At the Repair Bench – Ameco PT Pre-amp – June 2025

Recently, Club Member **Darrell Neron AB2E** brought to me for repair an old tube-type preamplifier unit known as an Ameco PT Preamplifier (Figure 1), which, at the time it was made, was a product of the Aerotron company. This was the first of a series of different preamplifier models manufactured under the Ameco nameplate.

Figure 1 - Ameco PT Preamplifier

The problem with this one was that it would shut down as soon as the preamplifier circuit was energized, but it would function OK in bypass mode. Now, this unit is a very simple circuit, utilizing a single 6EH7 vacuum tube as the amplifying element. It also uses an older design dual filter capacitor, which had two 20µF 150V electrolytics in a single axial component (Figure 2). That was a common methodology in the past, in which the capacitor would have a single lead off the negative end, and two leads off the positive end, one for each section of the capacitor. These were so-called "dry" electrolytics, which used a solid electrolyte rather than a liquid or paste-style compound.

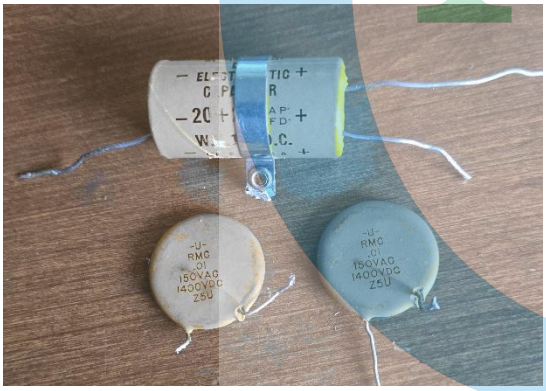

Figure 2 - Removed capacitors

Investigation of the unit showed that there was relatively little that could fail in the circuit. There are three solid-state diodes, several ceramic disc capacitors, several coils, an air-gap capacitor, several resistors, the dual electrolytic capacitor, two transformers, and the vacuum tube.

Going after the low-hanging fruit first, I immediately pulled and tested the vacuum tube, which surprised me by testing out at almost 100% of its new performance. I believe that this may actually be the original vacuum tube, as it is an Aerotron branded tube.

Some quick resistance checks showed that the resistors were all within their nominal tolerance values, and that the diodes were functional. While ceramic capacitors are fairly robust and do not fail often, they can and do sometimes fail. However, in this case, all of them tested OK, although there were two ceramic discs that were installed in a placement that nowadays is considered unsafe. More about them later.

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I decided to test the dual filter capacitor for leakage, first in-circuit, which led to failed tests. I then tested the unit out-of-circuit, and once again found that both capacitors in the device had failed in a very leaky condition.

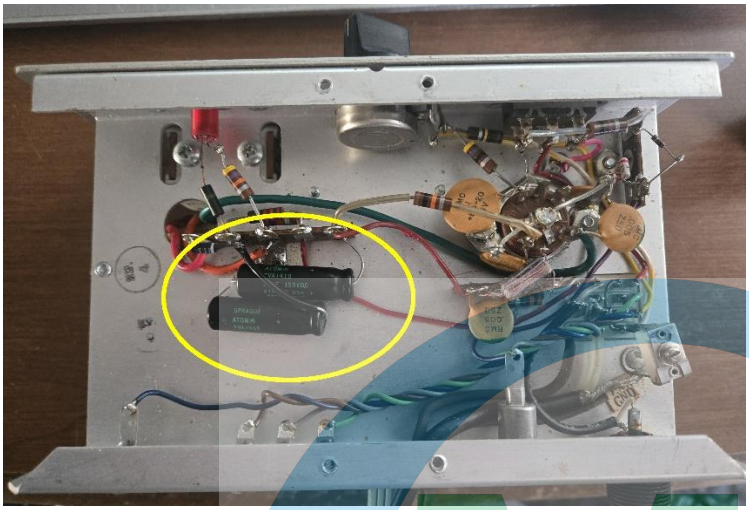

Figure 3 - Chassis underside - note new capacitors

I used my homebrewed capacitor leakage tester for testing the electrolytics, and it showed exactly what I thought that it might, what with the age of the dual capacitor. Needless to say, I replaced the dual capacitor with a pair of modern 20µF 150V axial-type electrolytics. After installation of the capacitors (Figure 3), the unit powered up and remained operational even in the pre-amp active mode of operation.

Now that the unit was operational, I went back to the two capacitors that I mentioned earlier as being installed in an unsafe manner. A few words about this topic are called for here.

It has long been a common practice to install ceramic capacitors in various configurations across the incoming AC power line to certain mains-powered electronic equipment. There are basically two different connection schemes that are widely used, an "X" scheme and a "Y" scheme.

In the "X" scheme, the capacitor is connected across the incoming AC line, from the line lead to the neutral lead. In the "Y" scheme, the capacitor is connected from one or both of the incoming power lines to chassis ground, *i.e.,* from the line lead to chassis ground and from the neutral lead to chassis ground. The safety risks of such capacitors are evident if one considers the capacitor failing in a shorted condition.

In the event of the "X" connected capacitor, this would create a direct short circuit across the incoming line cord, most likely blowing any fuse or tripping any circuit breaker that is hopefully present in the circuit. In those circuits without an overload protection device, the end result is a blown fuse or circuit in the service panel. In the event of the "Y" connected capacitor, failing shorted would most often result in a hot chassis, leading to an extreme shock hazard to the user of the equipment.

Nowadays, we have a device known as a *"safety capacitor",* which is designed to fail open rather than shorted. These devices carry certain ratings that indicate the level of protection afforded by the capacitors.

Table 1 "X" capacitor ratings

Subclass (IEC 60384-14)	Peak Voltage Pulse (while in service)	Peak Impulse Before Endurance Test
X1	>2.5kV ≤4.0kV	4kV per C ≤ 1µF 4/√C kV per C > 1µF
X2	≤2.5kV	2.5kV per C ≤ 1µF 2.5/√C kV per C > 1µF
X3	<1.2kV	None

Table 2 - "Y" capacitor ratings

Subclass (IEC 60384-14)	Rated Voltage	Peak Impulse Before Endurance Test
Y1	≤500VAC	8kV
Y2	150VAC ≤ V <300VAC	5kV
Y3	150VAC ≤ V <250VAC	None
Y4	<150VAC	2.5kV

Table 1 shows the rating values for "X" connected safety capacitors, while Table 2 shows similar rating values for "Y" connected safety capacitors. The safety capacitors that I typically use are 0.01µF X1-440V/Y2-300V ±20% Y5V-type ceramic disc safety capacitors. The capacitors originally installed in the Ameco PT Preamplifier were 0.01µF 150VAC/1400VDC Z5U-type ceramic discs, and there were as already mentioned two of them, connected in the "Y" configuration from each of the AC line leads to chassis ground. As these capacitors are not safety types, and are therefore just as likely to fail shorted as they are to fail open, they needed to go.

Figure 4 - Chassis top side - note blue safety capacitors

Once the new safety capacitors were installed (Figure 4), the unit was tested for proper operation one more time, and then the job was considered finished. I put the cover back onto the chassis and tied up the connected cables for return to Darrell.

So… what lesson(s) can be learned from this repair? Once again, it is the capacitors that almost always seem to be the earliest failure items in most electronic circuits. In a way, that makes sense, as the capacitors are the only components that have internal materials or structures that are guaranteed to deteriorate over time. Now, I am speaking about the electrolytics here, of course. But, if one looks back at my last dozen or so *Repair Bench* articles, how many of them came down to capacitor failures? I think that you will get the point.

See you next month!

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