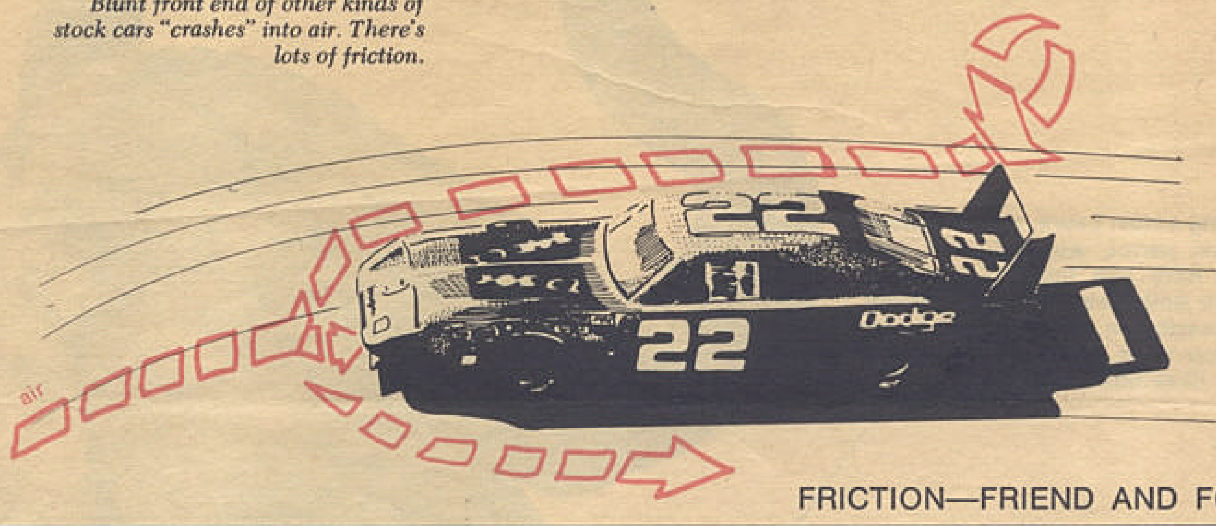


Friction works for and against a racing car. Air rubs against a moving car. This rubbing is called friction. And friction slows speed of car. To cut down on friction, engineers made front end of Dodge Daytona slope downward. Thus, front end "slips" through air. Blunt front end of other kinds of stock cars "crashes" into air. There's lots of friction.

How does friction work for a car? Air passing over Daytona is forced to make loop by tail spoiler (small "wing"). As air loops down, it presses on spoiler. This pushes car against road, which increases friction between tires and road. This makes car stick to road better.

FRICTION—FRIEND AND FOE

AIR POWER—INVISIBLE COPILOT

My hands were wet with sweat beneath the heavy, fireproof gloves. And the tight racing harness was already digging into my shoulders and neck. My mouth was dry. I felt like a prize fighter waiting for the other guy to throw the first punch.

I'd qualified eighth in the 40-car field; not bad, but not the best place to be. Yet a 500-miler at Daytona is a long race. Two hundred times (laps) around the track. Anything can happen.

Twenty rows of multi-colored stock cars were now moving two abreast. They grumbled down the long back straightaway of the two-and-one-half-mile oval, and through turn three. Then we approached turn four, the last of Daytona's high-banked corners. If the starter thought we were well grouped, he'd drop the green flag. And the neat formation would instantly scramble into one of the most exciting auto races in the world.

The engines growled impatiently like caged tigers as we rounded the turn. Every driver's eyes were fixed on the fancy convertible pace car leading the pack. Suddenly, the pace car veered sharply toward pit row. The green starting flag fell!

Forty throttle pedals were jammed to the floor. The field lunged forward. And the cheers of more than 100,000 spectators were muffled by the deafening roar of the engines. I held my position as we crossed the start-finish line and headed full tilt into turn one.

In my Dodge Charger Daytona, with its pointed nose and tall tail *spoiler* (wing-like attachment), I was a curiosity in that race. Sure, I had the most streamlined car in the field. But I also had the smallest engine!

I knew the fans were watching me closely. They expected me to drop to the back of the pack within the first five laps, or even sooner. Instead, I caught the sixth- and seventh-position drivers sleeping as we came off turn one and I managed to move up two places. I was now in sixth position.

When my crew chief, Ronnie Pearson, and I had planned our entry, we figured there'd be some chuckles from the boys on pit row. And we were right. The rule-makers of our division had really dropped the hammer on us. A whole new set of rules!

The season before had seen the birth of the *aerodynamic* stock cars. (These are cars whose body design helps them move more easily through air.) These "aerodynamic stockers" were the Dodge Daytonas, Plymouth Superbirds, Ford Talladegas, and Mercury Spoilers. They were a strange assortment of racers known as "funny cars" with sleek bodies and tricky spoilers. Powered by huge racing engines, these models really flew. And speed records were broken across the country.

But the season also had many serious racing wrecks. Had we finally reached the point where the cars were too fast for the men who raced them? The rule-making officials thought so.

As I held the sixth position down the long back straightaway, I thought about how I'd come to have the least powerful, strangest-looking car in the whole field.

The new rules required us to return to the old, standard bodies if we wanted to run the big powerful racing engines. What's more, the carburetors of these powerful engines had to be equipped with devices that cut down the amount of fuel delivered to the engine. The devices are called *carburetor restrictor plates.*

Those who chose to stay with the "funny cars" were limited to smaller, less powerful engines. But no restrictor plates were required. My fellow racers had all decided to go back to the standard bodies, and race with their big engines, even though the engines' power was restricted by the plates.

I lost the two positions I'd gained earlier just before turn three. But I held my own through three and four and down the front straightaway. Ronnie and I had two choices. We could convert my funny-car body to a standard Charger. How? We'd have to remove the high tail spoiler and pointed nose, and make some other minor changes.

The other choice? We could leave the body alone, and put in a smaller engine.

If we put the body back to standard, I could run a more powerful engine. Of course, the carburetor restrictor plate I'd have to install would make the engine a heavyweight with one arm tied. On the other hand, if I kept the funny-car set-up, I could run the smaller engine without a restrictor plate. That would make me a middleweight, but I'd have both arms free.

At the start of lap four, I slipped to ninth. The first two cars were opening a big gap ahead of the rest of the field.

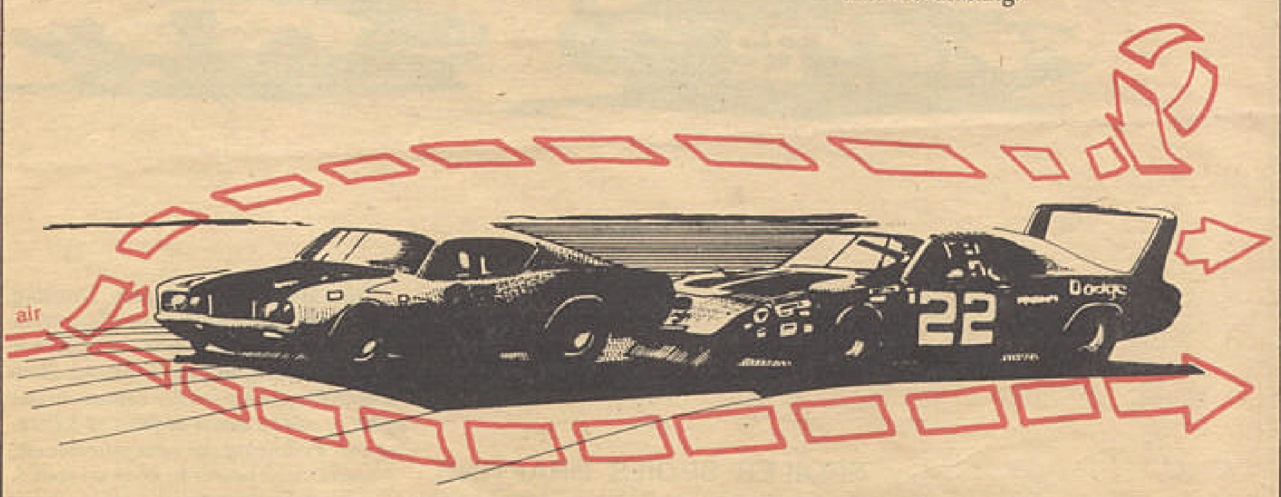
Ronnie's and my decision had hinged on just how much speed our aerodynamic design would give us over the rest of the field. There was no doubt that the pointed nose of my Daytona sliced through the air with less friction than the blunted front of a standard Charger. And the high tail spoiler kept my rear wheels on the ground, especially in the turns. This gave me greater *adhesion*—I "stuck" to the road better. And it gave me much better handling *(see illustration).* Sitting idle in our shop was a low-mileage, small engine

continued on next page

B

DRAFTING

Front car "runs interference" for Dodge Daytona. Car in front plows through normally dense air, while Daytona rides through "thinner" air. Thus, Daytona needs less power to overcome friction of air. This kind of tail-gating, not recommended for regular driving, is called drafting.



Drawings by Fred Pusterla

Airpower—continued

—one I could use in a funny-body car. So Ronnie and I decided to buck the system, just that once.

At the end of lap four, the caution flag came out. Two cars in the back of the pack had "kissed" (scraped) the wall between turns three and four. Oil had spilled on the track. While it was cleaned up, the leading cars headed for the pits. If you managed to get in and out fast enough under the caution, you could regain your position easily.

But Ronnie waved me away from the pit. And I was able to move up to third. The newspapers had called me "David in a field of Goliaths" and my racer became known as "the mini-motor" and "the sewing machine." I guess I was trying to prove that I could beat engine size with aerodynamics and some bold driving.

But no matter how aerodynamic my car was, and how boldly I drove it, most people thought that giving away a huge chunk of power to the other guys was crazy. Yet there I was, with the first five laps completed, and sitting third!

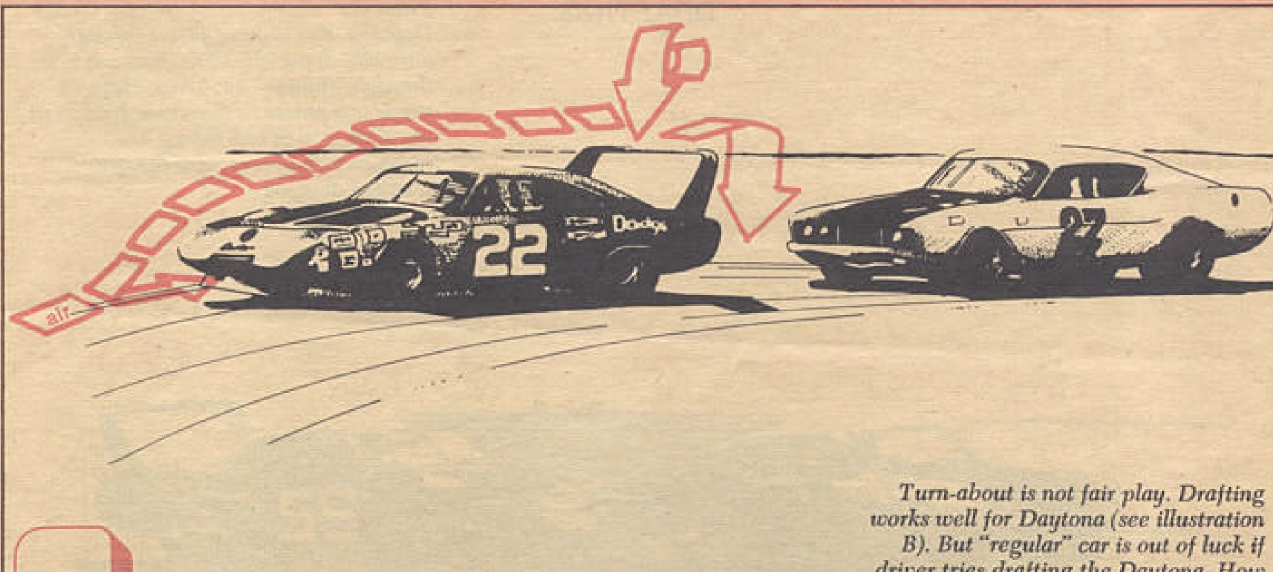
To run with the other, more powerful cars, I had to use aerodynamics to my best advantage. *Drafting* was my most valuable technique *(see illustration B)*. And I used it for the next 50 laps. But by that time the "big boys" had the lead positions all sewn up. The best I could hope for was a spot near the front of the field. The first- and second-place cars had opened up at least a mile lead over the rest of the field. They would soon lap the slower cars. But the Mercury in third position and the Plymouth in fourth were within catching distance.

I eased my Daytona in behind the Merc' and slowly closed the gap between the nose of my car and the tail of his. Experience had taught us that the aerodynamic cars such as my Daytona drafted better than standard models. Although it is easy for a funny car to draft a standard model, it doesn't work in reverse. I stuck behind the Merc' like a leech, and both of us picked up speed immediately. My engine's revolutions per minute (rpm) fell slightly. It wasn't working as hard as before. And I was able to ease off the throttle and conserve my fuel.

In my rear-view mirror, I noticed that the Plymouth was closing in behind me, moving close enough to hitch into my draft. He was trying to make a three-way draft. But he couldn't. The sleek body of my Daytona didn't provide a strong enough "suction" (low-pressure zone) to tow him. And he fell back quickly *(see illustration C)*.

The closer I got to the Merc', the stronger was the draft. Afraid that I might "kiss" his rear bumper if I ran too close, I backed off slightly. I found that the draft was strong enough to tow me when I was as far back as 10 to 15 feet. And that was a lot more comfortable than the six inches we use when drafting standard racers.

On lap 72, or 182 miles into the race, the Merc' began vibrating slightly. I could tell that its driver was having steering problems. I was running fifth by then, with the third car just ahead of the Merc'. I decided to "slingshot" the Merc', and try to pass the number three car *(see illustration D)*. I figured the



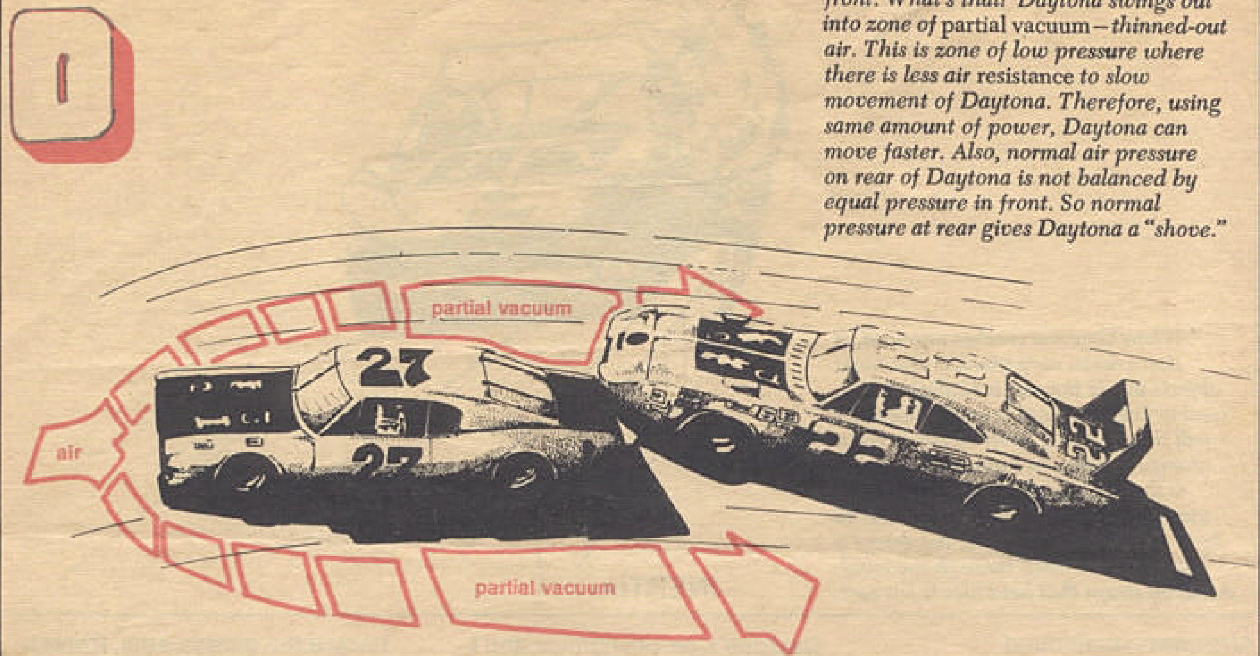
C

SPOILER SPOILS DRAFTING

Turn-about is not fair play. Drafting works well for Daytona (see illustration B). But "regular" car is out of luck if driver tries drafting the Daytona. How come? Daytona's spoiler causes stream of air to sweep down in front of following car. Following car runs into this air, needs more power to keep up speed.

SLINGSHOTTING

Daytona "slingshots" around car in front. What's that? Daytona swings out into zone of partial vacuum*—thinned-out air. This is zone of low pressure where there is less air* resistance *to slow movement of Daytona. Therefore, using same amount of power, Daytona can move faster. Also, normal air pressure on rear of Daytona is not balanced by equal pressure in front. So normal pressure at rear gives Daytona a "shove."*



Merc' would be heading for the pits to check his steering. I was right. He motioned toward pit row coming off turn four.

I floored my throttle and pulled up to his right-rear fender. Suddenly, as if a giant hand had reached down and whipped me ahead, my Daytona shot forward past the Merc' and right beside the Ford in third place.

My tiny engine roared as I tried to outrun the Ford down the front straightaway. But there was no way. The Ford's raw power gave it the edge and it pulled ahead by half a car length. Coming into turn one, I made up the difference. I was able to hold the Daytona farther into the corner before easing off the throttle. And as I drove down from the bank, my rpm picked up enough to give me a slight edge over the Ford.

I was ahead of the Ford through turn two. But on the back straight the Ford once again outran me. I decided to catch his draft and "coast" for the next several laps. When I was comfortably settled behind him, we picked up enough speed running together to close some of the gap between ourselves and the two leaders.

And so it went. As the race wore on, mechanical failure, accidents, and driver fatigue took their toll of the field as they always do. By lap 160, there were only 24 of the original 40 cars still running. And I was driving one of them—40 laps to go!

I'd drafted, dodged, and sweet-talked my Daytona through 400 rugged racing miles. Ronnie and the crew had serviced the car in record time during my pit stops. My fuel had stretched well. And the mini-motor was still purring smoothly. If I could keep it all together for another 100 miles, I could finish in the money. Maybe, I could even win.

Things had gone well for me most of the day. That is, until lap 173.

I was beginning to smell a good finish from my sixth position. The leaders had fallen back, and were then in catching distance. And I was able to hold on down the "straights" (straight stretches) by catching a light draft from the two cars side-by-side in front of me. Coming off turn two, I was all the way into the throttle and just breaking out of a draft. I estimated my speed at that moment on the faster side of 170 mph.

Suddenly, the concrete retaining wall seemed to draw my car like a magnet! The Daytona veered sharply into it! The right-side sheet metal grated angrily against the wall, as I fought to control the car. Fortunately, I hadn't been low on the bank, and the distance to the wall was short. So the impact was not too severe. But the forces caused by the sudden slowing of the car tore at my body and pulled at my face muscles. *(See illustration E).* My body lunged into the shoulder harness. My goggles slipped down.

For a moment, my insides felt like they were going to tear through my skin. I had spun violently across the track and onto the infield grass. The right side of my car was practically sheared off.

But my little engine still ran smoothly. And I was still in the race.

The caution flag was out because of the scraps of metal I had left on the track. So I

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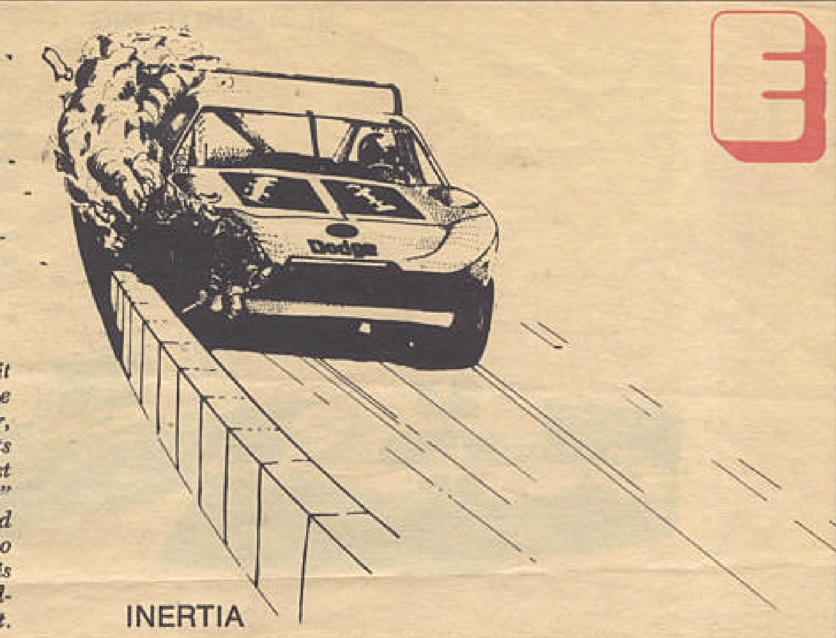


When Daytona crashes into wall, it slows down very quickly. But loose objects inside the car, including driver, tend to keep moving forward. Scientists call the tendency of an object to resist change, inertia. *In this case, "change" is the slowing down of the car. And inertia is the tendency of the driver to keep moving. Fortunately, the driver is kept from shooting through the windshield by straps that hold him in his seat.*

Airpower—continued

headed toward the pits and Ronnie's help. He and the boys poured 14 gallons of fuel into the Daytona. They also changed the two right tires, which were badly chunked, and pulled the crushed right fender out with a crowbar. Then, they sent me on my way—all in less than 40 seconds! They're magicians, those pitmen.

The accident had disturbed the Daytona's aerodynamics, and I felt the difference right away. Gone was the superior handling in the corners. And drafting wasn't nearly so smooth as it had been. I limped around the track for the last 20 laps.

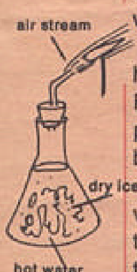
I saw the checkered flag go to a blue Plymouth. By then, I wasn't sure in what position I'd finished the race, but I'd finished. And that was an accomplishment in itself. As I came down pit row toward the garage area, Ronnie and the boys were screaming and jumping up and down like I'd won.

I'd finished sixth—in the money. A hundred hands patted me on the back in the garage area that afternoon. There were no remarks about my sewing-machine motor.

And no one seemed to think my funny car was so funny anymore. —MARSHALL SPIEGEL

Aerodynamics of Cars

(A) The drag that a moving object encounters as it moves through the air is caused, in part, by the way in which the air flows past the object. You can actually see the smooth flow, or the turbulence, of air if smoke or water droplets are added to the air.



Get a large flask or bottle to which you can fit a one-hole stopper that contains a right-angle delivery tube. Fill the flask three-quarters full with hot water. Add pieces of dry ice. (CAUTION: Do not handle dry ice with bare hands; use gloves or tongs.)

Place the stopper on the bottle. Direct the stream of vapor that comes out of the tube at the object you wish to study. Try different shapes; start with a small cube, then a large ball, then a ping pong ball.

Carve teardrop shapes from balsa wood to make model cars. If your teacher has a large lantern slide projector, you can project an image of the airflow by removing the bellows and placing the object under study at the position normally occupied by the slide.

(B) In 1738, the Swiss scientist Daniel Bernoulli studied the movement of fluids (remember, a fluid is a liquid *or* a gas) around objects. He came up with some surprising conclusions that explain such modern phenomena as the operation of the automobile carburetor, the origin of most of the lift force that keeps an airplane in the air, and why a chimney draws a greater draft on a windy day. Here are some experiments with moving air that you can perform that illustrate some of the astounding results of Bernoulli's theorem. See if you can explain what happens in each of the following:

1. Suspend two bottles or two apples next to each other, with a space of about a half-inch between them. Blow between the bottles or apples. Do they go apart or come together?

2. Get a spool of thread, a 3" x 5" card, and a straight pin. Push the pin into the center of the card. Then, place the card against the bottom of the spool with the pin extending up through the hole. (The pin is there to prevent the card from moving sidewise.) Now, holding the card against the bottom of the spool, place your lips against the upper part of the spool. As you begin blowing as hard as you can, remove your finger from the card. Will the card fall away from the spool or will it remain against the spool until you stop blowing?

If you want to know why each of these experiments works the way it does, go to the library, read up on Bernoulli's Principle in a science textbook.

WORKSHOP