RE-CAPPING THE ZC1-MK2.

Dr. H. Holden. July, 2020

BACKGROUND:

Further to my other articles on the ZC1 MK2, I thought I would add some notes on re-capping this radio.

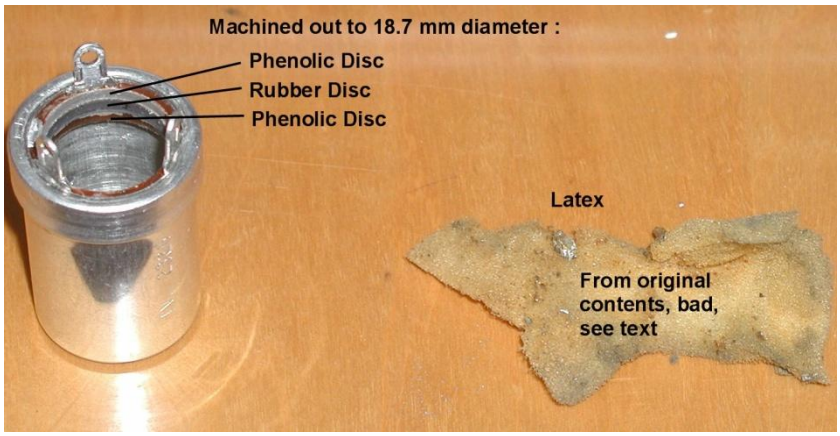
In my particular set I had replaced the electrolytic capacitors over 30 years ago. One interesting thing about the ZC1, being made "Mil Spec" quality, the other capacitors, which included wax paper types and moulded Mica types, at that time at least, remained in good condition, but that was 30 years ago. And now these capacitors are about 75 years old.

One reason why the wax-paper types had been so good is that they were sealed inside steel canisters, which kept the moisture out. These were custom made by Radio Corporation of NZ and they did a fabulous job on them and they are the longest lasting wax paper type I have ever seen. However, over time, the seals failed and the lower molecular weight part of the wax started to leak out, in addition, electrical leakage could be detected on testing.

Many of the Mica caps were custom made by Radio Corporation and some were American types made by El-Menco. These were also amazingly good for their age. It probably helped them that in the ZC1 they were "Tropicalized" with a coating of wax over the capacitor body. However testing showed electrical leakage of varying extents in all the Mica caps. So I decided to complete a full re-cap.

Below is a photo of my amazing ZC1 MK2 from my homeland in NZ, circa early 1940'a, which at that time cost 450 NZ pounds, or about $40,000 in today's money:

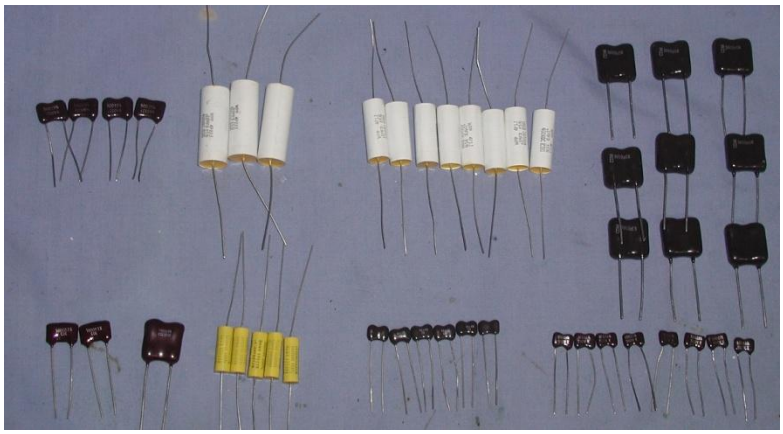
For the Electrolytic capacitor replacements, twist lock types are sometimes available in 1” diameter as new manufacture. Of late though, this size has been more difficult to acquire as a new part. I tend to re-build these types using the methods shown below, using a donor old stock capacitor:



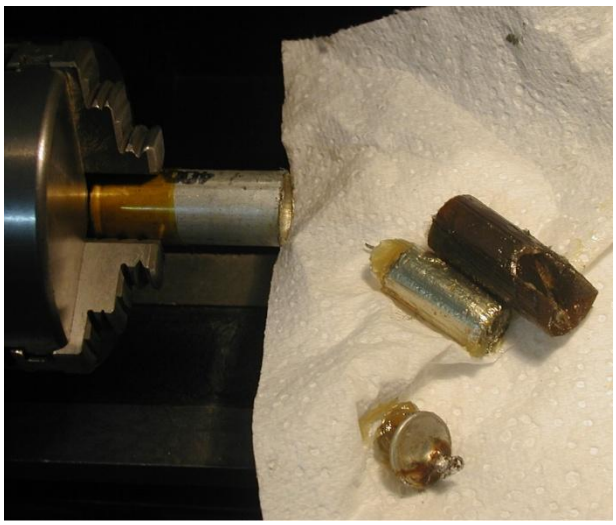
I generally start by machining out the base of the capacitor on the Lathe. If any Latex is found it must be discarded and the inside of the canister cleaned, latex can contain Halides which attack aluminium. The general principle of how I do this is indicated in the photos below. A 10mm thick plug made of phenolic material is machined to fit. And two 2.0mm metric threads are cut in the material for screws and lugs. Also holes are drilled beside those screws with a 1.0mm drill to pass the wires from the replacement electrolytic capacitors. The plug is glued in place with 24hr epoxy resin. Don’t forget to label the polarity of the pins before it is assembled. I drill a small countersink and fill it with a dot of red paint.

Replacing the original Mica & Wax Capacitors:

There are a good number of capacitors in the ZC1 on account of it being both a radio and transmitter. It pays to order what you require first. I use new resin dipped 500V Silver Mica types and for the wax paper types I replace with Polypropylene film and these are fitted inside the metal canisters.



The first move is to replace the wax-paper types. I found the better method was to unsolder the internal capacitor wire from the eyelet/tag as the end with the phenolic insulator. Then holding the capacitor (with protective tape around its body) in the Lathe chuck and then carefully going around the circumference very near the far end, creating an initial groove with a junior saw. Then to cut off the end with the saw and slide the capacitor contents out of the canister (It is more risky using the Lathe's cutting tool for this as it can bite into the thin material). The end is then smoothed with a file while rotating in the chuck and then smoothed further with 400 grade paper.



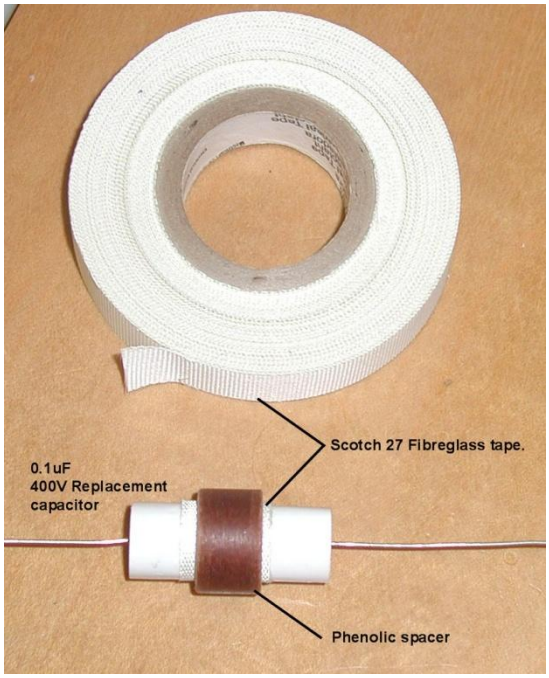
The photo below shows 5 of the cleaned out 0.1uF 400V capacitor canisters. Also the rivet and tag in the phenolic insulator is drilled out and discarded. I found these tags were in fairly poor order, the Brass being quite brittle where it was sharply folded and prone to cracking.

After that I fit 1/8” diameter silver plated brass eyelets in the phenolic end:

Then there is the issue of replacing the end of the capacitor which was cut off. A convenient choice is fibreglass pcb material. It is easily cut into discs using a 22mm diameter hole saw on the drill press. Then I make a 1/8” central hole and attach a screw & nut to secure it and rotate it, to machine the perimeter down to 16.8mm to be a close fit inside the end of the metal

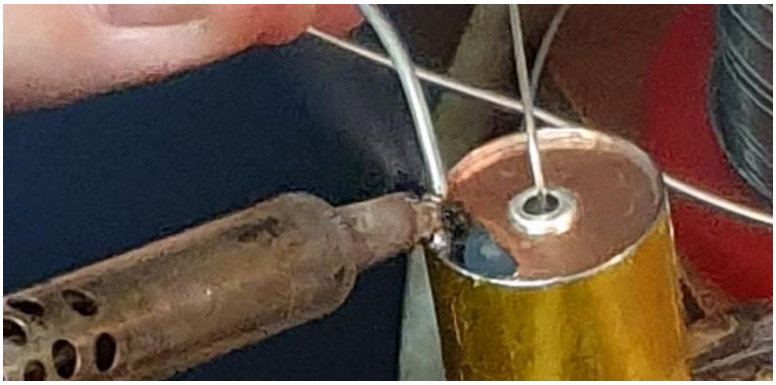
canister. The photo below shows some of the discs. The same principles apply to re-building the 0.2uF can capacitors, except that I used a 25mm hole saw initially to make a larger disc. These discs are then also fitted with 1/8” eyelets:

Then the replacement capacitor is prepared with a spacer and some fibreglass tape so it is a firm fit in the original canister:

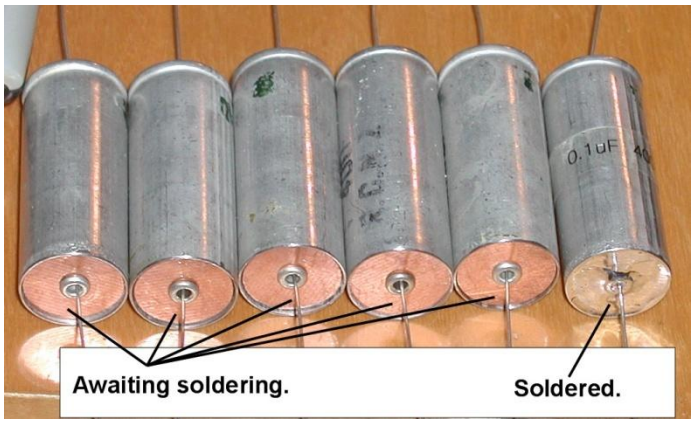


Soldering in the new end caps:

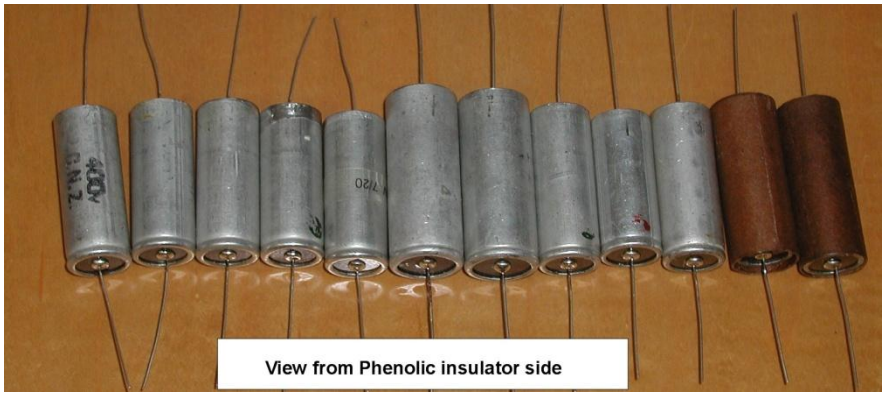
It is important to use the soldering iron (set on 400 Deg. C) to heat the edge of the canister around the 360 degrees initially to create a strong bond and then fill the well with more solder:



The discs are recessed about 0.5mm to 0.8mm into the end of the metal canister before soldering. This way a small well for the solder is created between the edge of the canister and the edge of the eyelet projecting from the copper side of the pcb material. This way a good amount of solder can be used. One very important thing: Polyamide tape must be wrapped around to capacitor body, right up to the edge being soldered or the solder will track down the outside of the canister, spoiling the appearance of the capacitor body:



Two of the 0.02uF capacitors have external paper sleeves.



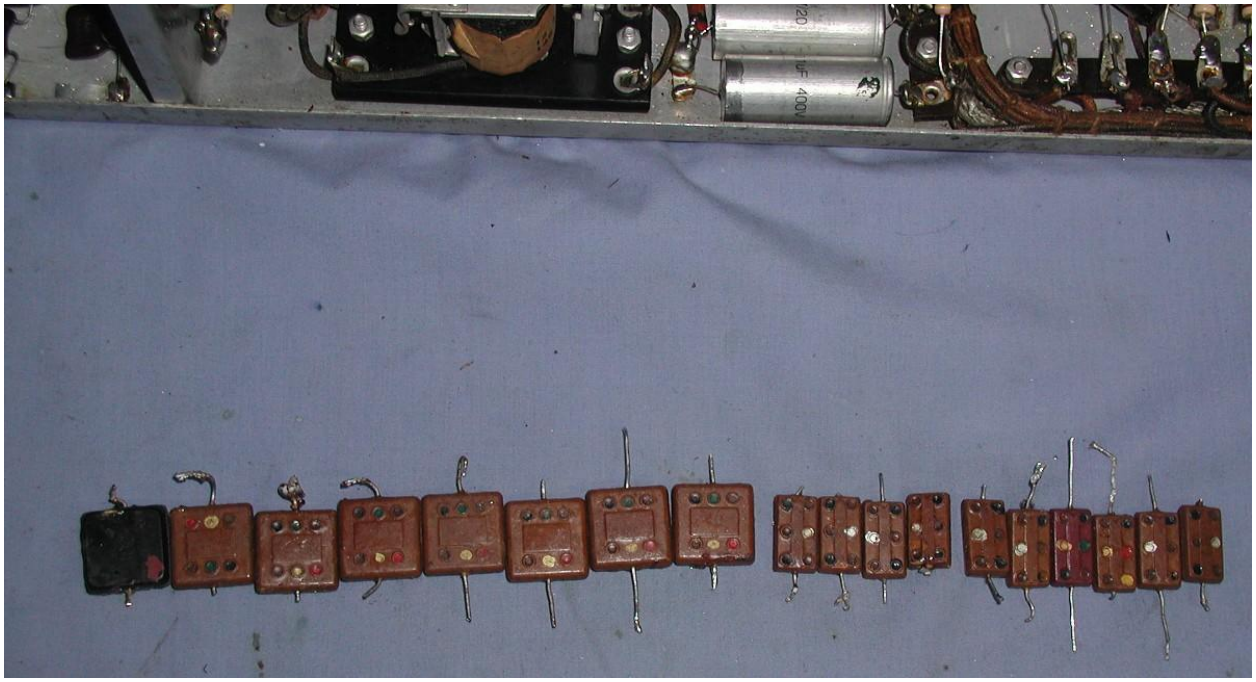
When these capacitors were finished I put a clear surface label on these with the uF value and voltage and the date, to help remind me when they were re-built. Though it is unlikely they will need doing again. (One of these labels can be seen 5th from the left in the above photo). Also I decided that having flying leads on the capacitors was a better way to mount them than the original tags that they once had.

An unusual finding while restoring these capacitors:

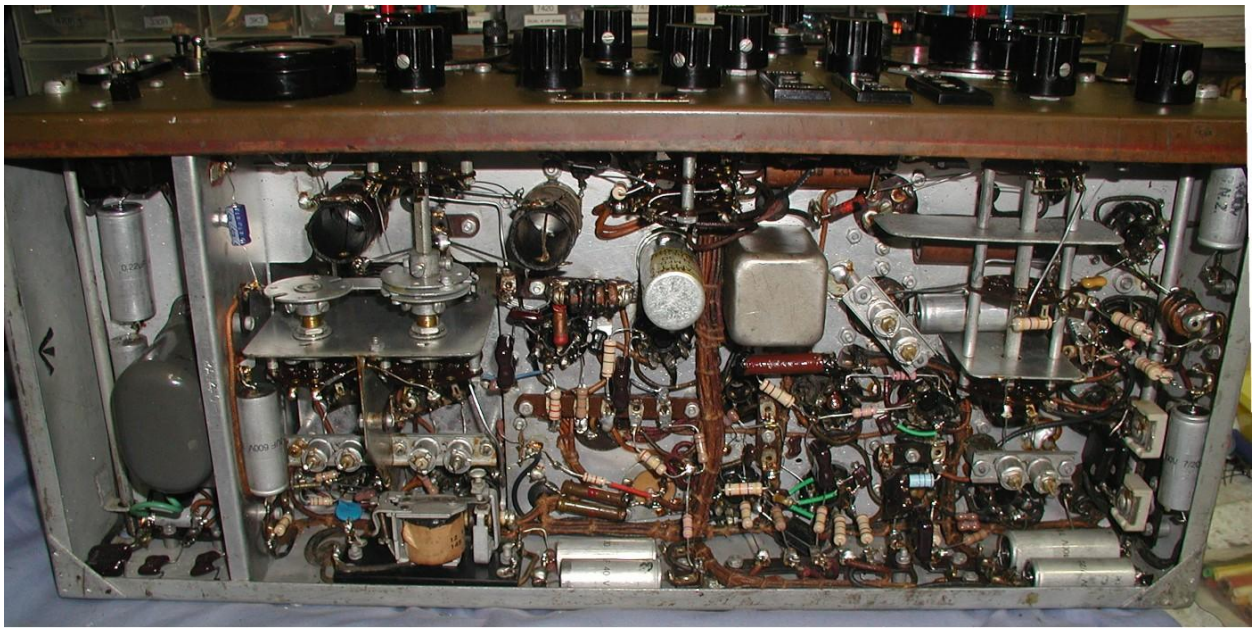
The 0.02uF types were clearly custom made by Radio Corporation with a brown paper tube over them inside the canister, also filled with wax. But they must have been running low on their own production because one of these capacitors turned out to be like Russian Doll, with a capacitor inside a capacitor. The photo shows the typical insides of the 0.02uF type with a plain brown sleeve:

But just one of the four capacitors had a commercial 0.02uF 600V “Dwarf Tiger” capacitor hiding inside it. So I re-built this capacitor and inserted inside the metal canister just as it was before.

The photo bellows shows some (not all) of the Moulded Silver Mica types which were replaced with new high quality resin dipped silver mica types.



The photo below shows the underside of the ZC1 after re-capping. Of note nearly every carbon resistor except just a few in this radio, were way out of spec and I had replaced them in the past.



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