



Staged Preparation of the 911 for Speed

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The scope of this article is to investigate a number of improvement options, as well as the resulting performance implications and costs. Novice, as well as seasoned drivers, lacking a car improvement plan and direction, and possibly not aware of the full impact of the modifications being considered, may make inappropriate choices, overspend their budgets and still be less than satisfied with the end results. How can this be avoided?

First, read the General Competitive Rules (GCRs) of the club or clubs you intend to compete in. Assuming your car has not been modified or prepared previously, a thorough reading of the GCRs will tell you what class your car will run in.

Consult with knowledgeable Club members for answers to your questions.

Second, Consider the various stages of car preparation delineated in this article as well as other sources. Discuss your preferred options with a member of the Competition Committee or Time Trial Committee.

Third: Get in as much seat time as possible with a qualified instructor. If at all possible, strongly consider enrolling in a professional driving school such as the Bondurant School, the Skip Barbour School at various locations around the United States, etc.. As an example of the "seat time" you will accumulate at a driving school, Bondurant provides five + hours of seat time per day. Attending the four day course, you will spend twenty hours behind the wheel, at speed. Considering that Time Trials provide about 2 hours of driving time per each two day event, the four day class will approximate at least a full year of Time Trial experience. This will give you an added edge as you start your Time Trial career.

Enter as many Slaloms, Time Trials, Auto Cross, Solo 1 or 2 events as possible. Make the commitment to be the best driver you are capable of becoming!

Consider starting your career in the Porsche Owners Club (POC) Show Room Stock and Porsche Club of America (PCA) Stock classes. Only a modest expense is required to prepare a car to compete in these classes, generally limited to the purchase and installation of two sets of five or six point competition belts, and an approved helmet and fire extinguisher. Budget approximately \$600 for these items. Average this amount over number of events you will be running; a paltry sum compared to other hobbies and vices!

If you are a Novice driver, a "rookie" season in the highly competitive POC and PCA Production classes may be extremely frustrating. Also, the series of modifications that serve to place a car in Production Class can severely impact one's budget.

From this point forward, you can work toward the most valuable commodity, "seat time" at speed, and with an instructor wherever possible! This is not to say you will not be rewarded with better times if you go out and spend to the limit of what is allowed in your class. You may be slightly faster than driver in the lesser prepared car, but those dedicated and committed drivers may soon be right behind you, or passing you! In the final analysis, the drivers with the best feel for their cars, the track and themselves will be making the most improvement and getting the best times.

Most will agree, a marginal driver in a modified car is at a distinct disadvantage compared to an experienced driver with a less modified car. Continue to fine tune your driving skills enabling you to extract the maximum advantage out of any future planned modifications.

The bottom line on car improvement costs: Expenses are very modest in POC Show Room Stock, somewhat more expensive in PCA Stock considering allowable improvements with points assessments, and can be substantial in POC's next class upward, Street Improved class.

Considering car improvements as an evolutionary process, the next level of competition is found in POC and PCA Production classes. Competition is intense in this class. It is not within the scope of this tract to elaborate on the modifications allowed for Production Class.

POC's Revised Competition Classifications: Commencing with the 1990 Season, POC has redefined Stock Class into two distinct classes. The entry level class is Show Room Stock class where POC has adopted a very strict interpretation of the word "Stock". Modifications that were formerly permitted in the previous Stock Class such as "R" compound tires and adjustable sway bars, are no longer allowed. Show Room Stock class allows only a few changes limited to safety and convenience items such as installation of a roll bar and a change to hard compound brake pads.

These limitations are well within the spirit behind creation of this class which was to provide an opportunity where the Novice driver may compete, and be competitive, with a minimal financial commitment. Read the POC GCRs for the specific details on the class.

The next class up is Street Improved. The POC Street Improved class, introduced in the 1990 season, was established for those developing and committed drivers, having earned their POC or PCA Competition Licenses and acquired some significant track time, who are now looking to reduce their times by an extra second, or better per lap. Options at this level are found in the Stage II and III discussions in this article.

For those competing in both POC and PCA events, here is where the situation gets complicated! PCA Stock Class is based on a points system where each improvement is assessed points. You may accumulate up to six points and still remain in PCA Stock Class, greater than six points, your car goes into the PCA Production Class. As an example, "R" compound tires are two points, oversize tires up to 30 millimeters over stock specifications are another two points, a strut tower connector is one point, totaling five points. This places you at the top of PCA's Stock Class while excluding you from running in POC Show Room Stock Class. Additionally, at a POC event, the PCA allowable improvements (Up to 5 points) will advance your car up to POC Street Improved class.

Most experienced Porsche Time Trial drivers will agree that the Porsche automobile, as delivered from the factory in stock form, has significantly more performance potential than the Novice driver can ever reasonably expect to exploit. This is prior to any performance modifications being made to the car!

Therefore, from the outset, it is generally recommended that the Novice driver thoroughly prepare and maintain the car and learn to drive it as delivered. There will be plenty of time to upgrade later in the season.

As you evaluate any possible modifications to your car, carefully analyze how you plan to utilize the car. If you are 90% street and 10% track, any modification that severely alters the ride of the car may not be practical. Reread the current GCR's and determine what class will

most closely fit your driving needs.

For those intent on optimizing their cars for better track performance, scrutinize the latest GCR's for allowable modifications. Then proceed to design a plan to maximize potential performance within that class. If that one little modification is going to elevate you out of your present class and into the bottom of the next higher, more competitive class, you may wish to reconsider the option.

Before you finalize your modifications list, talk to the most successful drivers in the class you plan to compete in. Find out what the winners are doing!

The final step, determine what do you want to spend? For good measure, add 25% to this figure. Something else will always come up! At this point, you are now ready to make up your list. If the budget figure you arrive at is somewhat limited, there are a number of very effective performance enhancements that can be accomplished in Stage I.

Discuss any planned modifications with whomever has jurisdiction over classification of the cars. Be certain to determine the potential safety implications of any changes under consideration.

STAGE I (Considerations for the Novice driver in POC Show Room Stock and PCA Stock Classes.)

Shop Selection: At this early point in your career, it is recommended you consider utilizing one primary shop as a source for your information, maintenance, modifications and any needed repairs. Select a shop with an established reputation for quality work, and hopefully, a shop with experience preparing Porsches to run at speed. Be certain to tell them of your plans to compete and ask for their suggestions.

Tires: Have your present tires inspected at a shop selling high performance tires. Ask them to look for any defects in the tires and request they inspect for adequate tire tread.

Should you decide to replace your tires, a speed rating of ZR is recommended for Time Trials. As far as specific brand selection, you will need a tire that has been proven adequate for speed events and street driving. I suggest you pose the question of tire selection to Club members and see what their experience has been. If you are not content with this approach, you may wish to check with your local Porsche dealers to see what tires are provided as standard equipment on the new 911's. The Porsche factory is very selective about the tires their cars are delivered with.

Tire pressure: Buy a good tire pressure gauge with an air bleeder valve. The bleeder valve allows you to rapidly and conveniently bleed off any excess air pressure. Concerning tire performance, too much air pressure can be as much of a problem as too little. With optimal pressures, you will get the best possible performance from the tires. This is true on the street as well as the track! Expect to spend from \$25 to \$50 for a high quality gauge.

Air Tank: Most automobile supply stores stock portable, compact air tanks that enable you to store about 180 pounds of air. You will need a source of air as you adjust tire pressures to compensate for changing track and tire conditions. Tanks cost in the area of \$50.

Brakes: Have your brakes inspected and check for pad and rotor wear. Should either need replacement, do it now.

Brake fluid: While you are having your brakes inspected, strongly consider a complete change of brake fluid. Polyglycol fluid is hygroscopic, it absorbs water, which serves to lower the effective boiling point of the brake fluid. Therefore the higher the boiling point of the fluid initially, the better performance is to be anticipated.

Upgrade your present polyglycol brake fluid to DOT 4 (Department of Transportation) specification fluid having a higher minimum dry boiling point of 446 deg. F. contrasted to DOT 3 at 401 deg. F.. At the track, boiling the fluid is to be avoided due to the production of air bubbles and accompanying brake fade.

Although there is a non-hygroscopic silicone based brake DOT 5 brake fluid with higher dry boiling point of 500 deg. F, some compromises are involved. Silicone fluid should not be mixed with polyglycol brake fluids, hence prior to installation of the silicon brake fluid, it is recommended the brake system be completely cleaned and purged, not an easy task.

On the down side, the silicone fluid appears to be slightly compressible with a resulting "spongy" feel to the brake pedal. Also, it is difficult to extract all the air out of the brake lines in the bleeding process. In summary, regardless of the benefits offered by DOT 5 fluid, it is seldom seen at the track. For a comprehensive discussion of brake fluids and brakes in general, see CIRCLE TRACK, Volume IX, Number 1., January, 1990, pp. 42-51. Also, The BRAKE HANDBOOK, Fred Puhn, HPBooks, Los Angeles, CA, 1985.

A complete replacement of brake fluid to DOT 4 specifications and a proper bleeding will generally enhance the stopping power of most cars. For routine non-track driving, brake fluid should be changed at least once per year, more frequently if you drive the car hard.

Time Trial and Slalom regulars are known to bleed their brakes before every event. This routine provides the driver with the confidence of knowing that maximum braking performance may be anticipated during the course of the event. Proper brake bleeding can easily become a do-it-yourself task (With a helper to pump the brakes), readily learned and easily implemented. For those less social drivers, a vacuum pump power bleeder, about a \$50 expense, is available which reduces the brake bleeding to a one person job. Having your repair shop bleed the brakes will result in a cost of approximately \$60, parts and labor.

Stop Watch: In Time Trials and Slalom competition, you will want to know how fast you and your competitors are going. A good digital stop watch will provide you with split times and should also have a memory for storing the last five to seven laps with a cost of under \$50.

Alignment: Annual front and rear alignment is recommended maintenance for the 911. This can be accomplished in the \$100 range.

Wheel Balance: Have the balance of your wheels checked. A properly balanced wheel results in a smoother and safer high speed ride.

Duct Tape (Racers Tape): At Time Trials, you will be required to tape up exposed lenses on

your car. This prevents glass on the track in the event a lens is broken by a flying stone, etc. Buy several rolls and consider selecting a color that contrasts with the color of your car. This enables your personal timers to pick your car out of the pack. You'll spend about \$7.00 per roll.

Driving Gloves: A number of advertisers sell a single to multi-layer fire resistant, brightly colored driving glove. The gloves are a safety item and allow your passing signals to be seen by overtaking drivers. Anticipate approximately about \$60 for a good pair.

White Shoe Polish, Liquid: You will need this to put numbers on your car and to mark the sidewalls of your tires to check for over or under inflation.

Tool Kit: Be certain your factory tool kit is complete, including a spare fan belt. This kit contains most of the tools you will ever need to make a basic repair or adjustment. Consider purchase of a torque wrench for about \$100. It is required to torque your wheels down to the recommended specifications.

Racers Kit: Obtain a small container for all the little extras you may need at an event. Consider storing at least the following: spare stop light bulbs, duct tape, white shoe polish, extra motor oil, tie wraps, window cleaner and towels, hand cleaner, a pair of cotton gloves for such chores as tire changing, sun screen, a set of allen wrenches, etc.

STAGE II (Considerations for the POC Street Improved and PCA Stock Classes.

At this point, you have accumulated "seat time" and are looking for some modifications to help you obtain a competitive edge. Some of the potential modifications are expensive and you may need an approach to rationalize away the dollars. I recommend you consider the following technique: First rule, don't throw away any parts you have replaced. Now you can say, should I ever sell the car, I can simply remove the modifications for potential sale and re-install the stock components. Using this approach, the cost for your planned improvements is original cost less resale value for the true net cost.

Numbers: Once you have you have earned your Competition License with POC or PCA, you will be assigned a permanent set of numbers for your car. If you are fortunate, your POC and PCA numbers will be the same. Consider ordering semi-permanent numbers to be placed on your car at events. They won't make you go any faster, but they certainly look tidy. Expect to pay approximately \$100 for numbers.

Stainless Steel Brake Lines: Deterioration from age and heat may allow the standard factory rubber hoses to swell under hard usage resulting in a "spongy" brake pedal. Replacement with Teflon lined, stainless steel (Dash 3), braided lines eliminates this possibility. A set of four will cost about \$60.00, plus the labor to install them in addition to the expense required to bleed the brakes. While you are in the shop getting your brake fluid changed to DOT 4, this would be an excellent opportunity to install the stainless steel lines.

Brake pads: Consider a change from stock pads to high performance pads. In my experience, these pads have demonstrated excellent performance on the track as well as the street. Please note there are contrary opinions concerning the suitability of track pads for street use. These pads are said to be less than desirable because they may not work well cold. Front and rear pads can be obtained for approximately \$100 plus labor to install

them.

COOL-brake kit: This kit, originated by Al Holbert Racing, provides two fiberglass scoops which are installed facing forward attached to the bottom side of the "A" arms with tie wraps. The kit also contains the necessary flexible ducting and funnels serving to force cooler "ram air" from under the car into the eye of the vented rotors resulting in cooler brake operating temperatures. Expect to pay about \$200 for the Holbert COOL-brake kit, \$300 or more if you purchase a COOL-brake style kit with air scoops constructed of stainless steel. Labor for installation should be under \$250.

Turbo Tie Rod Ends: The standard 911 tie rod joint is reputed to induce a "spongy" steering feel which is eliminated with installation of the Turbo tie rod ends. The direct replacement Turbo tie rod ends provide a uniball joint in place of the standard 911 rubber joint. Expect to spend about \$150 for the kit and budget another \$150 for installation.

Strut tower connector: This is a brace connecting the front strut (shock) towers. It is designed to prevent chassis flex and allow the car to maintain its alignment in the face of severe cornering forces. Allow approximately \$125 to \$300 for this item depending on the brand selected, and budget \$50 labor for installation. Both POC and PCA specify that the strut tower connector be removable with welding to the chassis prohibited. PCA assesses one point for this improvement; it is allowed in POC Show Room Stock class. Installation of a strut tower connector is not permitted in POC Stock Class.

Factory Short Shifter: This factory kit reduces the throw between gears by approximately 25%. This allows for more precise shifts, and some say faster, in exchange for increased shifting effort. See an article by Russ Dickerson M.D. in the Porsche Panorama, May 1987 issue, for complete details. Anticipate a cost of about \$90.00 and several hours labor to install.

Shock absorbers: Have a professional carefully inspect these critical items of your cars suspension. Contrary to myth, shock absorbers do not last indefinitely. A new set of four of the latest gas inserts, or replacement shocks, depending on how your car is set up, could cost \$500, possibly more, plus the labor for installation. If you have been driving on poor shocks, you will be amazed at the resulting performance after replacement. Shock replacement should be categorized under routine maintenance, regardless of whether or not you get in track time with the car.

Tires: High performance Z rated street tires cost from \$150 to \$225 each for the typical Porsche sizes. The tires are delivered with approximately 11/32 of an inch of tread and a tire compound of DOT 180 + - (The larger the number, the harder the tire.) which equates to decent tire wear under routine driving conditions.

Unfortunately, if you get these street tires really hot, as for example, running at speed for 20 minutes at Willow Springs Raceway in July, they may chunk, blister, or both. Blistered tires, or tires with missing chunks of tread are rendered unserviceable and must be replaced. As an option, in an attempt to reduce the possibility of chunking or blistering, you can have your street tires shaved to a tread depth of 6/32 of an inch. The net effect, useable tread depth is being reduced by 50%, or greater.

The biggest bang for your buck: There are several tire manufacturers (Kuhmo, Pirelli, BF Goodrich, Toyo, Hoosier, and others) offering "R" compound tires in ZR speed ratings.

These "R" compound soft tires carry a DOT rating in the 0 to 80 range, depending on the brand. In contrast, the standard ZR speed rated street tires generally carrying a DOT rating greater than 100.

These tires are either factory shaved or molded to a depth of 6/32 or less, and will not chunk. However, they will blister if you get them hot enough.

The soft compound allows for improved adhesion to the track surface with most drivers seeing substantial improvements in their track times with these softer "R" compound tires. Expect to pay from \$110 to \$250 for a "R" compound tire, depending on the size and brand selected. The trade offs: The "R" compound tires wear quickly and there is some controversy concerning the performance of "R" tires in the wet. Also, "R" compound tires are assessed 2 points at a PCA event, but are allowed without penalty in the POC Street Prepared class. POC Show Room Stock class does not permit these tires.

Alignment: Assuming you have decided your Porsche is to be set up for maximum track performance, let your car's alignment reflect your wishes. The magic word with the 911 is negative camber, how far the wheels slope in toward the top of the tire. Check your GCRs for the maximum allowable camber.

Optimal negative camber allows for more tread to be on the road in a turn providing better grip. As your car increases traction, you will be able to utilize more of the available horse power resulting in better track times.

Proper alignment and balance: Along with the correct camber, toe in, toe out and caster, a properly set up 911 will have approximately 40% of the weight on the front wheels and 60 % to the rear, with the chassis very slightly lower in the front. Do not assume that your car is now in this condition. If the car hasn't been correctly aligned and balanced, it probably isn't!

Corner balancing: Although a car may be perfectly set up as mentioned above, consider the effect of adding fuel at approximately 7 pounds per gallon, suppose you add 20 gallons? What is the impact of the drivers weight? It has to throw the car off balance with those extra pounds on the left side!

A professional corner balance and alignment will correct these inequities. When making your appointment at the alignment shop, you will probably be requested to arrive the day of the appointment with 1/2 to 3/4 of a tank of fuel in the car. You may also be asked to sit in the drivers seat of the car as the fine balancing adjustments are being made, or static weight may be utilized in your absence. Depending on how far out of balance your car is, and how far they have to go into the torsion bars, especially the rear bars, to correct the balance, determines the expense. Generally you may expect to spend up to \$400 for a professional corner balancing and alignment. What you are paying for is labor and expertise. Is it worth the expense? Ask the winners! You will find that their cars are always aligned, and most have also been corner balanced.

Racing Seat: This investment of approximately \$500 to \$1,000 allows you to fully concentrate on your driving. Net effect: you will be more relaxed and more receptive to subtle changes occurring in the car's handling as well as track conditions.

Roll bar: This is a safety item with a bonus, it stiffens the chassis somewhat which should lead to better handling. Installation of the standard bar requires that approximately 16 holes

need be drilled in the car chassis. The downside, the rear seat is now 100% useless for passengers, but wasn't it anyway? In addition, you will be adding the weight of the bar to the car. A quality roll bar is available for around \$250, with installation extra. For an additional \$125, you can have the bar powder coated for that extra finishing touch.

Roll Cage: For approximately \$700, you can purchase a full roll cage. The cage will provide an increased degree of safety. However, installation will be more expensive, you will be required to drill additional holes in the chassis, adding additional weight and the function of your sun visors will probably be lost.

Sway bars: Sway bars serve to reduce body roll under extreme cornering forces. Larger diameter, as well as adjustable bars are options to minimize the problem of body roll. Note: information on stabilizer bars, diameters, years offered, etc., was obtained from Porsche Factory Specifications Booklets. Frere's book, PORSCHE 911 STORY contains some slightly different specifications. In this article, I utilize the Porsche Technical Specifications booklets as my "gold standard", my primary source of information.

Front bars, pre 1974 cars: These cars came equipped with a "through the body" style front sway bar (Also found on the 1975-76 Turbo with a 18mm front bar). The earliest 911's were delivered with a 13mm bar to be updated soon thereafter to the 14mm bar on the 911S. Optional bars on these early pre-1969 cars were 11mm, 14mm and 15mm.

In 1968, the 911L was delivered received a 11mm front bar with a 15mm front bar standard on the R.O.W. 911S. 13mm,14mm and 15mm bars were 911 options.

In 1969 through 1971, a 15mm bar was standard on the 911S. On the 911T and 911E, an optional 13mm front bar was available. A 15mm front bar was also optional if a bar of the same diameter was ordered and installed at the rear.

In the years 1972 and 1973, the last years the "through the chassis" style bars were seen on the non-Turbo 911, a 15mm front and rear bar was an option for the 911T and 911E with the 15mm front and rear package standard on the 911S. The Carrera 2.7, not legal for sale in the U.S., was delivered with the 15mm front and rear package or with an optional 18mm front bar with a 19mm bar in the rear.

The 1976 Turbo utilized 18mm, through the chassis style, front bars. In 1977, the "through the body" style 18mm sway bar was replaced by a 20mm, simplified, non-drop link bar.

Rear bars: On 1968 and earlier cars, the 911S was delivered with a 16mm bar, reduced to a 15mm bar in 1969. The 15mm bar was an option in 1968 for non "S" models.

In 1969 through 1971, 15mm was the standard sway bar diameter on the 911S and optional for the 911T and 911E. This remained through 1973, where the Carrera 2.7 was offered with a 19mm bar package mentioned above.

The factory bars, front and rear, can be replaced with increased diameter aftermarket bars providing for greater rigidity and resulting in increased resistance to body roll under high cornering stresses. As an example, a popular aftermarket supplier of adjustable sway bars offers 19mm or 22mm bars for the front, and for the rear, 16mm, 19mm, and 22mm diameter bars.

Upgrade: Install 1986 Carrera 22mm front and 21mm rear sway bars for 1974 through 1985

non-Turbo 911s. From 1974 through the 1977 model year, the non-Turbo cars were delivered with 16mm front bars with no rear bars supplied as standard equipment. The 1974-77 Carreras (1977 not sold in the US) came with 20mm front bars and 18mm rear bars. Turbos were delivered with 18mm front and rear for 1975 and 1976 going to a 20mm front with 18mm rear bar for the 1977 models.

1978-1983SC's and Turbos were delivered with 20mm front and 18mm rear bars. The Carrera through 1985 incorporated the same package.

For approximately \$300, plus labor, you can upgrade to the larger 22mm front and 21mm rear bars introduced on the 1986 Carrera. These sway bars are ruled as "Non Stock" when installed on 1974-1985 911's. PCA will assess two points for this improvement. The 1986 Carrera bars are allowable in POC Street Improved but not permitted in POC Show Room Stock class.

STAGE III, (Considerations for the Committed Running in POC Street Improved and PCA Stock on their way to Production.)

Spoilers, pre-1974 cars: A spoiler is a performance device that serves to reduce lift generated as the car cuts its way through the air at speed. A spoiler(s) also greatly reduces the cars susceptibility to the effects of crosswinds. As a result of the body design of the 911, as the angle of crosswind increases relative to the longitudinal axis of the car, front lift increases much faster than rear lift. Net result, in a strong crosswind, the front end gets light and the car's handling may seriously deteriorate with the driver experiencing car wander. Sound familiar?

How serious is the overall problem of speed and wind induced lift? Consider the following information derived from The Porsche 911 Story 4th Ed., Paul Frere, 1989. Porsche factory wind tunnel testing confirmed that a non-spoiler equipped 1969 911 S, at a top speed of 143 MPH, would generate front lift forces of 183 Lbs. with 255 Lbs. at the rear. Addition of the modified air dam first appearing on the E Series 911 S in August of 1971, reduced front lift down to 102 Lbs. However, rear lift remained at 255 Lbs. And created a tendency for the car to oversteer in high speed turns, with pronounced oversteer in the event the driver were to lift off the throttle.

These facts led to the development of the "duck tail" spoiler which "proved extremely efficient in balancing front and rear end lift, and also proved beneficial in reducing the car's overall drag." (The Porsche 911 Story 4th Ed., Paul Frere, 1989). A Carrera RS equipped with the "duck's tail" spoiler and the standard E Series 1972 air dam, had front lift reduced from 183 Lbs. down to 77 Lbs. with rear lift going from 255 Lbs. down to 93 Lbs. with reduced sensitivity to crosswinds. The air dam and spoiler combination, in addition to reducing lift, also serves to move the aerodynamic center of pressure rearward toward the wheelbase center resulting in reduced vulnerability to the effects of crosswinds on car stability.

Wind tunnel tests run on a car equipped with the front air dam, without a rear spoiler, saw an increase in rear lift to 320 Lbs.! Therefore, the driver contemplating high speed Time Trial driving in an early 911, especially at Willow Springs International Raceway where strong side winds are commonplace, should be extremely reluctant to install a front air dam without an accompanying rear spoiler!

Aftermarket "duck tails" and the front air dam can be purchased for approximately \$600 per pair, unpainted. Spoilers, 1974 and later cars: Weissach testing also confirmed that employing the "whale tail" spoiler in conjunction with the front valance mounted rubber chin spoiler, resulted in even more dramatic reductions in lift. In a wind tunnel with a simulated maximum speed of approximately 140 M.P.H., total lift went from nearly 400 pounds for a car without aerodynamic aids, down to approximately 40 pounds total lift for a car equipped with "whale tail" and rubber chin spoiler.

"Whale tails" and chin spoilers are always installed in pairs! Installing a front spoiler with no rear spoiler, or the reverse, can be hazardous!

A "whale tail" installed without a matching chin spoiler may serve to induce dramatic understeer in a critical situation: Example, imagine you are in a high speed left turn and quite naturally you want to stay on course. Your "whale tail" has produced reduced lift to the rear while the front is significantly lighter. As a result of this imbalance, the car may ignore your steering inputs and continue in a straight line.

Installation of a chin spoiler without a matching "whale tail" could be equally dangerous, inducing premature oversteer, especially in the event of a throttle lift while negotiating a high speed bend. With the reduced lift on the front, the rear is correspondingly light. In the same left turn, the rear end may decide to swap ends, with the front end coming around to the rear in a spin.

Expect to pay approximately \$1,000 for a "Whale Tail" exclusive of paint and installation. For about \$250, the rubber chin spoiler can be obtained with a relatively simple installation required.

Oil Coolers: Admittedly the 911 was designed to run at speed on the German autobahn. However, based on the experiences of numerous Time Trial participants in S. California and Arizona, this level of oil cooling is not adequate for 20 minutes at full throttle in the warmer months at sites such as Firebird International Raceway outside of Phoenix, or Willow Springs Raceway.

Exposure of the 911 engine to oil temperatures in excess of 250 degrees F., for any length of time, may induce serious and permanent damage. There is controversy over the upper limit of 250 degrees F.; some feel the upper limit should be considerably lower, possibly 225 degrees F. The serious competitor will consider alternatives to the standard crankcase factory oil cooler.

Auxiliary Oil Coolers: Engines found in the pre 1974 earlier cars generally run cooler. They are devoid of heat generating anti-smog devices and have reduced engine displacements.

Historically high performance 911 models have been equipped with supplementary auxiliary oil coolers. The 1969-1971 911S was delivered with an aluminum radiator style oil cooler. The radiator cooler was replaced by the familiar loop cooler first delivered on the 1972 and 1973 911S and R.o.w.

2.7 Carrera models.

This same loop cooler was available as an option for the 1974-1977 911 cars and became standard issue with the 911SC, to be last seen on 1982 911SCs, replaced on the US 1983SC with a brass tube type cooler. The tube cooler was seen on European 911SC as early as 1980. In 1985, the tube cooler was replaced by an aluminum oil factory radiator which was to receive a auxiliary fan on the catalytic converter equipped

1987 911 Carreras.

Factory and aftermarket, non-spoiler mounted, oil coolers are fitted at the forward portion of the right front wheel well. An aftermarket cooler and the needed hardware and thermostat will cost approximately \$700.

Consider installation of an Integrated Aftermarket Front Spoiler for your 1974 and later 911. These aftermarket fiberglass front spoilers, sometimes referred to as "Ruf" spoilers from the original designer, replace the front valance and eliminate the need for a front rubber chin spoiler. Cut directly in the center of the spoiler is a rectangular area which accommodates an oil cooler, a most critical necessity for those planning to run at speed in Time Trial events in the warmer months events. B&B is the hot set up these days, no pun intended.

The total package including the heavy duty oil cooler, the front fiberglass "Ruf" style spoiler, and painting and labor to install the above will cost approximately \$1,800. This investment prolongs engine life and provides peace of mind, provided that an accompanying "whale tail" is also installed!

On 1974-1984 cars, for those who prefer the Factory look, the 87 Carrera aluminum oil cooler is an option. It incorporates a fan which is activated when a thermocouple located in the radiator senses oil temperature at 244 deg. F.. Budget about \$800 for the conversion. From personal experience, this upgrade is not as efficient as the "Ruf" style cooler.

Tires: The committed Time Trialer must strongly consider "R" compound ZR speed rated tires. Ask your racer buddies what are this year's "hot" tires. As driving skills go up, speeds follow. In order to apply your driving skill 100%, and obtain the highest level of performance from your car, you will need the "R" style soft compound tires. Street tires are inadequate for the high stress environment of competitive Time Trial driving; composition of the street tire compound is too hard resulting in street tires being incapable of providing the maximum traction necessary for winning lap times. You will also need the "R" compound tires because your competitors are running them. Expect to spend from \$110 to \$250 per tire depending on the size and the brand.

PCA assesses two points for "R" compound tires. POC allows "R" compound tires without penalty in the Street Improved class, but not in the Show Room Stock class.

Tire size: Check your GCR's for acceptable sizes. PCA will assess two points for tires up to 30 millimeters over the original stock tires delivered with the car.

Wheels: If you are truly committed to Time Trialing as a sport, at some point, you will become weary of the ritual and expense of removing your street tires and replacing them with your "R" rated tires just prior to race day. Now you are ready for a second set of wheels. And, you will need to find a racing buddy with a trailer to ferry your wheels to the track, or step up to the plate, buy a trailer and a tow vehicle.

Porsche Factory Fuchs diameter forged aluminum alloys cost approximately \$1,200 for a set of used seven and eight inch wide X 16" wheels, approximately \$750 for the used 15" wheels. Fuchs wheels are also a safety factor, they may bend or crack under extreme trauma, but they will not break!

PCA Zone 8 assess no points for wheel width as long as the track of the car is not increased greater than 2". POC Show Room Stock Class requires running on the wheels and tire sizes the car was delivered with; POC Street Improved class

allows up to 7" alloys on the front with a maximum of an 8" alloys mounted on the rear with no penalty.

Adjustable sway bars, front and rear: On pre-1974 cars, you have the option of adding larger (more rigid) bars front and rear and adjustable drop links. 1974 and later cars (with the exception of the 1975 and 1976 Turbo) were delivered with the new simplified, non-adjustable sway bars. With the obvious exception of the Turbo, you may replace these bars on 1974 and later cars with the larger diameter 1986 Carrera bars mentioned earlier, or take the next step and go to adjustable bars, front and rear. With adjustable bars, the suspension can now be tuned to meet track conditions. This modification will cost proximately \$950 for parts, add another \$400 or so for labor to install both bars. The labor cost results from the need to fabricate and install gussets for the rear bars which must now absorb the increased cornering forces generated by the heavier bars. Also, installation of the front bar requires removal of the gas tank to facilitate bolting the mounting brackets into place with some welding required. There are several brands of aftermarket suspension products available. Conduct your own research amongst knowledgeable Club members to determine the best selection to meet your needs.

You will receive a two point assessment from PCA. Adjustable bars are permitted in POC Improved class but not allowed in POC Show Room Stock Class.

Muffler: An aftermarket muffler may provide some horsepower increase at the expense of added noise. Conclusive dynamometer tests confirming the added horsepower appear lacking. Considering the increased public sensitivity toward excessive environmental pollution, and with the added noise serving as potential "ticket bait" during street driving, this option appears to be losing its utility. A muffler will cost in the range of \$250 plus installation costs.

A non-stock muffler is not allowed in POC Show Room Stock Class, PCA will assess 2 improvement points. POC Improved Class allows for a non-factory muffler.

Sport Shocks: There are numerous options to choose from. Boge, Bilstein, Koni and Sachs all manufacture sport shocks. Check your shop for their specific recommendations.

"S" Brake Calipers: Note: Information on the availability of calipers for specific model years was obtained from various Porsche Factory Technical Specifications Booklets issued from December 1967 through December 1986.

Commencing with the "B" Series in late 1968, Porsche delivered their highest performing 1969 models, the 911E and the 911S, with aluminum front calipers developed specifically for Porsche by the Ate Company. These new aluminum "S" calipers, designated as "S" originating from the German word "schwer" meaning heavy (heavy duty), are one piece in design and weigh considerably less, lighter by 3.44 Lbs. each, compared to the cast iron "A" caliper.

"S" calipers were standard on the high performance 911E and 911S through 1973. In 1974, the "S" calipers were found on the 911 S and the Carrera with the heavier, three piece, cast iron "M" calipers mounted on the standard 911.

In 1975, the "S" caliper could be found only on the US Carrera and the R.o.W (Rest of World) Turbo. 1976 saw the "S" caliper on the US and R.o.w. Turbo, but dropped from the Carrera (Not sold in the US) which acquired the new "A" cast iron calipers.

The Turbo introduced to the R.o.w. in 1975 and the US in 1976, incorporated the "S"

calipers until the introduction of the 1978 model when the 917 style alloy brakes became standard.

1977 saw the "S" caliper limited to the Turbo only, with the 3.0 Carrera equipped with "A" front calipers, and "M" calipers to the rear.

The "S" caliper was also delivered on some 1978 SCs only to disappear entirely on the 1979 model line, replaced by the cast iron "A" caliper. From the "I" series through the SC model run, "A" calipers brakes are found at the front with "M" calipers to the rear.

Advantages of the "S" front calipers over cast iron: In addition to the obvious reduced weight factor (Less unsprung weight with resulting better suspension response), aluminum "S" calipers conduct heat away better than cast iron, some say they provide improved pedal feel, and the "S" calipers utilize a thicker 13 millimeter brake pad, contrasted to the 10 millimeter pad of the "A" caliper.

On the down side, some drivers report the "S" brakes tend to flex under extremely hard usage. And being constructed of aluminum, they are subject to the possible corrosion.

Availability: Porsche "S" calipers are difficult to find and will cost at least \$600 per pair, used and rebuilt, plus installation. New "S" calipers are available but are extremely expensive. Stoddard's 1987 catalogue lists new "S" calipers at \$1,136.90 each.

Under the "update-backdate" provision of the PCA and POC GCRs, because the "S" caliper appeared on some models of the 1978 911SC, this allows for a "S" caliper update of "A" calipers equipped cars for the 1978-1983SC's model run. The update is a relatively simple bolt in operation.

The "S" caliper update does apply to 1984 and later cars. These model years were delivered with a redesigned, wider, "A" style cast iron calipers to accommodate a more efficient 24mm rotor, possessing better heat dissipation characteristics than the previous 20mm rotor, electronic wear indicators designed into the brake pads providing dashboard warning for needed brake pad replacement, larger rear brake cylinder bores, a larger brake servo, an engine driven vacuum pump and a brake pressure limiting proportioning device.

Note: Before you decide to rush out and upgrade your pre-1976 911 to "S" calipers, please remember they will not fit on struts having the "M" series calipers.

If you are in doubt as to what calipers are on your car, measure the distance between centers on the caliper mounting bolts on the front struts. If the distance measures 3", you have "M" calipers. "S" and "A" caliper mounting bolts are approximately 3 1/2" apart.

In order to install "S" calipers, on a "M" caliper equipped cars, you will first incur the added expense of changing out the old "M" caliper struts to struts accepting the "A" or "S" calipers. Expect to pay approximately \$1,000 for the struts alone, add in the cost of shock absorber inserts at about \$200, as well as the cost of used and rebuilt "S" calipers at \$600 or more, and the required labor. In summary, the total cost for the conversion to "S" calipers could exceed \$2,500.

In the long run, for those determined to own a 911 with "S" calipers, it could be less expensive in the long run to acquire a 911 delivered originally with "A", or preferably the "S" calipers, as standard equipment. Caution: for those considering the change from "M"

calipers to "S" calipers with the required strut change, you may wish to check your GCRs to see if this is an allowable modification.

Non "S" calipers equipped cars: From the earliest 911 models, the 911S prior to 1969, the 911T's and the 911L, all were equipped with the "M" front calipers which remained as the standard through the "H" production series ending in July 1975. At this point the "M" front caliper was replaced by the "A" caliper.

The "A" caliper, also developed by Ate, first integrated into the 1976 models, is similar in size to the "S" caliper and originally developed for Alpha Romeo hence the "A" designation. The "A" caliper is a three piece, cast iron caliper, providing the same 78 sq. cm brake pad area as the "S" caliper, utilizing a 10mm brake pad contrasted to the 13mm pad found on the "S" brakes.

Rear calipers: Ate also designed the "L" (light) caliper, mounted at the rear of the 911 from the first introduction of the car through the "A" production series ending in July 1968. From the "B" series 911 onward, the "M" caliper is found at the rear of the all 911's, with the exception of the 1978 and later Turbo which received 917 style light alloy rear brakes. The long reign of the rear mounted "M" caliper ended with the introduction of the 1984 Carrera.

Pyrometer: a precision heat measuring device utilizing a probe to determine tire temperatures. Tires deliver their maximum performance within specific heat ranges and tire pressures, hence the significance of monitoring tire temperature and making the appropriate adjustments to tire pressure, and ultimately, to the suspension. Immediately after a track session, the temperature is read across the tread on all four tires. Assuming the suspension settings are static, the degree of temperature variation across the tire tread indicates proper inflation, or will confirm an over inflation or under inflation situation.

Once tire pressures are optimized, the pyrometer can be further utilized to gauge suspension settings, such as camber, as well as providing fine tuning information required for any needed adjustments to the sway bars. Expect to pay \$100 to \$200 for a quality pyrometer. The pyrometer is a requisite for top performance; don't leave home without it!

"G" Analyst: This device can best be described as a vehicle dynamics monitor. Once installed in the car, the device monitors cornering and breaking forces generated as you motor around the track. At the completion of your session, after you have gathered your pyrometer data, you can analyze the "G" Analyst tapes to determine your consistency around the track, whether or not you applied maximum breaking in various situations, obtained maximum acceleration as well as measuring the amount of "G" forces generated from the corners. The "G" Analyst is available directly from the manufacturer for \$379. Add \$95 if you wish the interface adapter for a PC.

It is evident that one can spend a considerable amount of money preparing a car for optimal performance at the track. However, very little expense is required to get started initially. There are a number of regular Time Trial participants who never go beyond this initial stage. They "run what they brung" and they can be very competitive. As mentioned earlier, there is no substitute for "seat time" with good instruction. Until your driving skills reach a certain level, money spent on many of the more expensive improvements may be underutilized. You will be incapable of pushing the car hard enough to feel the difference.

Lap times are the true indicator. When you are producing consistent and competitive lap times, and have learned to drive smoothly, the time has arrived for you to seriously consider improvement options for your car.

And finally, before making any of the changes mentioned in this article, check with your Competition Director to see if it is safe and legal for the class you intend to run in.

Source Material and Recommended Reading:

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