

AERODYNAMICS



Every part of the car has been redesigned to achieve excellent aerodynamic performance. Before spending 40 hours in the wind tunnel, more than 150 CFD* simulations were carried out on the entire vehicle. Specific attention was paid to the rear wing with engineers from the Alpine F1 engineers assessing thousands of configurations that were then boiled down to a dozen CFD simulations that were then tested in the wind tunnel. The Alpine A110 R has benefited from Formula 1 technology and design systems. Their research led them to find the perfect balance between grip, drag, and brake cooling, making the Alpine A110 R currently one of the best-performing models in its class."

ANTOINE DELICOURT & PIERRE SANCINENA

Alpine Aerodynamics Experts

*(Computational Fluid Dynamics)

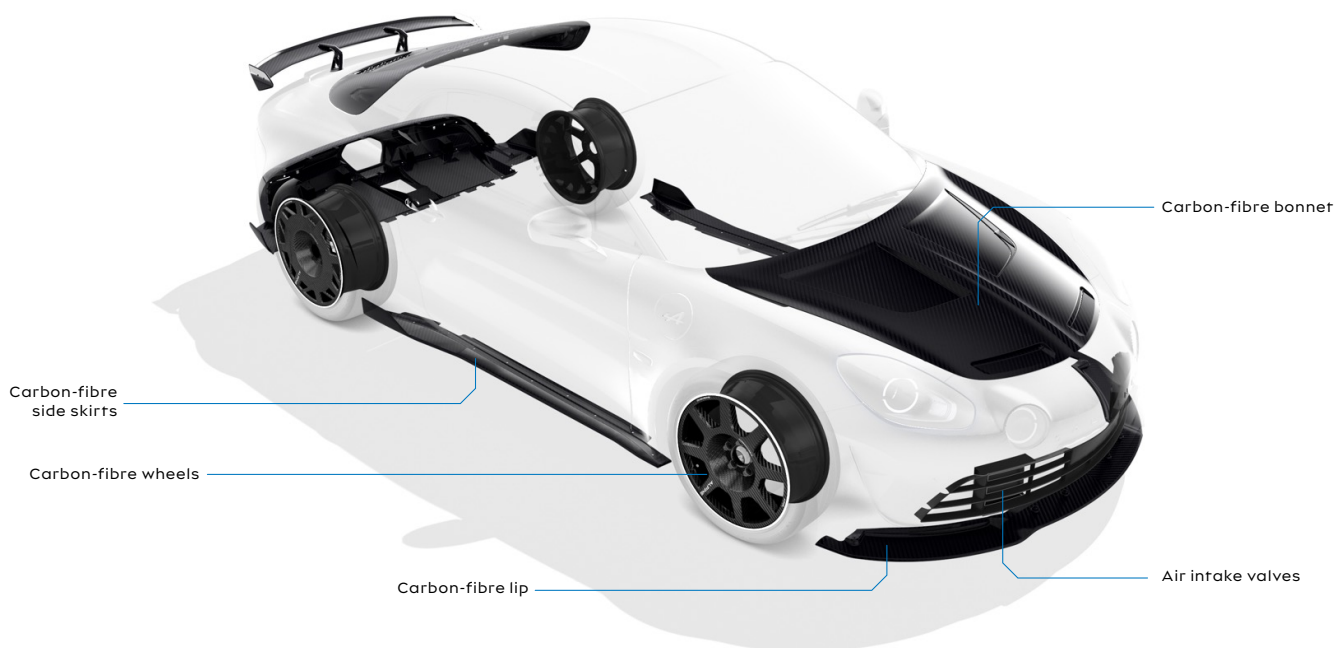


In light of the new chassis, the A110 R's front/rear aerodynamic balance has been completely redesigned.

With an optimal grip-drag ratio, the Alpine A110 R offers remarkable aerodynamic efficiency on both track and the open road. In light of the new chassis, the A110 R's front/rear aerodynamic balance has been completely redesigned. The downforce has been modified with an aerodynamic distribution centred more towards the rear of the car: the A110 R has a significantly higher rear downforce than the A110 S Pack Aéro, with gains of 29kg at top speed making the car more stable in turns and at high-speed.

The drag has also been improved compared to the A110 S, reduced by 2% when on the open road and by 5% on the track (with the car running an extra 10mm lower). In the track configuration, the car achieves the same drag as the A110, which is quite a remarkable performance! Nearly 140kg of additional downforce for near equivalent drag. Many parts have been either redesigned or added to the front and rear of the car, making it a benchmark model for its category.

- At the front, the A110 R features **the same carbon-fibre lip** as the A110 S and provides added downforce.
- **The air intake valves**, located at the front of the vehicle, serve a dual purpose: add downforce to the front while reducing drag, without affecting engine cooling. The intake valves regulate air flow by reducing the opening to let in just what is needed.
- **The carbon-fibre bonnet** features two ducts for optimal aerodynamics. Their unique shape serves mainly to redirect air off and over the wind shield when driving at high speeds, thereby also reducing pressure on the glass. It also slightly helps improve drag.
- **The carbon-fibre side skirts** widen the already flat bottom of the car, further increasing the overall downforce. In reducing undercarriage turbulence, it also reduces turbulence down the length of the car.
- **The front and rear wheels** have been redesigned and help improve the aerodynamic balance of the A110 R. More open at the front than at the rear, they reduce drag while ensuring optimized brake cooling thanks to the two purpose-built scoops located on the upper arm of the front axle and in the car's undercarriage. The rims and scoops have been developed together to achieve maximum performance.



- The A110 R also comes with a unique carbon and fibreglass **diffuser** in the rear. With its shape that extends further towards the rear of the car, its curve, and its revamped mini-wings, the air flows faster underneath, thereby adding more downforce and reducing drag at the same time. It was specifically designed to achieve both purposes and was optimised to work hand in hand with the rear wing.
- **The wing** was also specially designed for the A110 R. While the blade is the same as on the A110 S, its position and orientation are different. Alpine Cars engineers and Enstone's BWT Alpine F1 Team teams conducted two parallel studies using a wide range of estimates to find the optimal fin position. After running thousands of tests and numerical simulations, the teams chose the best configurations, which were put through their paces in the wind tunnel. Having determined the best configuration, it was then further optimized with the diffuser. The wing has been moved back by 18mm and raised by 46mm. Minor changes for a considerable improvement in downforce and drag.

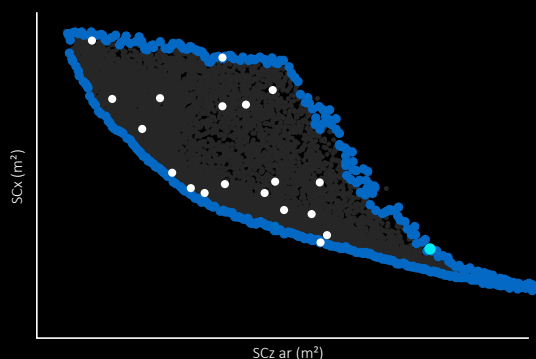
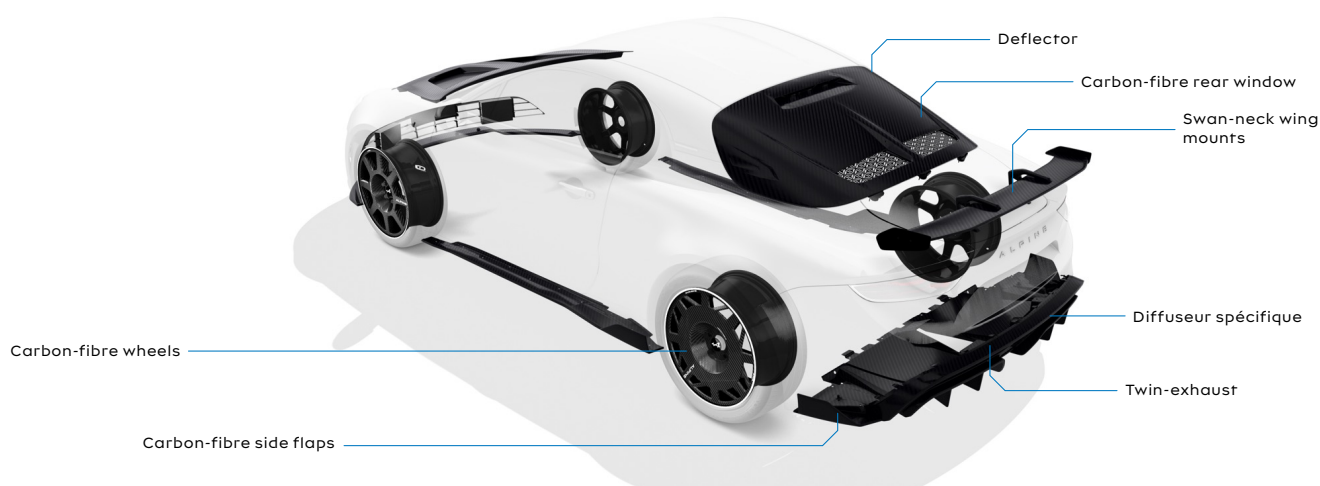


Illustration of the different rear spoiler positions evaluated and tested in CFD.



Illustrations of the different rear spoiler positions tested in the wind tunnel.

- **The swan-neck wing mounts** contribute significantly to wing's the performance. Its underside experiences low pressure and is therefore very sensitive to lift and other aerodynamic disturbances. Thanks to the positioning of the swan-neck mounts through the top of the wing, aerodynamic performance has been significantly improved.
- **The carbon-fibre rear window** has been given a unique curvature and two air intakes located in the lower section of the window for better air flow. The engine cover has been removed to reduce weight and has thereby changed the engine compartment's internal aerodynamics. Therefore, engineers paid particular attention to air flowing through the space, making sure no parts get too hot.
- Like its A110 predecessors, two air inlets are located near the quarter windows. The left-hand side inlet remains unchanged and supplies air to the engine. On the right quarter window, **a deflector** has been added to channel air to the top of the engine making the most of air entering the engine area to cool those parts that may need it.
- To achieve the desired on-track performance, engineers have also worked on a **custom-designed brake cooling system**. There are now two scoops: one on the upper arm of the front axle, the other on fairing located beneath the car. The former direct air from the exchanger to the brake discs, and the latter redirect air from the underbody to the brake discs. These features have improved the brake cooling system performance by 20%.
- The **twin-exhaust** creates a layer of fresh air between the exhaust fumes and the surrounding parts made of carbon-fibre. This helps maintain the carbon-fibre parts at a low temperature, thus ensuring their longevity.



LIGHTWEIGHT



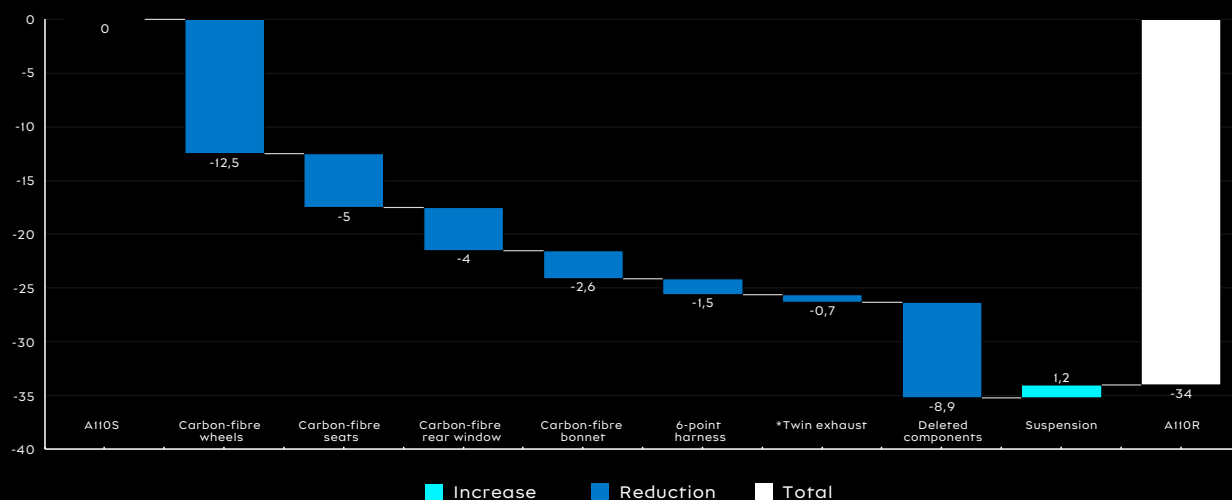
The All-new Alpine A110 R is a radical enough that we have been able to tackle a unique technical challenge head on: the car's weight, which we have dropped to a record-breaking 1,082 kilos. Thanks to the extensive use of carbon fibre, both outside and inside, the A110 R is the lightest of all existing Alpine A110 models. We managed to design a sleek and lean sport car, for ultimate driving sensations on both the track and open road."

FLORENT HUBERT

Lead Engineer Alpine Cars Body Parts and Composites



Alpine A110 R weighs even less, coming in at just 1,082kg. The carbon fibre materials designed by Carl Composite resulted sees the car weigh 24kg less than the A110 S. A further 10kg was lost by removing or redesigning certain key components. All in all, the Alpine A110 R weighs 34kg less than the A110 S.



- **The 100% carbon-fibre rims** developed with the supplier Duqueine help reduce the car's weight **by 12.5kg**. The rims are made up of two parts: while an identical 8-spoke structure is used on both front and rear wheels, the front features perforated flange for optimal brake cooling compared to a full flange at the rear for better aerodynamics.

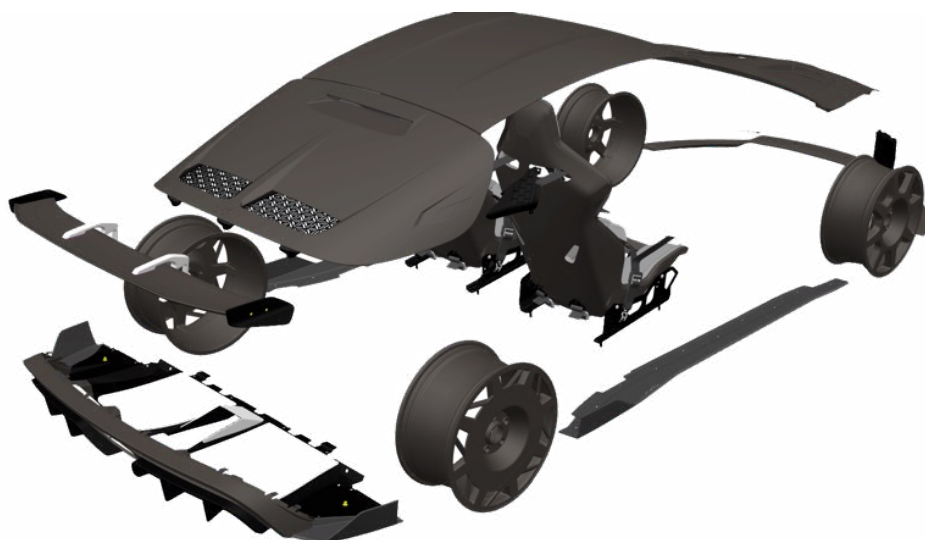


The front wheel (left),
and the rear wheel (right).

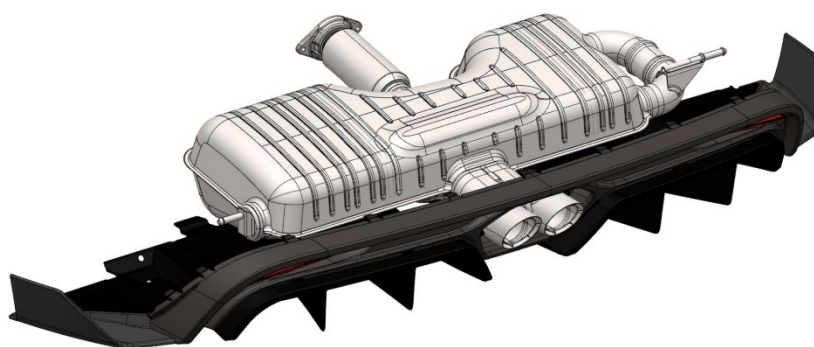
- **The 100% carbon fibre single-shell seats** are testament to the uniqueness of the Alpine A110 R and help considerably reduce its weight. The use of carbon fibre and the lighter design of the seat sliders make for a total reduction **of 5kg** on both seats. In replacing the seatbelt with a unique 6-point Sabelt harness safety system – very typical of race cars and boasting enhanced support – designers saved an additional **1.5kg**.



- **The rear window** is no longer glass, it is now entirely carbon fibre and opaque. To further reduce weight and avoid adding more parts, the air vent has been directly cut into the aluminium and sandwiched between the skin and the lining. All fixed parts, including the high-mount brake light, have been built into the rear window. For a total of **4kg** less weight.

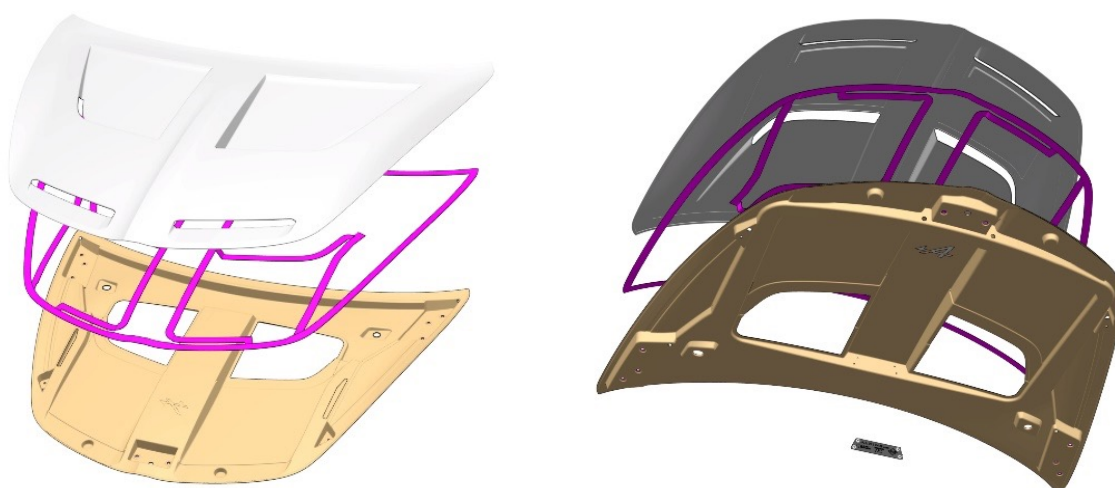


- The all-carbon fibre **bonnet** weighs only **3.9kg**, replacing the 6.5kg aluminium hood on the A110 S. That is a drop of **2.6kg**.
- **The exhaust system** has also undergone a transformation: the valve has been removed and twin exhaust has been 3D printed. The system weighs **0.7kg less**.
- Other parts such as the passenger-engine compartment partition glass, engine cover, and interior mirror have been removed to live up to the notion of being a radical car, boasting the most intense driving sensations. In total, the removed parts account for a total weight loss of **8.9kg**.
- New parts used for the bonnet and boot, redesigned diffuser, side flaps, swan neck wing stand, and side skirts not only give the car its unique, radical look, but they also help bring the car to Alpine's lightweight standards.



Twin exhaust and new diffuser

These exceptional results were achieved thanks to teams optimizing the function of each piece. All interior or exterior parts were designed with a precise goal in mind: no extra weight. For example, the air ducts on the front bonnet are created by the joining of the lining and the outer skin, thus avoiding adding two additional parts. Hinges, reinforcements, and connecting pieces were all designed to serve one purpose: create a high-performance car that harnesses Alpine's expertise and know-how in creating lightweight, agile vehicles.



Carbon-fibre front bonnet

The average thickness of a carbon-fibre part is less than 1mm and can even be as thin as 0.2mm in certain places. 200gsm twill carbon-fibre fabric has been used for decorative parts, while 630gsm twill is used where stronger fabric is needed. The use of carbon fibre throughout the vehicle, and the inclusion of tailor-made parts, places this model among the most efficient cars in its class, with an excellent weight-to-power ratio of 3.6kg/HP and 0-100km/h achieved in just 3.9 seconds.

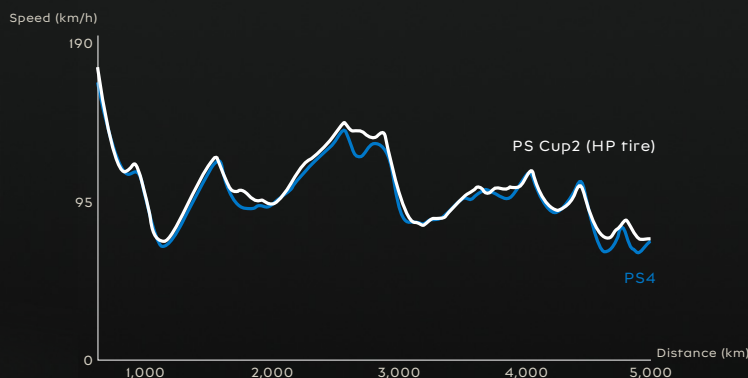
CHASSIS



For the All-new Alpine A110 R, we modified the car's entire suspension system to achieve maximum performance on the racetrack and the best in driving pleasure on the open road. It took thousands of kilometres and hundreds of hours on the closed circuit to develop the new chassis. We took it to a range of circuits in France and Europe, to teste, assess, and adjust the way the car handled in any temperature and any situation. Overall, we spent two-thirds of our time on the track and one-third on the open road to find the best set-up. The Alpine spirit is present in the car's every movement, both on the racetrack and the open road."

MAUD BOUVET & BASILE GRONFIER

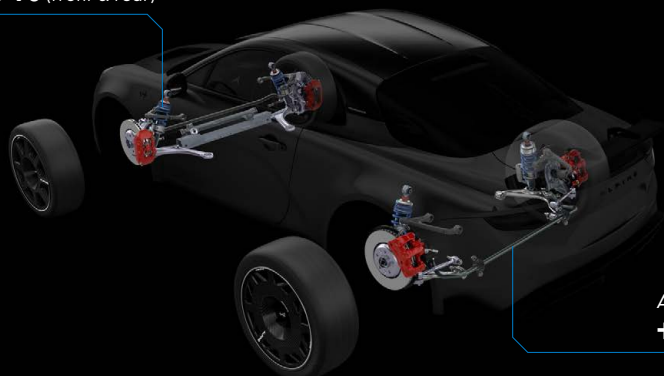
Vehicle Dynamics Engineers at Alpine



0,5s/km gain
vs Michelin PS4

The work done to the chassis goes hand in hand with the high-performance semi-slick Michelin Pilot Sport Cup 2 tires for a remarkable performance, running up to half a second faster than an A110 S on the racetrack.

Spring Stiffness
+10% (front & rear)



A110



A110 S



A110 R

Roll rate °/g

3,3

2,7

2,3

Anti Roll BAR
+10% (front) **+25%** (rear)

The numerous modifications and adjustments made to the body have also boosted the performance of this radical Alpine car. Thanks to a 10% increase in the stiffness of the front and rear suspension and anti-tilt bars (10% at the front and 25% at the rear), the roll rate (how the car responds to a corner) has been reduced by 15% compared to the A110 S, thus procuring the sort of absolute precision drivers are looking for. The geometry of the axles is also unique.

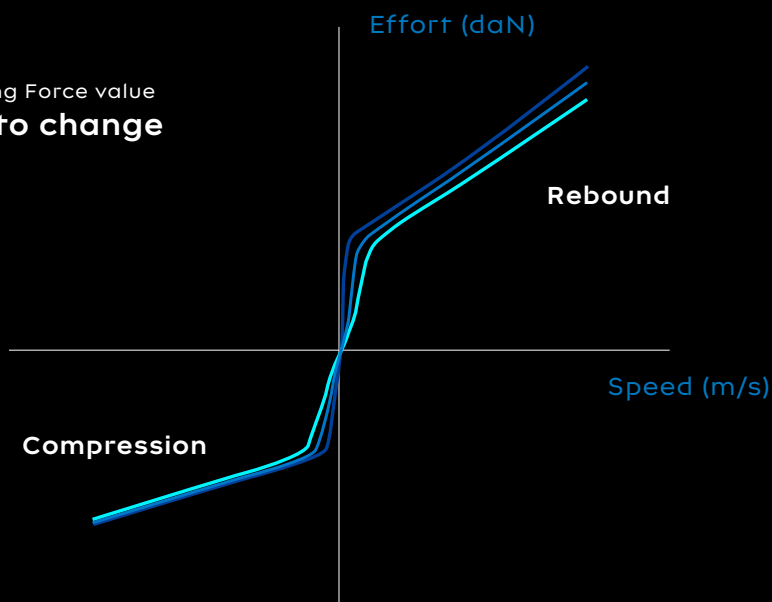
The Alpine A110R has been developed by engineers for use on the open road and on the racetrack, while still boasting maximum performance. To deliver on both points, the suspension has been designed to be adjusted in two ways.



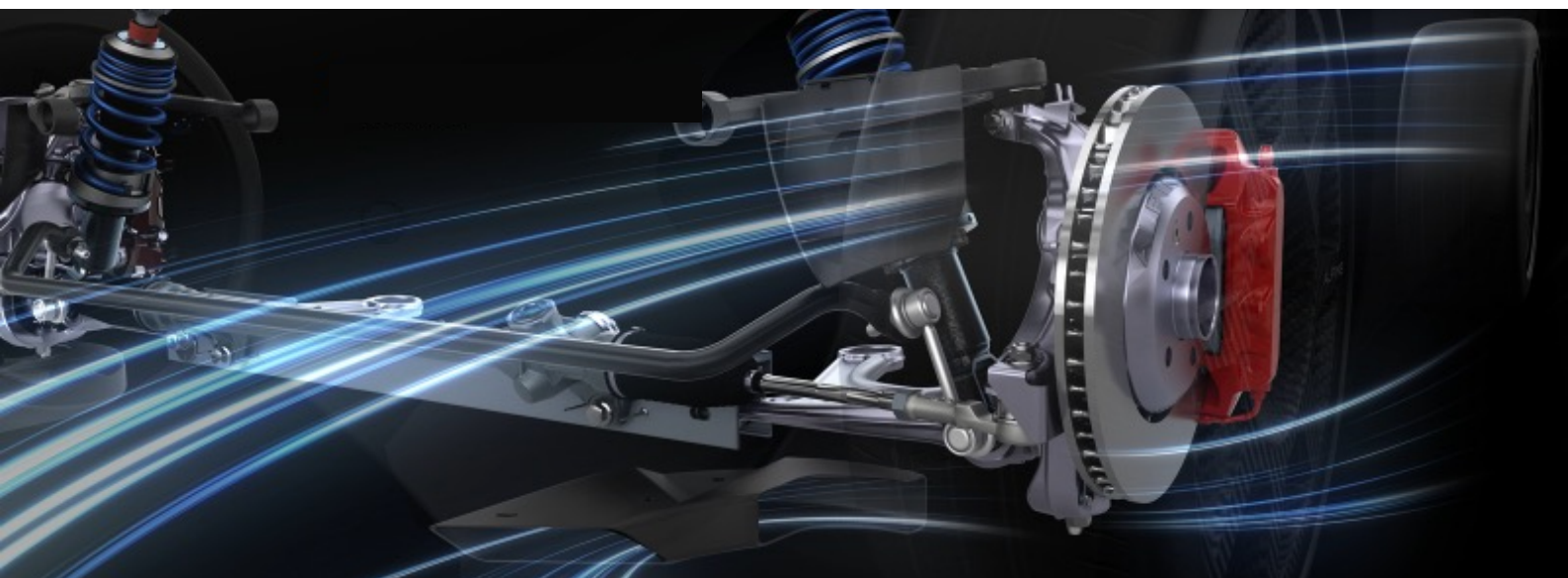
- First, the ride height. Leaving the factory, the car is 10mm lower than the A110 S. However, it can be lowered a further 10mm for track use only thanks to its threaded body and dual-nut locking mechanism. At the end of each track session, the car must be reverted back to its factory settings to be legally roadworthy.



Adjustable Damping Force value
**by 20 clicks to change
car balance**



- Second, the hydraulic settings of the shock absorbers. Straight from the world of racing, it is a 20-click adjustment of the system's compression and rebound. Multiple combinations are possible so drivers can choose the settings that really suit them. Each click of adjustment directly effects the car, altering its handling and balance. All the adjustments should be made starting from position '1', which corresponds to the stiffest setting, 20 being the softest. Adjustments change both the absorber's compression and rebound. Enthusiasts can adjust the settings to perfectly suit their own style.



Engineering worked with aerodynamics experts, thermal engineers, and test drivers to design a brake cooling system for the All-new Alpine A110 R. Consisting of two under-body ducts and two scoops attached to the upper triangle, the system redistributes cooler outside air to the brake discs, making it easier to cool them down. In addition to the new wheel caps that are more open on the front wheel than at the rear, brake cooling has increased by 20% for a longer, more intense experience on the track.



Two new carbon-fibre wheels have been designed and developed exclusively for the A110 R chassis. The wheels play a pivotal role in chassis development, in particular through work done to the unsprung weight - 12.5 kg lighter than the A110 S - and the tailor-made dynamic performance and mechanical fine-tuning (with specific targets for the new chassis).

Starting from scratch, the engineering teams imagined two different types of wheel for the front and rear, honing their cooling and aerodynamic performance. The wheels include carbon-fibre rims (the front different to the rear), mounted with structural carbon-fibre flanges (also different between the front and rear). By tweaking the patented flange's thickness and construction, drivers can focus entirely on fine tuning the vehicle down to the smallest detail. The Alpine test drivers' sensitivity and expertise is so keen that they saw the benefit in adjusting the thickness by 0.2 mm to create a stable, responsive vehicle, ideal for track driving!

Their constant input throughout the development phases helped bring about wheels that are very sophisticated and robust, and which have since undergone a series of resistance and durability tests to guarantee optimal performance, on the track and the open road.

Last but not least, work on the ESP unit was also a key part of chassis improvements. It has been specifically calibrated to meet the performance of the new chassis and perfectly suits the All-new A110 R with the same four driving modes: Normal, Sport, Track, and Off.



ACOUSTICS



Driving pleasure is a main feature at Alpine, and it is made up of the entire range of sensations customers feel when they are behind the wheel. Acoustics directly stimulate one of our five senses and play an essential part in conveying pleasure and emotions, especially in sports vehicles; it is even one of the most anticipated features. Be it upon ignition, during acceleration, deceleration, or when heel-toe shifting, the sound produced by the engine is essential: it is as if the car were talking to you.

And so it makes sense for Alpine to focus on it during the design development. Our objectives are based on our customers' expectations, and we make the right technical choices to bring them to life. For the A110 R, we had a clear idea from the outset: we wanted a car with its own personality and plenty of sensations. We looked at the work being done to the car's weight as an opportunity to subtly change the sound it made into something more demonstrative, while making sure it was still comfortable to drive every day."

LOUIS JEANNE

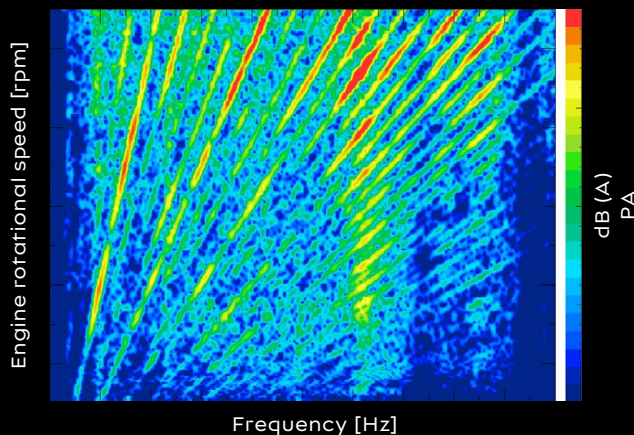
Acoustics Expert at Alpine

Technical modifications featured to the Alpine A110 R have significantly increased the presence of intake and exhaust noise in the passenger compartment, making it much clearer.

Below is a concrete example of what that means for the passenger compartment on the A110 R in the form of spectral analysis imagery:

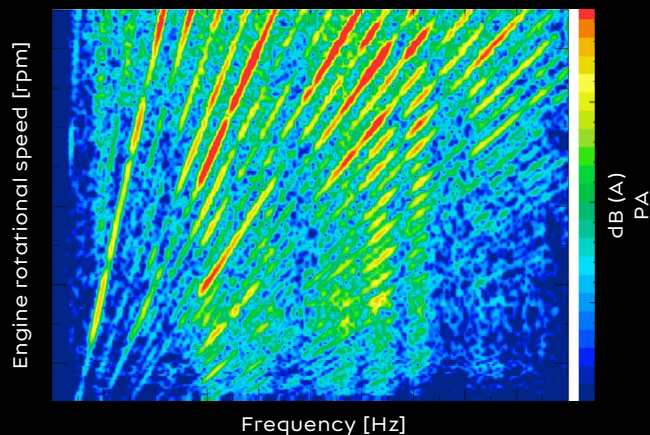
The A110 S inside sound

(blue = low level, red = high level)



The A110 R inside sound

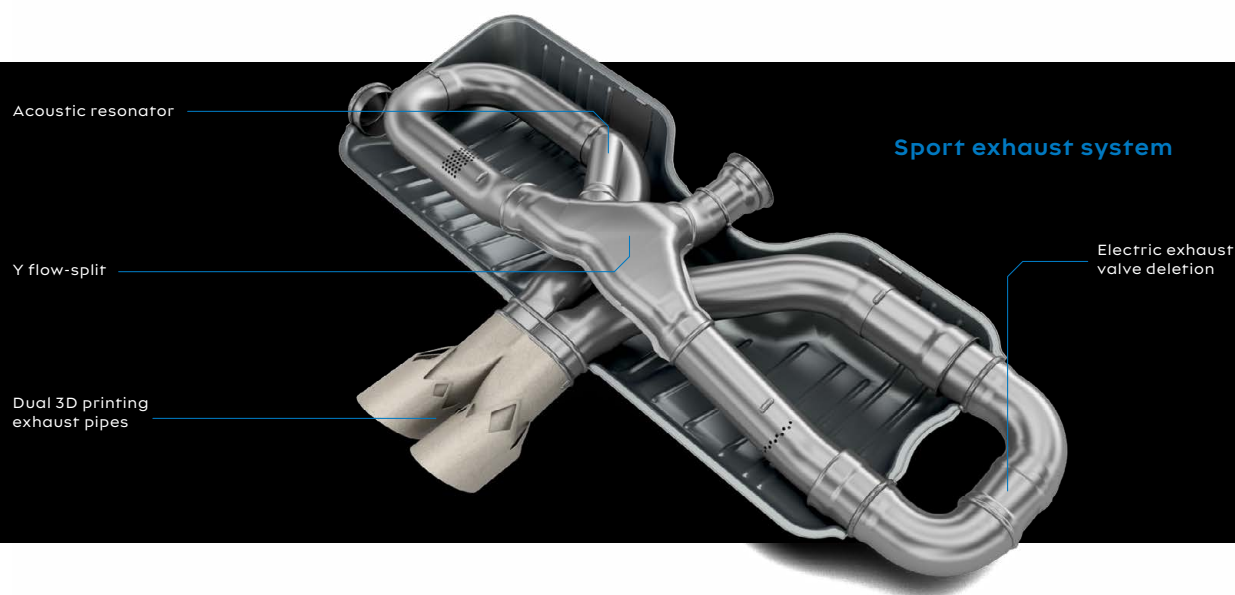
(blue = low level, red = high level)



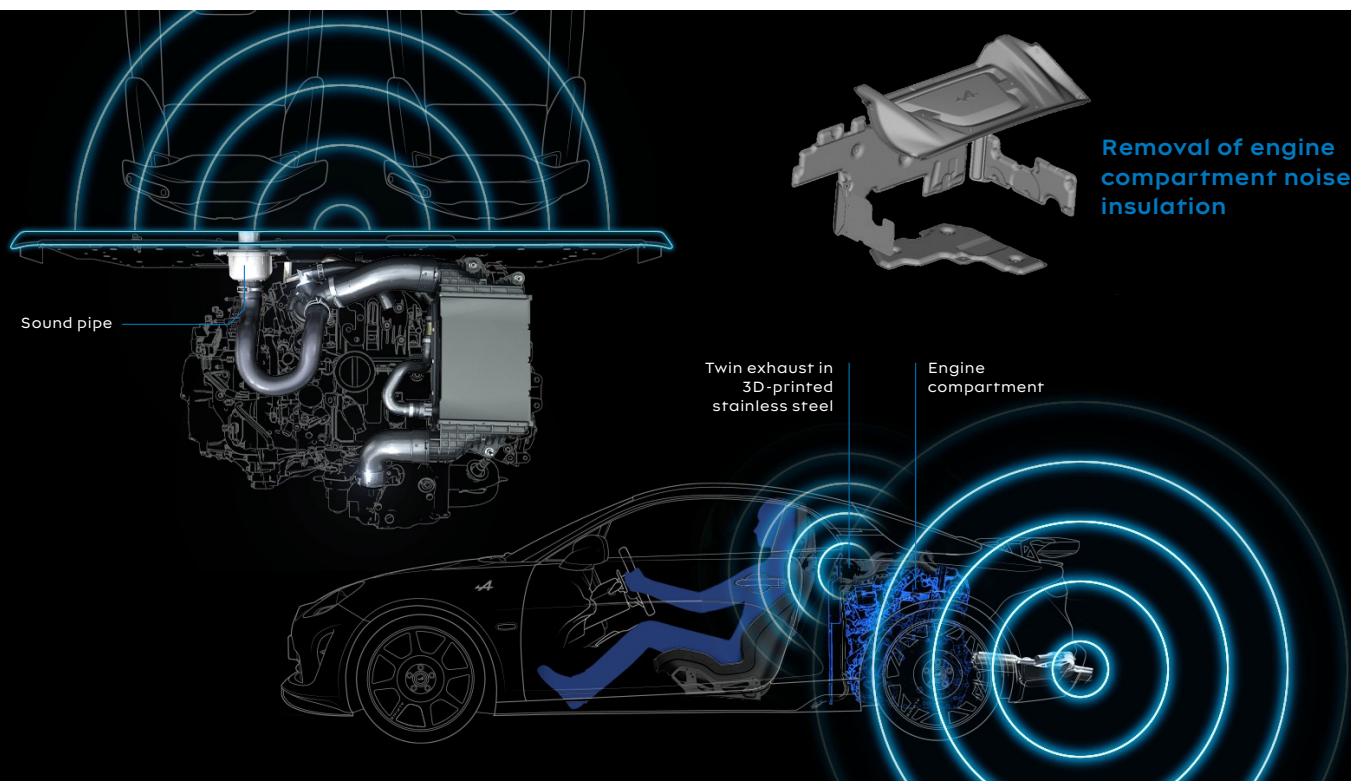
This sonogram shows the difference between the sound in the cabin of the A110 S and the A110 R. In total, the sound has been amplified by 2.6 dB in the Alpine A110 R.

The following parts and features played a major role in harmonizing the sound quality and amplifying the engine noise on board the Alpine A110 R:

- Rear panel with embossed aluminium plate instead of glass: influences acoustic transparency.
- Twin exhaust in 3D-printed stainless steel: provides a unique exhaust signature, its dimensions have been optimized to reduce the flow noise while improving the harmonics content.



- Sound pipe carried over from previous models: it makes for a brighter sound by incorporating more from the engine intake.
- Removal of engine compartment noise insulation: affects the acoustic transparency.



In total, the sports noise has been amplified by 2.6dB thereby giving the A110 R a unique sound signature.

CHARACTERISTICS		EXPLANATION	A110 R
Interior sporty sound	Global average [dB(A), dB _{ref} = 2.10 ⁻⁵ Pa]	Sound pressure level in dB (baseline 20 µPa). A-weighting = consideration of the sensitivity of the human ear as a function of frequencies.	+2,6 dB vs. A110 S
	500Hz octave average [dB, dB _{ref} = 2.10 ⁻⁵ Pa]	An octave is a frequency band where the upper limit is twice as high as the lower limit.	+2,9 dB vs. A110 S
	Spectral centre of gravity [Hz]	Characterizes how high a sound is on average.	+33 Hz vs. A110 S