HOW HARD & DURABLE ARE IWC CERAMIC WATCH CASES?

By Jack Freedman - November 19, 2008

A customer called me on the phone asking what can be done to his broken IWC IW378601 **Black Ceramic** Pilot's Watch Double Chronograph case. My first reaction was how "could" it break and would he e-mail me a photo so I can assess the damage.

Here's the photo of the watch which the customer sent and explained that he dropped it onto a hard floor. I was still baffled and intrigued that a ceramic case can break and so I began to research the subject matter so I could gain an understanding myself in order to pass along the information I acquired.

First, here's an introduction to ceramic watches from the IWC catalog:

The success story of ceramic watches began at IWC

Until the mid-1980's, high-performance ceramics – also known as fine or engineering ceramics – were used exclusively for cars and computers, as well as in the manufacture of surgical instruments. No other material is able to withstand such high temperatures or such mechanical and chemical extremes. It was IWC that discovered the material for the watch industry and, in 1986, released the first Da Vinci in a zirconium oxide case. Milling the case from a single block of the material is extremely complex and makes its production almost as expensive as gold. The extremely pure, almost white ceramic powder is coloured before further processing and first compressed into the form of a preblank. Subsequently, the blank is preformed with cutting tools. The compressed powder is baked in an oven at temperatures of between 1500 and 2000 degrees C to form ultrahard zirconium oxide. The baking process irreversibly transforms the microscopic powder particles into a highly dense and compact solid. The complex cooling process that follows ensures that the highly sensitive lattice-like structure is retained. The case is then shaped with diamond-tipped tools – and and immense amount of skilled craftsmanship. In 2008, IWC introduced the Pilot's Watch Double Chronograph, Ref. 3786, in a matt ceramic case which is milled out of a blank baked at ultrahigh temperatures.

Now that I understood better the process it takes to manufacture the ceramic case I still lacked the proper knowledge why the case can break away as shown instead of just perhaps a crack. So, I called on my friend Walt Arnstein, a now retired physicist/engineer and past contributor on several watch forums, to explain the dynamics of ceramic watch cases. He graciously consented to allow me to post his theories and explanations about this subject, as per his following e-mail:

Hi, Jack,

The photo of the damaged watch case is very revealing, pretty much what I had expected to see. It was struck a direct blow by the collision with what was probably a ceramic tile floor or kitchen counter. You see, the material is very **hard**, but it is not **tough**. Toughness is a material's ability to absorb **energy** through **compression** and **mechanical resistance**. **Hardness**, a quality of diamond or sapphire, describes a material's ability to resist scratching and denting. So, a diamond can cut glass, but it doesn't deform when pressed. In fact, large rough diamonds used to be (and maybe still are) broken into smaller ones in preparation for finishing by being struck in just the right place and direction by a metal chisel. The result, when done right, left no little chips to speak of.

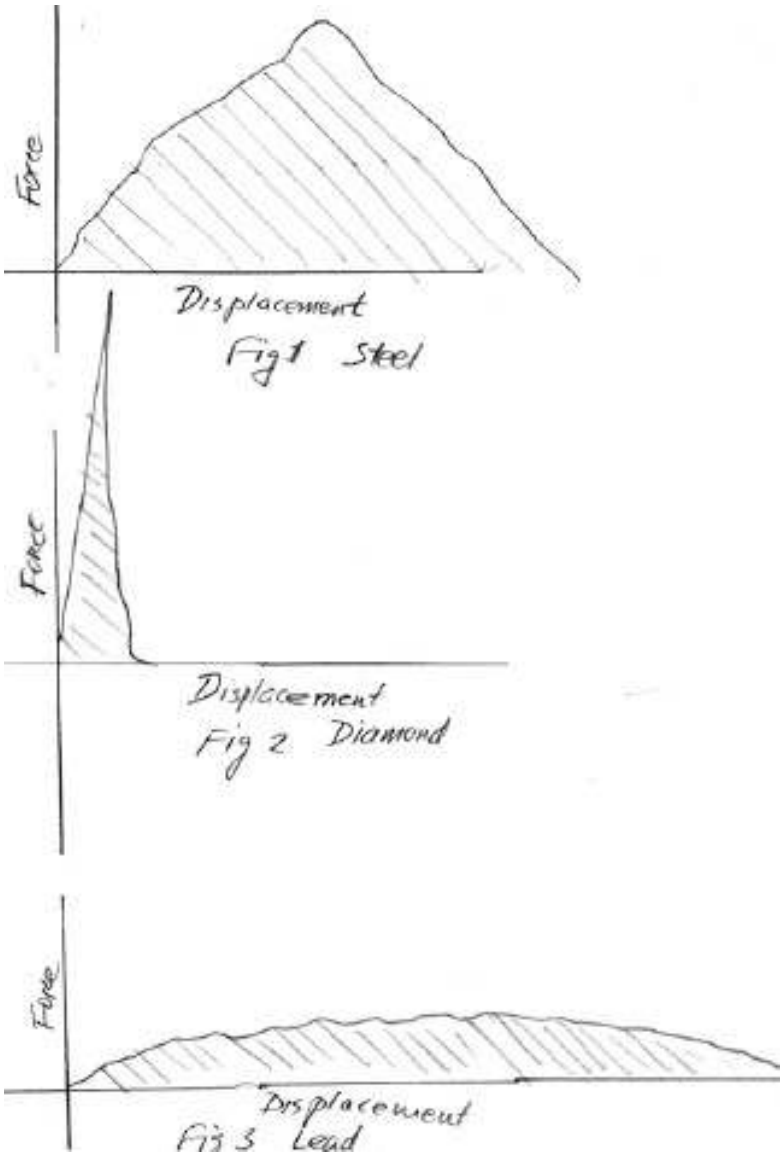

Figure 1 (attached) shows time (in milliseconds?) vs. resisting force in a **steel** object when struck with a hammer. Note that the resisting force is moderate and takes a significant time to come to rest.

Figure 2 shows time vs. resisting force in a **diamond** when struck with a hammer. (we assume the diamond doesn't shatter, of course). The resisting force is very high, but lasts a very short time. The diagram is basically a **spike**, since diamond doesn't compress.

The **area** under each curve is a measure of the **energy** absorbed by the materials through microscopic deformation. The area for the steel object is much greater than that for the diamond, although the height of the curve is much lower. This tells us that the metal is **tougher** than the diamond.

Since the diamond is not compressible, all the energy delivered to it is transformed into high frequency internal oscillation, which can result in breakage.

Just for comparison, Figure 3 shows the behavior of a lead object struck the same way. Lead deforms more easily than steel or diamond, but its mechanical resistance is lower, so it is not as **tough** as steel.

Looking at my hand-drawn pictures, by the way, the difference between the materials may not be clear enough. In actuality, the figure for the diamond is really a **very** skinny spike of great height, while that of the lead is a long, low curve. In all cases the area under the curves is a maximum for **steel**. Sorry about my inaccuracy.

Hope this is useful.

Regards,
Walt

The zirconium dioxide case of the new IWC Ceramic Doppelchronograph is a technological feat. It is special because it is different. But it is more than different, because it also reflects art, craft and science. And it displays the innovative spirit and technical prowess of IWC. An excellent writeup about IWC's ceramic watch cases was done by ***Michael*** **Friedberg** an expert on IWC and a forum moderator on IWC's website.

The following is a link to his article:

http://www.iwcforum.com/Articles/2006/ZirconiaText.html

Zirconium oxide, common in the application of artifical gems due to its excellent thermal stability and one of the hardest substances known to man, is also used nowadays as powder on the surface of floor tiles to enhance wear resistance. With modern metallurgy (powder metallurgy) zirco oxide powder can be fused into some alloys to give a super wear resistant surface.

Although zirconium is many times harder than steel, and nonbreakable in the stress range commonly applied to watches, the Black Ceramic Pilot's Watch Double Chronograph when dropped on a ceramic tile floor or any very hard surface can break as shown in the top photo.

It may be interesting to note that the IWC Pilot watch hollowed out ceramic case has an inner metal case that is special glued and fused as one to house the movement inside.

Therefore, when breakage of a ceramic case does occur, it is necessary for the watch to go back to the IWC factory where the inner and outer cases are separated and a new ceramic case is freshly glued on to the inner metal case.

Then it will once again look, brand new, like this: