OFFICIAL JOURNAL OF THE BRITISH HOROLOGICAL INSTITUTE

The Horological Journal

JANUARY 2020
www.bhi.co.uk

Behind the Scenes at Nomos

A Factory Visit by the HJ

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My first visit to Nomos was in the summer of 2006, when it was collaborating with Wempe to produce high-grade chronometer movements for the old established German jewellers. Back then, Nomos was entirely housed in the old Glashütte town railway station.* It still operates out of this building, but with its hugely expanded production capability the site now serves as offices, while the technical and design arms of the firm are in dedicated facilities elsewhere. Nomos is Germany's largest manufacturer by volume of mechanical watches. Prices range from £1,060 to £15,800 although the bulk of the collection is priced at £2,000–£3,000.

Aside from its buildings and facilities are the company's attitude and values, and the only true witnesses to that are its people. Since the time of that first visit, I have had many interactions with the staff from Nomos, and have been impressed by the long tenure of its employees: they must enjoy working there. Year in, year out, the same friendly and genuinely enthusiastic faces welcome us as old friends. There are none of the over-polished airs and graces about them that are so common in this industry. At Baselworld, one young chap called Merlin greeted us every year to take our coats and give us cloakroom tickets. I didn't realise until recently that he is the son of one of the founders, and presently vice-president of Nomos in North America.

When we visited this summer, our first stop was with Sarah Mie Nass, head of International Public Relations and Christiane Schönthier at their newest site, the *Fertigung*, or machine-production facility, in the neighbouring village of Schlottwitz, **Figure 1**. All watch manufacturers that produce large series in-house now are replete with every type of digitally-controlled machine, including sliding-head lathes with automatic bar feed, multi-axis precision milling machines and wire-erosion electro-discharge machining (EDM) cutters. The experienced production engineers at Nomos aim to have these machines running at capacity as much as possible, and typically the only thing a visitor can see through the machines' glazed cabinets is a flood of coolant while the cutters do their work. This is punctuated by the periodic clink as a new watch part drops along a chute into a waiting basket.

Don't get me wrong: although these parts are made by highly automated processes to an extremely high specification, they in no way resemble what ends up in the finished watch.

Figure 1. The Nomos machine-production facility is in the neighbouring village of Schlottwitz.

Figures 2A and B. Cupro-nickel balances, fresh off the sliding-head lathe.

Scores of further technical and finishing processes are needed to transform these 'grey' blanks into the jewel-like parts that bespeak traditional horology.

In the turning department, stocks of high quality European brasses steels and bronzes are kept on hand. The banks of bar-fed sliding-head lathes are extremely versatile and can produce an amazing range of geometries. The three-armed CuNi-alloy balances for the Nomos swing system escapement come straight off the machine with the rims chamfered and spot-drilled for later drilling or fine poising, **Figures 2A and B**.

The teeth on many wheels are cut on a hobbing machine. This can be done most efficiently by stacking a number of wheel blanks and then hobbing them together, but it can also be done on single wheels, as is the case with one type of upper crown wheel, where the toothed part is on a different plane from the boss, meaning that they can't be stacked – the step would create gaps that would lead to vibrations and burrs, **Figures 3A and B**.

* This hilly town in Saxony is fewer than 20 km from the Czech border. I have noticed that people often mispronounce it. Being a compound word, there is a break between the *s* and the *h*, they are pronounced separately, not together 'sh'. The correct way to say it is something like a clipped Yorkshire 'glass' followed by 'hooter'. Glass-hooter, not glar-shoot.

Figures 3A and B. In the 'Gearing' department, these steel blanks will become ratchet wheels. Due to the boss on their underside, these cannot be stacked and must be hobbed one at a time. The wishbone delivers jets of cutting fluid, whilst a pointed cutter in the foreground slices burrs off the work.

Instead, each of these wheels is given its own sacrificial backing piece, and together this pair is cut as one.

(I am often amused by direct translations into English; the name of this department is *Verzahnen*, which is 'gearing' in German, but directly translated it means something like 'betoothing', an expression I might very well adopt!

No CNC facility is possible without an associated toolmaker's workshop, where all the supporting devices, fixtures and tooling are made.

Stepping out of the *Fertigung* presents a marked change of air, from the compelling smell of cutting oil to that distinct cleanness that comes from proximity to mountains. A short drive along the riverside road takes us into Glashütte and then either a very stiff walk or a short drive up the hill to the *Chronometrie*, **Figure 4**. Determined to dignify the occasion by not being under-dressed even in one of the hottest European summers for decades, we were in jackets and ties, so for us there was only one way up that road! From the summit, the views are supremely rewarding. Glashütte is evocative and beautiful in the summer as it must be in the crisp snows of winter.

Here at the *Chronometrie*, the watch parts are transformed from their off-the-machine appearance to a fine finish acceptable for the wrist. Of the 600 or so hands that make Nomos 'Nomos', most are occupied at this hilltop location.

The steps needed to turn the machined parts into a finished watch seem almost innumerable. A critical process is that of organising and arranging components in such a way that the watch or sub-assembly can be put together quickly and efficiently. For example, when placing and pressing jewels into holes, the semi-automated process needs the supply of jewels to all be facing the same way. Jewels are placed in position by an operator who lays them in neat rows on dedicated pallets, **Figure 5**.

For headed parts like studs and screws, they are oriented head-up in grooved pallets in a vibratory process, **Figure 6**.

The automated fitting of jewel holes is supervised by an operator. A computerised vacuum head places the stones loosely in position, followed by driving in with servo-press calibrated for force and depth of insertion. Using this method, the lateral positioning of the stones is held to within 2μ of nominal which, with the tolerance of the jewels themselves, gives an overall tolerance of 4μ of the position of the pivot hole.

Even lubrication is systematised – micro-dosing equipment

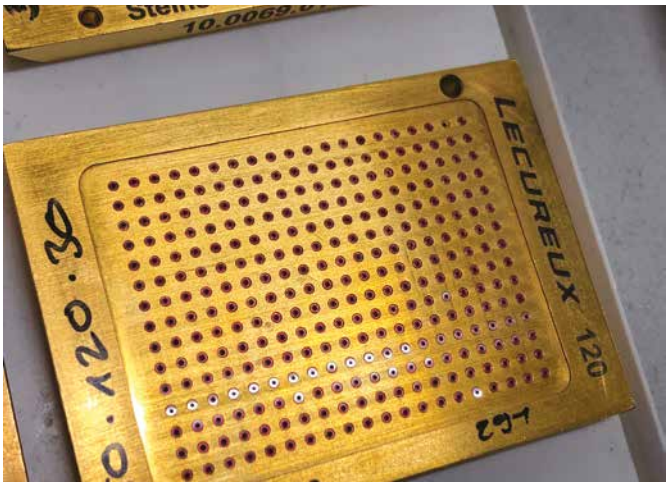
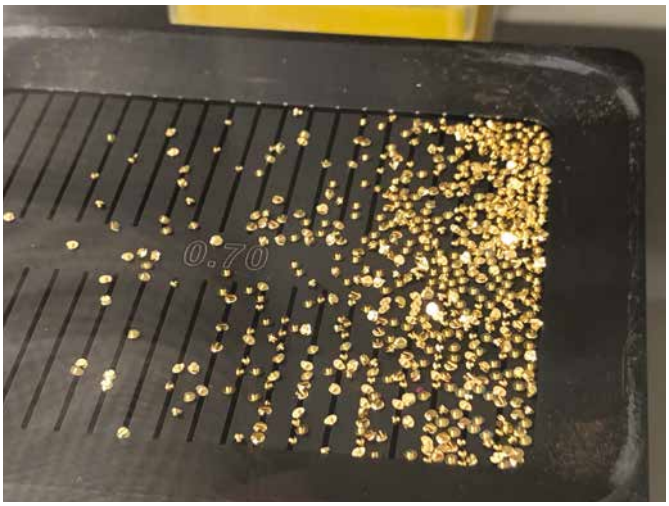


Figure 5. Jewels are placed into pallets so that automated jewel presses can repeatedly and predictably access them.



Figures 6. Some parts are first automatically oriented head-up so that they may be easily accessed by operator or machine.

delivers exactly the same amount of grease or oil every time the device is activated, **Figures 7A and B**. After lubrication, the watches are left running for periods first of 14 hours, then three days and five days in succession, with interim timekeeping tests being conducted between each period. This

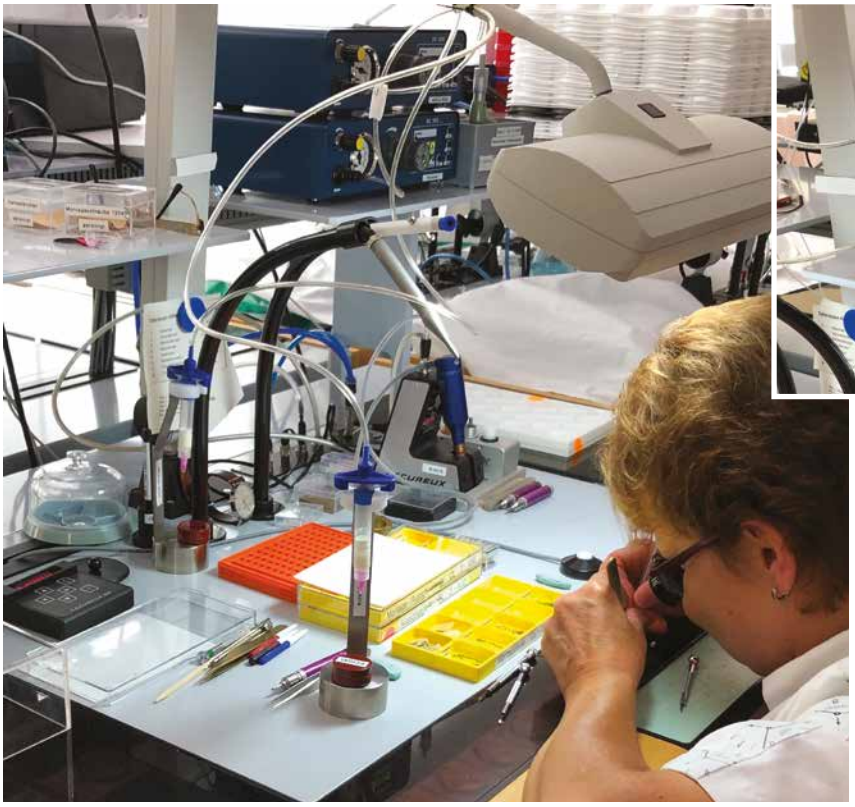


Figure 7B.

Figures 7A. At this assembly station, the lady is surrounded by aids to her work. Micro-dose dispensers ensure predictable and clean oiling. Automatic pneumatic screwdrivers start rotating when they are pressed down.

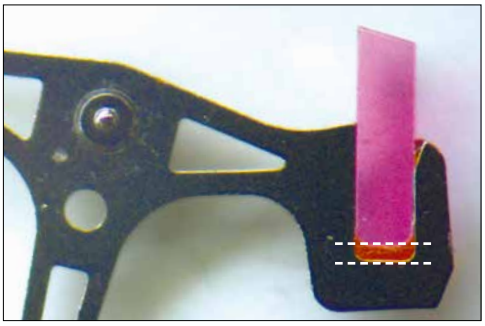


Figure 8. This gap is gauged as large, medium or small, and pallets with a suitable gap are chosen when controlling the amplitude of a new watch.

'running in' is largely to allow the grease to properly disperse over the mainspring.

Leading up to the regulation in six positions, fine adjustments are carried out. An example is dynamic poising, where shavings are removed with the balance in situ, and it is here where the dimples machined into the balance rims come into their own.

In a very specialised department they carry out the fine pre-assembly and adjustment to the swing system escapement. We watched in fascination as a lady shellacked the stones into new pallets. First a series of 20 pallets with stones are mounted on a brass pallet-warming tray. Pins in the tray jig the pallets so that they are all held firmly in the same orientation. A piece of shellac is warmed and drawn out into a long thread. This is then chipped with a watchmaker's screwdriver into even-length pieces about a millimetre long. The chips are placed on the stones, and the whole is warmed on a classical pallet heater. The lady told us that she swaps jobs with colleagues, because doing only this would drive her crazy! Considering that Nomos have produced many tens of thousands of swing system escapements, I did get to wonder if *all* the pallets are prepared in that one room, 20 at a time?

This pallet-setting process for the swing escapement is designed to have some variation. Nomos fits stones into the pallet bodies at three different depths, which are called large, medium and small. Large has the deepest engagement with the escape wheel (i.e. the stones protrude more) and therefore the deepest locking, **Figure 8**.

This becomes critical in the assembly of manual-wind versus automatic watches. The escapement, which has a 52° lift angle, is set to peak at 320° amplitude for manual-wind watches, but only at 310° for automatic. This is to accommodate possible variation in the degree of slip in the mainspring and the attendant risk of banking. Rather than adjusting each set of pallets on a watch-by-watch basis, they fit the watch with a suitable set from the range of three sizes, and this governs the amplitude to within a few degrees. Automatic watches are typically fitted with 'large' category pallets, whilst they aim to fit the medium pallets to the majority of their watches.

One can still buy Nomos watches with the classical Nivarox escapement; all the models with their calibre 'alpha' are fitted with Nivarox escapements, of which they bought large supplies in the early days.

In the same department, a chap peering through a microscope was truing balance springs in the round and in the flat. Centring at the collet is critical, and when properly done, the coils all appear to scroll outwards in a continuous, gliding motion when the holding arbor is spun.

One way to optimise the adjustment process of new escapements is to ensure that balances and springs are closely matched to each other before adjustment begins. For example, minute differences in manufacturing can have a big effect on the moment of inertia of a balance. If a balance whose mass is at one extreme of the tolerance range were fitted with a 'standard' spring, it will take a lot more work than normal to bring such a watch to time. This presupposes that a 'standard' spring exists, because the springs will experience similar variation in manufacture.

The industry has therefore developed a grading process, where loose balances are tested for their moments of inertia and springs for their elastic characteristics. Each of these is then classified within a number of groups. Springs and balances that fall into corresponding groups are then married to each other and require the least amount of tweaking

to oscillate at the theoretical rate. This work requires sophisticated equipment, the Greiner Class-O-Matic being the gold standard, as used by Nomos. The equipment is so sensitive that it can detect opening and closing drawers in the neighbouring area, so they operate it only in strictly controlled conditions.

Producing a new escapement is not for the timorous. Nomos began work on developing the escapement in 2007; by 2009 it had begun collaboration with the Institute of Machine Elements and Machine Design at the Technical University of Dresden. This collaboration, funded in part by the *Sächsische Aufbaubank* and the EU's European Regional Development Fund, led to the development not only of the swing system escapement but also to a new wheel tooth profile for the going train of their DUW calibres (DUW stands for *Deutsche Uhrenwerke*, and is applied to all calibres with the swing escapement and also the calibres 1001 and 2002, introduced in 2013 pre-swing). Most parts of the escapement are made under Nomos's own roof, including the escape wheel and balance. The jewels are ground and supplied by specialists to the company's specific pattern. Upon completion of the escapement's development, it was secretly included in some 10,000 watches in the years leading up to its official press launch in 2014 in the Metro model.

Why would Nomos expose itself to the expense and risks of making its own escapement? Of course, the cachet of being one of the few companies in the world to do so is hugely valuable. By association, the town of Glashütte also benefits, being perhaps the only place in Europe outside Switzerland where this is done at this scale. Does Nomos plan to sell the escapement? The company told us that whilst it has the capacity to do so, this is not its intention.

Beyond philosophical considerations, having its own escapement gives Nomos an edge at a technical level. Bought escapements from the likes of Nivarox are fixed with respect to the pinning points of the balance spring collet and the stud, and need to be oriented in the watch in a prescribed way if the system isn't to suffer from suffer from 'hard-wired' errors from the orientation of an escapement, such as the Caspari and Grossman effects. By developing an escapement afresh, they can orient it as they please in their movements.

Technology is at the heart of the entire design process, from the early concept stages of a new watch to the details of escapement optimisation. For example, when the model Ahoi was commissioned, **Figure 9**, the classical Nomos case style needed a full technical review due to the model's 20-atmosphere water-resistance. Starting with sketches, senior product designer Thomas Höhnel (a graduate of Berlin's University of the Arts and Central Saint Martins in London) studied his ideas using iterative steps with rapid prototyping first in plastics and then ceramic, **Figure 10**. Once a degree of confidence has been attained that the design is commensurate with what is technically possible, a metal prototype is produced. From plastic model to metal prototype typically takes 6–8 weeks. This might be repeated a number of times, before the production engineers can even think of assuming responsibility.

If it's a new calibre that's being designed, the process is, of course, even longer. Now that there is a track record of in-house calibre production, some of the steps may need less attention. For example, wheel trains, tooth forms and calendar work are all resolved; calibres now take about two years to develop, although some of the more complex automatics have

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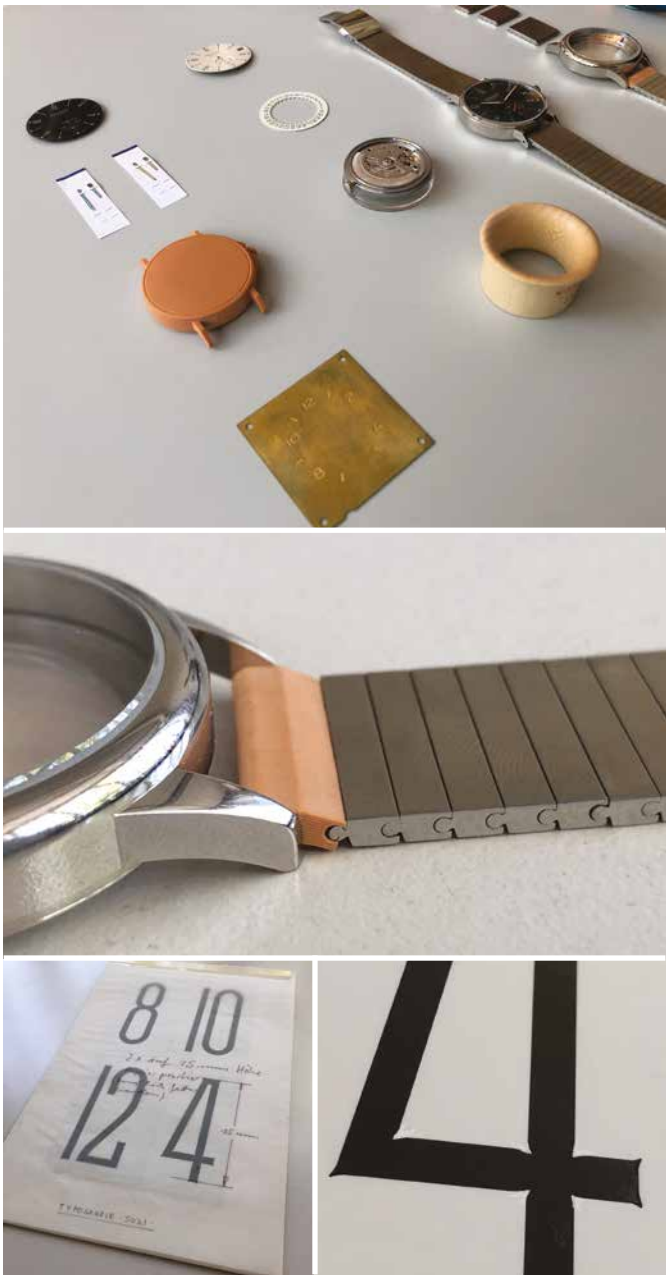
Figures 9. The Nomos Ahoi demanded additional design attention, because although it has the typical lean Nomos appearance, it is pressure-resistant to 20 ata.



Figures 10. Every detail is considered at the design stage, including microscopic typeface adjustments. Rapid prototyping sits side-by-side with industrial machining.

taken as many as five. Digital modelling of the escapement is performed using Finite Element Method CAD software, which is sophisticated enough to simulate the effects of different types of oil on the escapement. Another detail currently being studied is pallet bodies with different degrees of elasticity and how that affects escapement impulse, **Figure 11**.

Indeed, having experienced the earnestness and positive intensity of this relatively young company, I was forced to wonder not *how* it all started, but *why?* What compelled a man to rush to the distant reaches of a post-Cold-War Germany and set up an industry in a highly specialised field in which he had absolutely no background?

It seems there is no plain answer; obsessions grab us and hold us without needing reasons. By his own account, we can at least identify a few of the stepping stones that led founder Roland Schwertner, now 66, down this path. His first exposure to the watch industry was while working as a photographer and IT consultant in the 1980s; one of his clients was a Dusseldorf-based watchmaking company. Schwertner knew the region around Glashütte from visiting relatives there. He visited the town in 1990, two months after the fall of the Berlin Wall. No doubt energised by what was happening in Europe, he says that he was inspired by the potential he saw. Collaborating with a graphic designer and a watchmaker, Nomos was founded within a year. The first four models they introduced are still in production today: Tangente, Orion, Ludwig, and Tetra. Indeed, no Nomos models have yet been retired.

Then again, why would they be? Nomos watches are instantly recognisable, yet with enough variation in style to suit many tastes. The watches and the people making them have attained that rare balance of being technical whilst eminently approachable, you might as easily say fun. Looking at its history and working practices, it becomes clear why Nomos has lasted for 30 successful years, and why it looks set to run for many more.

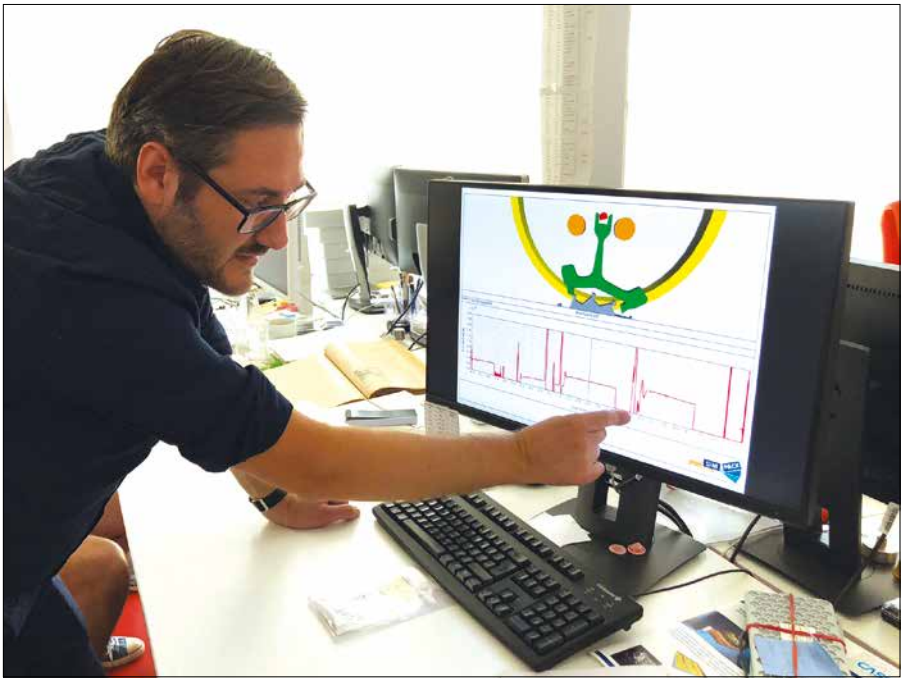


Figure 11. Theodor Prenzel discusses how finite element analysis helps Nomos refine subtleties like escapement lever geometry.

Figure 12. It seems that watchmaking has to compete with football for the hearts of the local fellows.

***A full tear-down of the Tangente Neomatik 41 has been written and will appear in a future edition of the* HJ.**