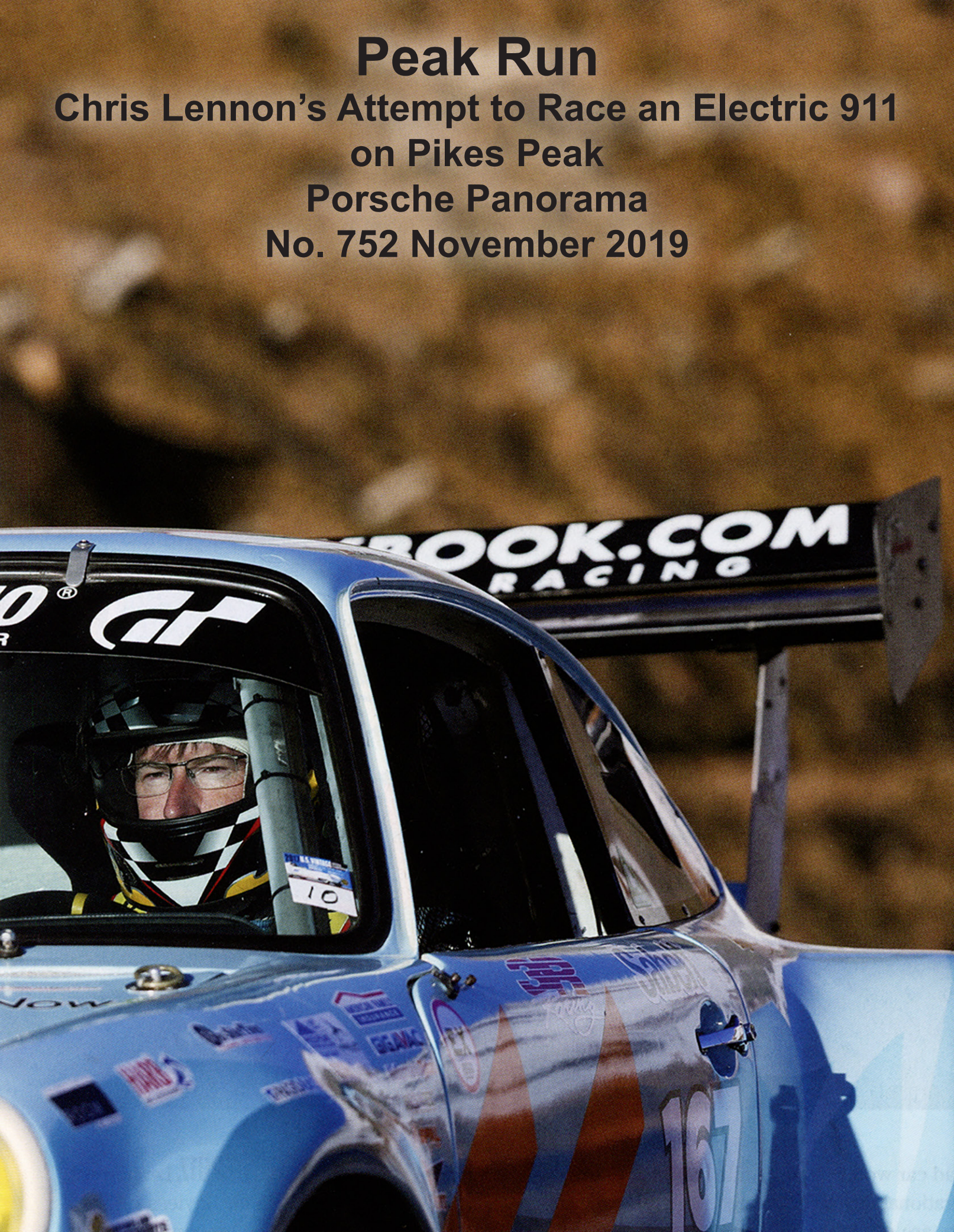
Peak Run

Chris Lennon's Attempt to Race an Electric 911 on Pikes Peak

Porsche Panorama
No. 752 November 2019



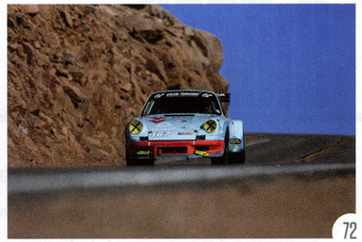
PORSCHE
PANORAMA

NOVEMBER 2019 • ISSUE NUMBER 752

THE OFFICIAL MAGAZINE OF THE PORSCHE CLUB OF AMERICA


44


92


72


56


64

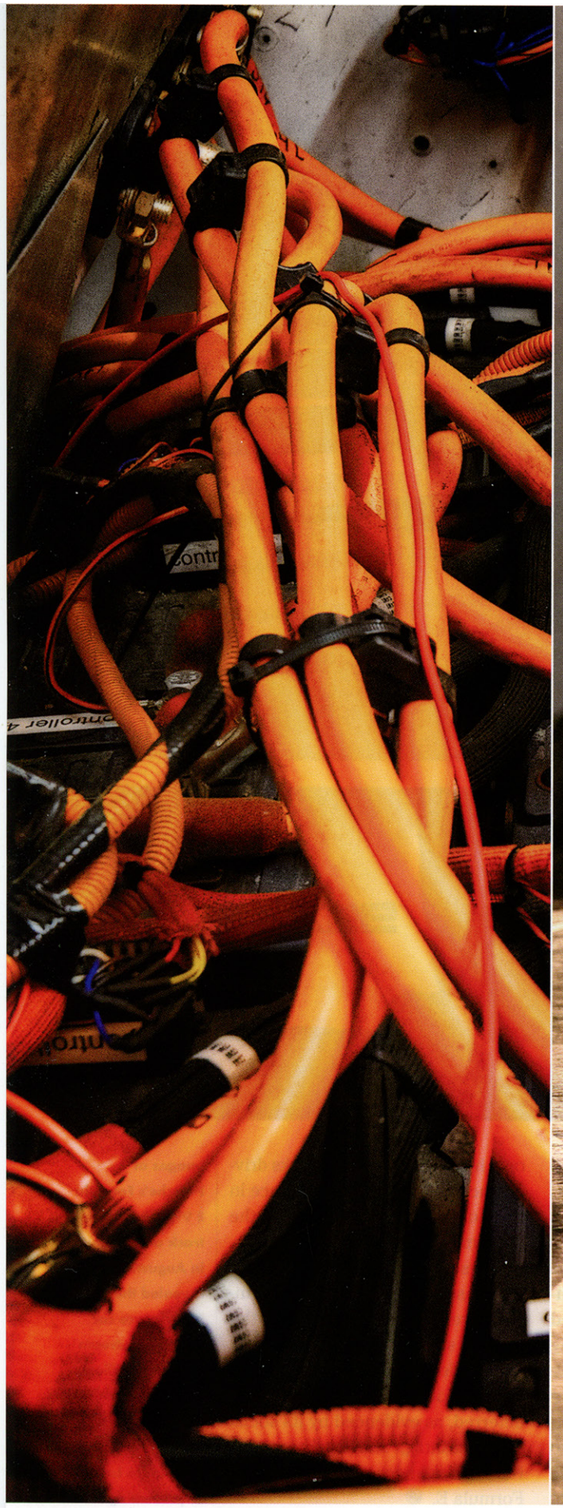

84

DEPARTMENTS

COVER TAYCAN IN CHARGE
PHOTO BY PORSCHE

FEATURES: SPECIAL ELECTRIC ISSUE

PORSCHE PANORAMA (ISSN 0147-3565) is published monthly by the Porsche Club of America, Inc., 9689 Gerwig Lane, Suite 4C/D, Columbia, MD 21046. Periodicals postage paid at Columbia, MD, and additional offices. PCA membership dues are $46.00 for one year, $90.00 for two years or $132.00 for three years. Dues include $12.00 per year for an annual subscription to Porsche Panorama. Postmaster: Send address change to Porsche Panorama, PCA Executive Office, PO Box 6400, Columbia, MD 21045.



Peak Run

CHRIS LENNON'S 912-BASED RSR TRIBUTE GETS AN EV CONVERSION.

STORY BY **SEAN CRIDLAND**
PHOTOS BY **SEAN CRIDLAND, STEPHANIE URSO & JOEL YUST**

Racers are always on the lookout for more power and more speed.

That's what PCA Alpine Mountain Region member and Pikes Peak specialist Chris Lennon was thinking when he converted his 912-based RSR tribute to electric power for the 2019 Broadmoor Pikes Peak International Hill Climb. Having previously raced the car up America's mountain with normally aspirated 2.7-, 3.6-, and 3.8-liter Porsche internal combustion engines, this past year Lennon became the first person to drive an electric-powered Porsche up the mountain.

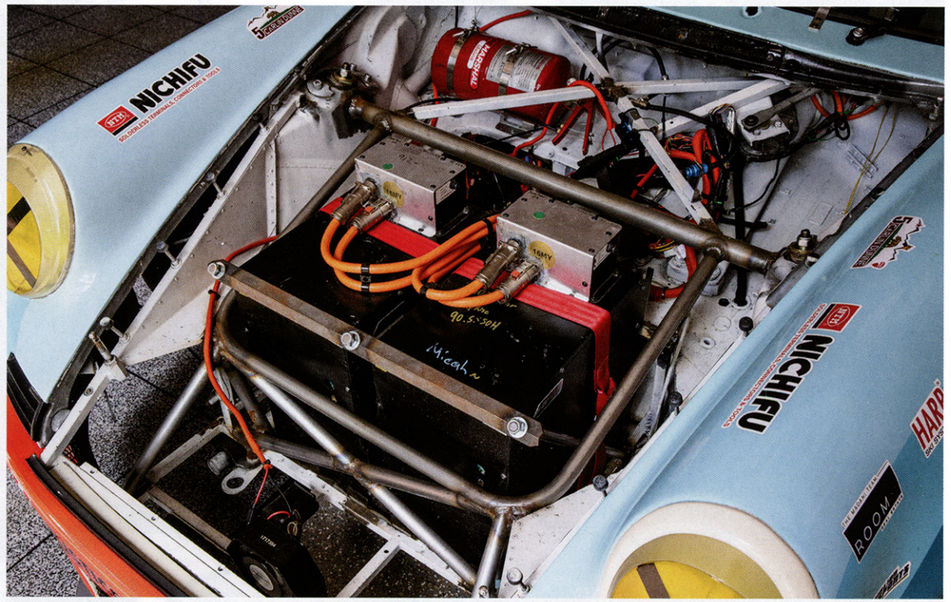
Lennon has raced on Pikes Peak since 2012, always in the same car but with a variety of increasingly powerful Porsche engines. He won or placed second in the Vintage Class every year through 2016. Then, in 2017, the organizers did away with the class, forcing Lennon to race in the more competitive Pikes Peak Open (PPO) Class. In 2017, the PPO-winning car was Pirelli World Challenge driver Peter Cunningham's Acura TLX GT, which outpowered Lennon's Porsche by several hundred horses and cost $200,000-$300,000 more. Racing on a tight budget, Lennon knew he could never compete against the factory cars. If he wanted to go faster, he would need more power. But at what cost?

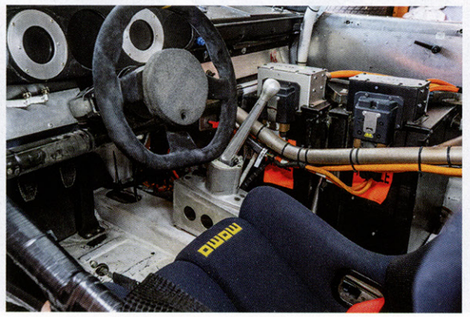
The 3.8-liter Porsche engine he used in 2017 developed 265 hp at the rear wheels (when measured at the 6,000-foot elevation of Colorado Springs) and a similar amount of torque. However, at the 9,390-foot elevation of Pikes Peak's start, the internal combustion engine (ICE) was already down about 30 horsepower, and by the time it reached the finish at 14,110 feet, the engine delivered around 160 horsepower with a commensurate loss in torque.

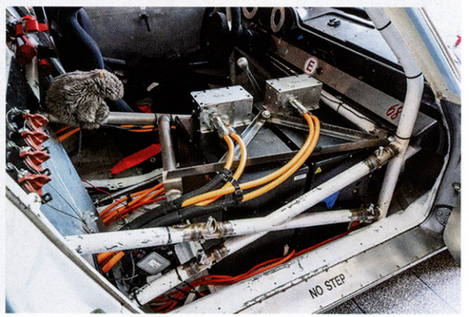
One way to address this would be a turbocharged engine, but that would have cost more money and also require other changes to the car. Another option that was starting to come into vogue on Pikes Peak throughout the decade was a conversion to an electric drivetrain similar to those in the Tesla or the new Porsche Taycan. Though Lennon has always considered himself a Porsche guy, he was willing to consider all options.

OVER THE YEARS, Lennon had watched several electric cars set fast times on Pikes Peak. While he did not drive the first electric car on the mountain, former winner Nobuhiro "Monster" Tajima was perhaps the most notable when, in 2012, he entered his Batmobile-looking E-Runner Concept One. In 2016, Rod Millen became the first driver to win the race overall with an electric car, the Drive eO PP03.

Electric race cars are perfectly suited to the Pikes Peak race for a couple of reasons. First, electric vehicles (EVs) aren't susceptible to power loss from altitude in the way that ICE cars are. Electric motors, assuming the battery still has charge, deliver consistent torque regardless of altitude. Second, whereas ICE-powered cars have to reach an optimum rpm range to deliver peak power, an EV drivetrain delivers the same amount of torque whether the car is stationary or in motion. Third, since a winning run for a production-based vehicle is in the nine-to-eleven-minute range, Pikes Peak EVs don't need the large battery storage







capacity that a road car would need for a 300-mile operational range.

However, there are other problems faced by teams running EVs on Pikes Peak. It's one thing to run an electric vehicle around town doing errands, when the hardest loads might involve making it through a yellow traffic light or pulling out of the shopping center parking lot into traffic. EV drivers don't necessarily need their cars to be fully charged every day. An EV racing on Pikes Peak, on the other hand, has to store large amounts of potential chemical energy in its battery array, and then rapidly dissipate all of that energy during its race run up a steep 12.5-mile course, braking and accelerating through 156 corners with a goal of expending the last bit of energy as it crosses the finish line.

To do all of that while keeping the car as light as possible requires teams of engineers working out every last detail of power usage, motor efficiency, and new battery technology. If you've read that VW's budget for its 2018 Pikes Peak win was in the neighborhood of $20 million, you can figure that a good portion of it was figuring the best possible usage of energy throughout the car's eight minutes of run time. Lennon didn't have $20 million at his disposal. Or $1 million. Or $10,000.

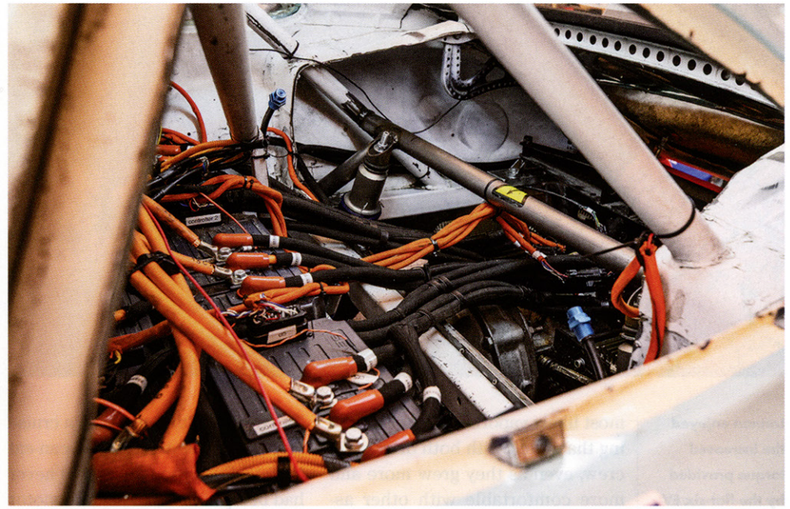
IN THE SUMMER OF 2017, Lennon got a call from Micah Bayless of Zero Motorcycles, a company based in Scotts Valley, California that manufactures a line of high-performance EV motorcycles. Bayless had done an EV conversion to his own street-going Porsche 912 and wondered if Lennon had considered switching to electric power. Of course he had. In fact, he had been researching it for a few years. Bayless invited Lennon to Scotts Valley to drive the car. Lennon describes his first drive in Bayless' conversion as "probably the fastest 912 I've ever driven." Although he was particularly impressed by the EV's instant torque and drivability in the hills around Scotts Valley, he didn't think it had enough power to race on Pikes Peak.

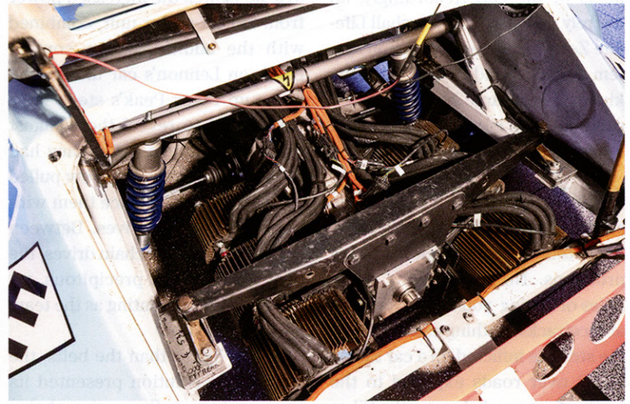
Instead of using one big motor to power his 912 EV, Bayless chose a different route. He linked four Zero motorcycle motors, which are each about the size of an air-cooled Porsche cylinder head. Given their size, he attached them to a Porsche 914 case—in essence creating an electric flat four—and then replaced the crank with a shaft. The electric motors connected to the shaft with Kevlar belts, and the shaft connected to a Porsche 901 transmission. The car shifted much the same as any Porsche road car, although the timing and gearing were slightly different because of the instant availability of torque with every shift.

The car's performance, as well as the novelty of the concept, gave Lennon a lot of food for thought. But wouldn't it be easier to start from scratch, with a tube-frame car? Bayless and Zero took an interest in Lennon's car because they wanted to show what could be done performance-wise with a pre-established baseline. Since Lennon already had a track record on Pikes Peak, they wanted to show how an EV drivetrain would compare with the car's more traditional ICE.

By December 2017, after consulting with his sponsors and volunteer crew, Lennon jumped in with both feet, knowing full well that the EV conversion couldn't possibly be done in time for the 2018 race. It was hard to be on the sidelines for a race he loved so much, but almost providentially it gave him an opportunity to study Volkswagen's I.D. R electric prototype driven by Le Mans and Pikes Peak winner Romain Dumas. Coming off its diesel scandal of a few years before, VW used the EV prototype to show the world that it was committed to developing alternative-energy vehicles. The I.D. R was a ground-up design that shat-

Chris Lennon's 912-based RSR tribute has become the perfect R&D lab for EV technology, with batteries and high-voltage lines filling almost every available space. The four "monolith" batteries are firmly anchored yet easily accessible.





The world's only electric flat-six motor fits perfectly into the Porsche engine space. Even though the snake pit of high-voltage cables might seem vexing to an EV neophyte, the electrical system was both reliable and powerful.

tered the race record with a time of 7:57.148. Seeing Dumas go that fast in an electric car was just the assurance Lennon needed to know he'd made the right decision.

THERE WAS MUCH work to do, with Bayless' 912 the test bed for the changes Lennon suggested. Most of the early development was done at Spring Mountain Motorsports Park in Pahrump, Nevada. Eventually, Lennon's Porsche was stripped of its ICE drivetrain and gas tank. Bayless and Zero then created a six-motor drivetrain, effectively making Lennon's car the only flat-six EV Porsche in the world. They kept the 915 transmission, but it was re-geared for the added torque by Porsche transmission guru Bill Rader.

Four large battery units were created and encased in ballistics-grade, impact-resistant steel. Two were placed in the space formerly occupied by the fuel tank, and the other two were placed to the right of the driver. Though they operated as a unit, Bayless says they were actually two independent systems. A spiderweb of electrical lines connected the power sources to the motor. The units were programmable via a custom app on crew chief Mark Stolberg's iPhone.

Because of the extra weight of the battery units and a subsequent shift of the weight to a 50/50 front-rear balance, the team elected to re-spring the car. Englewood, Colorado's 3R Racing assisted by fabricating new mounts for the Von Shocks coilover shocks and struts provided by Elephant Racing, which replaced the car's original torsion-bar suspension on all four corners. Brakes were upgraded to 996 TT slotted steel discs, calipers, and braided lines. The bigger brakes meant increasing wheel size to 18x10.5 Fifteen52 Outlaw fronts and 18x12.5 rears, mounted with Hoosier A7 tires (P245/40 front and P295/40 rear). Since Lennon anticipated greater speed and cornering forces, he also replaced the steering wheel, seat, and harnesses. A new pedal cluster was required to send the necessary shifting signals to the EV powertrain.

WHILE THE BETTER-FUNDED teams bring large charging units on the mountain with them to get every last bit of charge before their cars start the race, Lennon's team took a more economical approach. Instead, they had two sets of four-battery units that Lennon took home with him and plugged into the same 220V receptacle that powers his laundry-room appliances, using a special charger Bayless fabricated for the job. Each of the four power units—the team calls them "monoliths"—is about the size of a large traveling suitcase and weighs about 170 pounds, heavy enough that the crew employed a portable hydraulic engine lift to install the battery packs. For the cab-mounted batteries beside the driver, 3R Racing built an entirely new roll cage with a removable side brace for better access.

Because of the high levels of electrical charge involved, safety was always a concern. Orange cable housings are reserved for currents above 60 volts. Typical roadgoing hybrids and EVs operate at closer to 400 volts, and the new Porsche Taycan doubles that amount. Bayless says that the lines in Lennon's car nominally carry 102 volts, sometimes more, sometimes less, depending on loading. Each of the four battery monoliths is capable of dispersing 1,000 amperes. That meant Lennon had 4,000 amperes available for short bursts under hard acceleration.

Only two crew members, trained in EV drivetrain technology, were allowed to touch the car's inner workings. Lennon remembers Bayless telling the crew that if a wrench were to drop into the wrong place while the car was "live" it would

Lennon enjoyed the increased torque provided by the flat-six EV motor, especially in the high-altitude, steep, twisty part of the course called the Ws for its many switchbacks.

most likely vaporize! It was a warning that stuck with both driver and crew, even as they grew more and more comfortable with other aspects of the car. Accordingly, an entirely new four-liter Marshall Lifeline Zero 2000 fire-suppression system was installed to deal with the kinds of fires large batteries might generate from either overloading or in the event of a crash.

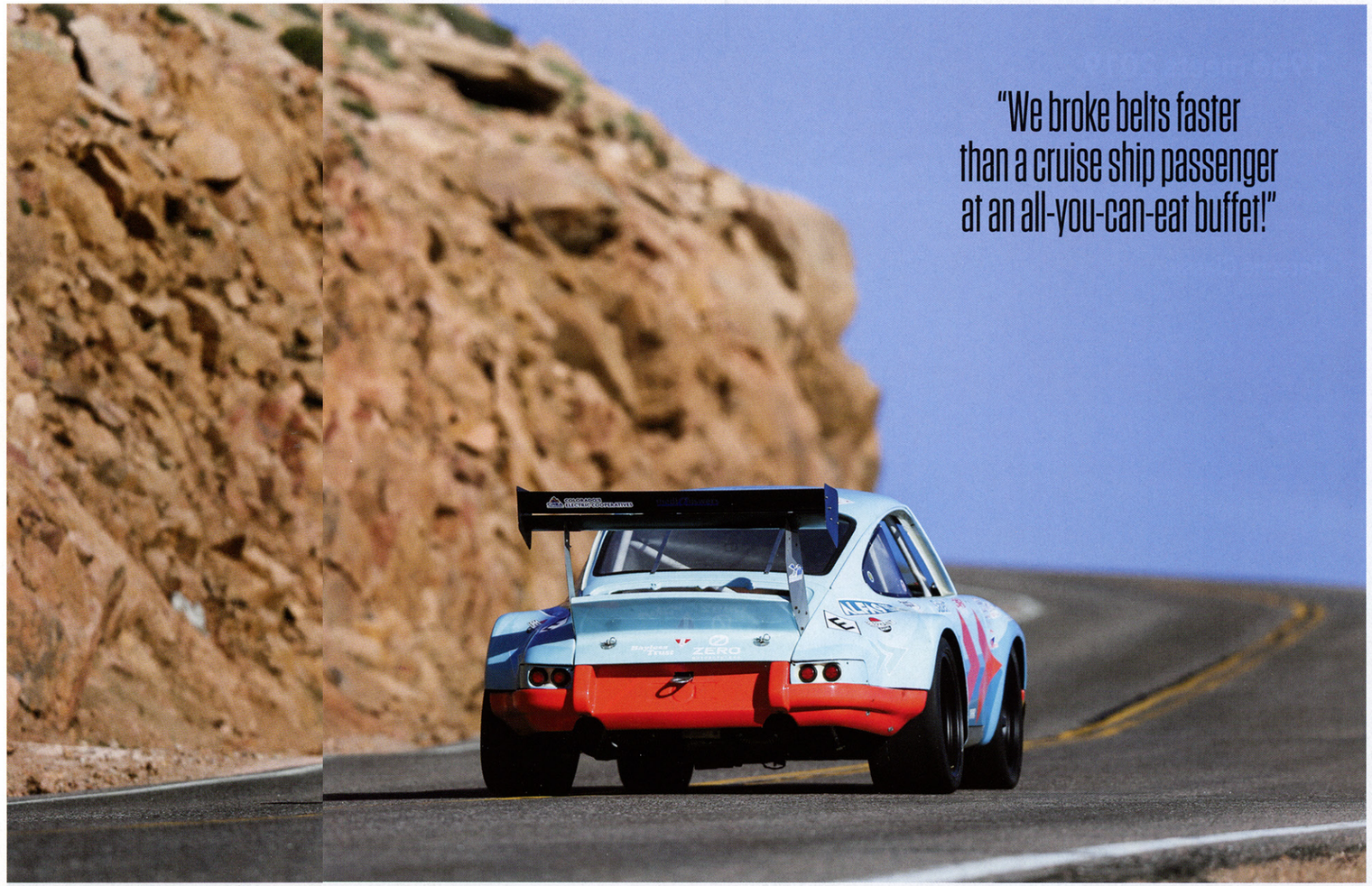
WHEN ON-HILL PIKES PEAK testing started in early June 2019, the crew expected to have some teething problems. No matter how many miles of testing you do on traditional racetracks, nothing can duplicate the stresses inflicted on a car racing uphill over roads exposed to the kinds of seasonal changes the Pikes Peak Highway endures. Every year, racers from around the world show up "ready" to compete, then find that CV joints wear out at alarming rates, suspension and engine mounts break, and transmissions eat themselves just from the pounding inflicted by the rough surface and increased loads from pushing up an incline for 12.5 miles.

Despite this knowledge, the Lennon/Zero team didn't expect problems from the Kevlar belts connecting each of the six Zero motors to the main driveshaft. The vendor had assured the team that the belts' stress tolerance would far exceed the torque figures they'd be running on the hill. Wrong. As Lennon says, "We broke belts faster than a cruise ship passenger at an all-you-can-eat buffet!" Even though Bayless never had belt problems in his four-motor 912, he figures the increased power from the six-motor unit, combined with the additional tire contact patch on Lennon's car under load going up Pikes Peak's steep hills, was bound to reveal the weakest link in the system. After they had broken a few belts, the crew pulled an all-nighter to replace them with a series of chain drives. Between the motors and the chain drives, the heat buildup was precipitous, requiring as much venting as the team could improvise.

While better than the belts, the last-minute solution presented its own problems. Since the chains didn't circulate in a contained oil bath, they were lubed before and after each run in the same way you'd lube a bicycle chain. It was hardly adequate, as the chains quickly threw off the lubrication into the drivetrain compartment and heat rapidly built up, either breaking links or welding them together. As one might imagine, it was also extremely messy. (Lennon spent an entire day cleaning the motor compartment for the photos in this article.) Considering time and budget constraints, it was the only workable solution.

As the team worked out the kinks in pre-race testing and practice sessions, Lennon became more familiar with the EV's power and handling characteristics. From the driver's seat, monitoring power was entirely by feel, as there was no instrumentation on the dashboard telling him when to shift. Even so, he figured it out after just a few miles of testing.

Despite having raced the car for several years, Lennon found its latest incarnation to be "like driving a new car, in every sense. The power was so different." Instant torque availability made it challenging when the pavement was wet and/or cold, but the improved balance and bigger brakes and tires allowed Lennon more freedom to charge every corner. Lennon says the new baby blue and Gulf orange wrap and new interior setup increased his perception of the car as entirely different from the old one.



Entered in the hill climb's Exhibition Class, Lennon started matching and beating his practice times from previous years. But the question remained: would the car make it to the top? Pikes Peak practice sessions only allow competitors to drive a third of the course at a time. The team wondered if the chains would last a full-speed race run on the whole course. Unfortunately, they would never find out.

RACE DAY COURSE DELAYS pushed Lennon's start time into the afternoon, when rain, sleet, and snow are likely to occur in the Colorado Rockies. Sure enough, bad weather forced organizers to shorten the course for those at the lower end of the starting order. In the rain, Lennon and his EV were only allowed to run to Glen Cove, which at 11,440 feet in elevation is roughly halfway up the mountain and just below the most stressful part of the climb through the famous Ws section. Lennon posted a very respectable 5:12.386 on the slippery, shortened course, but the team was disappointed they didn't get to push the car to its limits. That said, Lennon believes that the cool, damp weather may have saved the chain drive.

With the 2019 race out of the way and the major problems diagnosed, the team anticipates coming back in 2020 with a vastly improved package, allowing for more testing miles pushing the car harder and harder. They're hoping their next visit to the mountain sees vast improvements over this past year, and especially over the car's ICE incarnation of years past.

And, if called, they'd be happy to trade their data sheets with Frank-Steffen Walliser, Porsche's former director of motorsport and its current manager of the 911 program, as he contemplates the future viability of an all-electric 911, for a chance to run the factory effort on Pikes Peak.

Even with the shortened race-day run, the EV conversion made Lennon smile.