

Prototype Preparation

Poch Lada Prototype

Translated by Mary Waller

Years of experience have allowed Lada Poch's competition services to make their own Dakar prototypes.

Until 1983, the prototype was still close enough to the original vehicle. The self-bearing shell kept the same dimensions. The lightening and strengthening of the whole were starting to make the car competitive. In spite of all this the engine was at the limit of its possibilities. The reinforced original axles coped well with the rigors of the course, but the original brakes were on the limit.

The 1984 Dakar was to change everything. Indeed, the body was to undergo the largest transformation. The short wheelbase of the Lada was no longer sufficient. 20 extra centimetres took the wheelbase from 2 m 20 to 2 m 40, and gave the car a new start.

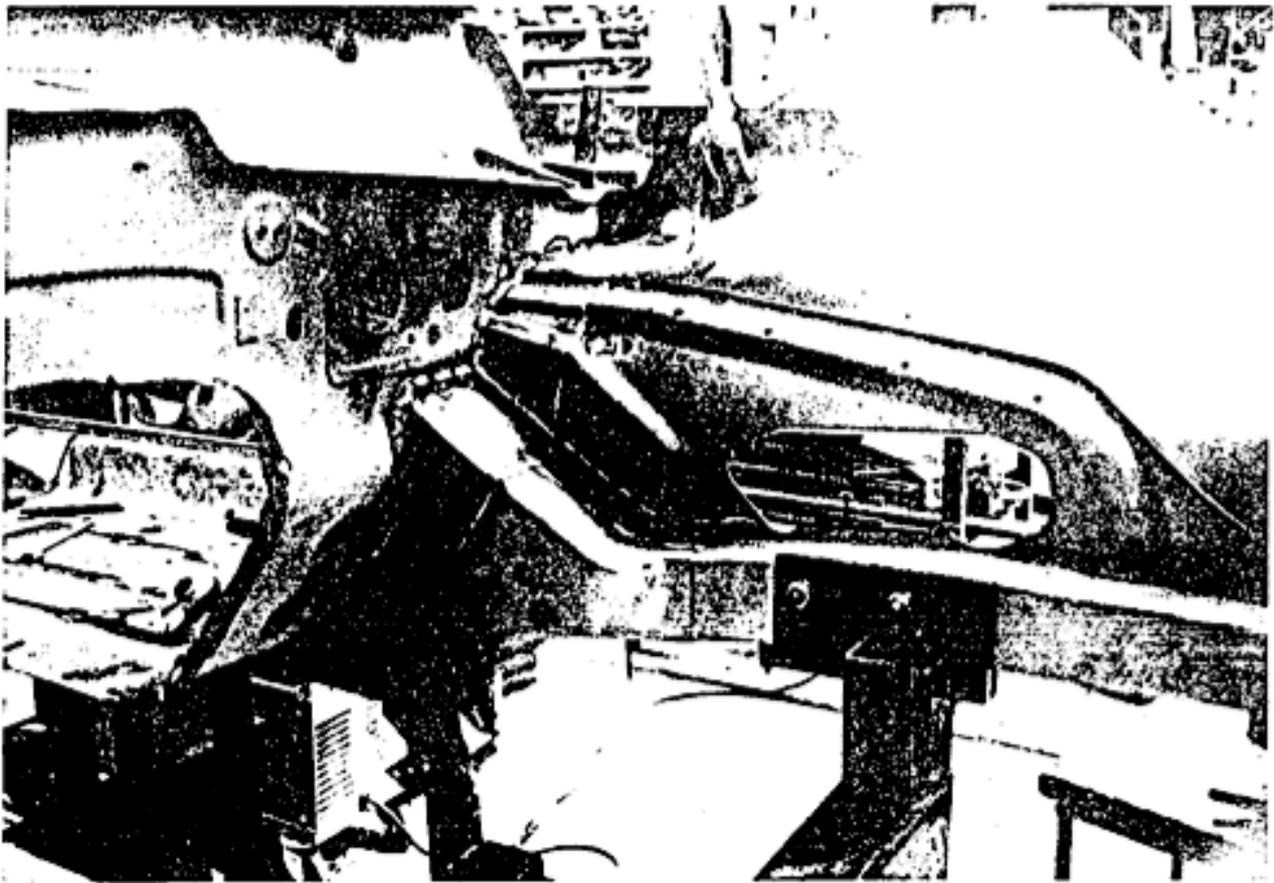
The "Maurelec" engine went to 240 horsepower, but the lightened shell kept its glass-fibre parts.

No drastic changes for the 1985 Dakar, but a particularly careful honing. The general characteristics remained unchanged.

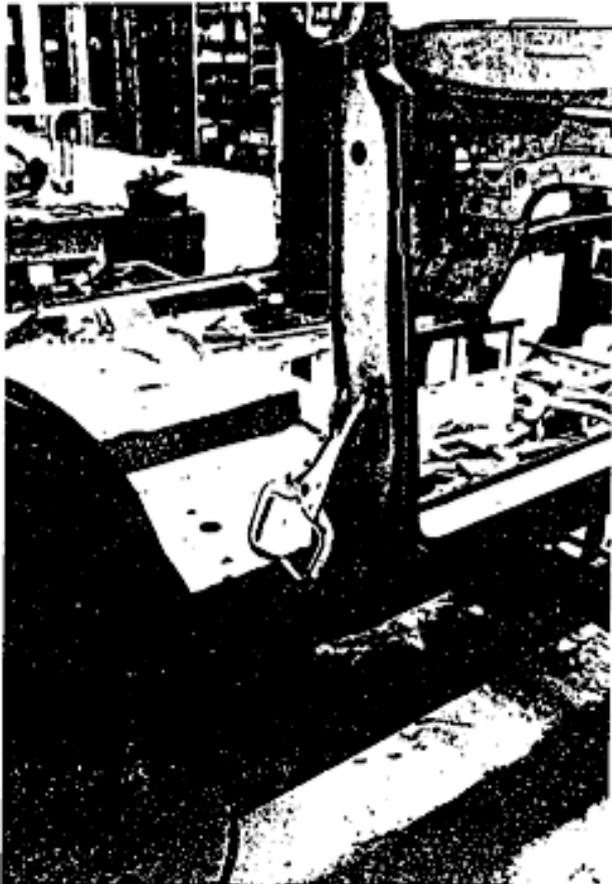
From 1986 a complete restructure of the car was decided on. Carbon-fibre replaced the glass-fibre, the 280 horsepower Roc engine appeared, the axels gained self-locking (diff-lock?), the brakes were at last worthy of a race car. Disk brakes all round, with four pistons on the front caliper. The Carbon shock-absorbers were replaced by Bilstein ones.

The rear axle guidance was improved by mounting a Watt's parallelogram (no more Panhard bar.)

The little original Lada has thus become a magnificent race car with a good future (and it can still evolve) and who can still assert the Lada name because the shell – even if lengthened, is still the same, the axles and transmission are faithful to the original, and last but not least, certainly the most fabulous part of the car, the transfer box has evolved but is totally original. Originally thought of as an 80 horsepower car, it now exceeds 290!



The car is lengthened to the front by 8 cms just after the apron. The wheel arches and the chassis are cut, shifted and securely fixed. The gap is filled with a sheet of pre-formed plate. The internal chassis reinforcements are welded before final assembly.



The floor is cut under the seats. Unwelded on the sides, it slides 12 cms backwards. The door pillar doesn't move but it is cut out, reinforced and made ready for the carbon-fibre parts. A 12cm strip of plate bridges the gap created by moving the floor back.

The rear is cut out to keep the original dimensions of the car. The wheel arches and spring supports are reinforced.

Body

This type of self-bearing bodywork, designed for a saloon, has the advantage of being light. It's true that when used for extreme off-road the workload results in little cracks and broken welds. This problem was easily fixed by a system of reinforcement.

For the prototype, things are a bit different.

The wheelbase is lengthened by 200mm for better road-holding. This work is much more difficult than lengthening a chassis.

A self-bearing body is an ensemble of folded and shaped plates, welded one to the other, making a rigid box that keeps a certain amount of give and has a certain number of parts grafted on. In a body, all parts contribute to the rigidity.

Doors, bonnet and tailgate have their uses, and hours of research are needed to replace or eliminate them.

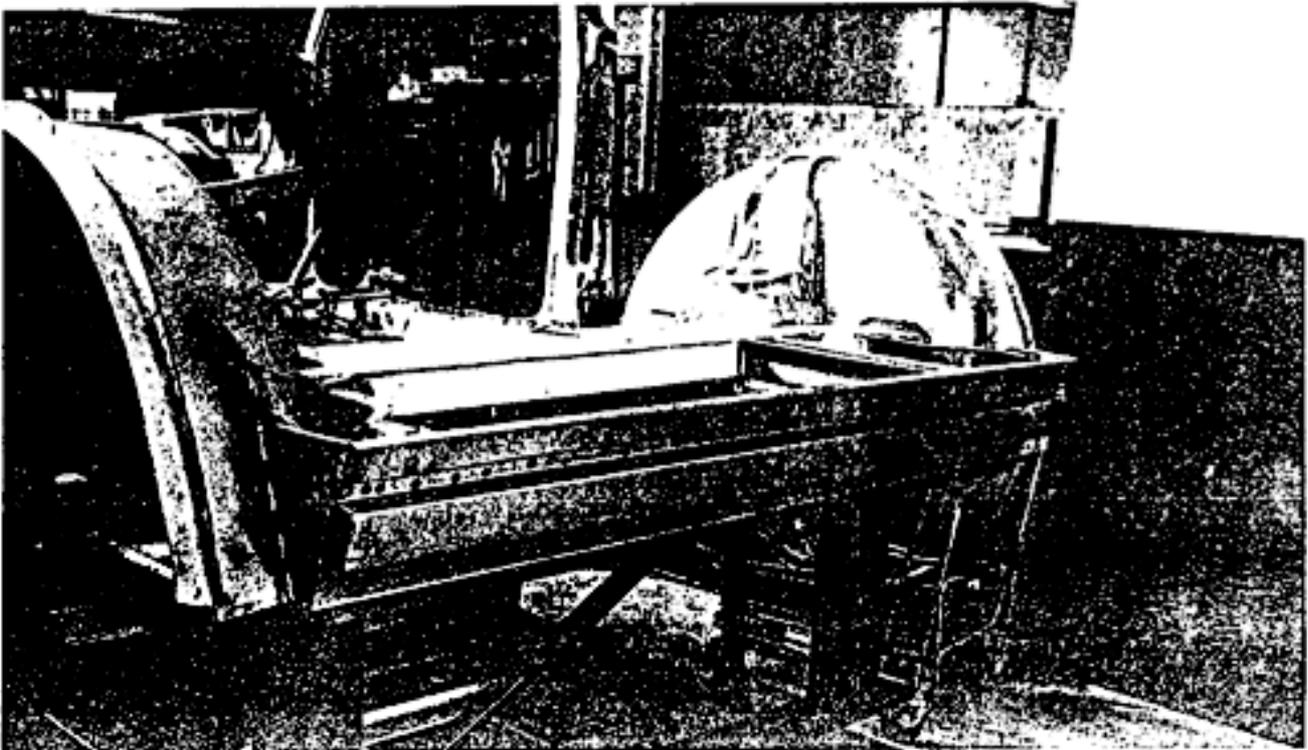
The lengthening of the car is particular in that it is done in two different places – 8cm at the front and 12cm at the back.

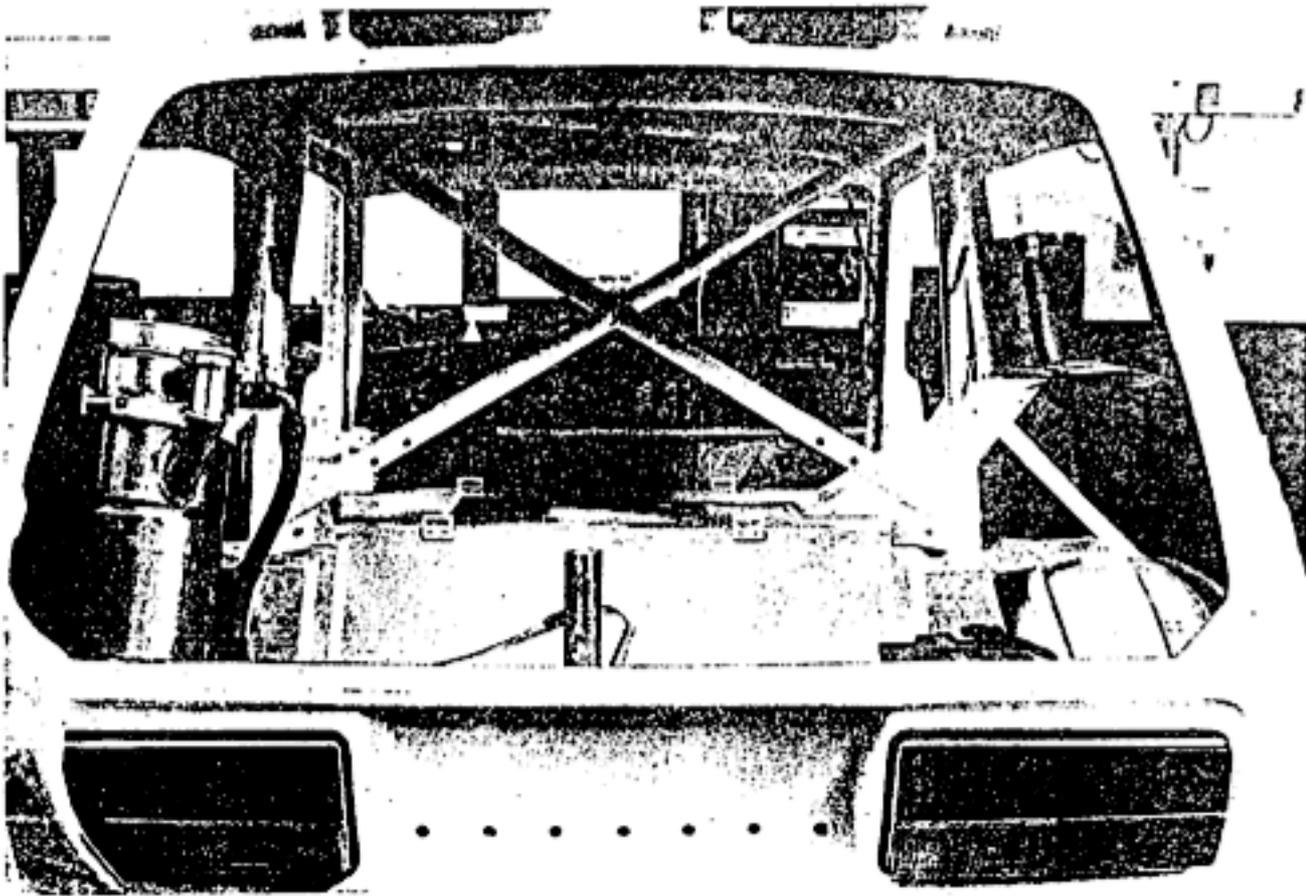
At the front, this increase is done just after the front apron (the front apron is the part where the dashboard, steering wheel, pedals, etc come from.)

Chassis and wheel arches are therefore cut with a chainsaw. The apron and chassis members are placed on an immovable surface and the 8cms between them are filled with a series of specially formed plates.

Reinforcing plates are welded inside the chassis, on both sides, and the whole is semi-automatically welded.

This electric welding under neutral gas reduces deformations. Reduce doesn't mean eliminate – it's down to the skill of the welder to adjust and compensate to avoid deforming the front block.



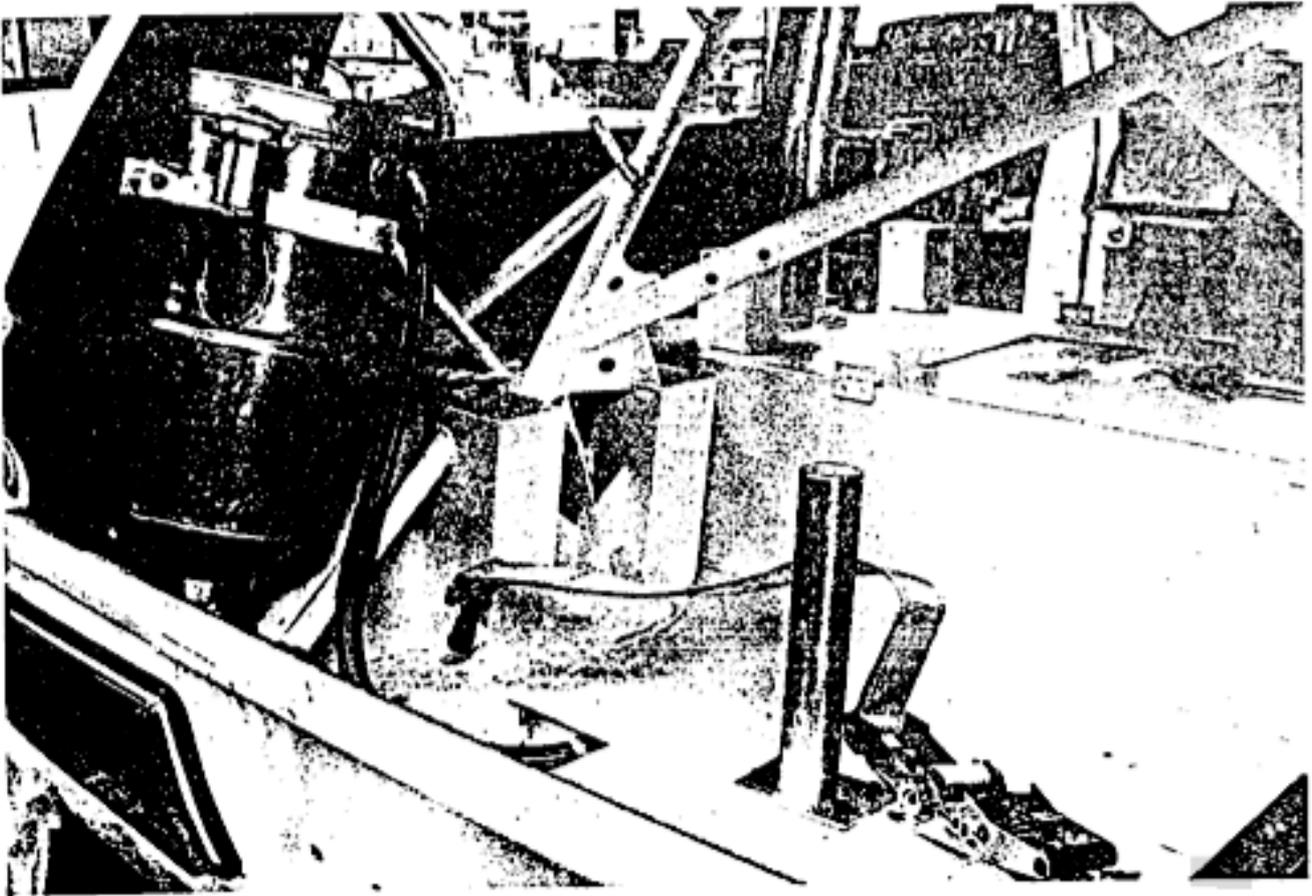


The roll cage makes a second tubular frame. Welded to the body, it gives rigidity and makes it almost unable to become misshaped. The central aluminium tube serves as a mount for the two spare wheels. For better weight distribution the battery is mounted on the right and the oil tank on the left.

The rear lengthening is probably more complicated than at the front. It is made on the rear three-quarters of the doors, just in front of the door pillars. The floor-pan is cut and moved back by 12cms.

The door pillar is cut in two vertically and reinforced.

The windscreen bay horizontal structure (up to the door pillar) and floor pan with the rear wheel arch are kept. All the rest (roof, horizontal structure behind the door pillar and the tailgate) is removed in order to lighten the car. The rear part is recut (almost at the wheel arch) to regain the original dimensions of the car. In brief, the car is transformed into a pick-up on which a carbon-fibre hard-top will be stuck and riveted. Doors, bonnet and tailgate are also in carbon-fibre.



The front and rear wings are enlarged to compensate for the greater track (the distance between the two wheels on the same axle), not to be confused with the wheelbase (distance between the two axles.)

A carbon-fibre lower bodywork links the front and rear wings.

The roll-cage is an integral part of the body. A six-point roll-cage, it becomes a tubular frame welded to the body in fourteen places. The aluminium is replaced with 25 CD 4S steel which is easier to integrate into the whole. In any case, it is now preferable not to use aluminium due to security reasons (forbidden in the 1988 Dakar rules.)

A mechanically welded structure reinforces the pressure points of the roll-cage and also the mountings of the rear shock absorbers fitted in the two plane-parallel shapes. The tube centres the spare wheels and the belt holds them. The container, left at the back, serves as an oil reserve for the engine with dry casing. The pipework in is on top. The fuel tank is that used at the "Pharaons" rally. For the 1988 Dakar it was flatter and came up to the rear apron and the two spares wheels were stored on it, one on top of the other.



Once the lengthening is done and the roll-cage welded, the carbon-fibre parts are riveted and glued. Windscreen and horizontal bays are glued. The track increase has necessitated a widening of the wings but the aesthetics are kept. Note the tube (in the engine compartment) welded on the roll-cage and on the body. It will take the mounts for the front shock absorbers. Two air intakes in the roof will allow the cockpit to be ventilated.



A cross-bar mechanically welded in aluminium allows the chassis members to keep the same gap (in spite of shocks), and the lower protection (in carbon-fibre) holds the front axle. The entirety becomes a very robust front axle.

The fixing of the roll-cage is done in strategic places on the body. The principal rear load point is situated by the shock absorbers. Two rectangular boxes serve as the upper mounts of the shock absorbers. These two parallel shapes are welded on the floor-pan on each side of the spring support, the length of the wheel arch, and reinforced by plates. A strut welded on the roll-cage allows the wheel arch and rear wing mounts to be strengthened.

Two diagonals (one is obligatory) crossed in the middle make the rear of the roll cage immovable.

The side parts of the roll cage match perfectly the door and side pillars. The entirety is welded with strips of weld every 10cms.

On the front, an additional tube – coming off the roll-cage at the apron level, crosses the apron and joins up at the front shock absorber placement. This allows shocks/knocks to the suspension to be sent on.

At the seat level, another tube is welded on the roll-cage and joins the front apron opposite the chassis member.

This tubular trelliswork of the body makes an unbendable cage. An aluminium crossbeam at the front keeps the two chassis members apart. At the same time it acts as mounting for the carbon-fibre armour plating, which in turn holds the crossbeam of the front suspension.

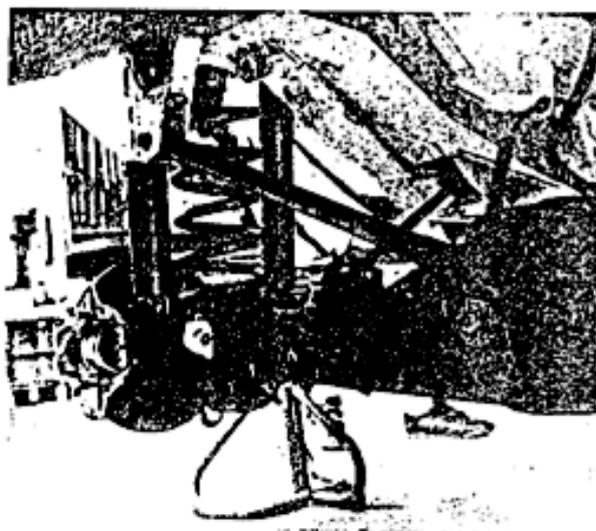
The laminated glass windscreen and polycarbonate windows are glued to the bodywork. This technique also contributes to the rigidity of the whole.

Suspension

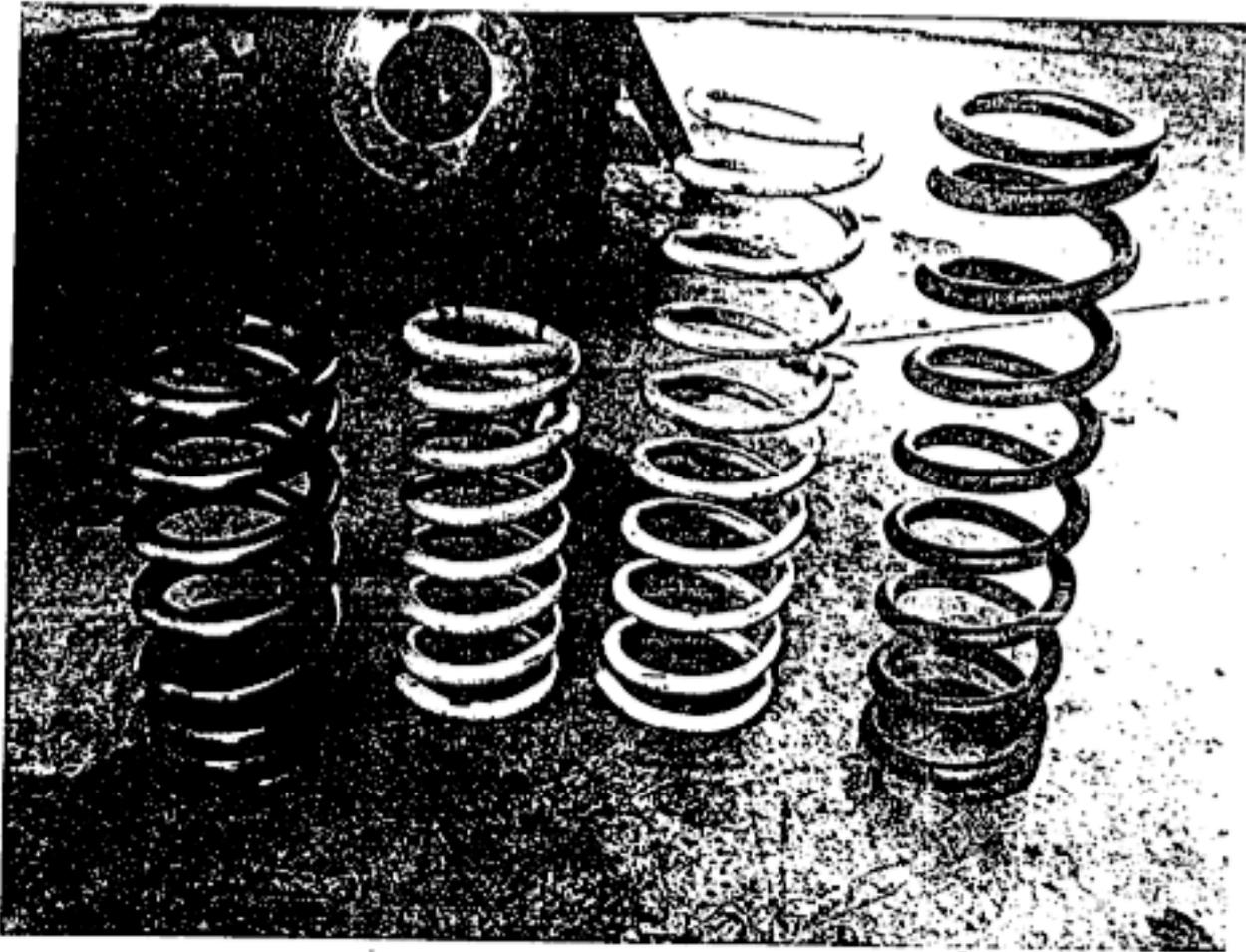
The principles of the suspension are retained. Triangular suspension in front with helical springs, and rear axle with tie-bars, Watt's parallelogram and helical springs. The biggest modification is to replace the original steel springs with progressive ones in titanium.

The new steel springs specially made for the new characteristics of the car had a tendency to break. Choosing titanium resolved this problem.

The lower triangles are mounted on Teflon rings instead of the traditional silentblocs (rubber bushes.) Two arms welded on the middle of the crossbeam take the front fixing of the pivotal axis of the suspension arms.



The axle guidance is achieved by a Watt's parallelogram. All the articulations are done with silentblocs. The central axis is mounted on an elastic ring. The axle tie-bars are also mounted on silentblocs. Note the shock absorber mountings secured by balljoints (unibal type) protected by a foam washer on each side. The floating rear caliper is one from a 505.



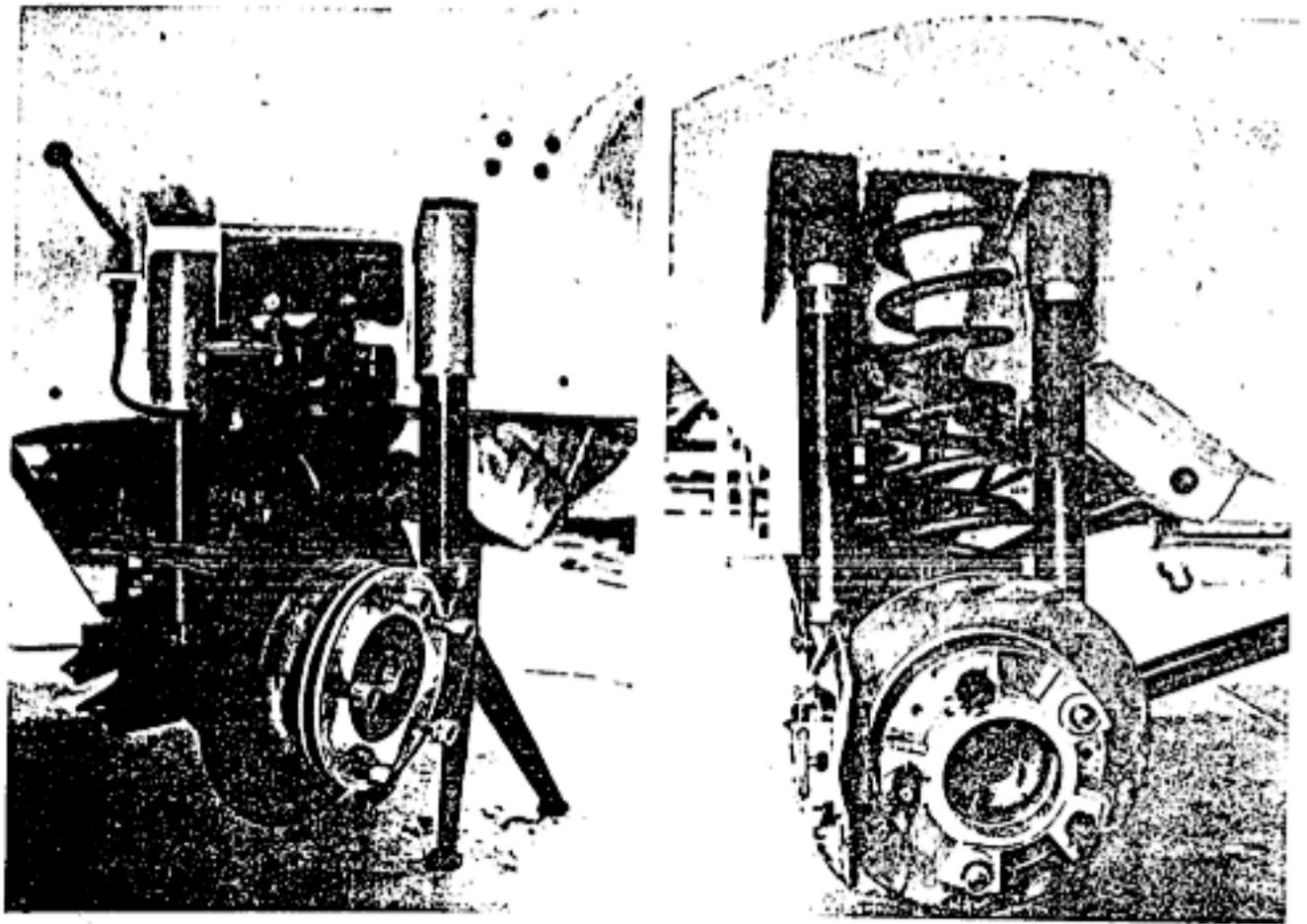
*In the middle, the original steel springs.
On the left, the new front titanium spring.
On the right, the rear titanium spring.
Slightly lighter, the titanium springs have
the advantage of being completely
reliable (they don't break and they retain
their properties.)*

The spring is positioned between the lower arm and the (upper) bodywork support.

The anchoring points of the shock absorbers are found on each side of the springs.

The upper forged steel triangles are mounted on Teflon rings instead of silentblocs. The principles of the rear suspension are the same as the original, except for the axle guide which is a Watt's parallelogram. The springs are in titanium, recalculated and adapted for the new weight on the rear axle. There too, the choice is made to have reliable springs that don't break.

The second advantage concerns the weight. Titanium springs are half as heavy as steel ones.



Shock Absorbers

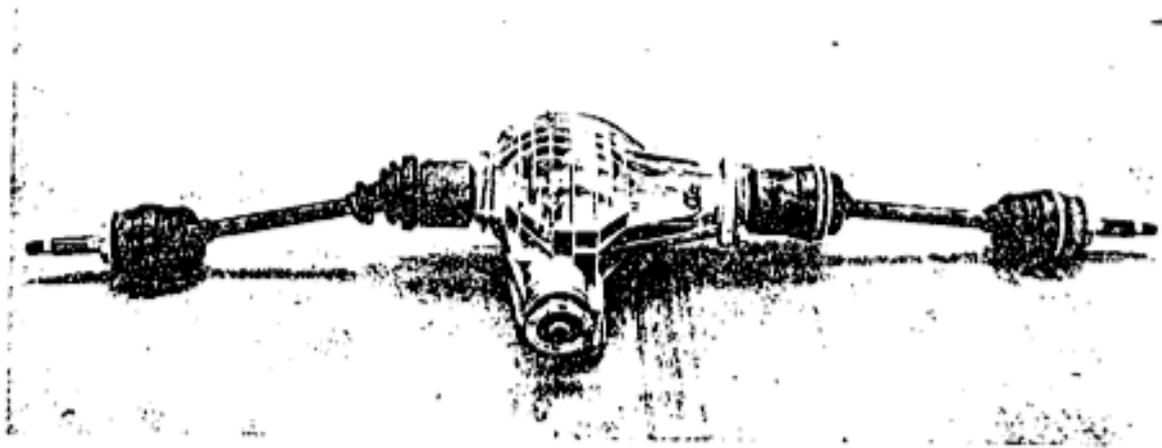
Two Bilstein shock absorbers for each wheel. At the front and back, the lower mount is done with a 'Unibal' balljoint and the upper mount is done traditionally with rubber chocks. The body of the shock absorber is in aluminium and the adjustment is specific to the attributes of the vehicle.

Axles

The principal of independent wheel suspension is of course retained. The ensemble consists of an aluminium body and two universal joints. The ratio of the conical coupling is changed to 4.44 to 1 for the moment. This choice was made for all the existing axles at Lada. This particular coupling, the shortest of the range, is still too long.

The front shock absorbers have balljoints at the lower mounts, with silentblocs retained for the upper mounts. The differing position of the front shock absorbers is due to their anchorage on the lower triangle being shifted upwards. This mounting is necessary to keep the same clearance. The front brake is a four piston one from AP.

The light alloy Bilstein shock absorbers mounted on either side of the springs are mounted with balljoints below and silentblocs at the top. An aluminium spacer allows the track to be increased and the use of Porsche rims. Full disk brakes (as at the front) and floating brake calipers from the 505 make the rear brakes certain.



The front axle and transmission remain the same. The mounting of the axle on the Roc engine is done the same as for the Lada engine.

The rear axle is a superbly crafted part. Reinforcement of the trumpets, new shock absorber mounts, even the support in the centre is reinforced. Taken during fabrication, it lacks the axle guidance (Watt's parallelogram) welded on the banjo.

For the front axle, the big difference from the original comes from the ZF differential box, with slip limited to 10%. The 10% comes from a box already used and retarded. The rear axle, although keeping the same size, is fundamentally changed. The old fixing of the centre onto the body is cut off. In its place a thicker ring is welded. This work is done by a specialist, who is able to perfectly position the centre of the axle on the body (the differential exits must be perfectly aligned with the wheels.) The trumpets are reinforced along their entire length with U shapes welded to the body. The tie-bars are re-welded. The new mounts for the shock absorbers are welded on either side of the bracket.

The axis of the Watt's parallelogram is welded on the banjo, and the original Panhard bar is removed. All of the parts constituting the axle guidance are reinforced and mounted on silentblocs. Only the central part of the system turns liberally on the axis (without bearings) by using a silentbloc.

Two arms welded on the body hold the Watt's parallelogram levers. The lower tie-bars are reinforced by an angle welded to the bar with each ring taken back at the two extremities. The small upper tie-bars are strictly original with no reinforcement.

As for the front axle, the ratio of the conical coupling is 44.4 to 1 (with tests for a shorter report/ratio for Dakar, and ZF differential box with limited slip is at 40 %).

For both the axles, the original bearings are changed to European ones.

Brakes

The evolution of the braking system has allowed the original rear drum brakes and front calipers to be done away with. Due to the increased performance of the car, and the differences between the original car and the race car (the top speed is about 200kph), the brakes had to be improved.

Unlike other teams, the choice was made between a mix of parts from the road model and those issued by competitors.

First of all, the four brakes are disk ones. At the rear, it is the original front disks that have been adapted. The front calipers are those from a 505 SDI. At the front the original disks are used with 4 piston AP Racing calipers (Lockeed). None of the disks are ventilated.

The original power brake booster (vacuum brake) is retained and produces an efficient braking, in spite of the

completely original diameters of the brake disks.

In this case, the master vacuum (vacuum brake mounted in series with the brake pedal and the master cylinder) gives little extra weight compared with the driving comfort and efficiency it offers.

Transmitters and repartition make up part of the improvement to the braking system. At the output of the master vacuum, the push-rod is relayed to two Girling master cylinders who feed the front and rear calipers. The linkage is established by a system of adjustable levers that allow more or less force to be applied to the pistons of the master cylinders and to share out the braking forces more to the front or rear. (see chapter: Brake AP)

The adjustment is done using a knob on the dashboard, which allows the driver to modify the share depending on the load (fuel) and the terrain. This can be done while the car is being driven.

The brake fluid is type Dot 5 – high temperature (see chapter: Brakes).

On the latest vehicles the steel brake pipes are replaced by aviation type pipes. This improvement has more to do with safety than performance.

The original limiter has been removed (it was doing double time with the mechanical sharing system of the pedal).

The brake shoes are Ferodo ones, with the shape adapted for the diameters of the disks used.

Wheels

Lada remains faithful to the Porsche rims (made for Lada). These are certainly the best rims for off-road. They are made from forged aluminium, which allows light rims due to the metal used and are almost indestructible due to the way they are constructed.

Two sizes are used depending on the race (15 or 16 inches). Inconvenient nonetheless – these rims are horribly expensive.

Steering

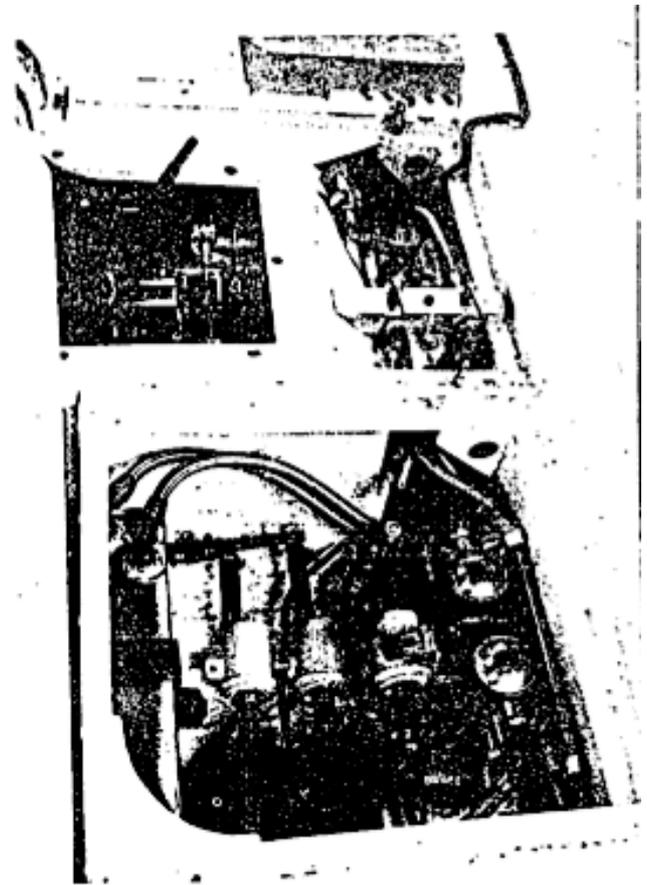
The main ideas behind the steering are retained. The steering box, the rods and the balljoints are the same. The choice of parts is very important. The balljoints are tested one by one, X-rayed and tested with Magnaflux to find the slightest flaw. Only those without any faults are taken. In spite of this they are changed regularly.

The connecting rods hanging down from the steering box and relay are replaced by titanium connecting rods (lighter and more robust). The steering column keeps the same placement. The intermediary tree is lengthened to compensate for the lengthening of the front bodywork.

Fuel and Feed tanks

Two flexible tanks (superflexit) placed behind the seats, with a capacity of 170 and 130 litres, feed the petrol engine.

A valve allows the tank to be changed, and a second allows the fuel to be sucked from the right or left of the tank that is found under the floorpan.



The transmission necessitates a shape in the middle that divides the tank in two when it is half-full. These two valves are positioned between the two seats in reach of the two teammates.

Under the driver's seat are found the two low pressure fuel pumps, that work at the same time and suck fuel from the tanks via two little filters. The petrol is sent into a buffer box (which allows elimination of air bubbles and avoids failure). From the buffer box the fuel is sucked by two high pressure pumps (one is a spare), filtered, and sent to the Kugelfischer mechanical injection pump.

For the 1988 Dakar, there is now only one tank moved back about 10 cms to allow more adjustment of the seat. Tall drivers had trouble finding a comfortable driving position with the present implementation. The tank is also slightly raised to reduce the separation in the centre of the transmission tunnel that lost the use of potentially about 30 litres of fuel.



All the fuel circuit is placed under the driver's seat and the valves between the two seats. Two low pressure fuel pumps, two high pressure pumps, of which one is a spare, feed the engine via three filters. A buffer box avoids failures.

The gearbox is a BA 10/5 fitted on the production 505s. Reinforced and made by Peugeot, it can exceed 50 mdaN. The original transfer box is not modified. The differential is free, the small and large ratios are the originals (2.135 and 1.2) and the difflock is kept. The link between the two is with the original gear coupling.

Gearbox, transfer box, transmission

The gearbox which had kept abreast up to 140 horsepower is replaced with a box fitted to production 505s made by Peugeot and sold by the preparer Danielson.

It consists of a 5 box, whose ratios are well adapted to the engine and to the development of the wheels.

The transfer box is the original (in relation to the latest boxes improved for the series). The only thing that is changed are the wheel bearings changed for European ones. The lipped sealing gaskets are also replaced by more resistant gaskets. The major modification of the old boxes consisted of re-machining the ranges of the planetary gears to insert bronze wedges to diminish the friction speed. This modification is now already done in the factory.

The link between the gearbox and the transfer box is made by an original gear-coupling (flexible link). It limits too violent fits and starts in the transmission.

The front universal joints are the originals, without reinforcement. The front and rear transmissions are lengthened by 8cms at the front and 12cms at the back to compensate for the lengthening of the wheelbase.

are spares in case one of the ignition systems breaks down. A switch on the dashboard allows their feed to be quickly reversed.

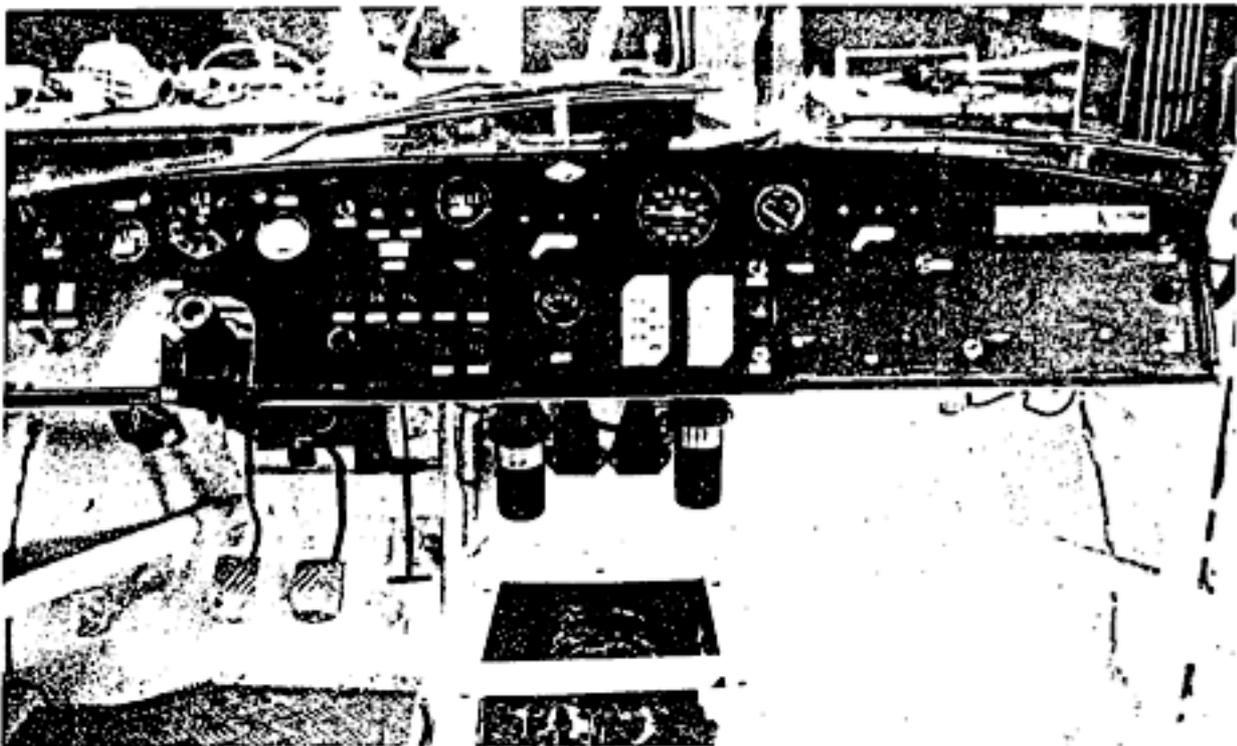
The dash instruments are laid out on an aluminium dashboard painted matt black. Pre-wired, it can be fitted rapidly due to its ¼ turn fixings and electrical plugs.

Cockpit

The steering column and the pedals are the originals. The whole gives a good driving position improved for the 1988 Dakar by a new seat position, until now a little too close to the dashboard. A false floor at the pedal level gives an additional possibility of adjustment. The wheel arch serves as a foot-rest. The "Modplastia" seats are adapted to the teammates.

Under the dashboard are two ignition control modules and two ignition coils. One of each

It only takes 2 minutes to fit the dashboard. All the lights and switches are within reach of the driver. The co-driver looks after the petrol gage and the navigation, he can change fuses and relays very quickly. Double ignition system in case of breakdown. Well protected from bad weather inside the car, it limits problems arising from crossing a ford a bit too deep. Two tubes go from the roll-cage to the point where the chassis members are mounted on the front apron (necessary for rigidity!)



Dashboard Setup

All the instruments and commands face the driver. Pressure gages, fuel gages, oil pressure gage, temperature gage, rev-counter, along with battery and oil warning lights, and all the switches necessary for the good running of the car (ignition, fuel pump, electric fan, etc) are regrouped within reach of the driver.

Two fuse boxes, a gearbox oil temperature gage and a transfer box oil temperature gage and a speedometer are placed in the centre of the dashboard.

Opposite the co-driver are grouped the navigational devices, the fuel pump switches, warnings and a series of electrical relays.

Even though reduced to a minimum, there is little space left for the addition of additional elements.

Engine

The needs of the competition in terms of power have, once again, made things evolve. From 140 horsepower in 1980, the Maurelac engine has gone to 180 horsepower, 200 horsepower, 230 horsepower and ended up at 240 horsepower. It is obvious that the cc for the latest versions has risen to 2.5 litres. The possibilities for this engine have been maximised, so it was necessary to find a more powerful one. The decision was taken for the "Roc" engine. The base of the engine (the block) is that of the N9T engine of the 505 turbo. The four valves per cylinder and the double overhead cams allowed a power rating of 280 horsepower at 7.200 rev/min and 27 mdaN.

Bore: 93 mm, stroke: 90, it is an honest/forthright engine of 2445cm³. The four and one exhaust is perfectly in tune with the input. The four trumpets support the mechanical injectors. A guillotine assures the opening and closing of the four input vents.

The Roc engine has been used in competitions for nearly 18 years now (NB: this document dates from 1989!). It has been used on a large number of cars, robust and weak, yet its engine torque is nevertheless placed too high in the revs. For an off-road vehicle this is a big handicap. The Kugelfischer mechanical injection system has the advantage of being simple and of an excellent reliability. The principal inconvenience is the fuel consumption and the lack of flexibility.

An electric injection, still being developed, will certainly give a greater flexibility in use and reduce the fuel consumption.

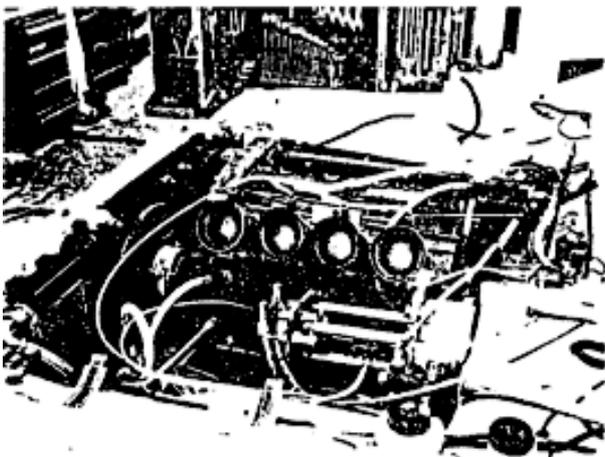
The fuel consumption is very important, because it affects the volume of the tanks which will affect the weight on the axles. The heavier the car, the more the parts need to be reinforced.

The Roc engine is particular in that it has a dry casing. In this case, the oil used to lubricate the elements falls back into the engine sump, is sucked up, cooled, and sent back to a tank in the rear of the car. Another pump sucks the oil out of the tank, and sends it under pressure into the engine via an oil filter.

A hydraulic ensemble with three stages (two emptying pumps and a pressure pump) is brought about by the crankshaft, with a notched belt.

There are many advantages that bring the vehicle preparers to use dry casings. The volume of the casing is kept to a minimum and helps lower the centre of gravity. The amount of oil needed is increased, as this leads to a reduction in temperature. The oil sucked up in the tank has had time to rest. The tank has a series of chicanes and decanters that allow the oil to de-emulsify (the small air bubbles in the oil due to the mixing induced by the suction pumps come up to the surface) and stops the risk of the pressure pump being damaged by cavitations, which above all lower the oil pressure and mark the bearings.

This also avoids a filter, often fragile, that could potentially break in the oil casing.



The Roc engine retains (at least until 1988) the Kugelfischer mechanical injection. Trumpets and guillotine ensure a good replenishment of the engine. The pressure and suction pumps (dry casing) are worked by the crankshaft via a notched belt (rectangular blocks surmounted by oil pipes). The water radiator (R20 diesel) and the oil radiator are perfectly placed. Two electric fans are controlled mechanically and manually. The division of braking, controllable from the cockpit, is realized by two Girling mast cylinders mounted on the master vacuum (vacuum brakes).

Inconveniences all the same: the oil tank is bulky and often difficult to put in, and the long pipework multiplies the risk of leaks.

The 4 in 1 exhaust is in "Inconel". This alloy of nickel (80%), chrome (14%) and iron (6%) has the advantage of holding temperature differences very well and being particularly reliable in terms of mechanical resistance.

The cooling is assured by an R20 radiator and two electric fans that can work automatically or by a manual switch on the dashboard.

An aluminium water box allows a good removal of air bubbles from the circuit, and avoids the cavitation phenomenon. This phenomenon has the tendency to create hot points in the engine potentially fatal to the pistons. An expansion tank serves to compensate for the volume differences in the water circuit depending on temperature.

Two track rods mounted in front of the engine and on the wheel arches by Unibal balljoints limit the clearance of the engine under shocks and fits and starts and go some way to protect the engine mountings.

The silentblocs (bushes/mounts) were particularly studied for the new engine.

The oil radiator placed next to the water radiator is perfectly exposed and allows a good cooling of the engine oil. An excellent engine, the Roc nevertheless remains a bit specialised for this type of use.