Tube Testers By Walter J. Swontek

The tube tester is one of the most valuable pieces of equipment a service technician can own. Since many are likely to disagree with this statement it might be advisable to change it to: A tube tester can be one of the most valuable pieces of equipment a service technician can own.

Practically all service shops own a tube tester of some sort. In many of these shops it is used only when a customer brings in tubes to be tested.

This article points out the many valuable uses to which tube testers can be put, and attempts to explain and overcome the prejudice in many technicians' minds against them.

Since a discussion of the merits of a tube tester is valueless when working against a heavy prejudice, let us see how this bias is produced and how entirely unfounded it is.

At the first contact with any sort of testing device, it is only human to expect a yes-or-no answer. In other words, the device is automatically expected to say: "Yes, the item is good" or "No, the item is bad." Actually, in real life, very few things are definitely good or clearly and undeniably bad.

Manufacturers cater to human weakness and provide a good-bad scale, clearly marked in red and green.

When such a device is offered, it is expected to be 100% accurate. In other words, the tester itself is judged on a "good-or-bad" basis. If 100% accurate, the tester is "good"; if not 100% accurate, the tester is "bad." Since nothing is absolutely perfect it is only human to judge tube testers "bad."

What usually happens is that the novice technician becomes acquainted with a tube tester and learns how to manipulate the knobs. He puts the tube tester on a pedestal as a tin god or supreme judge of all tubes. His tube worries are over! All goes well for a while, and the novice is a rabid tester of tubes. His faith is implict. He supports the tester ardently in discussions with more experienced technicians.

Then, one fatal day, the tube tester misses a bad tube. The bad tube is reinserted in the set and troubleshooting begins. All bad parts are replaced; everything is tested. The stubborn symptoms refuse to disappear. The technician becomes a nervous wreck. Finally, the help of a more experienced friend is sought. The friend swaps tubes and presto! the trouble is cleared.

"But I checked that tube . . . ," howls the novice. His friend just laughs with that horrible, superior air. The novice's faith in testers is completely shattered.

Now that we can see that this prejudice against tube testers is founded in unreasoning emotion (all prejudices are, really) we can inspect them for their real values.

The Tester as Tube Salesman

Let us consider this red-green scale in a realistic light. Its purpose is to sell tubes! The control settings given on the charts are calibrated so that the average new tube will read well in the green. If a tube measures an arbitrary percentage (usually 15% or 20%) "below normal," it will read in the red. This merely means that the tube is weak in emission (or transconductance on some testers) and not necessarily "bad" in the sense that it will not operate. However, the customer can accept the tester as a supreme judge with the net result that we sell him a tube when his tests in the red, even though we know his old tube may work.

The function of a tube tester as a tube-selling aid is one of its most valuable uses and will, in fact, pay for its cost many times over. There need not be any sense of guilt connected with this selling. Most customers will usually buy a new tube even though they are told: "This tube will probably work, but it tests weak on the tester." The customer's logic is good. The tube tests weak, therefore it is likely to fail in the near future.

If the customer does not purchase a replacement for the weak tube, the technician has still gained several advantages: the customer is impressed with the technician's honesty; in case the set fails within the guarantee period, the customer is not as hostile when he brings it back. His thought is: "Maybe that weak tube went."

When the question of testing tubes for troubleshooting arises, the usual answer is: "Why bother? Swap them! That'll tell." This is true enough on the surface, and swapping tubes is a helpful maneuver. There are several disadvantages, however. If new stock is used for swapping, it soon degenerates badly. The cartons

become shopworn and unusable. Unless extreme care is taken, used and defective tubes will work their way into the stock.

Many shops avoid the deterioration of their new stock by keeping a "bench stock" of tubes on the test bench for swapping. This is fine, but it represents an investment of a surprising number of dollars. In addition, the bench stock deteriorates rapidly. To prove this to yourself, take an afternoon when you are not busy and test the bench stock.

Advantages of Tube Testers

Tube swapping is not 100% accurate any more than a tube tester is! Swapping is accurate only when the substitute is known good. There can never be absolute certainty that it is.

One TV set was brought in for bench service. The outside man had (supposedly) swapped tubes. However, the bench man tested the tubes with a view of sales and found five defective (not just weak) tubes. This cleared all symptoms and the set required no further service. The only tube-swapping system that would have cleared the set would have been the insertion of a complete known-good set of tubes followed by reinsertion of the old tubes, one at a time.

This is time-consuming and not generally done by tube swappers. Had it not been for the tube testing, the bench man would have had a rip-snorting troubleshooting job.

A situation that arises repeatedly is the case of a circuit that contains both a defective component and a defective tube. The tube is swapped first, and, since no improvement is seen, it is reinserted. After the replacement of the defective component further trouble-shooting is needed to find the bad tube. Here, the tester would most likely have caught it on the first try.

As another example, take the case of a tube with a heater-cathode short. If this tube is inserted in a set where one side of the heater and the cathode are grounded and if the short is from the cathode to the grounded side of the heater, the tube will work perfectly and be considered a known good. This may seem a long chain of circumstances, but anyone who tests many tubes will testify that it happens surprisingly often. Now, when this "known-good" (but actually defective) tube is used as a substitute, it can cause a diagnosis that leads to much fruitless trouble-shooting.

Grid emission (not shown by the less expensive testers) also causes much confusion in tube swapping. If the tube is inserted in a circuit where the grid circuit resistance is very low, it may work perfectly and be considered a known good. This same tube inserted into another circuit with high resistance in the grid return will develop a positive voltage on the grid and cause many peculiar symptoms. The gas test on better tube testers catches these quickly.

The short test on tube testers is of more value to the bench technician than the emission or transconductance test. Any tube that shows an inter-element short can safely be considered defective (definitely "bad") and replaced. Circuits where the tube will work even though shorted are rare and the number of tubes unnecessarily replaced is negligible. If an intermittent short is suspected, the logical step is to tap the tube gently at each position of the short test.

The noise test present on some testers is seldom needed, but it is a life-saver when the occasion arises. Each tube can be checked for noise or microphonics separately with concrete, dependable indications.

Most of the preceding has been in favor of using the tube tester. However, this should not be taken as argument against tube swapping. The most profitable attitude a technician can take is to consider the tube tester as a valuable tool and tube swapping a valuable procedure, and use both.

The tube tester should be looked upon as a fact-indicating device, just as a voltmeter or ohmmeter, and not as a judge. The indications of the checker must be interpreted and judged, just as those of other test equipment.

A resistor measures 500,000 ohms. Is it bad? This reading of a resistor does not say whether it is good or bad. If it is marked 68,000 ohms, it is bad. Similarly, a 6K6-GT tests somewhat low on emission. It is bad? Well, let's see—if it is used in the sound output, the slight loss in volume may be unnoticeable. It will work, so we can consider it "good" or at least satisfactory. But wait—the focus coil is in the cathode of the sound output and the symptom is poor focus! Now, the interpretation is different. A new tube clears the trouble and the weak 6K6 is now considered bad.

When the disillusioned technician is ready to return to the use of a tube checker, he should also be ready to keep in mind the failings of most testers. The following is a list of common tube-tester shortcomings obtained from bench experience.

1. When a tube tester checks a tube "bad," the tester is much more likely to be accurate than when it says the tube is "good."

2. Rectifiers will often test in the green on emission test and still produce low B-plus voltage. This is because a tube may have sufficient emis-

sion to carry the dc required to test good and yet have insufficient emission to handle the peak currents demanded in actual operation.

3. Tubes used in high-frequency oscillators, such as the 6J6, will often test good and still refuse to operate.

4. Most power tubes, such as 6K6, 25BJ6, etc. operate at a much higher temperature in the receiver. If trouble shows up only after a long warmup, the suspected tube should be tested immediately upon removal from the set, while it is still hot.

5. High-voltage tubes, 1X2, 1B3, etc., are not tested under normal operation by most tube testers. A "good" test of one of these means little.

6. Certain tube type numbers, as those used in tuners, will show a strong tendency to test good and still refuse to operate.

Ten Commandments for Testers

A few general rules can be set up concerning the decision as to swap or check. These are merely guides to the use of the fastest and most convenient system.

1. In customers' homes it is generally much faster to swap tubes. A complete tube check is too time consuming. If the symptom is distinct and clearly indicates trouble in one specific circuit, the two or three tubes in that circuit can be changed quickly. In addition, carrying the tube tester is excess effort while the tube kit *must* be brought along for replacements.

2. When a set is placed on the bench and has many vague symptoms, it is wise to give it a complete tube test. Although new tubes will seldom cure the trouble completely, it will usually be found that defective tubes are causing some of the symptoms. Replacing these clarifies the remaining symptoms and makes troubelshooting easier.

3. If a receiver on the bench has one clear symptom, tube swapping is faster and more certain. For instance, lack of width indicates changing the horizontal output tube immediately without bothering to test it.

4. When a set has a long history of recalls and general customer dissatisfaction, a complete tube test is very helpful in most cases.

5. When a stubborn symptom, definitely in one specific circuit, is met, use both systems. Test the old tube. Test a new tube, then swap.

6. When a technician is completely stopped on a symptom that is apparently in one specific circuit, it is wise to give the set a complete tube test. The various circuits in any TV set are usually not completely isolated from each other. Often a defective tube in a completely different section of the receiver will be found to be causing the symptom.

7. When in doubt, test new tubes. Only too frequently will it be found that entire "runs" of a certain tube number will develop the same defect shortly after being placed in a radio or TV receiver.

8. If a set has too simple a trouble, the profit may be too small to provide for a possible recall. A tube test here serves a dual function. It reduces the possibility of a recall, and also increases the profit to enable the technician to accept a recall on this set with better grace.

9. Sometimes a technician will gamble a new tube rather than pull the chassis, and he will replace a tube that might have been caused to go by a defective component. If the tube tester is handy and the new tube is tested before insertion, the technician will know if he has lost the gamble. Thus he will not wonder whether the new tube was bad in the carton.

10. When selling a tube over the counter, it is wise to test the new tube. This improves goodwill by preventing the sale of defective tubes. If the tube is of a type number that is often blown by defective components (such as a 35Z5), the customer should be warned of the possibility. This will avoid arguments over tubes burned out by the customer and should bring the set to the shop.

The tube tester is also a very valuable psychological tool. Most technicians detest having the customer look over their shoulder when they are working. If the customer insists on watching while the technician takes a look at his set, the tester gives the service technician something to do while inspecting the set for an estimate. A tube test is a much more satisfying show for the customer than the spectacle of a man probing around with a test prod, apparently aimlessly.

Thus, if the technician thoroughly understands what the tube tester actually does and how it does it, the results he obtains will not be mystifying. In addition, this knowledge will enable him to use it in original ways, developed to fit the circumstances of a particular situation.

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