Transformer Issues in Tube Testers

The technology and manufacturing capabilities during the era of the tube tester period were much different than today. Materials and production methods have improved as has our knowledge of magnetic's and transformer characteristics. Back in the day of tube tester manufacturing and daily use, Transformer manufacturers, had some capabilities to produce a high end transformer, or a common typical low cost transformer. Due to cost consideration most equipment generally except military, were built with a lower cost in mind thus using materials of less quality and lower technical capacities/characteristics.

The transformers used in commercial equipment often had higher carbon content in the core material. In addition the insulating coating used on the wires and insulating papers between winding groups were of lesser quality. The wire itself was also of lesser quality in its manufacturing as well. The design of the core structure, carbon content, wire insulation, and the assembly of the transformer all together establish the transformer capacity, specifications, the amount of heat rise and the MTBF (mean time between failure) of the product. The old wire insulation coating, and other internal insulation materials, used back then was fine at the time, but it was never anticipated to last 40 to 50 years or more.

In the old type of transformers used in tube testers the coating (insulation) on the wires and paper between layers is now deteriorating from age, but also the continued use of the transformer and internal heat build up within the transformer is quickening the deterioration of the coating. This then allows electrical leakage to occur between adjoining wires up to even establishing a direct short between windings. How bad the result is depends on the level of leakage, or a short and the location within the wiring turns of the transformer. If you were to look at the insulation on the wires in an old transformer under a high power microscope you would see that the insulation coating would show clear creaks along and across the wire throughout the wiring. These cracks continue to widen as the coating slowly shrinks and breaks down more. Heat speeds up the process, and a higher load current draw on the transformer will also increase the heat. Leakage between wires causes electrical energy to transfer to other windings causing the voltages to increase in these other windings. Other types of defects can cause windings to loose electrical energy as well thus reducing the output voltage on some windings. This provides a serious problem to electronic test equipment which must have a tight control of the operating voltages to insure a proper operation and calibration. In some products you may not even notice a problem until the transformer just fails. But test equipment that must meet tight operating potentials will suffer quickly when these defect begin to occur.

The New Transformer:
Thanks to modern technology and materials and manufacturing process we can produce an excellent transformer today. We can even make lower cost units that have much, much better performance and longer life that those of the past. Heat build up internal to the transformer is caused by several factors, and in new transformer it also exists. However, it is much less than in the older versions, of course it can increases if the transformer suffers a massive failure due to un-noticed problems in the materials, or the manufacturing process, or it driven in excess of original design tolerances. Generally with modern materials as the transformer gets older the insulation will not be as negatively effected as in the past. However, the insulation of today is made of high tech., materials like epoxies and other materials that have extremely long life characteristics and much better electrical/insulating values as well. The new core material and design also greatly improve the performance of the modern transformer as well as the improved assembly process.

So how does this effect my tube tester?
A particular transformer my or may not have a problem that can be seen or measured. The degree of a problem will depend on what section of the transformer is effected and to what degree it is effected. For example if leakage takes place to the AC signal windings and causes an increase in the AC signal voltage, but the other windings have a smaller or no change in them, then you might only see that all the Gm test are to high. How high will be depend on how much the AC signal voltage goes up as a result of the leakage. You might also see that it slowly increases as time goes on as heat causes more leakage to occur.

Heater voltages may drop as the Transformer tries to maintain the necessary current to support the plate current during the test and the heater/filament current as well. This voltage drop will directly effect the Gm test result, because the lower heater voltage is not providing the correct current to heat the cathode for proper emissions. Yet another defect from internal leakage could cause the windings in one half of the bridge of a bridge designed tester to cause the bridge to be out of balance thus causing an incorrect Gm reading either high or low again depending on which side of the bridge is effected. These are only a few of the typical failures or weakness in the old transformers that can and does effect the performance and accuracy of the tube tester.

As can be seen and inferred, there are many types of problems that can be caused by weak or defective power transformers. Unfortunately many of the problems can not easily be seen or identified until they actually occur. Transformers can seem fine for several hours of use and then slowly develop a problem which can only then be seen with test equipment at that time.

There is a test known as a High Pot test which unfortunately is often a destructive test. That is the transformer will likely be destroyed by the test. This is fine for testing the capabilities of new prototype transformers to be mass produced, but in old transformers it would destroy the transformer for sure. I have tried to use modern test equipment (meager's - for non-destructive testing) designed for large power type transformers, but the test results are always in the questionable (?) range making it just about useless. This test is time consuming as all wires must be disconnected from the transformer to do the test. I have never had an old transformer read in the clearly good range, all units I have tested always read in the questionable range except for those with an open or shorted windings between major secondaries and do read as bad. However, this can easily be found with other simpler tests not requiring a special tester or disconnecting all the wires on the transformer.

The issues described here are applicable to all power transformers, and to all makes and models of tube testers regardless of design type, or if they are laboratory testers, or service testers.

It should be understood that all old testers will have transformers in various conditions and there is no way for you to know the condition of the transformer(s) in your tester, or one you plan to purchase. It will just be a crap shoot, no easy answers here. I have seen a NOS (new old stock) tester that was operated for only 6 months (so I was told from the customer) that had a leaky transformer. Of course it could have just been a bad transformer from the original manufacturing process in the first place and may have been fixed under warranty if the tester had been sold and used back then. It may have also been related to age and then the sudden shock use! A unit not used for years will have a large amount of inrush current and old parts may fail, or weaken quickly from immediate use without a slow increase over time to bring up the main AC line voltage so as not to stress the components in the unit.

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