

**Four-Cam Guru**

**Bill Doyle**

**as printed in**

***Porsche 356 Registry Magazine***

**Volume 39, Number 6: March/April 2016**





# Porsche 356 Registry



39-6 • 3-4 / 2016



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Volume 39, Number 6 • March / April 2016

Upcoming	.....7
The Miscellany File	Gordon Maltby .....10
President's Letter	George Dunn ..... 12
Princely Tales	Larry Crane .....17
Bill Doyle, 4-Cam Guru	Sean Cridland .....22
Retromobile, Paris	Tony Singer .....28
Spy Speedster	Orr Potebnya .....30
Winter Marathon, Italy	.....32
Net Results	Sebastian Gaeta .....38
Years Ago	Jim Perrin .....40
Barn Finding	Adam Wright .....42

Market Watch	Prescott Kelly.....46
356 Resto-Strips	Edwin Schweitzer ..52
356 Wiring: Charging Circuit	Greg Bryan .....56
Tech-Nique	Paul Christensen ....60
Lighting the LED way	Steve Thein .....63
Oil Filters, Part 2	Kit Sodergren .....64
Fuel Pumps, Part 2	Bruce Smith .....68
Tail lights	.....74

**Cover:** Alphonso von Hohentlohe, Konstantin Berkheim and Herbert Linge in a new 1500 Cabriolet outside the Mercedes Benz garages in Mexico City before the start of the Carrera Panamericana III in November, 1952.  
Porsche archivs, courtesy Jens Törner.

**This page:** Milton Cole and "Heidi" in Arches National Park on May 1, 2015 during a 4,300 mile round trip from Port Angeles, WA.





# Bill Doyle

By Sean Cridland

Bill Doyle has visited the Porsche factory only once, in 1977. Other than his friends Valentin Schäffer and the late Vasek Polak, he's never had much interface with any of the original factory mechanics who worked during the golden-age of the Carrera four-cam. Instead, his expertise is organic, risen from a deep interest and a never-ending passion for the engine that brought Porsche to the forefront in sports car racing during the 1950s, when the 550 Spyder and the Carrera 356 emerged as little giants in races around the globe. But don't look for a world-beater ego from the man some call "The Guru." Instead, Doyle is friendly, eminently down to earth, humble and — more than anything — hard working. With a passion for his work and more than a little serendipity, his love of the four-cam has led him through a wonderful career, allowing him to pursue his most favorite interests and making life-long friends all through the Porsche world.

## From the Cliffs of Santa Cruz to the Wyoming Wilds

Born and raised in Santa Cruz, California, Doyle says he was "never much of a sand-flea." While many of his friends were surfers, he was already making pocket money keeping their old VWs running by wrenching while they were out catching waves. He knew the tide schedules and where they surfed and how long they'd be out, so he'd work on their cars on the cliffs overlooking the ocean at spots like Mitchell's Cove, Waddell Creek, and Natural Bridges. Since he was into music, he worked at night as a roadie, hauling bands all over central California, setting up and repairing equipment and—you guessed it—keeping their vans going. For his own amusement, he drag-raced his motorcycle, a Honda 50. He replaced the intake with a Ducati system and—because he was already interested in Porsche four-cams—he was inspired to drill the heads and create his own dual plug arrangement. He says he was pretty small in high-school, so that allowed him to get that little bike to 83 mph on the drag-strip, setting a class record. He still has the trophy.

Out of high school and with an interest in electronics, he got a first-class radio-telephone license which would have allowed him a lucrative income as a chief engineer at a radio or television station. But he just couldn't see spending the next forty years of his life in a dark studio. His heart was in air-cooled engines. Around that time, the University of California, Santa Cruz was established, bringing with it an instant clientele of VW-driving students and Porsche-owning professors who would need competent service. So he and Long Beach friend Adam Smith started a company called JB Beetle in 1969. They did well, but after a couple of years Doyle got bored working on street cars day in and day out. The money was there, but the challenge wasn't. Along the way, he'd developed a fascination for the Porsche Carrera four-cam engine. He'd been reading about them, seeing them in some of

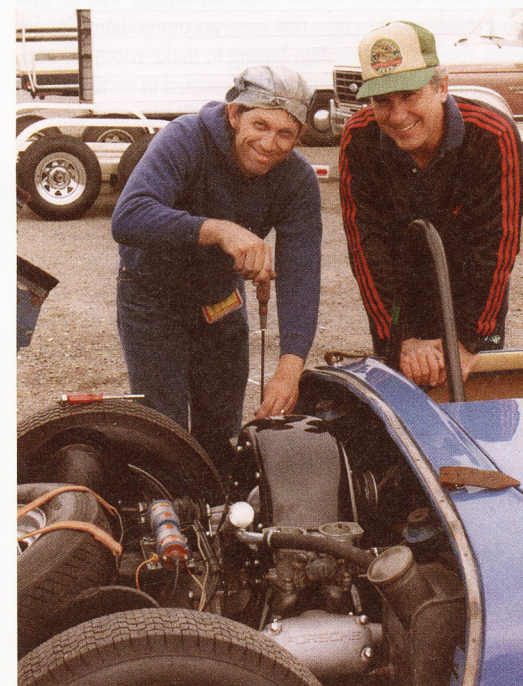
the cars around Southern California, and picking up pieces and parts wherever he could find them.

Soon, opportunity knocked again. A guy named Jim Wellington, in San Jose, had a sudden epiphany after being struck by lightning on a hiking trip in the Sierras. Wellington was the four-cam specialist of repute in the 1960s and '70s and was looking to train someone for that side of his business. For Doyle it meant driving over the Santa Cruz Mountains every day to what many called "the dead sea." Pre-Silicon Valley Santa Clara was not a place anyone from Santa Cruz would go willingly. But Doyle had an inexplicable passion that led him to do the unthinkable: quit a thriving business to drive over mountains and work on engines

already well past their prime. In the early seventies, there was a very limited clientele, and seemed to be getting smaller instead of bigger. Though he rejects any claim of divine inspiration or future-telling skill, his forty-plus year career working on four-cams seems to tell a different story.

From 1972 to 1980 he worked with Wellington in Santa Clara, gaining an intimate understanding of the Hirth roller-crank, the gear-driven cam system, valve shims and pressed-lobed camshafts. Doyle says his learning curve was steep with the cam-timing. And he trained closely with Wellington on how to re-build roller-cranks. He also credits Wellington for helping him develop the skill of how to "read" a piece of metal.

While Doyle was with Wellington, he found a 1959 Carrera Speedster in the back of the body shop in Mountain View, California for Fresno developer Don Orosco. Soon after, Doyle started building engines for him. Around that same time, vintage racing was becoming more popular and Orosco made it known that he needed a crew chief. Whoever got the job would get free shop-space and a job overseeing Orosco's racing effort. But... he'd have to move to Fresno. If commuting to the "dead sea" was a hard pill to swallow, making the move to Fresno in California's Central Valley was almost unspeakable. But it was an opportunity too good to pass up.

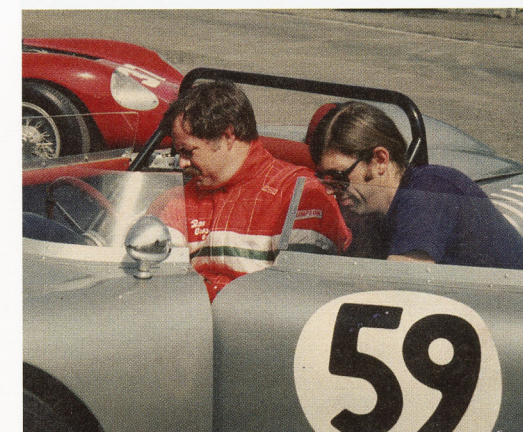


For ten years, Doyle crisscrossed the country caring for Orosco's cars for events at Sebring, Lime Rock, Watkins Glen, Road America, Laguna Seca, West Palm Beach and many more. Doyle was team-manager, race-prep mechanic, and Orosco's engine builder - and running his own four-cam business whenever there was time. Soon, Orosco started winning everything - including Pebble Beach - with a Porsche RS 60 Doyle had restored. With a record of building fast race engines, beautiful show engines and durable street engines, his reputation grew.

Meanwhile, Wellington was backing off from working on four-cams, meaning more business came Doyle's way. More and more, he found himself rebuilding roller cranks

in the precious few hours he had away from taking care of Orosco's vintage fleet. Eventually, he had to make a decision: continue traveling with Orosco's team or going his own way with a business specializing in four-cam rebuilds. By the '80s, interest in the four-cams was picking up among serious enthusiasts and there wasn't time to do both. So in 1980, Doyle took a chance and followed his passion. He opened his own shop in Fresno and focused almost entirely on the four-cam engines. True to his character, Doyle stayed friends with Orosco and is currently doing a full "refresh" on the RS60 he originally did for Orosco back in 1980.

In the meantime, he'd gotten married to a woman he'd met in Fresno and she had family in sleepy little Dubois, Wyoming. Never in love with Fresno, it struck Doyle that his business wasn't dependent on location. People were shipping him engines from all over the world, so why not to Wyoming? It took three semis to move all twelve tons of his parts and tools. Collecting since he was a teen-ager, Doyle had built up the largest collection of new-old stock Carrera four-cam parts in the United States, finding many of them at swap meets for comparatively "nothing." People were literally throwing them away. For 10 years, little Dubois, Wyoming was a world center for Hirth roller-crank and Porsche four-cam rebuilds. Eventually, he and his wife went their separate ways and - being that Dubois is a very



small town filled with her relatives - it was apparent he'd have to move.

Soon after, Doyle met current wife Leona on a blind-date and they've been together ever since. He moved over the continental divide to be with her in Jackson Hole. But his shop was too big to move, so every day for three years he drove 90 miles over majestic 9658' Togwotee Pass to Dubois and back for work till he was able to build a shop in Jackson Hole. That one stayed in one place for sixteen years during which he taught himself fabrication and sheet-metal shaping skills. It was either that or suffer impossible waits from out-of-state suppliers.

Eventually, Doyle sold the business and his vast collection of new-old parts stock to a concern in Southern California. Though he and Leona continue to make their home in Jackson Hole, Doyle commutes regularly to continue his work out of Steve Schmidt's Honest Engine shop and pass on his knowledge for when he retires in five years.

Over the years, Doyle had often worked out of Schmidt's shop, so it was natural for him to continue the connection, one that goes all the way back to the Wellington days. Leona likes the weather and Bill thinks it is more

Bill with a Lance Reventlow Scarab that Don Orosco bought from Reventlow's widow. Photo at Lime Rock, 1985.



Far left: Carb adjustment on Bob Baker's 550, about 1982. The car came from France, hence the blue color.

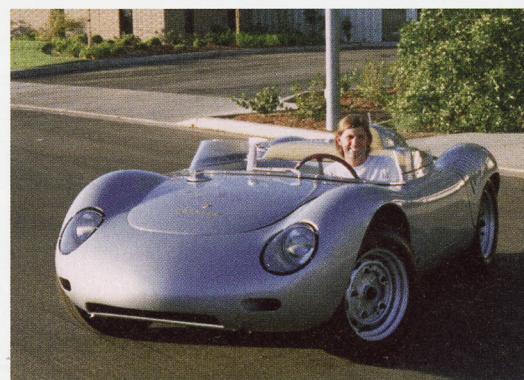
Left: Bill buckles Don Orosco into his RS 60 at Sears Point circa 1982.

Above: Gaining experience on a wide variety of machinery including a Birdcage Maserati.



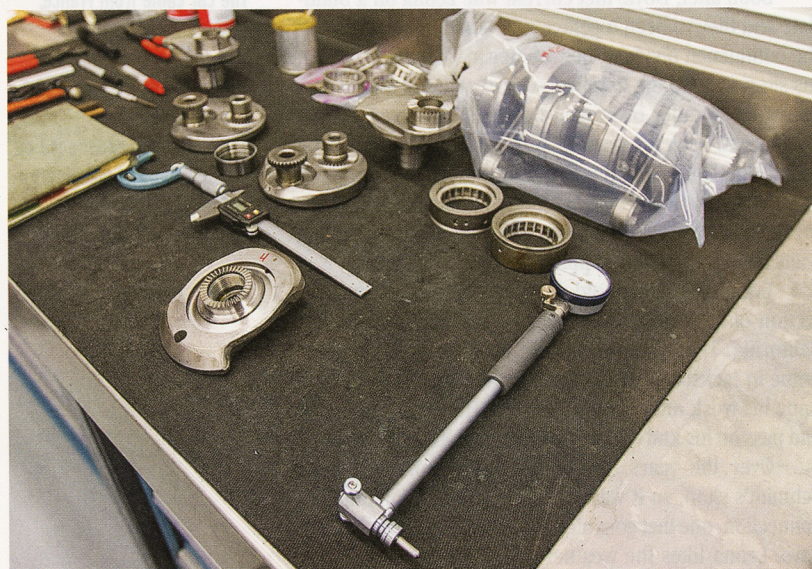
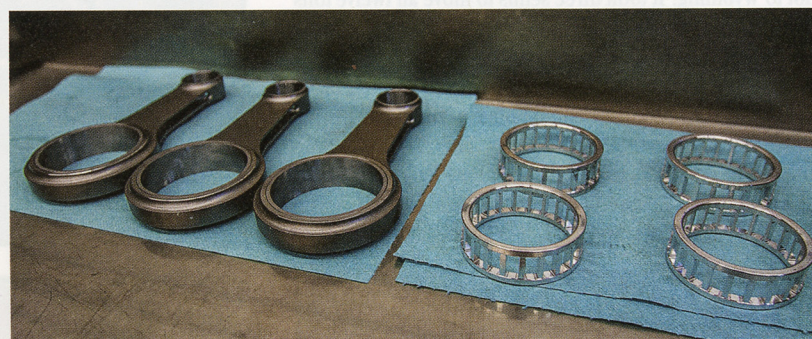
Bill Doyle in the "clean" area of his shop with a nearly completed RSK engine.

Right: Bill Doyle in the RSK that he restored for Dirk and Gerry Layer, in front of his shop in Fresno, circa 1984.





Top: Carillo rods and new cages await assembly in the clean room. Below left: New rollers are built to Doyle's specification in both size and metallurgy. Below: An original Porsche rod at left, compared to a modern Carillo rod, with a much beefier center section. Bottom: Crankshaft and rod bearing sections will be joined only after careful measurement. A complete crankshaft is inside a bag, ready for installation in a case.



likely he'll find a suitable apprentice in LA than in Wyoming. "Hopefully I've got a lot of years out ahead of me, but I'd like to start passing this stuff on before I'm drooling in a rocking chair and forget it all."

In 1979, Schmidt had bought an in-pieces Carrera 2 and talked Jim Wellington into letting him work on his own engine in Wellington's Santa Clara shop. That's when he met "this long-haired guy who would drive over the Santa Cruz Mountains every day." There's a Schmidt family story of Steve's then mother-in-law answering the door-bell one day to find this long-haired guy who'd come to gather some parts for Steve's engine. By the time Schmidt got home from work, Doyle was in the living room chatting with the whole family. They've been friends ever since, with Doyle frequently coming to Schmidt's Costa Mesa shop to service clients' cars.

### The Attraction of the Porsche Carrera Four-Cam Engine

By now, everyone knows the history of the Carrera four-cam; how Ernst Fuhrmann drew inspiration from the pre-war Auto-Union and Mercedes racers when he worked on the Porsche-designed and built Cisitalia F1 car. He then transferred the technology into the Type 547 engine Carrera four-cam. Though chain-driven camshafts have become the norm, Doyle thinks gear-driven cam-drives are more precise and reminds us that all of the race-purposed Porsche engines up through the Porsche 917 were gear driven. Collectors like them because they're rare, complex and exotic. Enthusiasts love them because they represent the highest state of engineering art for their historic period.

But the complexity of the four-cam engine goes far beyond gear-driven cam-shafts. The cam lobes on a four-cam are pressed onto the shaft and are adjustable, whereas modern cars use cheaper single piece cams created from a single piece of billet. With the pressed lobes, you can change an engine from being full race to being street docile by adjusting the lobes on the cam rather than replacing the cam and you don't have to reset all the gears. Ingenious, but eventually they figured that kind of adjustability was unnecessary and it was cheaper to just make different cams for different applications.

The engines are also well known for their complex Hirth roller-cranks, whose main advantage was to trim space inside engine cases that were accommodating longer piston strokes. Rather than having to make room for connecting-rod bolts, the cranks are designed in sections, with the roller bearings caged in each crank-pin, and then the sections are bolted together. So far as he knows, Doyle is the only one who regularly builds and services four-cam roller cranks in the United States.

The rollers come in a myriad of sizes, separated by microns. Because of variances in machining, in the crank-pins and the rod-ends, you can use a different size roller to meet the specified clearance. If the connecting rod opening is too small, you might use the Sunnen Hone machine to open it to the desired size. The Sunnen Hone might also be used to "true" the openings, making sure the rod fits with perfect alignment to the crank-pin.

The Carrera four-cam's advantages were its relatively high power-to-displacement output, its light weight, and its compact size. Though its horsepower was tiny compared to some of its larger rivals like Ferrari, Maserati or the American Fords or Chevrolets it raced against, it was quite efficient for a small engine and potent when placed in the lightweight aluminum-bodied Spyderys. While it didn't have the neck-snapping acceleration of its competitors, the combination of exceptional power/weight meant that it would usually catch its competitors by the braking zones and then fly through the corners. Later developments in the RS 60s, the Abarths, and the 904 were quite powerful, delivering as much as 175 horsepower in lightweight cars that could easily out-brake and out-handle their competition.

After the engine's success in the 550, it wasn't long before the mystique of the four-cam racing engines attracted the attention of the road-car enthusiasts who were looking for more power and performance. Hence, the limited edition Carrera 356A road and club-racing cars were debuted for enthusiasts who wanted something "more."

### Out of Vogue and into "the Dark Ages"

More than one four-cam enthusiast has said the original engines had very little troubles with their first owners, when they were new and well-cared for. The problems arose with second and third owners who didn't follow the service schedules or maybe didn't treat them as well. Though they were somewhat detuned for street use, the intricacies of the four-cam engine were originally engineered for high-rpm driving by skilled drivers who paid close attention to the engine's attributes. Of course those would be people who had the means for frequent maintenance by team mechanics.

Many common practices of road usage didn't treat the engines well. Most notably, Hirth roller-cranks don't respond well to low rpm lugging, common in city driving. Nor does the valve train do well without regular adjustment. And the roller-cranks require frequent oil-changes for longevity. Eventually, the roller crank was replaced by a plain-bearing crank, which solved some street-use problems, but by then, Porsche was already moving toward its higher displacement and more modern 911 cars, obsoleting the Carrera 2 356s.

As the cars moved further from production they were either meticulously cared for by loving enthusiasts or — more commonly — loathed by those with less means or shorter attention spans. Many Carrera 356s ended up with pushrod engines in them and the four-cams suffered a reputation for unreliability. Doyle and other four-cam experts dismiss the reputation as chaff, a story perpetuated by those who didn't know enough to care for them properly.

To illustrate: Doyle has one client with a 1958 Carrera Speedster that went close to 80,000 miles between rebuilds, once driving it all the way from Santa Barbara to the Lake Placid, New York Porsche Parade and back. With properly serviced engines and frequently changed oil, they should last.

### Doyle's Service Process

Doyle never wants the race engines to go past forty hours. With some of the more competitive drivers, he'd prefer to see them back to him in 30 hours. Maintenance isn't cheap, but it's far less expensive than replacing or repairing a case and other pieces of internals that can get badly chewed up if they're damaged. For road cars, again it depends on drivers and usage, but he wants to see them every 40,000 to 60,000 miles.

Because of their complexity, 1950s-era factory technicians, working in optimal conditions and having brand-new parts on the bench, were allowed 120 hours per build. Doyle has a different set of issues to contend with, almost always requiring more time, depending on the problem. Though he has a perfectly designed shop and a huge stock of parts, his job is to assess, diagnose, disassemble, repair, replace, and then rebuild. The factory technicians, for example, didn't have to build a crank, nor did they have to fabricate parts or sheet-metal. They also didn't have to second-guess other people's work. It's a given that almost all the engines Doyle services were cared for by other mechanics most of the time before they come to him for rebuilds.

Once in the shop, the engine is cleaned and disassembled in an area designated for "dirty" work. As the engine is coming apart, Doyle checks key areas that are known to wear, such as cam lobes or drag levers (Porsche's version

of rocker arms). Not until it's completely cleaned will any of it enter Doyle's "clean room," where he takes care of all the fine work necessary for proper care of a four-cam engine. If he notices debris in a certain area, discoloration of any parts, or something loose he takes note and considers those factors as he begins looking into the engine's interior for other potential problem areas. As he says, "When you're pulling them apart, you can read the metal and you can tell when something is getting ready to let go — and you want to find that before it happens."

Reading the metal? It's a skill he learned from Jim Wellington. With such fine tolerances, "reading the metal" means looking for tell-tale signs of minute flaws, damage, cracking, pitting or undue stress and/or flexing. Of course now all those things can be examined in great detail with various tools such as the Magnaflux or x-rays. The Magnaflux uses a process where you dip the metal piece into a solution with luminescent ferrous particle, then — using a



high-powered electro-magnet — magnetize the piece drawing the solution to the cracks, pits or stress-marks. They're then held under a black light where the clustered luminescent particles are easily seen. For Doyle, he says, "short of the cam-timing and the intricacies of the roller-cranks, the ability to 'read the metal' is what has served me best over the years..."

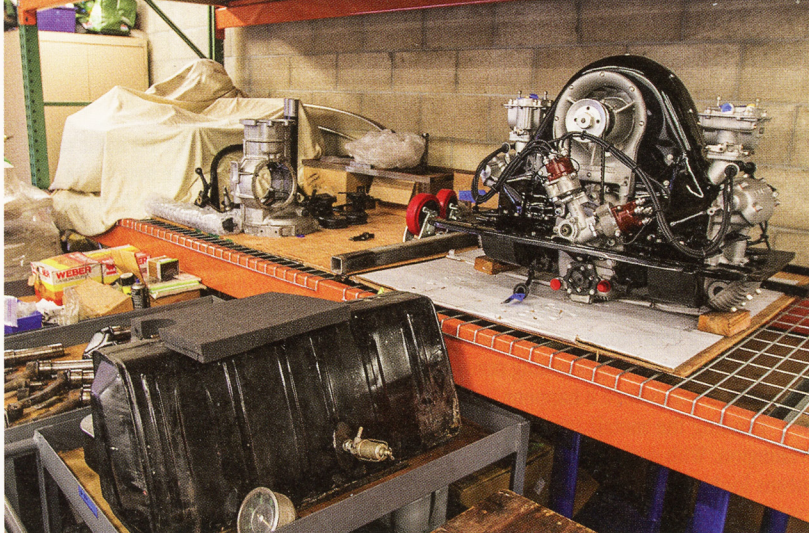
Once apart, everything gets laid out and numbered. Then a complete inventory is taken. All the parts are cleaned, inspected, Magnafluxed, an analysis is drawn up and a service estimate is made, so billing can go out to the customer.

Unless something's been changed by an owner or there's been a catastrophic failure — and you know what you're doing — four-cam rebuilds are pretty straightforward as long as you follow the original guidelines and meet their dimensions set by the Porsche engineers back in the 1950s and early '60s. "Meet their specifications," says Doyle, "and your job is relatively easy. But if you try to buck the form or swim upstream or try to cut corners, they'll bite and bite you — hard." He dismisses the notion that working on four-cams is a mysterious "black art." It's all about taking the time, having the tools and parts, and adhering to the specs.

**Fun fact:** His music roadie days are over but for entertainment Doyle himself plays both electric and acoustic guitar and fiddle. Though he started in rock and roll, he now specializes in blue-grass. He says that while some people get their thrills by jumping out of airplanes, his biggest adrenaline rush is playing in front of an audience. He did it quite a bit in his younger days, but mostly just plays for his own enjoyment now.

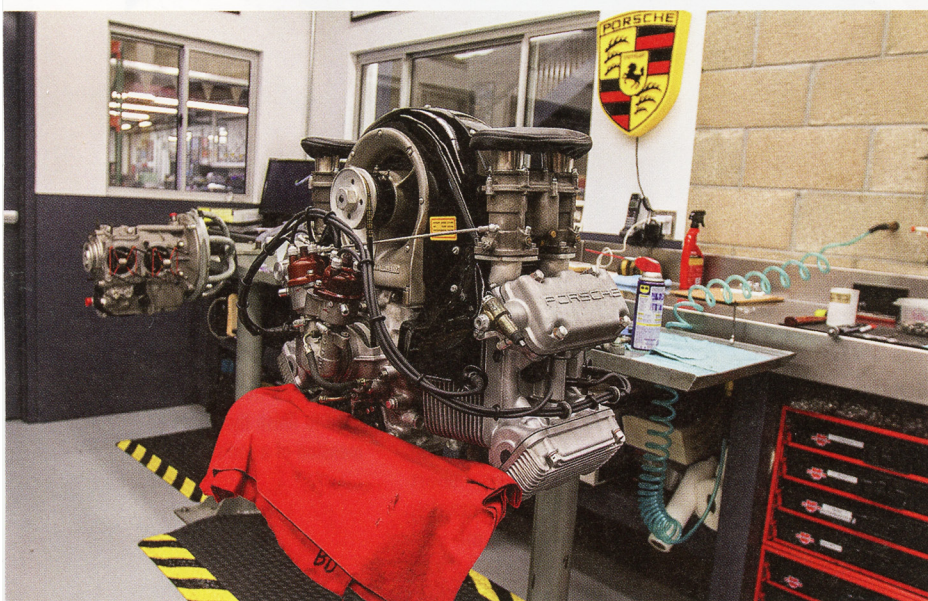
The Sunnen Hone machine is used to finish the inside dimension of a rod's big end.





**Above:** Engines and parts await cleaning and disassembly before they are used for rebuilding, eventually being re-assembled in the clean room, like the RSK engine below.

With everything cleaned, and stressed, broken, or pitted parts replaced, Doyle then builds the engine back up. He hand-turns it, checks for leaks, torques and re-torques every nut to original specification, then wheels it over to the engine dynamometer where he'll measure timing, exhaust temperatures, rpm, and in real time with the engine running assess for maximum efficiency and parts compatibility. Generally there are no problems, but if there are, Doyle finds them in the dyno phase. Once satisfied, he re-torques the cylinder heads, re-adjusts the valves, looks for any seepages, leaks, any detail work that might need care, and then the engine is shipped back to the customer.



### Contemporary Challenges

With the engines becoming more and more valuable, there are some challenges with what Doyle calls "kit" engines. More and more, Doyle encounters clients who have collections of parts and want them built up as engines. Sometimes they're told that a box of parts used to be a complete engine, but there's quite a bit of stuff missing. Or, they have a lot of parts, but they're from different engines and not compatible. They'll buy a crankcase here, a head there, whatever they might find. Some gear-sets may have never run together. It can take a tremendous amount of time to build up a kit engine but he'll always try to work with the client to find the necessary parts to complete an engine. However, it's more difficult – and more expensive – than working on a complete, original engine.

### An Originalist

Doyle figures he's rebuilt close to 400 engines and 150 Hirth roller-cranks. Because he's been working on them for forty-plus years, he can see areas where improvements in metallurgy have been made for the better, but not many. He still prefers OEM Porsche new-old stock, with a couple of exceptions. The big end of the original Hertz rods would go out of round and crack the bearing cages if they were over-revved, necessitating a replacement. The Carrillo rod is stronger and has a pressed in sleeve which can be replaced. He also likes the Swiss-built Capricorn oil-pump.

Otherwise, he figures if it was good enough for the factory and it didn't have some intrinsic problem that has since been solved by engineering or metallurgy, then he'll put the engine back to as close to original as possible.

At this point, Doyle is pretty set against pushing the technology for performance gains. He doesn't like the idea of special pistons, valves, or performance cam-shafts. The few cars left that actually run Carrera engines are in the gentleman classes of vintage racing. The engines are like running museum-pieces, so there's not much point in pushing them beyond the limits of their purposed engineering. He sees "hot-rodding" as almost sacrilegious, but in his profession it's something he deals with regularly.

Often engines come to him that have had "performance" work done to them. That might include lighter, high tech valves with narrower stems, or titanium retainers, or different valve springs thought to cut the weight down and increase rpms. Or, custom cam lobes. He's also seen over-bored engines, increased from 92mm to as much as 96mm. When parts were more common and cheaper, it didn't matter so much, but with climbing values and a Porsche culture yearning for authenticity and originality, it doesn't make much sense. Any changes you might make for performance can either damage the engine or diminish its authenticity - and its value.

### Racing into the Present

Though he and Leona continue to live in Jackson Hole, both are enjoying the warmth and conveniences during their time in California. Doyle sees many more of his clients and enjoys attending Cars and Coffee and is frequently asked to judge PCA and 356 Registry events and prestigious events like the Carmel Concours on the Avenue during Monterey car week. All in all, it's been a pretty good life for that long-haired kid who started working on VWs on the cliffs overlooking some of California's favorite surf spots and somehow took an interest in one of Porsche's most coveted, rare and misunderstood engines. 🏎️

