HOW TO GET THE MOST OUT OF YOUR Model TV-11

MARTIN CLIFFORD
Senior Instructor, Radio Television Training Assn.

INTRODUCTION

From an appearance viewpoint, your tube tester is without a doubt the most complicated test apparatus you have in your possession. Containing far more knobs, controls, levers, switches, and sockets than any multitester, vacuum-tube voltmeter, or oscilloscope, the operating panel of a tube tester can sometimes leave even an experienced technician with a feeling of frustration.

Despite its appearance, a tube tester is easier to operate than any of the instruments we have named above, without exception. A multimeter or signal generator may have the advantage of single-knob control, but do not let this deceptively simple facade fool you for a moment. A multitester requires that you have at least an understanding of the fundamentals of electricity. The use which you get out of such an instrument is in direct proportion to your own electronic ability. With the right kind and amount of knowledge, even a balky, contrary, complicated television set must yield to the skill of the technician who knows how to get the most out of his multimeter or signal generator. These latter-named instruments are all versatile. They can, depending upon the know-how of the operator, be made to do innumerable jobs, far over and above their normal operating requirements.

But what about a tube tester? Here we have an instrument that does not depend upon skill or a vast background of electronic knowledge. The tube tester does not have a hundred different jobs that it can do equally well, nor fifty, nor even ten. It has one, and one job only, and that is to test tubes. It is true that your TV-11 can also test for leakage of capacitors, but this is a special design feature that has been built into your tube tester, and is not usually found in such equipment.

Because the tube tester can actually do only one job, and because the tube tester is really so very easy to operate, it is quite possible that you might regard it as being among the least valuable of your test instruments. Yet if you will just consider for a moment, you will realize that your tube tester is probably your most used test instrument. The majority of troubles in AM, FM, or TV receivers are caused by tubes. You can meet this problem in two ways. You can either carry a complete stock of at least one of every radio tube made today (a tremendous variety) and check tubes by substitution, or you can use a tube tester. Quite obviously this latter technique is the most economical and the most practical.

LINE ADJUSTMENT

We have become so accustomed to using electrical appliances in our home and at work that we sometimes get the idea that our power line voltage is absolutely steady, constant, and unchangeable. Power line voltage not only can fluctuate, but can sometimes drop to such a low value as to affect the operation of radio and television receivers. The voltage that exists at your outlet depends upon the load being placed across the line. If you (and your neighbors) are using toasters, dish-washing and clothes-washing machines, electric heaters and ironers, or if you live or work in an area in which industrial machinery is operated, the line voltage can decrease seriously.

Your TV-11 tube tester operates from the a.c. power line. You should make sure that your power outlet supplies 117 volts a.c. The line frequency should be 60 cycles. If your line frequency is only 25 cycles, or if you live in a d.c. power area, do not attempt the use of your TV-11 tube tester. D. C. power or an a.c. power line having a frequency of only 25 cycles can burn out the power transformer in your tube tester.

If you have the slightest doubt about the type of power in your locality, check with your local power company. A telephone call or a letter costs much less than expensive repairs or replacement.

If you will look at the meter mounted on your TV-11 you will notice a vertical line at the center of the scale. Immediately above this line you will see the words LINE ADJ printed in red. This is an abbreviation for line adjustment. Connect your tube tester to the power line. At the left side of your tube tester you will find a 4-position slide switch. This switch can move in a vertical manner only. Move the switch so that it occupies the very bottom position. This position will correspond to the word line engraved on the metal panel to the right of the switch. Now turn the power on. Do this by moving the 2-position slide switch marked PWR (this stands for power) up to the ON position. When you do you will note that your meter needle will swing to the approximate center of the scale. However, an approximate needle position is not quite good enough for us. We want that needle to rest right on that black line under the words LINE ADJ. We can do this by turning the knob located to the right of the PWR switch. Actually, this knob is located between two slide switches. To help you find this knob, the words LINE ADJ appear engraved in the metal just above the knob itself. Now turn this knob slowly. Watch the needle. You will note that the motion of the knob controls

the movement of the needle. Now turn the LINE ADJ knob until the needle is right at the center of the scale. Your TV-11 is now ready to go to work for you! Remember, however, that this line adjustment procedure must be followed whenever you have tubes to test. An adjustment that you make today is not necessarily suitable for tomorrow. When you are finished with the TV-11, make sure that you put the PWR slide switch to the bottom or OFF position.

FILAMENT VOLTAGE

A radio tube works for us because we force it to do so. We do this by applying voltages to the tube. The average radio tube needs at least three different voltages before it will go through its paces for us. One of these voltages is known as the filament voltage. A filament voltage has the same job in a radio tube that a gas flame has in a kitchen stove. The only job that the filament has is that of a heating action. The amount of filament heat that a tube requires varies from tube to tube. Some tubes become so hot that they cannot be touched during normal operation. Others remain so comparatively cool that it is sometimes difficult to determine if a tube has warmed up or not.

Filament voltages for tubes vary from low of 3/4 volt to as much as 117 volts. The first two numbers of a tube type indicate the approximate filament voltage. Thus, a 6SN7 uses 6.3 volts to heat its filament. A 50L6 requires 50 filament volts, while a 117P7 needs 117 volts.

Filament voltage is improtant. If you use too high a filament voltage the filament will burn out. If you apply too low a filament voltage, the tube will refuse to work properly. At the bottom of the panel on your TV-11 you will see a large circle at the top of which is engraved the word FILAMENT. Turn the knob. By doing this you can select the filament voltage of any receiving-type radio tube.

On the panel of your TV-11 tube tester you will see a number of tube sockets. Quite obviously these are meant to accomodate the tube or tubes you are going to test. Before you so much as put a single tube in any one of the sockets, it is extremely important that you do these two things:

1. Adjust the line voltage.
2. Set the filament voltage control knob so that it is at the proper position.

If you do not observe these elementary precautions, you will either burn out your tube, or else you will force your TV-11 to give you a completely inaccurate and misleading reading. This means that the very first thing you must do before testing a tube is to know the tube type.

The number of a tube is printed on the tube itself. These numbers have the very unhappy faculty of being able to disappear. While this is an exasperating characteristic (expensive, too) there are a number of ways in which you can locate hard, or impossible-to-read numbers. Some of these ideas and suggestions may sound silly, but they do work.

If you cannot find the number on a glass tube, or if you can find the number but cannot read it because it is illegible, rub the tube in your scalp, at the back of your head. We know this sounds preposterous, but there is a very valid, scientific reason why this will help. The oil in the hair or on the scalp will make tube numbers reappear. The reason we mention the back of the head is that nearly all of us (despite the toll taken by age) have some hair at that spot. Try it. It works! If you prefer, dip the tube into some household ammonia (watch those fumes!) and then put the tube into your refrigerator for an hour. One other trick, often used by technicians, is to note the location of the tube in the receiver. Then, with the aid of a manufacturer's tube layout diagram, they can easily identify the tube. A successful technician is often at least 10% detective.

TUBE BASES

The average tube has at least four pins, usually more, coming out of its base. Not only can the number of pins vary from tube to tube, but the thickness of these pins is not necessarily the same for different tube types. Some tube pins are very rugged and can tolerate considerable punishment and abuse. This is true of large size tubes. Some tube pins are extremely fragile and if unduly molested will either break or will crack the glass through which they extend. When you put a tube into the socket on the panel of your TV-11, remember that the pins of the tube are going to make a snug fit, not a force fit. Forcing the tube can only mean that you are intent upon damaging both tube and tube tester.

At this stage of the game there are a few common-sense precautions we should take. Put the tube in its proper socket. The bottom of the tube should rest close to the bakelite face of the

socket itself and not hang half way out as though unable to make up its mind whether it is going in or coming out. If the tube has a metal cap, make sure that you connect to it the red lead coming out of the left (upper) side of your TV-11 panel. Handle miniature and subminiature tubes with the care and respect which their fragility and expense call for. Do not put more than one tube in the sockets. Your TV-11 (or any other tube tester) checks only one tube at a time. If you plan to test a large number of tubes, you will find the inside part of the lid of your tube tester an ideal temporary storage place. Before testing, group your tubes. Keep identical tubes together. Then group all tubes having similar filament voltages. Do not judge the quality of a tube by the speed with which your meter needle moves into position. Some filaments heat rapidly, others slowly. Most often, this is inherent in the tube design and is not a tube fault. Do not insert a tube, and especially do not remove a tube, by pulling on the glass body of the tube. If you do, you may find yourself with a hand-full of glass particles with the base of the tube comfortably seated in its tube socket. If a tube is too hot to touch, wait a moment and let it cool off. It's much easier to replace a tube than part of your skin, and much less painful. If you must carry tubes around with you, try to keep each tube in its own little carton. A paper bag designed to hold hardware is a little less than ideal.

HOW TO TEST A TUBE FOR QUALITY

By now we are almost completely acquainted with our TV-11, except that there still are a few controls that need our attention. The best way in which we can learn how to check a tube for quality (that is, whether the tube is good or bad) is to actually test a tube. However, since tubes do cost money, let's first make a "dry run" to make sure we do not make any mistakes.

Here, in a step-by-step fashion is how we test tubes.

1. At the bottom center of your TV-11 you will find a chart. This chart gives a listing of all modern radio tubes (and some that are not quite so modern). To the right of this chart is a small knob inserted vertically into your tube tester. Turn this knob. As you do, you will note that the chart (immediately under the words Tube Tester) will rotate. The very first column to the left on your turnable chart is the tube type. This corresponds to the number you will find imprinted on the tube itself. With very few exceptions, you will note that tube types always begin with a number. Further, if you will turn the chart control knob slowly,

you will see that these numbers are arranged in a numerical sequence. First we have all the tube types beginning with the number 1, then those beginning with the number 2, etc. This first number is your clue as to the filament voltage of a tube.

Now let's continue our examination of our chart. Go over to the next column. Stamped on the metal panel of your TV-11 you will now find the words Fil. V. This is an abbreviation for the words filament voltage. Note that the numbers that appear under this heading and the first number of the tube type are almost the same. If, for example, you will turn the chart and examine Tube Type 6A3, you will find that the filament voltage is 6.3 volts. Tube type 12AL5 has a filament voltage of 12 volts (actually 12.6 volts).

Before we go away from the Fil. V. column on the chart, there is just one important fact that we should remember. Every number in this column corresponds to a filament voltage chosen by the filament-voltage switch. The filament voltage switch is operated by the knob in the lower-left hand corner of your tube tester. This explanation has been rather lengthy, so let's repeat it very briefly this time.

Look at your tube. On it, find the tube type number. Turn your chart until you find this number on it. Look under Fil. V. Rotate your Filament voltage switch until it corresponds to this number.

> Example: You have a tube stamped with the numbers 12SK7. Turn your chart until you see this number. Alongside this number (under the heading Fil. V) you will see the number 12. Rotate your filament voltage switch until it comes to the number 12.

WHAT ABOUT ALL THOSE LEVERS IN THE CENTER OF MY TUBE TESTER?

These levers are designed to put various voltages on the tube you are testing so as to give the tube the impression that it's busy working in a radio or TV set. These levers are just as easy to use as any of the other controls on your TV-11.

Let's go back to our chart for just a moment. Locate the letter F engraved into the metal panel immediately above the chart. This same letter also appears else where on your panel. You will see that it appears to the right and left of your control levers.

Above and below each lever you will find a number. Thus, the first lever is the number 1 lever, the next is number 2, etc.

Let's go back to our chart for just a moment and look below the letter F. As you turn the chart you will see that various numbers appear in the F Column. These numbers refer to the levers immediately above the chart.

To make sure that we understand the function of the F column in the chart, let's assume that we are testing a tube such as a 6AL5. In the F column, corresponding to this tube type number we find the number 3. This means that we must pay attention to lever No. 3. Move this lever up as far as it will go, so that it intercepts or rests on the white line connecting the letter F on the left to the letter F on the right.

Experiment with this lever. You will note that it can occupy any one of four different positions. At the moment we are only interested in the top position or the F position. The other positions are labeled N; P; and K.

At the moment our No. 3 lever is in the top or F position. What about all the other levers? Push those down as far as they will go (gently - no force) until they all occupy the K position.

Just to make sure that we understand or remember all of the steps we have covered so far, let's pick a well known tube such as a 5U4.

1. We examine the tube and make sure that it is indeed a 5U4.
2. Turn the chart until you locate the tube type (5U4).
3. Look in the column marked Fil V. In this column we see the number 5.0.
4. Turn the filament switch to 5.0.
5. Now look on the chart in the column marked F. The number here is 2.
6. Pull down <u>all</u> levers until they are in the bottom or K position.
7. Move lever No. 2 up until it is in the top or F position.

Before you go a step further, please repeat these steps until you are familiar with them. Knowing these steps so well that you do not have to consult this booklet or the printed card accompanying your TV-11 has a number of decided advantages. You will

save tubes since you will automatically follow correct procedure. Equally important, if a customer is watching you test tubes you can build customer confidence by not consulting your instruction sheet. The time for you to learn is before you have a customer, not during or after. Do not let customers or other persons use your tube tester. Do not assume that others know as much about your TV-11 as you do.

THE N POSITION

Another column on your chart is headed by the letter N engraved into the metal panel. Here we follow exactly the same procedure that we did when we worked with the F position. (The letter N is an abbreviation for the word neutral). As an example, let us consider a tube such as a 6AS5. When we turn to this tube type on our chart we find the number 2 in the N column. All we need do is to push the No. 2 lever to the N position. Be careful! Do not confuse the top or F position with the next-to-the top or N position. Of course, if there is no number in the N column on the chart, you can then ignore the N column completely.

THE P POSITION

We can move a little faster now that you have the general idea. Look under the letter P on the tube chart. The number you will find here corresponds to a similar lever. Thus the number 3 means lever No. 3. Number 5 means lever number 5. Remember, however, to be sure to move the indicated lever to the P position.

That is all there is to operating the levers. It looks complicated, but actually, it is quite easy. Just one more word on this subject, however. If, for example, you find several numbers listed in the N column for a particular tube, this means that all these levers are all to be operated. Suppose, for instance, under the N heading you find the numbers 3,7. You should then move lever No. 3 and also lever No. 7 to the N position. The very last lever at the far right is marked T.C. Sometimes in the P column you will see reference made to T.C. All this means is that the T.C. lever should be set in the P position. The letters "T.C." represent the "top-cap" of a tube. Since the top cap of some tubes is the control grid (as in the 6K7, 6A7, etc.) and in others is the anode or plate lead (as in the 1B3, 6BG6, 6BQ6), the letters "T.C." (top cap) are used, rather than the words plate or grid.

LOAD

Nearly all radio tubes work into some kind of a load. The load for a radio tube can be a resistor, or it can be the primary of an interstage or an output transformer. Just as the very best way to test a 4-ton truck is to load it with 4 tons, so the best way in which to test a tube is to impose on it the load which it would have under actual operating conditions. The load adjustment is determined by the setting of the control placed at the bottom-right on the metal panel of your TV-11. This control can be turned clockwise and counter-colockwise. When it is set to some small number such as 1, or 2, then you are imposing a heavy load on the tube being tested. As you move the pointer or knob around and make it reach numbers such as 5, or 6, you are then decreasing the load. If you will look at the chart you will see that you have a column marked Load. The load may be any number from 1 to 10. Whatever this number may be, all you need do is to set the load control so that it coresponds to this number. For example: turn the tube chart until you locate the 12J5, a commonly used tube. In the column marked Load you will see the number 3. All you need do is to turn the load control knob until it comes to rest on the number 3. That's all there is to it!

Some technicians have the idea that the larger the value (in ohms) a plate load resistor has, the heavier is the load. This is not correct. The load is determined by the amount of current flowing in the plate circuit of a tube. If a plate-load resistor is in the order of megohms, for example, the current in the plate circuit will be low, hence we refer to such a condition as a light load. If we were now to decrease the value of our megohm-type resistor (connected to the same tube) the plate current would go up. An increase in plate current imposes a heavier burden on the tube (or a heavier load).

When you turn you load control clockwise, you are increasing the resistance. More resistance means less current. Less current means a lighter load. When the control is completely clockwise (as far as it will go), then the control is actually removed from the circuit (open-circuit condition), the plate current drops to zero, and the load is as light as you will ever get it.

SOME TUBES HAVE A TOUGH LIFE!

Many new and unusual tubes have been designed and developed since the first day that tubes were invented. Most tubes are single purpose tubes - that is, they have only one job to do. Others are multi-purpose tubes and do many jobs. Tubes such as the duo-diodes, diode-triodes, diode-pentodes, diode-triode-pentodes, are specially built to save space and money.

We'll learn how to test these tubes, but it will be much better if we start with single purpose tubes and then work our way along to the more complex ones. However, you will find that even the most complicated, multi-purpose tube is easy to test with your TV-11 tube tester.

TESTING TRIODES

As an example, let's pick a popular type such as the 6A3. Examine the tube first to make sure of the tube type number. Now connect your line cord to the power outlet (even the best technicians sometimes forget to do this) put the 4 position slide switch in the "line" position and move the power switch to the on position. Turn the line adj. knob until the meter pointer comes to rest at the center of the scale (this is a line marked Line Adj - and is printed on the face of the meter). Now readjust the line control again to compensate for the drain of the tube. After you have set the line adjustment so that the meter reads directly under the line adjust mark, then push the 4-position slide switch to the reg (top) position.

You may wonder why you have to make another adjustment for the line voltage, since your first step in using your tube tester was to compensate for any fluctuations in the line. Some tubes, particularly high-current rectifiers (such as the 5U4, etc.) draw a comparatively heavy current. This imposes such a load on the line that it is quite possible for the line voltage to drop. This effect is not as evident with miniature tubes since the current taken by such tubes is rather small.

Turn the chart until you locate the 6A3. You will note in the Fil. V. column that you have the number 6.3. Turn your filament voltage switch until it comes to rest on 6.3.

Now you can set the various levers. First, the lever corresponding to the F position on the chart. This is marked No. 1.

Take the first lever (the one at the extreme left) and move it to the very top or F position. (The starting position of all levers should be in the bottom or K position)

If you will look in the next column (N) on the chart you will see that it is blank, so we can disregard it. Our next step is to examine the P column on the chart. Here we see the number 3. We take lever No. 3 and move it up one space until it occupies the P position. Finally, we see that under the heading of load on your chart we have the number 3. We can now set the load control knob (bottom right on the panel) to position 3. Now you can insert the tube in its proper socket - carefully. The tube can go into the socket in only one way. If you have to use force, then you may have the tube reversed or are trying to put the tube into the wrong socket.

The meter will now tell us the quality of our 6A3. If you have a large number of 6A3's to test, you do not have to make any changes in the controls nor do you have to shut off the power to the meter. Just pull out the first 6A3 and put in the next one. In each case your TV-11 will tell you if the tube is good or if it has to be replaced.

TESTING PENTODES

Single purpose pentodes are tested in exactly the same way in which we test triodes. However, now that we know something about the operation of our TV-11, our instructions will be somewhat more brief.

Connect the line cord to an outlet (a.c. only). Set the 4-position slide switch to the line position and center the meter needle with the line adj. knob.

Let's assume that our pentode to be tested is a 6SH7, as indicated by the type number stamped or marked on the tube itself. Set your 4-position slide switch to Line (This is the bottom position for this switch). Locate 6SH7 on your chart. Fil. V. is 6.3, so we turn our filament knob to this number. F on the chart is 2, so move lever No. 2 to the top or F position. The next column on the chart (N) has the number 3, so we move lever No. 3 to the N position. Column P on your chart has the number 4, so we move lever No. 4 to the P position. All other levers must be in the bottom or K position. Plug in the tube, readjust the line adjust control (if necessary), then push the 4-position slide switch up

to the reg. (top) position. Look at the reading given by your tube tester, after the tube heats up sufficiently.

TESTING MULTI-PURPOSE TUBES

You can easily tell if a tube is a multi-purpose type in two different ways. You can consult a tube manual, or easier, you can look at the moving chart on your tube tester. As you know, the tube type is given in the extreme left-hand column on the chart. If a tube type number is repeated then you have a multi-purpose tube. Now let's go through the routine of checking a typical dual purpose tube such as the 6AL5. This is a miniature type widely used in FM and TV receivers.

Connect the TV-11 to the power line (a.c. only) and adjust for proper line voltage. The 4-position slide switch should then be moved from the line to the reg. position (from bottom to top position).

Find type 6AL5 on your chart. You will see that this type number appears twice. Since a dual purpose tube is really two tubes in one, what we are going to do is to test each section as though it were actually an individual tube. As you can see from your chart, we have two separate tests for this tube. It doesn't make any difference which test we do first.

Let's start with the first 6AL5 designation. Our control settings are Fil. V. 6.3; F - 3; P - 2; load - 10. (There is no setting for N) Following the instructions on our chart, we turn the Filament knob to 6.3, lever No. 3 to the F position; lever No. 2 to the P position (all other levers must be in the K position) and put our load control knob on position 10. Once you are sure that all of your settings are correct, insert the tube in the proper socket. Throw your 4-position slide switch to line and make sure that the line voltage is correct. Turn the line adj. knob, if necessary. Now you can move your slide switch to the reg position. Your meter will indicate the quality of the first section of this tube.

Testing the second section of this tube is easy since we need change only one control. You do not have to remove the tube from its socket and you do not have to shut off the power. If you will examine the setting requirements for the second half of the 6AL5 (on your chart) you will see that all control settings are exactly the same as for the first half with but one exception. Lever No. 7 must be moved into the P position, and lever No. 2 (used in the

first test) is dropped back to the bottom or K position. That's all there is to it! Your meter will now tell you the quality or condition of the second half of the tube. Sometimes one half of a tube will test good while the other half tests poorly. It may be exasperating to throw away a tube, part of which is still good, but in most cases there is just no choice in the matter.

Some tubes really earn their keep. Take a tube such as the 12SQ7 for example, widely used in popular a.c.-d.c. radio receivers. This tube does the work ordinarily performed by three tubes. It acts as a diode detector, automatic gain control, and also as a first audio amplifier. Since the tube has three jobs we test it just as though it were actually three separate tubes. If you will locate the 12SQ7 on your chart you will see that it has three listings, one for each section of the tube. The order in which you make these tests is not important. Our personal preference is to do the tests in order, just to make sure we do not omit any.

Plug the meter into the a.c. line and adjust for proper line voltage. During this check, remember that your 4-position slide switch must be in the line position.

Look at the chart. Fil. V. column specifies 12. Rotate the filament knob to this number. The F column has the number 7. Up goes lever No. 7 to the F position. The P column on the graph has the number 2. Lever No. 2 moves up to the P position. All other levers remain in the bottom or K position. The load column on the graph has the number 3, so we turn our load control knob to this number. Put the 12SQ7 into its proper tube socket. Readjust the line adj. control, if necessary, then push the 4-position slide switch up to the reg (top) position. Now read the quality of the tube from the meter.

To test the second section of the tube we must make some minor adjustments. As you can see from the graph, lever No. 4 is to be moved to the P position. This position was formerly occupied by lever No. 2. Lever No. 2 must now be moved back to its starting or K position. Turn the load knob to 10 and you are now ready to read the condition of the second part of the tube.

By this time you probably suspect the procedure we are going to use for checking the third part of this versatile tube. Look at the chart. Everything remains the same, with a minor exception. Lever No. 5 moves into the P position. Lever No. 4 that was set in the P position for the second test, now drops down

to the bottom or K position. That's all. Just read the quality of this part of the tube on the meter.

NOT ALL TUBES ARE ALIKE

People are different, cars are different, houses are different...and so are tubes. Some tubes have a very low resistance. The current flowing through such tubes is comparatively high. Some tubes have a very high resistance, consequently the current going through them is very small. For the most part, tubes having a high resistance are used as rectifiers. Tubes such as the 1B3, 1X2, 1X2-A, 2V3, 2X2 belong to the high-resistance family. If you will examine the listings for these tubes on your chart you will see that they all have a load setting of 10. Because of the very high resistance of such tubes, a reading of 10 or higher on your meter is an indication that the tube is good. When testing such tubes, disregard the red "replace" part of the meter face. The number 10 on your meter is a line halfway between the zero mark and the number 20. This number 10 is a minimum reading. If, for example, you are testing a 1B3 and the meter needle reaches the number 20, then the tube is satisfactory.

SHORTS AND LEAKAGES

A tube consists of tiny pieces of metal placed inside a glass or metal housing. These bits of metal are arranged somewhat like a sandwich, but with much more precision. These metal pieces (we call them elements) must not touch each other, must not move around. All the air inside the tube is pumped out, so that the current flowing in the tube does not meet any unexpected interference. The air outside the tube has just one idea in mind and that is to sneak back into the tube from which it was pushed out. If the air can get inside the tube, it makes the tube behave in a noisy, erratic manner.

The spacing between the elements in a tube is very small. Sometimes in a radio tube, one element may be only a few thousandths of an inch away from another element. If a tube gets tossed around, or otherwise abused, one of the elements may not be able to take the punishment and may lean over on another element for support. This is bad, since elements falling all over each other usually forget the work they are supposed to be doing.

We can't see the air that worms its way into a tube, and it's hard for us to see those elements that are too lazy to stand on their own feet, so we rely on our TV-11 to do a bit of detective work for us.

You should make a short and leakage test as part of your regular, routine check for tube quality. After you have tested a tube for quality, move the 4-position slide switch to the short position. Over on the extreme right-hand side of your TV-11 you will find a 2-position slide switch marked L K G. Move this switch up, until it occupies the tube position. This is marked tube at the top of the switch. Now turn your load control knob in a clockwise manner until you reach the number 10.

Make sure that all levers are in the K position. Do not touch levers which are in the F or N positions. These levers, placed in the F and N positions by the quality test you made earlier should not be moved during this check.

Now take lever No. 1 and move it up one space until it is in the P position. Over at the right on your TV-11 you have a neon bulb protected by a glass covering. If this neon bulb remains lit, then the tube is shorted. If the neon bulb flashes just once (fairly quickly) you can disregard this as it is caused by the capacitance of the tube. All tubes have capacitance - some have more, others have less.

If the neon bulb does not light, move lever No. 1 back to its K position. Now repeat the test using lever No. 2. Move lever No. 2 up into the P position. Look at the neon bulb. If it glows, the tube is shorted or has high leakage.

Go through all of your levers in the same way. There are only two precautions which you need take. First, after making a short and leakage test, be sure to return the lever to its original or K position. Second, make the test in numerical sequence, starting with lever No. 1 and ending with lever marked T.C. Do not, however, touch any lever that you had previously set in the F or N positions.

DO ALL TUBES HAVE THE SAME LEAKAGE PROBLEMS

No! Just as it's much easier to thoroughly sweep a small room rather than a large auditorium, so is it easier to get all the air out of a tiny tube. The problem gets more difficult as the tube gets bigger. Most of our big receiving tubes are power amplifier tubes such as the 6L6, 50L6, 6A3, and the 6BG6-G. Some of these tubes have a certain amount of leakage. For example, if you will watch a 6BG6-G in operation in a television receiver (this is the horizontal output tube) you will notice a blue glow

down near the base of the tube. This glow is due to the presence of a small amount of air in the tube. This does not mean that the tube is defective or that it will not work properly.

When you test tubes such as these for leakage, it is entirely possible for the neon bulb on your TV-11 to glow faintly. For tubes of this type such a glow does not mean that the tube is defective.

FILAMENT CONTINUITY TEST

A filament in a tube is like steam radiator in a room. It has to be fairly warm before it begins to do any good. We heat a radiator with steam or hot water; we heat the tube filament with an electrical current. Not all tubes require the same amount of filament power. Small tubes remain fairly cool to the touch; others become so hot that it is foolhardy to touch them until the power has been turned off for several minutes.

There are a number of ways in which you can check filament continuity. The easiest is to look at the tube in operation, either in the receiver or in your TV-11. If the tube is lit, there is no doubt about the continuity of the filament. Of course, this applies only to glass tubes. If you have a metal tube and it feels warm or hot to the touch, again you can stop concerning yourself about filament continuity.

Some tubes use such a small amount of filament power that our senses of sight and touch are of no help. In such cases, use your TV-11! This test is even easier than the others we have described so far.

Set up your TV-11 just as though you were going to check for shorts and leakages. This means that the 4-position slide switch will be in the short position, the leakage slide switch will be in the tube position, the load control will be on the number 10.

Now look on your chart. At the extreme right on the chart is a column which we have not used as yet. This column is marked Fil. Cont., these words being marked in the metal panel immediately above the chart. Note that the numbers in the Fil. Cont. (filament continuity) column come in pairs. Each of these numbers represents the actual filament pin numbers of the various tubes. If you will roll the chart until you reach tube type 6V6 you will see that the numbers in the Fil. Cont. column are 2 and 7. These are the pin numbers of that tube.

The numbers in the Fil. Cont. column are lever-moving instructions for you. To test for filament continuity, put one of the levers in the P position, while the other remains in the K position. As an example, consider the 6V6 we have just mentioned. Its Fil. Cont. numbers are 2 and 7. To check for continuity put lever No. 2 in the P position, making sure that lever No. 7 is in the K position. All other levers should also be in the K position. If the neon bulb glows steadily, you have a continuous, unbroken filament. If the bulb does not glow, the filament is open.

Considering the 6V6 just once again, the numbers in the Fil. Cont. column are 2 and 7. Although we asked you to put the number 2 lever in the P position and the number 7 lever in the K position, this procedure could have been reversed, and the results would have been the same. (That is, No. 7 lever in P position, and No. 2 lever in K position). You can use either test you wish - it is not necessary to use both.

TESTING FOR NOISE

Tubes are like people. Some of us work best in an atmosphere of noise and bustle, while others prefer quiet, calm, serene surroundings. As far as tubes are concerned, the less noise they make during our radio and TV programs, the better will be our music or picture.

You cannot expect tubes to be absolutely quiet any more than you can expect people to remain quiet. However, you can insist that a tube have no more than a certain amount of noise - after which it is best to discard it.

Tubes get noisy for a number of reasons. The elements in the tube may vibrate slightly. Vibrations from the floor, from people walking near the set, from the cabinet itself, can set tube elements into a swinging motion like the pendulum of a clock. This motion of tube elements is so slight that we cannot see it, nor can we hear it directly. However, since a tube is the kind of a device that can make the footfalls of a fly sound like the roll of thunder, you can easily appreciate why tube manufacturers go to great lengths to make sure that elements remain in position where they are put. This vibration of tube elements is sometimes given the more technical name of microphonics.

Tubes can also be noisy because of the current flowing through them. Electrons flowing through the tube are deliberately

thrown against one of the elements (the anode or plate). This results in noise just as surely as if you threw an unlimited supply of baseballs against a tin roof.

To test for noise you will need a set of magnetic earphones. Use phones having an impedance of 2,000 ohms or more. Connect the phones to a plug and insert the plug into the jack marked noise test.

The various controls on your TV-11 should be set up exactly as though you were going to check for the quality of the tube. In turn, starting with lever No. 1, move each lever to the P position. Tap the tube gently. If you hear a loud ping when you do so, then the tube is microphonic. If you do not hear this particular sound, move lever No. 1 back to its K position, and repeat this with lever No. 2. Of course, if some of your levers were in the F or N positions originally, you should leave them there during the complete test. Disregard any hum you hear in the phones as this is normal.

LEAKY CAPACITORS

Next to tubes, capacitors (also known as condensers) can be serious trouble makers. They can ruin the sound and picture of a receiver with an ease that is really remarkable. Bad or leaky capacitors can force a picture to roll, tear, streak, black out; can cause hum or distorted sound. When they are good, they are very, very good, but when they are bad...!

You can use your TV-11 to check capacitors for leakage in just as simple and as easy a way in which you test tubes. Connect your TV-11 to the power line (keep it away from D.C.) and move the power slide switch to the on (the up) position. Now go over to the left side of your panel and put the 4-position slide switch in the line or bottom position.

Over on the far right of your tube tester panel you will find the LKG (leakage) 2-position slide switch. Move this down until it occupies the cond. position. (This is known as the condenser or capacitor position).

Over on the right-hand side of your meter panel you will see a pair of pin jacks. You can easily identify them by the fact that they have the word cond engraved on the panel between them. The capacitor is to be connected to these pin jacks. Connect the

capacitor by means of test leads, or bend over the capacitor leads and insert them in the jack. Make sure they make good contact.

When you connect the capacitor you will note a momentary flash from your neon bulb. If the bulb flashes once only, then you can assume that the capacitor is not leaky. If the bulb flashes rapidly and continuously, discard the capacitor.

Whether leakage can be tolerated in a capacitor depends upon the circuit in which you are going to put the capacitor and also upon the amount of leakage. A good general rule is to throw away any capacitor that flashes more than one time per second.

The larger the value of capacitance, the greater will be the flash made by the neon bulb. A small capacitor (such as a 10 uuf capacitor, for example) may cause the neon bulb to flash so rapidly that you may not even notice it. In such cases, you will find it helpful to test these low-value capacitors in a somewhat darkened room.

You can use this capacitor test to check any capacitor types - mica, paper oil-filled, ceramic - but not electrolytic capacitors. Of all capacitors, electrolytics have the greatest amount of leakage, so great, in fact, that it would be useless for you to attempt to test them by this method.

TESTING PILOT LAMPS

In many receivers, a pilot lamp does much more than just light and look cheerful. In some circuits pilot lamps are used as ballast or are placed in shunt across rectifier tube filaments. It is quite possible for a receiver to continue working with the pilot lamp removed or defective, but this can place a severe strain on the radio tubes associated with the pilot lamp and will result in shortened tube life. Considering the very low cost of pilot lamps, it is the better part of wisdom to test them and replace them when necessary.

To test a pilot lamp you must know its correct operating voltage. This will vary from lamp to lamp. If you do not know the voltage, you can get this information from the manufacturer, from his distributor, or from books which give pilot lamp data. An experienced technician can tell the voltage from the color of the bead supporting the filament inside the lamp, or from its position in the circuit of a radio receiver.

To test a pilot lamp, first set the filament voltage selector to the filament voltage of the lamp. Put the first lever (the No. 1 lever) in the F position, while all other levers should be in the K position. Now examine the tube sockets that are on the left-hand side (top) of your meter panel. The middle socket is a 7-pin socket with a metal-lined center hole. The pilot lamp should be inserted here. If the pilot lamp lights, you can consider it to be in good working order.

ODDS AND ENDS

Some tubes are very temperamental and require very special handling. Fortunately, the majority of tubes used in radio and television receivers are sensible, hard-working, and lead decent, useful lives. We would say that this description applies to about 98% of all tubes. However, since we have to work and live with a giddy minority of radio tubes, the best we can do is to learn to handle them with the particular treatment they demand.

One such "I'm a genius, treat me well" tube is the 0Z4. This tube goes under the very imposing royalty-like title of "cold-cathode, gassy diode". The tube has only two elements. The cathode is heated in a very special way from inside the tube. At one time this tube was widely used as a rectifier in auto radios, but because it couldn't do its job without making lots of noise (technicians call it hash), it has gradually been replaced with much more quiet, high-vacuum diodes.

To text the 0Z4, first turn your filament switch to the extreme clockwise position, until the pointer touches the number 117. Put the 4-position slide switch into the line (bottom) position. Now instead of centering your meter needle as you always do, this time we are going to ask you to turn the line adj knob until the meter needle is as close to the 100 mark on the scale as you can get.

After you have done this, go back to the 4-position slide switch and put it in the spec. (special) position. Put lever No. 8 in the P position and the load control so that the knob points to zero. Now put the tube in the proper socket. Watch the meter needle. If it starts to move to the right, turn your load control and stop at the number 3. You can now read your meter for tube quality.

The 0Z4, unlike most tubes, is not a vacuum type but is filled with an inert gas. Inert gases (such as Argon or Neon) are very stable, non-explosive, and are not violent. In the 0Z4 the gas must break down before the tube can work. This breaking-down process

is known as ionization. It requires a certain amount of voltage to produce ionization; an insufficient amount of voltage just means that the tube will sit back in its socket, will sulk, and refuse to work. Now it is entirely possible that the line voltage in your particular area may be too low to keep the 0Z4 happy. That is why we asked you to turn the line adj. knob to maximum. Sometimes even this is not enough, particularly if your line voltage is especially low. There are only two things we can suggest under such circumstances. The first of these is that you keep a record of your line voltage. Line voltage in some localities will fluctuate widely throughout the day. By making line voltage checks throughout the day you will easily determine when the line voltage is highest. You should check the 0Z4 when the line voltage is at its maximum.

Another technique which might prove helpful, is to test in some other location or in a different part of the town or city in which you live. If you work in a heavily industrialized area, the load placed on the line may often be heavy enough to drop its voltage seriously.

SUB-MINIATURE TUBES

Sub-miniature tubes are expensive. Unless you are very careful it is quite easy to break the pins of such tubes. These tubes, unlike all other tubes, are symmetrical...that is, you can insert these tubes in their sockets in two different ways. Unfortunately, however, only one of these two positions is the correct one. If you will carefully examine the sub-miniature tube you will see that it has a red dot on one side.

The tube socket for sub-miniature tubes is on the upper right-hand side of your meter panel. It is made of mica bakelite and has a dull-yellow appearance. You can further identify it by the fact that all of the holes for the tube pins are in a straight line. If you will now look carefully, you will see that there is a tiny dot on this tube socket. This dot is at the lower right-hand side of the socket. You should insert the tube into the socket in such a way that the red dot on the tube is immediately above the dot on the socket. Sub-miniature tubes today are made with a raised dot (or glass bead). The red dot has been discarded, but you will still find it on older type sub-miniatures.

NOTES

Please examine the chart on your tube tester, and, while turning the chart, keep your eye on the N column. You will observe that in a few cases we have inserted special notes. For example, if you will examine tube type 1Q6 or 1S6 on your chart you will see that we have written "see Note A" in the N column. Here is the meaning of these notes:

Note A - Reading above 10 is OK.
Note B - Reading above 20 is OK.
Note C - Pin No. 1 is missing.

ELECTRON-RAY TUBES

These are more popularly known as magic eye tubes. These tubes have lost a considerable amount of their popularity, but many of them are still used on older types of radios. The 6AF6 is a typical magic-eye tube. If you will locate this tube on your chart you will see that you are asked to disregard the meter reading.

A magic-eye tube is so called because it produces an effect similar to the opening and closing of the eye. If the eye of the tube (actually a shadow) can be made to open and close, then the tube may be considered to be in working order. When testing a magic-eye tube, such as the 6AF6, proceed just as though you were going to test a tube for quality. If, however, you will look in column P on your chart, you will see that it tells you to move lever No. 5 to the P position. When you do so, the eye shadow will open. Now move lever No. 8 to the P position. The shadow will close.

SOME SUGGESTIONS

You have received operating instructions for your TV-11 in two ways. One of these is the form of a printed card. The information contained on the printed card and in this booklet describes the operating procedure for your TV-11. Both types of instruction are the same. The only difference is that the information on the card is highly condensed and abbreviated, while in this booklet we have gone to greater lengths in our explanation. Some persons, because of greater familiarity with test instruments, find condensed card instructions adequate. Others may need more detailed, more elaborate help. Hence this booklet.

In either case, whether you read the card or this booklet, we would suggest that you fasten the printed card to the inside of the top of the TV-11 carrying case. You can use scotch tape to fasten the card into place. The card will then act as a constant reminder for you, just in case you should be away from your TV-11 for a while and forget the procedure.

A WORD OF CAUTION

Carelessness in the use of your TV-11 can result in damage to this instrument or to the tubes you are testing. For example, if you should happen to put the filament selector switch at a higher setting than that called for by the Fil. V. column on your chart, you may burn out the tube. Our own personal approach is to make all the settings called for by the chart, and then, before plugging in the tube into its socket, check the knob and lever settings at least once.

The meter needle will move slowly or rapidly depending on the tube you are testing. Some tubes are notoriously slow heaters, and as a result the meter needle will move slowly to its final position. Your meter needle cannot move any faster than the tube permits it to do.

If the meter needle moves slowly, or if it stops in the red (replace) portion of the meter scale, slapping the sides of the meter case is not a remedy. Your TV-11 cannot possibly change a bad tube into a good one.

Do not allow customers, strangers, or friends to use your TV-11. You may take the time and the trouble to read the instructions which accompany your TV-11. It is doubtful if they will. Also be wary of the individual who claims to have "read a book on radio" or who has familiarity with tube testers of other manufacturers. This does not qualify him as an expert.

You can let customers watch you use the TV-11. The instrument will create prestige for you, and it will be very easy for you to show your customers (by letting them look at the chart on the TV-11) that they are being treated honestly.

When not in use, keep the cover on the TV-11. It will protect the instrument against dust.

HOW FAR SHOULD THE METER NEEDLE MOVE?

Some users of tube testers have the odd notion that the meter needle must try to push itself out of the right-hand side of the meter case. This assumption is not only incorrect; it is extremely undesirable. If your meter scale gives you a reading of 60 or 70, this is perfectly satisfactory.

Do not expect a new tube to read 100 on the meter dial. The meter is so arranged that it will easily read small currents, but requires heavier and heavier currents to deflect the meter as the scale progresses. Starting at the center scale mark (just below the "line adjust" position), the meter will require twice the current to deflect it to the 60 point, and almost four times the center scale current to deflect it to the 70 point. Tubes will therefore rarely read past the 65 mark. This is normal.

The reason for such design is simple. It does not do a meter needle or meter movement much good if the meter pointer (or needle) always slams against the right-hand stop. Such an action can bend the needle. Your meter has been deliberately designed to prevent this.