

TAG HEUER

TAG HEUER Pendulum Concept - The first-ever mechanical movement

Tag Heuer Pendulum Concept : A radical “out of the box” rethink of mechanical time regulation design and performance

TAG HEUER PENDULUM CONCEPT: A RADICAL “OUT OF THE BOX” RETHINK OF MECHANICAL TIME REGULATION DESIGN AND PERFORMANCE.

Since the creation of the Galileo-inspired hairspring by Christiaan Huygens in 1675, the regulating organ of all mechanical watches has been based on a balance wheel and spiral-shaped torsion hairspring system. A coiled strip of fine metal alloy, the hairspring provides the torque necessary for the balance wheel to oscillate and regulate its frequency. Over the centuries, it has been significantly modified and improved. Charles-Edouard Guillaume (1861-1938), the son of a Swiss watchmaker, discovered new alloys (Invar and Elinvar) that significantly reduced the metal spring's thermal sensitivity. Guillaume won the Nobel Prize for Physics for this invention in 1920.

With the challenge of temperature diminished by Guillaume's alloys, the spiral hairspring regulation system came to dominate mechanical movement design. However, the mechanical hairspring has three serious design limitations: a mass that makes it sensitive to gravity and deforms its geometry; a material that makes it sensitive to thermal expansion; and a divergence between its geometric centre and its centre of mass. These may cause isochronal issues that can be technically and physically improved but never completely eliminated.

Overcoming the design limitations inherent in the traditional regulation system by eliminating the need for a spiral hairspring was the first challenge TAG Heuer set for itself. The second was keeping the movement 100% mechanical: conventional watchmaking wisdom has always held that a mechanical watch without spiral hairspring would necessarily require another energy source for its regulation.

In the TAG Heuer Pendulum Concept, the traditional hairspring is replaced by an “invisible” or virtual spring derived from magnets. The complete device forms a harmonic oscillator. The magnetic field, generated by means of 4 high-performance magnets and controlled in 3D through complex geometric calculations, provides the linear restoring torque necessary for the alternative oscillations of the balance wheel. The oscillating period of the TAG Heuer Pendulum Concept is resistant to changes from perturbing forces, which is what makes it an exceptionally good timekeeping device. The movement built with this revolutionary oscillator is fully mechanical and does not contain any electronics or driven actuators. The magnets generate a constant field over decades.

TAG Heuer Pendulum Concept, the world's first oscillator in a mechanical movement without hairspring, beats at 43,200/hour (6 Hertz) — making it a superlative representative of TAG Heuer's unique mastery of high frequencies and ultimate precision. It requires no additional components and is based on physical magnetic properties. It gets its name from an earlier Huygens creation — the pendulum clock of 1657.

TAG HEUER PENDULUM CONCEPT: A POTENT NEW TECHNICAL MILESTONE IN MECHANICAL MOVEMENTS

The TAG Heuer Pendulum Concept not only overturns 3 centuries of conventional watchmaking tradition, it also represents in and of itself an enormous technological leap forward. In a classical spiral hairspring system, the effect of gravity due to mass is a dominant issue. With the TAG Heuer Pendulum Concept, the problem no longer even exists. There is no loss of amplitude and the movement's frequency can be modulated on a very large spectrum of frequency without overburdening the power supply. The result is a significant increase in precision (division of time) and performance (frequency accuracy and stability).

The TAG Heuer Pendulum Concept is the first-ever magnetic oscillator without hairspring capable of providing a restoring torque comparable to that of a hairspring: the basic principle of the Swiss anchor escapement is therefore unchanged, but the absence of mass and therefore inertia allows for much larger frequencies. Theoretical precision is significantly higher as it is possible to oscillate at small angles (the elementary principle of oscillator accuracy) without altering the return torque and, especially important, without causing geometric deformations.

TAG HEUER PENDULUM CONCEPT PROJECT: 5 YEARS OF R&D EFFORT

The TAG Heuer Pendulum Concept project involved in-house TAG Heuer R&D engineers and watchmakers working in an extensive research partnership with microsystems research experts at the Integrated Actuators Laboratory (LAI), part of the Microtechnics Institute of the Swiss Federal Institute of Technology in Lausanne (EPFL).

Starting from scratch has required advanced digital simulation coupled with physical analysis (mechanics, magnetism and thermal behaviour). It took TAG Heuer's R&D team 3 years of intensive digital 3D simulation research to precisely orient the TAG Heuer Pendulum Concept's virtual magnetic spring.

An old adversary still remains: the magnets are sensitive to temperature. The challenge facing TAG Heuer now is to discover the magnetic equivalent of invar-elinvar: to, in a sense, add Charles Edouard Guillaume's accomplishments to those of Christiaan Huygens. Once addressed, the TAG Heuer Pendulum Concept will no longer be a concept but a new milestone in mechanical regulator technology. As with the V4, this may take years, but TAG Heuer is committed to taking on the challenge and pursuing the epic Pendulum adventure.

TAG Heuer does not claim that the Pendulum Concept will take the place of traditional, high-quality Swiss hairsprings in mainstream mechanical movements, but rather offer a “Haute Horlogerie” alternative, which could lead to high-end limited editions in the future, as was the case with the Monaco V4's movement transmission innovations.

TAG HEUER GRAND CARRERA PENDULUM CONCEPT: A BREAKTHROUGH MOVEMENT HOUSED INSIDE A MOTOR SPORTS-INSPIRED ICON OF PREMIUM LUXURY

The Grand CARRERA is the utmost prestigious incarnation of TAG Heuer's unrivalled motor racing heritage and passion for avant-garde design and technology. Launched in 2007 and inspired by modern GT cars, the series was an instant success, widely acclaimed by watch and motor-sports enthusiasts for its effortless, at-a-glance readability and superlative aesthetics.

The design of the TAG Heuer Grand Carrera Pendulum Concept is faithful to the exclusive luxury codes of the GRAND CARRERA: polished and angled edges, curved and faceted horns on both sides of black titanium covered steel case. The special dial aperture at 9 o'clock allows to admire the beating heart of TAG Heuer Pendulum Concept's avant-garde movement.

Inside and out, this is a superlative timepiece, a noble extension of the GRAND CARRERA collection and a worthy showcase of a breakthrough advancement in watchmaking technology.

The TAG Heuer Grand Carrera Pendulum Concept opens a promising new era in watchmaking, with potentially powerful new movements precise to ever-smaller fractions of time. The effect on future watches and chronographs design and function may be huge — and TAG Heuer once again leads the way even though it will take years before it will become a commercial reality. Patents have been filed and are pending.