ZERO-SPEED RACE

The slowest car wins. But it must never stop.

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Uncompressed Thinking

I was admiring the SpaceX launch of the Nancy Grace Roman Space Telescope the other day. What a gorgeous liftoff! The enormous rocket rose from the launchpad gently and smoothly, like a hot knife through butter. There was fire, smoke, tremendous noise and almost unimaginable power underneath it, but the motion itself looked beautifully controlled. The rocket simply lifted and climbed.

As I watched the numbers on the screen, I saw its speed build toward Mach 2 in about two minutes. Mach 2 means approximately twice the speed of sound. Speaking the language of hot cars, the SpaceX rocket reached 60 miles per hour in about **4.5 seconds,** going upward against gravity, mind you, not horizontally along a nice flat road.

That is not bad for something the size of a building.

Almost immediately, another analogy came into my mind: Tesla.

A Tesla automobile and a SpaceX rocket are obviously very different machines. The rocket burns fuel and throws a huge stream of hot gas downward at enormous speed, pushing the rocket upward. A Tesla sends electrical current into electric motors, which create torque and turn the wheels. Yet they share a quality that fascinates me: their propulsion can be controlled smoothly, continuously and with enormous precision.

With an electric motor, the amount of torque, the twisting force that turns the wheels, can be changed by controlling the electrical current. We can ask the motor for a large amount of torque, a small amount, or just a tiny bit more than almost nothing. The increase does not have to happen in large steps. It can happen through extremely small electronic adjustments.

That is one reason a Tesla can accelerate with such beautiful grace. But the same characteristic that allows an electric car to accelerate quickly should also allow it to move extremely slowly. And that is where my race begins.

From Very Fast to Almost Not Moving

A gasoline-powered car can certainly move slowly. We see cars creeping through parking lots and inching forward in traffic every day. But a gasoline engine presents a difficult mechanical problem: the engine must keep rotating even when the car is hardly moving at all.

The engine cannot simply stop turning and continue pushing the car forward. It needs a transmission, gears, a clutch or torque converter, and other mechanical arrangements to connect an engine rotating hundreds or thousands of times per minute with wheels that may be turning very slowly.

Modern gasoline cars solve that problem remarkably well, but quite a bit of machinery is working behind the scenes.

An electric motor is different. It can produce torque at extremely low rotational speed. Electrical current can be fed into the motor with great precision, and the motor can respond in very small increments. The car can accelerate smoothly, but it can also creep forward smoothly at a speed very close to zero.

That thought led me to an idea for a completely different kind of automobile competition: a reverse race.

In a normal race, the winner covers a specified distance in the shortest possible time. In my race, the winner covers the distance in the **longest** possible time.

There is, however, one caveat, one rule that turns this from parking into racing:

The car cannot stop, even for an instant.

If it stops, the driver is immediately disqualified and loses the race. The car must continue moving forward from the starting line to the finish line, no matter how slowly.

Now imagine two Teslas side by side. Ahead of them is a straight one-mile course. The signal is given, both cars begin to move, and each driver tries to travel more slowly than the other without ever coming to a complete stop.

The first car to cross the finish line loses.

Suddenly, going slowly does not sound quite so easy.

How Slow Is Slow?

Suppose one driver manages to maintain a speed of 0.1 mile per hour. That is extremely slow. A person normally walks at about 3 miles per hour, so the Tesla would be moving roughly thirty times more slowly than a walking person.

At 0.1 mph, however, the one-mile race would still take only 10 hours.

“Only” is an interesting word here. Ten hours is already a rather long automobile race, especially when the cars appear to be doing almost nothing. The spectators would need lunch, dinner and possibly a comfortable chair.

Now suppose the driver reduces the speed to 0.01 mph. At that speed, the car moves only about 0.18 inch per second, or roughly 4.5 millimeters.

Four and a half millimeters is less than the width of an ordinary pencil. If you watched the car for just a few seconds, you might not be able to tell whether it was moving at all. You might have to look away, count to ten, and then compare the position of the tire with a mark on the pavement.

Yet the car would still be moving.

At 0.01 mph, completing one mile would take 100 hours: more than four days. The drivers would need relief shifts, food, sleep and perhaps a small travel support team crawling along beside them.

Now let us become even more unreasonable. Suppose a Tesla could maintain a continuous speed of 0.001 mph. The one-mile race would take 1,000 hours, which is almost 42 days.

At that point, the Zero-Speed Race would no longer be merely an automobile race. It would become an engineering experiment, an endurance competition, a measurement challenge and perhaps a serious test of everyone's patience.

It would also raise the question that makes the whole idea interesting: how slowly can an electric car actually move without stopping?

I do not know.

That is exactly why I would like to see the race.

Elon, We Need a Better Speedometer

The normal Tesla speedometer would not be very useful for this competition. We would need it to display not simply 1 or 2 miles per hour, but 0.1, 0.01 and perhaps even 0.001 mph.

Totally doable for Elon and Tesla.

The car would also need to record its speed continuously. It would not be enough for the driver to claim that the car never stopped. The measuring system would have to prove it. If the speed reached zero, even for a moment, the system would signal a disqualification.

But as the cars approached zero speed, measurement itself would become part of the challenge.

Normally, we determine a car's speed partly by measuring how quickly its wheels are rotating. At very low speeds, however, the situation becomes more complicated. A tire is not a perfectly hard circle. It is made of flexible rubber. The part touching the road flattens slightly, bends and then returns to its normal shape as the wheel turns.

A wheel might rotate by a tiny amount while some of that movement is absorbed by the bending of the tire. There could also be microscopic slipping between the rubber and the road. The car might rock slightly on its suspension without making any real forward progress.

So, for a serious Zero-Speed Race, we might need to measure more than wheel rotation. We would need an independent system watching the actual movement of the vehicle over the ground. Cameras, lasers, radar or another precise positioning system could follow a marked point on the car and determine whether it was truly advancing.

Then we would have to define exactly what "stopping" means.

Suppose the car remains in the same measured position for one second. It is clearly stopped. The driver is out.

But what if the position does not change for one tenth of a second? What about one hundredth of a second? Perhaps the car moved such a tiny distance that the measuring instrument could not detect it. Does that mean the car stopped, or does it mean that our instrument was not accurate enough?

At 60 mph, nobody needs a scientific discussion to decide whether a car is moving. Near zero speed, the definition of motion itself becomes part of the sport.

That is when the silly race begins to turn into real physics.

The Driver’s Problem

The Zero-Speed Race would test more than the car. It would test the driver’s ability to control the car at the very edge between moving and stopping.

The driver would have to ask the electric motor for the tiniest possible amount of forward torque. There must be enough force to overcome friction and keep the car moving, but almost no extra force.

Too much torque would make the car move faster. In an ordinary race, that would be good. In this race, it would mean losing ground by gaining ground.

Too little torque would be worse. The car would stop, and the driver would be disqualified.

The winning driver would have to remain continuously on that narrow boundary. The car would have to move, but almost not move.

The task becomes even harder because no real road is perfectly flat or perfectly smooth. A tiny rise in the pavement would require a little more torque. A tiny downward slope would require less. A rough patch of asphalt might resist the tires. A smoother patch might let the car move too easily.

Tire pressure could matter. Tire temperature could matter. The weight of the driver and passengers could matter. A breeze from behind might speed the car up, while a breeze from the front might bring it dangerously close to stopping.

At normal automobile speeds, these tiny effects are hidden inside the much larger motion of the vehicle. Near zero speed, they could become the whole game.

The driver would need extremely delicate control. A standard accelerator pedal might not be precise enough. Tesla might have to install a special low-speed racing control, a small lever, wheel or dial that allows the driver to adjust motor torque in microscopic increments.

Then the driver would watch the speed display, feel the changes in the pavement and make constant tiny corrections. Add a touch more current to climb a slight rise. Remove a touch as the car reaches the top. Add a little when the wind changes. Reduce it when the tires warm up.

A Zero-Speed Race might look completely motionless from the grandstand, but inside the car, the driver could be working constantly.

Human Skill or Computer Control?

There is also an interesting question about how much help the driver should receive from the car’s computers.

A Tesla already contains sophisticated control systems. Sensors measure what different parts of the car are doing, computers compare the measurements with what the car is supposed to do, and the system makes rapid adjustments.

For the Zero-Speed Race, the computer could probably control the motor more precisely than a human foot could. The driver might simply select the desired speed, perhaps 0.01 mph, and allow the vehicle to maintain it automatically.

But would that still be a driver’s race?

Perhaps we would need two categories. In one, the driver controls the car directly. In the other, teams of engineers create the best automatic zero-speed control system. The first would test human skill. The second would test sensors, software, electronics and electric-motor control.

The automatic category could become a fascinating engineering competition. Each team would try to move its car slightly more slowly than the others while guaranteeing that it never stopped. The cars would constantly measure road slope, wheel position, tire behavior and actual motion over the ground.

The winning system would have to approach zero speed more closely than any competitor without touching zero even once.

It would be like walking toward the edge of a cliff, getting closer and closer with every step, but never stepping over it.

What Would the Record Be?

Could an ordinary production Tesla maintain 0.1 mph without stopping? I would expect that it could.

Could it maintain 0.01 mph? That would be much more interesting.

Could it maintain 0.001 mph? I have no idea.

Somewhere there must be a practical lower limit. That limit may not be set by the electric motor alone. The motor might be capable of producing an even smaller amount of torque, but the tires may not roll smoothly enough. The electronics might be capable of sending a tiny amount of current, but the sensors may not measure the resulting movement accurately enough.

Friction could also produce an effect called “stick-slip.” An object may resist moving until the applied force becomes strong enough. Then it suddenly moves a little, stops again and repeats the process. Instead of creeping forward smoothly, the car might advance through tiny jumps.

If that happened, would the car count as continuously moving? Between the jumps, it might be stopped. The driver could therefore lose the race even though the car was slowly progressing down the course.

The pavement itself might set the limit. On a normal road, tiny bumps and hollows would be enormous compared with the microscopic movement of the car. Perhaps the first official Zero-Speed Race would need a specially prepared track, extremely flat, smooth and carefully measured.

Or perhaps that would make the race too easy. Real roads might be part of the challenge.

These details would all have to be decided before the first race. Once the rules were established, however, somebody would set a record. Then somebody else would immediately try to beat it.

That is what people do.

We race to see who can run fastest. We race cars, bicycles, boats, airplanes, horses and even lawnmowers. We compete to jump higher, dive deeper, lift more weight and travel farther.

Why not compete to answer the opposite question: how slowly can we go?

Picture the Race

Imagine two Teslas side by side on the starting line. The grandstand is full, the cameras are ready and the electronic measuring system is watching every tiny movement.

The starting signal sounds.

Both cars begin moving.

Five minutes pass. From the grandstand, neither car appears to have gone anywhere. Ten minutes pass, and the spectators begin leaning forward, trying to compare the front bumpers with lines painted on the pavement.

Half an hour later, one child points toward the track and excitedly tells his father, “Look! That car is winning!”

The father studies the two cars carefully and replies, “No. That car is ahead.”

The child looks confused.

The father smiles and explains, “That means it is losing.”

Now that is a race I would watch.

Children might enjoy the strange rules, but they might also discover something important. Speed is not only about going fast. Motion is not always large, noisy and obvious. Sometimes the most interesting engineering begins when we try to make a machine do something extremely small and precise.

The electric motor is usually celebrated because it can send a Tesla from zero to sixty with astonishing speed. That is impressive, of course. But the same ability to control torque precisely opens another, almost invisible possibility.

Perhaps we have been looking in only one direction.

The most interesting electric-car race may not be about getting away from zero as quickly as possible. It may be about getting as close to zero as possible, and remaining there without ever quite arriving.

Interestingly, I discussed the beauty of electrical propulsion in another recent essay and podcast: https://youtu.be/fyzPwnE08Do

Wild stuff. And almost completely invisible until somebody stops to question it.