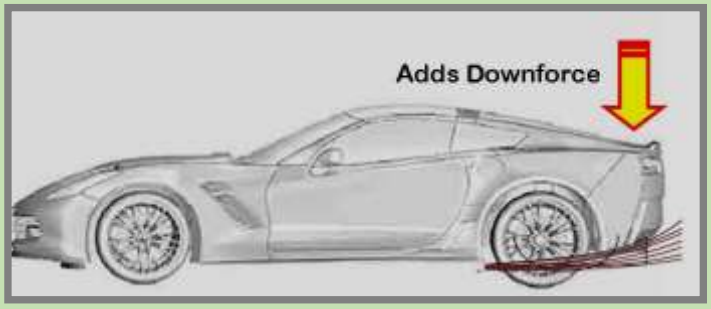
WA Technology

C8.R & C7 Rear Diffuser (updated 6/29/2021; w/info F1 Red Bull Ring Austria)

Rear Diffuser Increases Downforce With Minimum Extra Drag

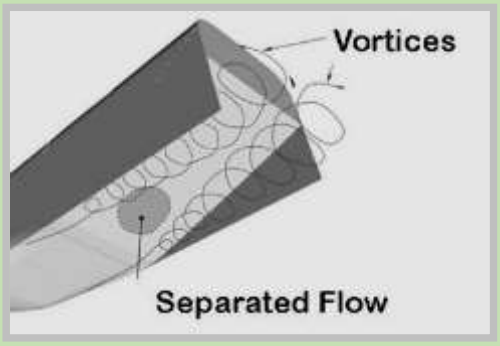
Several aerodynamic devices can increase downforce, such as rear spoilers. However, spoilers also significantly increase drag that takes power to overcome.



For example, the Z06 Stage 3 aero, large spoiler, with full width wicker, is the main reason for the 35% higher drag compared to the base Z06 with smaller spoiler.

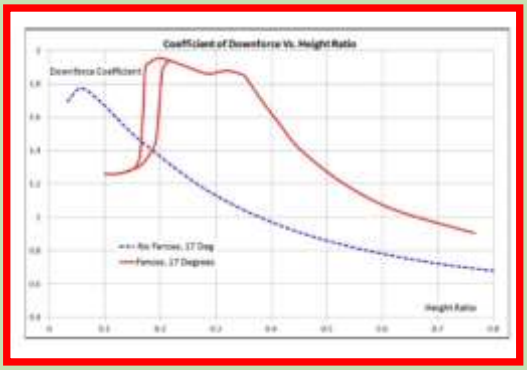
A diffuser is a shaped section of the car underbody which improves the car's aerodynamic performance by enhancing the transition between the high-velocity airflow underneath the car and the much slower freestream airflow of the ambient atmosphere. This speeds up the airflow underneath the car, which using Bernoulli's principles creates reduced pressure. A greater difference in pressure between the upper and lower surfaces of the car means more downforce, allowing faster cornering with minimum extra drag.

Diffuser Design is Complex



The fins or "fences" as they are referred to are important to the diffuser's performance. There are two counter-rotating vortices formed along the fence surfaces. The flow is separated, and this has a positive effect on flow quality and downforce performance.

In the graph at right, suffice for our purposes to note the line in red is the downforce over a wide range of heights from the bottom of the car over the road. That is the performance when "fences" are present.



The blue line is he downforce without fences and with more chaotic flow than when the counter-rotating vortex flow is present. It has a lower peak downforce over a narrow range and only a low height over the road.

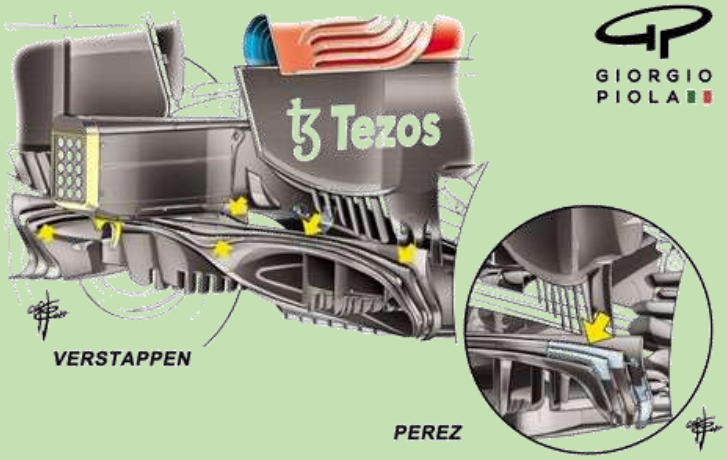
If you want to work for a F1 team there is much theory and math to master! LOL

Interesting Information About "Fence" Vortices from the F1 Race at the Red Bull Rig Track in Austria on June 27, 2021.

F1 teams spend a lot of wind tunnel time and with Computation Fluid Dynamics (CFD) models (*as allowed by F1 rules*.) In fact, CFD models were getting close to much more expensive wind tunnel time. Some teams were operating their wind tunnels 24/7. As a cost reduction, F1 rules limited that to a number of test runs they can make.

Because of the accuracy of simulated aerodynamics programs, the F1 rules also *limit the amount of computer teraflops of solver time* they can use to help reduce costs. Can't just limit computer time since teams with big bucks could just buy a Cray Supercomputer!

Mark Hughes and Giorgio Piola describe why Verstappen was much faster than his fellow Red Bull Driver, Perez and Hamilton in at the F1 race in Austria on June 27th!



The latest version of Verstappen's rear diffuser features serrations across its full width. The vortices created help keep the whole flow over the top of the diffuser energized even as the diffuser is rising further away from the ground at low speeds as the downforce reduces with the speed.

Verstappen ran an updated rear diffuser with Perez still running the older spec part.

Linking the airflow coming through the diffuser from the underfloor with that coming over the top is critical in making the underfloor work harder in sucking the car to the ground. The height at which you can keep those flows attached at low speeds determines how much rake you can realistically run. The more rake you can run, the greater the downforce. (*My Note*: *So as shown in the graphic on page 1, vortices created with essentially more "fences" over the center of the diffuser allowed more downforce over a wider range of speeds.)*

These shark teeth serrations effectively allowed Red Bull to keep the diffuser airflow attached at higher ride heights than before. The more downforce that can be created from the underfloor, the less rear wing area is needed to give an equivalent total downforce.

Downforce created by the rear wing is very costly in drag. Downforce created by the underfloor costs very little drag. Therefore, if Red Bull have found a way – through these latest diffuser tweaks – to derive a greater proportion of its total downforce from the underfloor, it will be faster down the straights for no penalty in corner speeds.

Perez was forced to run an older spec diffuser in the Austria race so was at a disadvantage.

Which is very much what Mercedes has been observing of the Red Bull in the last two races, with the Silver Arrows losing a reported 0.25s down the straights of the Red Bull Ring.

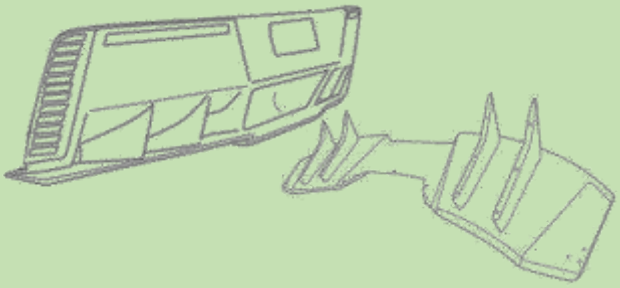
Because a high-rake car can better link up the flows from the rear brake ducts and the diffuser strakes, tweaking the diffuser in this way will tend to find a greater advantage than from a low-rake car. Especially under the '21 aero restrictions around this area of the car.

Could this be why Mercedes feels its car has effectively run out of development potential at a time when Red Bull is still finding significant gains?

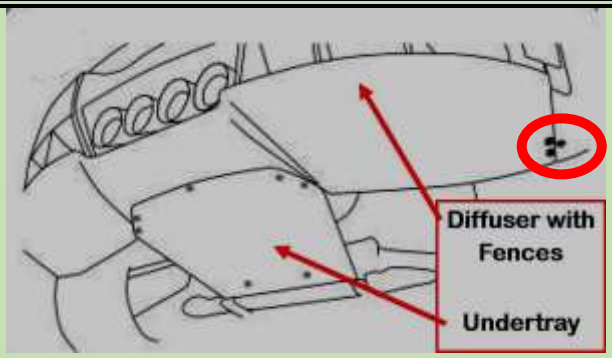
Note: ***Pic of C8.R Rear Diffuser on Last Page of Appendix***

Install C7 Carbon Diffuser

Install of the C7 Carbon Diffuser is a 3 of 5 wrench difficulty unless you carefully read the modified C7 Carbon instructions (attached) AND this PDF - then it's a 2 wrench effort!



Tools: 7 & 10 mm Sockets; a 7 mm open end wrench; Torx T15, T20 &T25; Plastic Trim Tools



The Diffuser uses exiting bolts including those outside ends (red circle) and 3 supplied bolts in each of the 4 "fences" as they are called. These allow the air under the car to merge more smoothly with the air behind the car.

The included Undertray extends the smooth path in the center of the car to assist air entering the rear Diffuser.

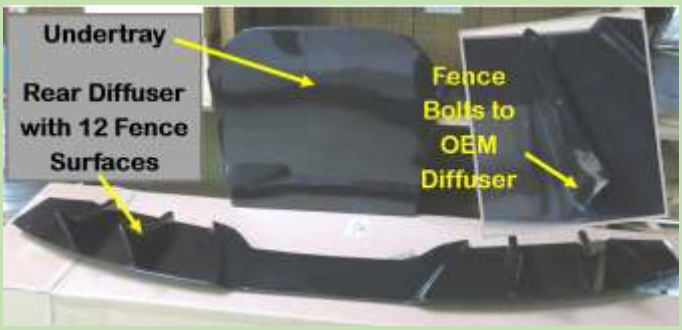
UNBOXING:

The box holding the Diffuser and Undertray is 6 feet long.

The product is very well packed

My experience with a C7 Carbon splitter installed on my 2014 Z51 was the same, excellent packing and well protected.

No damage. It has flexible foam padding covered by bubble wrap.



The carbon flash painted finish is excellent. Perfect match to the OEM diffuser bottom.

It has 4 added fins or properly called "Fences." This gives 12 surfaces that will form counter rotating Vortex flow on each fence wall. This makes flow smoother and regular compared to the more turbulent flow without them.

These are the screws under the back of each fender. The one in Red holds the GM Splash Guard in the Grand Sport and Z06 and the one circled in Red, the splash guard.

The inner most Green circled bolt holds the Splash Guard for C7s with narrow rear fenders! I now see how this one part fits all C7s! The inner bolts are on all C7s and are at the same spacing regardless of model!

Prior to performing the C7 Carbon Instruction Step 3, I checked the fit.

Placed the Diffuser on two 6-inch-high stanchions I had available. Could use cardboard boxes etc. It is not heavy, 10.5 pounds, but it is awkward.

Best not to lift the car at this point. In fact, not needed until installing the undertray.

Found it would hold with one bolt on each side. However, to get it to fit flush for accurate marking and to check the fit of the Fences I used a scissor jack to hold the Diffuser so the fences fit tightly.

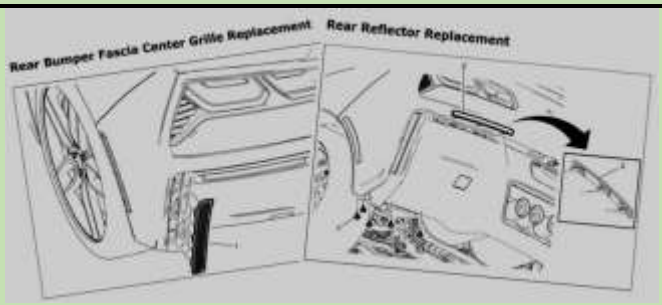
There was a good fit. So ready for the Step 3 & 4 measuring for and drilling the 12 holes in the OEM diffuser.

Wondered why they would not just support the assembly with OEM bolts and perhaps two-sided tape? However, those 6 bottom auto body bolts are small like sheet metal screws! Much stronger to have bolts holding each Fence to the OEM Diffuser. It's a secure assembly with the supplied 1.9-inch OD plastic washers to support added downforce.

I suggest you watch 1 minute of this video starting at 2:30 in to 3:30:

https://www.bing.com/videos/search?q=install+corsa+exaust+c7+corvette&&view=detail&mid=3B1AB478B4859AF42E933B1AB478B4859AF42E93&&FORM=VRDGAR

However, don't get the wrong impression! It will take up to 1 hour to remove the OEM part that you'll see done in one minute!



In addition to the modified C7 Carbon Instructions in the Appendix, another pics/text from *Stingrayforum*, member *Pilotsdiscreation*, is included for installing another type of Diffuser that has some helpful removal hints and pics of the OEM lower bumper (diffuser.)

Will spend a number of pics on Step 3 and Step 4 as these were probably the most difficult to perform properly.

Tried several methods of the simple statement in Step 3, *"Add marking material on the predrilled holes."* As well as marking the OEM diffuser for drilling.

Devised a method that worked. Using the suggested clay and paint to mark masking tape placed on the OEM diffuser face- did not!

"Eight pics down is a summary of the Suggested Best Approach in Red."

"

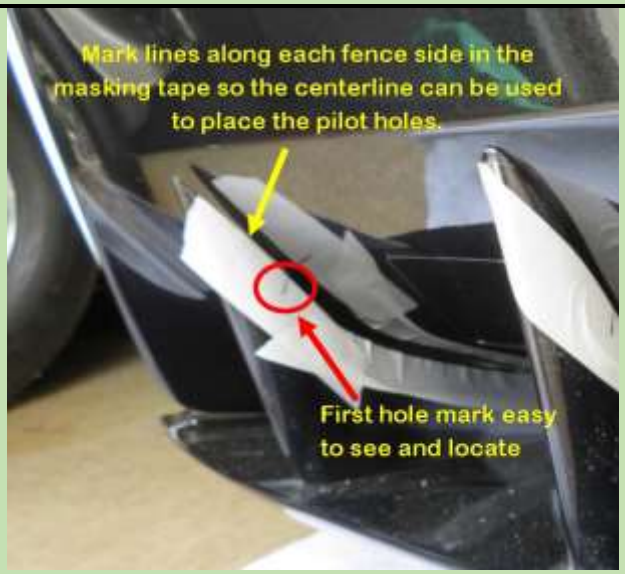
Anticipating the small clay balls (recommend for possible use by C7 Carbon) and the drop of paint placed on top of each may not work, so also used another method! I even put some Vaseline on the hole to make it easier for the painted clay to stick to the OEM diffuser and not the fence. *Only two did!*

Placed a strip of masking tape along the fence and placed a mark where the holes were located. Then after bolting the fence assembly to the OEM diffuser using the 6 end screws, made marks on that masking tape corresponding to the threaded hole marks shown here.

Although it is not easy to get the hole marks identified on all three holes it is possible to mark a line on the masking tape placed on the OEM diffuser surface.

The outer, Top hole mark is also easy to reach and accurately placed on the masking tape for the proper hole location.

As noted in the "Suggested Best Method" below, properly marking these top hole locations is all that is necessary. The other two holes can be located on a fence centerline with a simple paper template!



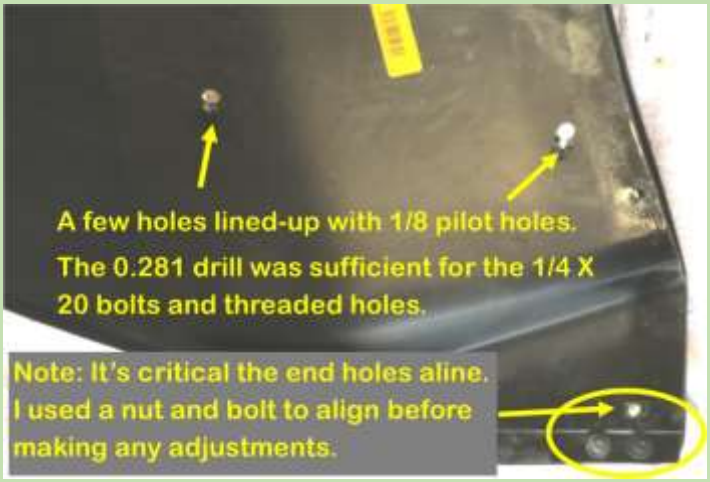
The lines placed were wider than the 7/8-inch-wide fence but by using the midpoint they defined the centerline.

This would have worked better if I had used a sharp very short pencil as the marks placed further inside the "tunnels" between fences did not show well and were not accurate. In addition, only the first hole locations were accurate as ones further down the "tunnel" were difficult to reach and proved not to be in the exact locations needed.

However, I only drilled 1/8-inch pilot holes, so no harm done. The method used to locate the proper position was easy to mark with a few properly located top holes.

All of the upper most or top marks were relatively easy and accurate to mark on the OEM diffuser masking tape. However, the center and particularly the marks farthest into the "tunnel" could not be reached to accurately mark them.

A template was made from paper that accurately marked all of the holes. It followed the contour of the fence on the surface of the OEM diffuser. Using the center location between the lines made on the masking tape along the edges of each fence allowed a more accurate location to mark for drilling.



All pilot holes along the top edge, as were in good alignment. This positioned the new diffuser system properly. Note the 6 end holes that attach the diffuser to the body must align perfectly. I used a bolt and nut on each side and two screws in those holes to assure proper alignment before final drilling.

Note, I only used a 9/32 drill (0.281") for the 0.250 threaded holes while the fence is 7/8 inches wide. Could have used a larger drill but some holes were off sufficiently, that would not have worked!

Where the drilled 1/8-inch pilot hole did not fall directly over the predrilled ¼ inch threaded holes but was close, I used a 9/32 drill and then enlarged the hole where needed with a Carbide Burr to get alignment.

Checked to see if the 1/8-inch hole was over the ¼ inch hole by inserting the drill bit. With the two parts bolted together with the 6 bolts on the ends, used the 1/8-inch drill through the original pilot holes to just make a mark on the inner fence surface. As shown in pic right this one was off about 1/4 inch. Then drilled a 9/32 hole in the OEM diffuser in that location. It wasn't always in perfect alignment BUT a Carbide Burr quickly enlarged the hole to the side where needed. *Better than using a very large drilled hole!*

If the 9/32 (0.281) hole was close to correct for the 0.250 threaded hole, enlarged the edge needing adjustment with a Carbide Burr.

SUGGESTED MARKING APPROACH: Just mark the sides of each fence on masking tape placed on OEM diffuser. Mark the Top hole position on a center line between side lines. Then using a paper template mark the other two hole locations on each fence. Use a 1/8-inch pilot drill then check position.

Pic shows the finished assembly with the supplied, thick 1.9-inch OD hard plastic washers that spread the load over the back of the OEM diffuser.

This approach suggested (left text) was much easier than trying to get the original holes perfectly aligned. With the shape, even a full template would not have achieved perfect alignment. Once the 6 end holes are aligned using nuts and bolts, using the 1/8-inch pilot holes and drilling just the fence surface to mark the exact location needed, was relatively easy.

Six OEM body bolts hold the diffuser to the body and screw into metal extruded U nuts. They are a fine thread 4.2 mm X 25 mm long automotive body bolts with a captive washer.

Could not locate a longer hex head body bolt but was able to fine one with a T20 Torx head bolt (screw.) By using a small fender washer, they worked as good replacements. As shown in the pic, after going through the C7 Carbon diffuser they protruded the same as the OEM screw without it.

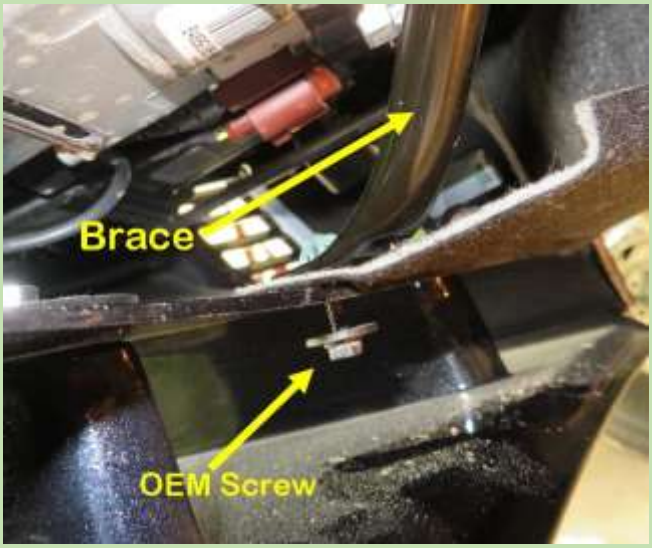
Was concerned the OEM screws were not catching enough of the extruded nut threads. These six screws (only two in a narrow body C7) bolt the OEM and new C7 Carbon diffuser to the other body parts.

The C7 Carbon part is about ½ inch thick, so the longer screw grabs all the extruded threads.

Note, a #8 sheet metal screw is slightly larger and also has a coarser thread. It would probably work OK by cutting new threads in the extruded nut.

Bolting the assembled OEM diffuser with the added 4 fences and bottom assembly is straight forward. Slip the top tabs into the matting slots and a modest hit with the side of your hand is all that is needed. Put in the bolts you removed, and the 6 longer body bolts described above on the underside.

The side vents are a bit more of a pain. Putting the three tabs on one side, it's hard to get the side in! Used a plastic trim tool to leverage the tabs into the matting slots.



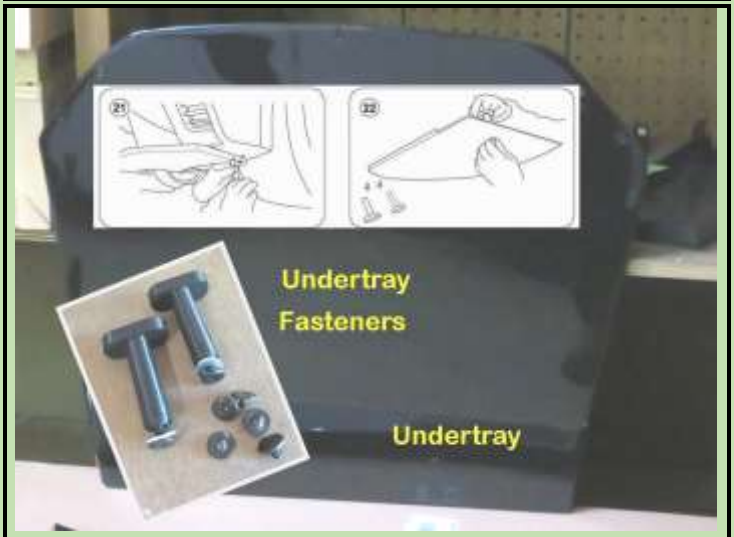
Up to this point there was no need to jack up the car. This next task is to install the Undertray and that requires raising the rear about 6 inches.

The first task that can be completed with the car raised is installing the two OEM screws that attach the OEM diffuser to a tubular brace. Those could not be reached without lifting the car and accessing from the rear. The new lower diffuser section prevents easy access, but the screw can be started by hand.

You can move the tubular brace with one hand while aligning the hole to start the screw.

After screwing in as much as possible by hand a 7 mm open end wrench is needed to tighten the screw. Can only get about a 90 degree turn so it takes patience!

There is another screw to the outside of the two on either side connecting to the brace. It is only attaching a piece of fiber type material with an extruded U nut. It does not appear to be needed and hopefully it is not as it was difficult to get the screw started. Left it out!



Installing the Undertray is straight forward following the simple instructions. A T25 Torx bit is needed.

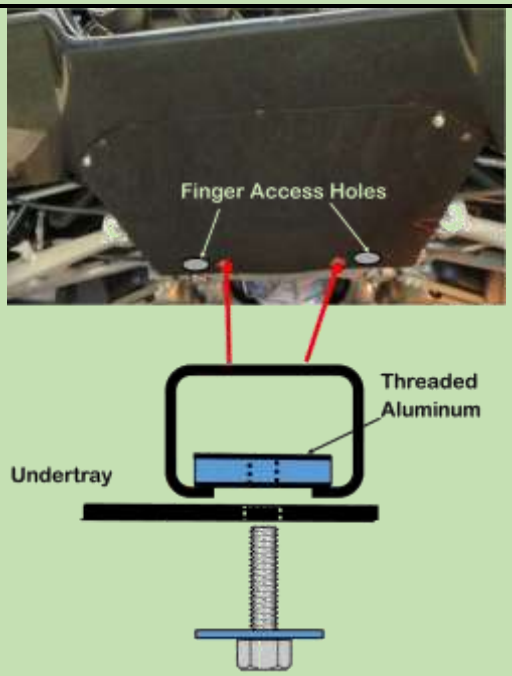
Used a long ¼ x 20 bolt in the rear center hole to hold the end up before installing the very short screws supplied.

The front supports float and I wondered about possible vibration when at speed.

This is the finished Undertray install. However, the front edge is the lowest point in the rear underside! Lower than the diffuser.

The TEE does not hold the undertray it floats in the hollow C7 rear crossmember. One of plastic TEEs broke and while I waited for C7 to ship a "new design" (which they did-see pic insert, its metal, much better IMO.

I had an idea for a fix!



I could thread the center of an aluminum bar the same size as the top of the supplied TEE. Then use a bolt with washer to pull and hold the Undertray tightly to the hollow C7 crossmember.

The bar would be inserted like the TEE with it parallel to the crossmember and slipped into the crossmember hole. Then it would be rotated 90 degrees to hold in the Undertray. The only question-*HOW TO HOLD THE BAR SO IT DID NOT TURN AS THE BOLT WAS TIGHTENED?*

An answer is to make two finger-hold holes in the Undertray near the bar!

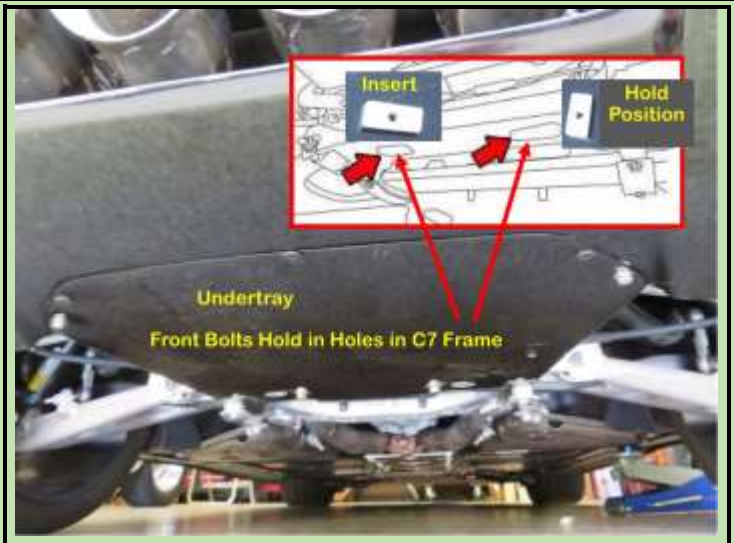
Not a solution C7 Carbon would use but good enough for me!

Drilled two finger-hold holes next to each bolt, using a 1¼ inch hole saw. The Undertray is made of fiberglass and drills easily.

The holes are to the outside of the bolts as that is where the C7 hollow crossmember holes are located.

As the plastic TEE is used, the bolt is placed through the Undertray (with a washer and lock washer) into the aluminum bar on the top side. Before tightening the bolt, the bar is positioned parallel to the crossmember and inserted in holes in the hollow crossmember.

Then the bar is rotated 90 degrees to clamp the front of the Undertray.



Undertray Installed:

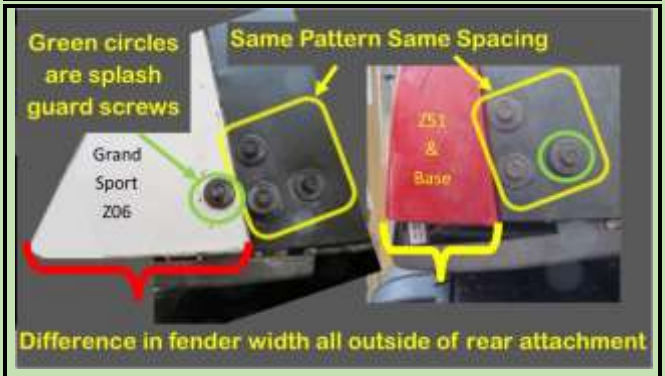
Treaded the bolts and washers through the Undertray and turned both bars parallel to the C7 hollow crossmember to insert. Then turned both 90 degrees and held the bar with my finger as the bolt was tightened. Once it contacts the inside of the crossmember, friction also helps stop it from turning.

The rear 5 bolts were tightened then the front two. The Undertray bent slightly to the shape of the crossmember and is held tightly to it.

Interesting Observation:

Viewing the pic right, shows why C7 Diffuser can fit the narrow fender Base/Z51 as well as the wider fender Grand Sport/Z06.

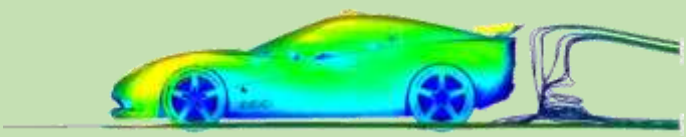
Pic shows that is possible because the three inner screws are in the same location for both narrow and fat fenders! In my Z51 the inner screw held the splash guards.



It Fits Well with the C7 Rear and Finish is Great

Appendix: Aerodynamics

General, Followed By Specifics



The base C7 was designed with many optimized aerodynamic elements. But more can be done! The rear spoiler on the Z51, for example, decreases lift at speed but adds drag. It also reduces the slight vacuum formed behind the car.

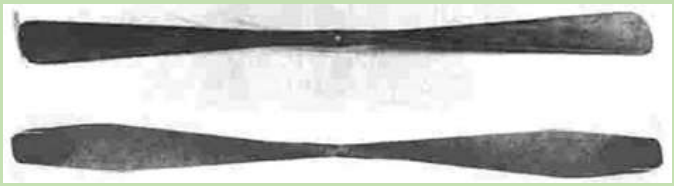
	CD Drag Cd	Lift Coefficient
C7 Base	0.30	0.20
Z51	0.35	0.03
Z06 Base	0.37	0.0
Z06 Stage 2	0.40	-0.152
Z06 Stage 3	0.50	-0.279

Note the base C7 still has lift (a positive 0.20 coefficient,) the Z51 spoiler provides no downforce, it just counters lift. The Stage 2 aero Z06 provides rear downforce, Stage 3 even more but both adding significant drag!

Tadge provided this drag and lift information in a 2016 post. He also stated; ***"We have strict criteria for pitch moment. The ratio needs to be held within a fairly narrow range so that the vehicle handling remains consistent. Too much down force on the rear and the car will understeer at higher speeds. Too much on the front and the car will oversteer. We tune all our cars to maintain neutral handling biased slightly towards understeer."*** A rear diffuser can add downforce with minimum extra drag.

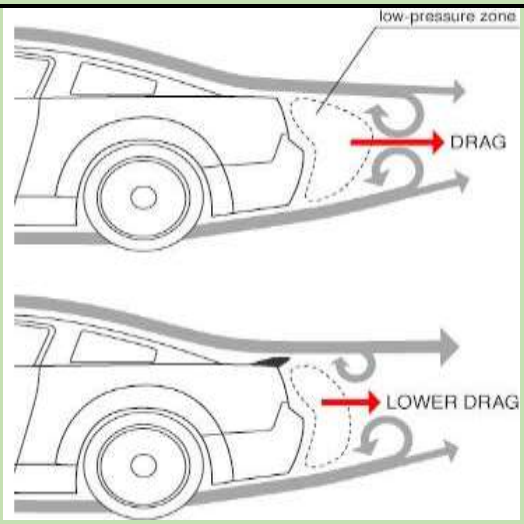
Aerodynamics is not intuitive, even the Wright Brothers measured lift on various models in a home-built wind tunnel.

Of interest, the shape they developed for the propellers for best performance is optimum even today!



In his 1923 race car, Bugatti knew at speed there was a partial vacuum formed in the rear of a flat rear shaped car, so he used the tapered shape shown.

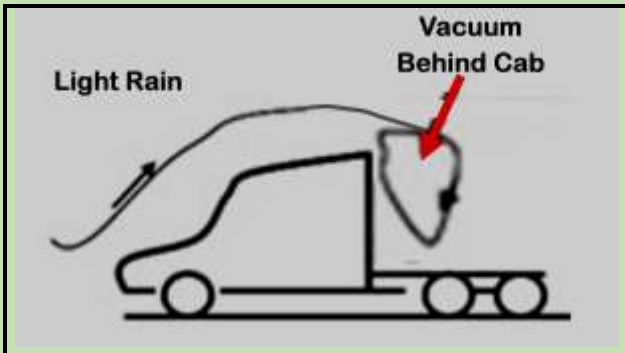
This 1968 907 Porsche used a long tail approach to reduce drag.



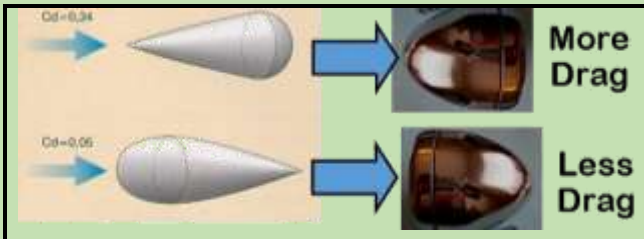
In addition to providing downforce, a small rear spoiler decreases the low-pressure area directly behind the car.

This Ferrari 1960 Superamerica employs a small rear spoiler than allows a sharp cut off rear body shape.

A personal example occurred as I was stopped waiting to enter a 4-lane highway! An 18-wheeler cab was traveling about 60 mph on a light rainy day. The rain and light created visible air streams. The turbulence directly behind the cab was obvious. You could visualize the partial vacuum being formed. That pressure difference was pulling on the cab causing a drag force.



Recall in a fluid dynamics class the Prof showed the Teardrop Spotlights used "In The Day" had more drag with the bullet shape facing forward! The low pressure behind the flat surface "pulls" it back. Air forms a bubble in the front on the forward flat surface.



On high humidity days you can see the vortices form at the ends of the wing in a race car.

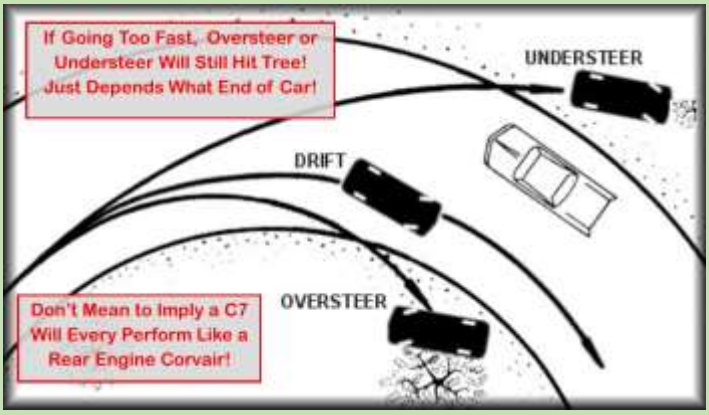
As the low pressure under the wing increases to atmospheric pressure, the gaseous water vapor becomes visible. Like in a cloud!

MY EXPERIENCE WITH LIFT:

My 260Z was known to have considerable lift at speed. The standard car produced about 140 lbs. of lift in the front and 35 lbs. in the rear at 70 mph. That was a lot for a 2700 lb. car. At 100 mph you could feel the front end become light and stability was inferior to that at normal highway speeds.

The balance between front and rear downforce must be considered.

I added a large front air dam and a rear spoiler like those shown left. The front was advertised as adding 100 lbs. of downforce and the rear 35 lbs at 100 mph. It was very stable at even 120 mph! Then I hit the air dam on a curb! It cracked so I took it off. While I waited for a new one to arrive, have it painted, then found time to install, the stability even at 70 mph was definitely worse! The spoiler adding downforce in the rear made the situation worse that even stock!

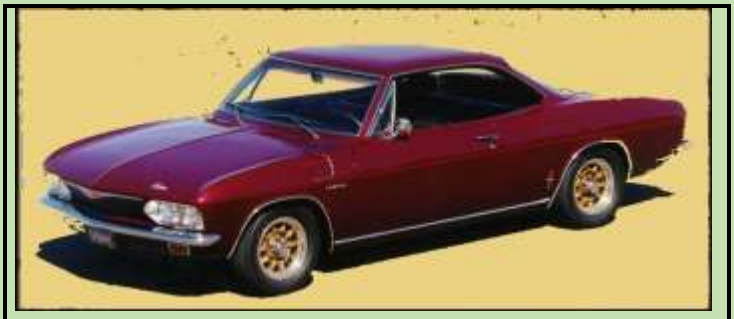


Front and Rear Downforce Balance

When adding downforce, you must consider how the balance affects handling. Excess on one end or the other can cause understeer or oversteer.

Tadge said regarding the Z06, *"The center air dam was not used because it increased downforce excessively and resulted in Oversteer at high speeds when they require slight Understeer!"*

Perhaps with the increased downforce, with a diffuser the air dam could be added to models without one!



C7 oversteer could never be like the Corvair!!

CORVAIR OVERSTEER:

My first new car was a 1967 Corvair ordered with every HD option offered; quick steering, HD suspension, etc. Like the pic left I added aluminum 14-inch wheels and "low profile" Continental 714 tires. Great car. It was my 2nd Corvair, and I was very familiar with high speed oversteer!

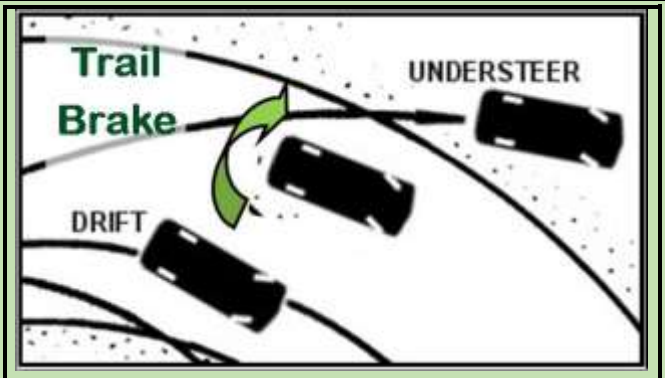
UNDERSTEER:

Had a front wheel drive Dodge Colt Turbo in the 1980's when we were only allowed to get gas every other day! It was a great fun car once I installed 14-inch aluminum wheels and Pirelli P7s!

As it was called by the car mags, it was a "Pocket Rocket!" But like all front wheel drive cars it had significant understeer.

That 2200-pound front drive Colt was fun to drive if the understeer was understood and managed. The NASCAR word "plowing" sure fit this model. Being my first front drive car, I wasn't used to turning the wheel, hitting the gas coming out of a turn and having the car trying to go off the road, front first!

Found I could use a form of trail braking to get the car pointed in the direction I wanted to go! Used the emergency brake with the button held in to reduce the side traction of the rear tires! The car rotated around!



The center handle brake was an excellent tool to steer the car in turns! For racing, just remove the locking button.

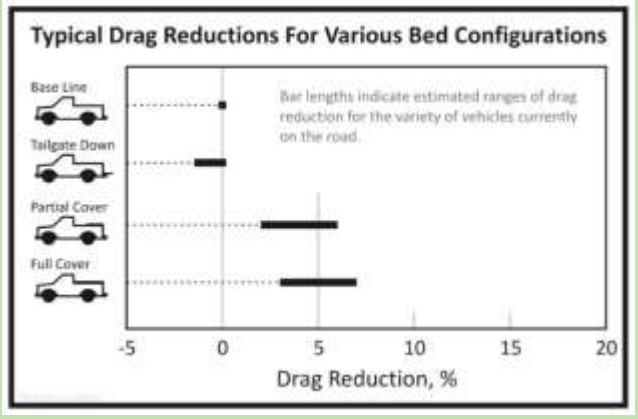
Modified S10, every HD option, Bed Cover, many mods

Fun Aero Discussions:

One area I had fun discussing aero was my pick-up truck and how leaving the tailgate down was decreasing mpg! All documentation says it is worse! There is a bubble of air in the bed makes air move over the area and reduce drag.

These are information that quantifies the amount of extra drag as measured by mpg with the tailgate up versus down. The graph left shows a 2% mpg advantage being up and a 7% mpg advantage with my full bed cover.

Adam and Jamie, hosts of the TV show MYTH BUSTERS, drove two identical Ford F150 pickup trucks filled with identical amounts of gas. One with the tailgate up the other down. They drove the same road and after 500 miles the one with the tailgate up went 30 miles further before it ran out of gas! That's 6% better (30/500!)

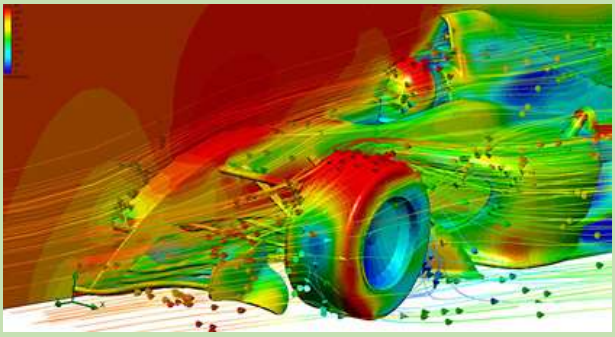


With the tailgate down there is a larger are of low pressure behind the cab increasing drag!

COMPUTATIONAL AERODYNAMICS

Tadge said in a forum post about C7 aerodynamics, computer programs can give answers very close to the much more expensive wind tunnel tests!

These programs are getting very sophisticated and can match very expensive moving floor wind tunnel data.



This video link: https://www.youtube.com/watch?v=7hVMwKJQ0wE shows the Sauber F1 team using their expensive wind tunnel for a full week. Note, their wind tunnel employs a moving steel floor!

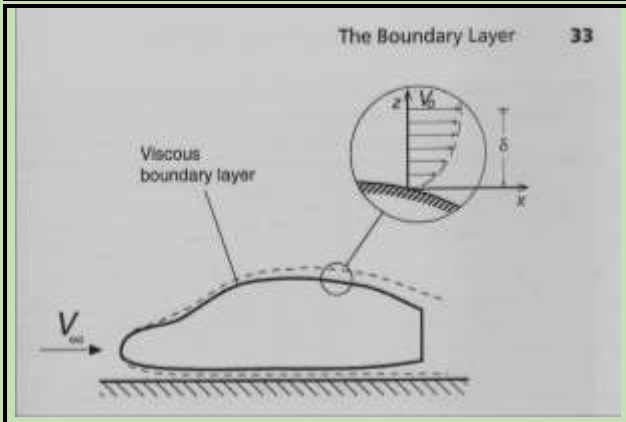
It states the teams were operating their wind tunnels 24/7 then as a cost reduction, F1 rules limited that to a number of test runs they can make.

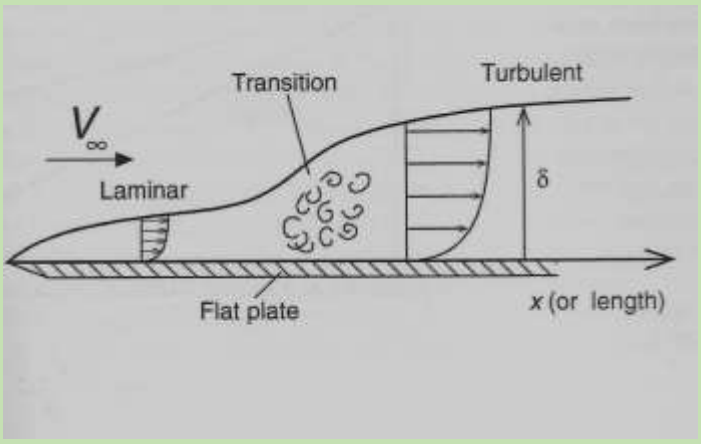
Because of the accuracy of simulated aerodynamics programs, the F1 rules also limit the amount of computer teraflops of solver time they can use to help reduce costs.

Boundary Layer

The layer of air next to a moving body is moving at the same speed as the body. Further from the surface, the velocity progressively changes to the surrounding velocity.

Pic right is form Reference 1. It shows the air moving at ~60 mph hugs the surface in a thin layer at the start (~ 1/16 inches) but can increase to an inch or more toward the rear of a car. A thicker boundary layer results in a more drag.





A step increase in the boundary layer thickness creates a turbulent boundary layer and flow separation. Flow separation in a wing, for example, will decrease downforce. (See Coanda Effect below.) Pic left from Reference 1 shows this effect occurring on a flat plate.

This turbulent area creates even more drag. However, where separation is inevitable, as in the rear of the car, it is usually better to have a turbulent area with some drag penalty than flow separation that reduces downforce!

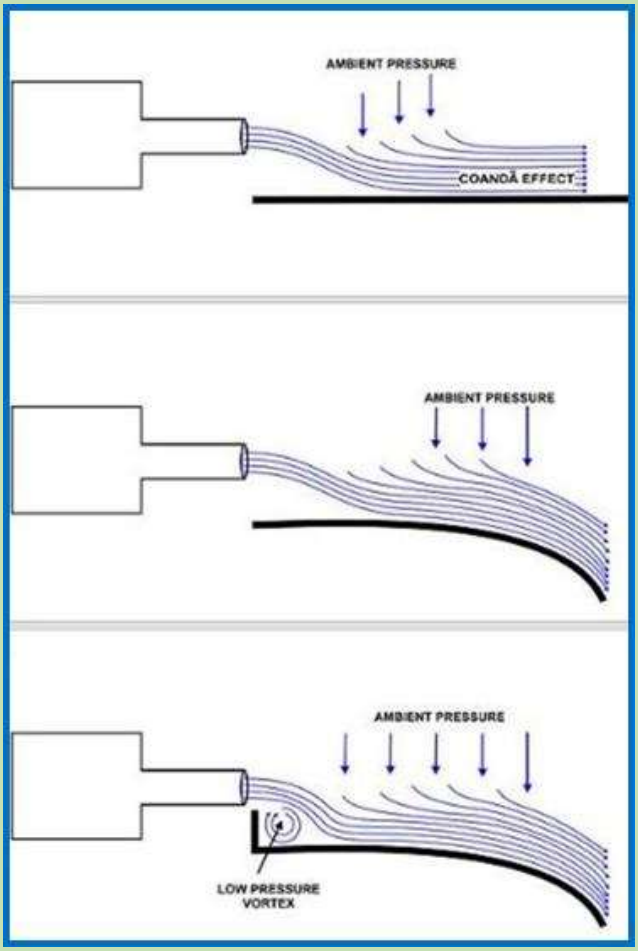
There are ways to induce turbulence where desirable such as small vortex generators or even sandpaper!

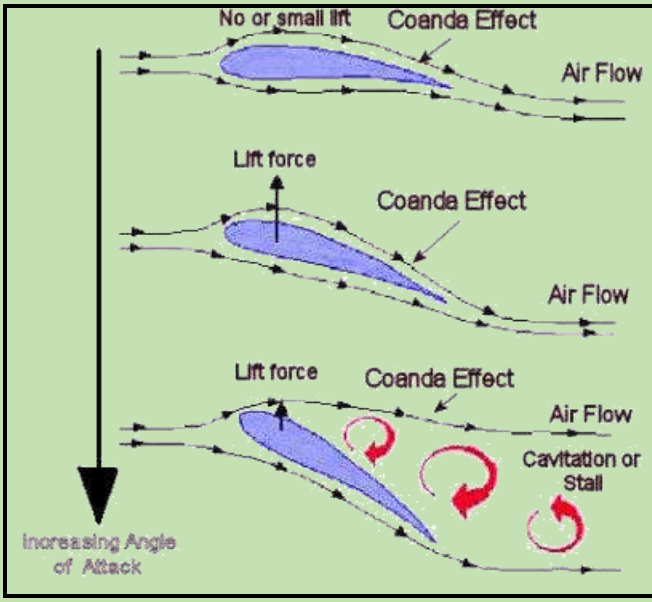
Coanda Effect

Aerodynamics pioneer Henri Coanda made a very important contribution to how the aircraft wings produce lift when he discovered what is now called the *Coanda Effect*.

A natural question is "how does the wing divert the air down?" When a moving fluid, such as air or water, comes into contact with a curved surface it will try to follow that surface.

Coanda Graphic: **The pressure difference across the air jet causes the jet to deviate towards the nearby surface, and then to adhere to it. If the surface is not too sharply curved, the jet can, under the right circumstances, adhere to the surface even after flowing 180° round a cylindrically curved surface, and therefore be traveling in a direction opposite to its initial direction. The forces that cause these changes in the direction of flow of the jet cause an equal and opposite force on the surface along which the jet flows. These Coandă effect induced forces can be harnessed to cause lift and other forms of motion, depending on the orientation of the jet and the surface to which the jet adheres**



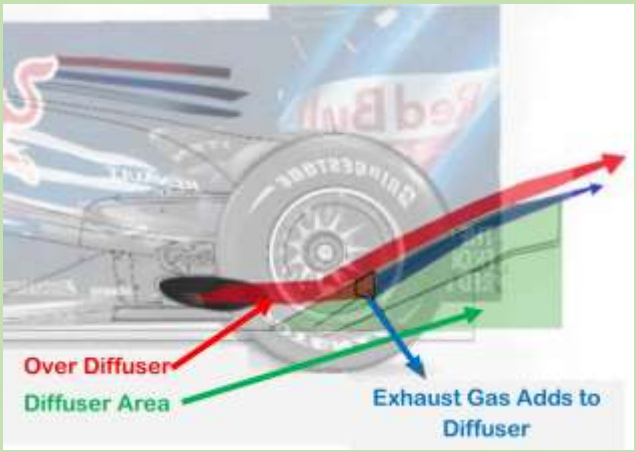


This phenomenon explains why a wing (airplane or inverted race car) stops being effective it the angle of attack is too steep.

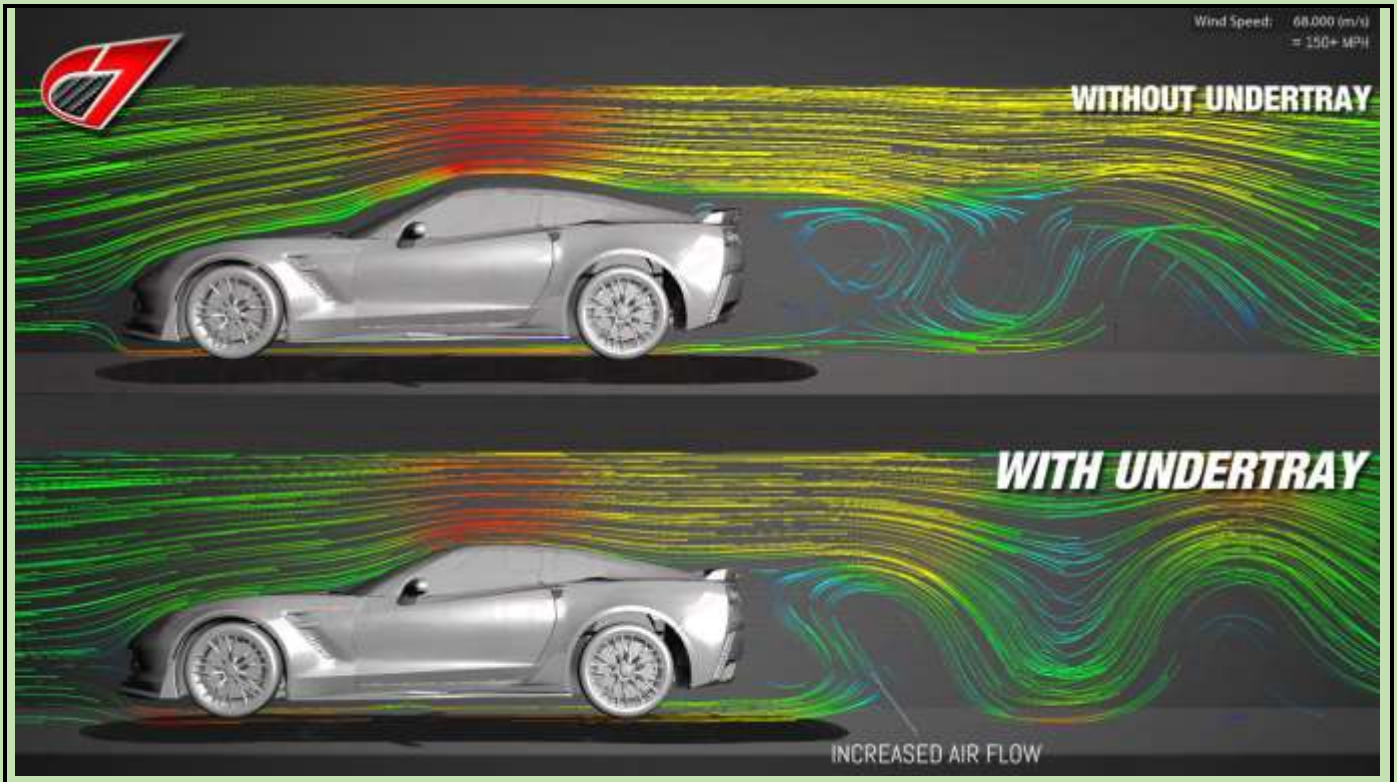
To get around air stream separation problem in Formula 1, and increase the Coanda effect on wings, dual or more element or slot-gap wings are used, these allow for some of the high-pressure flow from the upper surface of the wing to bleed to the lower surface of the next flap energizing the flow. This increases the speed of the flow under the wing, increasing downforce and reducing the boundary flow separation.

Blown Diffuser

An interesting approach was use in F1 as rules reduced that allowable configuration of diffusers. A blown diffuser is basically a way of using the exhaust gases to add to the diffuser airflow. There are two main purposes for this:
1. To try to move the wake from the rear wheels outwards where it will cause less disturbance
2. To re-energize the low-pressure air at the back of the diffuser to create more rear downforce.



Does the C7 exhaust position add to the diffuser rear downforce? Don't know how much but appears it should!



Graphic from C7 Carbon website.

Summary: There Are Number Of Devices That Increase Downforce:

- **A Rear Spoiler Increases Downforce But Also Significantly Increases Drag.**

  For example, the larger spoiler on a Stage 3 Z06 provides an increased downforce coefficient of -0.279 from 0 for the base Z06 with its smaller spoiler. However, it is also responsible for the majority of the drag increase that goes from a coefficient of 0.37 to 0.50 = a 35% increase!

- **A Rear Diffuser Increases Downforce With Minimum Increase in Drag.**

Reference 1: "Race Car Aerodynamics:" by J Katz PhD:306 pages; Bentley Publishing 2006

Reference 2: Internet source by W. Toet, 12/2015: https://www.linkedin.com/pulse/insight-design-performance-aero-f1-willem-toet/

Also 4/2016 https://www.linkedin.com/pulse/secrets-formula-1-front-wing-part-willem-toet/

WA Technology

"54" C8, 2017 Grand Sport & 2014 Z51 Stingray Mods, Info Available As PDFs:

54 PDFs discuss improvements or info about a C8, 2017 Grand Sport, 2014 Z51 Stingray function and/or esthetics. Some are minor and others, like the installing "Low Dust Brake Pads" on C8 & C7s, have detailed information.

Below are the PDF's available. Click on picture or Blue PDF link or copy and paste the PDF link (Blue type) into your browser. Or email me at GUttrachi@aol.com **and state the title desired, shown in Yellow:**

C8 Install High Wing ***How To Remove Rear Bumper- Install Wing*** **http://netwelding.com/C8_High_Wing.pdf**	
C8 FWD Hybrid ***WFWD Hybrid Provides More Power & MPG*** **http://netwelding.com/C8_FWD_Hybrid.pdf**	
C8 Edge Red Engine Cover ***Engine Cover Matches Valve Covers*** **http://netwelding.com/Engine_Cover.pdf**	
C8 Engine Compartment Lights ***Multicolor Lights Remote operated*** **http://netwelding.com/Engine_Lights.pdf**	
C8 Side Skirts & Splitter ***Install C7 Carbon side skirts & splitter on C8*** **http://netwelding.com/Side_Skirts.pdf**	
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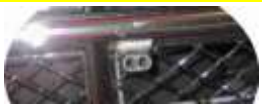
C8 & C7 Splitter & C8 Condenser Mesh ***Mesh Protects AC Condenser & Splitter Install*** **http://netwelding.com/CF_Splitter.pdf**	
C8/GS/C7 Splash Guards ***GM splash guards. ACS Best Front Guards for GS.*** ***http://netwelding.com/Splash_Guard.pdf***	
Jacking a C8/GS/C7 Vette ***Safely jacking either front only or back & front*** ***http://netwelding.com/Jacking_A_C7.pdf***	
C8 & C7 Plates & Frame; **Must Meet South Carolina Law** **http://netwelding.com/License_Plate_Frame.pdf**	
Change GS/C7 Oil ***WHY change your own oil and C7 Lifting Methods*** **http://netwelding.com/Changing_Oil.pdf**	
C8/GS/C7 Mirror Proximity Alarm ***Limit switch alarm warns when close to door frame*** **http://netwelding.com/Mirror_Proximity_Alarm.pdf**	
Jacking Pads for C8/GS/C7 ***Manual says Jacking Pads 2 1/2-inch max OD..*** **http://netwelding.com/Jacking_pads.pdf**	
C8/GS/C7 Radar Power ***For C7 tapped rear fuse panel. For GS tapped mirror*** **http://netwelding.com/Radar_Detector_Power.pdf**	
C8 & C7 Wheel Chatter/Hop ***Why sharp, low speed turns with cold tires causes the front tires to chatter/hop.*** ***http://netwelding.com/Wheel_Chatter.pdf***	
C8/GS/C7 Wheel Locks ***Wheel locks, help protect your expensive wheels.*** **http://netwelding.com/Wheel_Locks.pdf**	
Deer Whistle Installed on C8/GS/C7 ***Do they work? Plus Install Info*** ***http://netwelding.com/Deer_Whistle.pdf***	
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C8 & C7 Cargo Area ***Rear cargo area storage device and rear protector*** **http://netwelding.com/Rear_Cargo_Area.pdf**	
C8 Coilover Tower Covers ***Prevent water from filling Cast aluminum cavities*** **http://netwelding.com/Tower_Covers.pdf**	

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GS/C7 Belt Rattle ***Passenger seat belt rattles against the seat back.*** **http://netwelding.com/Eliminate_Rattle.pdf**	
Aluminum C7 Chassis and Weld Repair ***The C7 aluminum chassis. Includes weld repair info.*** **http://netwelding.com/Aluminum_Chassis.pdf**	
Manage GS/C7 Spilled Gas & Door Lock ***Protect when filling gas. Preventing door lock failure.*** **http://netwelding.com/Manage_Spilled_Gas.pdf**	
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GS Rear Diffuser (Fits Any C7) ***Rear Carbon Flash Composite Diffuser*** **http://netwelding.com/Rear_Diffuser.pdf**	
GS/C7 Door Panel Protector ***Black plastic protector prevents scuffing of door*** **http://netwelding.com/Door_Panel_Protector.pdf**	
GS/C7 Improved Cup Holder ***A solution to the cup holder spilling*** **http://netwelding.com/Improved_cup_Holder.pdf**	
C7 Carbon Fiber Grille Bar ***Install genuine carbon fiber grille bar overlay*** ***http://netwelding.com/CF_Grille_Bar.pdf***	
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GS/C7 Skid Pad Protector ***After the air dam, the aluminum "skid pad" hits*** **http://netwelding.com/Skid_Pad_Protector.pdf**	

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GS/C7 Skip Shift Eliminator ***Skip Shift Eliminator install with suggestions on jacking a C7.*** **http://netwelding.com/Skip_shift_Eliminator.pdf**	
GS/C7 Catch Can & Clean Oil Separator ***What is Coking and how to reduce the potential*** **http://netwelding.com/Catch_Can.pdf**	
GS MGW Flat Stick Shifter ***The MGW shifter shortens throw and is more precise*** **http://netwelding.com/MGW_Shifter.pdf**	
GS/C7 Round Shift Knob ***A round shift knob shortens throw on OEM shifter*** **http://netwelding.com/Shift_Knob.pdf**	
GS/C7 Stingray Sill Plate ***Stingray sill plate replaces original.*** **http://netwelding.com/Sill_Plate.pdf**	
GS/C7 Nylon Bra ***Nylon Bra Stops Bugs. Fits with Stage 3 Winglets*** **http://netwelding.com/Nylon_Bra.pdf**	
GS/C7 Clutch Fluid Change ***Clutch fluid after 3000 miles gets dirty*** **http://netwelding.com/Clutch_Fluid.pdf**	
C7 Carbon Fiber Hood Vent ***Replaces Plastic Hood Vent*** **http://netwelding.com/Hood_Vent.pdf**	
GS/C7 Cold Air Intake ***Low Restriction Air Filter & Duct*** **http://netwelding.com/Cold_Air_Intake.pdf**	
GS/C7 Soler Modified Throttle Body ***For Improved Throttle Response*** **http://netwelding.com/Soler_Mod_TB.pdf**	
Garmin GPS for GS Cubby ***Garmin Mounts in GS Cubby & Apple CARPLAY*** **http://netwelding.com/GPS_In_Cubby.pdf**	

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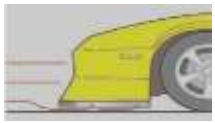
GS Splitter Stage 3 Winglet ***Stage 3 Winglets Integrate with Spats*** **http://netwelding.com/Stage_3_Winglets.pdf**	
C7 Removing GM Plastic Film ***How To Remove The Rocker Panel Film*** **http://netwelding.com/Rocker_Panel_Film.pdf**	
GS 2LT to 2.5 LT ***Red Upper Dash Pad Like 3LT*** **http://netwelding.com/Red_Dash_Pad.pdf**	
Jake Emblem/Decals for GS ***Jake Symbols Support GS Racing Image*** **http://netwelding.com/Jake_Emblems.pdf**	
Rusty GS/C7 Muffler ***Why the C7 muffler rusts way to turn matte black.*** **http://netwelding.com/Muffler_Rust.pdf**	
GS Engine Compartment Mods ***Cosmetic Additions in Engine Compartment*** **http://netwelding.com/Engine_Compartment.pdf**	
GS Vitesse Throttle Controller: Fits All C7s ***Adjustable Throttle-by-Wire Control*** **http://netwelding.com/Throttle_Control.pdf**	
Boomy Bass Solution ***Use Presets to Adjust Bass etc. Tone/Balance*** **http://netwelding.com/Boomy_Bass**	
GS/C7 Air Dam, Functions ***Why Missing from Z51, Some GS & Z06*** **http://netwelding.com/Air_Dam.pdf**	
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Engineering a ProStreet Rod ***How Our '34 ProStreet Rod Was Designed and Built*** **http://netwelding.com/Engineering%20Street%20Rod%203-08.pdf**	
Motorsports Welding Article ***Wrote a 5 Page Article for AWS March 2018 Journal*** ***Covers NHRA and NASCAR Chassis Design*** **http://netwelding.com/Motorsports_Welding_2018.pdf**	

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