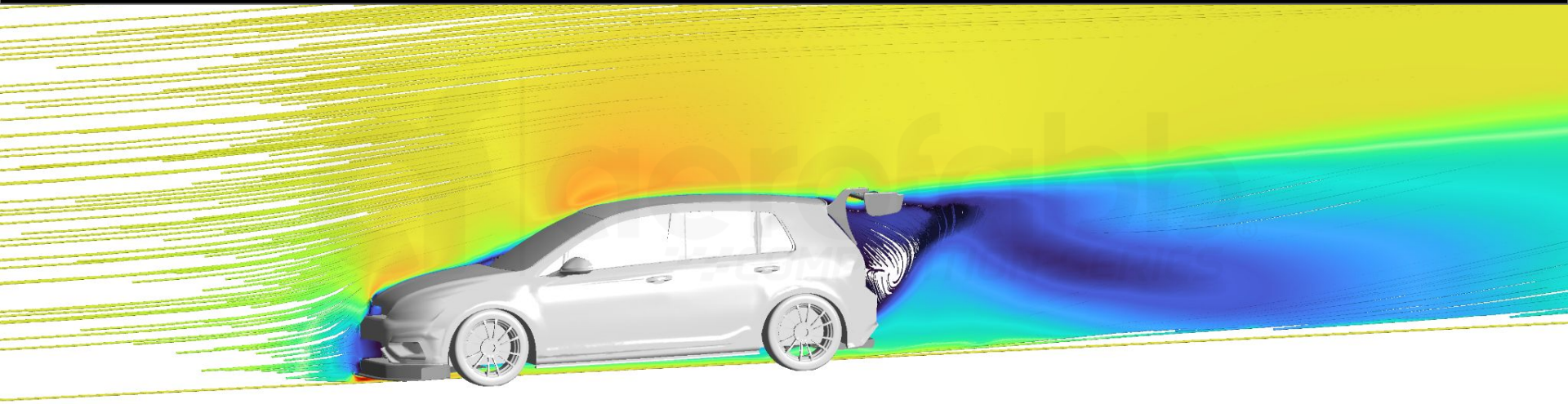


VOLKSWAGEN GOLF MK7/MK7.5 GTI-R

COMPETITION SERIES AERO KIT

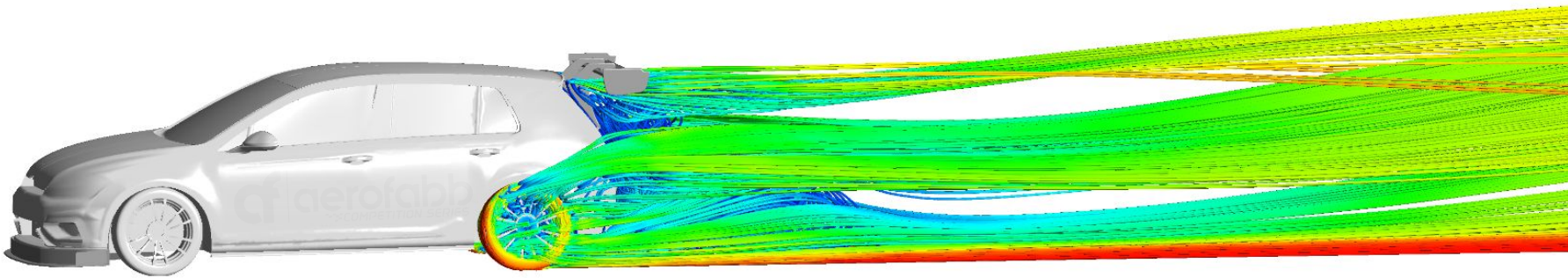
OVERVIEW

This report outlines the methodology employed for a simulation conducted using Ansys software's Fluent workbench. The objective of the simulation was to model the behavior of a car in a steady-state scenario, utilizing the k-omega turbulence model to account for turbulence.

The simulation process involved creating different settings based on the mesh elements to ensure the accuracy of the results. Boundaries for the inlet, outlet, ground, and sky were established, with the same velocity applied to each to better simulate the actual scenario.

The simulation was further enhanced by giving rotation to the cars tires, therefore increasing the realism and accuracy of the entire simulation.

Post-processing was performed in CFD-Post.

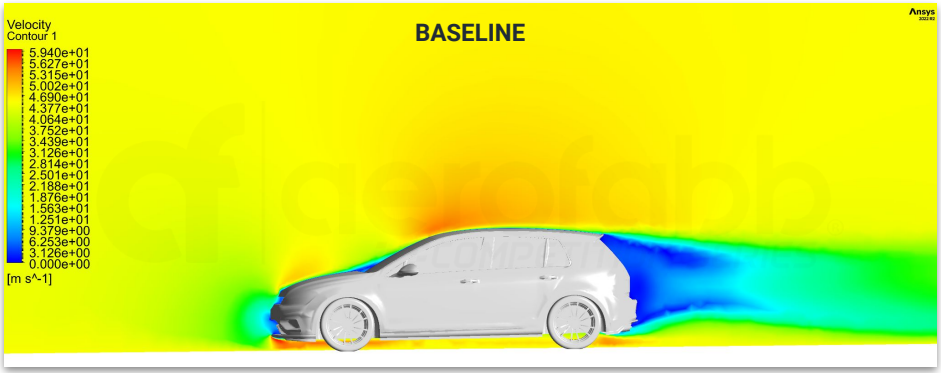


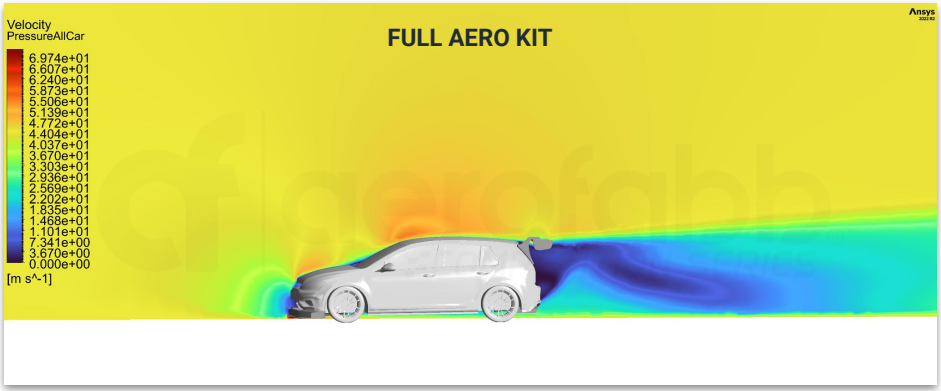
DATA - BASELINE

To establish a baseline, the car was simulated in stock body form without any aftermarket aero components.

Note: *Tire, wheel, and suspension specifications remained the same throughout all simulations. Car is equipped with a factory Rabbit/Golf R performance pack "lip spoiler add-on" which is attached to the trailing edge of OEM spoiler. This OEM add-on also remained modeled throughout all simulations. A minor reduction in the Competition Series Rear Wing efficiency was noted.*

- Refer to page 10 for full details on our vehicle set-up.





DATA - FULL AERO KIT DOWNFORCE VS. DRAG

Figure 1. compares total downforce produced by the Full Aero Kit installed vs. total downforce the car makes without aero.
Figure 2. compares total drag produced by the Full Aero Kit installed vs. total drag the car makes without aero.

- A downforce increase of 368% with a drag penalty of 39% is recorded.

Fig 1.

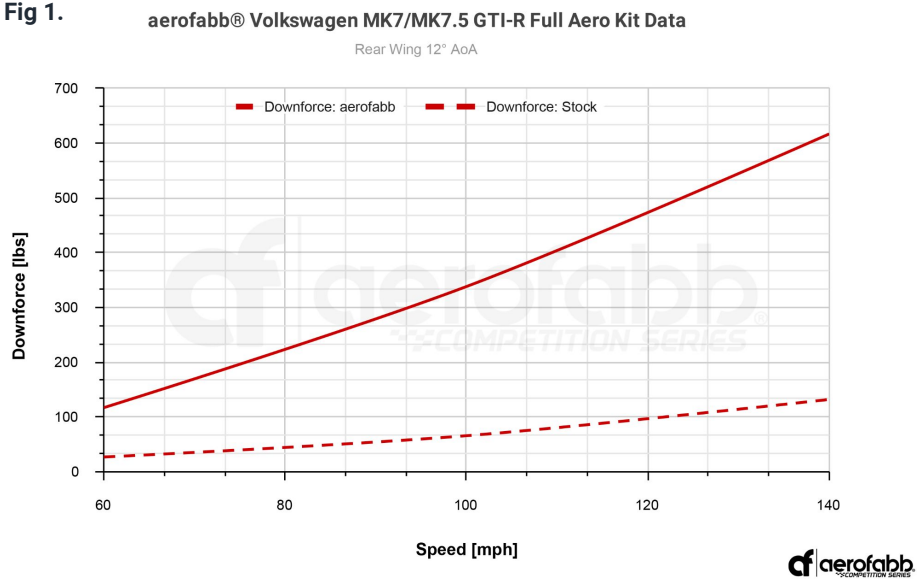
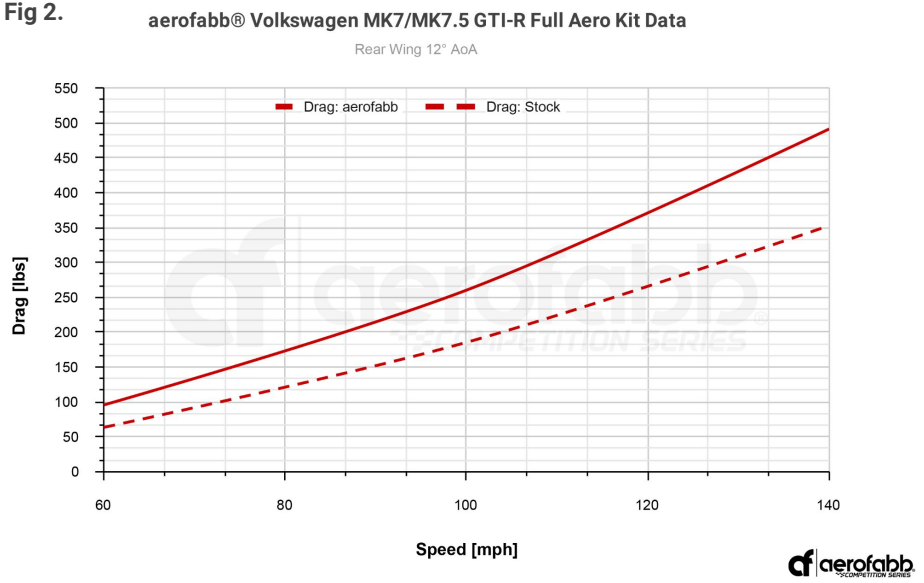
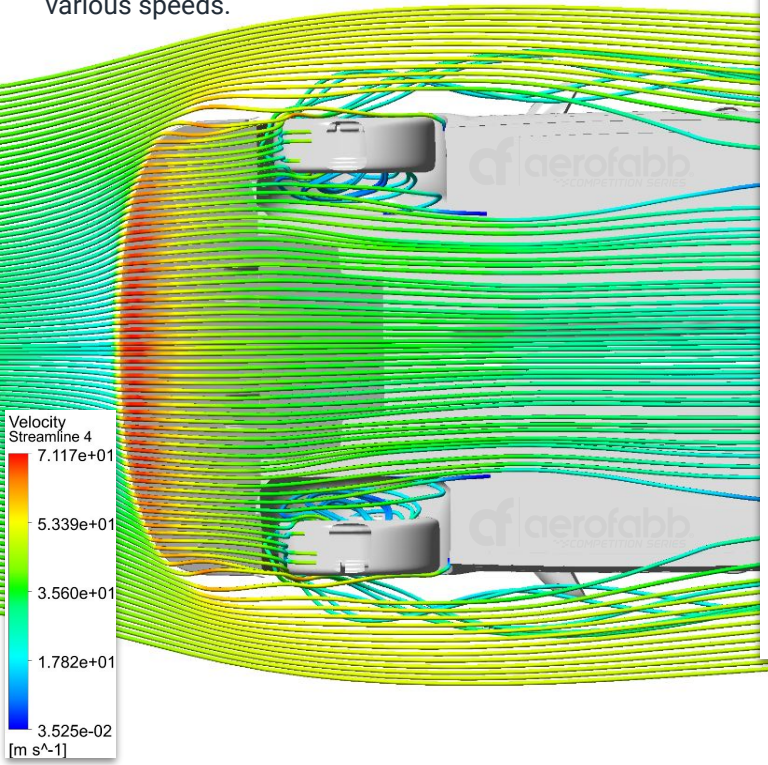


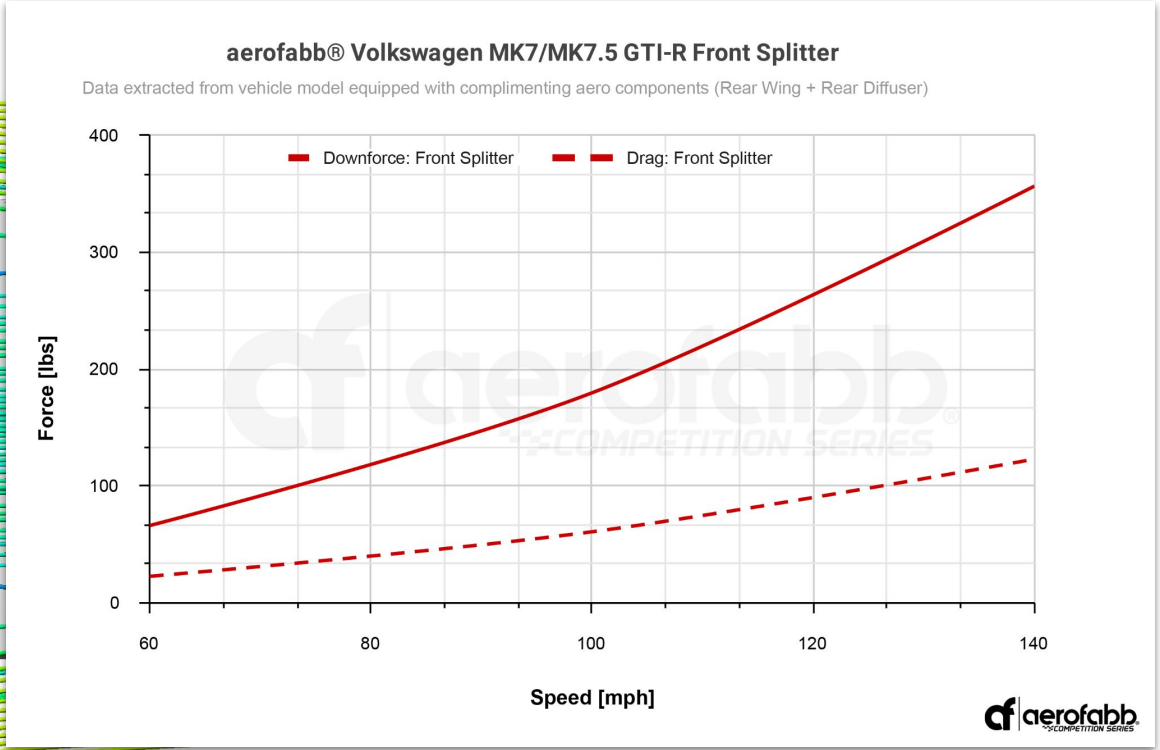
Fig 2.



DATA - FRONT SPLITTER

This graph compares total downforce vs. total drag produced by the Competition Series Front Splitter at various speeds.

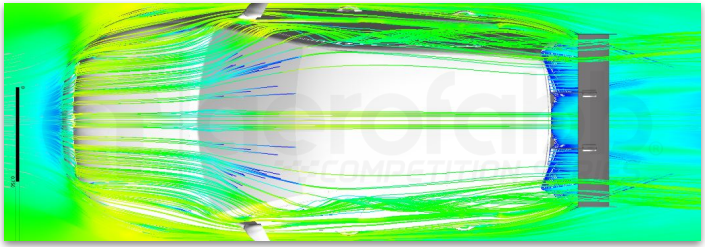


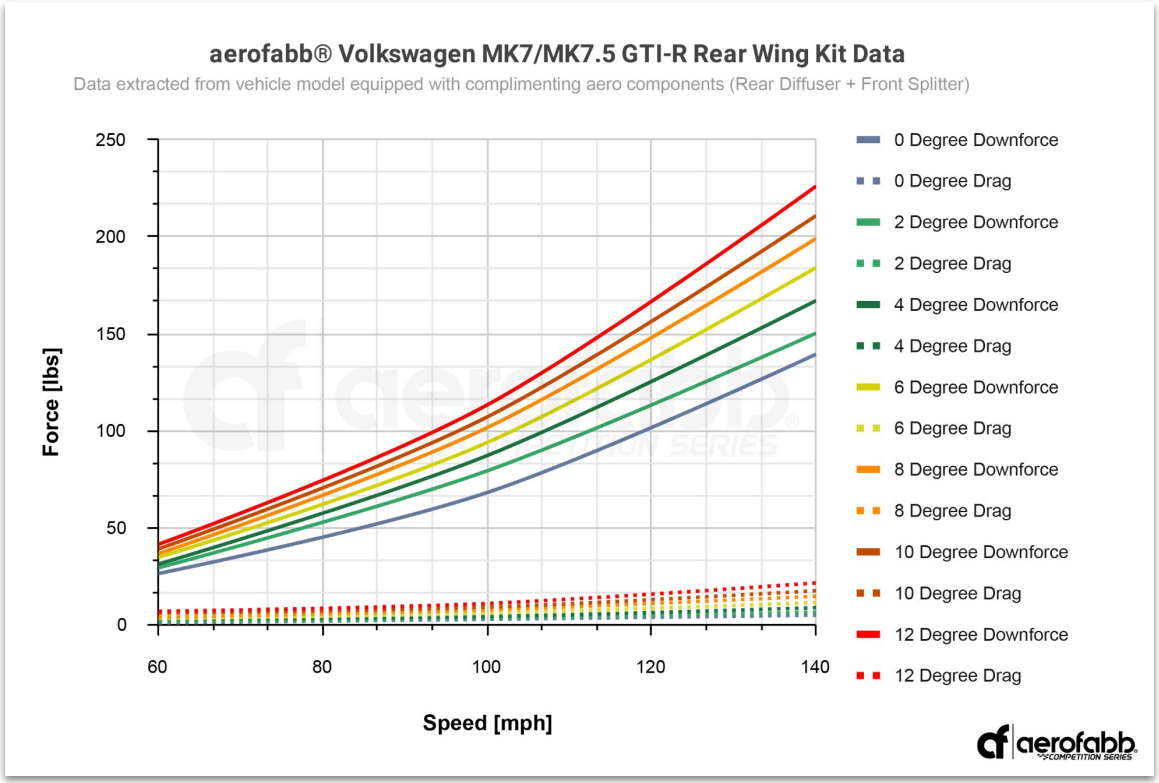


DATA - REAR WING KIT

This graph compares total downforce vs. total drag produced by the Competition Series Rear Wing Kit by AoA at various speeds.

- The Competition Series Rear Wing Kit allows for the user to adjust AoA and shift the balance to what fits best within their needs.
- An aero balance of 55F/45R was the result of 12° AoA.

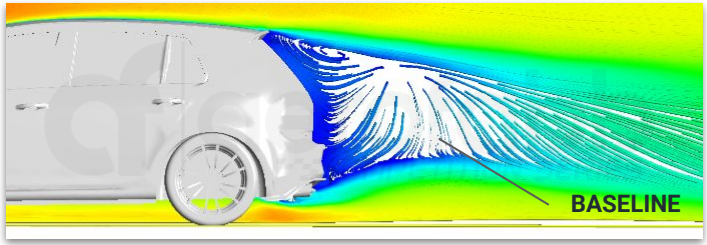


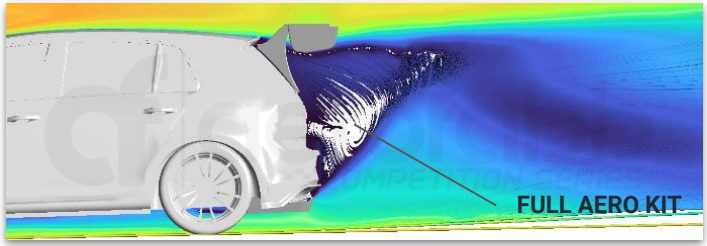


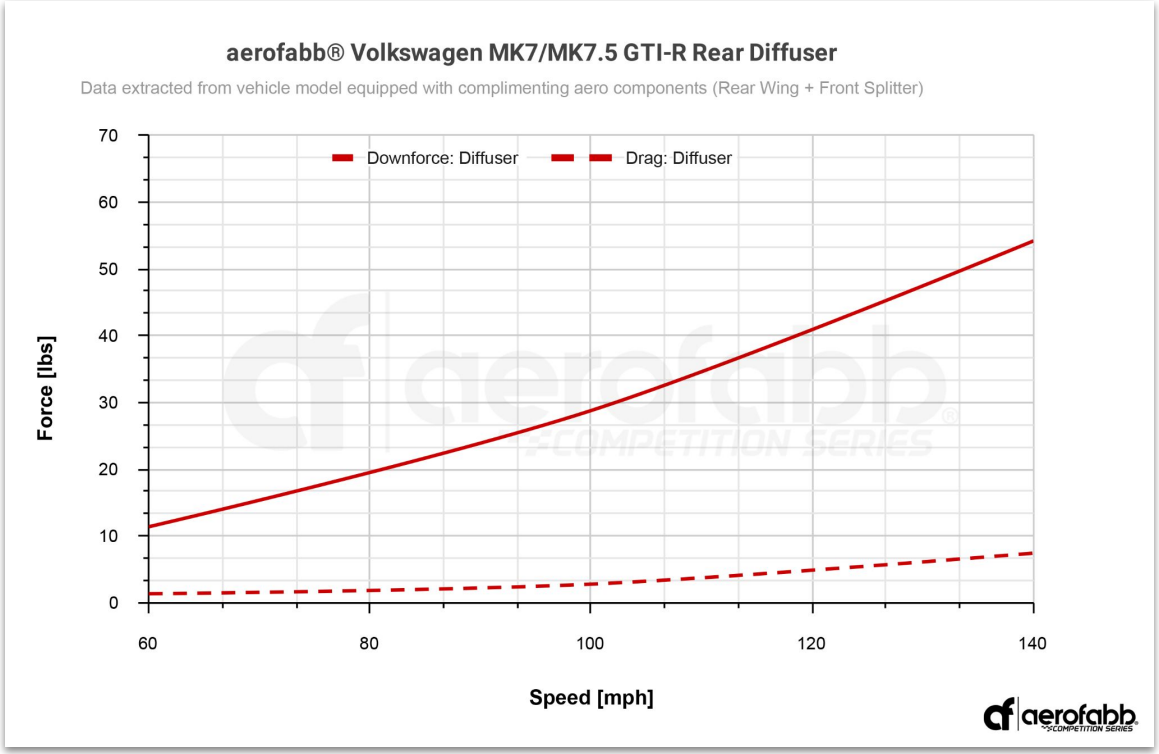
DATA - REAR DIFFUSER

This graph compares total downforce vs. total drag produced by the Competition Series Rear Diffuser at various speeds.

- While this component alone may induce minor drag (<7lbs) the overall drag is reduced significantly by feeding the low pressure area at the rear of the car with higher velocity air from its underside which is represented in the figures below. Less flow separation = less drag.



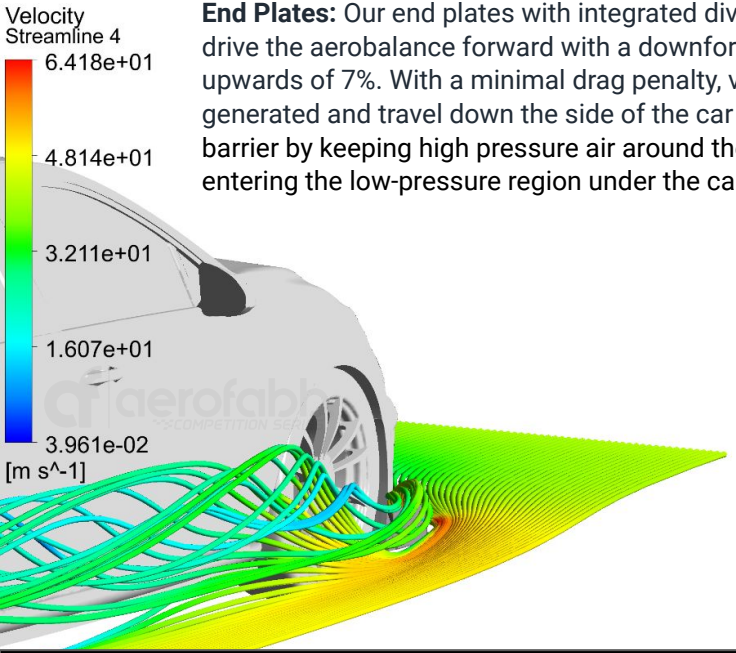


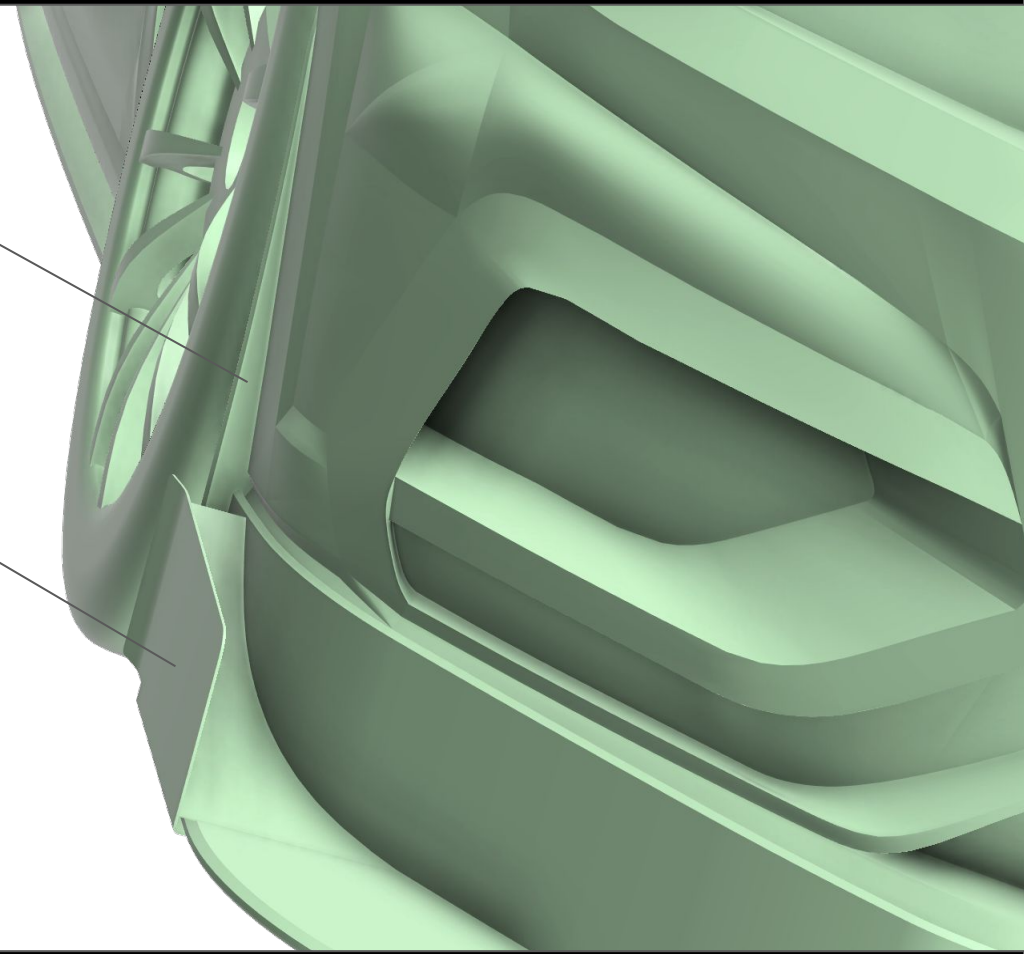


DETAILS - TIRE SPATS / END PLATES

Tire Spats: With lower offset wheels and larger tires exposed beyond the body of the car, these tire spats help to keep air from entering the turbulence caused by their rotation, ultimately reducing drag.

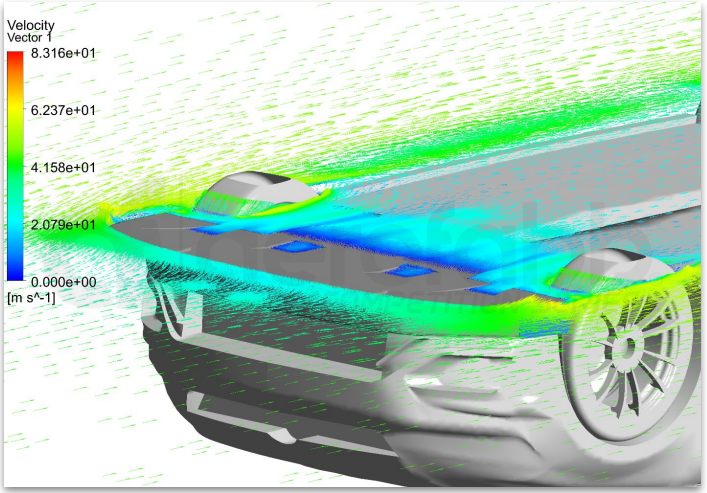
End Plates: Our end plates with integrated dive planes help drive the aerobalance forward with a downforce boost upwards of 7%. With a minimal drag penalty, vortices are generated and travel down the side of the car acting as a barrier by keeping high pressure air around the car from entering the low-pressure region under the car.

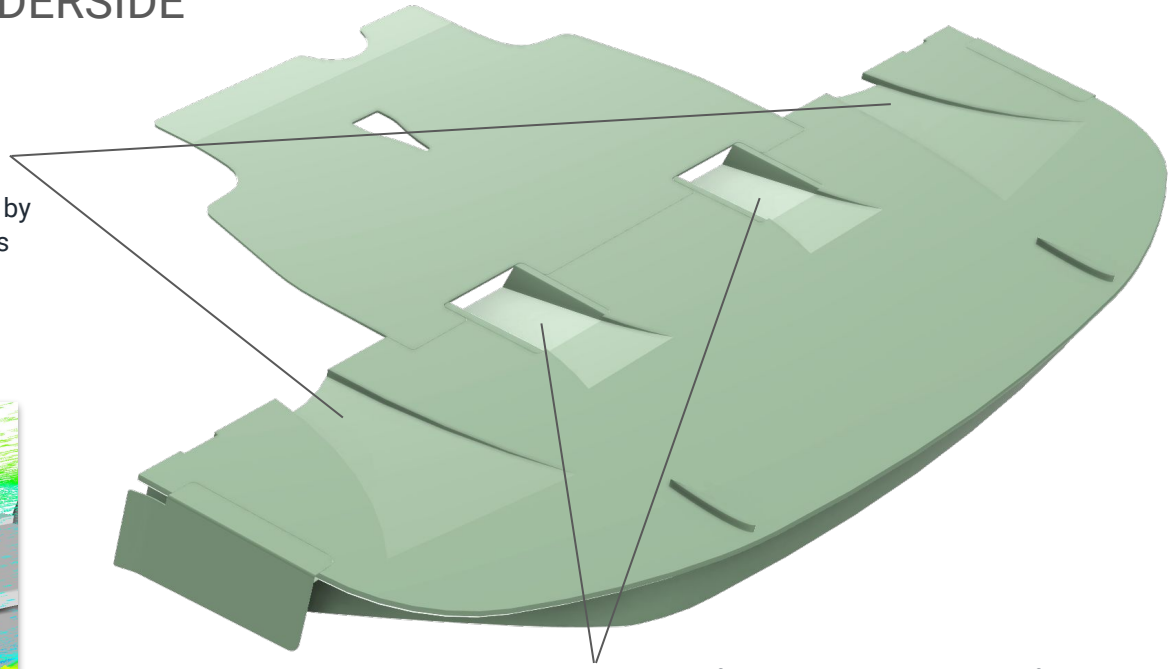




DETAILS - FRONT SPLITTER UNDERSIDE

Integrated Diffuser Ramps: The front splitter diffuser ramps are machined directly into the underside of the blade. The main purpose for these ramps is to increase downforce and reduce drag. Downforce is improved by further speeding up the already low pressure air created by the splitter itself. Drag is reduced by helping to divert this high velocity air away from the front tires.





Cooling Ducts: The front splitter cooling ducts feed both the oil pan and transmission casing with high velocity air to aid in maintaining lower operating temperatures experienced during competitive driving. The leading mouths of the cooling ducts are also milled into the splitter blade for an ideal surface transition.

SETUP - GEOMETRY

The final run geometry consisted of a Volkswagen MK7.5 Golf R equipped with aerofabb® Competition Series aero components:

- Front Splitter
- Rear Diffuser
- Rear Wing Kit

NOTE: *The front splitter is fully optioned with end plates/integrated dive planes, tire spats, cooling ducts, low drag skid pucks, and rearward tray.*

Many areas of high detail were simplified as they were not necessary to study the behaviors of turbulent airflow we were looking for. Simplification was also made in order keep computing power at a reasonable level.

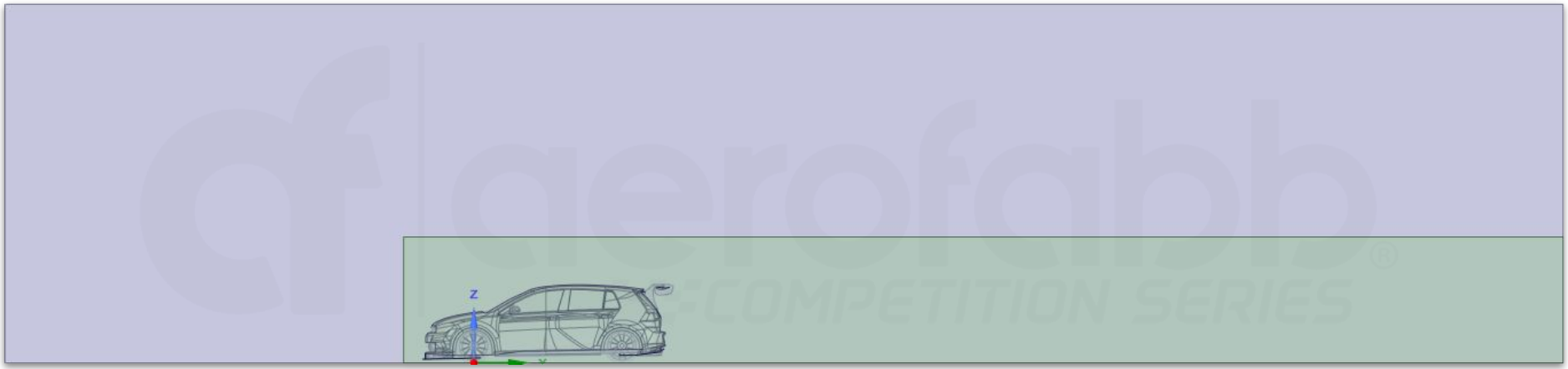
- Modeled with a wheel size of 18x8 and a tire size equivalent to a 245/45/18. The wheels and tires were modeled "flush" to the outer wheel arches of the car with a front camber of -2.5° and a rear camber of -1.5°.
- The ride height was set to 634mm Front and 630mm Rear. Our ride height is measured from the most center of the fender arch to the ground.
- The center leading edge of our front splitter measures a distance of 64.5mm from the ground with an AoA of 1.5°.
- The rear diffuser forward flat floor measures at a distance of 139mm from the ground and the planes at their standard fixed angle of 7°.

SIMULATION - GENERAL

The simulation involved the calculation of downforce and drag on various components of the car (Front Splitter, Rear Wing, Rear Diffuser). These calculations were conducted in Ansys software, which allowed for a comprehensive analysis of the car's overall performance.

By assessing the downforce and drag on individual components, the simulation was able to provide insights into the car's aerodynamics and its ability to generate downforce for improved stability at high speeds. These insights informed design decisions and optimizations aimed at improving the car's performance on the track.

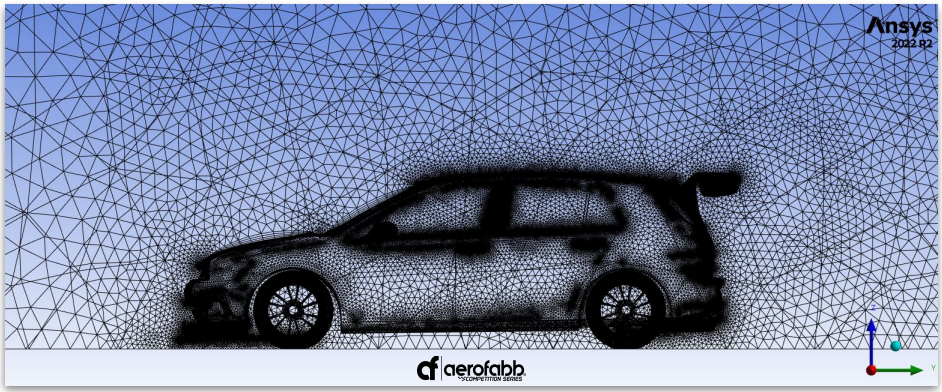
Overall, the simulation's assessment of downforce and drag, in conjunction with its comprehensive analysis of the car's overall performance, provides valuable insights for the design and optimization of Volkswagen Golf MK7 Chassis.



SIMULATION - MESH

Mesh is generated by using the Fluent workbench meshing tool. The with a quality of 1237537 Nodes and 5943370 Elements.

Results are shown in the figures to the right.



SUMMARY

The aerofabb Competition Series Aero Kit for the Volkswagen Golf MK7 chassis was developed in pursuance of increasing the cars overall aerodynamic efficiency. We wanted to accomplish this while still remaining within the "aero rulesets" for the most commonly entered competitive classes. This did pose limitations for us during the development phase when it came to the total heights and widths of each component, but we quickly learned that “bigger” isn't always “better”, especially if the end user is unable to participate in an event due to aero restrictions.

Individual components from the full aero kit can be installed by themselves however, we recommend that the entire kit be installed in order to maintain a safe aerobalance whether on or off the track. The behavior of each component changes without the presence of the other complementary components.

CFD, FEA, and real world testing on track were utilized during the R&D stages in order to refine our designs and validate their functionality.