

Navigational timepieces of the Luftwaffe

War requires much from man and machine. In this series, Dr Konrad Knirim considers the hierarchy of these critical navigational tools

The purpose of this article is to summarise the details already known, and to provide information from newly found documents. The timepieces are only shown as examples, without details of the movements or caseback marks. The huge variety is shown in detail in my book *'Military Timepieces'* with its thousands of pictures, and I do not want to compete with that here. Here, like so often in a technical history, maybe 20% of the models represent 80% of the items used.

Another reason for this article is that I have in my possession the *Luftwaffe* (Air Force) service manual *Luft 1255/2d*, which describes the use of these timepieces for aerial navigation.

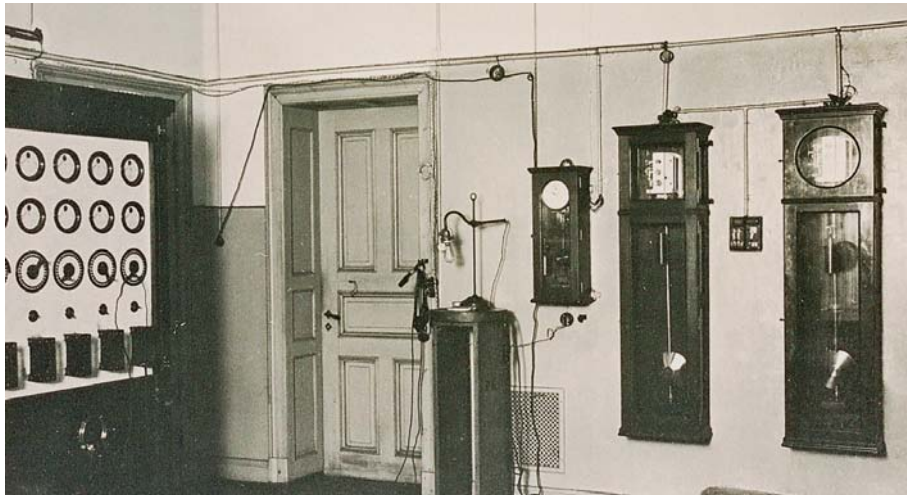
Briefly, the time was communicated from a precision pendulum clock at the *Deutsche Seewarte* (German Naval Observatory) in Hamburg by radio from the time signal station in Nauen to the *Luftwaffe* chronometer in the flight preparation room on the airfield. From the chronometer, the time indication was transferred to the aerial navigation watches, *B-Uhren* (Navigators' watches) and from there to the wrist watches of the flying personnel, as well by 'transport watch' to the clocks on the instrument panels of the aircraft.

Basics of Aerial Navigation

As was the case during the golden years of seafaring, when solving the



High Command. Regulators such as this one by Riefler, no. 368, defined the standard time, disseminated by the Observatory, and used for rating military chronometers.



Nerve centre. The time-service room at the German Naval Observatory in Hamburg. The most important job done here was to trigger and monitor the radio-telegraphic time signal broadcast from Nauen; the signal was crucial for setting chronometers and navigational watches in flight preparation rooms across the country. Visible at left is the transmission switch board.

Additional information was provided by a former commander of an aerial Marine Reconnaissance Group, Lieut. Hellmut Nagel. From his lively memories, the use of the chronometer, watches, instruments and astronomical tables, in conjunction with those contemporary navigation procedures, became clearly understandable. In his group, *Fern-Aufklärungs-Gruppe 5* (FAG 5), based in Mont Marsan in Southern France, there was a surface chronometer and 45 aerial navigation watches for the pilots and navigators (observers).

It is important to explain the structure of the use and application of time keepers as well as the hierarchy of precision in distributing the exact time.

'problem of longitude' meant that ships were equipped with clocks that kept time with the greatest possible accuracy, so too it was during the early years of aeronautical navigation: aviators needed consistently accurate, robust and readily legible timepieces aboard their aircraft to determine their location and flight times. Marine chronometers that kept time aboard ships were augmented by deck watches, which were used on deck while making navigational observations and also to transfer the precise time indicated by the regulators in naval observatories to the ships while at port. These deck watches were high-grade pocket watches and kept safe inside sturdy wooden or metal containers.

Pilots, by comparison with seamen, were typically only airborne for relatively brief spans of time, and deck watches in pocket watch format were not the optimal solution. An aviator needed a watch that he could read quickly and unambiguously, with to-the-second accuracy, while allowing him to keep his hands free to operate his aircraft. A wrist watch format was ▶▶



A Lange & Söhne no. 650; an early timing instrument for the German Airforce, four-pillar movement, with hour angle dial, and an external safety hand-setting device. Supplied as a surface chronometer for airfields.



A later Lange & Söhne Luftwaffe hour angle watch, gilt three-quarter plate movement, base cal. 43, in a silver case, marked 92665. Luminous hands for degrees, minutes and radial four-degree indication.

►►therefore preferred. An Observer's navigation watch also had to have a very long strap so that he could wear it on the outside of the sleeve of his flight suit. It wasn't until the mid-1930s that the first watches were developed in Germany to meet the specific needs and requirements of aviators.

Decisions and developments by the German Air Ministry in the 1930s

The defeat of the German airforce during World War One, and the terms of the Treaty of Versailles, which prohibited German aeronautics, meant that the development of aeronautical technology, navigational instruments

and precise timepieces languished in the doldrums during the subsequent years, and was further exacerbated by the severe economic recession of the 1920s. Not until the 1930s, in response to political demands and new modes of transportation, was more attention and R&D funding invested towards this technical environment. The Luftwaffe was established as an armed force in its own right in March 1935. Afterwards, the *Reichs-Luftfahrtministerium* (RLM, Imperial Air Ministry) collaborated with the *Deutsche Seewarte* to call for and encourage further development of precise timepieces.

This was preceded by efforts to improve navigational instruments used by the navy. A document from the *Deutsche Seewarte*, dated 5 January 1935, invites watchmakers to participate in the 'Fifth Competitive Test of Precision Pocket Watches', in which the suitability of timepieces '...for scientific purposes and for nautical and aeronautical applications' will be tested.

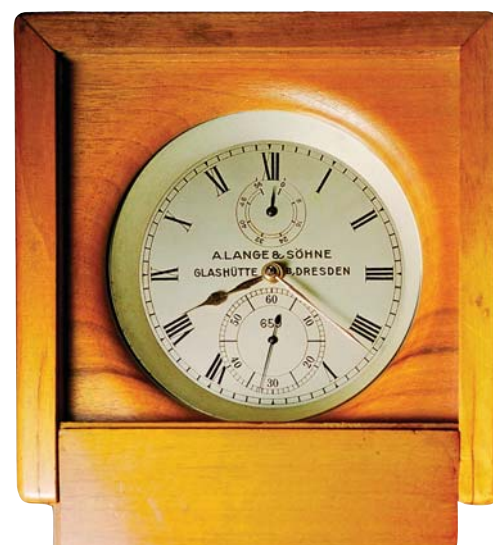
The submitted watches, which had to be of German origin, were first tested, and the entrants were assigned to three classes: Special Class, First Class and Second Class. Special requirements with respect to accuracy of rate and degree of perfection of the movement were meticulously defined by the relevant German offices and commanding authorities during the Second World War.

Before a watch could be shipped to the military, it had to undergo testing in accordance with these standards and had to receive a rate certificate from the *Deutsche Seewarte* or other official testing institution. These standards stipulated that nothing but the best materials, impeccable components and the most precise adjusting were to be used in these watches. They had to be equipped with a high-quality balance (usually made of nickel-steel) and a specially treated balance spring (with an outer and an inner terminal curve).

Furthermore, each watch had to undergo fine adjustment in six positions and at three temperatures. As a rule, only watches which had been subjected to the aforementioned treatment were able to satisfy the test conditions for the Special Class or the First Class categories for precision pocket-watches.

Few documents about the *RLM's* collaboration with the *Deutsche Seewarte* and the watch industry survive from this era. Many records were no doubt destroyed during the night-time aerial bombardments that occurred between 1942 and 1945.

The specifications to be fulfilled by a special pilot's watch were listed, perhaps for the first time, on a document from the *RLM*. Dating from 1935, this document was recently discovered at the Military Archive in Freiburg. Bearing neither a title nor a signature, it appears to be the notes of a meeting. The text begins with a terse 'in regard to' line which reads as follows: 'Re: watches, chronometers, dials.' The document probably refers to the plans for a new Nautical Yearbook of Aeronautics and to a suggestion contained therein about the kind of



A Lange & Söhne Luftwaffe chronometer no. 659, supplied on 24 June 1936. Spring detent escapement, nutwood box with sliding top. There are no gimbals but the clock is pivoted along its 12-6 axis.

watches that would be needed for purposes of celestial navigation.

These recommendations can be regarded as heralding the birth of specially developed watches for the German air force:

1. The watches should include hour angle indication. Later, the decision was made to dispense with hour angles as all astronomical tables and yearbooks would have had to be changed.
2. The dial of a deck watch or ground-based chronometer should have clear numerals, and be unambiguously, easily legible. Interestingly, a design like that used on the face of the Longines Lindbergh was tested (Fl. 22604), but was rejected because of the double set of indications for hours and degrees and because it could be inadvertently reset.
3. Deck watches should be equipped with mechanisms to halt their seconds hands so that these could be precisely set to show Greenwich Mean Time.



Notice the vulcanised rubber suspension fitted to this chronometer. These instruments were designed for use in the flight preparation room, and not at sea, so gimbals would have been an extravagance on a device which, at 830 Marks, was already costly. The invoice is illustrated right. Chronometer no. 1102, supplied by A Lange & Söhne on 19 January 1939. Lever escapement, electrical contacts, an external hand-setting device, and 32 hour power reserve.

Pulling the crown stopped the watch so its hands could be set exactly. The watch would begin running again when the crown was pushed back in. This mechanism also enabled such timepieces to be used for measuring brief intervals of time. This 'hacking' mechanism was not included in naval deck watches.

4. In accord with their purpose, only chronometers with lever escapements and hacking mechanisms were used as ground-based chronometers. These specifications defined the Luftwaffe's ground-based chronometer.

5. Further requirements for deck watches included resistance to vibration, reliability at low temperatures (-20°C.) and regularity of rate. Furthermore, all aerial navigation watches had to be crafted as wristwatches.

The aforementioned document essentially defines all of the specifications that would later characterise Observers' watches for the Luftwaffe. Not all details were specified, e.g. the use of hour angles and the as-yet incomplete testing of sidereal time watches. The now rare and consequently avidly coveted hour angle chronometers and navigation watches were undoubtedly created in the

response to these military specifications.

In their final form, all movements were housed in grey brass or steel cases measuring 55 mm in diameter and fitted with snap-on case-backs. The inside of the case-backs were marked with the following information: type of construction, device number, movement number, order mark, and the name of the watch manufacturer. The dials were black; large Arabic numerals coated with radium-based or non-radioactive luminous material indicated the hours; strokes marked the minutes and seconds. The hour hand, minute hand and seconds hand were coated with radium-based luminous material; the seconds hand had a counterpoise. Furthermore, all watches had a centre-seconds hand, as well as a hacking mechanism.

The German Naval Observatory in Hamburg

The Deutsche Seewarte in Hamburg wasn't only responsible for testing watches for the Luftwaffe. This observatory also administered, monitored and disseminated the precise time for civil aviation. The prime reference time for all events at sea and air was kept by precise one-second pendulum regulators.

The following main clocks were kept either in the time-service room at the observatory or atop granite foundations in the building's cellar: Knoblich No. 2090, Strasser & Rohde No. 219, Riefler No. 223, Max Richter No. 101 and 102. All precision timepieces were tested here, e.g. chronometers and navigation watches for the navy and the air force.

The time service's most important task was to trigger and monitor the radio-telegraphic Nauen time signal, which was used to set the timepieces in the radio rooms and operations rooms of military airfields, as well as the ground-based chronometers at flight-preparation rooms.

Production and Suppliers

Our knowledge of watches and clocks of the Luftwaffe comes from existing items. Due to destruction during the war, the requisition by allied forces after the war and the severe downturn of the watch and clock industry in the 1970s, there are only a few extant documents relating to orders, production and shipments.

Precision Timepieces

At first the only manufacturers of chronometers and navigation watches ▶▶



Wempe Chronometerwerke Hamburg, no. 2389, c1940, rubber suspension, two-point axial balance-locking mechanism, external safety hand-setting device, 89mm four-pillar movement with Alfred Hellweg's main-spring barrel, and Griesback integral balance. The Luftwaffe 'Manual for Aerial Navigation' has a photograph of the Wempe chronometer no. 2385, where it prescribes the necessary equipment and techniques for astronomical navigation.

A. LANGE & SÖHNE
Glashütte/Sachsen

Bestell. Auftrag Nr. LC IV 4b Nr. 1271/37 v. 21.4.37. Seite 65/3
Buch-Serie: (LC III 35) **Vorsandbuch-Original**

reguliert am 19. Januar 1939

Empfänger: Herrn Reichsminister der Luftfahrt, Berlin 8

Versandt: 20. Jan. 1939, Berlin, Chronometer
Auftrag vom 21.4.37 (8233) des Empfängers
Gesamtbetrag Reichsmark: 4.195.-- rein netto

Nr.	Beschreibung	Edelmetall-Gewicht	Uhr Nr.	RM
5 Stück:	Marine-Chronometer, mit Ankergang, Stundenrifferblatt, in qualitativ feinsten Ausführung, in einem geeigneten Holzkasten mit Zettelschloß, Zeigerstellvorrichtung seitwärts außen, mit Auf- und Abwerk, ohne Überkasten, einschließlich Versand-Gefäßung, Stückpreis: 830.--		1101 ✓ 1102 ✓ 1103 ✓ 1104 ✓ 1105 ✓	4.150.--
	+ Versandwesen für 6 Teillieferungen des Auftrages Nr. LC IV 4b Nr. 1271/37 (LC III 35 Nr. 48424/37) v. 21.4.37			45.--
			Summe	4.195.--

Chronometer invoice from A Lange & Söhne.



'Einheitschronometer' - This example of the Unified three-pillar chronometer is by Gerard D Wempe. By 1942, the production of surface-bound chronometers had been standardised and simplified. Now all makers built their devices according to one pattern, the specification 'Fl. 23881'. Features included the lever escapement, external handset, and balance locking device. The outer box with leather binding straps is still present on this example.

» were in Glashütte, the foremost being A. Lange & Söhne. To a lesser extent there were some manufacturers from the Black Forest, for example Junghans. Test items were ordered from Swiss makers such as Longines and Zenith. The Chronometerwerke in Hamburg regained economic stability after Gerhard D. Wempe took it over in 1938. Wempe were then able to produce chronometers and watches in large numbers.

Chronometers

Due to destruction of Hamburg in 1942-43, the production and shipment data from Wempe are not available, so we cannot know exactly when and to whom specific items were shipped. We do know that as late as 1938, they made a detent chronometer, no. 2074, without gimbals, but with a vulcanised rubber suspension to minimise the impact of vibrations and shocks. Only after this, with the help of the Watchmaking School in Glashütte, did they develop a lever chronometer. It was boxed with the same rubber suspension. No. 2385 is mentioned and shown in the *Luft 1255/2d* manual, and no. 2389 is in the author's collection.

The Luftwaffe service orders of 1935 and 1937, no. 268/1 for ground-based chronometers 'BC 1010', show A. Lange & Söhne as the supplier. Only in 1940 was the 'Wempe

Chronometerwerke Hamburg' added. The shipment documents of A. Lange & Söhne are still available and the whereabouts of the relatively small number of detent and lever chronometers delivered to the Luftwaffe are known. From 1934 to 1937 only thirty-eight detent chronometers, and from 1938-39 only twenty lever chronometers, were shipped to the RLM. After that no Glashütte, but only Hamburg chronometers, went to the Luftwaffe, obviously according to agreements between the RLM and the manufacturers.

One protocol of the Committee for Chronometers and Navigation Watches of the Deutsche Seewarte from 8 August 1942, lists the total number of chronometers to be shipped: Wempe commits forty chronometers per month, twenty-five for the *Kriegsmarine* (German navy) and fifteen for the Luftwaffe.

The production of the classic German four-pillar chronometer ended at that time, by order of the High Command of the *Wehrmacht* (German Military) and the RLM at the end of 1942, demanding a common design and production of standardised chronometers by several manufacturers.

This resulting *Einheitschronometer* (Unified Chronometer) was developed under the guidance of Lange and Wempe. Only Wempe and his partner Leutert produced the lever chronometer version for the Luftwaffe with fusee and provisions for external adjustment and stop mechanism, and rubberised ring suspended on the 3-9 axis of the timepiece.

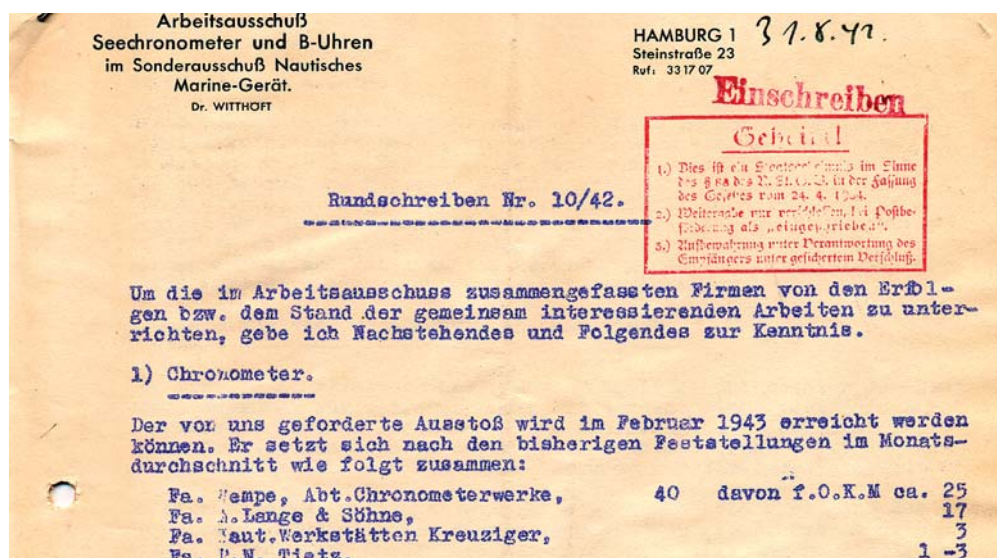
After the war, this Luftwaffe chronometer would become the base for the Kirov lever chronometer of the Soviet Air Fleet, used until 1990, just as



German airmen synchronise their navigation watches.

the detent *Einheitschronometer* was the base for the Wempe marine chronometer as well as for the Soviet Fleet. Glashütte did reactivate the 4-pillar design after the war.

To be continued in December's HJ.



Minutes of a meeting, showing that Wempe were expected to deliver 40 chronometers per month.