

HONDA CIVIC TYPE R – FL5

PERFORMANCE OF VERUS ENGINEERING VENTUS PACKAGES

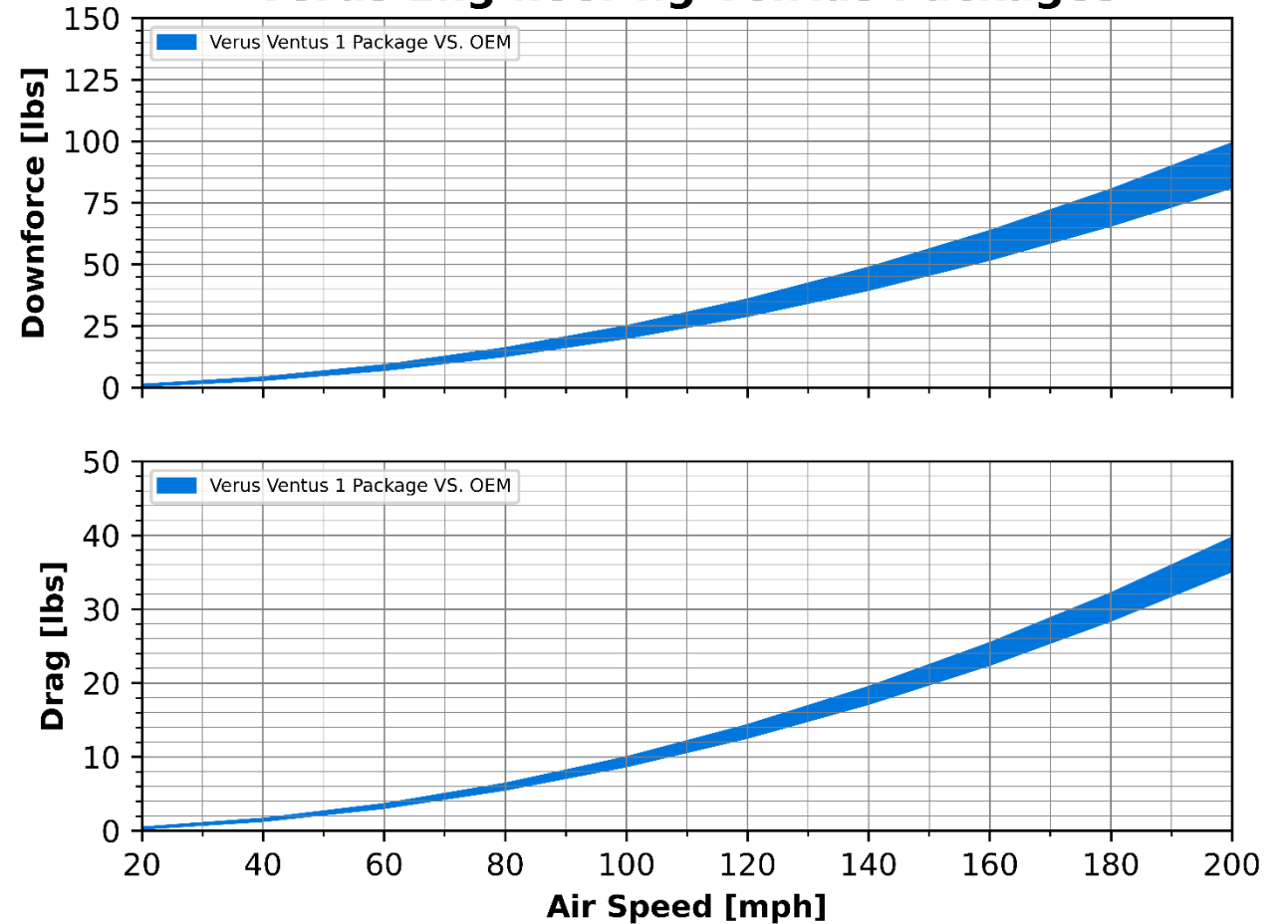
OVERVIEW

SUMMARY : AERODYNAMIC FORCES	pg. 3
VENTUS 1 PACKAGE	pg. 4
VENTUS 2 PACKAGE	pg. 5
DIVE PLANES / CANARDS	pg. 6
REAR WING AOA KIT	pg. 7
SUMMARY	pg. 8
QUALITY OF CAD MODEL	pg. 9
THE SCIENCE	pg. 10
DEFINITIONS	pg. 11

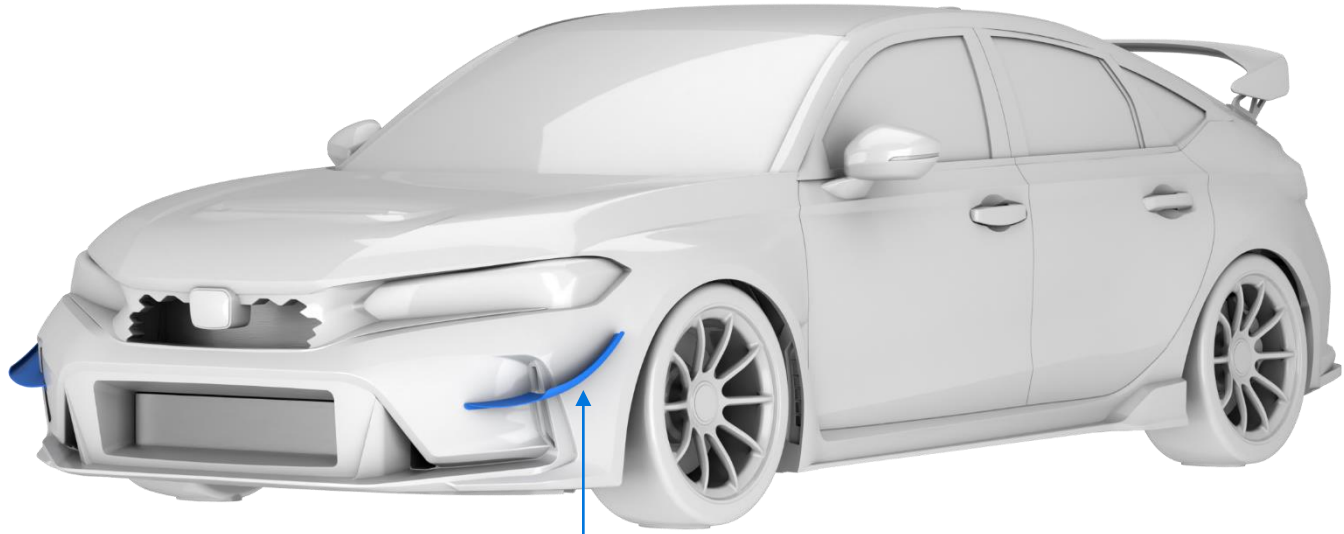
SUMMARY : AERODYNAMIC FORCES

- 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 and Rear Wing Angle of Attack Kit.
- Angle of Attack (AoA) adjustment allows the driver to fine tune aerodynamic balance to his or her preference.
- The thick diverging lines show performance variations depending on setup.
 - Ventus 1 is shown at 0° AoA and 3.6° AoA with the OEM wing element.

Verus Engineering Ventus Packages

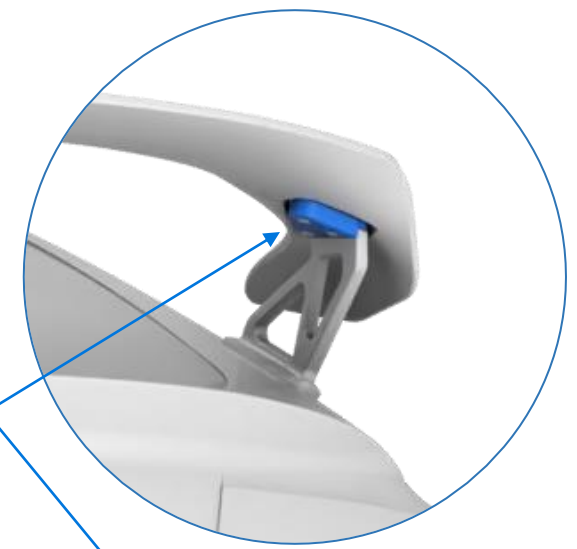


VENTUS 1 PACKAGE



DIVE PLANES

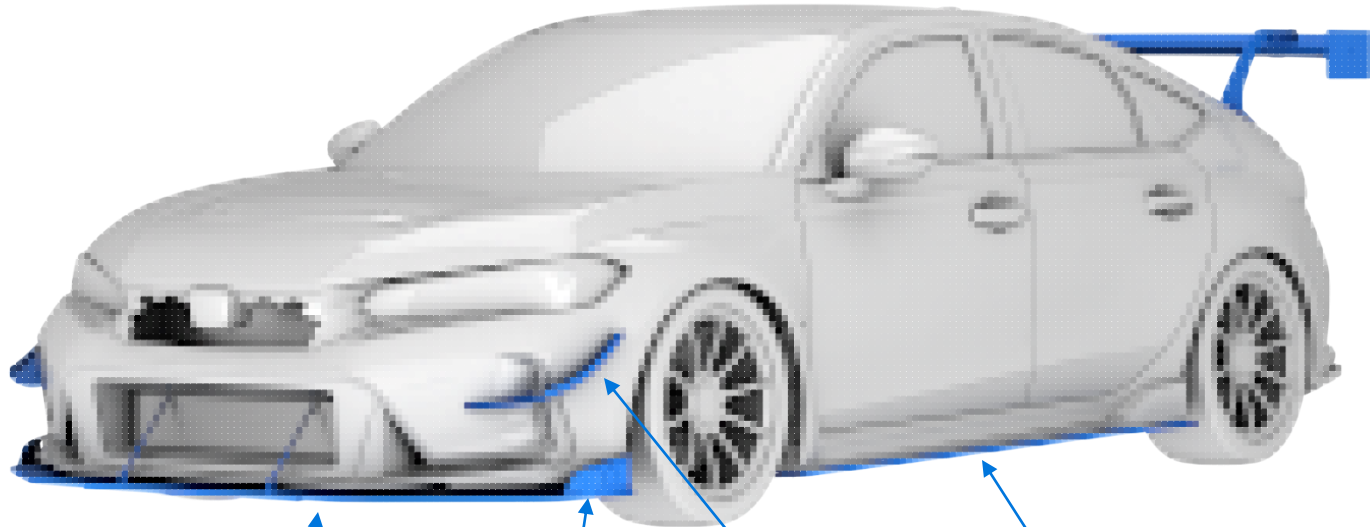
REAR WING AOA KIT



VENTUS 2 PACKAGE



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SPLITTER

SPLITTER END
PLATES

DIVE PLANES

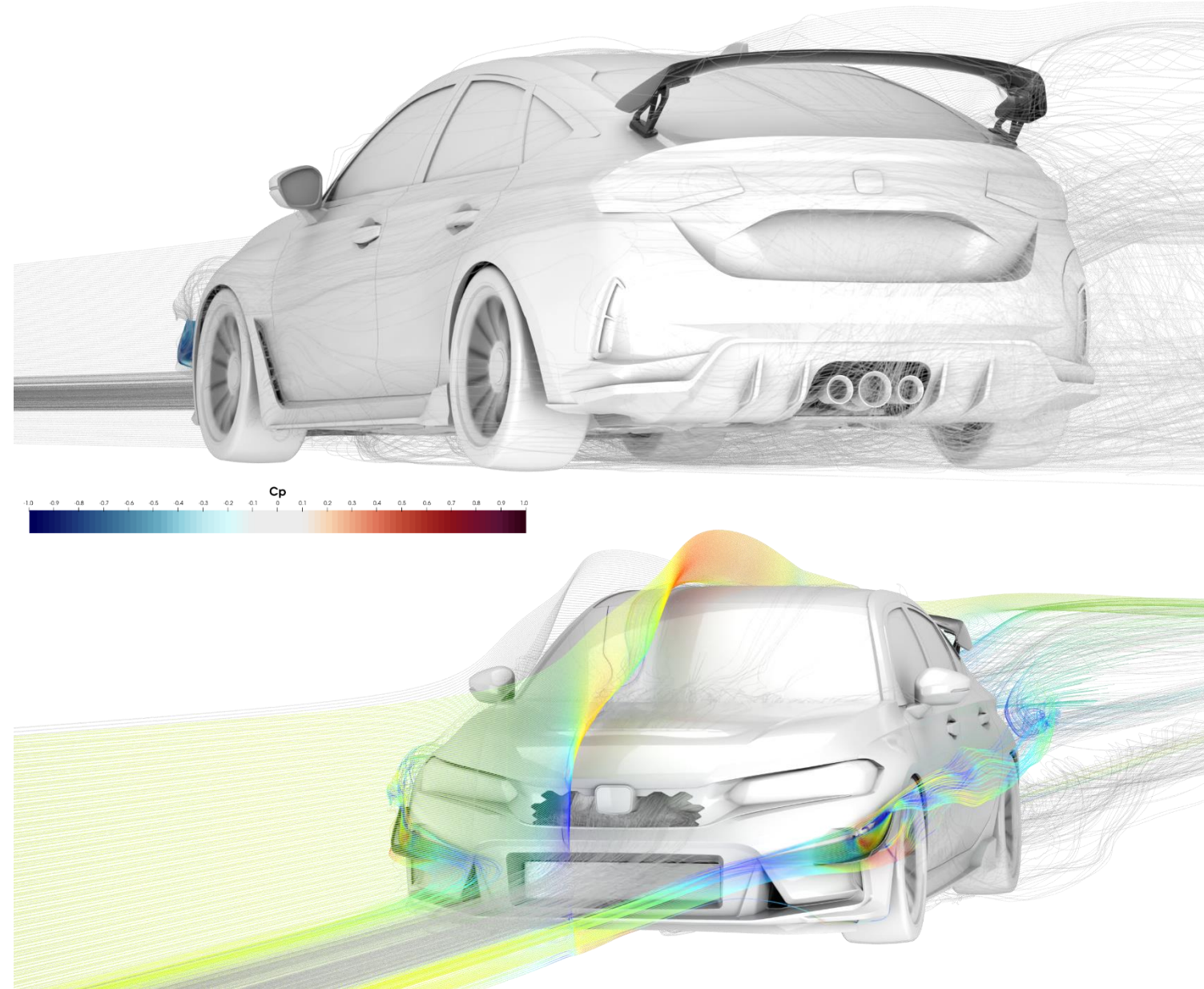
SIDE SPLITTERS

UCW REAR WING



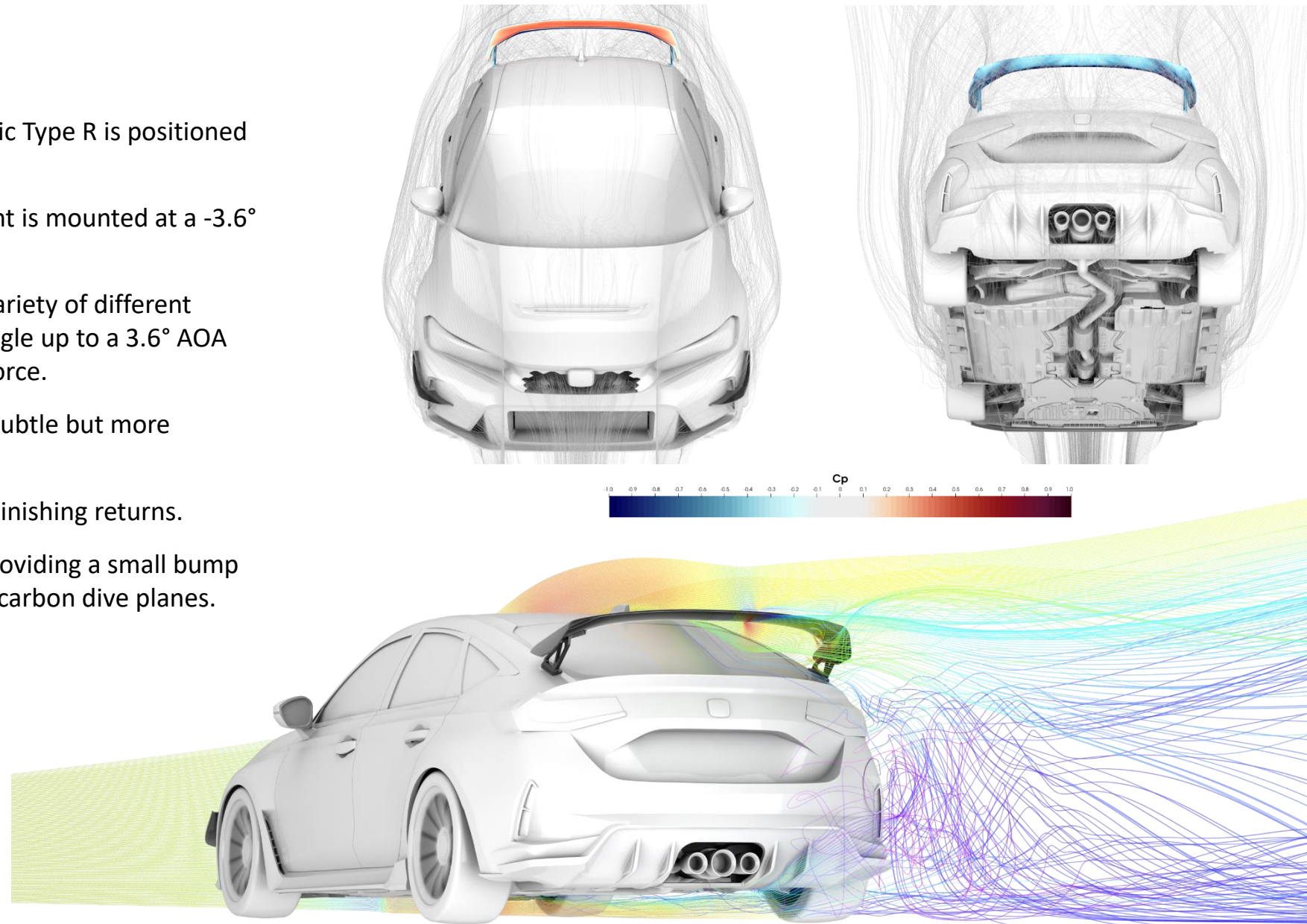
DIVE PLANE / CANARDS

- 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.



REAR WING AOA KIT

- The OEM rear wing element on the FL5 Civic Type R is positioned to maximize efficiency.
- The chord at the center of the wing element is mounted at a -3.6° angle of attack.
- We analyzed the OEM wing element at a variety of different angles and found that bringing the wing angle up to a 3.6° AOA still provided a reasonable bump in downforce.
- The extra downforce is accompanied by a subtle but more aggressive look.
- Going beyond 3.6° is an area of rapidly diminishing returns.
- Our spacers allow for a 0° or a 3.6° AOA, providing a small bump in rear downforce, a perfect match for our carbon dive planes.



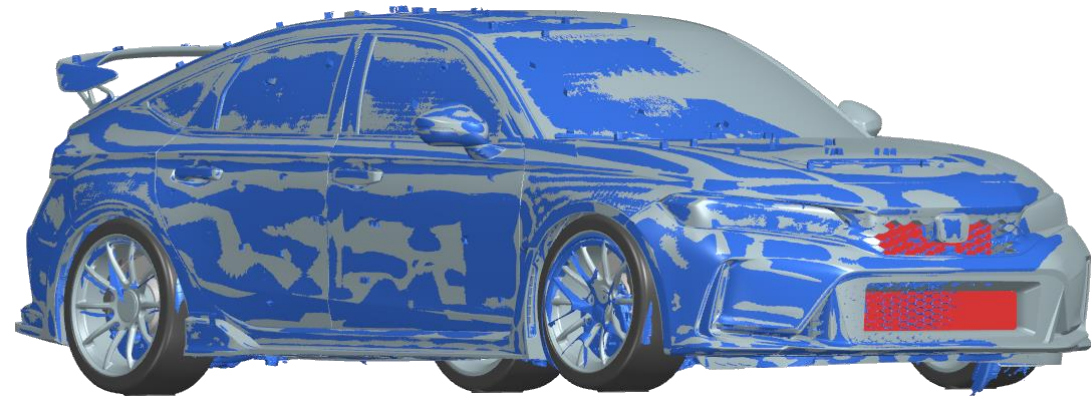
SUMMARY

- The Verus Engineering Ventus Packages for the FL5 Civic Type R 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.
- 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

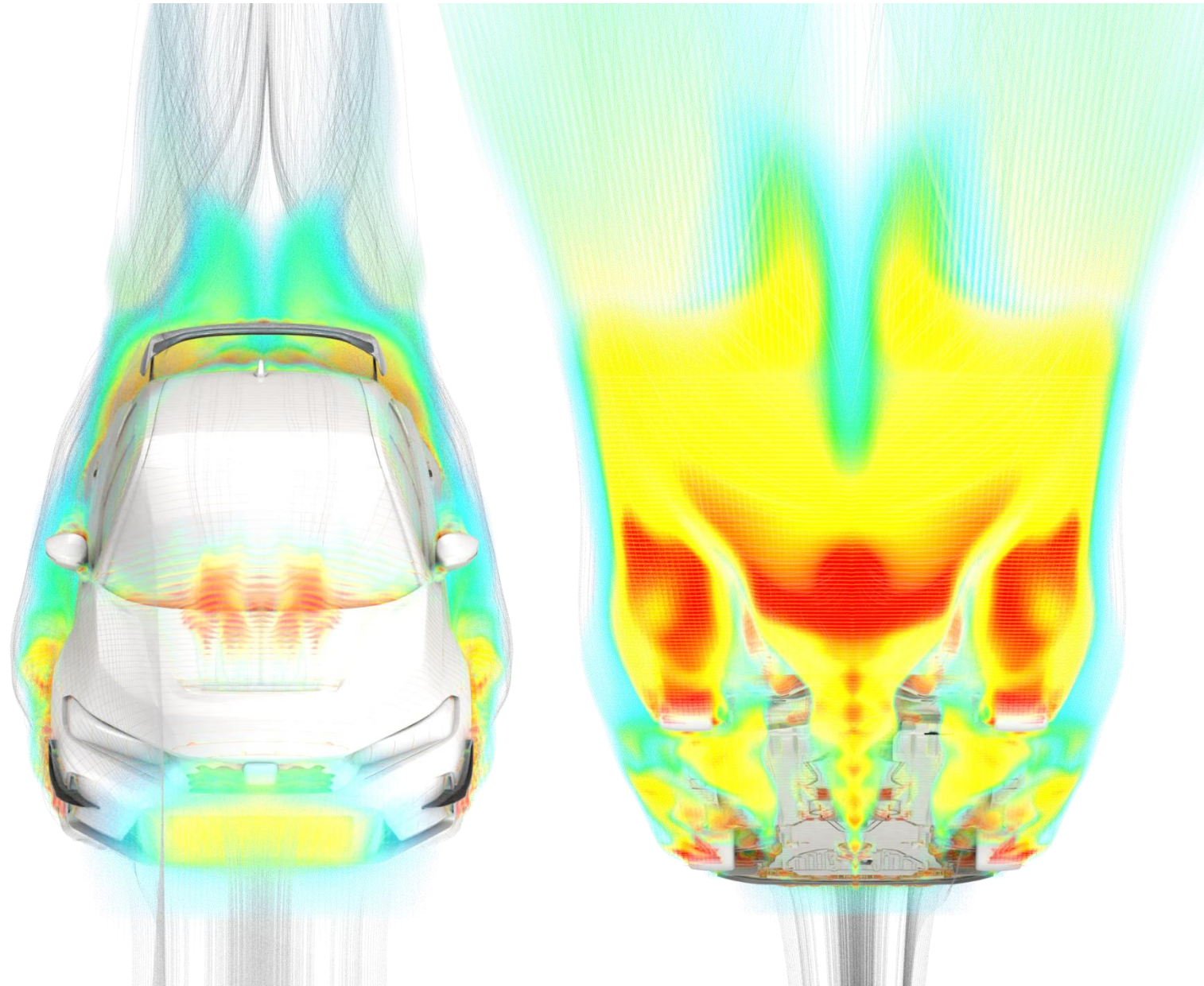
- The CAD model is a crucial aspect of accuracy.
- Bad inputs result in bad outputs.
- The CFD simulation is only as good as the geometry and setup of the CFD analysis.
- The FL5 was scanned in house and a 3D CAD model was created from this scan.
- The image to the right shows the overlay of the CAD 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 v2306 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. Two 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).