PRICE $2.00

HEATHKIT®
ASSEMBLY MANUAL

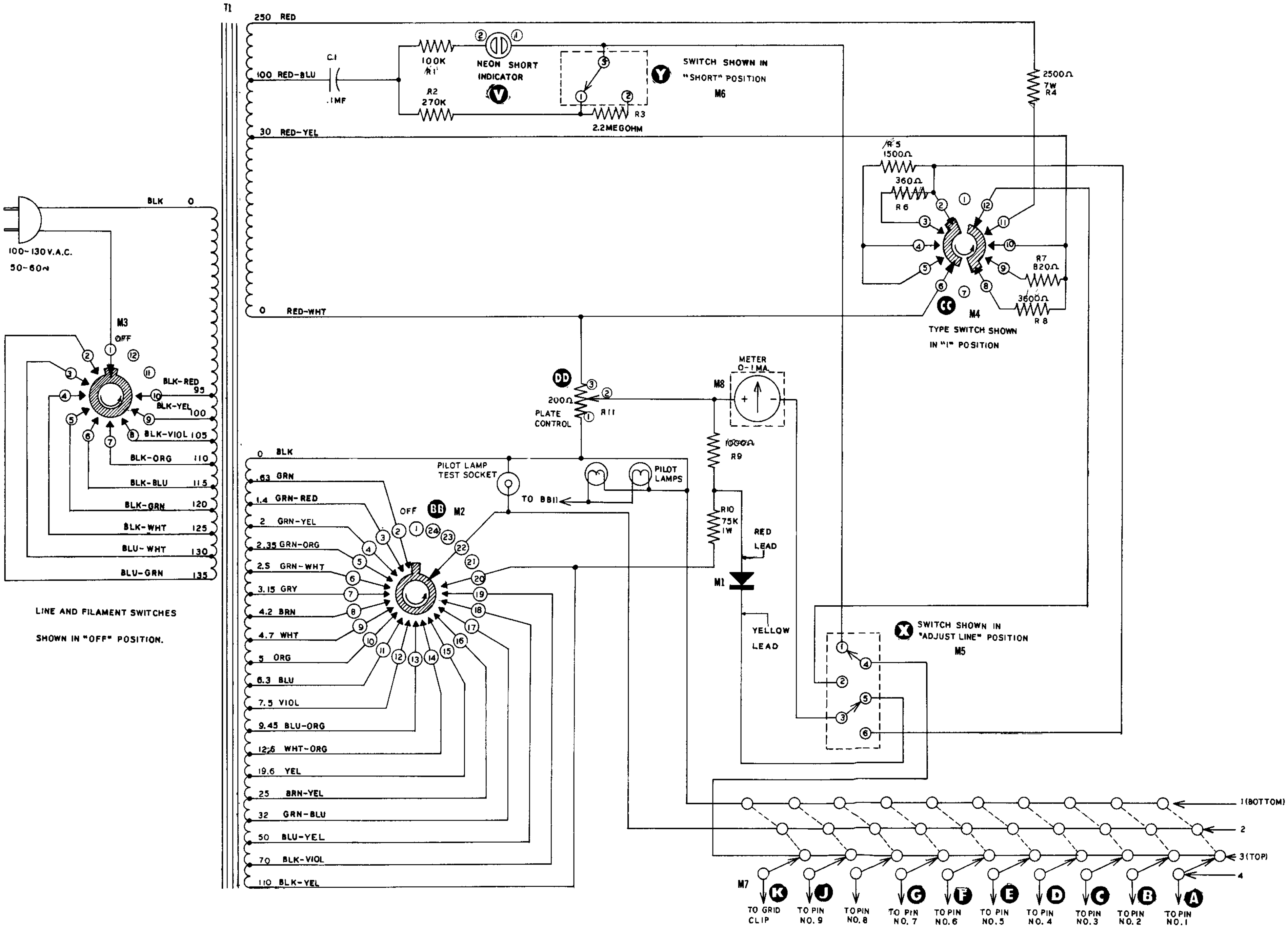
HEATHKIT® by DAYSTROM

TUBE CHECKER
MODEL TC-3

ASSEMBLY AND OPERATION OF THE HEATHKIT TUBE CHECKER
MODEL TC-3

SPECIFICATIONS

Power Requirements:......................	105-125 volts 50/60 cycle AC.
Dimensions:.............................	13" wide x 8 1/2" high x 5 1/2" deep.
Element Test Voltages:..................	30, 100, 250 volts AC.
Filament Voltages:......................	.63, 1.4, 2, 2.35, 2.5, 3.15, 4.2, 4.7, 5, 6.3, 7.5, 9.45, 12.6, 19.6, 25, 32, 50, 70, 110 volts AC.
Roll Chart Mechanism:...................	Constant tension, free rolling, thumbwheel operated, illuminated.
Line Voltage Adjustment:................	Step type
Meter:..................................	1 ma full scale deflection BAD - ? - GOOD scale, illuminated
Socket Accommodations:..................	4 pin, 5 pin, 6 pin, 7 pin combination and pilot light, 7 pin miniature, 7 pin subminiature, octal, loctal, 9 pin miniature, blank.
Available tests:........................	Emission, short, leakage, open element, filament continuity.



SCHEMATIC
HEATHKIT TUBE CHECKER
MODEL TC-3

INTRODUCTION

A vacuum tube possesses a number of operating characteristics, any one of which may be used to indicate, to a limited degree, the operational capabilities of the tube. Any number of tube testing devices are available, utilizing one or more of these characteristics, each one subject to its own limitations. It is universally recognized that no tube tester can provide a complete and accurate account of the condition existing within a given vacuum tube when that tube is in operation in the receiver. If maximum benefit is to be obtained from a tube tester, regardless of its design, two things should be known:

(1) the requirements placed on the tube
(2) the limitations of the tube tester.

With this thought in mind, we have listed some of the more commonly used methods of tube testing.

EMISSION TESTING

Testing the emission capabilities of the cathode provides the simplest and most economical means of determining the overall quality of a vacuum tube. This is accomplished by connecting all the grids to the plate and operating the tube as a rectifier. The actual emission of the cathode is then compared to a predetermined value accepted as standard for that tube type. If the cathode should have one particularly active portion, the emission checker will indicate the quality of the tube to be good, even though the remainder of the cathode may be inactive. On the other hand, modern coated cathodes are capable of large emission, often far in excess of the emission required for the particular application. In some cases the emission checker will indicate the quality of the tube to be questionable or even unacceptable. This tube may not function in an application requiring a large emission but would probably operate satisfactorily for a long time in a circuit where the emission requirements are less.

TRANSCONDUCTANCE TESTING

A transconductance tester places a standard voltage on each tube element, creating a plate current flow. Measurement of this plate current will indicate the transconductance of that particular tube under static conditions. Here again, since the tube is not operating EXACTLY as it does in the receiver, the test may be termed inconclusive. An improved version of the transconductance test is available in:

DYNAMIC TRANSCONDUCTANCE TESTING

The dynamic transconductance of a tube is measured by using the circuit of the static transconductance tester and adding a signal generator. By applying a signal to the tube under test, the action of the plate current will be similar to that experienced in the receiver, varying in relationship to the input signal. Although this system gives an indication of how the tube will operate under signal conditions, it is still limited in scope. Certain types of tubes cannot be satisfactorily checked on any type of tester, even the dynamic transconductance tester. Particular offenders in this respect are tubes used in the vertical and horizontal deflection circuits of television receivers. The only method of accurately checking these tubes is by:

SET TESTING

No tube tester is required in this system of tube testing; simply insert a new tube in the receiver and observe the results. At first glance this appears to be the most inexpensive testing system available. Bear in mind, however, that if all tubes were to be tested in this manner, a stock of tubes representing an investment of several hundred dollars is required.

POWER OUTPUT TESTING

This testing system is perhaps the most satisfactory in regards to similarity between test results and actual operation in the receiver. Since both the input and output powers are known, the other factors can be determined. In the case of voltage amplifiers the voltage amplification and output voltage will be of prime interest. The power output test is ideally suited to testing power amplifiers, where the output power is of major concern.

LOW LINE TEST

In this testing system the input voltage to the receiver is lowered to 105 volts. Sufficient time should be allowed (10 minutes) for the tube heaters to stabilize. If the questionable tube fails to function properly it should be replaced.

INSTRUMENT DESCRIPTION

In designing a tube checker, the designer is faced with the problem of deciding which of the above mentioned testing procedures to follow. Points that must be considered are the cost, relative merits of each system, and the net value to the purchaser. On the basis of these and other considerations, the Heathkit Tube Checker has been designed around the emission testing circuit. There are several reasons for this decision, some of which are : (1) the emission checker will provide the best overall indication of tube quality when compared with other types on a cost per unit basis, (2) the transconductance of a tube is dependent upon cathode emission, (3) some busy service men do not wish to take the time necessary to check the tube thoroughly. They plug in the tube, push the button and observe the meter to check the emission; if the emission of the tube is too low for the intended service, determining any of the other characteristics is a waste of valuable time, (4) the emission testing circuit is relatively simple, requires few components, and lends itself well to kit-type construction, (5) the low selling price made possible by the use of this circuit more than compensates for any inherent shortcomings it may possess. We sincerely believe the Heathkit Tube Checker will give the most test information per dollar invested.

The action of the instrument has been made quite flexible by the use of multiple filament voltages, adjustable cathode current, variable meter sensitivity and individual element switching. The ten lever switches make it possible to connect any element to any other element, regardless of the pin numbers involved.

The instrument may be used in darkened areas (such as the inevitable dark corner behind the TV receiver) with ease since both the roll chart and the meter are illuminated.

No difficulty should be experienced in roll chart operation on the part of the left-handed operator. Thumbwheel drive knobs have been provided on both sides of the panel to eliminate any "cross-over" problems. The roll chart mechanism is a unique design which permits the roll chart to run freely throughout its entire length without binding. The chart rollers are spring loaded to keep the chart taut at all times to present a smooth viewing surface.

TUBE TYPE ACCOMMODATIONS

The Heathkit TC-3 Tube Checker was designed for checking tubes encountered in everyday radio and TV service work, but is not specifically limited to these types. It will check satisfactorily any tube that can be accomodated in the tube sockets if the data provided by the tube manufacturer is available. Sockets provided are: 4 pin, 5 pin, 6 pin, 7 pin combination, 7 pin miniature, 7 pin subminiature, octal, loctal, and 9 pin miniature. A blank socket is also provided to facilitate modification for checking newly added base types as protection against obsolescence.

ROLL CHART DATA

The roll chart contains necessary data for the checking of currently used tubes. Because of the constantly growing list of tubes it is impossible to list all the tubes on the chart. Many tubes not listed on the chart may be found in the roll chart supplement. The Heath Company periodically revises the roll chart to include the newly released tube types. Announcement of revised roll chart availability is usually made in the Heathkit Flyer.

FILAMENT VOLTAGES

Filament voltages used in the operation of the tube checker are derived from a secondary winding on the power transformer which is tapped to provide nineteen different voltages. These voltages are switch selected for convenience of operation and assure the application of the proper filament voltage for a given tube type under test.

TEST VOLTAGES

Voltages used in the various tests provided by the TC-3 are derived from a secondary winding on the power transformer which is tapped at 30, 100, and 250 volts. During the operation of the checker, three basic circuits are set up using these voltages.

LINE TEST CIRCUIT

The first basic circuit is in use when the TEST switch is in the SET LINE position. The SET LINE switch in the primary of the power transformer varies the voltage across the primary, thus controlling the voltage across both secondary windings simultaneously. The meter, with the voltage divider and rectifier network now in the circuit, will indicate the proper secondary voltage when the needle is within the LINE TEST block. The purpose of the SET LINE switch is to assure proper voltages on the tube under test, thus minimizing the possibility of an erroneous indication due to abnormally high (or low) power line voltages

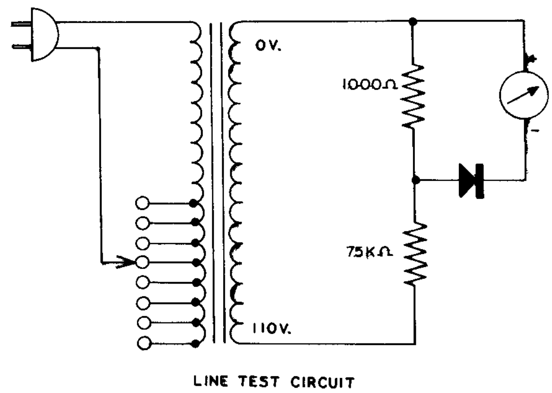


Illustration 1

SHORT TEST CIRCUIT

The second basic circuit is used in the short, leakage, and filament continuity tests. The 100 volt tap is connected to the neon short indicator and associated network and is in series with the plate of the tube under test. The meter is not in the circuit; the tests are indicated by the neon bulb. Moving the lever switches in the prescribed manner connects the tube elements in such a manner that a shorted element will cause considerable increased current flow through the resistor in parallel with the neon bulb. The voltage drop then produced reaches the operating voltage of the neon bulb causing it to glow, thus indicating a short. For the leakage test, the circuit remains unchanged in all respects except one: the value of the resistance in parallel with the neon bulb is increased, thus increasing the sensitivity of the test. The term short as used in this test should not be confused with the direct short formed by connecting two terminals with a piece of wire. The sensitivity rating of the short test is 250 KΩ, which means the bulb will glow if the resistance between the shorted elements is anywhere between the values of 0 and 250,000 ohms. The sensitivity rating of the leakage test (high-sensitivity short test) is 2 megohms, which means that the bulb will glow if the resistance between the shorted elements is anywhere between 0 and 2,000,000 ohms. Actually, this test may be altered to any desired sen-

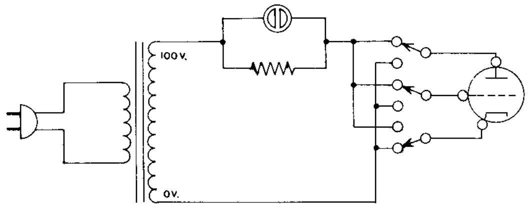


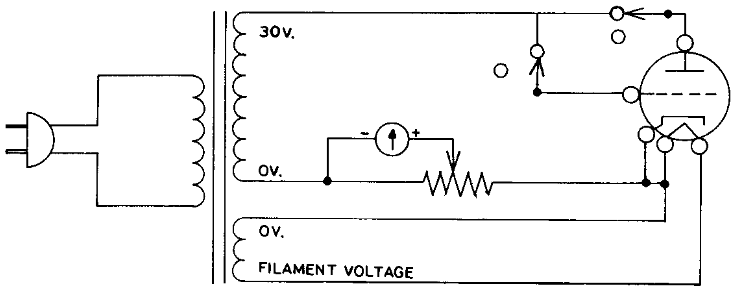
Illustration 2

sitivity by replacing the 2.2 megohm resistor with the required value. The short test is a very critical test and should be performed carefully and evaluated in terms of the amount of leakage which can be tolerated in the circuit.

QUALITY TEST CIRCUIT

The third basic circuit is used when making the quality and open element tests. The plate and grids are connected together to the 30 volt transformer tap. The filament and cathode are connected together to the 0 volt tap of the high voltage winding through the PLATE control. The plate control adjusts the sensitivity of the meter, which is in the circuit at this time. The tube now conducts as a half-wave rectifier, the total emission of the cathode being passed to a single terminal (anode) and out through the meter circuit.

A good tube, with the sensitivity of the meter properly adjusted, will have sufficient cathode emission to swing the meter needle into the GOOD section of the scale. If the emission is too low, the current through the tube will not be high enough to bring the needle into the GOOD section; it will remain in the (?) section or drop into the BAD section.



QUALITY TEST CIRCUIT

Illustration 3

An open element may be detected in the following manner. Since all tube elements (except cathode) are connected to the plate terminal, the current indicated by the meter during the quality test represents the total current through the tube. Disconnecting an element from the plate terminal will cause the current through the tube to diminish. The meter reading will then be less than originally noted. Therefore, a drop in the meter reading indicates the element is not open. If the element were open, disconnecting it from the plate terminal would make no change in the tube current, hence no change in the meter reading. For tubes with a number of grids, the operation is somewhat more complex, but the same theory applies in general. For gas tubes (OZ4, etc.) the 250 volt tap is used instead of the 30 volt tap. The rest of the circuitry remains unchanged.

NOTES ON ASSEMBLY AND WIRING

The Heathkit Model TC-3 Tube Checker, when properly constructed, will provide a service type instrument capable of many years of satisfactory operation. We urge you to take the necessary time to assemble and wire the instrument carefully. Do not hurry the work and you will be rewarded with a greater sense of confidence both in the instrument and your own workmanship.

This manual is supplied to assist you in completing the instrument with the least possible chance of error. We suggest that you take a few minutes now and scan through the entire manual carefully before any work is started. This will enable you to proceed with the work much faster and with greater accuracy. The large fold-in pictorials are handy to attach to the wall above your work space. Their use will greatly simplify the construction of the kit. These diagrams are repeated in smaller form within the manual. We suggest that you retain the manual in your files for future reference, both in the use and maintenance of the TC-3 Tube Checker.

Unpack the kit carefully and check each part against the parts list. By so doing, you will become acquainted with each part. Refer to the charts and other information shown in the manual, to help you identify any parts about which there may be a question. If some shortage is found in checking the parts, please notify us promptly and return the inspection slip with your letter to us.

Leads on resistors and capacitors are generally much longer than they need to be to make the indicated connections. The excess lead length should be cut off before the part is added to the circuit. In general, the leads should be just long enough to reach their terminating points.

The pictorials indicate actual chassis wiring and designate values of the component parts. We very strongly urge that the chassis layout and lead placement be followed exactly as shown. While the arrangement shown is probably not the only satisfactory layout, it is the result of considerable experimentation and trial. By following the pictorials of lead and component placement carefully, neat appearance and dependable operation are assured.

Space has been provided for you to check off each operation as it is completed. This is particularly important in wiring and it may prevent omissions or errors, especially where your work is interrupted frequently as the wiring progresses. When interrupted, it is often helpful to review the preceding two or three steps before continuing with the assembly. Some kit builders have also found it helpful to mark each lead in colored pencil on the pictorial as it is added.

Resistors and controls generally have a tolerance rating of ±20% unless otherwise stated in the parts list. Therefore a 100 KΩ resistor may test anywhere from 80 KΩ to 120 KΩ. (The letter K is commonly used to designate a multiplier of one thousand.) The parts furnished with your Heathkit have been specified to provide optimum performance of the finished instrument.

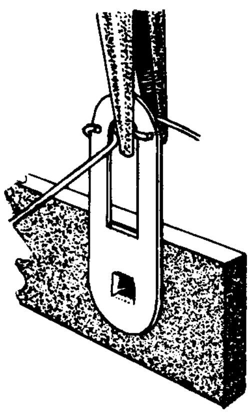
In order to expedite delivery to you, we are occasionally forced to make minor substitutions of parts. Such substitutions are carefully checked before they are approved to insure that the parts supplied will work satisfactorily. By checking the parts list for resistors, for example, you may find that a 2 megohm resistor has been supplied in place of a 2.2 megohm as shown in the parts list. These changes are self-evident and are mentioned here only to prevent confusion to you in checking the contents of your kit.

PROPER SOLDERING PROCEDURE

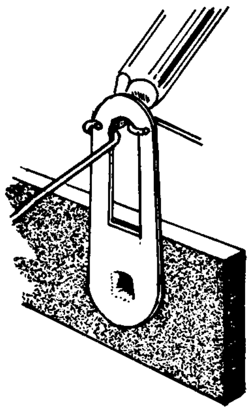
Only a small percentage of Heathkit purchasers find it necessary to return an instrument for factory service. Of these kits, by far the largest proportion function improperly due to poor or improper soldering.

Correct soldering technique is extremely important. Good solder joints are essential if the performance engineered into the kit is to be fully realized.

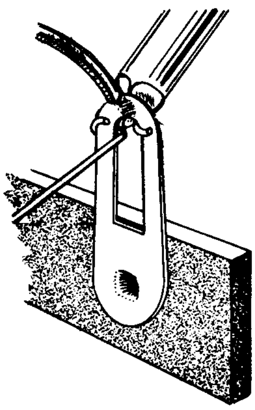
Read the notes on soldering and wiring on the inside rear cover. If terminals are bright and clean and wires free of wax, frayed insulation and other foreign substances, no difficulty will be experienced in soldering. Crimp or otherwise secure the wire (or wires) to the terminal, so a good joint is made without relying on solder for physical strength. To make a good solder



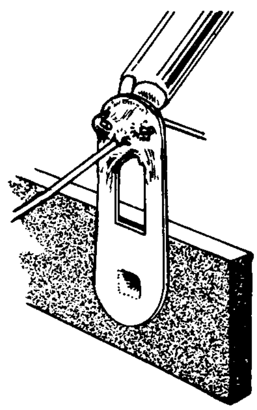
CRIMP WIRES



HEAT CONNECTION



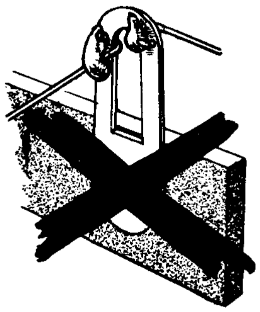
APPLY SOLDER



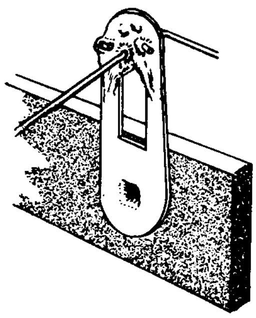
ALLOW SOLDER TO FLOW

joint, the clean tip of the soldering iron should be placed against the joint to be soldered so that the terminal is heated sufficiently to melt the solder. The solder is then placed against both the terminal and tip of the iron and will immediately flow out over the joint. Refer to the sketch shown on page 7. Use only enough solder to cover wires at the junction; it is not necessary to fill the entire hole in the terminal with solder. Excess solder may flow into tube socket contacts, ruining the socket, or it may creep into switch contacts and destroy their spring action. Position the work so that gravity tends to keep the solder where you want it.

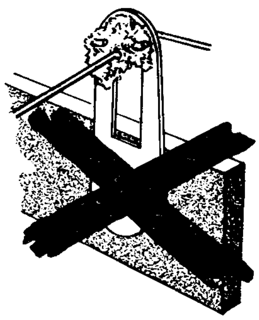
A poor solder joint will usually be indicated by its appearance. The solder will stand up in a blob on top of the connection, with no evidence of flowing out caused by actual "wetting" of the contact. A crystalline or grainy texture on the solder surface, caused by movement of the joint before it solidified is another evidence of a "cold" connection. In either event, reheat the joint until the solder flows smoothly over the entire junction, cooling to a smooth, bright appearance. The following illustration clearly indicates these two characteristics.



COLD SOLDER JOINT CONNECTION INSUFFICIENTLY HEATED



PROPER SOLDER CONNECTION



COLD SOLDER JOINT CONNECTION MOVED WHILE COOLING

A good, clean, well-tinned soldering iron is also important to obtain consistently perfect connections. For most wiring, a 30 to 100 watt iron, or the equivalent in a soldering gun, is very satisfactory. Small irons generally will not heat the connections enough to flow the solder smoothly over the joint and are recommended only for light work, such as on etched circuit boards, etc. Keep the iron tip clean and bright. A clean rag may be used to wipe the tip occasionally during use.

Take these precautions and use reasonable care during assembly of the kit. This will insure the wonderful satisfaction of having the instrument operate perfectly the first time it is turned on.

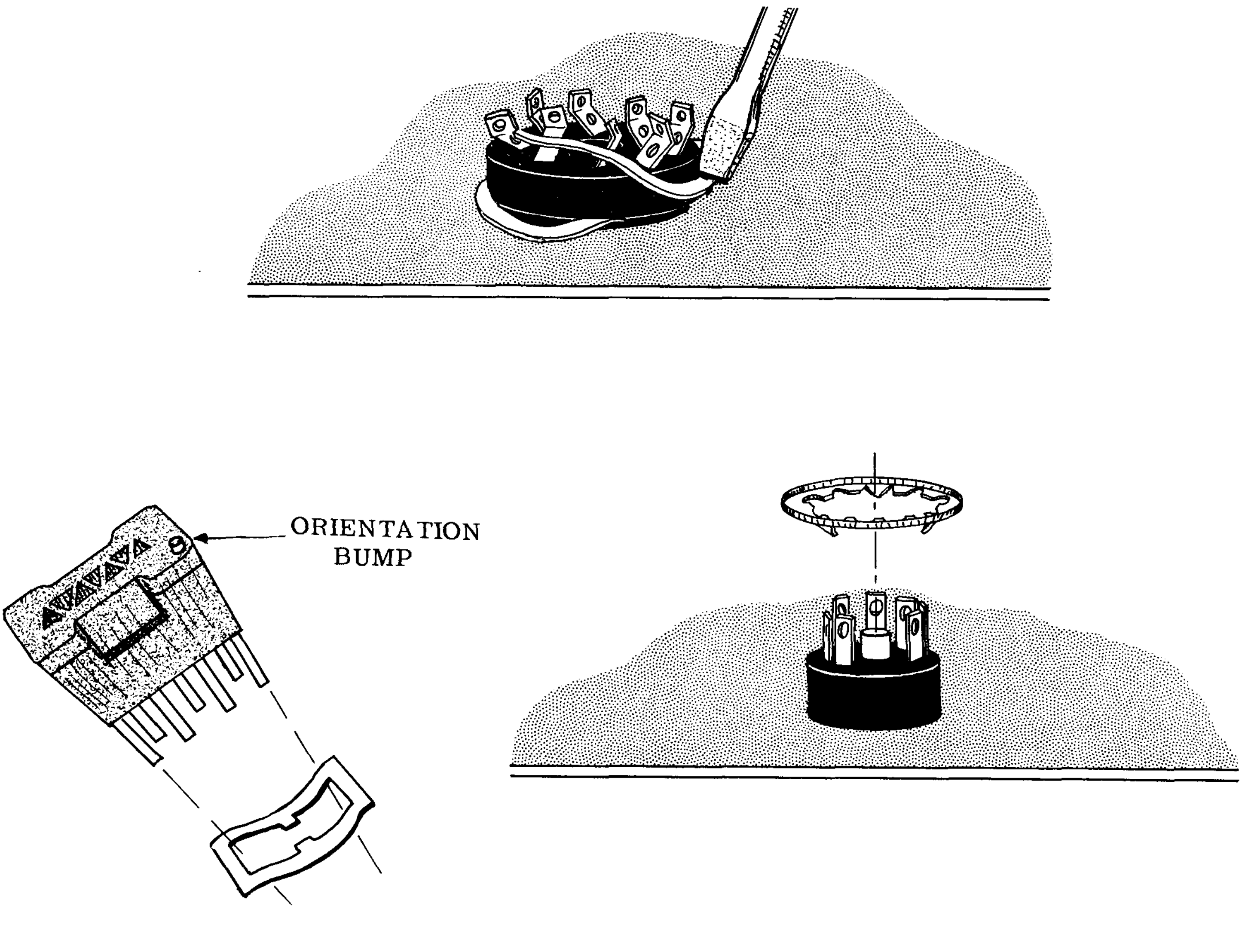
STEP-BY-STEP ASSEMBLY INSTRUCTIONS

Study Pictorial 1 carefully and note the placement of the various parts. This pictorial shows the aluminum panel as viewed from the rear. Throughout this manual a system of alphabetical designation will be used for each part, and each terminal connection of the part will be assigned a number. Therefore, the first tube socket in the upper left corner, which is the loctal socket, is designated as L, and the eight pin connections will be identified as L1, L2, L3, etc. Actually marking the panel openings will prove helpful. This same procedure will be used throughout the entire instrument construction. Please note also that some parts have been assigned a dual alphabetical designation, such as AA, BB, CC, etc.

Actual assembly will first begin with the mounting of the ten tube sockets. All of these sockets are of the ring mounting type to provide a neat panel appearance. See Figure 1. When installing these sockets with the mounting ring, be sure to make the installation properly so that no difficulty with socket loosening will occur later on after the wiring has been installed. When installing sockets, note the keyway positioning carefully. This is very important, as a misaligned keyway may cause incorrect wiring. Note that in some cases each pin of the socket has a molded number for quick identification.

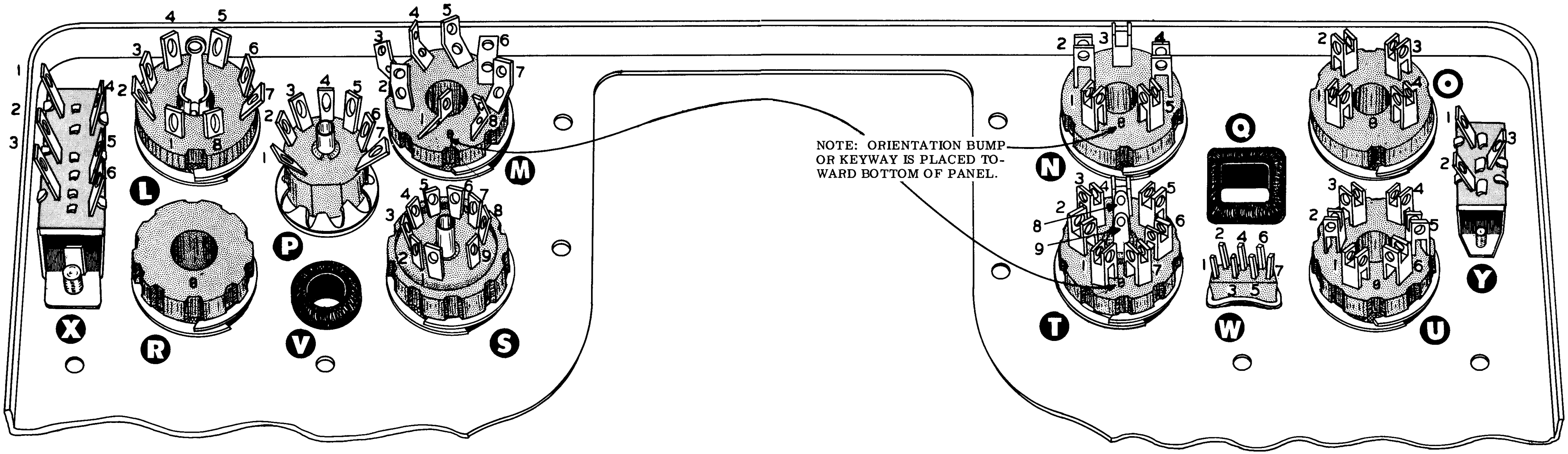
An additional wavy ring and lock ring have been provided for your convenience in the event a ring should become damaged during construction. Please note that one of the wavy rings is much larger than the rest; this ring is to be used on the large 7 pin socket having the pilot light socket incorporated in its design.

To prevent marring the finish of the Tube Checker panel, it is advisable to place a pad or cloth over the workbench or working surface.



METHOD OF INSTALLING TUBE SOCKETS

Figure 1



( ) Mount the 7 pin miniature socket in location P. Note placement of the flat on the side of the socket. The socket is held in place by a lock ring, which is pressed over the base of the socket after it has been properly placed in the panel. In the event the lock ring fits too tightly for installation, bend the teeth slightly with a pair of long-nose pliers.

( ) Mount the loctal socket in location L, using the wavy ring mounting method previously described. Note keyway placement.

( ) Mount the octal socket in location M. Note keyway placement.

( ) Mount the blank socket in location R.

( ) Mount the 9 pin miniature socket in location S. Note that the blank space is placed toward the bottom of the panel.

( ) Mount the DPDT spring return slide switch in location X. When mounting the switch orient it so that the slide button is normally in the SHORT-ADJUST LINE position (see front of panel). Use 6-32 screws. No lockwashers or nuts are needed as the switch frame is tapped to receive the screws.

( ) Insert a 1/2" rubber grommet in location V.

( ) Mount the 7 pin subminiature socket in location W. Place the orientation bump toward the center of the panel adjacent to the white dot. Push the retaining ring down firmly to hold the socket securely against the panel. See Figure 1 on page 9.

( ) Mount the 5 pin socket in location N.

( ) Mount the 4 pin socket in location O.

( ) Mount the large 7 pin socket in location T. This socket uses the largest of the wavy rings supplied.

( ) Mount the 6 pin socket in location U.

( ) Using 6-32 screws, mount the SHORT-LEAKAGE switch in location Y. Position the lugs as shown in Pictorial 1.

( ) Insert a 3/4" rubber grommet in location Q. Work the grommet carefully into the corners until a uniformly square appearance is obtained.

The mechanical assembly of the Tube Checker is interrupted at this point in order to partially wire the tube sockets before the chassis is installed. Before proceeding with the socket wiring, however, re-check carefully all assembly up to this point. In the event any errors are present, it is much easier to correct them before the wiring is in place.

In order to simplify the detailed and important wiring between the tube sockets and lever switches, color coded wire will be used. A four foot length of 8-wire color-coded cable has been furnished with this kit. Two lengths of this cable will be required for two separate wiring harnesses.

Measure and cut off a 15" length of 8-wire cable and a 10" length of 8-wire cable. Separate the remaining length of cable by cutting a portion of the outer plastic insulation and removing the wires one at a time. DO NOT separate the 15" and 10" lengths of cable previously cut. You should now have:

1 . . . . 15" length of 8-wire cable

1 . . . . 10" length of 8-wire cable

8 . . . . lengths (approximately 29") of color coded wire (one each of brown, red, orange, yellow, green, blue, white and black).

The color code used for resistor identification will be followed as closely as possible, with the exception of the white and black wires. The code used for all socket wiring in this kit will be:

1.	Brown	5.	Green
2.	Red	6.	Blue
3.	Orange	7.	White
4.	Yellow	8.	Black

All No. 1 socket terminals will therefore be connected with brown wire, all No. 2 socket terminals with red wire, etc.

Since the wire used in connecting the tube socket terminals is a stranded wire, it will be necessary to solder the fine wires together before connecting the lead to the terminal. In each step measure the amount of wire needed to perform the operation, trim off 1/4" of the plastic insulation from the ends and tin with a hot soldering iron. Allow the solder to flow freely into the strands to provide a good bond between the individual wires. Perform the operation as quickly as possible to prevent damage to the plastic insulation.

(S) means solder. (NS) means DO NOT solder yet.

The number associated with soldering instructions denotes the number of wires tied to that particular point at the time of soldering.

Example: (S-1) means there should be one wire connected to the soldered terminal.

(S-2) means there should be two wires connected to the soldered terminal, etc.

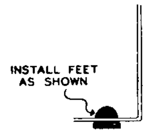
Dress all leads as shown in the pictorial diagrams.

The following chart is provided so that the high voltage secondary of the transformer may be checked for proper connections. Before making the voltage checks, rotate the SET LINE control till the meter pointer falls in the LINE TEST block at mid-scale.

Connect AC voltmeter test leads to:	Meter should read: (±10%)
DD3 and CC10	30 volts AC
DD3 and HH4	100 volts AC
DD3 and HH1	250 volts AC

If preliminary tests indicate the Tube Checker to be functioning properly, the action of the instrument can be further tested by making actual tests on a variety of tubes. Remember that for the purpose of testing the instrument, a tube known to be defective in some way may be just as useful, if not more so, than a tube which is perfect in every respect.

CABINET INSTALLATION



( ) Install the rubber feet in the bottom and back of the cabinet.
( ) Install the handle using #10 sheet metal screws.

( ) Place the Tube Checker face down on your work bench. Slide the line cord through the hole in the back of the cabinet and push the cabinet down inside the flanges at the edge of the panel. Secure with two 6-32 screws.

USING THE HEATHKIT TC-3 TUBE CHECKER

The instrument you have just completed will provide a variety of tests to indicate the relative value of the particular tube being checked. The following steps may be used as a guide in setting up tube testing procedures. Remember that the ultimate value of any measuring device is dependent upon the skill of the operator and, more important, his ability to properly evaluate the information provided by the instrument.

(1) With the power cord connected, move the roll chart to the listing of the tube to be tested, and turn the SET LINE control until the meter pointer falls within the LINE TEST block.

(2) Set the TYPE switch to the number shown on the chart.
(3) Set the FILAMENT selector to the voltage shown on the chart.
(4) Set the PLATE control according to the chart information.

(5) Set the LEVER switches to the T-TOP and B-BOTTOM positions as shown in the top and bottom columns on the chart.

(6) Insert the tube and re-set the SET LINE control if necessary. Pin positions and keyways determine tube positioning on all sockets except subminiature. For subminiature tubes, position color dot adjacent to color dot on panel.
(7) Check the tube for shorts by moving levers shown in light type through the two positions, returning to the position shown on the chart. The TEST switch remains in the SHORT position for this test. The SHORT-LEAKAGE switch should be in the SHORT position. A shorted tube is indicated by a steady glow of the neon bulb. Disregard neon bulb flashing as the lever switches are moved. It is possible that some serious short circuits will momentarily overload the power transformer. This condition will be indicated by complete dim out of the panel lamps. Do not allow the Tube Checker to operate under this extreme condition for any length of time. Make the test as quickly as possible in order to obtain the desired information. CAUTION: The following note concerning internal connections appears at the bottom of the roll chart: "*Special short test for tubes with internal connections. A good tube will not show short when the levers shown in parenthesis ( ) are moved simultaneously." When testing a tube type marked with the asterisk, it is important to move the levers simultaneously to prevent damage to the internal connections.

(8) Check the tube for leakage between elements by moving the SHORT-LEAKAGE switch to the LEAKAGE position and repeating the short test as outlined above.

(9) After allowing sufficient time for the tube to reach operating temperature, check for quality by moving the test slide switch to TEST position. If the meter pointer falls in the GREEN scale, the quality of the tube is GOOD.

(10) Check for open elements as follows: holding the slide switch in the TEST position, move each lever in the TOP position (only those shown in light type) to the BOTTOM position and return. Satisfactory tube elements (those properly connected to their pins) are indicated by a decrease in meter reading. The grid element usually shows a large decrease, while a screen or plate may show only a slight decrease.

NOTE: If the meter indication in the quality test is off scale, reduce the meter reading to an on-scale reading by turning the PLATE control counterclockwise, then proceed with the open element test.

(11) To check filaments, filament taps and internal connections for continuity, set the FILAMENT selector to .63 volts. Move each lever shown in dark type through each of its other two positions. Always move only one lever at a time. Satisfactory filaments, taps and internal connections will be shown by a bright glow of the SHORT test indicator.

In any of the above tests, should the tube prove to be faulty in some respect, the defective element can be traced by comparing the lever switch in question with a base diagram of the tube. Lever switch A corresponds to tube pin 1, lever switch B to tube pin 2, etc.

Multiple tube types (tubes which contain more than one set of elements) are indicated on the chart by a bracket set of listings, one for each test to be made on the tube. The tester is set up according to the test in each line and checked through all of the tests as outlined in the preceding steps.

Check pilot lights by setting the FILAMENT selector to the proper voltage and inserting the pilot light in the socket found in the center of the large seven pin socket. This is a universal type pilot light test socket and does not require that the lamp be permanently inserted. It is only necessary to hold the pilot lamp so that the side wall of the base and the center pin of the lamp make contact with the corresponding points in the lamp socket.

NEW TUBES

The Heath Company periodically revises the Tube Checker roll chart in order to keep abreast of new tube releases. However, because of the great quantity of new tubes being released by manufacturers, a customer will occasionally desire to check a new tube before the test data appears on the roll chart. If the tube you wish to check does not fit any of the sockets provided, it will be necessary for you to obtain the proper socket from a local source and mount it in the blank socket location. Wire it in as follows:

(1) Connect pin one of the new socket to pin one (brown wire) of the loctal socket.

(2) Connect pin 2 of the new socket to pin 2 (red wire) of the loctal socket, etc. If the new socket has nine pins, connect pin No. 9 to S9 on the 9-pin miniature tube socket. If the new socket has 10 pins, connect pin No. 10 to terminal K4 on the lever switch gang.

In the event the new socket will not fit into the blank socket location, make it into an adaptor using an octal plug. Connections to pins 9 and 10 may then be made by test leads to S9 and the grid clip, respectively.

The instructions below indicate how to set up the instrument for obtaining temporary settings so that these new tubes may be checked (provided manufacturer's data is available).

(1) Note manufacturer's data carefully concerning the base diagram of the pin connections and filament voltage.

(2) Set the Tube Checker TYPE switch as follows:

Type 1 - for low cathode current tubes (below 4 ma), usually diode types.
Type 2 - for tube types with cathode current between 3 ma and 15 ma. These are usually filament type tubes with the exception of diodes.
Type 3 - for tube types with cathode current greater than 8 ma. These are usually indirect-heated cathode types with the exception of diodes.
Type 4 - for gas control tubes, gaseous rectifiers, and eye or target tubes.

(3) Set FILAMENT voltage to value specified by manufacturer.

(4) Set all levers to the CENTER position.

(5) Determine the first filament connection from the tube base diagram and leave its connection lever in the CENTER position. Its connection lever corresponds to the letter on the lever— A corresponds to pin 1, B to pin 2, C to pin 3, etc.

(6) Determine the second filament connection from the tube base diagram and set its connection lever to the BOTTOM position.

(7) Determine from base diagram if the tube has a filament tap. The position of the lever corresponding to the filament tap will depend upon the placement of the tap in respect to the other filament connections. Some filament taps are placed in the center of the filament, as in the 12AU7. For this type filament, the two outer terminals (pins 4 and 5) are connected to one side of the filament supply (levers in CENTER position) and the tap is connected to the other side (lever in BOTTOM position). The FILAMENT control is then set at 1/2 the voltage rating of the entire filament, or (in this case) 12.6/2 = 6.3 volts. When the filament tap is not symetrically located, as in the 35Z5, the tap must be connected to that end of the filament which is electrically nearer the tap position. For the 35Z5, pins 2 and 3 should be connected to one side of the filament supply and pin 7 to the other. The FILAMENT control is then set to the voltage closest to that recommended by the tube manufacturer, in this case 32 volts.

(8) If the tube has more than one section (duo diodes, duo triodes, etc.) make a separate test for each section. For the section being tested follow instructions below. For the section not being tested, move all corresponding connection levers to the bottom position. If the tube has only one section, follow the instructions below.

(9) Move the connection lever corresponding to the cathode to the BOTTOM position.

(10) Move all other elements of the section being tested (screens, suppressors, grids, etc.) to the TOP position.

(11) Plug the tube into the correct socket

12) Plug the line cord into the power supply and turn the instrument on.

(13) Adjust the SET LINE control till the meter pointer falls in the LINE TEST block.

(14) Hold the ADJUST LINE SHORT-TEST switch in the TEST position and adjust the PLATE control to bring the pointer to the middle of the GOOD scale. (If possible, make this adjustment for at least three new tubes of the same type and select the average setting.)

(15) List all these settings in the space provided at the back of the manual.

(16) If the tube is of the multi-section type, check the remaining sections in the manner outlined above and list the settings in the manual.

IN CASE OF DIFFICULTY

(1) Re-check all the wiring. Follow each lead on the schematic diagram with a colored pencil and trace it out on the instrument. Most cases of difficulty result from wrong or reversed connections. (Often it is helpful to have a friend check the wiring - he may be able to discover an error consistently being overlooked.)

(2) Check the voltages in the manner outlined under TESTING. This may help to show up a mis-interpretation of the transformer lead identification code.

(3) Make continuity checks between the lever switch common lugs and the various socket pins to make sure that all contacts are properly connected to the lever switches.

(4) If you are unable to locate the difficulty, write to the Heath Company Technical Consultation Service department, supplying all possible pertinent information. Include voltage data, as well as any characteristic of operation that may afford a clue to the difficulty. Trained technical correspondents will analyze the problem and suggest the corrective measures that may be required.