C8 CORVETTE – Z06

PERFORMANCE OF VERUS ENGINEERING VENTUS PACKAGES

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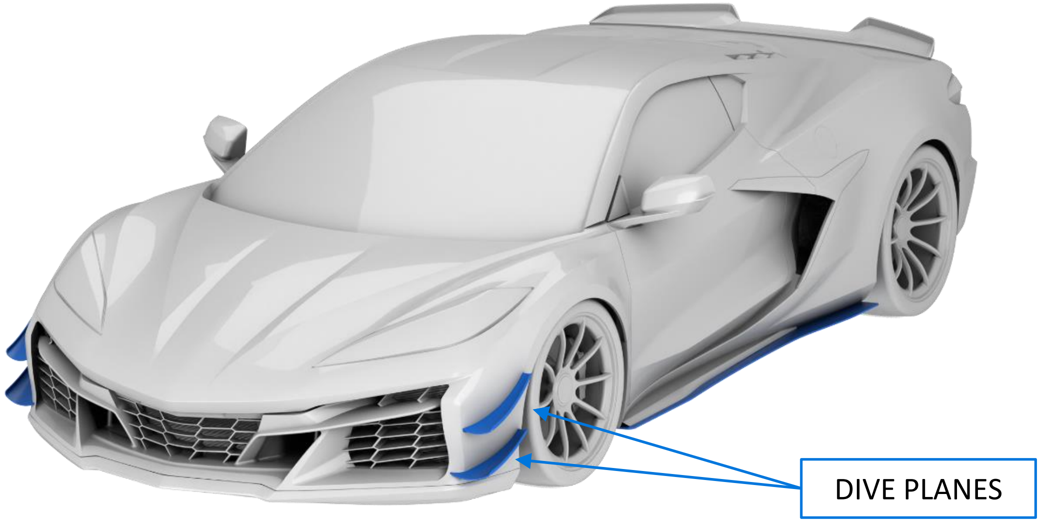
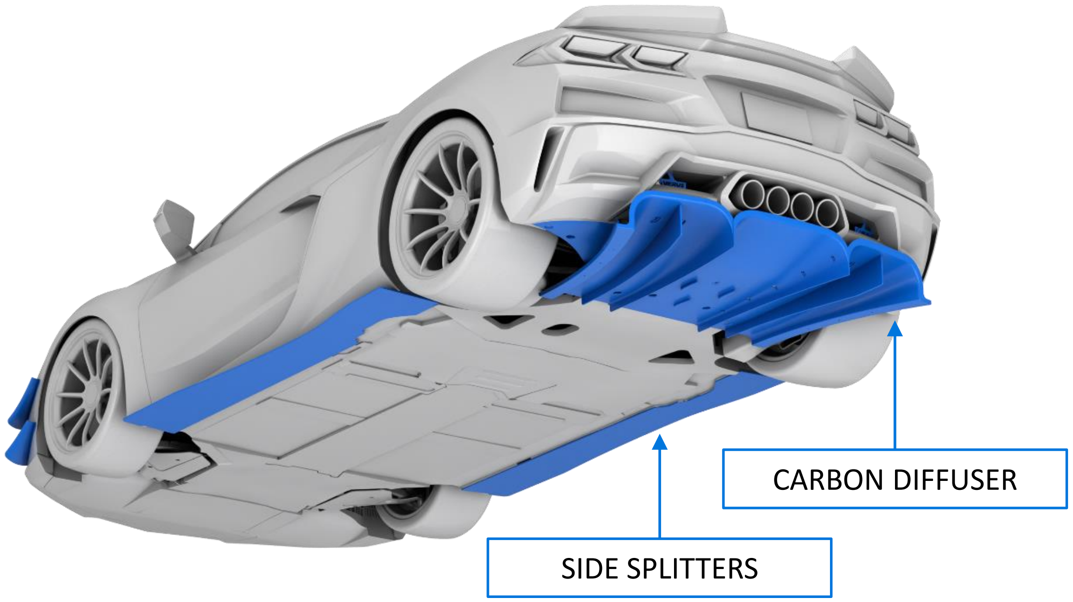
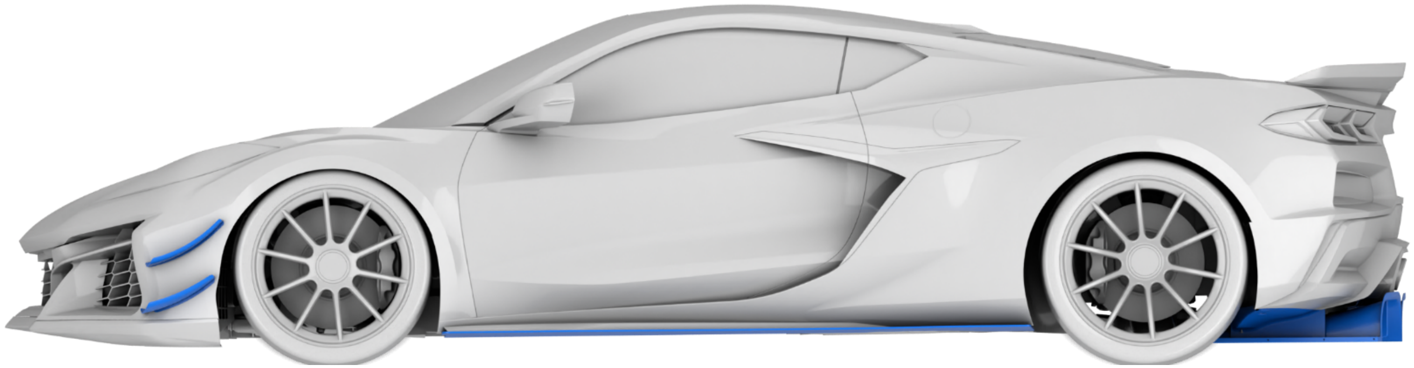
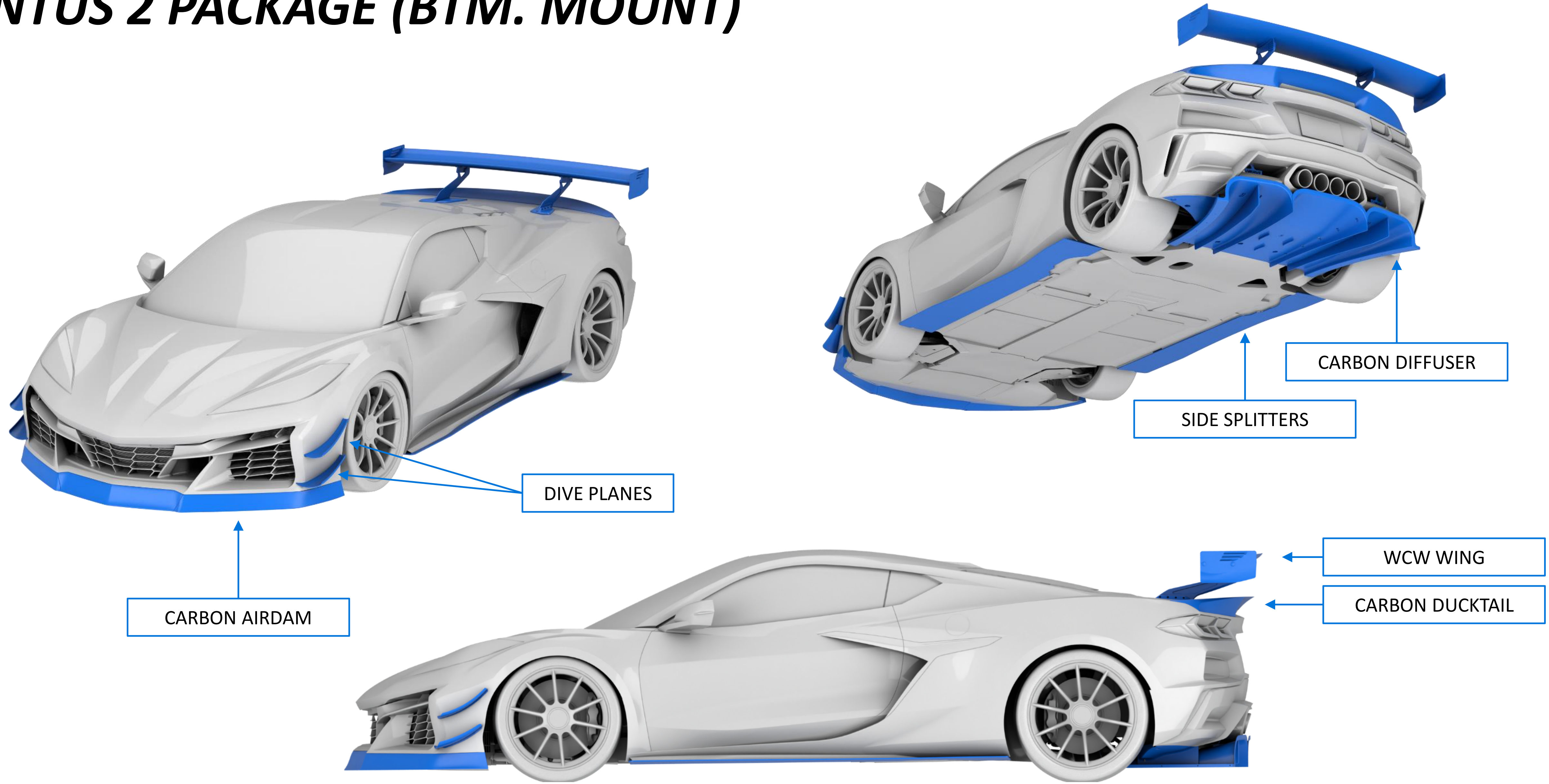
VENTUS 1 PACKAGE



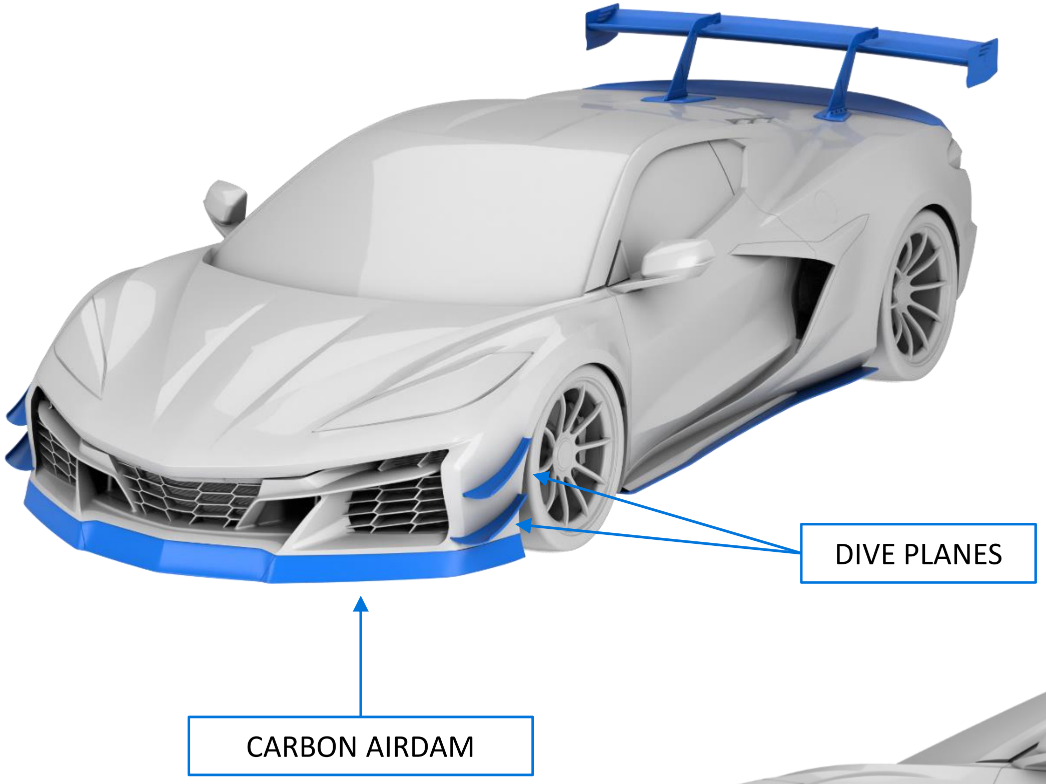


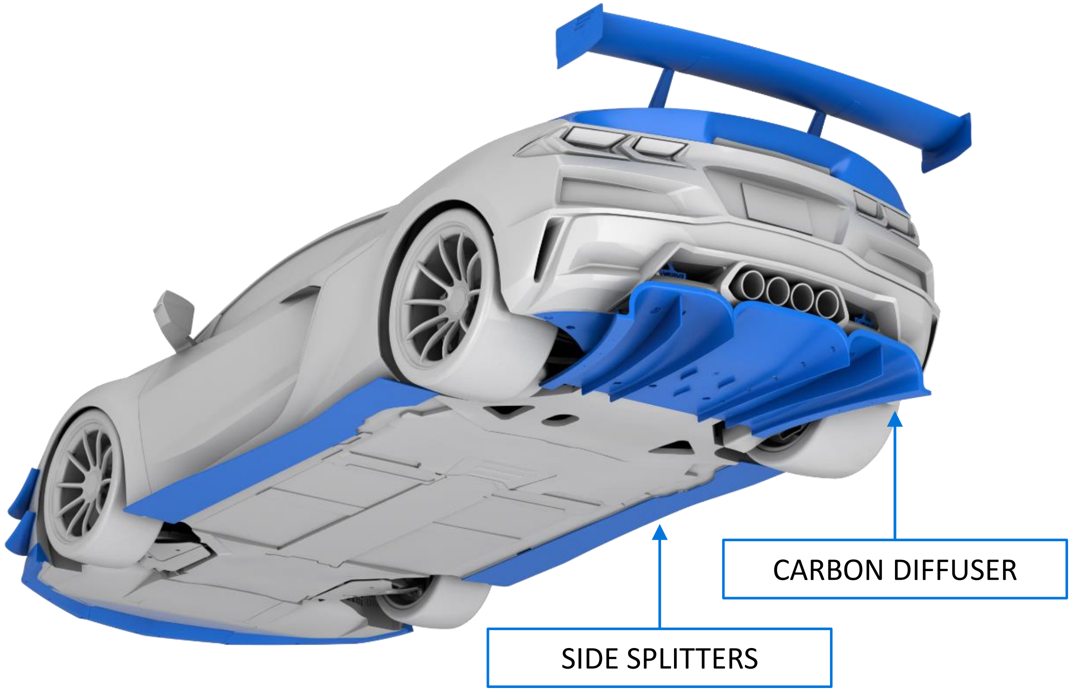


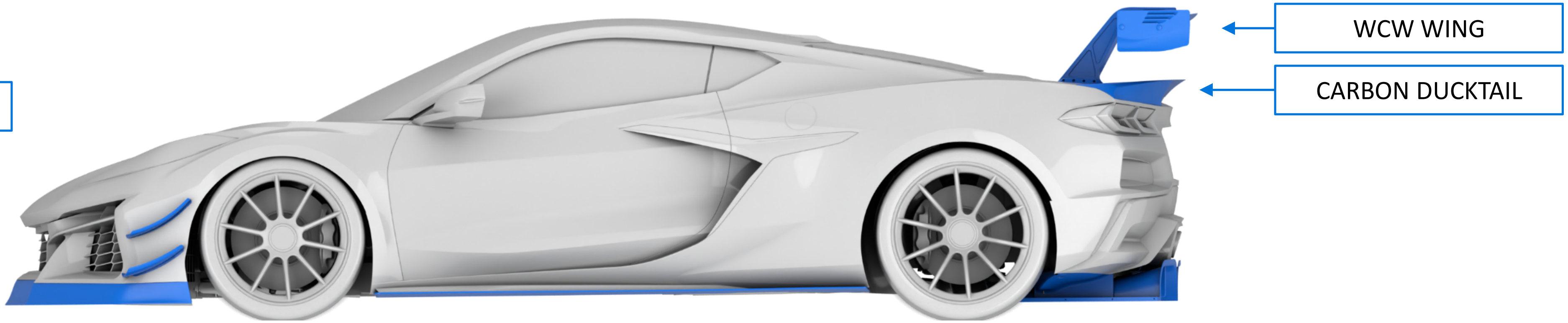
VENTUS 2 PACKAGE (BTM. MOUNT)



VENTUS 2 PACKAGE (SWAN NECK)

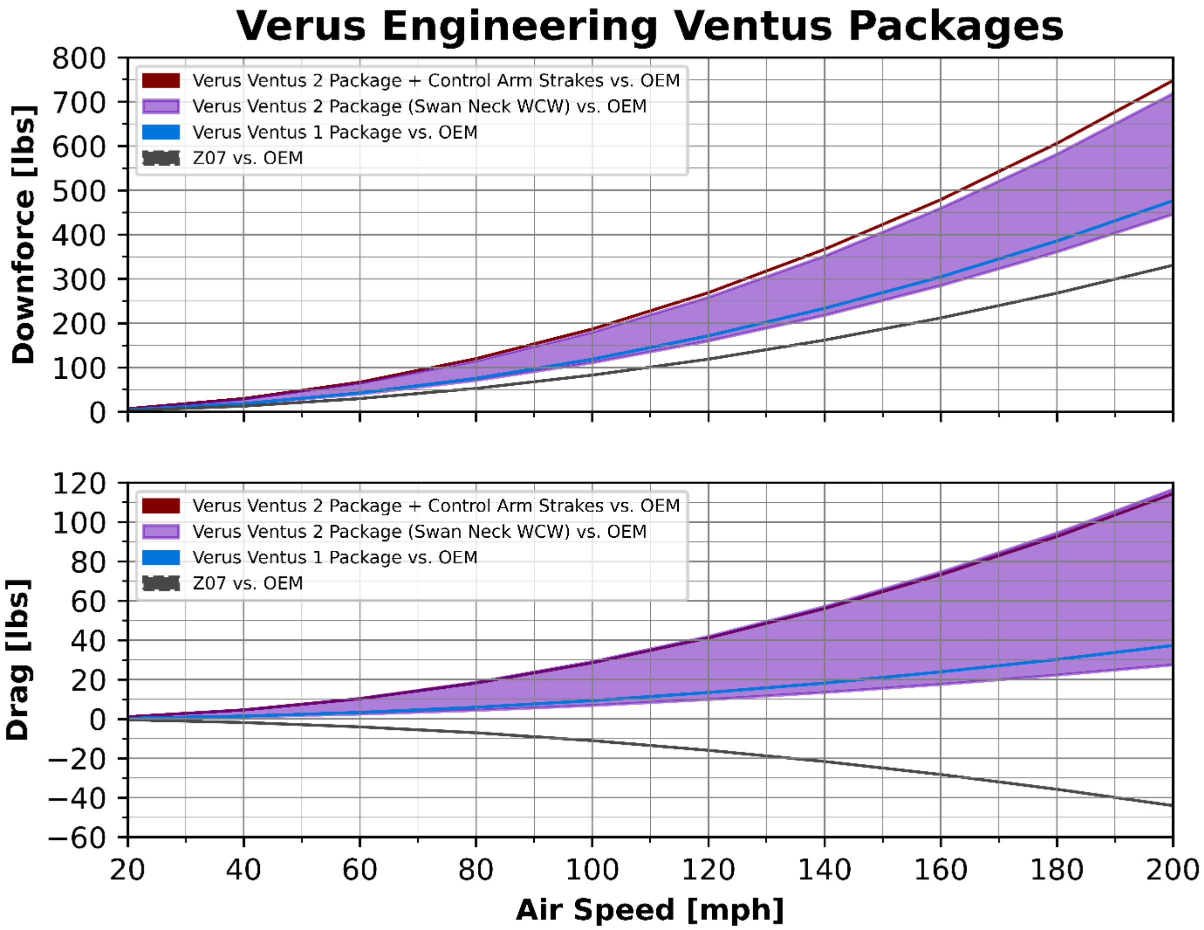






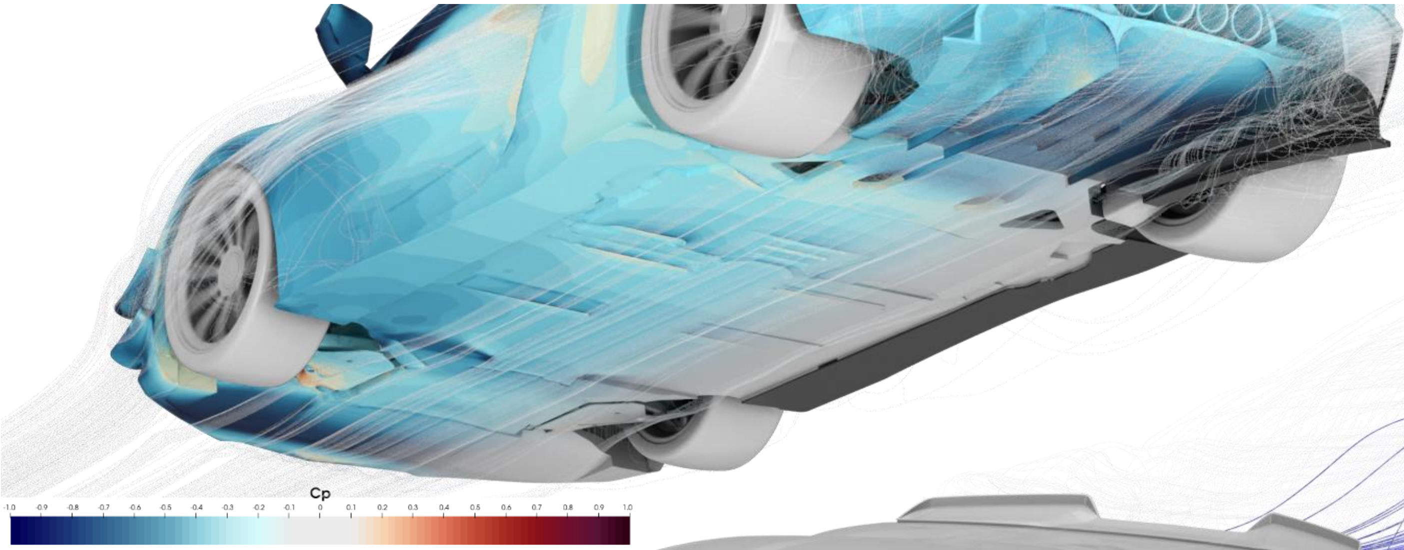
SUMMARY : AERODYNAMIC FORCES

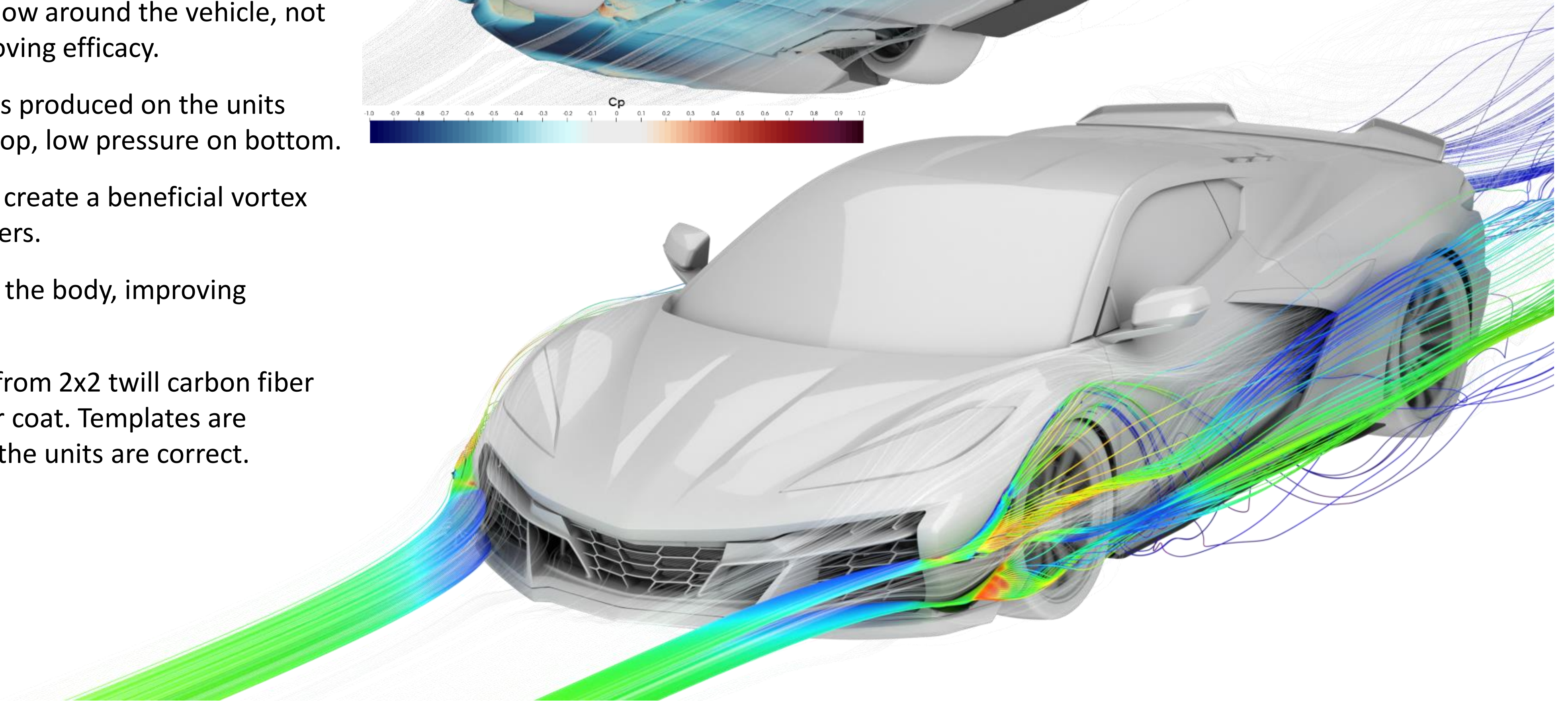
- Aerodynamic forces change with the square of the vehicle speed, which is why we use a graph.
- The Ventus packages significantly increase downforce over stock with a comparatively minimal impact to drag and are a great choice for track enthusiasts and competitive racers alike.
- The Ventus 1 package uses the Verus Engineering Dive Planes, Polyweave Side Splitters and Carbon Diffuser.
- The Ventus 2 packages add the, Carbon Air Dam/Front Lip, Ducktail Spoiler & Btm. Mount or Swan Neck WCW Wings.
- Angle of Attack (AoA) adjustment allows the driver to fine tune aerodynamic balance to his or her preference.
- The thick diverging lines for Ventus 2 shows performance variations depending on setup.
    - Ventus 2 is shown from -1° AoA to 12° AoA with the WCW
    - Ventus 2 is also shown with the addition of the Control Arm Guide Strakes with the WCW at 12°. In this configuration the addition of the Strakes shift the aero balance from 29.5% front, to 31.8%



DIVE PLANE / CANARDS

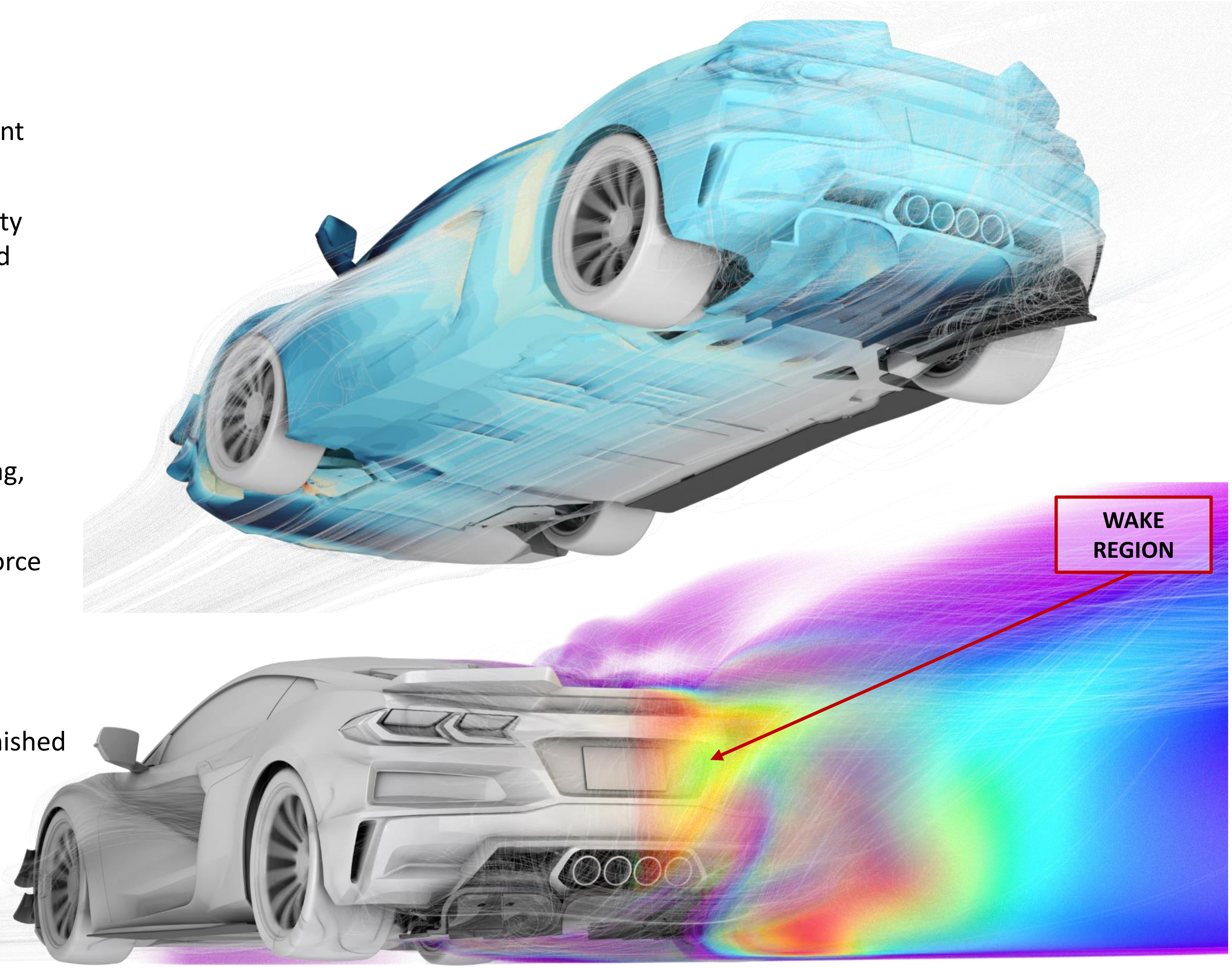
- Dive planes are great for customers looking for a slight bump in front downforce and no reduction in ground clearance.
- Verus Engineering develops dive planes to produce downforce by controlling the flow around the vehicle, not on the units themselves, improving efficacy.
- A small amount of downforce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





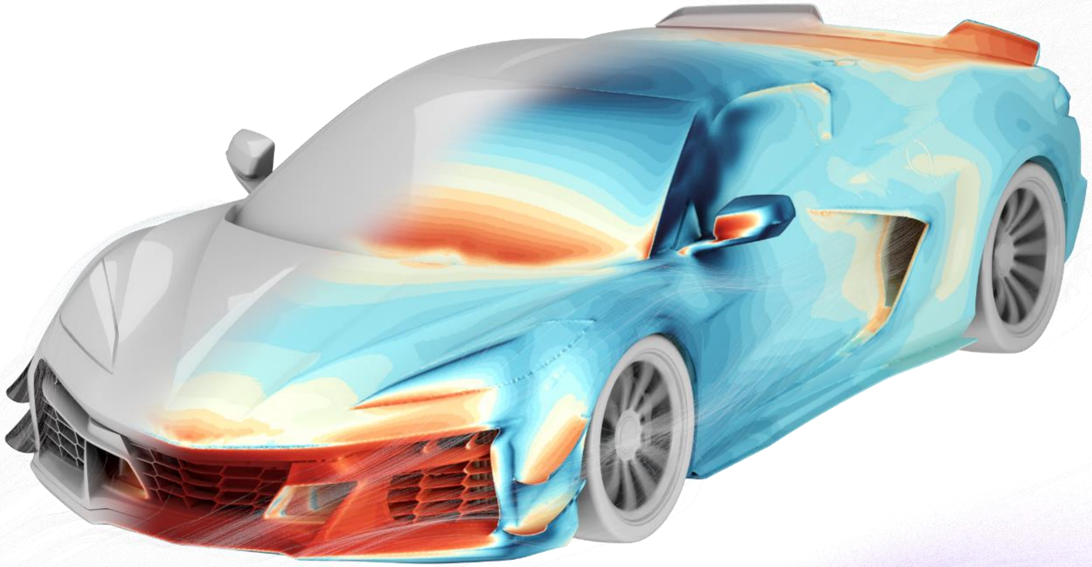
DIFFUSER

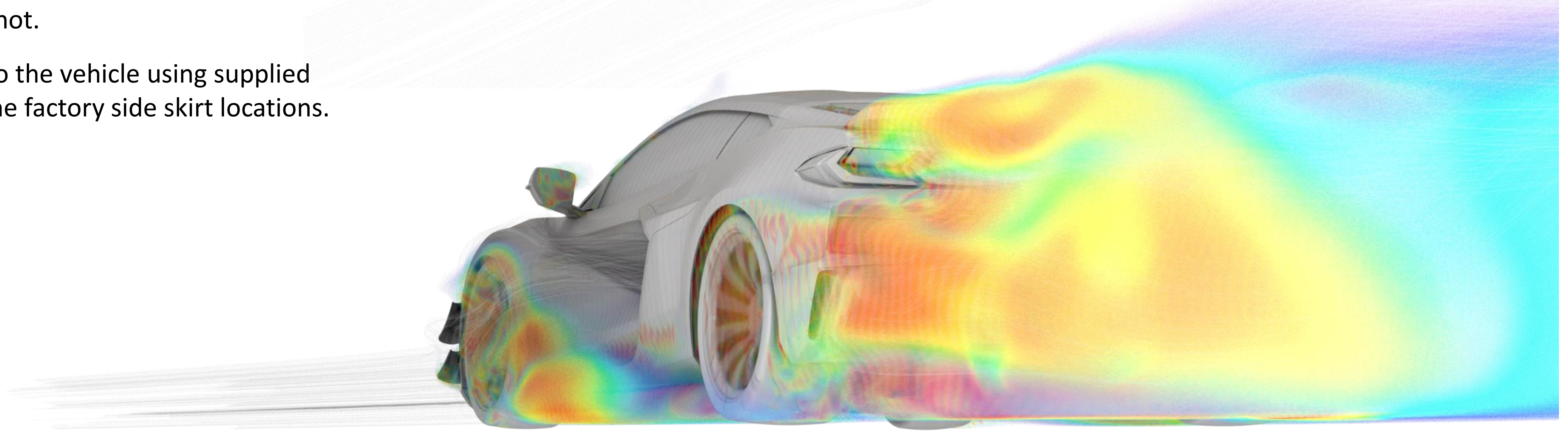
- The rear diffuser is a key component in creating efficient downforce.
- A diffuser is perfect for a street car as it will add stability (downforce) *and* reduce overall drag, when designed properly.
- The diffuser functions by creating low pressure on the bottom surface and reduces drag by filling in the wake region 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 region (aka wake region) creates a force that pulls rearward on the car.
- Using CFD and good design practices, we developed a solution that creates downforce and reduces drag.
- The diffuser is produced from 2x2 twill carbon fiber finished in an automotive clear coat.



SIDE SPLITTERS

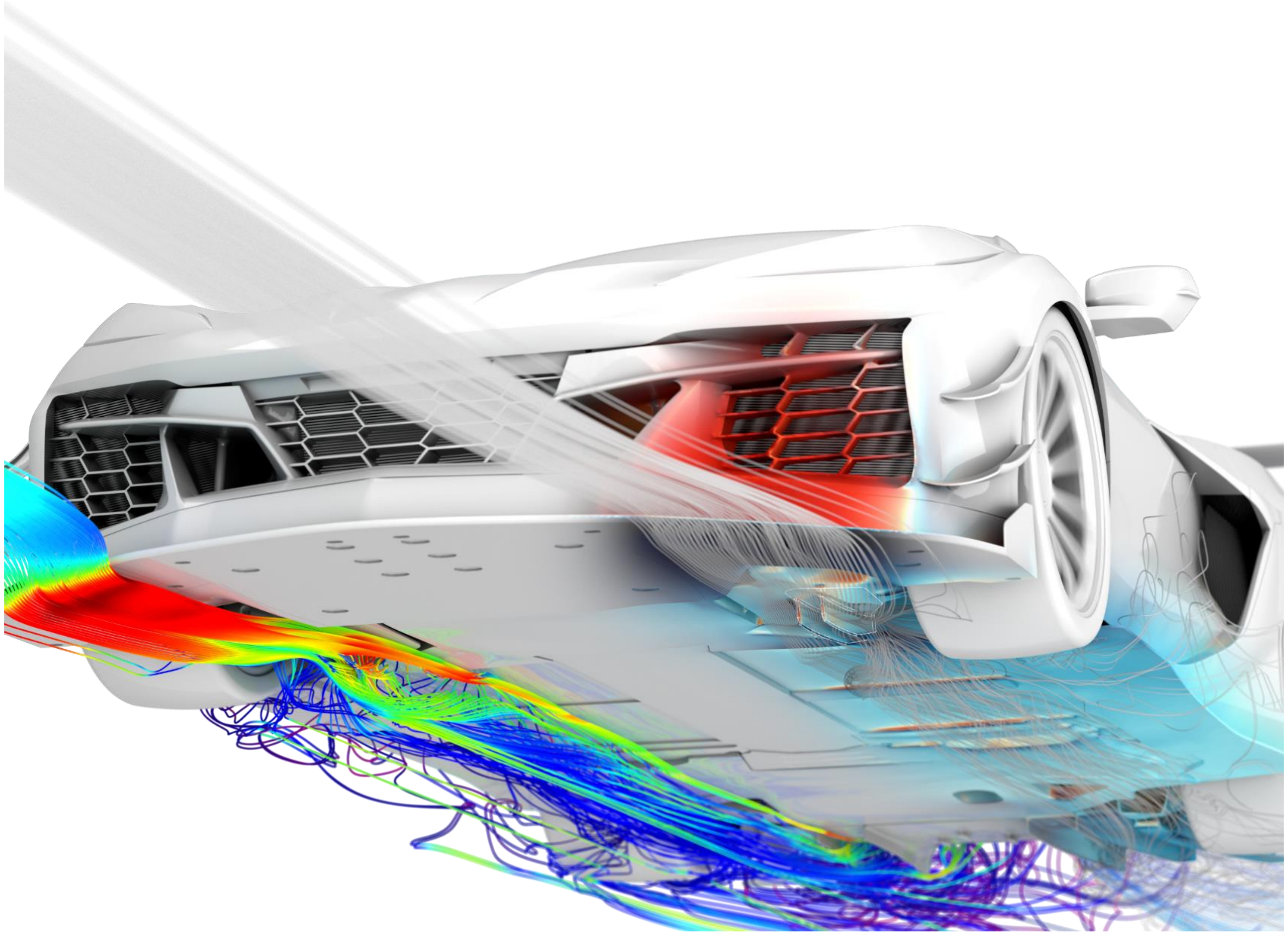
- Side splitters reduce the amount of high-pressure air from the top side of the vehicle, making it under the vehicle.
- We focused on designing the units to clean up underbody airflow during turning or high yaw conditions.
- The increase in downforce is centrally located on the vehicle, and the aero balance is minimally affected.
- Our side splitters are made with 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.
- The side splitters bolt to the vehicle using supplied hardware installed in the factory side skirt locations.





CONTROL ARM GUIDE STRAKE

- The control arm guide strakes increase the downforce generated by the C8 body.
- Most of the additional downforce is created by modifying the airflow around the body rather than producing downforce with the surfaces of the part. This is more similar to the function of our dive planes than a wing element.
- The strakes create a strong vortex that helps reduce the negative impact of tire squirt on the underbody of the C8.
- On a Z06 with our Dive Planes, Splitter, Rear Diffuser, V1X Rear Wing and Ducktail the guide strakes increase total downforce by 2.8% with no impact to drag.
- They substantially shift the aero balance forward. From 34.6% front (without guide strakes) to 39.0% front (with guide strakes). This increases front grip, or total downforce when matched with increased wing angle.
- This increase shift in front bias showcases how the control arm guide strakes improve function when a splitter is in use, though beneficial without as well.

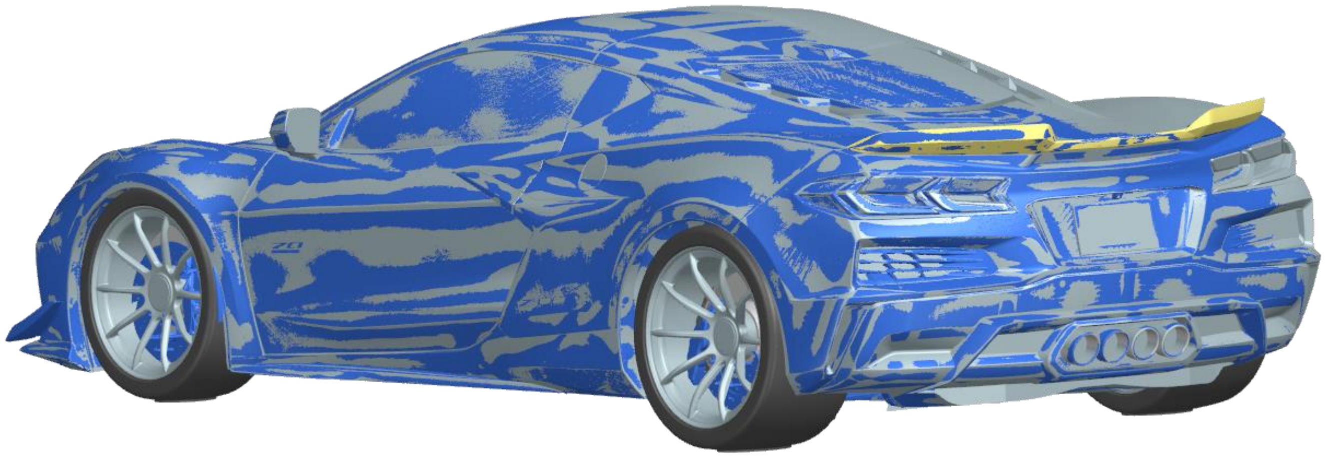


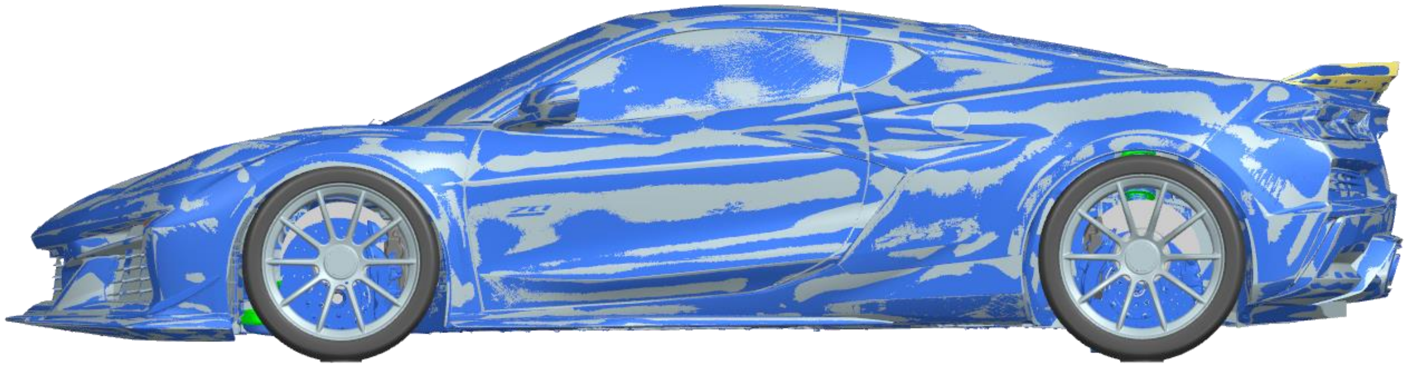
SUMMARY

- The Verus Engineering Ventus Packages for the C8 Z06 platform are designed to decrease lap times utilizing well developed and functional aerodynamic components.
- These packages are designed to fit like OEM and increase the factory performance all while keeping the factory warranty.
- The components increase vehicle performance on and off track.
- The R&D of the packages was done using cutting edge technology in CFD, knowledge gained through wind tunnel testing, track testing with professional driver, and proven designs from past work.
- The 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 Z06 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 front radiator ducting were modeled for improved analysis accuracy.

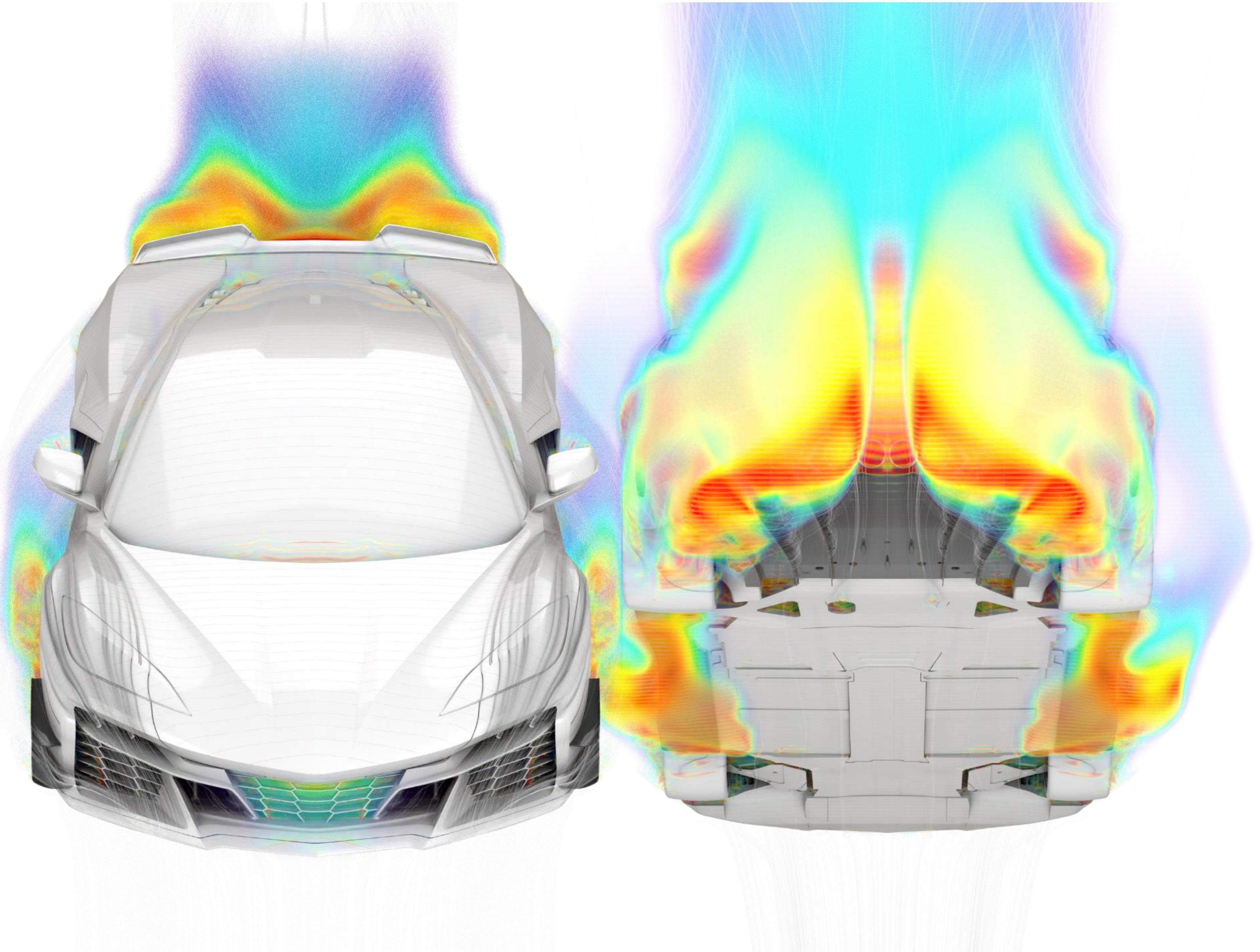




THE SCIENCE

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 five coolers in the front, as well as to side heat exhangers 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).