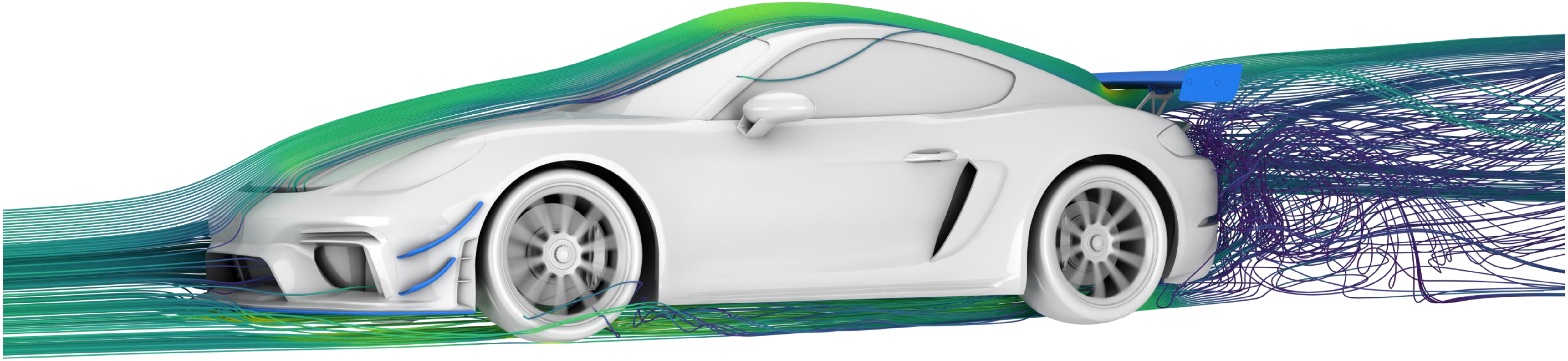
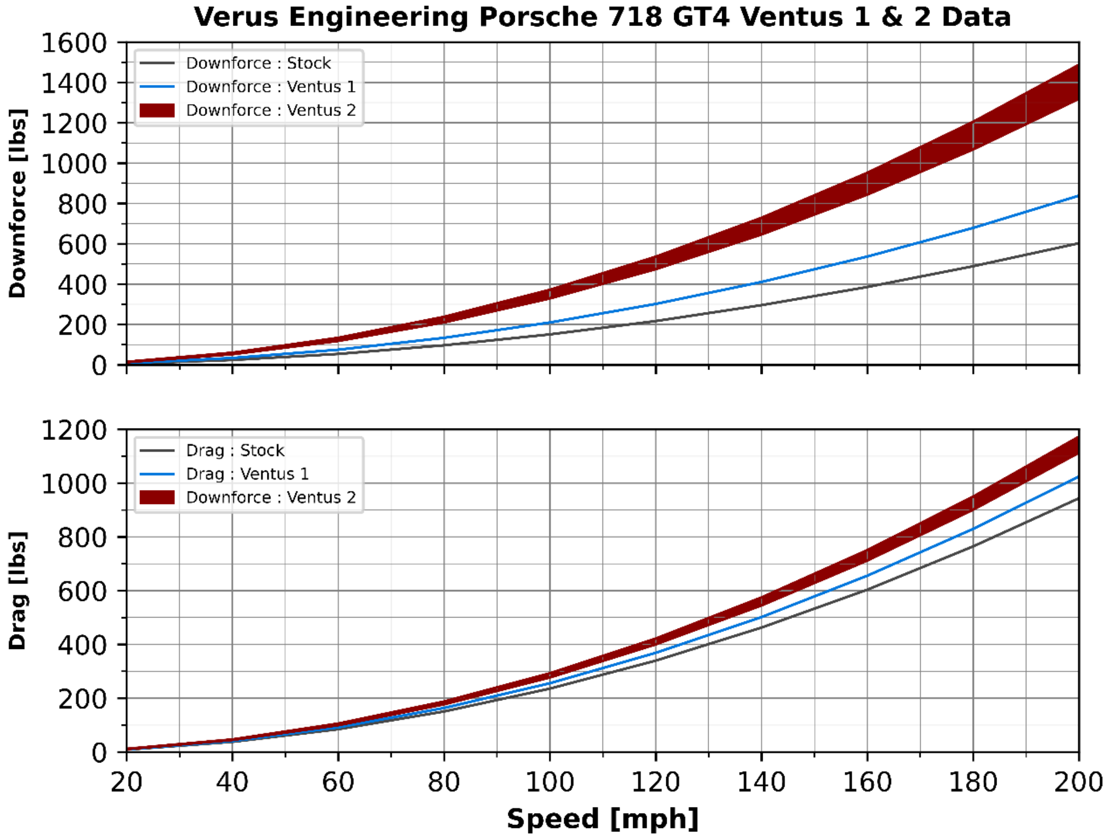


PORSCHE 718 GT4

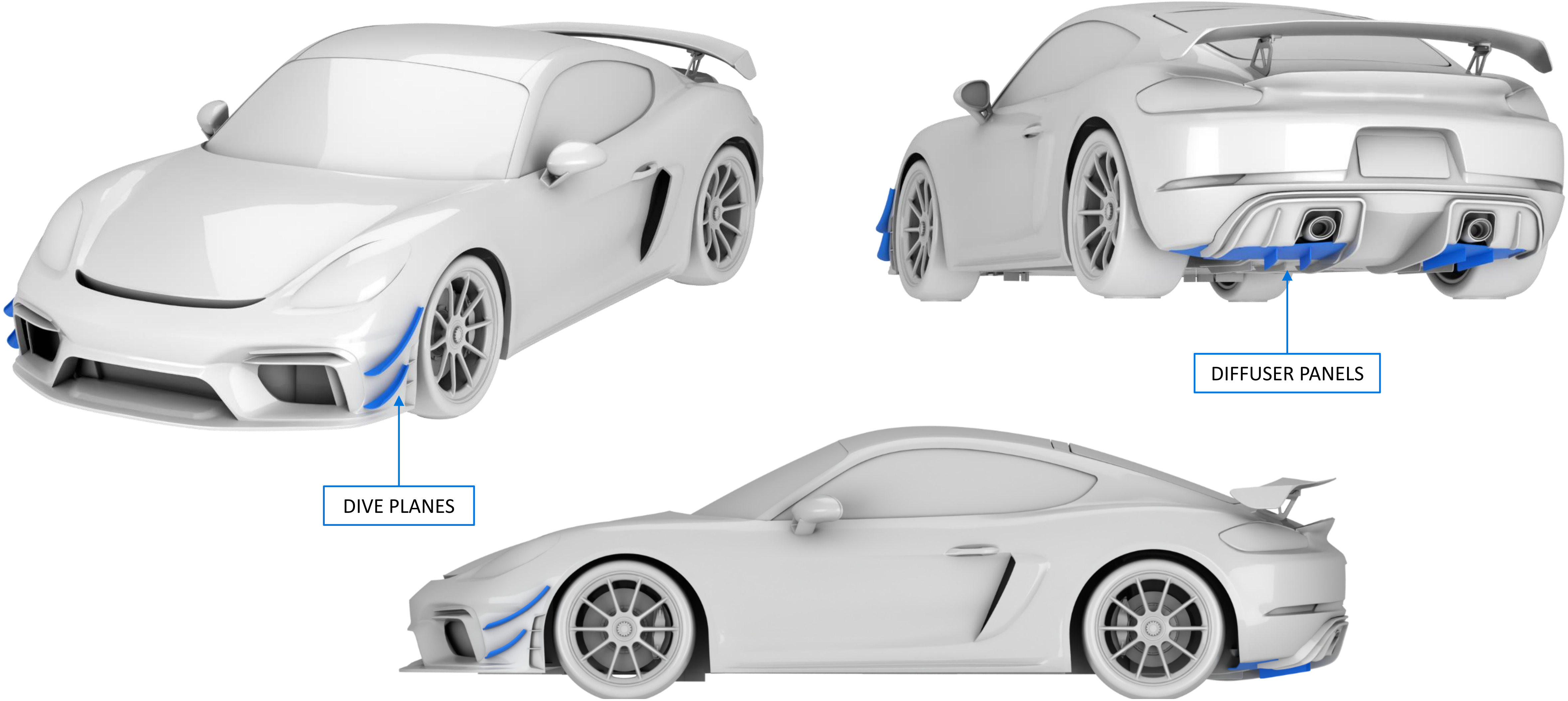
PERFORMANCE OF VERUS ENGINEERING'S VENTUS 1 & 2 PACKAGES

SUMMARY : AERODYNAMIC FORCES

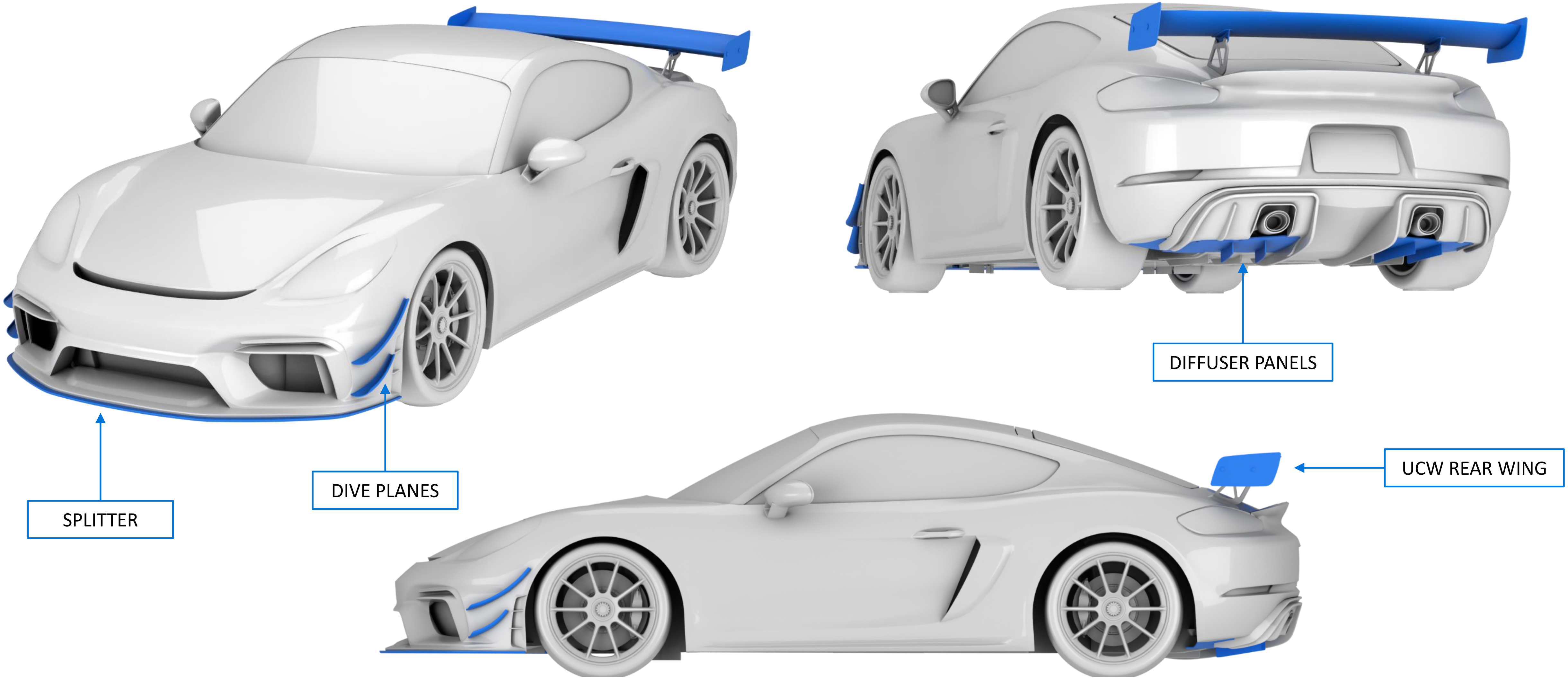
- Aerodynamic forces change with the square of the vehicle speed, which is why we use a graph.
- The Ventus 1 & 2 packages increases downforce over stock with minimal impact to drag.
- The Ventus 1 package uses the factory wing with the Verus Engineering Dive Planes and Exhaust Cover Diffusers.
- The Ventus 2 package with UCW wing is shown at a lower value of 5°, while the higher value is with the wing at 12.5° (with 80mm wing risers).
- AOA adjustment allows the driver to fine tune aerodynamic balance to his or her preference.
- The Ventus kits are designed and tested to make your 718 GT4 faster around the track.



VENTUS 1 PACKAGE



VENTUS 2 PACKAGE

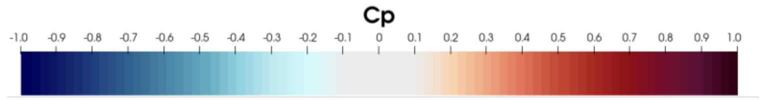


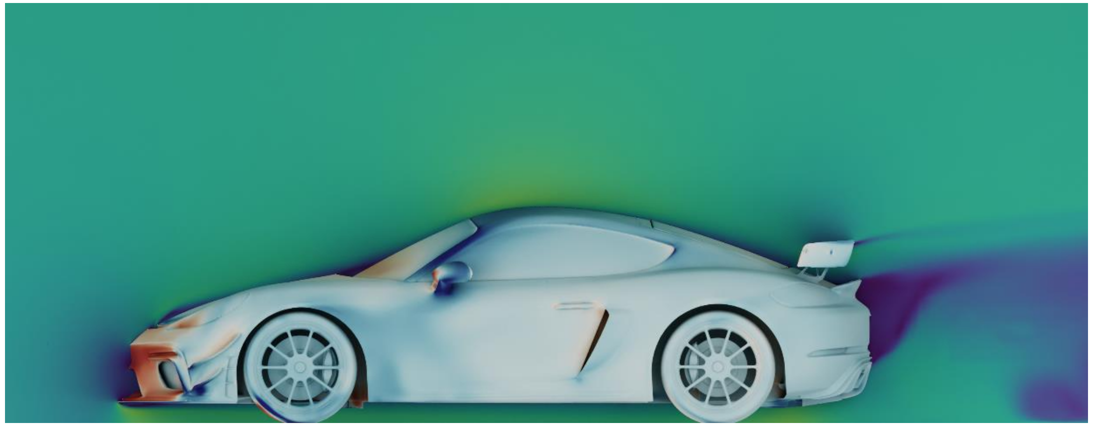
REAR WING: UCW

- The rear wing is great for customers looking for a large bump in rear downforce.
- The UCW wing profile was developed in CFD and refined in the wind tunnel.
- The airfoil produces efficient downforce on the 718 GT4.
- The bottom surface is where the majority of the downforce is generated. This low pressure pulls the car downward.
- The top surface still produces downforce, but not like the bottom surface.
- The wing bolts on like stock and is produced from 2x2 twill, pre-preg carbon fiber.

Note:

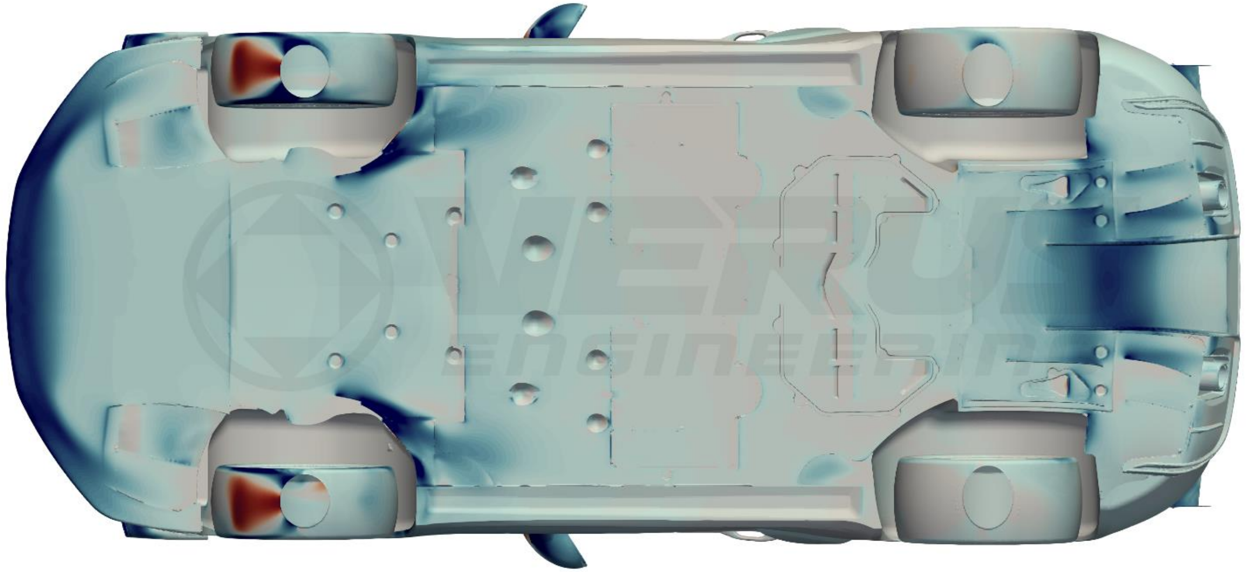
- If the angle of attack (AoA) of the wing will be set to greater than 7.5° it is recommended to use wing risers or taller mounts (+80mm or more).
- The low OEM mounts cause a detrimental interaction between the wing and airflow traveling down the rear hatch. At steep AoA this interaction causes flow to detach from the wing.
- This can be seen in images A & B. A shows UCW at OEM height and 12.5°, B shows UCW raised by 80mm and 12.5°

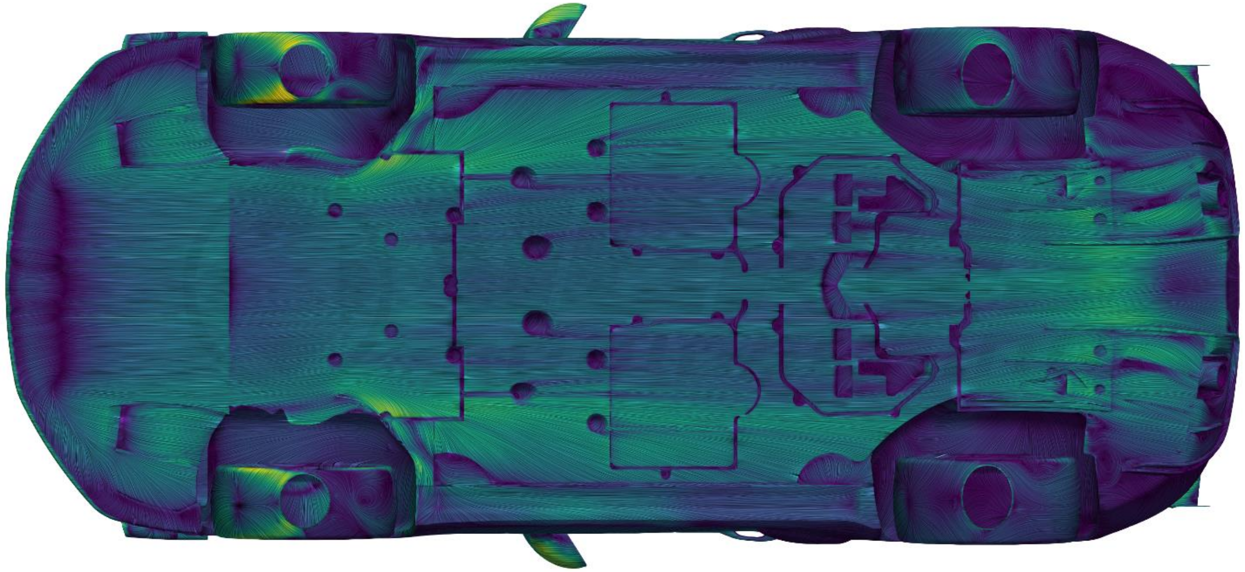




SPLITTER

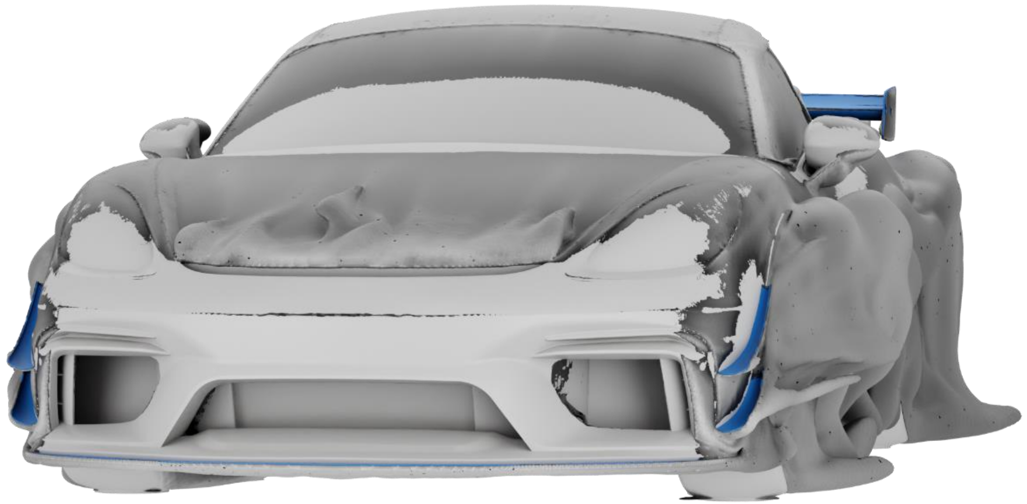
- The splitter is great for customers looking to generate significantly more front end downforce.
- The entire splitter assembly is modeled and simulated.
- Front splitters are a very efficient aero device.
- High pressure on the top side helps drive the splitter downward at speed.
- The bottom side, like the rear wing, produces more downforce than the top side.
- The bottom is designed to feed the factory splitter diffusers for improved performance.
- Our splitter is a motorsports grade composite material. Carbon polyweave is rigid while exhibiting excellent wear characteristics. Where traditional carbon fiber components may fail due to an impact, the carbon polyweave will not.

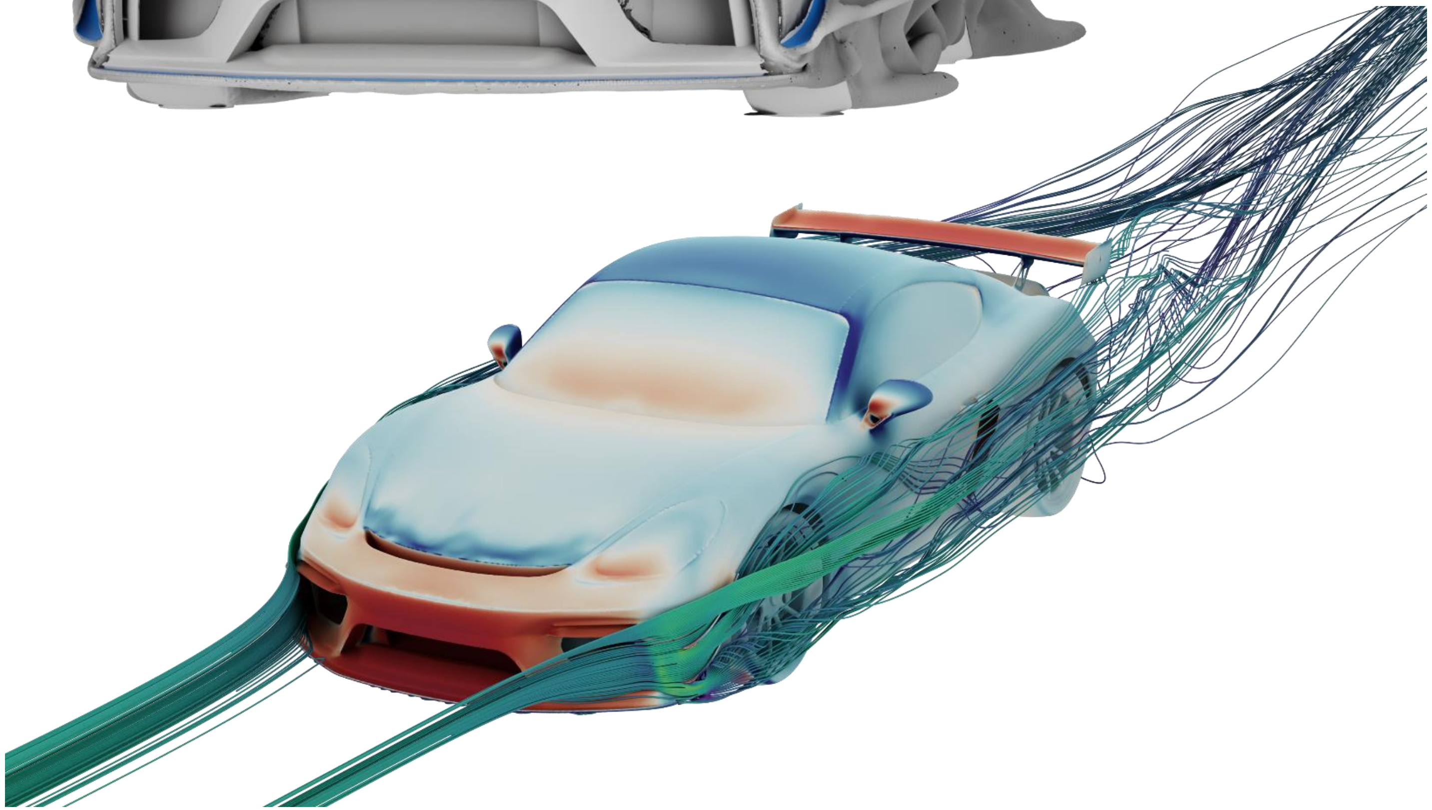




DIVE PLANES / CANARDS

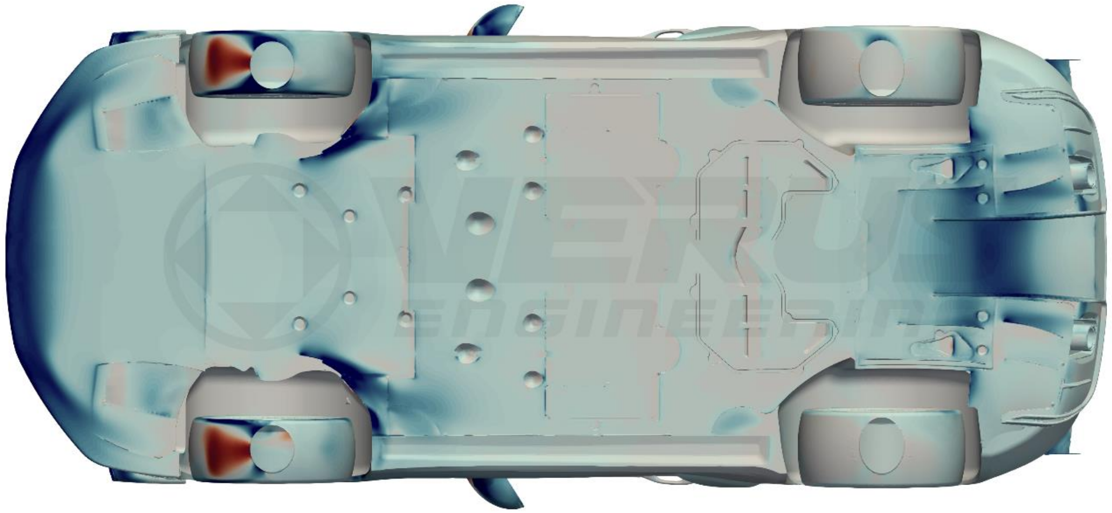
- Dive planes are great for customers looking for a slight bump in front downforce and no reduction in ground clearance.
- Verus Engineering develops dive planes to produce downforce by controlling the flow around the vehicle, not on the units themselves, improving efficacy.
- A small amount of downforce is produced on the units themselves, high pressure on top, low pressure on bottom.
- We develop the dive planes to create a beneficial vortex which helps evacuate the fenders.
- This evacuation reduces lift on the body, improving performance.
- The dive planes are produced from 2x2 twill carbon fiber finished in an automotive clear coat. Templates are supplied to ensure location of the units are correct.

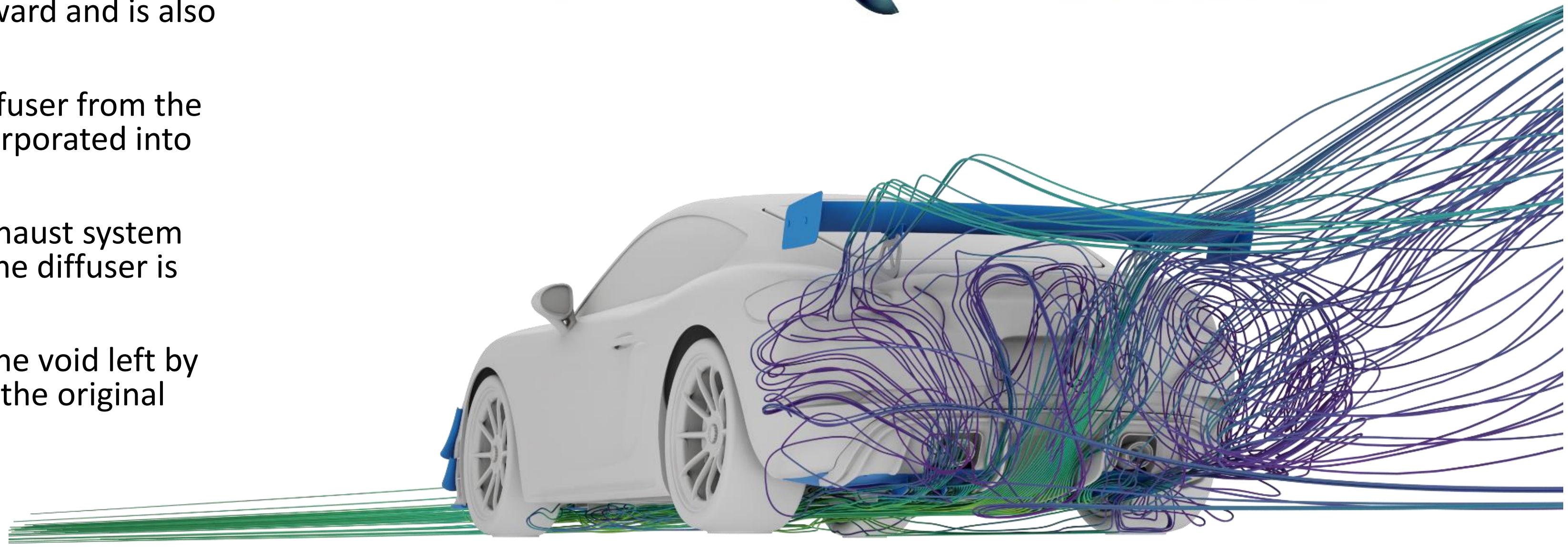




REAR DIFFUSERS / EXHAUST COVERS

- The rear diffuser is a key component in creating efficient vehicle downforce.
- The diffuser is perfect for street cars as it will add stability (downforce) *and* reduce drag, when designed properly.
- The diffuser functions by creating low pressure on the bottom surface and reduces drag by filling in the void behind the vehicle.
- A large portion of drag on road vehicles is pressure drag, which is the low pressure region behind the car.
- This low pressure wants to pull the car rearward and is also known as the wake region.
- The 718 GT4 comes with a well designed diffuser from the factory. However, the OEM mufflers are incorporated into the diffuser design.
- When a GT4 is fitted with an aftermarket exhaust system and a large open cavity is left, airflow over the diffuser is disturbed. This reduces its effectiveness.
- The Verus Engineering Rear Diffusers fill in the void left by the OEM mufflers, improving the efficacy of the original design.





SUMMARY / GENERAL

- The Ventus kits are designed to decrease lap times utilizing well developed and functional aerodynamic components.
- The products feature an OEM like fit and finish with **zero permanent modifications** to the vehicles.
- The components increase vehicle performance.
- **No engine modifications means you retain the factory drivetrain warranty!**
- The R&D was done using cutting edge technology in CFD, wind tunnel testing, track testing with a professional driver, and proven designs from past work.
- Individual components can be installed without the full package, though to ensure a safe balance, we recommend the packages.

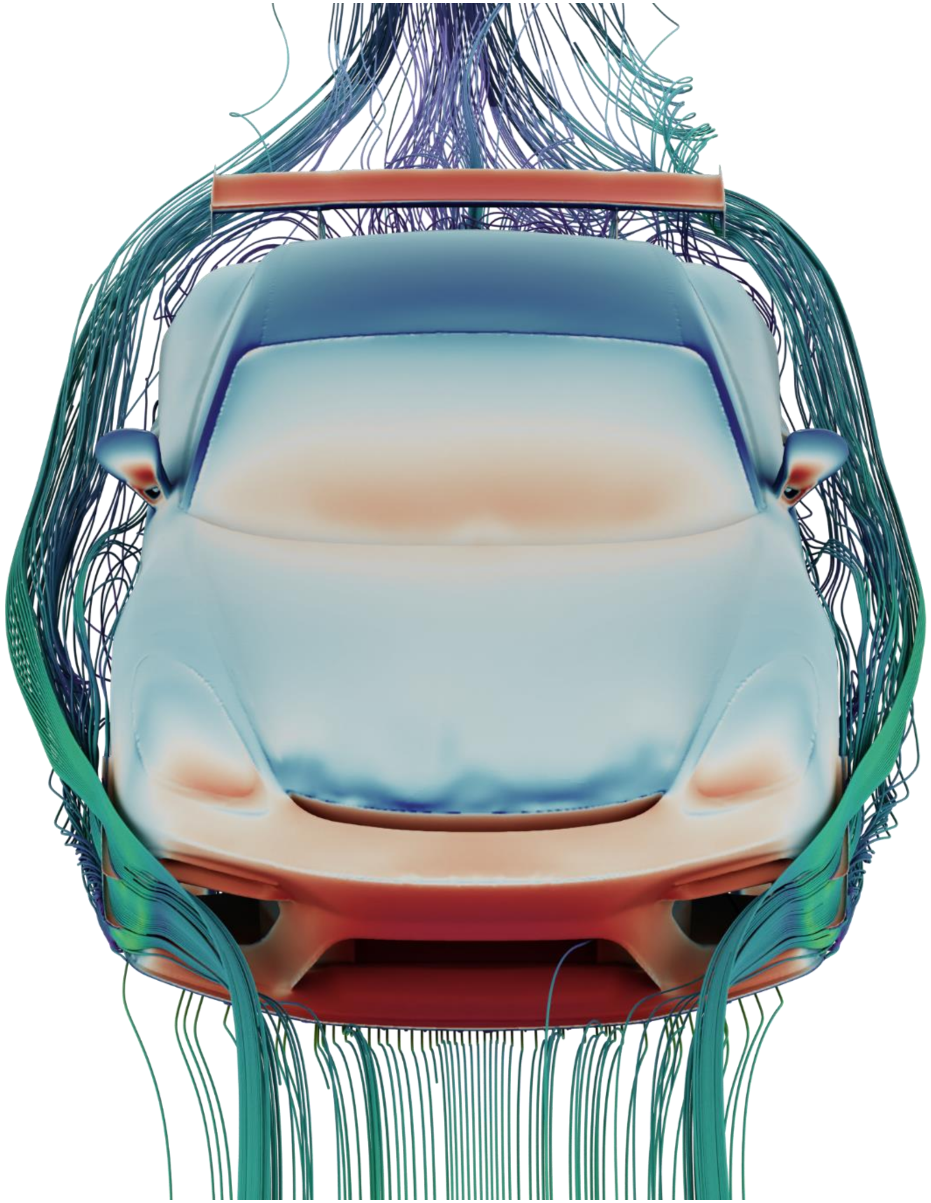
QUALITY OF CAD MODEL

- The CAD model is a crucial aspect of accuracy.
- Bad inputs result in bad outputs.
- The CFD simulation is only as good as the geometry and setup of the CFD analysis.
- The 718 GT4 was scanned in house and a 3D CAD model was created from this scan.
- The image to the right shows the overlay of the CAD model (gray) and the scan (blue).
- The surfaces are less than 1mm off from the actual scan model in the “worst” locations, with most of the car being less than this.
- Through ducts and radiator ducting were modeled for improved analysis accuracy.

THE SCIENCE

The development was done using OpenFOAM v2106 which is a finite volume CFD software. The solver was SIMPLE and the turbulence model was K-Omega SST using standard wall conditions. We use standard automotive arrangement when setting up boundary conditions and running a full-car. Most of the cases simulated used a slight yawed airflow of 0.5 degrees. This yawed airflow is to ensure we are not analyzing a condition the car will almost never see which is perfectly straight airflow down the length of the car. Other ride heights and yaw rates were also used to simulate cornering.

The use of porous flow was used for all the cooling stacks on the car. The darcy-forchheimer values used were based on past work of similar radiators/heat exchangers. All three coolers in the front were used for the porous flow.



DEFINITIONS

1. **Coefficient of Pressure (Cp)** = This is a dimensionless number which describes relative pressure to atmospheric pressure. A Cp of 0 equates to atmospheric pressure while a number below 0 represents low pressure and a number above 0 represents high pressure.
2. **CpX** = This is a dimensionless number which describes Cp normal to the x-direction. This helps us visualize locations which create drag. Red represents locations which are creating drag, while blue represents locations where thrust is created.
3. **CpZ** = This is a dimensionless number which describes Cp normal to the z-direction. This helps us visualize location which create downforce or lift. Red represents locations which are creating lift, while blue represents locations where downforce is created.
4. **Total Pressure Coefficient (CpT)** = This is a dimensionless number which describes total energy of the airstream. It is the sum of static pressure and dynamic pressure.
5. **Wall Shear** = This is a force per unit area due to fluid friction on the wall. This is used to visualize areas of separation and rapid changes on the surface.
6. **LIC Plot** = Line integral convolution (LIC) is used to visualize “oil” flow on the surface. It is a great way to correlate to flow vis testing and to study the flow on the surface of the vehicle.
7. **Streamline** = These are fluid tracers which are used to visualize where the air is going or coming from. These are normally colored as velocity where red is high-velocity and blue is low-velocity.
8. **Points** = One point is considered 0.001 of a coefficient. This is used in coefficient of drag (Cd) and coefficient of lift (Cl).