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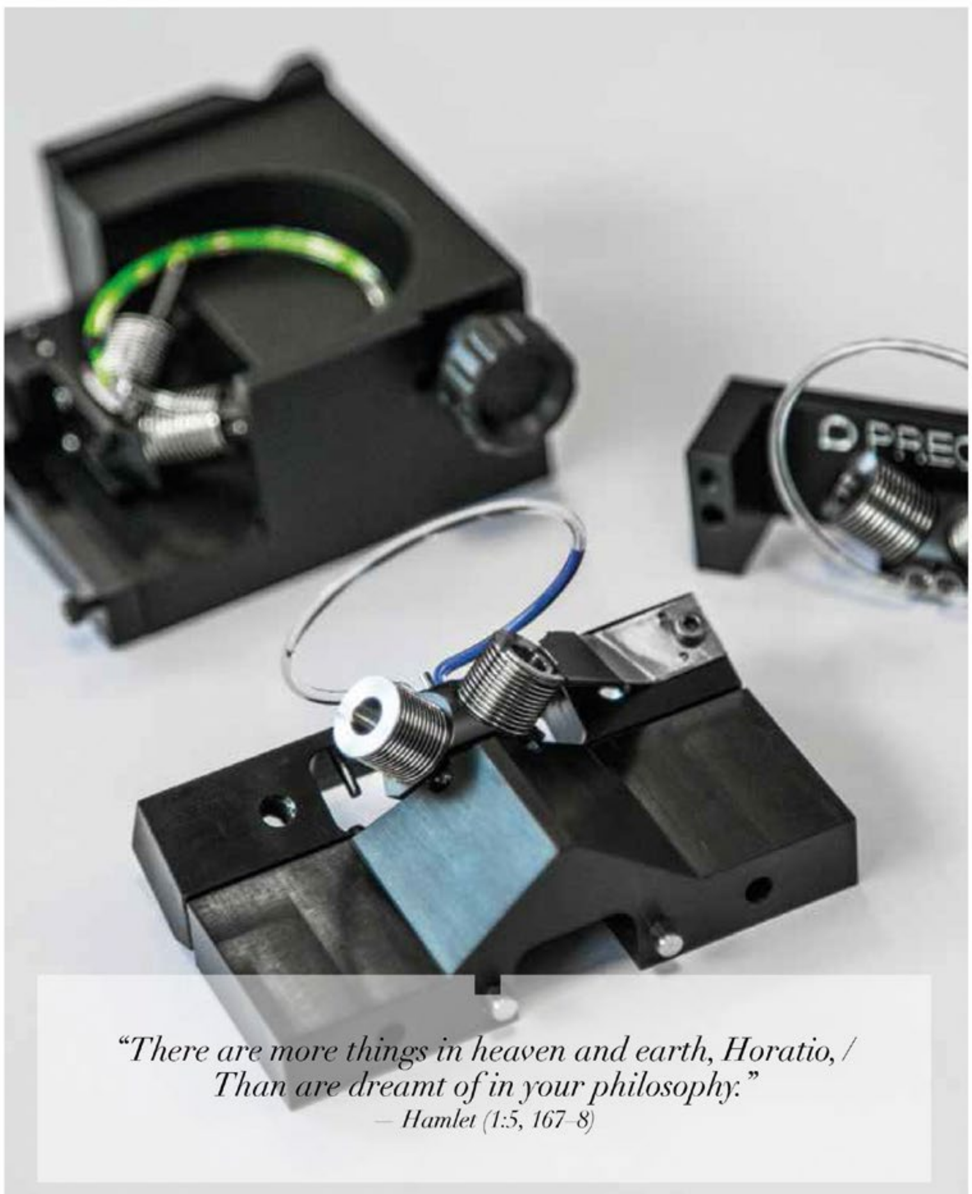
« REVOLUTION »

FLUID DYNAMIC

As stunning as they are, the watches produced by HYT are only the tip of the company's technical iceberg.

by **suzanne wong**



"There are more things in heaven and earth, Horatio, / Than are dreamt of in your philosophy."
— Hamlet (1:5, 167–8)

What does it take to create a new watch brand? Not much, in some instances. Have a look around the market to see what sells, get some design sketches together, score a couple of good suppliers, and you're in business. There'll always be room for such brands, but to be honest they're not really the sort of thing that excites us, and we're guessing that they don't particularly excite you either. Thankfully, there is the other type of watch brand — the kind that actually tries to bring us something new.

One of the biggest triumphs this year at Baselworld watch fair was the much-anticipated H3 of HYT — the hydro-mechanical horologists who brought us the genre-defying H1 and H2. The main difference in features between the H3 and its predecessors relates to its linear, rather than circular, display. To many observers, the linear display and the H3's massive oblong case are the most obvious markers of its identity and must therefore be the most important features of the watch.

The truth is, there is something revolutionary buried in the inner workings of the H3, something that evokes the theories of history's greatest physicists, something linked to a natural law that underpins the most fundamental systems of the universe.

Instead of sending its fluid column around the periphery of the dial, as the H1 and H2 did, the H3 takes it across the breadth of its imposing case. As broad as the case is, you'd be hard-pressed to read the time on it if it had to be split into 12 hour divisions (not to mention 24 of them, as the H3 eventually ended up with). The H3 therefore incorporates a rotating line of six hour blocks that flip over with each retrograde motion of the fluid column.

The conventional method of effecting such an action would be to use a sprung snail cam that rotates once every six hours to drive the change of the hour blocks. This has the disadvantage of drawing off energy from the mainspring that would otherwise be directed toward the balance. It would also decrease the power reserve of the watch. Instead of this method, the H3 harnesses the substantial force generated by the retrograde motion of the fluid column to flip the hour cubes over, in a solution that is simultaneously elegant, simple and efficient.

So much of the sum-total effort expended in watchmaking is dedicated to the business of energy management. It's the reason that long and high-torque power reserves with consistent release are so highly desired — with such an energy source, your canvas for horological innovation and experimentation is instantly expanded on an exponential scale.

The law of the conservation of energy is what lies behind the first law of thermodynamics; it also supports quantum theory and Einstein's special theory of relativity. At its most basic level, the law states that energy cannot be created or destroyed, only transferred from one form to another. By taking the energy of the retrograde fluid column — which would otherwise be dispersed beyond the system of the watch — and putting it to secondary use, HYT and their movement partner APRP are engaging in higher-level energy management, resulting in a mechanically optimized creature that gives a whole new meaning to the term "smart watch".

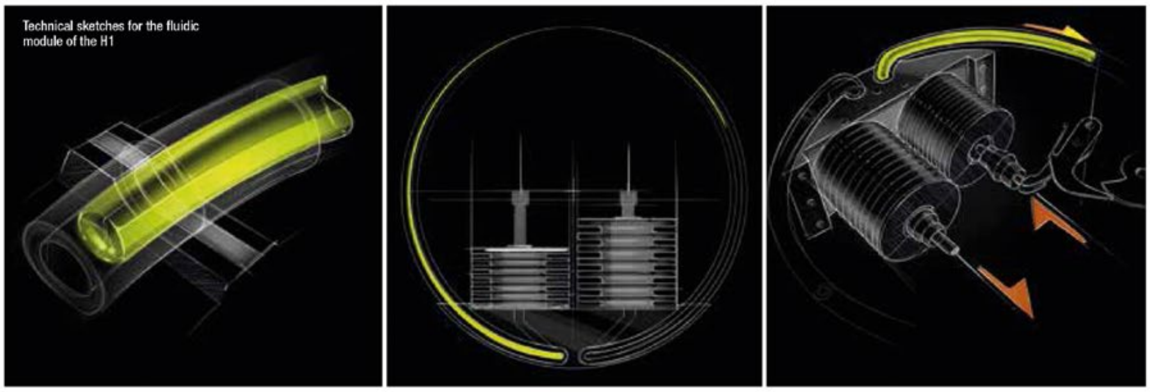
Origin of Species

It was 2012 when HYT burst onto the scene, bringing with them an unheard-of technology in the context of watchmaking: fluid displays. When you, as a longtime initiate of watchmaking concepts and knowledge, think of liquids and watch movements in the same context, something just doesn't sit quite right. Haven't you — haven't we all! — been taught to regard liquids and their concomitant threat of corrosion as the ultimate downfall of micromechanics? By integrating a capillary tube of liquid as a key time-telling extension of the movement, HYT have not just thrown open the doors on a vast new landscape of horological expression, but they have forced us to confront and overturn our most fundamental assumptions about watchmaking.

The essential workings of a HYT hydromechanical watch sound pretty straightforward when you first hear about them. A column of colored liquid, counterbalanced by a column of colorless liquid, moves along a loop of glass tubing at a constant speed, taking 12 hours to travel from one end to another. The position of the inter-liquid meniscus indicates the hour, and a secondary scale indicates the minutes via a more conventional system of gears. The position of the meniscus is controlled by a complementary system of bellows and pistons positioned at each end of the capillary tube, and the bellows and pistons are themselves calibrated according to a snail cam that rotates once every 12 hours. The highest point of the snail cam takes the meniscus to the furthest point on its clockwise journey around the dial, and the interaction of the lowest point of the snail cam with the system of bellows and pistons actuates the retrograde motion of the liquid, resetting its 12-hour progression.

This is the theory behind the HYT liquid display — a child could grasp its basic principles. In practice (the tyrannies of the imperfect physical world!), however, there is a legion of complications that can trip up the successful implementation of this idea. The majority of these are concerned with the fluidic module that indicates the hours, and HYT's technical partner in the creation of these modules, Preciflex, were challenged to their limits in coming up with suitable solutions. Just a small sampling of the issues that had to be resolved even before the very first HYT timepiece was created: the right liquid had to be found for the fluidic module — at the right viscosity to easily flow through the capillary tube, with a low thermal expansion coefficient to minimize the need for temperature compensation, able to take dye to suit different HYT models with different color palettes, non-corrosive to minimize damage to the movement in case of accidental breakage, with a refractive index that will facilitate the

Clockwise from top left:
CEO of HYT Vincent Perriard with the stunning new H3 on his wrist; the liquid used in the fluidic modules of the HYT timepieces relies on a very specific chemical formulation; the H3 in PVD-coated titanium and platinum; filling the capillary tube with liquid is an extremely delicate process; the H1 Cigar with a case made of tobacco-imbued resin; the H1 Blue 2.


Technical sketches for the fluidic module of the H1

The H3 is a mechanically optimized creature that gives a whole new meaning to the term "smart watch"

reading of the time. This set of criteria has to be fulfilled not once, but twice, since there are two different liquids in each column, both transparent, with one being dyed to aid time telling. Also, the liquids have to be immiscible, in order to maintain the liquid meniscus that allows the fluid column to act as a moving indicator.

The dye used in the fluidic module also can't just be any old coloring agent. Most dyes tend to fade with exposure to ultraviolet radiation. Now, this is desirable in that vintage Rolex Sub with tropical dial that you're trying to flog on the forums, but less so with an avant-garde, aesthetically aggressive ultra-modern timepiece which relies on a column of colored liquid to perform its most basic function. For this, Preciflex turned to a type of dye used in the medical industry for contrast imaging, which is stable and does not degrade under exposure to sources of ultraviolet radiation such as sunlight. Finding a UV-resistant dye that has adequate hue saturation was also problematic. The red liquid column used in models such as the H1 Red 2 and the H2 Platinum Red, for example, went through several incarnations before the shade of red was deemed to be good enough for production.

Another big hurdle for HYT and Preciflex to overcome was the glass capillary tube that holds the liquid. The tube itself is high-grade borosilicate glass, which is frequently used in laboratories and kitchens due to its resistance to thermal shock — it is also known under the trade name of Pyrex. The initial tests for drawing the two-liquid column through the tube yielded discouraging results — the liquid didn't move cleanly through the capillary tube but instead left traces on the inner surface. Minute droplets of colored liquid could therefore be seen through the column of transparent fluid, and the column of colored liquid looked uneven due to trapped pockets of transparent fluid. This was happening because the inner surface of the glass tube had microscopic inclusions or irregularities that created friction and provided nucleation points for the liquids, made visible as the meniscus moved. A thin hygrophobic coating was therefore formulated for the inner surface of the tube, which would repel the liquid on a molecular level. This drastically reduced the friction and surface tension between the tube and the liquid, preventing the separation issue.

Turn Up the Heat

Lastly, the thermal-compensation aspect of using a narrow fluid column to indicate the time had to be dealt with. The expansion of a fluid in reaction to a change in temperature is useful in many situations — the medical thermometer is based on this very concept. It is decidedly not useful when you're using it to show the time. You can't have your watch suddenly leap backwards or forwards whenever you step outdoors. Admittedly, it may feel like time is moving glacially when you leave the temperature-controlled comfort of your home and step out into a blizzard, but this is an emotional fallacy and perhaps ought not to be reflected by your watch.

The thermal compensator built into the HYT fluidic module is a miracle of modern micromechanics and involves a third set of bellows, absolutely tiny in size, that is embedded into one of the fluid reservoirs (there is one reservoir at each end of the tube, each holding a different liquid). This third set of bellows is filled with a third type of fluid that expands and contracts with changes in temperature, changing the effective volume of the fluid reservoir. This system is calibrated to compensate, with great precision, for the expansion and contraction of the liquid in the tube. It's an incredible engineering development and not without significance in terms of how the watch performs. Without the thermal compensator, each increase in temperature of 1° Celsius would result in the gain of 2.7 minutes in terms of the fluidic display. Of course, you'd refer to the minute hand for absolute precision, but the incorporation of the thermal-compensation system is reassuring on a symbolic level — it is a sign of the perfectionism and refusal to compromise that permeate each and every HYT watch.

As we now know, getting those elements sorted out — the liquid, the dye, the coating and the thermal compensator — was the hard part. Rather unsurprisingly, all the equipment used by Preciflex to assemble the fluidic module is custom-built to their specifications. It ought to be abundantly clear by now that the watches of HYT, as visually exciting as they are, are only the beginning of what we can expect from the brand and its partners. ★