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THE NEW OPENNESS

Folding technology as graceful spectacle: The innovative panel bow roof of the new 911 Cabriolet achieves a sweeping, coupe-like roofline.

By Peter Weidenhammer

The whole spectacle takes 13 seconds, and can be performed while driving at speeds of up to 50 km/h (31 mph).
To top it all off: there's nothing blowing up or flapping around to disturb the placid scene—the new 911 is perfectly composed.

911 CARRERA CABRIOLET (TYPE 991)
Engine: Six-cylinder boxer
Displacement: 3,436 cc
Power: 350 hp (257 kW)
Maximum torque: 390 Nm at 5,600 rpm
0–100 km/h: 5.0 (4.8*) sec.
Top track speed: 286 (284*) km/h (178/176* mph)
CO_2 emissions: 217 (198*) g/km
Fuel consumption
City: 13.1 (11.4*) l/100 km
Highway: 7.0 (6.7*) l/100 km
Combined: 9.2 (8.4*) l/100 km
** with Porsche double-clutch transmission (PDK)*

THE WIND DEFLECTOR IS NOW INTEGRATED IN THE REAR COMPARTMENT AND CAN BE RAISED AT THE PUSH OF A BUTTON.

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"Grace is a kind of movable beauty." Friedrich Schiller and a convertible roof; why not? Technology can be graceful too. And beautiful. And fascinating. Like the roof of the new 911, pure aesthetics. The words of the poet are perfectly apt.

The 911 Carrera Coupé, the icon of sports-car design, is the benchmark. With nearly identical lines, the closed fabric roof elegantly spans the arc between the windshield frame and the soft-top compartment lid. No bows are visible beneath the fabric, nor are there sections to disturb the flowing design. Thanks to a new technique, even the rear window with defroster sits practically flush with the surface, integrated into the structure with just a minimal joint. "Our goal," says Dr. Heinz Soja, one of the fathers of the new roof, "was to combine the silhouette of the Coupé with the classic Cabriolet roof."

At the push of the "open" button, beauty begins to move with grace. The front section rises vertically above the heads of the passengers, describes a parabola back toward the rear, and sets down atop the rest of the roof before landing softly in the roof compartment and half disappearing beneath the cover. Coming back in the other direction, gracefulness is again matched by maximum precision. Over a length of 1.7 meters (5.6 feet), the unfolding roof fans out toward the windshield and yet finds the vanishingly narrow slot in the windshield frame in a precise docking maneuver with the centering pins. The whole spectacle takes just 13 seconds, and can be performed while driving at speeds of up to 50 km/h (31 mph). To top it all off: there's nothing blowing up or flapping around to disturb the placid scene—the new 911 is perfectly composed. Beauty and grace bear witness to a completely new roof design. Porsche has invented the panel bow roof.

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Bows are the horizontal ribs that provide stability and support the exterior skin of the roof in any convertible roof construction. A "panel bow," explains Detlev Ranft, team leader for roof systems for the 991 Cabriolet, "is essentially nothing more than a widened bow." The innovative technology makes it possible to achieve a previously unattainable coupe-like curvature of the closed fabric roof—a feat of ingenuity that yields aerodynamic benefits as well. The entire soft top—apart from the side sections—spans a rigid roof surface composed of four sections that abut each other seamlessly. The four elements are the front roof frame, two panel bows, and the rear window.

The panel bows and the fabric of the roof connect only insofar as the four segments fold flush over one another in the proven Z-folding mechanism when the roof is opening. This unique design means that the opened roof package consisting of the roof fabric, frame, panel bows, and rear window, at just 23 centimeters (9 inches) high and 55 centimeters (21.6 inches) wide, has minimal space requirements. While the front section of the roof remains visible in the open position, the sickle-shaped soft-top compartment lid covers the rear portion just as before. Unlike its predecessor, the lid now stretches down to the spoiler. This obviates the need for a body joint from the rear lid, giving the rear an even more elegant appearance.

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With the exception of the glass window, all form-defining segments are made of the lightest metal used in production automobiles—magnesium. A majority of the frame guide rods are made of magnesium as well. Only the side guides, the actuator, and the rear bow are made of aluminum. "One of our premises in developing the new roof of our sports car was to achieve the greatest possible weight reduction while optimizing the functionality," says Dr. Heinz Soja. A heavy roof raises the center of gravity of the whole car—deadly for the driving dynamics of a sports car. Despite the increased length and significantly improved comfort, the new roof tips the scales at a weight comparable to its predecessor. "That's another reason we only considered a soft top rather than a hard top." And because Porsche customers want to have an open-top sports car that looks like a convertible when it's closed, too.

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With the solid top above their heads, driver and passengers enjoy levels of climate and noise control that come closer to those of the Coupé than ever before. The entire surface of the exterior fabric is lined with an insulating mat, while in the interior the roof segments are covered with rigid roof panels that lend the cockpit an enveloping interior feel. The side sections are also completely covered with fabric, so that no technical components are visible when the roof is closed. Headroom is also roughly equivalent to that of the Coupé.

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The real marvel of the panel bow roof becomes visible only during the opening ceremony—the kinematics. And yet it does not even appear very complicated; after all, it makes do with fewer parts than some conventional roofs. "Simple, robust, and light—that's the great challenge," says Ranft. Designing every part to move in perfect unison with the entire system, following the desired trajectory without being thrown off track by longitudinal or lateral forces, pushed engineers to the very limits of their innovative capabilities. "Roofs are one of Porsche's core competencies. Roof designs are hammered out here in our development facilities before being refined for series production together with a system development partner," says Dr. Heinz Soja.

All elements of the skeleton are connected kinematically in a manner similar to the inner workings of a watch: just as a precision mechanical timepiece has only one spring, the new panel bow roof has just one motor on each side for the entire motion. This feat, too, is anything but commonplace: it derives from intelligent Porsche lightweight design. Some 140 bar of nominal pressure generated by an electrical pump is enough to drive the two hydraulic cylinders. When fixing the roof to the front windshield frame, Porsche opted for an enhanced version of the proven electronic central closure mechanism supported by centering pins.

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The kinematics can be calculated—the fabric is a bit more problematic. "Predicting exactly how the fabric is going to fold is a very inexact science—we have to test our predictions on actual constructions," says Ranft. The skillful handiwork of experienced saddlers was indispensable to the engineers in developing the groundbreaking roof. Through a series of prototypes and countless hours of painstaking labor, a network of strips and guide strings emerged which direct the roof fabric and the side sections of the interior ceiling through every phase of the motion. ■