"Water Resistance Testing of Watch Cases"

Review of the Chronometer Club Annual Technical Seminar

July 31st, 2008

AWCI Convention – St. Louis/Clayton, MO.

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This article has been edited by the author for content from its original form, which appeared in the Horological Times, and will review some, but not all, of the topics covered by Mr. Fenwick, Technical Training Manager for Swatch Group, U.S delivered at the Chronometer Club Annual Technical Seminar on July 31st, 2008.

Mr. Fenwick began the seminar with a very thorough overview of the developmental history of the water-resistant watch, citing material from "Watches Under Water" an internet blog by Michael Friedberg. As this history is available on line, it will not be reviewed in this article, but may be viewed at the following web link: http://watchescorner.blogspot.com/2007/09/watches-under-water.html

Some of us may be old enough to know or remember the time when watches may have been labeled "water proof." In 1947 the Federal Trade Commission issued guidelines which forbade the use of "water proof," and issued testing requirements for the use of the term "water resistant" and associated explanations regarding specific depth. These guides spawned the 70's evolution of the modern requirements (norms) which exist today for water resistant watches, and that are set forth by both the Normes de l´*Industrie Horlogère* Suisse (NIHS) and the International organization for Standardization (ISO).

Those interested in learning more about these specific standards are encouraged to visit this topic online, by googling the terms "ISO 2281 Horology -- Water-resistant watches" which not only prohibits the term "water proof" from being utilized to describe a watch, but more importantly defines water resistance and specifies detailed testing procedures for watches intended for ordinary and daily use which may come into contact with water. The tests in the ISO 2281s standard are not suitable for "diving" watches. In fact, to earn the 2281 rating not every watch in a production batch has to be tested. In order to test these watches designed for recreational and commercial scuba diving a separate standard, "ISO 6425 – Diver's Watches," was formulated which each individual watch is required to pass. To learn more about these standards readers are encouraged to visit the source material referenced by Mr. Fenwick at http://en.wikipedia.org/wiki/ISO_6425

Important in the understanding of the 6425 standard is the fact facility-based testing conducted on the watch case with modern equipment involves only static pressure, and not dynamic. This is to say that in laboratory conditions, the watch is tested with only static forces. However in practice, the watch may be exposed to situations that produce additional force, due to the fact that the user may encounter pressurized/moving water (dynamic forces), such as by exposing to the watch to dynamic pressure water events in sports such as water skiing or wake boarding. For this and other reasons (water density variations due to salinity and degradation of seal/gaskets), the ISO standard states that to pass one of its numerous requirements, the watch case must maintain its water resistance when subjected to 125% of the pressure associated with its rated depth. For example, a watch rated at 300 meters, would have to pass a test of pressure equivalent to 375 meters. This is not the only tests specified by the ISO 6425 standard. Again, the reader is encouraged to visit http://en.wikipedia.org/wiki/ISO_6425 for more detailed information.

Mr. Fenwick also stated that the term "saturation diving" and the utilization of helium-release valves on certain watch models were sometimes problematic for watch owners and watchmakers to completely fathom (yes, this is a pun). Briefly explained, saturation diving involves breathing a mixture of helium and oxygen so that the duration of the dive is not a safety factor. However, when exposed to the mixture of pressurized oxygen and helium inside the diver's saturation chambers, the watch case can become filled with the helium mixture, as the helium molecules are smaller than oxygen. If some method of releasing this pressure build up did not exists, such as the helium valve, the watch would likely explode (crystal/bezel would pop off) during controlled resurfacing. In order to help alleviate some of the concerns in the audience about saturation diving and the watch's release valve, Mr. Fenwick ended this discussion by sharing an interesting quote from a Navy SEAL he had spoken with, "It would be easier to find a practicing astronaut than a person who actually uses the helium release valve for its intended purpose." The use and proper position of the helium release valve during testing will be discussed later in this article.

The practical exercises for our seminar began with Mr. Fenwick demonstrating the proper removal of the bezel on an Omega Seadweller watch case utilizing an Omega specialized tool, and following the instructions in Omega's technical literature. The rubber jaws of tool, with correctly sized inserts for the caliber in question, allowed very easy removal of what may otherwise be a problematic affair. Mr. Fenwick noted that the bezel could be in any position prior to removal, and that titanium-case watches and bezels could sometimes be difficult even with the special tool.

With regard to case tubes, Mr. Fenwick pointed out that on the Seamaster Professional models, the tubes were soldered in place. If one needed to be replaced, the official instruction was to send the case in to Swatch (which in turn currently sends this type of issue to Switzerland), and reminded us of the fact that both case and serial numbers needed to match, especially as this concerns the use of the "Extranet" for parts and ordering. Jack Kurdzionak, present at the seminar, offered some advise for protecting a case tube during various service procedures, "Consider attaching an older crown to protect the case tube during servicing." An alternate method of the soldered steel case tube's removal and reinstallation was discussed. This included the unofficial use of a spiral "easy-out" tool (counter clockwise) to remove the tube, and then to tap the case for the reinstallation of the titanium case tube (which is threaded). Reaming of the case tube before using the easy out would make the job easier. New tubes are secured with Loctite 243. Appropriate curing time (24 hours) should be allowed prior to re-assembling the watch. Participants then proceeded to remove the crystal and helium valves on our practice watches.

Complete servicing of the helium release valve and its tube (in various configurations and calibers) is accomplished in part with the use of specialized tools and techniques. The tube of these valves is screwed in, and is installed in Switzerland with Loctite XXX. For the Seamaster model, the servicing of the helium release valve is discussed fully in Omega technical communication, and is not discussed in detail in this article due to space restrictions, as is extraction of the helium valve. One precaution mentioned by Mr. Fenwick when installing threaded case tubes was extreme cleanliness, combined with a thorough inspection for any damage to the gaskets, and conservative use of Loctite/glue. When applying Loctite, the correct application method is to apply it to the INTERNAL threads only, and NOT the external threads, and to apply sparingly. When servicing an Omega which employs the helium valve, it is also recommended and is factory practice to replace the entire valve, due to spring assemblies in some of the earlier models being of insufficient strength.

Several tools (pictured in the original article only) one might find useful for proper servicing of Omegas include Pusher Tool, Tube Tool, Valve Tool and Hex Tool. In addition, one might find useful a German "Wiha" 3.2 m drive tool for use on the Aqua Terra and 300m professional diver models. This tool is typically not available in the Wiha sets, but can be individually ordered from various suppliers.

After disassembly and inspection, seminar participants then reassembled the case, including the crystal, in preparation for water-resistance testing. Mr. Fenwick mentioned that, when installing the crystal and crystal gasket, it was important to wait one hour after initially installing the crystal, and to double check the tightness of the crystal gasket by re-tightening with appropriate dies and press, as the new gasket may change shape enough during settling to cause a leak. Fomblin UT 18 is of course used on all gaskets/o-rings (caseback, helium valve and crown).

Water-resistance tests were then conducted following the procedures outlined in Omega technical guide. This technical guide covers both vacuum and pressure tests, *which are mandatory for all Omega models*, and tests in water *which are mandatory for watches rated at 100m and more.*

Seminar participants were fortunate to be able to practice both types of tests by utilizing a variety of modern equipment, including:

For Vacuum & Pressure Tests (dry):

- Witschi ACL 2000 (being replaced by the Witschi Proofmaster in 2009)
- Greiner Vibrograf Poseidon LT 100

For Tests in Water (wet):

- Roxer Natator 125
- Lititz Watch Company (LWC) 125

- LWC Preciso-temp 47 (to test for leakage after wet pressure testing)

During vacuum and dry testing, some highlights of the differences in testers were discussed. The relatively new Greiner Vibrograf Poseidon LT 100 gives the user the option, during testing, to view the live data associated with the test, including a graph of both pressure change and indices of case deformation, and the numerical values associated with each value type. This is not the case with the ACL 2000.

The highlight of the seminar, at least for the author, was the announcement by Dan Fenwick that the Lititz Watch Company's (LWC) new 125 wet pressure tester had been examined by the Swatch Group in Switzerland, and deemed appropriate for use in facilities wishing to acquire and/or maintain their Swatch Group parts accounts. One of the changes on the horizon for Swatch is the eventual requirement that shops currently utilizing a 40-bar wet tester, upgrade to a 125 bar or greater wet tester. The LWC 125 wet pressure tester is US made, exceptionally well built, and currently costs about ½ what one would otherwise have to spend on Swiss machines designed to test at this or greater pressures. To view the process of wet testing a watch utilizing the LWC 125 readers are encouraged to visit this link: http://www.youtube.com/watch?v=YexiNN_rnxc

Also of interest at the seminar was the use of the equally-new Lititz Preciso-temp 47. This device is utilized after the sequence dry and wet pressure testing by first wiping the watch dry, and then placing the case on the Preciso-temp 47 which gently heats the watch to a critical temperature between 45 and 50 degrees Celsius. This must be sustained for 20 to 30 minutes. A drop of room-temperature water (18 to 25 degrees Celsius) is placed on the center of the crystal for one minute. The glass is then wiped dry. Under a strong light, the crystal is then examined to determine if condensation has formed on the underside of the crystal, indicating a leak. When Omega watches pass this test, a blue point of color is placed between the case and the caseback, indicating a successful test. If condensation appears, there is a leak which must be identified and remedied, and then the entire test procedure repeated.

Helpful Links:

Greiner Vibrograf, www.greinervibrograf.com
Jules Borel & Co., www.julesborel.com
Roxer S. A., www.roxer.ch
The Lititz Watch Company, www.lititzwatch.com
Witschi Electronic Ltd., www.witschi.com