch housing to engine.
- Disengage tarpaulin/gearbox assembly.

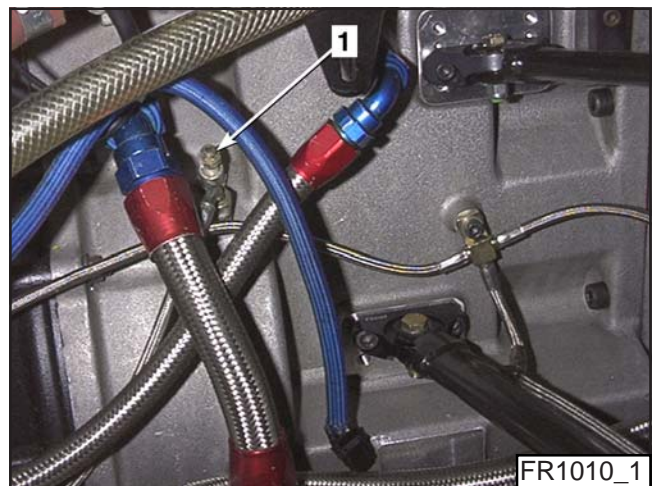


Installation

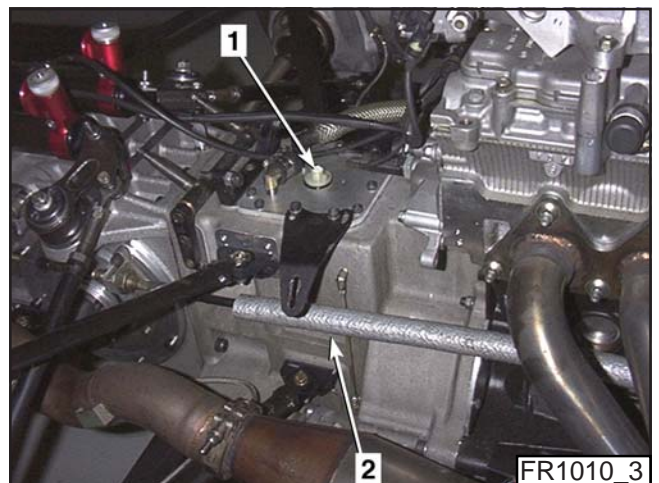
- Carry out the above steps in the reverse order.
- Observe torques.
- **Bleed the following:**
 - brakes **(1)**,



- clutch **(1)**,

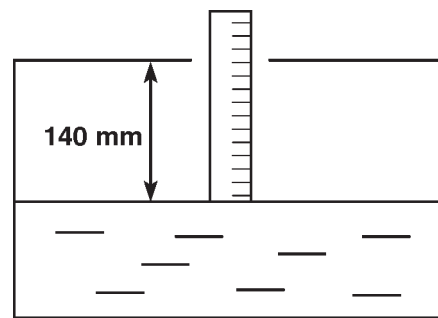


- **Adjust the levels of the following:**
 - engine oil [filler cap **(1)** and level gauge **(2)**],



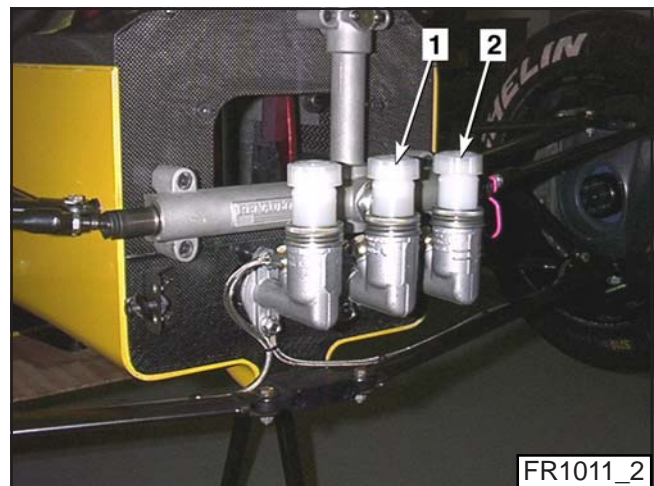
NOTE: The oil level is adjusted following the following steps:

- Run the engine for 2 or 3 minutes.
- Use a rule plunged into the tarpaulin to check that the level between the surface of the oil and the filler hole is 140 mm.



FR1010_4

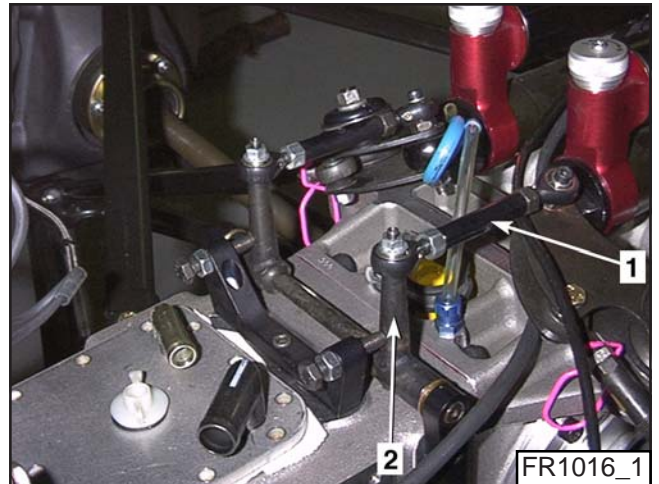
- clutch system (2),
- rear brake fluid (1).



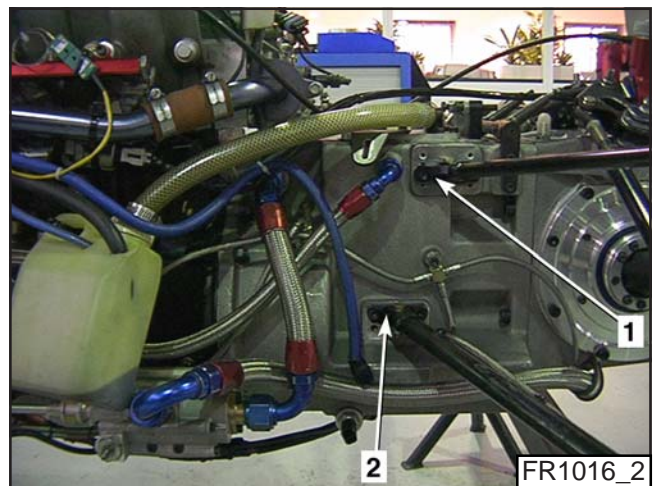
TARPAULIN

Removal

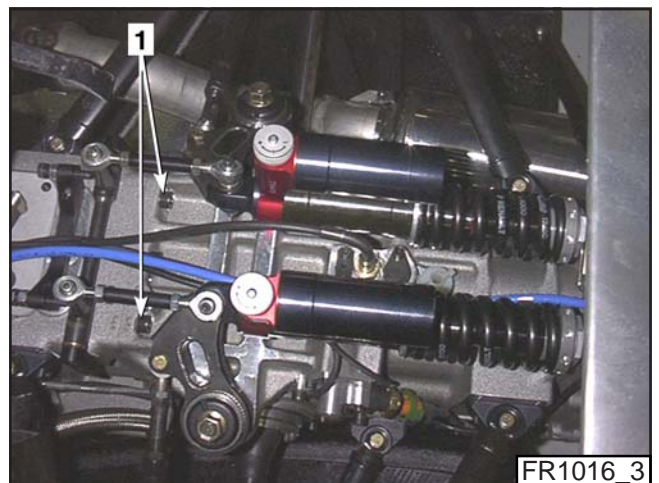
- Remove tarpaulin/gearbox assembly (see above).
- Uncouple antiroll bars **(2)** from antiroll bar **(1)**.



- Remove bolts fastening bottom A-arms **(2)** and top A-arms **(1)** to tarpaulin.

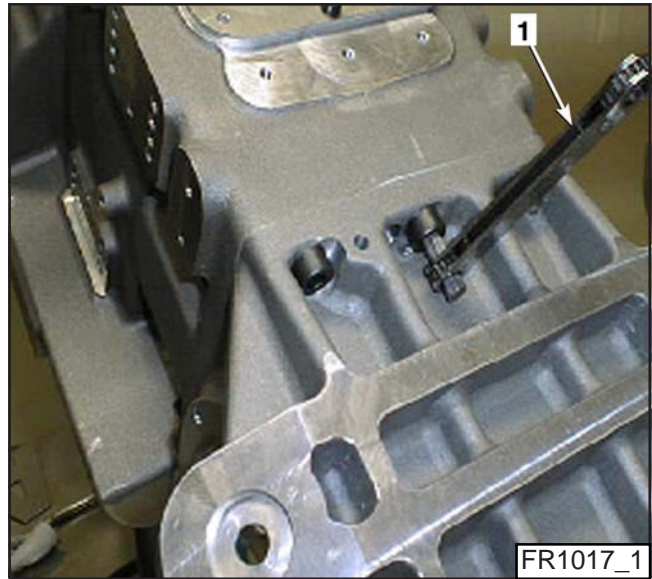


- Remove bolts **(1)** fastening tarpaulin to gearbox. Remove tarpaulin.

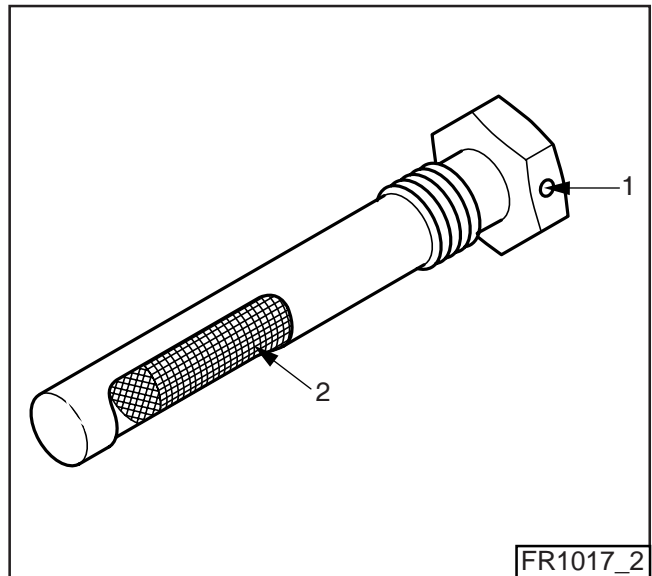


Installation

- Use an M10 x 150 tap to clean tarpaulin tappings, then remove grease from tappings, screws and bolts, and mating planes of both tarpaulin and gearbox.
- Coat gearbox mating plane with Loctite 518 sealant and fit tarpaulin on gearbox.
- Put a few drops of Loctite low-strength Screwlock 222 on the seven mounting bolts. Insert. Use a Facom P/N 68B 6 x 8 (1) type ratchet ring wrench to tighten.
- Torque bolts to 55 N.m.
- Carry out the above steps in the reverse order.
- Observe torques.
- Install tarpaulin/gearbox assembly (see above).



- Since the tarpaulin intake connector is equipped with a strainer (2), when changing the connector, make sure that the indexing hole (1) is turned downwards on completion of tightening.



- To improve the mounting of the air box support (P/N: 77 11 154 847) on F4R 738 engines, a specific support is from now on available.

This part is sold under the part number **77 11 154 882** in the Renault Sport Spare Parts department (Alpine, Dieppe).

The use of the new support (P/N: 77 11 154 882) is compulsory on F4R 738 engines for the season 2005.

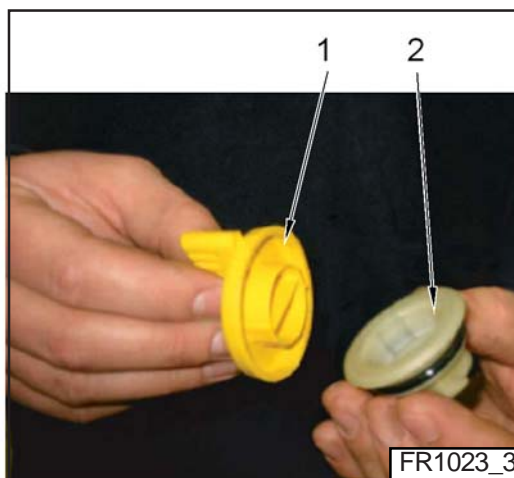
- The use of the intake manifold launched in 2004 entails a compulsory modification of the oil filler cap for the Formula Renault 2.0 F4R engines, as described below.

MODIFICATION OF THE CAP

- Remove the cap.



- Separate both parts of the cap.



- Set-up the part which insures the sealing and the fastening of the cap.



MAIN COMPONENT PARTS OF THE FUEL INJECTION SYSTEM

DESCRIPTION	MANUFACTURER	P/N
Engine computer	MAGNETI MARELLI	77 11 154 130
Air temperature sensor	MAGNETI MARELLI	77 11 155 393
Water temperature sensor		77 11 155 372
Air pressure sensor	DELCO	77 11 155 392
Oxygen probe	BOSCH	77 11 155 391
Catalyseur	ORBISOUD	77 11 154 183
Air filter	JR	01 03 20 007
Ignition coil	SAGEM	77 11 155 389
Ignition plugs	NGK	77 11 155 292
Fuel pump	WALBRO	77 11 154 287
Electromagnetic injectors	MAGNETI PICO	77 11 155 388
Throttle valve	MAGNETI MARELLI	77 11 154 256
Magnetic sensor (Engine TDC and RPM)	SIEMENS	77 11 126 782

Principle

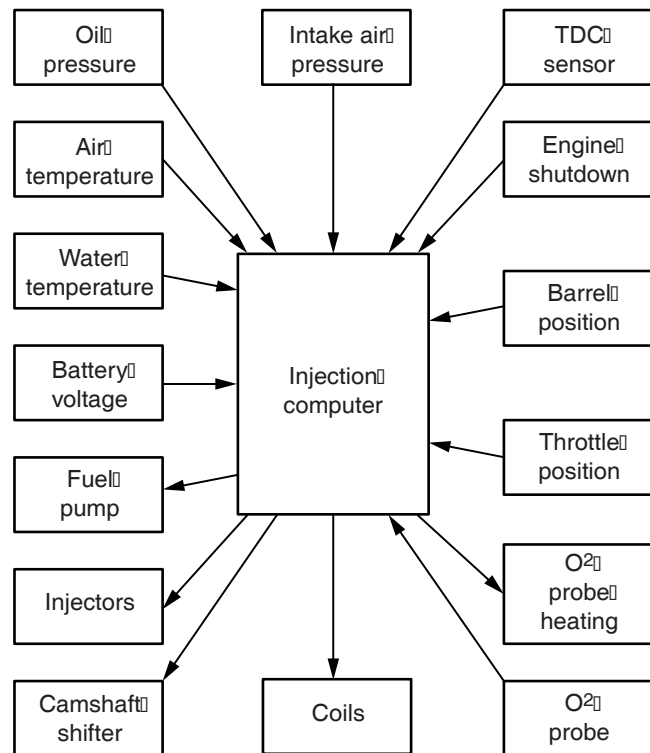
INJECTION SYSTEM COMPONENT PARTS

Fuel system

- Electric petrol pump.
- Petrol filter.
- Petrol pressure regulator.

Injection system

- Injection computer.
- Water temperature sensor.
- Air temperature sensor.
- Intake air pressure sensor.
- Engine speed and TDC sensor.
- Camshaft shifter.
- Oxygen probe.
- Engine shutdown switch.
- Barrel position potentiometer.
- Throttle valve position potentiometer.



FR1102_1

Power

- Ignition coils.
- Electromagnetic injectors.FUEL TANK

FUEL TANK

IMPORTANT : FIA recommandations reminder

«Rubber bladders must bear a code showing the name of the manufacturer, the specifications under which the tank was made and the date of manufacture. No rubber bladder must be used more than five years after the manufacture date, unless it has been re-certified by the manufacturer for a maximum extension period of two years.»

- As far as the first Formula Renault 2000 were built in 1999, it is asked to the competitors to verify the date of fabrication of the fuel tank equipping their car.
- For all tanks made more than 5 years ago, we ask the competitors to contact PRONAL (phone: +33 (0)3 20 99 75 00).

PETROL PUMP

SPECIAL TOOLS REQUIRED

Mot. 1311-01 Petrol pump test case
2000 ml test tube

Description

- Nominal flow rate: 80 l/h on no-load

The petrol pump is electric. It is installed in a pump well immersed in the tank.

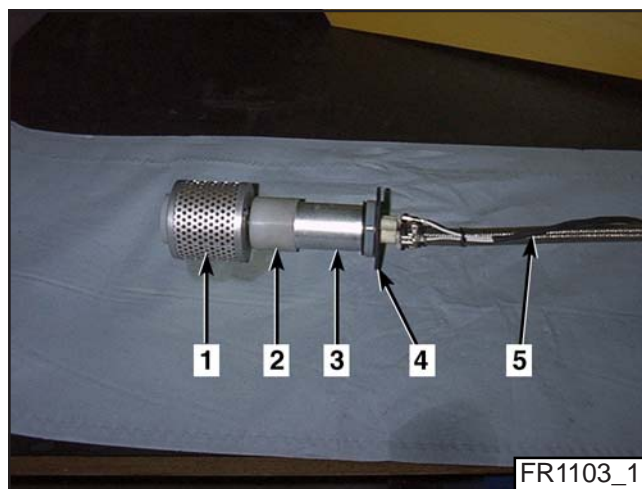
The petrol pump assembly contains the following:

- electric pump (3) which houses the engine fuel supply line (5),
- pump mounting (4),

NOTE: It should be installed at the top end of the pump.

- filter mounting (2),
- fuel filter (1).

The pump is driven by the computer upon ignition switch-on and while the engine is running. If the engine does not start 3 sec after ignition switch-on, the petrol pump stops.

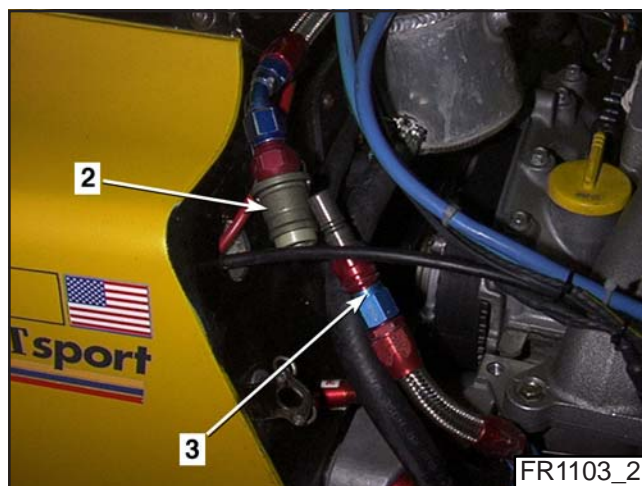


FR1103_1

Testing pump flow-rate

CAUTION: Do not smoke and do not place any incandescent object close to the working area.

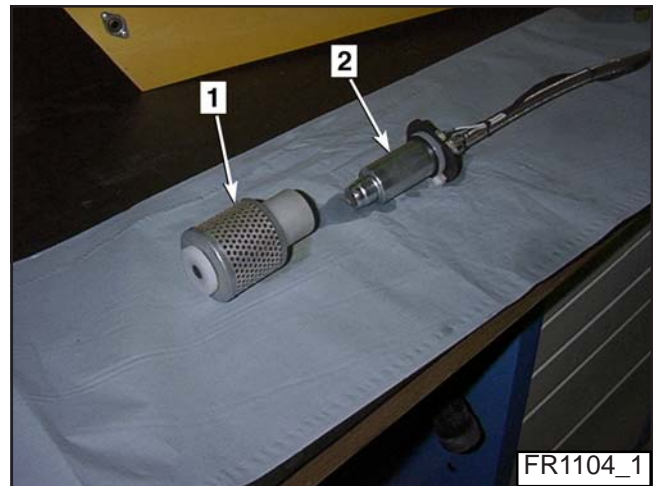
- Disconnect the coupler (1).
- Connect the test case hose to the link (2) and insert the other end into the test tube.
- Switch on ignition.
- Check flow rate to be at least 60 l/h min.
- If the flow rate is low, check pump power supply voltage (flow rate loss of about 10 % per voltage drop of 1 V).



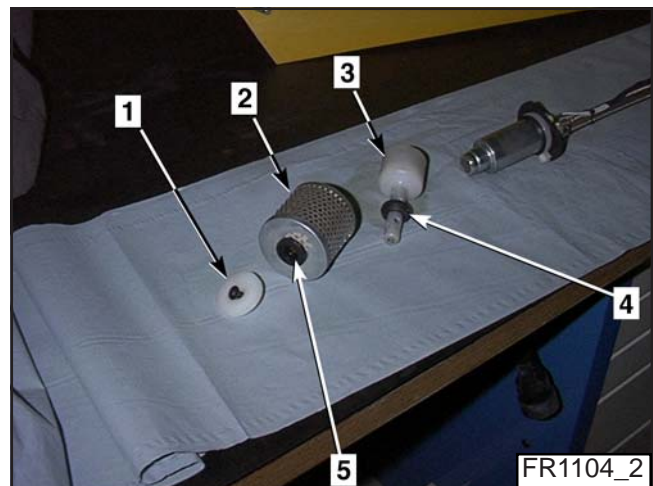
FR1103_2

Petrol filter exchange

- Separate the filter/mounting assembly (1) from the pump (2).



- Remove bolt (1) and washer.
- Remove filter (2) from its mounting (3).
- On reinstallation, make sure that the seals and gaskets (4) and (5) are correctly position on the filer (2).



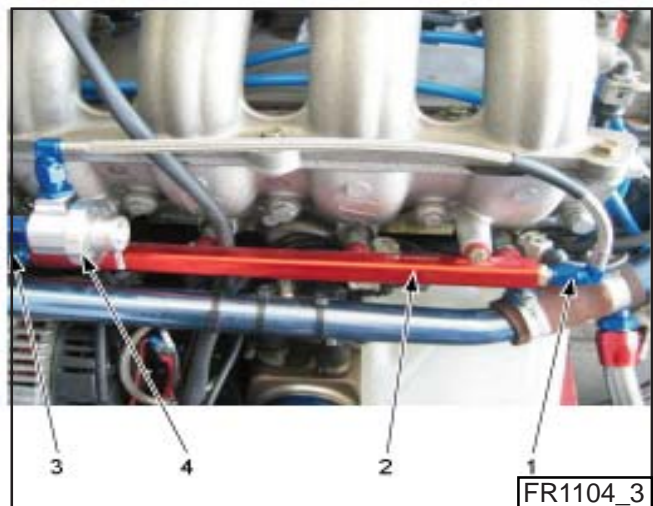
INJECTION MANIFOLD

Description

The injection system is composed of an injection manifold (2) fitted with four injectors secured by a clip. Each injector is connected to the computer by a connector.

The manifold includes:

- a petrol return end-piece (1),
- a petrol inlet end-piece (3),
- a pressure regulator (4) that maintains the fuel pressure at 3 ± 0.06 bar with a pump capacity of 80 ± 2 l/h.

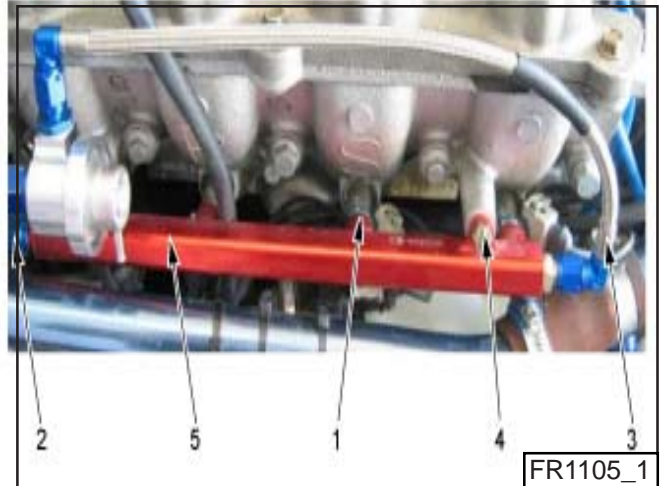


TIGHTENING TORQUE VALUES (in N.m)

Intake manifold screw	11 ± 2
Injection manifold screw	10

Removal of ramp

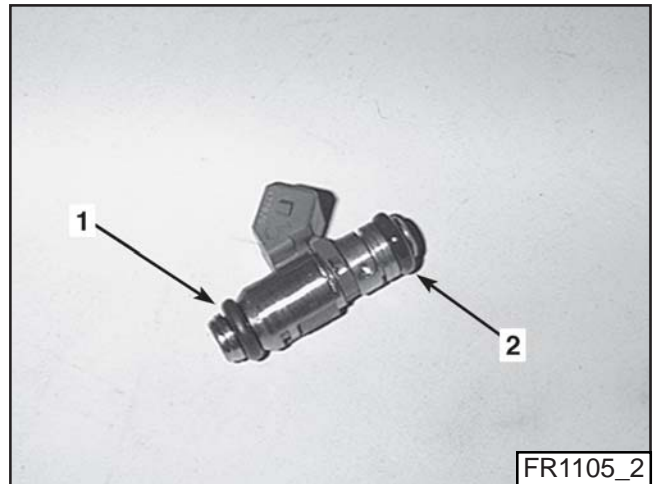
- Disconnect:
 - injectors (1),
 - petrol inlet pipe (2) and return pipe (3).
- Remove manifold attaching screws (4).
- Remove manifold (5).



FR1105_1

Installation

- Replace injector foot O-rings (2).
- If the injector has been removed, replace injector head seal (1).
- Correctly connect petrol inlet and return unions.
- Proceed to installation steps in the reverse order of removal.
- Comply with tightening torques.



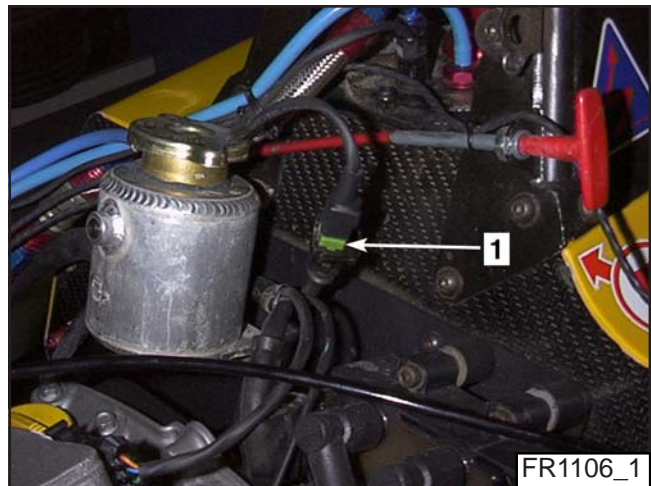
FR1105_2

Testing fuel supply pressure

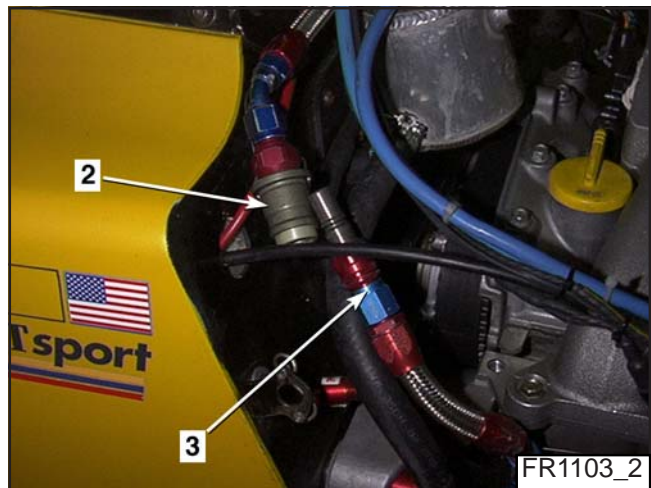
- Connect pressure gauge to coupler.
- Check pressure to be 3 ± 0.06 bar with a pump capacity of 80 ± 2 l/h and engine full loaded.

Draining fuel tank

- Disconnect supply connector from pump (1).



- Disconnect pump coupler (3). Connect drain end-piece onto connector (2).
- Plunge other end of drain end-piece into a recipient of a sufficient capacity.



- Supply power to petrol pump by means of a battery connected to connector (4).

To respect the article n°16 of the technical regulations, the fuel system draining procedure described below must be followed.

At the beginning of every meeting:

- empty the tank and the fuel system,
- put 2 litres of fuel delivered on the circuit,
- run the engine for a couple of minutes,
- empty the tank and the fuel system,
- run the free practice session with fuel delivered on the circuit,
- empty the fuel tank and fuel system,
- put 2 litres of fuel delivered on the circuit,
- empty the tank and the fuel system,
- the fuel contained in the tank is now in accordance with the one distributed on the circuit.



MAIN UNITS

Computer

The computer (1) is mounted on a digital technology PCB mainly driven by a microprocessor.

The injection is the multipoint, half-sequential type.



FR1107_1

Water temperature sensor

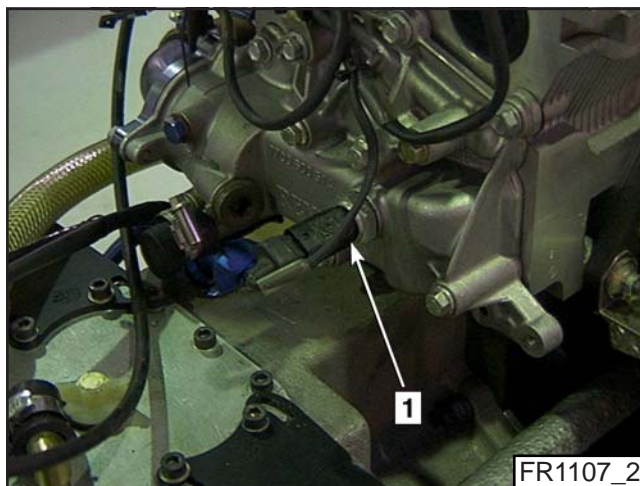
The water temperature sensor (1) is installed on the water outlet unit.

It is a CTN (negative temperature coefficient) type thermistor that sends to the computer the electric image of the water temperature.

The computer uses this information to:

- manage the injection system,
- display the temperature on the dashboard.

NOTE: *When replacing, make sure the sensor is of the correct type.*



FR1107_2

Air temperature sensor

Air temperature sensor (1) is fitted to the intake manifold. It consists of a CTN type (negative temperature factor) thermistor feeding the computer with the electrical translation of air temperature.

Thus, the computer receives data on intake air specific gravity. When the air temperature decreases, its specific gravity increases and the computer increases the petrol quantity injected to restore the expected air/petrol ratio.

NOTE: *During a replacement, make sure that the sensor type is compliant. If this is questionable, check temperature reading on the dashboard under cold engine condition.*



FR1107_3

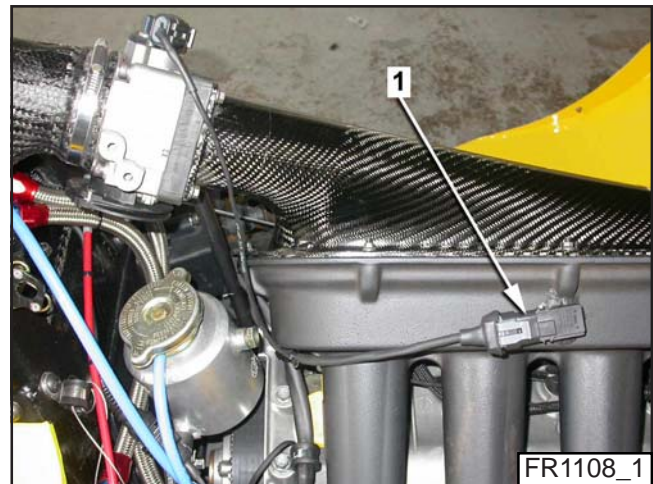
Injection Operating

Intake air pressure sensor

Intake air pressure sensor (1) is fitted to the intake manifold.

It provides the computer with intake manifold air pressure electrical translation data.

This signal is one of the primary parameters for computing injection time.

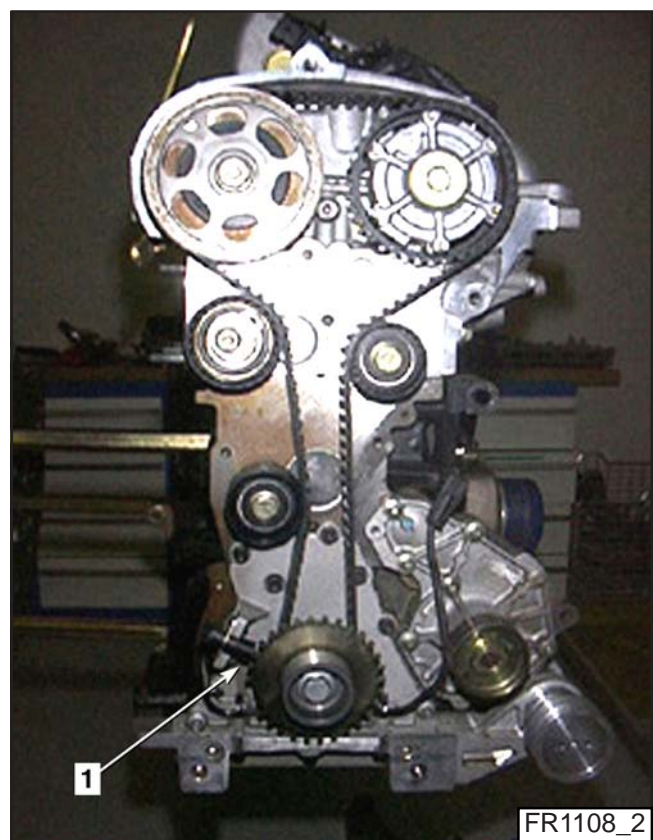


Engine speed and TDC sensor

This sensor (1) is installed in the top section of the target, fastened between the pulley and the crankshaft gear. The target has 28 teeth (-2 teeth).

This toothless gap enables the sensor to provide the computer with:

- TDC and BDC position data,
- engine rotation speed data.



Camshaft shifter solenoid valve

The camshaft shifter is designed for modifying the timing pattern. It is "go/no go" operated by a solenoid valve (1) fitted to cylinder head cover and driven by the computer.

The solenoid valve is open when engine rating ranges from 1,500 to 6,500 RPM.



Injection Operating

Throttle valve potentiometer

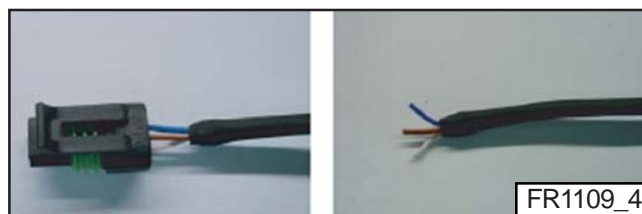
Throttle valve potentiometer (1) provides the computer with an accurate item of information on throttle valve position throughout its operating range.

Valve : Ø 60 mm.

For cars older than 2004, the modification of the intake manifold requires the use of a loom extension (P/N: 77 11 154 855), available from the Renault Sport Spare Parts department) and the modification of the original plug. This has to be made the following way:



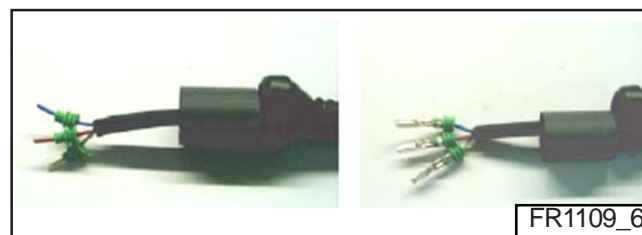
- Cut the original connector.



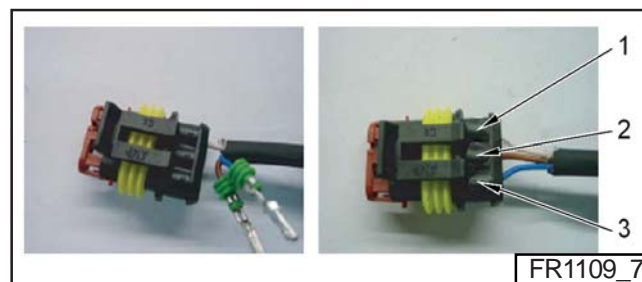
- Insert the thermo-retractable rubber sleeve.



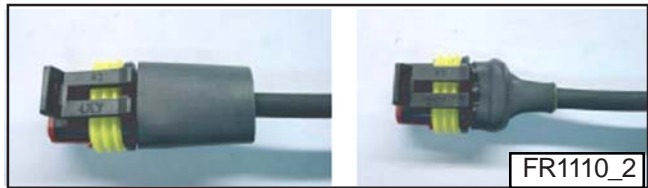
- Insert the gromets in any cable and crimp the pin on the gromets.



- Insert the pins in the connector.



- Fit the thermo-retractable sleeve on place and heat till the all shrink tightly.



- Re-position the rubber cover.



- Connect the loom extension (P/N: 77 11 154 855) to the new plug on one side, and to the throttle potentiometer on the other side.

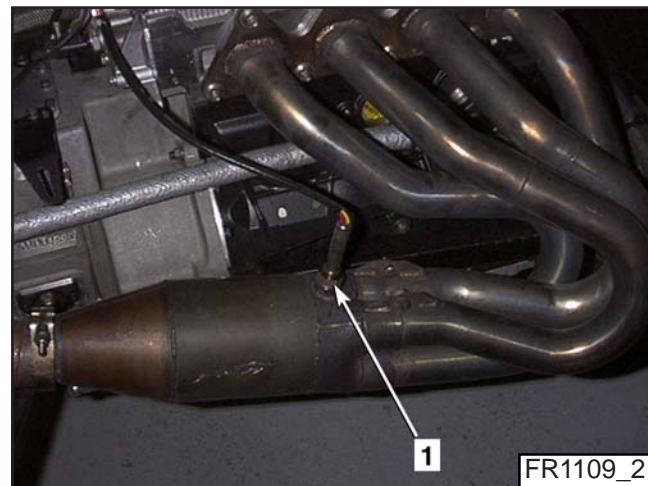
Oxygen probe

Oxygen probe **(1)** determines the oxygen ratio contained in exhaust gases the value of which varies as a function of mixture richness. A probe specific feature is that any carburetted mixture composition variation causes the output voltage to vary accordingly.

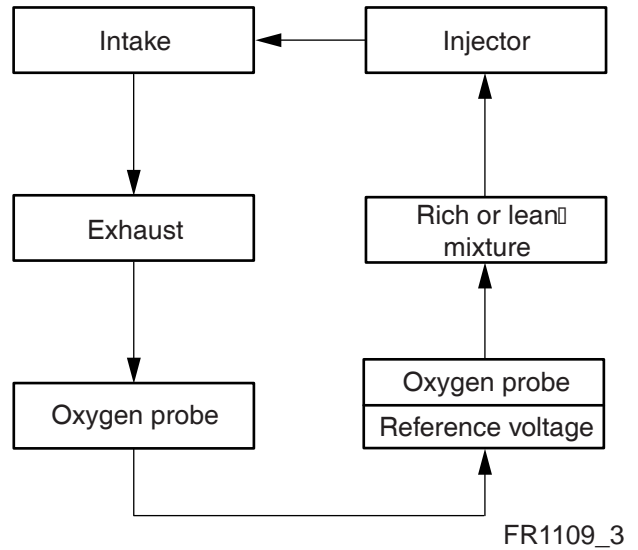
The computer corrects the air/petrol mixing ratio so that the carburetted mixture be always as close as possible to the stoichiometric ratio ($\text{Lambda} = 1$), which jointly makes it possible to use catalyst to thoroughly decontaminate exhaust gases.

Richness control is active when water temperature is greater than 75 °C.

The oxygen probe is fitted with a heating resistor which makes it possible to prime the probe more quickly when starting up the engine.



Regulation principle using an oxygen probe



POWER

Electromagnetic injectors

An electromagnetic injector is mainly composed of an injector body and a needle carrying a magnetic core. This assembly is spring-loaded to the tight injector body seat.

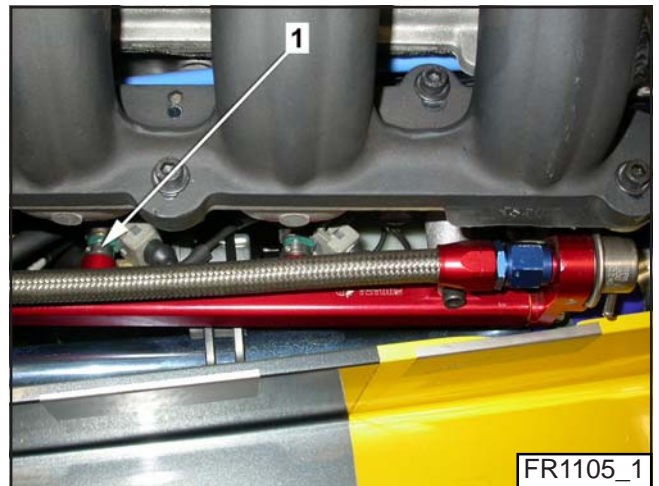
The injector body includes:

- at the rear, a computer-driven magnetic winding,
- at the front, an injector needle guide.

When the magnetic winding is energised, the magnetic core is attracted and the needle moves off the seat, allowing the pressurised fuel to flow through. When the magnetic winding is de-energised, the spring pushes back the needle to its seat and the circuit is closed.

Each cylinder features an injector **(1)** mounted in the intake pipe which sprays petrol upstream of the intake valve.

Injection is said to be the half-sequential, phase-controlled type except during start-up where a special procedure is used in order to produce the best start-up possible.



Start-up

During cold starts, a small proportion of the injected fuel is sprayed and plays a part in combustion. This critical air/fuel metering step is called "side-wall wetting". When the computer detects a starting phase by measuring engine rating, it will carry out asynchronous injections the duration of which will be dependent on water temperature (the four injectors are simultaneously operated for each target tooth). When the engine exceeds 300 RPM, the computer considers that it is normally running and selects the normal procedure by returning to a synchronous operating mode (half-sequential injection).

Start-up is facilitated if the circuit-breaker is used to switch on the system. In such a case, the computer carries out a "cold start" by operating the petrol pump then, upon starter motor signal, triggers side-wall wetting injections.

Using the "IGNITION" push-button in ignition function holds the computer power on. The computer then carries out a "hot start". This procedure, which makes it possible to avoid flooding the engine, is to be used during mechanical repairs or multiple starts close together.

Deceleration cut-off

The injection is cut off during deceleration phases. When the throttle valve is fully closed for an engine rating greater than 4,000 RPM, the injectors are no longer controlled. Injection is restored in either of the following two cases:

- throttle valve opening upper than 3 %,
- engine rating lower than 4,000 RPM.

Battery voltage correction

The battery delivers a 12 V rated voltage. According to operating conditions, this voltage may vary from 8 V to 16 V and affect injector mechanical opening time. This so-called "dead time" increases when the battery voltage decreases. In order to compensate for the opening time, the injection time actually applied to the injectors is corrected as a function of battery voltage.

Down-graded mode of operation

This function allows the injection computer to carry out a self-diagnostic based on input parameters, to alert the driver about an abnormal measurement through a dashboard warning device and to store intermittent failures for further look-up using a display tool. The alarm will remain activated on the dashboard as long as the fault is present. The stored alarms are maintained if the engine is shut down using the "IGNITION" push-button. They will be lost if the system is cut off using the main circuit-breaker or if the battery or the computer is disconnected. If it remains powered, the latter holds a diagnostic code in storage, to be further used for trouble-shooting.

Should there be an abnormal parameter, the computer runs in the down-graded mode applying a default value for the defective input. These default values are:

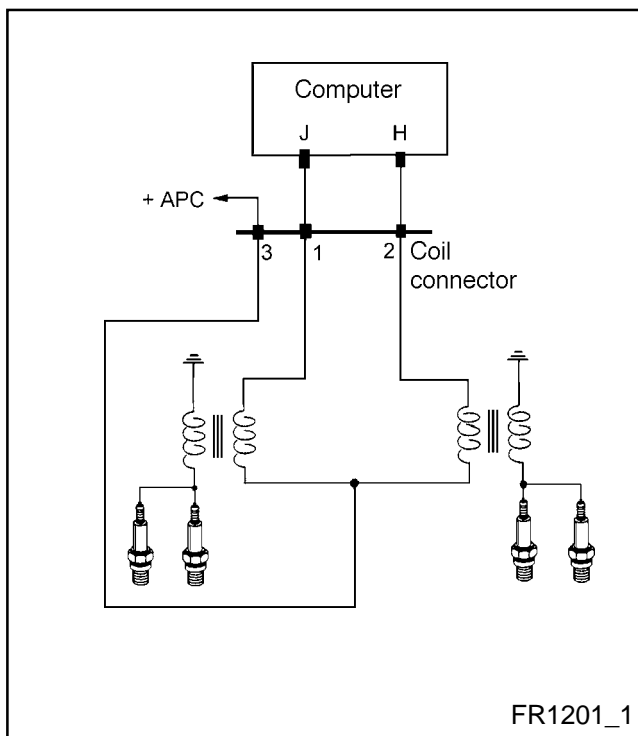
- Air temperature: 28 °C.
- Water temperature: 80 °C.
- Throttle valve potentiometer: 98 %.
- Intake pressure: reconstituted from a throttle valve rating indexed mapping.

GENERALITES

The static ignition system has been designed for increasing the power quantity applied to ignition plugs by suppressing any intermediate device between plugs and coils.

The system includes:

- a computer including the ignition power stage,
- a module composed of two dual output coils,
- four ignition plugs.



FR1201_1

COMPUTER

Depending on the data received from the various sensors, but mainly as a function of engine rating and load, the computer **(1)** determines:

- the number of lead angle degrees to apply and consequently the ignition point,
- the cylinders at TDC and consequently the coil to be controlled.

It triggers the spark to the two cylinders at TDC by cutting off the relevant coil earth path.



FR1201_2

COILS

Fitted to the intake manifold, both ignition coils **(1)** make up a single module. They cannot be separated.

Individually controlled by the computer, each coil simultaneously delivers two sparks.

- The coil of cylinders 1 and 4 is controlled from computer channel J.
- The coil of cylinders 2 and 3 is controlled from computer channel H.



FR1201_3

IGNITION PLUGS

TIGHTENING TORQUE VALUES (in N.m)	
Ignition plugs	25 à 30
Intake manifold screw	11 ± 2

Characteristics

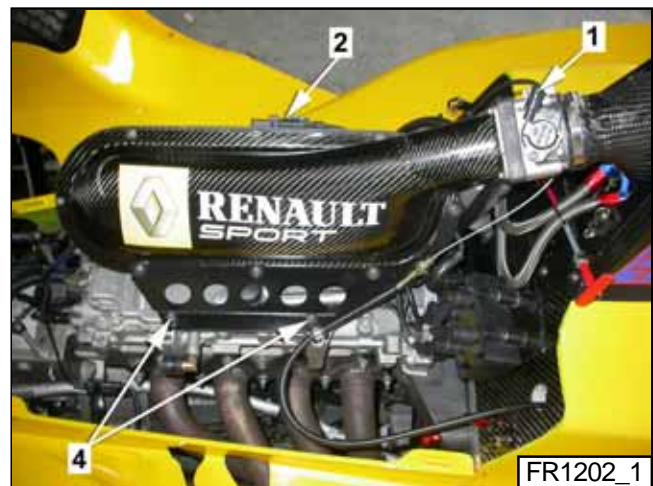
For the engine to operate smoothly, it is compulsory to use the type of ignition plug prescribed.

Flat socket with Resistive type seal.

Manufacturer: NGK
Type: PFR6E-10
P/N: 77 11 155 292

Removal

- Disconnect:
 - the throttle valve potentiometer (1),
 - the intake air pressure sensor (2),
 - the intake air temperature sensor (3),
- Remove:
 - fastening screws of the support (4),
 - fastening screws of the intake manifold (5),
- Release the admission unit on the exhaust side,
- Disconnect and remove ignition blugs.



Installation

- Proceed in the reverse order of removal.
- Install the intake manifold fitted with new seals. Tighten the screws to the prescribed torque starting from the two upper screws.



Compulsory modifications

AIR INLET

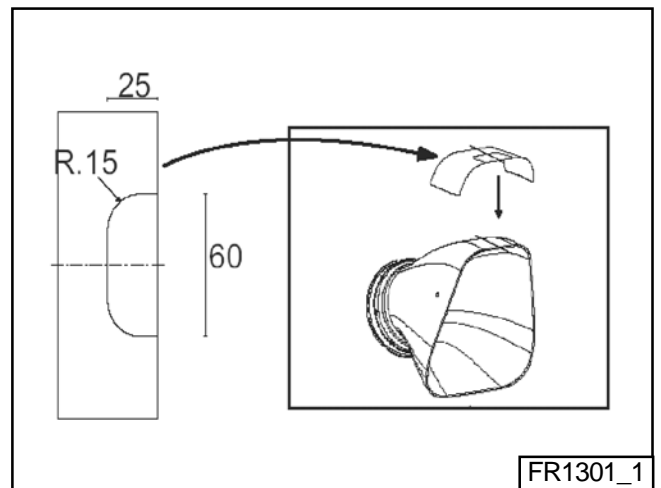
To make easier the installation of the belts of extraction, the air inlet must be modified, as presented below.

This modification will be made by the teams. So we ask them to respect scrupulously the various orders below.

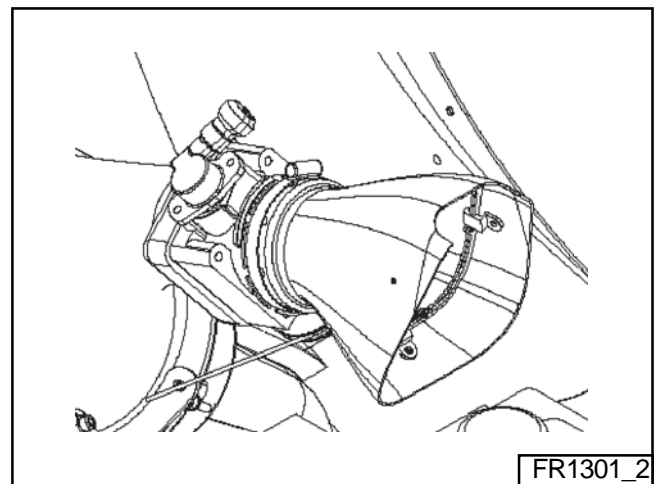
IMPORTANT REMARK:

THE PART TO BE MODIFIED BEING IN CARBON-EPOXY, WE ASK TO THE TEAMS TO MAKE THESE MODIFICATIONS IN A WELL VENTILATED AREA, AND WITH APPROPRIATE TOOLS: BLADE IN CARBIDE-TUNGSTEN, HIGH SPEED OF ROTATION.

- Draw on a piece of adhesive tape the profil presented below by respecting scrupulously coasts; then put the adhesive tape on the air inlet, by centring it suitably.
- Cut then the bailer with an appropriate tool, by following the strip (profile) drawn on the end of adhesive tape.



Obtained result:



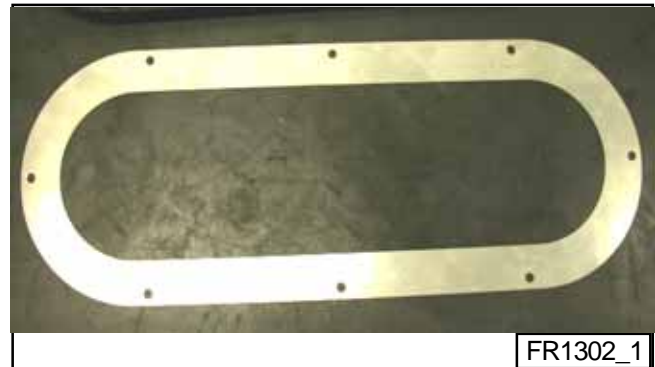
Compulsory modifications

AIRBOX

In order to increase the tightness between the air filter and the airbox, we ask all competitors to modify the Formula Renault 2.0 airbox as explained hereafter.

Required stuff

- The «tightness airbox plate», P/N: 77 11 154 340, has to be used. From now, it is available at the Renault Sport Spare Parts department in Dieppe.



- The use of universal joint « Kent Sili Gasket 2 » or similar is compulsory.



Assembly procedure

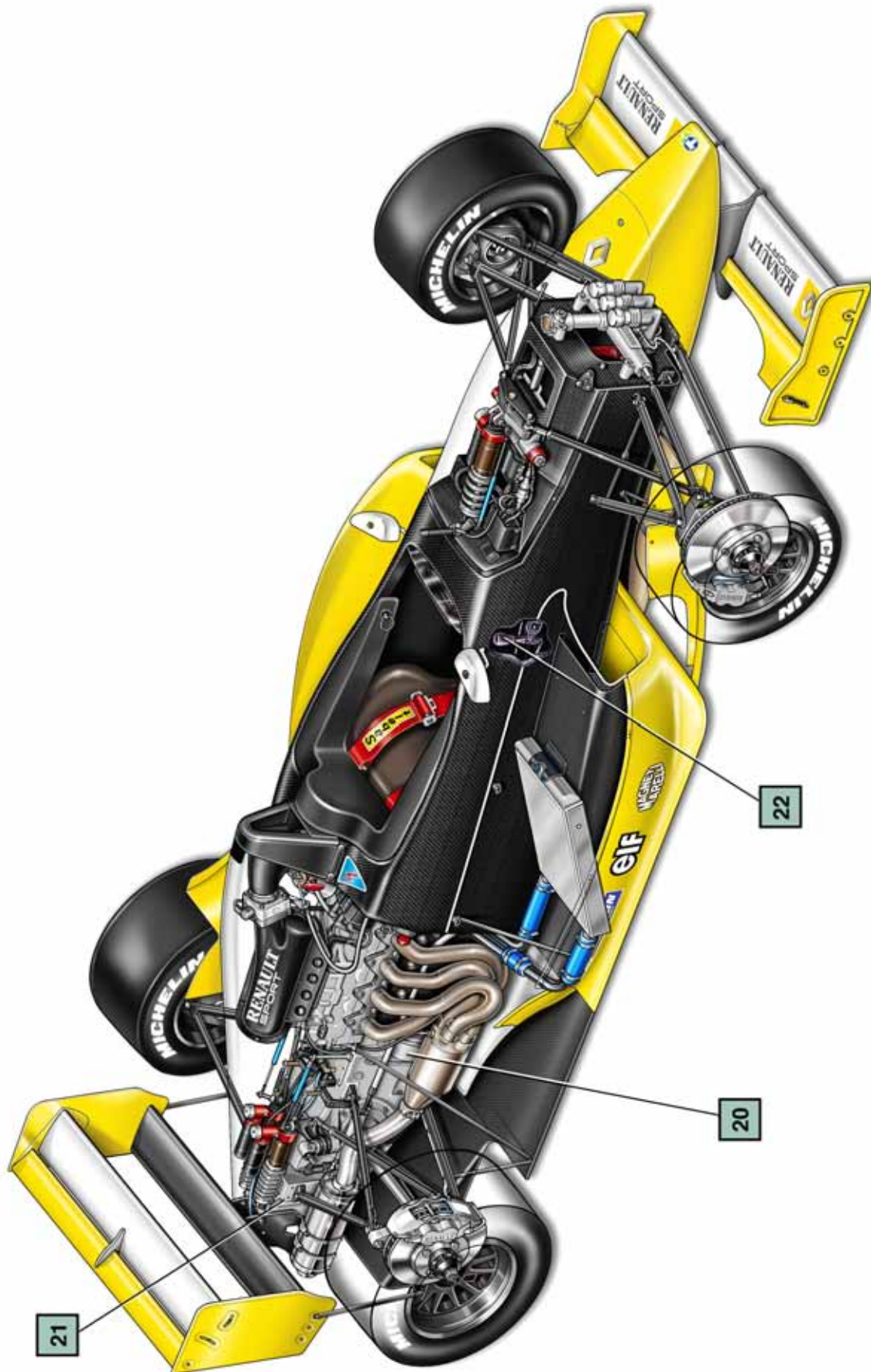
- Dismantle the airbox and the air filter from the intake manifold.
- Degrease and defrost the airbox tightness plane.
- Apply a silicone strip on the airbox tightness plane.
- Mount the tightness plate on the airbox.
- Fix the airbox + plate block on the intake manifold, without the air filter, and tighten the 8 assembling nuts.
- Let the joint dry 8 hours minimum.
- Dismantle the intake system and cut the joint in excess.
- Reassemble the intake elements with the air filter.



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POWER DRIVES

Exploded view

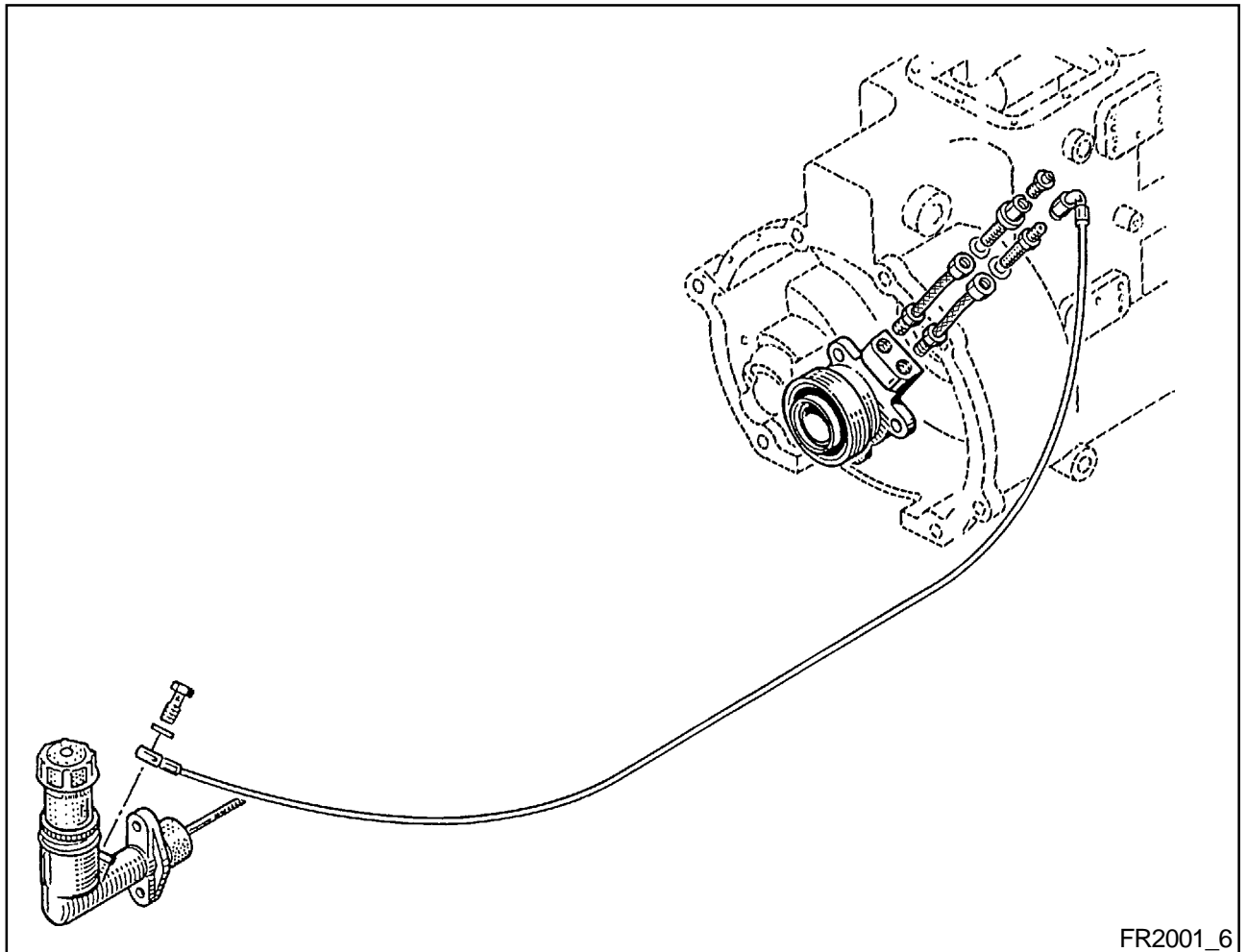


CLUTCH Identification

20

				
<p>FR2001_1</p>	<p>FR2001_2</p>	<p>FR2001_3</p>	<p>FR2001_4</p>	<p>FR2001_5</p>
<p>Mechanism Type: ALCON</p>	<p>Thrust plate</p>	<p>Friction disc 1 Diameter: 5" 1/2 Splines: 23 Pressure angle: 30° Material: cerometallic</p>	<p>Intermediate thrust plate</p>	<p>Friction disc2 Identical to friction disc 1</p>

Exploded view



CLUTCH

Description

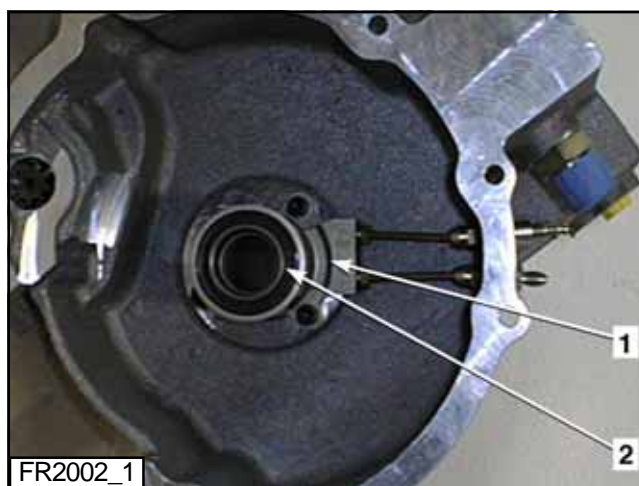
20

The clutch is dual-disc with hydraulic control (1), runs dry. It is installed on the front of the engine oil housing forming the clutch housing. It contains:

- a diaphragm clutch plate,
- hydraulic ball bearing (2) in constant abutment,
- 7/10° master cylinder.

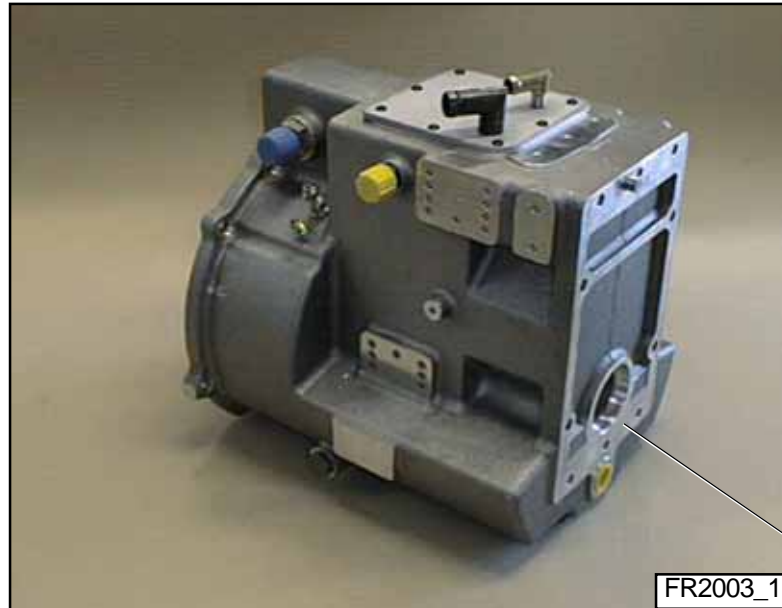
NOTE: Overhaul of the master cylinder requires use of **Renault** repair kit P/N: 77 11 150 528.

NOTE: It is permitted to install a fast coupler on the clutch hydraulic circuit.

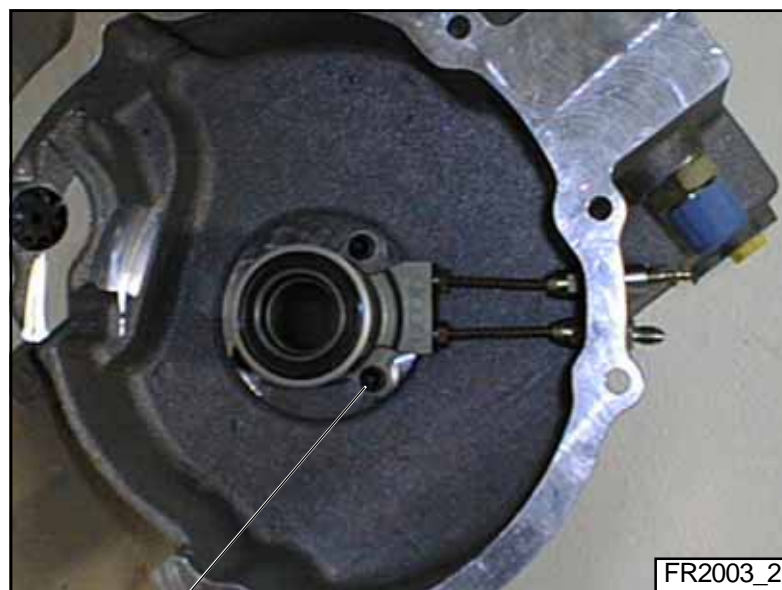


Products

Type	Organe
Copper grease	Clutch or gearbox output shaft.
DOT5 hydraulic fluid	Clutch system
Loctite 222 low-strength threadlocker	Housing mounting bolt
Loctite 243 medium-strength threadlocker	Hydraulic bearing mounting bolt
Loctite 518 sealing compound	Box/housing mating plane



Gearbox/housing mating plane:
Loctite 518 sealing compound



Hydraulic bearing bolt: 22 N.m
Loctite 243 medium-strength threadlocker

REPLACEMENT

SPECIAL TOOLS REQUIRED

OUT 008 5002	Centring tool
--------------	---------------

TIGHTENING TORQUE VALUE (in N.m)

Mechanism screw	22.5
-----------------	------

Removal

- Remove the gear box.
- Install centring tool **OUT 008 5002** (to prevent friction disc from falling).
- Remove attaching screws from mechanism **(1)**.
- Remove mechanism, thrust plates **(2)** and friction devices **(3)**. Mark order and direction of installation.
- Remove attaching screws from mechanism **(1)**.

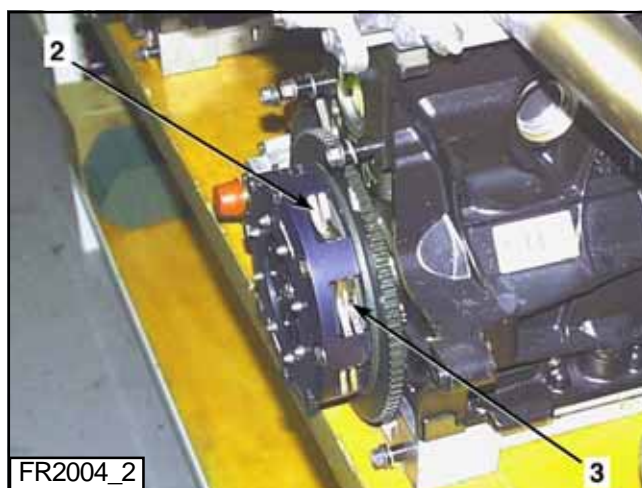


Installation

- Degrease flywheel attaching face.
- Slightly smear clutch shaft splines with copper grease.
- Install thrust plates and friction devices in the order marked on removal.

NOTE: *Observe direction of installation of discs: shift largest hub turned towards clutch mechanism.*

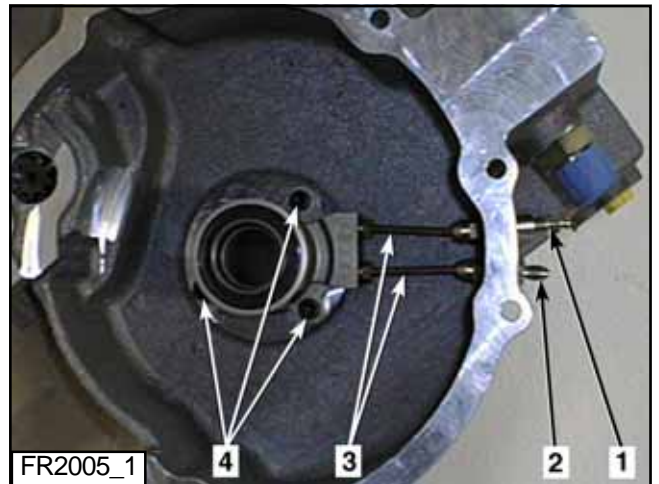
- Install clutch mechanism and secure using screws **(1)**. Progressively tighten in a star pattern then apply the prescribed torque.
- Remove both centring tool and retaining quadrant.
- Install the gear box.



REPLACEMENT

Removal

- Remove the gear box.
- Drain hydraulic lines.
- Remove connector **(1)**, bulkhead union **(2)** and the two pipes **(3)**.
- Remove the three bolts **(4)** fastening the clutch stop. Remove stop.



Installation

- Clean with a M7x100 tap, then remove grease from bolts and tappings.
- Slightly tighten pipes onto clutch stop.

NOTE: *Lubricate end fittings on pipes with hydraulic stop oil so as to seal them.*

- Take threads on connector **(1)** and bulkhead union **(2)** up onto the two pipes **(3)** then position stop.
- Put a few drops of Loctite 243 medium-strength threadlocker on bolts. Fasten clutch stop onto housing. Torque bolts to 22 N.m.
- Slightly tighten connector and bulkhead union.
- Bleed hydraulic system for connector plug **(1)**.

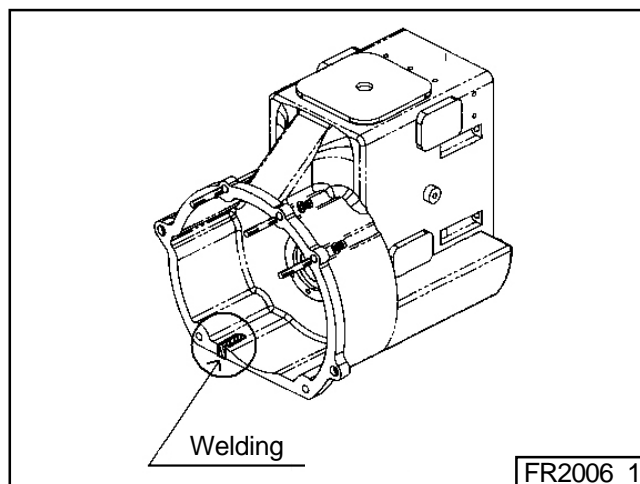
NOTE: *When tightening bleed plug, correctly secure connector with an open-end wrench. Risk of damaging system sealing.*

- Check sealing of assembly.

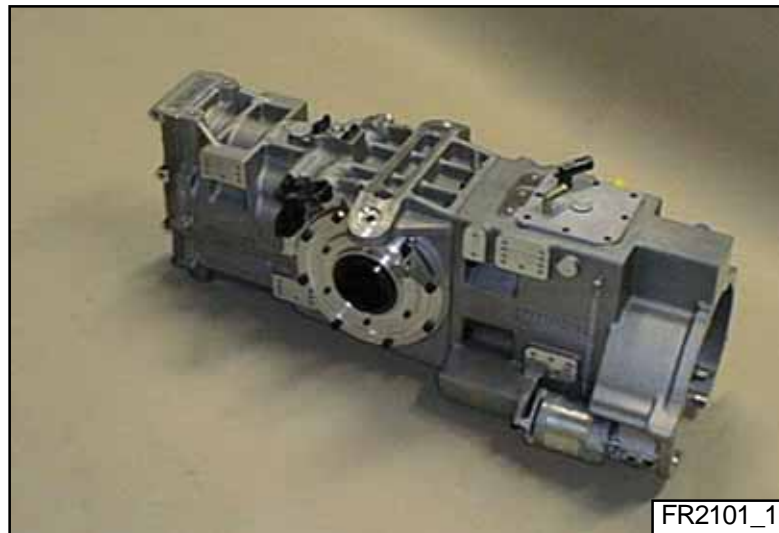
REPAIR

Housing crankcase near the starter

In case of crack of the clutch housing near the starter, according to the drawing, it is authorized to repair by a welding cord on each parts of the housing with a maximum length of 3.5 cm (1.378 in) without any additional part.



PRESENTATION



- The Renault Sport gearbox is a SADEV **SL75/14 FR 2000**, type it has 6 forward gears and one reverse which can quickly be changed.
- The gearbox control is sequential.
- The gearbox is fitted with a ZF limited slip differential; the tripod transmission seals are integrated inside the differential.
- The rev limiter switch is integrated in the gearbox.
- Weight of gearbox assembly without oil casing: 45 kg.

TECHNICAL DATA ON GEARS

Three ratio sets which cannot be combined are available, depending on the circuit characteristics.

Short staging ratios

Cylindrical pair	1st	2nd	3rd	4th	5th	6th
10	12	16	16	18	21	23
31	36	36	29	27	27	26

Engraved
SHORT

Medium staging ratios

Cylindrical pair	1st	2nd	3rd	4th	5th	6th
10	12	17	19	20	20	22
31	34	36	32	28	24	23

Long staging ratios

Cylindrical pair	1st	2nd	3rd	4th	5th	6th
10	14	18	18	21	20	27
31	37	35	28	27	22	26

Engraved
LONG

MANUAL GEARBOX

Characteristics

Reverse ratio

The reverse ratio is constant.

14	transfer
18	
40	

- 5th gear in the short version (21 / 27) is equal as 4th in the long version (21 / 27). The engraving **SHORT** or **LONG** will identify these.
- It is absolutely essential to fit the gears marked **SHORT** in short staging, and those marked **LONG** in long staging.

LSD

- The LSD acts symmetrically on acceleration and deceleration.
- The slopes used on the plates give a friction percentage of 45 %.
- The preload on the LSD in new unused state is 80 m.kg, with a tolerance of -1.5 N.m , + 10 N.m.

NOTE: *The preload on the LSD is measured with a torque wrench.
The gearbox is in neutral, one wheel is blocked and measurement taken on the other wheel.*

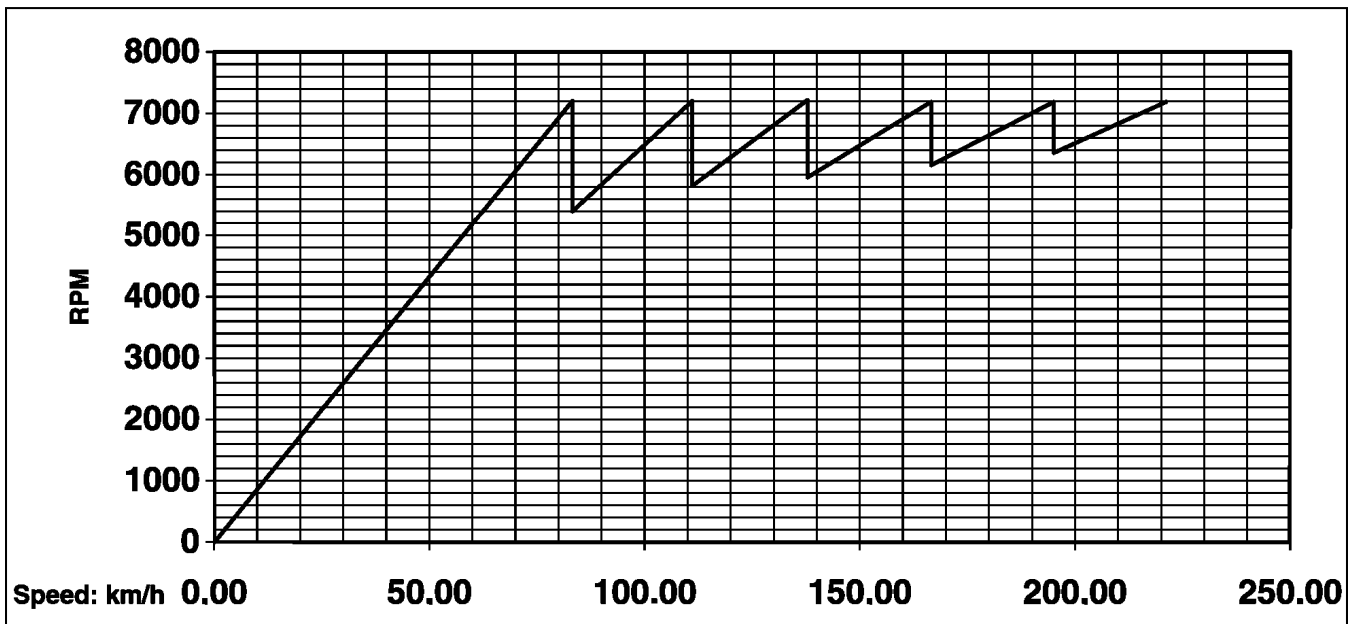
- It is normal for the preload on the LSD to reduce by around 30 % after a period of use.

Gear ratio diagrams

Short ratios

FINAL RATIO: 3.1

	I	II	III	IV	V	VI
Ratio:	12/36	16/36	16/29	18/27	21/27	23/26
	3.00	2.25	1.81	1.50	1.28	1.13
Seed drop:	-	1800	1400	1241	1056	844
Seed in rpm: 7200	83.14	110.85	137.61	166.28	194.86	220.72

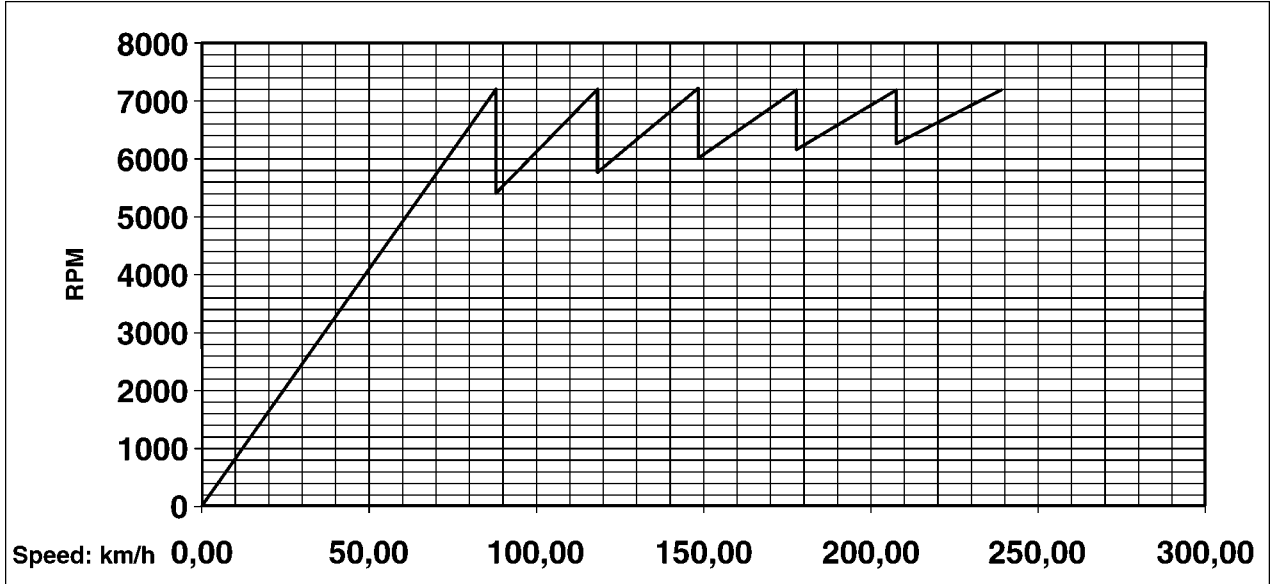


MANUAL GEARBOX

Gear ratio diagrams

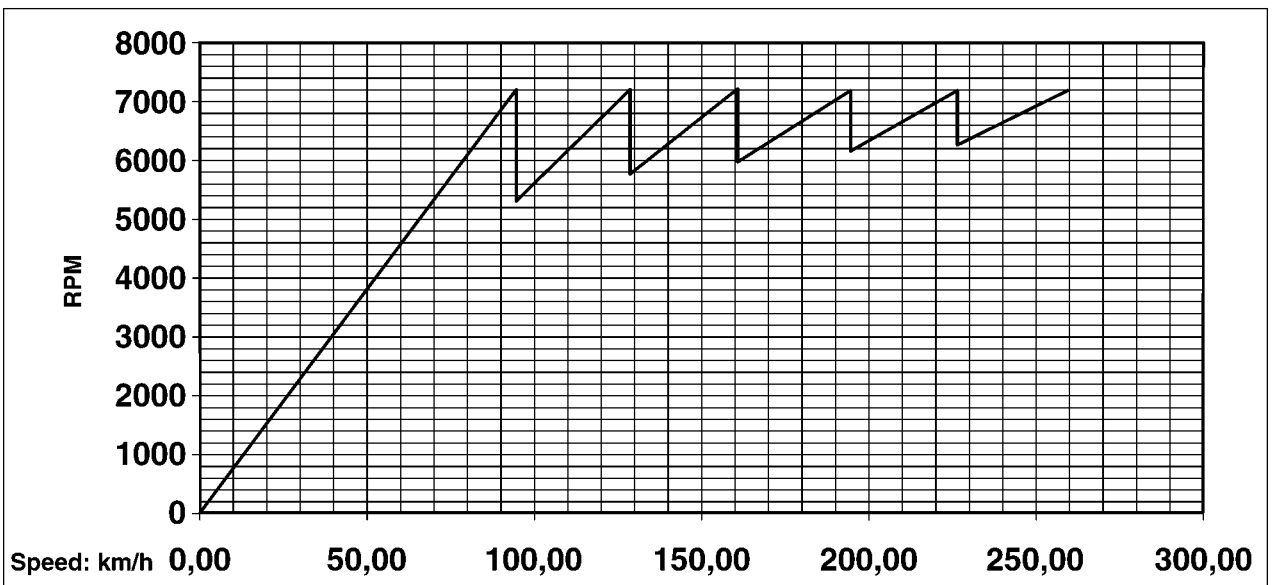
Average ratios

	FINAL RATIO: 3,1						
	I	II	III	IV	V	VI	
Ratio:	12/34	17/36	19/32	20/28	20/24	22/23	
	2,83	2	2	1	1	1	
Speed drop:	-	1831,80	1467,30	1200,00	1028,57	960,00	
Speed in rpm	7200	88,13	118,21	148,46	178,16	207,85	239,82



Long ratios

	FINAL RATIO: 3,1						
	I	II	III	IV	V	VI	
Ratio:	14/37	18/35	18/28	21/27	20/22	27/26	
	2,64	1,94	1,55	1,28	1,10	0,96	
Speed drop:	-	1909	1447	1254	1013	916	
Speed in rpm	7200	94,48	128,57	160,91	194,86	226,74	259,81



Lubricants

Capacity: 1.7 l.

Draining

1st fill	Frequency of change	Viscosity quality
After first 50 km	After every race	ELF HTX 752 SAE 80W140

Level:

- Adjust the oil level to the opening **(1)**.



SPECIAL 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.

PRESSURE WASHING

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

Products

TYPE	ELEMENT
Loctite strong threadlock 270	Primary shaft bolts Secondary shaft nut Reverse rocker bolt Barrel retainer bolt
Loctite normal threadlock 243	Crown bolt
Loctite sealant 577	Reverse pin anti-rotation bolt RENAULT elbow connector
Loctite freinfilet faible 222	Upper and lower closing plate bolt Left/right plate bolt Control closing block bolt
Loctite blockpress 648	Secondary fixing shaft bolt Bevel gear bearing bolt
Loctite blockpress 601	Permaglide ring
Loctite gasket paste 518	Contact faces between gearbox and cover
Dow Corning 732	Contact faces between rear housing and gearbox

SYMBOL	METHODS REFERENCE	MPR No	DESCRIPTION
 FR2106_1	SADEV Ref.	OUT 0085001	Locking plate
 FR2106_2	SADEV Ref.	OUT 0085002	Clutch plate centring pin
 FR2106_3	SADEV Ref.	OUT 0085003	Fork repositioning tool
 FR2106_4	SADEV Ref.	OUT 0085004	Play adjuster
 FR2106_5	SADEV Ref.	OUT 0085005	Spacer
 FR2106_6	SADEV Ref.	OUT 0085006	Roller cage positioning set
 FR2106_7	SADEV Ref.	OUT 0085007	LSD preload tester
 FR2106_8	SADEV Ref.	OUT 0085009	Tool for installing lip seal
	SADEV Ref.	OUT 0085010	Anti-rotation pin for LSD
	FACOM Ref.	U.49D6	Bearing extractor
	FACOM Ref.	U.306G2 U.306M	Inertia extractor

Tightening torques

Indexing bolt: 13 N.m
Loctite low-strength threadlock 222

Pusher guide bolt: 6 N.m
Loctite low-strength threadlock 222

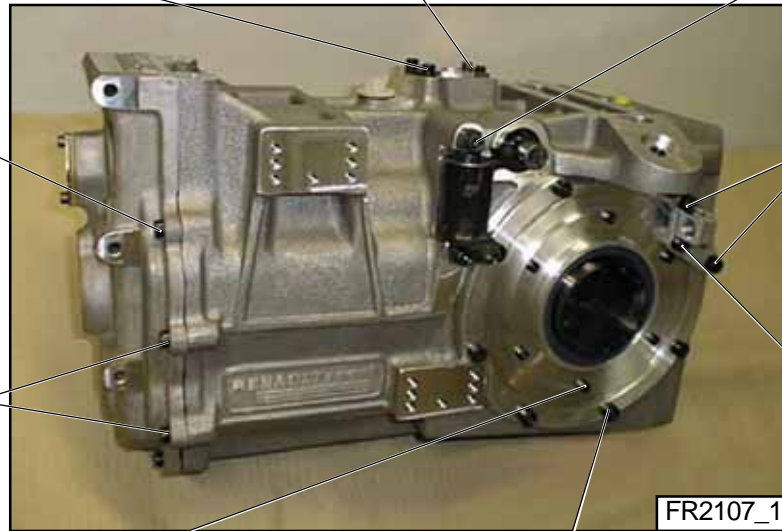
External transfer shaft bolt: 22 N.m
Loctite normal threadlock 243

Joint face between rear casing and gearbox:
Dow Corning 732

Push-pull lock bolt: 25 N.m
Loctite low-strength threadlock 222

Rear casing bolt: 22 N.m
Loctite low-strength threadlock 222

Push-pull lock bolt: 22 N.m
Loctite low-strength threadlock

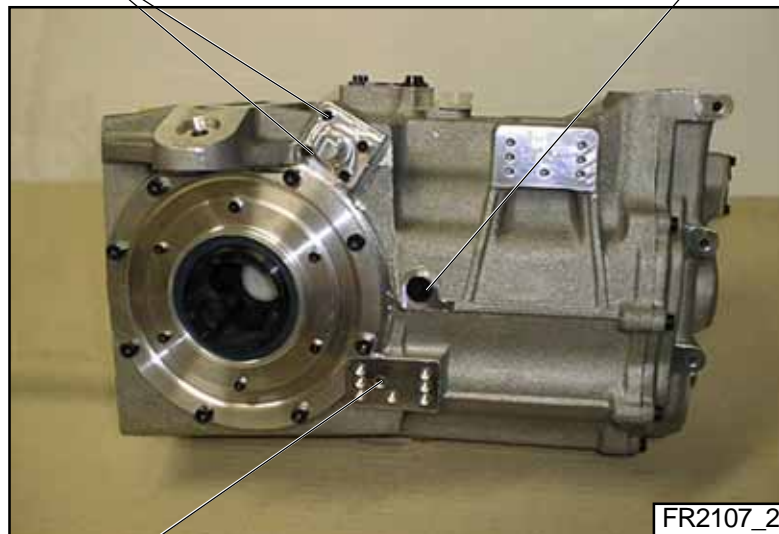


Oil seal plate bolt: 6 N.m
Loctite low-strength threadlock 222

Right hand plate bolt: 25 N.m
Loctite low-strength threadlock 222

Control closing block bolt: 6 N.m
Loctite low-strength threadlock 222

Reverse rocker bolt: 55 N.m
Loctite high-strength threadlock 270



Reverse pin anti-rotation bolt: 22 N.m
Loctite sealant 577

Barrel retainer bolt: 22 N.m
Loctite normal threadlock 243



Secondary shaft nut: 180 N.m
Loctite high-strength threadlock 270

Primary shaft bolt: 100 N.m
Loctite high strength threadlock 270



MANUAL GEARBOX

Tightening torques

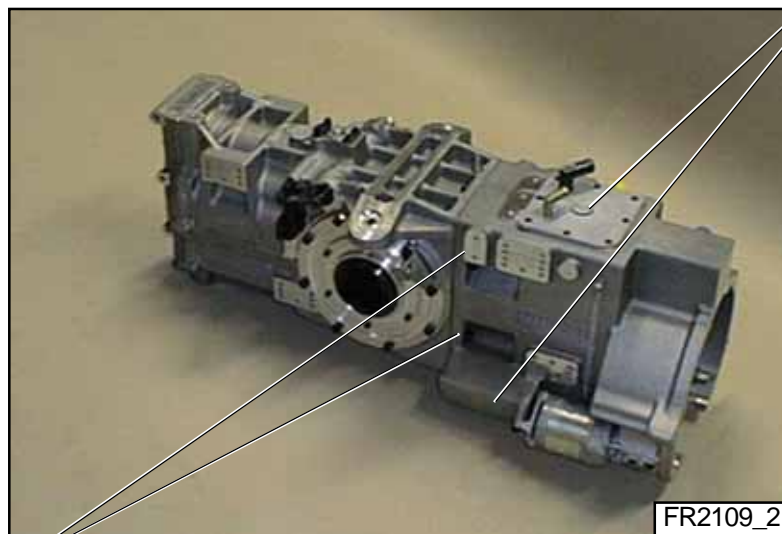
21

Bevel gear bearing bolt: 15 N.m
Loctite normal threadlock 243

Crown bolt: 90 N.m
Loctite blockpress 648



Joint face on upper and lower plates:
Loctite gasket paste 518



Joint face between casing and gearbox:
Loctite gasket paste 518

Gearbox Rebuild

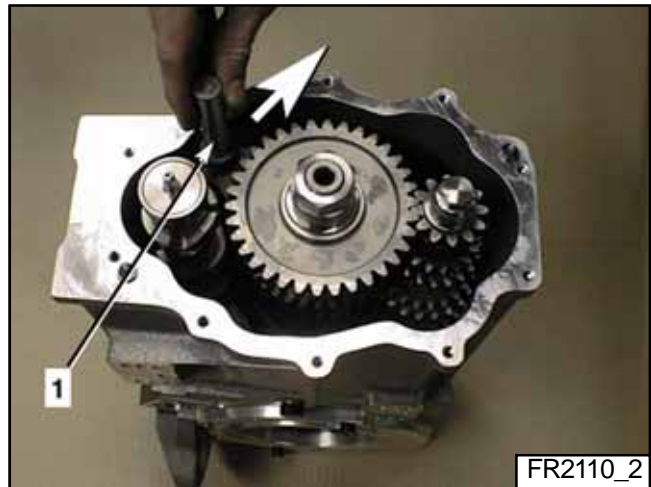
GEARS

Removal

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

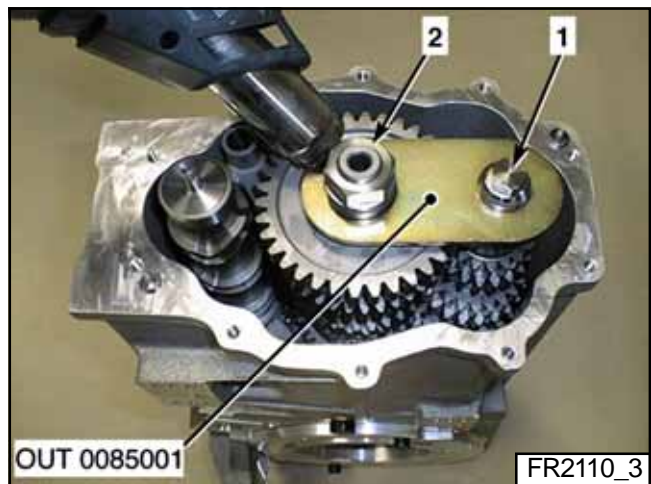


- Remove fork shaft **(1)** and swing forks to release barrel slope control fingers.



- Engage 2nd gear.
- Fit primary and secondary shaft lock plate **OUT 0085001**.
- Remove primary shaft bolt (right-hand thread) **(1)** and secondary shaft bolt (left-hand thread) **(2)**.

NOTE: *These bolts are glued and a hot air gun must be used.*

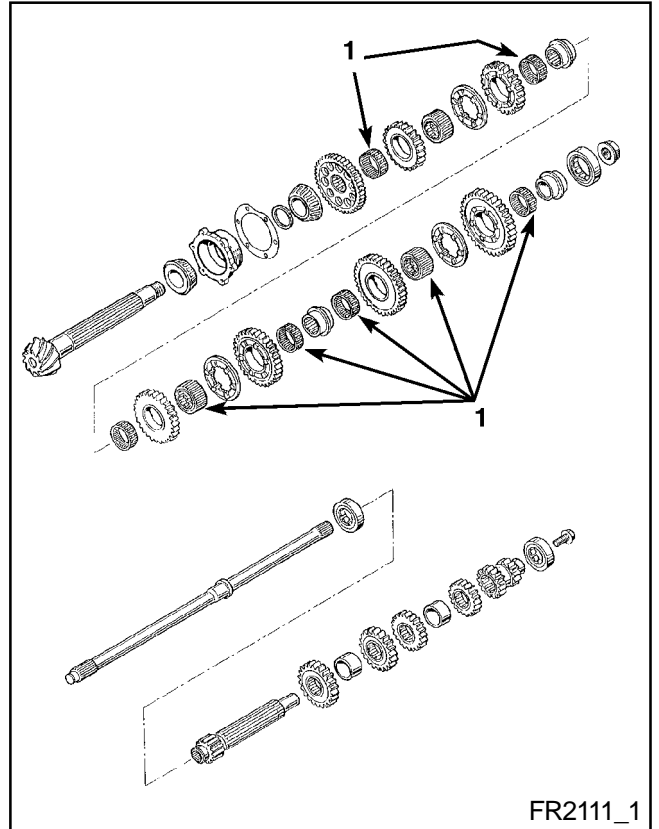


- Remove gears one after the other marking installation direction.

Refitting

CAUTION : *Do not invert the gears so as to ensure their initial rotation direction: risk of breaking teeth.*

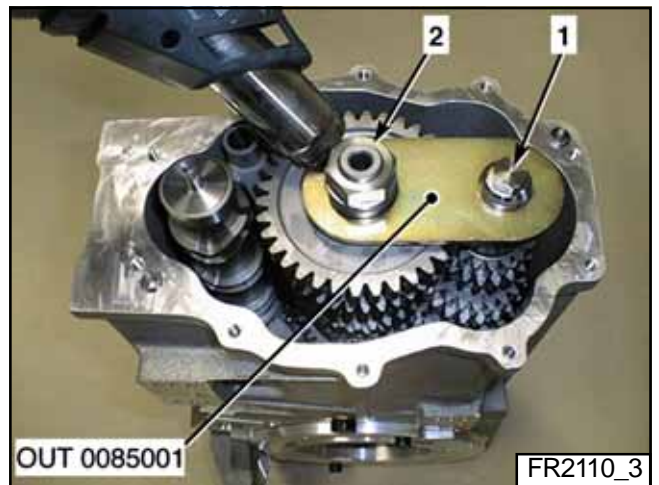
- Clean and check condition of parts.
- Lightly lubricate the needle roller bearing cages using gearbox oil (1).
- Replace gears one after the other in the reverse order from removal.
- Engage 2nd gear to prevent gearbox turning.



FR2111_1

- Mount the primary/secondary lock plate **OUT 0085001**.
- Clean and degrease threads on shafts and bolts.
- Coat primary shaft bolt (1) and thread of secondary shaft (2) with Loctite threadlock 270 and tighten to torques:

- primary shaft bolt: 100 N.m,
- secondary shaft nut: 180 N.m.



OUT 0085001

FR2110_3

- Replace forks in initial locations using the fork repositioning tool **OUT 0085003**.
- Clean the joint face of the rear casing (1).
- Coat the joint face with Dow Corning gasket paste 732.
- Connect potentiometer and ensure that its coupling is still correct: the gear display must indicate reverse.
- Refit rear casing.
- Top up gearbox oil to level stop.



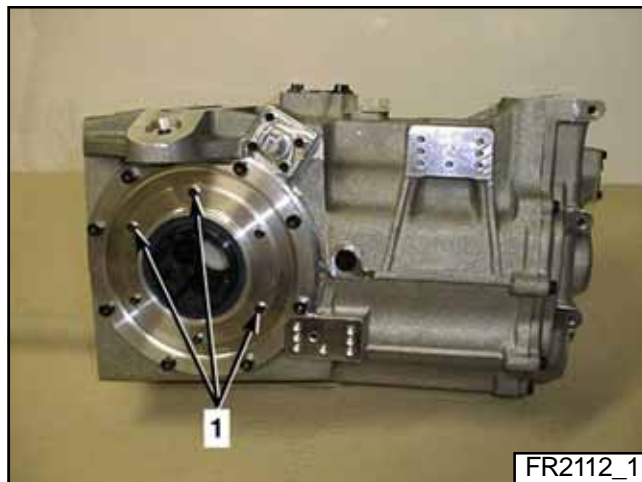
OUT 0085003

FR2111_3

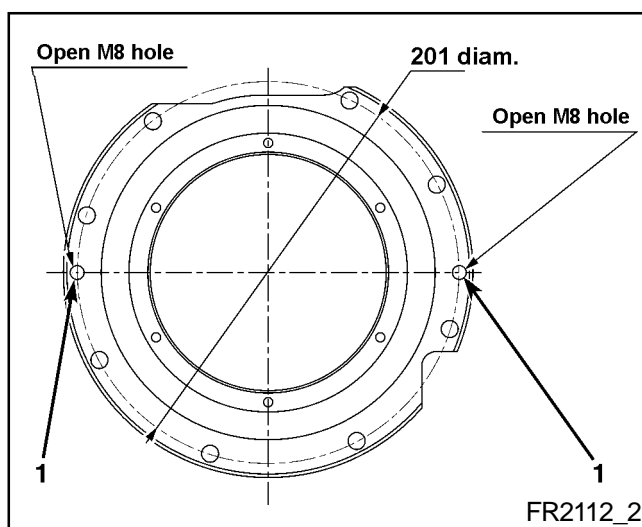
LIMITED SLIP DIFFERENTIAL

Removal of the LSD (without affecting the bevel crown gear)

- Remove only the left-hand oil seal plate (1).



NOTE: Make the two tapped holes (1), as shown in the figure, to make disassembly easier. It is compulsory to observe the dimensions listed.

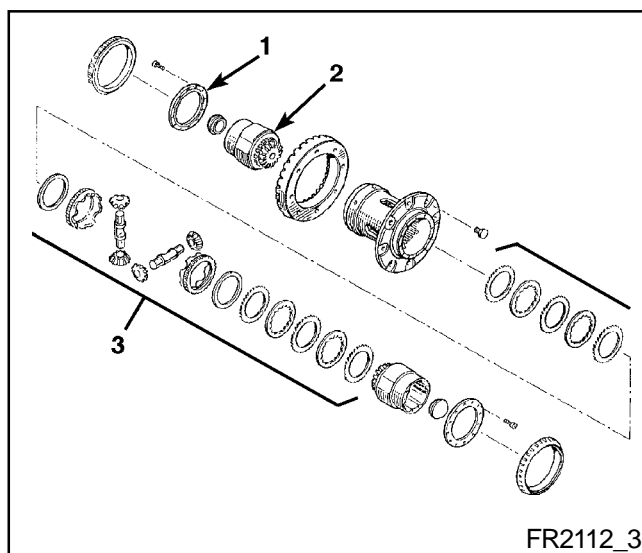


Dismantling of the LSD

- Remove the bevel gear bearing (1).

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

- Remove bevel gear (2).
- Remove the LSD elements (3) one after the other, noting the refitting sequence.
- Check condition of the various parts and housing. Replace faulty parts.



Refitting of the LSD

- Clean parts.
- Using an M6x100 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 **(1)** on the housing using bolts coated with a few drops of Loctite normal threadlock 243, tighten bolts to 15 N.m.
- Check good operation of LSD.
- Check preload on LSD:
 - fit tool **OUT 0085010** on one of the two hollow bevel gears in order to prevent the diff. from turning,
 - check the preload by using a torque wrench and tool **OUT 0085007** positioned on the second bevel gear,
 - this must be between 65 N.m and 90 N.m for a new diff. and between 40 N.m and 50 N.m for a used diff.
- Check the preload.
- If the preload is different from required, replace the spring washers by other ones (with different thickness). Three different thicknesses are available: 1.6, 1.85, and 2 mm.

CAUTION: *Check the real dimensions of the parts before mounting them : The minimum dimensions below must be respected.*

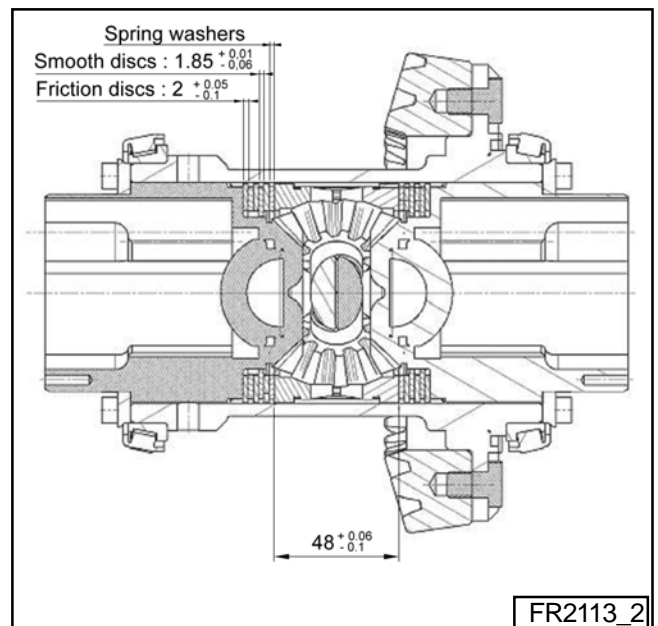
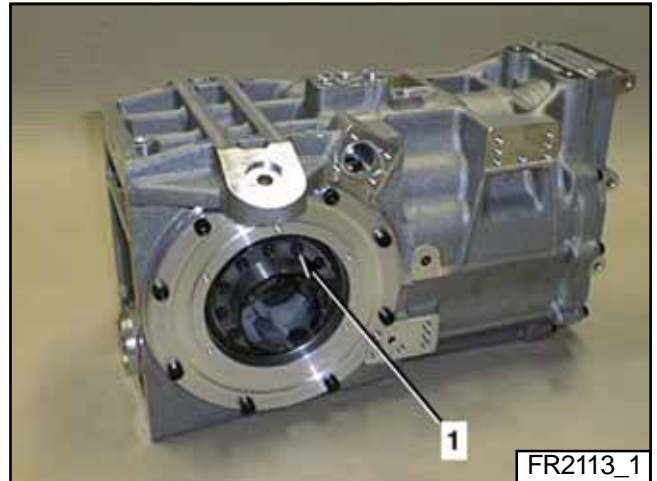
Spring washers : nominal thickness -0.08 mm
 Smooth discs : -0.06 mm
 Friction discs: +0.05 / -0,1 mm

For information, for a used LSD:

- Brand new smooth discs (1.85 mm thick) and friction discs (2 mm thick) + 1.6 mm spring washer 5 m.kg. preload.
- Mid-used smooth and friction discs + 1.85 mm spring washer 4 m.kg. preload.
- Used smooth discs (1.79 mm) + used friction discs (1.94 mm thick) + 2 mm spring washer 4.5 m.kg. preload.

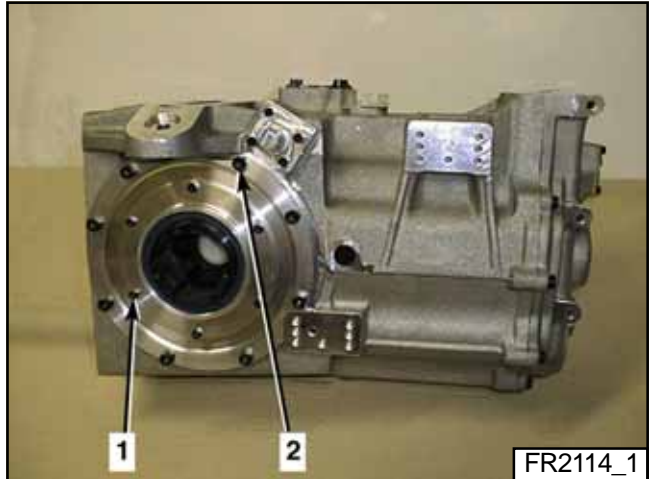
Refitting of the LSD

- Clean the joint face of the oil seal plate.
- Using an M5x80 tap, clean and degrease the threads on the casing and bolts.
- Check condition of O-ring seal and lip seal.
- Attach the oil seal plate to the gearbox using bolts coated with a few drops of Loctite low-threadlock 222. Tighten bolts to 6 N.m.



Removal of the LSD crown wheel

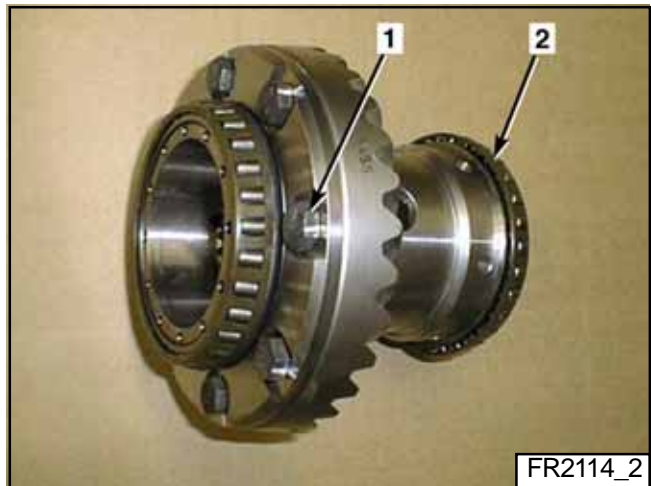
- Drain the box through the lower drain plug.
- Remove the right-hand (remove push-pull stop tripod) and left-hand oil seal plates (1).
- Remove left-hand plate (2).
- Extract the LSD assembly.



Disassembly of the LSD crown wheel

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

NOTE: *The bolts are glued and a hot airgun must be used.*

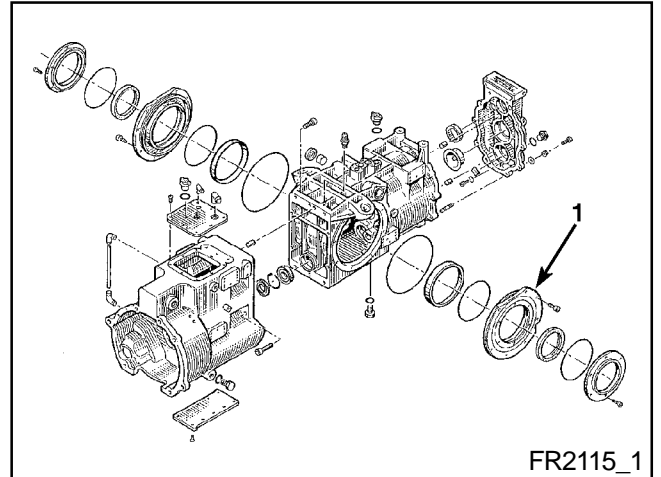


Re-assembly of the LSD crown wheel

- Using an M10x100 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 90 N.m.
- Replace bearing then bevel gear bearing (see corresponding paragraph).
- Adjust the various plays: bearing preload, check tothing play (see corresponding paragraph on removing secondary shaft).

Re-fitting of the LSD crown wheel

- Clean joint face on left-hand plate **(1)**.
- Using an M8x125 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 25 N.m, while turning the differential in order to position the tapered roller bearings properly.
- Using an M5x80 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 6 N.m.
- Check condition of O-ring and lip seal.
- Top up oil in the gearbox to the stop level.



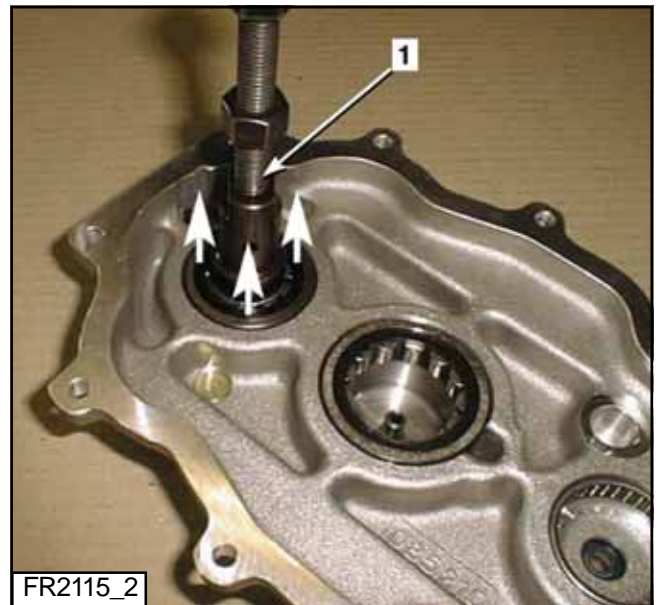
REPLACEMENT AND ADJUSTMENT OF VARIOUS BEARINGS

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.
- Remove lip seal from potentiometer
- Heat rear casing to 120 °C.
- Fit an extractor U.49D6 **(1)** on the primary shaft bearing and extract using an inertia extractor.

NOTE: 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 corresponding paragraph).
- Remove primary shaft.
- Remove LSD assembly (see corresponding paragraph).
- Remove bearing by tapping from the inside of the differential casing.

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

Refitting of primary shaft bearing

- 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.

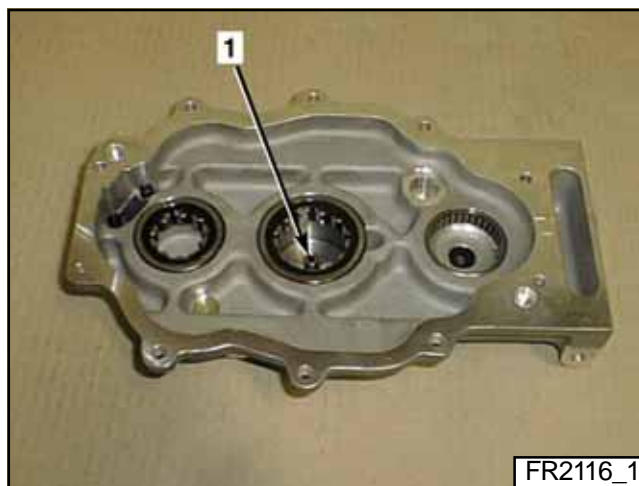
Removal of the secondary shaft bearing

- Remove the potentiometer lip seal
- Heat the rear casing to 120 °C.
- 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.

NOTE: *Check that the bearing housing and spline have not been damaged on dismantling.*

Refitting the secondary shaft bearing

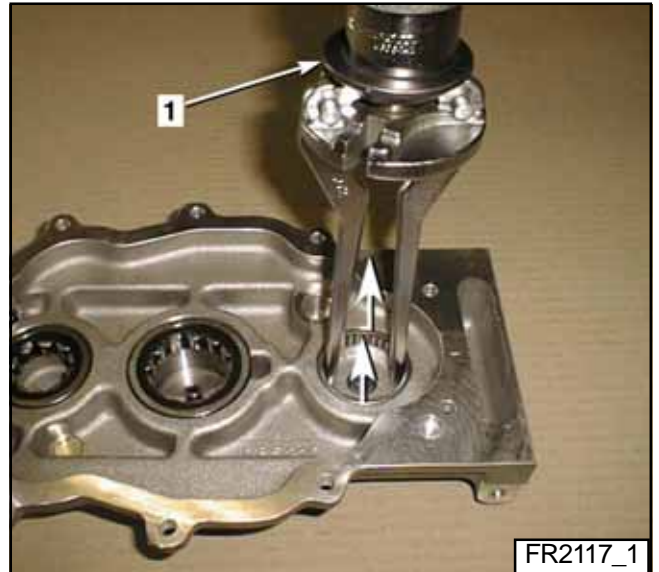
- Refit spline **(1)** at the bottom of the bearing housing.
- Apply a small quantity of Loctite "fixing product" 603 on the outer bearing cage.
- Press fit bearing on the rear casing ensuring this is well seated at the bottom of its housing.
- Install the bearings on the differential side (see corresponding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



Removal of the rear casing side barrel bearing

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

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



Refitting the rear casing side barrel bearing

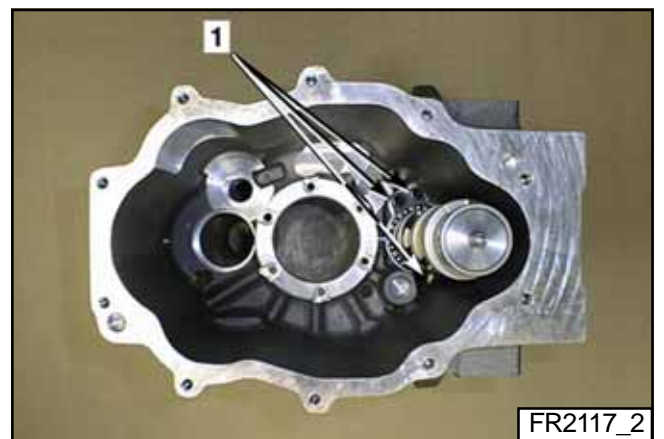
- Apply a small quantity of Loctite "fixing product" 603 on the outer bearing cage.
- Press fit the bearing on the rear casing ensuring this is properly seated at the base of its housing.

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

Removal of the differential side barrel bearing

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

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



Refitting of the rear casing side barrel bearing

- 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 corresponding paragraph).

Removal of the differential bearing

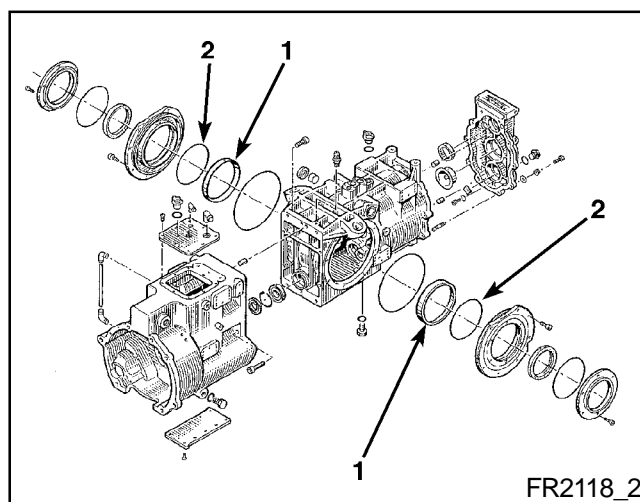
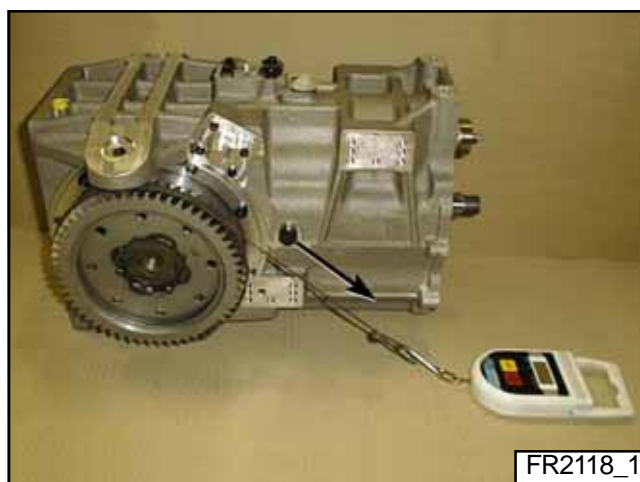
- Drain the box through the lower drain plug.
- Remove gears (see corresponding paragraph).
- Remove right-hand (remove the push-pull locking tripod) and left-hand oil seal plates.
- Remove right-hand and left-hand plates.
- Extract the LSD assembly.
- Remove left-hand and right-hand bevel gear bearings and LSD elements (see corresponding paragraph).
- Remove right-hand and left-hand tapered roller bearings.
- Separate bearing shells and shims for the right-hand and left-hand plates.
- Remove secondary shaft (see corresponding paragraph).

Refitting of the differential bearing

- Press fit the tapered roller bearings on the LSD casing.
- Refit the bearing shells and shims on the left-hand and right-hand plates.
- Refit the LSD assembly (see corresponding paragraph).

Check preload on differential bearings

- Refit right-hand and left-hand plates without glue and tighten bolts to 25 N.m.
- Check the preload on the LSD bearings using a torque wrench and a tool **OUT 0085007** to measure the load necessary for rotation. This must be between 3.4 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 and left-hand plates and bearing shells (**1**), and adjust thickness of the shims (**2**).
- Refit the plates.
- Rotate the differential to position the tapered roller bearings correctly.
- Check the preload.
- Once the correct preload has been obtained, check the thickness of the two shims.
- Refit secondary shaft (see corresponding paragraph), and adjust operating play on the conical pair (see corresponding paragraph).

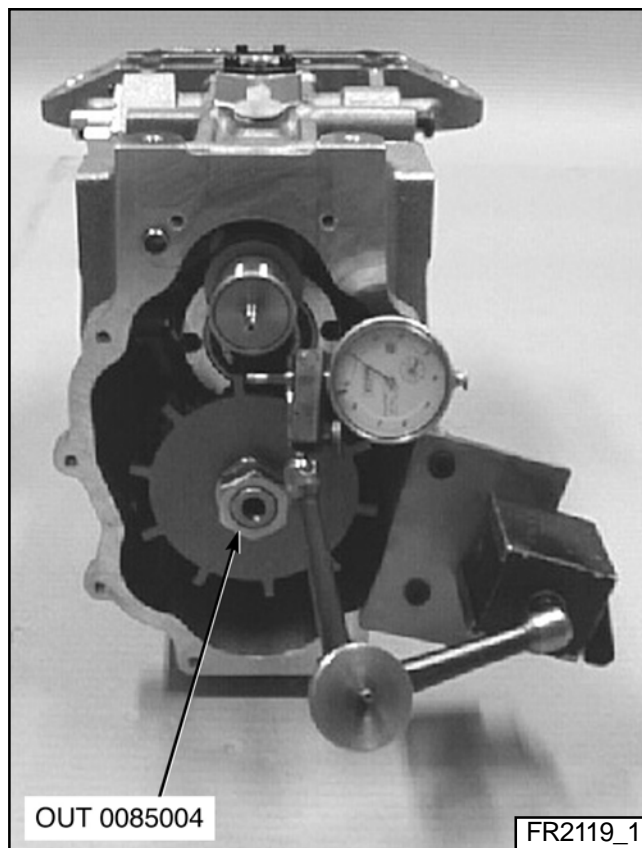


ADJUSTMENT OF OPERATING PLAY ON CONICAL PAIR

- Drain the box via the lower drain plug.
- Remove gears (see corresponding paragraph).
- Fit tool **OUT 0085004** and **OUT 0085005** on the secondary shaft and tighten the secondary shaft nut to 180 N.m.
- Check the inter-tooth play using a comparator placed on tool **OUT 0085004** (play 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 oil ring plates and the right-hand and left-hand plates, 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 sufficient, 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.
- Recheck play.

CAUTION: *Keep the total thickness of the two shims constant so as not to affect the preload on the bearings.*

- Once the play has been checked, refit the LSD (see corresponding paragraph).
- Refit gears (see corresponding paragraph).

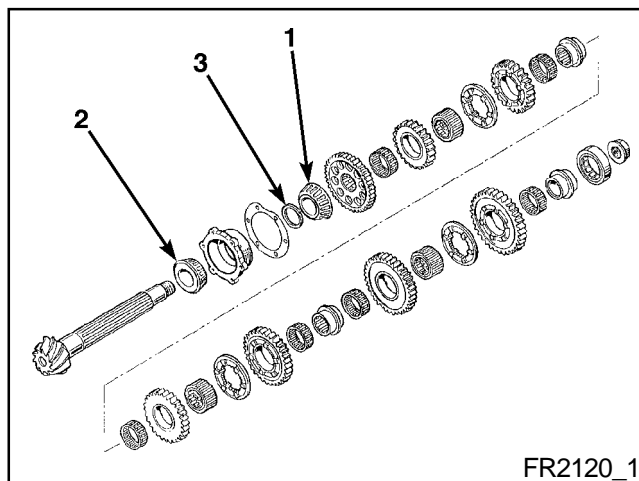


SECONDARY SHAFT

Removal

- Drain the box through the lower drain plug.
- Remove gears (see corresponding paragraph).
- Remove LSD (see corresponding paragraph).
- Remove secondary shaft fixing bolts **(4)**.
- Remove secondary shaft by tapping on its end with a mallet (do not damage the thread) and withdrawing this through the differential housing.
- Withdraw bearing **(2)**, and preload brace **(3)**.
- Remove bearing cage by heating the casing uniformly to 120 °C around the zone concerned.

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

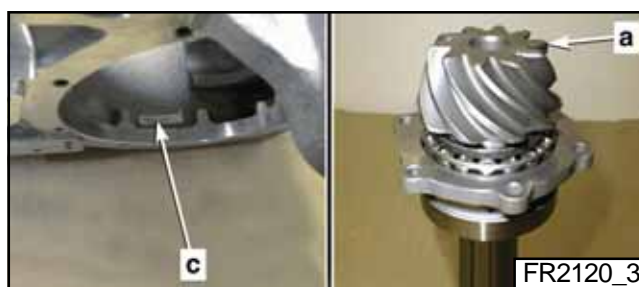


Refitting

- Using an M7x100 tap, clean and degrease the bearing cage threads and bolts.
- Clean the joint faces of the left-hand and right-hand plates.
- Using an M8x125 tap, clean and degrease the casing threads and bolts.



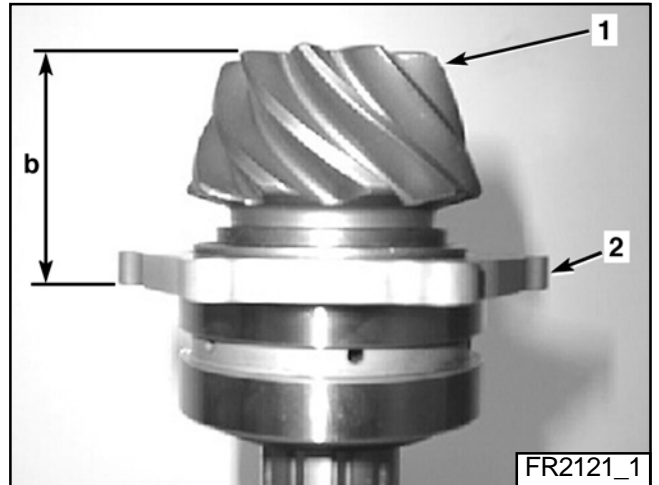
- Calculate advance and thickness **e (5)** of the shims:
 - press fit the preload assembly of brace-bearing-case on the secondary shaft. Fit brace **OUT 0085005** and tighten the secondary shaft nut to 180 N.m,
 - note the value marked on the top of the secondary shaft pinion **(a)**, and that on the bottom of the LSD casing **(c)**,



- measure dimension **(b)** between the upper face of the secondary shaft pinion **(1)** and the lower face of the bearing cage **(2)**,
- perform the following operation:

exemple

a	(1)	60,95
b	(2)	48,98
a + b	(3)	109,93
c	(4)	110,449
e = (4) - (3)	(5)	0,519

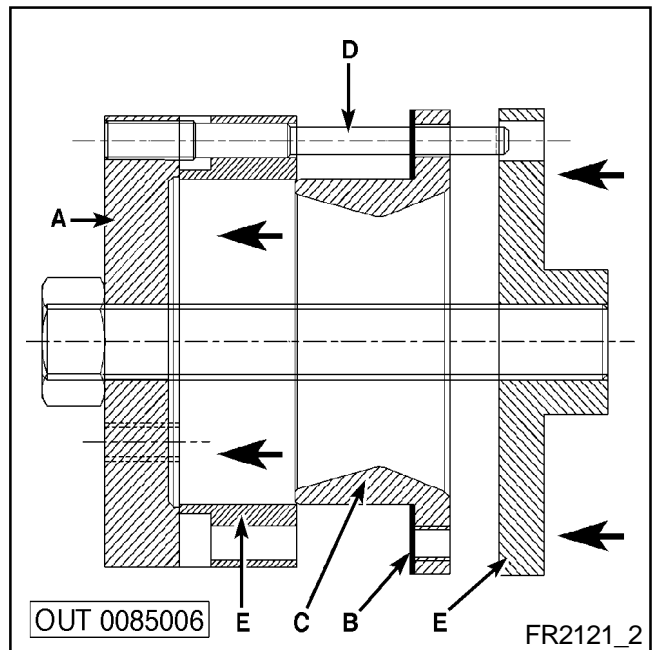


Replace the secondary shaft

- Remove cage and bearing from the secondary shaft **(1)**.
- Fit the backplate **(A)** of tool **OUT 0085006** on the casing.
- Taking care not to damage backplate **(A)**, heat the gearbox casing until the temperature of the roller cage housing is 120 °C.
- Fit shim thickness **e (B)** on the roller cage **(C)** (see calculation of the previous chapter).
- Position the cage on the centring pins of tool **(D)** so that its bores coincide with those on the shim and casing **(E)**.
- Fit support plate **(F)** on tooling.
- Tighten the nut of backplate **(A)** in contact with the retaining of the bell race **(C)** with the housing.
- 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.
Tighten bolts to 30 N.m.
- Refit secondary shaft preload brace and bearing **(1)** on the cage.

NOTE: *Ensure that the two tapered roller bearings are in contact with the cage.*

- Refit LSD.
- Check the operating play of the conical pair (see corresponding paragraph).
- Top up the gearbox oil to the level.

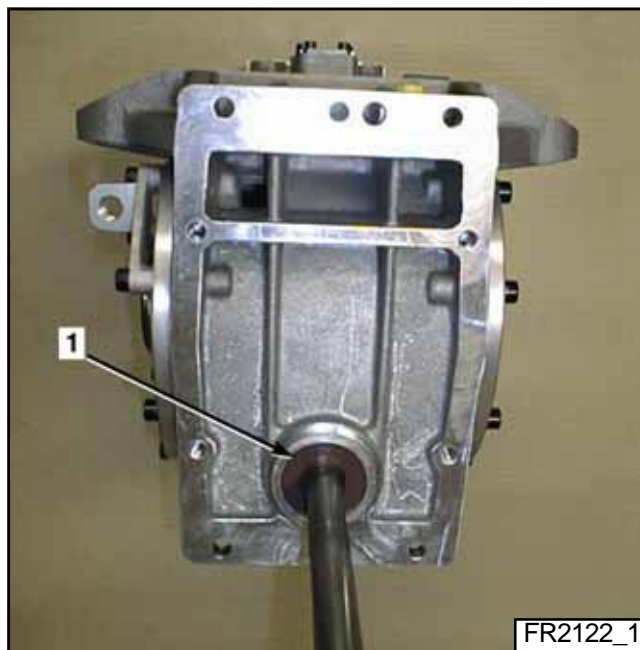


CLUTCH SHAFT

Removal

- Destroy lip seal **(1)** to remove.
- Remove circlips **(2)** behind the seal.
- Remove clutch shaft.
- Remove clutch shaft bearing.

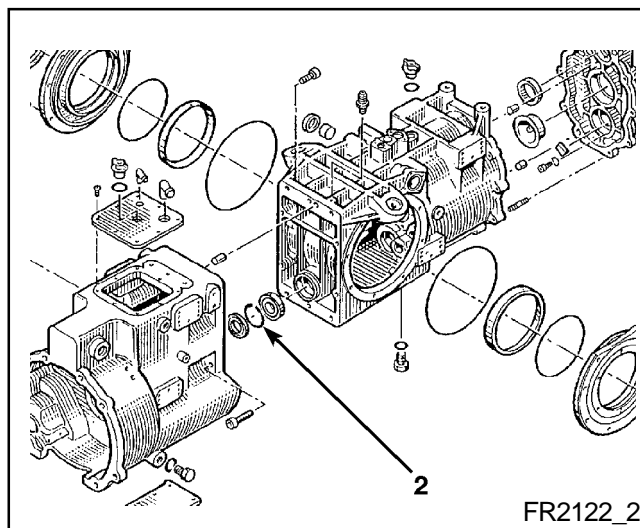
NOTE: *If the clutch shaft is seized in the primary shaft, remove the rear casing and bolt on the primary shaft, then insert a shaft 10 diam. inside the primary shaft and tap the clutch shaft to release.*



FR2122_1

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 with circlips **(2)**.
- Apply tool **OUT 0085009** on the splines then fit the new lip seal in place.

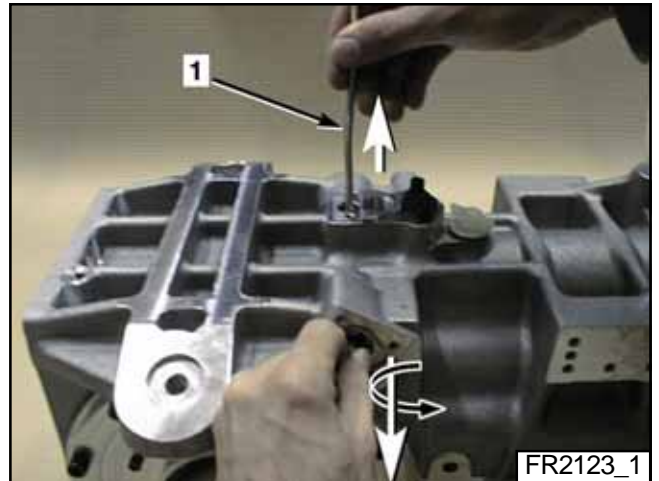


FR2122_2

SELECTION

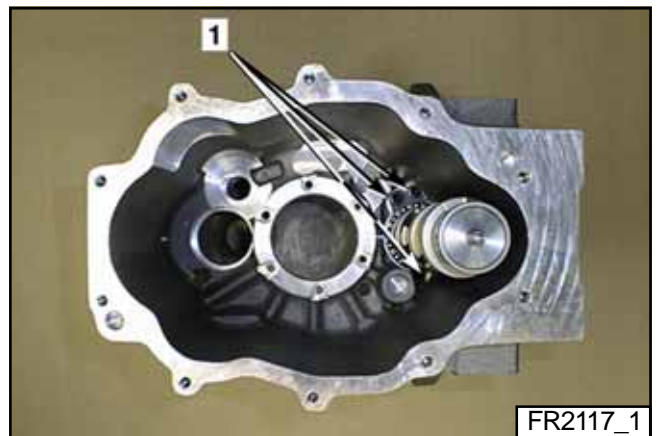
Removing the control lever

- 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.



Removal of the selector barrel

- Remove all gears (see corresponding paragraph).
- Remove reverse gear rocker (see corresponding paragraph).
- Remove indexer guide.
- Remove the three bolts **(1)** of the barrel retainer bearing and extract barrel.

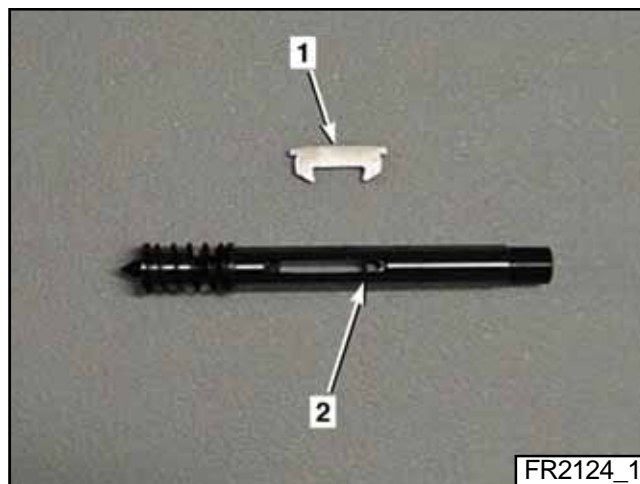


Refit selection barrel

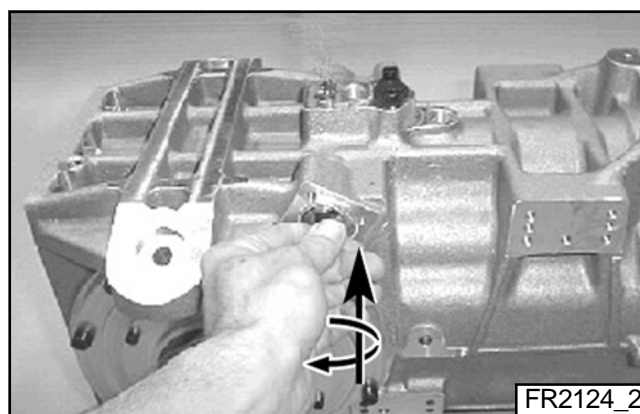
- Proceed in the reverse order from removal.
- Clean and degrease the three fixing bolts **(1)** of the retainer and the reverse gear rocker bolt.
- Apply a few drops of Loctite normal threadlock 243 on the bearing retainer bolt and Loctite high-strength threadlock 270 on the reverse gear rocker bolt. Tighten as follows:
- Bearing retainer bolt: 22 N.m
- Reverse gear rocker bolt: 55 N.m
- Refit indexer guide and tighten bolts to 13 N.m, after coating with a few drops of Loctite low-strength threadlock 222.

Refit control lever

- 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 M5x80 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 6 N.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 6 N.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 22 N.m.
- Refit push-pull cable on external transfer.



FR2124_1



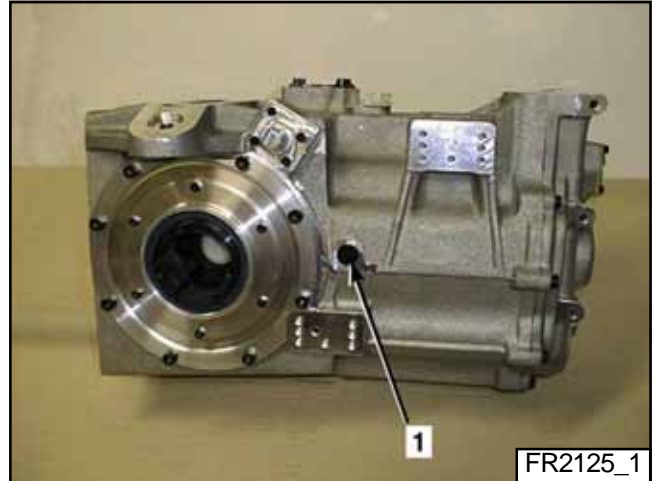
FR2124_2

Gearbox Rebuild

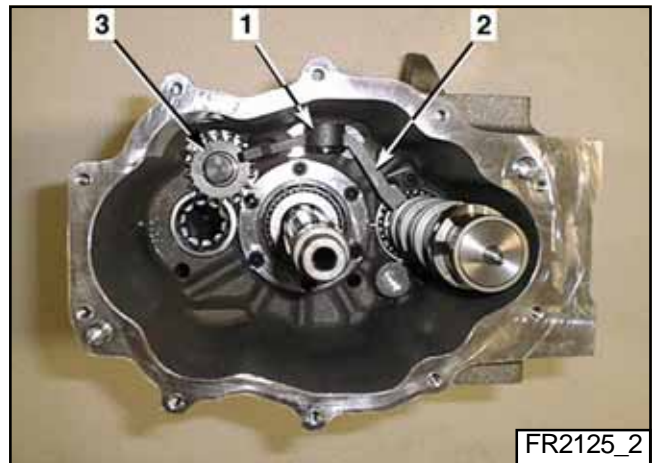
REVERSE GEAR

Remove reverse gear transfer pinion

- Remove all gears (see corresponding paragraph).
- Withdraw primary shaft.
- Withdraw cover on rocker bolt (1).



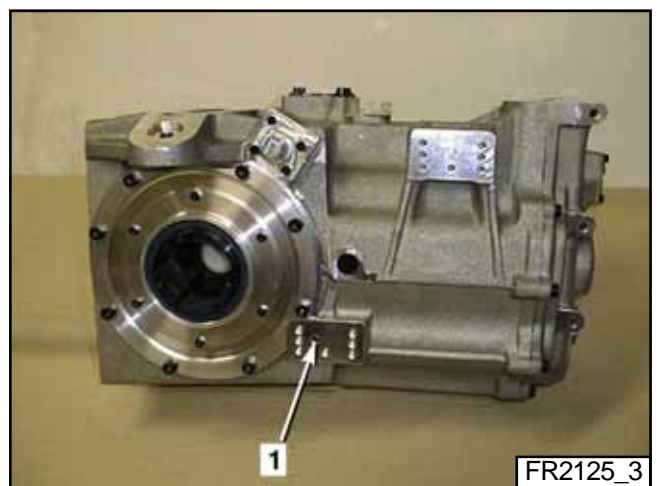
- Using an open-ended wrench, stop the reverse rocker nut turning (1) and release rocker bolt.
- Withdraw rocker (2) and reverse transfer pinion (3).



Remove reverse pin

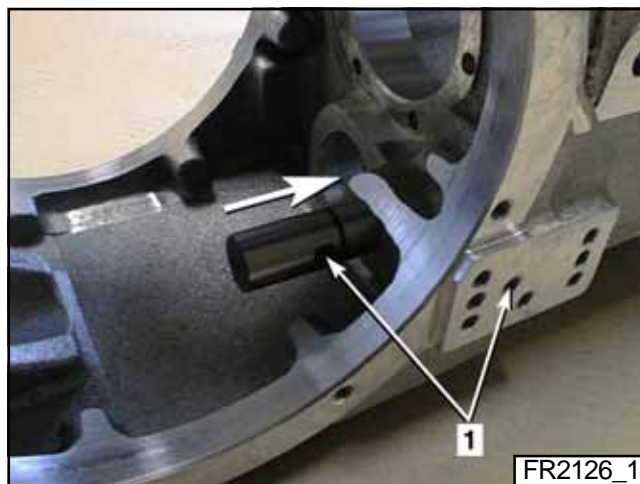
- Remove LSD (see corresponding paragraph).
- Remove anti-rotation bolt of reverse pin (1).
- Heat the casing to 120 °C around the reverse pin.
- Remove the pin from the LSD casing side by tapping with a mallet.

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



Refit reverse pin

- Check condition of all parts and using an M8x125 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 **(1)**.
- 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 22 N.m.
- Refit LSD assembly.



Refit reverse gear transfer pinion

- 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 55 N.m while stopping the reverse nut from turning with an open-ended spanner.
- Refit the bolt head cap.

SETTING THE POTENTIOMETER

- Set the gear box shifting lever to reverse.
- Switch on ignition.
- Slightly loosen two screws **(1)**.
- Turn potentiometer body until the dashboard displays letter "R".
- Tighten the two potentiometer attaching screws **(1)**.
- Engage gears, one after the other, and check that the display on the dashboard corresponds.
- If the display indicate the number "3" in 6th gear, repeat adjustment procedure.



MANUAL GEARBOX

Engine shutdown switch

21

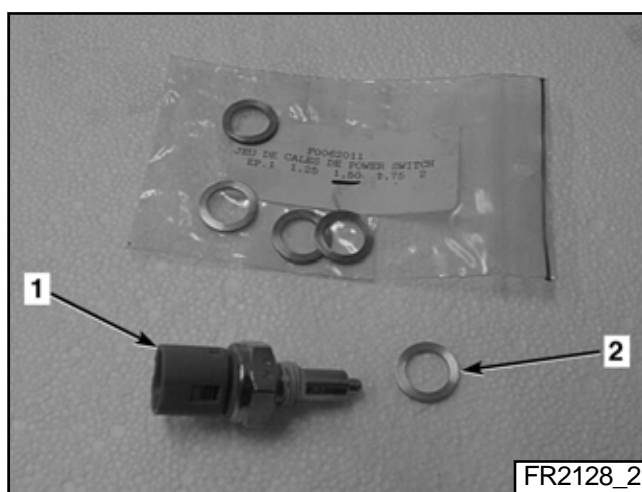
SETTING THE ENGINE SHUTDOWN SWITCH

Engine shutdown switch (1) is set by means of shims (2) fitted between switch (1) and casing.

A set of four 0.25 mm pitch shims is delivered along with the gear box.

To obtain a very accurate adjustment, shim thickness must be minimum.

- Increase shim thickness if the engine untimely shuts down.
- Decrease shim thickness if the gears do not easily disengage.



Tightening torque values (in N.m)	
Ball joint screw on gearbox	22

DISASSEMBLY

On gearshift lever

- Remove sheath stop screw (2).

NOTE: This screw is inserted in the middle of the sheath stop mounting bolt.

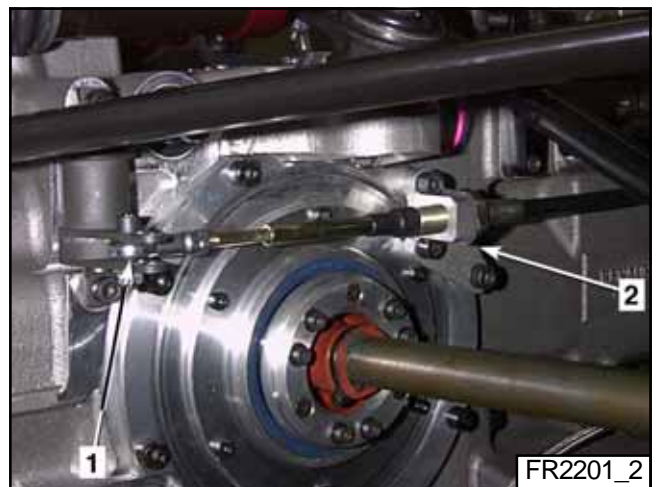
The sheath stop (2) has three mounting positions. Mark its position if it has to be removed.

- Disconnect ball joint (1) from gearshift lever. Remove ball joint.



On gearbox

- Disconnect ball joint (1).
- Unscrew control cable from its mounting (2). Remove cable.
- Check play of ball joints. Replace if necessary.



ASSEMBLY

- Repeat the above steps in the reverse order.

ADJUSTMENT

- Disengage protective sheath (1).



- Make sure that dimension (A) is between 2 mm and 50 mm.
- Torque bolts to recommended torque.



NOTE: *The installation of thermal protection of sleeve type is authorized.*

DISASSEMBLY

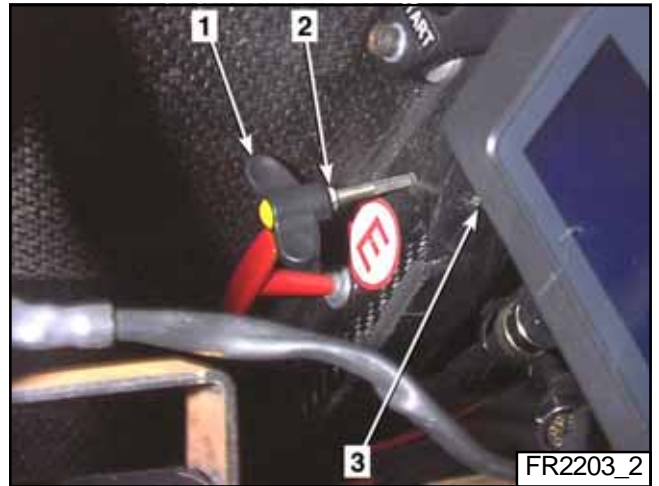
On gearbox

- Unscrew brass screw (1). Disconnect cable from gearbox.



On dashboard

- Loosen locknut (2). Remove pull (1) and locknut.
- Loosen locknut behind pair (3).
- Loosen cable on pair. Remove cable.



ASSEMBLY

On gearbox

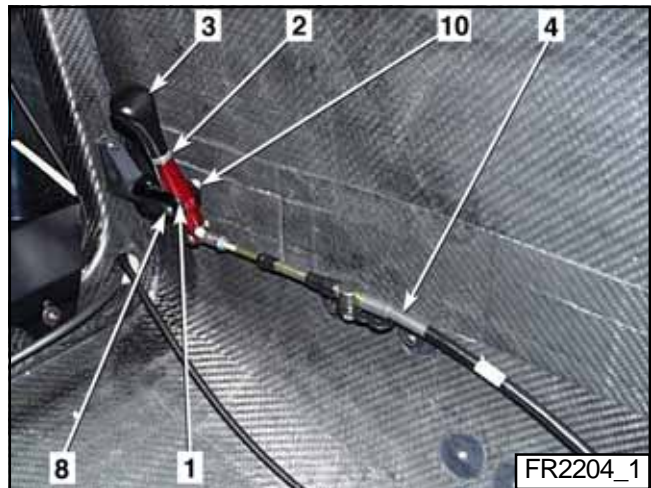
- Clean brass screw. Coat threads with Loctite 577 pipe sealant.
- Engage cable in its housing. Slightly tighten brass screw.

On dashboard

- Repeat the disassembly steps in the reverse order.

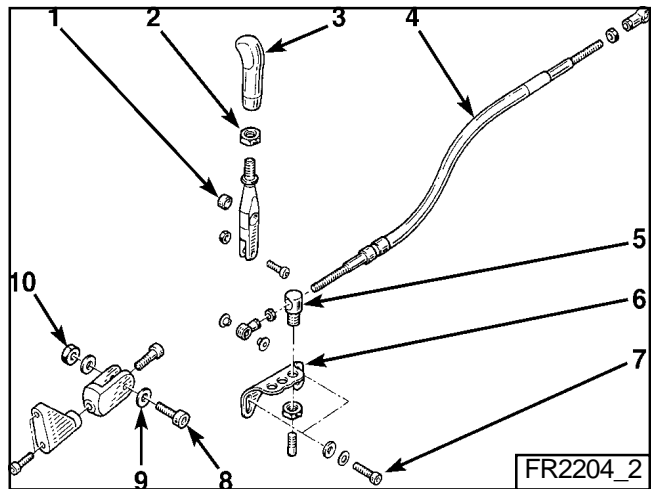
DISASSEMBLY

- Remove control cable (4) from gearshift lever (see section covering this).
- Remove nut (10), bolt (8), and the two washers (9). Remove holder for gearshift lever protective cover.
- Remove bush (1) from holder for gearshift lever protective cover.
- Loosen locknut (2). Remove holder for gearshift lever protective cover (3).



ASSEMBLY

- Assemble lever in reverse order of disassembly.
- Check condition of bush (1). If worn, replace.



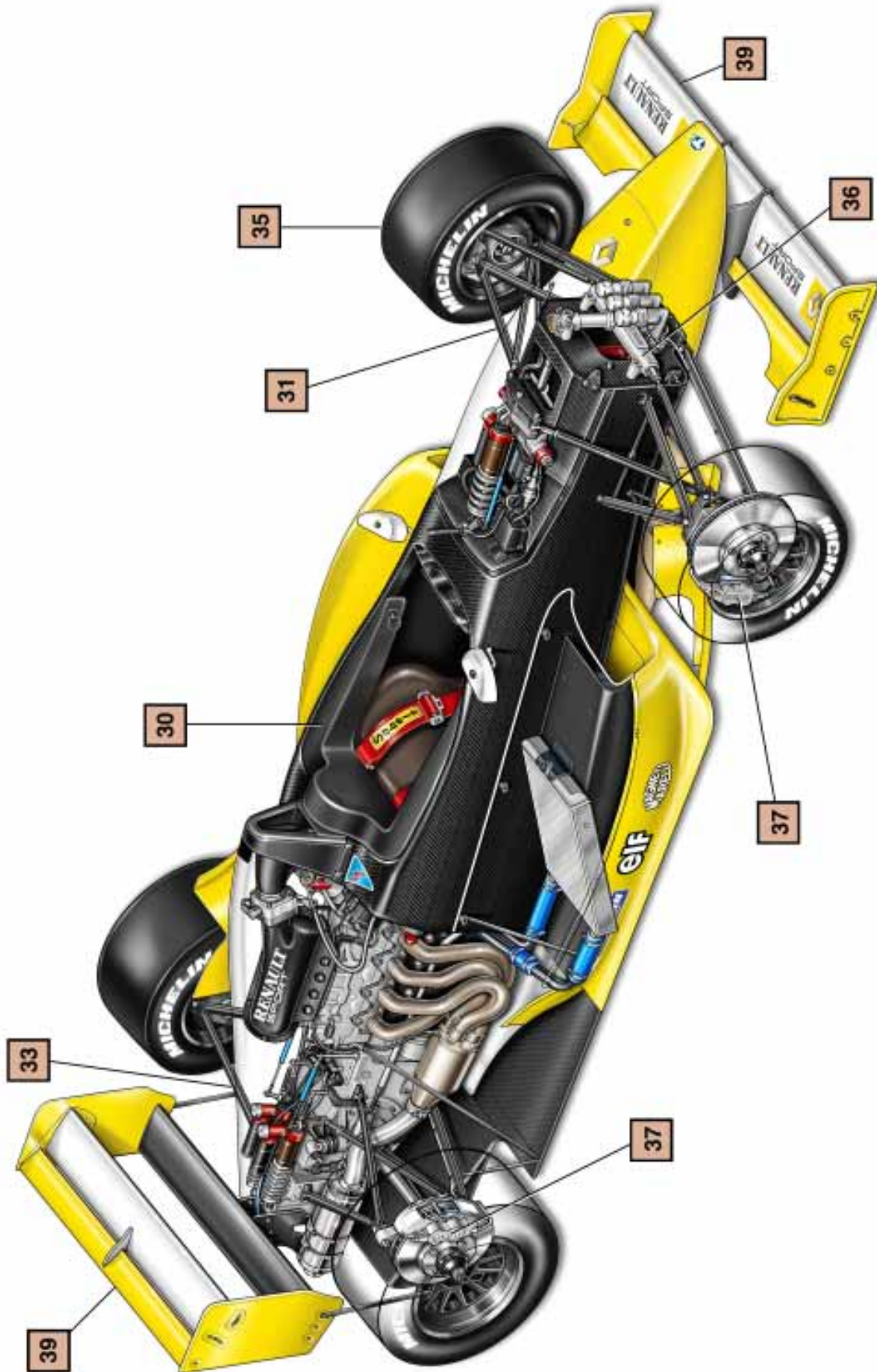
ADJUSTMENT

- Adjust tilt of gearshift lever by positioning cable clamp (5) in one of the three mounting holes (6).
- Loosen screws (7). Correct position of mounting so as to align cable.

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FRAME

Exploded view



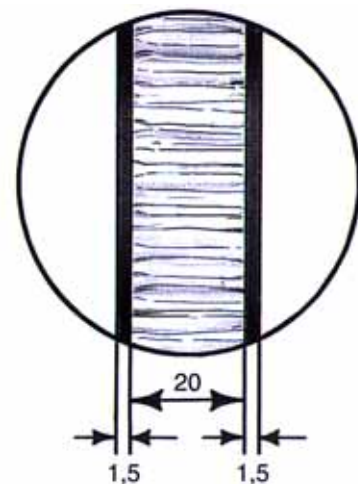
CHARACTERISTICS

- Front suspension: single-damper push-rod.
- Rear suspension: bi-damper push-rod.
- Dampers: adjustable compression travel and rebound travel.
- Springs: four rigidity front and rear spring stiffeners. Helical type.
- Brake callipers: four pistons.
- Brake discs: 274 x 17.5 mm, ventilated.
- Rims: middle fastener.
 - Front: 8 x 13 mm,
 - Rear: 10 x 13 mm.
- Wheelbase: 2,645 mm.
- Front track: 1,471 mm.
- Rear track: 1,366 mm.
- Weight: 490 kg.
- Fuel tank capacity: 39 liters.

PRESENTATION

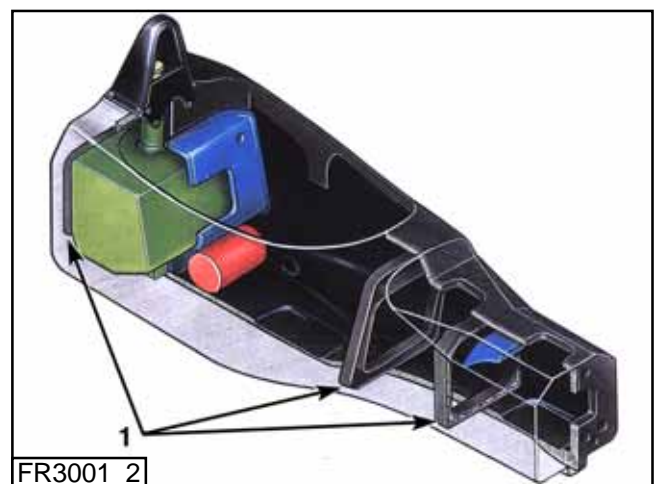
Body structure

The body structure is made up of an aluminium honeycomb structure with a vacuum-kilned carbon fibre skin.



FR3001_1

Three aluminium bulkheads (1) take up the loads of the engine and suspension fasteners.



FR3001_2

Identification

It is executed by:

- a plate **(1)** fixed on the left side of the body.



- a sticker stuck on the body under the head protection.



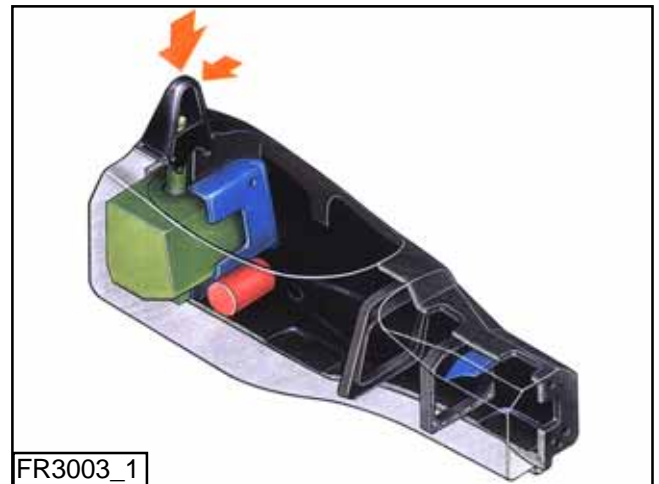
SAFETY TESTS

NOTE: All tests are performed in accordance with standard FIA F.3.

Load test on safety roll bar

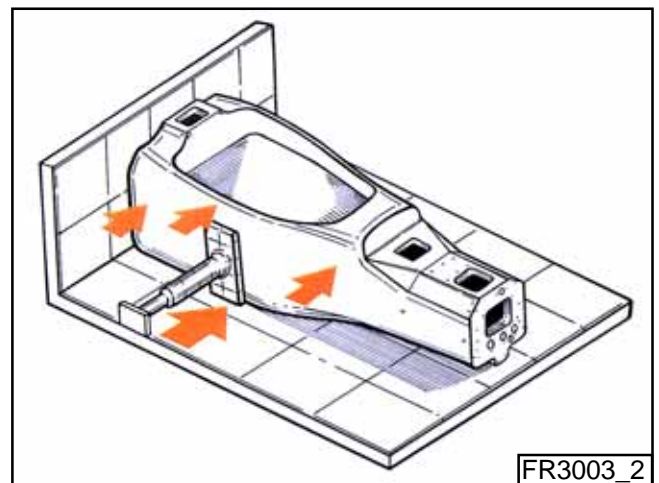
This test was performed with the safety roll bar installed on the frame. Three forces equivalent to 7.5, 5.5 and 1.5 times the weight of the car, with the driver in it, were applied simultaneously:

- vertically.
- longitudinally.
- laterally.



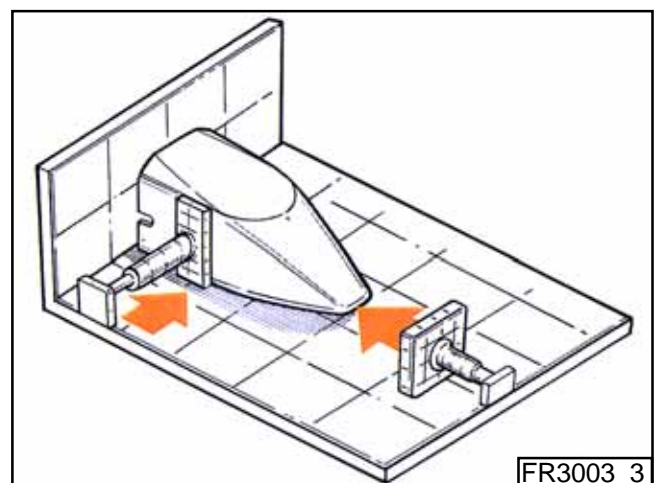
Lateral load test on body structure

The body structure was subjected to various lateral load tests, from 1,000 to 2,000 kg.



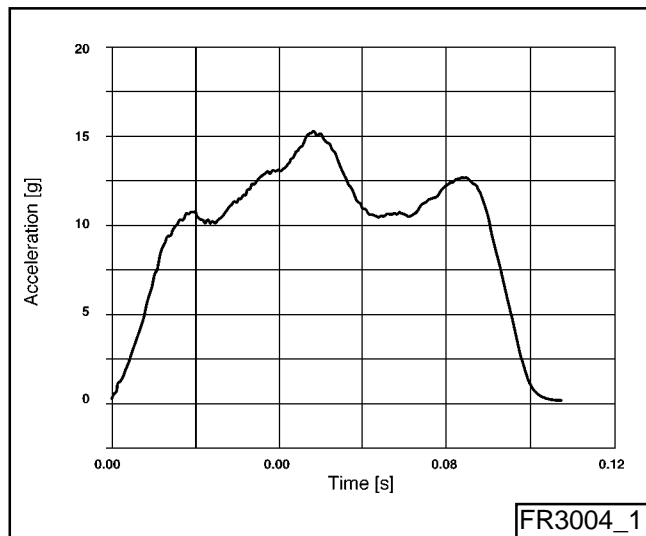
Frontal crash test and nose fastening test

- Nose fasteners were subjected to a lateral load of 2,000 kg.
- The front crash test, with the nose installed on the frame, was carried out at a speed of 10 m/s.



- Test characteristics:

- Weight of impact: 560 kg.
- Speed of impact: 10.56 m/s.
- Average acceleration: 10.70 g.
- Maximum acceleration: 15.26 g.
- Maximum displacement: 448 mm.

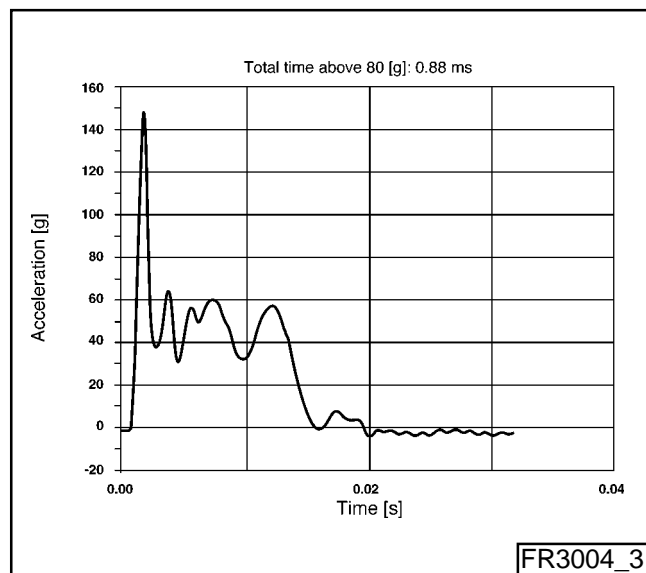


Steering column test crash

The test was performed on a tube fitted with its mountings. The impact on the steering wheel was made with a weight of 8 kg, at a speed of 7 m/s.



The deceleration undergone was within permissible limits: ≤ 80 g for 3 ms (see curve opposite).



HANS SYSTEM (ACCORDING TO SPECIFIC REGULATIONS)

In some championships, the adaptator (ref. 77 11 154 747) necessary to attach the HANS-compatible harness shoulder straps is mandatory. It has to be attached in place of the original shoulder straps.

Suspension fastening points

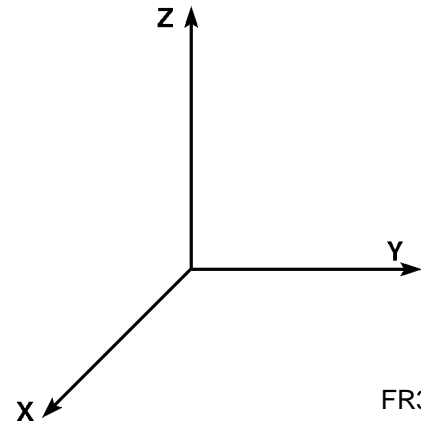
ADJUSTMENT OF FASTENING POINTS OF SUSPENSION

Reference system

Suspension geometry is defined by the coordinates of the points in space.

The X, Y and Z reference axis system is defined as follows.

- X: represents longitudinal axis (car's direction of motion) going through centre of vehicle and having as origin the axis going through the point of contact with the ground of the wheels in the same axle assembly.
- Y: represents transversal axis (towards exterior) and having as origin the longitudinal axis going through the wheel's point of contact with the ground.
- Z: represents the vertical axis (upwards) having the transversal axis with the ground as origin.

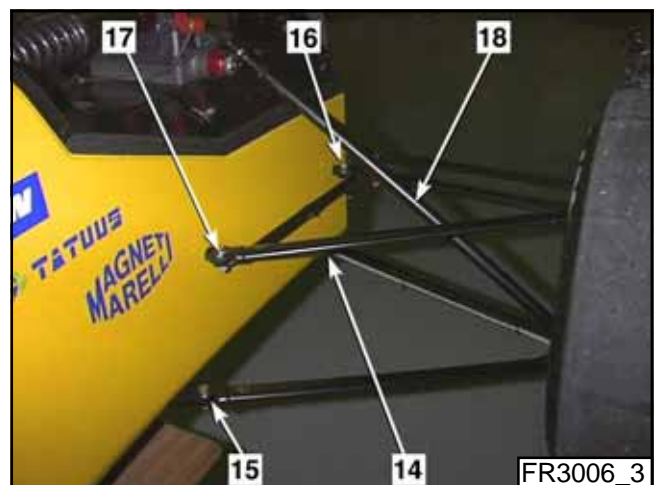
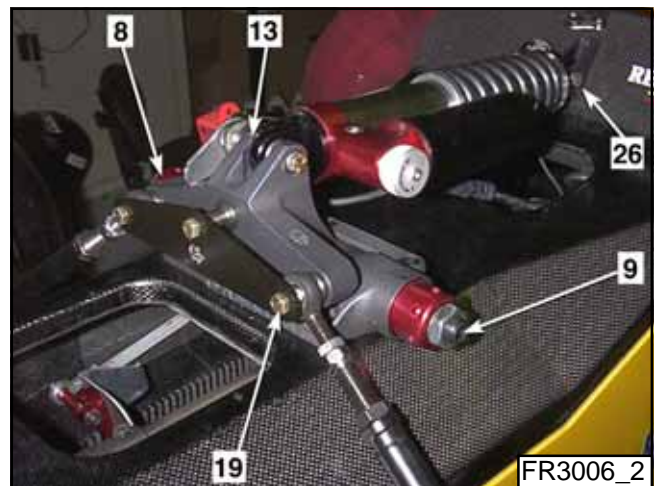


Suspension fastening points

DEFINITION OF SUSPENSION POINTS

Front axle assembly

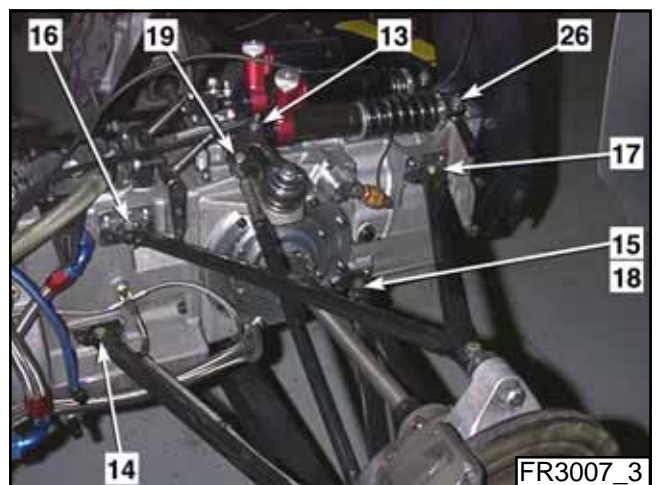
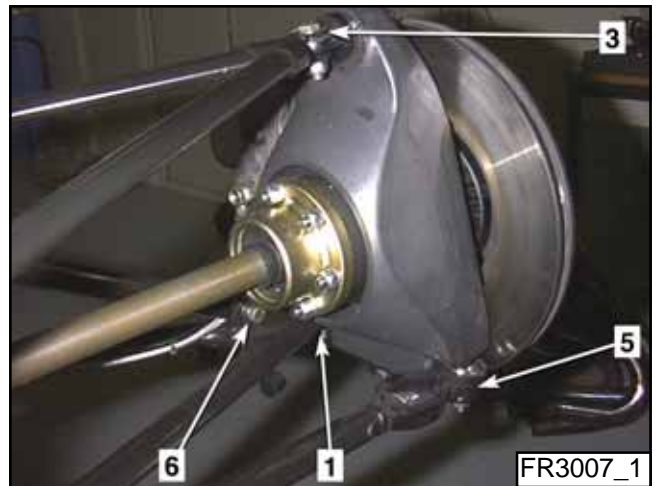
Point	Definition
1	Bottom A-arm, wheel side
3	Top A-arm, wheel side
5	Alignment bar, wheel side
6	Push-rod, wheel side
8	Right end of antiroll axis
9	Left end of antiroll axis
13	Point of attachment of damper on ON/OFF switch
14	Front attachment, bottom A-arm, frame side
15	Rear attachment, bottom A-arm, frame side
16	Front attachment, top A-arm, frame side
17	Rear attachment, top A-arm, frame side
18	Alignment bar, gear rack side
19	Push-rod, ON/OFF switch side
20	Wheel centre
26	Point of attachment of damper on frame



Suspension fastening points

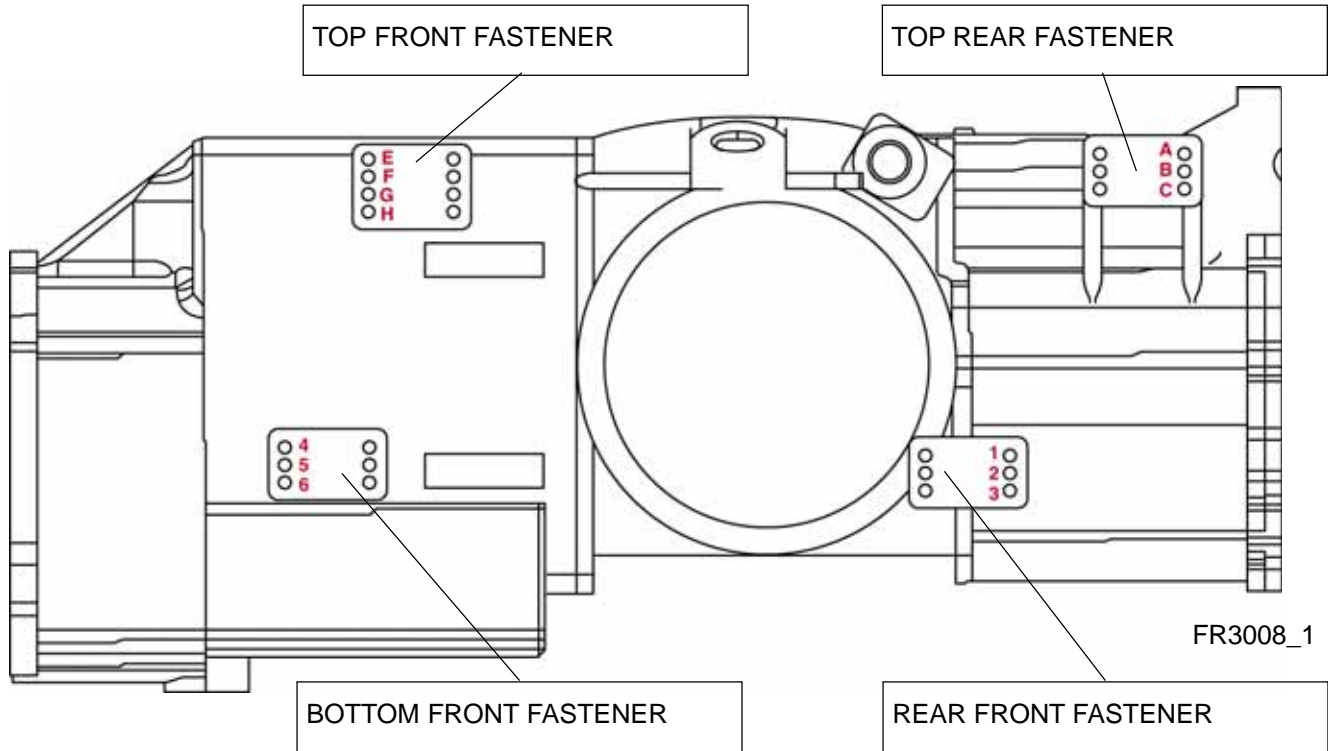
Rear axle assembly

Point	Definition
1	Bottom A-arm, wheel side
3	Top A-arm, wheel side
5	Alignment bar, wheel side
6	Push-rod, wheel side
8	Bottom point, ON/OFF switch pivot axis
9	Top point, ON/OFF switch pivot axis
13	Point of attachment of damper on ON/OFF switch
14	Front attachment, bottom A-arm, gearbox side
15	Rear attachment, bottom A-arm, gearbox side
16	Front attachment, top A-arm, gearbox side
17	Rear attachment, top A-arm, gearbox side
18	Alignment bar, gearbox side
19	Push-rod, ON/OFF switch side
20	Wheel centre
26	Rear point of attachment of damper



Suspension fastening points

LOCATION OF REAR SUSPENSION FASTENING POINTS



IMPORTANT: There should not be more than one notch of a difference between the front and rear fastening points.

*Examples : Front point 4 only authorizes rear points 1 and 2,
Front point E only authorizes rear points A and B.*

Definition of position of A-arms

Example: 3 5 C H

3	5	C	H
			Top front fastener (bottom positions)
			Top rear fastener (bottom positions)
			Bottom front fastener (middle positions)
			Bottom rear fastener (bottom positions)

ABBREVIATIONS USED IN TABLES

- Wheel deflection
- Camber
- Alignment
- Roll centre
- Spring length
- Wheel deflection in relation to spring movement
- Variation in Wheelbase
- Variation in-track width
- Wheel castor
- Centre of gyration/rotation
- Rim/wheel offset
- Caster trail/offset

Suspension adjustment Tables

FRONT DRIVE TRAIN

Position of A-arms: STANDARD

Loaded wheel/tyre assembly radius	263.99 mm
Initial setting	
- camber	- 5°
- alignment	- 0.2°
- body/superstructure height (height between pads and groundl):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	6.680	653.120	150.860
3	Top A-arm, wheel side	- 10.000	594.150	363.050
5	Alignment rod, wheel side	82.000	622.040	365.490
6	Push-rod, wheel side	- 0.560	594.040	175.350
8	Right end of antiroll bar	- 106.140	- 134.380	530.420
9	Left end of antiroll bar	- 106.140	134.380	530.420
13	Damper fastening point on tipper	- 95.440	0.000	598.570
14	Front fastener, bottom A-arm, frame side	181.190	51.500	143.710
15	Rear fastener, bottom A-arm, frame side	- 319.160	198.120	166.910
16	Front fastener, top A-arm, frame side	103.000	188.690	315.660
17	Rear fastener, top A-arm, frame side	- 246.600	193.660	327.260
18	Alignment bar, gear rack side	188.250	186.200	317.230
19	Push-rod, tipper side	- 45.730	77.430	550.770
20	Wheel centre	0.000	694.250	263.990
26	Damper fastening point on frame	- 416.950	0.000	574.110

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in -track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 4.22	- 0.16	83.59	348.51	1.308	- 1.18	- 2.88	4.29	14.75	22.41	17.58
- 25.00	- 4.34	- 0.16	78.59	344.58	1.256	- 0.96	- 2.31	4.34	14.87	22.42	17.76
- 20.00	- 4.47	- 0.17	73.60	340.50	1.207	- 0.76	- 1.78	4.37	15.00	22.43	17.93
- 15.00	- 4.60	- 0.17	68.62	336.25	1.160	- 0.55	- 1.28	4.41	15.13	22.45	18.08
- 10.00	- 4.73	- 0.18	63.65	331.83	1.115	- 0.36	- 0.82	4.44	15.26	22.46	18.22
- 5.00	- 4.86	- 0.19	58.69	327.23	1.071	- 0.18	- 0.39	4.47	15.39	22.48	18.35
0.00	- 5.00	- 0.20	53.74	322.44	1.029	0.00	0.00	4.49	15.53	22.49	18.46
5.00	- 5.14	- 0.21	48.81	317.45	0.988	0.17	0.36	4.52	15.67	22.51	18.56
10.00	- 5.29	- 0.22	43.88	312.26	0.948	0.33	0.68	4.54	15.82	22.52	18.65
15.00	- 5.43	- 0.24	38.96	306.86	0.910	0.48	0.97	4.55	15.96	22.54	18.72
20.00	- 5.58	- 0.25	34.06	301.22	0.872	0.62	1.22	4.57	16.12	22.56	18.78
25.00	- 5.74	- 0.27	29.16	295.34	0.836	0.76	1.44	4.58	16.27	22.58	18.83
30.00	- 5.90	- 0.29	24.28	289.20	0.800	0.88	1.63	4.59	16.43	22.59	18.87

100 % braking torque compensation angle	12.437°
Effective braking torque compensation angle	3.341°
BRAKING TORQUE COMPENSATION ANGLE	26.472 %

REAR DRIVE TRAIN

Position of A-arms: 35 CH (basic setup)

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and groundl):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	178.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	152.300
16	Front fastener, top A-arm, frame side	214.300	106.440	318.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	330.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	-297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in-track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 3.91	0.06	91.50	342.02	1.567	- 0.81	- 3.21	20.68	16.20	15.84	147.61
- 25.00	- 4.08	0.06	85.83	338.75	1.512	- 0.68	- 2.57	20.59	16.38	15.87	146.93
- 20.00	- 4.26	0.05	80.16	335.36	1.457	- 0.55	- 1.97	20.49	16.56	15.91	146.25
- 15.00	- 4.45	0.04	74.50	331.84	1.401	- 0.41	- 1.42	20.40	16.74	15.95	145.58
- 10.00	- 4.63	0.03	68.84	328.17	1.344	- 0.28	- 0.90	20.30	16.92	15.98	144.92
- 5.00	- 4.81	0.02	63.19	324.34	1.286	- 0.14	- 0.43	20.21	17.11	16.01	144.25
0.00	- 5.00	0.00	57.55	320.34	1.227	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.19	- 0.02	51.91	316.14	1.166	0.14	0.39	20.02	17.48	16.07	142.94
10.00	- 5.38	- 0.04	46.27	311.71	1.104	0.29	0.73	19.93	17.67	16.10	142.29
15.00	- 5.57	- 0.06	40.64	307.02	1.039	0.43	1.04	19.83	17.86	16.13	141.65
20.00	- 5.76	- 0.09	35.01	302.01	0.970	0.58	1.30	19.74	18.05	16.16	141.01
25.00	- 5.96	- 0.11	29.39	296.63	0.897	0.73	1.52	19.65	18.25	16.18	140.37
30.00	- 6.15	- 0.14	23.77	290.77	0.817	0.88	1.70	19.56	18.44	16.21	139.74

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	9.435°
WEIGHT TRANSFER FROM AXLE ANGLE	51.710 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	- 0.265°
BRAKING TORQUE COMPENSATION ANGLE	- 3.602 %

Suspension adjustment Tables

REAR DRIVE TRAIN

Position of A-arms: 35 CG

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and ground):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	178.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	152.300
16	Front fastener, top A-arm, frame side	214.300	106.440	328.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	330.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in -track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 3.96	0.06	87.04	342.23	1.554	- 1.10	- 3.07	20.53	16.26	15.88	146.70
- 25.00	- 4.13	0.05	81.30	338.93	1.499	- 0.92	- 2.45	20.46	16.42	15.91	146.17
- 20.00	- 4.30	0.05	75.57	335.51	1.444	- 0.74	- 1.87	20.39	16.59	15.94	145.65
- 15.00	- 4.48	0.04	69.85	331.95	1.388	- 0.56	- 1.34	20.32	16.77	15.96	145.13
- 10.00	- 4.65	0.03	64.13	328.25	1.331	- 0.37	- 0.85	20.25	16.94	15.99	144.62
- 5.00	- 4.82	0.01	58.42	324.39	1.273	- 0.19	- 0.40	20.18	17.12	16.02	144.10
0.00	- 5.00	0.00	52.71	320.34	1.214	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.18	- 0.02	47.01	316.09	1.154	0.19	0.36	20.04	17.47	16.07	143.09
10.00	- 5.36	- 0.03	41.32	311.62	1.091	0.38	0.68	19.98	17.65	16.09	142.59
15.00	- 5.54	- 0.05	35.63	306.87	1.026	0.57	0.95	19.91	17.83	16.11	142.09
20.00	- 5.72	- 0.08	29.95	301.80	0.957	0.77	1.19	19.84	18.01	16.13	141.59
25.00	- 5.91	- 0.10	24.27	296.34	0.884	0.96	1.38	19.77	18.20	16.15	141.10
30.00	- 6.09	- 0.12	18.60	290.39	0.803	1.16	1.53	19.70	18.38	16.17	140.61

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	8.041°
WEIGHT TRANSFER FROM AXLE ANGLE	43.961 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	0.839°
BRAKING TORQUE COMPENSATION ANGLE	11.398 %

REAR DRIVE TRAIN

Position of A-arms: 35 BG

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and groundl):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	178.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	152.300
16	Front fastener, top A-arm, frame side	214.300	106.440	328.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	340.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in-track width	Wheel castor	C.gyration/rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 4.06	0.05	81.60	342.14	1.560	- 0.79	- 2.74	20.70	16.35	15.84	147.65
- 25.00	- 4.21	0.05	75.92	338.85	1.505	- 0.67	- 2.17	20.60	16.50	15.87	146.96
- 20.00	- 4.37	0.04	70.25	335.45	1.450	- 0.54	- 1.66	20.50	16.66	15.91	146.28
- 15.00	- 4.52	0.03	64.58	331.90	1.393	- 0.41	- 1.18	20.41	16.81	15.95	145.60
- 10.00	- 4.68	0.03	58.92	328.22	1.336	- 0.27	- 0.74	20.31	16.97	15.98	144.93
- 5.00	- 4.84	0.01	53.26	324.37	1.278	- 0.14	- 0.35	20.21	17.13	16.01	144.26
0.00	- 5.00	0.00	47.61	320.34	1.219	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.16	- 0.02	41.96	316.11	1.159	0.14	0.31	20.02	17.45	16.07	142.94
10.00	- 5.33	- 0.04	36.32	311.65	1.096	0.28	0.58	19.92	17.62	16.10	142.28
15.00	- 5.49	- 0.06	30.68	306.92	1.031	0.43	0.80	19.82	17.79	16.13	141.63
20.00	- 5.66	- 0.08	25.05	301.88	0.962	0.57	0.99	19.73	17.95	16.15	140.99
25.00	- 5.83	- 0.10	19.42	296.45	0.888	0.72	1.13	19.63	18.12	16.18	140.35
30.00	- 6.00	- 0.13	13.79	290.53	0.808	0.87	1.23	19.54	18.30	16.20	139.73

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	9.127°
WEIGHT TRANSFER FROM AXLE ANGLE	49.991 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	- 0.020°
BRAKING TORQUE COMPENSATION ANGLE	- 0.275 %

Suspension adjustment Tables

REAR DRIVE TRAIN

Position of A-arms: 35 BF

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and ground):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	178.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	152.300
16	Front fastener, top A-arm, frame side	214.300	106.440	338.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	340.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in -track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 4.12	0.05	77.03	342.35	1.547	- 1.09	- 2.59	20.55	16.41	15.88	146.72
- 25.00	- 4.26	0.04	71.29	339.03	1.492	- 0.91	- 2.05	20.48	16.55	15.91	146.19
- 20.00	- 4.41	0.04	65.55	335.59	1.437	- 0.73	- 1.55	20.40	16.70	15.94	145.67
- 15.00	- 4.55	0.03	59.82	332.02	1.380	- 0.55	- 1.10	20.33	16.84	15.97	145.14
- 10.00	- 4.70	0.02	54.09	328.30	1.324	- 0.37	- 0.69	20.26	16.99	15.99	144.62
- 5.00	- 4.85	0.01	48.37	324.41	1.266	- 0.19	- 0.32	20.19	17.14	16.02	144.11
0.00	- 5.00	0.00	42.65	320.34	1.206	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.15	- 0.01	36.94	316.07	1.146	0.19	0.28	20.04	17.44	16.07	143.09
10.00	- 5.31	- 0.03	31.23	311.56	1.083	0.38	0.52	19.97	17.60	16.09	142.58
15.00	- 5.46	- 0.05	25.53	306.77	1.018	0.57	0.72	19.90	17.75	16.11	142.08
20.00	- 5.62	- 0.07	19.83	301.66	0.919	0.76	0.87	19.83	17.91	16.13	141.58
25.00	- 5.78	- 0.09	14.14	296.16	0.875	0.96	0.98	19.75	18.07	16.15	141.08
30.00	- 5.94	- 0.11	8.46	290.14	0.794	1.15	1.05	19.68	18.23	16.17	140.59

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	7.817
WEIGHT TRANSFER FROM AXLE ANGLE	42.722 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	1.016°
BRAKING TORQUE COMPENSATION ANGLE	13.796 %

REAR DRIVE TRAIN

Position of A-arms: 35 AF

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and groundl):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	178.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	152.300
16	Front fastener, top A-arm, frame side	214.300	106.440	338.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	350.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in-track width	Wheel castor	C.gyration/rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 4.22	0.04	71.40	342.26	1.553	- 0.78	- 2.25	20.72	16.51	15.84	147.69
- 25.00	- 4.34	0.04	65.73	338.96	1.498	- 0.65	- 1.77	20.62	16.64	15.87	146.99
- 20.00	- 4.47	0.03	60.06	335.53	1.442	- 0.53	- 1.33	20.52	16.76	15.91	146.30
- 15.00	- 4.60	0.03	54.39	331.97	1.386	- 0.40	- 0.93	20.42	16.89	15.95	145.62
- 10.00	- 4.73	0.02	48.72	328.27	1.329	- 0.27	- 0.58	20.31	17.02	15.98	144.94
- 5.00	- 4.87	0.01	43.06	324.39	1.271	- 0.14	- 0.27	20.21	17.16	16.01	144.26
0.00	- 5.00	0.00	37.41	320.34	1.211	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.14	- 0.01	31.75	316.08	1.151	0.14	0.23	20.01	17.43	16.07	142.93
10.00	- 5.28	- 0.03	26.10	311.59	1.088	0.28	0.41	19.91	17.57	16.10	142.27
15.00	- 5.42	- 0.05	20.46	306.83	1.022	0.42	0.56	19.81	17.71	16.12	141.62
20.00	- 5.56	- 0.07	14.81	301.74	0.954	0.57	0.66	19.71	17.85	16.15	140.96
25.00	- 5.70	- 0.10	9.18	296.27	0.880	0.71	0.72	19.61	18.00	16.17	140.32
30.00	- 5.85	- 0.12	3.54	290.28	0.799	0.86	0.74	19.51	18.14	16.19	139.68

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	8.851°
WEIGHT TRANSFER FROM AXLE ANGLE	48.458 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	0.198°
BRAKING TORQUE COMPENSATION ANGLE	2.692 %

Suspension adjustment Tables

REAR DRIVE TRAIN

Position of A-arms: 35 AE

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and ground):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	178.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	152.300
16	Front fastener, top A-arm, frame side	214.300	106.440	348.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	350.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in -track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 4.28	0.04	66.74	342.47	1.540	- 1.08	- 2.09	20.57	16.57	15.88	146.75
- 25.00	- 4.40	0.03	60.99	339.14	1.485	- 0.90	- 1.64	20.49	16.69	15.91	146.22
- 20.00	- 4.51	0.03	55.24	335.68	1.429	- 0.73	- 1.22	20.42	16.80	15.94	145.68
- 15.00	- 4.63	0.03	49.50	332.09	1.373	- 0.55	- 0.85	20.34	16.92	15.97	145.16
- 10.00	- 4.75	0.02	43.77	328.35	1.316	- 0.37	- 0.53	20.26	17.04	15.99	144.63
- 5.00	- 4.88	0.01	38.04	324.44	1.258	- 0.18	- 0.24	20.19	17.17	16.02	144.11
0.00	- 5.00	0.00	32.31	320.34	1.199	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.13	- 0.01	26.59	316.04	1.138	0.19	0.20	20.04	17.42	16.06	143.08
10.00	- 5.25	- 0.03	20.87	311.49	1.075	0.37	0.36	19.96	17.55	16.09	142.57
15.00	- 5.39	- 0.04	15.16	306.67	1.010	0.57	0.47	19.89	17.68	16.11	142.07
20.00	- 5.52	- 0.06	9.45	301.52	0.941	0.76	0.54	19.81	17.81	16.13	141.56
25.00	- 5.65	- 0.08	3.75	295.96	0.867	0.95	0.57	19.74	17.94	16.15	141.06
30.00	- 5.79	- 0.10	- 1.95	289.89	0.785	1.15	0.56	19.66	18.08	16.16	140.57

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	7.617°
WEIGHT TRANSFER FROM AXLE ANGLE	41.614

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	1.174°
BRAKING TORQUE COMPENSATION ANGLE	15.940 %

REAR DRIVE TRAIN

Position of A-arms: 36 CG

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and groundl):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	168.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	152.300
16	Front fastener, top A-arm, frame side	214.300	106.440	328.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	330.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in-track width	Wheel castor	C.gyration/rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 4.02	- 0.03	77.52	342.86	1.514	- 0.57	- 2.71	20.36	16.31	15.85	145.76
- 25.00	- 4.18	- 0.02	71.76	339.47	1.459	- 0.48	- 2.15	20.32	16.47	15.88	145.39
- 20.00	- 4.34	- 0.01	66.00	335.95	1.404	- 0.38	- 1.63	20.27	16.63	15.91	145.03
- 15.00	- 4.50	- 0.01	60.25	332.30	1.349	- 0.29	- 1.16	20.23	16.79	15.95	144.67
- 10.00	- 4.67	0.00	54.51	328.49	1.293	- 0.19	- 0.73	20.19	16.96	15.98	144.31
- 5.00	- 4.83	0.00	48.77	324.51	1.236	- 0.10	- 0.34	20.15	17.12	16.01	143.95
0.00	- 5.00	0.00	43.04	320.34	1.177	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.17	0.00	37.32	315.96	1.118	0.10	0.30	20.07	17.46	16.07	143.24
10.00	- 5.34	0.00	31.60	311.33	1.056	0.20	0.56	20.03	17.63	16.10	142.89
15.00	- 5.51	0.00	25.89	306.42	0.991	0.30	0.77	19.99	17.80	16.13	142.54
20.00	- 5.69	- 0.01	20.18	301.17	0.923	0.40	0.94	19.96	17.98	16.16	142.20
25.00	- 5.86	- 0.01	14.48	295.51	0.850	0.51	1.07	19.92	18.15	16.19	141.85
30.00	- 6.04	- 0.02	8.78	289.31	0.769	0.61	1.16	19.88	18.33	16.22	141.51

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	5.014°
WEIGHT TRANSFER FROM AXLE ANGLE	27.302 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	0.417°
BRAKING TORQUE COMPENSATION ANGLE	5.661 %

Suspension adjustment Tables

REAR DRIVE TRAIN

Position of A-arms: 36 CH

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and ground):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	168.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	152.300
16	Front fastener, top A-arm, frame side	214.300	106.440	318.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	330.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in -track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 3.96	- 0.03	82.12	342.65	1.526	- 0.28	- 2.86	20.51	16.25	15.81	146.68
- 25.00	- 4.13	- 0.02	76.43	339.29	1.472	- 0.24	- 2.27	20.44	16.42	15.85	146.16
- 20.00	- 4.30	- 0.01	70.74	335.81	1.417	- 0.19	- 1.73	20.37	16.59	15.89	145.64
- 15.00	- 4.47	- 0.01	65.05	332.18	1.362	- 0.15	- 1.24	20.31	16.76	15.93	145.12
- 10.00	- 4.65	0.00	59.37	328.41	1.305	- 0.10	- 0.78	20.24	16.94	15.97	144.61
- 5.00	- 4.82	0.00	53.70	324.47	1.248	- 0.05	- 0.37	20.18	17.11	16.00	144.10
0.00	- 5.00	0.00	48.03	320.34	1.190	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.18	0.00	42.37	316.01	1.130	0.05	0.33	20.05	17.47	16.08	143.09
10.00	- 5.36	- 0.01	36.71	311.43	1.068	0.11	0.61	19.98	17.65	16.11	142.59
15.00	- 5.54	- 0.01	31.06	306.58	1.003	0.16	0.86	19.92	17.83	16.15	142.10
20.00	- 5.73	- 0.02	25.42	301.40	0.935	0.22	1.06	19.86	18.02	16.18	141.60
25.00	- 5.91	- 0.03	19.78	295.81	0.862	0.28	1.21	19.79	18.20	16.21	141.11
30.00	- 6.10	- 0.04	14.14	289.71	0.782	0.34	1.33	19.73	18.39	16.25	140.63

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	6.333
WEIGHT TRANSFER FROM AXLE ANGLE	34.537 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	- 0.659
BRAKING TORQUE COMPENSATION ANGLE	- 8.945 %

REAR DRIVE TRAIN

Position of A-arms: 36 BG

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and groundl):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	168.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	152.300
16	Front fastener, top A-arm, frame side	214.300	106.440	328.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	340.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in-track width	Wheel castor	C.gyration/rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 4.11	- 0.04	71.90	342.77	1.519	- 0.26	- 2.38	20.53	16.40	15.81	146.71
- 25.00	- 4.26	- 0.03	66.20	339.40	1.465	- 0.22	- 1.88	20.46	16.55	15.85	146.18
- 20.00	- 4.40	- 0.02	60.50	335.89	1.410	- 0.18	- 1.42	20.39	16.69	15.89	145.66
- 15.00	- 4.55	- 0.01	54.81	332.25	1.354	- 0.14	- 1.00	20.32	16.84	15.93	145.14
- 10.00	- 4.70	- 0.01	49.13	328.46	1.298	- 0.10	- 0.62	20.25	16.99	15.97	144.62
- 5.00	- 4.85	0.00	43.45	324.49	1.241	- 0.05	- 0.29	20.18	17.14	16.01	144.11
0.00	- 5.00	0.00	37.77	320.34	1.182	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.15	0.00	32.10	315.98	1.122	0.05	0.25	20.05	17.45	16.08	143.09
10.00	- 5.31	0.00	26.44	311.37	1.060	0.10	0.45	19.98	17.60	16.11	142.58
15.00	- 5.47	- 0.01	20.78	306.48	0.996	0.16	0.62	19.91	17.76	16.15	142.08
20.00	- 5.63	- 0.01	15.12	301.26	0.927	0.21	0.74	19.84	17.92	16.18	141.59
25.00	- 5.79	- 0.02	9.47	295.62	0.854	0.27	0.82	19.78	18.08	16.21	141.09
30.00	- 5.95	- 0.03	3.82	289.45	0.773	0.33	0.86	19.71	18.24	16.24	140.60

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	6.117°
WEIGHT TRANSFER FROM AXLE ANGLE	33.347 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	- 0.482°
BRAKING TORQUE COMPENSATION ANGLE	- 6.543 %

Suspension adjustment Tables

REAR DRIVE TRAIN

Position of A-arms: 36 BF

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and ground):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	168.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	152.300
16	Front fastener, top A-arm, frame side	214.300	106.440	338.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	340.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in -track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 4.17	- 0.04	67.20	342.98	1.507	- 0.56	- 2.23	20.37	16.46	15.85	145.78
- 25.00	- 4.31	- 0.03	61.43	339.58	1.452	- 0.47	- 1.75	20.33	16.60	15.88	145.41
- 20.00	- 4.44	- 0.02	55.66	336.05	1.397	- 0.38	- 1.31	20.29	16.73	15.92	145.04
- 15.00	- 4.58	- 0.01	49.90	332.37	1.342	- 0.28	- 0.92	20.24	16.87	15.95	144.68
- 10.00	- 4.72	- 0.01	44.14	328.54	1.285	- 0.19	- 0.57	20.20	17.01	15.98	144.31
- 5.00	- 4.86	0.00	38.39	324.54	1.228	- 0.10	- 0.26	20.16	17.15	16.01	143.95
0.00	- 5.00	0.00	32.65	320.34	1.170	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.14	0.00	26.91	315.93	1.110	0.10	0.22	20.07	17.44	16.07	143.24
10.00	- 5.29	0.00	21.18	311.27	1.048	0.20	0.40	20.03	17.58	16.10	142.89
15.00	- 5.44	0.00	15.45	306.32	0.983	0.30	0.53	19.99	17.73	16.13	142.53
20.00	- 5.58	0.00	9.73	301.03	0.915	0.40	0.62	19.94	17.88	16.16	142.18
25.00	- 5.73	0.00	4.01	295.31	0.841	0.50	0.67	19.90	18.03	16.18	141.84
30.00	- 5.89	- 0.01	- 1.70	289.04	0.760	0.60	0.67	19.86	18.18	16.21	141.49

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	4.875°
WEIGHT TRANSFER FROM AXLE ANGLE	26.542 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	0.530°
BRAKING TORQUE COMPENSATION ANGLE	7.196 %

REAR DRIVE TRAIN

Position of A-arms: 36 AF

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and groundl):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	168.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	152.300
16	Front fastener, top A-arm, frame side	214.300	106.440	338.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	350.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in-track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 4.27	- 0.05	61.38	342.89	1.512	- 0.24	- 1.89	20.55	16.56	15.81	146.74
- 25.00	- 4.39	- 0.04	55.68	339.50	1.458	- 0.21	- 1.47	20.47	16.68	15.85	146.21
- 20.00	- 4.51	- 0.03	49.98	335.98	1.403	- 0.17	- 1.09	20.40	16.80	15.89	145.68
- 15.00	- 4.63	- 0.02	44.29	332.32	1.347	- 0.13	- 0.75	20.33	16.92	15.93	145.15
- 10.00	- 4.75	- 0.01	38.60	328.51	1.291	- 0.09	- 0.46	20.26	17.04	15.97	144.63
- 5.00	- 4.87	0.00	32.91	324.52	1.233	- 0.05	- 0.21	20.18	17.17	16.01	144.11
0.00	- 5.00	0.00	27.23	320.34	1.175	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.13	0.00	21.55	315.95	1.115	0.05	0.17	20.04	17.42	16.08	143.08
10.00	- 5.26	0.00	15.88	311.31	1.053	0.10	0.29	19.97	17.55	16.11	142.57
15.00	- 5.39	0.00	10.21	306.38	0.988	0.15	0.37	19.90	17.68	16.14	142.07
20.00	- 5.52	0.00	4.54	301.12	0.919	0.20	0.41	19.83	17.82	16.18	141.57
25.00	- 5.66	- 0.01	- 1.12	295.43	0.846	0.26	0.41	19.76	17.95	16.21	141.07
30.00	- 5.80	- 0.02	- 6.77	289.20	0.765	0.32	0.37	19.69	18.09	16.24	140.57

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	5.923°
WEIGHT TRANSFER FROM AXLE ANGLE	32.284 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	- 0.324°
BRAKING TORQUE COMPENSATION ANGLE	- 4.397 %

Suspension adjustment Tables

REAR DRIVE TRAIN

Position of A-arms: 36 AE

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and ground!):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	168.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	152.300
16	Front fastener, top A-arm, frame side	214.300	106.440	348.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	350.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in -track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 4.33	- 0.05	56.57	343.11	1.499	- 0.54	- 1.73	20.39	16.62	15.85	145.80
- 25.00	- 4.44	- 0.04	50.79	339.69	1.445	- 0.45	- 1.33	20.35	16.73	15.88	145.42
- 20.00	- 4.55	- 0.03	45.02	336.14	1.390	- 0.37	- 0.98	20.30	16.84	15.92	145.05
- 15.00	- 4.66	- 0.02	39.25	332.44	1.334	- 0.28	- 0.67	20.25	16.95	15.95	144.68
- 10.00	- 4.77	- 0.01	33.48	328.59	1.278	- 0.19	- 0.40	20.21	17.06	15.98	144.32
- 5.00	- 4.88	- 0.01	27.72	324.56	1.221	- 0.09	- 0.18	20.16	17.18	16.01	143.96
0.00	- 5.00	0.00	21.97	320.34	1.162	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.12	0.00	16.22	315.90	1.102	0.10	0.14	20.07	17.41	16.07	143.24
10.00	- 5.24	0.01	10.47	311.21	1.040	0.19	0.23	20.02	17.53	16.10	142.88
15.00	- 5.36	0.01	4.73	306.22	0.975	0.29	0.28	19.98	17.65	16.13	142.53
20.00	- 5.48	0.01	- 1.00	300.88	0.907	0.39	0.29	19.93	17.77	16.15	142.17
25.00	- 5.61	0.01	- 6.74	295.11	0.833	0.49	0.25	19.89	17.90	16.18	141.82
30.00	- 5.73	0.00	- 12.46	288.78	0.751	0.59	0.18	19.84	18.02	16.21	141.48

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	4.751°
WEIGHT TRANSFER FROM AXLE ANGLE	25.861 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	0.631°
BRAKING TORQUE COMPENSATION ANGLE	8.571 %

Suspension adjustment Tables

REAR DRIVE TRAIN

Position of A-arms: 25 CG

Loaded wheel/tyre assembly radius	283,92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and groundl):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	178.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	162.300
16	Front fastener, top A-arm, frame side	214.300	106.440	328.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	330.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in-track width	Wheel castor	C.gyration/rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 3.87	0.21	99.74	341.95	1.570	- 0.89	- 3.57	20.34	16.17	16.05	145.38
- 25.00	- 4.06	0.17	93.95	338.68	1.516	- 0.75	- 2.87	20.30	16.35	16.05	145.08
- 20.00	- 4.24	0.14	88.17	335.30	1.461	- 0.60	- 2.21	20.27	16.54	16.05	144.78
- 15.00	- 4.43	0.11	82.40	331.79	1.406	- 0.45	- 1.59	20.23	16.72	16.05	144.48
- 10.00	- 4.62	0.07	76.63	328.13	1.349	- 0.30	- 1.02	20.19	16.91	16.05	144.18
- 5.00	- 4.81	0.04	70.88	324.33	1.292	- 0.15	- 0.49	20.15	17.10	16.04	143.89
0.00	- 5.00	0.00	65.13	320.34	1.234	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.19	- 0.04	59.38	316.16	1.174	0.15	0.44	20.08	17.48	16.04	143.30
10.00	- 5.39	- 0.08	53.65	311.77	1.112	0.31	0.84	20.04	17.68	16.04	143.01
15.00	- 5.58	- 0.12	47.92	307.11	1.048	0.46	1.20	20.00	17.87	16.03	142.72
20.00	- 5.78	- 0.16	42.20	302.16	0.980	0.61	1.51	19.97	18.07	16.03	142.44
25.00	- 5.97	- 0.20	36.49	296.83	0.908	0.77	1.78	19.93	18.27	16.02	142.15
30.00	- 6.17	- 0.24	30.78	291.05	0.829	0.93	2.01	19.89	18.46	16.02	141.87

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	5.341°
WEIGHT TRANSFER FROM AXLE ANGLE	29.092 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	0.462°
BRAKING TORQUE COMPENSATION ANGLE	6.278 %

Suspension adjustment Tables

REAR DRIVE TRAIN

Position of A-arms: 25 CH

Loaded wheel/tyre assembly radius	283,92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and ground!):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	178.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	162.300
16	Front fastener, top A-arm, frame side	214.300	106.440	318.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	330.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in -track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 3.82	0.21	104.24	341.75	1.584	- 0.60	- 3.72	20.49	16.11	16.01	146.30
- 25.00	- 4.01	0.17	98.52	338.51	1.529	- 0.51	- 2.99	20.43	16.30	16.02	145.84
- 20.00	- 4.21	0.14	92.80	335.16	1.474	- 0.41	- 2.30	20.36	16.50	16.02	145.39
- 15.00	- 4.40	0.11	87.09	331.68	1.419	- 0.31	- 1.66	20.30	16.69	16.03	144.94
- 10.00	- 4.60	0.07	81.38	328.06	1.362	- 0.21	- 1.07	20.24	16.89	16.03	144.49
- 5.00	- 4.80	0.04	75.69	324.28	1.305	- 0.10	- 0.51	20.18	17.09	16.04	144.04
0.00	- 5.00	0.00	69.99	320.34	1.247	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.20	- 0.04	64.31	316.21	1.187	0.11	0.47	20.05	17.49	16.05	143.15
10.00	- 5.41	- 0.08	58.63	311.86	1.125	0.21	0.89	19.99	17.70	16.05	142.72
15.00	- 5.61	- 0.12	52.96	307.26	1.061	0.32	1.28	19.93	17.90	16.05	142.28
20.00	- 5.82	- 0.17	47.30	302.37	0.993	0.43	1.62	19.87	18.11	16.05	141.85
25.00	- 6.02	- 0.21	41.64	297.12	0.921	0.54	1.92	19.81	18.32	16.05	141.42
30.00	- 6.23	- 0.26	35.99	291.42	0.843	0.66	2.17	19.75	18.52	16.05	140.99

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	6.836°
WEIGHT TRANSFER FROM AXLE ANGLE	37.306 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	- 0.595°
BRAKING TORQUE COMPENSATION ANGLE	- 8.083 %

REAR DRIVE TRAIN

Position of A-arms: 25 BG

Loaded wheel/tyre assembly radius	283,92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and groundl):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	178.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	162.300
16	Front fastener, top A-arm, frame side	214.300	106.440	328.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	340.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in -track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 3.97	0.19	94.30	341.86	1.576	- 0.59	- 3.24	20.51	16.26	16.01	146.33
- 25.00	- 4.14	0.17	88.57	338.61	1.522	- 0.49	- 2.60	20.44	16.43	16.02	145.87
- 20.00	- 4.31	0.14	82.84	335.24	1.467	- 0.40	- 1.99	20.38	16.60	16.02	145.41
- 15.00	- 4.48	0.10	77.12	331.74	1.411	- 0.30	- 1.43	20.31	16.77	16.03	144.95
- 10.00	- 4.65	0.07	71.41	328.10	1.355	- 0.20	- 0.91	20.24	16.94	16.03	144.49
- 5.00	- 4.82	0.04	65.70	324.31	1.297	- 0.10	- 0.43	20.18	17.12	16.04	144.04
0.00	- 5.00	0.00	60.00	320.34	1.239	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.18	- 0.04	54.31	316.18	1.179	0.10	0.39	20.05	17.47	16.04	143.15
10.00	- 5.36	- 0.08	48.62	311.80	1.117	0.21	0.74	19.98	17.65	16.05	142.71
15.00	- 5.54	- 0.12	42.94	307.17	1.053	0.32	1.04	19.92	17.83	16.05	142.27
20.00	- 5.72	- 0.16	37.26	302.24	0.985	0.42	1.31	19.85	18.01	16.05	141.83
25.00	- 5.90	- 0.21	31.59	296.94	0.913	0.53	1.53	19.79	18.19	16.05	141.40
30.00	- 6.09	- 0.25	25.93	291.19	0.834	0.64	1.70	19.73	18.38	16.05	140.97

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	6.577°
WEIGHT TRANSFER FROM AXLE ANGLE	35.880 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	0.412°
BRAKING TORQUE COMPENSATION ANGLE	- 5.589 %

Suspension adjustment Tables

REAR DRIVE TRAIN

Position of A-arms: 25 BF

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and ground):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	178.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	162.300
16	Front fastener, top A-arm, frame side	214.300	106.440	338.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	340.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in -track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 4.03	0.20	89.70	342.07	1.563	- 0.88	- 3.10	20.36	16.32	16.05	145.40
- 25.00	- 4.19	0.17	83.90	338.79	1.509	- 0.74	- 2.47	20.32	16.48	16.05	145.09
- 20.00	- 4.35	0.13	78.11	335.39	1.454	- 0.59	- 1.89	20.28	16.64	16.05	144.79
- 15.00	- 4.51	0.10	72.32	331.86	1.398	- 0.45	- 1.35	20.24	16.80	16.05	144.49
- 10.00	- 4.67	0.07	66.54	328.18	1.342	- 0.30	- 0.86	20.19	16.96	16.05	144.19
- 5.00	- 4.83	0.04	60.77	324.35	1.285	- 0.15	- 0.41	20.15	17.13	16.05	143.89
0.00	- 5.00	0.00	55.01	320.34	1.226	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.17	- 0.04	49.25	316.14	1.166	0.15	0.36	20.07	17.46	16.04	143.30
10.00	- 5.34	- 0.07	43.50	311.71	1.104	0.30	0.68	20.03	17.63	16.03	143.01
15.00	- 5.51	- 0.11	37.75	307.02	1.040	0.46	0.96	19.99	17.80	16.03	142.72
20.00	- 5.68	- 0.15	32.02	302.02	0.972	0.61	1.19	19.95	17.97	16.02	142.43
25.00	- 5.85	- 0.19	26.29	296.65	0.899	0.76	1.39	19.91	18.14	16.02	142.14
30.00	- 6.02	- 0.23	20.56	290.81	0.820	0.92	1.53	19.88	18.32	16.01	141.86

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	5.175°
WEIGHT TRANSFER FROM AXLE ANGLE	28.184 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	0.579°
BRAKING TORQUE COMPENSATION ANGLE	7.866 %

REAR DRIVE TRAIN

Position of A-arms: 25 AF

Loaded wheel/tyre assembly radius	283,92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and groundl):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	178.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	162.300
16	Front fastener, top A-arm, frame side	214.300	106.440	338.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	350.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in-track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 4.13	0.18	84.07	341.98	1.569	- 0.57	- 2.76	20.53	16.42	16.01	146.36
- 25.00	- 4.27	0.16	78.33	338.71	1.514	- 0.48	- 2.19	20.46	16.56	16.02	145.89
- 20.00	- 4.41	0.13	72.60	335.33	1.459	- 0.39	- 1.67	20.39	16.70	16.03	145.43
- 15.00	- 4.56	0.10	66.88	331.81	1.404	- 0.29	- 1.19	20.32	16.85	16.03	144.96
- 10.00	- 4.70	0.07	61.16	328.15	1.347	- 0.20	- 0.75	20.25	16.99	16.04	144.50
- 5.00	- 4.85	0.03	55.44	324.33	1.290	- 0.10	- 0.35	20.18	17.14	16.04	144.05
0.00	- 5.00	0.00	49.73	320.34	1.231	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.15	- 0.04	44.03	316.15	1.171	0.10	0.31	20.04	17.44	16.04	143.15
10.00	- 5.30	- 0.07	38.33	311.74	1.109	0.20	0.58	19.98	17.60	16.04	142.70
15.00	- 5.46	- 0.11	32.64	307.07	1.044	0.31	0.80	19.91	17.75	16.04	142.25
20.00	- 5.62	- 0.16	26.95	302.10	0.976	0.42	0.99	19.84	17.91	16.04	141.81
25.00	- 5.77	- 0.20	21.27	296.76	0.904	0.52	1.13	19.77	18.07	16.04	141.38
30.00	- 5.93	- 0.24	15.60	290.95	0.825	0.63	1.22	19.71	18.23	16.04	140.94

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	6.347°
WEIGHT TRANSFER FROM AXLE ANGLE	34.614 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	- 0.249°
BRAKING TORQUE COMPENSATION ANGLE	- 3.376 %

Suspension adjustment Tables

REAR DRIVE TRAIN

Position of A-arms: 25 AE

Loaded wheel/tyre assembly radius	283,92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and ground!):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	178.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	162.300
16	Front fastener, top A-arm, frame side	214.300	106.440	348.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	350.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in -track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 4.19	0.19	79.37	342.19	1.556	- 0.87	- 2.61	20.38	16.48	16.06	145.42
- 25.00	- 4.32	0.16	73.56	338.89	1.501	- 0.73	- 2.07	20.33	16.61	16.06	145.11
- 20.00	- 4.45	0.13	67.76	335.48	1.446	- 0.58	- 1.57	20.29	16.74	16.05	144.80
- 15.00	- 4.59	0.10	61.96	331.93	1.390	- 0.44	- 1.11	20.24	16.88	16.05	144.50
- 10.00	- 4.72	0.07	56.17	328.23	1.334	- 0.29	- 0.70	20.20	17.01	16.05	144.19
- 5.00	- 4.86	0.03	50.38	324.38	1.277	- 0.15	- 0.33	20.16	17.15	16.05	143.89
0.00	- 5.00	0.00	44.60	320.34	1.218	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.14	- 0.03	38.83	316.11	1.158	0.15	0.28	20.07	17.43	16.04	143.30
10.00	- 5.28	- 0.07	33.07	311.65	1.096	0.30	0.52	20.03	17.58	16.03	143.00
15.00	- 5.43	- 0.11	27.31	306.92	1.031	0.45	0.72	19.98	17.72	16.03	142.71
20.00	- 5.57	- 0.15	21.55	301.88	0.963	0.60	0.87	19.94	17.87	16.02	142.42
25.00	- 5.72	- 0.19	15.81	296.47	0.891	0.76	0.98	19.90	18.01	16.01	142.13
30.00	- 5.87	- 0.23	10.07	290.56	0.811	0.91	1.05	19.86	18.16	16.01	141.84

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	5.028°
WEIGHT TRANSFER FROM AXLE ANGLE	27.375 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	0.683°
BRAKING TORQUE COMPENSATION ANGLE	9.280 %

REAR DRIVE TRAIN

Position of A-arms: 26 AE

Loaded wheel/tyre assembly radius	283,92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and groundl):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	178.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	162.300
16	Front fastener, top A-arm, frame side	214.300	106.440	348.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	350.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in-track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 4.19	0.19	79.37	342.19	1.556	- 0.87	- 2.61	20.38	16.48	16.06	145.42
- 25.00	- 4.32	0.16	73.56	338.89	1.501	- 0.73	- 2.07	20.33	16.61	16.06	145.11
- 20.00	- 4.45	0.13	67.76	335.48	1.446	- 0.58	- 1.57	20.29	16.74	16.05	144.80
- 15.00	- 4.59	0.10	61.96	331.93	1.390	- 0.44	- 1.11	20.24	16.88	16.05	144.50
- 10.00	- 4.72	0.07	56.17	328.23	1.334	- 0.29	- 0.70	20.20	17.01	16.05	144.19
- 5.00	- 4.86	0.03	50.38	324.38	1.277	- 0.15	- 0.33	20.16	17.15	16.05	143.89
0.00	- 5.00	0.00	44.60	320.34	1.218	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.14	- 0.03	38.83	316.11	1.158	0.15	0.28	20.07	17.43	16.04	143.30
10.00	- 5.28	- 0.07	33.07	311.65	1.096	0.30	0.52	20.03	17.58	16.03	143.00
15.00	- 5.43	- 0.11	27.31	306.92	1.031	0.45	0.72	19.98	17.72	16.03	142.71
20.00	- 5.57	- 0.15	21.55	301.88	0.963	0.60	0.87	19.94	17.87	16.02	142.42
25.00	- 5.72	- 0.19	15.81	296.47	0.891	0.76	0.98	19.90	18.01	16.01	142.13
30.00	- 5.87	- 0.23	10.07	290.56	0.811	0.91	1.05	19.86	18.16	16.01	141.84

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	5.028°
WEIGHT TRANSFER FROM AXLE ANGLE	27.375 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	0.683°
BRAKING TORQUE COMPENSATION ANGLE	9.280 %

Suspension adjustment Tables

REAR DRIVE TRAIN

Position of A-arms: 26 AF

Loaded wheel/tyre assembly radius	283,92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and groundl):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	168.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	162.300
16	Front fastener, top A-arm, frame side	214.300	106.440	338.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	350.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in -track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 4.18	0.10	74.22	342.62	1.527	- 0.03	- 2.40	20.35	16.47	15.98	145.40
- 25.00	- 4.31	0.08	68.44	339.26	1.473	- 0.03	- 1.89	20.31	16.60	15.99	145.09
- 20.00	- 4.45	0.07	62.66	335.78	1.418	- 0.03	- 1.43	20.27	16.74	16.00	144.79
- 15.00	- 4.58	0.05	56.90	332.16	1.363	- 0.02	- 1.01	20.23	16.87	16.01	144.49
- 10.00	- 4.72	0.04	51.14	328.39	1.308	- 0.02	- 0.63	20.19	17.01	16.02	144.19
- 5.00	- 4.86	0.02	45.39	324.46	1.251	- 0.01	- 0.29	20.15	17.15	16.03	143.89
0.00	- 5.00	0.00	39.64	320.34	1.193	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.14	- 0.02	33.90	316.02	1.134	0.01	0.25	20.07	17.43	16.05	143.30
10.00	- 5.29	- 0.04	28.17	311.46	1.072	0.02	0.45	20.04	17.58	16.06	143.01
15.00	- 5.43	- 0.06	22.44	306.63	1.008	0.03	0.62	20.00	17.72	16.06	142.72
20.00	- 5.58	- 0.09	16.72	301.47	0.941	0.05	0.74	19.96	17.87	16.07	142.43
25.00	- 5.73	- 0.11	11.00	295.92	0.869	0.06	0.81	19.92	18.02	16.08	142.15
30.00	- 5.88	- 0.14	5.29	289.87	0.789	0.08	0.85	19.89	18.17	16.08	141.86

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	3.317°
WEIGHT TRANSFER FROM AXLE ANGLE	18.033 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	- 0.784°
BRAKING TORQUE COMPENSATION ANGLE	- 10.643 %

REAR DRIVE TRAIN

Position of A-arms: 26 BF

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and groundl):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	168.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	162.300
16	Front fastener, top A-arm, frame side	214.300	106.440	338.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	340.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in-track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 4.08	0.11	80.03	342.71	1.521	- 0.34	- 2.74	20.18	16.37	16.02	144.43
- 25.00	- 4.23	0.09	74.19	339.34	1.467	- 0.29	- 2.17	20.17	16.52	16.03	144.29
- 20.00	- 4.38	0.07	68.35	335.84	1.413	- 0.23	- 1.65	20.16	16.67	16.03	144.15
- 15.00	- 4.53	0.06	62.53	332.21	1.358	- 0.17	- 1.17	20.14	16.83	16.03	144.03
- 10.00	- 4.69	0.04	56.71	328.42	1.303	- 0.12	- 0.74	20.13	16.98	16.04	143.83
- 5.00	- 4.84	0.02	50.90	324.48	1.246	- 0.06	- 0.35	20.12	17.13	16.04	143.73
0.00	- 5.00	0.00	45.09	320.34	1.188	0.00	0.00	20.11	17.29	16.04	143.60
5.00	- 5.16	- 0.02	39.29	316.00	1.129	0.06	0.30	20.10	17.45	16.04	143.46
10.00	- 5.32	- 0.04	33.50	311.42	1.068	0.12	0.56	20.09	17.61	16.05	143.33
15.00	- 5.48	- 0.06	27.72	306.57	1.004	0.18	0.77	20.08	17.77	16.05	143.??
20.00	- 5.64	- 0.08	21.95	301.39	0.936	0.24	0.95	20.07	17.93	16.05	143.05
25.00	- 5.80	- 0.11	16.18	295.81	0.864	0.30	1.07	20.07	18.10	16.05	142.9?
30.00	- 5.97	- 0.13	10.42	289.72	0.785	0.36	1.16	20.06	18.26	16.05	142.7?

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	2.134°
WEIGHT TRANSFER FROM AXLE ANGLE	11.598 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	0.081°
BRAKING TORQUE COMPENSATION ANGLE	1.100 %

Suspension adjustment Tables

REAR DRIVE TRAIN

Position of A-arms: 26 BG

Rayon sous charge roue	283,92 mm
Réglage initial	
- Carrossage	- 5°
- Parallélisme	0°
- Hauteur de caisse (hauteur entre patins et sol) :	
• Avant	25 mm
• Arrière	35 mm

Position of actual suspension point (in mm)

Point	Définition	X	Y	Z
1	Triangle inférieur côté roue	77.880	587.570	180.530
3	Triangle supérieur côté roue	- 5.900	516.350	409.310
5	Biellette de parallélisme côté roue	- 69.160	583.780	170.130
6	Push rod côté roue	76.660	507.590	200.510
8	Point inférieur axe pivot du basculeur	21.900	125.030	355.640
9	Point supérieur axe pivot du basculeur	21.900	149.430	410.460
13	Point d'attache amortisseur sur basculeur	21.900	45.250	407.580
14	Attache avant triangle inférieur côté boîte	264.300	105.500	168.500
15	Attache arrière triangle inférieur côté boîte	- 110.490	105.500	162.300
16	Attache avant triangle supérieur côté boîte	214.300	106.440	328.080
17	Attache arrière triangle supérieur côté boîte	- 214.300	106.440	340.470
18	Biellette de parallélisme côté boîte	- 110.490	105.500	152.300
19	Push rod côté basculeur	63.800	87.410	388.810
20	Centre roue	0.000	634.730	283.920
26	Point d'attache amortisseur arrière	- 297.970	47.630	390.340

H roue mm	Carro. degré	Para. degré	CR mm	L. ress mm	DR/MR mm	V. empa. mm	V. voie mm	Chasse degré	Pivot degré	Déport mm	Ch. Sol mm
- 30.00	- 4.02	0.11	84.76	342.50	1.534	- 0.05	- 2.89	20.33	16.31	15.98	145.38
- 25.00	- 4.18	0.09	78.99	339.16	1.480	- 0.05	- 2.30	20.29	16.47	15.99	145.07
- 20.00	- 4.34	0.08	73.23	335.69	1.426	- 0.04	- 1.75	20.26	16.63	16.00	144.77
- 15.00	- 4.50	0.06	67.47	332.09	1.371	- 0.03	- 1.25	20.22	16.80	16.01	144.48
- 10.00	- 4.67	0.04	61.73	328.34	1.315	- 0.02	- 0.79	20.18	16.96	16.02	144.18
- 5.00	- 4.83	0.02	55.98	324.43	1.258	- 0.01	- 0.37	20.15	17.12	16.03	143.89
0.00	- 5.00	0.00	50.25	320.34	1.201	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.17	- 0.02	44.52	316.05	1.141	0.01	0.33	20.08	17.46	16.05	143.30
10.00	- 5.34	- 0.04	38.80	311.52	1.080	0.03	0.62	20.04	17.63	16.06	143.02
15.00	- 5.51	- 0.07	33.08	306.73	1.016	0.04	0.86	20.01	17.80	16.07	142.73
20.00	- 5.68	- 0.09	27.38	301.61	0.949	0.06	1.06	19.97	17.97	16.07	142.45
25.00	- 5.86	- 0.12	21.67	296.11	0.877	0.08	1.22	19.94	18.15	16.08	142.16
30.00	- 6.03	- 0.15	15.98	290.12	0.798	0.09	1.33	19.91	18.32	16.09	141.88

Empattement	2645 mm
Hauteur du centre de gravité (estimée)	340 mm

Angle 100 % anticabrage	17.815°
Angle anticabrage effectif	3.456°
ANTICABRAGE	18.790 %

Angle 100 % antiplongée	7.325°
Angle antiplongée effectif	- 0.886°
ANTIPLONGEE	- 12.025 %

REAR DRIVE TRAIN

Position of A-arms: 26 CH

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and ground):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	168.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	162.300
16	Front fastener, top A-arm, frame side	214.300	106.440	318.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	330.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in-track width	Wheel castor	C.gyration/rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 3.87	0.12	95.01	342.38	1.541	- 0.07	- 3.36	20.31	16.16	15.98	145.35
- 25.00	- 4.05	0.10	89.25	339.05	1.487	- 0.06	- 2.69	20.28	16.34	15.99	145.06
- 20.00	- 4.24	0.08	83.50	335.60	1.433	- 0.05	- 2.07	20.25	16.53	16.00	144.76
- 15.00	- 4.43	0.06	77.76	332.02	1.378	- 0.04	- 1.48	20.21	16.72	16.01	144.43
- 10.00	- 4.62	0.04	72.02	328.30	1.322	- 0.03	- 0.95	20.18	16.91	16.02	144.13
- 5.00	- 4.81	0.02	66.29	324.41	1.266	- 0.01	- 0.45	20.15	17.10	16.03	143.88
0.00	- 5.00	0.00	60.57	320.34	1.208	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.19	- 0.02	54.85	316.08	1.149	0.02	0.41	20.08	17.48	16.05	143.33
10.00	- 5.39	- 0.05	49.14	311.58	1.088	0.03	0.77	20.05	17.68	16.06	143.03
15.00	- 5.58	- 0.07	43.44	306.82	1.024	0.05	1.10	20.02	17.88	16.07	142.7?
20.00	- 5.78	- 0.10	37.75	301.75	0.957	0.07	1.37	19.99	18.07	16.08	142.4?
25.00	- 5.98	- 0.13	32.06	296.30	0.885	0.09	1.61	19.96	18.27	16.08	142.1?
30.00	- 6.18	- 0.16	26.38	290.37	0.807	0.11	1.80	19.93	18.47	16.09	141.9?

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	3.612°
WEIGHT TRANSFER FROM AXLE ANGLE	19.642 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	- 1.000°
BRAKING TORQUE COMPENSATION ANGLE	- 13.579 %

Suspension adjustment Tables

REAR DRIVE TRAIN

Position of A-arms: 26 CG

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and ground!):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	168.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	162.300
16	Front fastener, top A-arm, frame side	214.300	106.440	328.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	330.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in -track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 3.93	0.12	90.38	342.58	1.529	- 0.36	- 3.22	20.16	16.22	16.02	144.42
- 25.00	- 4.10	0.10	84.55	339.23	1.475	- 0.30	- 2.57	20.15	16.39	16.03	144.28
- 20.00	- 4.28	0.08	78.74	335.75	1.420	- 0.24	- 1.97	20.15	16.57	16.03	144.14
- 15.00	- 4.46	0.06	72.93	332.14	1.366	- 0.18	- 1.41	20.14	16.75	16.03	144.01
- 10.00	- 4.64	0.04	67.12	328.38	1.310	- 0.12	- 0.90	20.13	16.93	16.04	143.87
- 5.00	- 4.82	0.02	61.33	324.45	1.253	- 0.06	- 0.43	20.12	17.11	16.04	143.73
0.00	- 5.00	0.00	55.54	320.34	1.196	0.00	0.00	20.11	17.29	16.04	143.60
5.00	- 5.18	- 0.02	49.77	316.03	1.136	0.06	0.38	20.11	17.47	16.04	143.46
10.00	- 5.37	- 0.04	43.99	311.48	1.075	0.12	0.72	20.10	17.66	16.05	143.33
15.00	- 5.55	- 0.07	38.23	306.67	1.012	0.19	1.01	20.09	17.85	16.05	143.??
20.00	- 5.74	- 0.09	32.47	301.53	0.944	0.25	1.26	20.09	18.03	16.05	143.06
25.00	- 5.93	- 0.11	26.73	296.00	0.872	0.31	1.47	20.08	18.22	16.06	142.93
30.00	- 6.12	- 0.14	20.98	289.97	0.793	0.38	1.63	20.07	18.41	16.06	142.??

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	2.206°
WEIGHT TRANSFER FROM AXLE ANGLE	11.988 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	0.029°
BRAKING TORQUE COMPENSATION ANGLE	0.388 %

REAR DRIVE TRAIN

Position of A-arms: 24 CG

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and ground):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	188.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	162.300
16	Front fastener, top A-arm, frame side	214.300	106.440	328.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	330.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in-track width	Wheel castor	C.gyration/rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 3.82	0.29	108.97	341.32	1.614	- 1.42	- 3.93	20.52	16.11	16.08	146.33
- 25.00	- 4.02	0.25	103.21	338.14	1.559	- 1.19	- 3.16	20.45	16.31	16.08	145.87
- 20.00	- 4.21	0.20	97.45	334.86	1.504	- 0.95	- 2.44	20.38	16.50	16.07	145.41
- 15.00	- 4.41	0.15	91.71	331.44	1.448	- 0.72	- 1.77	20.32	16.70	16.06	144.95
- 10.00	- 4.60	0.10	85.96	327.90	1.391	- 0.48	- 1.13	20.25	16.89	16.06	144.49
- 5.00	- 4.80	0.05	80.23	324.20	1.333	- 0.24	- 0.55	20.18	17.09	16.05	144.04
0.00	- 5.00	0.00	74.50	320.34	1.274	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.20	- 0.05	68.78	316.30	1.213	0.24	0.50	20.05	17.49	16.03	143.15
10.00	- 5.40	- 0.11	63.07	312.04	1.150	0.48	0.96	19.98	17.69	16.02	142.71
15.00	- 5.61	- 0.17	57.36	307.55	1.086	0.73	1.38	19.91	17.90	16.01	142.27
20.00	- 5.81	- 0.23	51.66	302.77	1.017	0.97	1.75	19.85	18.10	16.00	141.83
25.00	- 6.02	- 0.29	45.97	297.64	0.945	1.22	2.08	19.78	18.31	15.99	141.40
30.00	- 6.23	- 0.35	40.28	292.10	0.866	1.47	2.37	19.72	18.52	15.98	140.96

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	8.558°
WEIGHT TRANSFER FROM AXLE ANGLE	46.830 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	0.912°
BRAKING TORQUE COMPENSATION ANGLE	12.386 %

Suspension adjustment Tables

REAR DRIVE TRAIN

Position of A-arms: 24 CH

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and ground!):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	188.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	162.300
16	Front fastener, top A-arm, frame side	214.300	106.440	318.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	330.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in -track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 3.77	0.29	113.34	341.13	1.628	- 1.13	- 4.06	20.67	16.06	16.04	147.24
- 25.00	- 3.97	0.25	107.64	337.98	1.573	- 0.94	- 3.28	20.57	16.26	16.04	146.62
- 20.00	- 4.17	0.20	101.94	334.72	1.517	- 0.76	- 2.54	20.48	16.46	16.04	146.01
- 15.00	- 4.38	0.15	96.25	331.34	1.461	- 0.57	- 1.84	20.39	16.67	16.04	145.40
- 10.00	- 4.58	0.10	90.57	327.82	1.404	- 0.38	- 1.18	20.30	16.88	16.04	144.79
- 5.00	- 4.79	0.05	84.89	324.16	1.346	- 0.19	- 0.57	20.20	17.08	16.04	144.19
0.00	- 5.00	0.00	79.22	320.34	1.287	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.21	- 0.06	73.55	316.34	1.226	0.19	0.53	20.02	17.50	16.04	143.00
10.00	- 5.42	- 0.11	67.89	312.13	1.164	0.39	1.01	19.93	17.71	16.04	142.41
15.00	- 5.64	- 0.17	62.24	307.69	1.099	0.59	1.46	19.84	17.93	16.03	141.83
20.00	- 5.85	- 0.23	56.59	302.97	1.031	0.79	1.86	19.75	18.14	16.03	141.25
25.00	- 6.07	- 0.30	50.95	297.92	0.958	0.99	2.21	19.66	18.36	16.02	140.67
30.00	- 6.28	- 0.36	45.32	292.45	0.880	1.19	2.53	19.57	18.58	16.01	140.10

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	10.139°
WEIGHT TRANSFER FROM AXLE ANGLE	55.646 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	- 0.175°
BRAKING TORQUE COMPENSATION ANGLE	- 2.378 %

REAR DRIVE TRAIN

Position of A-arms: 24 BG

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and groundl):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	188.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	162.300
16	Front fastener, top A-arm, frame side	214.300	106.440	328.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	340.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in-track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 3.92	0.28	103.70	341.24	1.621	- 1.11	- 3.59	20.69	16.21	16.04	147.27
- 25.00	- 4.10	0.24	97.99	338.07	1.565	- 0.93	- 2.89	20.59	16.39	16.04	146.65
- 20.00	- 4.27	0.20	92.29	334.80	1.510	- 0.75	- 2.23	20.49	16.57	16.04	146.03
- 15.00	- 4.45	0.15	86.60	331.40	1.453	- 0.57	- 1.60	20.40	16.74	16.05	145.41
- 10.00	- 4.63	0.10	80.90	327.87	1.396	- 0.38	- 1.03	20.30	16.93	16.05	144.80
- 5.00	- 4.82	0.05	75.22	324.19	1.338	- 0.19	- 0.49	20.21	17.11	16.04	144.20
0.00	- 5.00	0.00	69.54	320.34	1.279	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.19	- 0.05	63.87	316.31	1.218	0.19	0.45	20.02	17.48	16.04	143.00
10.00	- 5.37	- 0.11	58.20	312.08	1.155	0.39	0.86	19.92	17.66	16.03	142.40
15.00	- 5.56	- 0.17	52.54	307.60	1.090	0.58	1.22	19.83	17.85	16.03	141.81
20.00	- 5.75	- 0.23	46.88	302.84	1.022	0.78	1.55	19.74	18.04	16.02	141.23
25.00	- 5.94	- 0.29	41.23	297.75	0.950	0.98	1.83	19.64	18.24	16.01	140.65
30.00	- 6.14	- 0.36	35.59	292.23	0.871	1.18	2.07	19.55	18.43	16.01	140.07

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	9.770°
WEIGHT TRANSFER FROM AXLE ANGLE	53.582 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	0.079°
BRAKING TORQUE COMPENSATION ANGLE	1.078 %

Suspension adjustment Tables

REAR DRIVE TRAIN

Position of A-arms: 24 BF

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and groundl):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	188.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	162.300
16	Front fastener, top A-arm, frame side	214.300	106.440	338.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	340.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in -track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 3.98	0.28	99.24	341.43	1.607	- 1.41	- 3.45	20.54	16.27	16.08	146.35
- 25.00	- 4.14	0.24	93.47	338.24	1.552	- 1.18	- 2.77	20.47	16.44	16.08	145.88
- 20.00	- 4.31	0.19	87.70	334.94	1.496	- 0.95	- 2.13	20.40	16.60	16.07	145.42
- 15.00	- 4.48	0.15	81.94	331.51	1.440	- 0.71	- 1.53	20.32	16.77	16.07	144.96
- 10.00	- 4.65	0.10	76.19	327.94	1.383	- 0.48	- 0.98	20.25	16.94	16.06	144.50
- 5.00	- 4.83	0.05	70.44	324.23	1.325	- 0.24	- 0.47	20.18	17.12	16.05	144.05
0.00	- 5.00	0.00	64.70	320.34	1.266	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.18	- 0.05	58.97	316.27	1.205	0.24	0.42	20.04	17.47	16.03	143.15
10.00	- 5.35	- 0.11	53.24	311.99	1.142	0.48	0.81	19.97	17.64	16.02	142.70
15.00	- 5.53	- 0.16	47.52	307.46	1.077	0.73	1.14	19.90	17.82	16.01	142.26
20.00	- 5.71	- 0.22	41.81	302.64	1.009	0.97	1.44	19.84	18.00	16.00	141.82
25.00	- 5.89	- 0.28	36.10	297.47	0.936	1.22	1.69	19.77	18.19	15.98	141.38
30.00	- 6.08	- 0.34	30.40	291.87	0.857	1.46	1.90	19.70	18.37	15.97	140.95

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	8.291°
WEIGHT TRANSFER FROM AXLE ANGLE	45.349 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	1.095°
BRAKING TORQUE COMPENSATION ANGLE	14.867 %

REAR DRIVE TRAIN

Position of A-arms: 24 AF

Loaded wheel/tyre assembly radius	283,92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and groundl):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	188.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	162.300
16	Front fastener, top A-arm, frame side	214.300	106.440	338.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	350.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in-track width	Wheel castor	C.gyration/rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 4.08	0.27	93.80	341.35	1.613	- 1.10	- 3.11	20.71	16.37	16.04	147.31
- 25.00	- 4.23	0.23	88.08	338.17	1.558	- 0.92	- 2.49	20.61	16.52	16.04	146.68
- 20.00	- 4.38	0.19	82.38	334.88	1.502	- 0.74	- 1.91	20.51	16.67	16.05	146.05
- 15.00	- 4.53	0.14	76.67	331.47	1.446	- 0.56	- 1.37	20.41	16.82	16.05	145.43
- 10.00	- 4.69	0.10	70.98	327.91	1.388	- 0.38	- 0.87	20.31	16.98	16.05	144.81
- 5.00	- 4.84	0.05	65.29	324.21	1.330	- 0.19	- 0.41	20.21	17.13	16.04	144.20
0.00	- 5.00	0.00	59.60	320.34	1.271	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.16	- 0.05	53.92	316.29	1.210	0.19	0.37	20.01	17.45	16.04	142.99
10.00	- 5.32	- 0.11	48.24	312.02	1.147	0.38	0.70	19.92	17.61	16.03	142.39
15.00	- 5.49	- 0.16	42.57	307.51	1.082	0.58	0.99	19.82	17.78	16.03	141.80
20.00	- 5.65	- 0.22	36.91	302.71	1.014	0.78	1.23	19.72	17.94	16.02	141.21
25.00	- 5.82	- 0.28	31.25	297.57	0.941	0.98	1.43	19.63	18.11	16.01	140.62
30.00	- 5.99	- 0.35	25.60	292.00	0.862	1.18	1.59	19.53	18.28	16.00	140.04

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	9.443°
WEIGHT TRANSFER FROM AXLE ANGLE	51.756 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	0.305°
BRAKING TORQUE COMPENSATION ANGLE	4.137 %

Suspension adjustment Tables

REAR DRIVE TRAIN

Position of A-arms: 24 AE

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and ground!):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	188.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	162.300
16	Front fastener, top A-arm, frame side	214.300	106.440	348.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	350.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in -track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 4.14	0.27	89.24	341.55	1.599	- 1.40	- 2.97	20.56	16.43	16.08	146.37
- 25.00	- 4.28	0.23	83.45	338.35	1.544	- 1.17	- 2.37	20.48	16.57	16.08	145.90
- 20.00	- 4.42	0.19	77.68	335.03	1.488	- 0.94	- 1.81	20.41	16.71	16.07	145.43
- 15.00	- 4.56	0.14	71.91	331.58	1.432	- 0.71	- 1.29	20.33	16.85	16.07	144.97
- 10.00	- 4.71	0.10	66.14	327.99	1.375	- 0.47	- 0.82	20.26	17.00	16.06	144.51
- 5.00	- 4.85	0.05	60.39	324.25	1.317	- 0.24	- 0.39	20.19	17.14	16.05	144.05
0.00	- 5.00	0.00	54.63	320.34	1.257	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.15	- 0.05	48.89	316.24	1.197	0.24	0.34	20.04	17.44	16.03	143.14
10.00	- 5.30	- 0.10	43.15	311.93	1.134	0.48	0.64	19.97	17.59	16.02	142.69
15.00	- 5.45	- 0.16	37.42	307.36	1.069	0.72	0.90	19.89	17.75	16.01	142.25
20.00	- 5.61	- 0.21	31.69	302.50	1.000	0.97	1.12	19.82	17.90	15.99	141.81
25.00	- 5.77	- 0.27	25.97	297.29	0.927	1.21	1.29	19.75	18.06	15.98	141.37
30.00	- 5.92	- 0.33	20.25	291.63	0.848	1.46	1.42	19.68	18.22	15.96	140.93

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	8.054°
WEIGHT TRANSFER FROM AXLE ANGLE	44.032 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	1.257°
BRAKING TORQUE COMPENSATION ANGLE	17.072 %

REAR DRIVE TRAIN

Position of A-arms: 14 AE

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and groundl):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	188.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	172.300
16	Front fastener, top A-arm, frame side	214.300	106.440	348.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	350.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in-track width	Wheel castor	C.gyration/rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 4.04	0.42	101.90	341.26	1.618	- 1.20	- 3.50	20.36	16.33	16.26	145.04
- 25.00	- 4.20	0.36	96.05	338.09	1.563	- 1.00	- 2.80	20.32	16.49	16.23	144.79
- 20.00	- 4.36	0.29	90.22	334.81	1.508	- 0.80	- 2.15	20.28	16.65	16.19	144.55
- 15.00	- 4.52	0.22	84.40	331.41	1.452	- 0.60	- 1.55	20.24	16.81	16.15	144.33
- 10.00	- 4.68	0.14	78.58	327.87	1.396	- 0.40	- 0.99	20.20	16.97	16.12	144.07
- 5.00	- 4.84	0.07	72.77	324.19	1.338	- 0.20	- 0.47	20.15	17.13	16.08	143.83
0.00	- 5.00	0.00	66.97	320.34	1.279	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.16	- 0.07	61.18	316.32	1.219	0.20	0.43	20.07	17.46	16.00	143.30
10.00	- 5.33	- 0.15	55.39	312.08	1.157	0.41	0.81	20.03	17.62	15.96	143.13
15.00	- 5.50	- 0.22	49.62	307.61	1.093	0.61	1.15	19.99	17.79	15.93	142.90
20.00	- 5.67	- 0.30	43.85	302.87	1.025	0.82	1.45	19.95	17.96	15.89	142.6?
25.00	- 5.84	- 0.38	38.09	297.79	0.954	1.02	1.70	19.91	18.13	15.84	142.4?
30.00	- 6.01	- 0.45	32.33	292.30	0.876	1.23	1.91	19.87	18.30	15.80	142.23

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	5.336°
WEIGHT TRANSFER FROM AXLE ANGLE	29.066 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	0.742°
BRAKING TORQUE COMPENSATION ANGLE	10.070 %

Suspension adjustment Tables

REAR DRIVE TRAIN

Position of A-arms: 14 AF

Loaded wheel/tyre assembly radius	283,92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and ground!):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	188.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	172.300
16	Front fastener, top A-arm, frame side	214.300	106.440	338.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	350.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in -track width	Wheel castor	C.gyration/rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 3.98	0.42	106.49	341.06	1.631	- 0.90	- 3.64	20.52	16.28	16.22	145.98
- 25.00	- 4.15	0.35	100.72	337.92	1.577	- 0.75	- 2.92	20.45	16.44	16.19	145.57
- 20.00	- 4.32	0.29	94.95	334.67	1.522	- 0.61	- 2.25	20.38	16.61	16.16	145.17
- 15.00	- 4.49	0.22	89.20	331.30	1.466	- 0.46	- 1.62	20.31	16.78	16.13	144.77
- 10.00	- 4.66	0.15	83.45	327.79	1.409	- 0.31	- 1.04	20.25	16.95	16.10	144.38
- 5.00	- 4.83	0.07	77.71	324.15	1.352	- 0.15	- 0.50	20.18	17.12	16.07	143.99
0.00	- 5.00	0.00	71.97	320.34	1.293	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.17	- 0.07	66.24	316.36	1.233	0.15	0.45	20.05	17.47	16.01	143.21
10.00	- 5.35	- 0.15	60.52	312.17	1.171	0.31	0.86	19.98	17.64	15.98	142.82
15.00	- 5.53	- 0.23	54.81	307.76	1.106	0.47	1.23	19.92	17.82	15.94	142.44
20.00	- 5.71	- 0.31	49.10	303.07	1.039	0.63	1.56	19.85	18.00	15.91	142.06
25.00	- 5.89	- 0.39	43.40	298.07	0.968	0.79	1.84	19.79	18.18	15.88	141.68
30.00	- 6.07	- 0.47	37.71	292.66	0.890	0.95	2.08	19.72	18.36	15.84	141.31

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	6.821°
WEIGHT TRANSFER FROM AXLE ANGLE	37.222 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	- 0.164°
BRAKING TORQUE COMPENSATION ANGLE	- 2.233 %

REAR DRIVE TRAIN

Position of A-arms: 14 BF

Loaded wheel/tyre assembly radius	28392 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and groundl):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	188.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	172.300
16	Front fastener, top A-arm, frame side	214.300	106.440	338.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	340.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in-track width	Wheel castor	C.gyration/rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 3.89	0.43	111.94	341.14	1.625	- 1.21	- 3.98	20.35	16.18	16.26	145.02
- 25.00	- 4.07	0.36	106.11	337.99	1.571	- 1.01	- 3.20	20.31	16.36	16.22	144.78
- 20.00	- 4.25	0.29	100.29	334.72	1.516	- 0.81	- 2.47	20.27	16.54	16.19	144.54
- 15.00	- 4.44	0.22	94.48	331.34	1.460	- 0.61	- 1.79	20.23	16.73	16.15	144.30
- 10.00	- 4.62	0.15	88.68	327.82	1.404	- 0.41	- 1.15	20.19	16.92	16.12	144.06
- 5.00	- 4.81	0.07	82.89	324.16	1.346	- 0.20	- 0.55	20.15	17.10	16.08	143.83
0.00	- 5.00	0.00	77.10	320.34	1.288	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.19	- 0.07	71.33	316.34	1.228	0.20	0.51	20.08	17.48	16.00	143.36
10.00	- 5.38	- 0.15	65.56	312.14	1.166	0.41	0.97	20.04	17.67	15.97	143.13
15.00	- 5.57	- 0.23	59.80	307.70	1.101	0.61	1.39	20.00	17.87	15.93	142.90
20.00	- 5.77	- 0.30	54.04	303.00	1.034	0.82	1.77	19.96	18.06	15.89	142.67
25.00	- 5.96	- 0.38	48.30	297.97	0.963	1.03	2.10	19.93	18.26	15.85	142.45
30.00	- 6.16	- 0.46	42.56	292.53	0.885	1.24	2.39	19.89	18.45	15.81	142.22

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	5.512°
WEIGHT TRANSFER FROM AXLE ANGLE	30.029 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	0.635°
BRAKING TORQUE COMPENSATION ANGLE	8.618 %

Suspension adjustment Tables

REAR DRIVE TRAIN

Position of A-arms: 14 BG

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and groundl):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	188.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	172.300
16	Front fastener, top A-arm, frame side	214.300	106.440	328.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	340.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in -track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 3.83	0.43	116.43	340.95	1.639	- 0.91	- 4.11	20.50	16.12	16.21	145.95
- 25.00	- 4.02	0.36	110.67	337.82	1.585	- 0.77	- 3.32	20.43	16.31	16.19	145.55
- 20.00	- 4.21	0.29	104.91	334.59	1.530	- 0.61	- 2.57	20.37	16.51	16.16	145.16
- 15.00	- 4.41	0.22	99.17	331.23	1.474	- 0.46	- 1.86	20.30	16.70	16.13	144.76
- 10.00	- 4.60	0.15	93.43	327.75	1.417	- 0.31	- 1.20	20.24	16.90	16.10	144.37
- 5.00	- 4.80	0.07	87.70	324.12	1.360	- 0.16	- 0.58	20.18	17.09	16.07	143.98
0.00	- 5.00	0.00	81.97	320.34	1.301	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.20	- 0.08	76.26	316.38	1.241	0.16	0.53	20.05	17.49	16.01	143.21
10.00	- 5.40	- 0.15	70.55	312.23	1.179	0.31	1.02	19.99	17.69	15.98	142.83
15.00	- 5.60	- 0.23	64.84	307.85	1.115	0.47	1.47	19.93	17.90	15.95	142.45
20.00	- 5.81	- 0.31	59.15	303.20	1.048	0.63	1.87	19.87	18.10	15.91	142.08
25.00	- 6.01	- 0.39	53.46	298.23	0.977	0.80	2.23	19.80	18.30	15.88	141.70
30.00	- 6.22	- 0.48	47.78	292.88	0.900	0.96	2.55	19.74	18.51	15.85	141.33

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	7.096°
WEIGHT TRANSFER FROM AXLE ANGLE	38.734 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	- 0.332°
BRAKING TORQUE COMPENSATION ANGLE	- 4.514 %

REAR DRIVE TRAIN

Position of A-arms: 14 CH

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and groundl):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	188.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	172.300
16	Front fastener, top A-arm, frame side	214.300	106.440	318.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	330.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in-track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 3.68	0.44	126.11	340.84	1.647	- 0.93	- 4.57	20.48	15.97	16.21	145.93
- 25.00	- 3.90	0.37	120.35	337.73	1.592	- 0.78	- 3.70	20.42	16.19	16.18	145.53
- 20.00	- 4.11	0.30	114.61	334.51	1.537	- 0.62	- 2.87	20.35	16.41	16.16	145.14
- 15.00	- 4.33	0.22	108.87	331.17	1.482	- 0.47	- 2.09	20.29	16.63	16.13	144.75
- 10.00	- 4.55	0.15	103.14	327.71	1.425	- 0.31	- 1.35	20.23	16.85	16.10	144.36
- 5.00	- 4.78	0.08	97.42	324.10	1.368	- 0.16	- 0.65	20.17	17.07	16.07	143.98
0.00	- 5.00	0.00	91.71	320.34	1.309	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.22	- 0.08	86.00	316.41	1.249	0.16	0.61	20.05	17.52	16.01	143.22
10.00	- 5.45	- 0.16	80.30	312.28	1.188	0.32	1.18	19.99	17.74	15.98	142.84
15.00	- 5.68	- 0.24	74.61	307.93	1.124	0.48	1.70	19.94	17.97	15.95	142.46
20.00	- 5.91	- 0.32	68.93	303.32	1.056	0.64	2.18	19.88	18.20	15.92	142.09
25.00	- 6.14	- 0.40	63.25	298.41	0.985	1.80	2.62	19.82	18.43	15.89	141.72
30.00	- 6.37	- 0.48	57.58	293.10	0.909	1.97	3.01	19.76	18.66	15.85	141.36

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	7.407°
WEIGHT TRANSFER FROM AXLE ANGLE	40.452 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	- 0.523°
BRAKING TORQUE COMPENSATION ANGLE	- 7.105 %

Suspension adjustment Tables

REAR DRIVE TRAIN

Position of A-arms: 14 CG

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and ground!):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	188.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	172.300
16	Front fastener, top A-arm, frame side	214.300	106.440	328.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	330.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in -track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 3.73	0.44	121.70	341.03	1.633	- 1.22	- 4.44	20.33	16.02	16.25	145.01
- 25.00	- 3.94	0.37	115.89	337.89	1.579	- 1.02	- 3.59	20.29	16.23	16.22	144.77
- 20.00	- 4.15	0.30	110.09	334.64	1.524	- 0.82	- 2.78	20.26	16.44	16.18	144.53
- 15.00	- 4.36	0.22	104.29	331.28	1.468	- 0.61	- 2.02	20.22	16.65	16.15	144.30
- 10.00	- 4.57	0.15	98.51	327.78	1.412	- 0.41	- 1.30	20.18	16.86	16.11	144.06
- 5.00	- 4.79	0.08	92.73	324.14	1.354	- 0.20	- 0.63	20.15	17.08	16.08	143.83
0.00	- 5.00	0.00	86.96	320.34	1.296	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.22	- 0.08	81.20	316.37	1.236	0.21	0.59	20.08	17.51	16.01	143.36
10.00	- 5.43	- 0.15	75.45	312.19	1.174	0.41	1.13	20.04	17.72	15.97	143.13
15.00	- 5.65	- 0.23	69.70	307.79	1.110	0.62	1.62	20.01	17.94	15.93	142.91
20.00	- 5.87	- 0.31	63.97	303.12	1.043	0.82	2.08	19.98	18.16	15.89	142.68
25.00	- 6.09	- 0.39	58.24	298.13	0.972	1.03	2.49	19.94	18.38	15.86	142.46
30.00	- 6.31	- 0.47	52.51	292.75	0.895	1.24	2.85	19.91	18.60	15.82	142.23

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	5.711°
WEIGHT TRANSFER FROM AXLE ANGLE	31.118 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	0.514°
BRAKING TORQUE COMPENSATION ANGLE	6.975 %

REAR DRIVE TRAIN

Position of A-arms: 15 CG

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and groundl):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	178.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	172.300
16	Front fastener, top A-arm, frame side	214.300	106.440	328.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	330.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in-track width	Wheel castor	C.gyration/rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 3.78	0.36	112.62	341.66	1.588	- 0.68	- 4.09	20.15	16.07	16.23	144.05
- 25.00	- 3.98	0.30	106.77	338.43	1.534	- 0.57	- 3.30	20.14	16.27	16.20	143.97
- 20.00	- 4.18	0.24	100.93	335.09	1.480	- 0.46	- 2.55	20.14	16.48	16.16	143.89
- 15.00	- 4.39	0.18	95.10	331.62	1.425	- 0.34	- 1.84	20.13	16.68	16.13	143.82
- 10.00	- 4.59	0.12	89.29	328.02	1.369	- 0.23	- 1.18	20.12	16.88	16.10	143.74
- 5.00	- 4.79	0.06	83.47	324.26	1.312	- 0.11	- 0.57	20.12	17.09	16.07	143.67
0.00	- 5.00	0.00	77.67	320.34	1.254	0.00	0.00	20.11	17.29	16.04	143.60
5.00	- 5.21	- 0.06	71.88	316.24	1.195	0.11	0.53	20.11	17.50	16.01	143.52
10.00	- 5.41	- 0.12	66.09	311.92	1.134	0.23	1.01	20.10	17.71	15.98	143.45
15.00	- 5.62	- 0.18	60.32	307.36	1.071	0.35	1.44	20.10	17.91	15.95	143.38
20.00	- 5.83	- 0.24	54.55	302.51	1.004	0.46	1.84	20.10	18.12	15.92	143.30
25.00	- 6.04	- 0.30	48.79	297.33	0.933	0.58	2.19	20.09	18.34	15.89	143.23
30.00	- 6.26	- 0.37	43.04	291.71	0.856	0.69	2.49	20.09	18.55	15.86	143.16

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	2.369°
WEIGHT TRANSFER FROM AXLE ANGLE	12.873 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	0.051°
BRAKING TORQUE COMPENSATION ANGLE	0.692 %

Suspension adjustment Tables

REAR DRIVE TRAIN

Position of A-arms: 15 CH

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and groundl):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	178.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	172.300
16	Front fastener, top A-arm, frame side	214.300	106.440	318.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	330.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in -track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 3.73	0.35	117.15	341.46	1.601	- 0.40	- 4.23	20.30	16.02	16.18	144.98
- 25.00	- 3.94	0.30	111.37	338.26	1.547	- 0.33	- 3.41	20.27	16.23	16.16	144.74
- 20.00	- 4.15	0.24	105.59	334.95	1.493	- 0.27	- 2.64	20.24	16.44	16.14	144.51
- 15.00	- 4.36	0.18	99.82	331.51	1.438	- 0.20	- 1.91	20.20	16.65	16.11	144.28
- 10.00	- 4.57	0.12	94.06	327.94	1.382	- 0.14	- 1.23	20.17	16.86	16.09	144.05
- 5.00	- 4.79	0.06	88.31	324.22	1.325	- 0.07	- 0.59	20.14	17.08	16.07	143.82
0.00	- 5.00	0.00	82.57	320.34	1.267	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.22	- 0.06	76.84	316.28	1.208	0.07	0.55	20.08	17.51	16.02	143.37
10.00	- 5.43	- 0.12	71.11	312.01	1.147	0.14	1.06	20.05	17.72	15.99	143.15
15.00	- 5.65	- 0.19	65.39	307.50	1.084	0.21	1.52	20.03	17.94	15.97	142.93
20.00	- 5.87	- 0.25	59.68	302.72	1.017	0.28	1.94	20.00	18.16	15.94	142.71
25.00	- 6.09	- 0.32	53.98	297.60	0.947	0.35	2.32	19.97	18.38	15.92	142.49
30.00	- 6.31	- 0.38	48.28	292.07	0.870	0.43	2.65	19.94	18.61	15.89	142.27

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	3.962°
WEIGHT TRANSFER FROM AXLE ANGLE	21.550 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	- 0.956°
BRAKING TORQUE COMPENSATION ANGLE	- 12.986 %

REAR DRIVE TRAIN

Position of A-arms: 15 BG

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and ground):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	178.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	172.300
16	Front fastener, top A-arm, frame side	214.300	106.440	328.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	340.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in-track width	Wheel castor	C.gyration/rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 3.88	0.34	107.18	341.58	1.594	- 0.38	- 3.76	20.32	16.17	16.18	144.99
- 25.00	- 4.06	0.29	101.38	338.36	1.540	- 0.32	- 3.03	20.28	16.35	16.16	144.76
- 20.00	- 4.25	0.23	95.59	335.03	1.485	- 0.26	- 2.33	20.25	16.54	16.14	144.52
- 15.00	- 4.43	0.18	89.81	331.58	1.430	- 0.19	- 1.68	20.21	16.73	16.11	144.29
- 10.00	- 4.62	0.12	84.04	327.99	1.374	- 0.13	- 1.08	20.18	16.91	16.09	144.06
- 5.00	- 4.81	0.06	78.28	324.25	1.318	- 0.07	- 0.52	20.15	17.10	16.07	143.82
0.00	- 5.00	0.00	72.52	320.34	1.260	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.19	- 0.06	66.77	316.25	1.200	0.07	0.47	20.08	17.48	16.02	143.37
10.00	- 5.38	- 0.12	61.03	311.95	1.139	0.13	0.90	20.05	17.68	15.99	143.14
15.00	- 5.58	- 0.18	55.30	307.41	1.076	0.20	1.29	20.02	17.87	15.97	142.92
20.00	- 5.77	- 0.25	49.57	302.59	1.009	0.27	1.63	19.98	18.06	15.94	142.69
25.00	- 5.97	- 0.31	43.86	297.43	0.938	0.34	1.93	19.95	18.26	15.91	142.47
30.00	- 6.17	- 0.37	38.14	291.85	0.861	0.41	2.19	19.92	18.46	15.89	142.25

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	3.774°
WEIGHT TRANSFER FROM AXLE ANGLE	20.526 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	- 0.837°
BRAKING TORQUE COMPENSATION ANGLE	- 11.371 %

Suspension adjustment Tables

REAR DRIVE TRAIN

Position of A-arms: 15 BF

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and ground!):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	178.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	172.300
16	Front fastener, top A-arm, frame side	214.300	106.440	338.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	340.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in -track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 3.94	0.35	102.55	341.78	1.580	- 0.67	- 3.62	20.16	16.23	16.23	144.05
- 25.00	- 4.11	0.29	96.68	338.53	1.526	- 0.56	- 2.91	20.16	16.40	16.20	143.98
- 20.00	- 4.29	0.23	90.83	335.17	1.472	- 0.45	- 2.24	20.15	16.58	16.17	143.90
- 15.00	- 4.46	0.17	84.98	331.69	1.417	- 0.34	- 1.61	20.14	16.75	16.14	143.82
- 10.00	- 4.64	0.12	79.14	328.06	1.361	- 0.23	- 1.03	20.13	16.93	16.10	143.75
- 5.00	- 4.82	0.06	73.31	324.29	1.304	- 0.11	- 0.49	20.12	17.11	16.07	143.67
0.00	- 5.00	0.00	67.49	320.34	1.247	0.00	0.00	20.11	17.29	16.04	143.60
5.00	- 5.18	- 0.06	61.68	316.21	1.187	0.11	0.45	20.11	17.47	16.01	143.52
10.00	- 5.36	- 0.12	55.87	311.86	1.126	0.23	0.85	20.10	17.66	15.98	143.45
15.00	- 5.55	- 0.18	50.08	307.27	1.062	0.34	1.21	20.09	17.84	15.95	143.37
20.00	- 5.73	- 0.24	44.29	302.38	0.996	0.45	1.52	20.08	18.02	15.91	143.30
25.00	- 5.92	- 0.30	38.51	297.15	0.924	0.57	1.80	20.08	18.21	15.88	143.23
30.00	- 6.11	- 0.36	32.74	291.48	0.847	0.68	2.02	20.07	18.40	15.85	143.16

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	2.283°
WEIGHT TRANSFER FROM AXLE ANGLE	12.405 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	0.105°
BRAKING TORQUE COMPENSATION ANGLE	1.430 %

REAR DRIVE TRAIN

Position of A-arms: 15 AF

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and groundl):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	178.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	172.300
16	Front fastener, top A-arm, frame side	214.300	106.440	338.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	350.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in-track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 4.03	0.34	96.92	341.69	1.586	- 0.36	- 3.29	20.33	16.33	16.19	145.01
- 25.00	- 4.19	0.28	91.12	338.46	1.532	- 0.31	- 2.63	20.30	16.48	16.16	144.77
- 20.00	- 4.35	0.23	85.31	335.12	1.477	- 0.25	- 2.01	20.26	16.64	16.14	144.53
- 15.00	- 4.51	0.17	79.52	331.64	1.422	- 0.19	- 1.44	20.22	16.80	16.12	144.30
- 10.00	- 4.67	0.12	73.74	328.03	1.366	- 0.13	- 0.92	20.19	16.96	16.09	144.06
- 5.00	- 4.84	0.06	67.96	324.27	1.310	- 0.06	- 0.44	20.15	17.13	16.07	143.83
0.00	- 5.00	0.00	62.19	320.34	1.252	0.00	0.00	20.11	17.29	16.04	143.59
5.00	- 5.17	- 0.06	56.43	316.23	1.192	0.06	0.39	20.08	17.46	16.02	143.36
10.00	- 5.33	- 0.12	50.67	311.90	1.131	0.13	0.74	20.04	17.62	15.99	143.14
15.00	- 5.50	- 0.18	44.93	307.32	1.067	0.20	1.05	20.01	17.79	15.96	142.91
20.00	- 5.67	- 0.24	39.19	302.46	1.000	0.26	1.31	19.97	17.96	15.94	142.68
25.00	- 5.84	- 0.30	33.45	297.25	0.929	0.33	1.53	19.94	18.14	15.91	142.46
30.00	- 6.02	- 0.37	27.73	291.62	0.852	0.40	1.71	19.90	18.31	15.88	142.23

Wheelbase	2645 mm
Height of centre of gravity	340 mm

100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	3.608°
WEIGHT TRANSFER FROM AXLE ANGLE	19.622 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	- 0.733°
BRAKING TORQUE COMPENSATION ANGLE	- 9.947 %

Suspension adjustment Tables

REAR DRIVE TRAIN

Position of A-arms: 15 AE

Loaded wheel/tyre assembly radius	283.92 mm
Initial setting	
- camber	- 5°
- alignment	0°
- body/superstructure height (height between pads and ground!):	
• front	25 mm
• rear	35 mm

Position of actual suspension point (in mm)

Point	Definition	X	Y	Z
1	Bottom A-arm, wheel side	77.880	587.570	180.530
3	Top A-arm, wheel side	- 5.900	516.350	409.310
5	Alignment rod, wheel side	- 69.160	583.780	170.130
6	Push-rod, wheel side	76.660	507.590	200.510
8	Right end of antiroll bar	21.900	125.030	355.640
9	Left end of antiroll bar	21.900	149.430	410.460
13	Damper fastening point on tipper	21.900	45.250	407.580
14	Front fastener, bottom A-arm, frame side	264.300	105.500	178.500
15	Rear fastener, bottom A-arm, frame side	- 110.490	105.500	172.300
16	Front fastener, top A-arm, frame side	214.300	106.440	348.080
17	Rear fastener, top A-arm, frame side	- 214.300	106.440	350.470
18	Alignment bar, gear rack side	- 110.490	105.500	152.300
19	Push-rod, tipper side	63.800	87.410	388.810
20	Wheel centre	0.000	634.730	283.920
26	Damper fastening point on frame	- 297.970	47.630	390.340

Wheel deflection	Camber	Alignment	Roll centre	Spring length	Wheel DR/SM	Variation in wheelbase	Variation in -track width	Wheel castor	C.gyration/ rotation	Rim/wheel offset	Caster trail/offset
in mm	in degrees	in degrees	in mm	in mm	in mm	in mm	in mm	in degrees	in degrees	in mm	in mm
- 30.00	- 4.09	0.34	92.19	341.90	1.573	- 0.66	- 3.14	20.18	16.39	16.23	144.06
- 25.00	- 4.24	0.28	86.31	338.64	1.519	- 0.55	- 2.51	20.17	16.53	16.20	143.98
- 20.00	- 4.39	0.23	80.44	335.26	1.464	- 0.44	- 1.92	20.16	16.68	16.17	143.90
- 15.00	- 4.54	0.17	74.57	331.76	1.409	- 0.33	- 1.37	20.15	16.83	16.14	143.83
- 10.00	- 4.69	0.11	68.72	328.11	1.353	- 0.22	- 0.87	20.13	16.98	16.11	143.75
- 5.00	- 4.85	0.06	62.87	324.31	1.296	- 0.11	- 0.41	20.12	17.14	16.07	143.67
0.00	- 5.00	0.00	57.03	320.34	1.238	0.00	0.00	20.11	17.29	16.04	143.60
5.00	- 5.16	- 0.06	51.20	316.18	1.179	0.11	0.37	20.10	17.45	16.01	143.52
10.00	- 5.31	- 0.12	45.37	311.80	1.118	0.22	0.69	20.09	17.60	15.98	143.44
15.00	- 5.47	- 0.17	39.56	307.17	1.054	0.34	0.97	20.08	17.76	15.94	143.37
20.00	- 5.63	- 0.23	33.75	302.25	0.987	0.45	1.20	20.07	17.92	15.91	143.30
25.00	- 5.79	- 0.29	27.95	296.97	0.916	0.56	1.39	20.06	18.08	15.88	143.22
30.00	- 5.96	- 0.35	22.15	291.24	0.838	0.67	1.54	20.05	18.25	15.84	143.15

Wheelbase	2645 mm
Height of centre of gravity	340 mm

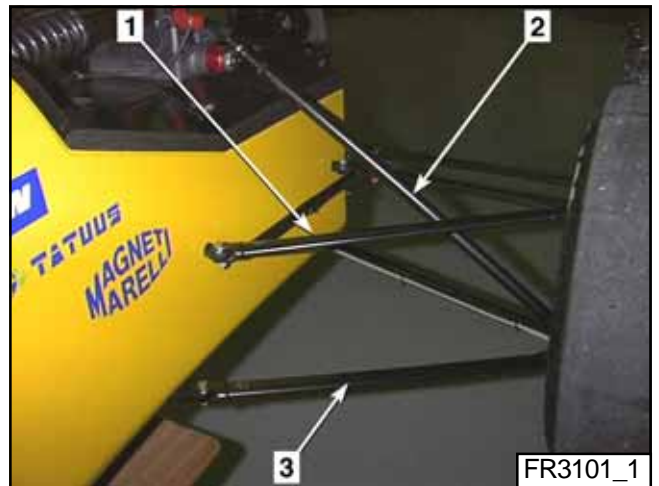
100 % weight transfer from axle angle	17.815°
Effective weight transfer from axle angle	2.207°
WEIGHT TRANSFER FROM AXLE ANGLE	11.990 %

100 % braking torque compensation angle	7.325°
Effective braking torque compensation angle	0.153°
BRAKING TORQUE COMPENSATION ANGLE	2.083 %

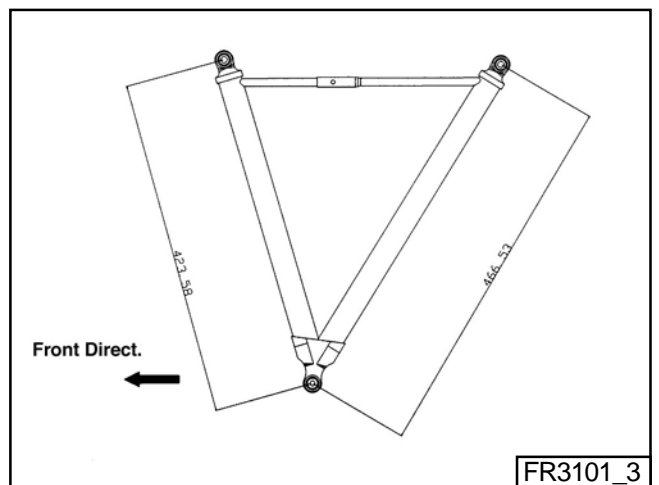
OVERVIEW

Each side of the front axle assembly contains:

- top A-arm (1),
- bottom A-arm (3),
- push-rod (2),
- damper (5),
- a return (4), which houses the head of the damper and the push-rod arms,
- a anti-rolling motion (6).



The shortest arm of the top A-arm should be installed towards the front of the car.



FRONT AXLE ASSEMBLY

Adjustment

31

FRAME HEIGHT

The height of the front of the frame is adjusted the push-rods arm.

One turn of the arm screw (1) varies the height of the frame by 4.3 mm.

An increase of 4.3 mm in height varies the angles of the front axle assembly by the following values:

- Camber: -0.119°
- Caster: -0.022°
- Alignment: 0.008° (toe)



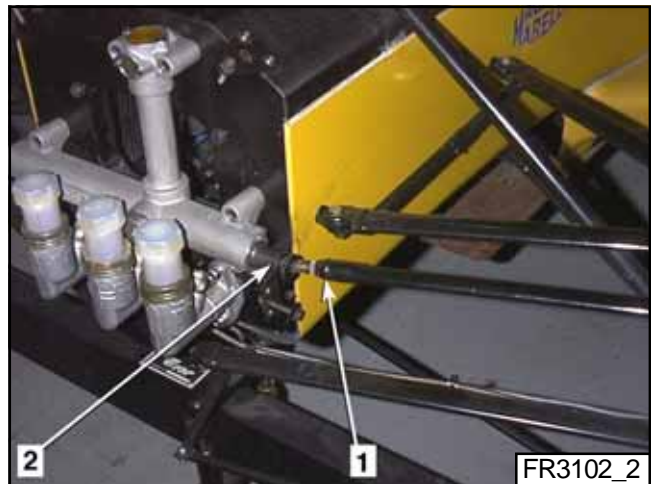
ALIGNMENT

The alignment is adjusted by means of the steering rod.

- Check that the gear rack is at the middle point. The length of the bar on the exterior of the gear rack (2) should be the same on each side.
- Actuate arm (1).

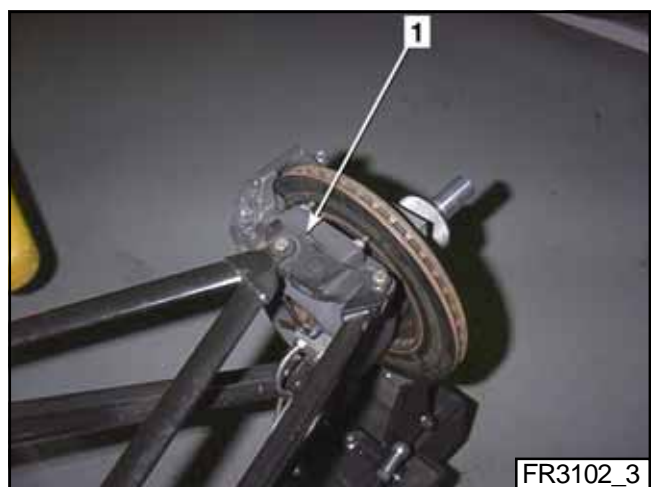
One turn of the arm screw (1) varies the alignment by 0.62° .

This adjustment increases the opening and raises the height of the frame by 0.056 mm.



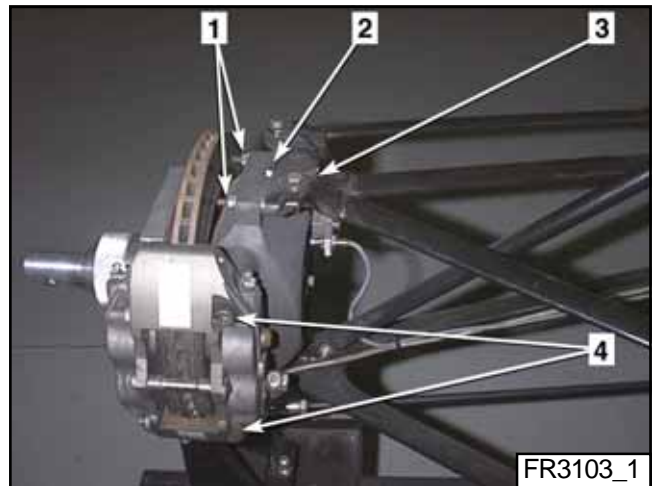
CAMBER

- The camber is adjusted by means of shims (1) inserted on the hub carrier.
- One 2 mm shim thickness varies the camber by 0.5° .
- Two shim thickness are available :
 - 1 mm Ref. FR01-07.26A,
 - 2 mm Ref. FR01-07.26B.



REMOVAL

- Remove wheel.
- Remove the two bolts (4) fastening the calliper on the hub carrier. Disengage calliper and hook it onto A-arm.
- Remove disc.
- Remove the two bolts (1) fastening the top A-arm mounting/steering rod (3).
- Save the shims (2).

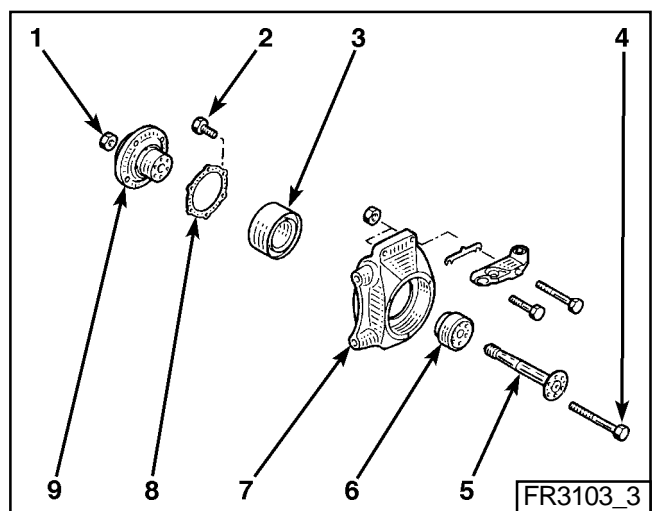


- Remove nut fastening bottom A-arm (5).
- Remove hub carrier. Save tapered spacer on bottom A-arm.



DISASSEMBLY

- Remove nuts (1). Save the bolts (4).
- Remove spindle (5) from hub by tapping on end of spindle with a plastic mallet. Make sure not to damage the threading.
- Remove external hub (9) from hub carrier (7) using 4 mm dia. pin drift. Do it through the hole in the external hub (9).
- Remove internal hub (6) from hub carrier (7) in the same manner.
- Remove bolts (2) fastening bearing end shield (8). Remove end shield.
- Heat hub carrier (7) to 120° C. Remove bearing (3).



NOTE: *The bearing should come out without having to use any tools.*

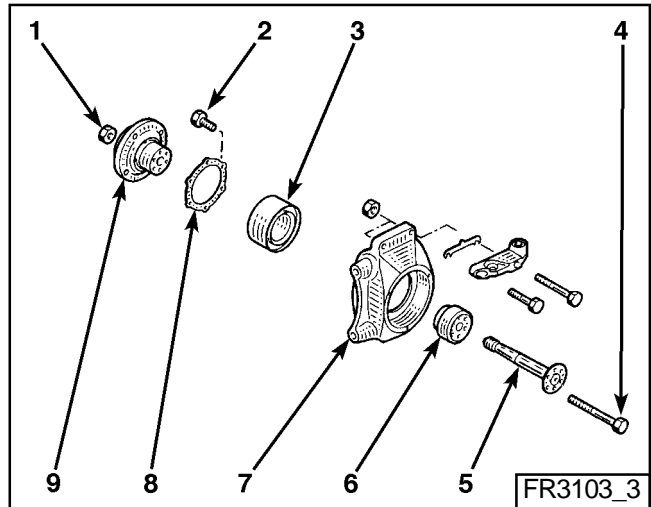
Hub carrier

ASSEMBLY

- Heat hub carrier (7) to 120° C and install bearing (3) in hub carrier.

NOTE: *The bearing should come out without having to use any tools.*

- Fasten bearing end shield (8) with bolts (2) coated with a few drops of Loctite 243. Torque bolts to 6 N.m.
- Use press and drive it home onto internal bearing cage (3) to install external hub (9) in bearing.
- Install internal hub (6) on hub carrier (7).
- Install wheel spindle (5) in hub.
- Run bolts (4) through holes in wheel spindle. Torque nuts (1) to 25 N.m.



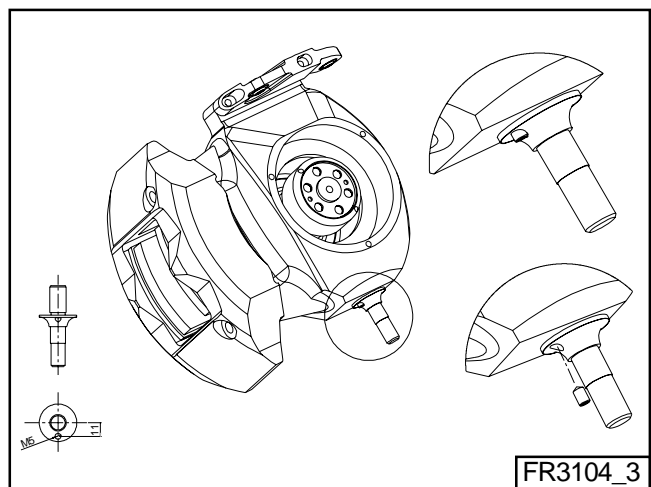
INSTALLATION

- Follow removal steps in reverse order.
- Observe tightening torques.
- When replacing axis pivot of the bottom A-arm (1):
 - clean axis and tapping with solvent
 - install spindle using Loctite 270 or 2701. Torque to 70 N.m.



ALLOWED MODIFICATION

- Improvement of the axis pivot (1) holding.
- It is allowed to make a M5 thread hole on upright pin cod FR02-07-012 in order to use bolt cod UNI 5927 M5X4 like draw show on the right.
- After tightened pin make on upright surface where there is thread M5 hole on pin for to accept conic bolt tip.
- Screw bolt and lock it by loctite n° 270 in order to prevent that pin can loose.

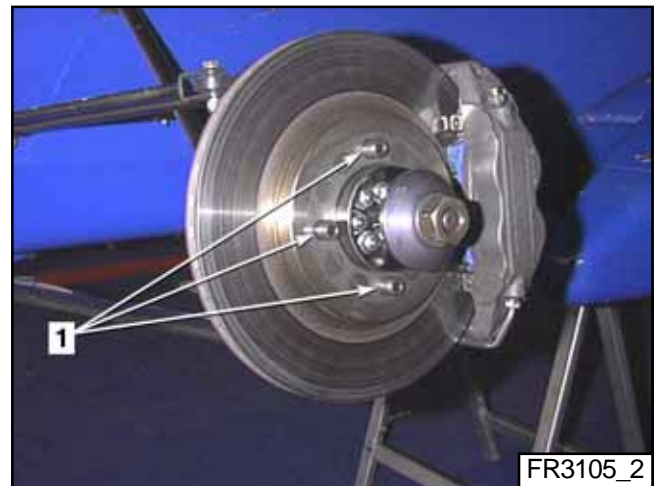


Hub carrier

- Coat bolts **(2)** for fastening brake callipers with copper grease. Torque to 45 N.m.



- When replacing dowels **(1)**, put a few drops of Loctite 270 or 2701 on them. Torque to 45 N.m.



DESCRIPTION

The front suspension is by means of push-rod (2) and single damper (1).

The compression and rebound can be adjusted.

It contains:

- rebound regulator (3),
- nitrogen reservoir (5) equipped with a screw (4), which makes it possible to measure the pressure and drain the reservoir.
- compression regulator (6).



FR3106_1

ADJUSTMENT

WARNING: *Do not touch screw (7).*

Compression

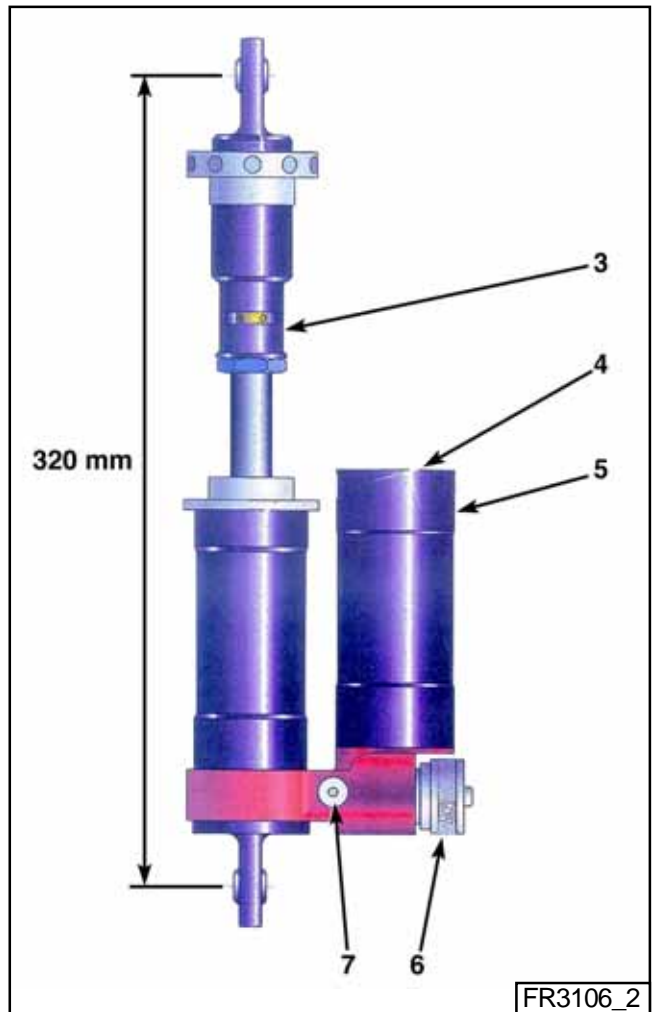
- Turn knurled knob until it abuts in the clockwise direction = hard compression.
- Turn knurled knob until it abuts in the counterclockwise direction (24 clicks) = flexible compression.

NOTE: *It is possible that there will be more than 24 clicks when turning the knurled knob in this direction. After 24 clicks, there is no change in the setting.*

Rebound

- Turn regulator until it abuts in the clockwise direction = hard rebound.
- Turn regulator until it abuts in the counterclockwise direction (24 clicks) = flexible rebound.

NOTE: *If the regulator notches are not accessible, slightly turn end-fitting to bring them opposite the window. Make sure that dimension between middle of the two ball joints is 320 mm.*



FR3106_2

FRONT AXLE ASSEMBLY

Spring-damper set

Pressure check

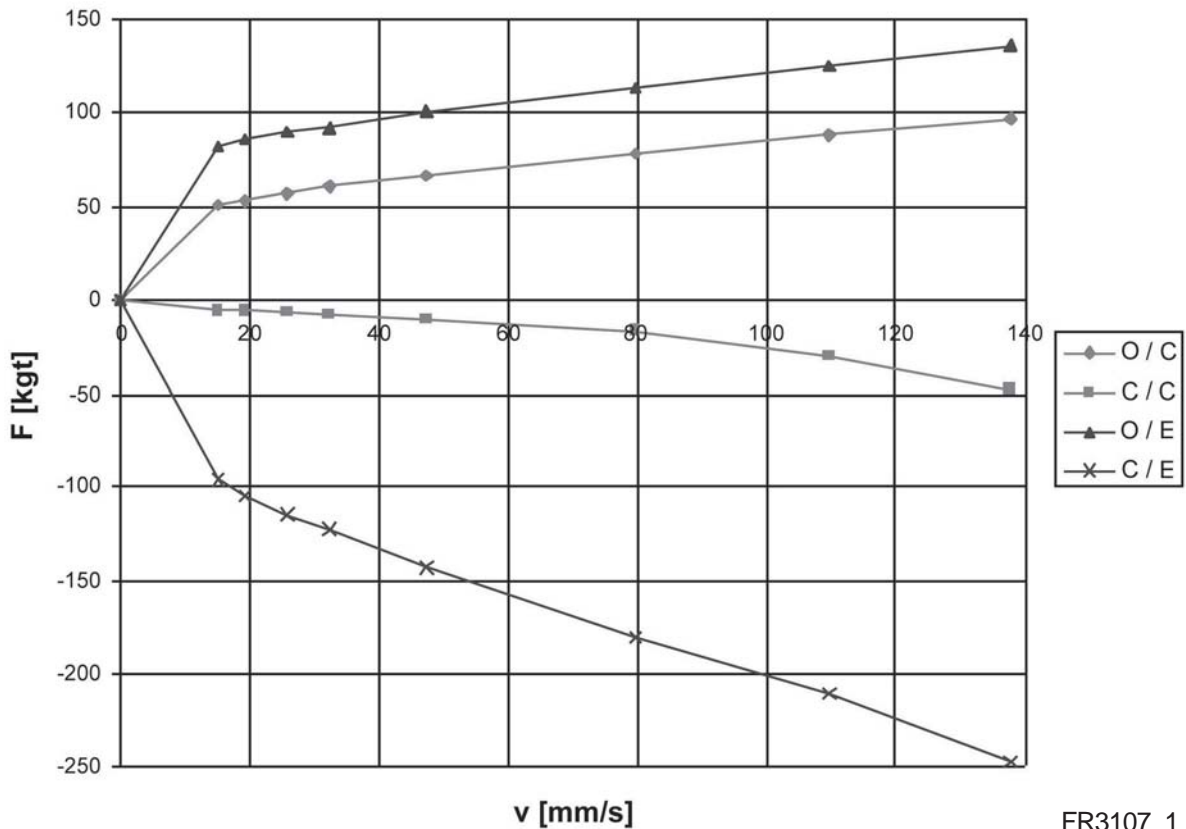
- Remove damper. Lock it in place in a vice.
- Remove screws **(5)** (see figure on next page). Connect pressure gauge.
- Check that pressure in reservoir is between 8 and 8.5 bar. If necessary, adjust pressure.

NOTE: Make sure to take the pressure loss of 0.5 to 1 bar in the measuring instrument into account.

v [mm/s]	F [kgf]	F [kgf]	F [kgf]	F [kgf]
	O / C	O / E	C / C	C / E
15.04	50.3	- 5.9	82.6	- 95.7
19.35	53.1	- 6.4	86.2	- 104.3
25.81	56.7	- 6.8	90.3	- 114.3
32.26	60.3	- 8.2	92.5	- 122.5
47.29	66.2	-10.9	100.7	- 143.3
79.55	78	- 16.8	113.4	- 180.1
109.68	88	- 30.8	125.2	- 210.9
137.67	96.6	- 47.6	136.1	- 246.8

O/C = Open compression
 C/C = Closed compression
 O/E = Open expansion
 C/E = Closed expansion

FRONT DAMPER



FR3107_1

Maintenance

- Wash damper with soap and water. Use of petrol, gasoline and solvents are forbidden.
- Change oil for the first time at 2,500 km, then after that, every 4,000 km.

NOTE: *It is compulsory to use the oil recommended by the damper manufacturer. Ref.: 152.*

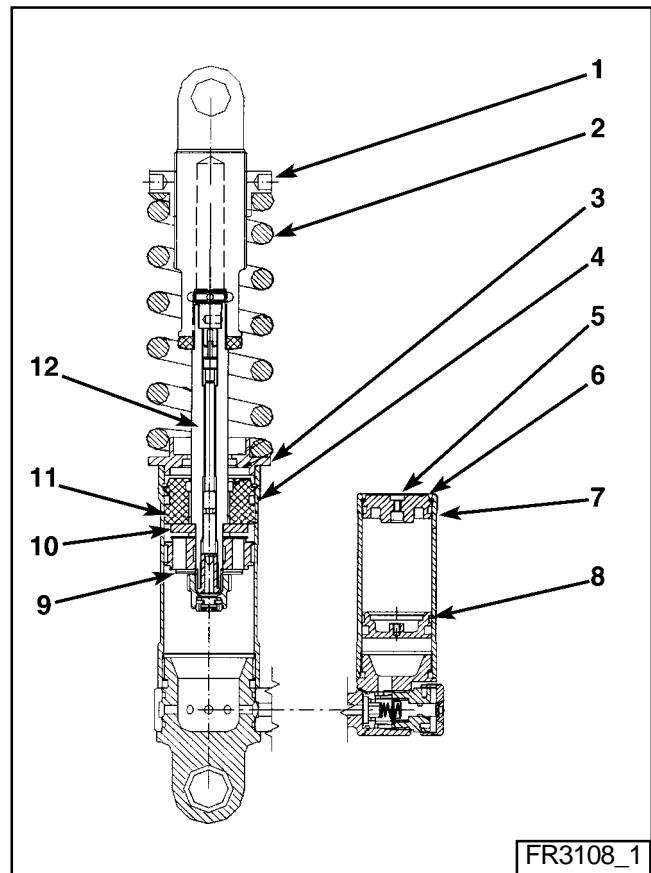
DISASSEMBLY/ASSEMBLY

Disassembly of damper

- Remove nut (1). Take out spring (2).
- Turn compression knurled knob until it abuts in the counterclockwise direction.
- Turn rebound regulator until it abuts in the counterclockwise direction.
- Remove screw (5). Bleed gas off reservoir.

WARNING: *Before disassembly, make sure that damper is no longer pressurized. The reservoir is correctly discharged if the bottom of the reservoir can be pushed up with fingers.*

- Use rubber mallet to remove seat (3).
- Push guide (11) so as to gain access to snap ring (4). Remove snap ring.
- Separate top of damper casing. Drain oil.
- Unscrew rod (12) in top of damper.



Disassembly of gas separator

- Push plug (6) so as to gain access to snap ring (7). Remove snap ring.
- Remove plug (6).
- Remove separator (8).

FRONT AXLE ASSEMBLY

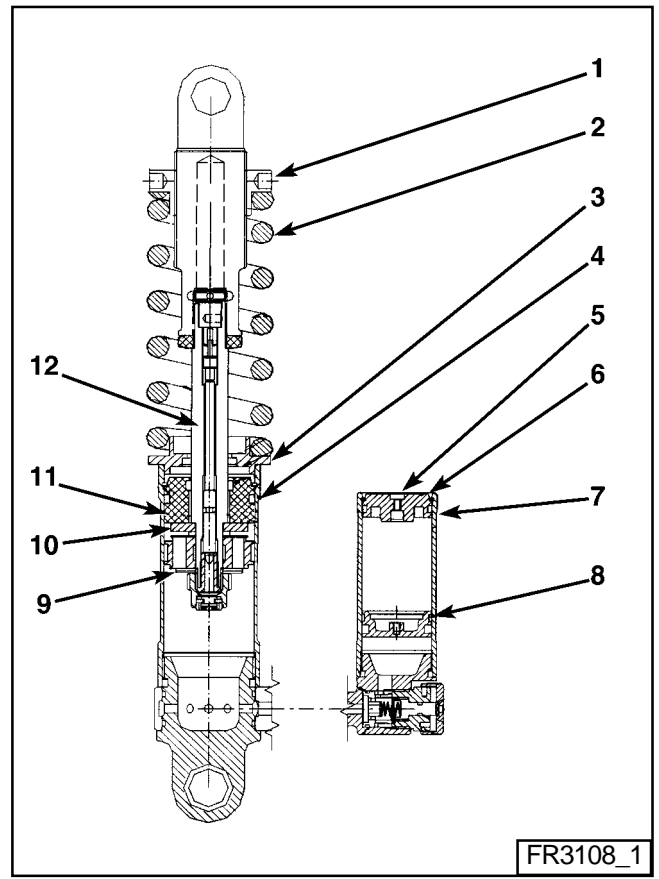
Spring-damper set

31

Assembly

- Follow removal steps in the reverse order.
- Install compression shims (10) and rebound shims (9) as shown in the table below.

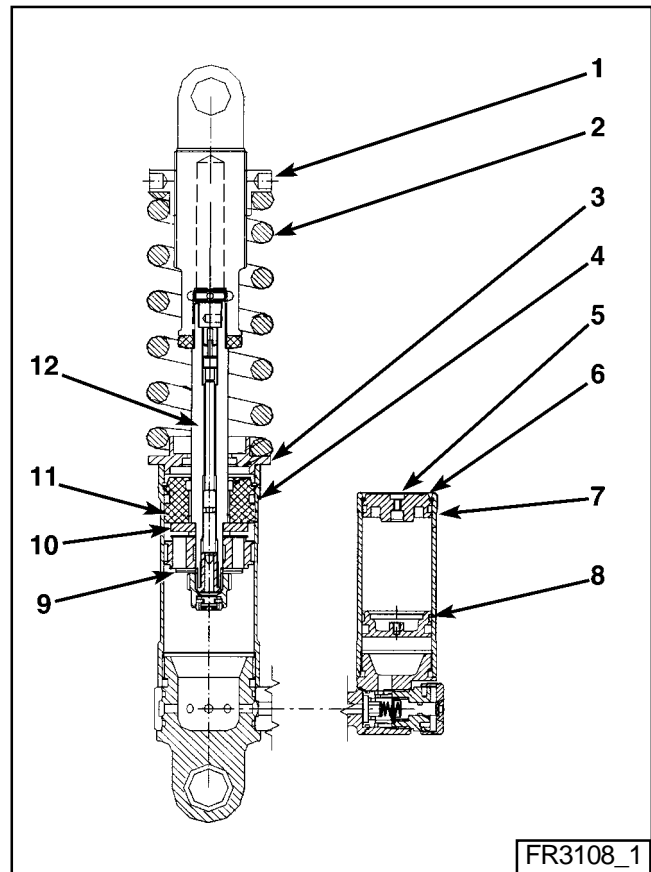
Shim	Compression	Rebound
1	- Thickness: 0.2 mm - Diameter 34 mm	- Thickness: 0.3 mm - Diameter: 32 mm
2	- Thickness: 0.2 mm - Diameter: 30 mm With ring: - Thickness: 0,3 mm - Inside diameter: 30 mm - Outside diameter: 34 mm	- Thickness: 0.25 mm - Diameter: 32 mm
3	- Thickness: 0.25 mm - Diameter:34 mm	- Thickness: 0.3 mm - Diameter: 28 mm
4	Washer: - diameter 18 mm - sharp angle towards shims	- Thickness: 0.3 mm - Diameter: 26 mm
5		- Thickness: 0.3 mm - Diameter: 24 mm
6		- Thickness: 0.3 mm - Diameter: 22 mm
7		Washer: - diameter: 18 mm - sharp angle towards shims



- Clean interior of damper.
- Fill casing of damper with oil, up to the edge. It is compulsory to use the oil recommended by the damper manufacturer.
- Lubricate separator O-ring (8) with silicon grease, then insert separator O-ring in reservoir.
- Completely unscrew rebound regulator.
- Wait until oil no longer emulsifies and install rod (12).
- Completely close compression regulator.
- Push rod (12) firmly. Wait a moment, then pull it without letting any air in. Repeat this step two or three times.
- Pull rod and add oil. The level should come up to the throat of the snap ring (4).

Spring-damper set

- Fit guide (11), checking that a thin stream of oil flows before its seal is in the cylinder.
- Open compression regulator.
- Push guide (11) to release snap ring throat. Insert snap ring (4).
- Lubricate separate seal (8). Install separator.
- Fit snap ring (7).
- Build pressure back up in reservoir, to 8 or 9 bar.
- Insert plug (6) and seat (3).



Spring

Table for various springs available.

Stiffness in lb/in	Stiffness in kg/mm
700	12.40
800	14.17
900	15.49
1000	17.72
1100	19.49
1200	21.26



Antiroll

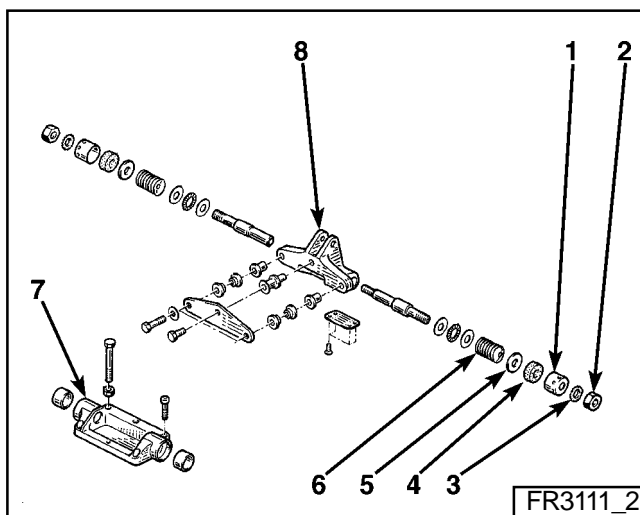
ADJUSTMENT

- Remove lock nut (2), washer (3) and bush (1).
- Set aside spacer (4) and shim (5).
- Check that ON/OFF switch (8) is correctly centred in its mounting (7). If necessary, use shims to correct.
- Insert dished washers (6), following the installation configurations in the table below.



Characteristics of dished washers (6):

- Outside diameter: 31.5 mm.
- Inside diameter: 16.3 mm.
- Thickness: 2 mm.



Example of configuration or setting

Configuration	Débattement maxi (mm)	Epaisseur empilage (mm)	Rigidité (daN/mm)	Précharge mini	Précharge maxi
<<<>>>	1,125	13,5	1796	1	5,5
<<<>>><<<	1,6875	20,5	1197	2	5,5
<<>><<	1,6875	14,25	751	3	5,5
<<>><>>	2,25	19	571	3,5	6,5
<<>><>><<	2,8125	23,75	457	4	8,5
<><	1,6875	8,25	362	4	5,5
<>>	2,25	11	272	5	6,5
<><><	2,8125	13,75	218	6	8,5
<>>>	3,375	16,5	181	6,5	10

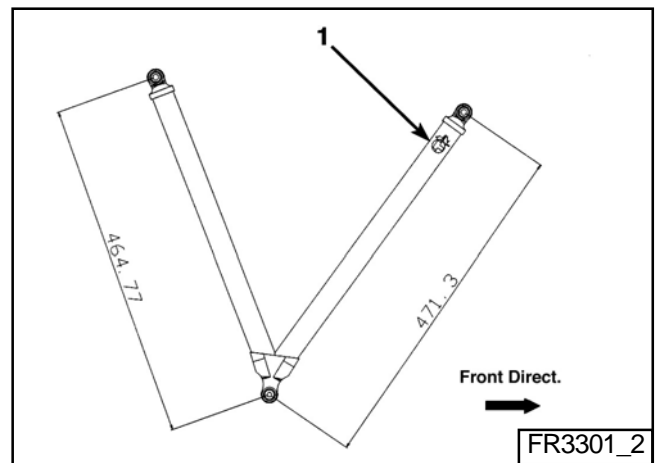
OVERVIEW

Each side of the rear axle assembly contains:

- top A-arm (4),
- bottom A-arm (5),
- push-rod (1),
- damper (2),
- ON/OFF switch (3), which houses the head of the damper and the push-rod and antiroll bar arms

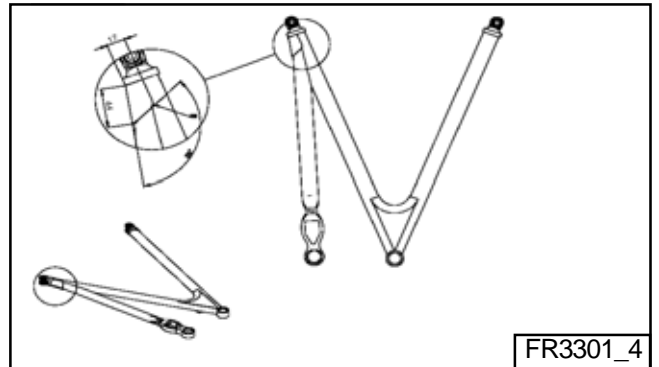


The top A-arm bears the mark FRONT (1) on the longest arm. This mark should be placed towards the front of the car.



To improve the reliability of the Formula Renault 2.0, the rear lower wishbones have been modified by the addition of a reinforcement (see drawing).

In 2005, only the reinforced wishbones will be allowed.



The antiroll bar (1) is available in three diameters.

DIAMETER (in mm)	STIFFNESS (in N.mm)/Degrees
13	51,216
15	90,859
17	149,900



REAR AXLE ASSEMBLY

Adjustment

33

FRAME HEIGHT

The height of the rear of the frame is adjusted by means of the push-rod arm.

One turn of the arm screw (1) varies the height of the frame by 6.13 mm.

An increase of 6.13 mm in height varies the angles of the rear axle assembly by the following values:

- Camber: -0.228° ,
- Caster: -0.115° ,
- Alignment: 0.019° (toe).



ALIGNMENT

The alignment is adjusted using shims (1) inserted on the behind arm of the inferior triangle.

A shim thickness of 0.5 mm varies the alignment by 0.189° .

This adjustment increases the opening and raises the height of the frame by 0.137 mm.

Three thickness of shim are available:

- 0.3 mm Ref. : FR01_10_10A,
- 0.5 mm Ref. : FR01_10_10B,
- 1 mm Ref. : FR01_10_10C.



CAMBER

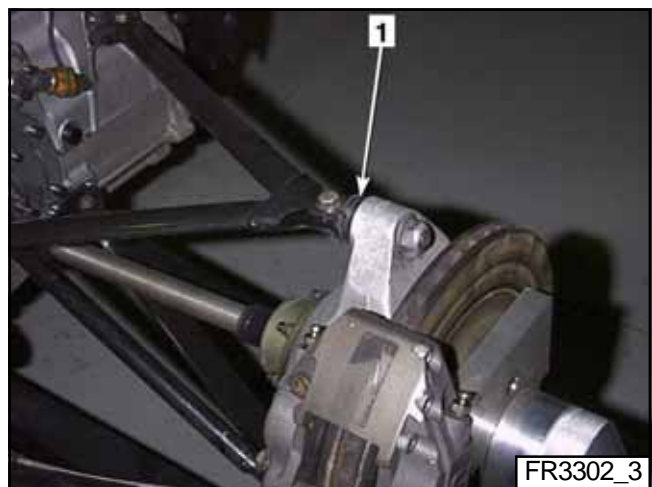
The camber is adjusted by means of shims (1) inserted on the hub carrier.

One 2 mm shim thickness varies the camber by 0.5° .

Observe the positioning of shims in order to prevent friction with the rim.

Two thickness of shim are available:

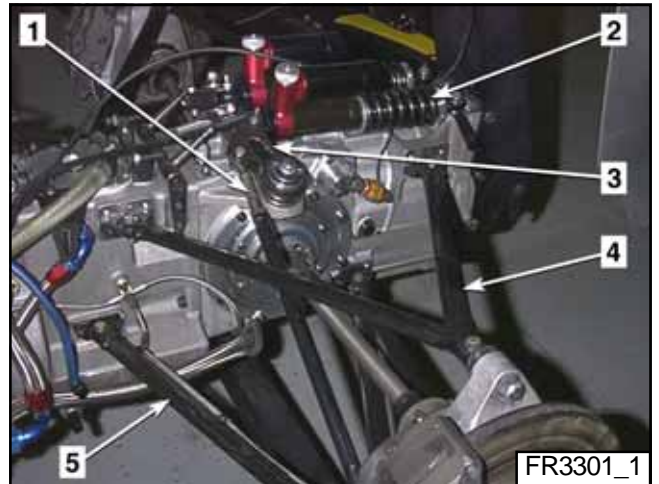
- 1 mm Ref. : FR01_11_14A,
- 2 mm Ref. : FR01_11_14B.



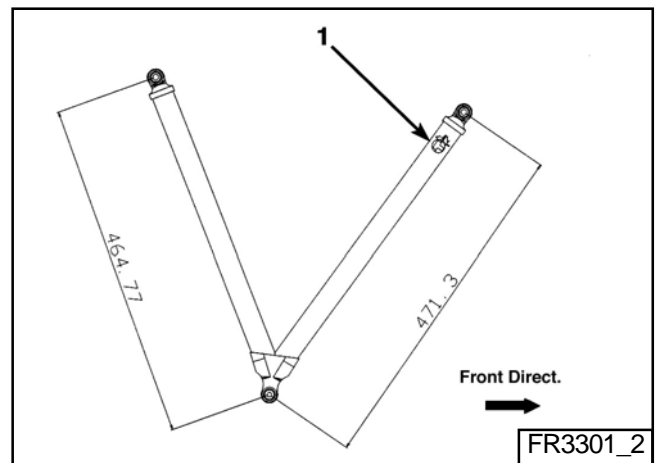
OVERVIEW

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- bottom A-arm (5),
- push-rod (1),
- damper (2),
- ON/OFF switch (3), which houses the head of the damper and the push-rod and antiroll bar arms

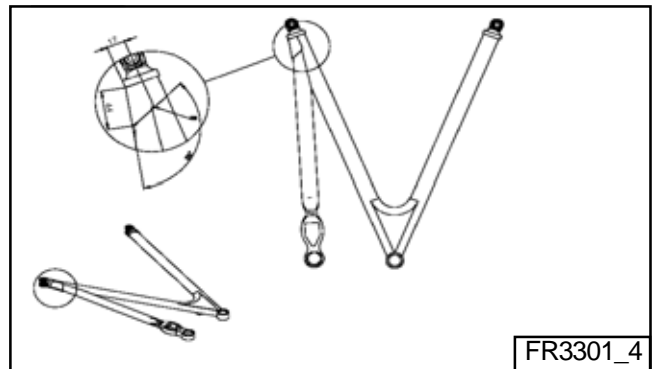


The top A-arm bears the mark FRONT (1) on the longest arm. This mark should be placed towards the front of the car.



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REAR AXLE ASSEMBLY

Adjustment

33

FRAME HEIGHT

The height of the rear of the frame is adjusted by means of the push-rod arm.

One turn of the arm screw (1) varies the height of the frame by 6.13 mm.

An increase of 6.13 mm in height varies the angles of the rear axle assembly by the following values:

- Camber: -0.228° ,
- Caster: -0.115° ,
- Alignment: 0.019° (toe).



ALIGNMENT

The alignment is adjusted using shims (1) inserted on the behind arm of the inferior triangle.

A shim thickness of 0.5 mm varies the alignment by 0.189° .

This adjustment increases the opening and raises the height of the frame by 0.137 mm.

Three thickness of shim are available:

- 0.3 mm Ref. : FR01_10_10A,
- 0.5 mm Ref. : FR01_10_10B,
- 1 mm Ref. : FR01_10_10C.



CAMBER

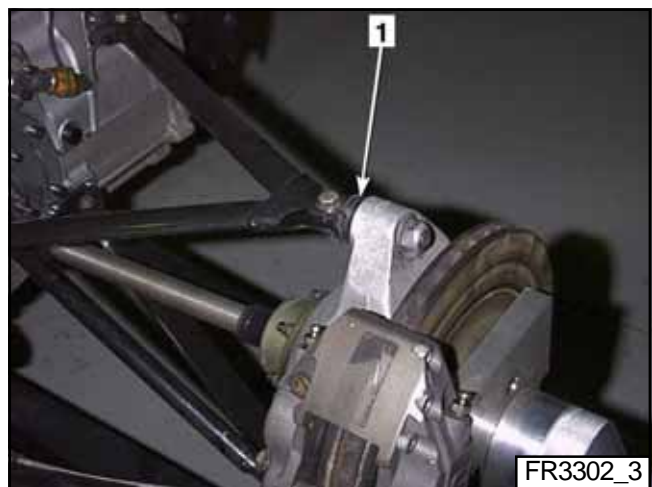
The camber is adjusted by means of shims (1) inserted on the hub carrier.

One 2 mm shim thickness varies the camber by 0.5° .

Observe the positioning of shims in order to prevent friction with the rim.

Two thickness of shim are available:

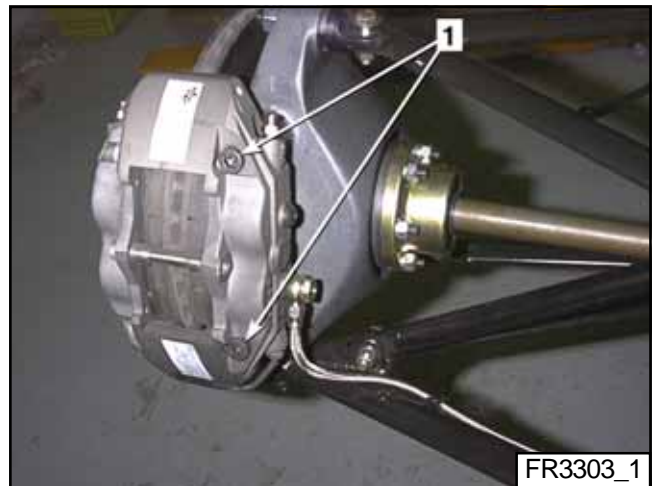
- 1 mm Ref. : FR01_11_14A,
- 2 mm Ref. : FR01_11_14B.



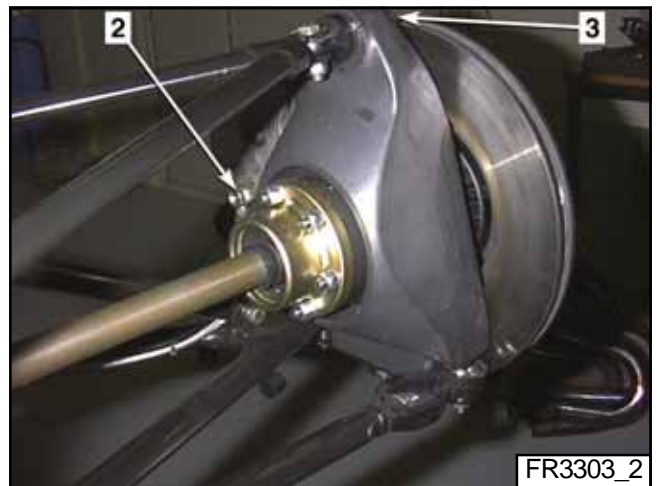
Hub carrier

REMOVAL

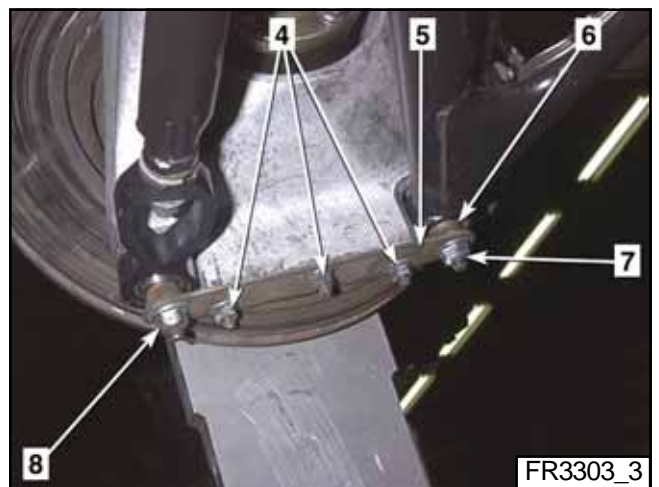
- Remove wheel.
- Remove the two bolts **(1)** fastening the calliper on the hub carrier. Disengage calliper and hook it onto A-arm.
- Remove disc.



- Remove:
 - nuts fastening drive shaft **(2)**,
 - bolts fastening top A-arm **(3)**.



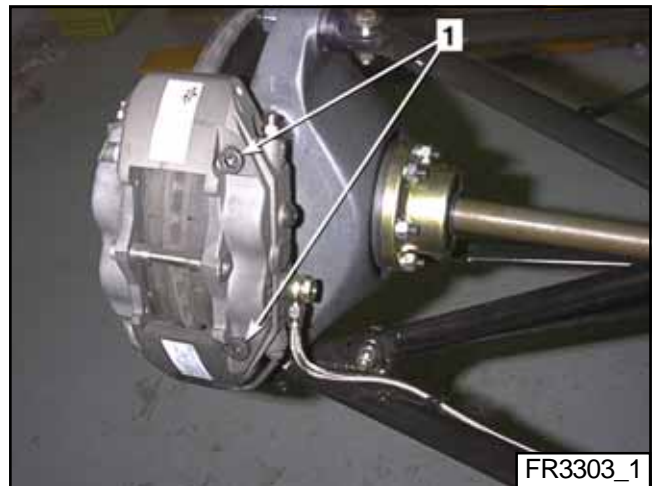
- Remove:
 - the two nuts fastening the bottom A-arm **(7)** and **(8)**,
 - the three nuts **(4)**. Set aside plate **(5)** and bottom tapered spacers **(6)** on bottom A-arm ball joints.
- Remove hub carrier. Save top tapered spacers on A-arm.



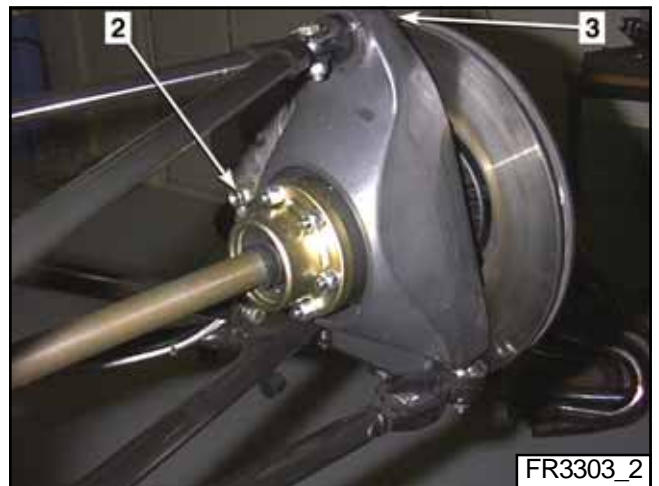
Hub carrier

REMOVAL

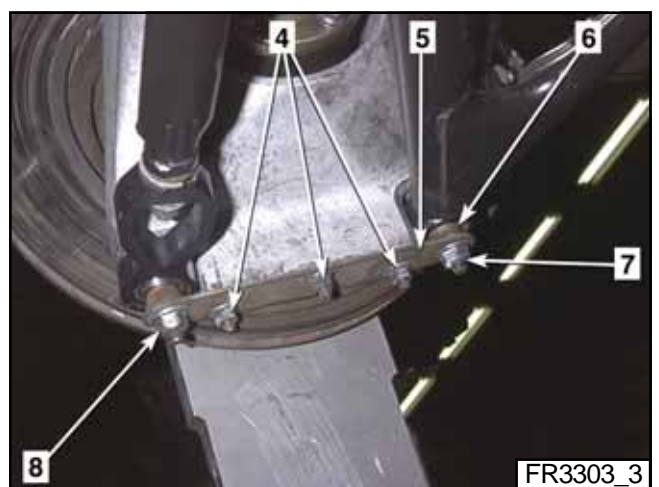
- Remove wheel.
- Remove the two bolts **(1)** fastening the calliper on the hub carrier. Disengage calliper and hook it onto A-arm.
- Remove disc.



- Remove:
 - nuts fastening drive shaft **(2)**,
 - bolts fastening top A-arm **(3)**.



- Remove:
 - the two nuts fastening the bottom A-arm **(7)** and **(8)**,
 - the three nuts **(4)**. Set aside plate **(5)** and bottom tapered spacers **(6)** on bottom A-arm ball joints.
- Remove hub carrier. Save top tapered spacers on A-arm.

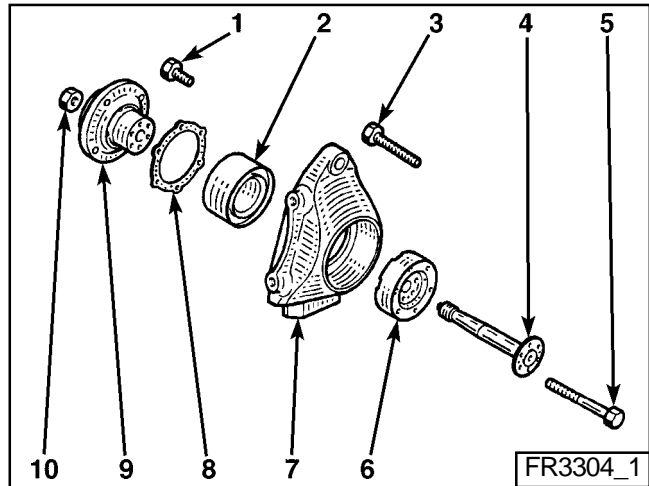


Hub carrier

DISASSEMBLY

- Remove nuts (10). Save the bolts (5).
- Remove spindle (4) from hub by tapping on end of spindle with a plastic mallet. Make sure not to damage the threading.
- Remove external hub (9) from hub carrier (7) using 4 mm dia. pin drift. Do it through the hole in the external hub (9).
- Remove internal hub (6) from hub carrier (7) in the same manner.
- Take out screws (3) on internal hub (6).
- Remove bolts (1) fastening bearing end shield (8). Remove end shield.
- Heat hub carrier (7) to 120° C. Remove bearing (2).

NOTE: *The bearing should come out without having to use any tools.*



ASSEMBLY

- Heat hub carrier (7) to 120° C and install bearing (2) in hub carrier.

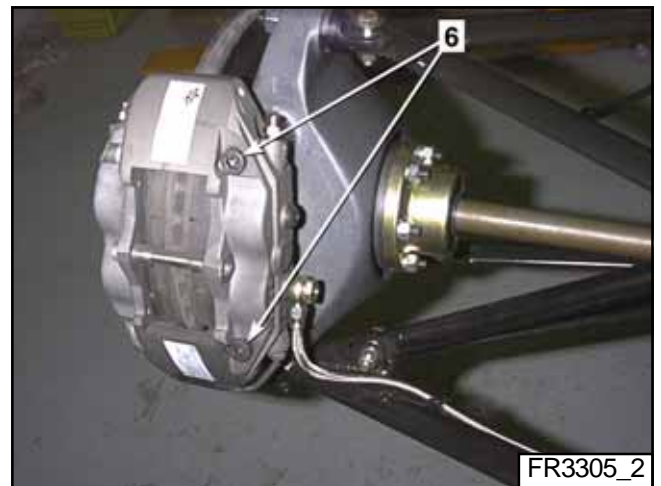
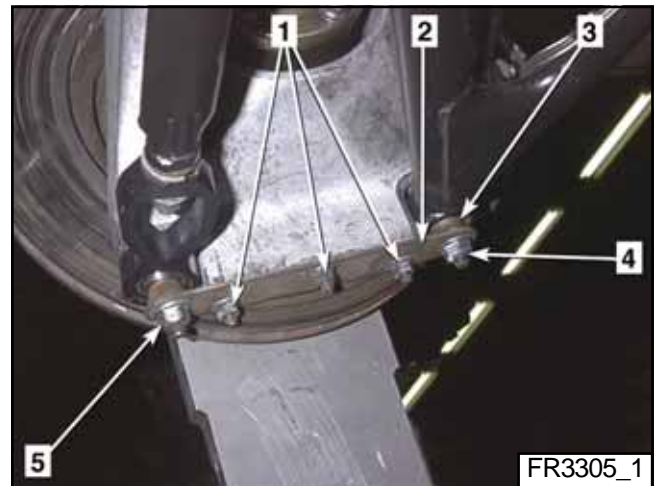
NOTE: *The bearing should come out without having to use any tools.*

- Fasten bearing end shield (8) with bolts (1) coated with a few drops of Loctite 243. Torque bolts to 6 N.m.
- Use press and drive it home onto internal bearing cage (2) to install external hub (9) in bearing.
- Run bolts (3) through internal hub (6) holes to fasten drive shaft.
- Install internal hub (6) on hub carrier (7).
- Install wheel spindle (4) in hub.
- Run bolts (5) through holes in wheel spindle. Torque nuts (10) to 25 N.m.

Hub carrier

INSTALLATION

- Follow removal steps in reverse order.
- Observe tightening torques.
- When replacing studs **(4)** and **(5)** fastening bottom A-arm, install studs with Loctite 270 or 2701. Torque to 25 N.m.
- When replacing studs **(2)** fastening plate, install studs with Loctite 270 or 2701. Torque to 11 N.m.
- Torque nuts **(1)** for fastening plate to 10 N.m.
- Coat bolts **(6)** for fastening brake callipers with copper grease. Torque to 45 N.m.



- When replacing dowels **(7)**, put a few drops of Loctite 270 or 2701 on them. Torque to 45 N.m.



DESCRIPTION

The rear suspension is by means of push-rod (2) and two dampers (1).

The compression and rebound can be adjusted.

It contains:

- rebound regulator (3),
- nitrogen reservoir (5) equipped with a screw (4), which makes it possible to measure the pressure and drain the reservoir.
- compression regulator (6).



ADJUSTMENT

WARNING: Do not touch screw (7).

Compression

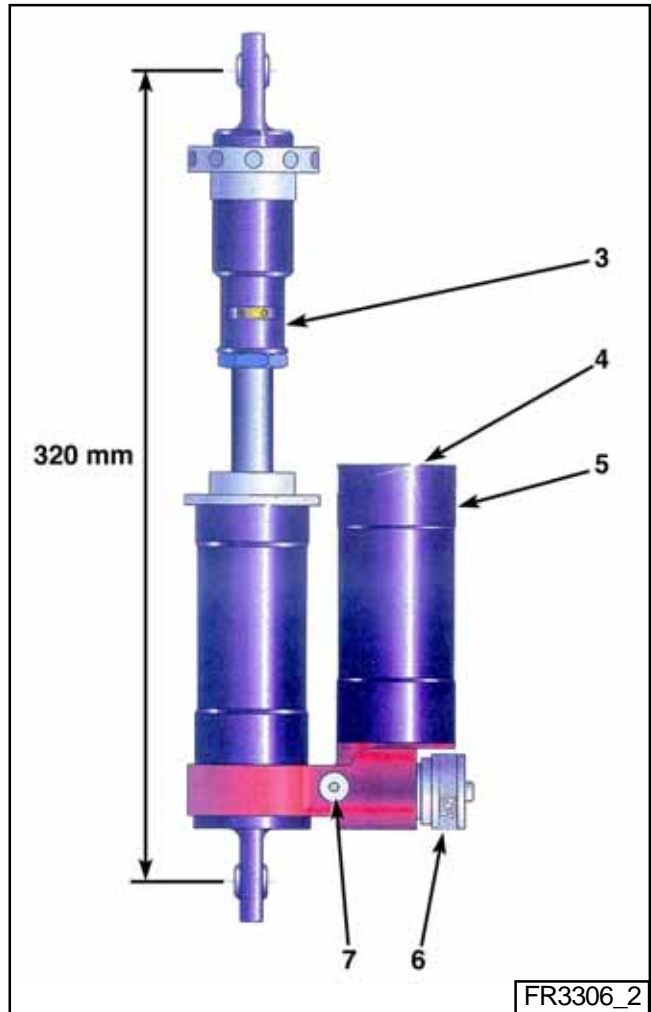
- Turn knurled knob until it abuts in the clockwise direction = hard compression.
- Turn knurled knob until it abuts in the counterclockwise direction (24 clicks) = flexible compression.

NOTE: It is possible that there will be more than 24 clicks when turning the knurled knob in this direction. After 24 clicks, there is no change in the setting.

Rebound

- Turn regulator until it abuts in the clockwise direction = hard rebound.
- Turn regulator until it abuts in the counterclockwise direction (24 clicks) = flexible rebound.

NOTE: If the regulator notches are not accessible, slightly turn end-fitting to bring them opposite the window. Make sure that dimension between middle of the two ball joints is 320 mm.



Spring-damper set

Pressure check

- Remove damper. Lock it in place in a vice.
- Remove screws in reservoir. Connect pressure gauge.
- Check that pressure in reservoir is between 8 and 8.5 bar. If necessary, adjust pressure.

NOTE: Make sure to take the pressure loss of 0.5 to 1 bar in the measuring instrument into account.

v [mm/s]	F [kgf]	F [kgf]	F [kgf]	F [kgf]
	O / C	O / E	C / C	C / E
12.9	39.5	- 9.5	68.9	- 49.9
17.22	40.8	- 10	72.6	- 54.9
23.67	44	- 10.4	76.7	- 60.3
30.12	46.3	- 10.9	79.4	- 65.3
49.48	51.7	- 14.1	86.2	- 78
77.42	61.2	- 19.5	96.6	- 103
107.54	70.3	- 31.3	109.68	- 123.8
137.67	78	- 44.5	115.2	- 141.1

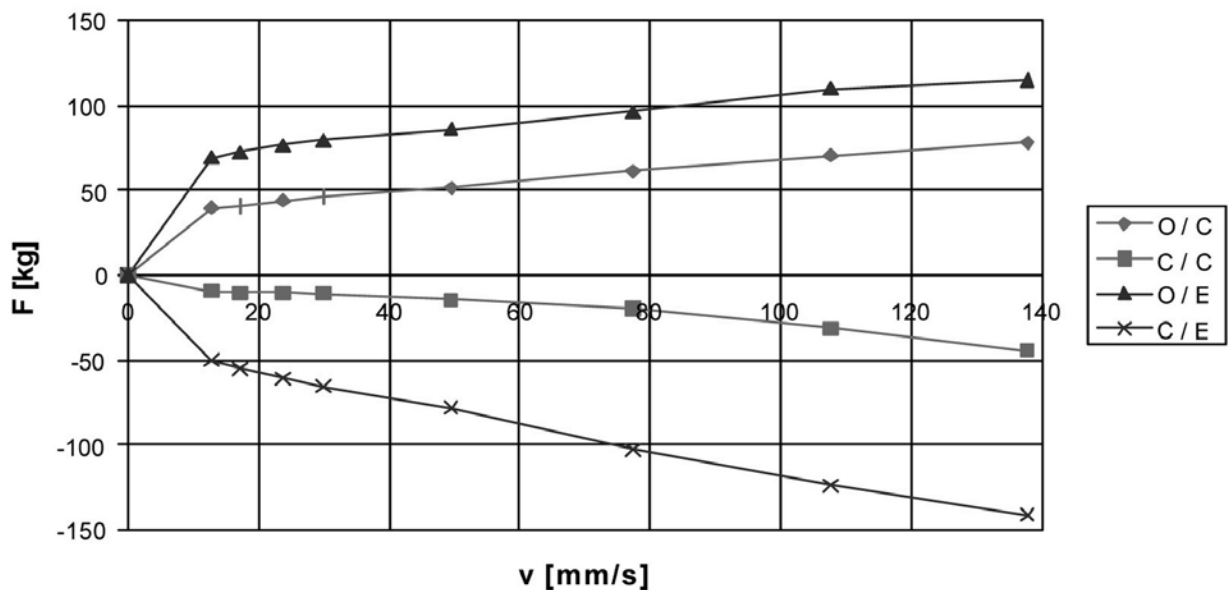
O/C = Open compression

C/C = Closed compression

O/E = Open expansion

C/E = Closed expansion

REAR DAMPER



FR3307_1

Spring-damper set

Maintenance

- Wash damper with soap and water. Use of petrol, gasoline and solvents are forbidden.
- Change oil for the first time at 2,500 km, then after that, every 4,000 km.

NOTE: *It is compulsory to use the oil recommended by the damper manufacturer. Ref.: 152.*

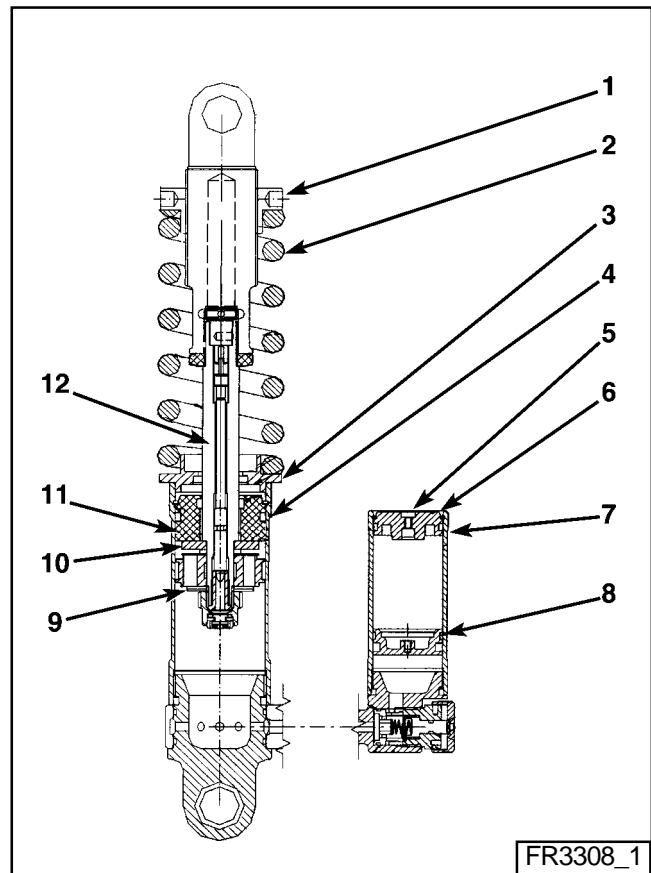
DISASSEMBLY/ASSEMBLY

Disassembly of damper

- Remove nut (1). Take out spring (2).
- Turn compression knurled knob until it abouts in the counterclockwise direction.
- Turn rebound regulator until it abouts in the counterclockwise direction.
- Remove screw (5). Bleed gas off reservoir.

WARNING: *Before disassembly, make sure that damper is no longer pressurized. The reservoir is correctly discharged if the bottom of the reservoir can be pushed up with fingers.*

- Use rubber mallet to remove seat (3).
- Push guide (11) so as to gain access to snap ring (4). Remove snap ring.
- Separate top of damper casing. Drain oil.
- Unscrew rod (12) in top of damper.



Disassembly of gas separator

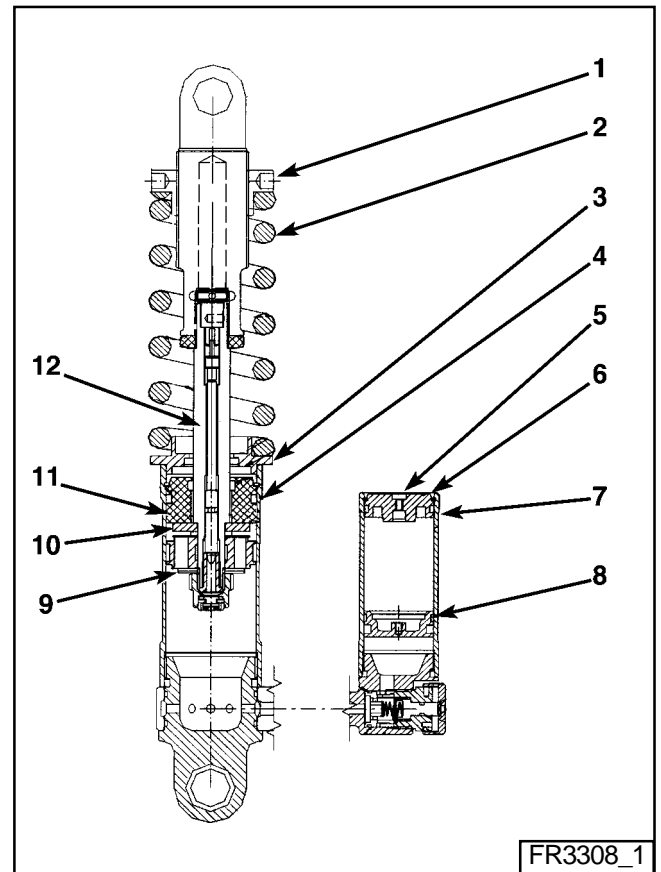
- Push plug (6) so as to gain access to snap ring (7). Remove snap ring.
- Remove plug (6).
- Remove separator (8).

Spring-damper set

Assembly

- Follow removal steps in the reverse order.
- Install compression shims (9) and rebound shims (10) as shown in the table below.

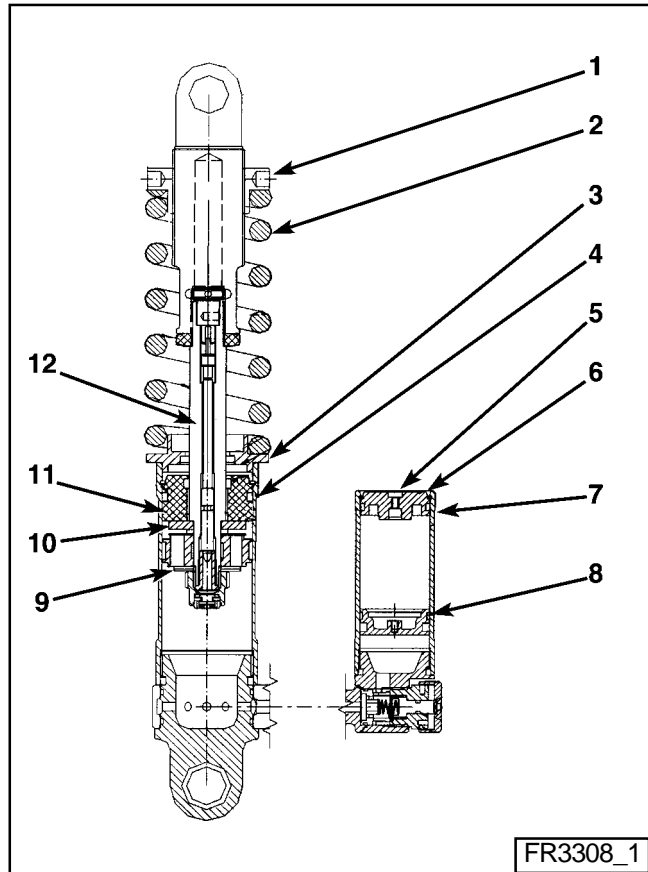
Shim	Compression	Rebound
1	- Thickness: 0.2 mm - Diameter 34 mm	- Thickness: 0.2 mm - Diameter: 32 mm
2	- Thickness: 0.2 mm - Diameter: 30 mm With ring: - Thickness: 0.3 mm - Inside diameter: 30 mm - Outside diameter: 34 mm	- Thickness: 0.3 mm - Diameter: 26 mm
3	- Thickness: 0.2 mm - Diameter: 34 mm	- Thickness: 0.3 mm - Diameter: 24 mm
4	Washer: - diameter 18 mm - sharp angle towards shims	- Thickness: 0.25 mm - Diameter: 22 mm
5		- Thickness: 0.3 mm - Diameter: 20 mm
6		Washer: - diameter: 18 mm - sharp angle towards shims



- Clean interior of damper.
- Fill casing of damper with oil, up to the edge. It is compulsory to use the oil recommended by the damper manufacturer.
- Lubricate separator O-ring (8) with silicon grease, then insert separator O-ring in reservoir.
- Completely unscrew rebound regulator.
- Wait until oil no longer emulsifies and install rod (12).
- Completely close compression regulator.
- Push rod (12) firmly. Wait a moment, then pull it without letting any air in. Repeat this step two or three times.
- Pull rod and add oil. The level should come up to the throat of the snap ring (4).

Spring-damper set

- Fit guide (11), checking that a thin stream of oil flows before its seal is in the cylinder.
- Open compression regulator.
- Push guide (11) to release snap ring throat. Insert snap ring (4).
- Lubricate separate seal (8). Install separator.
- Fit snap ring (7).
- Build pressure back up in reservoir, to 8 or 9 bar.
- Insert plug (6) and seat (3).



Spring

Table for various springs available.

Stiffness in lb/in	Stiffness in kg/mm
700	12.40
800	14.17
900	15.49
1,000	17.72
1,100	19.49
1,200	21.26



WHEELS AND TYRES

Characteristics

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WHEELS

Material: aluminium.

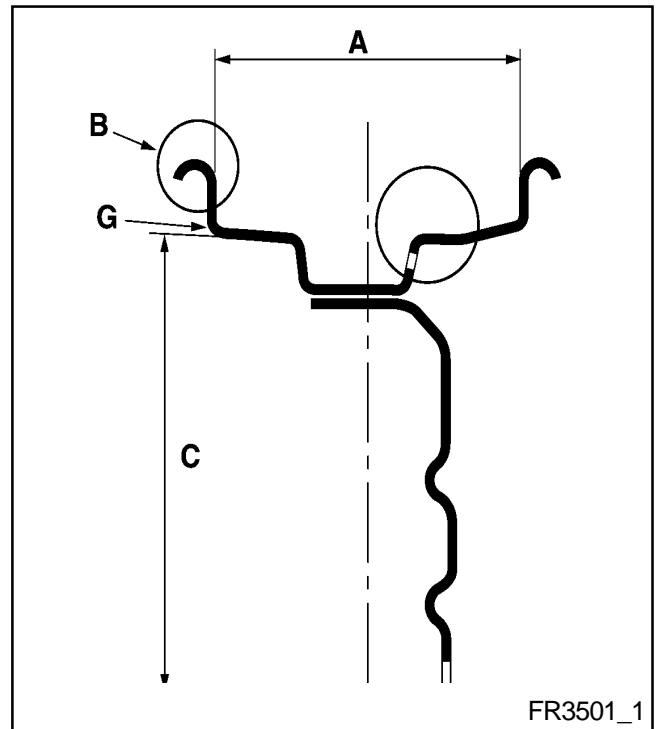
		A	B	C
		Width (in inches)	Rim edge profile	Ø nominal (in inches) under tyre bead
FRONT WHEEL	Type of wheel	8	J	13
REAR WHEEL	Type of wheel	10	J	13

Maximum run-out: 1.2 mm measure on rim edge **(G)**.

Maximum out of round: 0.8 mm measured on tyre bead mating face.

Precautions to avoid the slow losses of pressure:

- The valves of wheels must be changed at least once during the season,
- The valve caps must be in place.



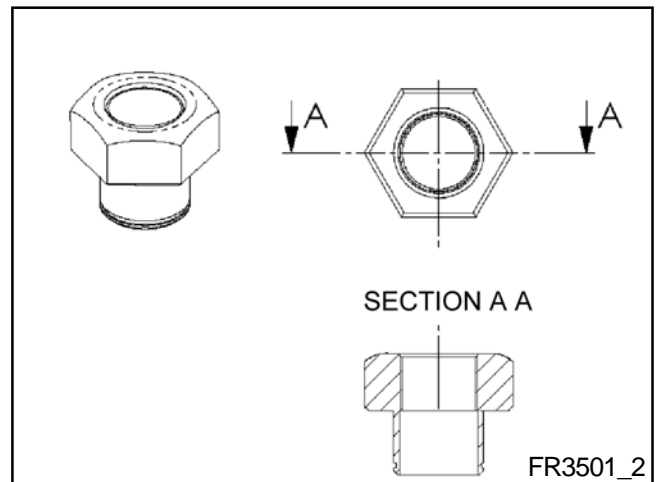
ATTACHMENT

Type : central

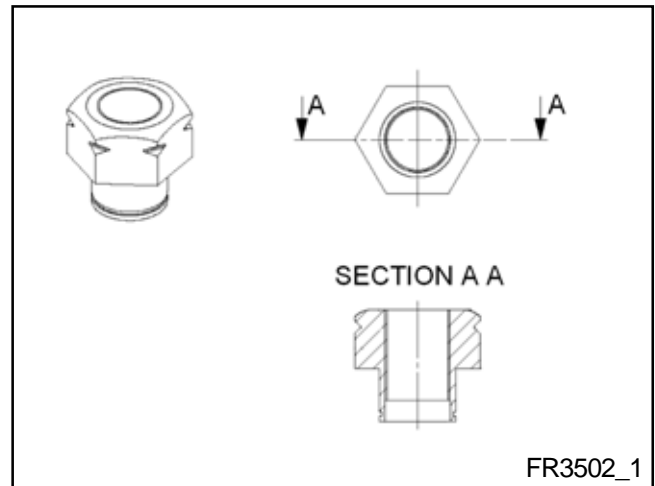
Nuts : To improve the reliability and the safety of use of the Formula Renault 2.0, a new type of wheel nut has been specified.

Tightening torque: 130 Nm

Former type: P/N: 01 00 07 033



New type: P/N: 01 04 07 033



TYRES

- Michelin tubeless tyres.

		SLICK	RAIN
TYPE	Front	FR 2.0 or S210, accordind to regulation	P220
	Rear	FR 2.0 or S210, accordind to regulation	P220
SIZE	Front	16 x 53 x 13	16 x 53 x 13
	Rear	23 x 57 x 13	23 x 57 x 13
HOT INFLATING PRESSURE	Front	1.45 bar	1.45 bar
	Rear	1.6 bar	1.6 bar

Steering rack

TIGHTENING TORQUES (in N.m)

Axial ball joint	5
Ball joint nut	3.5
Alignment adjustment sleeve screw	2
Rack mounting screw	9.5

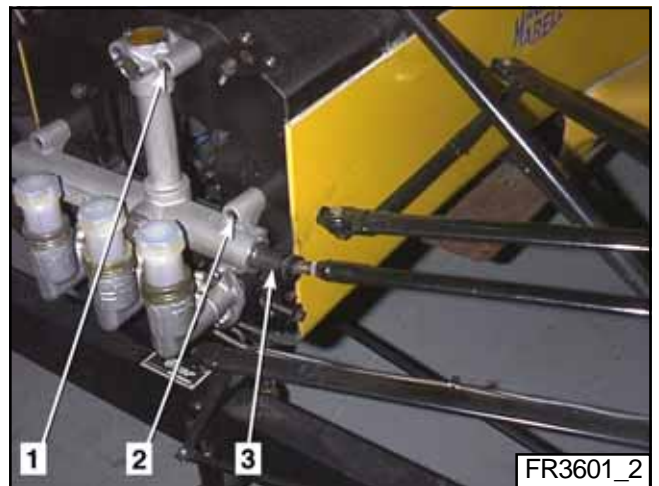
REPLACEMENT

Removal

- Unscrew screw **(1)** on steering column.



- Disconnect left and right ball joints **(3)**.
- Remove the two top screws **(1)** and the four bottom screws **(2)**, then take out rack.

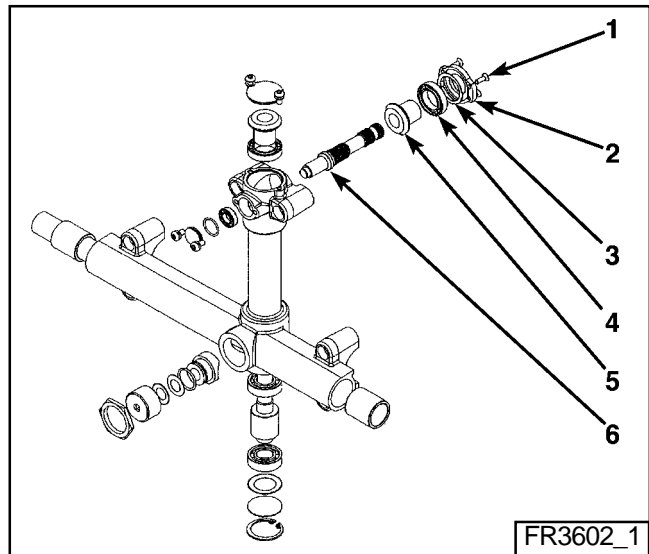


Installation

- Repeat removal steps in reverse order.
- Observe tightening torques.

REPLACEMENT OF INPUT SHAFT

- Remove the four screws (1), then take out flange (2) and shims (3).
- Take out input shaft assembly (6).
- Take out bearing shaft (5) and remove roller bearing (4).
- Install bearing housing (5) on shaft (6). Make sure that bearing housing is abutted onto shoulder of shaft.
- Install roller bearing (4) on bearing housing (5).
- Install input shaft assembly on rack.
- Insert shims (3) in flange (2) and fasten flange to rack with screws (1).
- Check that there is no play. Make sure that there is a slight prestress on the mounting and that the clearance of the rack is from stop to stop, without jerks.
- If necessary, adjust with shims (3).



Inspection of steering column mounting

- Check mounting (1) regularly as well as after each impact with product type «Ardrox».
- Replace mounting if it is cracked.



Steering Wheel play control

- If the play in the steering wheel is important, one can rotate the pinion by 180°, so that the pinion uses new teeth.

MASTER CYLINDER

TIGHTENING TORQUES (in N.m)	
Banjo fittings	15
Master cylinder mounting nuts	23

Characteristics

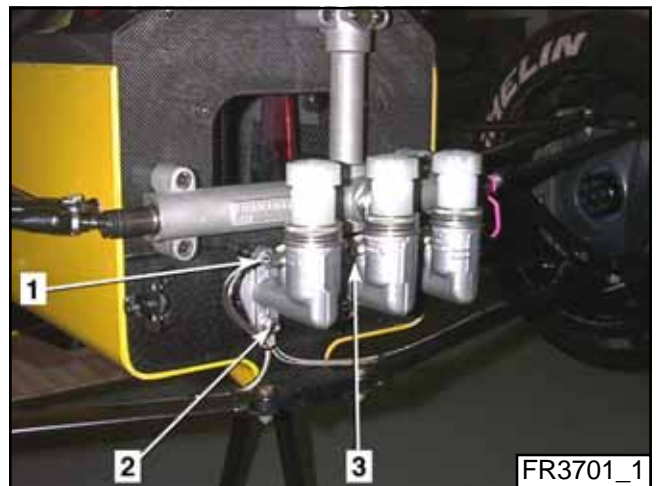
- Diameter of master cylinders:
 - Front brake: 5/8",
 - Rear brake: 3/4".
- Brake fluid: DOT5.
- Repair kit part number:
 - front brake master cylinder: 77 11 150 526,
 - rear brake master cylinder: 77 11 150 527.

Removal

- Remove screws fastening banjo fitting **(1)** for front brake master cylinder or **(3)** for rear brake master cylinder (provide for outflow of brake fluid).
- Remove the two nuts **(2)** and take out master cylinder.

Installation

- Repeat disassembly steps in reverse order.
- Observe braking torques.
- Bleed brake lines.



BRAKE PROPORTIONING DEVICE

Functioning

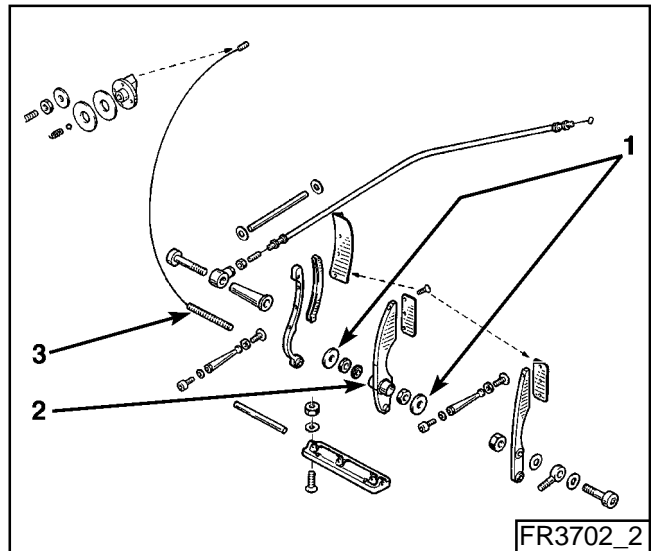
The driver can adjust the brake proportioning device from his or her seat.

- Turn control **(1)** in clockwise direction to increase braking on rear and decrease it on front.
- Turn control **(1)** in counterclockwise direction to decrease braking on rear and increase it on front.



Replacement

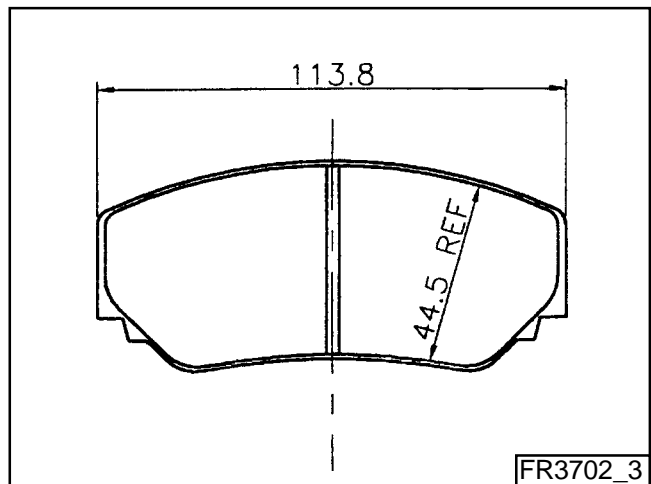
- Bring ball joint **(2)** to middle of threading **(3)**.
- Check that assembly is free-moving. The washers **(1)** should not be tight.



BRAKE PADS

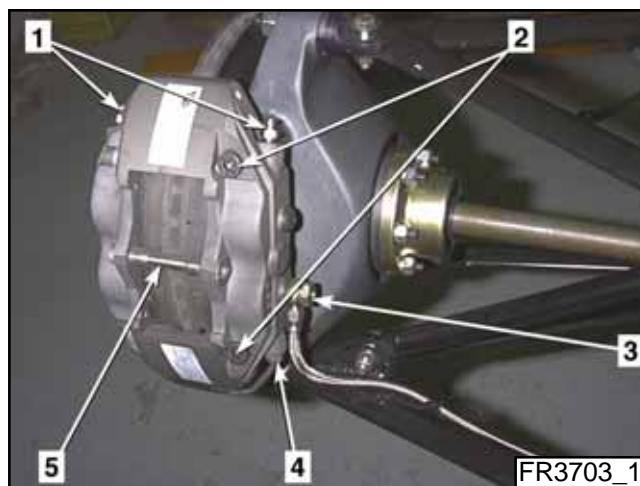
The quality of the linings is open, on condition of maintaining the original friction surfaces (see figure opposite).

- Thickness of pads: 16 mm.
- Brake fluid: DOT5.
- Example of types of pads:
 - Ferodo 4003F (type mounted on mass-produced models),
 - Ferodo,
 - Pagid, blue type U2127RS4/2.



CALLIPERS

TIGHTENING TORQUES (in N.m)	
Calliper mounting screw (2)	45
Wheel bolts	130
Banjo fitting (3)	15
Connecting tube connector (4)	14
Bleed screw (1):	
- hot	14
- cold	18
Carrier screw (5)	12



IMPORTANT: The callipers should be rebuilt:

- at least once at the end of the season,
- every time the calliper has undergone extremely high temperature stress.

NOTE: According to the nomenclature part of the technical regulations, the brake caliper springs belong to the C category, and then can be removed.

Characteristics

- Bottom piston diameter: 34.9 mm.
- Top piston diameter: 31.8 mm.
- Springs setting : 2 kg $\begin{matrix} +0.2 \\ -0.25 \end{matrix}$

General instructions

- Drive back pistons with suitable clamps so as not to change geometry or leave chips likely to nick seals.
- Do not tighten bleed screw (1) to too high of a torque so as not to damage the tapered bearing surface (risk of leaks).
- Systematically replace damaged hydraulic lines.
- Observe torque of carrier screw (5): risk of deforming calliper.

Maintenance

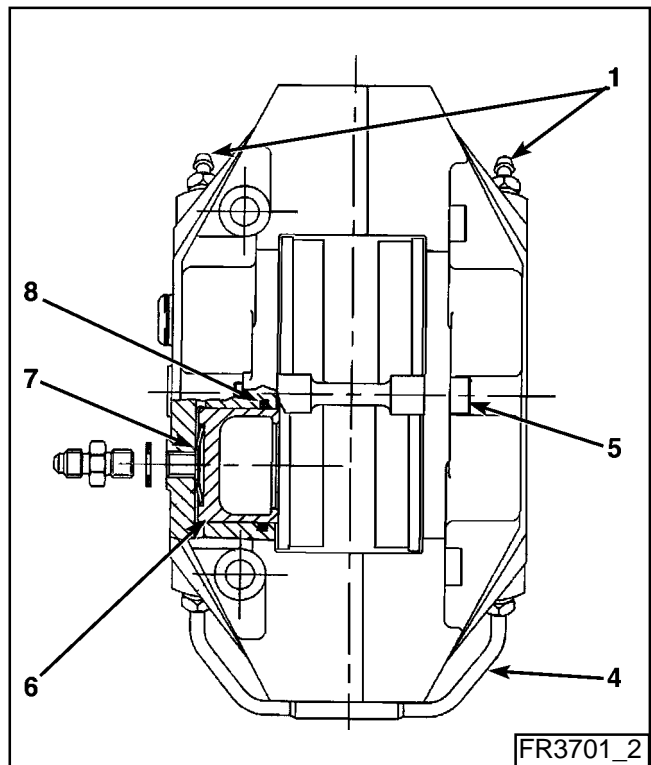
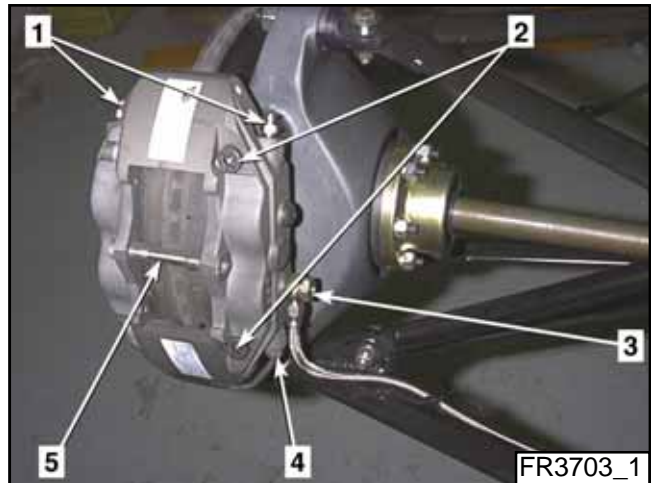
WARNING: *Take the necessary precautions so that no chemical products contaminate the brake system components. Never try to separate the two parts of a calliper.*

- Clean callipers with a brake cleaning product.
- Remove carrier (5) and brake pads.
- Remove screws (2) fastening calliper to hub carrier. Remove calliper, making sure not to twist or deform hydraulic lines.
- Place a recipient capable of holding the brake fluid contained in calliper under the calliper. Gently actuate brake pedal so as to extract pistons, then remove them by hand.
- Disconnect banjo fitting (3).
- Use a soft tool to take out seals (8), making sure not to scratch throats and bores. Throw away seals.
- Clean interior of calliper with brake fluid. Dry it. Check that there are no signs of wear or corrosion on the pistons (6) and in bores.
- Systematically replace all parts that are deeply scratched or marked.
- Lubricate seals (8) and pistons (6). Use ONLY the grease supplied in the repair kits.

NOTE: *It is normal that the inside diameter of the seals (8) is greater than the inside diameter of the pistons (6).*

- Unscrew bleed screws (1). Reinsert seals (8), pistons (6) and springs (7) carefully so as not to pinch seals.

NOTE: *Only install new seals.*



BRAKES

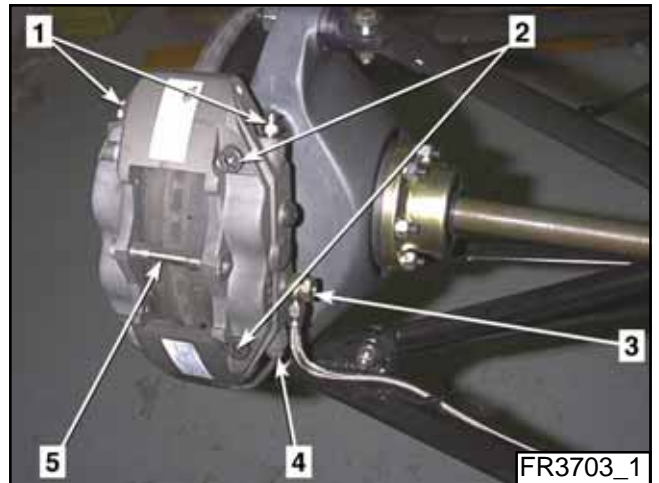
System components

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- Tighten bleed screws (1).
- Install calliper, pads and carrier.
- Observe recommended tightening torques.
- Fit banjo fitting (3) with a new copper gasket. Connect fitting.
- Bleed lines completely. Adjust level in master cylinder reservoir, using suitable brake fluid.

WARNING: *Check that there are no leaks before using the vehicle.*

NOTE: *To make interventions easier, a fast coupler can be installed on the rear brakes circuit.*



THROTTLE COMMAND

Recommandation

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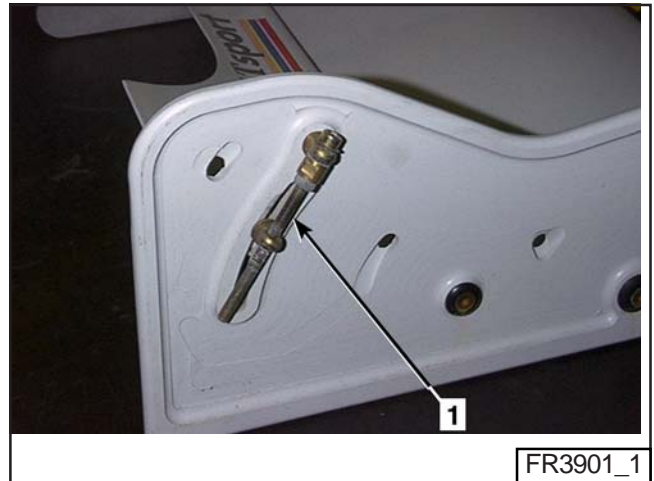
RECOMMANDATION

For safety reasons, check the the silicone protection inside the throttle cable conduit doesn't go ahead of the conduit stop, near the pedal. If it does, cut the silicone protection just ahead of the conduit stop.

Wings

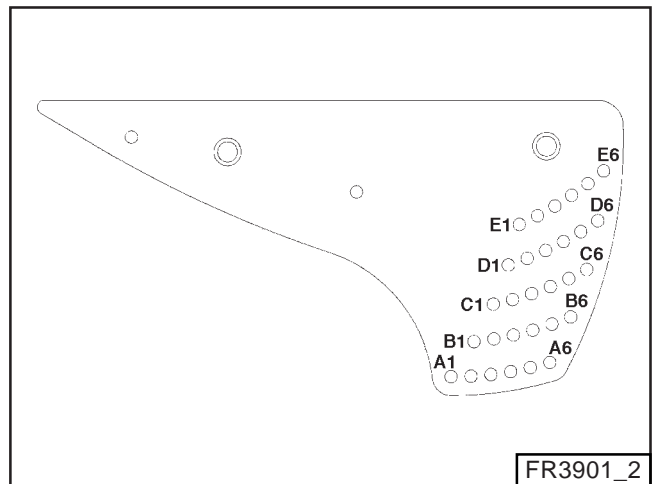
FRONT WING

Front wing angle of incidence is modified by adjusting the adjustable flaps. Seven turns of the screws **(1)** varies the angle of incidence by 1°.



REAR WING

Rear wing angle of incidence is modified by changing the position of its fasteners. Changing from one fastening hole to the juxtaposed hole varies the angle of incidence by 1°.

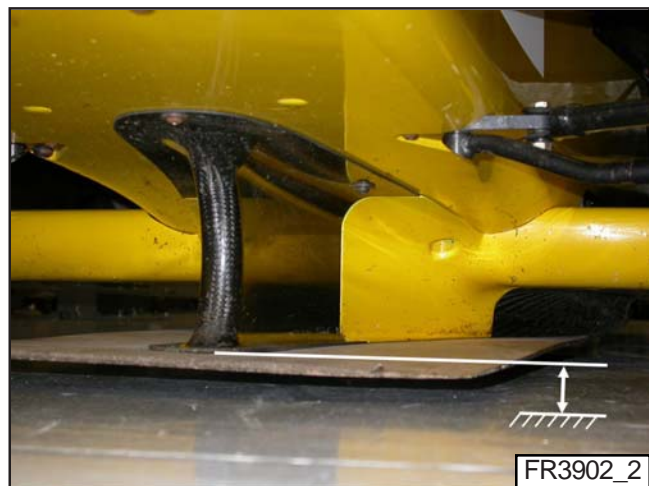


GENERAL

The tests were carried out with three throughput speeds on a pit equipped with balances of measurement. The results can be interpreted in absolute value.

The value of drag presented in the tables hereafter is to be used carefully; indeed, during the passages over the balances, measurements of the longitudinal and lateral loads are extremely sensitive to the variations longitudinal and lateral speed; also the values of drag deduced from measurements are not easily reproducible; those which are presented in the tables hereafter are thus the most relevant values, deduced after analysis from the 3 tests from each passage. The efficiency is defined by the relationship between the deporting and the drag. The efficiency is thus to also use carefully.

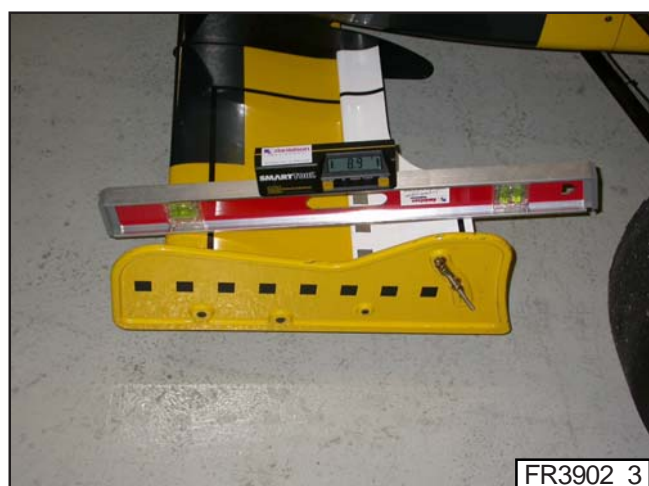
The frame heights presented in the tables hereafter are measured with the vertical of the front shoe and with the vertical of the trailing edge of the rear flat bottom (axis of the rear wheels)



The steering angle of the front wing is measured between the leading edge of the main element and the trailing edge of the secondary element; this steering can vary from 0° up to more than 12°.

The steering of the rear wing is expressed compared to the fixings position; this steering can vary from position A1 ($\pm 0^\circ$) up to position E6 ($\pm 30^\circ$).

The static burden-sharing on the front, pilot of 75 kg on board and all full facts, is 41 %.



INFLUENCE OF THE FRAME HEIGHT AND ATTITUDE

These tests were carried out with the following aerodynamic configuration:

- front wing: 9°
- rear wing: C5 ($\pm 16^\circ$)

RESULTS AT 140 KM/H

F/R height (mm)	22-34	16-26	20-30	24-34	16-31	20-35	24-39	16-36	20-40	24-44
Pitch (mm)	12	10	10	10	15	15	15	20	20	20
Front deport (daN)	45	51	66	62.5	56	69.5	66	68	70.5	71.5
Rear deport (daN)	103	92	95.5	104.5	86.5	102	99	85	88	110.5
Tot. deport (daN)	148	143	161.5	167	142.5	171.5	165	153	158.5	182
Tot. drag (daN)	70	54	50	39	37	39	41	42	50	51
Efficiency	2.11	2.65	3.23	4.28	3.85	4.40	4.02	3.64	3.17	3.57
Front aero. sharing (%)	30.4	35.7	40.9	37.4	39.3	40.5	40.0	44.4	44.5	39.3

RESULTS AT 180 KM/H

F/R height (mm)	22-34	16-26	20-30	24-34	16-31	20-35	24-39	16-36	20-40	24-44
Pitch (mm)	12	10	10	10	15	15	15	20	20	20
Front deport (daN)	82	73	71	70.5	78	70.5	75	71	75.5	80.5
Rear deport (daN)	123	120	117.5	135.5	111.5	123	130	107	118	138.5
Tot. deport (daN)	205	193	188.5	206	189.5	193.5	205	178	193.5	219
Tot. drag (daN)	93	100	85	102	100	84	94	78	100	110
Efficiency	2.20	1.93	2.22	2.02	1.90	2.30	2.18	2.28	1.84	1.99
Front aero. sharing (%)	40.0	37.8	37.7	34.2	41.2	36.4	36.6	39.9	39.0	36.8

RESULTS AT 220 KM/H

F/R height (mm)	22-34	16-26	20-30	24-34	16-31	20-35	24-39	16-36	20-40	24-44
Pitch (mm)	12	10	10	10	15	15	15	20	20	20
Front deport (daN)	105	94	100	97.5	97	104.5	110	108	107.5	111.5
Rear deport (daN)	166	203	194.5	208.5	188.5	208	198	197	190	207.5
Tot. deport (daN)	271	297	294.5	306	285.5	312.5	308	305	297.5	319
Total drag (daN)	160	178	140	171	123	166	156	175	145	191
Efficiency	1.69	1.67	2.10	1.79	2.30	1.88	1.97	1.74	2.05	1.67
Front aero. sharing (%)	38.7	31.6	34.0	31.9	34.0	33.4	35.7	35.4	36.1	35.0

It comes out from this first series of tests that the best compromise in term of aerodynamic efficiency and total deport for three speeds tested, could be obtained with a front height of 20 mm and a back height of 35 mm.

On the other hand, with the aerodynamic set-up retained for these tests, the aerodynamic burden-sharing, on the front, is rather unfavourable. Indeed, the value obtained for high speeds (180 and 220 km/h) is too far away from the static load.

Also, starting from this fixed «average» set-up, the purpose of the following tests will be thus to analyze the influence of the aerodynamic adjustments on the behaviour of the car.

WING SETTINGS INFLUENCE

These tests were carried out with the following heights of case:

- front height : 20 mm
- rear height : 35 mm

RESULTS AT 140 KM/H

Front wing (°)	9	9	9	11	11	11	6	6	6	3	12
Rear wing	C5	D3	C1	C1	C5	E1	A5	C1	A1	A1	E6
Front deport (daN)	69.5	46	51	51	52	49	52	52.5	57	46	70.5
Rear deport (daN)	102	117.5	107.5	104.5	105.5	106.5	99	114.5	80	87	101
Tot. deport (daN)	171.5	163.5	158.5	155.5	157.5	155.5	151	167	137	133	171.5
Tot. drag (daN)	39	55	41	60	70	37	47	43	37	45	52
Efficiency	4.40	2.97	3.87	2.59	2.25	4.20	3.21	3.88	3.70	2.96	3.30
Front aero. sharing (%)	40.5	28.1	32.2	32.8	33.0	31.5	34.4	31.4	41.6	34.6	41.1

RESULTS AT 180 KM/H

Front wing (°)	9	9	9	11	11	11	6	6	6	3	12
Rear wing	C5	D3	C1	C1	C5	E1	A5	C1	A1	A1	E6
Front deport (daN)	70.5	97	102	108	102	95	79	69.5	67	38	79.5
Rear deport (daN)	123	157.5	133.5	118.5	140.5	151.5	117	135.5	95	98	129
Tot. deport (daN)	193.5	254.5	235.5	226.5	242.5	246.5	196	205	162	136	208.5
Tot. drag (daN)	84	137	88	95	110	104	89	79	95	86	100
Efficiency	2.30	1.86	2.68	2.38	2.20	2.37	2.20	2.59	1.71	1.58	2.09
Front aero. sharing (%)	36.4	38.1	43.3	47.7	42.1	38.5	40.3	33.9	41.4	27.9	38.1

RESULTATS A 220 KM/H

Front wing (°)	9	9	9	11	11	11	6	6	6	3	12
Rear wing	C5	D3	C1	C1	C5	E1	A5	C1	A1	A1	E6
Front deport (daN)	104.5	103	110	118	117	118	89	88.5	91	49	104.5
Rear deport (daN)	208	204.5	166.5	166.5	162.5	199.5	136	201.5	144	146	204
Tot. deport (daN)	312.5	307.5	276.5	284.5	279.5	317.5	225	290	235	195	308.5
Tot. drag (daN)	166	167	152	128	123	154	114	174	115	145	173
Efficiency	1.88	1.84	1.82	2.22	2.27	2.03	1.97	1.67	2.04	1.34	1.78
Front aero. sharing (%)	33.4	33.5	39.8	41.5	41.9	37.2	39.6	30.5	38.7	25.1	33.9

In a total way, the wing settings influence on the total deport of the car is rather weak, insofar as between an adjustment typified weak rests (6°/A1) and an adjustment typified strong rests (11°/E1), the variation in term of deport is only 122.5 daN, with 220 km/h.

40

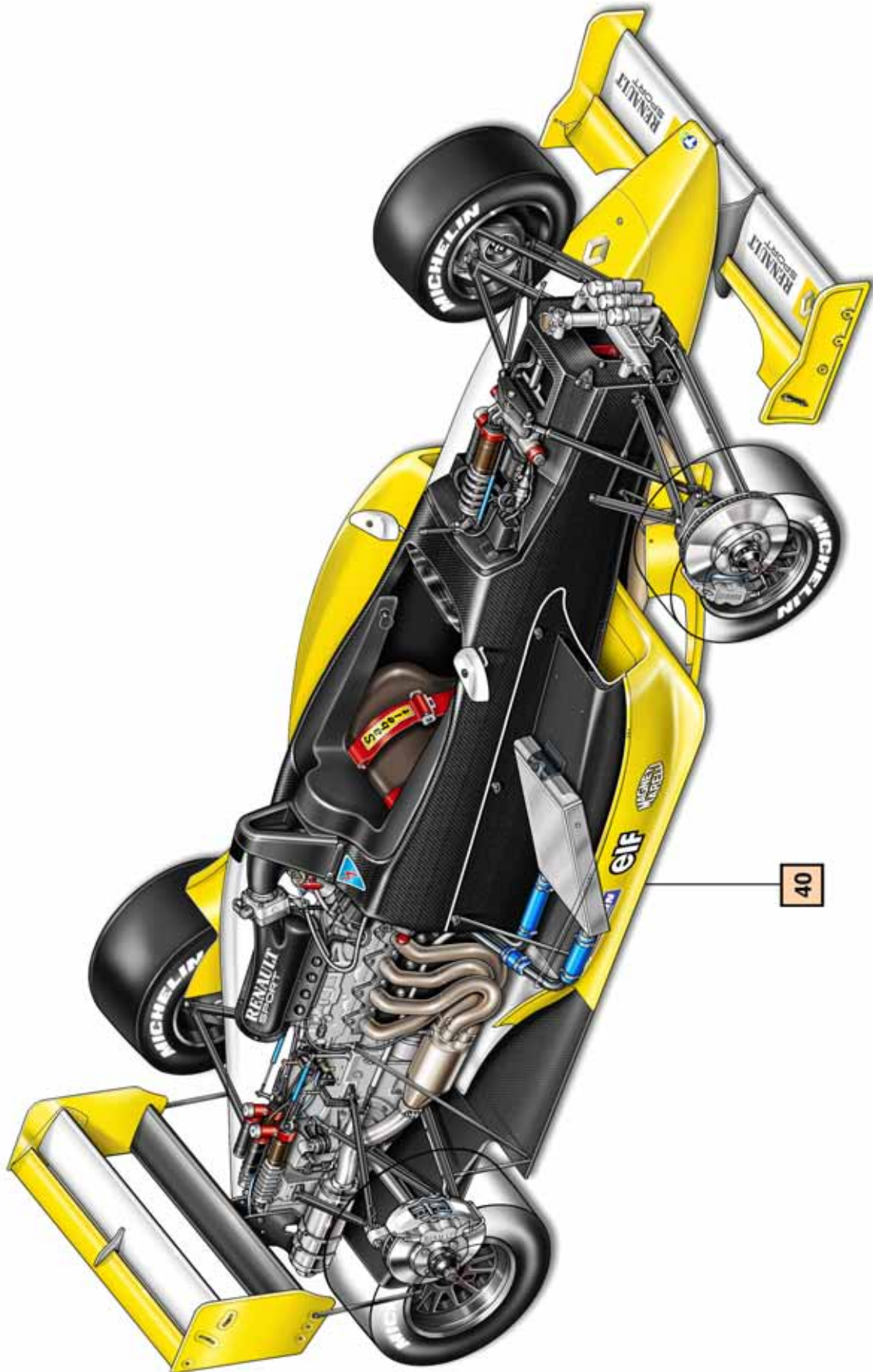
BODYWORK

Authorised modifications	40-1
Ballast	40-3
Bodywork, wings and bow	40-4

BODYWORK

Exploded view

4

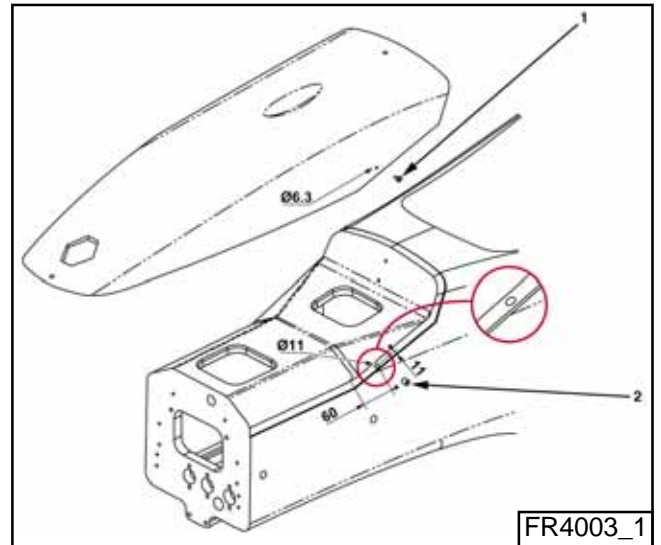


FRONT BONNET

It is authorised to add an additional, identical fastener to the other fasteners on the front bonnet.

NOTE : *Observe dimensions shown on figure.*

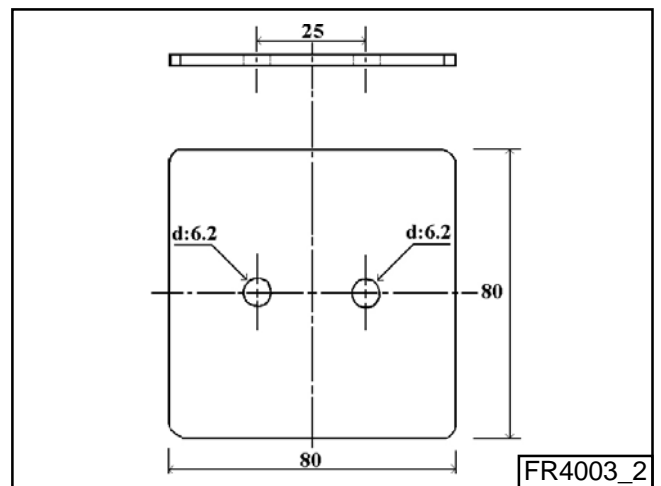
- Drill an 11 mm diameter hole in the bodyshell.
- Slightly bevel for gluing.
- Apply Araldite glue. Install receptacle **(2)** in hole.
- Drill a 6.3 mm hole in the bonnet. Install Camloc **(1)**.



FLAT BOTTOM / EXTRACTOR

To respect the article 3.13 of the technical regulation, it is authorised to add between the aerodynamic extractor and the support of the pad a metallic spacer plate following the sheet here on the right.

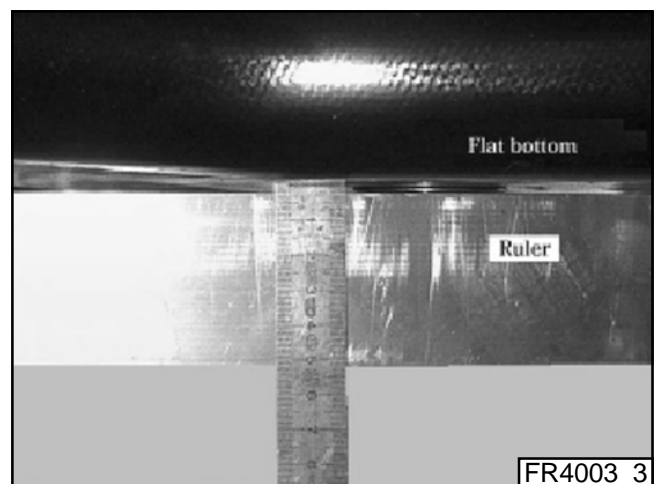
The thickness permitted the location of the aerodynamic extractor to be in line with the reference flat bottom.



Checking procedure

Position a ruler under the flat bottom (reference plane) in the longitudinal plane of the vehicle by placing it near the pad and measure the distance between the ruler and the flat bottom.

If the distance is more than 5 mm (0.197 in), it is compulsory to set up a shim between the pad and the gear box to respect the regulation.



You will find below precisions on the technical regulations.

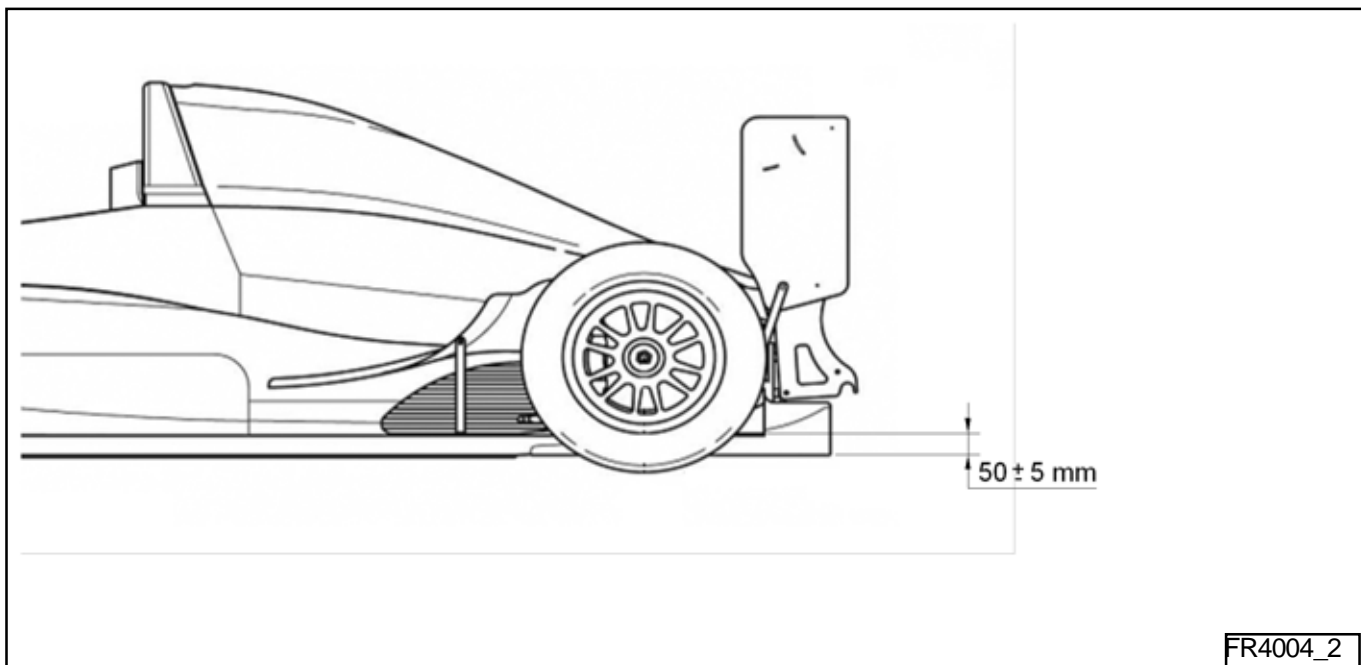
GROUND-FACING BODYWORK

Between the furthest-rear edge of the complete front wheels and the furthest-forward edge of the complete rear wheels, all suspended parts of the car visible from below must be located on one of the following two parallel planes: the reference plane or the step plane.

Reference plane: surface between the furthest-rear edge of the complete front wheels and the furthest-forward edge of the complete rear wheels with a maximum width of 500 mm symmetrical to the longitudinal axis of the car.

Step plane: all suspended parts of the car visible from below and not in the reference plane, must be positioned 50 mm above the reference plane. No part of the car must be positioned more than 50 cm to the rear of the rear wheel axis, or more than 100 cm to the front of the front wheel axis.

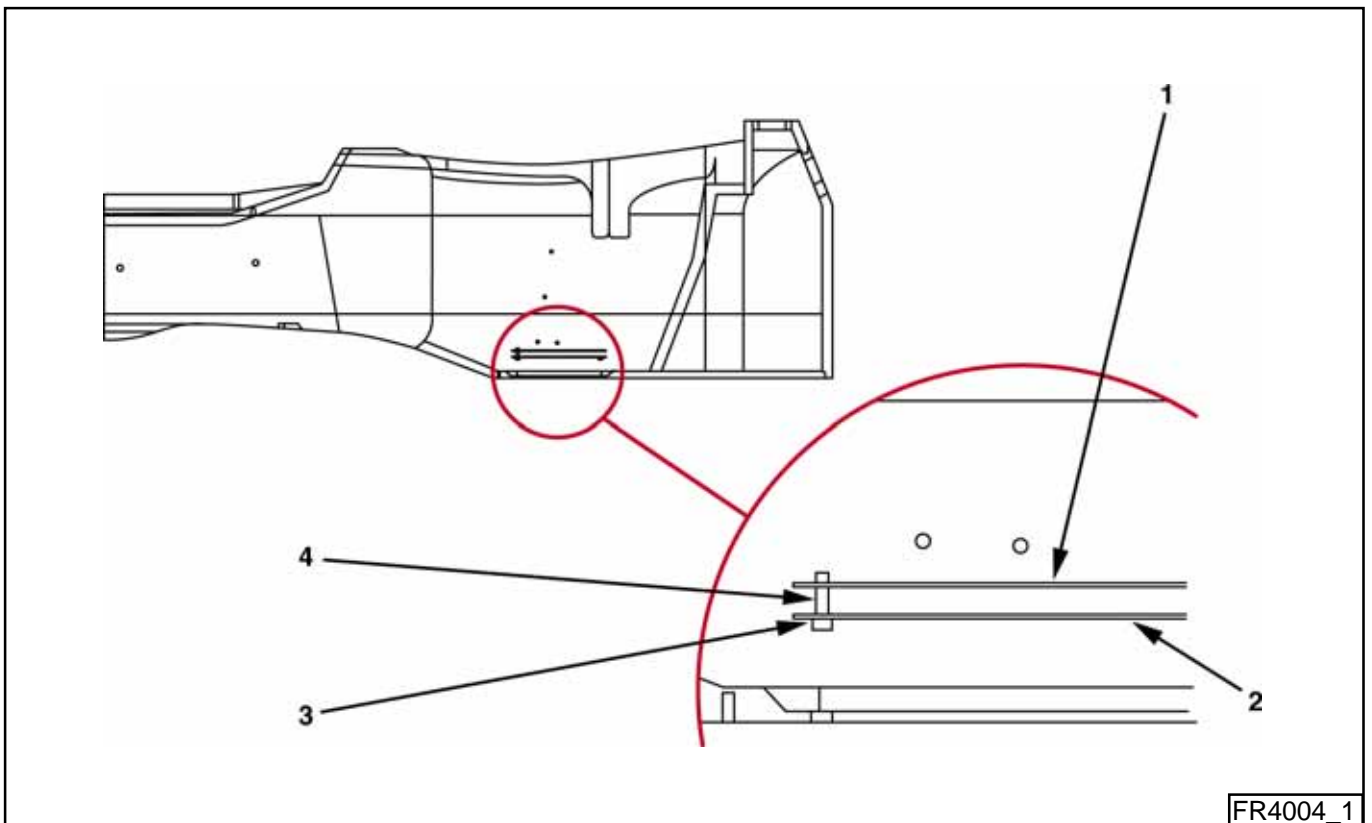
Rear diffuser: a tolerance of ± 5 mm is granted on the relative position of the extension of the step plane on the further-rear edge of the diffuser with regard to the reference plane (see drawing below). This adjustment can be obtained by adding washers or shims between the stay main plate / diffuser (part 01 03 02 060/061) and the diffuser.



In order to respect the regulation with regard to the minimum weight of the vehicle, ballast plates specific to the FR2000 are available in the Renault Sport equipment store - Ref : 77 11 154 298.

ASSEMBLY OF BALLAST PLATES

- Fit bottom plate **(2)**. Align it with edges of bodyshell sunk spot.
- Use bottom plate **(2)** as gauge to drill bodyshell.
- Drill four holes for inserts **(3)** and 3.2 mm dia. holes for rivets.
- Run sandpaper over bodyshell and bottom plate sections to be glued.
- Glue bottom plate **(2)** onto bodyshell using Scotch 3M Wild 9323 a/b resin, then fasten it with rivets.
- Screw the four studs **(4)** onto the inserts **(3)**. Adjust their length as a function of the ballast thickness.
- Assemble top plate **(1)**.
- Drill end of studs so sealing can be applied.



MARKING

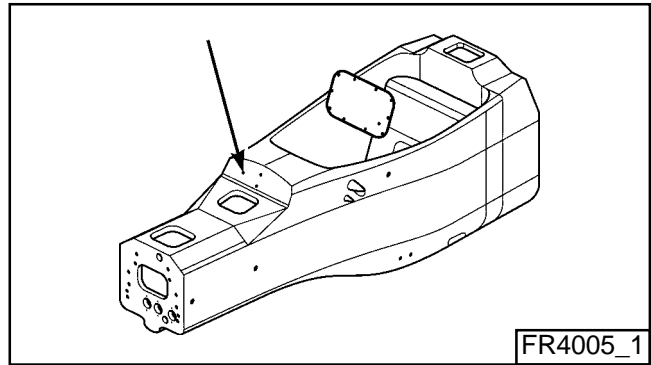
All parts making up the bodywork, wings and bow are marked with hologram discs.

It is compulsory that they be present and that they be visible.

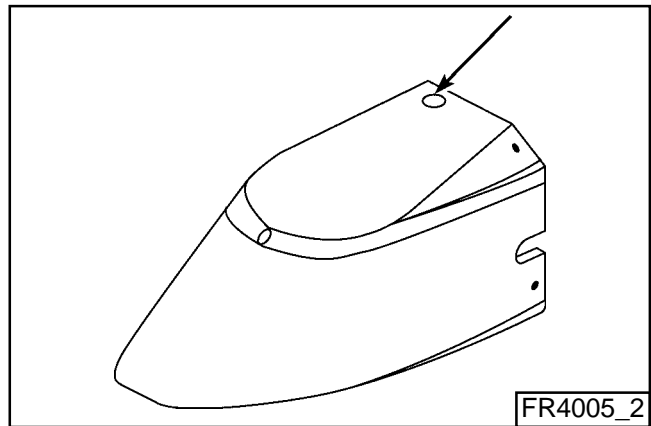
Contestants are in charge of the condition of discs.

The arrows in the figures opposite show the location of the discs.

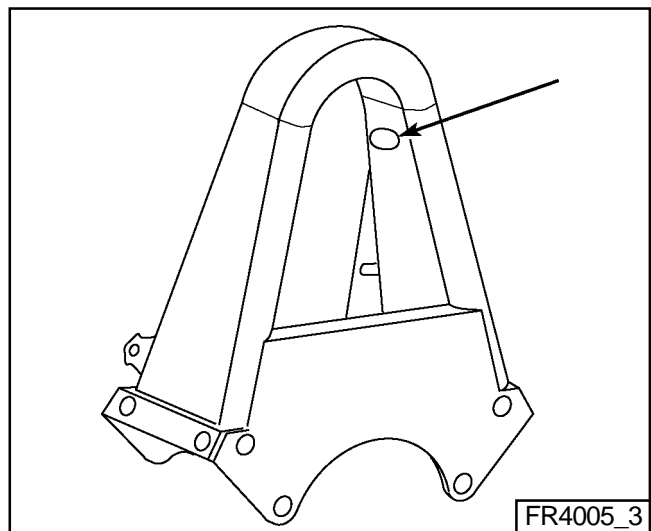
- Frame 01.00.01.001 (1 disc).



- Nose 01.00.01.002 (1 disc).



- Bow 01.00.01.003 (1 disc).

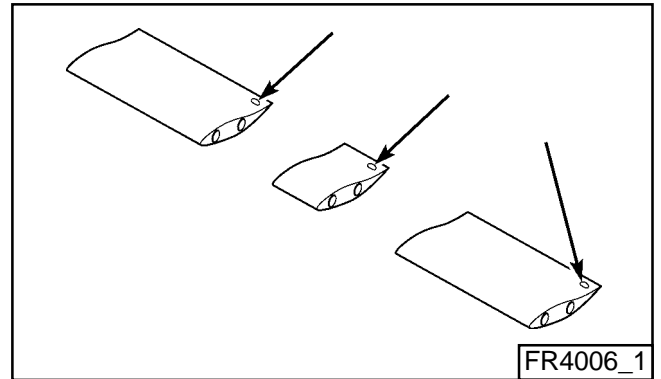


BODYWORK

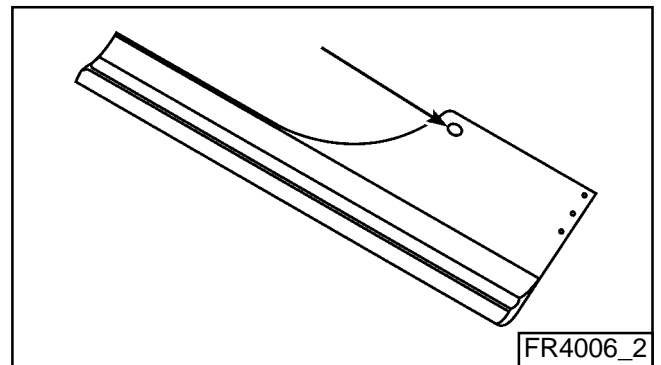
Bodywork, wings and bow

40

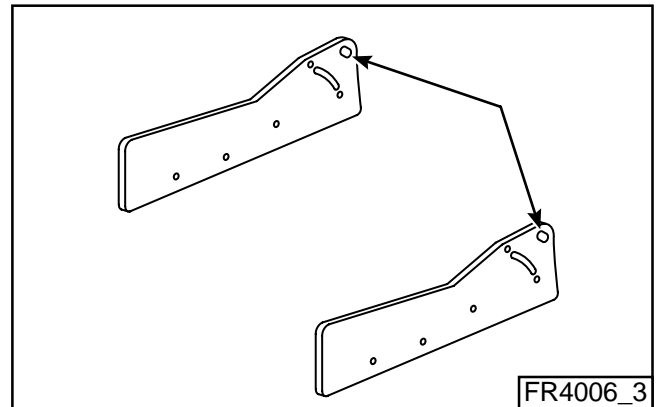
- Front wing 01.00.04.001/003 (1 disc per component).



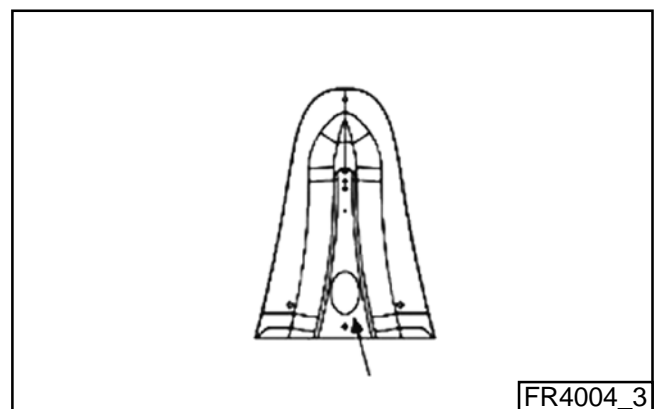
- Front wing flaps 01.00.04.006/007 (1 disc per flap).



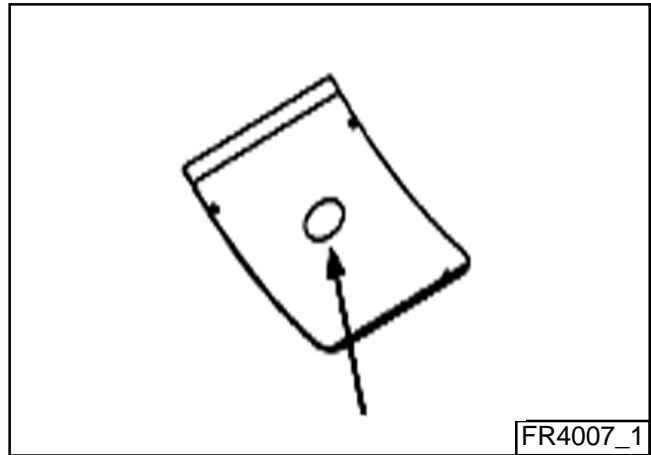
- Front wing cross-wind deviations 01.01.04.004/005 (1 disc per cross-wind deviation).



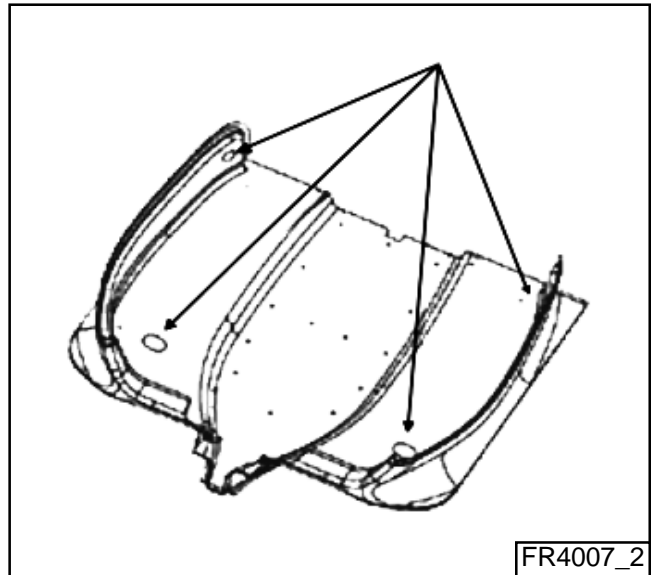
- Front splash guard 01.00.01.004 (1 disc).



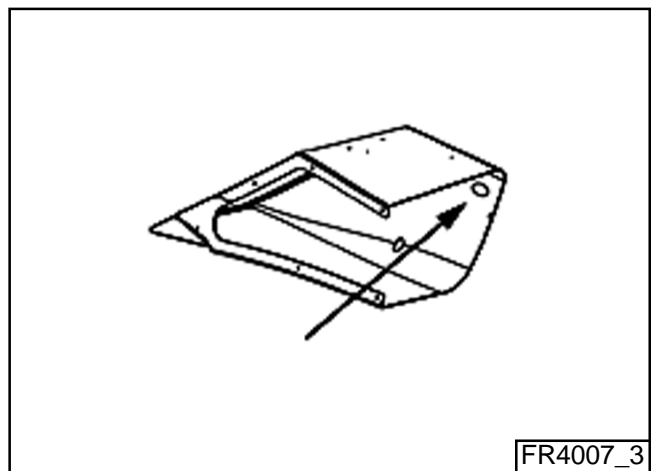
- Front floorboard 01.03.02.050 (1 disc).



- Front floorboard 01.00.02.001 (4 discs).



- Radiator mountings FR01-02-003 and FR01-02-004 (1 disc on each mounting).

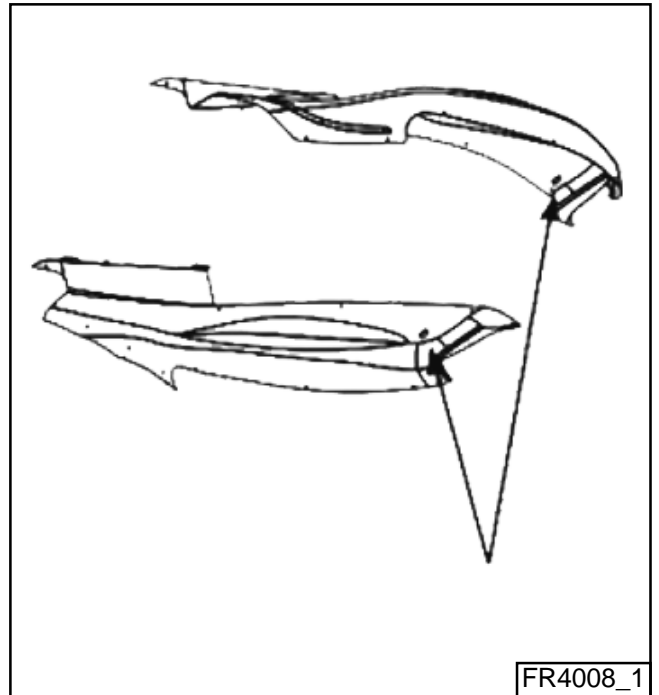


BODYWORK

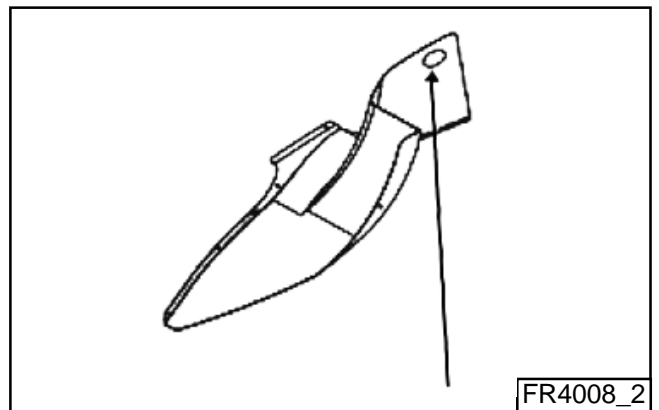
Bodywork, wings and bow

40

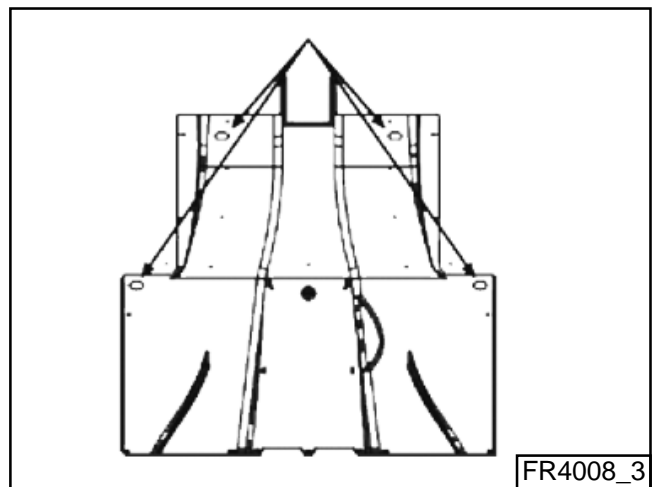
- Connecting pieces 01.00.03.004/005 (1 disc on each connecting piece).



- Rear splash guard 01.00.03.002/003 (1 disc on each splash guard).



- Rear floorboard 01.00.02.002 (4 discs).

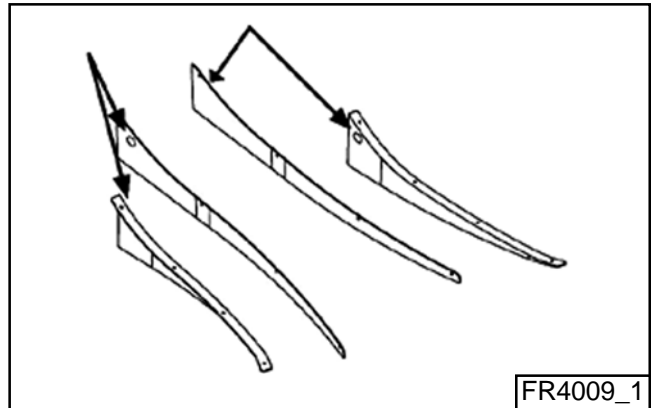


BODYWORK

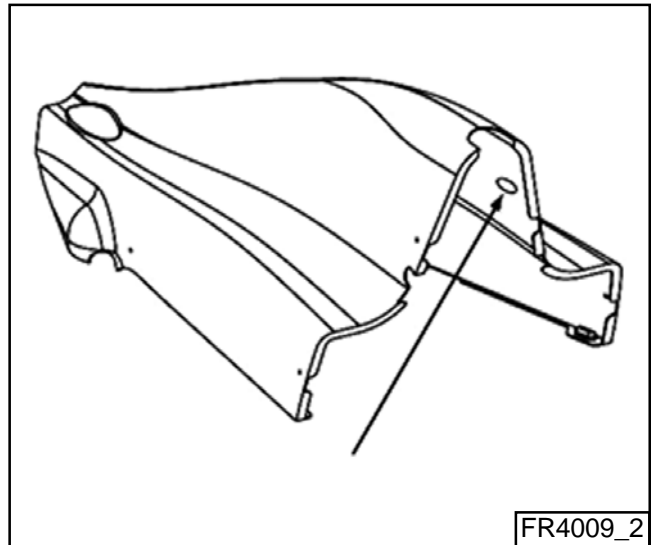
Bodywork, wings and bow

40

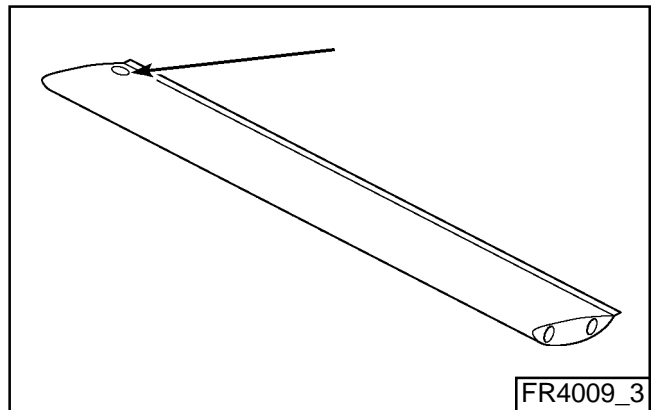
- Rear floorboard cross-wind deviation 01.03.02.044/045/046/047 (1 disc per cross-wind deviation).



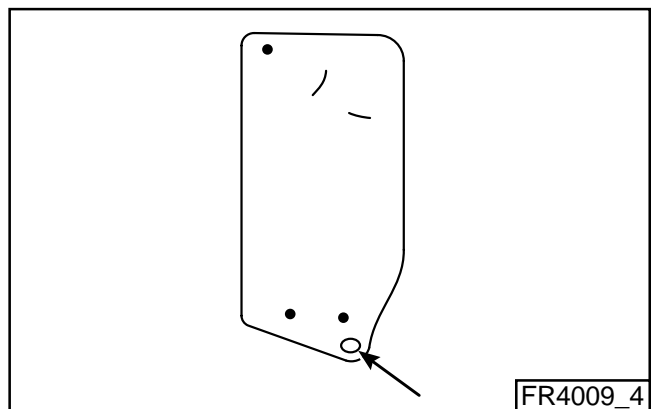
- Engine bonnet 01.00.03.001 (1 disc).



- Rear wing FR02-04-016 and FR02-04-022 (1 disc per wing).



- Rear wing cross-wind deviation 01.02.04.011/012 (1 disc).

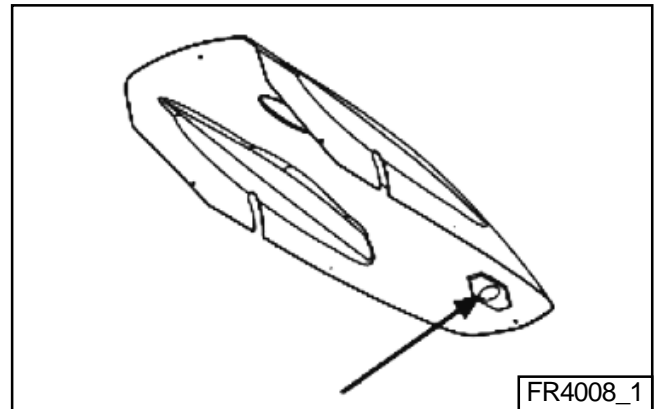


BODYWORK

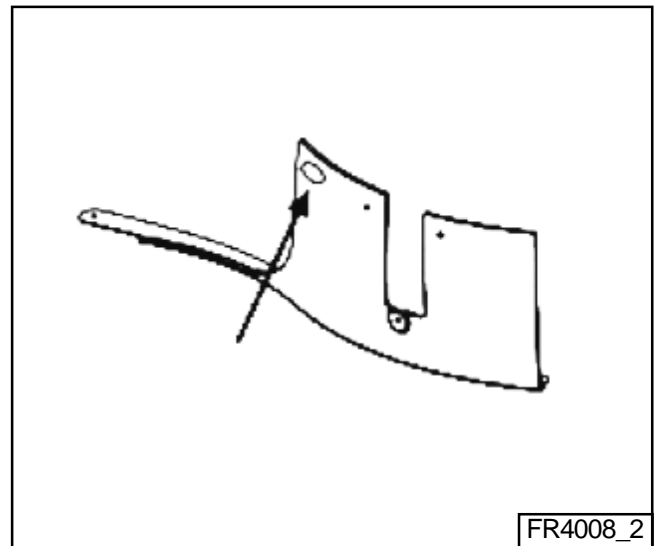
Bodywork, wings and bow

40

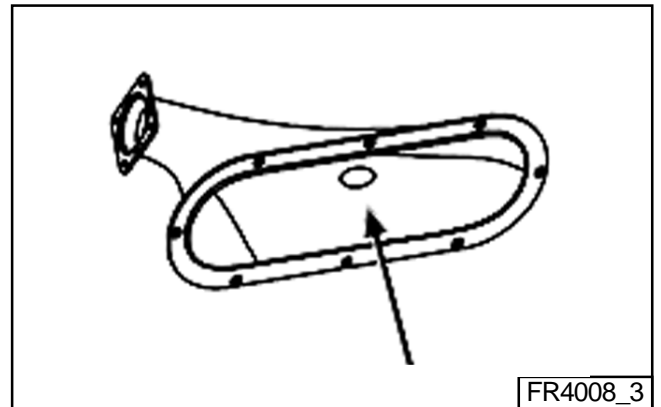
- Front bonnet 01.00.01.005 (1 disc).



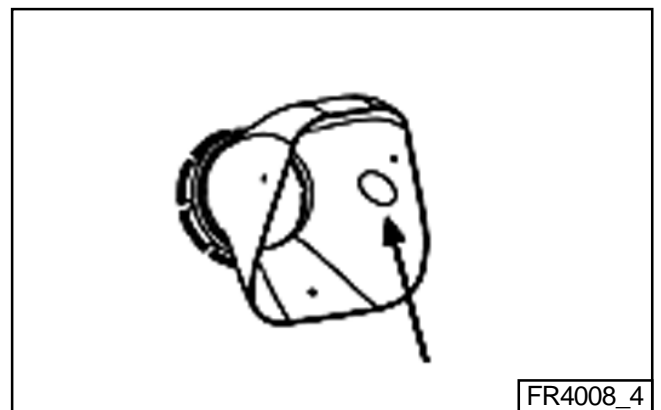
- Front cross-wind 01.03.02.048/049 (1 disc).



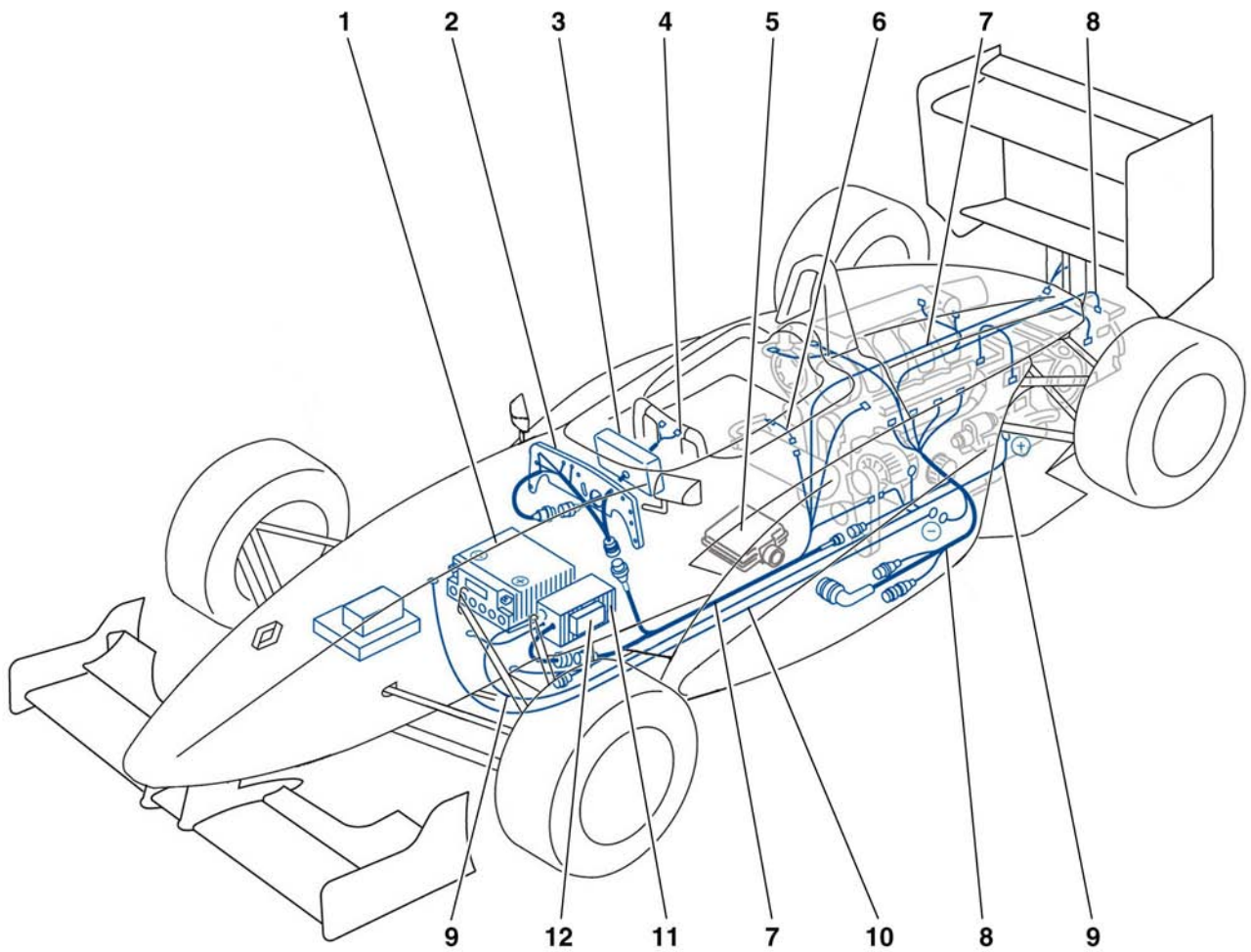
- Air box 01.03.20.002 (1 disc).



- Intake air engine 01.03.20.003 (1 disc).

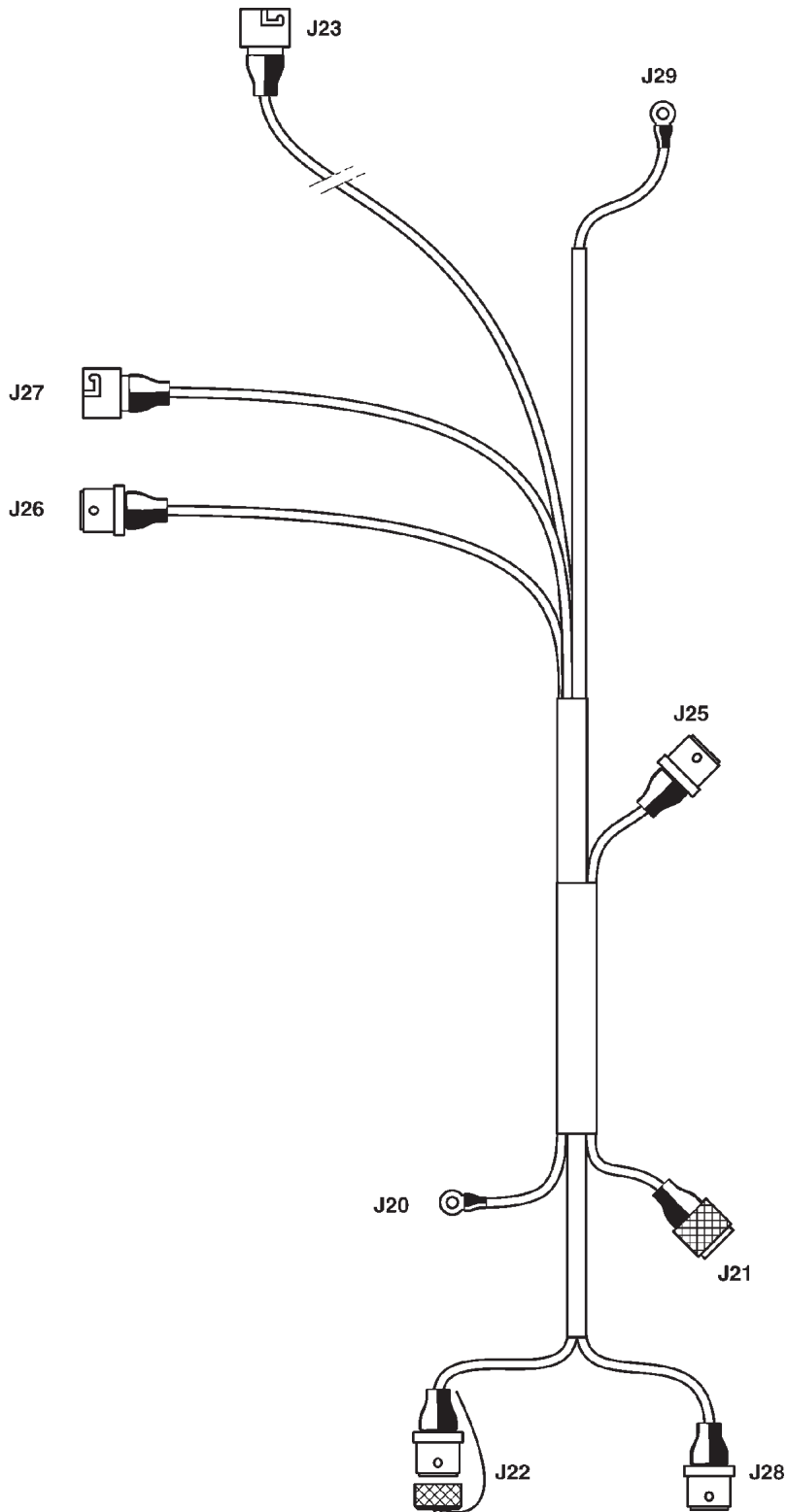


ELECTRICAL INSTALLATION



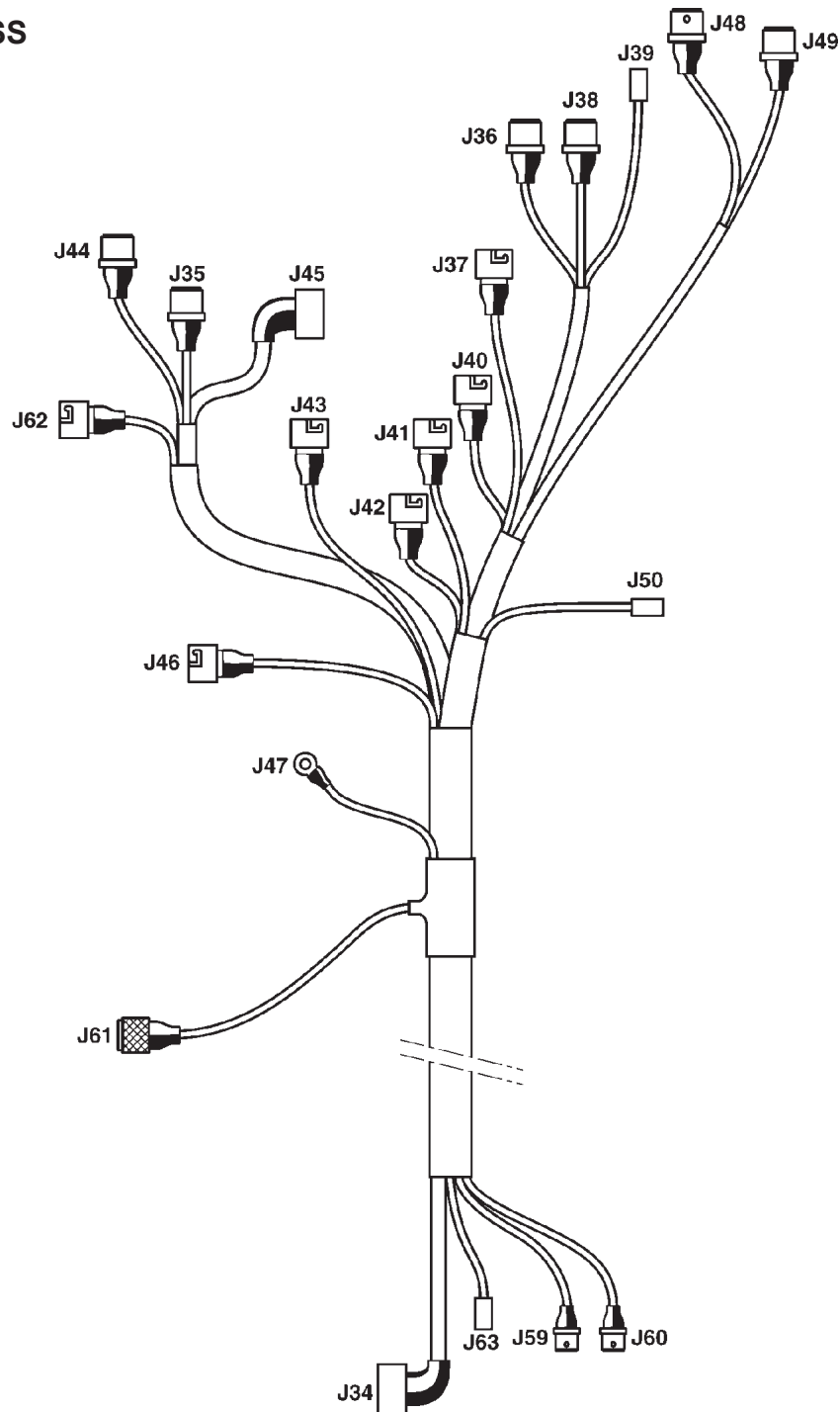
Item No.	Description	Item No.	Description
1	Battery	7	Frame wiring
2	Dashboard wiring	8	Engine wiring
3	Dashboard	9	Starter wiring
4	Steering wheel wiring	10	Battery earth wiring
5	Computer	11	Battery main switch
6	Extinguisher wiring	12	Gearbox

FRAME HARNESS



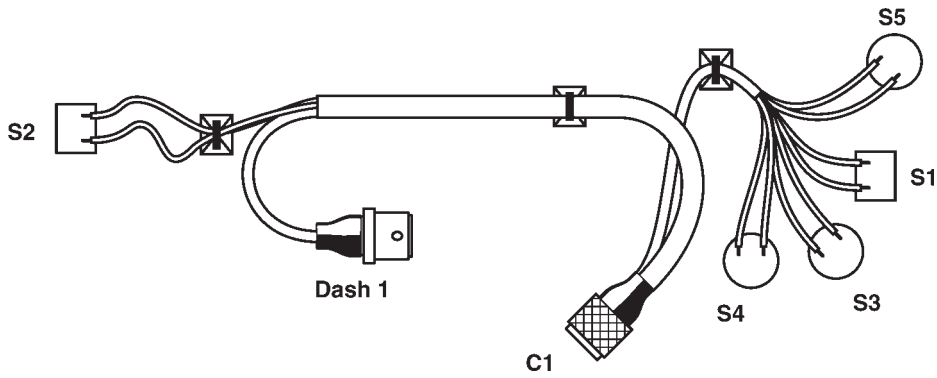
Item No.	Description	Item No.	Description
J20	Battery earth	J26	Auxiliary
J21	Battery main switch	J27	Extinguisher
J22	Speed connector	J28	Dashboard
J23	Rain light	J29	Starter excitation
J25	Engine harness connection		

ENGINE HARNESS



Item No.	Description	Item No.	Description
J34	Computer	J45	Coil
J35	Air pressure	J46	TDC
J36	Butterfly valve	J47	Engine earth
J37	Air temperature	J48	Gearbox potentiometer
J38	Water temperature	J49	Gearbox contactor
J39	Oxygen probe	J50	Oil pressure
J40	Injector 1	J59	Diagnostic
J41	Injector 2	J60	Acquisition
J42	Injector 3	J61	frame connection
J43	Injector 4	J62	Pump
J44	Camshaft offset	J63	Oil pressure interface

DASHBOARD HARNESS

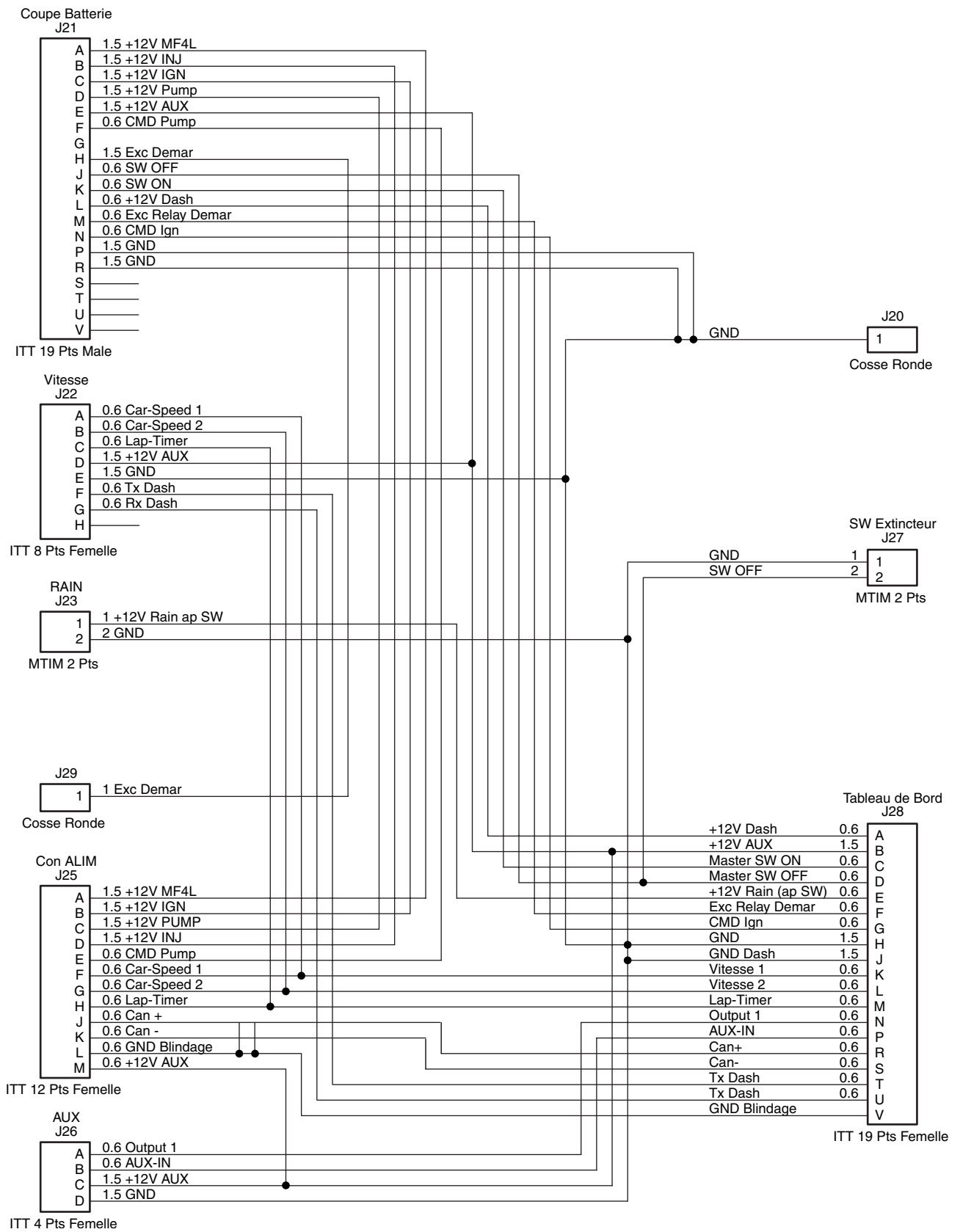


Item No.	Description	Item No.	Description
C1	Frame harness	S3	START starter pushbutton
Dash 1	Air Dashboard	S4	Battery ON pushbutton
S1	Ignition switch	S5	Battery OFF pushbutton
S2	Rain light on/off switch		

WIRING

Wiring diagram

FRAME WIRING DIAGRAM

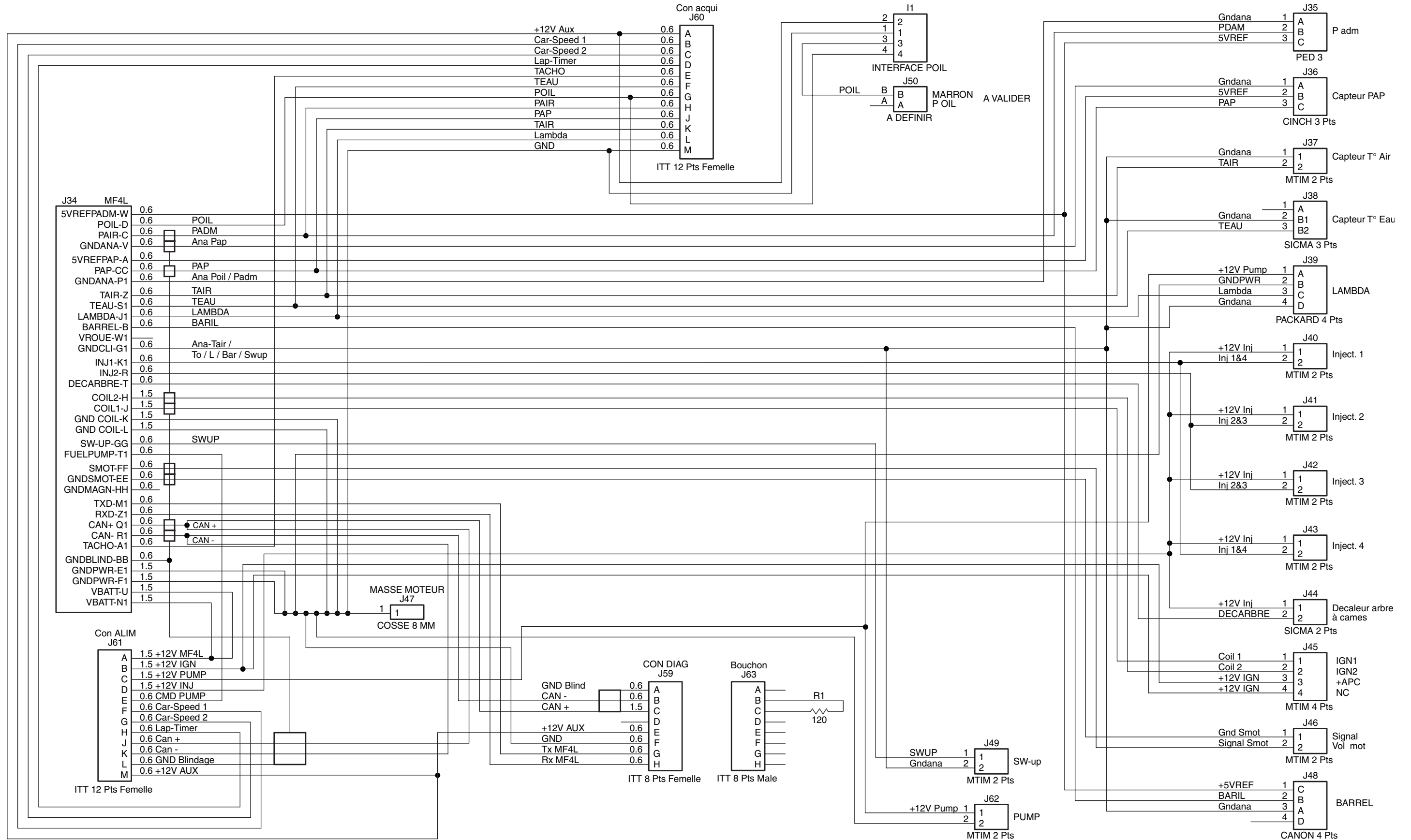


WIRING

Wiring diagram

80

ENGINE WIRING DIAGRAM



STARTUP

The logos opposite appear for 2 seconds when switching on.

NOTE: *If the IGN switch is in the ON position, the logos do not appear so as not to lose time when a power disturbance reboots the dashboard while the car is running. Press one of the steering wheel pushbuttons to interrupt display of the logos.*



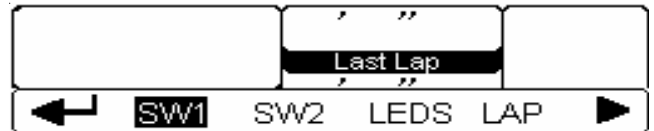
Setup screens

The setup screens can be accessed by simultaneously pressing the two pushbuttons when the Renault Sport FR2000 and XAP logos are displayed.

Choose the screens you want in the scrolling menu:

- SW1 to choose the driver's screen which can be accessed using the right pushbutton on the steering wheel.
- SW2 to choose the driver's screen which can be accessed using the left pushbutton on the steering wheel.
- LEDS to configure the 12 red speed LEDs.
- LAP to change the parameters for the lap and speed option.

Push the right pushbutton to scroll the cursor and the left pushbutton to enable your choice.



Screens SW1 and SW2

With the IGN switch set to "ON", the driver can only access the two screens selected with the right or left pushbuttons. These screens are selected by going into dashboard setup mode using options SW1 and SW2.

- Push the right pushbutton to select the screen you want.
- Enable by pressing the left pushbutton.



LED setup

For each LED, these screens configure the speed at which it lights up RPM ON, and at which it goes off, RPM OFF.

The RPM OFF and RPM ON values are changed by adjusting the position of the engine throttle with the left pushbutton pressed down.

When the value you want is displayed, release the left pushbutton to enable it.

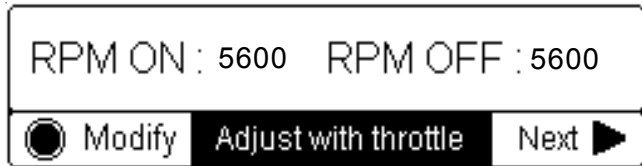
The right pushbutton is used to go to another variable to be configured or to another LED.

The LED for the RPM ON and RPM OFF value adjustment lights up.

When all the RPM OFF and RPM ON values have been set, the screen opposite appears so that you can check that the LEDs are properly set.

The displayed speed varies as a function of the accelerator position, and lights them up as a function of the configuration selected.

- Use the right pushbutton to exit.



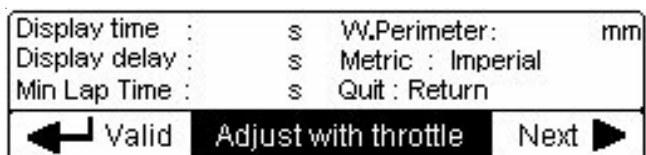
Lap and speed setup

The lap and speed setup screen can be accessed using the lap and speed option. This screen is used to configure the following parameters:

- Display time for lap time screen: normally 4 sec.
- Display delay for lap time screen: normally 0 sec.
- Min. time for best lap (min. lap time).
- Diameter of wheel for speed measurement (wheel dia.): normally 1,700 mm.
- Number of contacts per wheel (pulse/rev.): 4 if DPS/ AIM target.
- Display in Kph or Moh (metric or imperial).

Use the right pushbutton to move the cursor and the left one to enable your selection. This value is underlined when its can be changed.

Change values by adjusting the engine throttle position, with the left pushbutton pressed down (method similar to LED setup).



When the value you want is displayed, release the left inter to enable it.

To go to another variable for configuration, use the right pushbutton.

When all the variables are enabled, put the cursor on "Quit" (exit) and press right pushbutton to enable.

Race, diag., DataLog and lap modes

- With the IGN switch set to "OFF", press the right pushbutton. The Diag, Race, DataLog and Lap menu appears.
- Select the mode you want using the left pushbutton.
- Press right button again to enable.

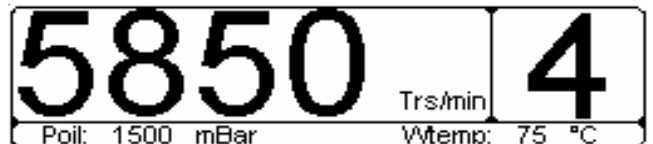
You can access the screens for each of these modes by pressing the left pushbutton.

With the IGN switch set to "ON", the driver can only access the two screens selected with the right and left pushbuttons. These screens are selected by going into dashboard setup mode using options SW1 and SW2. This screen selection prevents the driver from getting lost in the numerous screens that are available.

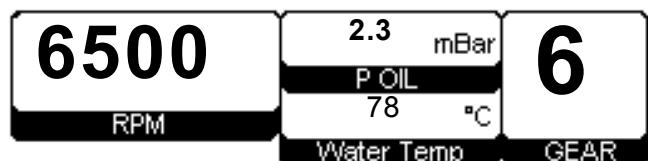


Race screens

The race screens display, at all times, information indispensable to the driver (speed and gear).

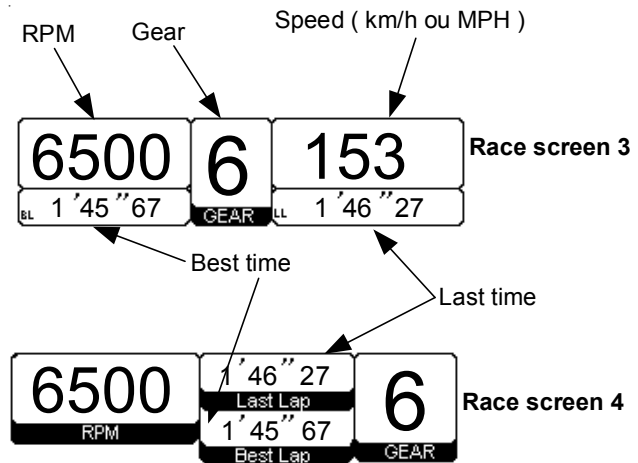


Depending on the screen, other information is also displayed: oil pressure, battery voltage, water temperature, and lap time.



The lap and speed option has:

- the two screens shown opposite,

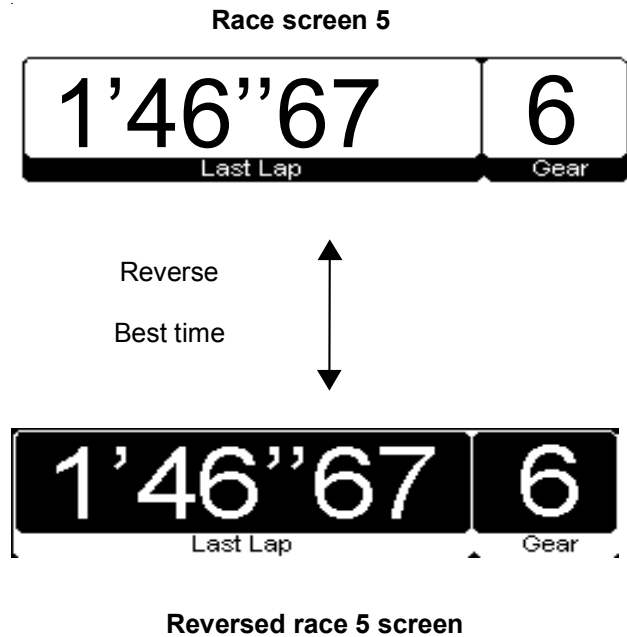


- this screen, which the driver uses to get his or her lap time and also to monitor engine parameters.

This appears x seconds after passing in front of the infrared emitter beacon for a duration of y seconds. Parameters x and y can be adjusted using the lap time setup menu. This flexibility allows the driver to easily and safely read his or her time even if the beacon is placed just before a critical curve.

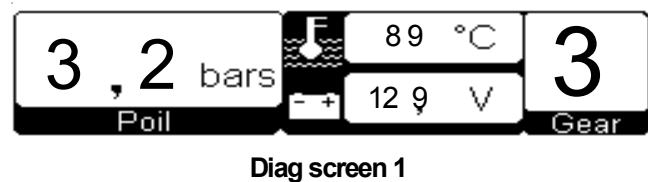
In addition, when the driver does his or her best time, the screen flashes in 2 Hz reverse mode.

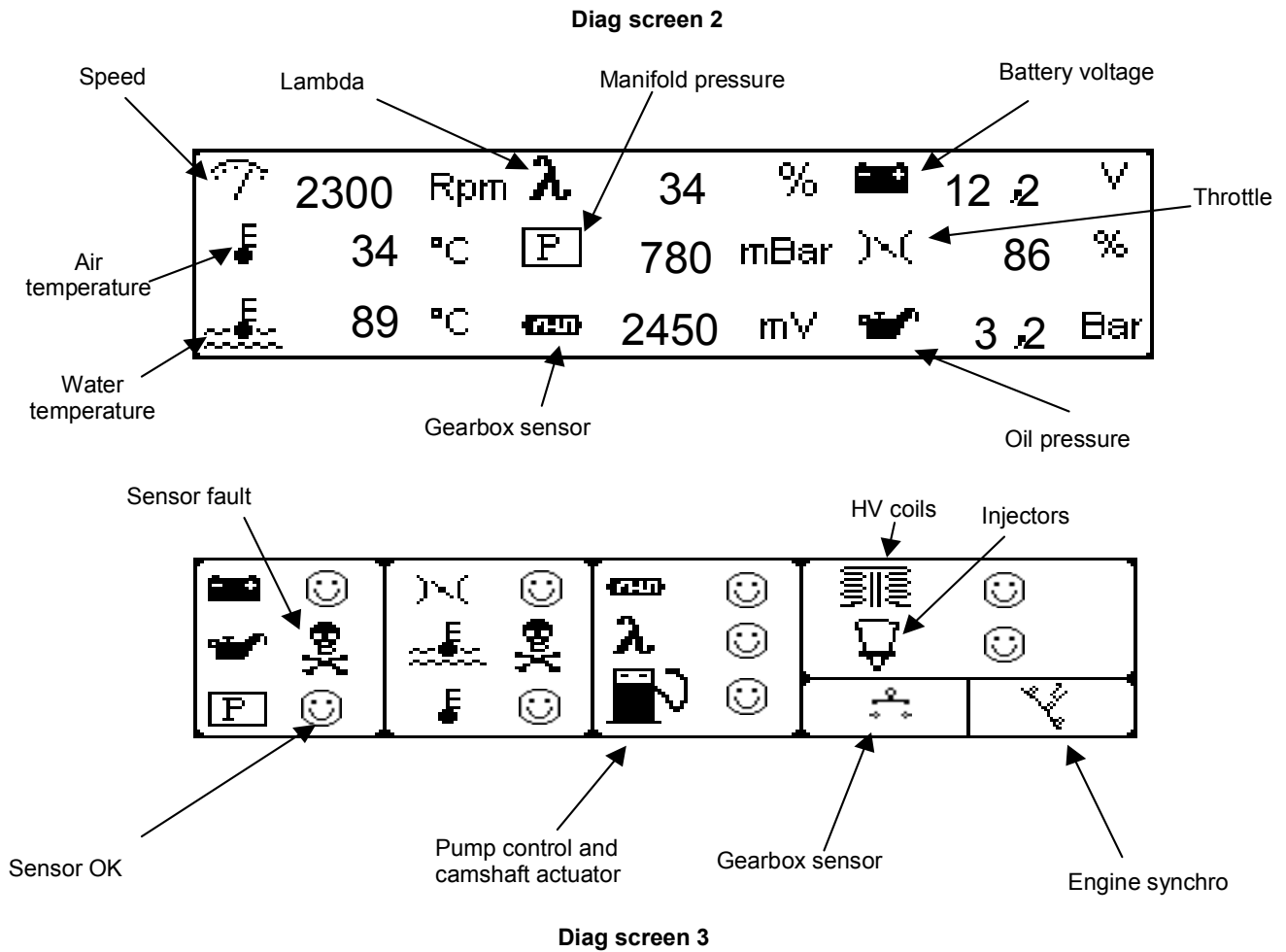
NOTE: This screen can be deactivated by selecting a zero display time on the "setup" screen.



Diag 1, 2 and 3 screens

The Diag screens display the level of the engine sensors, as well as troubleshooting information.





DataLog screens

The dashboard continually records the parameters listed below in memory:

- Max. speed.
- Max. speed in 6th gear.
- Oil pressure, min. and max. values.
- Water temperature, min. and max. values.
- Air temperature, min. and max. values.
- Battery voltage, min. and max. values.
- Consumption.
- Storage in memory of number of sensor faults and alerts.

Recording starts when the engine speed exceeds 2,000 rpm and stops when it drops to below 500 rpm.

Data are reinitialised as soon as the engine speed goes back up to 2,000 rpm.

RPM Max	8 750	Trs/min
RPM Max Gear 6	6 750	Trs/min
Poil Min-Max	1.2 - 6.7	Bar
Water T° Min-Max	7 8 - 8 9	°C

DataLog screen 1

DataLog screen2

Air T° Min-Max	24	—	32	°C
V Bat Min-Max	12.7	—	13.5	V
Consommation	12.7		Litres	
Capteurs Alerte-Défaut	0	1	0	— 12 Nbr

Oil pressure alert Water temperature alert Battery voltage alert

Number of sensor faults

0 : no alert

1 : at least 1 alert

DataLog screen 3

0	0	0	0
0	0	0	0
1	1	0	0
			0

0 : no sensor faults

1 : at least 1 sensor fault

This screen is available using the lap and speed option.

DataLog screen 4

Max Speed	223
Number of Lap	23
Best Lap	1' 46" 67
Overage Lap-Time	1' 46" 95

Lap screens

This mode gives you the time for all laps in memory, on a single screen.

This mode can only be accessed using the lap and speed option.

The last eight laps are always displayed on the screen, and change as a function of the number of laps.

Nonetheless, you can go back to the laps that are no longer displayed on the screen by pressing the left pushbutton.

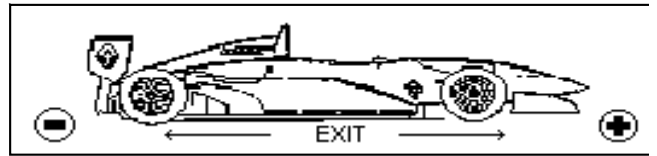
The lap times are reset when the master ON/OFF switch is set to OFF and when the engine goes back up to 2,000 rpm.

1	1' 46" 95	2	1' 44" 15
3	1' 46" 44	4	1' 47" 67
5	1' 46" 09	6	1' 46" 95
7	1' 48" 34	8	1' 48" 32

Contrast adjustment

The contrast can be adjusted at any time.

- Press both pushbuttons at the same time.
- When the contrast screen appears:
 - decrease using the left pushbutton,
 - increase using the right pushbutton.
- Press both pushbuttons at the same time to exit.



Alert mode

The dashboard goes into alert mode when one of the following conditions appears:

- Oil pressure < 2 bars or > 6 bars if RPM > 2,000 rpm.
- Water temperature > 110° C if RPM > 1,000 rpm.
- Battery voltage < 11 V if RPM > 400 rpm.

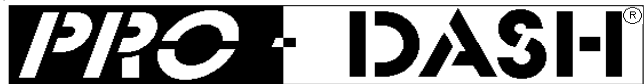
The screen flashes in reverse mode on sensor screen 1.

Press right pushbutton to acknowledge alert and return to the previous screen.

As long as the alert is active, the first LED will flash rapidly.



DATA ACQUISITION AND PERFORMANCE ANALYZER OPTION



The data acquisition and performance analyser option allows the driver and the tuning person to display recorded data on the dashboard, and to compare two laps to each other. This can be done during a test session, when data acquisition is not being used in order not to lose time.

The main characteristics of this option are:

- Real-time performance analysis mode.
- Comparison mode for two laps accessible on dashboard.
- Integration of data acquisition.

On track: real-time performance analysis mode

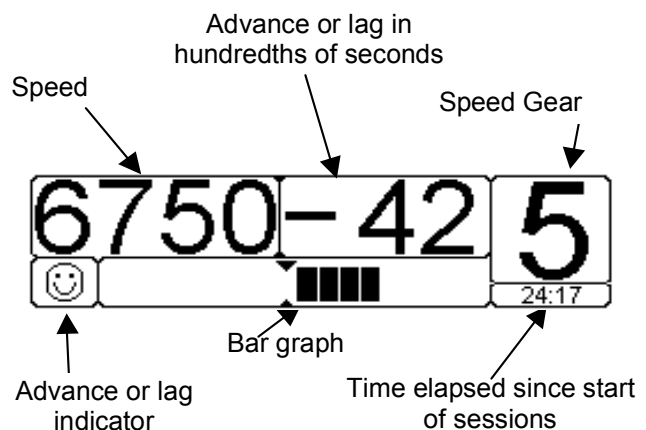
This screen can be selected instead of the race 2 screen.

It shows the advance or lag for the lap in real time, in relation to a perfect, theoretical lap.

The screen displays:

- Speed.
- Gear.
- Timer, which starts as soon as the dashboard is switched on, and which shows the time elapsed since the beginning of the session (< 59 min 59 sec). It is reset when the master ON/OFF switch is activated.
- display of advance or lag in real time and in large characters, in hundredths of seconds (in this case, the driver is 42 hundredths of a second ahead).
- the bar graph, which shows the advance or lag, with one square corresponding to a tenth of a second. If the bar graph goes to the right, this signals that the current lap is ahead in relation to the reference.

NOTE: For the performance analyser to function correctly, it is indispensable to initialise the dashboard memory. The performance analyser is therefore not operational during the first laps on a new circuit.



In stands: mode for comparing two laps accessible

In the lap menu, the first screen is used to select a reference lap.

The cursor is automatically points towards the best lap for the session. Move with the right pushbutton and select a lap using the left pushbutton.

Once the reference lap has been selected, the strip asking for the lap to be compared is displayed on the screen.

Movement is still with the right pushbutton and enabling with the left pushbutton.

1	1' 32" 11	2	1' 32" 67
3	1' 32" 45	4	1' 32" 28
5	1' 32" 34	6	1' 32" 23
← Valid		REFERENCE LAP	Next →

1	1' 32" 11	2	1' 32" 67
3	1' 32" 45	4	1' 32" 28
5	1' 32" 34	6	1' 32" 23
← Valid		COMP LAP	Next →

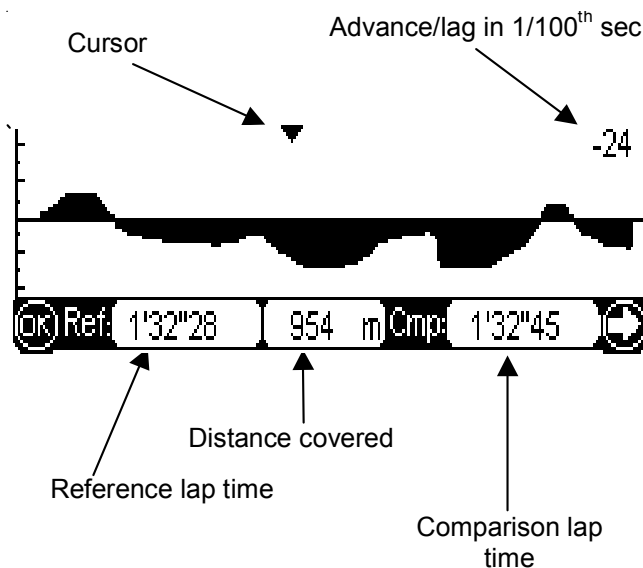
When both laps have been selected, "comptime" (comparison time) appears on the screen.

The graph unit is: 1 pixel = 2/100th of a second. The display accepts a range of +/-4/10th of a second.

When the graph moves upwards, the driver is lagging behind; when it moves downwards the driver is ahead, as shown by the number at the top right.

For reasons of quickness, the cursor moves 8 pixels by 8 pixels.

If the driver moves the cursor on the screen using the right pushbutton and validates using the left pushbutton, he or she can select where they want to examine the acquisition data. There will then be a switch to the analysis screen, next section.



Data acquisition

The recording shown always points to a fiftieth of a meter before the selected range.

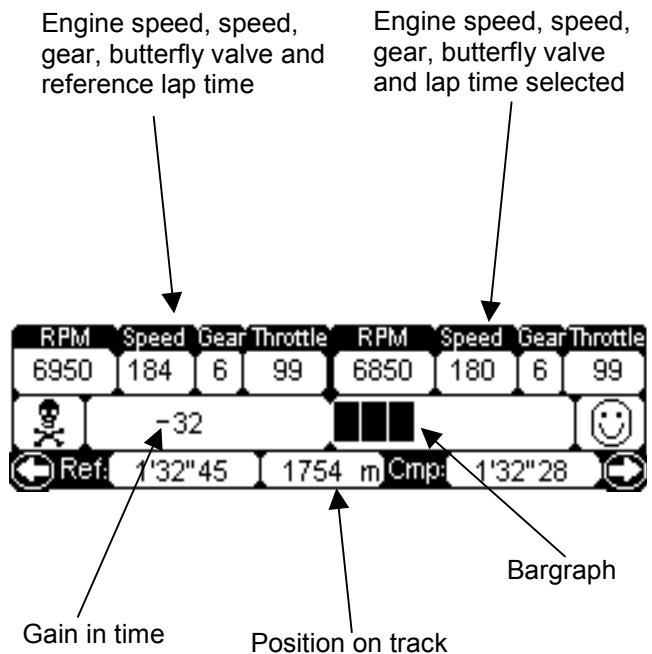
By moving forwards or backwards on the circuit using the right and left pushbuttons respectively, the driver and the tuning person can find out why the driver has gained 32' on the 1,754 distance of the circuit.

Example: comparison of reference lap in 1'32'45 with the lap in 1'32'28. In the 1,754-m position on the circuit, it is possible to see that:

- On the reference lap, the driver is at 6,950 rpm, at 184 kph, in 6th gear, and at 99 % throttle.
- On the compared lap, the driver is at 6,850 rpm, at 180 kph, in 6th gear, and at 99 % throttle. He or she is ahead by 32 hundredths in relation to the reference lap.

The bar graph repeats this advance in tenths, as on the real time screen. A smiley is displayed next to the lap in advance and the skull next to the lag.

Press the pushbuttons twice simultaneously during display of the last screen to exit from analysis mode.



BATTERY CHARGE

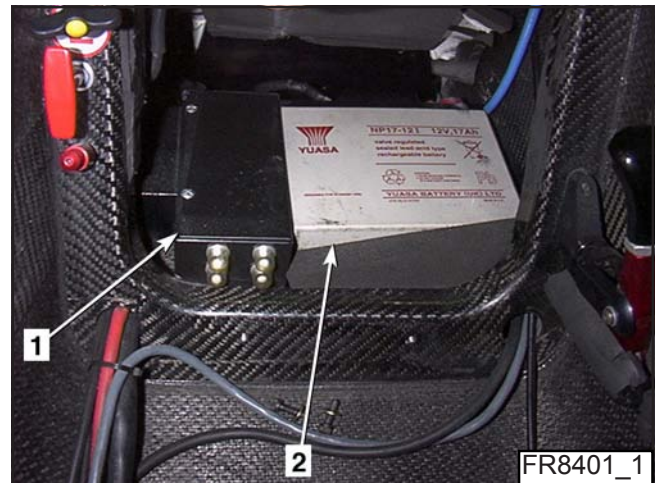
The battery charge is max. 5 A/h.

WARNING: *Disconnect battery cables (2) before charging battery. Failure to follow these instructions leads to destruction of the alternator voltage regulator.*

RESERVE BATTERY

When using a reserve battery, connect it directly to the terminals of the main battery with an explosion-proof connector.

MANDATORY: *In order that the operator stays behind the vehicle to do the connection, this one must necessarily be placed behind the rear axle assembly.*



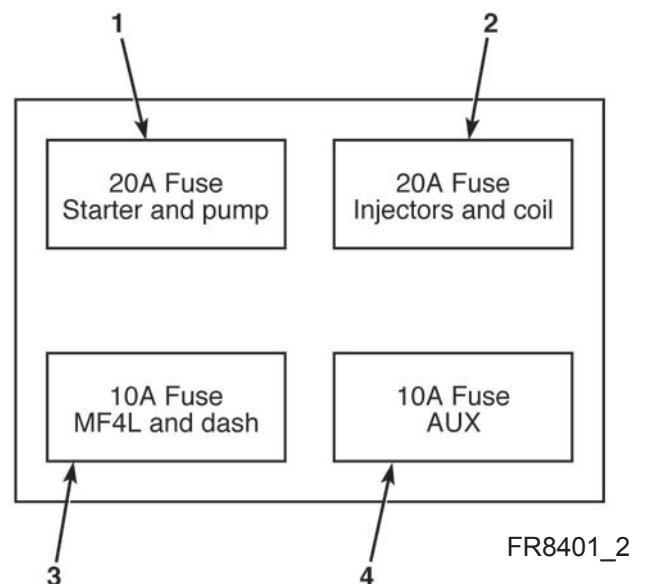
FUSE

Functioning

If startup is not being controlled 20 minutes after switching on the electrical circuit, the fuse (1) automatically cuts off the electricity supply.

Connector

A	+ 12 V MF4L	Very light green	10A fuse (3) MF4L and dash
B	+ 12 V INJ	Dark green	20A fuse (2) injector and coil
C	+ 12 V IGN	Grey	20A fuse (2) injector and coil
D	+ 12 V PUMP	Black	
E	+ 12 V AUX	Pink	10A fuse (4) AUX
F	Pump command	Black/green	
G	Alternator excitation	Red	20A fuse (1) starter and pump
H	Starter excitation	Blue	
J	Switch "OFF"	Salmon	
K	Switch "ON"	Brown	
L	+ 12 V dash	Light green	10A fuse (3) MF4L and dash
M	Starter relay excitation	Red	
N	IGN Commande	Light blue	
P	GND	Orange	
R	GND	Yellow	



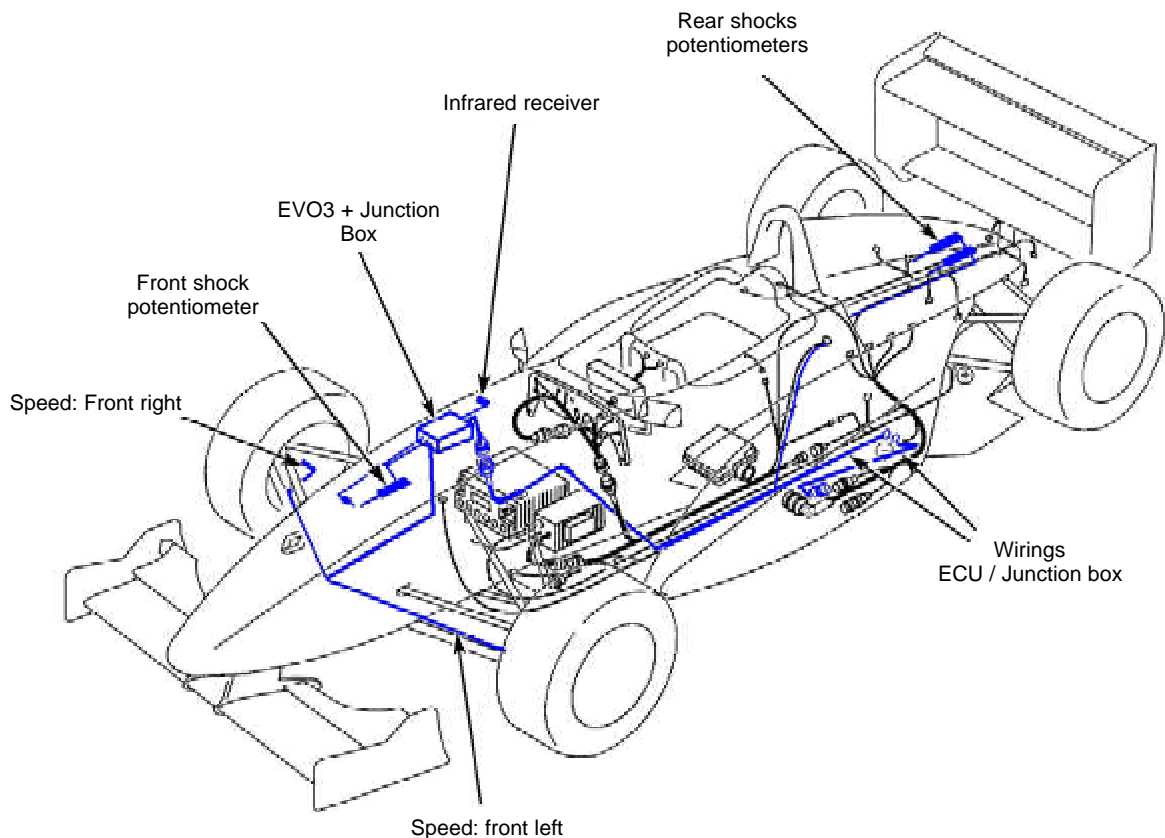
NOTE: *Wait 20 sec before closing back a thermal fuse that has tripped.*

KIT DESCRIPTION

- EVO 3 data logger (8 or 13 channels version)
- Interface "Junction Box" Aim
- Infrared transmitter
- 12 Volts power cable for infrared transmitter
- Infrared receiver
- Wirings to ECU
- 2 speed sensors
- 2 brackets for speed sensors
- 2 magnetic phonic wheels
- Patch cable for speed channel (Speed split cable)
- USB data download cable
- CD-Rom including **Race Studio 2**
- Documentation

INSTALLATION LAYOUT

Wirings connections



EVO 3 “8 channels” installation

Install the data logger (2) and the Junction Box (3) as shown either in figure 8502_1.

The data logger and the Junction Box have to be installed on the front cockpit.

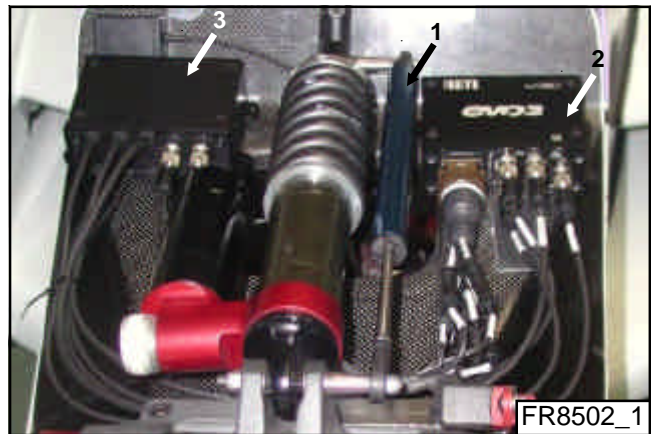
Figure 8502_1 : the front shock is installed with near the spring (1).

When installing the data logger and the Junction Box it is reminded to fix them to the chassis using a large piece of Velcro.

Ensure that the data logger is firmly mated to the chassis, in order to avoid possible movements.

Use plastic wrappers to group and fix the wirings.

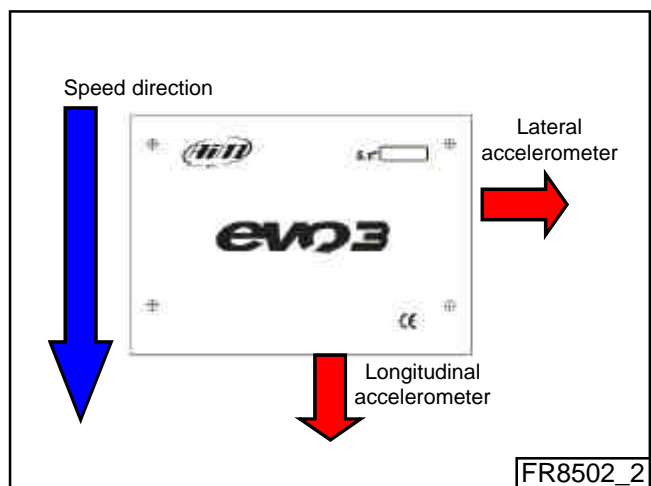
Your **EVO 3** (8 or 13 channels) data logger is equipped with 2 internal accelerometers. In order to correctly record the **longitudinal** (i.e. parallel to the vehicle speed) and the **lateral** (i.e. perpendicular to the vehicle speed) acceleration, it is reminded to install the data logger as shown in figure 8502_1.



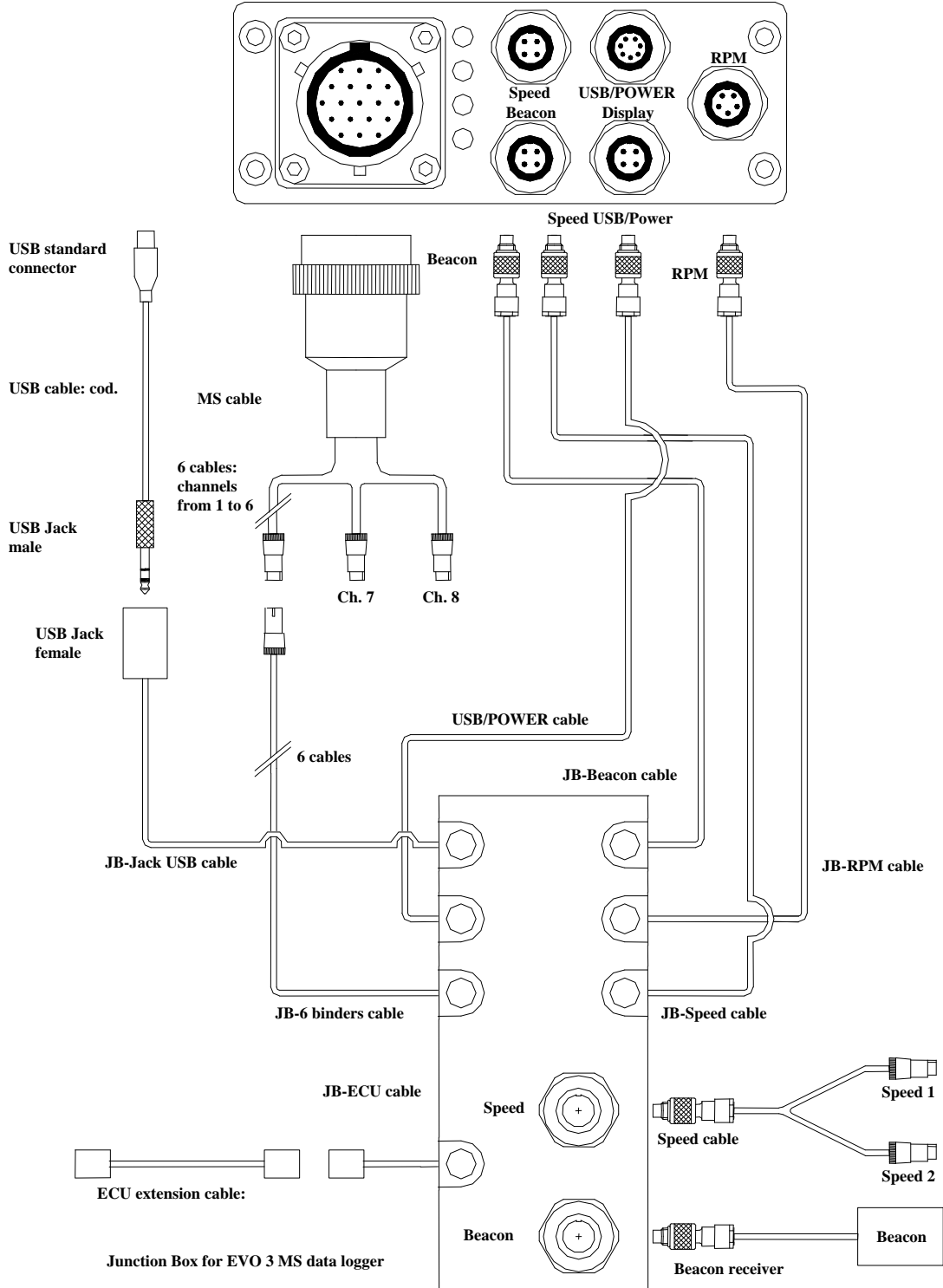
Connect the wirings from the Junction Box to the data logger as here above explained:

- Connect the “8 plastic connectors” cable inside the EVO 3’s input connector.
- Channels “Throttle”, “Oil P.” and “Water T.” have to be connected on the corresponding plastic connectors of the input cable.
- Channels “Air P.”, “Air T.”, “Lambda” have to be connected, respectively, on the plastic connectors labelled from number “4” to number “6”. [Channels “7” and “8” are free].
- Channels “RPM”, “SPEED”, “USB/Power” and “BEACON” have to be plugged in the corresponding metallic connectors of the data logger.
- Connect the “ECU input” to the “Junction Box to ECU” patch cable.

See Figure 5 for further information concerning the **EVO 3 “8 channels”** installation layout.

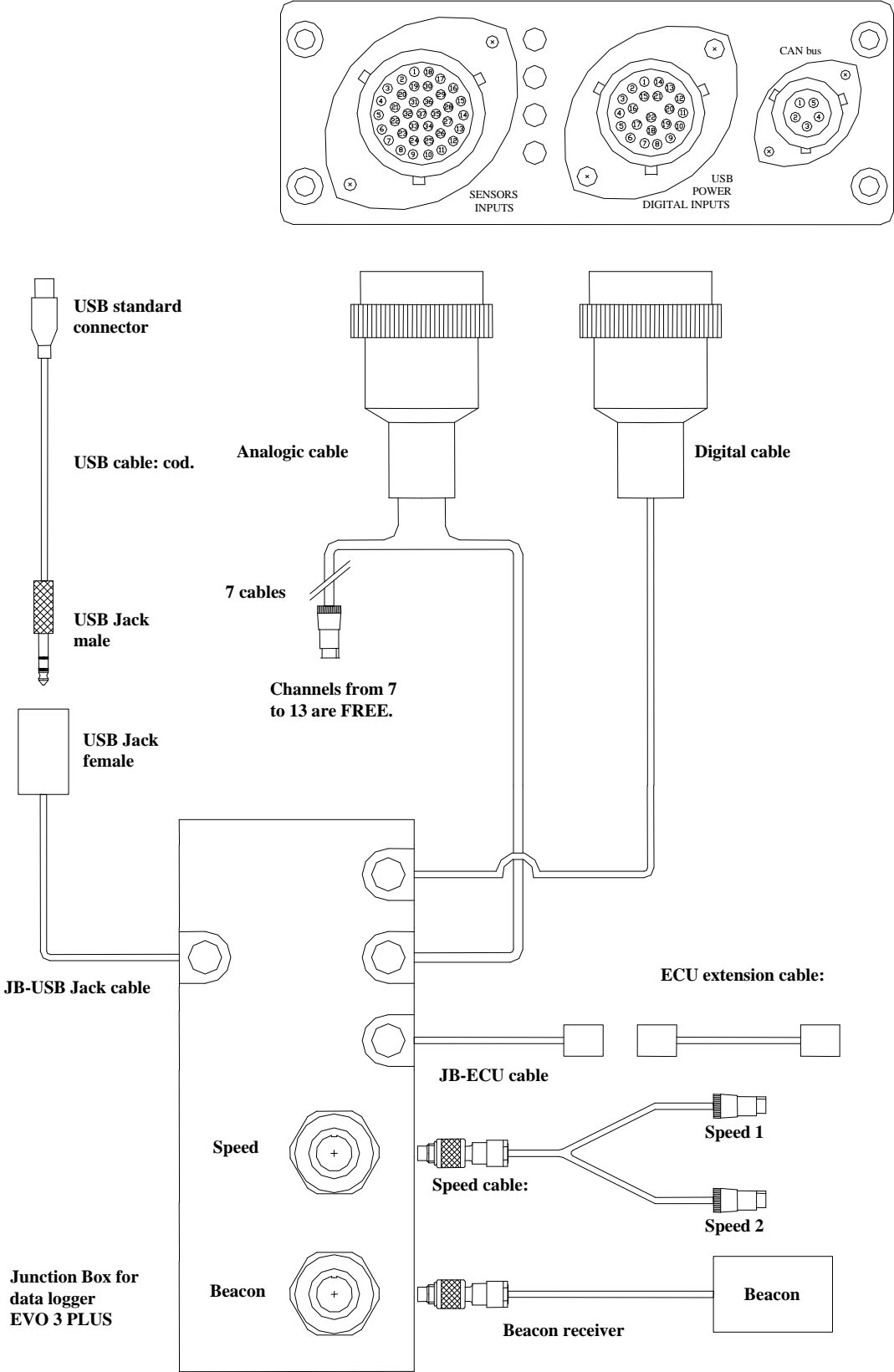


EVO 3 "8 channels" installation



EVO 3 “13 channels” installation

The installation procedure is similar to the one previously described for the **EVO 3 “8 channels”**. Please refer to Figure 8504_1 for further information.



“Wirings to ECU” installation

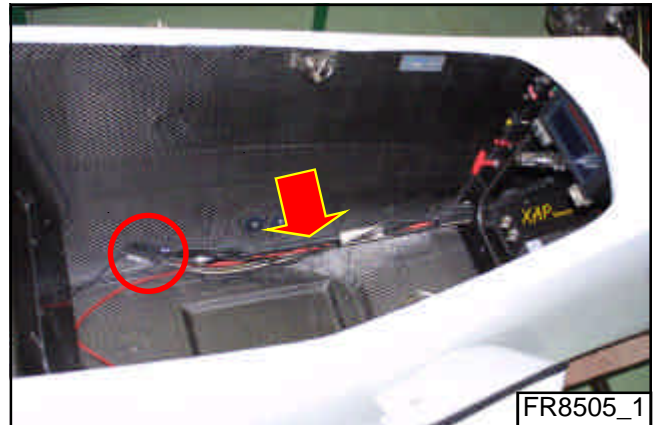
The ECU patch cable has to be plugged both in the Junction Box and in the Magneti Marelli ECU.

The patch cable has to run on the left of the interior body cell, as shown in figure 8505_1.

Use the hole (ircled) on the left of the body cell to let the patch cable pass from the interior body cell to the left side of your vehicle.

When running the patch cable in the interior body cell, fix them to the chassis using plastic wrappers.

Connect the “Wirings to ECU” male connector to the ECU’s female connector as shown in figure 8505_2.



FR8505_1



FR8505_2

USB data download cable installation

It is suggested to install the USB female Jack connector inside the interior body cell, under the display, as shown in figure 8505_3.

It is recommended to fix the connector to the display unit using either «Velcro» or bi-adhesive tape.

Speed sensor installation



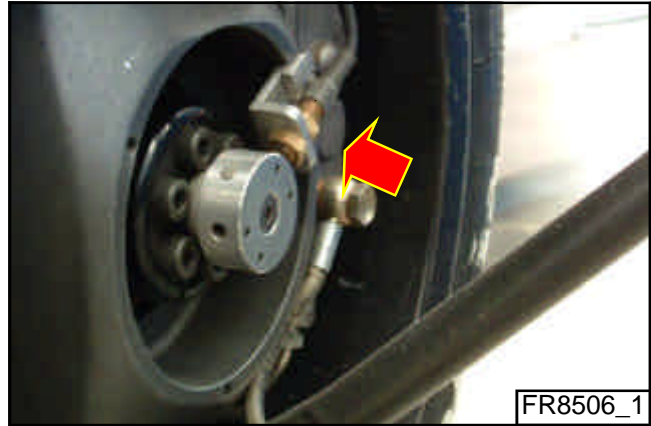
FR8505_3

Install the 2 magnetic phonic wheels coaxially to the front wheels.

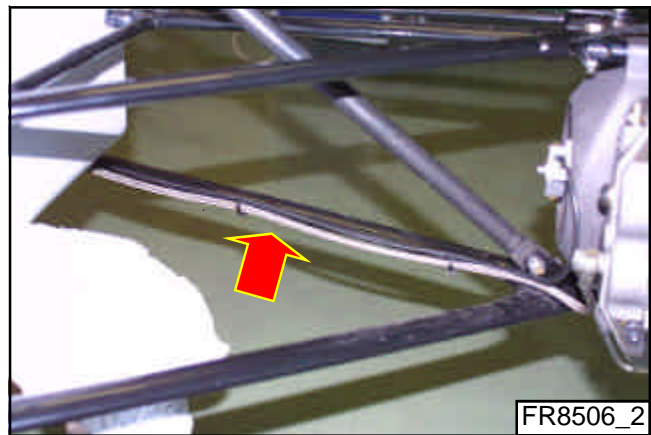
Then mount the metal bracket on the wheel hub. Install the speed sensor on the bracket as shown in figure 8506_1 to a distance included between 8 and 15 mm (0.3 and 0.6 in).

WARNING : LTHE SPEED SENSOR IS FRAGILE. DO NOT EXCEED THE SUGGESTED TIGHTENING TORQUE:

- MAX tightening torque = 2.5 Nm.
- Use Loctite threadlocking to fix the nuts.



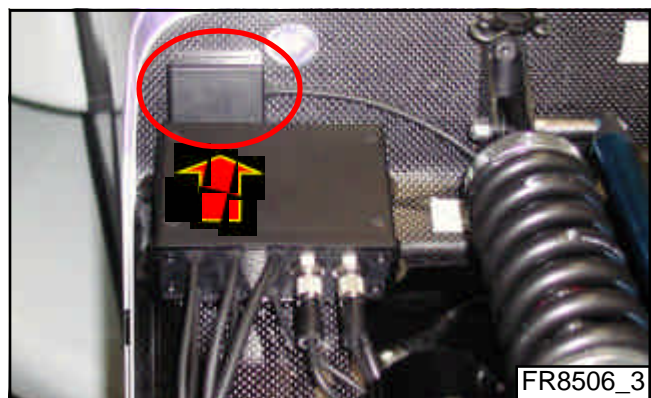
- Install the speed cables on the front suspension lower triangle and insert them inside the chassis using the hole located on the right of the oil brake pump.
- Fix the speed cable to the suspension triangle (see figure 8506_2) with wrappers.
- Pay particular attention when inserting the cable inside the cockpit in order to avoid damages to the speed cable.
- Connect the 2 speed cables to the Junction Box using the proper "Speed split cable".



Infrared lap receiver installation

The Infrared lap receiver has to be installed as shown in figure 8506_3.

- The "receiver eye" has to see the transmitter placed on the track side.
- The receiver has to be fixed to the chassis using either a piece of Velcro or a piece of bi-adhesive tape.
- The hole on the front fairing facing the "receiver eye" has to be of 8 mm diameter minimum (20 mm suggested).
- Plug the infrared receiver in the Junction Box.



NOTE : Depending on the circuit rotation way, the transmitter position can change. Changgge the receiver of side.

Infrared transmitter installation

The infrared transmitter must be installed on the trackside, perpendicular to the track.

It is powered by a 12 Volt external power source using the proper power cable (furnished as equipment) and a 12 Volt battery (optional).

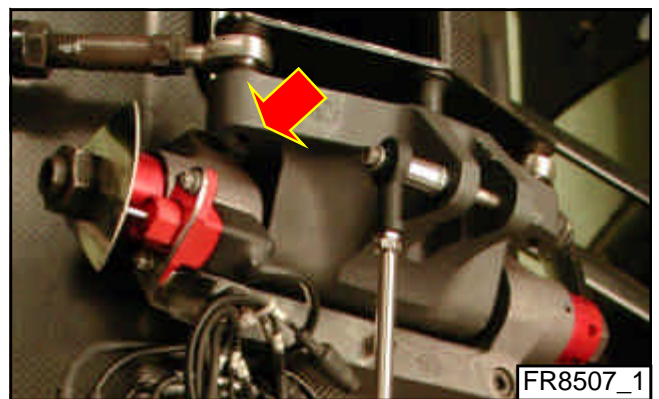
In case you do not have an external battery, the transmitter is equipped with a 9 Volt internal battery.

The internal battery has a limited autonomy.

Rolling potentiometer installation

The rolling potentiometer has to be installed as shown in figure 8507_1.

Connect the potentiometer on the desired input channel.



Steering angle potentiometer

The steering angle may be measured either using a **rotary potentiometer** installed on the steering column (figure 8507_3) or using a **linear potentiometer** installed on the steering rack (figure 8507_2).



Connect the potentiometer on the desired logger's input channel.



Suspension potentiometers installation

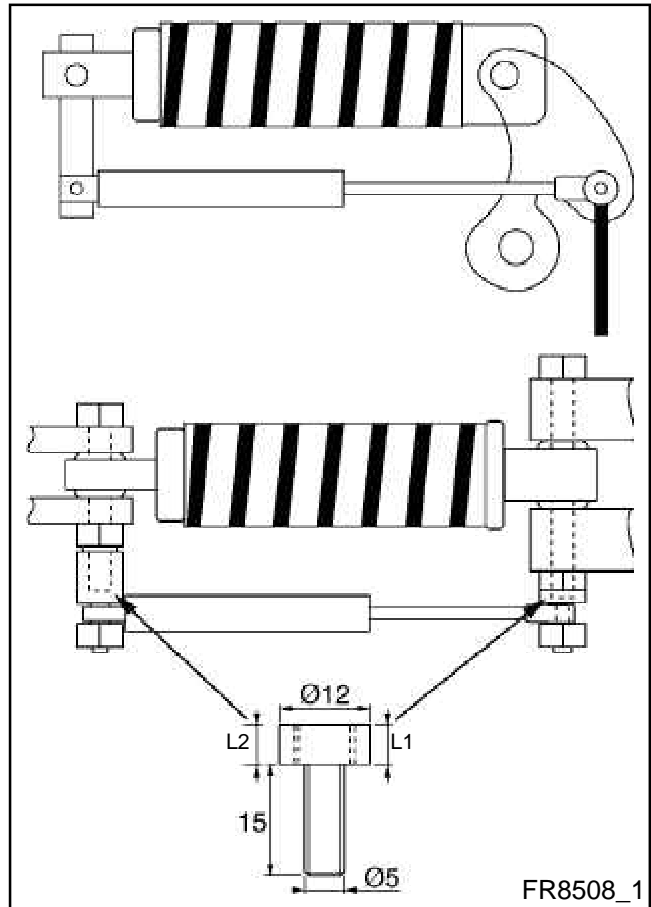
In figure 8508_1 it is shown 2 drawings describing the installation procedure for the rear shocks potentiometer (upper drawing) and for the front shock one (lower drawing).

It is reminded to use a 100 mm linear potentiometer for both the front and rear shocks.

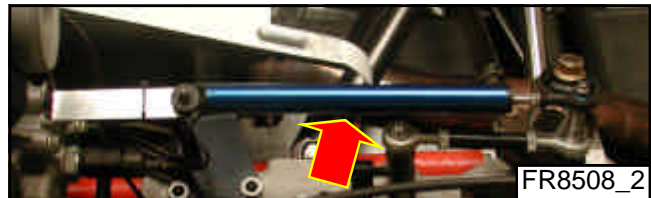
Connect the potentiometer on the desired input channel.

Attaching parts characteristics:

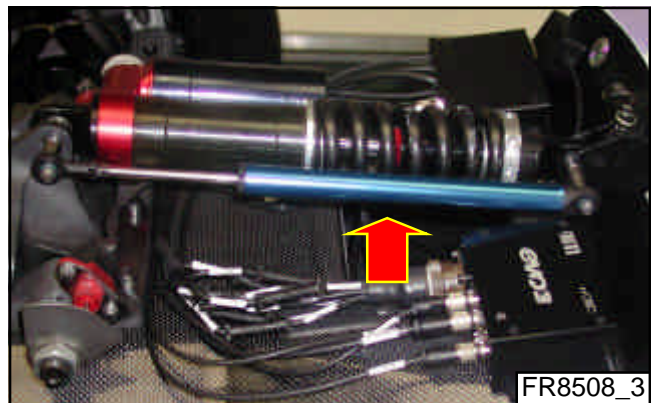
- Tapping: M8 x L
- Thread: M5 x 15



Installation of a linear potentiometer on the rear shocks.



Installation of a linear potentiometer on the front shocks.



CONFIGURATION VIA SOFTWARE

Race Studio 2 installation

NOTE: The installation procedure described here below refers to the software Race Studio 2 and not to the software Race Studio 1 or Wdrack.

- Insert the CD-ROM including the software **Race Studio 2** in your CD-ROM drive and follow the instruction prompted on your PC's monitor.
- Connect the data logger (switched off) to the PC's USB port using the USB data download cable. Once connected, switch on the data logger and install the USB drivers: the driver's name is **WDUSB503.inf**.
- Restart the PC if prompted.

How to use Race Studio 2

- Run **Race Studio 2** using the proper shortcut on the PC's desktop.
- Select **EVO 3** and press button *Logger manager*.
- Import the default configurations for FR2000 using the *Import configuration* function. These configurations are located inside the installation directory of **Race Studio 2** (usually C:\Program files\AIM).
- *Threshold* acquisition means that the logger samples data only when speed is greater than 10 km/h. When speed becomes lower than the threshold value for more than 3 seconds, the data acquisition stops.
- Set the desired unit of measure.

N	Channel ider	Enabled/disabled	Channel name	Sampling fr	Sensor type	Measur	Lower bound	Upper bound	Param. 1	Param. 2
1	RPM	Enabled	Engine	10 Hz	Engine revolution speed	rpm	0.000	20000.000	0.167	25000.000
2	SPD_1	Enabled	Speed #1	10 Hz	Speed	mph	0.000	250.000	65.591	1.000
3	SPD_2	Enabled	Speed #2	10 Hz	Speed	mph	0.000	250.000	-17.874	1.000
4	CH_1	Enabled	Channel 1	10 Hz	Air temp. (FR2000)	°C	0.000	150.000		
5	CH_2	Enabled	Channel 2	10 Hz	Oil press. (RENAULT)	bar	0.000	50.000		
6	CH_3	Enabled	Channel 3	10 Hz	Water temp. DPS (FR2000)	°C	0.000	150.000		
7	CH_4	Enabled	Channel 4	1 Hz	Potentiometer distance	degree	0.000	500.000	0.000	
8	CH_5	Enabled	Channel 5	1 Hz	Zero based potentiometer	degree	0.000	150.000		
9	CH_6	Enabled	Channel 6	10 Hz	Mid zero potentiometer	degree	0.000	500.000		
10	CH_7	Enabled	Channel 7	1 Hz	Pressure VDO 0-5 bar	bar	0.000	150.000		
11	CH_8	Enabled	Channel 8	100 Hz	AIRBOX pressure sensor	bar	0.000	500.000		
12	ACC_1	Enabled	Acc. 1	10 Hz	Longitudinal accelerometer	g	-3.000	3.000		
13	ACC_2	Enabled	Acc. 2	10 Hz	Lateral accelerometer	g	-3.000	3.000		
14	LOG_TMP	Enabled	Data logger Temp.	10 Hz	Cold joint	°C	0.000	50.000		
15	BATT	Enabled	Battery	1 Hz	Battery	V	5.000	15.000		

Configuration name	Logger name	Display name	Available time	Total frequency
Pippo	EVO3 - 8 channels - 32 Mb	Mychron 3	22.50.41 (h.m.s)	204 (Hz)

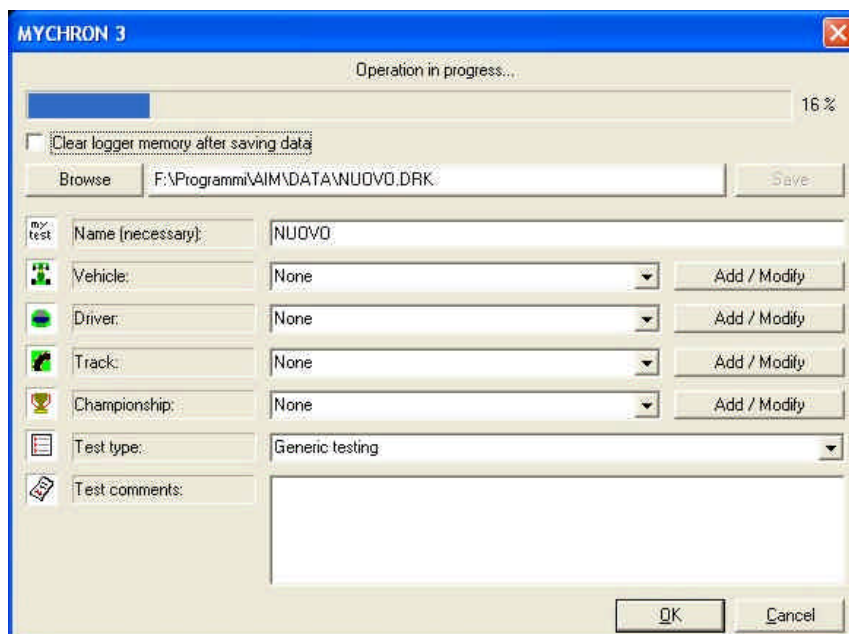
- Click *Channels* and set the desired input channels (see figure 8509_1) :
 - Channels must be **enabled**.
 - Verify that the wheel circumference is correct.
 - Verify that the RPM parameters are correct;
 - If you set a *Potentiometer distance* sensor, insert the potentiometer's total travel.
- Connect the data logger to the PC's USB port, switch it on (use button *Ignition* inside the car's switchboard) and press button *Transmit*.
- Press button *Calibrate*:
 - Accelerometers number 1 and 2 and channel "Potentiometer distance" need to be autocalibrated. Press button *Start autocalibration*.
 - Channels "Mid zero potentiometer" and "Zero based potentiometer" need to be calibrated. Select the channel you wish to calibrate, press button *Start calibration* and follow the instruction prompted on your PC's desktop.
- Once the desired channels have been calibrated/autocalibrated, press button *Transmit* in order to transmit the calibration to the data logger.
- Press button *Online*. Verify that the accelerometers show a lateral g-force of 0 g. Move the throttle (if a throttle displacement sensor is installed), the front/rear shocks (if a shock potentiometer is installed) and verify that such sensors have been correctly calibrated.

DOWNLOADING DATA

Once a test session has finished, it is possible to download the data stored in the instrument's memory.

In order to correctly download these data, connect your **EVO 3** to the PC's USB port, using the USB cable, and switch on the data logger.

- Run **Race Studio 2**.
- Select **EVO 3** and press button *Download*. It will appear the screenshot shown in figure 8510_1.



- Insert the file name (necessary) and *browse* the folder where you wish to save the test file (default folder C:\Program files\AIM\DATA).
- Insert the database's desired sub-categories pressing button *Add/Modify*. If no sub-category is specified, the test will be included inside the tests database as "None" for the Vehicle, the Driver, the Track and the Championship type, and as "Generic testing" for the Test type.
- Once the download has finished, press button *Save*.
- Checkbox *Clear logger memory after saving data* allows the user to clear the logger's memory after the data have been downloaded.

ANALYZING DOWNLOADED DATA

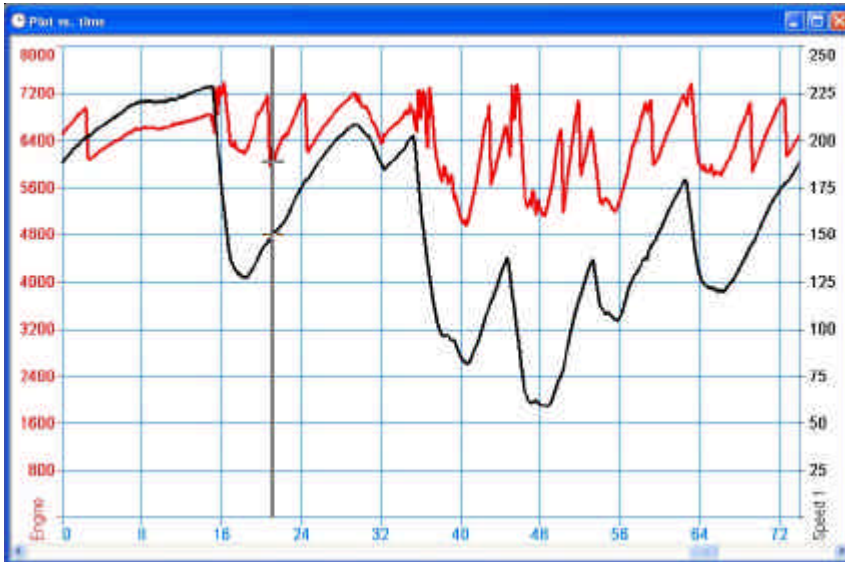
How to use Race Studio Analysis

Race Studio Analysis will allow you the ability to plot the recorded laps and the sampled channels versus time, distance and frequency.

- Press the shortcut *Race Studio Analysis* on your PC's desktop in order to run **Race Studio Analysis**.

If you wish to plot engine's RPM and the vehicle speed versus time, for instance, first of all you have to select these measures by clicking on them in the *Measures and laps* toolbar (see figure 8511_2) located on the left of **Race Studio Analysis** window, and then you have to click on the *Plot vs. time* icon.

An example of a *Plot vs. time* (RPM superior curve and Speed inferior curve) is shown in figure 8511_1.



FR8511_1

Measure	Lap 20	Lap 7
Engine	6927.3	6948.1
Speed 1	4.1	184.3
Speed 2	4.9	183.7
Throttle	0.6	10.0
Oil Pressure	4.1	4.6
Water temp	54.6	57.5
Lambda	0.9	0.8
Lateral acc	0.0	0.0
Longitudinal acc	0.0	-0.1
Oil Temp	27.8	28.4
Battery	13.7	14.0
Gear	1.0	5.0

FR8511_2

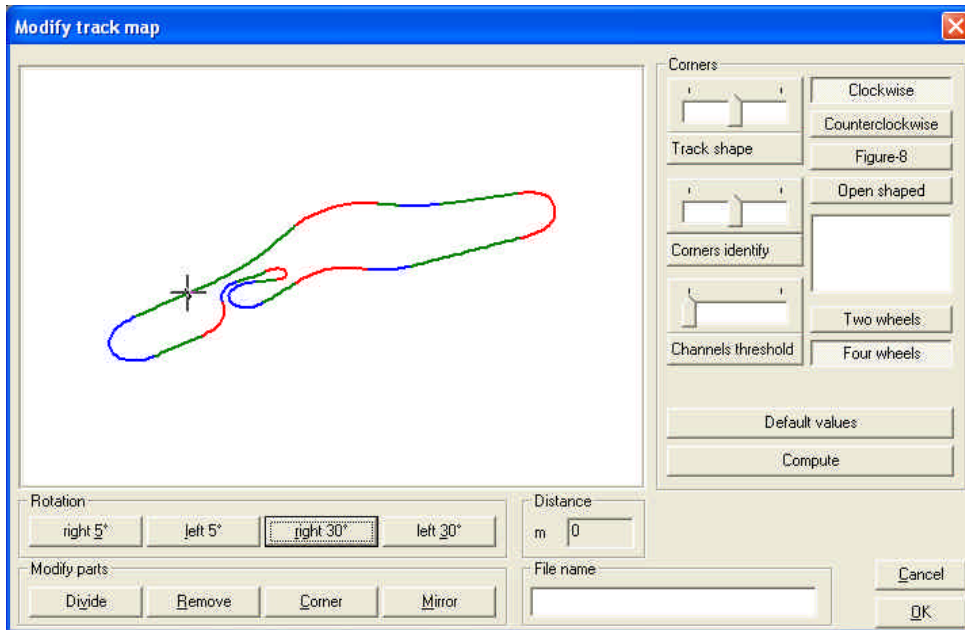
Click on the coloured-boxes column (Figure 8511_2) if you wish to change the graph colour: the user may set the desired colour for each recorded lap and for each sampled channel. If you wish to add the scale to the graph, click in the checkbox corresponding to the desired channel name.

Click on the pushbuttons of the last column of the *Measures and laps* toolbar to load the *Measure information* window: this function allows the user to change the channel name, the plotting scale and the unit of measure.

Create the track map

The internal lateral g-sensor allows y

The internal lateral g-sensor allows you the ability to create the circuit map on your PC. In order to create it, once loaded a test and selected a good lap (labelled as "Lap marker" in the Lap cause column of the Lap manager dialog box), press *Map \ New* from the Command toolbar or "Shift+F4" keys: it will appear the following screenshot:



FR8512_1

- *Track shape* cursor: this button allows the user to modify the curves' radius of curvature, obtaining more or less open shaped curves.
- *Track type*: it is possible to choose the track type between 4 choices: Clockwise, Counter Clockwise, Figure-8 and Open Shaped. Most of circuits belong to the first two types, while, for instance, the circuit of Suzuka (Japan) is a Figure-8 track type.
- *Two Wheels / Four Wheels*: this option has to be set to "Four Wheels" if using a car or to "Two Wheels" if using a bike.
- *Default values*: this pushbutton loads the default values for the different parameters that can be set during the map creation.
- *File name*: once the map has been correctly created, it is possible to save it by choosing its "file name" and clicking the OK pushbutton.
- *Rotation pushbuttons*: by using these buttons it is possible to right (Clockwise) or left (Counter Clockwise) rotate the circuit map of a 5 or 30 degrees angle.
- *Modify parts pushbuttons*: these four buttons will allow the user to modify the track map.

Once the map has been created and saved, it is possible to recall it from the *Map Manager* window (shortcut "SHIFT+F2") by double clicking on the desired one.

TROUBLESHOOTING

Speed

Symptom	Most probable causes	Suggested solution
No speed signal is sampled	<ul style="list-style-type: none"> - Verify that the distance between the sensor and the phonic wheel is included between 8 and 15 mm - Verify that the speed sensor's connector is plugged in the corresponding logger's connector - The speed cable is broken or damaged - The sensor is damaged 	<ul style="list-style-type: none"> - Fix the distance between the sensor and the phonic wheel - Plug the Speed connector in the logger's speed input - Replace the cable with a new one - Replace the sensor with a new one
Speed values are incorrect	<ul style="list-style-type: none"> - Verify that the wheel circumference is correct (default value 1666 mm) - Verify that the magnet's number of the phonic wheel is correct 	<ul style="list-style-type: none"> - Set the correct wheel circumference in Configuration - Channels - Set the correct number of pulses per engine revolution in Configuration - Channels
High/low peak values	<ul style="list-style-type: none"> - Verify that the distance between the sensor and the phonic wheel is included between 8 and 15 mm - The sensor is damaged 	<ul style="list-style-type: none"> - Fix the distance between the sensor and the phonic wheel - Replace the sensor with a new one

Data

Symptom	Most probable causes	Suggested solution
The logger has stored no data	<ul style="list-style-type: none"> - Logger switched off - The infrared lap receiver is broken and the logger has a Threshold start - The configuration has been re-transmitted to the logger before downloading data 	<ul style="list-style-type: none"> - Ensure that the logger is powered by the car's 12 Volts battery - Ensure there is no short-circuit on the wirings of lap, potentiometer and speed sensors - Replace the infrared receiver with a new one - Each time the configuration is transmitted to the logger, its memory is erased
Sampled data are incorrect	<ul style="list-style-type: none"> - Sensors are damaged or broken - Sensors' cables are damaged - Channels have not been calibrated / autocalibrated 	<ul style="list-style-type: none"> - Replace the sensor - Replace the sensor - Run Race Studio 2, press button Calibrate and calibrate / autocalibrate the sensors

Lap times

Symptom	Most probable causes	Suggested solution
Some laps are grouped	<ul style="list-style-type: none"> - Incorrect lap receiver installation 	<ul style="list-style-type: none"> - Re-install the Beacon receiver
All laps are grouped	<ul style="list-style-type: none"> - Verify that the lap receiver is installed on the car side facing the lap transmitter - Verify the lap receiver, or the cable, are not broken - Verify the lap transmitter is not broken - The hole in the front fairing is too little - The transmitter's battery is low-charged - The Beacon is incorrectly fixed 	<ul style="list-style-type: none"> - If broken, replace them - If broken, replace it - The hole must be of 8 mm at least (20 mm suggested); enlarge the hole - Use the 12 Volts power cable and a 12 Volts battery to power the lap transmitter - Re-fix the Beacon
Lap times too short	<ul style="list-style-type: none"> - Verify you are not on the pit lane or inside the paddock - Check if more than 1 transmitter is installed at the track side - Verify the Beacon is not installed near sources of electrical interference (i.e. coil) - The data logger switches off/on during race 	<ul style="list-style-type: none"> - Hide these laps in Race Studio Analysis using the Hide lap function - Set the Beacon's obscuring time to a value lower than a few seconds of the best lap time - Install the lap receiver where suggested, i.e. under the front fairing - Check the "Junction Box to ECU" patch cable

Communication

Symptom	Most probable causes	Suggested solution
No communication when interfacing the logger with the PC	<ul style="list-style-type: none"> - The logger is switched off - USB drivers not installed or incorrectly installed - The PC's USB port is broken - The USB cable is damaged - The USB cable is incorrectly connected either to the PC or to the logger 	<ul style="list-style-type: none"> - Switch on the data logger - Re-install the USB drivers - If available, try another USB port - Replace the USB cable - Correctly connect the USB cable

Track map

Symptom	Most probable causes	Suggested solution
<p>The track map does not correspond to the real track or an error message is prompted</p>	<ul style="list-style-type: none"> - Incorrect EVO 3 installation - Incorrect EVO 3 installation: the logger is non firmly fixed to the chassis - The internal accelerometers have not been autocalibrated - Problems on the <i>Reference speed</i> channel - The created track map does not correspond to the real track map - <i>Invalid data to compute track map</i> warning message is shown 	<ul style="list-style-type: none"> - Install the data logger as shown in Figure 4 - Firmly fix the logger to the chassis using a large piece of Velcro - Run Race Studio 2 and select the <i>Autocalibration function</i> - <i>Race Studio Analysis - Modify - Reference speed</i> and double click on the new reference speed channel - Use functions <i>Mirror, Corners identity</i> and <i>Rotation</i> to modify the track map - Select a lap labelled as "lap marker" inside the <i>Test database and Lap manager</i> window