OFFICIAL JOURNAL OF THE BRITISH HOROLOGICAL INSTITUTE

The Horological Journal

JUNE 2023
www.bhi.co.uk

MHP30 Hotplate Update

Testing Different Types of Glass

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In the *HJ*, January 2022, Guy Gibbons asked if any readers would do further tests on bluing steel, inspired by my earlier article on the MHP30 mini electronics hotplate. To recap, the MHP30 is a small electrical hotplate, intended to help with soldering surface-mount electronic circuit boards. It uses a 28-volt USB-C power supply. It heats a 30 mm-per-side ceramic plate up to 350 °C under fine control. I have used it to controllably blue watch parts such as screws and hands.

In the initial article (*HJ*, November 2021), I described how the surface temperature dissipated quickly, not able to sustain the heat in a relatively massive steel part. To improve things, I added a small bell jar to trap the heat, being the bottom of a cut-down borosilicate test tube. With this the bluing proceeded very well. The idea for this little heat chamber came from Figures 84 and 86 of *Watchmaking* by George Daniels, showing an upturned wine glass used in a similar way.

Guy Gibbons had built his own electronically controlled bluing box. After reading my article, he also tried cut-down test tubes to slow heat dissipation and control the temperature gradient off the hotplate when bluing small parts. Guy turned a recess into an aluminium disc, into which he variously installed a cut-down test tube and a sapphire watch glass.

Guy suggested that others might like to experiment using mineral watch glasses, to see if they would stand up to the amount of heating, and whether thermal shock would affect them.

I agreed to test some mineral glasses. I proceeded to make a frame of heat-resistant material that sits exactly over the hotplate, with a 30 mm recess, into which different watch glasses can be inserted. I turned and milled the item, shown upside-down in **Figure 1**, from a length of phenolic bar.

Unfortunately, my choice of material was flawed. The laminated material tended to tear when turned, even with a sharp steel cutter, although with care I managed to get a reasonable finish. The real problem is that the material is, ironically, not at all heat-resistant to the degree I had hoped. It began to smoke and char heavily almost immediately on its first outing, and became much too hot to touch. In hindsight, I should have just made it out of aluminium with a tab for holding by pliers, after Guy's pattern.

I decided to keep a watching brief on the smoke and char. The chamber also filled with fog at first, but this later cleared as the temperature rose, **Figure 2**. At first I wondered whether the smoke or fumes from the phenolic resin might contaminate the bluing, but they did not seem to have any effect. Likely they are poisonous – consider your own health. Subsequent heating caused less smoke, but no doubt the paper or textile within the phenolic material will soon become charcoal if I keep using it in this way.

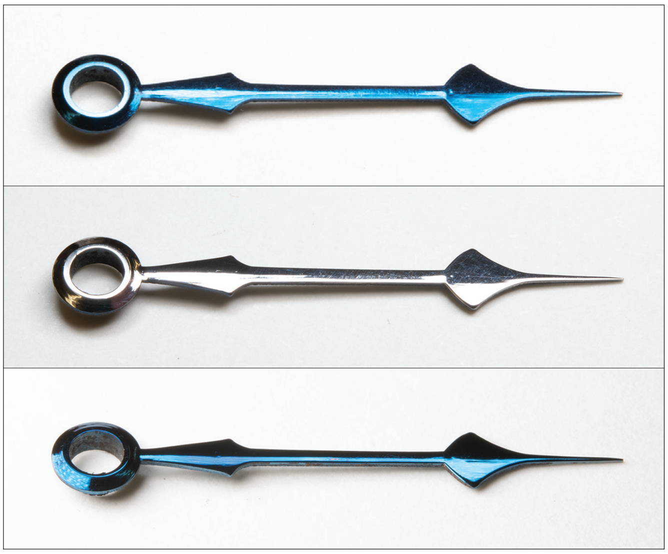
I polished away the blue off some spare pocket watch hands for these tests. As before, the hotplate turned the parts a most beautiful blue, **Figures 3A–C**. I successfully repeated

Figure 1. A phenolic frame (shown here upended) to sit over the hotplate, capped by a watch glass to create a heating chamber.

Figure 2. The chamber filled with fog, but this later cleared as the temperature rose.

this test a few times. However, the point of this series of tests was not about blueing, which is already well established, but whether different types of watch glass would stand that amount of heating.

I therefore tested three watch glasses: an antique domed mineral glass by VTF, with its little paper label still attached (the heating no doubt adding to the notorious tenacity of this brand's labels). Second, I tried a brand new modern domed



Figures 3A–C. (Top-down) The same watch hand, as original, polished, and re-blued in the phenolic chamber.

Figure 4. This antique glass survived heating – the colour of its label exhibiting the only change.

mineral glass. I also wanted to try a sapphire 'box' crystal. This shape imitates the old-fashioned 'high dome' acrylic crystals, and is now often used on high-end watches, such as certain models of the Omega Speedmaster Professional.

I thought that by using a box crystal, one could get the effect of a raised chamber directly, without needing a metal or phenolic frame. However, the cheapest one I found was a generic type being sold in China for about £100. At that price, I decided to forego the box crystal. However, I did find a plain domed sapphire from a vendor in China called Minging.

Thus armed with the Minging sapphire, a VTF mineral and a modern generic mineral, I subjected each one to a series of heating and cooling cycles. The hotplate reaches 300 degrees in about 2 minutes 20 seconds, and takes longer than that to cool.

Both the mineral glasses and the Minging sapphire were completely unaffected by the process, with no cracking or other trouble. The only obvious change was that the VTF's paper label turned a lovely toffee-brown! See **Figure 4**.

On Guy's point of subjecting the glasses to drops of water, I at first thought there is no point – when would that scenario ever arise in real life? In the end, though, my curiosity got the better of me and I dropped room temperature water onto the 300-degree glasses.

The result: nothing. The water simply boiled off. I also did this with the glass heated directly on the hotplate, with the same result. This was surprising – I expected it to shatter or at least crack. Only when I dunked the hot glass wholly into a beaker of water did it respond, and even then it only crazed, but stayed in one piece, **Figure 5**.

The reason glass cracks with sudden temperature change is because it's a relatively poor conductor of heat; a temperature change causes strain that can't 'flex' out of the object in the way a more elastic material would. The heating cycle here is relatively slow; therefore it's likely that no sudden mechanical strains develop. I can't explain why water drops had no effect – possibly the domed shape adds to the strength of these glasses, or the manufacturer's tempering process helps.

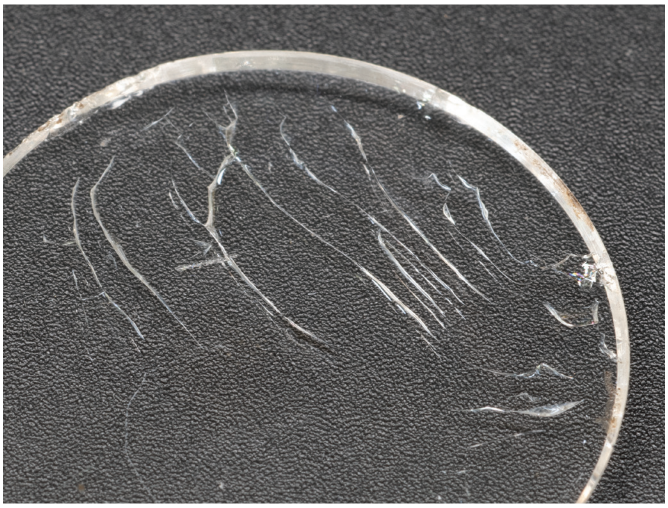


Figure 5. One of the glasses after dunking in water. Crazed but intact.

Guy had suggested that perhaps a 'high dome' mineral glass would eliminate the need to make a metal mounting chamber. I don't think that the domes on any of these glasses are high enough for anything but watch screws, and in any event a loose glass isn't as easy to handle as one mounted in a frame or chamber.

In summary, the exercise was didactic in discovering what type of glass may work in such a setting, and the resilience of mineral glass was surprising. New ordinary sapphire glasses are not expensive, but many repairers will have supplies of used chipped or scratched glasses of all types that may serve perfectly well.