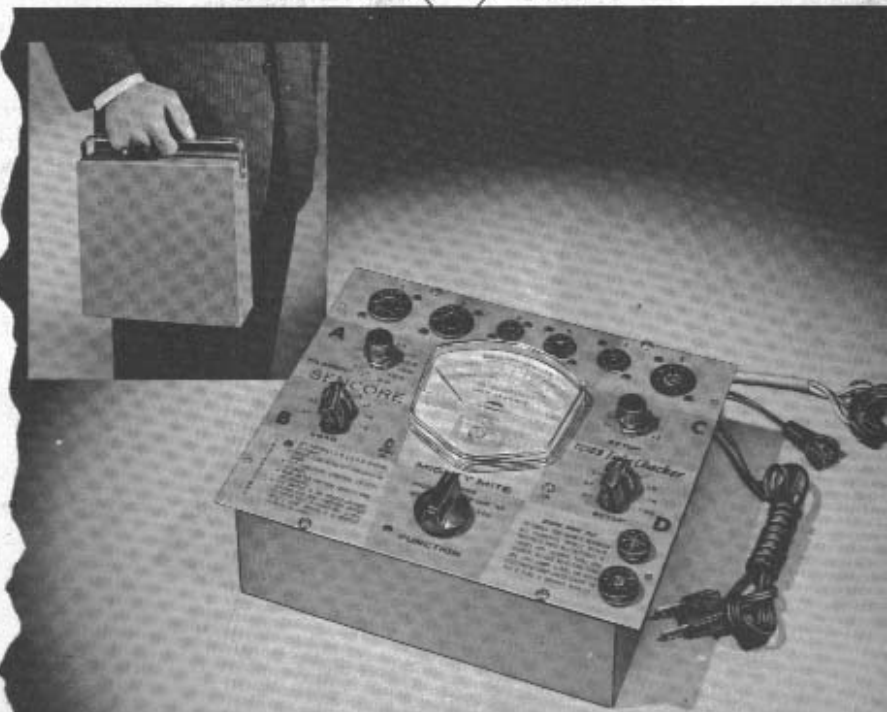


INSTRUCTION MANUAL — TC109 TUBE CHECKER



## MIGHTY MITE



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MADE IN AMERICA

# SENCORE

ADDISON 2, ILLINOIS

# INSTRUCTION MANUAL FOR THE MIGHTY MITE TUBE TESTER

You have purchased one of the finest instruments that the electronic industry has to offer. This tester is completely hand wired with no printed circuits. It has been tested completely by a competent technician and inspected twice. We know that there are many reasons why you have purchased this unit but we would like to cover all of its benefits so that you can fully appreciate them.

**WHY THE NAME MIGHTY MITE?** The TC109 is named the Mighty Mite because it is the smallest most compact tester made and still does as much as testers costing hundreds of dollars. The Mighty Mite is especially made for the serviceman that makes many calls each day but is so simple to operate that a non technical user can rent it for the weekend to test his own tubes. The Mighty Mite will test all tubes used in Radio and TV sets and really sort out those "trouble makers".

**WHAT THE MIGHTY MITE TESTS . . .** The Mighty Mite will test over 1,300 tubes in addition to picture tubes. This is more tubes than any other tester in this price range and as many tubes as laboratory testers test. Additional new tubes can be added to the tube chart by merely registering the tester with the company by filling out the registration card. New listings will be sent to you free of charge.

**WHAT THE MIGHTY MITE TESTS TUBES FOR . . .** A new unique principle is used in this tester that will enable you to test for leakage and gas between control grid and other elements, shorts between all elements, leakage between cathode and heater of 50,000 ohms plus the all important cathode emission test. Cathode emission has a special significance here because it serves as a positive quality check if leakage tests have been made first. In other words, it tests tubes completely. In test after test, we found that these checks have revealed troublesome tubes that all other testers did not find; even expensive dynamic testers.

**WHAT IS THE GRID LEAKAGE SENSITIVITY?** The control grid leakage sensitivity is over 100 megohms in the Mighty Mite. This is the same sensitivity that has made the Sencore LC 3 Leakage checker so popular. The high sensitivity is realized by using an expensive moving coil meter. Most testers use lower cost moving iron movements. This high sensitivity is especially important in circuits controlled by AGC voltage. A lower sensitivity of 2 to 5 megohms as found in many tube testers, may eventually reject the tube but not during the time that it is being tested because tube heat causes the leakage to increase with time. On some tubes, leakage may not reach this low level and the checkers with lower sensitivity will not find the "tough dog" tube.

**HOW THE MIGHTY MITE CHECKS EMISSION . . .** The Mighty Mite tests all tubes for Cathode emission near their operating current level. For example, a 5U4 is tested at 150 Ma. This is very important as many testers do not test at operating levels and may test the tube good, but it will not work satisfactorily in circuit.

**HOW THE MIGHTY MITE CHECKS FOR SHORTS . . .** The Mighty Mite uses a unique circuit to test shorts between each and every element. This is especially important to a technician who wants to make a complete shorts test before proceeding with quality checks. Shorts tests are made by merely rotating switch D through all positions.

**HOW TO CHECK HORIZONTAL OUTPUT TUBE PLATES . . .** The plate picks up very little current when measuring just cathode emission. Likewise, plates or screens seldom open up. However, the horizontal output tubes with plate caps can open because of mechanical disturbance. So, it is a good idea to check the plate current separately after making the emission test. Here is how you do it.

Leave the tester set up for emission. Then, set switch B to "H" and set switch D to "H". If the plate is O.K., the meter will read. The amount of current indicated by the reading is not important as this does not change with age. It is either good or bad; open or connected. Tap the plate cap to be sure that the reading stays constant.

**HOW TO USE THE ADAPTOR SOCKET . . .** The adaptor socket that is included with your Mighty Mite is for checking the portable radio tubes. See the first page of the set-up booklet for complete instructions.

**NEW MECHANICAL FEATURES . . .** The Mighty Mite has a number of mechanical features not found on other tube testers. First, note the stainless steel mirror on the inside of the cover. This is one of the handiest things ever put on a test instrument. A mirror is needed on nearly every service call to adjust the TV set and seldom is one handy. A stainless steel mirror placed in a tool box must be replaced often because of scratches. The second mechanical feature is the make up of the meter. Not only does it have that easy to read appearance but lights up as soon as the tester is turned on. This is especially handy when you are behind a TV set in dim light. An all steel carrying case insures maximum protection.

**TO ACQUAINT YOURSELF WITH THE MIGHTY MITE . . .** First, note the four controls marked A, B, C, and D. These are the four controls that you will be setting up from the chart. Next, note the six sockets numbered one through six. You will be inserting the tube in one of these sockets as indicated in the chart. Locate the picture tube socket: you will be using this for all picture tube tests. The set up chart is in the same compartment where you found the picture tube socket. Directly under the meter is the FUNCTION switch. This is set to the desired test. Locate the grid cap lead. This will be used on all tubes having grid or plate caps.

**TO OPERATE THE MIGHTY MITE . . .** Simple instructions are on the front of the tester. Complete operating instructions are in the first few pages of the tube chart booklet.

### **TUBE LIFE EXPECTANCY TEST**

If the meter needle climbs very slowly into the good or questionable area on emission test, the life expectancy can be considered to be much less than if the meter indicates GOOD in a shorter time. Also, if the needle should climb to the GOOD area and then "fall off" life expectancy can be considered much less. This is also true of picture tubes. We cannot recommend that you replace these tubes. This decision is between you and your customer.

**METER BURN-OUT.** Most tube testers have cautions about burning out the meter. The meter in the MIGHTY MITE has built-in circuit protection so that you cannot burn out the meter.

**REJUVENATION.** If you wish to rejuvenate a small tube or a picture tube, merely increase the filament voltage by setting switch A to one setting higher for a minute or two. You will also find that this will accelerate gas and leakage conditions when on the GRID LEAKAGE test. If you get a grid leakage reading in the BAD area with a slight increase in filament voltage, reduce the filament setting to normal. If the leakage reading returns to GOOD, the tube is a good tube and should not be rejected. If the meter remains in the BAD area, replace the tube.

### DIFFERENT WAYS TO USE THE MIGHTY MITE

The Mighty Mite can be used by any serviceman to carry into a home on every service call. It is smaller than the smallest portable typewriter and weighs less than seven pounds. In carrying case, as shown here, it can also be loaned on a rental basis. Many servicemen have found that this is a good way to combat do it yourself tube testing. They get the rental plus the price of the tube.

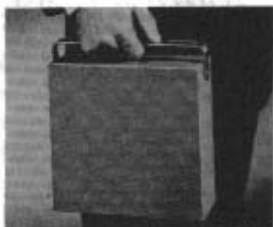
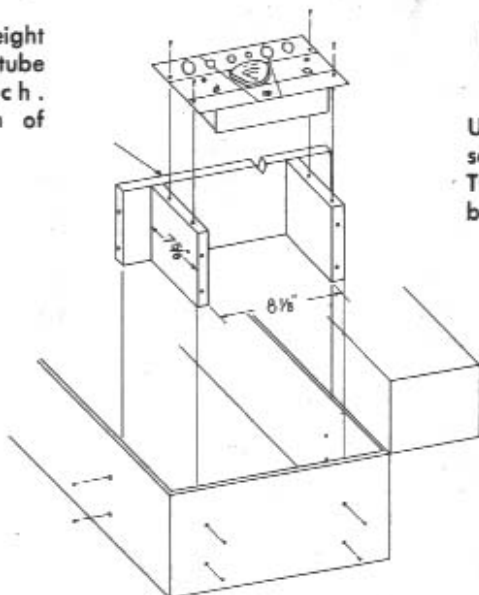


Figure 1. In Carrying Case being carried by man.

This board to be height of lower shelf in tube caddy minus 1 inch. Length to be width of lower shelf.



Use 4 #6 1/2 inch wood screws to hold the TC109 to the wood boards.

Figure 2. Installing the Mighty Mite in your tube caddy using 1 inch boards. If you wish to use tester in caddy only part time, leave out the four #6 wood screws.

The third method of installing the tester is shown here. This can either be in the back end of your work bench or in a panel in your store for customers to use. Merely cut a hole, the dimensions shown and fasten the tester with four #6 wood screws.

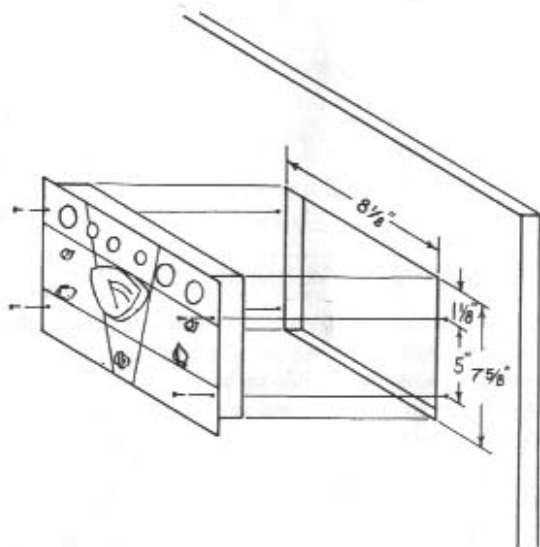


Figure 3. Installing Mighty Mite in wall board or counter.

## CIRCUIT DESCRIPTION

A Complete schematic of the TC109 circuit is shown in Figure 8. Note that the layout of this schematic is very similar to the TC109 panel layout. This, we find, helps one to understand the electrical function of each control in the circuit.

The three major tests that determine the quality of a vacuum tube are selected with the FUNCTION Control (S-3). These are cathode emission, grid leakage, and shorts between elements. Each of these functions is described in detail below. The FUNCTION control also is used to turn the unit off (position 1) and to check calibration of the unit (position 5). Calibration could be compared to "Line Adjust" in some older testers.

If some trouble should develop in your tester a few minutes spent in studying the following circuit descriptions will help you to find the defect and get your tester back into operation.

### A. BASIC CIRCUIT

A simplified schematic of the basic indicating circuit is shown in Figure 4. This circuit is essentially a single ended vacuum tube voltmeter using a 6C4 tube as an amplifier. Although only one tube is used, the circuit is ultra sensitive and has many outstanding features. One of the main features is the response. With zero volts on the grid (input to the 10 meg. resistor) the meter in the cathode circuit will read very low, less than 0.1ma. As voltage is applied and gradually increased the meter current will rise linearly until it reaches approximately 0.75ma with +6 volts applied to the grid circuit. At this point bias on the 6C4

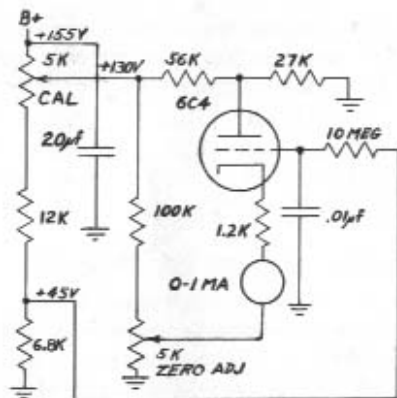


Figure 4. BASIC INDICATOR CIRCUIT

is almost zero and any additional voltage applied to grid is dropped across the 10 meg. resistor due to grid current flow. Consequently, approximately 45 volts is required to make the meter read full scale (1.0ma). This broad response feature is used to advantage in both the emission and grid leakage tests as will be described later in this section.

The circuit, Figure 4, is shown with the FUNCTION switch in the CAL position, ie, +45 volts from the junction of the 6.8K and 12K resistors is fed directly into the 6C4 grid circuit. The CAL potentiometer in the B+ lead is used to adjust meter current to full scale (CAL line on meter), by changing the operating level of the circuit. Note that the only voltage that does not change with this control is the +50 volt reference on the grid.

## B. CATHODE EMISSION TEST

Cathode emission of a vacuum tube is tested by applying an AC voltage to the grid, or plate if the tube is a rectifier or diode, and measuring the amplitude of the pulsating DC present on the cathode. See figure 5. All tubes are tested at or near normal operating current levels.

The grid is used as a "pick-up" of Cathode current because it was learned that nearly all current flows to the grid in testers where grid and plate are tied together. By leaving the plate open, a short test can be made between the grid and plate and tests turn out the same as if the plate was connected.

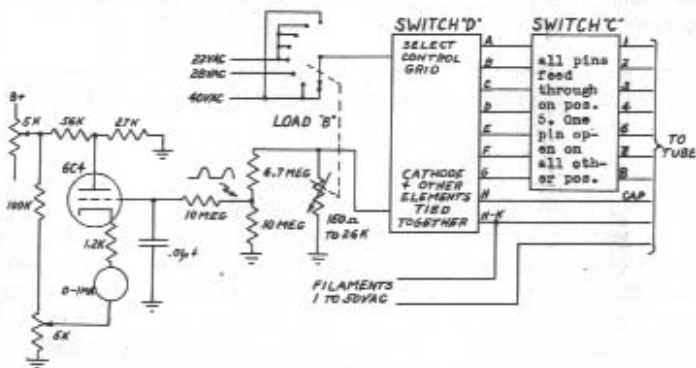


Figure 5. CATHODE EMISSION TEST

The pulsating DC on the cathode of the tube under test is reduced in the voltage divider 4.7 meg. and 10 meg. and applied to the grid of the indicator circuit through 10 meg. and .01  $\mu$ f. to ground. This network filters the signal so that pure DC is present on the grid of the 6C4. A tube with normal emission will cause the meter to indicate at approximately .78 ma or 100 on the EMISSION-QUALITY scale of the meter. If emission is lower than normal, a proportionately lower meter reading will result. At 50% of normal the meter will read in the BAD area. If emission is higher than normal the meter indication will be compressed as described above such that it will never exceed full scale. This is an important feature, because (1) it is impossible to burn out the meter even with a shorted tube or with the load setting "B" on the wrong position and (2) it permits more usable range on the meter scale (from 0 to .75ma).

## GRID LEAKAGE

The grid leakage test circuit, see figure 6, uses the same basic indicating circuit. Actually the grid leakage test circuit could be considered as an ultra sensitive ohmmeter. The break between the good and the questionable areas on the grid leakage scale represents approximately 200 megohms and the break between the questionable and the bad areas represents approximately 100 megohms.

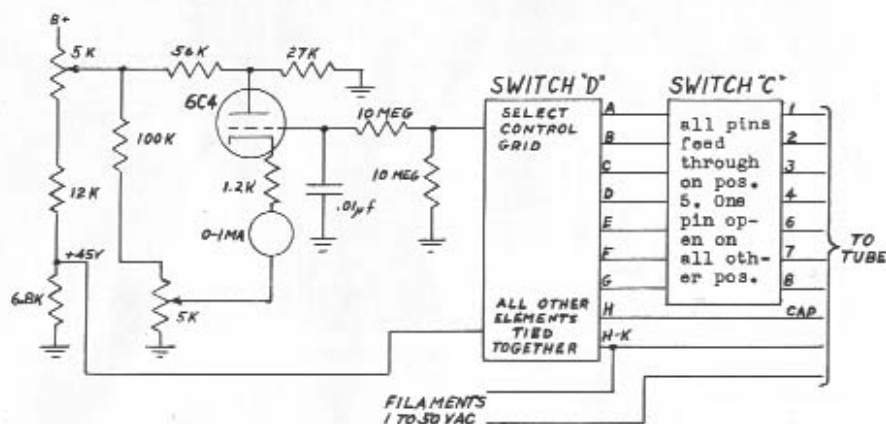


Figure 6. GRID LEAKAGE CIRCUIT

In use, the control grid of a tube under test is connected through 10 megohms to ground. All other elements are connected to +45 volts, the junction of the 6.8K and 12K resistors. If a tube has grid leakage or emission, a positive voltage will be developed across the 10 megohm resistor (with respect to ground) which is then fed to the 6C4 grid and causes the meter to indicate. The more leakage there is, the higher the meter will read (towards and then into the bad area) until finally a dead short would cause the meter to read full scale. Leakage of 100 meg. or a grid emission current of approximately 0.5 microamp would produce a leakage indication just into the bad area.

## SHORT TEST

Shorts between elements of 50,000 ohms or less are indicated by a simple neon indicator operated from line voltage. See figure 7. As switch "D" is

rotated each pin or element is checked against all of the other pins for shorts, gas, or leakage up to 50,000 ohms. In the H-K position of switch "D", heater to cathode leakage will be indicated.

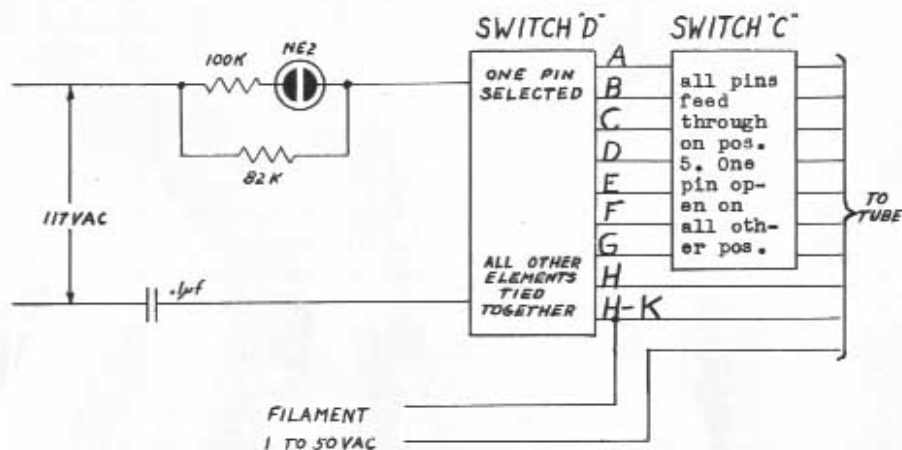


Figure 7. SHORTS TEST CIRCUIT

The 0.1 $\mu$ f condenser in series with the neon indicating circuit reduces the effect of normal tube conduction lighting the bulb on one anode. A "true" short will light both anodes of the bulb.

Note, some tubes have internal connections between pins. These tubes will show shorts, and are indicated on the tube chart with an asterisk.

## SWITCHING AND SOCKETS

Referring to the complete schematic Figure 8, note that all tube pins, except filaments, first go through SETUP switch "C" and then SETUP switch "D". Switch "C" is a special switch that has been designed to let all pin connections feed through in position 5 but in any other position one of the pins is opened. For example, the schematic shows all pins feeding through except the first position which is open. In number 2 position, this lead would be open etc.

Switch "C" is used to reject one of two control grid leads, or a filament center tap that otherwise would prevent normal testing procedure.

Switch "D" is designed to select one of the remaining tube pins (the control grid, or on rectifiers or diodes the plate) and short all of the other pins together. The selected pin and the junction of all of the other pins are used in testing emission, grid leakage and shorts as discussed above.



Symptom	Probable Cause	Corrective Measure
No meter indication on any position of function switch (meter lamp lights).	Defective 6C4.	Check tube and replace if bad.
	Defective meter.	Check meter, if bad replace.
	Loose connection at meter terminals.	Check connections.
	Defective rectifier.	Check rectifier and replace if defective.
	Defective electrolytic.	Check electrolytic and replace if defective.
Meter indicates but will not calibrate.	Defective CR1.	Check CR1 and replace if defective.
	Defective 6C4.	Check tube and replace if defective.
	Defective CAL potentiometer	Check pot. & replace if defective.
Meter can be calibrated but will not indicate emission or leakage on some sockets.	Loose connection at tube socket or at switch C or D.	Check tube socket in use and wires which feed thru each terminal on both wafers of switch C. If switch C is OK check wires connecting between switch C and switch D for a poor connection.
Short indicator glows without tube in socket in some positions of switch D when Function Switch is in "SHORTS" position.	Wire at tube sockets touching	Check wiring at tube sockets. To locate short, turn TC109 on and set Function Switch in "SHORTS" position. Then move wires with a non-metallic probe until light goes out. This will locate shorted wires.
Emission measurements O K, but grid leakage will not indicate.	Function switch	Check switch & connections to switch.
Grid leakage measurements OK, but emission will not indicate.	Function switch	Check switch & connections to switch.
	Load switch "B"	Check switch
	Transformer	Check transformer for opens.
Short ind. glows on one anode when testing tube for shorts	Defective 0.1 $\mu$ f cond.	Check for shorted or leaky capacitor
Meter reads high (above O on emission scale) with no tube in socket.	Defective 6C4. Zero adj. pot. misadjusted or defective	Check 6C4 & replace if defective
		Check pot.

## PARTS LIST

Ref. #	Part #	Desc.	Ref. #	Part #	Desc.
C1	24G27	.1 $\mu$ f200V	R11, R19	15S10	5K potentiometer
C2	24G8	20 $\mu$ f175V	R12	14G86	12K $\frac{1}{2}$ w10%
C3	24G14	.01 $\mu$ f600V	R13	14G83	6.8K $\frac{1}{2}$ w10%
CR1	16S2	50MA6 plate	R14	14G38	56K $\frac{1}{2}$ w10%
I1	20G3	#51 bulb	R15	14G15	27K $\frac{1}{2}$ w10%
I2	20G1	NE2 bulb	R16	14G48	10 meg. " "
M1	23S6	O-1MA moving coil	R17	14G82	1.2K $\frac{1}{2}$ w10%
			R20	14G85	10 meg. $\frac{1}{2}$ w5%
R1	14G80	15K $\frac{1}{2}$ w10%	R21	14G84	4.7 meg. $\frac{1}{2}$ w5%
R2	14G34	10K $\frac{1}{2}$ w10%	R23	14G79	3.3K $\frac{1}{2}$ w10%
R3	14G55	680 $\Omega$ $\frac{1}{2}$ w10%	S1	25S24	2P8P switch
R4, R5	14G77	220 $\Omega$ $\frac{1}{2}$ w10%	S2	25S22	1P12P switch
R7, R8	14G73	150 $\Omega$ 5w	S3	25S21	4P5P switch
R9	14G81	82K $\frac{1}{2}$ w10%	S4	25S23	8P8P switch
R10, 18	14G39	100K $\frac{1}{2}$ w10%	S5	25S25	2P9P switch
			T1	28S10	Fil. trans.
			V1	18G2	6C4

### TC109 PRODUCTION CHANGES BEGINNING WITH RUN #2

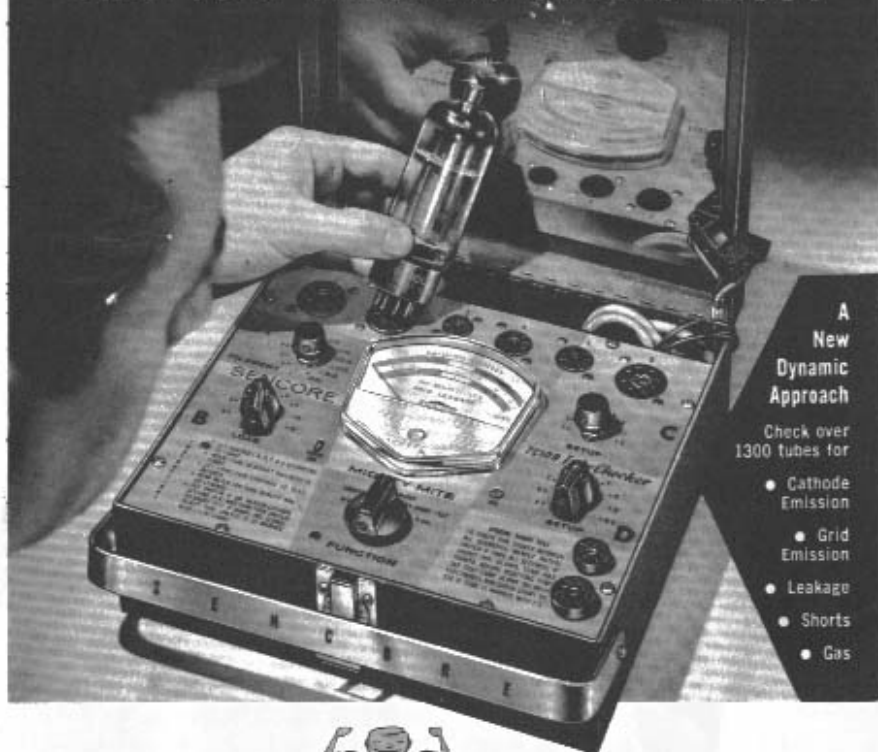
A few circuit changes have been made on the Mighty Mite (TC109) tube testers beginning with Run #2. Run #2 is stamped on the inside of the panel.

The changes have been made to increase the accuracy of the meter readings due to circuit variations in production. The main change is the addition of a potentiometer located under the front panel and on the same bracket as the calibrate control. This control is pre-set at the factory and will generally only need readjustment in the field if you change the 6C4 tube.

If you should find it necessary to adjust this control, proceed as follows:

1. Turn the TC109 on and allow it to warm up for a few minutes. Be sure the line voltage is 117 volts.
2. Turn the FUNCTION switch to SHORT TEST and adjust the control added in Run #2 (zero adjust, located under the chassis on the same bracket as the Calibrate pot.) for a meter indication of zero on the emission scale. Note that the zero line is about one quarter of an inch from the left edge of the scale and not directly on the left edge.
3. Next, turn the FUNCTION switch to CAL and calibrate the unit for full scale indication with the CAL adjustment (top of chassis). Note that full scale is marked CAL.
4. At this point, recheck the zero setting and reset if necessary because there is some interaction between the zero adjust and CAL controls.

# FIND TUBE TROUBLES OTHERS MISS!



A  
New  
Dynamic  
Approach

Check over  
1300 tubes for

- Cathode Emission
- Grid Emission
- Leakage
- Shorts
- Gas

## SENCORE "MIGHTY MITE" TUBE CHECKER



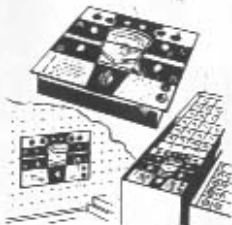
Answers the needs of the fast moving, profit minded serviceman who hates time consuming call backs. A "mite" to carry but a whale of a performer that spots bad tubes missed by large mutual conductance testers.

New unique "stethoscope" approach tests for grid emission and leakage as high as 100 megohms, yet checks cathode current at operating levels. Special short test checks for shorts between all elements. The MIGHTY MITE will test every radio and TV tube that you encounter (over 1300!) plus picture tubes, foreign, five star and auto radio tubes (without damage). As easy to set up as a "speedy tester" from easy to follow tube booklet. New tube charts free of charge.

AND check these added Sencore servicing features: • Meter glows in dark for easy reading behind TV set • Stainless steel mirror in cover for TV adjustments • Rugged, all steel carrying case and easy grip handle • Smallest complete tester made.

Model TC109.....DEALER NET **59<sup>50</sup>**

Ask your distributor for the "MIGHTY MITE" with the mirror in the cover



Use it everyday in every way. Especially designed so you can transfer inner chassis to your tube caddy, bench or counter. Only 9" x 8" x 2 1/2".

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