# Porsche® Boxster® In-Depth

Like the original Boxster® concept car first shown at the 1993 North American International Automobile Show, the production version echoes design themes from mid-engine Porsche® road/race cars of decades past, including the 550 Spyder and RS60. Yet, while the Boxster design may evoke images of classic Porsche sports cars, engineers optimized its shape in the wind tunnel. The clean, sleek Boxster cheats the wind with a low 0.31 coefficient of drag (Cd).
A retractable rear spoiler located between the taillights rises at speeds above 75 mph (120 km/h) per hour, reducing axle lift by 30 percent. The spoiler retracts when speed falls below 50 mph (80 km/h), at which point it would have no effect.
A smooth underbody design and various underbody panels guide airflow under the car for reduced drag and lift. In front and rear, small, flexible spoiler lips at the front of the wheel arches also reduce drag and lift.
Ducts in each rear quarter panel serve separate functions. The left side duct supplies air to the induction system. Warm air from the engine compartment escapes through the right-side duct, aided by a fan when engine and compartment temperatures dictate.
The Boxster shares a mid-engine layout with classic Porsche road/race cars. However, physics – not nostalgia – guided the engineering. Engineers describe the handling benefits of a mid-engine layout in terms of a “low moment of inertia about the car’s vertical axis.” Translation: the closer you concentrate a car’s mass near its center, the quicker the response to steering inputs. In the Boxster, this layout yields 46/54-percent front/rear weight distribution, a key contributing factor in the car’s outstanding response.
The Porsche engine design itself contributes to outstanding handling. A horizontally opposed layout – called “boxer” because the piston movement resembles opposing boxers throwing punches – concentrates an engine’s mass in a package that’s lower and shorter than a comparable-displacement inline-6 or V-6 engine.

The compact packaging of a boxer engine offers another space benefit. Located between the rear suspension and the driver, the Boxster’s engine sits low enough to provide a storage area above it for the lowered roof. With the roof raised, the space above the engine cover can augment the car’s front and rear luggage compartments, each of which offers 4.5 cubic feet of carrying space. The 16.5-gallon fuel tank sits behind the front luggage compartment.
To provide space for luggage and a front-mounted radiator, Porsche uses two small radiators, one in each front fender ahead of the wheels. Consequently, the forward radiators and their attendant coolant lines also help weight distribution.
To perform any major service, technicians access the Boxster engine from underneath the car. A service tray in the rear luggage compartment provides easy access to the oil level dipstick and filling spout and the engine coolant fill spout.
In addition, an instrument panel gauge displays oil level after each refueling. After unlatching a single lock handle in the center of the windshield header,

pressing a console-mounted button lowers the power convertible roof in just 12 seconds. To ensure long life for the window seals, the side windows lower by 6 millimeters if they're closed when the driver operates the roof. As the roof begins to lower, the rear cover tilts open and slides rearward. The roof folds into a compact "Z" shape, lowers into the compartment and the cover closes. While the forward section of the roof remains partially exposed, it fits flush against the cover to retain the car's sleek lines.

Porsche constructed the roof frame mainly from die-cast magnesium. The frame's smooth shape ensures that the load bearing points don't show inside the car, benefiting aesthetics, comfort and safety. The roof frame weighs just 28 pounds, yet is strong enough to maintain its shape even under heavy snow. The three-layer Boxster roof provides four-season comfort and function:

• A synthetic fabric outer layer provides outstanding protection against the elements.
• A rubber middle layer insulates the top and prevents water leakage.
• A cloth headliner, which covers the roof frame and reduces noise.

Strategically placed tensioning elements and reinforcements, the result of extensive wind tunnel development, ensure tight sealing and a consistent fit.

A three-piece wind deflector, included in the Sport and Sport Touring option packages, reduces wind buffeting and noise during top-down driving. The deflector includes two mesh panels that clip onto each supplemental safety bar and a clear plastic window panel that snaps into place between the bars.

For even greater protection from the elements – especially during colder months – Porsche offers an optional aluminum hardtop for the Boxster. Fully lined and painted to match the body, the hardtop features a glass rear window with defroster. Two people can easily install the roof, which weighs just 55 pounds (25 kg).

To extend the Boxster's cargo carrying capability, Porsche designed a truly innovative roof transportation system – a feature unique among open cars. The optional system attaches to the convertible roof (open or closed) or the optional aluminum hardtop. Suitable for carrying skis, kayaks or even bicycles, the transportation system will hold up to 165 pounds (75 kg).

Each teardrop-shaped aerodynamic headlight unit includes the main beams, high beams, turn signals and foglights, plus the optional headlight washers if ordered. Innovative "free-form" reflectors allow maximum permissible illumination, despite their relatively small light size. Strong polycarbonate (plastic) headlight covers with a scratchproof coating resist chips and cracks more effectively than glass, and weigh less, too.

Instead of conventional halogen bulbs, the optional Litronic high-intensity headlights feature gas-discharge bulbs, in which an electric current passes through Xenon gas. A polyellipsoid reflector directs the resulting light. Benefits of Litronic over conventional lights include:

• Increased illumination range

• Improved lighting of the edges
• Improved illumination to the sides, for safer cornering
• Improved color vision – the higher color temperature imparts a daylight quality

Because optimal Litronic performance requires precise headlight aiming, the system includes an automatic headlight level adjustment. Front and rear sensors signal stepped motors to compensate for any changes in vehicle inclination, such as caused by acceleration or braking. The high beams use H7 halogen bulbs, and the level adjustment system raises them by 1.2 degrees to optimize the combined Litronic/high beam pattern. Litronic also depends on clean headlight lenses to prevent blinding oncoming traffic, so ordering the option also requires ordering the optional headlight washers, as well.

Inside the Boxster, inspiration from classic Porsche sportscars combines with modern electronics and luxury amenities to make the roadster an excellent everyday car.

Soft-touch grain gives the instrument panel, door trim panels, console, and other areas a high-quality appearance and feel. Cars with the five-speed manual transmission feature an aluminum shift lever and shift pattern indicator. Tiptronic-equipped cars feature an aluminum shift gate. Aluminum-look door handles and aluminum-look parking brake release button and side airbag symbols impart an additional classic design touch. Dual cupholders were added for model year 2001.

Beginning with the 2001 models, all Porsche models feature new light-emitting diode (LED) interior orientation lights. One LED provides gentle illumination of the
cockpit and center console. An LED on the driver's side door handle illuminates the ignition lock and light switch, and an LED illuminates each door latch.

A three-spoke steering wheel with color Porsche crest replaces the previous four-spoke wheel for model-year 2001, and the car keys gain a color Porsche crest.

The Boxster instrument panel combines unique style with traditional Porsche driver-oriented function. Tradition dictates locating the ignition key switch to the left of the steering column. While inspired by the arc shape of previous Porsche gauge panels, the Boxster departs by featuring three separate, overlapping gauge pods. The central and largest pod includes the tachometer and, at the bottom, a digital speedometer readout.

The analog speedometer occupies the left pod, which also houses a digital odometer and tripodometer, plus the high beam indicator. The right instrument pod displays fuel level, coolant temperature and a digital oil-level indicator. In Tiptronic-equipped cars, the right pod also includes gear selection displays for both automatic and manual shift modes.

A row of lamps underneath the gauge panels provide warnings for various functions,
including battery charge, oil pressure, brake fluid level and brake pad wear.

The two seats feature integrated headrests and partial leather trim. Standard equipment includes manual seat height adjusters and power recliners and a

telescoping steering column. Leather trim covers the steering wheel rim, gearshift knob and parking brake lever. As an option, the customer can choose optional heated seats, as well as optional full power seats with memory function for the seat and sideview mirrors.
The standard automatic climate control system includes a dust/pollen filter and an activated charcoal odor filter. The climate control not only holds temperature settings, but also responds to sunlight intensity.

Significant for a high-performance car, the air conditioner compressor power consumption remains constant. Cooling demand controls intake pressure, which in turn determines output between five percent and 100 percent. This type of compressor does not cycle “on” and “off,” thus avoiding the associated lurching affect and noise.
By design, the ventilation system circulates heated or cooled air – depending on the temperature setting – through the rear luggage compartment.
Standard interior equipment includes power windows with one-touch lowering and raising, an AM/FM cassette stereo system, two-speed windshield wipers, a heated windshield washer system, power side view mirrors, dual illuminated vanity mirrors and an inside luggage compartment release.
Interior storage includes compartments in the doors and a locking compartment in the center console. The roof compartment provides additional storage space with the roof raised.
The optional Porsche Communication Management system includes a cassette stereo, GPS navigation system with separate CD-ROM drive, an on-board computer, and a climate control indicator. A five-inch (diagonal) LCD color screen
displays all functions. The onboard computer, which is also included as part of the optional Sport Touring package, displays remaining driving range, average fuel consumption, ambient temperature and other functions.
For precise navigation, the PCM integrates navigation maps on CD-ROM discs (produced by Navigation Technologies), a GPS antenna mounted in the dashboard, ABS wheel speed sensors and a gyroscope. The system reads directions aloud and displays the car’s progress via onscreen maps. The driver or passenger can enter specific addresses or various points of interest.
Boxster customers can personalize the interior by choosing among a number of options:
• Full leather upholstery, in standard and special colors
• Expanded leather interior
• “Wood,” “Carbon,” and “Aluminum/Chrome/Stainless Steel” interior design packages
Porsche remains as committed to the safety of its vehicles as it does to the performance. The automaker includes anti-lock brakes as standard equipment on all its models, and the Boxster incorporates the latest thinking from Porsche in structural integrity, restraint systems and rollover protection.

The Porsche Boxster more than satisfies all current safety requirements for

frontal, offset-frontal and side impacts, as well as rollover standards where they exist. Passive safety – the ability of a vehicle to protect its occupants in a collision – starts with a body structure designed to absorb impact energy and protect the passenger compartment.

In a frontal impact, several defined energy paths direct impact energy toward the high-strength steel bulkhead and sidemembers. Front and rear crumple zones protect the extremely rigid passenger compartment.

Because the term “crumple zone” has become commonplace in the auto industry, it’s important to describe the Porsche-patented system. In a frontal impact, several defined energy paths direct impact energy toward the high-strength steel bulkhead and sidemembers. Front and rear crumple zones protect the extremely rigid passenger compartment.

Porsche arranged front impact protection in two tiers. The first tier includes the front lateral body shell members. The front longitudinal members and bulkhead crossmembers behind the luggage compartment form the second tier. The front-mounted fuel tank and fuel pipes lie outside the crumple zone. The rear crumple zone dissipates crash energy in a similar way, with the rear bulkhead designed to prevent engine intrusion into the passenger compartment.

Porsche uses high-strength steel for many panels and components in these areas, including the front and rear bulkheads, front and rear sidemembers, cowl frame and A-pillar braces. Overall, high-strength steel accounts for nearly 30 percent of the body weight. Strategically placed lateral reinforcements include even the seat bases. As a whole, the Boxster provides the torsional rigidity and flexing strength of a closed coupe, which benefits not only safety, but handling and ride comfort, as well.

Porsche has equipped all its cars with dual airbags as standard equipment since 1989. Airbags supplement the protection offered by the three-point seatbelts, which, along with the retractors, anchor to the supplemental safety bar structure (see below). In addition, Porsche equips all its current models with the Porsche Side Impact Protection System, which includes energy-absorbing door panels and door-mounted side airbags. The 30-liter capacity sidebags provide additional protection for the head, chest, pelvis and arms in a side impact.

At a customer’s request, a U.S. Porsche dealer can install a system that deactivates the passenger airbags when a Porsche-approved baby seat is used. The system features a cross brace with belt lock in front of the passenger seat. Buckling the special baby seat into this brace deactivates the airbags. To install the system, the dealer also must reprogram the airbag control module.

Porsche designed the Boxster to protect its occupants even in statistically rare rollover accidents. Boron steel tubing runs inside the windshield header and A-pillars to reinforce them. The supplemental safety bars behind the seats form the top of a rollover protection structure. Made from welded high-tensile steel, this structure includes a transverse support tube and anchors the bars to solid members in the body structure. Beginning with model-year 2001, Porsche added standard soft-touch covering to the supplemental safety bars. As an option, the buyer can choose silver or body color safety bars.

Porsche drew on decades of mid-engine sports and racecar experience to design a chassis that would make the Boxster handle and ride superbly whether taming a backroad or a freeway commute. That's not a new philosophy for Porsche, which has always balanced high performance with everyday driveability.
A unitized body with welded box sections and bolt-on front fenders, the Boxster "chassis" features light but strong and responsive suspension systems, quick, accurate steering and racecar-derived brakes. Porsche builds most of the Boxster from one of the strongest, most versatile materials available – steel.
Aluminum accounts for about 20 percent of the car's weight. Porsche uses aluminum in the Boxster mainly for mechanical systems, such as the engine, the transmission case, suspension components, brake calipers and wheels.
Porsche uses several kinds of steel in the Boxster, including high-strength low alloy (HSLA) in key load-bearing and safety areas. For rollover protection, for example, Porsche uses super-strong boron steel (steel alloyed with the element Boron) in the reinforcement tubing inside the windshield frame.
To build strength into large steel areas, Porsche uses a technique called "tailored blanks" in place of single large pressings. Tailored blanks start as separate sheet steel pieces made from different thickness and qualities. Laser welding the pieces subjects them to little heat, producing one larger distortion-free "blank." Deep-drawing the blank produces a tailor-made panel of exceptional strength, yet low weight. For the Boxster, Porsche makes the front bulkhead, rear inside sidemembers and rear floor section from tailored blanks.
The Porsche Boxster suspension systems endow the car with handling limits in line with the powertrain performance potential, and predictability in line with the automaker's safety philosophy. The Porsche-optimized MacPherson strut design uses an aluminum lower control arm, aluminum wheel carrier, aluminum crossmember, coil spring, twin-tube gas-charged shock absorber and a 23.1 x 3.4 mm tubular stabilizer bar. The aluminum crossmember carries the lower control arms, diagonal steering arms and the rack-and-pinion steering.

The MacPherson strut design provides exceptional lateral and longitudinal rigidity with low unsprung weight. Negative 7.0-mm steering offset helps stabilize the car under varying braking forces, including ABS intervention. The suspension geometry prevents brake dive.
Also a Porsche-optimized MacPherson strut design, the rear suspension mounts to an aluminum subframe that carries the aluminum transverse, diagonal and toe-control arms and the transaxle mount. The subframe also provides lateral reinforcement for the body. The rear stabilizer bar measures 18.5 x 2.5 mm.
As on the front, the struts use dual-tube gas-charged shock absorbers.
The rear suspension advances the "Weissach axle" toe-control concept – so named for its development at Porsche's Weissach, Germany, test track. During cornering, the toe control arms effect slight toe-in on the outside wheel. This action minimizes the effect of weight transfer during hard cornering, helping to keep the car stable through a turn. Suspension geometry prevents "squat" during acceleration.
Customers who demand even sharper handing response can order the Sport

Chassis option package, which features more rigidly tuned springs and shocks, spring plates (front & rear) and includes stronger, larger-diameter stabilizer bars (23.6 x 3.5 mm front and 19.6 x 2.6 mm rear).
Rack-and pinion steering combines the benefits of light weight, quick response and excellent road feel that Porsche drivers demand. The hollow rack reduces unsprung weight, while the hydraulic power assist eases low-speed maneuvering without compromising higher-speed response or road feel. A second power steering fluid non-return valve reduces susceptibility to road shocks.
The 16.9:1 steering ratio yields a quick 2.98 turns lock-to-lock. The tight 35.8-ft. (10.9 meter) turning circle ensures outstanding maneuverability from twisty, narrow back roads to crowded parking lots. The standard 15-inch (380 mm), leather-wrapped steering wheel telescopes up to 1.6 inches (40 mm) to accommodate driver comfort.
Derived from the Porsche GT1 racecar, the Boxster four-wheel vented disc brakes use innovative “monoblock” brake calipers, which contribute to quick brake release for reduced heat and optimal brake pedal travel and feel. In addition, the monoblock design reduces unsprung weight because it does not require the connection bolts of a two-piece caliper. The four-pistons in each caliper vary in diameter to help prevent uneven brake wear.

The front discs measure 11.7 inches in diameter and 0.95-inch thick (298 mm x 24 mm). The rear discs measure nearly as large – 11.5 inches in diameter and 0.8-inch thick (292 mm x 20 mm). Cooling air flows to the front discs through two ducts and through guide spoilers on the longitudinal suspension arms.
Like every new Porsche, the Boxster features an anti-lock brake system (ABS) as standard equipment.
Beginning with model-year 2001, the Porsche Stability Management system (PSM) replaced the optional traction control system for the Boxster. PSM, a system first introduced on the all-wheel drive 911 Carrera 4 model, gives the Boxster the highest level of stability in racetrack performance driving and adds another measure of dynamic safety on slippery roads. In addition, PSM provides a traction control function for the rear wheels.
PSM can detect any loss of grip at the front or rear wheels and prevent instability by applying selective braking (braking one wheel) to keep the car on course. On slippery roads, PSM can help keep the Boxster going in the direction the driver steers. On the racetrack, PSM can lend a “helping hand” through the slalom and fast turns.
PSM collects data from a steering angle sensor, lateral acceleration sensor and the ABS wheel speed sensors to determine if the car is heading in the direction the driver is steering. If PSM detects any deviation, it attempts correction by applying an opposite yawing moment – braking one inside or outside wheel to nudge the car back on course.
PSM requires an electronic throttle (“drive-by-wire”) because it may need to reduce power – not just apply selective braking – to help restore stability. PSM reduces power first by adjusting ignition timing and then, if necessary, fuel flow.

The PSM system operates so quickly that most drivers likely will not feel it making
corrections. The driver can disengage PSM with a dashboard switch. However, for safety, PSM will engage during braking and then disengage when the driver lifts off the brake.
A warning lamp on the instrument panel indicates PSM operation. While confident
in the system's ability as a dynamic handling aid, Porsche cautions drivers that PSM cannot counteract the laws of physics, such as gravity and available friction. The driver should heed the light and adjust his/her driving technique.
The Porsche Boxster applies a racecar-derived "staggered" wheel and tire arrangement – wider wheels with wider, lower-profile tires on the rear. The standard aluminum alloy wheels measure 16 x 6 inches in front and mount 205/55 ZR16 tires; the 16 x 7-inch rear wheels mount 225/50 ZR16 tires.

An optional 17-inch wheel/tire package features 17 x 6 inch wheels with 205/50 ZR17 tires in front and 17 x 8.5 inch wheels with 255/40 ZR17 tires in the rear. An additional option package includes 18 x 7.5 inch wheels with 225/40 ZR18 tires in front and 18 x 9 inch wheels with 265/35 ZR18 tires in the rear.
Powered by a 2.7-liter, 217-horsepower horizontally opposed six-cylinder engine, the Porsche Boxster can accelerate from 0-60 mph in just 6.4 seconds (0-100 km/h in 6.6 sec.) and reach a top speed of 155 mph (250 km/h) on the test track. The 2.7-liter engine replaced a 201-horsepower 2.5-liter version that powered the 1998-1999 Boxster models. The larger displacement engine features a twin-resonance induction system – similar to that in the 911 – that helps boost horsepower and torque. An E-Gas electronic "drive-by-wire" throttle control provides more precise throttle control than mechanical linkage for improved response and lower emissions.
The 2.7-liter Boxster engine produces 192 lb.-ft. of peak torque at 4,500 rpm, with a significant 147 lb.-ft. of torque available as early as 1,750 rpm. The engine sustains peak torque from 4,200 rpm to nearly 6,000 rpm, providing quicker response than "peaky" smaller-displacement engines. The driver experiences this torque performance through instant engine response in any gear. Engineers refer to this aspect of performance as an engine's flexibility – its ability to respond to throttle input at various loads and speeds. They measure flexibility by acceleration in top-gear (no downshifting). The Boxster accelerates from 50 mph (80 km/h) to 75 mph (120 km/h) in top gear in 10.4 seconds – a full second quicker than the previous 2.5-liter model.
The arrival of the Boxster to the U.S. market in model-year 1998 ushered in a new era for Porsche engine design. While the classic horizontally opposed "boxer" layout owes its heritage to the very first Porsche, liquid cooling replaced air cooling for Porsche standard-production road cars after nearly five decades. Consequently, the greater efficiency of liquid cooling allowed Porsche to use four-valves-per cylinder in place of two valves per-cylinder in the air-cooled engines.
The "boxer" name for this engine layout comes from the motion of the rods and

pistons, which resembles opposing boxers throwing punches. Horizontally opposed engines are also known as “flat” engines, because their cylinders lie in a flat plane. Benefits of the boxer layout include compact packaging and low inherent vibration. In addition, a boxer engine contributes to a low center of gravity, since the layout concentrates most of the engine’s mass at a low point in the vehicle.
The Boxster engine shares only its horizontally opposed layout with previous Porsche boxer engines. Porsche introduced new engine architecture and new construction techniques with the Boxster engine.

The Boxster engine features a two-piece (vertically split) aluminum block (crankcase). The block holds the two-piece (also vertically split) aluminum bearing case, which feature nodular cast iron bearing shells. This construction technique reduces bearing clearance changes caused by temperature fluctuations, which in turn reduces noise. Oil spray jets inserted into the bearing case provide additional piston cooling.
Multi-piece engine construction allows Porsche to cast oil and coolant passages into the block rather than drill them in later. That simplifies engine construction and reduces the chances of debris getting into the engine. The cylinders feature innovative wear-reducing technology called LOKASIL. The process casts sleeves made from 25 percent silicon/75 percent air directly into the cylinders. During block casting, the air escapes, leaving the silicon “locally” along its path – hence the name, LOKASIL. A chemical etching process then exposes the silicon in the sleeves.
The drop-forged crankshaft rides in seven main bearings and features 12 counterweights. Porsche laser-scores and then cracks the connecting rods after forging, creating perfectly matched halves.
Porsche has long featured race-proven “dry sump” oil systems. In past engines, Porsche used a separate, remote oil tank. The Boxster engine features an integrated dry-sump system – the sump sits inside the block, next to the crankshaft.
A return oil pump in each cylinder head (oil cannot fall back into the sump from the cylinder heads in a boxer engine) routes the oil through two separators, which centrifuge the oil to defoam it and remove combustion gases. Doing so ensures oil consistency for optimal performance, emissions and durability. The Boxster engine holds 8.7 quarts (8.2 liters) of oil, and the Porsche Boxster engine can go a remarkable 15,000 miles (24,000 km) between oil changes and 30,000 miles (48,000 km) between oil filter changes.
The coolant system includes an oil cooler. During engine warm-up, the engine coolant helps heat the oil to bring the engine up to operating temperature quickly. When the engine oil reaches 200 degrees Fahrenheit (93 degrees Celsius), the oil cooler dissipates heat to the engine coolant.
Three-piece aluminum cylinder heads include the actual head, camshaft housing and a cover. As with the cylinder block, multi-piece construction allows casting coolant and oil passages into the heads, eliminating the need to drill them after manufacturing. Making the left and right cylinder heads identical (and therefore

interchangeable) reduces manufacturing complexity and cost.

Chain-driven double overhead camshafts – hollow-cast for lower reciprocating weight – actuate four valves per cylinder via bucket-type tappets. Automatic chain tensioners and hydraulic valve lash compensation reduce maintenance.
The Boxster engine employs the Porsche-patented VarioCam® system, which boosts low-end and mid-range torque by varying valve overlap at different engine speeds. Valve overlap – the fraction of a second at the end of the engine's exhaust stroke and beginning of the intake stroke when all valves are open – directly affects torque and emissions. "Early" valve timing – when the intake valves open and close sooner – creates greater valve overlap, which enhances cylinder filling and boosts torque. "Late" valve timing closes the intake valves later in the stroke, which draws in more air to boost power. Late valve timing also reduces exhaust hydrocarbon emissions at idle and low engine speeds.
In the past, engineers had to set camshaft timing (and thus valve overlap) as a compromise, sometimes sacrificing low-end torque for high-end horsepower, or vice versa. Porsche introduced the VarioCam system in the early 1990s to vary valve overlap, enhancing torque output without reducing high-end power.
In operation, the engine control unit operates timing pistons in the intake camshaft chain tensioners. When the engine reaches 1,200 rpm, the control unit signals the piston to rotate the intake camshafts by 12.5 degrees. When the engine reaches 5,120 rpm, the pistons return the camshafts to their normal positions. (The control unit will delay VarioCam until 1,480 rpm if the engine oil temperature exceeds 266 degrees Fahrenheit.)
The Porsche VarioCam system requires fewer parts than variable valve timing systems in other automaker's models.
The Boxster inherits its twin-resonance air induction system from the 911 Carrera. The system acts as a "resonance supercharger," allowing the engine to draw from higher velocity airflow at certain engine speeds. A crossover pipe connects the individual air collector/resonance chambers for each cylinder bank. A flap in the pipe remains closed from idle to about 3,100 rpm. When it opens, each cylinder bank can draw from airflow "excited" by the resonance created by alternating induction between all six cylinders. In essence, "dual resonance" creates two induction paths for each cylinder. Below 3,000 rpm, the cylinders draw air from a "short" path. From 3,000 rpm to about 5,100 rpm – when the resonance flap opens – the cylinders draw from a long intake path, which boosts torque. Above 5,100 rpm, the flap again closes to allow the cylinders to draw intake air from a shorter intake path to boost horsepower at higher engine speeds.

The Motronic ME 7.2 engine control unit, which Porsche added in model-year 2000, essentially duplicates the functions of the ME 5.2 unit, but with the significant addition of the E-Gas electronic throttle control. Instead of the gas pedal pulling a cable attached to the throttle valve, it pulls a short cable connected to a pedal value transmitter in the dashboard. The transmitter uses a potentiometer to convert the pedal travel path and speed into an electronic signal.

The control module processes the signal, sending it to an electric motor that operates the throttle valve.
By providing full computer control over air intake at all engine speeds, the electronic throttle control enhances throttle response and helps reduce emissions. The system also reduces parts, since it eliminates the throttle linkage and separate idle speed control.
The ME 7.2 engine control unit also controls:
• Sequential multipoint fuel injection (fuel injected according to firing order) with separate fuel mixture control for each cylinder bank.
• Coil-on-plug ignition system. Each cylinder features its own ignition coil mounted
directly on a sparkplug, and sparkplug service interval extends to 100,000 miles (161,000 km).
• Adaptive knock control. When a knock sensor detects detonation, the ECU can retard ignition timing for individual cylinders until the condition stops.
• Torque manipulation for the optional Porsche Stability Management system.
• Torque reduction for Tiptronic shifting. (The ECU will slightly reduce torque between gearshifts to ensure smooth operation.)
• VarioCam operation.
• Twin-resonance air induction.
A separate exhaust system for each cylinder bank feeds into two catalytic converters, which feature a tri-metal (Platinum, Palladium and Rhodium) substrate
coating for improved emission reduction. From the converters, the exhaust gases flow into a single large muffler and exit through a central tailpipe, which emits a characteristic Porsche exhaust note.
The Porsche Boxster comes equipped with a precise-shifting, fully synchronized (including reverse) five-speed manual transmission. To match the torque characteristics of the larger, more powerful engine, Porsche slightly lowered the fourth and fifth and slightly raised the final drive ratio in the manual transmission. Gear ratios in the optional Tiptronic S automatic transmission remain the same as before.

The five-speed manual transmission features a dual-mass flywheel and a cable-actuated shift lever to reduce vibration and noise. Because the shift pattern puts reverse directly below fifth, the transmission includes a reverse lock to prevent shifting from fifth to reverse.
Many driving enthusiasts have long proclaimed a manual transmission to be the “proper” transmission for a sportscar. Automatics, they felt, did not allow the driver to make best use of an engine’s speed range and torque. Nor could an automatic provide real driver involvement, essential to the sportscar driving experience. However, with the optional Tiptronic S five-speed automatic transmission, even diehard stick shift drivers may experience greater driving pleasure than they’d ever expect from an automatic.
With the Tiptronic S transmission, the floor shifter includes positions for P (Park),

R (Reverse), N (Neutral), D (Drive) and, to the left of D, M (Manual). When shifted
into D, the transmission offers full automatic operation of the five gears, yet with greater intelligence and sophistication than traditional automatic transmissions. For example, Tiptronic S can downshift when the driver brakes into a corner. In manual mode, this innovative transmission allows the driver to shift via racecar-inspired steering wheel controls.
In automatic mode, the Tiptronic S transmission offers five different shift “maps” or programs. Leisurely driving will call up a map that upshifts quickly to keep engine speeds low – for relaxed, quiet cruising. Rapid accelerator pedal movement and frequent changes in acceleration – as one might experience on a twisty stretch of road – trigger a change to a sporty shift map that holds lower gears longer to make use of engine speed. Tiptronic S will immediately switch to the shifting map appropriate for the driving style. For example, it will switch from “sporty” mode to a more leisurely shift map if the driver leaves a twisty two-lane and enters a residential zone.
The Tiptronic S transmission even behaves like a manual transmission when cornering. As the driver quickly releases the gas pedal while entering a corner, Tiptronic S holds the current gear. If the driver then applies the brake, Tiptronic S downshifts to provide engine braking going into the turn and acceleration when exiting. The Tiptronic S control module recognizes cornering by comparing speeds of the inner and outer wheels.

The Tiptronic S transmission uses the following information to determine a shift program and perform shifts:

Information ... Source:
Accelerator pedal position ... Throttle potentiometer
Vehicle speed ... ABS sensors
Longitudinal vehicle acceleration ... ABS sensors
Lateral vehicle acceleration ... ABS sensors
Engine speed Speed ... sensor/flywheel

A continuously engaging lockup torque converter can lock up in all but first gear to optimize efficiency. To ensure smooth shifting, the Motronic engine control unit slightly reduces engine torque during gearchanges by retarding ignition timing
for a fraction of a second.
Sliding the shift lever into M from D at any time gives the driver instant manual control of the Tiptronic S transmission. The car will hold the current gear until the driver upshifts or downshifts using thumb switches on the right or left steering wheel spokes. Pushing the “+” button upshifts, and pushing button marked “-” downshifts. Tiptronic S also allows the driver to shift manually with the steering wheel switches even when the shift lever is in \"D.\"
Shifts occur instantaneously, with no loss of tractive force. That is, shifting up or down does not reduce engine speed, as it does when taking your foot off the

gas when shifting a manual transmission.
The Tiptronic S transmission performs additional functions beyond the capabilities
of a traditional automatic transmission. For example, when the driver first starts the car, Tiptronic S operates with a Warm-up program. This shift map delays upshifts and keeps the lockup torque converter open to help bring the engine up to operating temperature rapidly (for optimal performance and lowest emissions). Once underway, Tiptronic S will respond to changes in road grade, delaying upshifts on inclines to sustain climbing power, and holding a gear on descents to provide engine braking. The transmission even helps out in low-traction situations. If the ABS wheel speed sensors detect wheel slip, Tiptronic S will upshift to help restore traction.
Every new Porsche car sold in the United States and Canada is covered by a fouryear/
50,000-mile (80,000 kilometer), bumper-to-bumper limited warranty, which includes Porsche's roadside assistance program. The body and 26-step paint and anti-corrosion process enable Porsche to warrant each car against rust perforation for 10 years and unlimited mileage. In addition, Porsche guarantees the paint finish for three years – also without a mileage limitation.