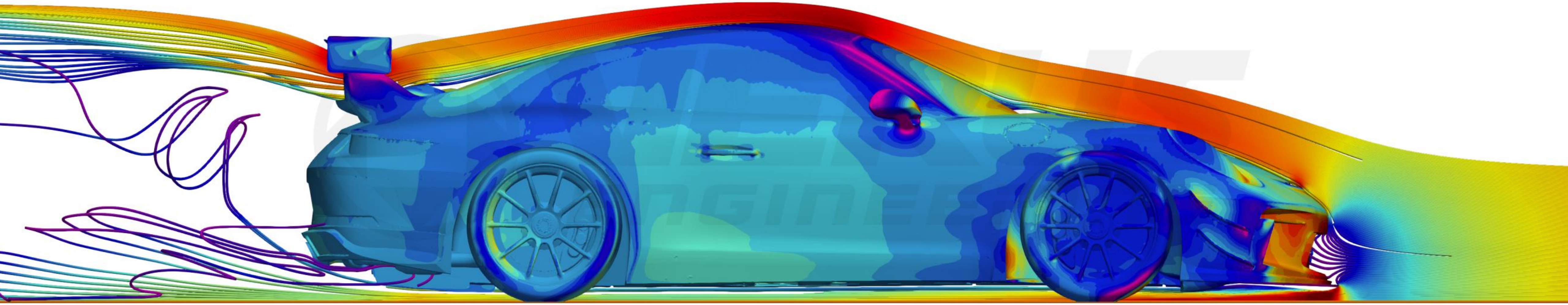
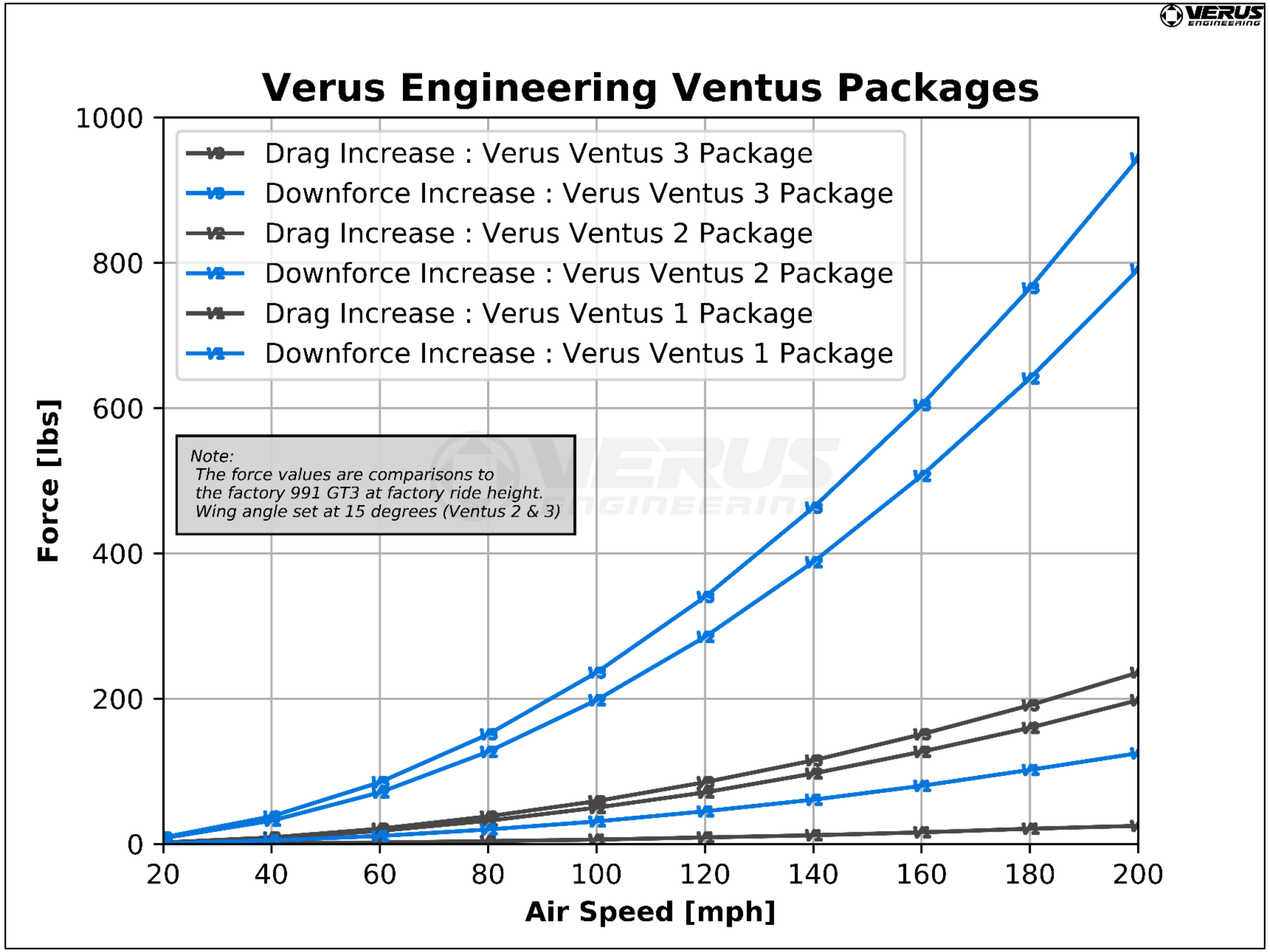


991 PORSCHE GT3

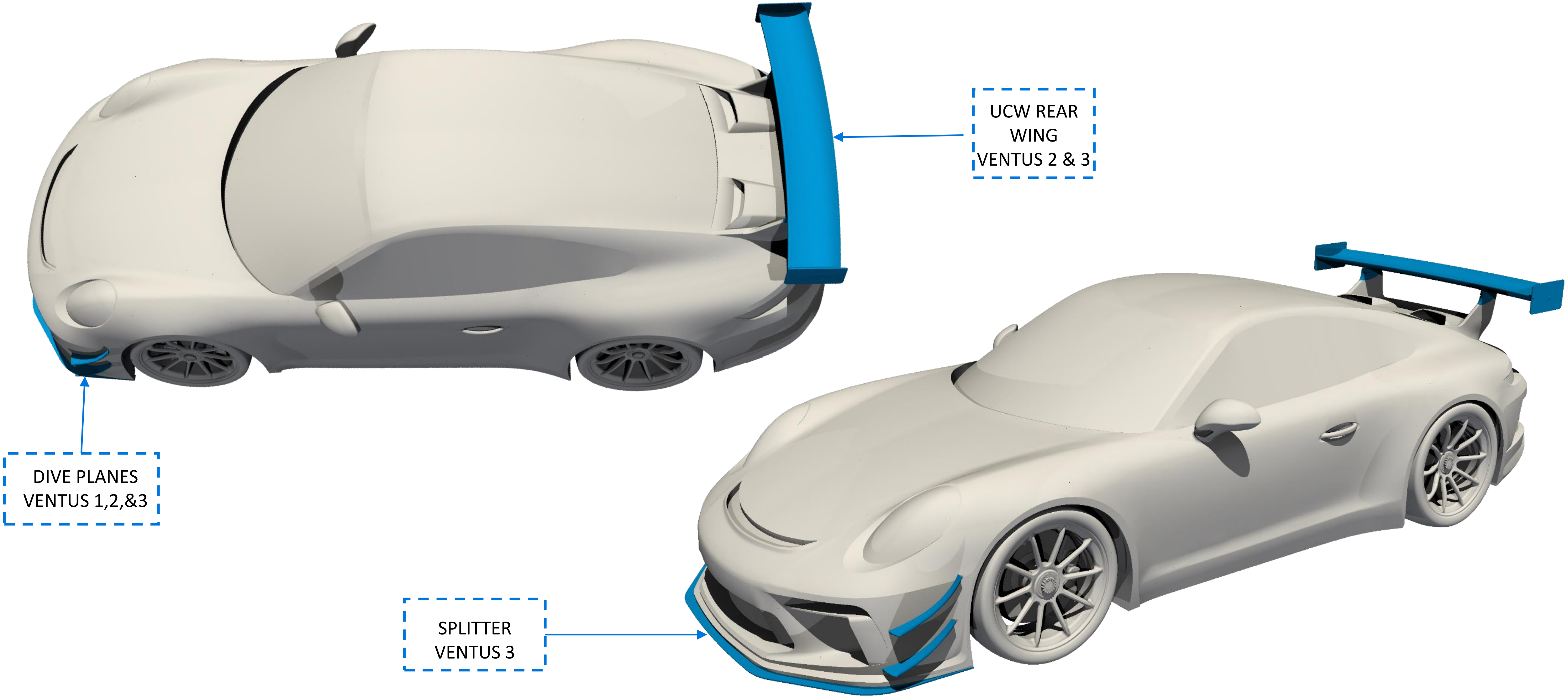
PERFORMANCE OF VERUS ENGINEERING'S VENTUS PACKAGES

SUMMARY : AERODYNAMIC FORCES

- Aerodynamic forces change with the square of the vehicle speed, which is why we use a graph.
- The Ventus 1, 2, and 3 packages increases downforce over stock with minimal impact to drag.
- When developing an aerodynamic package, Verus Engineering focuses on maximizing efficiency.
- Efficient downforce decreases lap times and improves vehicle performance.
- AOA adjustment, shown on a later slide, allows the driver to fine tune aerodynamic balance to his or her preference.
- The Ventus kit is designed and tested to make your 991 GT3 faster around the track.

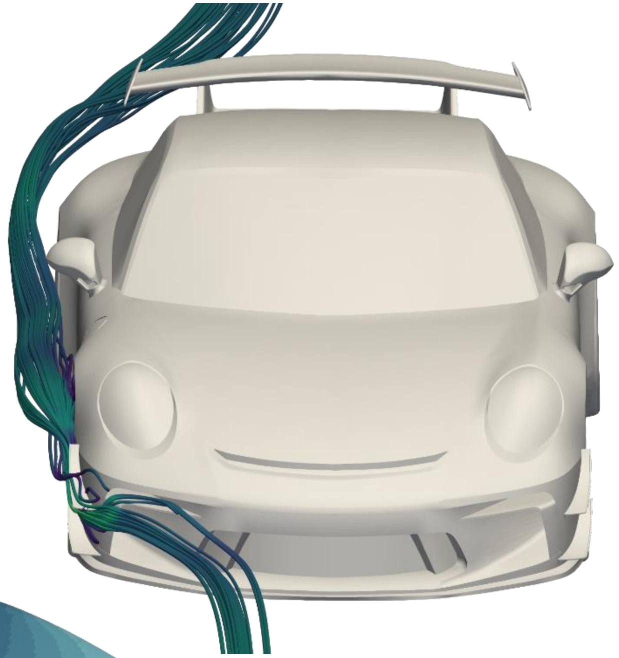


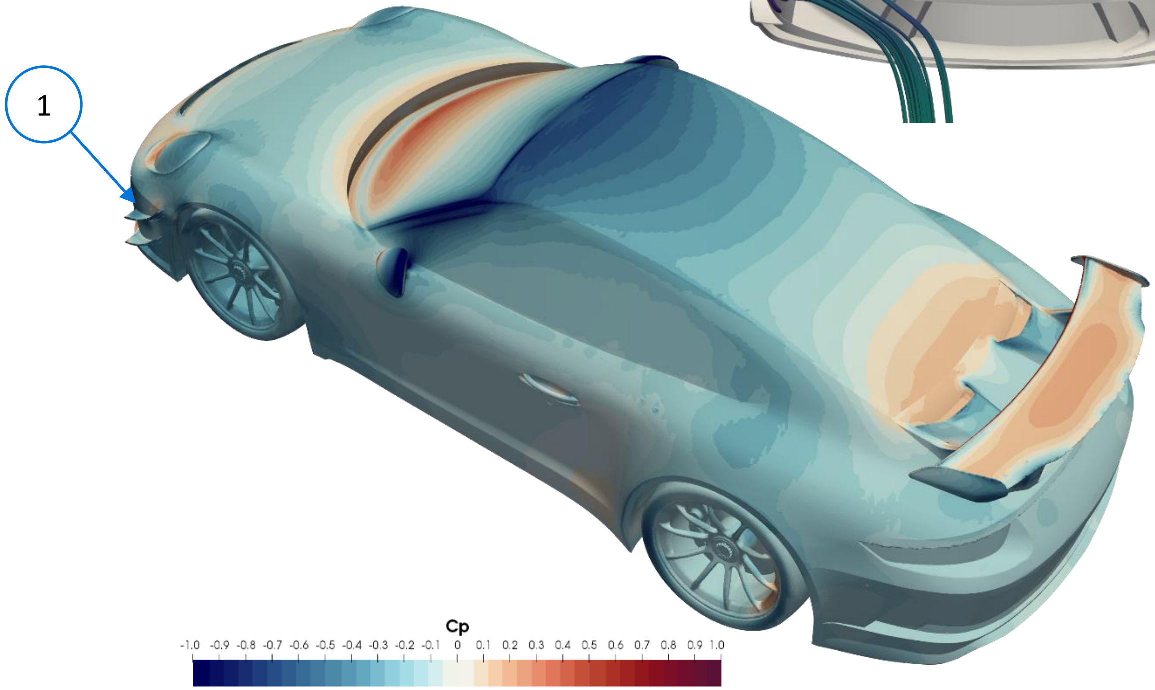
VENTUS PACKAGES



DIVE PLANES / CANARDS

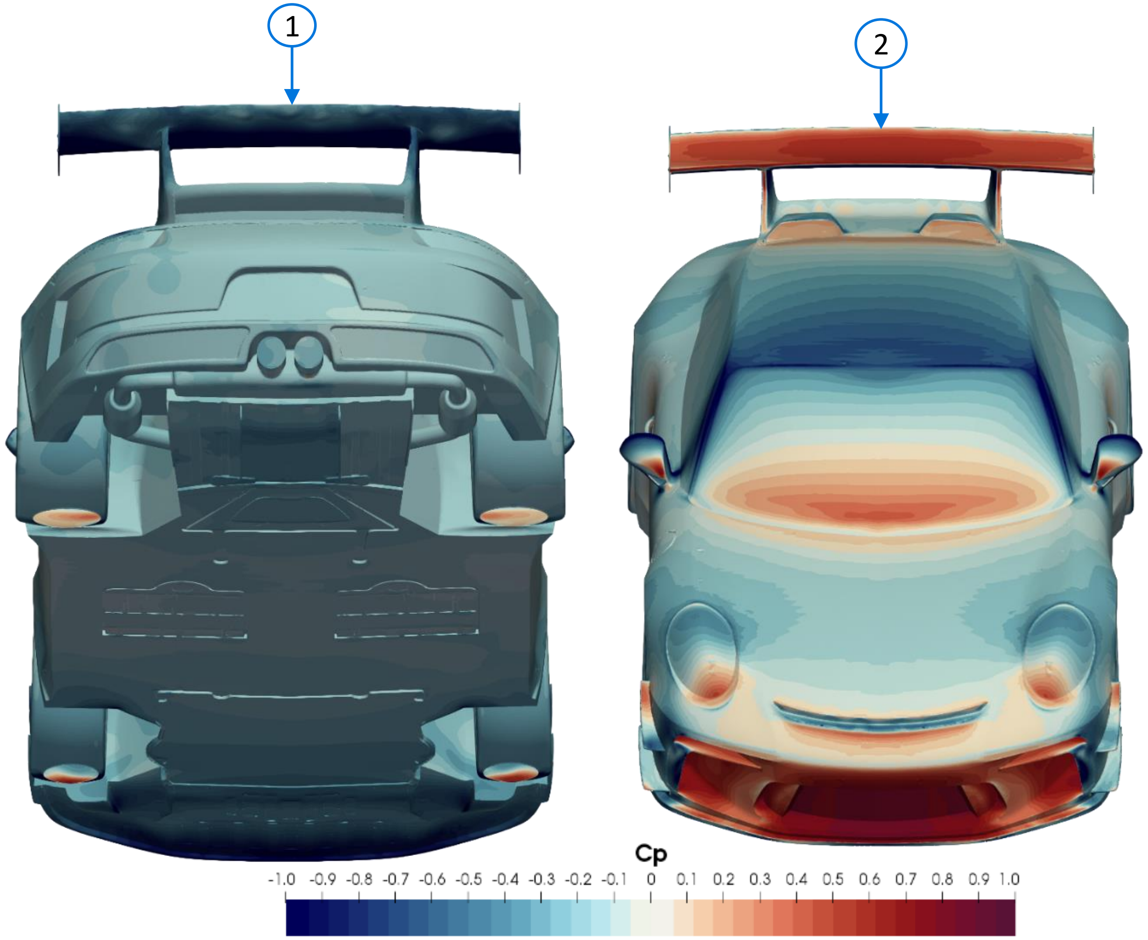
- Dive planes are great for customers looking for a slight bump in front downforce and no reduction in ground clearance.
- Verus Engineering develops dive planes to produce downforce by controlling the flow around the vehicle, not on the units themselves, improving efficacy.
- A small amount of downforce 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.





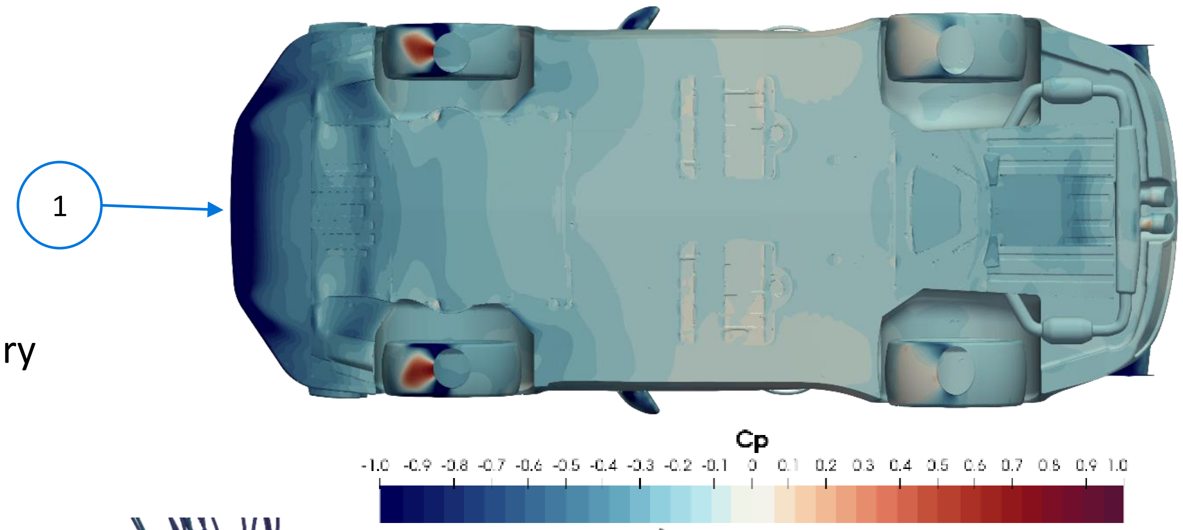
REAR WING : UCW

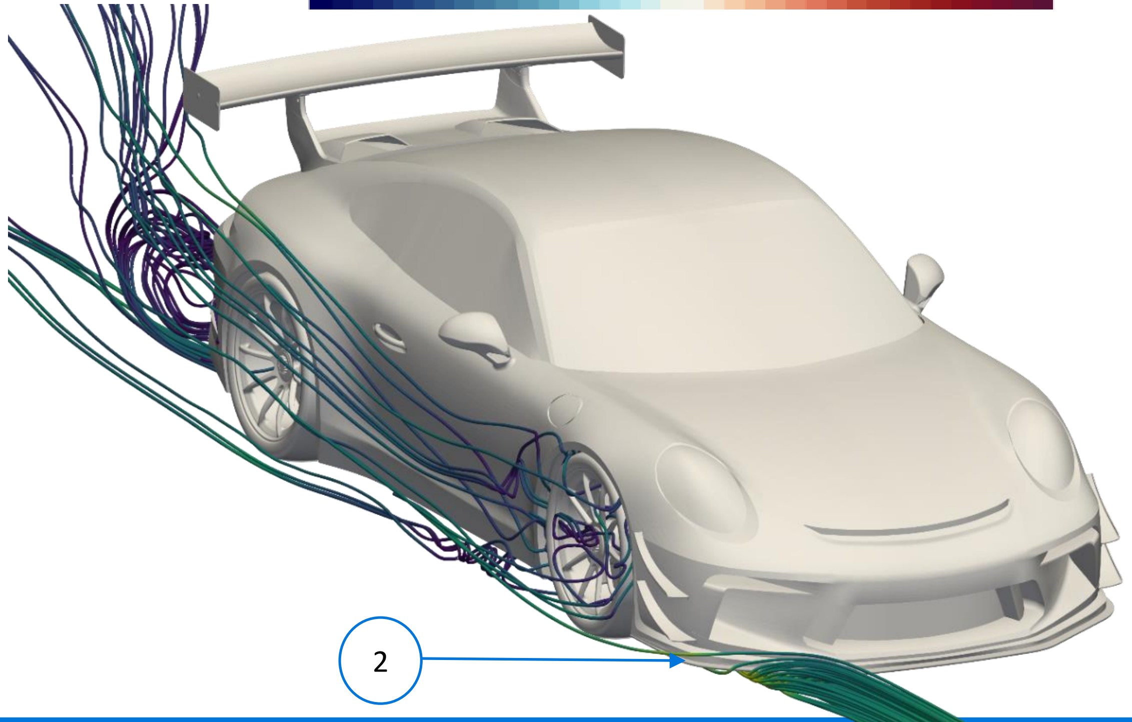
- The rear wing is great for customers looking for a large bump in rear downforce.
- The UCW wing profile was developed in CFD and refined in the wind tunnel.
- The airfoil produces efficient downforce on the 991 GT3.
- The bottom surface is where the majority of the downforce is generated. This low pressure pulls the car downward (#1)
- The top surface still produces downforce, but not like the bottom surface (#2)
- The Cp (coefficient of pressure) does not go above 0.7 on the top, but the bottom goes below -1.
- The wing bolts on like stock and is produced from 2x2 twill, pre-preg carbon fiber. It is adjustable from 5 to 15 degrees AOA.



SPLITTER

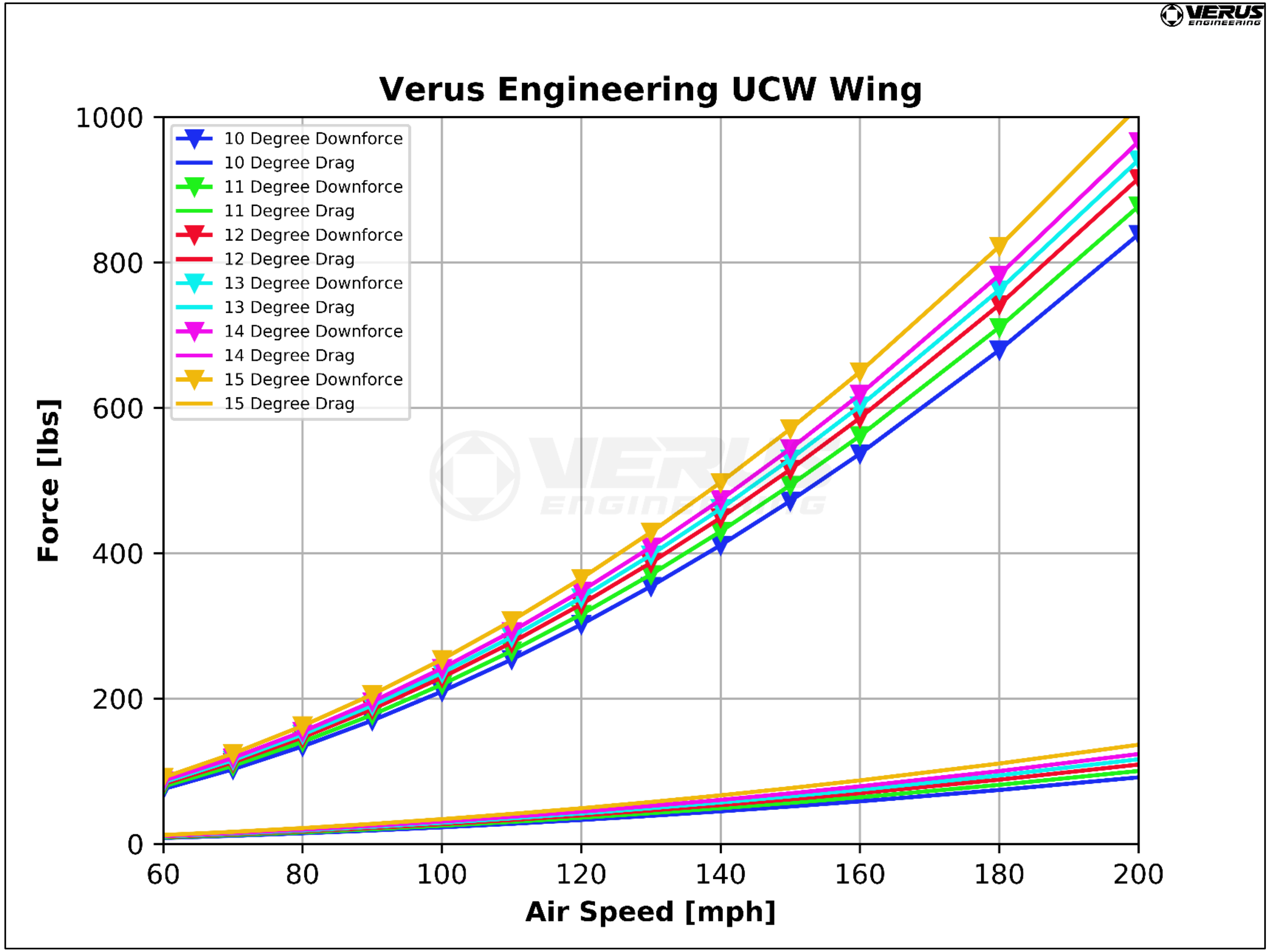
- The splitter is great for customers looking to generate significantly more front end downforce.
- The entire splitter assembly is modeled and simulated.
- The splitter has an efficiency (L/D, Lift Over Drag) of 45. This is a very efficient aero device.
- High pressure on the top side helps drive the splitter downward at speed
- The bottom side, like the rear wing, produces more downforce than the top side. The peak low pressure zone is shown at #1.
- A vortex is formed on the leading edge of splitter and moves out and rearward. This causes a large low pressure zone which creates downforce, and is shown as #2.
- 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.





SUMMARY : REAR WING FORCES (PART OF VENTUS 2 & 3 PACKAGE)

- The UCW wing can be adjusted anywhere between 5 and 15 degrees AOA, with the two different uprights included in the kit.
- This can be used to tune the aerodynamic balance to the driver's preference.
- Uprights are machined from 6061-T6 aluminum and bolt onto the factory location like the factory wing.

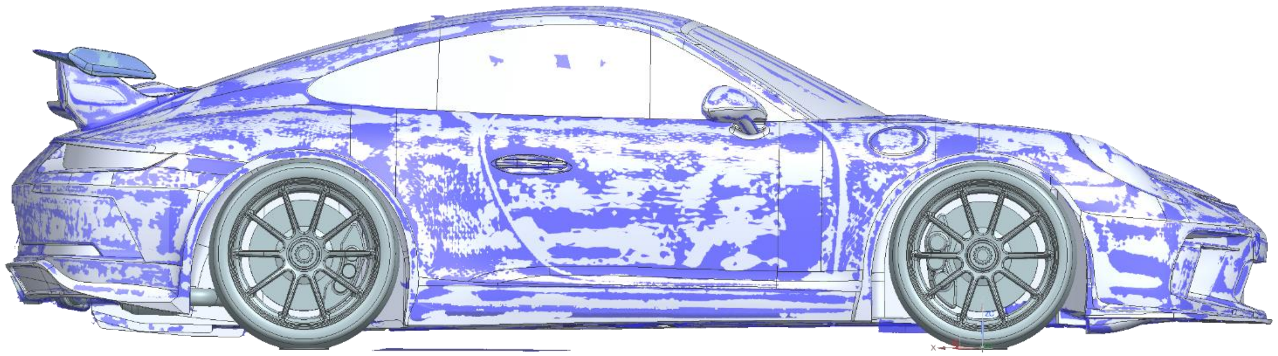


SUMMARY

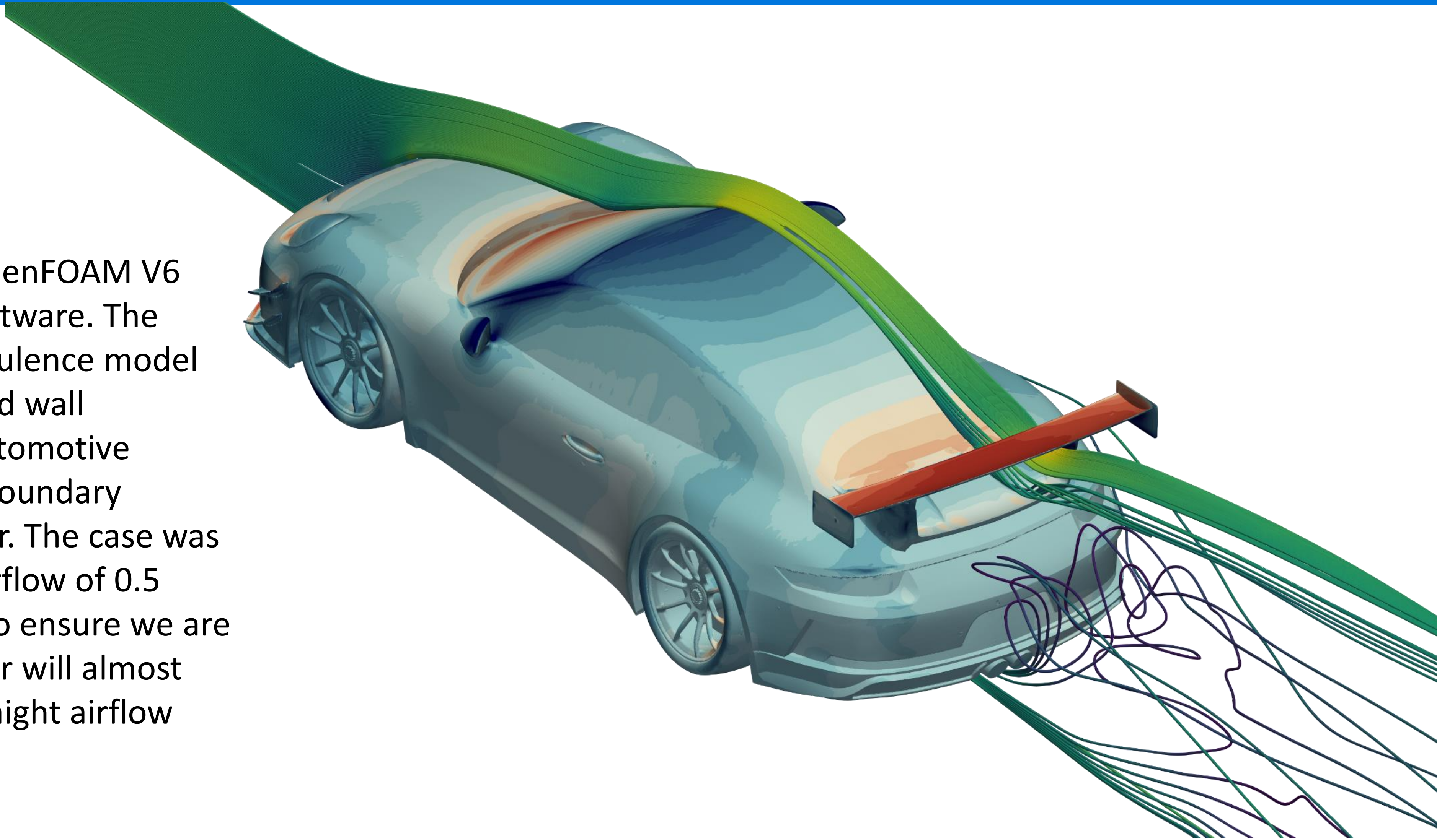
- The Ventus kits are designed to decrease lap times utilizing well developed and functional aerodynamic components.
- The products feature an OEM like fit and finish with **zero permanent modifications** to the vehicles.
- The components increase vehicle performance.
- **No engine modifications means 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 image to the right shows the overlay of the CAD model (gray) and the scan (blue).
- The surfaces are less than .7mm 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



This analysis was done using OpenFOAM V6 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. The case was simulated using 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.

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).