In-Depth: Quantifying Performance and Trade-Offs in Movement Design

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There are a lot of traditions in the luxury watch industry. From the use of pegwood to polish bevels, to the Roman "IV" rendered as "IIII", the culture of watchmaking is full of interesting customs passed down over generations. But the most fundamental tradition remains the reliance on incremental improvements towards better timekeeping.

"Better" might mean absolute performance measured over a defined period such as an observatory trial (the objective of the superstar *régleurs*), or reliable long-term performance on the wrist. Regardless, for almost four hundred years the quest for better precision was the guiding principle of the trade. To paraphrase from historian David S. Landes' *Revolution in Time*, "… it has always been the rule that the quality of [a watch] is a function of [its] precision."

Today, some 50 years after mechanical timekeepers were left in the dust by their "better" electronic brethren, some makers of mechanical watches are more pious in their observance of this traditional approach to incremental improvement than their competitors. And if we look carefully, we can quantify this difference in approach by looking at how different watchmakers choose to use the available energy within their movements.

Our interest was to find a way to quantify which watchmakers are making high-performance timekeeping choices and examine how measures like COSC might not reflect real on-the-wrist performance.

The Analysis

Starting with publicly available data, we compiled a database of the balance inertia, frequency, amplitude, and power reserve for a sample of 43 watch movements, from the enormous Kerbedanz KRB-08 with its 27 mm central tourbillon cage, to the slender RMXP1 micro-rotor automatic made by Vaucher inside the RM 33, as well as many familiar staples such as the Rolex 3135, Omega 8500, Jaeger-LeCoultre 899, and ETA 2892.

With such tomes as WOSTEP's *The Theory of Horology* as our guide, we calculated the amount of balance power (the amount present in the oscillating balance and a function of its inertia, amplitude, and frequency) and the balance maintaining power (the amount required to maintain the balance oscillation).

The ratio of these is known as 'Q' – essentially the rate of energy loss to friction in the balance system. For instance, a Q of 300 means 1/300th of the balance power is lost in each oscillation; the higher the 'Q' the better. Doing this for our sample allowed us to estimate the power transfer through the going train from the mainspring and better understand the decisions made by the movement designers.

It should also be noted that chronometric performance is dependent on a host of factors beyond the power of the oscillator. Consistency of delivery of the driving force from the mainspring is key, as well as numerous other factors includ-